Comment Response Summary

PixID GSA Public Review Draft Groundwater Sustainability Plan dated October 27, 2019

Comment letters on the PixID GSA Draft GSP were received from the following entities/individuals:

Comment Letter	Entity/Individual	Abbreviation
A	Arvin Edison Water Storage District / Shafter-Wasco Irrigation District	AEWSD / SWID
B	Audubon California	AC
C	Bureau of Reclamation	BR
D	California Department of Fish and Wildlife	CDFW
E	Community Water Center	CWC
F	Friant Water Authority	FWA
G	Hancock Farmland Services	HFS
H	Lindsay-Strathmore Irrigation District	LSID
I	Tulare County Farm Bureau	TCFB
J	The County of Tulare	TC
K	Westchester Group Investment Management, Inc.	WGIM

Review comments have been grouped by similar topic and summarized, with a response from the GSA.

Topics

1. Subsidence/ Infrastructure Impacts
2. Environmental
   - *-Groundwater Dependent Ecosystems*
3. Beneficial Users
   - *-Public Water Systems*
   - *-Domestic Well Users*
4. Water Quality
   - *-Disadvantage Communities*
5. Public Participation
6. Land Use (Future Growth)
7. Water Budgets/Technical Issues
8. Generalized Comments
   - *-GSA Policies*
   - *-Basin Setting*
   - *-Sustainable Management Criteria*
   - *-Projects & Management Actions*

Subsidence/ Infrastructure Impacts		Comments received from: AEWSD-SWID, BR, FWA, LSID
*Response to these comments are provided in **Master Response 1***		
Comment #	**GSP Reference**	**Review Comment Summary***
A.1	3.5.2.4	Minimum thresholds are not protective of beneficial users' ability to receive FKC water deliveries downstream of the Tule Subbasin due to subsidence in the Tule Subbasin.
A.2	5.2	Tule Subbasin GSPs should include P&MAs that allow zero additional subsidence beyond legacy.
A.3	TSCA - 4.3.4	UR be defined at each RMS for Subsidence on the FKC. Incorporate RMS at 1-mile intervals along FKC. GSP does not identify P&MA's that will be taken to avoid subsidence UR along the FKC.
A.4	5.2.1	Mitigation to damages to the FKC should be proposed from the use of Transitional Pumping.
A.5	TSCA - 4.2	The Sustainability Goal in the TSCA and the Tule Subbasin GSPs is not fully consistent with the General Principles laid forth in the GSP Regulations.
A.6	TSCA - 4.3	The definition of Undesirable Results in the TSCA and the Tule Subbasin GSPs is not compliant with the GSP Regulations.
A.7	2.3.5	The Basin Setting information lacks sufficient discussion of the serious issue of subsidence.
A.8	4.2.3.5	The Monitoring Network for subsidence in the vicinity of the FKC is inadequate.
A.9	3.5.1.4	The proposed Sustainable Management Criteria for subsidence are insufficient in their consideration of impacts on adjacent basins.
A.10	5.2	The proposed Projects and Management Actions do not adequately address and mitigate impacts from subsidence.
A.11	3.5.1.4	The "Undesirable Results for Land Subsidence" were not adequately defined regarding subsidence related impacts on the FKC.
A.12	3.4; TSCA - 4.3.4	Allowing less than 50% of the Representative Monitoring Sites (RMSs) to exceed the Minimum Thresholds (MT) criterion might not be protective of adequate conveyance capacity of the FKC.
A.13	3.5.2.5.3	The FKC current and projected conveyance capacity based on SMC should be defined.
A.14	3.5.1.4	The relationship between the FKC Conveyance Capacity and Measurable Objectives (MOs).
A.16	DEID GSA	Insufficient RMSs along the FKC in the DEID GSA MA.
A.17	4	RMSs at river crossing might not be approximate
A.18	4.2.3.5	There are not RMSs dedicated to address the concern of FKC structural damages.
A.19	DEID GSA	The FKCSMA does not include the portions of FKC in the ET and DEID GSA MA. Although historical subsidence along the FKC in the DEID GSA MA has been small, future subsidence will increase if groundwater extraction increases in the vicinity of the FKC.
A.21	General	Subsidence and associated ground deformation are mostly irreversible
A.22	5.2	Curtailment of groundwater extraction near the FKC should be included in Projects & Management Actions.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Subsidence/ Infrastructure Impacts

Comments received from: AEWSD-SWID, BR, FWA, LSID

*Response to these comments are provided in **Master Response 1***

Comment #	GSP Reference	Review Comment Summary*
C.1	General	Concurrence with FWA letter to Tule Subbasin GSA's
F.1	5.2.1	Mitigation for additional subsidence along the FKC caused from "Transitional Pumping".
F.2	ETGSA	Undesirable Result would occur if Minimum Threshold occurred at 1 RMS.
F.3	ETGSA	Incorporate additional RMS along the FKC, spaced no more than 1 mile apart.
F.4	ETGSA	Develop a "Friant-Kern Canal Subsidence Management Area".
H.1	General	Concurrence with FWA letter to Tule Subbasin GSA's
H.2	3	Unacceptable to allow 3 additional feet of subsidence and for 50% of RMS to reach their MT before an UR occurs.

Environmental/ Groundwater Dependent Ecosystems

Comments received from: AC, CDFW

*Response to these comments are provided in **Master Response 2***

Comment #	GSP Reference	Review Comment Summary*
B.1	ES	Environmental users should be added to those reliant on groundwater pumping.
B.2	1.4.3.1	Add Pixley NWR areas within Pixley ID GSA.
B.3	Figure 1-5	Add additional Pixley NWR, Allensworth Ecological Reserve and Allensworth State Park to figure.
B.4	Land Use	Pixley NWR to primary land uses.
B.5	1.4.6	Manage habitat should be identified as a major water use sector.
B.6	1.4.6.3	Recharge within the Pixley NWR should be identified and credited appropriately.
B.7	Figure 1-10	Pixley NWR should be identified as a potentially GDE.
B.8	1.5.1	Managed wetlands should be included in beneficial users of groundwater.
B.9	Exhibit 1-1	Amend figure to include land use designations for managed habitat.
B.10	2.2.6.5	Include managed habitat in beneficial uses of groundwater.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Environmental/ Groundwater Dependent Ecosystems		Comments received from: AC, CDFW
*Response to these comments are provided in **Master Response 2***		
Comment #	**GSP Reference**	**Review Comment Summary***
B.11	2.3.7	Provide clarification on inconsistencies for identify GDEs.
B.12	2	Include water demand for managed habitat in water budget.
B.13	3.5.2.5.3	Managed habitat should be included as a beneficial user of groundwater and any impacts from projects and management actions should be evaluated.
B.14	4.2.3.1	Include wells in Pixley NWR in monitoring network.
B.15	5	Encourage development of wildlife friendly recharge.
B.16	5.2.1	Pumping caps should not be implemented on the Pixley NWR.
B.17	5.2.1.5	Update water budget to include full Level 4 water demand of Pixley NWR.
B.18	5.2.3	Surface water requirements for the Pixley NWR should be included in water budget.
B.19	5.2.4	Provide co-benefit for wildlife to managed aquifer recharge, banking, and temporary storage projects.
B.20	5.2.5	Areas surrounding Pixley NWR should be prioritized for land retirement.
B.21	6	Recommend that no fees be imposed on wetlands areas.
D.1	3.5.2.5.3	Effects of SMCs on beneficial users including GDEs and species therein.
D.2	2.3.7	The statement that ISWs do not occur in the Tule Subbasin is not adequately supported.
D.3	2.3.6	The analysis that GDEs do not exist based on depth to groundwater analysis is not adequate to support justification.
D.4	2.3.6	Reevaluate SMC with consideration to adverse impacts to environmental beneficial users & revise MTs to reflect critically over drafted subbasin.
D.5	4.2.3	Install additional shallow groundwater monitoring wells near potential GDEs and along ISWs.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Beneficial Users Identification		Comments received from: CWC, TC
*Response to these comments are provided in **Master Response 3***		
Comment #	**GSP Reference**	**Review Comment Summary***
E.1	1.4	Include a map indicating the location of public water systems serving SDACs and or DACs as well as domestic well communities.
E.17	1.4.12	Revise the draft GSP to include information on rural population estimates and density so that the public can assess whether it is reasonable to exclude rural residential demands from the water budget. Also include a discussion of the water use by livestock operations and other public water systems and how it is represented in the water budget.
E.22	3.5	Clarify the rationale for the water level decline used to develop MTs/MOs and explain how this water level decline is reasonable and sustainable for DACs and domestic well communities in the LTRID GSA.
E.23	3.5.2.5	Undertake a drinking water well impact analysis that adequately quantifies and captures well impacts at the minimum thresholds, measurable objectives, and proposed undesirable results.
E.24	3.5.2.5	Describe how the approach to develop MTs/MOs is protective of diverse drinking water users.
E.25	3.4	Clarify how the projected water level decline before reaching the UR is not significant and unreasonable.
E.26	3.5.2.1	Analyze how groundwater gradients will influence water quality near DACs and water levels at each minimum threshold.
E.28	5	Develop and include a plan that outlines steps that will be taken is a drinking water well goes dry as a result of the LTRID GSA's projects and management actions.
E.29	3.5.2	Develop a protective minimum threshold near vulnerable communities, including domestic wells, to avoid localized impacts and ensure the protection of these important water sources.
E.47	4	Revise the draft GSP to include maps of the proposed monitoring network over laying the three communities (Tipton, Woodville, and Poplar) and domestic well locations.
E.56	5.2.1	Revise the groundwater accounting system to identify the accounting plan or mechanism for each type of user that will be used to create individually tailored allocations. At a minimum identify key policies that will be incorporated into the groundwater accounting system that will ensure that DACs, small water systems, and domestic well users will have access to safe, clean, affordable, and accessible drinking water.
E.57	5.2.1	Clarify if future pumping restrictions will be placed on communities and under what conditions. Revise this section to ensure communities will not be subject to future pumping restrictions.
E.64	5.2	GSP is missing drinking water well mitigation program.
J.7	1	The County will continue to monitor the municipal and domestic user interests. This could lead to decisions being made that adversely impact these beneficial users.
J.10	3.5.2.5	Include domestic well users as beneficial users and expand on impacts to domestic well users and mitigation that will be provided.
J.13	5	Groundwater extraction limitations should not be imposed on communities.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Beneficial Users Identification

Comments received from: CWC, TC

*Response to these comments are provided in **Master Response 3***

Comment #	GSP Reference	Review Comment Summary*
J.14	5	A mitigation program should be included in projects and management actions for continued lowering of groundwater levels caused from ramp down.
J.16	5.2.5	Focused land retirement in areas with higher concentration of domestic wells. Recharge projects to protect domestic wells from increased contamination
J.18	5.2.1	Clarify the community systems and de minis extractor are not subject to pumping fees

Water Quality

Comments received from: CWC

*Response to these comments are provided in **Master Response 4***

Comment #	GSP Reference	Review Comment Summary*
E.30	3.3	Clearly and transparently describe the basis for water quality sustainable management criteria.
E.31	3.5.1.3	Clarify what is intended by methodology for developing MTs/MOs and explain how ever-increasing water quality concentrations are sustainable and protective of beneficial users and uses, including domestic well owners and small community water systems.
E.32	3.4	Revise the MTs for groundwater quality to be any degradation above MCL; If under MCL, a degradation of more than 25%, or approaching 75% of the MCL; if over MCL, any further degradation.
E.33	3.5.2.5	Revise the draft GSP to explain how the proposed SMCs will be protective of drinking water users located in agricultural areas, specifically rural residential domestic well users.
E.35	3.5.1.3.1	Provide an analysis of water quality data in the GSA to describe how the contaminants of concern (COC) list was determined and explain which contaminants were not included.
E.36	TSS - 2.1.7.4	Revise the draft GSP to include a more comprehensive discussion of water quality related to the two National Priority List sites, including those issues that may impact drinking water beneficial users, including DACs.
E.37	TSS - 2.1.7.4	Revise the draft GSP to fully consider all available water quality data in its analysis of groundwater conditions and the hydrogeologic conceptual model.
E.38	TSS - 2.1.7.4	Revise the draft GSP to include specific discussions of the water quality conditions and trends for applicable constituents and uses and include an evaluation of the change in water quality constituent concentrations relative to change in water levels, particularly over drought periods, to evaluate the potential relationship between water quality and groundwater management activities.
E.39	TSS - 2.1.7.4	Revise the draft GSP to have an analysis and discussion of the spatial relationship between the presence of the Corcoran Clay and arsenic concentrations in the GSP.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Water Quality		Comments received from: CWC
*Response to these comments are provided in **Master Response 4***		
Comment #	**GSP Reference**	**Review Comment Summary***
E.40	Tb. 3-5; Tb.3-9	Revise Tables 3-5 and 3-9 of the draft GSP to use the proper units for conductivity which are micro Siemens per centimeter (µS/cm).
E.42	3.5.1.3; 3.5.2.3	Revise the GSP to establish MOs and MTs for conductivity for the two-water system CCR RMS.
E.43	5.2	Consider working with local and regional water agencies or the county to implement groundwater quality remediation projects that could improve both quality as well as levels and to ensure groundwater management does not cause further degradation of groundwater quality.
E.44	3.5.1.3	Provide an explanation of whether and how the CCR data are representative of groundwater conditions.
E.45	4.2.3	Evaluate and demonstrate how the proposed water quality monitoring network is sufficient to monitor for impacts to domestic well users in the PixID GSA area and expand the monitoring network to address these gaps.
E.46	4.2.3.4	Revise the draft GSP to consistently identify the number and location of the water quality RMS within the PixID GSA area.
E.48	4.2.2.3	Revise the draft GSP to clarify and correct inconsistencies between the GSP and the Tule Subbasin Monitoring Plan, include a clear description of the monitoring schedule for all COCs identified in the GSPs, and revise the monitoring schedule to sample all COC for each RMS at least annually.
E.49	3.5.1.3	Clarify how the PixID GSA intends to establish SMCs for RMS not identified as specific wells.
E.50	3.4	Clarify how URs will be evaluated within the PixID GSA area given that there are several non-well RMS.
E.51	3.5.1.3	Clarify which form of nitrogen will be monitored for purposes of compliance with the SMCs.
E.52	4.2.3.4	Develop long-term access agreements for RMWs owners and operators and identify who the owners are.
E.53	4.2.2.3	Clarify how pH will be measured.
E.54	3.5.1.3	Clarify how much data will be considered sufficient for the purposes of calculating the 10-yer baseline and describe what methodology will be used if baseline values are incorrect.
E.55	3.5.1.3	Clarify how the GSA plans to align groundwater monitoring efforts and the sustainable management criteria with any emerging contaminants of concern and new MCLs.
E.60	5.2.4	Revise P&MAs to include all details required by required by 23 CCR § 354.44 and explicitly describe how such risks to water quality will be evaluated and monitored as a part of the development of the specific recharge projects. As future specific projects are developed, the details should be clearly communicated to the public through an active stakeholder outreach and communication process that proactively seeks to include members of DACs.
E.62	5.2	Assess the impacts and identify the benefits of the water supply augmentation projects near DACs and small water systems.
E.63	5.2.4	Develop criteria for recharge projects that prevent unintended impacts to drinking water.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Public Participation		Comments received from: CWC
*Response to these comments are provided in **Master Response 5***		
Comment #	**GSP Reference**	**Review Comment Summary***
E.2	1.5.4.4	Properly notice all public meetings, including the Groundwater Planning Commission, and send out both agendas and all meeting materials within 72 hours of the proposed meeting.
E.3	1.5.4.2	Ensure there is a public comment period at minimum at the beginning of all public meetings.
E.4	1.5.4.4	Properly notice the release of all-important materials, including revisions to the GSP, and share with all interested parties.
E.5	General	Structure documents in ways that are easier for the public to review and interpret and ensure that any inconsistencies between documents are revised.
E.6	1.5.4.4	Engage domestic well owners and the small community water systems by offering presentations and holding community meetings to share information about the GSP development process and solicit feedback from key beneficial users of groundwater.
E.7	1.5.4.4	Host GSP workshops and public outreach meetings in the evening so community members are able to attend.
E.8	1.5.4.4	Utilize existing community venues for community meetings, workshops and events to provide information.
E.9	1.5.4.4	Identify community social media (Facebook, Instagram, etc.) groups, pages and websites and post information.
E.10	1.5.4.4	Identify, and work with key community leaders /trusted messengers to distribute information and encourage community participation.
E.11	1.5.4.4	Provide bilingual (English and Spanish) information and materials on the website, via email and consider inserting short notices (notices must include key messages, visuals and information that is relevant to the average water user) in water bills and/or community newsletters.
E.12	General	Partner with other educational programs to leverage resources and explore opportunities to educate different generational groups.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Land Use (Future Growth)

Comments received from: TC

*Response to these comments are provided in **Master Response 6***

Comment #	GSP Reference	Review Comment Summary*
J.1	1.4.12	Tulare County maintains land use and zoning authority in LAFCo designated PUD and CSD through administration of the County general plan, zoning ordinance, and ordinance code.
J.3	1.4.8	Address impact to domestic wells.
J.4	Figure 1-7	Consider rural domestic wells when discussing groundwater dependent communities.
J.5	1.4.12	Reference updated Community Plans. Add additional Tulare County General Plan and Regional Planning Framework to exhibits. Include addition applicable list of water resources policies.
J.9	2	Anticipated growth of communities needs to be recognized through 2070.
J.17	5.2.6	How will growth be recognized and what is the County's role for municipal management areas?

Water Budget

Comments received from: AEWSD-SWID-GSI, CWC, HFS, TC, WGIM

*Response to these comments are provided in **Master Response 7***

Comment #	GSP Reference	Review Comment Summary*
A.20	2.4.2.4	Overdraft in the subbasin was defined based on averaged hydrology from the years 1990/91 through 2009/10. The average condition between 1990/91 and 2009/10 might not be representative of the long-term average condition.
E.14	2.4.2.4; TSS - 2.3.2.4; TSCA - 3.6	Clarify which values for average annual historical overdraft were used and clarify why the three different documents (GSP, Coordination Agreement, Tule Subbasin Setting) have used different values.
E.15	TSCA - 3.7	Clarify the methods used to develop the historical water budget and the groundwater flow model-projected water budget and if the methods are different, describe how the two methods relate to each other in terms of common assumptions, uncertainties, and inherent differences.
E.16	TSS - 2.3.1.1.4	Revise the draft GSP to include summary information on land use and crop evapotranspiration information and detail how the irrigation efficiency value was determined over the various model time periods so that the validity of the crop demand can be assessed.
E.18	TSS - 2.3.2.1.9	Revise the draft GSP to include a more detailed discussion of how subsurface flow was determined and the level of uncertainty inherent in its estimation.
E.19	TSS - 2.3.2.2.1	Revise the projected water budget to include an estimated increase in municipal pumping or include a justification for maintaining the municipal pumping at a constant rate.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Water Budget		Comments received from: AEWSD-SWID-GSI, CWC, HFS, TC, WGIM
*Response to these comments are provided in **Master Response 7***		
Comment #	**GSP Reference**	**Review Comment Summary***
E.20	2	Revise the draft GSP to include information on the range of model inputs that were used in evaluating the uncertainty of the projected water budget.
E.21	TSS - 2.3.2.3	Revise the draft GSP to clearly and consistently define and describe the sustainable yield estimates and allocation methods within the subbasin and within the LTRID GSA. Include a description of how the sustainable yield value and the allocation method will affect municipal and rural groundwater drinking water users in the LTRID GSA area.
E.58	5.2.1	Revise P&MAs to clarify whether a reduction in groundwater pumping will be implemented and by how much. If groundwater is estimated to increase, describe how this contributes to reaching groundwater sustainability given the severely overdraft conditions of the subbasin.
E.59	Tb. 2-7; Tb. 5-1; TSS - Tb. 4	Revise the draft GSP to clarify inconsistencies between the P&MA section and the Tule Subbasin Setting.
G.1	2.4.2.6	Clarify Sustainable Yield calculation for the water budget and landowner allocations.
J.2	1.4.6	Limiting groundwater extractions may affect the ability of urban and ag users to meet existing demands or expand urban municipal services.
J.6	TSS - App A - Tb. 3b	The projected water budgets need to reflect increased rates of groundwater pumping reflecting of 1.3% growth rate of the communities annually
J.8	2.4.1.1.5	Instead of stating average municipal usage current usage should be stated.
K.1	2.4.2.6	Clarify Sustainable Yield calculation for the water budget and landowner allocations.
E.19	TSS - 2.3.2.2.1	Revise the projected water budget to include an estimated increase in municipal pumping or include a justification for maintaining the municipal pumping at a constant rate.
E.20	2	Revise the draft GSP to include information on the range of model inputs that were used in evaluating the uncertainty of the projected water budget.
E.21	TSS - 2.3.2.3	Revise the draft GSP to clearly and consistently define and describe the sustainable yield estimates and allocation methods within the subbasin and within the LTRID GSA. Include a description of how the sustainable yield value and the allocation method will affect municipal and rural groundwater drinking water users in the LTRID GSA area.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Generalized Comments		Comments received from: AEWSD-SWID-GSI, CWC, HFS, TCFB, TC, WGIM
*Response to these comments are provided in **Master Response 8***		
Comment #	**GSP Reference**	**Review Comment Summary***
A.15	3	Model uncertainties and margin of error should be incorporated into subsidence related SMC.
E.27	3	Identify the SMCs set by the Tri-County Water Authority (TCWA) GSA in the northwest corner of PID GSA and include a discussion of how the TCWA SMCs will affect water levels within the PID GSA.
E.61	5.2.5	Revise Section 5.2.5 to include details on the planned fallowing and describe how this project was factored into the groundwater flow model, water budget and planned transitional pumping projections.
G.2	General	Allocation methodology should be consistent with various legal consideration.
G.3	General	Allow for stakeholder input on allocation methodology and utilize historical pumping data to determine such allocations.
G.4	General	Promote a open market with limited restrictions on transferability of groundwater credits.
G.5	General	GSA's to develop quality assurance process for ET consumptive use calculations.
I.1	General	GSPs should remain adaptive documents to maximize water resources for farm and rural communities impacted by the GSP implementation.
I.2	General	Avoid exportation of local water resources.
I.3	General	Water markets should be developed carefully.
I.4	General	Land fallowing and retirement should be avoided at all cost.
I.5	General	GSAs should incentivize landowner recharge.
I.6	General	Increase importations of water resources.
I.7	General	GSAs should prevent management changes.
I.8	General	GSAs should prevent the idling farmland.
I.9	General	GSAs should promote public outreach.
J.11	5	Include statement "maintain groundwater supplies and quality for domestic and municipal users". Also, there is concern with the economic implications of diminished ag operations.
J.12	5.2.1	The County does not want GSAs to cap municipal water use.
J.15	5	Provide clarification on how mitigation to impacted domestic and small system well will be addressed.
K.2	General	GSA to use best available data when applying pumping restrictions. Sustainable Yield allocations and pumping allowances should be consistent across the entire subbasin.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

Generalized Comments		Comments received from: AEWSD-SWID-GSI, CWC, HFS, TCFB, TC, WGIM
*Response to these comments are provided in **Master Response 8***		
Comment #	**GSP Reference**	**Review Comment Summary***
K.3	General	Sustainable Yield allocations, initial pumping allowances and ramp down schedules should be consistent across the entire subbasin.
K.4	General	GSAs should implement a coordinated subbasin wide DMS and measurement methodology.
K.5	General	GSA's to develop quality assurance process for ET consumptive use calculations.

* Review comments have been grouped by similar topic and summarized. For full text of comment, see respective comment letter as noted.

December 17, 2019 (**Revised GSI 4-page Memo)**

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RE: Public Comments to Tule Basin Groundwater Sustainability Plans (GSP)

To Whom It May Concern,

The letter concerns the Groundwater Sustainability Plans (GSPs) that have been drafted by each of the agencies addressed in this letter pursuant to the Sustainable

Groundwater Management Act (Water Code § 10720 *et seq*.) ("SGMA"). The GSPs are referred to herein collectively as the "Tule Subbasin GSPs".

SGMA regulations are set forth in Title 23 of the California Code of Regulations. 23 CCR § 350.4(f) (General Principles) state a GSP "will be evaluated, and its implementation assessed, consistent with the objective that a basin be sustainably managed within 20 years of Plan implementation *without adversely affecting the ability of an adjacent basin to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon.*" (Emphasis added.) Furthermore, 23 CCR § 354.28 (Minimum Thresholds) states a GSP must describe "how minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals." There are other sections that speak to similar requirements regarding adjacent basins (e.g., §§ 354.34, 354.38, 355.4).

As you are well aware, there are at least two (2) Kern County water districts, Arvin-Edison Water Storage District and Shafter-Wasco Irrigation District (collectively referred to as "Friant Districts"), that have contracts for 441,275 acre-feet of water service with the United States Department of Interior's Bureau of Reclamation (Reclamation) from Millerton Lake located in Fresno/Madera County that is subsequently conveyed through the Friant-Kern Canal (FKC).

The Friant Districts encompass over 170,000 acres within the Kern Subbasin, which is adjacent to and just south of the Tule Subbasin**. The Friant Districts are concerned that the minimum thresholds in the Tule Subbasin GSPs as currently drafted are not protective of the beneficial water users downstream of the Tule Subbasin and will negatively impact the Friant Districts by limiting their ability to receive significant quantities of their contracted surface water imports due to past and ongoing subsidence within the Tule Subbasin**. Historically, the surface water imports into Kern County from the FKC have enabled the Friant Districts to achieve sustainable groundwater conditions. Unlike declines in groundwater levels, subsidence is a largely irreversible process and therefore once they occur impacts to the FKC from subsidence cannot be reversed, only mitigated through costly infrastructure repairs. A.1

While the Tule Subbasin GSPs did not report loss of water supply from continued subsidence, the Friant Water Authority (FWA) in coordination with others, has completed a draft feasibility study and performed engineering estimates that are detailed in the attached "Friant-Kern Canal Middle Reach Capacity Correction Project Draft Recommended Plan Report" (Report), with current FKC repairs being in excess of $500 million. The Report estimated a projected average annual loss of up to 145,000 acre-feet per year of surface supply caused by continued land subsidence and the corresponding reduction in the conveyance capacity of the FKC (Report Table 5-4). However, during wet years, similar to 2017 and 2019, FWA has estimated the water supply losses to be nearly 300,000 acre-feet in both wet years, which figure would be significantly higher with an additional 3 feet of subsidence. Under such conditions of continued subsidence, the Friant Districts' imported surface water supplies through the FKC will be restricted such that the Friant Districts' ability to

contribute to the sustainable management of the Kern Subbasin will be greatly compromised. The continued subsidence negatively impacts the Friant Districts and does not comport with the SGMA regulations, which therefore violates the following, including without limitation: 23 CCR §§ 350.4(f), 354.28, and 355.4(b)(7).

Friant Districts take great exception to the Tule Subbasin GSPs that assume up to a **maximum of 3 feet** of additional subsidence along the FKC (as well as up to nearly 9 additional feet of subsidence in other areas in the Tule Subbasin). While the GSPs did not calculate the amount of FKC capacity loss from such 3 feet drop in elevation, the FWA estimated the capacity reduction to be 1,140 cfs (or 460 cfs drop from current conditions and 2,860 cfs from original design of 4,000 cfs) (Report Figure 5-2). Given current conditions that already restrict FKC deliveries, any further subsidence would be significant and unreasonable and substantially interfere with surface land uses. (See Water Code § 10721(x)(5)). **Consequently, the Friant Districts recommend the Tule Subbasin GSPs include immediate management actions that provide for no additional subsidence (0 feet) beyond that "legacy" subsidence[1] which would occur if pumping were to cease immediately.** No analysis was undertaken to demonstrate how minimum thresholds for subsidence would impact the FKC and affected interests of beneficial users of groundwater or land uses and property interests. Furthermore, the analysis conducted to establish minimum thresholds in the Tule Subbasin GSPs relies on modeling for which sufficient uncertainty and sensitivity analysis have not been completed, or at the very least are not presented. Given the inherent uncertainty in the subsidence model, use of a safety factor in establishing minimum thresholds is warranted. A.2

The Friant Districts' note that in addition to negative impacts to the Friant Districts' water supply, other FKC contractors that are located upstream of the Tule Subbasin will also experience negative financial impacts as a result of the FWA's FKC Operations & Maintenance (O&M) cost recovery methodology, which methodology is essentially based on *actual deliveries*. With continued subsidence in the Tule Subbasin, the Friant Districts' deliveries will be reduced and therefore northern FKC contractors' prorata share of the FKC O&M will increase.

In addition to the continued 3-foot subsidence allowance, the Tule Subbasin GSPs define an Undesirable Result for subsidence to occur when subsidence minimum thresholds are exceeded at greater than 50% of Representative Monitoring Sites (RMS) on a Management Area basis. This definition would allow exceedances of minimum thresholds at multiple RMS (e.g., 3 out of 7 RMS along the FKC in the Eastern Tule GSA area) without it being deemed an Undesirable Result. Friant Districts' recommend an Undesirable Result at just 1 RMS. In addition to changing the threshold, provided that the FKC is critical infrastructure, Friant Districts recommend that the Tule Subbasin GSPs incorporate additional RMS, located at one-mile intervals or less, along the FKC that spans the entire length of the Tule Subbasin. **However,** A.3

[1] "Legacy" subsidence here refers to subsidence resulting from ongoing depressurization and compaction of compressible subsurface units due to historical groundwater pumping and groundwater level declines. Based on the physical characteristics of the compressible subsurface units in the Tule Subbasin, such "legacy" subsidence would be expected to continue for a period of up to approximately two years if groundwater pumping were to cease immediately (see attached letter from Dr. Chin Man Mok, GSI Environmental Inc.).

the GSPs do not clarify the projects or management actions that would be taken to avoid such Undesirable Results.

The GSPs contemplate the continued overdraft conditions (aka "transitional pumping") through the implementation period of 2040, which has been modelled by the Tule Subbasin to cause subsidence. However, the Tule Subbasin GSPs (except one) do not propose any form of mitigation. (See CCR 23 § 354.44) In that regard, the Friant Districts' appreciate the Delano-Earlimart Irrigation District's (DEID) Policy Point #8 (Transitional Pumping), which states unmitigated transitional pumping within the Tule Subbasin would not be supported by DEID, and DEID's treatment of the Western Management Area covering non-districted or "white lands", which states transitional pumping would be subject to mitigation fees. A.4

It shall be noted that the Tule Subbasin Coordination Agreement states the following regarding FKC subsidence:

- "…may result in an interim loss of benefit to the users of such infrastructure…"
- "…exceedance of minimum thresholds…could likely induce financial hardship on land and property interest…"

Given the acknowledged effects of continued subsidence proximate to the FKC, management actions expressly required to avoid and mitigate such impacts are promptly required. (See CCR 23, § 355.4 and Water Code § 10720.1(e).)
Additional observations about the GSP, including review of subsidence information from local experts, is detailed in the attached is EKI Environment and Water and GSI Environmental Technical memorandums.

Sincerely,

Edwin Camp
AEWSD President

Craig Fulwyler
SWID President

cc. California Department of Water Resources
Friant Water Authority
Kern Groundwater Authority
AEWSD Board of Directors
SWID Board of Directors
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Mike McKenzie, DWR (Charles.McKenzie@water.ca.gov)
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16 December 2019

To: Jeevan Muhar, Arvin-Edison Water Storage District (AEWSD)
Dana Munn, Shafter-Wasco Irrigation District (SWID)

From: Anona Dutton, P.G., C.Hg., EKI Environment & Water, Inc. (EKI)
Christopher Heppner, Ph.D., P.G., EKI

Subject: Review and Comment on Treatment of Subsidence in Draft Tule Subbasin Groundwater Sustainability Plans, Particularly in the Vicinity of the Friant-Kern Canal
(EKI B60064.03)

Dear Messrs. Muhar and Munn,

EKI Environment & Water, Inc. (EKI) has conducted a review of selected draft Tule Subbasin Groundwater Sustainability Plans (GSPs) with respect to their treatment of subsidence, particularly in the vicinity of the Friant-Kern Canal (FKC). This review was conducted on behalf of the Arvin-Edison Water Storage District (AEWSD) and the Shafter-Wasco Irrigation District (SWID), collectively referred to herein as "Friant Districts". Our review encompassed the following documents, collectively referred to herein as the "Tule Subbasin GSPs":

1. Eastern Tule Groundwater Sustainability Agency, Tule Subbasin, *Sustainable Groundwater Management Act Groundwater Sustainability Plan*, September 2019.[1]
2. Delano-Earlimart Irrigation District Groundwater Sustainability Agency, Tule Subbasin, *Sustainable Groundwater Management Act Groundwater Sustainability Plan*, November 15, 2019, 1st Revision.[2]
3. Alpaugh Groundwater Sustainability Agency, *Groundwater Sustainability Plan*, DRAFT, October 2019.[3]
4. Lower Tule River Irrigation District Groundwater Sustainability Agency, Tule Subbasin, *Sustainable Groundwater Management Act Groundwater Sustainability Plan*, September 2019.[4]

[1] "ETGSA Draft GSP_19.10.2.pdf" obtained from https://easterntulegsa.com/gsp/ on 10/22/2019.
[2] "0.1-DEIDGSA Draft GSP (Full Document)_11.15.19_Rev1.pdf" obtained from https://deid.org/gsa/ on 12/11/2019.
[3] "Alpaugh_GSP_2019 DRAFT with appendices.pdf" obtained from https://alpaughgsa.com/ on 11/11/2019.
[4] "LTRID GSA Draft GSP_10.2.19.pdf" obtained from http://www.ltrid.org/sgma/#gsp on 11/7/2019.

5. Pixley Irrigation District Groundwater Sustainability Agency, Tule Subbasin, *Sustainable Groundwater Management Act Groundwater Sustainability Plan*, September 2019.[5]
6. Tri-County Water Authority, *Groundwater Sustainability Plan*, December 2019.[6]
    a. Addendum No. 1 to Tri-County Water Authority, *Groundwater Sustainability Plan*, dated September 25, 2019.[7]

This letter is structured as follows: First, relevant background information is presented regarding the Tule Subbasin Groundwater Sustainability Agencies (GSAs), the coordination amongst the GSAs, and the FKC. Next, we provide a set of specific comments on the reviewed documents related to the topic of subsidence. Comments are organized by topic and are prefaced by specific background information relevant to that topic. In some cases, comments are further refined to address issues identified in those three GSPs that cover lands that are "adjacent" to the FKC as well as issues identified in the other GSPs that cover lands that are "non-adjacent" to the FKC but still have the potential to impact the FKC (i.e., critical infrastructure).[8] The FKC should reasonably be considered as one of the "land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin" per 23 CCR § 354.28(c)(5)(A).

GENERAL BACKGROUND INFORMATION

Tule Subbasin GSAs

There are seven GSAs within the Tule Subbasin:

- "Adjacent" GSAs
    - Delano-Earlimart GSA (DEIDGSA)
    - Eastern Tule GSA (ETGSA)
    - Lower Tule River Irrigation District GSA (LTRIDGSA)
- "Non-adjacent" GSAs
    - Alpaugh GSA (AGSA)
    - Pixley Irrigation District GSA (PIDGSA)

[5] "Draft PixID GSA GSP_10.27.19.pdf" obtained from http://www.ltrid.org/sgma/#gsp on 11/7/2019.
[6] "GSP PUBLIC DRAFT MASTER B-3 REVISIONS_FINAL_120419.pdf" obtained from https://tcwater.org/ on 12/11/2019.
[7] "TCWA-GSP-Addendum-No.-1.pdf" obtained from https://tcwater.org/ on 11/7/2019.
[8] The DWR DRAFT Sustainable Management Criteria Best Management Practices (BMP) document (https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf) states that "A GSA may decide, for example, that localized inelastic land subsidence near critical infrastructure (e.g., a canal) and basinwide loss of domestic well pumping capacity due to lowering of groundwater levels are both significant and unreasonable conditions."

- Tri-County Water Authority GSA (TCWAGSA)
- Tulare County GSA

The map figure below shows the jurisdictional boundaries of the seven GSAs in the Tule Subbasin, as well as the location of the FKC. The DEIDGSA, the ETGSA, and the LTRIDGSA cover lands that underlie portions of the FKC, and for the purposes of this comment letter are classified as "adjacent" GSAs. The remaining four GSAs cover lands that do not underlie the FKC and are thus considered "non-adjacent", but still have the potential to impact the FKC indirectly through management actions related to groundwater supply, demand, and level management.

Figure 3-2 from the ETGSA GSP

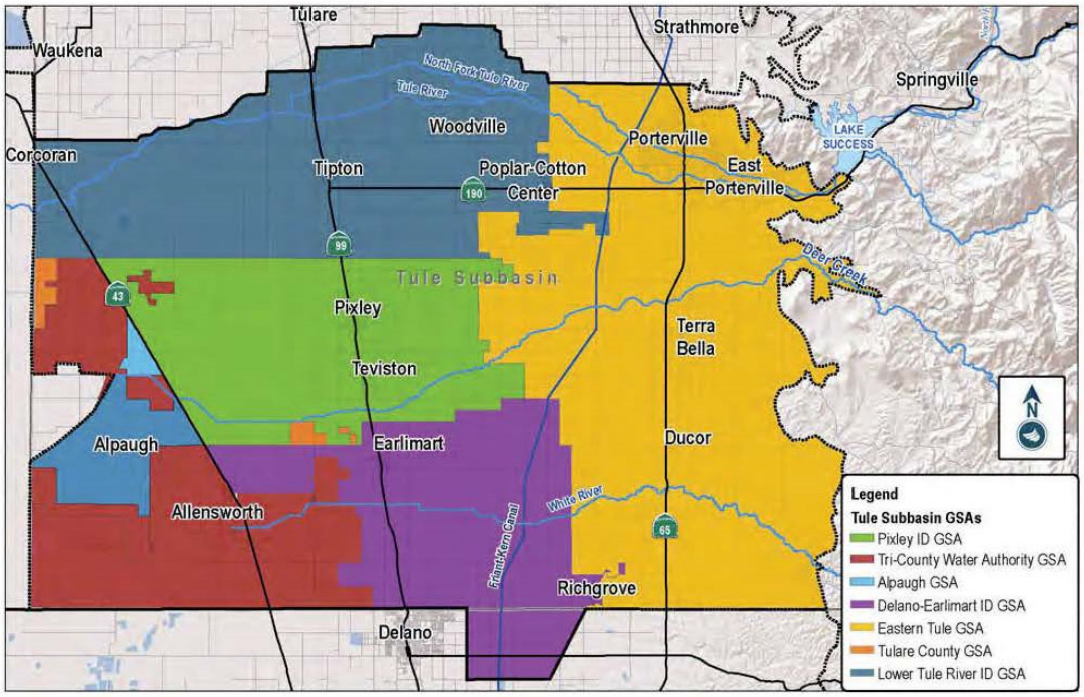


Figure 3-2: Tule Subbasin GSAs and GSP Plan Areas

Tule Subbasin Coordination Agreement

The seven Tule Subbasin GSAs have developed six coordinated GSPs[9], with certain key elements contained in a draft Tule Subbasin Coordination Agreement (TSCA). The version of the TSCA available at the time of this review is dated 9/16/2019. The key elements in the TSCA include:

[9] According to the Tule Subbasin Coordination Agreement (Section 1.2), the Tulare County GSA has entered into Memoranda of Understanding concerning coverage of territories under adjacent GSPs, and is therefore not preparing its own GSP.

- Coordinated Data and Methodologies for groundwater elevation and extraction, surface water supply, total water use, change in groundwater storage, and water budgets;
- Sustainable Management Criteria, including Undesirable Results (but not Minimum Thresholds, Measurable Objectives, and Interim Milestones);
- Monitoring Protocols, Networks, and Identification of Data Gaps; and,
- Implementation of GSPs.

The TSCA includes the following two attachments:

- Attachment 1: Tule Subbasin Monitoring Plan
- Attachment 2: Tule Subbasin Setting

Comments herein that pertain to topics covered in the TSCA are generally applicable to all Tule Subbasin GSAs, including the adjacent and non-adjacent GSAs, unless otherwise noted.

Friant-Kern Canal (FKC)

The FKC is a 152-mile long canal that forms the backbone of the United States Bureau of Reclamation (USBR) Central Valley Project's (CVP) Friant Division. The FKC conveys CVP Friant Division water from the Division's primary storage reservoir, Millerton Lake (formed by Friant Dam on the San Joaquin River), southwards to CVP Friant Division contractors within the Fresno, Kings, Kaweah, Tule and Kern County Subbasins, including to the Friant Districts. The Friant Districts collectively hold CVP contracts totaling 90,000 acre-feet (AF) of Class 1 Friant water (11.25% of the total Class 1) and 351,275 AF of Class 2 Friant water (25.0647% of the total Class 2 amount) (Friant Water Authority, 2019)[10]. As such, the Friant water supplies delivered through the FKC are critical to the ability of the Friant Districts to maintain and/or achieve sustainability within their service areas.

To date, subsidence along the FKC has impacted its conveyance capacity by 60 percent (Friant Water Authority, 2019).[11] As such, the Friant Districts have already lost access to a significant volume of their surface water supply, which has exacerbated groundwater issues in the Kern County Subbasin. Any further reduction in this critical surface water supply due to conveyance restrictions will impact the ability of the Friant Districts to support sustainable groundwater management locally and will impact the Kern County Subbasin's ability to implement its Plan and achieve and maintain its sustainability goal over the planning and implementation horizon.

[10] Future Friant Division Supplies Tech Memo, https://friantwater.org/s/Future-Friant-Supplies-TM_20181228.pdf. Friant District contract amounts: Class 1 contracts: AEWSD: 40,000 AFY (5% of total Class 1), SWID: 50,000 AFY (6.25% of total Class 1). Class 2 contracts: AEWSD: 311,675 (22.2391% of total Class 2), SWID: 39,600 AFY (2.8256% of total Class 2).

[11] Friant Kern Canal Subsidence Fact Sheet, https://friantwater.org/s/Friant_Subsience_Impacts_Brochure.pdf

As shown in the figure above, the FKC passes through the eastern portion of the Tule Subbasin, primarily through the areas of the ETGSA and the DEIDGSA (with a small segment passing through the LTRIDGSA area). For this reason, some of the comments herein focus specifically on the treatment of subsidence in the DEIDGSA GSP, the ETGSA GSP and the LTRIDGSA GSP (i.e., the "adjacent" GSPs). However, given the critical importance of the FKC to the region's water supply, the comments pertain as well to the other GSPs prepared by the other Tule Subbasin GSAs (i.e., the "non-adjacent" GSPs) as they also have potential ability to impact the canal.

SELECTED COMMENTS

Based upon our review, we have the following comments, organized by topic.

1. **Regarding Tule Subbasin Sustainability Goal**

Background

Section 4.2 of the TSCA presents the Sustainability Goal for the Tule Subbasin, as follows:

> "Pursuant to 23 Cal. Code Regs. §357.24, the Sustainability Goal of the Tule Subbasin is defined as the absence of significant and unreasonable undesirable results associated with groundwater pumping, accomplished by 2040 and achieved through a collaborative, Subbasin-wide program of sustainable groundwater management by the various Tule Subbasin GSAs.
>
> Achievement of this goal will be accomplished through the coordinated effort of the Tule Subbasin GSAs in cooperation with their many stakeholders. It is further the goal of the Tule Subbasin GSAs that coordinated implementation of their respective Groundwater Sustainability Plans will achieve sustainability in a manner that facilitates the highest degree of collective economic, societal, environmental, cultural, and communal welfare and provides all beneficial uses and users the ability to manage the groundwater resource at least cost. Moreover, this coordinated implementation is anticipated to ensure that the sustainability goal, once achieved, is also maintained through the remainder of the 50-year planning and implementation horizon, and well thereafter.
>
> In achieving the Sustainability Goal, these Plans will inherently balance average annual inflows and outflows of water so that negative change in storage does not occur over time. The stabilization in change in storage should also drive stable groundwater elevations, which, in turn, works to inhibit water quality degradation and arrest land subsidence."

Comment: *The Sustainability Goal in the TSCA and the Tule Subbasin GSPs is not fully consistent with the General Principles laid forth in the GSP Regulations.* A.5

This comment pertains to all of the Tule Subbasin GSPs (i.e., both the adjacent and the non-adjacent GSPs), as they all employ the same basin-wide definition of the Sustainability Goal found in the TSCA.

Under the GSP Emergency Regulations (Title 23 of the California Code of Regulations; 23 CCR) § 350.4(f), "a Plan will be evaluated, and its implementation assessed, consistent with the objective that a basin be sustainably managed within 20 years of Plan implementation without adversely affecting the ability of an adjacent basin to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon." The Sustainability Goal for the Tule Subbasin (Section 4.2 of the TSCA) does not mention ensuring that the GSPs prepared by GSAs within and for the Tule Subbasin will not adversely affect the ability of an adjacent basin to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon. Therefore, the Sustainability Goal does not reflect the General Principles of the GSP Emergency Regulations.

2. Regarding Undesirable Results Definitions

Background

This comment pertains to all of the Tule Subbasin GSPs (i.e., both the adjacent and the non-adjacent GSPs), as they all employ the same basin-wide definition of Undesirable Results found in the TSCA.

Section 4.3 of the TSCA asserts that four of the six Sustainability Indicators are relevant to the Tule Subbasin: (1) Chronic Lowering of Groundwater Levels, (2) Reduction of Groundwater Storage, (3) Degraded Water Quality, and (4) Land Subsidence. Section 4.3.4 of the TSCA provides the basin-wide definition of Undesirable Results for Land Subsidence.

Section 4.3.4.1 of the TSCA states:

> "Land subsidence shall be considered significant and unreasonable if there is a loss of a functionality of a structure or a facility to the point that, due to subsidence, the structure or facility cannot reasonably operate without either significant repair or replacement."

Section 4.3.4.2 of the TSCA further states:

> "the criteria for an undesirable result for land subsidence is defined as the unreasonable subsidence below minimum thresholds at greater than 50% of GSA Management Area [Representative Monitoring Sites] RMS resulting in significant impacts to critical infrastructure."

Section 4.3.4.3 of the TSCA further states:

> "the avoidance of an undesirable result of land subsidence is to protect critical infrastructure for the beneficial uses within the Tule Subbasin, including excessive costs to fix, repair, or otherwise retrofit such infrastructure and may also result in an interim loss of benefits to the users of such infrastructure."

Comment: *The definition of Undesirable Results in the TSCA and the Tule Subbasin GSPs is not compliant with the GSP Regulations.* A.6

This comment pertains to all of the Tule Subbasin GSPs (i.e., both the adjacent and the non-adjacent GSPs), as they all employ the same basin-wide definition of Undesirable Results found in the TSCA.

Currently portions of the FKC have already experienced a 60 percent reduction of capacity due to subsidence (see Section 3.2 of the ETGSA Joint Powers Authority [JPA] Communication and Engagement Plan; Section III.B.3 of the DEIDGSA Communication & Engagement Plan). The Undesirable Results definition for Land Subsidence (Section 4.3.4.1 of the TSCA) does not provide a clear statement regarding whether the loss of FKC capacity to date is considered "significant and unreasonable". The TSCA also does not quantify how much additional capacity loss would be allowed by the GSAs before they would determine that the FKC "cannot reasonably operate without either significant repair or replacement". The Friant Districts maintain that the current 60 percent loss in FKC capacity is significant and unreasonable and that already the FKC is not able to reasonably operate without either significant repair or replacement. As such, the current condition meets the definition of an "Undesirable Result" and must be addressed.

As discussed further below under Comment #5, the Minimum Thresholds (MTs) for subsidence in the ETGSA GSP and DEIDGSA GSP allow for between 1.3 and 3.0 feet of additional subsidence at the eight Representative Monitoring Sites (RMS) along the FKC. The MT established in the LTRIDGSA GSP for the RMS closest to the FKC (RMS location W) would allow for up to 2.55 feet of additional subsidence. Any additional subsidence and subsequent loss of FKC capacity (and surface water supply) will adversely affect the ability of the Kern County Subbasin (which includes the Friant Districts) to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon. As such the MT definitions in the adjacent GSPs are inconsistent with GSP Regulations 23 CCR § 350.4(f) and § 354.28(b)(3). Furthermore, as discussed below, potential impacts to adjacent basins are required to be considered in the development of GSP monitoring networks, per GSP Regulations 23 CCR § 354.34(f)(3) and § 354.38(e)(4), and in the evaluation of Plans by the Department of Water Resources (DWR) per GSP Regulations 23 CCR § 355.4(b)(7).

The Undesirable Results definition for Land Subsidence (Section 4.3.4.2 of the TSCA) allows for up to 50 percent of the RMS to exceed their MTs. Given the sensitivity of the FKC capacity to changes in land surface elevation, and the documented loss of FKC capacity under historical subsidence conditions (mentioned in Sections 1.6 and 3.2 of the ETGSA JPA Communication and Engagement Plan; Sections III.A.1 and III.B.3 of the DEIDGSA Communication & Engagement Plan; Sections 5.2.1.2.1 and 5.2.2.2.2 of the DEIDGSA GSP; Section 2.5 of the Tule Subbasin Monitoring

Plan [Attachment 1 of the TSCA]; and Section 2.3.4 of the Tule Subbasin Setting [Attachment 2 to the TSCA]), allowing further subsidence to exceed MTs in up to 50% of RMS is not protective of this critical infrastructure. This Undesirable Results definition has the potential to significantly and unreasonably affect not only the Tule Subbasin but the Friant Districts and adversely affect the ability of the Kern County Subbasin (which includes the Friant Districts) to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon, which would be inconsistent with GSP Regulations 23 CCR § 350.4. and § 354.28(b)(3).

The Undesirable Results definition for Land Subsidence (Section 4.3.4.3 of the TSCA) only recognizes the beneficial uses within the Tule Subbasin, neglecting to recognize those downstream beneficial uses and users of critical infrastructure (i.e., the Friant Districts). This limited consideration of only in-basin beneficial uses and users in inconsistent with the GSP Emergency Regulations 23 CCR § 354.26(b)(3) which makes no such distinction between in-basin and out-of-basin beneficial uses and users, and § 350.4(f) which describes the evaluation of a Plan "consistent with the objective that a basin be sustainably managed within 20 years of Plan implementation without adversely affecting the ability of an adjacent basin to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon."

3. Regarding the Basin Setting

Background

A Tule Subbasin-wide summary of the Basin Setting element of GSPs is contained within the TSCA (Section II and Attachment 2) and includes a discussion of subsidence (Section 2.2.5 of Attachment 2 of the TSCA). With respect to subsidence along the FKC, the subsidence section in the TSCA Tule Subbasin Setting includes a single sentence providing a range of cumulative subsidence values for the 58-year period from 1959 – 2017 from benchmarks monitored by the Friant Water Authority:

> "Based on benchmarks located along the Friant-Kern Canal and monitored by the Friant Water Authority, cumulative land subsidence along the canal between 1959 and 2017 has ranged from approximately 1.7 ft in the Porterville area to 9 feet in the vicinity of Deer Creek (see Figure 2-24)".

A number of other subsidence rates for different time periods and different parts of the Tule Subbasin are mentioned and two subsidence map figures (one for the period 2015-2018 and the other for 2007-2011 which does not cover the FKC area) are included in the TSCA. However, despite the statement that "land surface subsidence in the Tule Subbasin as a result of lowering the groundwater level from groundwater production has been well documented" (TSCA, Attachment 2, Section 2.2.5), no supporting information is provided on groundwater level changes or groundwater production as it relates to observed subsidence rates. Additional and readily available information available through the SGMA Data Viewer is not used. As such, the Basin Setting portion of the TSCA and the GSPs is inconsistent with the standard that the "best available information" be used (23 CCR § 354.16).

The water budget section of the Tule Subbasin Setting (TSCA Attachment 2, Section 2.3.5) mentions impacts to the FKC due to subsidence:

> "The primary surface water supply issue affecting the ability of agencies to operate within the Sustainable Yield of the subbasin is reduced delivery capacity in the Friant-Kern Canal due to land subsidence. Land subsidence has lowered the canal elevation in certain areas resulting in a reduction in downstream canal delivery capacity".

The above statement does not include any quantitative descriptions of impacts to the FKC from subsidence, although such description is mentioned elsewhere in the document (i.e., in the Communication and Engagement Plans of the ETGSA and DEIDGSA).

Each individual GSP also contains a brief discussion of the Basin Setting elements, including subsidence, but the discussion refers to the TSCA Tule Subbasin Setting and does not provide any additional information.

Comment: The Basin Setting information lacks sufficient discussion of the serious issue of subsidence. A.7

Adjacent GSPs: The Basin Setting sections of the adjacent GSPs do not provide detailed information about subsidence, particularly as it pertains to the impacts on the FKC. For example, the cumulative subsidence data provided at several points along the FKC are values over a very long time period (58 years), with no attempt made to correlate such values either in time or in space with changes in groundwater elevation. The InSAR data shown on one map figure (Figure 2-25 of the Tule Subbasin Setting) only cover four years. These exhibits are therefore of limited value in understanding the scale of the subsidence issue in the Tule Subbasin and its relation to declining groundwater levels which are the key factor over which GSAs are likely to have direct control (i.e., through management of water supplies and demands). By providing such a limited presentation of data and discussion, the GSPs are not in compliance with 23 CCR § 354.16(e), which states that a GSP must include information on "the extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department… or the best available information". Additional datasets available through the SGMA Data Viewer (i.e., data from USGS and DWR extensometers and InSAR data from the TRE Altamira and NASA JPL) should be examined and presented in the GSPs to the greatest extent possible and applicable, along with data on changes in groundwater levels.

While the 60 percent reduction in FKC delivery capacity as a result of subsidence in the Tule Subbasin is mentioned in the ETGSA JPA Communication and Engagement Plan and in the DEIDGSA Communication & Engagement Plan, it is not discussed elsewhere in either of these two GSP documents, nor in the LTRIDGSA GSP. This important fact should be mentioned in the "Potential Effects on Beneficial Uses and Users" sections of the GSPs and/or the Land Subsidence section (Section 2.2.5) of the Tule Subbasin Setting document (Attachment 2 to the TSCA). Additional information related to impacts to the FKC conveyance capacity should be included and appropriately cited.

Non-Adjacent GSPs: The non-adjacent GSPs similarly contain only limited information and discussions about subsidence in their Basin Setting sections. No correlations between subsidence, groundwater level declines and/or groundwater production area provided. Given the significance of the subsidence issue in the Tule Subbasin, and the relatively large subsidence rates observed over time and recently, more detailed information should be provided (for example, the additional datasets that have been made readily available through the DWR SGMA Data Viewer website; see list above). By providing such a limited presentation of data and discussion, the GSPs are not in compliance with 23 CCR § 354.16(e), which states that a GSP must include information on "the extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department… or the best available information".

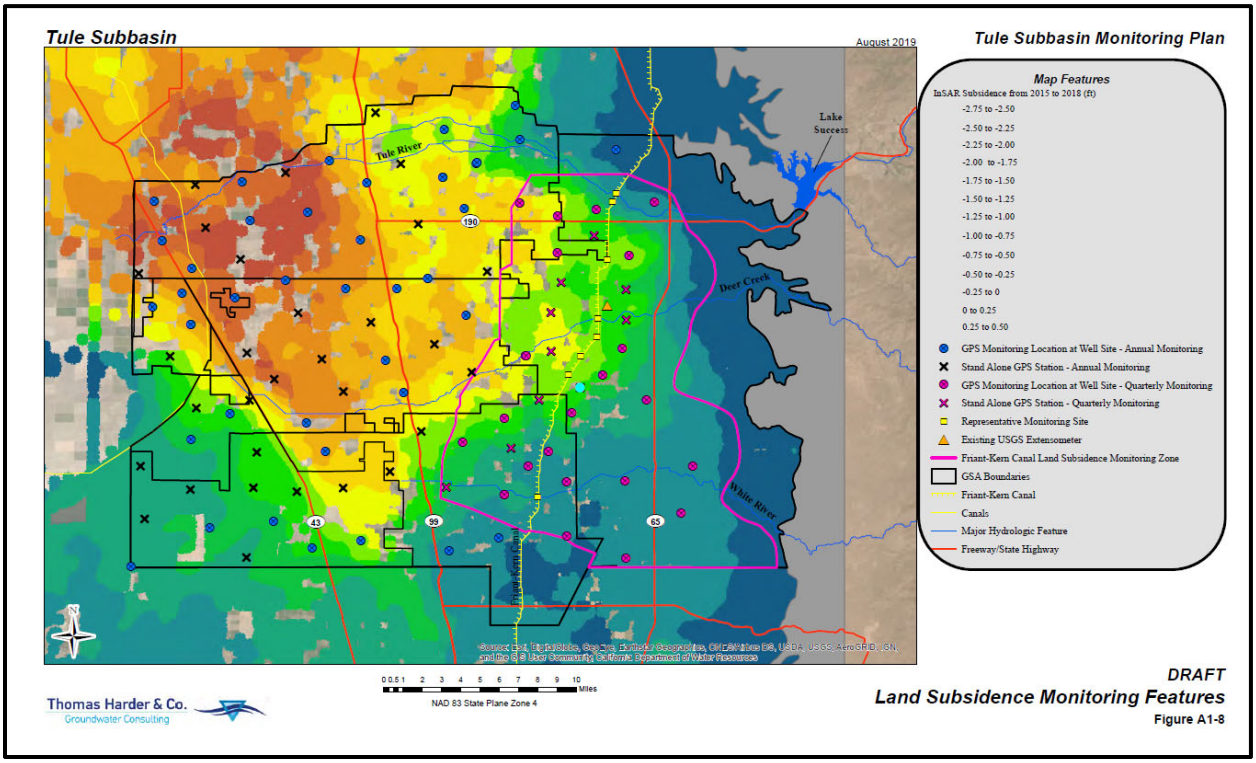
4. Regarding Monitoring Networks and Management Areas for Subsidence

Background

The Tule Subbasin contains a "land subsidence monitoring area" that is approximately centered around the FKC and extends west four miles and eastward to the 1-ft cumulative subsidence 1986-2017 contour. This area is shown by the solid pink line in Figure A1-8 of Attachment 1 of the TSCA (see figure below). This map figure also shows the cumulative subsidence between 2015 and 2018 based on InSAR data. Based on this data, the subsidence along the FKC during this period was up to 1.25 ft.

The ETGSA contains a "Friant-Kern Canal Subsidence Management Area" which appears to be the same as the "land subsidence monitoring area" mentioned in the TSCA Monitoring Plan.

Figure A1-8 from the Tule Subbasin Monitoring Plan (Attachment 1 of the TSCA)



The Tule Subbasin Monitoring Plan (Attachment 1 to the TSCA) describes the network and protocols for land subsidence (and other indicators). It consists of:

- GPS stations (existing ones operated by USBR along the FKC, and new ones including 63 at monitoring well locations and 39 standalone GPS stations); annual frequency for all sites, except quarterly for sites within the "FKC Monitoring Zone" (which is presumably the same as the "land subsidence monitoring area" mentioned in the TSCA);
- Extensometers (one operated by USGS along the FKC one mile north of Deer Creek crossing); continuous data collection with periodic uploads by USGS; and
- Satellite data (InSAR), obtained from JPL, USGS, or ESA and analyzed/interpreted by 3rd party to develop maps, for six periods over the first year of monitoring and then less frequent after that.

The Tule Subbasin Monitoring Plan also recommends the installation of a new extensometer in the northwestern portion of basin (not near the FKC).

There are a total of eight GPS monitoring locations along the FKC that are used as RMS in the three adjacent GSPs (seven RMS in the ETGSA GSP and one RMS in the DEIDGSA GSP). These locations are labeled B through I and shown in the two figures below.

Figure 6-3 from the ETGSA GSP

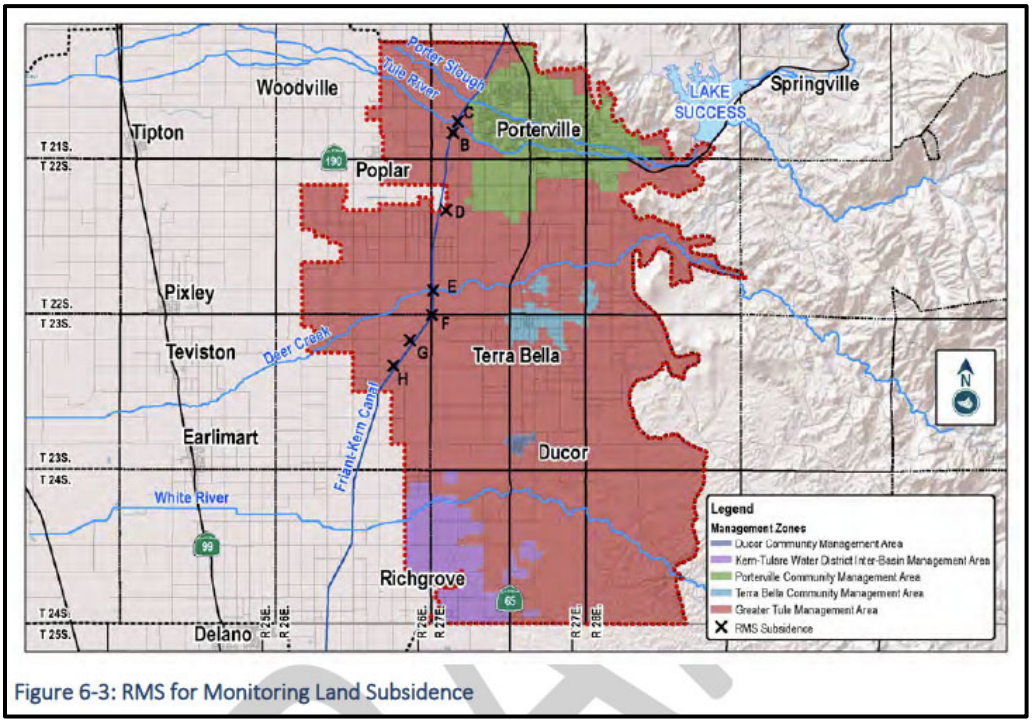


Figure 6-3: RMS for Monitoring Land Subsidence

Figure 4-3 from the DEIDGSA GSP

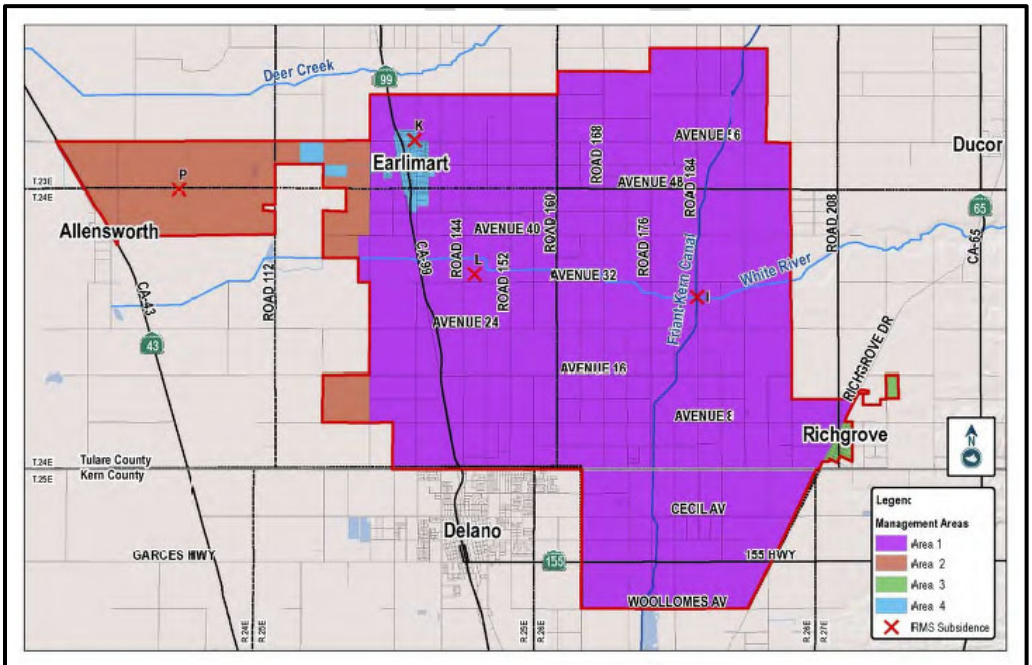


Figure 4-3: RMS for Monitoring Land Subsidence

Comment: *The Monitoring Network for subsidence in the vicinity of the FKC is inadequate.* A.8

Adjacent GSPs: The DEIDGSA GSP monitoring network (Section 4.2.3.5) only contains a single RMS along the FKC, which provides inadequate spatial resolution to capture the details of subsidence in the DEIDGSA area. The GSP Regulations 23 CCR § 354.34(f) requires that the Agency "determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors … (3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal." Given that the DEIDGSA GSP monitoring network only contains a single subsidence RMS along the FKC, the network will not allow for sufficient characterization of impacts to overlying land uses (i.e., including critical infrastructure such as the FKC) and impacts to adjacent basins. As such, the subsidence monitoring network does not appear to satisfy the requirements of GSP Regulations 23 CCR § 354.34(f).

5. Regarding Sustainable Management Criteria for Subsidence in Adjacent GSPs

Background

Sustainable Management Criteria (SMCs) include Measurable Objectives (MOs), Interim Milestones (IMs), and Minimum Thresholds (MTs). The IMs and MOs for subsidence are defined based on the projected depth of subsidence calculated by the Groundwater Flow Model[12] based on a model run that incorporates planned Projects & Management Actions (P/MAs).

The MTs for subsidence, in terms of change from baseline (2020) elevations, are defined in the ETGSA GSP (Section 5.8.3.1.1) as the lesser of 3 ft -OR- the amount of elevation change observed over the 2007-2016 period (a "recent drought") subtracted from the lowest interim milestone from 2020-2030). This value is then subtracted from the baseline elevation to determine the MT in terms of elevation at each RMS. In the DEIDGSA GSP, there is no 3-ft maximum included in the subsidence MT definition (Section 3.5.2.4.1). Similarly, in the LTRIDGSA GSP, there is no 3-ft maximum included in the subsidence MT definition (Section 3.5.2.4.1), meaning that the MT is not limited to 3 feet.

The SMCs for the eight subsidence monitoring locations along the FKC are shown in Table 1, below, compiled by EKI from information included separately in the ETGSA and DEIDGSA GSPs. As shown in Table 1, five of the eight RMS locations along the FKC have MTs for subsidence that are 3.0 feet below the Baseline elevation (i.e., they would allow an additional 3.0 feet of land subsidence directly adjacent to the FKC). SMCs for subsidence RMS locations that are not along the FKC are also shown in Table 1. These MTs allow for subsidence of up to approximately 9.0 feet at some RMS locations.

[12] The numerical Groundwater Flow Model is based on the hydrogeologic conceptual model (see TSCA Section 2.2). Thomas Harder & Co., 2019. Groundwater Flow Model of the Tule Subbasin (DRAFT in Progress).

Table 1
SMCs for Land Subsidence in the Tule Subbasin GSPs

GSA	RMS ID	Baseline	Interim Milestones			Measurable Objective	Minimum Threshold	Difference between Baseline and MT
		2020	2025	2030	2035	2040		
		ft msl	ft msl	ft msl	ft msl	ft msl	ft msl	ft
RMS Locations Along the Friant-Kern Canal								
ETGSA	B	406.46	406.12	405.90	405.84	405.85	404.80	1.66
ETGSA	C	404.30	404.03	403.83	403.78	403.77	403.00	1.30
ETGSA	D	403.99	403.50	403.25	403.25	403.25	400.99	3.00
ETGSA	E	396.86	396.54	396.38	396.39	396.39	393.86	3.00
ETGSA	F [(1)]	406.46	406.12	405.90	405.84	405.85	403.46	3.00
ETGSA	G	391.70	390.59	389.98	389.92	389.85	388.70	3.00
ETGSA	H	394.13	392.57	391.62	391.49	391.36	391.13	3.00
DEID GSA	I	396.24	396.00	395.77	395.65	395.62	394.77	1.47
RMS Locations Not Along the Friant-Kern Canal								
PIDGSA	A	201.95	201.2	200.39	199.83	199.66	194.6	7.35
PIDGSA	J	261.59	260.77	259.96	259.23	258.80	256.51	5.08
PIDGSA	Q	258.93	258.90	257.31	256.74	256.43	252.84	6.09
PIDGSA	R	232.34	231.07	230.22	229.70	229.37	225.94	6.40
PIDGSA	T	193.10	190.99	188.95	187.04	185.44	184.38	8.72
LTRIDGSA	U	202.19	200.80	199.35	197.94	194.91	194.91	7.28
LTRIDGSA	W	350.25	349.71	349.10	348.60	348.28	347.70	2.55
LTRIDGSA	X	259.71	257.98	256.14	254.48	253.24	250.73	8.98
LTRIDGSA	Y	255.53	254.39	253.25	252.10	251.18	249.64	5.89
LTRIDGSA	Z	228.86	227.34	225.84	224.51	223.60	220.25	8.61
TCWAGSA	No subsidence SMCs established	-	-	-	-	-	-	-
AGSA		-	-	-	-	-	-	-

Abbreviations

AGSA = Alpaugh Groundwater Sustainability Agency
DEID = Delano-Earlimart Irrigation District
ET = Eastern Tule
ft = feet
ft msl = feet above mean sea level
GSA = Groundwater Sustainability Agency
GSP = Groundwater Sustainability Plan
LTR = Lower Tule River
MT = Minimum Threshold
PID = Pixly Irrigation District
RMS = Representative Monitoring Site
SMC = Sustainable Management Criteria
TCWA = Tri-County Water Authority

Note:

(1) The Baseline, Interim Milestones, and Measurable Objective for RMS location F appears to be duplicative of RMS location B, and therefore may be incorrect.

The ETGSA GSP contains a subsidence discussion of "Minimum Thresholds in Relation to Adjacent Basins" (Section 5.8.3.3), as follows:

> "Per criteria described for define minimum thresholds for groundwater levels in Section 5.8.3.1 Criteria to Define Minimum Thresholds, the GFM projects groundwater elevations based the Tule Subbasin reaching sustainability by 2040, with built in operational flexibility of a 10-year drought occurring during the 20-year implementation horizon of this plan. Adjacent basins have been tasked with the same objective to reach sustainability 2040, therefore, based on the criteria previously described, if minimum thresholds were experienced at groundwater level RMS, adjacent basins would experience similar groundwater conditions not as a direct result of minimum thresholds set by the Agency."

The DEIDGSA GSP contains a section called "Effects on Adjacent Basins" that simply concludes that:

> "as groundwater elevations are stabilized to natural conditions during the Plan Implementation period, adjacent basins should not be affected by the GSA".

The DEIDGSA GSP also includes a section called "Effects on Beneficial Uses" that has a bullet on subsidence that mentions impacts to existing critical infrastructure "including the District canal system" but does not mention the FKC.

Comment: The proposed Sustainable Management Criteria for subsidence are insufficient in their consideration of impacts on adjacent basins. A.9

Adjacent GSPs: The definitions of MTs for subsidence in the ETGSA GSP and the DEIDGSA GSP allows for large amounts of additional subsidence at the eight RMS locations along the FKC relative to present "Baseline" elevations. The MTs for subsidence at these eight RMS locations range from 1.3 feet to 3.0 feet, with five RMS locations with MTs of 3.0 feet. The MT established in the LTRIDGSA GSP for the RMS closest to the FKC (RMS location W) would allow for up to 2.55 feet of additional subsidence. These amounts of additional subsidence in close proximity to the FKC could have significant and unreasonable impacts on the FKC's ability to convey water to all downstream users and adversely affect the ability of the Kern County Subbasin (and Friant Districts) to implement its Plan or achieve and maintain its sustainability goal over the planning and implementation horizon. The MTs are therefore not protective of those beneficial users of the FKC both within the Tule Subbasin and in the adjacent Kern County Subbasin.

No analysis is provided in the ETGSA, DEIDGSA, and LTRIDGSA GSPs or in the TSCA as to specifically how the MTs for subsidence would impact the FKC, a "land use" of critical regional importance. Therefore, the discussion does not satisfy the requirements of GSP Regulations 23 CCR § 354.28(b)(4) which states that the description of MTs shall include "How minimum thresholds affect the interests of beneficial uses and users of groundwater or land uses and property interests" and GSP Regulations 23 CCR § 354.28(c)(5), which states "The minimum

thresholds for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results."

The reference to Section 4.3.4.3 of the TSCA is insufficient in this regard, as that section (which pertains to Undesirable Results for Land Subsidence) only mentions "financial hardship on land and property interests, such as the redesign of previously planned construction projects and the fixing and retrofitting of existing infrastructure"; it does not contemplate the reduction in FKC capacity and subsequent reduced availability of FKC supplies to downstream users which will directly impact those users' and basin's ability to achieve and maintain sustainability throughout the planning and implementation horizon. Nor does it contemplate the significant financial impacts related to addressing the subsidence impacts to the FKC.

The ETGSA GSP discussion of "Minimum Thresholds in Relation to Adjacent Basins" (Section 5.8.3.3) is not specific to or relevant to the subsidence sustainability indicator (i.e., the same text is used for subsidence as for the chronic lowering of groundwater levels sustainability indicator). The discussion furthermore dismisses the possibility that actions or inactions within the Tule Subbasin could negatively affect adjacent basins, rather stating that "adjacent basins would experience similar groundwater conditions not as a direct result of minimum thresholds set by the Agency". This assertion is not supported by facts or consistent with the reality that the MTs for subsidence set by the Agency (i.e., the ETGSA) will affect FKC conveyance capacity and therefore adversely affect the Friant Districts and impact the Kern County Subbasin's ability to achieve groundwater sustainability.

The DEIDGSA GSP contains a section "Effects on Adjacent Basins" (Section 3.5.2.5.2) that simply concludes that "as groundwater elevations are stabilized to natural conditions during the Plan Implementation period, adjacent basins should not be affected by the GSA." This assertion is not supported by facts or consistent with the reality that the MTS for subsidence set by the Agency (i.e., the DIEDGSA) will very likely impact FKC conveyance capacity and therefore adversely affect the Friant Districts and impact the Kern County Subbasin's ability to achieve groundwater sustainability.

None of the adjacent GSA GSPs contains a discussion of how the out-of-basin interests were considered during the Minimum Threshold development process. The definitions of MTs in the ETGSA GSP and the DEIDGSA GSP, therefore, do not satisfy the requirements of GSP Regulations 23 CCR § 354.28(b)(3), which states that the description of MTs shall include "how minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals".

Non-Adjacent GSPs: The establishment of SMCs for subsidence in the non-adjacent Tule Subbasin GSPs is also problematic, even though subsidence in those areas may not have a direct impact on the FKC. For the two non-adjacent GSPs that do establish SMCs for subsidence, the MTs are set so as to allow for significant further subsidence beyond baseline conditions (see Table 1). Specifically, the MTs for subsidence in the LTRGSA GSP for RMS locations other than location W (discussed above) allow for between 5.89 and 8.98 feet of subsidence relative to baseline

conditions, and the MTs for subsidence in the PIDGSA GSP allow for between 5.08 and 8.72 feet of subsidence relative to baseline conditions.

The other two non-adjacent GSPs do not even set SMCs for subsidence. The TCWAGSA GSP does not set SMCs for subsidence, citing a lack of ground-based measurements, even though the available satellite-based subsidence data suggest subsidence rates of approximately 0.7 to 2.0 feet over the 16-month period from May 7, 2015 to September 10, 2016. Likewise, the AGSA GSP does not define SMCs for subsidence, but rather states that five years of monitoring (i.e., from 2020 – 2024) will be used to establish baseline rates of subsidence and then to set site-specific SMCs.

6. Regarding Projects and Management Actions

Background

The DEIDGSA GSP mentions subsidence-related FKC capacity constraints in one P/MA (Action 2 – Increase Importation of Imported Waters; Section 5.2.1.2), but only as a reason to pursue the action, not as a problem to be addressed. Under another P/MA (Action 1 – Transitional Pumping [for White Areas]), the DEIDGSA GSP includes additional discussion of impacts to the FKC, and states that additional study and analysis will:

> "look at finding the relative cause of future predicted subsidence along the FKC … likely to lead to an assessment of costs of FKC subsidence mitigation to those lands employing transitional pumping … collection of mitigation fees would then be used to correct subsidence impacts on the FKC … would restore the carrying capacity of the FKC … would restore the ability of Friant contractors in the Tule Subbasin and those further south to receive their contractual imported water without capacity limitations."

The ETGSA mentions subsidence as being one of the sustainability indicators that will be "generally" affected by various P/MAs.

The planned P/MAs that are aimed at achieving sustainability through a balancing of the groundwater budget are described in Section 2.3.5 of the Tule Subbasin Setting (Attachment 2 of the TSCA). Details of "transitional pumping" schedules for each of the GSAs under the planned P/MAs are provided in Table 2-7 of the Tule Subbasin Setting (below). As shown in Table 2-7, the projected year for achieving sustainability ranges from 2035 to 2040 for all areas except for the DEIDGSA District Area which is described as already being sustainable (i.e., "No Change / Sustainable"). Until sustainable conditions are achieved (i.e., for at least 15 more years in all areas except the DEIDGSA District Area), the planned P/MAs will allow for continued over-pumping which will result in continued water level declines. For the DEID White Lands (i.e., the "Western Management Area" consisting of undistricted lands), the transitional pumping schedule calls for no reduction in pumping relative to existing crop consumptive use.

Table 2-7 of the Tule Subbasin Setting (Attachment 2 of the TSCA)

Tule Subbasin
Chapter 2 - Basin Setting

DRAFT
Table 2-7

Planned Transitional Pumping by GSA

	Eastern Tule GSA	LTRID GSA	Pixley ID GSA	DEID-District Area	DEID White Lands Area	Tri-Co GSA	Alpaugh GSA
	2	A	A		-	-	-
2020-2025	90% of over-pumping[1]	2.0 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining no change	No Change/ Sustainable	100% of over-pumping	100% of over-pumping	Reduce cropped area by 880 acres; 80% of overpumping
2025-2030	80% of over-pumping	1.5 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining 1.5 af/ac Over Cons. Use Target[2]		Linear Transitional Pumping	Reduce pumping 10,000 af/yr	
2030-2035	30% of over-pumping	1.0 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining 1.0 af/ac Over Cons. Use Target				50% of overpumping
2035-2040	Sustainable	0.5 af/ac Over Cons. Use Target	Fallow 5,000 acres; Remaining 0.5 af/ac Over Cons. Use Target		Sustainable	Sustainable	20% of overpumping
2040+		Sustainable	Sustainable				Sustainable

Notes:
[1]Over-pumping means pumping in excess of the consumptive use target
[2]Over consumptive use target means over pumping

Comment: *The proposed Projects and Management Actions do not adequately address and mitigate impacts from subsidence.* A.10

Adjacent GSPs: None of the adjacent GSA GSPs include projects whose specific anticipated benefits will be mitigation of subsidence related impacts. The DEIDGSA GSP, under Action 1 for the Western Management Area "White Lands" (Section 5.2.2.2), discusses impacts to the FKC, and says that a future study is "anticipated", but it is not specifically called for. The P/MAs section of the ETGSA GSP (Section 7) only mentions subsidence as being one of the sustainability indicators that will be "generally" affected by various P/MAs.

GSP Regulations 23 CCR § 354.44(b)(1) require that a GSP include a description of P/MAs that includes "A list of projects and management actions … that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent." Given that significant and unreasonable impacts for land subsidence may have already occurred or are imminent, and that the list of P/MAs in the ETGSA GSP and DEIDGSA GSP does not include actions to address these undesirable results (only mentioning an "anticipated" future study), the list of P/MAs does not meet the requirements of GSP Regulations 23 CCR § 354.44(b)(1).

Further, the transitional pumping schedule for the DEIDGSA Western Management Area "White Lands" calls for no reduction from existing crop consumptive use demands for the first five years. This five-year delay in commencement of transitional pumping will perpetuate the water budget deficits in the DEIDGSA Area which are estimated through groundwater modeling to be in excess of -30,000 acre-feet per year (AFY) initially in 2020, eventually ramping down to -15,000 AFY in 2030 and -4,000 AFY in 2040 (Appendix C of the Tule Subbasin Setting). This five-year delay in commencement of transitional pumping will also perpetuate the subsidence issues and impacts

to the FKC. As such evaluation of this P/MA has not considered "the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected…" as is required per CCR 23 § 354.4(b)(4).

Non-Adjacent GSPs: The TCWAGSA GSP similarly delays commencement of transitional pumping for the first five years (i.e., until 2025) which is projected to results in continued groundwater deficits of -12,000 AFY in 2020, -8,000 AFY in 2030, -6,000 AFY in 2040, and -3,000 AFY in 2070. These continued water budget imbalances will likely result in continued groundwater declines, as is corroborated by the projected hydrographs from the groundwater model (included in Appendices A through F of the Tule Subbasin Setting [Attachment 2 to the TSCA]). Consequently, the declining groundwater levels will likely lead to further land subsidence, effects of which could negatively impact beneficial uses and users within the Tule Subbasin and the adjacent Kern County Subbasin. As such evaluation of potential P/MAs has not considered "the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected…" as is required per CCR 23 § 354.4(b)(4).

Please let us know if you have any questions regarding this matter.

Sincerely,

EKI Environment & Water, Inc.

Anona Dutton, P.G., C.Hg.	Christopher Heppner, Ph.D., P.G.
Vice President	Supervising Hydrogeologist

December 16, 2019
GSI Proposal No. 9000-910
GSI EKI MSA 20180103

Jeevan Muhar
Arvin-Edison Water Storage District (AEWSD)
and
Dana Munn
Shafter-Wasco Irrigation District (SWID)

Re: Subsidence-Focused Review of Tule Subbasin Groundwater Sustainability Plans
For Friant Districts in Kern County

Dear Mr. Muhar and Mr. Munn:

Per the request by EKI Environment and Water, Inc. (EKI) on behalf of the Friant Districts (Arvin Edison Water Storage District and Shafter-Wasco Irrigation District), GSI Environmental Inc. (GSI) has performed a subsidence-focused review of the following six draft Groundwater Sustainability Plans (GSPs) individual released by six respective Groundwater Sustainability Agencies (GSAs) in the Tule Subbasin:

- Alpaugh (A) GSA GSP,
- Delano-Earlimart Irrigation District (DEID) GSA GSP,
- Lower Tule River Irrigation District (LTRID) GSA GSP,
- Pixley Irrigation District (PID) GSA GSP,
- Eastern Tule (ET) GSA GSP, and
- Tri-County Water Authority (TCWA) GSA GSP.

The review focused on assessing whether subsidence has been adequately addressed in the GSPs to avoid negative future impacts on the Friant-Kern Canal (FKC) to an extent that will adversely affect the Friant Districts plan to achieve the groundwater sustainability goals in compliance with the State of California's Sustainable Groundwater Management Act (SGMA). The version of each document reviewed was downloaded through the website (https://tulesgma.com/) on December 2, 2019.

BACKGROUND

The Friant Districts are developing a GSP. To achieve the groundwater sustainability goals, the Friant Districts relies on contracts with the United States Bureau of Reclamation (USBR) for 90,000 acre-feet per year (AFY) of Class 1 water and 351,275 AFY of Class 2 water from the Friant Division of the Central Valley Project (CVP), delivered through the FKC, as a component of the available water resources to meet the predicted agricultural water demands. The FKC transmit water from the north, through the DEID and ET GSP Management Area in the Tule Subbasin and then through the Kern-Tulare GSP Management Area, into Kern County Subbasin.

Groundwater extraction has caused ground subsidence along the FKC in the Tule Subbasin since its construction was completed. The rate of subsidence was accelerated between 2008 and 2016 due to extreme drought condition. The water flow through the FKC was primarily driven by gravity. It has been reported that the FKC has lost approximately 60 percent of its design delivery capacity because historical land subsidence has reduced the topographic slope along the FKC alignment. In addition to ground subsidence and topographic slope changes, groundwater extraction also induces horizontal and vertical curvatures along a line on the ground surface in the vicinity of the extraction well. Differential subsidence also causes stresses and strains in the subsurface soils. Excessive strains can generate fissures and compaction faults. If the induced curvatures and slopes along the FKC are excessive, or if fissures and compaction faults developed in the subsurface underlying the FKC, FKC structural damage and water leak might occur. Reduction of water conveyance capacity and water leak along the FKC in the Tule Subbasin would potentially jeopardize Friant District's ability to achieve the groundwater sustainability goal set in their GSP. According to the GSP Regulations under the SGMA, the Tule Subbasin GSPs

should "avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals".

OVERVIEW OF THE GSP REVIEW

The six GSPs were developed primarily based on a similar document structure. The GSPs include sections that describe the plan area, basin setting, sustainable management criteria, monitoring network, and projects and management actions. The following two attachments to the Tule Subbasin Coordination Agreement (TSCA):

- Attachment 1 (A1) – Tule Subbasin Monitoring Plan
- Attachment 2 (A2) – Tule Subbasin Basin Setting

were presented as appendices attached to the GSPs and are the basis for developing the GSPs. The TSCA provides a platform for coordinating data sharing and GSP approach. In addition, the GSPs were developed using the results of a Tule Subbasin Groundwater Flow Model (TSGFM) which has not been released for this review. Therefore, our review focused on how the TSGFM results were utilized to establish sustainability metrics. The quantitative metrics should be reviewed when the TSGFM is finalized.

The FKC passes through the ET and DEID GSA Management Areas (MA). The TSCA defined an area centered around the FKC and extends west four miles and eastward to the 1986-2017 one-foot subsidence contour as "land subsidence monitoring area". The ETGSA GSP refers to this area as "Friant-Kern Canal Subsidence Management Area" (FKCSMA). The A GSA and TCWA GSA GSP Management Areas (MA) are over ten miles from the FKC. The subsidence in these two GSP MAs is not expected to induce significant topographic slope changes, curvatures, or strain along the FKC. Our review focused on the sections related to subsidence along the FKC in the ET and DEID GSA GSPs. The sections in the LTRID and PID GSA GSP related to subsidence within the FKCSMA were also reviewed.

REVIEW COMMENTS

The following comments are related to defining the performance metric in relation to the potential subsidence impacts on FKC:

- The "Undesirable Results for Land Subsidence" were not adequately defined regarding subsidence related impacts on the FKC A.11

  The GSPs only consider conveyance capacity reduction as an undesirable result of the FKC. Other undesirable results, such as structural damage resulting from curvatures and ground strains induced by groundwater extraction from nearby wells, were not considered. Based on our past experience, a major groundwater production well in the Corcoran area can potentially induce a vertical curvature on the order of 5e-6 ft^{-1}. In addition, such well can induce a horizontal movement of up to approximately 1/4 of the vertical subsidence within 2000 ft from the well. The FKC was constructed almost seventy years ago. The GSPs do not address the current condition and the vulnerability of the FKC. A major groundwater production well in close proximity to the FKC can potentially affect the structural integrity of the FKC. Based on the historical subsidence data from the United States Geologic Survey (USGS) and Jet Propulsion Laboratory (JPL), subsidence in the Tule Subbasin has been shifting eastward in the past decades due to additional groundwater extraction. The GSPs do not preclude the possibility of groundwater production wells in close proximity to the FKC.

- Allowing less than 50% of the Representative Monitoring Sites (RMSs) to exceed the Minimum Thresholds (MT) criterion might not be protective of adequate conveyance capacity of the FKC. A.12

Conveyance capacity is governed by topographic slope, which is dictated by the differential subsidence at two locations. Although only up to 50% of the Representative Monitoring Sites (RMSs) are allowed to exceed their MTs, it does not prohibit the differential subsidence between two neighboring RMSs to be large (e.g., no subsidence at one RMS while the next upgradient RMS has reached the maximum subsidence limit). Based on our past experience, a major groundwater production well in the Corcoran area can potentially induce a vertical slope on the order of 0.002. A major groundwater production well in close proximity to the FKC can potentially affect the conveyance capacity of the FKC. In addition, the 50% criterion is not location specific. In an extreme case, if 50% of the upgradient RMSs has reached the MT limits and the subsidence at the downgradient RMSs are minimal, it is unclear whether the FKC conveyance capacity can meet the target flow rate needed.

- The FKC Conveyance Capacity needed was not defined A.13

  Although FKC conveyance capacity is a major groundwater sustainability consideration, the GSPs did not present the FKC conveyance capacity needed. It has been reported that the FKC has already lost 60% of its conveyance capacity due to historical subsidence. The GSPs did not discuss the current conveyance capacity can adequately meet the flow rate needed and how much additional conveyance capacity loss is acceptable. The subsidence related Sustainable Management Criteria should address the acceptable FKC conveyance capacity loss.

- The relationship between the FKC Conveyance Capacity and Measurable Objectives (MOs) A.14

  The GSP subsidence metric was defined in terms of subsidence, but the FKC conveyance capacity is a major groundwater sustainability consideration. The relationship between the subsidence metric and the FKC conveyance capacity was not addressed. The subsidence related Sustainable Management Criteria should be established to represent the acceptable FKC conveyance capacity loss.

- The ET and DEID GSA GSPs did not consider the amount of FKC flow needed by the Kern-Tulare GSA and Friant Districts (among others downstream that have historically taken delivery of FKC water) to achieve their GSP. A.14

  According to the GSP Regulations under the SGMA, the GSP should "avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals". The Friant Districts and many water agencies south of the Tule Subbasin rely on the water delivered through the FKC to meet their groundwater sustainability goals. The GSPs should ensure that subsidence would not cause the FKC conveyance capacity to be lower than the flow rate needed for the impacted GSAs to meet their groundwater sustainability goals.

- The Interim Milestones (IMs) and MTs were defined based on a TSGFC that has not been completed at the time this review is performed. When TSGFC is completed, its accuracy and uncertainty shall be evaluated, especially regarding the simulation of elastic and inelastic subsidence as well as the delayed responses. Matching ground level change does not guarantee accurate representation of individual deformation components. It appears that the current versions of the GSPs do not consider model errors and uncertainty. If model errors/uncertainty are large, uncertainty/error margin or a safety factor should be considered in deciding the IMs and MTs. A.15

The following comments are related to monitoring:

- Insufficient RMSs along the FKC in the DEID GSA MA A.16

  Only one RMS is located in the DEID GSP MA. Although historical subsidence along the FKC in the DEID GSA MA has been small, future subsidence will increase if groundwater extraction

increases in the vicinity of the FKC. The GSPs do not preclude the possibility of groundwater production wells in close proximity to the FKC. Without additional RMSs along the FKC in the DEID GSP MA, the FKC conveyance loss and structural impacts might not be noticeable.

- RMSs at river crossing might not be approximate A.17

  A few RMSs are located at river crossing. The actual siting should be appropriately evaluated to avoid potential subsurface influence by the river flow condition.

- The is no RMSs to address the concern of FKC structural damages A.18

  Groundwater extraction close to the FKC might induce curvatures and strain. Monitoring and/or precaution against this situation was not addressed in the GSPs.

- The FKCSMA does not include the portions of FKC in the ET and DEID GSA MA. Although historical subsidence along the FKC in the DEID GSA MA has been small, future subsidence will increase if groundwater extraction increases in the vicinity of the FKC. A.19

Other Comments:

- Overdraft in the subbasin was defined based on averaged hydrology from the years 1990/91 through 2009/10. The average condition between 1990/91 and 2009/10 might not be representative of the long-term average condition. A.20

- Subsidence and associated ground deformation are mostly irreversible A.21

  When the subsurface is stressed by groundwater extraction from a well, the associated elastic deformation is relatively small in comparison to inelastic deformation. Due to the presence of compressible materials in the aquifer unit, compression and subsidence has a delayed response component. After pumping stops, subsidence might continue for one to two years. Even if groundwater level rises in the future, ground surface elevation rebound is typically on the order of 10% of the subsided amount. If subsidence MTs are reached, they are not recoverable.

- Under the current project and management actions, if there is no curtailment of groundwater extraction, especially in the area close to the FKC, subsidence will continue and MTs would likely be reached in the future. A.22

If you have any questions regarding the review comments, please let us know.

Best regards,
GSI ENVIRONMENTAL INC.

Chin Man W. Mok, PhD, PE, GE, D.WRE, D.GE
Vice President and Principal Engineer

November 2019

Chin Man W. Mok

PhD, PE, GE, PG, D.WRE, D.GE, F.ASCE, F.EWRI

Biographical Summary

Dr. Mok is a water resources and geo- professional with 34 years of consulting experience. He has directed many projects supporting the analysis and design of infrastructures, such as buildings, bridges, highways, tunnels, railroads, locks, dams and levees, pipelines, and underground structures; water resources management, such as watershed/groundwater basin evaluation, sustainability planning and optimization, system reliability assessment, flood and drainage evaluation, recharge study, and environmental remediation. His has substantial technical experience in evaluating subsurface stability and deformation due to infrastructure loading, groundwater extraction, and natural hazards. He has recently completed a subsidence study for the California High-Speed Rail System from San Francisco to Los Angeles through the rapidly subsiding Corcoran, El Nido, and Antelope Valley areas. He has been appointed to serve as a hydro- and geo- specialist on review panels for several high-profile projects. In addition, he has experience providing technical support to litigation projects.

In addition to consulting, Dr. Mok has been active in teaching and research. He is an adjunct professor at the University of Waterloo and Rice University. He has been teaching undergraduate and graduate courses on groundwater, geotechnics, engineering risk, data sciences, ground improvement, and environmental remediation at several universities, including the University of California at Berkeley. He has been a Principal Instructor of short courses in California and overseas, including workshops sponsored by the California State Water Resources Control Board and internal training classes for the Thailand Department of Groundwater Resources on issues related to water resources management, land subsidence, and environmental remediation. He has been the Principal Investigator of many research projects funded by federal agencies on high-resolution subsurface characterization, groundwater optimization, and subsurface system reliability analysis. He has been a Chair of the Groundwater Management Committee and is currently a panel member of the KSTAT standard committee of the American Society of Civil Engineers developing guidance documents.

Professional Background

Consulting:

Vice President / Principal Engineer and Hydrogeologist, GSI Environmental Inc., Oakland, CA. 2013 to present

Principal Engineer and Hydrogeologist, AMEC Environment and Infrastructure (currently Wood PLC), Oakland, California. 2008 to 2013

Principal Engineer and Hydrogeologist, Geomatrix Consultants, Inc., (acquired by AMEC), Oakland, California. 1987 to 2008

Structural and Geotechnical Engineer, Maunsell Consultants Asia, (currently AECOM), Hong Kong. 1985 to 1986

Academic:

Adjunct Professor, Earth, Environmental and Planetary Sciences, Rice University, Houston. 2017 to present

Adjunct Professor, Earth and Environmental Sciences, University of Waterloo, Canada. 2008 to present

Lecturer, Civil and Environmental Engineering, University of California at Berkeley, California. 2014, 2016

Rudolf Diesel Industry Fellow and Affiliated Professor, Engineering Risk Analysis, Institute for Advanced Study, Technical University of Munich, Germany. 2011 to 2014

Visiting Associate Professor, Civil and Environmental Engineering, University of Hong Kong, 2010

Education

Ph.D., Department of Civil and Environmental Engineering, University of California at Berkeley, 1999.

M.S., Department of Civil and Environmental Engineering, University of California at Berkeley, 1987.

B.Sc. (Eng.), Department of Civil and Structural Engineering, University of Hong Kong, 1985.

Professional Registrations, Qualifications and Affiliations

Professional Civil Engineer, California 46755, Arizona 39042, Florida 75351, Texas 119446

Professional Geologist, Arizona 40746

Registered Geotechnical Engineer, California 2365

Founding Diplomate, Water Resources Engineer, American Academy of Water Resources Engineers

Diplomate, Geotechnical Engineer, Academy of Geo-professionals

Honors and Awards

Rudolf Diesel Industry Fellow, Institute for Advanced Study, Technical University of Munich

Fellow, American Society of Civil Engineers

Fellow, Environmental and Water Resources Institute

Jane Lewis Fellowship, University of California, Berkeley

Parker Trask Fellowship, University of California, Berkeley

Hui Yin Hing Fellowship, University of Hong Kong

S.L. Pao Education Foundation Scholarship, University of Hong Kong

Representative Projects

Ground Subsidence Study, California High-Speed Rail Authority (CAHSR). Principal-in-charge. Task Leader of the AMEC Foster Wheeler team. Directed three-dimensional coupled groundwater and geomechanical modeling to estimate the potential impacts of groundwater extraction on subsurface deformation and induced vertical/horizontal topographic curvatures for infrastructure analysis. Evaluated the accuracy and reliability of an USGS' Central Valley Hydrologic Model in regard to refinement and specific calibration for HSR use. Applied data fusion to integrate available LiDAR, InSAR, GPS/RTK, survey data collected in the different areas and periods to develop data-driven subsidence prediction model. Developed simulation models to predict future subsidence in the HSR alignment areas in the San Joaquin Valley and Antelope Valley. Performed flood modeling to delineate runoff pathways and evaluated the subsidence induced flood plain changes in the historical Tulare Lake area. Flood plain change will impact surface water recharge to groundwater.

Tai Hang Road Subsidence Investigation, Government Geotechnical Engineering Office, Hong Kong. Principal-in-charge. Tasked by the Geotechnical Engineering Office, Dr. Mok was engaged by Fugro (Hong Kong) Limited as a subject expert in a detailed study of the subsurface conditions below Tai Hang Road where land subsidence occurred. Notable signs of subsurface deformation, slope failure, and road damages were observed. He conducted field-testing at several locations to investigate the hydrogeologic condition in the area for evaluating the likelihood of groundwater being the major cause of failure.

Northern California Toll Bridges, San Francisco Bay Area, California. Project Manager. Provided geotechnical engineering support for the seismic retrofit and vulnerability studies of the San Mateo–Hayward Bridge, Benicia-Martinez Bridge, Carquinez Bridge, Richmond–San Rafael Bridge, and the cable-suspension section of the San Francisco–Oakland Bay Bridge. Static and dynamic stability analyses were performed for natural terrain and slopes during and after construction. Analysis also

included settlement and subsurface deformation estimation. The foundation types of these bridges include spread footings, driven piles, cast-in-drilled-hole piles, cast-in-steel-shell piles, and large caissons. Some of these piles terminate in soil and some are anchored in rock. Difficult geotechnical conditions were encountered at many bridge locations, including liquefiable zones, soft surficial soils, and weak rocks.

Optimized Regional Water Supply Operation Management and Water Resources Planning, Tampa Bay Water, Florida. Principal-in-charge. The project team developed an optimization framework to identify the best plan for operating the Agency's interconnected water supply system and managing the integrated water resources. The goal is to reliably and sustainably meet the municipal and industrial water demands while minimizing the hydro-ecological impacts on wetlands and the potential of seawater intrusion in multiple counties. The optimization considers physical system capacity, water use regulations and other operational constraints, as well as the uncertainties associated with the forecasting of water demands, surface water availability, climatic condition, and groundwater-surface water interaction.

Effects of Climate Variations and Water Management Strategies on Eco-Hydrologic Condition, Tampa Bay Water, Florida. Principal-in-charge. The project team evaluated the eco-hydrologic effects of various water management and operational strategies while accounting for the uncertainty of future climate condition, including severe droughts. A Monte Carlo approach was used to generate time series realizations of future climatic events. These realizations were utilized to generate time histories of the resulting water supply operation under various water management strategies. The effects of these water supply operations on the environmental and hydrologic condition in the region were estimated using a calibrated Integrated Hydrologic Model. The results were used to evaluate the reliability associated with each water management strategy to address the issues associated with large groundwater production during droughts.

Cost-effective Characterization of Large Plume Arrival Front at Edwards AFB, Air Force Civil Engineering Center, United States Department of Defence. Principal Investigator. This project demonstrated and validated that integrating data from hydraulic tomography (HT); groundwater and mass flux measurements; geophysical tomography (GT); chemical and hydraulic monitoring data; and geologic data cost-effectively improves the prediction of groundwater flow regime and reduces the associated uncertainty at the EAFB. Downhole, cross-hole, and hole-to-surface electrical resistivity tomography was performed. Tracer-enhanced time-lapsed tomography was conducted. Flux measurements using single-hole tracer dilution test, point velocity probes, and passive mass fluxmeters were performed and compared.

Erodibility Assessment of Lyons Dam, Tiger Creek Dam, Spaulding Lake Dams, Balch Diversion and Afterbay Dams, Lake Tabeaud Dam, and Lower Bear River Dam (Multiple Projects), Pacific Gas and Electric Company, California. Directed analyses to address the erosion potential of the foundation and abutment materials due to the hydrodynamic impact forces caused by water overflowing over dam crests during the maximum flood event. Both the Erodibility Index Method as well as the Comprehensive Fracture Mechanics and Dynamic Impulsion Models are used. Rock quality were evaluated based on field investigation and inspection.

Groundwater Training Courses, Thailand Department of Groundwater Resources. Principal Instructor. Retained to provide a series of three five-day short courses to train the Agency's professional staff on groundwater modeling, focusing on applications to water resources management, environmental remediation, and land subsidence control.

Groundwater and Seepage, University of California at Berkeley. Taught a one-semester course on flow through porous media, numerical analysis, hydrogeology, aquifer testing, and contaminant transport, focusing on the practical applications to geotechnical, water resources, and environmental problems, such as dams, levees, slope stability, land subsidence, water supplies, landfills, waste disposal, and contamination control and remediation.

Groundwater, University of Hong Kong. Taught a one-semester graduate-level course on groundwater and geotechnics. The course covered saturated and unsaturated flow, seepage, infiltration, slope stability, land subsidence, and contaminant transport. The focuses were on applications to water infrastructures and geo-environmental issues.

RECLAMATION

Managing Water in the West

SAN JOAQUIN RIVER RESTORATION PROGRAM

Friant WATER AUTHORITY

Friant-Kern Canal Middle Reach Capacity Correction Project

Draft Recommended Plan Report

October 2019

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.

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Abbreviations and Acronyms

AF	acre-feet
APE	Area of Potential Effect
B-C	benefit cost
CalSim II	California Water Resources Simulation Model
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CER	Canal Enlargement and Realignment
cfs	cubic feet per second
CVP	Central Valley Project
CWC	California Water Commission
DEC	Design Engineering and Cost
D&S	Directives and Standards
DWR	California Department of Water Resources
EA	Environmental Assessment
EIS/R	Environmental Impact Statement/Environmental Impact Report
ESA	Endangered Species Act
FAA	Financial Assistance Agreement
FKC	Friant-Kern Canal
FWA	Friant Water Authority
GSA	groundwater sustainability agency
GSP	groundwater sustainability plan
Guidelines	Guidelines for the Application of Criteria for Financial Assistance for Local Projects under Part III of Public Law 111-11
HGL	Hydraulic Grade Line
ID	Irrigation District
IDC	Interest During Construction
InSAR	interferometric synthetic aperture radar
IS	Initial Study
JPA	Joint Powers Authority
MP	Mile Post
MUD	Municipal Utility District
NED	National Economic Development
NEPA	National Environmental Policy Act
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NMFS	National Marine Fisheries Service
NRDC	Natural Resources Defense Council

O&M	operations and maintenance
OM&R	operations, maintenance, and replacement
OPCC	opinion of probable construction cost
PCA	Project Cooperation Agreement
P.L	Public Law
PR&G	Principles, Requirements, and Guidelines for Federal Investment in Water Resources
Project	Friant-Kern Canal Middle Reach Capacity Correction Project
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Report	Draft Recommended Plan Report
ROD	Record of Decision
ROW	Right of way
RWA	Recovered Water Account
Settlement	Stipulation of Settlement of Natural Resource Defense Council (NRDC) et al. v. Kirk Rodgers et al.
Settlement Act	San Joaquin River Restoration Settlement (Title X, Subtitle A) Provisions of Public Law 111-11
SGMA	Sustainable Groundwater Management Act
SJRRP	San Joaquin River Restoration Program
State	State of California
Study	FKC Middle Reach Capacity Correction Project Feasibility Study
SWAP	State-Wide Agricultural Production
TAF	thousand acre-feet
TM	technical memorandum
URFs	Unreleased Restoration Flows
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VERA	Voluntary Emission Reduction Agreement
WD	Water District
WEAT	worker environmental awareness training
WIIN Act	Water Infrastructure Improvements for the Nation Act (P.L. 114-322) of 2016.
WSD	Water Storage District

Chapter 1
Introduction

The Friant-Kern Canal (FKC) is a principal feature of the Central Valley Project (CVP) that extends approximately 152 miles from Millerton Lake to the Kern River in the eastern portion of the San Joaquin Valley in central California. The FKC delivers CVP water supplies to Friant Division long-term contractors. The Middle Reach of the FKC, an approximately 33-mile section located within Tulare and Kern Counties, has experienced significant capacity loss. The capacity loss is a result of both regional land subsidence that has occurred over the past decade and an original design deficiency that prevents the intended flow capacity to be actualized. The FKC Middle Reach Capacity Correction Project (Project) is being developed to provide improvements to restore its originally designed and constructed capacity through the Middle Reach of the FKC.

The FKC Middle Reach Capacity Correction Project Feasibility Study (Study) is being developed by the Friant Water Authority (FWA) in coordination with the U.S. Department of the Interior, Bureau of Reclamation (Reclamation). Progress and results of the Study are being documented in a series of interim reports that will culminate in a Final Feasibility Report and associated compliance documentation consistent with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), the *Principles, Requirements, and Guidelines for Federal Investment in Water Resources* (PR&G) (CEQ 2013), Reclamation Directives and Standards (D&S) CMP 09-02 for Water and Related Resources Feasibility Studies (2015), and applicable environmental laws.

In recognition of the urgent need to address the capacity problems in the FKC, the Study is being prepared on an expedited schedule. This Draft Recommended Plan Report (Report) is the second progressive document in the development of the Final Feasibility Report. This Report presents the formulation and evaluation of Initial Alternatives, selection and evaluation of Feasibility Alternatives, and identification of a Recommended Plan.

Reclamation is the lead Federal agency for reviewing and approving this Study. FWA is the non-Federal partner and will implement the Selected Plan that will be identified in the Final Feasibility Report. The following subsections describe Federal, State of California (State), and local authorization and legislation relevant to this Project.

Purpose

The reduced capacity of FKC Middle Reach has resulted in water delivery impacts on Friant Division long-term contractors, reduced ability of the FKC to convey flood waters during wet periods, and reduced ability to implement provisions of the Water Management Goal as

described in Paragraph 16 of the San Joaquin River Restoration Settlement (Settlement). The reduced delivery of water via the Friant-Kern Canal under long-term Friant Division contracts, the Recovered Water Account (RWA), and Unreleased Restoration Flows (URFs) also reduces funding necessary to implement the Restoration Goal provisions of the Settlement as described in Paragraph 11.

The purpose of the Project is to restore the conveyance capacity of the FKC Middle Reach to such capacity as previously designed and constructed by Reclamation, as provided for in the San Joaquin River Restoration Settlement Act (Public Law 111-11, Title X, Part III(a)(1)). The purpose of this Study is to describe the formulation, evaluation, and comparison of alternatives that address Project planning objectives and identify a Recommended Plan consistent with Federal authorizations and requirements. Information developed through the Study will be used in preparation of required environmental compliance documentation.

Planning Objective

The planning objective is to restore the capacity of the FKC in the Middle Reach from Mile Post (MP) 88.2 to MP 121.5 to address the subsidence-induced and original design deficiency capacity reductions. The FKC was designed to convey water at a normal capacity for the delivery of water under CVP contracts, and maximum capacity for the short-term conveyance of flood flows.

Organization of this Report

This report is organized as follows:

- **Chapter 1** provides background information about the study and related studies, projects, and programs.
- **Chapter 2** provides an overview of the water and related resources, problems, opportunities, and constraints.
- **Chapter 3** describes the initial alternative formulation process.
- **Chapter 4** presents the No Action Alternative and the two Feasibility Alternatives in terms of major features, costs, and other defining characteristics.
- **Chapter 5** presents benefit cost analyses of the Feasibility Alternatives and identifies a Recommended Plan.
- **Chapter 6** describes the Recommended Plan.
- **Chapter 7** presents findings.

- **Chapter 8** presents recommendations.
- **Chapter 9** provides a list of sources consulted in preparation of this report.

This report is supported by several appendices, attachments, and exhibits that provide greater technical detail used in the evaluation of project feasibility. The organization hierarchy of the Draft Recommended Plan Report is shown in Figure 1-1.

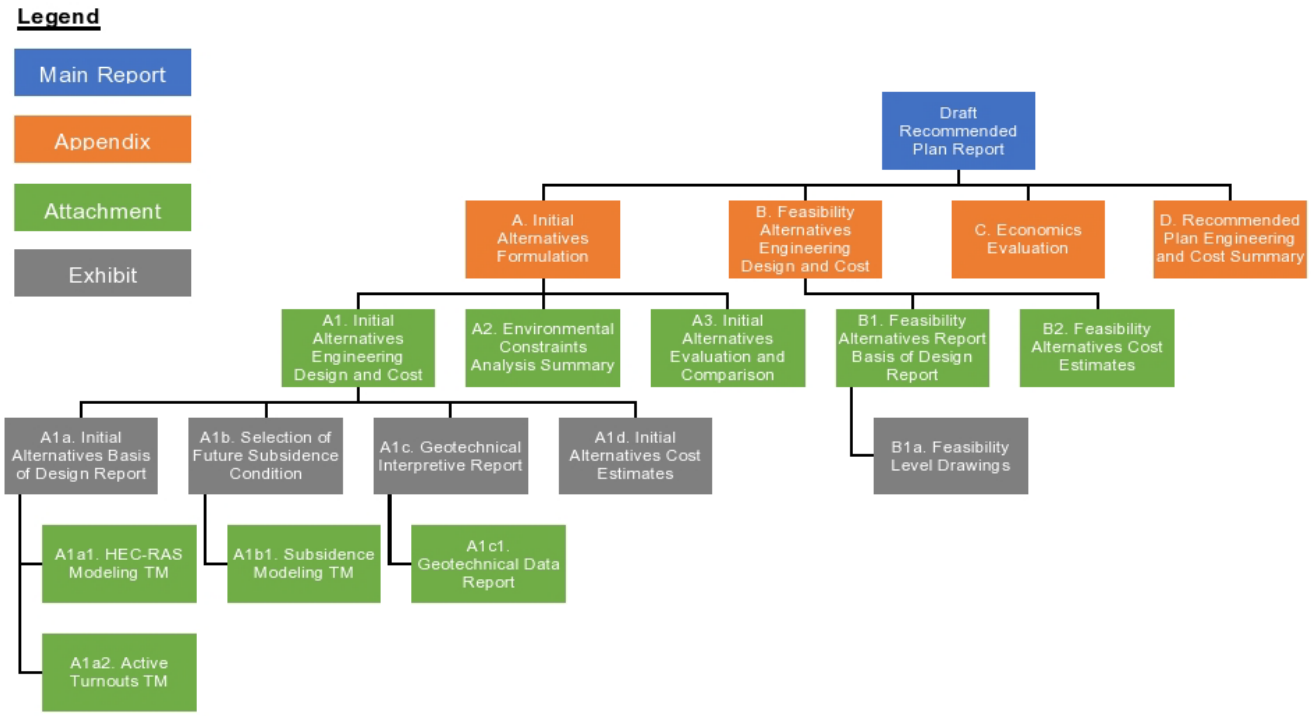

Figure 1-1. Draft Recommended Plan Report Document Hierarchy

Federal Authorities

The Study is being prepared to support feasibility determinations in accordance with the following Federal authorities:

- San Joaquin River Restoration Settlement (Title X, Subtitle A) provisions of Public Law [P.L.] 111-11 (Settlement Act), the Omnibus Public Land Management Act of 2009;
- Section 9603, Extraordinary Operation and Maintenance Work Performed by the Secretary, of P.L. 111-11; and
- The Water Infrastructure Improvements for the Nation Act (WIIN Act) (P.L. 114-322) of 2016.

P.L. 111-11

The Project and Study is authorized and funded in part by Sections 10201 and 10203(a) of the Settlement Act.

> *Section 10201:*
>
> *"(a) The Secretary of the Interior (hereafter referred to as the 'Secretary') is authorized and directed to conduct feasibility studies in coordination with appropriate Federal, State, regional, and local authorities on the following improvements and facilities in the Friant Division, Central Valley Project, California:*
>
> > *(1) Restoration of the capacity of the Friant-Kern and Madera Canal to such capacity as previously designed and constructed by the Bureau of Reclamation...*
>
> *(b) Upon completion of and consistent with the applicable feasibility studies, the Secretary is authorized to construct the improvements and facilities identified in subsection (a) in accordance with applicable Federal and State laws.*
>
> *(c) The costs of implementing this section shall be in accordance with Section 10203 and shall be a nonreimbursable Federal expenditure."*
>
> *Section 10203(a):*
>
> *"(a) The Secretary is authorized and directed to use monies from the fund established under section 10009 to carry out the provisions of section 10201(a)(1), in an amount not to exceed $35,000,000."*

Shortly following enactment of P.L. 111-11, Reclamation began evaluating the restoration of the capacity of the FKC and Madera Canal jointly. However, due to unique differences in the design and construction of these canals, Reclamation, in agreement with FWA and Madera-Chowchilla Water and Power Authority, separated the authorized funding as follows: $25 million for the FKC; and $10 million for the Madera Canal (Reclamation 2011). Of the $25 million for the FKC, approximately $6.1 million has been obligated and about $18.9 million remains available to study and implement projects that address FKC restored capacity, including the Project.

Project construction is also authorized under Section 9603, which addresses Extraordinary Operation and Maintenance Work Performed by the Secretary.

> *9603 (a) IN GENERAL.—The Secretary or the transferred works operating entity may carry out, in accordance with subsection (b) and consistent with existing transfer contracts, any extraordinary operation and maintenance work on a project facility that the Secretary determines to be reasonably required to preserve the structural safety of the project facility.*
>
> *(b) REIMBURSEMENT OF COSTS ARISING FROM EXTRAORDINARY OPERATION AND MAINTENANCE WORK.—*
>
> *(1) TREATMENT OF COSTS.—For reserved works, costs incurred by the Secretary in conducting extraordinary operation and maintenance work will be allocated to the authorized reimbursable purposes of the project and shall be repaid within 50 years, with interest, from the year in which work undertaken pursuant to this subtitle is substantially complete.*
>
> *(2) AUTHORITY OF SECRETARY.—For transferred works, the Secretary is authorized to advance the costs incurred by the transferred works operating entity in conducting extraordinary operation and maintenance work and negotiate appropriate 50-year repayment contracts with project beneficiaries providing for the return of reimbursable costs, with interest, under this subsection: Provided, however, That no contract entered into pursuant to this subtitle shall be deemed to be a new or amended contract for the purposes of section 203(a) of the Reclamation Reform Act of 1982 (43 U.S.C. 390cc(a)).*

WIIN Act

Authorization and funding for planning has been provided under authority of the WIIN Act. The WIIN Act addresses the needs of the nation's harbors, locks, dams, flood protection, and other water resources infrastructure critical to the economic growth, health, and competitiveness. The WIIN Act authorizes appropriations for Federal funding for the final design and construction of water storage projects and extends the authorization for Federal feasibility studies.

Unless directed otherwise by Congress, all costs for studies, report preparation, and review that falls under the WIIN Act authorization must be shared with a non-Federal cost-sharing partner. Costs will be accounted for and in-kind services valued in accordance with *Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards* (2 CFR 200). Cost-sharing must be in the form of in-kind services, cash payments, or a combination of the two. Unless authorizing legislation specifies a cost-share formula, the minimum non-Federal cost-share will be 50 percent of the total study costs.

The WIIN Act is applicable to non-reimbursable federal expenditures for authorized purposes. The Settlement Act authorizes non-reimbursable federal expenditures to restore the designed and

constructed capacity of the FKC, thus, the WIIN Act is applicable for up to 50 percent federal non-reimbursable funding for the Project.

Local Authorities

The FWA is a Joint Powers Authority (JPA) public agency formed through its members under California law to operate and maintain the FKC and to represent its members in policy, political, and operational decisions that could affect the Friant Division of the CVP. FWA was formed in 2004 as the successor agency to the Friant Water Users Authority, which began FKC operations and maintenance (O&M) under agreement with Reclamation in 1986.

FWA maintains a professional staff with expertise in project operations, finance, and technical services that perform all on-going services related to the FKC O&M and represent their member entities. During the past 25 years, FWA has conducted several O&M actions along the FKC, including panel replacements, canal embankment seepage control, gate maintenance and repairs, automated monitoring, and control systems implementation.

As the responsible O&M entity for the FKC, FWA is leading the planning, permitting and design of the Project in coordination with Reclamation. FWA is the lead agency for environmental compliance pursuant to CEQA and will be responsible for the construction and O&M of the Project, if implemented.

Study Area

The study area, shown in Figure 1-2, encompasses the FKC from MP 88.2 (Fifth Avenue check) to MP 121.5 (Lake Woollomes check), the service areas of six[1] Friant Division long-term contractors that can experience water supply reductions as a result of capacity restrictions in this reach, and the areas that would be directly affected by construction-related activities.

[1] The six affected Friant Division long-term contractors include: Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Kern-Tulare Water District, Saucelito Irrigation District, Shafter-Wasco Irrigation District, and Southern San Joaquin Municipal Utility District.

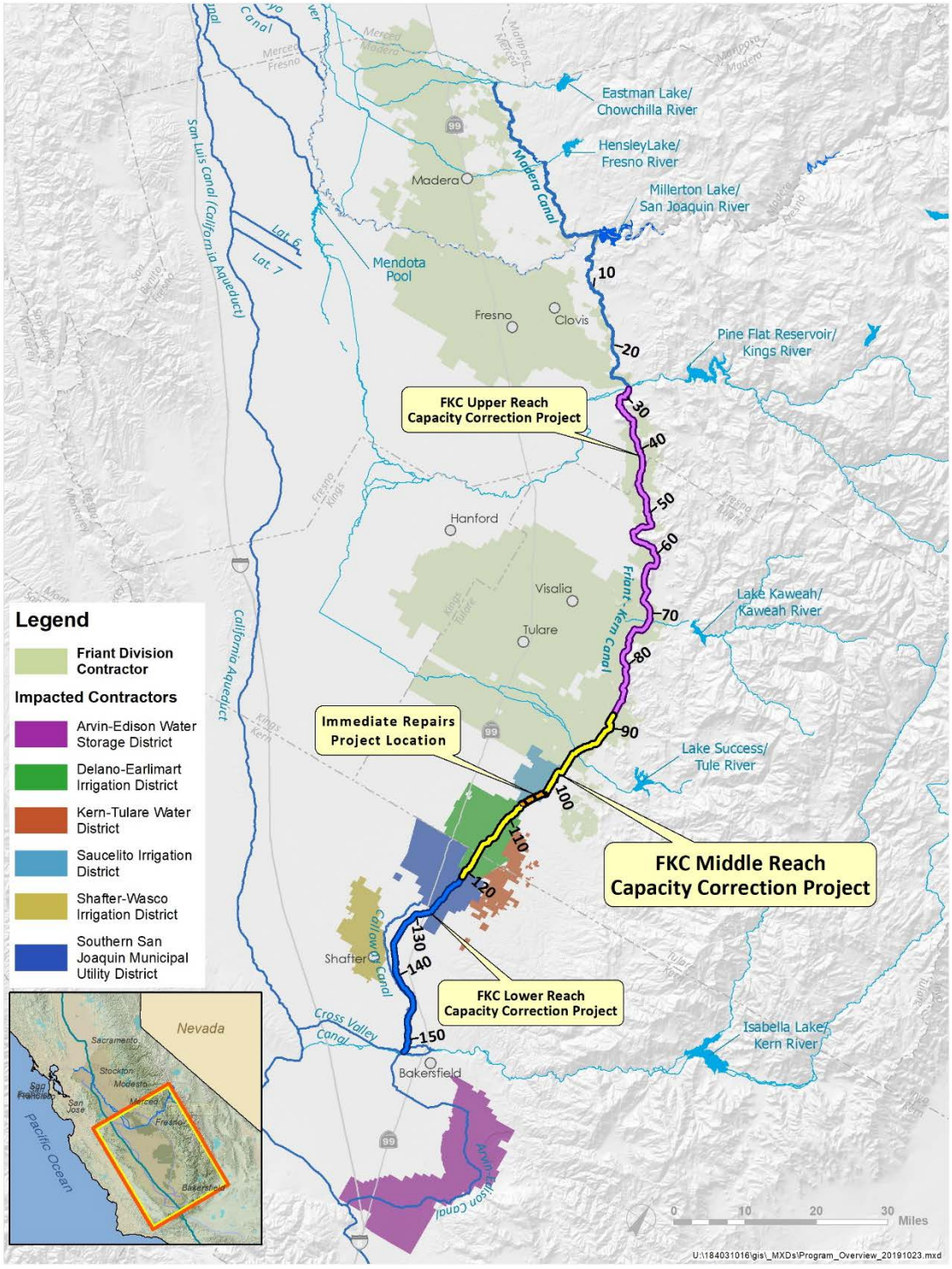

Figure 1-2. Study Area

Background

The FKC has a maximum design capacity of 5,300 cubic feet per second (cfs), gradually decreasing to 2,500 cfs to accommodate conveyance for downstream water demand. However, the maximum conveyance capacity has not been actualized due to several factors. Original design assumptions regarding the roughness or Manning's "n" value were found inaccurate shortly following construction completion. As a result, the FKC operating capacity is less than designed. Capacity has been further reduced by additional canal surface roughness with age, vegetation within canal sections, changes in water delivery patterns, localized seepage through embankments, and regional land subsidence.

In conjunction with the adjacent land, the canal has subsided. The FKC was designed with a relatively flat gradient, approximately 6 inches per mile, which makes it vulnerable to capacity reductions from subsidence. In particular, the section from MP 99 to MP 116 has subsided the most, with a significant localized depression between MP 103 and MP 107 that experienced subsidence greater than 10 feet since the FKC was constructed.

Over the decades, several efforts have been made to restore the canal capacity. In the late 1970s, Reclamation addressed subsidence-associated capacity reduction between MP 99 and MP 116 by raising the concrete lining on the canal. In the 1980s, Reclamation performed a subsequent lining raise between MP 0.0 and MP 28.5 that increased the canal capacity from 5,000 cfs to the design capacity of 5,300 cfs. While these efforts were successful, capacity restrictions continue to limit water deliveries throughout most of the canal.

The Settlement Act authorized the Secretary of the Interior to study, construct, and fund FKC capacity restoration to the original designed and constructed capacity. Under this authorization, Reclamation, identified four alternatives to restore the capacity of the entire FKC. However, the cost of all alternatives exceeded the available funding, which led to a focus on first restoring the Upper Reach from MP 29.14 to MP 88.2. Alternatives to restore capacity in the Upper Reach also exceeded the available funding. Reclamation presented the estimated costs to restore capacity of the Upper Reach to a group of Friant Division long-term contractors and FWA staff in September 2015. From that meeting, the contractors determined they would take the lead in identifying a path forward and report back to Reclamation.

In February 2017, FWA observed that a flow of 1,900 cfs was encroaching on the top of the liner and the lower chords of some bridges in the portions of the FKC Middle Reach (MP 88.2 to MP 121.5). In December 2017, FWA, on behalf of the Friant Division long-term contractors, provided their recommendations to Reclamation to complete appropriate feasibility, design, and compliance documents for the FKC Middle Reach and apply any remaining funds toward construction. To temporarily reduce capacity constraints in the Middle Reach of the FKC before the Project is constructed, FWA also implemented an Immediate Repairs Project which installed a temporarily liner between 103.85 to MP 106.32 in the winter of 2018-2019.

The Project is part of the FWA's approach to restore the design capacity of the entire FKC. The approach, with Reclamation's guidance and approval, will be implemented through projects located in three reaches of the FKC, based on the operational characteristics of the canal as well as the nature of the corrective actions to be accomplished. Reaches with the greatest capacity reduction will be prioritized, and all reaches will be designed to restore the original design capacity of the FKC:

- Upper Reach Capacity Correction Project – this project will address design capacity reduction in the FKC from approximately MP 29 (Downstream Kings River Siphon) to MP 88 (Fifth Avenue Check). As noted above, this project was previously evaluated by Reclamation and has an estimated cost of $140 million in 2014 dollars;

- Middle Reach Capacity Correction Project – this project, which is the subject of this Report, will address design and subsidence capacity reduction in the FKC from approximately MP 88 (Fifth Avenue Check) to MP 121 (Woollomes Check). The Project includes the Immediate Repairs Project (MP 103.6 to MP 107.3). If the Project includes modifications at the same location, the Immediate Repair improvements will be removed and replaced with Project actions. The Project will be coordinated with the FKC Pump-back Project, also authorized by the SJRRS Act, to the extent possible to identify infrastructure affected by both projects in the Middle Reach; and

- Lower Reach Capacity Correction Project – this project will address capacity reduction in the FKC from approximately MP 121 to the canal terminus at MP 152. The project will also coordinate with FKC Pump-back Project for affected infrastructure in the Lower Reach. The extent of work required in the Lower Reach has not been evaluated at this time and does not impact the Project.

As of December 2018, Reclamation and the FWA finalized a Financial Assistance Agreement (FAA) for the FKC Capacity Correction Project (R19AC00013). The FAA describes authorized federal funding sources including the Settlement Act and the WIIN Act.

Related Studies, Projects, and Programs

The following is a summary of pertinent previous studies and current activities that affect the Study.

1960s – Reclamation Technical Memorandum No. 661

In the 1940s and 1950s, Reclamation constructed several large concrete canals and subsequently found they were incapable of conveying the flows specified in the original designs. In response, Reclamation conducted a technical investigation of several canals, including the FKC, to determine the cause of conveyance limitations in canals and published its findings in Technical Memorandum No. 661 – Analyses and Descriptions of Capacity Tests in Large Concrete-Lined Canals (Reclamation 1964). A major conclusion from the Technical Memorandum No. 661 was

that the basic hydraulic loss formulas used during the design of the large concrete canals required adjustment. Specifically, the original designs for the FKC used a Manning's "n-value" (or friction coefficient) of 0.014 for concrete-lined sections. Results from the Technical Memorandum No. 661 demonstrated that the friction coefficient for concrete-lined sections ranges from 0.015 to 0.019.

1970s – Reclamation Friant-Kern Canal Liner Raise

In the late 1970s, Reclamation addressed subsidence problems along the FKC between MP 99 to MP 116. In the 16.5-mile stretch, the concrete lining was raised between 1 foot and 4.5 feet above the top-of-canal lining. To accommodate the canal lining raise, Reclamation raised four concrete bridges approximately 3 feet (Ave. 112, Ave. 88, Ave. 80, and Road 192) and reconstructed and raised a farm bridge by 4.5 feet. When raising the bridges, Reclamation also modified attached utility pipe crossings. In conjunction with the liner raise and bridge work, Reclamation adjusted several turnouts, drain inlets, check structures, and culverts.

1980 – Reclamation Upper Reach Work

Between 1977 and 1980, Reclamation authorized, designed, and constructed a lining raise between the FKC headworks at MP 0.00 and the Kings River Check at MP 28.50. This work was necessitated by an increase in water demand and operational control. Thus, the initial maximum capacity of the FKC was increased from 5,000 cfs to 5,300 cfs and the design deficiency in this reach was corrected. The details for this construction can be found in Reclamation specification DC-7295.

2002 – FWA Liner Raise

In 2002, FWA installed an 18-inch concrete liner raise, from MP 75.77 (Spruce Bridge) to just downstream of MP 76.37 (Marinette Bridge). The purpose of this project was to both address subsidence and increase the flow capacity from 3,950 cfs to 4,300 cfs.

2018-2019 – Immediate Repairs

During the winter of 2018 to 2019, FWA undertook a series of repairs to increase the capacity of the Middle Reach to the extent possible while the Project is implemented. FWA installed a 0.045-inch-thick reinforced polypropylene liner between MP 103.85 and MP 106.32, coated five bridges with a protective sealant, repaired or reinforced utility supports spanning bridges, and mud-jacked as necessary to control seepage.

San Joaquin River Restoration Program

The Settlement Act, included in Public Law 111-11 and signed into law on March 30, 2009, authorizes and directs the Secretary of the Interior to implement the Stipulation of Settlement of Natural Resource Defense Council (NRDC) et al. v. Kirk Rodgers et al. (Settlement), which ended an 18-year legal dispute over the operation of Friant Dam and resolved longstanding legal claims brought by a coalition of conservation and fishing groups led by the NRDC. Reclamation

is the Federal lead agency for the San Joaquin River Restoration Program (SJRRP). Along with Reclamation, the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), California Department of Water Resources (DWR), and California Department of Fish and Wildlife (CDFW) are implementing agencies.

The Settlement establishes two goals: (1) the Restoration Goal is to restore and maintain fish populations in good condition in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish, and (2) the Water Management Goal is to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

To achieve the Water Management Goal, Paragraph 16 of the Settlement and Part III of the Settlement Act provide for actions to recapture Restoration Flows and increase access to water supply during wet hydrologic conditions, including restoration of the capacity of the FKC and Madera Canal. The reduced capacity of the FKC constrains Reclamation's ability to implement actions to achieve the Water Management Goal.

Interim Flows for experimental purposes began in 2009, and Restoration Flows began January 1, 2014. Current channel capacity constraints limit the ability to release full Restoration Flows. The flows will increase gradually over the next several years as channel capacity is increased through the implementation of SJRRP actions.

Friant-Kern Canal Capacity Restoration Feasibility Study

Part III of the Settlement Act authorizes Reclamation to conduct feasibility studies on restoration of the designed and constructed capacity of the FKC and Madera Canal. In 2011, Reclamation completed a Draft Feasibility Report for the FKC with the planning objective to improve the water deliveries and reliability within a funding constraint of $25,000,000. Estimated costs to restore the original designed and constructed capacity of the entire FKC exceeded the available funding. Therefore, the feasibility study alternative focused on raising the canal lining in the Upper Reach from the Kings River Siphon outlet (MP 29.14) to the 5th Avenue Check (MP 88.2). Based on the Draft Feasibility Report recommendations, Reclamation prepared a 60 percent design and cost estimate for the Upper Reach of the FKC, which found the project formulation was not feasible within the funding authorized in the Settlement Act.

Part III Financial Assistance for Local Projects

Part III of the Settlement Act authorizes Reclamation to provide financial assistance to local agencies within the Friant Division of the CVP for the planning, design, environmental compliance, and construction of local facilities to bank water underground or recharge groundwater. A project will be eligible if all or a portion of the project is designed to reduce, avoid, or offset the quantity of expected water supply impacts to Friant Division long-term contractors caused by Restoration Flows in the San Joaquin River released pursuant to the Settlement.

Reclamation completed Guidelines for the Application of Criteria for Financial Assistance for Local Projects under Part III of Public Law 111-11 (Guidelines) in consultation with Friant Division long-term contractors. The Guidelines provide a framework for obtaining Federal financial assistance for Friant Division groundwater recharge and/or banking projects as authorized by Part III. Consistent with statutory requirements of Part III of the Settlement Act, Office of Management and Budget cost principles and Reclamation policy, the Guidelines address the contents of a complete Planning Report and cost-share agreement.

Several Part III Projects have been constructed and are in operation in the Study Area and result in an increased ability to recharge groundwater. This increase in recharge capability can increase demand during wet hydrologic periods when FKC flows are typically highest. The reduced capacity of the FKC constrains the ability to deliver water to Part III projects.

Friant-Kern Canal Reverse Flow Pump-back Project

In September 2016, Reclamation and FWA entered into FAA Number R16AC00106 for the Friant-Kern Canal Reverse Flow Pump-back Project whereby FWA will perform the planning, environmental compliance documentation, and design and construction of Reverse Flow Pump-back Facilities. Reclamation initially studied permanent pump-back facilities along the southern portion of the FKC as part of the SJRRP. Reclamation evaluated permanently increasing pumping capacities to 200 cfs at the Shafter Check Structure and 75 cfs at the Lake Woollomes and Deer Creek Check structures. Building on the appraisal study, FWA is considering sizing the Reverse Flow Pump-back to improve water management during drought conditions. The MRCCP involves coordination with the Pump-Back Facilities Project.

Sustainable Groundwater Management Act

A three-bill package, known as the Sustainable Groundwater Management Act (SGMA), was passed by the California legislature and signed into law by Governor Edmund G. Brown in 2014. This legislation, amended in 2015, allows local agencies to customize groundwater sustainability plans to their regional economic and environmental needs, and creates a framework for sustainable, local groundwater management. The act defines sustainable groundwater management as the “management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results” such as land subsidence and water quality degradation.

The Study Area includes several high-priority basins under SGMA due to the severity of groundwater overdraft. As a result of this designation, the managing agencies or groundwater sustainability agencies (GSA) in the area are required to adopt groundwater sustainability plans (GSP) by January 31, 2020. The GSAs have twenty years to implement their GSPs and achieve their sustainability goal in the basin by 2040.

Chapter 2
Water Resources and Related Conditions

One of the most important elements of any water resources evaluation is defining existing conditions in the study area, the associated problems and opportunities, and how these conditions may change in the future. This chapter describes these critical topics which will provide guidance for the solutions presented in subsequent chapters.

Existing Conditions in Study Area

The existing and likely future conditions are used to establish the basis of comparing potential alternative plans, a process consistent with PR&G, NEPA, CEQA, and Reclamation D&S Standards. This section briefly discusses existing conditions in the study area.

Surface Water

The major surface water resources in the study area are the San Joaquin River and its tributaries. The San Joaquin River is the second longest river in California. It originates in the Sierra Nevada mountain range at an elevation of approximately 12,000 feet above mean sea level and carries snowmelt from mountain meadows to the valley floor before turning north and becoming the backbone of tributaries draining into the San Joaquin Valley. The San Joaquin River discharges to the Sacramento-San Joaquin Delta from the south and, ultimately, to the Pacific Ocean through San Francisco Bay.

Groundwater

The San Joaquin Valley Groundwater Basin, Figure 2-1, makes up the southern two-thirds of the 400-mile-long, northwest-trending, asymmetric trough of the Central Valley regional aquifer system (Page 1986). The study area overlies two main hydrologic regions within the San Joaquin Valley Groundwater Basin: The San Joaquin River Hydrologic Region and the Tulare Lake Hydrologic Region.

The San Joaquin River Hydrologic Region consists of surface-water basins that drain into the San Joaquin River system, from the Cosumnes River basin in the north through the southern boundary of the San Joaquin River watershed (DWR 1999). Aquifers in the San Joaquin Valley Groundwater Basin typically extend to depths of 800 feet. The San Joaquin River Hydrologic Region relies heavily on groundwater, accounting for approximately 30 percent of the region's annual water supply for agricultural and urban uses (DWR 2003).

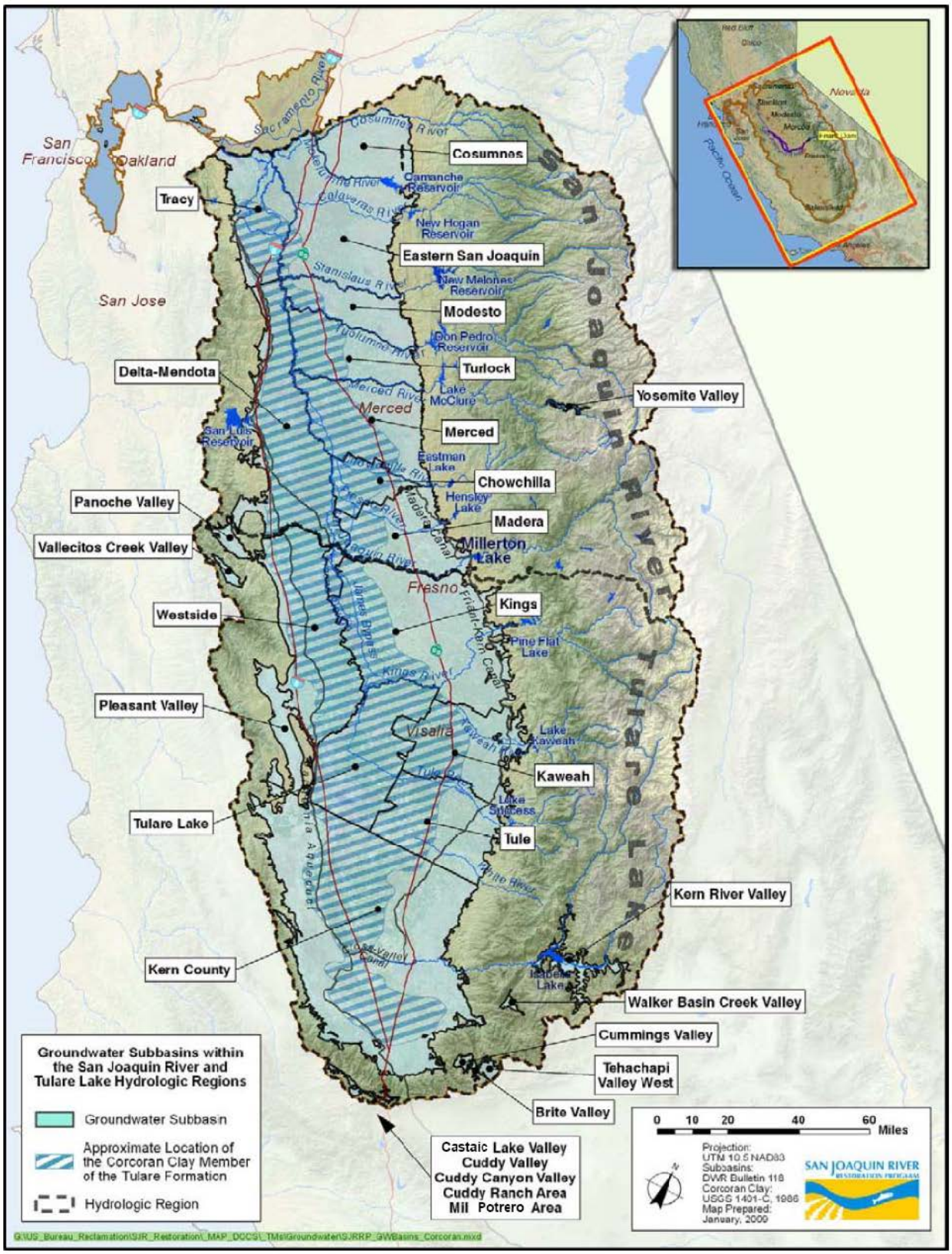

Figure 2-1. San Joaquin Valley Groundwater Basin and Sub-basins

The Tulare Lake Hydrologic Region is a closed drainage basin at the south end of the San Joaquin Valley, and encompasses the Kings, Westside, Pleasant Valley, Kaweah, Tulare Lake, Tule, and Kern County groundwater sub-basins. In the hydrologic region, the primary aquifer extends 1,000 feet below the surface (DWR 2003). The Tulare Lake Hydrologic Region also relies heavily on groundwater supplies; groundwater use has historically accounted for 41 percent of the total annual water supply within the region and for 35 percent of all groundwater use in California. Groundwater use in this hydrologic region represents approximately 10 percent of the state's total agricultural and urban water use (DWR 1998).

Friant Division of the Central Valley Project

The Friant Division of the CVP provides water to over one million acres of irrigated land on the east side of the southern San Joaquin Valley. Principal features of the Friant Division include Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals.

Friant Dam and Millerton Lake

Friant Dam is a concrete gravity dam that impounds Millerton Lake on the San Joaquin River, located about 16 miles northeast of Fresno near the community of Friant. The dam, owned and operated by Reclamation, began releasing water from Millerton Lake in 1942. The lake has a capacity of 524 thousand acre-feet (TAF) which is typically filled during late spring and early summer from snowmelt. Prior to SJRRP implementation, annual water allocations draw down the reservoir storage to minimum levels by the end of September. Post-SJRRP implementation, the reservoir will reach minimum storage levels during late fall to early winter.

Friant Dam releases water deliveries to the Friant-Kern and Madera canal through outlet works. Outlets to the Madera Canal are located on the right side of the dam and outlets to the Friant-Kern Canal are located on the left. There is also a river outlet works located to the left of the spillway within the lower portion of the dam. The Friant Power Authority owns and operates powerhouses located on the FKC and Friant Dam river outlets that have a combined capacity of about 30 megawatts.

Madera Canal

The Madera Canal, operated and maintained by the Madera and Chowchilla Water and Power Authority, is a 36-mile-long canal that begins at Millerton Lake and terminates at the Chowchilla River. The canal was designed with an initial capacity of 1,000 cfs at the headworks, decreasing to 625 cfs at the Chowchilla River. In 1965, the canal lining was raised from the headworks to MP 2.09, increasing the capacity in that reach to 1,250 cfs.

Friant-Kern Canal

The FKC, operated and maintained by FWA, is a 152-mile, gravity canal that spans from Friant Dam south to the Kern River. The FKC has a maximum design capacity of 5,300 cfs, gradually decreasing to 2,500 cfs to accommodate conveyance for downstream water demand. However, maximum design capacity has not been actualized. Original design assumptions regarding the

roughness or Manning's "n" value were found inaccurate shortly following completion of the canal, resulting in capacity reductions. The capacity has been further reduced because of increased canal surface roughness with age, vegetation within canal sections, changes in water delivery patterns, localized seepage through canal embankments, and land subsidence. As described in Chapter 1, the Project focuses on the Middle Reach of the FKC, from MP 88.2 to MP 121.5, which comprises four segments, as described below. The features and structures of the Middle Reach FKC are depicted in Figure 2-2A and 2-2B and summarized in Table 2-1. For more detail, refer to Appendix B Feasibility Alternatives Engineering Design and Cost.

Segment 1: 5th Ave. to Tule River The first (most upstream) segment of the Project is about 13 miles long and extends from the 5th Ave. Check (MP 88.2) to the Tule River (MP 95.6). It was designed for a normal flow of 3,500 cfs and a design maximum flow of 4,500 cfs. Sixteen state/county bridges cross the FKC in this segment and one bridge runs parallel to a siphon. In addition, this segment includes seven turnouts, three siphons, one wasteway, and one weir.

Segment 2: Tule River to Deer Creek The second segment is about seven miles long and extends from Tule River (MP 95.6) to Deer Creek (MP 102.7). It was designed for a normal flow of 3,000 cfs and a maximum flow of 4,000 cfs. Six state/county bridges one farm bridge, and one bridge parallel to a siphon cross the FKC in this segment. In addition, this segment includes ten turnouts and one siphon.

Segment 3: Deer Creek to White River The third segment is about 10 miles long and extends from Deer Creek (MP 102.7) to White River (MP 112.9). It was designed for a normal flow of 3,000 cfs and a maximum flow of 4,000 cfs.. Ten state/county bridges and two farm bridges cross the FKC in this segment. In addition, this segment includes, nine turnouts, one siphon, and one wasteway in this segment.

Segment 4: White River to Woollomes The fourth segment is about eight miles long and extends from White River (MP 112.9) to Lake Woollomes (MP 121.5). It was designed for a normal flow of 2,500 cfs and a design maximum flow of 3,000 cfs. Eight state or county bridges, two farm bridges, and one abandoned railroad bridge cross the FKC in this segment. In addition, this segment includes 12 turnouts, one siphon, and one reservoir structure (Lake Woollomes). The downstream limit of the Project is MP 121.5.

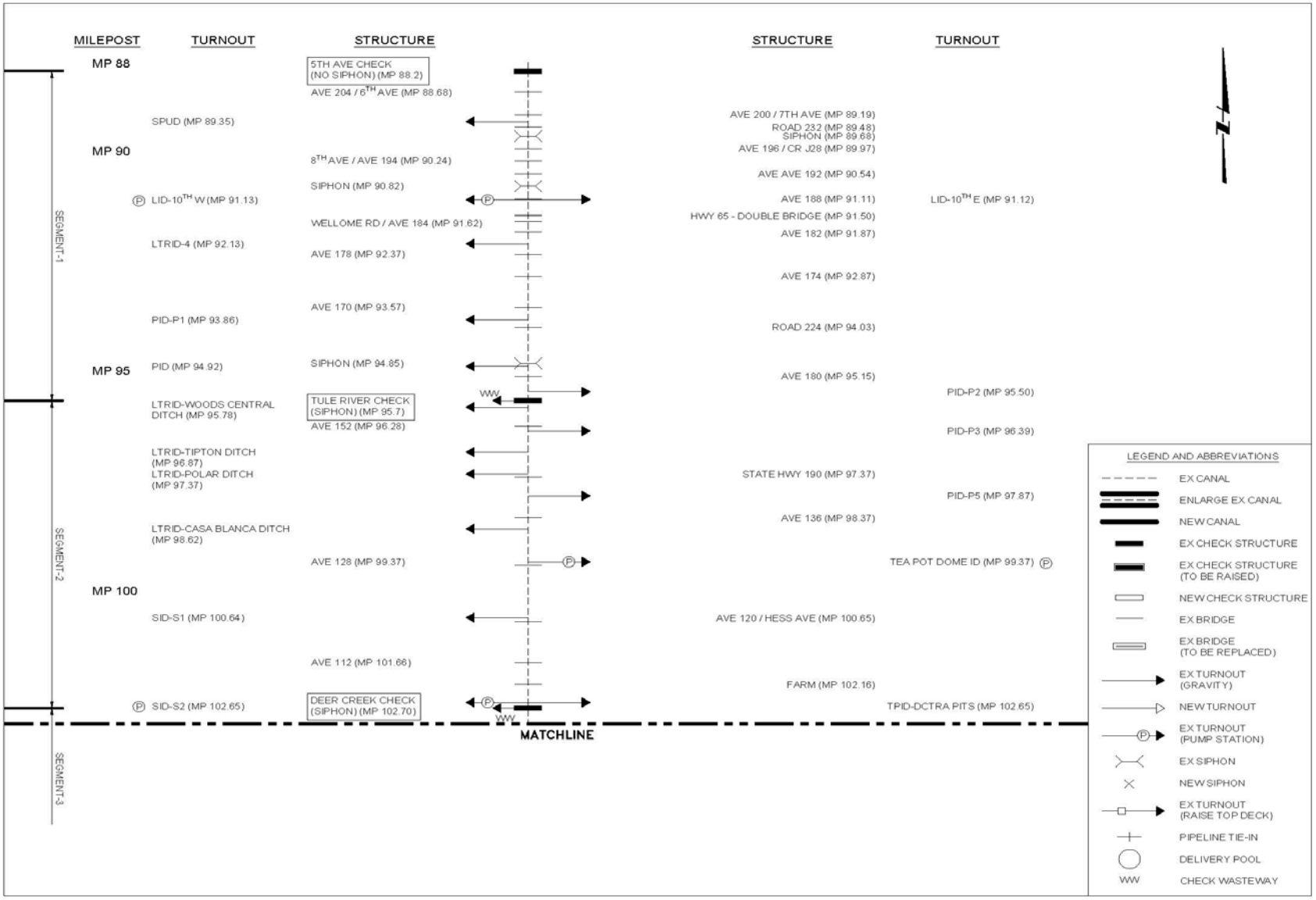

Figure 2-2A. Existing Canal Diagram Segments 1 and 2

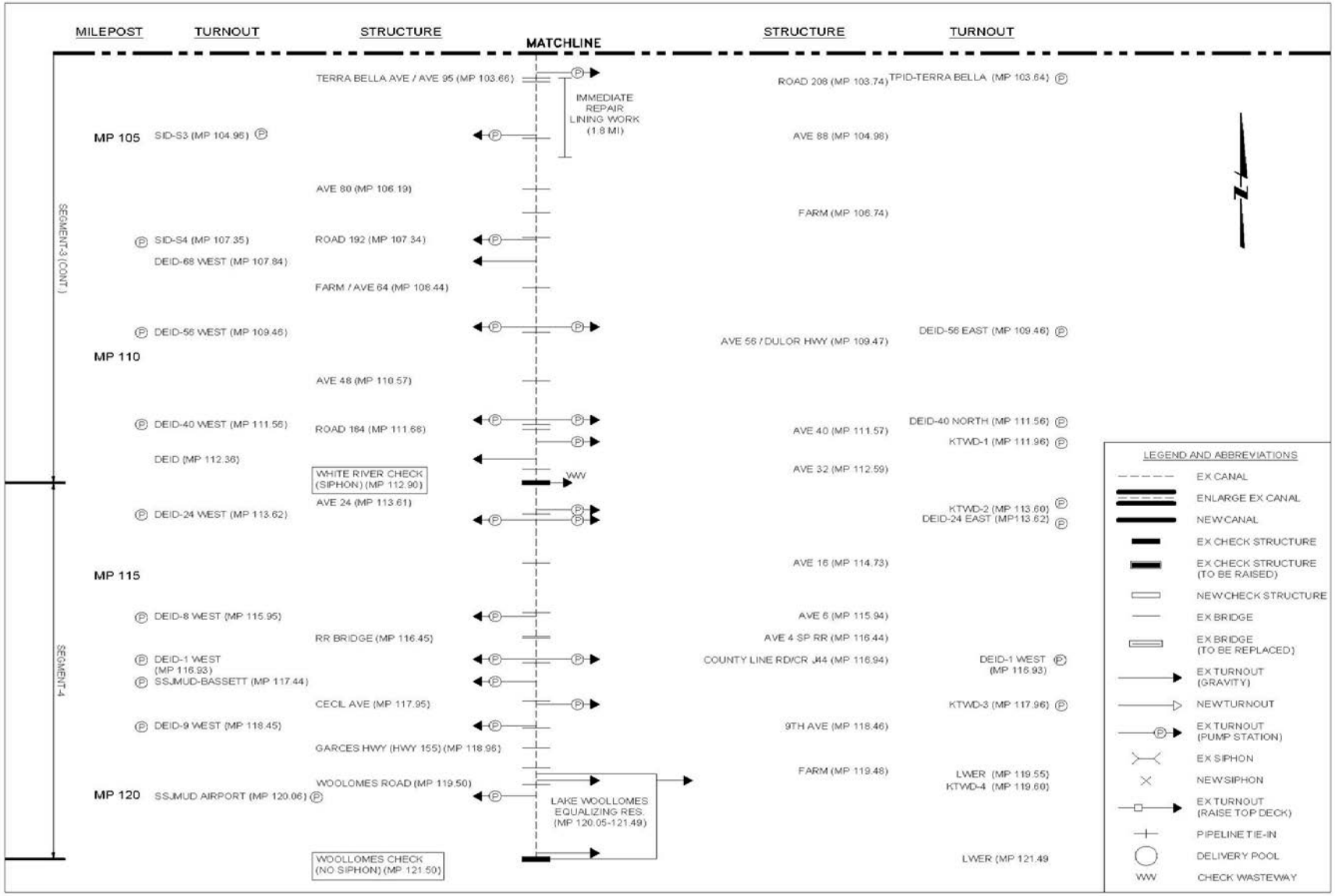

Figure 2-2B. Existing Canal Diagram Segments 3 and 4

Table 2-1. Friant-Kern Canal Structures by Segment

Structures	Segment 1 5th Ave. to Tule River (MP 88.2 – 95.6)	Segment 2 Tule River. to Deer Creek (MP 95.6 – 102.7)	Segment 3 Deer Creek to White River (MP 102.7 – 112.9)	Segment 4 White River. to Woollomes (MP 112.9 – 121.5)
Bridges, State/County	16	6	10	8
Bridges, Farm	0	1	2	2
Bridges, Other	1	1	0	1
Turnouts	7	10	9	12
Siphons	3	1	1	1
Other Structures	1 Wasteway, 1 Weir	0	1 Wasteway	1 Reservoir Structure

Note: Bridges, Other refers to the bridges parallel to siphons or the abandoned railroad bridge.

Friant Division Water Contracts

Reclamation holds most of the water rights on the San Joaquin River, allowing diversions at Friant Dam through purchase and exchange agreements with entities, or long-term contractors. Thirty-two Friant Division long-term contractors in Madera, Fresno, Kings, Tulare and Kern counties supply water to over 1.2 million acres of irrigated land, several small rural communities, and large urban areas.

Reclamation employs a two-class system of water contracts in the Friant Division. Class 1 contracts total 800 TAF and are dependable water supply and are generally assigned to agricultural and urban water users who have limited access to good quality groundwater. Class 2 contracts total approximately 1,401 TAF and, because of its uncertainty as to availability and timing, Class 2 contracts are considered undependable in nature and are applicable only when Reclamation makes available. Class 2 contracts support regional conjunctive use and are the basis to provide water supplies for groundwater replenishment during wetter years. Contract amounts for all Friant Division long-term contractors are listed in Table 2-2 and locations are shown in Figure 2-3.

Table 2-2. Friant Division Long-Term Contractors and Friant Water Authority Membership

Friant Division Long-Term Contractor[1]	FWA Membership		Class 1 Contract		Class 2 Contract		Total Contract	
	FKC O&M Membership	Representation Membership	(AF)	(% of Total)	(AF)	(% of Total)	(AF)	(% of Total)
Chowchilla WD		X	55,000	6.9	160,000	11.4	215,000	9.8
Madera ID		X	85,000	10.6	186,000	13.3	271,000	12.3
Gravelly Ford WD			-	0.0	14,000	1.0	14,000	0.6
Madera County			200	0.0	-	0.0	200	0.0
Fresno County			150	0.0	-	0.0	150	0.0
Garfield WD	X		3,500	0.4	-	0.0	3,500	0.2
International WD	X		1,200	0.2	-	0.0	1,200	0.1
City of Fresno	X	X	60,000	7.5	-	0.0	60,000	2.7
Fresno ID	X	X	-	0.0	75,000	5.4	75,000	3.4
Tri-Valley WD	X		400	0.1	-	0.0	400	0.0
Hills Valley ID	X	X	1,250	0.2	-	0.0	1,250	0.1
City of Orange Cove	X		1,400	0.2	-	0.0	1,400	0.1
Orange Cove ID	X	X	39,200	4.9	-	0.0	39,200	1.8
Stone Corral ID	X		10,000	1.3	-	0.0	10,000	0.5
Ivanhoe ID	X		6,500	0.8	500	0.0	7,000	0.3
Kaweah Delta Water Conservation District	X	X	1,200	0.2	7,400	0.5	8,600	0.4
Tulare ID	X	X	30,000	3.8	141,000	10.1	171,000	7.8
Exeter ID	X		11,100	1.4	19,000	1.4	30,100	1.4
Lewis Creek WD	X		1,200	0.2	-	0.0	1,200	0.1
City of Lindsay	X		2,500	0.3	-	0.0	2,500	0.1
Lindsay-Strathmore ID	X	X	27,500	3.4	-	0.0	27,500	1.2
Lindmore ID	X	X	33,000	4.1	22,000	1.6	55,000	2.5
Lower Tule River ID	X		61,200	7.7	238,000	17.0	299,200	13.6
Porterville ID	X	X	15,000	1.9	30,000	2.1	45,000	2.0
Saucelito ID	X	X	21,500	2.7	32,800	2.3	54,300	2.5
Terra Bella ID	X	X	29,000	3.6	-	0.0	29,000	1.3
Tea Pot Dome WD	X		7,200	0.9	-	0.0	7,200	0.3
Delano-Earlimart ID	X		108,800	13.6	74,500	5.3	183,300	8.3
Kern-Tulare WD	X	X	-	0.0	5,000	0.4	5,000	0.2
Southern San Joaquin MUD	X		97,000	12.1	45,000	3.2	142,000	6.5
Shafter-Wasco ID	X		50,000	6.3	39,600	2.8	89,600	4.1
Arvin-Edison Water Storage District	X	X	40,000	5.0	311,675	22.2	351,675	16.0
Total Contract (AF)	**800,000**		**1,401,475**		**2,201,475**			

Note: [1]Contractors listed in a north to south orientation
Key:
AF = acre-feet
FKC = Friant-Kern Canal
FWA = Friant Water Authority
ID = irrigation district
MUD = municipal utility district
O&M = operations and maintenance
WD = water district

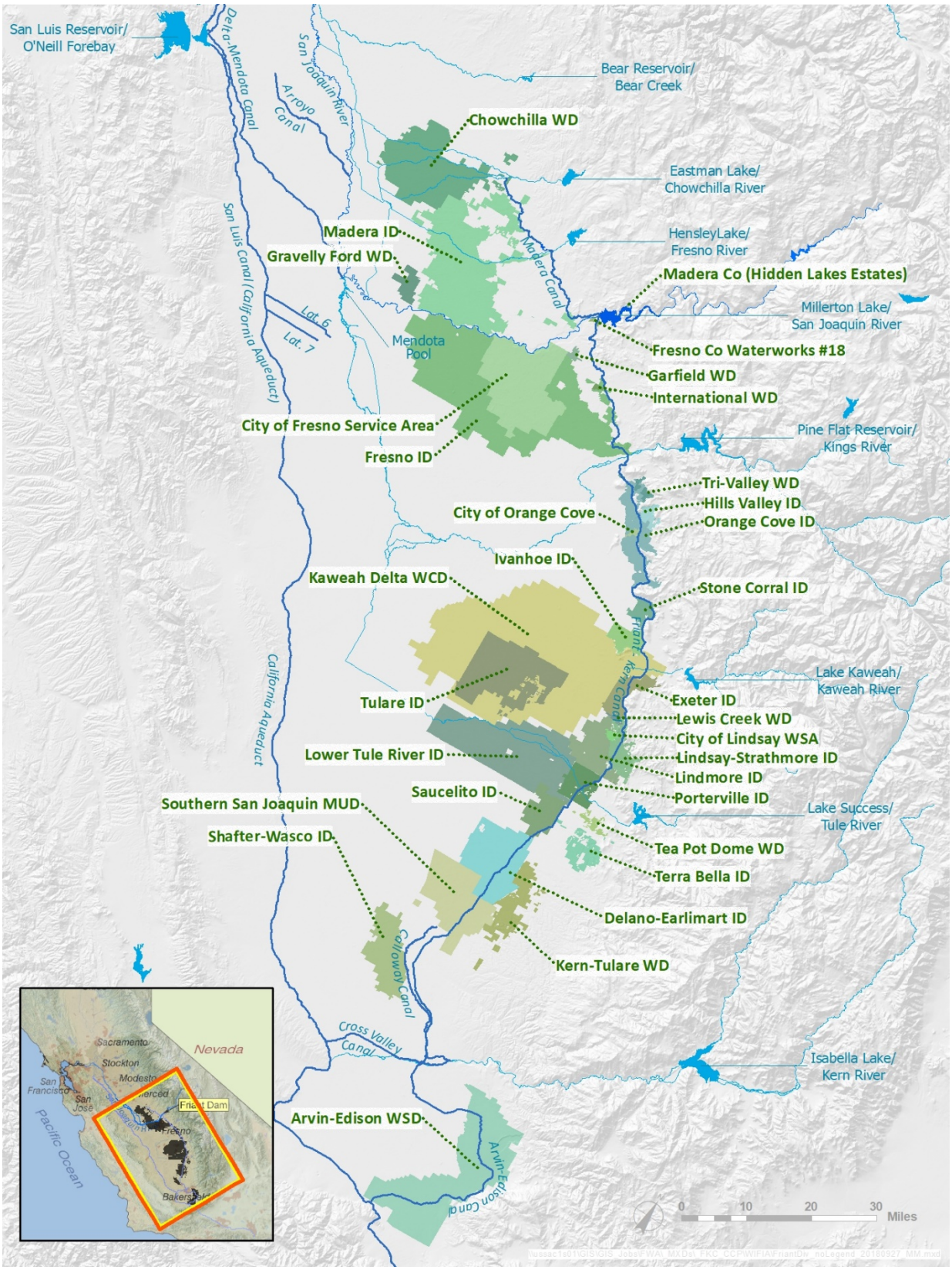

Figure 2-3. Friant Division Long-Term Contractors

In addition, Friant Division long-term contractors can obtain surface water in accordance with Section 215 of the Reclamation Reform Act of 1982 and under the provisions of Paragraph 16(b) of the Settlement. Section 215 authorizes Reclamation to deliver water that cannot be stored and otherwise would be released in accordance with flood management criteria or unmanaged flood flows. Delivery of Section 215 water has enabled the replenishment of San Joaquin Valley groundwater at higher levels than otherwise could be supported with Class 1 and Class 2 contract deliveries. Paragraph 16(b) provides for the delivery of water during wet hydrologic conditions at a cost of $10 per acre-foot, when water is not needed for Restoration Flows.

Friant Division long-term contractors schedule deliveries through daily water orders to Reclamation at Friant Dam. Due to long-standing irrigation practices, water delivery amounts vary by day of the week; water delivery demands are generally higher mid-week and lower on weekends. A review of historical releases at the FKC headworks from 2000 to 2017 demonstrates that daily demand can vary by week, month, and water year type. During a week, daily demand can vary by as much as 30 percent during July, at the peak of the irrigation season (Figure 2-4). The magnitude and timing of the variations fluctuate in accordance with the water year type; the largest variations occur during the peak irrigation months of dryer years and late irrigation months of wet years, as shown in Figure 2-5.

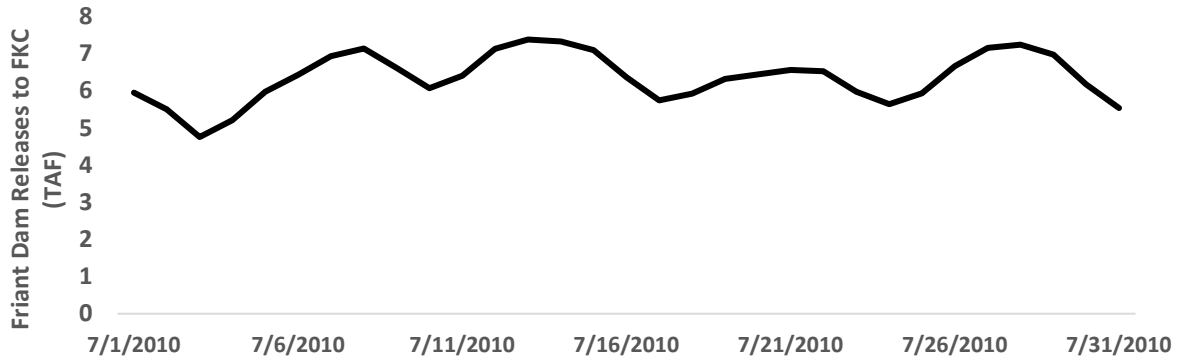

Figure 2-4. Variation of Daily Friant Dam Releases to Friant-Kern Canal During July 2010

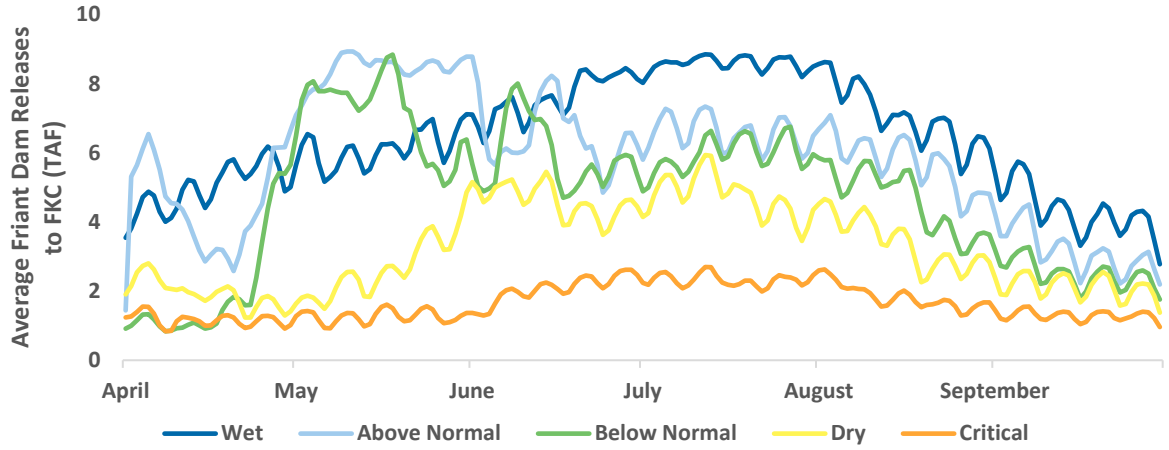

Figure 2-5. Average Daily Distribution Pattern by Water Year Type from 1921-2003

Land Use and Agricultural Resources

The Friant Division of the CVP contains some of the most productive lands in California, with the study area containing the top three agricultural producing counties in the nation (USDA 2007). The primary land uses in the study area are agriculture, urban, and open space; agriculture accounts for the majority of land use, with urban and open space accounting for only a small percentage. Table 2-3 shows the acreages of land use by the Friant Division long-term contractors that receive water deliveries from the FKC.

Table 2-3. Existing Land Uses in Friant Division Long-Term Contractors

Friant Division Long-Term Contractor	Land Use (acres)			
	Agricultural	Open Space	Urban	Total
Chowchilla ID	85,869	0	2,250	88,119
Madera ID	123,830	1	6,882	130,713
Gravelly Ford WD	8,431	0	0	8,431
*Madera County**	0	0	154	154
Fresno County WW No. 18	251	2	0	253
Garfield WD	1,813	0	0	1,813
International WD	724	0	0	724
City of Fresno	0	1,210	88,790	90,000
Fresno ID	187,489	64	60,336	247,889
*Tri Valley WD**	1,800	2,700	0	4,500
*Hills Valley ID**	3,500	800	0	4,300
City of Orange Cove	286	0	674	960
Orange Cove ID	29,163	0	116	29,279
Stone Corral ID	6,882	0	0	6,882
Ivanhoe ID	10,983	0	0	10,983
*Kaweah Delta Water Conservation District**	299,000	11,000	30,000	340,000
Tulare ID	69,293	0	4,220	73,513
Exeter ID	14,078	0	1,136	15,214
Lewis Creek WD	1,297	0	0	1,297
City of Lindsay	415	0	1,113	1,528
Lindsay-Strathmore ID	15,628	0	492	16,120
Lindmore ID	27,483	0	214	27,697
Lower Tule River ID	102,159	932	185	103,276
Porterville ID	15,842	0	1,194	17,036
Saucelito ID	19,826	0	0	19,826
Terra Bella ID	13,642	0	272	13,914
Tea Pot Dome WD	3,581	0	0	3,581
Delano-Earlimart ID	56,264	0	353	56,617
Kern-Tulare WD	17,433	2,639	0	20,082
Southern San Joaquin MUD	56,233	79	5,308	61,620
Shafter-Wasco ID	36,042	0	2,952	38,994
Arvin-Edison WSD	128,941	220	3,691	132,852
Total	**1,338,178**	**19,647**	**210,332**	**1,568,157**

Source: Draft SJRRP PEIS/R.
** Friant Division Atlas*
Key:
ID = Irrigation District
MUD = Municipal Utility District
WD = Water District
WSD = Water Storage District

Problems, Needs, and Opportunities

Four predominant problems in the study area impact Friant Division water supply delivery and reliability: FKC design deficiency, groundwater overdraft, subsidence, and reduced canal capacity. These problems can be addressed through the Settlement Act, other provisions of P.L. 111-11, the WIIN Act, and the local implementation of SGMA.

Friant-Kern Canal Design Deficiency

The FKC was built prior to the development of Reclamation's current Design Standards No. 3, Release No. DS-3-5, dated 1967, and revised in 1994. As such, assumptions used in the original design led to an inability to achieve design conveyance capacity.

The design deficiency was recognized in the 1940s and 1950s when Reclamation observed that many large concrete canals were incapable of conveying flows specified in the original designs. This problem prompted a study on several canals in the 1950s, including the FKC. Reclamation documented the conclusions and results of this study in their early 1960s Technical Memorandum No. 661 – Analyses and Descriptions of Capacity Tests in Large Concrete-Lined Canals. Through Part III of the Settlement Act, Reclamation is authorized to restore the original design capacity.

Groundwater Overdraft

Groundwater overdraft is a regional problem that directly impacts FKC water deliveries. Overdraft occurs when use exceeds the recharge rate of an aquifer. Through an extensive evaluation process, the State classified which groundwater basins are subject to critical conditions of overdraft.[1] According to Bulletin 118 (DWR 2016), five subbasins in the Tulare Lake Hydrologic Region (Kings, Tulare Lake, Kern County, Kaweah, and Tule) and three subbasins in the San Joaquin River Hydrologic Region (Chowchilla, Eastern San Joaquin, and Madera) are subject to critical conditions of overdraft.

These eight subbasins are subject to critical conditions of overdraft as a result of limited access to surface water during dry hydrologic periods and widespread agricultural land use. The reduced FKC capacity, as a result of subsidence, affects Friant Division water deliveries to lands in some of these subbasins. As FKC capacity decreases, Friant Division contractors will likely meet their water needs with additional groundwater, causing groundwater levels to further decline. As groundwater levels decrease, the risk grows for impaired water quality, reduced water storage, and increased subsidence. To mitigate these risks, GSAs are developing GSPs under SGMA requirements. As the plans go into effect, it is likely that water users will adopt water management practices that include greater conservation of groundwater and surface water, yet their ability to implement these actions will be limited due to reduced capacity in the FKC.

Subsidence

Subsidence is a consequence associated with groundwater overdraft. When groundwater is extracted faster than the natural rate of replenishment, the water suspending fine-grained sediments are removed and the sediments compact, resulting in subsidence.

Subsidence is an ongoing regional issue, which was exacerbated during the 2012 to 2016 drought. Data from an interferometric synthetic aperture radar (InSAR) shows regional land

[1] Bulletin 118, Update 1980 defines a groundwater basin subject to critical conditions of overdraft "when continuation of present water management practices would probably result in significant adverse overdraft related environmental, social, or economic impacts."

subsidence from May 2015 to September 2016 lowered the land surface elevation by as much as 25 inches; within the FKC Middle Reach, the land subsided between 5 and 20 inches during this 16-month period (Figure 2-6).

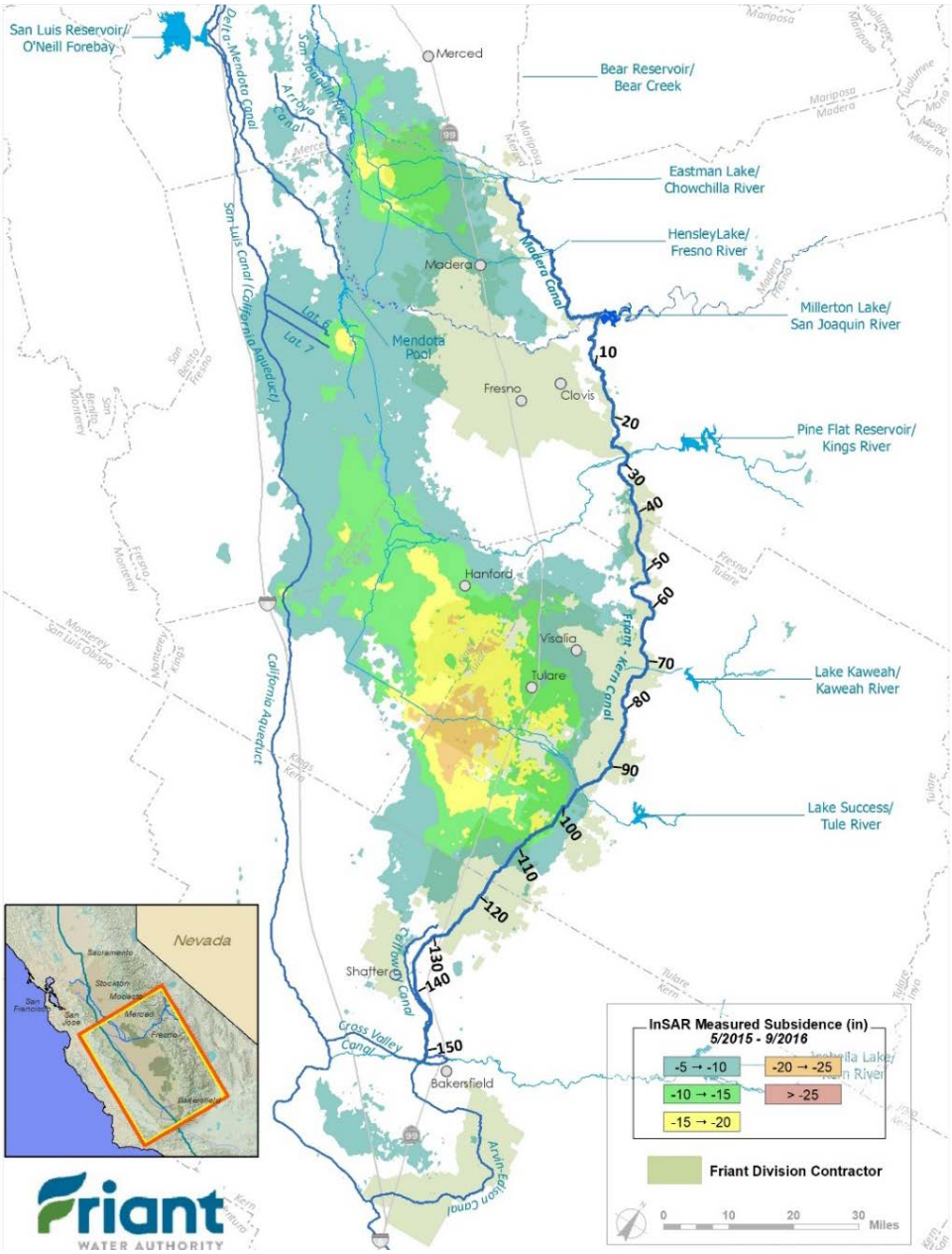

Figure 2-6. Recent Subsidence in the Friant Division

The FKC is located over the eastern portion of the regionally subsided area. As of July 2018, it is estimated that the FKC is approximately 12 feet below the original constructed elevation, creating a significant low point in the Middle Reach between MP 103 and MP 107 (Figure 2-7). Subsidence, and its consequences for the FKC, can be minimized through implementation of

both SGMA and the Settlement Act. With the implementation of GSPs, it is expected that subsidence will lessen over time. While the GSPs address the root cause of subsidence, the Settlement Act provides the authority to restore the original design capacity of the FKC. To minimize the potential recurrence of this problem, design improvements should include features to accommodate future subsidence.

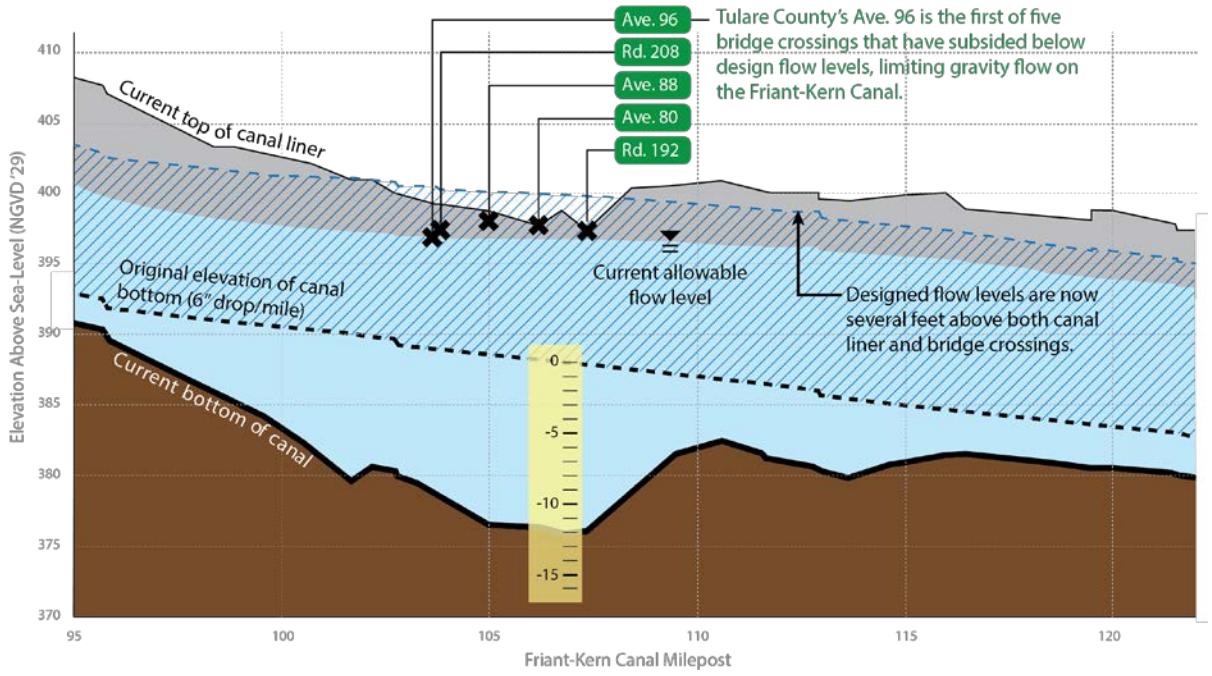

Figure 2-7. Schematic Illustration Along Friant-Kern Canal

Reduced Canal Capacity

As shown in Figure 2-8, the canal capacity is well below its designed maximum flow. The capacity reduction causes the water surface to encroach upon the operating freeboard and, at times, approach the top of the existing concrete liner. Operating canals at reduced freeboard increases seepage, which can damage the liner and increase risk of embankment failure. Higher water surface elevations can also adversely affect bridges, utilities, and other infrastructure.

During wet years, the reduced canal capacity limits the delivery of surface water supplies that would be used for groundwater replenishment, thereby creating an even greater reliance on groundwater supply. During dry years, contractors in the Friant Division conjunctive use area rely more on groundwater than surface water. The increased groundwater pumping reduces groundwater levels, which can further exacerbate subsidence and reduce the FKC capability to deliver surface water.

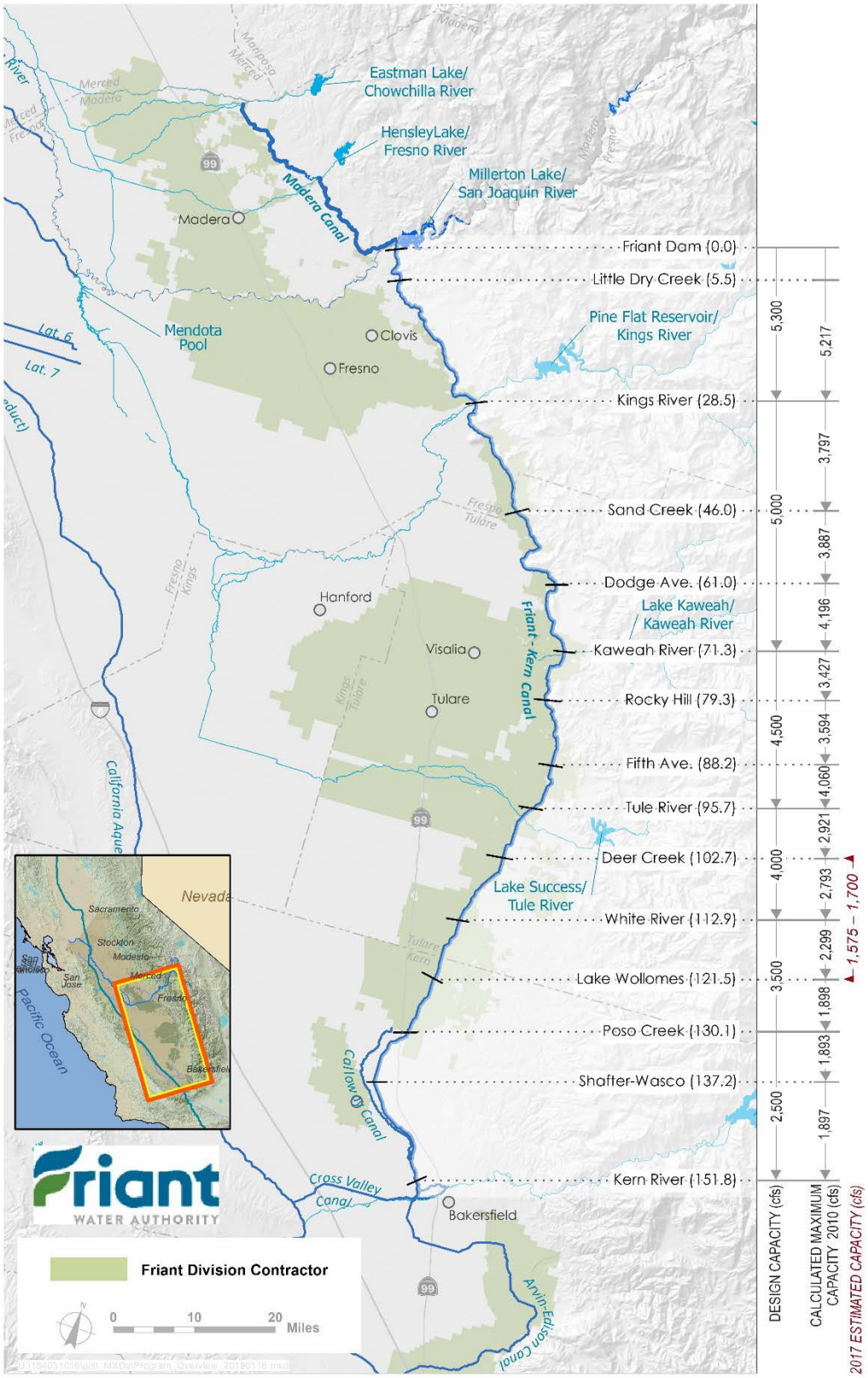

Figure 2-8. Friant-Kern Canal 2017 Capacity

Likely Future Without-Project Conditions Summary

The magnitude of potential water resources and related problems, needs, and opportunities is based not only on the existing conditions described above, but also on how these conditions may change in the future. Predicting future conditions is complicated by a variety of factors, including uncertainty regarding future regulatory requirements, ongoing programs and projects in the study area, future land subsidence, SGMA implementation, and future hydrologic conditions. The likely future without-project conditions represent the No Action Alternative, as discussed further in Chapter 4.

San Joaquin River Restoration Program Implementation

Physical changes to the San Joaquin River from Friant Dam to the Merced River are being implemented by the SJRRP and are assumed to be in place in the future without-project condition. These changes include levee modifications associated with incorporating new floodplain and related riparian habitat in the San Joaquin River, structure modifications to ensure fish passage, and channel capacity changes to accommodate Restoration Flows. The release of Restoration Flows will result in reductions to Friant Division water supplies.

Implementation of the SJRRP is progressing more slowly than planned due to unforeseen conditions and funding limitations. Currently, the release of full Restoration Flows is not possible due to downstream channel capacity constraints. As a result, URFs have been made available to Friant Contractors. The availability of URFs will decrease as channel improvements enable greater releases of Restoration Flows. Stage 1 SJRRP Implementation is scheduled to be completed by 2024 (SJRRP, 2018). The SJRRP anticipates project implementation would enable the release of full Restoration Flows no later than 2030. If that occurs, water deliveries to Friant Division contractors will decrease to levels anticipated by the SJRRP no later than the year 2030.

SGMA Implementation

Over the coming decades, SGMA will be implemented by GSAs. The eight high priority basins will have from 2020 until 2040 to come into compliance. Since the GSPs are still under development, the specific projects, programs, and anticipated timelines could not be included in this Study. Despite these unknowns, it is likely that SGMA implementation will include changes in agricultural practices and cropping patterns, reduction in irrigated acreage, and implementation of local and regional water management programs.

Future Subsidence

The performance of alternative designs should be evaluated relative to potential future conditions, particularly as it relates to subsidence. Subsidence projection studies relevant to the Middle Reach of the FKC are being developed in support of the Eastern Tule Basin GSA using the Tule Subbasins Groundwater Model.

To support evaluations presented in this Study, four potential groundwater pumping and hydrologic scenarios were evaluated to identify potential future subsidence along the alignment of the FKC. Results for each scenario are provided by decade (2030 – 2070), cumulating in a total of 20 potential subsidence profiles in the project area. Because it is not feasible to evaluate each design alternative over all subsidence projections, it is necessary to define a small number of potential conditions that represent a reasonable range of future outcomes. To achieve this, results were grouped into the following potential future subsidence conditions:

- Group 1. Minimal Mid-Term Subsidence Condition;
- Group 2. Moderate Mid-Term Subsidence Condition;
- Group 3. Severe Mid-Term Subsidence Condition; and
- Group 4. Severe Long-Term Subsidence Condition.

Each of the potential future subsidence conditions are based on achieving SGMA compliance by the year 2040, and residual subsidence continuing to the year 2070 and no subsidence thereafter. The subsidence conditions vary based on hydrologic assumptions and the timing of groundwater pumping reductions from current pumping levels to anticipated pumping levels that would achieve SGMA compliance.

Both Groups 1 and 2 represent conditions that are similar to today's groundwater pumping and may come to fruition by the time the Project is constructed with little addition subsidence thereafter. Group 4 represents a worst-case scenario in terms of both hydrology and timeframe to achieve SGMA compliance and is thus unlikely. Therefore, the future subsidence condition described by Group 3, Severe Mid-Term Subsidence Condition, was selected as most representative for use in the evaluation of Project alternatives.

The results of Group 3 indicate that about 8.5 feet of additional subsidence could occur on the FKC by the year 2070 (see Figure 2-9). For a detailed explanation, please refer to Appendix B Engineering Design and Cost, Attachment 3 Selection of Future Subsidence Condition.

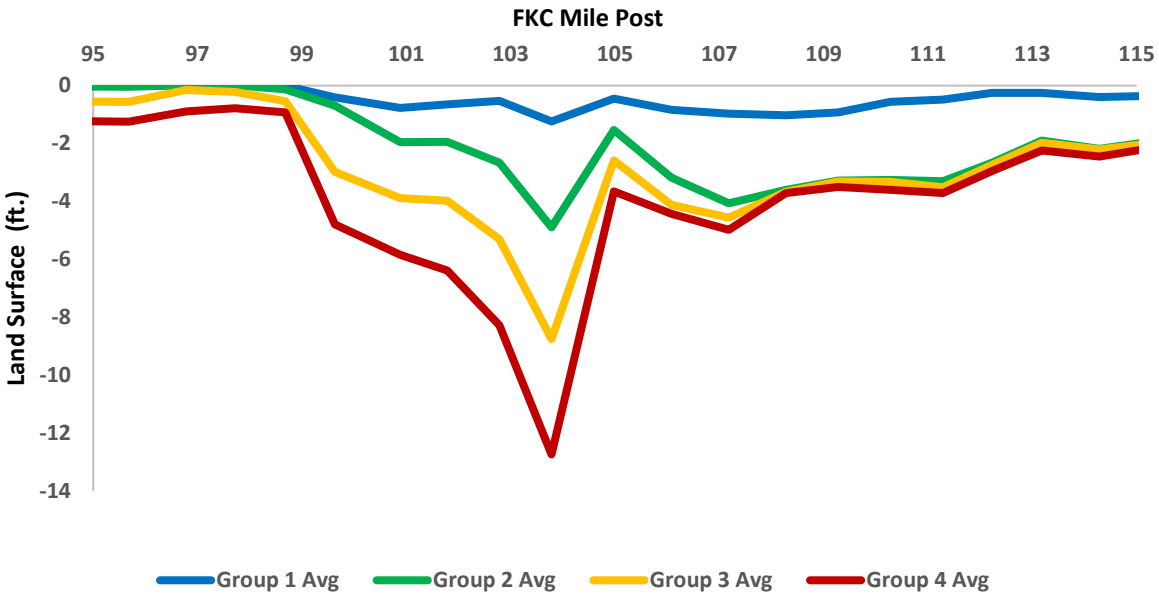

Figure 2-9. FKC Profiles Under Future Subsidence Scenarios

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Chapter 3
Initial Alternatives

The plan formulation process to the Study is based on the PR&G (CEQ 2013) and consists of the following deliberate and iterative steps:

1. Specify the water and related land resources problems and opportunities associated with the Federal objective and specific State and local concerns.

2. Inventory, forecast, and analyze existing and projected future resources conditions in the study area.

3. Formulate alternative plans.

4. Evaluate the potential effects of alternative plans.

5. Compare alternative plans.

6. Select a recommended plan to decision makers based on the comparison of alternatives.

Alternatives formulation was accomplished through a two-step approach: the Initial Alternative evaluation and Feasibility Alternative evaluation. This chapter describes the first step of the formulation, evaluation and comparison of Initial Alternatives and the selection of alternatives to be carried forward for evaluation as Feasibility Alternatives. Information in this chapter is supported with additional detail provided in Appendix A Initial Alternatives Formulation.

Project Planning Horizon

The Project is intended to be integrated into a long-term solution to restore capacity of the entire FKC, as part of the FWA's approach to restore the design capacity of the entire FKC. The planning horizon is 100 years, which is consistent with the expected service life of large civil engineering projects.

Planning and Resource Constraints

The primary constraints that affect the Project are funding availability and physical boundary conditions.

Funding Constraints

As described in Chapter 1, two Federal funding sources are currently available for the Project. These include SJRRP non-reimbursable funds of about $19 million and 2019 WIIN Act

appropriations of about $2.2 million. WIIN Act appropriations are subject to a 50 percent cost share.

Boundary Conditions

When designing either a new canal or modifications to an existing canal, the first step is to identify the boundary conditions, or the required (design) water levels at each end of the system. Boundary conditions may be difficult to define, especially since they can change significantly with relatively minor changes to the Project. Although the upstream and downstream limits for this Project are the 5th Avenue Check and the Lake Woollomes Check, hydraulics were analyzed from the 5th Avenue Check through the canal terminus at the Kern River Check. The boundary condition was considered the Kern River Check because the Project needs to be compatible with any future modifications in the Lower Reach. From the analysis, it was determined that the hydraulic head varies about 25 feet between 5th Avenue Check and the Kern River. Of this, approximately 20 feet is required for the canal gradient and the remaining 5 feet is required to accommodate for losses at canal structures, including bridges, turnouts, checks, and siphons.

The boundary conditions, along with the Project objectives, were used to establish a proposed hydraulic grade line (HGL). The proposed HGL was set as low as possible to minimize embankment raise requirements and the need to modify bridges. All management measures considered, and subsequent Project alternatives, are based on the proposed HGL. The proposed HGL is shown in Figure 3-1.

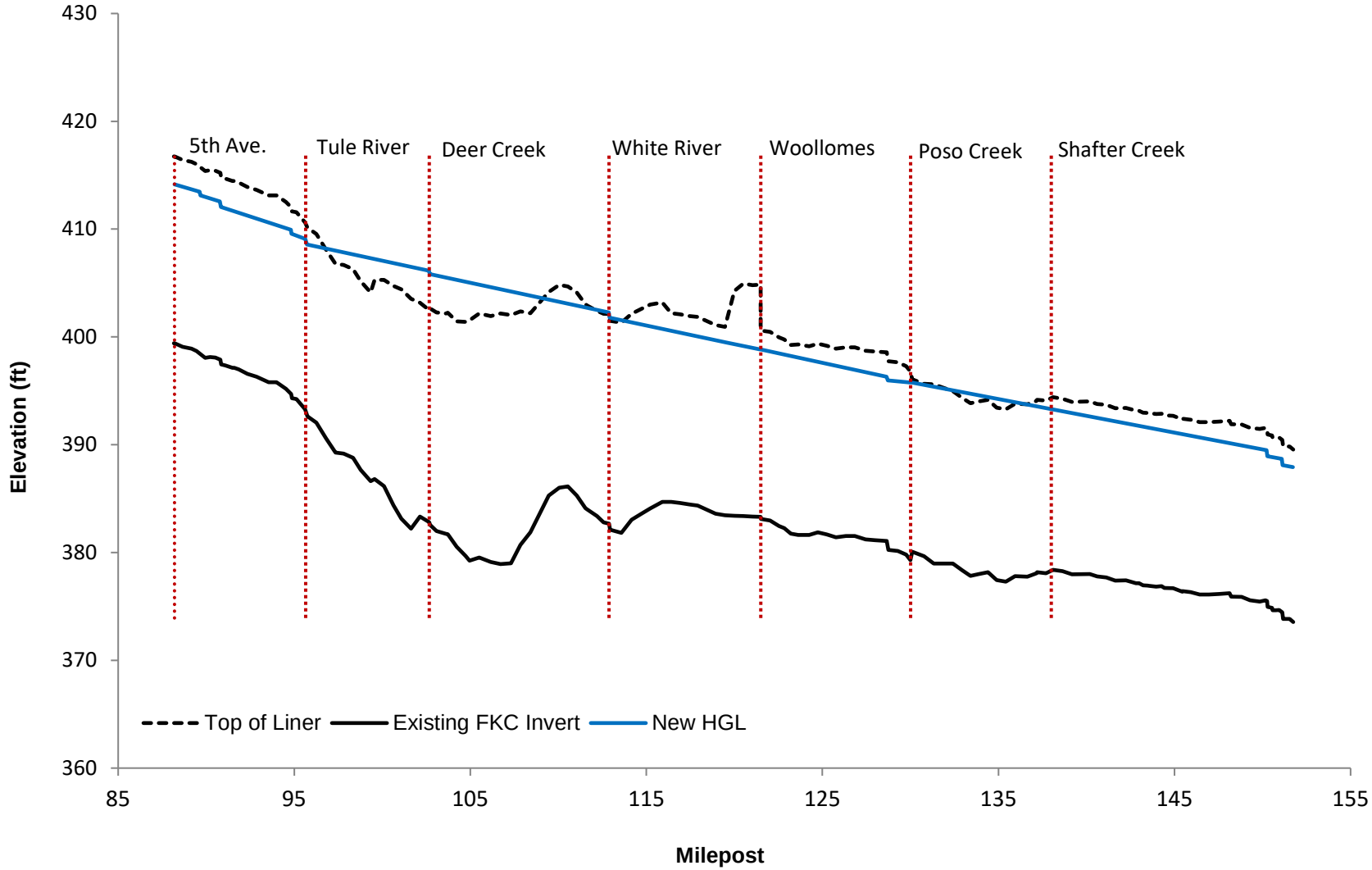


Figure 3-1. Canal Profile with Proposed Hydraulic Grade Line

Initial Alternatives Formulation

The Initial Alternatives Formulation describes the development, evaluation, and comparison of a set of seven Initial Alternatives. From the evaluation, two Initial Alternatives were selected for further development in this Study. For more detail, refer to Appendix A Initial Alternatives Formulation.

Measures Considered

In the formulation of Initial Alternatives, several structural measures were identified that could contribute to the Project objective of restoring the design FKC flow capacity. Nonstructural measures were not considered because the SJRRS Act requires the restoration of the originally designed and constructed capacity, which cannot be achieved through the implementation of nonstructural actions. Structural measures were organized into the following categories: canal enlargement, pumping plant, new canal, bridge modification, and other. Of the measures identified, several were selected for development into Initial Alternatives investigated in this Study (Table 3-1).

Table 3-1. Measures to Restore Friant-Kern Canal Capacity

Resource Management Measure	Status	Rationale
Canal Enlargement		
Raise Canal	Retained	Raising the canal would contribute to the Project objectives.
Raise and Widen Entire Cross Section	**Removed**	This measure is cost prohibitive and raises constructability concerns. Dropped from further consideration,
Raise and Widen Upper Portion of Cross Section	Retained	Enlarging the canal would contribute to Project objectives.
Pumping Plant		
Pumping Plant	Retained	The addition of a pumping plant would help restore capacity, thus contributing to Project objectives.
New Canal		
Bypass Canal	Retained	A bypass canal would restore capacity, though not in the original FKC.
Parallel Canal	Retained	A parallel canal would restore capacity, though not in the original FKC.
Bridge Modification		
Bridge Raise	Retained	A bridge raise does not sufficiently meet Project objectives but is an operational requirement.
Bridge Replacement	Retained	A bridge replacement does not sufficiently meet Project objectives but is an operational requirement to be included.
Other		
Pipeline	**Removed**	Initial hydraulic analysis revealed that headlosses would be greater than the available head, and project would require a pump station(s) to move water. This would be more costly than other available options.

Capacity Restoration Objectives for Initial Alternatives

As stated in Chapter 1, the objective of the Project is to restore the capacity of the FKC as previously design and constructed, consistent with SJRRS Act authority. This involves restoring the original design capacity of the FKC consistent with current Reclamation design standards for Normal and Design Maximum flow rates. The design of all Initial Alternatives was based on a canal capacity equal to the Design Maximum Flow Rate (Table 3-2). Canal lining depths were based on the normal depths at the Design Maximum Flow Rates plus the lined freeboard criteria for normal operations. The design flow rates were used to develop the HGL profiles for the Initial Alternatives. This approach is considered conservative and is inclusive of all potential flow and freeboard design requirements that may be considered in future evaluations.

Table 3-2. Design Flow Rates for Initial Alternatives

Canal Section No.	Canal Segment (MP to MP)	Description (Check to Check)	Normal Flow Rate (cfs)	Design Maximum Flow Rate (cfs)
4	88 to 95.67	5th Avenue to Tule	3,500	4,500
5	95.67 to 112.90	Tule to White River	3,000	4,000
6.1	112.90 to 128.69	White River to HWY 99	2,500	3,500
6.2	128.69 to 130.03	HWY 99 to Poso	2,500	3,000

Key:
cfs = cubic feet per second
HWY = highway
MP = mile post

Initial Alternatives

Seven Initial Alternatives were developed to meet the Project objective using the management measures. A brief overview of each alternative is provided below. A summary of features of each Initial Alternative is provided in Table 3-3.

Initial Alternative 1: Canal Enlargement

Initial Alternative 1 would increase the capacity of the FKC by either raising the embankments and the concrete liner or raising and widening the embankments and liner. To raise and widen the canal, a portion of the existing liner would be removed, a bench would be cut into the existing grade, the embankment would be widened, and liner would be extended on the bench and the raised embankment. This approach would minimize land acquisition requirements; however, 67 miles of embankment would be modified.

Initial Alternative 2: Pump Station at MP 109

Initial Alternative 2 would change the FKC from a gravity canal to a pumped canal. When flows are high and cannot be conveyed by gravity, water would be diverted from the original canal at MP 109, into a forebay, then pumped back into the original canal. The initial pump station design includes eight 250-cfs pumps. In the event of a power failure, water would be directed into a 400-acre emergency reservoir to prevent a surge.

Initial Alternative 3: Pump to Woollomes

In Initial Alternative 3, capacity restoration would be achieved by moving water from the original canal into an approximately 10-mile-long bypass canal and pumping it into Lake Woollomes. The existing canal would be used to maintain deliveries within the bypassed section.

Initial Alternative 4A: Bypass Canal-Tule River to White River

Alternative 4A is an offset bypass canal that would move water into a new canal at the Tule River and connect back into the existing canal at White River. The existing canal would be used solely to maintain deliveries between the two checks.

Initial Alternative 4B: Bypass Canal-Tule River to Woollomes

Initial Alternative 4B is the same as Initial Alternative 4A but extends to Lake Woollomes.

Initial Alternative 5A: Parallel Canal-Tule River to White River

Initial Alternative 5A is a combination of the canal enlargement and parallel canal measures. The parallel canal would run from Tule River to White River.

Initial Alternative 5B: Parallel Canal-Tule River to Woollomes

Initial Alternative 5B is the same as Initial Alternative 5A but extends to Lake Woollomes.

Table 3-3. Initial Alternative Features Summary

Alternative	Capital Cost (M)	Present Worth Additional OM&R (M)	Material Balance[1] (1,000 yd^3)	ROW Required (acres)[2]	Bridge Modification[3]	Stream Crossing	Embankment Modification (mi)
1: Canal Enlargement	$290	$0.3	-1,550	170	17	0	66
2: Pump Station at MP 109	$270	$3.1	+542	522	14	0	52
3: Pump to Woollomes	$380	$3.5	+945	622	23	1	27
4A: Bypass Canal—Tule River to White River	$300	$1	+1,750	508	18	1	32
4B: Bypass Canal—Tule River to Woollomes	$320	$1.4	+2,418	650	24	2	20
5A: Parallel Canal—Tule River to White River	$300	$0.9	Balanced	321	18	0	49
5B: Parallel Canal—Tule River to Woollomes	$300	$1.3	Balanced	390	24	0	43

Notes:
[1] Negative values indicate borrow and positive values indicate surplus.
[2] ROW required is the additional ROW needed outside the existing Reclamation ROW.
[3] Modifications can be a raise, replace, or new bridge. Farm bridge modifications are not included in this count.
Key:
M = million dollars
mi =miles
MP = mile post
OM&R = operations, maintenance, and replacement
yd^3 = cubic yard

Evaluation and Comparison of Initial Alternatives

The seven Initial Alternatives were evaluated and scored based on five criteria and several related sub-criteria, as listed in Table 3-4. The criteria addressed: (1) constructability, (2) operational requirements and flexibility, (3) cost, (4) schedule, and (5) environmental compliance and permitting. The evaluation and scoring considered both current (2018 survey) and projected future land surface elevations. Scoring results were evaluated as unweighted and weighted based on Project priorities of cost and schedule. A summary of the ranking results based on existing land surface is shown in Figure 3-2. The results from this analysis, as well as an analysis that considered potential future subsidence, revealed that Alternatives 1 and 5 consistently ranked highest. On the basis of these findings, Alternatives 1 and 5 were selected for further evaluation. Additional information on the Initial Alternatives evaluation can be found in Appendix A Initial Alternatives Formulation.

Table 3-4. Initial Alternatives Evaluation Criteria and Sub-Criteria

I. Constructability	II. Operational Requirements and Flexibility	III. Cost	IV. Schedule	V. Environmental Compliance and Permitting
CON-1. Complexity to Maintain Water Deliveries during Construction	OPS-1. Additional O&M Requirements and Expertise of FWA Staff	COST-1. Construction Cost*	SCH-1. Time to Start Construction	ENV-1. Complexity of Required Environmental Compliance
CON-2. Ability to O&M during Construction	OPS-2. Operations of District Turnouts	COST-2. Non-contract Cost*	SCH-2. Construction Duration	ENV-2. Number of Stream Crossings*
CON-3. Temporary Bypasses and Tie-Ins Needed to Construct the Project*	OPS-3. Ability to Accommodate Power Outages	COST-3. Present Worth Additional OM&R Costs*	SCH-3. Time Until Benefits Realized	ENV-3. Number of Bridges*
CON-4. Extent of Dewatering			SCH-4. Potential to Phase Construction	ENV- 4. Length of Modified Existing Embankment*
CON-5. Material Balance*			SCH-5. Land Acquisition*	
			SCH-6. Schedule Risk	

Note:
*Qualitative sub-criterion
Key:
O&M = operations and maintenance
OM&R = operations, maintenance, and replacement

			UNWEIGHTED							COST							SCHEDULE						
Project Information			Average Scores					UNWEIGHTED		Average Scores					COST		Average Scores					SCHEDULE	
ID	Alternative Name	Alternative Type	Constructability	Operational Requirments and Flexibility	Cost	Schedule	Environmental Compliance and Permitting	Composite Score	Alternative Ranking	Constructability	Operational Requirments and Flexibility	Cost	Schedule	Environmental Compliance and Permitting	Composite Score	Alternative Ranking	Constructability	Operational Requirments and Flexibility	Cost	Schedule	Environmental Compliance and Permitting	Composite Score	Alternative Ranking
			20%	20%	20%	20%	20%	UNWEIGHTED		10%	15%	50%	10%	15%	COST		10%	15%	10%	50%	15%	SCHEDULE	
1	Canal Enlargement	G	1.8	5.0	4.7	4.8	2.6	3.8	1	1.8	5.0	4.7	4.8	2.6	4.1	1	1.8	5.0	4.7	4.8	2.6	4.2	1
2	Pump Station at MP 109	PS	2.7	2.3	3.4	2.8	2.9	2.8	5	2.7	2.3	3.4	2.8	2.9	3.0	5	2.7	2.3	3.4	2.8	2.9	2.8	4
3	Woollomes Pump Station	PS	2.8	2.0	1.0	1.9	1.7	1.9	7	2.8	2.0	1.0	1.9	1.7	1.5	7	2.8	2.0	1.0	1.9	1.7	1.9	7
4A	Bypass Canal: Tule River to White River	G	4.1	3.7	3.8	2.0	2.3	3.2	4	4.1	3.7	3.8	2.0	2.3	3.4	3	4.1	3.7	3.8	2.0	2.3	2.7	5
4B	Bypass Canal: Tule River to Woollomes	G	4.2	3.0	2.1	1.2	1.6	2.4	6	4.2	3.0	2.1	1.2	1.6	2.3	6	4.2	3.0	2.1	1.2	1.6	1.9	6
5A	Parallel Canal: Tule River to White River	G	4.2	4.3	3.9	3.0	2.4	3.6	2	4.2	4.3	3.9	3.0	2.4	3.7	2	4.2	4.3	3.9	3.0	2.4	3.3	2
5B	Parallel Canal: Tule River to Woollomes	G	4.5	3.7	3.4	2.4	2.0	3.2	3	4.5	3.7	3.4	2.4	2.0	3.2	4	4.5	3.7	3.4	2.4	2.0	2.8	3

Figure 3-2. Evaluation and Comparison of Initial Alternatives

Selection of Alternatives for Feasibility-Level Evaluation

Alternatives 1 and 5 were further evaluated following the failure of California Proposition 3 in November 2018, a potential non-Federal funding source for the Project. The additional evaluation considered various design capacity and freeboard requirements for Initial Alternatives 1 and 5 with the objective of identifying challenges that may be associated with Project phasing.

Estimates of material quantities and costs were prepared for Initial Alternatives 1 and 5 under the following capacity and freeboard options:

- **Option 1 - Maximum Historical Flow with Flood Freeboard**. This option was defined based on a review of historical peak flows in each segment of the FKC. The existing flood freeboard was applied based on the assumption that historical peak flows were associated with the conveyance of flood flows. This condition occurs during the delivery of 215 water supplies and, in some instances, the delivery of Class 2 water supplies.

- **Option 2 - Design Normal Flow with Standard Freeboard**. This option was defined based on the original normal design flow using the current standard freeboard requirements.

- **Option 3 - Design Maximum Flow with Flood Freeboard**. This option was defined based on the original maximum design flow using the current flood freeboard requirements.

- **Option 4 - Design Maximum Flow with Standard Freeboard**. This option was defined based on the original maximum design flow using the current standard freeboard requirements. This assumption was applied in the assessment of all Initial Alternatives.

A summary of results of the additional analysis of Initial Alternatives is presented in Table 3-5. Based on this analysis, the following alternatives were selected for evaluation as Feasibility Alternatives:

- Initial Alternative 1 Option 1, hereafter referred to as Canal Enlargement, was selected for feasibility evaluation because it identifies modifications necessary to maintain continued operations of the FKC consistent with historical operations. While this capacity the original designed capacity, this information may be beneficial in evaluating cost allocation requirements.

- Initial Alternative 5 Option 3, hereafter referred to as Parallel Canal, was selected for feasibility evaluation. Option 3 would restore the canal to the original design capacity.

Table 3-5. Additional Analysis of Initial Alternatives for Selection of Feasibility Alternatives

Quantity	Alternative 1				Alternative 5			
	Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Length of Modified Canal (miles)	**17.10**	24	31	31	17.08	24	**31**	31
Length of Modified FKC Embankment (miles)	**34.20**	47.20	62.00	62.00	17.08	23.60	**38.40**	38.43
Permanent ROW required (acres)	**0**	0	154	170	218	299	**371**	386
Number of Parcels for Permanent ROW	**0**	16	131	165	70	87	**189**	182
Excavation of Existing Canal (1,000 cubic yards)	**190**	577	4,015	3,709	1,533	3,014	4,871	4,875
Embankment Material Required (1,000 cubic yards)	**1,883,537**	2,690,072	4,359,154	5,259,535	3,110,475	3,968,826	**3,552,038**	4,459,080
Material Balance (Borrow) or Waste (1,000 cubic yards)	**(1,694)**	(2,113)	(344)	(1,551)	(1,578)	(955)	**1,319**	416
Borrow / Waste Disposal ROW (acres)	**210**	326	469	488	195	403	**396**	448
Lining Required (thousand square yards)	**405**	488	1,612	1,686	968	1,327	**1,845**	1,946
Bridge Raise	**2**	2	3	3	0	0	**1**	1
Bridge Replacement/New Bridge	**16**	17	17	17	19	27	**27**	27
Total Project Cost ($M)	**$150**	$191	$298	$316	$192	$270	**$309**	$330
Low Cost Range (-25% on Field Costs; $M)	**$113**	$144	$228	$240	$147	$208	**$236**	$252
High Cost Range (+25% on Field Costs; $M)	**$185**	$235	$369	$391	$236	$334	**$381**	$405

Note: The ROW information presented in this table was calculated using two map layers. One layer called record ROW shows the right-of-way for the Friant-Kern Canal as described in the deed maps on record with the Bureau of Reclamation. Any misclosures or overlaps that occur reflect the problems contained within the legal description. The other layer called adjusted ROW shows the approximation of the right-of-way boundaries corrected and adjusted based upon minimal survey control. This information is not to be considered official or final and is only intended to show discrepancies and or problems between the deed and preliminary survey evidence recovered in the field.

Key:
$M = Million Dollars
FKC = Friant-Kern Canal
ROW = Right of Way

Chapter 4
Feasibility Alternatives

This chapter provides a description of the No Action Alternative and the two Feasibility Alternatives. The physical features of the Feasibility Alternatives, as well as the costs and anticipated permitting requirements, are summarized below and evaluated further in Chapter 5.

No Action Alternative

The No Action Alternative represents a projection of reasonably foreseeable future conditions that could occur if no action is taken to address current and projected future capacity reductions to the FKC (i.e., the future without the proposed Project). Reclamation recommends several criteria for including proposed future actions within the No Action Alternative: proposed actions should be (1) authorized; (2) approved through completion of NEPA, CEQA, Endangered Species Act (ESA), and other compliance processes; (3) funded; and (4) permitted. The No Action Alternative is considered the basis for comparison with the Recommended Plan, consistent with NEPA and the PR&G (CEQ 2013) guidelines. Therefore, if no proposed action is determined feasible, the No Action Alternative is the default option.

Under the No Action Alternative, Reclamation and FWA would not take additional actions towards restoring the capacity of the Middle Reach of the FKC. However, four foreseeable actions have been identified that affect future conditions: SJRRP implementation, continued subsidence, SGMA implementation, and CVP water delivery rescheduling in Millerton Lake.

SJRRP Implementation

Under the No Action Alternative, water supply availability to Friant Division long-term contractors will decrease as San Joaquin River channel improvements are implemented that allow for increased and ultimately full release of Restoration Flows. As shown in Figure 4-1, simulated long-term average annual Friant Division deliveries under the current level of SJRRP implementation is estimated at 1,119 TAF per year. As of October 2019, release of full Restoration Flows is not possible due to downstream channel capacity constraints. With full release of Restoration Flows to the San Joaquin River, anticipated by 2030, long-term annual average deliveries to the Friant Division would be reduced to about 1,052 TAF.

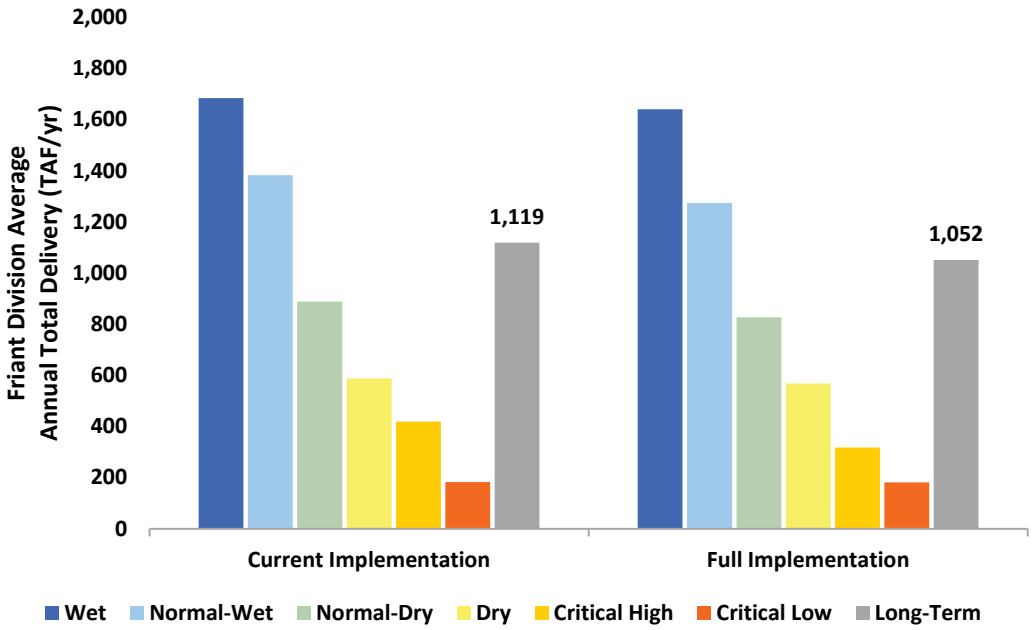


Figure 4-1. Simulated Friant Division Delivery Capability with SJRRP Implementation

Under the No Action Alternative, the current capacity-restricted condition of the FKC would continue to limit affected Friant Division long-term contractors' ability to receive water during periods of peak demand or peak flow. This could impact the ability of the contractors to take delivery of water under Paragraph 16 (b) of the Settlement "for the purpose of reducing or avoiding impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration Flows," thus limiting the Secretary of the Interior's ability to achieve the Water Management Goal in the Settlement. As subsidence continues, water delivery impacts associated with decreased canal capacity would increase.

Future Subsidence

Under the No Action Alternative subsidence is expected to continue throughout the project area. As described in Chapter 2, a groundwater model of the Tule Subbasin was developed to simulate potential future groundwater and land subsidence conditions in support of planning for SGMA compliance. As described in Chapter 2 a condition of Severe Mid-Term Subsidence conditions was selected for use in Project evaluations, resulting in the maximum total subsidence displacement from the current condition of each year described in Table 4-1.

Table 4-1. Maximum Simulated Additional Subsidence in the Middle Reach of the FKC

Year	Displacement from Current Condition (ft)
2025	3.9
2030	6.7
2040	8.5
2070	9.5

Key:
ft = feet

SGMA Implementation

In response to reduced deliveries from Friant Dam as a result of SJRRP implementation and FKC capacity reduction, affected Friant Division long-term contractors would likely increase groundwater pumping. However, the duration of this response will be limited. SGMA implementation is expected to limit allowable groundwater pumping to amounts less than historical and current amounts. SGMA requires that actions to achieve sustainable groundwater management be in place no later than 2040. Therefore, it is assumed that any increased groundwater pumping in response to surface water reductions due to SJRRP Restoration Flow increases and FKC capacity limitations would be gradually reduced to zero by 2030.

Water Delivery Rescheduling

It is reasonable to expect the Friant Division long-term contractors would take some action to minimize water delivery shortages by rescheduling affected water deliveries in Millerton Lake. The potential for rescheduling affected water supplies is based on the following factors:

- Water demands for affected Friant Division contractors that would be served by non-Friant Division water supplies (local surface water, groundwater, or other supplies).
- Available storage capacity in Millerton Lake.
- Available capacity in the FKC to convey rescheduled water supplies.

The potential to reschedule affected Friant Division water deliveries in Millerton Lake was simulated by creating an account to track the storage of affected water supplies. Water in the rescheduled water account would be the first water subject to spill to assure that all existing obligations for the operation of Friant Dam would continue under existing priorities. Water would be diverted from the rescheduled water storage account to the FKC in months when demand that would be served by other supplies is available, as constrained by available conveyance capacity in the FKC.

Water would remain in the rescheduled storage account, including into successive years, until the account is evacuated, or flood releases are made from Friant Dam to the San Joaquin River. It is assumed that the rescheduled supplies would result in a shifting the timing of groundwater

pumping and local surface water supply use to continue to meet demands in districts that would have a reduction in allocated CVP water supplies due to FKC capacity limitations. When capacity in the FKC is available to deliver rescheduled supplies, this would come at a time that would offset typical use of groundwater pumping or local surface water supplies.

Feasibility Alternative Plans

Based on the evaluation of Initial Alternatives, two alternatives were carried forward for an evaluation at a feasibility level. The Parallel Canal Alternative was developed based on refinements to Initial Alternative 5 Option 3, which includes construction of a new canal parallel to the FKC and modifying the FKC where possible to convey maximum design flow of the original authorized project. The Canal Enlargement Alternative was developed based on refinements to Initial Alternative 1 Option 1, which includes modifying the FKC to convey maximum capacity based on maximum historic flow. A summary of design capacity and freeboard requirements for the Feasibility Alternative Plans is provided in Table 4-2.

Table 4-2. Design Capacity and Freeboard Requirements in Feasibility Alternatives

	Canal Enlargement		Parallel Canal	
	Capacity (cfs)	**Freeboard (ft)**	**Capacity (cfs)**	**Freeboard (ft)**
Segment 1	4,008	1.12	4,500	1.12
Segment 2	3,497	1.08	4,000	1.08
Segment 3	2,888	1.08	4,000	1.08
Segment 4	2,490	1.03	3,500	1.03

Key:
cfs = cubic feet per second
ft = feet

In refining the retained Initial Alternatives, additional detail was developed regarding turnouts and canal crossings, consideration was given to minimizing ROW requirements, and modifications were made to minimize material hauling requirements. Descriptions of Feasibility Alternatives are provided below.

Parallel Canal Alternative

The Parallel Canal Alternative was refined after the Initial Alternatives Formulation in terms of alignment, water delivery strategy (turnouts), canal cross-section design, road crossings, check structures, utilities, and costs. A single-line schematic showing features included in the Parallel Canal Alternative is provided in Figure 4-2A and Figure 4-2B. As shown, the Parallel Canal Alternative includes a combination of modifications to the existing FKC and the construction of a new parallel canal immediately to the east of the FKC. The selection of canal modification or parallel canal was made based on the extent of modifications that would be required to the FKC. The parallel canal would be constructed in reaches where land subsidence has occurred to an

extent that raising and widening the FKC to achieve the design capacity is considered less practical. Features of the Parallel Canal Alternative are described in the following sections.

Canal Alignment and Cross Sections

In comparison to Initial Alternative 5, significant refinements were incorporated in the Parallel Canal Alternative regarding the canal alignment and the cross sections. Initial Alternative 5 was based on a parallel canal from the 5th Avenue Check to either White River or Lake Woollomes, and the continued operation of the existing FKC for deliveries in the bypassed reaches.

Through the refinement process, the length of the parallel canal portion of this alternative was reduced. In some locations, it was found that modifying the FKC to achieve the objective conveyance capacity would be more practical than constructing a parallel canal. It was also found that retaining long segments of the existing FKC to provide deliveries in the bypassed segments would require modifications to several turnouts. In light of these refinements, the Parallel Canal Alternative was revised to a configuration that includes modifications to the FKC and the construction of a replacement parallel canal.

Where constructed, the parallel canal would be the exclusive water conveyance and delivery mechanism and most of the existing FKC would be demolished, filled in, and taken out of service. This approach was selected due to the numerous benefits it provides; it would reduce ROW acquisition requirements, reduce material hauling during canal earthwork, provide access to existing material, improve constructability, and would provide greater long-term durability.

The Parallel Canal Alternative would include modifications to the current FKC alignment from 5th Ave. Check (MP 88) to Ave. 152 (MP 96.3). Through this reach, the cross section of the existing FKC would be enlarged with a 24-foot bench on either side to increase canal capacity to meet the Design Maximum flow rate of 4,500 cfs in this segment, as shown in Figure 4-3. From 5th Ave. Check (MP 88) to Ave. 152 (MP 96.3) the existing bridges are estimated to be high enough to accommodate the new canal water surface level and the existing turnouts could continue to function without modification. To reduce cost, the enlarged canal would transition into the existing canal prism upstream and downstream from existing bridges and turnouts so that these structures may remain in place without modification.

At MP 96.3, the Parallel Canal Alternative alignment would head east, away from the existing canal centerline, and run on a parallel alignment until it reaches Garces Highway (MP 118.96). In this reach, the Parallel Canal would have a regular trapezoidal shape based on the configuration shown in Figure 4-4. At MP 118.96, the Parallel Canal Alternative would head west and reconnect with the existing alignment of the FKC, which would be enlarged between MP 118.96 to MP 121.5 as described above and shown in Figure 4-3.

The Parallel Canal Alternative, as described in this Report is based on canal embankments and liner that would achieve objective capacities if constructed at the current ground level. The alternative also includes design features to accommodate anticipated future subsidence. For example, the siphon-type road crossings are sized to accommodate future increases in HGL. In

addition, canal embankments were configured such that they could be raised without interfering with the operation of the restored FKC and necessary right of way to accommodate the future raise is included, as identified as future concrete liner raise with embankment on Figure 4-4.

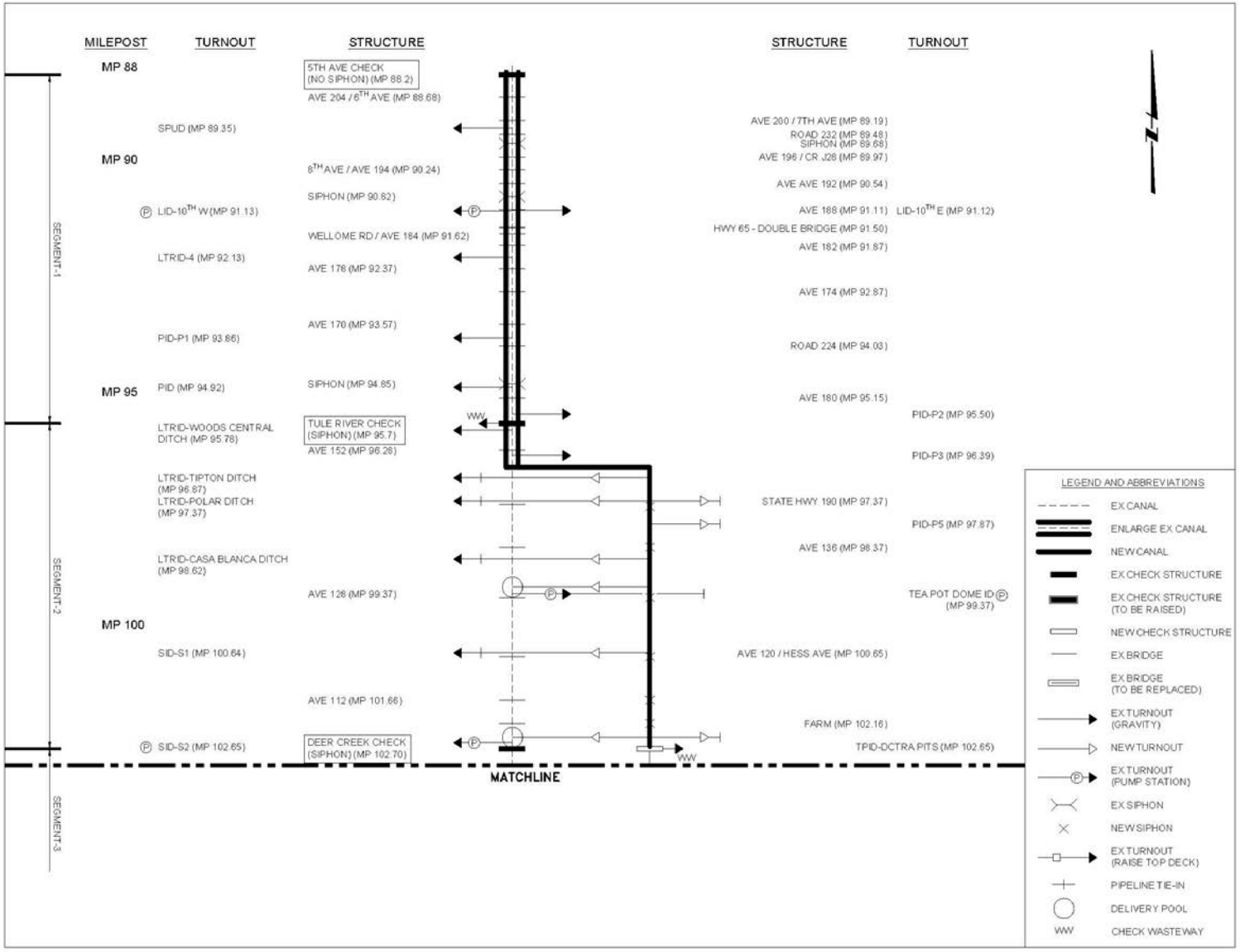


Figure 4-2A. Parallel Canal Alternative Single-Line Diagram of Canal Segments 1 and 2

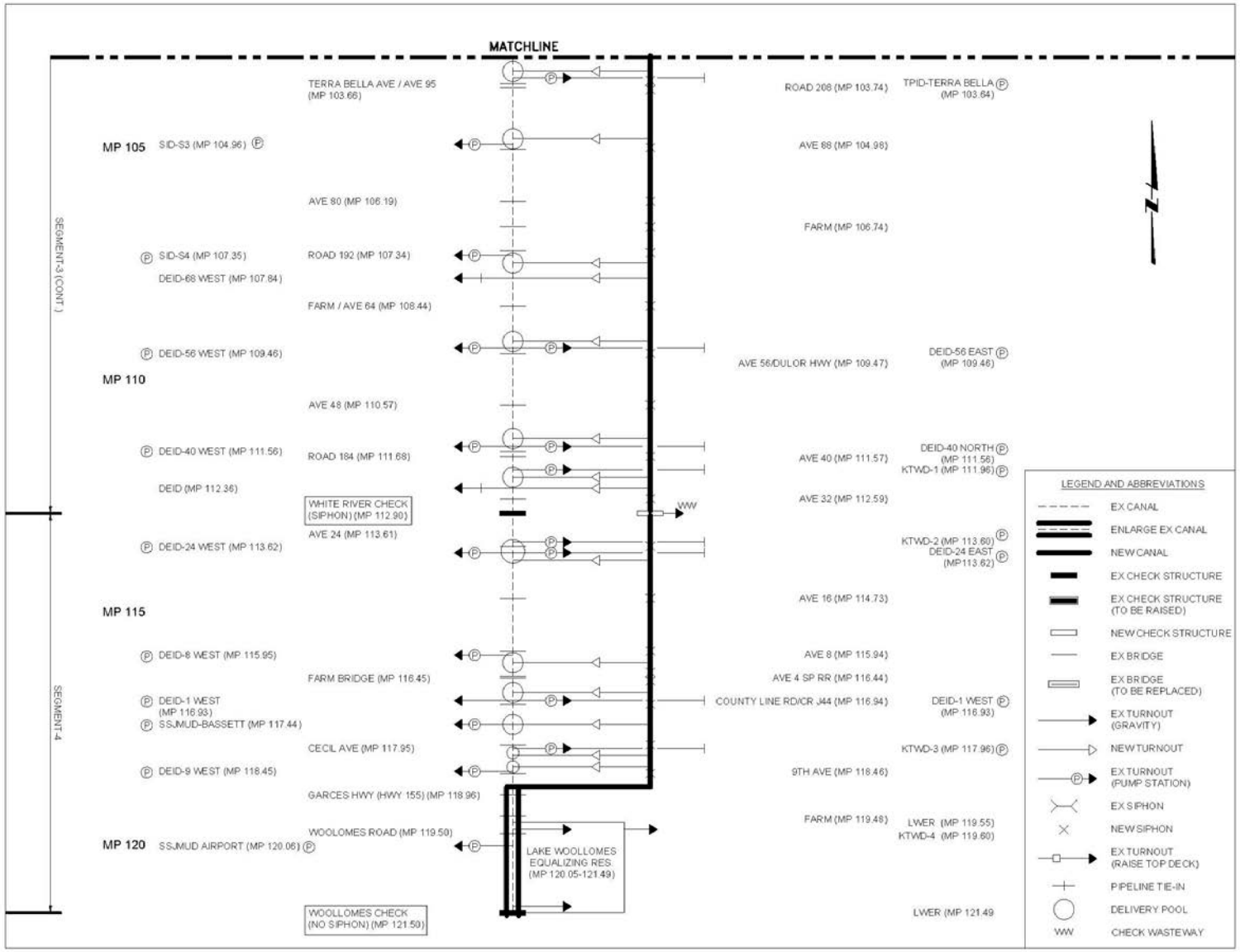


Figure 4-2B. Parallel Canal Alternative Single Line Diagram of Segments 3 and 4

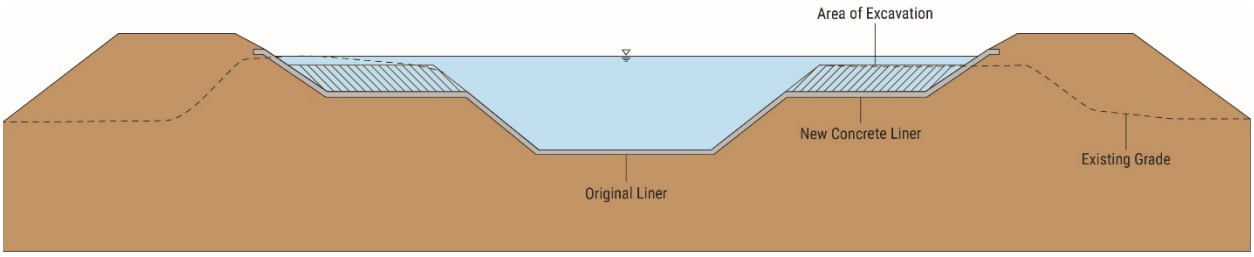


Figure 4-3. Compound Trapezoidal Cross Section in the Parallel Canal Alternative

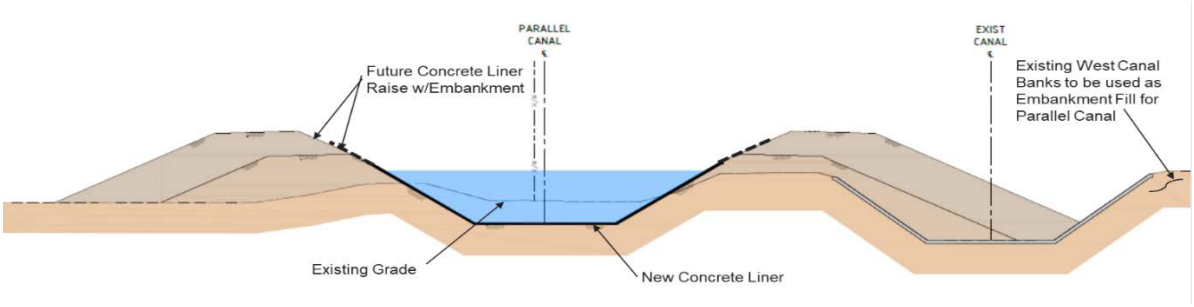


Figure 4-4. Trapezoidal Cross Section in the Parallel Canal Alternative

Construction Sequencing

The parallel canal portion of the Parallel Canal Alternative would be constructed as follows:

1. Partially build the right bank, from existing canal left bank material, while maintaining water deliveries in the existing canal.

2. Excavate the new cross section and use the excavated material to build the left bank. This work could be accomplished while the existing canal is in operation.

3. Put the Parallel Canal into operation and decommission the bypassed portion of the existing FKC.

4. Complete building the Parallel Canal right bank by using the decommissioned FKC right bank material.

For a detailed discussion on construction sequencing, refer to Appendix B Engineering Design and Cost.

Turnouts

The Parallel Canal Alternative includes features to address water delivery at existing turnouts, based, in part, on input provided by Friant Division long-term contractors. The Parallel Canal Alternative incorporates design concepts for pressurized and gravity systems to ensure compatibility between the canal and the contractors' distribution systems, maintain water delivery capability during construction, control overflow, and enhance operational flexibility.

Pressurized Turnout Modifications In the Middle Reach, many of the 20 pressurized distribution systems have subsided at different rates than the land under the canal, causing varying differential head conditions from those used in the original system designs. All alternatives have been developed to achieve the proposed HGL, which is higher than the current water surface in the FKC. Increasing the HGL would increase head on the suction side of the pumping plants, which would increase the delivery head on district distribution systems. The removal and replacement of current pump stations at a location compatible with the current design was considered and dropped because of significant costs.

The water elevation in the parallel canal would often be above the elevation of the top decks of existing pump stations. If a pump station were to unexpectedly shutdown, the incoming flow from the adjacent canal could overflow the pump station and flood the facility and surrounding land, resulting in equipment and property damage. To avoid the potential risk associated with unexpected shutdowns, the Parallel Canal Alternative includes small delivery pools at each pump station turnout. As shown in Figure 4-5, the delivery pool would be created by preserving small portions of the existing FKC. Water would flow from the parallel canal through a new pipe to the delivery pool which would serve as a forebay for the existing turnout pump station. The parallel canal alignment would be modified at the location of each pump station turnout and be customized to meet the specific needs of each pressurized delivery system. A list of the modifications proposed to the pump station turnouts is provided in Table 4-3.

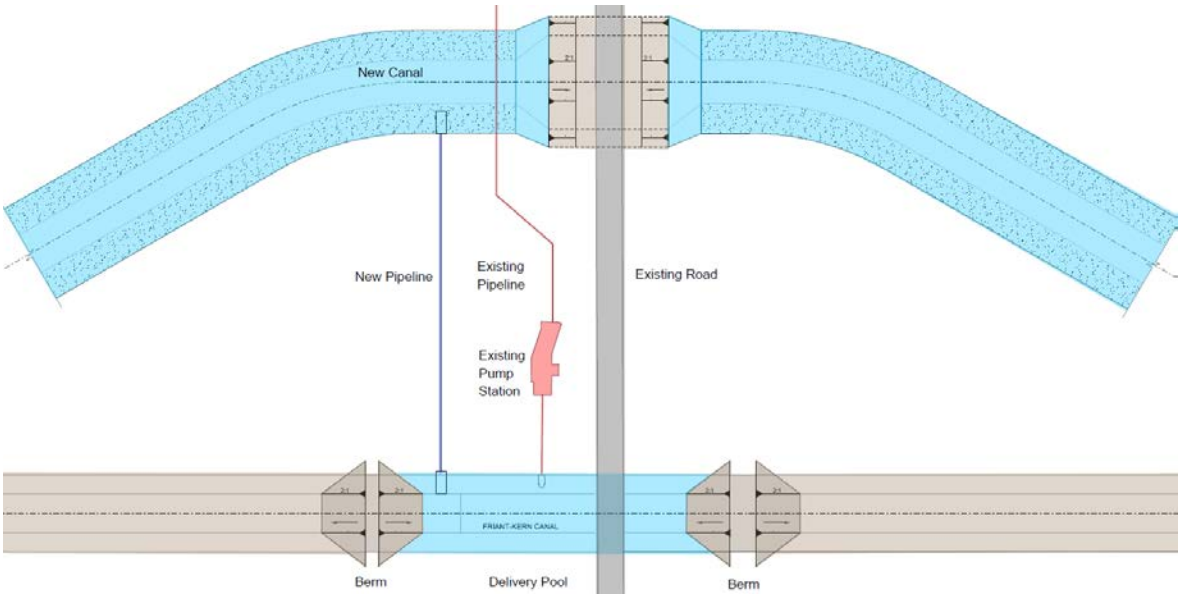


Figure 4-5. Example Pressurized System Turnout Design in the Parallel Canal Alternative

Table 4-3. Modifications at Pump Station Turnouts in the Parallel Canal Alternative

Pump Station Turnout	Canal Side	MP	Modification
LID-10th W	West	91.12	Unmodified
TPDWD-Teapot Dome	East	99.35	Remain Plus Delivery Pool
SID-S2	West	102.65	Remain Plus Delivery Pool
TBID-Terra Bella	East	103.64	Remain Plus Delivery Pool
SID-S3	West	104.96	Remain Plus Delivery Pool
SID-S4	West	107.35	Remain Plus Delivery Pool
DEID-56 EAST	East	109.46	Remain Plus Delivery Pool
DEID-56 West	West	109.46	Remain Plus Delivery Pool
DEID-40 North	East	111.56	Remain Plus Delivery Pool
DEID-40 West	West	111.56	Remain Plus Delivery Pool
KTWD-1	East	111.96	Remain Plus Delivery Pool
KTWD-2	East	113.6	Remain Plus Delivery Pool
DEID-24 East	East	113.62	Remain Plus Delivery Pool
DEID-24 West	West	113.62	Remain Plus Delivery Pool
DEID-8th West	West	115.95	Remain Plus Delivery Pool
DEID-#1 West	East	116.93	Remain Plus Delivery Pool
SSJMUD-Bassett	West	117.44	Remain Plus Delivery Pool
KTWD-3	East	117.96	Remain Plus Delivery Pool
DEID-9th West	West	118.45	Remain Plus Delivery Pool
SSJMUD-Airport	West	120.06	Unmodified

Gravity Turnout Modifications There are 18 gravity systems located in the Middle Reach, each of which were individually analyzed to determine an appropriate design approach. The analysis revealed that all existing gravity turnouts can either be preserved and reused or connected to new turnouts and pipelines on the parallel canal. A summary of actions for gravity turnouts under the Parallel Canal Alternative is provided in Table 4-4.

Table 4-4. Modifications at Gravity Turnouts Under the Parallel Canal Alternative

Gravity Turnout	Canal Side	MP	Modification
SPUD-STRATHMORE	West	89.35	Unmodified
LID-10th E	East	91.12	Unmodified
LTRID-4	West	92.13	Unmodified
PID-P1	West	93.86	Unmodified
PID-Porter Slough	West	94.92	Unmodified
PID-P2	East	95.50	Unmodified
LTRID-Tule River WW Gates	West	95.64	Unmodified
LTRID-Woods Central Ditch	West	95.78	Unmodified
PID-P3	East	96.39	Build Turnout on Parallel Canal
LTRID-Tipton Ditch	West	96.87	Build Turnout on Parallel Canal
LTRID-Poplar Ditch N&S	West & East	97.34	Build Turnout on Parallel Canal
PID-P5	East	97.86	Build Turnout on Parallel Canal
LTRID-Casa Blanca Ditch	West	98.62	Build Turnout on Parallel Canal
SID-S1	West	100.63	Build Turnout on Parallel Canal
TBID-DCTRA Pits	East	102.65	Build Turnout on Parallel Canal
DEID-68 West	West	107.84	Build Turnout on Parallel Canal
DEID	West	112.36	Build Turnout on Parallel Canal
LWER	East	119.55	Unmodified
LWER	East	121.49	Unmodified

Checks and Siphons

In the analysis of Initial Alternative 5, it was assumed that the parallel canal would tie-in to the FKC at the existing check and siphon structures at Deer Creek and White River, and that existing structures and gates would be raised to meet the new canal design objectives. It was expected that continued use of existing structures would reduce cost and environmental consequences. Upon further refinement, it was discovered that this approach would require significant structural modifications to the existing structures, would add two new road crossings (bridges) at the White River check, and ultimately increase the amount of bridge work and overall project cost. Thus, the Parallel Canal Alternative includes new checks and siphons at Deer Creek and White River.

Road Crossings

In the formulation of Initial Alternative 5, bridge modification options included either a raise of the existing bridge or replacement with a new bridge. However, after further analysis it has become apparent that raising or replacing bridges as part of the Parallel Canal Alternative would add complexity and cost.

Designs for raising or replacing existing bridges would require that each bridge design be assessed for current highway and seismic design standards. It is anticipated that significant bridge retrofits would be required should the existing bridge infrastructure remain. In addition, raising or replacing bridges would require approach roadway improvements. It is estimated that

up to 1,800 feet of additional road work would be required per bridge, including significant amounts of earthwork to build up the approaches consistent with vertical curve requirements.

Through the refinement process, raised bridges and replacement bridges have been removed from further consideration in the Parallel Canal Alternative in favor of siphon- type crossings that divert canal flow below the existing roadway and allow the road to stay at existing grade. Two typical siphon-type road crossing designs were developed, based on the relative elevation of the existing roadway in comparison to the elevation of the parallel canal. Siphon A would be applied in conditions where the parallel canal water surface elevation would be higher than the existing road elevation at the crossing, as illustrated in Figure 4-6. Siphon B would be applied in conditions where the parallel canal water surface elevation would be lower than the existing road elevation at the crossing, as illustrated in Figure 4-7.

For either application, the existing bridge over the current FKC would be demolished and the abandoned portion of the FKC would be filled to road grade, with the new siphon placed under the new parallel canal. For bridges that fall outside of the parallel canal, no action would be taken. A list of anticipated modifications to bridges in the Parallel Canal Alternative is provided in Table 4-5.

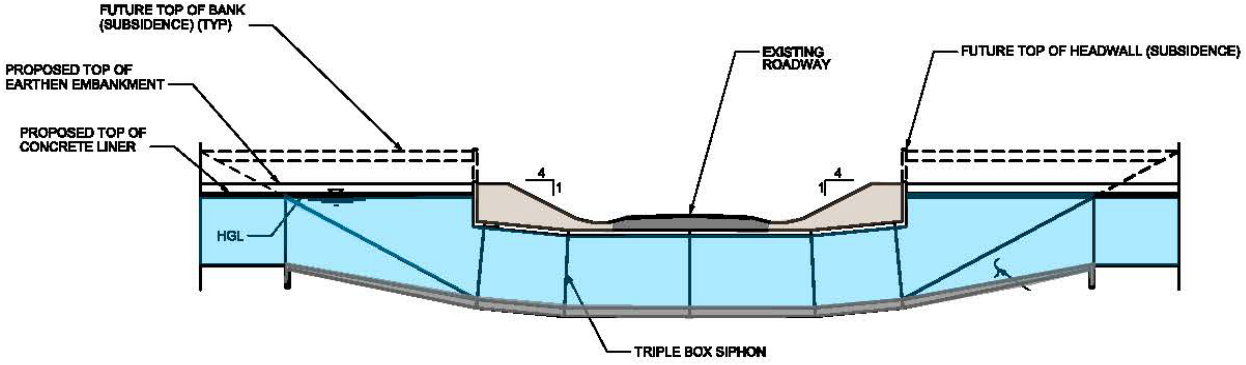


Figure 4-6. Typical Siphon A Road Crossing

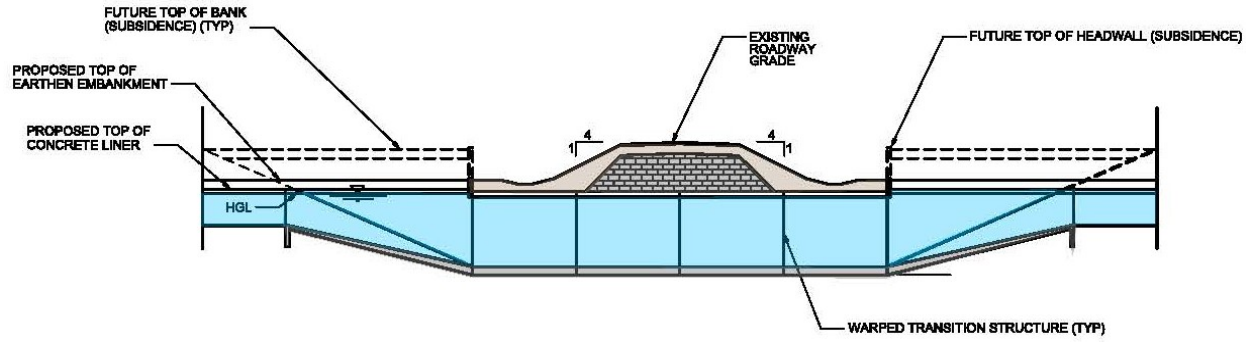


Figure 4-7. Typical Siphon B Road Crossing

Table 4-5. Road Crossing Actions in the Parallel Canal Alternative

Name	MP	Modification
6th Avenue Bridge	88.67	Unmodified
7th Avenue Bridge	89.17	Unmodified
Road 232 Bridge	89.45	Unmodified
Frazier Highway 196 Bridge	89.95	Unmodified
8th Avenue Bridge	89.95	Unmodified
Avenue 192 Bridge	90.23`	Unmodified
Avenue 188 Bridge	91.10	Unmodified
State Highway 65 Northbound Bridge (Double Bridge)	91.51	Unmodified
Welcome Avenue Bridge (Avenue 184)	91.60	Unmodified
Avenue 182 Bridge	91.85	Unmodified
Avenue 178 Bridge	92.35	Unmodified
W Linda Vista Avenue	92.85	Unmodified
W North Grand Avenue Bridge	93.55	Unmodified
N Westwood Street Bridge	94.01	Unmodified
W Henderson Avenue Bridge	95.12	Unmodified
Avenue 152 Bridge	96.26	Unmodified
Avenue 144 Bridge (Highway 190)	97.35	Demo- New Road Crossing/Siphon A
Avenue 136 Bridge	98.35	Demo- New Road Crossing/Siphon A
Avenue 128 Bridge	99.37	Demo- New Road Crossing/Siphon A
Hesse Avenue Bridge	100.64	Demo- New Road Crossing/Siphon A
Avenue 112 Bridge	101.64	Demo- New Road Crossing/Siphon A
Timber Farm Bridge	102.14	Demo- New Road Crossing/Siphon A
Road Terra Bella Avenue (J24)	103.65	Demo- New Road Crossing/Siphon A
Road 208 Bridge	103.72	Demo- New Road Crossing/Siphon A
Avenue 88 Bridge	104.95	Demo- New Road Crossing/Siphon A
Avenue 80 Bridge	106.72	Demo- New Road Crossing/Siphon A
Farm Bridge	106.75	Demo- New Road Crossing/Siphon A
Road 192 Bridge	107.32	Demo- New Road Crossing/Siphon A
Avenue 64 Bridge	108.42	Demo- New Road Crossing/Siphon A
Avenue 56 Bridge	109.45	Demo- New Road Crossing/Siphon A
Avenue 48 Bridge	110.55	Demo- New Road Crossing/Siphon A
Avenue 40 Bridge	111.55	Demo- New Road Crossing/Siphon A
Road 184 Bridge	111.66	Demo and Fill
Avenue 32 Bridge	112.57	Demo- New Road Crossing/Siphon A
Avenue 24 Bridge	113.59	Demo- New Road Crossing/Siphon A
Avenue 16 Bridge	114.71	Demo- New Road Crossing/Siphon B
Avenue 8 Bridge	115.91	Demo- New Road Crossing/Siphon B
Timber Farm (Avenue 4) Bridge (2 Bridges)	116.41	Demo- New Road Crossing/Siphon B
County Road Avenue 0 Bridge	116.91	Demo- New Road Crossing/Siphon B

Table 4-5. Road Crossing Actions in the Parallel Canal Alternative (contd.)

Name	MP	Modification
Timber Farm (Avenue 4) Bridge (2 Bridges)	116.41	Demo- New Road Crossing/Siphon B
County Road Avenue 0 Bridge	116.91	Demo- New Road Crossing/Siphon B
Cecil Avenue Bridge	117.92	Demo- New Road Crossing/Siphon B
9th Avenue Bridge	118.44	Demo- New Road Crossing/Siphon B
Garces Highway Bridge	118.94	Unmodified
Timber Farm Bridge	119.46	Unmodified
Woollomes Avenue Bridge	120.02	Unmodified

Utilities

Numerous utilities located in, along, and across the FKC would be affected by implementation of the Parallel Canal Alternative. The utilities include parallel irrigation canals, fly overs, overhead power lines, adjacent wells, drainage siphons and irrigation crossings under the existing canal, and utilities connected to bridges. Depending on the location and extent of canal modifications, the utilities will either be relocated or entirely replaced, as determined in the final design. A current estimate of potentially affected utilities, based on observations made during a site visit during February 2019, is provided in Table 4-6. It is expected that additional utilities that would be affected by the Parallel Canal Alternative will be identified as design progresses. More detailed information on utilities is provided in Appendix B Engineering Design and Cost.

Table 4-6. Preliminary Estimate of Modifications to Utilities for the Parallel Canal Alternative

Utility Modification	Quantity
Parallel Overhead Powerline Relocations	14 miles
Adjacent Groundwater Well Abandonments	23 wells
Culvert Extensions	13 extensions
Pipeline Overcrossing Replacements	7 replacements
Utility Crossing Replacements	14 crossings

Estimated Quantities and Cost

A list of items that will be included in the summary of quantities and costs is included in Table 4-7. A cost estimate is provided in Table 4-8.

Table 4-7. Parallel Canal Alternative Summary of Estimated Quantities

	-	Seg 1: 5th Ave. to Tule	Seg 2: Tule to Deer Creek	Seg 3: Deer Creek to White River	Seg 4: White River to Garces Highway	Seg 4: Garces Highway to Woollomes	-
Design Flow (Design Maximum) (cfs)	-	4,500	4,000	4,000	3,500	3,500	-
From MP to MP	-	88.2-96.67	95.67-102.7	102.7-112.9	112.9-118.96	118.96-121.5	-
Total Canal Miles	-	7.47	7.0	10.2	6.06	2.54	-
Description	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
NEW CANAL							
Clearing and grubbing	Acres	**-**	102	149	95	**-**	**346**
Pre-wetting	LS	**-**	**-**	**-**	**-**	**-**	**-**
Dewatering	LS	**-**	**-**	**-**	**-**	**-**	**-**
Excavation	CY	1,050,639	1,896,999	2,710,319	1,761,749	175,558	**7,595,264**
Compacted Canal Embankment construction	CY	530,741	1,939,674	2,748,399	401,363	43,436	**5,663,613**
Spoil Embankment		519,898	0	0	1,319,983	132,437	**1,972,318**
Trimming	SY	384,213	396,505	632,657	366,827	0	**1,780,202**
3-1/2" thick concrete lining	SY	384,213	396,505	632,657	366,827	0	**1,780,202**
Furnish and Place Transverse Canal Joints	LF	230,528	237,903	379,594	220,096	0	**1,068,121**
Furnish and Place Longitudinal Canal Joints	LF	313,720	265,534	423,682	263,499	0	**1,266,435**
Ladders	EA	105	99	144	92	0	**440**
Aggregate base O&M road surfacing	SY	105,011	98,653	149	92,245	28,701	**468,565**
CHECK STRUCTURES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
New Check/Siphon Structure	-	0	1	1	0	0	**2**
Existing Check Structures Demolition and Disposal	-	0	1	1	0	0	**2**

Table 4-7. Parallel Canal Alternative Summary of Estimated Quantities (contd.)

		Seg 1: 5th Ave. to Tule River	Seg 2: Tule to Deer Creek	Seg 3: Deer Creek to White River	Seg 4: White River to Garces Highway	Seg 4: Garces Highway to Woollomes	
ROAD CROSSINGS – BRIDGES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Canal Transitions to Existing Bridges	EA	18	1	0	0	0	19
Bridge Replacement on Existing Canal – County or State Bridges	EA	0	0	0	0	0	0
Bridge Replacement on Existing Canal – Farm Bridges	EA	0	0	0	0	0	0
Existing Bridge Demolition	EA	0	6	12	8	0	26
ROAD CROSSINGS – SIPHONS	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Siphon Construction on New Canal	EA	0	6	11	8	0	25
TURNOUTS	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Canal Transitions on Existing Canal to Existing Turnouts	EA	7	2	0	0	3	12
Raise/Modify Existing Turnout Top Deck and Actuators	EA	0	0	0	0	0	0
Turnouts on New Canal	EA	0	9	8	6	0	23
Delivery Pools	EA	0	2	6	6	0	14
UTILITIES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Parallel Overhead Powerline Relocations	MI	4.5	3.5	3.0	2.5	0.5	14
Adjacent Groundwater Well Abandonments	EA	6	4	8	4	1	23
Culvert Extensions (Each End)	EA	4	5	4	0	0	13
Pipeline Overcrossing Replacements (8" to 12")	EA	0	1	2	4	0	7
Impacted Utility Crossings (Attached to Existing Bridge sizes range from 4" to 24")	EA	0	4	7	3	0	14
LAND ACQUISITION	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Impacted Parcels	EA	69	17	25	20	8	139
Permanent Land Acquisition (ROW)	Acres	20	110	260	80	40	510

Key:
- = Not Applicable or zero
cfs = cubic feet per second
CY = cubic yard
EA = each
LF = linear feet
LS = lump sum
MI = mile
MP = milepost
O&M = operations and maintenance
ROW = Right of Way
SY = square yard

Table 4-8. Parallel Canal Alternative Cost Estimate

Item	Reference	Cost	Notes/ Inclusions
Segment 1 - 5th Ave to Tule	from estimate	$28,799,642	
Segment 2 - Tule to Deer Creek (New Bypass Canal)	from estimate	$56,507,656	
Segment 3 - Deer Creek to White River (New Bypass Canal)	from estimate	$91,356,060	
Segment 4 - White River to Garces Hwy (New Bypass Canal)	from estimate	$58,590,113	
Segment 5 - Garces Hwy to Woollomes (Widen Existing Canal)	from estimate	$1,943,335	
Construction Allowances, Mobilization, Startup, Commission, and Owner Training	from estimate	$4,001,997	
Subtotal		*$241,198,803*	
Contract Cost Allowance - Design Contingency	17%	$41,003,796	
Contract Cost		**$280,000,000**	Rounded
Construction Contingencies	20%	$56,000,000	
FIELD COST		**$340,000,000**	Rounded
Land Purchase - Construction Phase and ROW		$15,300,000	510 acres at $30,000/acre
Environmental Mitigation	5%	$17,000,000	Calculated as % of Field Cost
Engineering, Permitting, and Construction Management	10%	$34,000,000	Calculated as % of Field Cost
Legal and Administrative	2%	$6,800,000	Calculated as % of Field Cost
Non-Contract Costs		**$73,000,000**	Rounded
TOTAL CONSTRUCTION COST		**$410,000,000**	Rounded
Interest During Construction	3% Discount Rate	$22,091,214	2.5 year construction period
TOTAL CAPITAL COST		**$430,000,000**	Rounded
Annualized Capital Costs		$16,446,466	2.875% (FY19) over 50 years
Additional Annualized O&M Costs		$967,676	Excludes current O&M costs; 2.875% (FY19) over 50 years
TOTAL ANNUALIZED COST		**$17,500,000**	Rounded

Canal Enlargement Alternative

The Canal Enlargement Alternative closely follows the design evaluated as Initial Alternative 1. The design capacity was modified based on historical maximum flows. A single-line schematic showing features included in the Parallel Canal Alternative is provided in Figure 4-8A and Figure 4-8B.

In comparison to the Initial Alternative configuration, the concrete liner freeboard height in the Canal Enlargement Alternative was revised from the standard freeboard requirements applied to maximum design to the flood flow freeboard lining requirements applied to historical maximum flows. The application of revised freeboard criteria resulted in a concrete canal liner that is 1.03 to 1.18 feet lower than originally presented in the Initial Alternative 1. Other project refinements have been made to the canal cross section, turnouts, and road crossings.

Canal Alignment and Cross Section

The Canal Enlargement Alternative design was modified in comparison to the version included in Initial Alternative 1. The design of the canal cross section in Initial Alternative 1 used a 24-foot wide benched section to accommodate the maximum design flow and flood freeboard at the proposed HGL. The section was applied to the entire length of the Middle Reach.

The use of historical delivery capacity for the Canal Enlargement Alternative limited the need for a large bench and the extent of modifications. The Canal Enlargement Alternative design includes enlarging the FKC from the Tule River Check (MP 95.7) to Ave. 6 (MP 115.94). A 10-foot wide bench is included in the most subsided sections for the purpose of maintaining slope stability, as shown in Figure 4-9, not to provide additional cross section for conveyance capacity. Enlarging other portions of the canal would be accomplished by raising the lining at the current slope with no bench because the relatively small lining raise would not be expected to adversely affect slope stability.

The Canal Enlargement Alternative, as described in this Report, is based on canal embankments and liner that would achieve objective capacities if constructed at the current ground level. The alternative also includes design features to accommodate anticipated future subsidence. For example, the siphon-type road crossings are sized to accommodate future increases in HGL. In addition, canal embankments were configured such that they could be raised without interfering with the operation of the restored FKC and necessary right of way to accommodate the future raise is included, as indicated as the Stage 2 Raise in Figure 4-9.

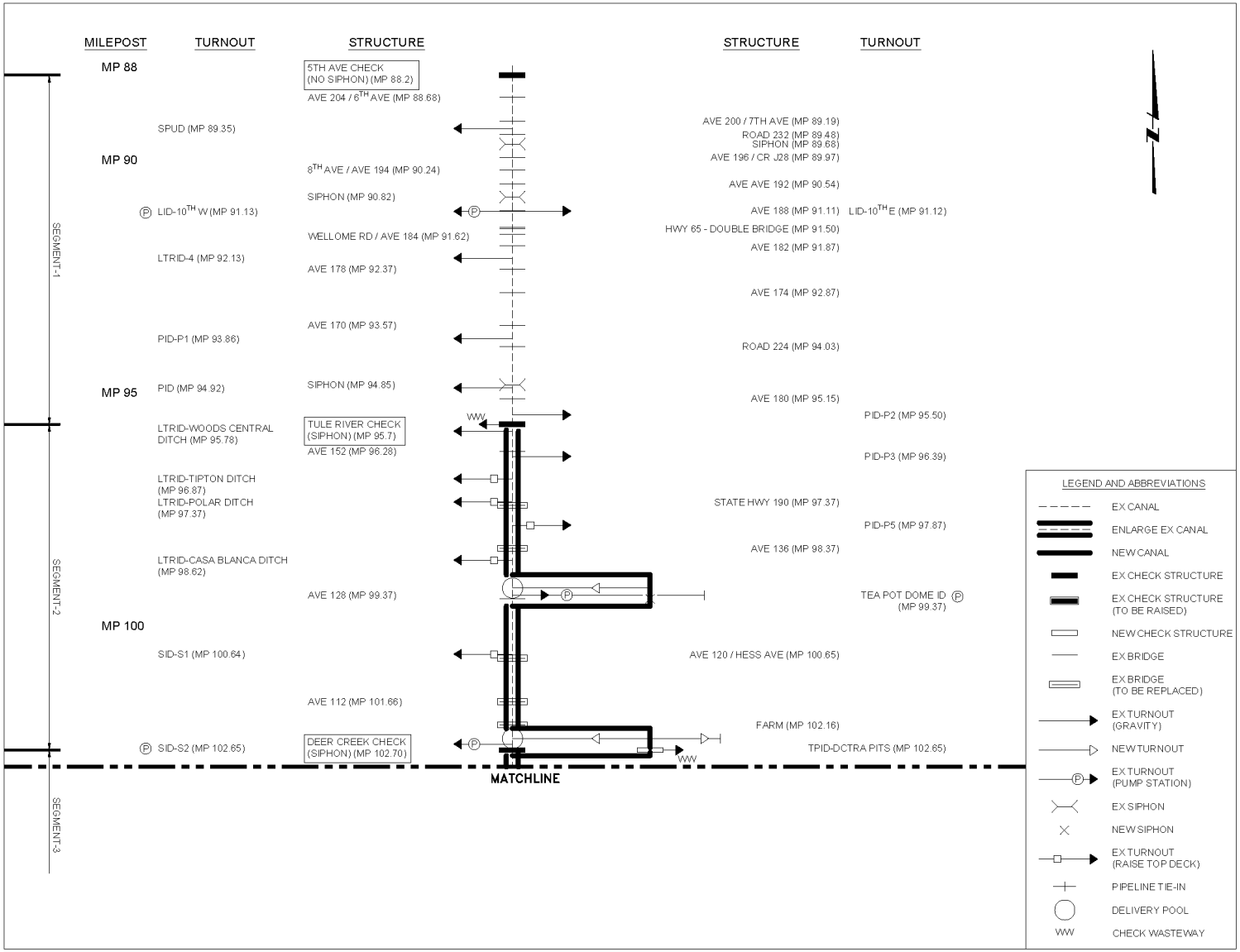


Figure 4-8A Canal Enlargement Alternative Single Line Diagram for Segments 1 and 2

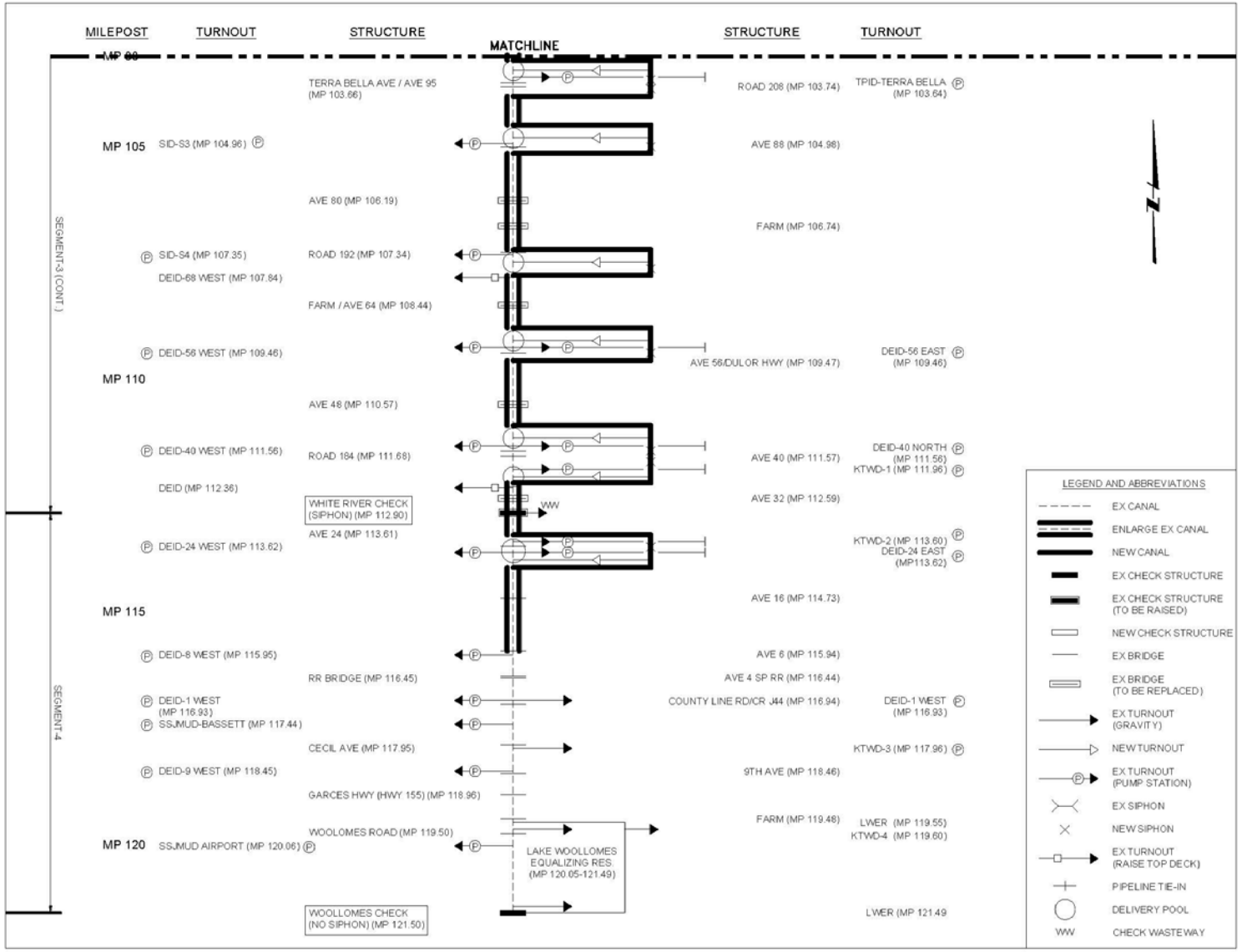


Figure 4-8B. Canal Enlargement Alternative Single Line Diagram for Segments 3 and 4

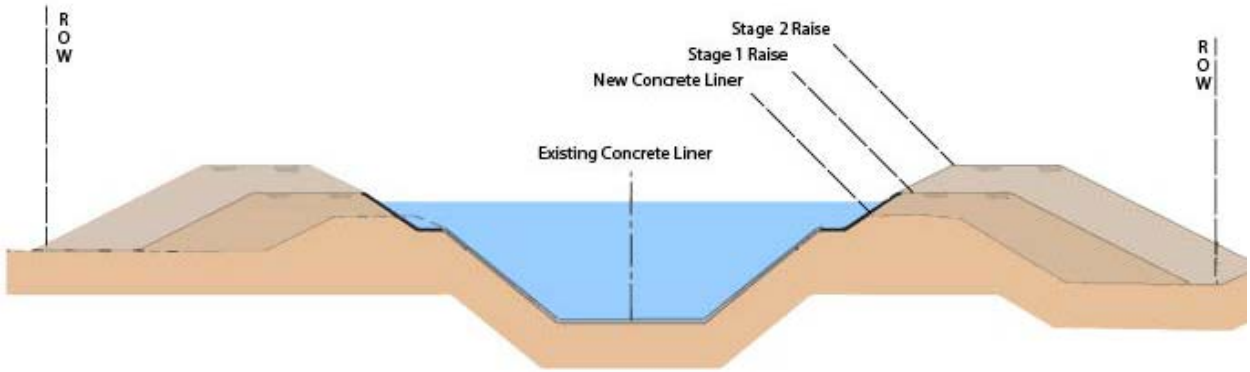


Figure 4-9. Typical Canal Enlargement Cross Section with 10-ft Slope Stability Bench

As shown in Figures 4-8A and 4-8B, the alignment of the Canal Enlargement Alternative would jog out to the east, away from the existing canal alignment, in the vicinity of each pumping plant turnout. Each jog out would include construction of a new trapezoidal canal similar to the trapezoidal cross section described for the Parallel Canal Alternative and shown in Figure 4-4.

Construction Sequencing

The enlargement of the existing canal would be constructed as follows:

1. During an annual two-month maximum canal shutdown period, the existing canal would be taken out of service and drained down to a level below the original grade at the toe of the existing canal banks. Existing bank material would be removed, processed, and recompacted with added material sourced offsite to construct the new, taller banks. During this step, the existing canal lining and supporting bank would be left in place for use during the following operational period.

2. The existing canal would be put back into service for use during the operational season. The existing canal would continue to operate at typical water surface elevations. "In-canal" work would cease until the next two-month canal shutdown period. Work outside of the existing canal prism, such as parallel canal sections and siphons, could continue during this period.

3. During the next shutdown period, the existing canal would be taken out of service and drained down to a level below the original grade at the toe of the existing canal banks. The portion of canal that had the bank earthwork completed in Step 1 above would have part of the existing lining removed, the slope stability bench constructed, and the new lining installed to the final elevations. This portion of canal would then be ready to operate at the new water surface elevations; however, this could not be done until an entire canal segment (check to check) had been completed and lined.

For a detailed discussion on construction sequencing and constraints, refer to Appendix B Engineering Design and Cost.

Turnouts

Similar to the Parallel Canal Alternative, the Canal Enlargement Alternative includes more detail for modifications at pressurized and gravity turnouts. Each turnout in the Middle Reach of the FKC was reviewed to determine modifications that would be required to maintain compatibility between the enlarged canal and district distribution systems, maintain water delivery capability during construction, control overflow, and enhance operational flexibility.

Pressurized Turnout Modifications The Canal Enlargement Alternative uses the same design for pressurized turnouts that is described under the Parallel Canal Alternative. The Canal Enlargement Alternative would modify a shorter portion of the Middle Reach and therefore fewer pressurized turnout modifications are required. It is estimated that this delivery pool concept would be applied at nine locations for the Canal Enlargement Alternative using the design approach shown in Figure 4-5. A summary of modifications to pressurized turnouts under the Canal Enlargement Alterative is provided in Table 4-9.

Table 4-9. Modifications to Actions for Pressurized Turnouts Systems Under the Canal Enlargement Alternative

Name	Side	MP	Modification
LID-10th West	West	91.12	Unmodified
TPDWD-Teapot Dome	East	99.35	Remain Plus Delivery Pool
SID-S2	West	102.65	Remain Plus Delivery Pool
TBID-Terra Bella	East	103.64	Remain Plus Delivery Pool
SID-S3	West	104.96	Remain Plus Delivery Pool
SID-S4	West	107.35	Remain Plus Delivery Pool
DEID-56 EAST	East	109.46	Remain Plus Delivery Pool
DEID-56 West	West	109.46	Remain Plus Delivery Pool
DEID-40 North	East	111.56	Remain Plus Delivery Pool
DEID-40 West	West	111.56	Remain Plus Delivery Pool
KTWD-1	East	111.96	Remain Plus Delivery Pool
KTWD-2	East	113.6	Remain Plus Delivery Pool
DEID-24 East	East	113.62	Remain Plus Delivery Pool
DEID-24 West	West	113.62	Remain Plus Delivery Pool
DEID-8th West	West	115.95	Unmodified
DEID-#1 West	East	116.93	Unmodified
SSJMUD-Bassett	West	117.44	Unmodified
KTWD-3	East	117.96	Unmodified
DEID-9th West	West	118.45	Unmodified
SSJMUD-Airport	West	120.06	Unmodified

Gravity Turnout Modifications In the portions of the Middle Reach where no modifications would be necessary to convey historical peak flows, existing gravity turnouts would not be modified. In the reach from MP 95.7 to MP 115.94, nearly all existing gravity turnouts would require raising the top deck by two to five feet. The extent of the raise at each turnout is dependent upon the lining raise at that location.

Raising the top deck of a gravity turnout generally consists of removing the existing top concrete deck, extending the turnout wall height to the new lining height, modifying the existing turnout gates to the new structure height, and rebuilding the top deck and site appurtenances such as retaining walls, railing, and fencing. A list of modifications to gravity turnouts in the Canal Enlargement Alternative is provided in Table 4-10 and shown in Figure 4-10. Additional detail is provided in Appendix B Engineering Design and Cost.

Table 4-10. Modifications to Gravity Turnouts Under the Canal Enlargement Alternative

Name	Side	MP	Modification
SPUD-STRATHMORE	West	89.35	Unmodified
LID-10th East	East	91.12	Unmodified
LTRID-4	West	92.13	Unmodified
PID-P1	West	93.86	Unmodified
PID-Porter Slough	West	94.92	Unmodified
PID-P2	East	95.5	Unmodified
LTRID-Tule River WW Gates	West	95.64	Unmodified
LTRID-Woods Central Ditch	West	95.78	Unmodified
PID-P3	East	96.39	Unmodified
LTRID-Tipton Ditch	West	96.87	1' Top Deck Raise
LTRID-Poplar Ditch N&S	West & East	97.34	2' Top Deck Raise
PID-P5	East	97.86	2' Top Deck Raise
LTRID-Casa Blanca Ditch	West	98.62	3' Top Deck Raise
SID-S1	West	100.63	4' Top Deck Raise
TBID-DCTRA Pits	East	102.65	Build New Turnout on New Canal
DEID-68 West	West	107.84	3' Top Deck Raise
DEID	West	112.36	2' Top Deck Raise
LWER	East	119.55	Unmodified
LWER	East	121.49	Unmodified

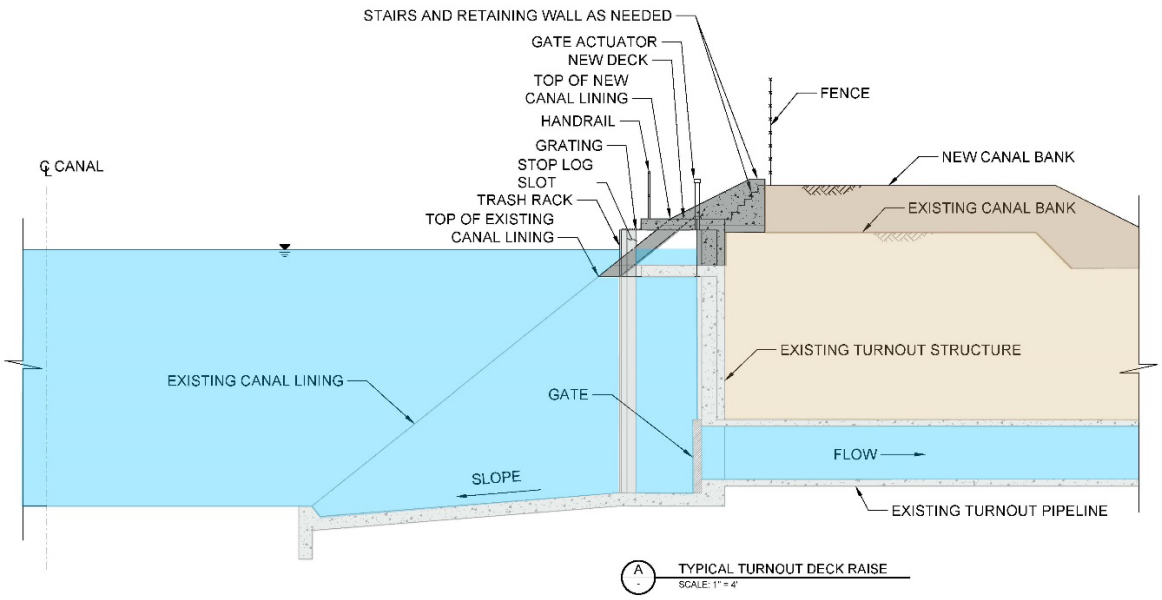


Figure 4-10. Typical Gravity Turnout Deck Raise

Checks and Siphons

The Canal Enlargement Alternative involves a new check and siphon at Deer Creek and modification of the existing check and siphon at White River. Modification of the White River check would generally consist of extending the height of the concrete canal warped transitions and the headwalls at upstream and downstream end of the existing siphon, plus raising the two existing radial gates and invert sill on the upstream end of the structure.

Road Crossings

Modifications at each road crossing would depend on the alignment and cross section modification at that location. In the segment from MP 88 to MP 95.7, where no modifications would be required, the road crossings would remain unchanged. In the modified portion, from MP 95.7 to MP 115.94, road crossings would either be replaced with a trapezoidal bridge along the existing FKC alignment or filled in and replaced with a siphon where the alignment jogs to the east to accommodate an existing pump station turnout. The Canal Enlargement Alternative includes installation of a trapezoidal bridge at 10 locations along the existing FKC alignment. A typical section for a trapezoidal bridge is shown in Figure 4-11. Siphons would be installed at nine road crossings affected by canal jogs to accommodate pump station turnouts, based on the design. Siphon A design is shown in Figure 4-6. A summary of road crossing modifications in the Canal Enlargement Alternative is provided in Table 4-11.

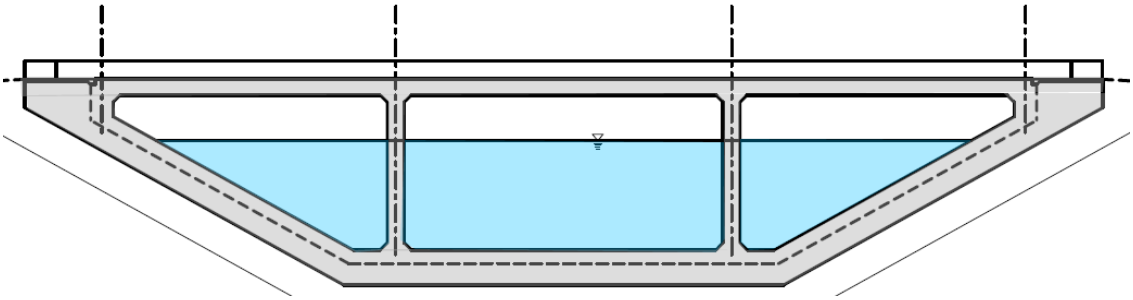


Figure 4-11. Trapezoidal Bridge Concept

Table 4-11. Road Crossing Modifications in the Canal Enlargement Alternative

Name	MP	Modification
6th Avenue Bridge	88.67	Unmodified
7th Avenue Bridge	89.17	Unmodified
Road 232 Bridge	89.45	Unmodified
Frazier Highway 196 Bridge	89.95	Unmodified
8th Avenue Bridge	89.95	Unmodified
Avenue 192 Bridge	90.23	Unmodified
Avenue 188 Bridge	91.10	Unmodified
State Highway 65 Northbound Bridge (Double Bridge)	91.51	Unmodified
Welcome Avenue Bridge (Avenue 184)	91.60	Unmodified
Avenue 182 Bridge	91.85	Unmodified
Avenue 178 Bridge	92.35	Unmodified
W Linda Vista Avenue	92.85	Unmodified
W North Grand Avenue Bridge	93.55	Unmodified
N Westwood Street Bridge	94.01	Unmodified
W Henderson Avenue Bridge	95.12	Unmodified
Avenue 152 Bridge	96.26	Unmodified
Avenue 144 Bridge (Highway 190)	97.35	New Trapezoidal Bridge
Avenue 136 Bridge	98.35	New Trapezoidal Bridge
Avenue 128 Bridge	99.37	Demo- New Road Crossing/Siphon A
Hesse Avenue Bridge	100.64	New Trapezoidal Bridge
Avenue 112 Bridge	101.64	New Trapezoidal Bridge
Timber Farm Bridge	102.14	New Trapezoidal Bridge
Road Terra Bella Avenue (J24)	103.65	Demo- New Road Crossing/Siphon A
Road 208 Bridge	103.72	Demo- New Road Crossing/Siphon A
Avenue 88 Bridge	104.95	Demo- New Road Crossing/Siphon A
Avenue 80 Bridge	106.72	New Trapezoidal Bridge
Farm Bridge	106.75	New Trapezoidal Bridge
Road 192 Bridge	107.32	Demo- New Road Crossing/Siphon A
Avenue 64 Bridge	108.42	New Trapezoidal Bridge

Table 4-11. Road Crossing Modifications in the Canal Enlargement Alternative (contd.)

Name	MP	Modification
Avenue 56 Bridge	109.45	Demo- New Road Crossing/Siphon A
Avenue 48 Bridge	110.55	New Trapezoidal Bridge
Avenue 40 Bridge	111.55	Demo- New Road Crossing/Siphon A
Road 184 Bridge	111.66	Demo- New Road Crossing/Siphon A
Avenue 32 Bridge	112.57	New Trapezoidal Bridge
Avenue 24 Bridge	113.59	Demo- New Road Crossing/Siphon A
Avenue 16 Bridge	114.71	Unmodified
Avenue 8 Bridge	115.91	Unmodified
Timber Farm (Avenue 4) Bridge (2 Bridges)	116.41	Unmodified
County Road Avenue 0 Bridge	116.91	Unmodified
Cecil Avenue Bridge	117.92	Unmodified
9th Avenue Bridge	118.44	Unmodified
Garces Highway Bridge	118.94	Unmodified
Timber Farm Bridge	119.46	Unmodified
Woollomes Avenue Bridge	120.02	Unmodified

Utilities

Numerous utilities located in, along, and across the FKC would be affected by implementation of the Canal Enlargement Alternative. The utilities include parallel irrigation canals, fly overs, overhead power lines, adjacent wells, drainage siphons and irrigation crossings under the existing canal, and utilities connected to bridges. Depending on the location and extent of canal modifications, the utilities will either be relocated or entirely replaced, as determined in the final design. A current estimate of potentially affected utilities, based on observations made during a February 2019 site visit, is provided in Table 4-12. It is expected that additional utilities that would be affected by the Parallel Canal Alternative will be identified as design progresses. More detailed information on utilities is provided in Appendix B Engineering Design and Cost.

Table 4-12. Preliminary Estimate of Modifications to Utilities for the Canal Enlargement Alternative

Utility Action	Quantity
Parallel Overhead Powerline Relocations	8 miles
Adjacent Groundwater Well Abandonments	12 wells
Culvert Extensions	9 extensions
Pipeline Overcrossing Replacements	5 replacements
Utility Crossing Replacements	12 crossings

Estimated Quantities and Cost A list of items that will be included in the summary of quantities is included in Table 4-13. The cost for the Canal Enlargement Alternative is presented in Table 4-14.

Table 4-13. Canal Enlargement Alternative Summary of Estimated Quantities

		Seg 1: 5th Ave. to Tule River	Seg 2: Tule to Deer Creek	Seg 3: Deer Creek to White River	Seg 4: White River to Ave. 8 Bridge	Total
Design Flow (Historical Maximum) (cfs)	-	4,008	3,497	2,888	2,490	-
From MP to MP	-	88.2-95.67	95.67-102.7	102.7-112.9	112.9-115.94	-
Total Canal Miles	-	7.47	7.0	10.2	3.04	-
Description	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
NEW CANAL						
Clearing and grubbing	Acres	-	34	50	14	**99**
Pre-wetting	LS	-	-	-	-	**-**
Dewatering	LS	-	-	-	-	**-**
Excavation	CY	-	152,649	430,113	122,032	**704,794**
Compacted Canal Embankment construction	CY	-	695,487	1,679,261	96,709	**2,471,457**
Spoil Embankment		-	146,123	307,553	69,142	**522,818**
Trimming	SY	-	146,123	307,553	69,142	**522,818**
3-1/2" thick concrete lining	SY	-	87,674	184,532	41,485	**313,691**
Furnish and Place Transverse Canal Joints	LF	-	121,681	230,482	64,923	**417,086**
Furnish and Place Longitudinal Canal Joints	LF	-	100	146	42	**287**
Ladders	EA	-	99,515	145,860	41,938	**287,313**
Aggregate base O&M road surfacing	SY	-	4,000	14,500	2,500	**21,000**
CHECK STRUCTURES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
New Check/Siphon Structure		-	1	0	0	1
Existing Check Structures Demolition and Disposal		-	0	1	0	1

Table 4-13. Canal Enlargement Alternative Summary of Estimated Quantities (contd.)

		Seg 1: 5th Ave. to Tule	Seg 2: Tule to Deer Creek	Seg 3: Deer Creek to White River	Seg 4: White River to Ave. 8 Bridge	
ROAD CROSSINGS – BRIDGES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Canal Transitions to Existing Bridges	EA	-	1	0	2	**3**
Bridge Replacement on Existing Canal - County or State Bridges	EA	-	4	3	0	**7**
Bridge Replacement on Existing Canal - Farm Bridges	EA	-	1	2	0	**3**
Existing Bridge Demolition	EA	-	1	7	1	**9**
ROAD CROSSINGS - SIPHONS	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Siphon Construction on New Canal	EA	-	1	7	7	**9**
TURNOUTS	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Canal Transitions on Existing Canal to Existing Turnouts	EA	-	10	10	11	**31**
Raise/Modify Existing Turnout Top Deck and Actuators	EA	-	5	2	0	**7**
Turnouts on New Canal	EA	-	3	6	1	**10**
Delivery Pools	EA	-	2	6	1	**9**
UTILITIES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Parallel Overhead Powerline Relocations	MI	-	3.5	3.0	1	**8**
Adjacent Groundwater Well Abandonments	EA	-	4	8	0	**12**
Culvert Extensions (Each End)	EA	-	5	4	0	**9**
Pipeline Overcrossing Replacements (8" to 12")	EA	-	1	2	2	**5**
Impacted Utility Crossings (Attached to Existing Bridge sizes range from 4" to 24")	EA	-	4	7	1	**12**
LAND ACQUISITION	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Impacted Parcels	EA	-	TBD	TBD	TBD	**TBD**
Permanent Land Acquisition (ROW)	Acres	-	20	70	10	**100**

Key:
- = Not Applicable or zero
cfs = cubic feet per second
CY = cubic yard
EA = each
LF = linear feet
LS = lump sum
MI = mile
MP = milepost
O&M = operations and maintenance
ROW = Right of Way
SY = square yard

Table 4-14. Parallel Canal Alternative Cost Estimate

Item	Reference	Cost	Notes/ Inclusions
Segment 1 - 5th Ave to Tule	from estimate	$0	
Segment 2 - Tule to Deer Creek (Enlarge Canal)	from estimate	$42,956,860	
Segment 3 - Deer Creek to White River (Enlarge Canal)	from estimate	$87,815,210	
Segment 4 - White River to Ave 8 Bridge (Enlarge Canal)	from estimate	$12,425,645	
Construction Allowances, Mobilization, Startup, Commission, and Owner Training	from estimate	$6,369,115	
Subtotal		*$149,566,830*	
Contract Cost Allowance - Design Contingency	17%	$25,426,361	
Contract Cost		**$175,000,000**	Rounded
Construction Contingencies	20%	$35,000,000	
FIELD COST		**$210,000,000**	Rounded
Land Purchase - Construction Phase and ROW		$3,000,000	100 acres at $30,000/acre
Environmental Mitigation	5%	$10,500,000	Calculated as % of Field Cost
Engineering, Permitting, and Construction Management	10%	$21,000,000	Calculated as % of Field Cost
Legal and Administrative	2%	$4,200,000	Calculated as % of Field Cost
Non-Contract Costs		**$39,000,000**	Rounded
TOTAL CONSTRUCTION COST		**$250,000,000**	Rounded
Interest During Construction	3% Discount Rate	$40,895,938	10-year construction period
TOTAL CAPITAL COST		**$290,000,000**	Rounded
Annualized Capital Costs		$10,989,353	2.875% (FY19) over 50 years
Additional Annualized O&M Costs		$284,611	Excludes current O&M costs; 2.875% (FY19) over 50 years
TOTAL ANNUALIZED COST		**$11,300,000**	Rounded

Chapter 5
Evaluation of Feasibility Alternatives

This chapter presents an evaluation and comparison of the No Action Alternative and the Feasibility Alternatives described in Chapter 4 based on an assessment of economic effects associated with changes in the delivery of water to Friant Division long-term contractors. Other potential benefit categories have not been evaluated for this Study. This chapter also presents a comparison of Feasibility Alternatives with respect to effectiveness, efficiency, completeness, and acceptability, the selection of a Recommended Plan, and the summary of refinements to the Recommended Plan.

Evaluation Approach to Quantify Water Supply Effects

Evaluating the benefits of the Feasibility Alternatives involves consideration of conditions that are expected to change over the 100-year planning horizon. Identified conditions that are expected to change and affect the Project include water supply availability at Friant Dam, the delivery capability of the FKC under the no action and all action alternatives in response to future subsidence, and changes in the value of water. The quantification of physical effects and calculation of monetary benefits of Feasibility Alternatives was accomplished through a multiple-step process, that included the following:

- Estimate water supply available at Friant Dam
- Determine the capacity of the existing FKC and the capacity of Feasibility Alternatives in response to future subsidence over the planning horizon
- Quantify water deliveries affected by reduced canal capacity
- Reschedule affected supplies in Millerton Lake to the extent possible
- Pump additional groundwater to offset reduced deliveries during the SGMA implementation period
- Quantify and value lost water supply based on current and future water values

A schematic of the evaluation approach is shown in Figure 5-1 and described in the following sections; additional detail is provided in the Appendix C Economics Evaluation.

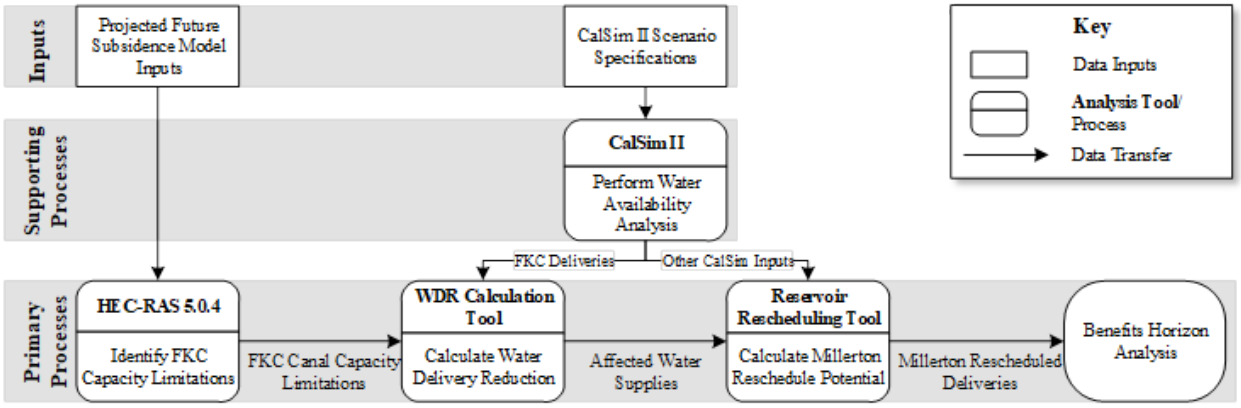


Figure 5-1. Modeling Process for Economics Evaluations

Water Supply Availability at Friant Dam

The California Water Resources Simulation Model (CalSim II) was used to estimate water deliveries from Friant Dam to Friant Division long-term contractors over an 82-year simulation period based on historical hydrologic data for water years 1922 through 2003. The CalSim II model simulates the operation of Millerton Lake to meet a variety of objectives, including the release of flows to the San Joaquin River for water rights and SJRRP Restoration Flows, diversion to the San Joaquin River and Friant-Kern and Madera canals for delivery of water under Friant Division Class 1 and Class 2 contracts and Section 215/other contracts and obligations, and flood operations. Simulated diversions to the Friant-Kern and Madera canals are based on CalSim-estimated water supply allocations under the various contract types, as applied to typical diversion patterns into the canals based on historical data. Only the capacity at the headworks of the canal is considered in the operation of the CalSim II model, meaning the diversions assume no conveyance capacity restrictions due to design deficiencies or subsidence.

For the benefits evaluation, the current implementation of the SJRRP Flow is used for the current water supply availability in the year 2019. This amount is projected to linearly decrease to delivery amounts under the full implementation of the SJRRP Flow in the year 2030. It is assumed that annual average Friant Division water supply availability would remain constant after 2030.

FKC Capacity

The capacity of the FKC will continue to decrease as land subsides in the future and the decreased capacity will reduce water delivery capability. The rate of land subsidence is assumed to be the same in the No Action Alternative and all action alternatives. Estimates of subsidence along the FKC for Group 3 conditions, as described in Chapter 2, for years 2030, 2040, and 2070 were used in a HEC-RAS model of the FKC, described in Appendix A1a1 HEC-RAS Modeling Technical Memorandum ™, to determine canal capacity at these dates. The groundwater model results indicate that the greatest amount of future land subsidence is projected occur between 2017 (first year of groundwater model simulation) and 2030, with additional subsidence

occurring to 2040 when actions to achieve SGMA requirements would be fully implemented, and additional subsidence occurring to 2070 as a result of 'residual' subsidence of subsurface formations. As shown in Figure 5-2, additional land subsidence will reduce the capacity of the FKC. Similar computations were conducted to estimate the effect of land subsidence on the restored canal capacity at future points in time under the two Feasibility Alternatives.

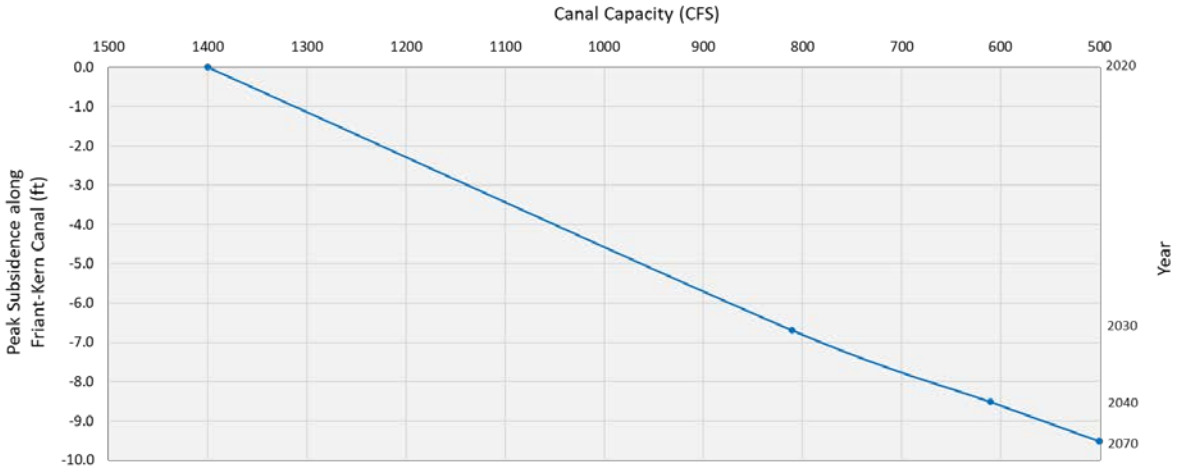


Figure 5-2. Friant-Kern Canal Capacity Under Future Peak Subsidence

Affected Water Deliveries

The modeled canal capacities from HEC-RAS simulations, combined with the variations of water availability, were used in the Water Delivery Reduction Tool to calculate the affected Class 1 and Class 2/other water supply for the Friant Division long-term contractors on the FKC downstream of the subsidence chokepoint. As described in the Economics Evaluation Appendix, the Water Delivery Reduction Tool applies historical patterns of daily diversions to the FKC to estimate water deliveries that would be affected as a result of reduced canal capacity. Evaluations were made for years corresponding to results for simulated ground subsidence during the project planning horizon and interpolated for intervening years. Table 5-1 presents the results of modeled flow capacity, from the HEC-RAS model and the total expected annual affected water deliveries, based on the Water Delivery Reduction Tool described in Appendix C.

Table 5-1. Modeled FKC Capacity and Average Annual Affected Water Supplies

Year	Estimated Minimum Capacity (cfs)	Average Annual Affected Water Supply (AF/yr)
2018	1,400	27,083
2030	810	102,651
2040	610	149,346
2070	500	179,746

Source: Information is from the Water Delivery Reduction Tool Calculation described in Appendix C-Economics Evaluation
Key:
cfs = cubic feet per second

The average annual affected water supply quantities listed in Table 5-1 apply to Class 1 and Class 2/Other water deliveries, based on information provided in the CalSim II model, which includes delivery of water under Paragraph 16(b) of the Settlement "for the purpose of reducing or avoiding impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration Flows."

In the benefits evaluation over the planning horizon, the values of annual estimated capacity of the FKC and corresponding average annual affected water deliveries were linearly interpolated between the evaluation results listed in Table 5-1. It is assumed canal capacity and average annual affected water deliveries would remain constant after 2070.

Rescheduled Water Deliveries

As described in Chapter 4, the No Action Alternative and the Feasibility Alternatives assume that affected water supplies due to FKC capacity constraints would be rescheduled through Millerton Lake operations to the extent possible. While Millerton Lake is typically operated as an annual reservoir with no long-term carry-over storage objectives, the operation of Millerton Lake provides some opportunities to store water for use in successive periods. The approach used to evaluate rescheduled water deliveries for the Project assumes that all affected deliveries would be rescheduled using available conservation storage capacity in Millerton Lake. This approach is considered conservative because it represents the maximum opportunity for rescheduling and therefore results in a minimum estimate of additional groundwater pumping or lost water supplies. Actual opportunities for rescheduling are expected to be less than evaluated due to several factors, including supply and demand forecasting uncertainty, Millerton Lake operations, the ability of Friant Division long-term contractors to adjust local water uses, and CVP Friant Division contract term requirements. The economic analysis assumes that rescheduling of affected water deliveries could be accomplished at no additional cost.

Additional Groundwater Pumping

Under the No Action and Feasibility Alternatives, affected water supplies that could not be delivered through rescheduling in Millerton Lake would result in water supply reductions to Friant Division long-term contractors. In the near future, it is assumed that reduced deliveries would be replaced with additional groundwater pumping in the affected districts. However, this additional groundwater pumping to replace undeliverable supplies would exceed groundwater pumping conditions being used to develop long-term SGMA implementation plans. As a result, groundwater pumping to replace undeliverable water supplies was assumed to reduce from full replacement in 2020 to no groundwater pumping after 2030.

Reduced Deliveries to Friant Division Long-Term Contractors

Affected water supplies that could not be rescheduled in Millerton Lake or replaced with additional groundwater pumping would be lost as flood releases from Friant Dam to the San Joaquin River and represents a loss of water supply to affected Friant Division long-term contractors.

Water Valuation

The cost for pumping additional groundwater and value of water are both expected to change over the life of the project. Groundwater pumping cost is based on the cost of energy and the depth to groundwater, and capital costs associated with the construction or replacement of groundwater infrastructure. Costs for additional groundwater pumping in this analysis are limited to those associated with energy.

As reported by the California Energy Commission (CEC), electricity costs are projected to increase by about 1.7 percent annually between 2015 and 2024 (CEC 2014). The CEC does not provide estimated electricity costs after 2024.

The depth to groundwater in each affected Friant Division long-term contractor service area was estimated using 2018 available groundwater depth information. The weighted cost of groundwater pumping was calculated for years 2015, 2020, and 2024 using the groundwater depth, projected electricity prices, and the share of total subsidence water affected delivery for each affected contractor. Values were linearly interpolated between calculated years and assumed to remain constant after 2024. The calculated weighted average value of groundwater pumping is listed on Table 5-2.

Table 5-2. Weighted Average Value of Groundwater Pumping

Year	Groundwater Pumping Cost ($/AF)[1,2]
2015	$203
2020	$219
2024	$229

Notes:
1 Based on CEC electricity costs projections
2 2018 Price Level

In 2015, the California Water Commission (CWC) prepared estimates of water value in California under current operational requirements. The CWC classified current unit values of water as those for 2030 conditions. The values provided by the CWC in 2015, escalated to 2018 price levels using the U.S. Bureau of Economic Analysis GDP Deflator, are shown in Table 5-3.

Table 5-3. Estimated Water Values in the Eastern San Joaquin Valley

Water Year Type	2030 Condition Friant Service Area 2015 Price Value ($/AF of Consumptive Use)	2030 Condition Friant Service Area 2018 Price Value ($/AF of Consumptive Use)
Wet	$200	$211
Above Normal	$251	$265
Below-Normal	$261	$276
Dry	$278	$294
Critical	$324	$342
Weighted Average	$256	$271

Source: CWC WSIP Technical Reference Document

Monetary Benefits of Feasibility Alternatives

This Study anticipates that regional subsidence will continue and cause a decrease in the capacity of the FKC over the planning horizon, under the No Action Alternative and with the implementation of Feasibility Alternatives. To estimate the benefits of Feasibility Alternatives, the value of water delivery reductions was estimated for the No Action Alternative and Feasibility Alternatives. Benefits of the Feasibility Alternatives are based on differences in delivery reduction value in comparison to the No Action Alternative.

Table 5-4 through Table 5-6 show the planning horizon analysis for the No-Action and Feasibility Alternatives. Computations are made each year in the planning horizon. For ease of presentation, the tables report annual results for years 1 through 10 and then every decade following until year 100, the end of the planning horizon. The tables provide the net present value of reduced water deliveries over the planning horizon.

Feasibility Alternatives cost estimates are reported as an opinion of probable construction cost (OPCC) and cost ranges were provided based on plus or minus 25 percent variation in field costs. Feasibility Alternatives costs include Interest During Construction (IDC) over the construction duration, and life cycle costs over the planning horizon.

A summary of benefits associated with water deliveries and costs of Feasibility Alternatives is provided in Table 5-7.

Table 5-4. No-Action Horizon Analysis

Year	Average Annual Deliveries (TAF)	Average Annual No Action Affected Water Supply (TAF)	Reschedule in Millerton (TAF)	Percent Groundwater Pumping (%)	Assumed Groundwater Pumping (TAF)	Average Annual Reduction in Supply (TAF)	Value of Water Lost ($M)	Groundwater Pumping Cost ($M)	Annual Value of Water ($M)
1	410.2	41.3	15.6	90%	23.2	2.6	$271	$221	$5.8
2	408.2	46.1	17.3	80%	23.0	5.8	$271	$224	$6.7
3	406.2	50.9	19.0	70%	22.3	9.5	$271	$226	$7.6
4	404.2	55.6	20.8	60%	20.9	13.9	$271	$229	$8.6
5	402.2	60.4	22.5	50%	18.9	18.9	$271	$229	$9.5
6	400.2	68.8	24.7	40%	17.7	26.5	$271	$229	$11.2
7	398.2	77.3	26.8	30%	15.1	35.3	$271	$229	$13.0
8	396.2	85.7	29.0	20%	11.3	45.4	$271	$229	$14.9
9	394.2	94.2	31.2	10%	6.3	56.7	$271	$229	$16.8
10	392.2	102.7	33.3	0%	0.0	69.3	$271	$229	$18.8
20	392.2	149.3	36.4	0%	0.0	112.9	$271	$229	$30.6
30	392.2	159.5	35.7	0%	0.0	123.8	$271	$229	$33.5
40	392.2	169.6	34.9	0%	0.0	134.7	$271	$229	$36.5
50	392.2	179.7	34.1	0%	0.0	145.6	$271	$229	$39.4
60	392.2	179.7	34.1	0%	0.0	145.6	$271	$229	$39.4
70	392.2	179.7	34.1	0%	0.0	145.6	$271	$229	$39.4
80	392.2	179.7	34.1	0%	0.0	145.6	$271	$229	$39.4
90	392.2	179.7	34.1	0%	0.0	145.6	$271	$229	$39.4
100	392.2	179.7	34.1	0%	0.0	145.6	$271	$229	$39.4
								Net Present Value	$923

Table 5-5. Canal Enlargement Horizon Analysis

Year	Average Annual Deliveries (TAF)	Average Annual No Action Affected Water Supply (TAF)	Reschedule in Millerton (TAF)	Percent Groundwater Pumping (%)	Assumed Groundwater Pumping (TAF)	Average Annual Reduction in Supply (TAF)	Value of Water Lost ($M)	Groundwater Pumping Cost ($M)	Annual Value of Water ($M)
1	410.2	41.3	15.6	90%	23.2	2.6	$271	$221	$5.8
2	408.2	46.1	17.3	80%	23.0	5.8	$271	$224	$6.7
3	406.2	50.9	19.0	70%	22.3	9.5	$271	$226	$7.6
4	404.2	55.6	20.8	60%	20.9	13.9	$271	$229	$8.6
5	402.2	60.4	22.5	50%	18.9	18.9	$271	$229	$9.5
6	400.2	68.8	24.7	40%	17.7	26.5	$271	$229	$11.2
7	398.2	77.3	26.8	30%	15.1	35.3	$271	$229	$13.0
8	396.2	85.7	29.0	20%	11.3	45.4	$271	$229	$14.9
9	394.2	94.2	31.2	10%	6.3	46.7	$271	$229	$16.8
10	392.2	102.7	33.3	0%	0.0	69.3	$271	$229	$18.8
20	392.2	0.3	0.1	0%	0.0	0.2	$271	$229	$0.1
30	392.2	0.7	0.2	0%	0.0	0.4	$271	$229	$0.1
40	392.2	1.0	0.3	0%	0.0	0.7	$271	$229	$0.2
50	392.2	1.3	0.4	0%	0.0	0.9	$271	$229	$0.2
60	392.2	1.3	0.4	0%	0.0	0.9	$271	$229	$0.2
70	392.2	1.3	0.4	0%	0.0	0.9	$271	$229	$0.2
80	392.2	1.3	0.4	0%	0.0	0.9	$271	$229	$0.2
90	392.2	1.3	0.4	0%	0.0	0.9	$271	$229	$0.2
100	392.2	1.3	0.4	0%	0.0	0.9	$271	$229	$0.2
								Net Present Value	$100

Table 5-6. Parallel Canal Horizon Analysis

Year	Average Annual Deliveries (TAF)	Average Annual No Action Affected Water Supply (TAF)	Reschedule in Millerton (TAF)	Percent Groundwater Pumping (%)	Assumed Groundwater Pumping (TAF)	Average Annual Reduction in Supply (TAF)	Value of Water Lost ($M)	Groundwater Pumping Cost ($M)	Annual Value of Water ($M)
1	410.2	41.3	15.6	90%	23.2	2.6	$271	$221	$5.8
2	408.2	46.1	17.3	80%	23.0	5.8	$271	$224	$6.7
3	406.2	50.9	19.0	70%	22.3	9.5	$271	$226	$7.6
4	404.2	0.0	0.0	60%	0.0	0.0	$271	$229	$0.0
5	402.2	0.0	0.0	50%	0.0	0.0	$271	$229	$0.0
6	400.2	0.0	0.0	40%	0.0	0.0	$271	$229	$0.0
7	398.2	0.0	0.0	30%	0.0	0.0	$271	$229	$0.0
8	396.2	0.0	0.0	20%	0.0	0.0	$271	$229	$0.0
9	394.2	0.0	0.0	10%	0.0	0.0	$271	$229	$0.0
10	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
20	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
30	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
40	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
50	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
60	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
70	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
80	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
90	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
100	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
								Net Present Value	$20

Table 5-7. Benefit Cost Analysis of Feasibility Alternatives

Item	Canal Enlargement Alternative	Parallel Canal Alternative
Value of reduced water delivery in the No Action Alternative[1,2]	$923	$923
Value of reduce water delivery in the Project Alternative[1,2]	$100	$20
Net Benefit[1,2]	$823	$904
Net Present Value of Total Capital and Life Cycle Costs [1,3]	$267	$452
Cost Range of Net Present Value of Total Capital[1,4]	($220 - $360)	($320 - $540)

Notes:
[1] All costs are in millions of dollars
[2] Net Present Value based on 100-year project life
[3] Construction Cost of Initial Alternatives
[4] +/- 25% applied to field cost

Evaluation of Feasibility Alternatives using Federal Planning Criteria

The Federal planning process described in the PR&G includes four criteria for consideration in formulating and evaluating alternative plans: completeness, effectiveness, efficiency, and acceptability (CEQ 2013). A summary of the evaluation is provided in Table 5-8 and described in the following sections.

Table 5-8. Summary of Federal Planning Criteria Evaluation

	Canal Enlargement Alternative	Parallel Canal Alternative
Effectiveness	Medium-High	High
Efficiency	High	Medium-High
Completeness	Medium	High
Acceptability	Not yet determined	Not yet determined

Effectiveness

Effectiveness is the extent to which an alternative plan would alleviate problems and achieve the planning objectives for a project. Both Feasibility Alternatives would restore the capability to convey water supplies based on historical operations. However, the performance of the Feasibility Alternatives would not be the same if future operational objectives include deliveries that exceed historical peak flows.

Evaluations presented in this report are based on historical deliveries and do not include operational objectives in response to changing water supply conditions, particularly the

implementation of SGMA. For example, many Friant Division long-term contractors have considered development of local water projects such as groundwater banking, canal enlargement or interties, and other actions that would improve water management in response to reduced water supply availability. If the implementation of such projects results in delivery of water from Friant Dam under existing CVP contracts at flows that exceed historical FKC flow rates, the performance of the Feasibility Alternatives would change.

Efficiency

This evaluation criterion is a measure of how an alternative plan alleviates the specified problems and realizes the specified opportunities at the least cost, or in a cost-effective manner. As noted in the discussion on Effectiveness, all analyses presented in this report are based on historical deliveries and do not include potential changes in future operations. Economic benefits for water supply based on this approach were compared to costs estimated for the Initial Alternatives (Alternative 1 Option 1 and Alternative 5 Option 3) as described in Chapter 3. Using this information, the benefit cost (B-C) ratios are 2.0 for the Parallel Canal Alternative and 3.0 for the Canal Enlargement Alternative. Both alternatives are efficient in achieving project objectives as evaluated. If future operational objectives include deliveries that exceed historical peak flows, the efficiency of the Feasibility Alternatives would change.

Completeness

Completeness is a determination of whether an alternative plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. Sub-criteria that are important in measuring completeness include (1) authorization, (2) planning objective(s), (3) reliability or durability, (4) physical implementability or constructability, and (5) effects on environmental resources. Each of these sub-criteria are described below.

Authorization

Authorization for Reclamation participation in this Project is provided by the Settlement Act (Public Law 111-11) and the WIIN Act.

Part III of the Settlement Act authorizes the restoration of the FKC to such capacity as previously designed and constructed by the Bureau of Reclamation. The Canal Enlargement Alternative, as evaluated in this Study, would restore the capacity of the FKC to less than the original capacity. The Parallel Canal Alternative, as evaluated in this Study, would restore the capacity of the FKC to the original maximum capacity with current freeboard Reclamation freeboard criteria. Both Feasibility Alternatives are consistent with the Settlement Act.

Reclamation is reviewing requirements of the WIIN Act as applicable to the FKC Middle Reach Subsidence and Capacity Correction Project. Additional benefit evaluations to support WIIN Act funding may be included in subsequent versions of this report.

Planning Objectives

The two Feasibility Alternatives evaluated in this Study would meet the planning objectives of increasing canal capacity and improving water supply reliability to Friant Division long-term contractors south of the FKC low point.

Reliability or Durability

The two Feasibility Alternatives would have different degrees of reliability in response to future land subsidence. The Canal Enlargement Alternative, which would be constructed to meet maximum historical deliveries, would be subject to reduced capacity in response to additional land subsidence early in the project life. As evaluated in this Study, the Parallel Canal Alternative, which would be constructed to the maximum design capacity, would not experience water delivery reductions during the planning horizon in response to additional land subsidence.

Physical Implementability or Constructability

Similar features have been included in both Feasibility Alternatives to address requirements for turnouts, road crossings, checks, siphons, and utilities. Both Feasibility Alternatives are constructible using accepted construction methods, however constraints associated with construction of canal modifications differ between the Feasibility Alternatives. Although detailed construction constraints and sequencing plans have not been developed, several challenges associated with their construction, particularly within the prism of an operating canal, have been identified.

- Borrow Material – The Parallel Canal Alternative could be constructed with either balanced material requirements for earthwork or a surplus that could be spoiled on project features. The Canal Enlargement Alternative would require significant borrow material, with borrow sources ideally located on each side of the FKC to limit hauling over the existing bridges, many of which have load restrictions. Depending on the location of borrow sources (which have not yet been identified), constraints on the larger equipment ideally suited to hauling large loads may be imposed.

- Potential Reduction in Water Deliveries During Construction – The water surface elevation in the FKC will need to be lowered in order to remove existing concrete lining to construct a new bench (setback) below the existing top of lining. This is required to reduce additional loading on the existing 1.25:1 canal side slopes. During this portion of the construction, the conveyance capacity of the canal will be reduced. Detailed analyses will need to be performed to define the actual bench elevation, with full consideration of geotechnical slope stability, and then estimate this impact to water supply deliveries. It is envisioned that scheduling of this construction will need to be coordinated with low delivery periods, which would extend the construction schedule so that water supply deliveries can be maintained as much as possible. Reduced water levels to accommodate in-prism construction would be more significant in the Canal Enlargement Alternative because the bench features would be constructed in the most subsided portion of the FKC, whereas bench features in the Parallel Canal Alternative would be located in the upper-most and lower-most portions of the Middle Reach.

- Safety Risk During Construction – The Canal Enlargement Alternative would have a greater safety risk to staff during construction than the Parallel Canal Alternative because more of the work would be completed within an active water delivery system.

- Tie-ins – Both Feasibility Alternatives include structures, such as check structures, wasteways, and siphons, that will require upstream and downstream tie-ins to the existing FKC. While achievable, tie-ins require appropriate advance planning, reliable concepts, and carry some risk that water deliveries could be interrupted during construction.

Environmental Resources

An analysis of potential environmental constraints was prepared and applied to the evaluation of Initial Alternatives. This evaluation contributed to the selection of the Feasibility Alternatives. Further environmental evaluations are being performed through the development of environmental compliance documents.

Acceptability

Acceptability is the viability and appropriateness of an alternative plan from the perspective of the Nation's general public and consistency with existing Federal laws, authorities, and public policies. It does not include local or regional preference for particular solutions or political expediency. Acceptability among Friant Division long-term contractors will consider several factors that have not yet been evaluated, including the availability of Federal and State funding, the allocation of costs among Friant Division contractors, and the need for conveyance capacity to accommodate potential future operational requirements.

Identification of the Recommended Plan

The identification of the Recommended Plan is based on evaluation and comparisons of the net benefits and additional criteria to limit the impacts to Friant Division long-term contractors. As described below, the Parallel Canal Feasibility Alternative is identified as the Recommended Plan. The selection of the Parallel Canal Feasibility Alternative was also supported by the findings of a Value Planning Study performed by Reclamation which ranked the alternative highest compared to alternatives considered during the value planning process.

National Economic Development Plan

The objective of the National Economic Development (NED) analysis estimates the economic benefits of potential effects is necessary to establish the feasibility and identify a corresponding alternative plan that maximizes net benefits. As described above, the maximum net benefit is achieved by the Parallel Canal Feasibility Alternative, which supports the selection of this alternative as the Recommended Plan.

Constructability and Operational Considerations

Additional criteria considered in the selection of the Recommended Plan included potential to impact water deliveries during construction. The Parallel Canal Feasibility Alternative has a

construction duration of two and half years compared to the Canal Enlargement Alternative could last up to ten years due to limitations time available for canal construction during lowered water levels. Water delivery impacts during construction of the Parallel Canal Feasibility Alternative would be minimal because most construction activities will be in the dry, using new materials and does not rely on the existing embankments for stability. The shorter construction duration, limited impact to contract deliveries during construction, and the more reliable construction methods are reasons support the selection of Parallel Canal Feasibility Alternative as the Recommended Plan.

Value Planning Study

In October of 2019 Reclamation performed a value planning study of the Friant-Kern Canal Capacity Correction Project. The goal of the value planning study is to achieve the most appropriate and highest value solution for an identified problem. The value planning study included an examination of the component features of the Project, or activity to define the critical functions, governing criteria, and associated costs. Alternative ideas and solutions were suggested to perform the functions, consistent with the identified criteria, at a lower cost or with an increase in long-term value.

The Value Planning review of the Initial and Feasibility Alternatives confirmed the Parallel Canal Feasibility Alternative as the superior alternative considered in this Study. The value planning study considers the Parallel Canal Feasibility Alternative as the Baseline Design in which alternative ideas are compared to, and additional design considerations are added to. The ideas were evaluated, analyzed, and prioritized, and a few of these were evaluated to a level suitable for comparison, decision-making, and adoption.

Reclamation produced the Draft Value Planning Report that summarizes the activities and ideas developed the value planning team. Table 5-9 shows the analysis matrix developed by the value planning team that ranked the developed ideas compared to the Baseline Design (Parallel Canal Feasibility Alternative). From the proposed ideas the Parallel Canal Feasibility Alternative was evaluated as the highest value project and confirms that selection of the Parallel Canal Alternative as the Recommended Plan.

Table 5-9. Analysis Matrix from Value Planning Study

Analysis Matrix

Criteria	A		B		C		D		E		F					
Weight	0.07		0.04		0.19		0.04		0.33		0.33					
Idea	Score	Weighted	Score	Weighted	Score	Weighted	Score	Weighted	Score	Weighted	Score	Weighted	Raw Score	Weighted Score	Ranking	Disposition
Baseline Design	4	0.27	5	0.22	5	0.93	5	0.22	4	1.31	5	1.64	28	4.6	**1**	
RCC Embakment	2	0.14	2	0.09	4	0.75	5	0.22	4	1.31	2	0.66	19	3.2	**4**	
MSE Wall	3	0.20	5	0.22	4	0.75	4	0.18	4	1.31	4	1.31	24	4	**3**	
Unlined Parallel Canal	4	0.27	5	0.22	5	0.93	3	0.13	3	0.99	5	1.64	25	4.2	**2**	
Recharge w/ Existing	5	0.34	5	0.22	5	0.93	5	0.22	2	0.66	5	1.64	27	4.01		

Score: Excellent = 5, Very Good = 4, Good = 3, Fair = 2, Poor = 1

Score 4-5
Score 3-4
Score 2-3

Summary of Refinements to the Parallel Canal Feasibility Alternative

As described above, the Parallel Canal Feasibility Alternative was selected as the Recommended Plan. Following that selection, several refinements were made to reduce material requirements and improve constructability and project resilience. Design refinements included reduction of the required length of canal realignment portion, refinement of the location of the center-line of the realigned segment, selection of canal cross-sections that provide greater resiliency under future subsidence conditions, identification of potential borrow sites, and other considerations. The results of these additional refinements reduced the cost of the Recommended Plan without reducing the estimated benefits in comparison to the Parallel Canal Feasibility Alternative described above. The refinements to the Parallel Canal Feasibility Alternative described below are reflected in the description of the Recommended Plan presented in Chapter 6. The Recommended Plan is also referred to as the Canal Enlargement and Realignment (CER) Alternative in environmental compliance documents.

Refinement of Length of Canal Realignment

The Parallel Canal Feasibility Alternative included a realigned canal segment from south of Ave. 152 near MP 96 to Garces Highway near MP 119. Through additional modeling and refinement, it was determined that the length of canal realignment segment could be shortened and achieve the maximum design capacity and HGL. The canal realignment in the Recommended Plan extends from MP 96 to Avenue 8 near MP 116. This refinement resulted in reducing the canal realignment by approximately 3 miles, reducing the among of required embankment material and reducing project costs.

Refinement of Canal Realignment Offset from Existing FKC

The realigned canal portion of Parallel Canal Feasibility Alternative, which was developed based on minimizing ROW requirements, required the placement of material within the existing FKC.

Upon consideration of material requirements, the centerline of the realigned canal was moved further east such that the west embankment of the realigned canal tied into the existing the eastern canal embankment. This refinement reduced the required embankment material by about 1 million cubic yards and enables a construction sequencing that provides for potential use of material in the existing canal embankments to construct parts of the realigned canal embankments.

Refinement of Raised and Widened Canal Segment Cross-Sections

The Parallel Canal Feasibility Alternative included canal enlargement in Segment 1 and a portion of Segment 4 through raising and widening the FKC. In these segments, the raised and widened section would include a 24-foot bench on either side of the canal. Through additional hydraulic modeling, it was determined that required capacity could be achieved by extending the existing prism by raising the embankment and extending the lining, thereby eliminating the need to widen the canal. Depending on location, the required lining raise varies from 15 inches to 24 inches. The elimination of the bench reduced the amount of embankment material and liner on the bench portion, and lowered cost. Table 5-10 shows the approximate lining raise required in Segment 1, a portion of Segment 2, and Segment 4B to achieve the maximum design flow.

Table 5-10. Lining Raise Requirements for the Recommend Plan

Segment	Maximum Design Flow (cfs)	Required Lined Freeboard	Canal Milepost (MP)	Canal Milepost (MP)	Approx. Canal Length	Lining Raise "H"
1	4,500 cfs	1.15' (13.80")	88.2 (5th Ave Check Outlet)	95.1 (Ave 180 Bridge)	6.9-miles	15"
			95.1 (Ave 180 Bridge)	95.7 (Tule Check Inlet)	0.6-miles	24"
2	4,000 cfs	1.11' (13.32")	95.7 (Tule Check Outlet)	96.3 (Ave 152 Bridge)	0.6-miles	24"
2/3/4A	*4,000 cfs 3,500 cfs*	*1.11' 1.08'*	*96.3 (Ave 152 Bridge)*	*115.9 (Ave 8 Bridge)*	*19.6-miles Parallel Canal*	
4B	3,500 cfs	1.08' (12.96")	115.9 (Ave 8 Bridge)	119.5 (Woollomes Rd Bridge)	3.6-miles	13"
4C	3,500 cfs	1.08' (12.96")	*119.5 (Woollomes Rd Bridge)*	*121.5 (Woollomes Check Inlet)*	*2.0-miles Existing Earth Canal (No Mods Necessary)*	

Key:
ave – avenue
cfs – cubic feet per second
mp – milepost
rd - road

Refinement of Realigned Canal Segment Cross-Sections

The cross-section geometry of the Parallel Canal Feasibility Alternative was based a 40-foot bottom width of the canal in all realigned segments. Further evaluation revealed that material balance could be improved and resiliency under future subsidence could be increased if the bottom width were narrowed. An analysis was performed to identify effect on canal capacity

under future subsidence for a variety of bottom-width canal designs at the same design capacity Table 5-11 shows the reduction in capacity resulting from capacity on a variety of canal sections designed to convey 4,000 cfs. Under a future subsidence of 4 feet, the capacity of a 16-foot bottom width would be reduced by about 12 percent whereas the same subsidence would cause a 25 percent reduction of the capacity for a 40-foot bottom with canal.

On the basis of this analysis, the design for the Recommended Plan was revised to include varying widths from 16 to 24 feet. This change was made to minimize the canal capacity loss that would be experienced in the future from subsidence. This reduction in bottom width has the added advantage of reducing the amount of concrete lining required as part of the construction.

Table 5-11. Effect of Subsidence on Canal Capacity of Various 4,000 cfs Canal Designs

Future Subsidence	Canal Capacity Reduction Resulting from Subsidence			
	16-ft Bottom Width	24-ft Bottom Width	32-ft Bottom Width	40-ft Bottom Width
2-feet	5% (200 cfs)	7% (280 cfs)	10% (400 cfs)	12% (480 cfs)
4-feet	12% (480 cfs)	16% (640 cfs)	20% (800 cfs)	25% (1,000 cfs)
8.5-feet	32% (1,280 cfs)	41% (1,640 cfs)	49% (1,960 cfs)	56% (2,240 cfs)

Key:
cfs – cubic feet per second

Refinement to Identification of Borrow Sources

During the refinement of the Recommended Plan, as described above, additional potential borrow sites were identified through coordination with Friant Division long-term contractors. In response to SGMA requirements, some Friant Division long-term contractors are advancing plans to develop permanent groundwater recharge basins. To date, Friant Division long-term contractors have expressed interest in developing three sites in the general vicinity of the Project Area and have indicated their interest in making material from these sites available as borrow. In addition, at least one site, which is immediately adjacent to the FKC, is a candidate construction staging location. Preliminary designs, environmental compliance and permitting has been completed for some sites, whereas others have been evaluated at a conceptual or appraisal level. Geotechnical information is available at all sites and further evaluations will be included in the design development of the Recommended Plan.

Based the current design of the Recommended Plan and consideration of potential borrow from nearby and adjacent identified sites, the identified available borrow to construct exceeds the requirements for the Recommended Plan. Table 5-12 shows the borrow source and the amount of material identified as available from that source. As noted in Table 5-12 over 9 million cubic yards of potential borrow material has been identified, which significantly exceeds the estimated material requirements of approximately 5.7 million cubic yards.

Table 5-12. Borrow Sources and Estimated Volume Available

Borrow Source	General Location	Estimated Volume Available (CY)
Excavation of Realigned Canal	MP 96 to MP 116	2.1M
Existing FKC Bank Material[1]	Along 20 miles of existing canal (MP 96 to MP 116)	3.0M
SITE B - Terra Bella Irrigation District Site	East of canal at Milepost 102.2	1.5M
SITE A – Private Landowner Site	East of canal at Milepost 97.4	0.5M
SITE C - Delano-Earlimart Irrigation District Site	1 mile West of Canal near Milepost 114.0	2.0M
Total Potential Available Borrow		9.1M

Notes:
1 Material is not available until segments of old canal are out of operation.

Chapter 6
Recommended Plan

This chapter describes the Recommended Plan and project implementation requirements. It includes the demonstration of the feasibility of the Recommended Plan, identification of areas of potential risk and uncertainty, project implementation requirements, Federal and non-Federal responsibilities, and a project timeline.

Description of Recommended Plan Features

A single-line schematic showing features included in the Recommended Plan is provided in Figure 6-1A and Figure 6-1B. The Recommended Plan includes modification to enlarge the FKC where practical, and construction of a new canal realignment in locations where the land subsidence has occurred or is expected to occur to an extent that modifying the existing FKC to achieve the design capacity and HGL is considered less practical. Features of the Recommended Plan are described in the following sections.

Canal Alignment and Cross Sections

The Recommended Plan would include modifications to the current FKC alignment from 5th Ave. Check (MP 88) to Ave. 152 (MP 96.3). Through this reach, the cross section of the existing FKC would be enlarged with a canal embankment and lining raise to increase canal capacity to meet the Design Maximum flow rate and HGL in this segment, as shown in Figure 6-2. From 5th MP 88 to MP 96.3 existing bridge soffits are anticipated to be above the new maximum water surface elevation in the canal. Many of the existing turnouts in this segment of the canal will require raising the top deck by 0.5 to 2 feet. The extent of the raise at each turnout is dependent upon the lining raise at that location.

At MP 96.3, the new canal alignment would head east, away from the existing canal centerline, and run on a generally parallel alignment to the existing FKC until it reaches Ave. 8 (MP 115.94). In this reach, the new canal alignment would have a regular trapezoidal shape based on the configuration shown in Figure 6-3. At MP 115.94, the canal realignment would reconnect with the existing alignment of the FKC, which would be enlarged between MP 115.94 to Woollomes Ave. (MP 120) as described above and shown in Figure 6-2. From MP 120 to Reservoir Check Structure (MP 121.5) will remain as is with no modifications necessary to convey the Design Maximum flow.

The Recommended Plan is based on canal embankments and liner that would achieve objective capacities if constructed at the current (2018 survey) ground level and includes design features to accommodate anticipated future subsidence. For example, the siphon-type road crossings are

sized to accommodate future increases in HGL. In addition, canal embankments were configured such that they could be raised without interfering with the operation of the restored FKC. The necessary ROW to accommodate such a future raise, as identified as future concrete liner raise with embankment on Figure 6-3.

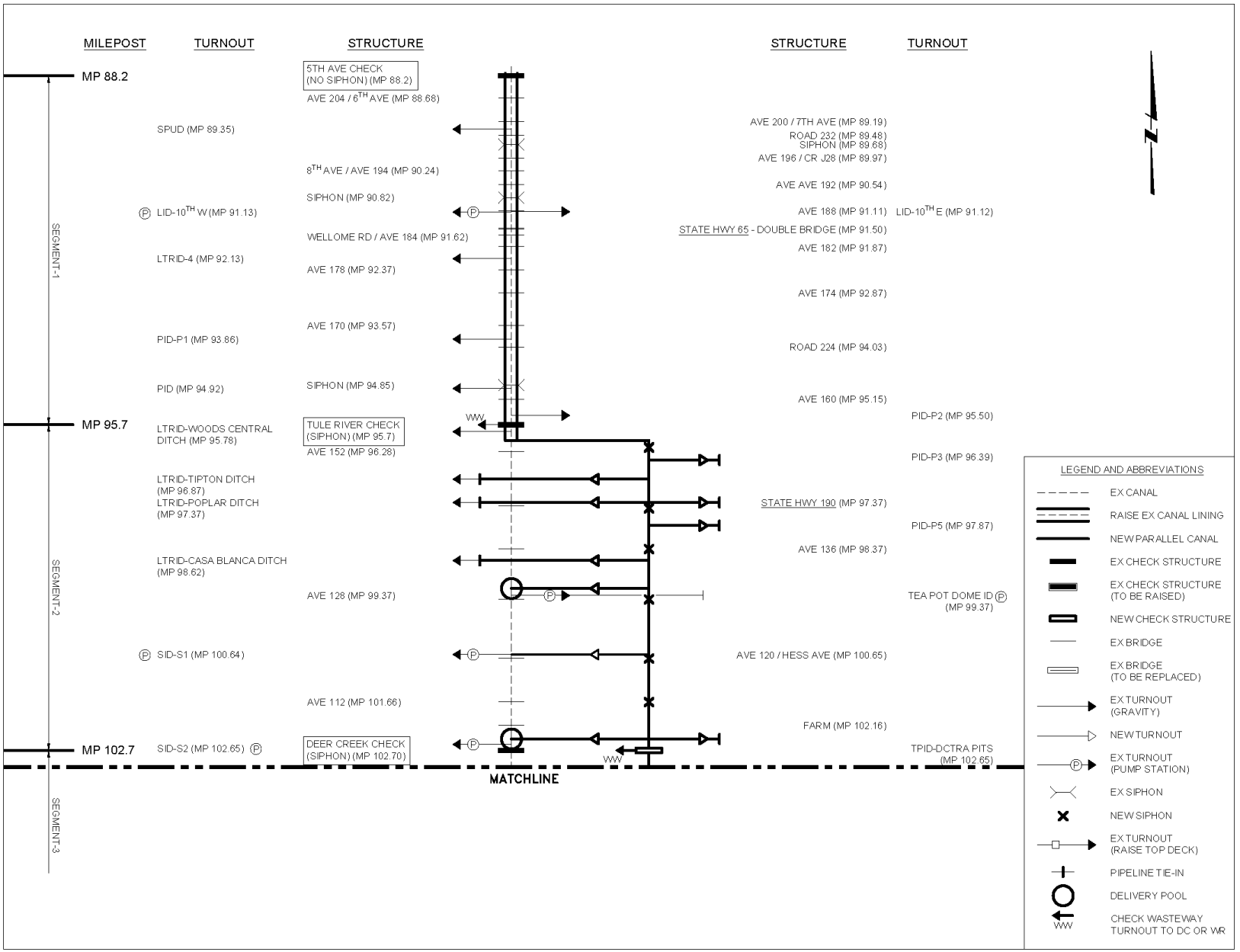


Figure 6-1A. Recommended Plan Single-Line Diagram of Canal Segments 1 and 2

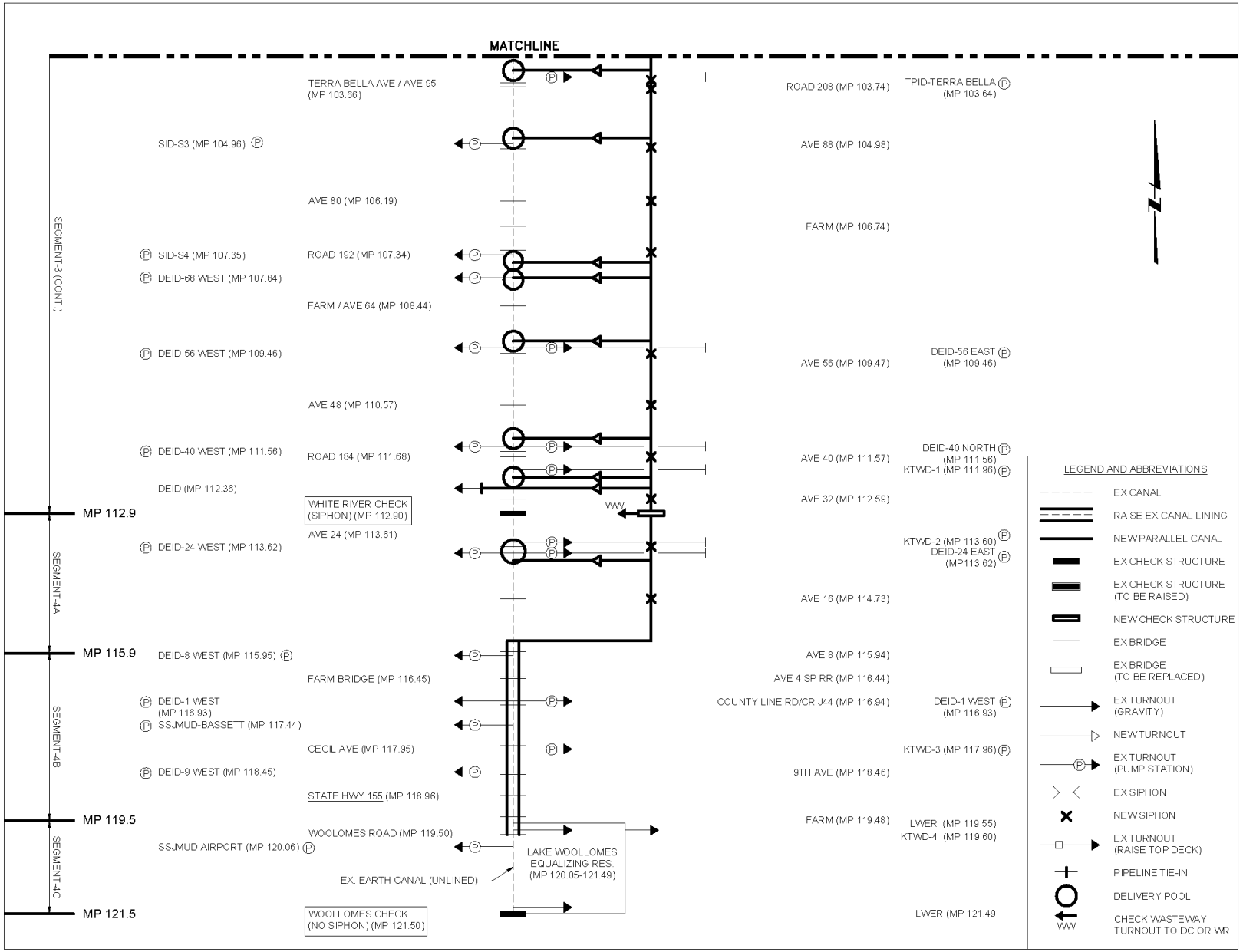


Figure 6-1B. Recommended Plan Single Line Diagram of Segments 3 and 4

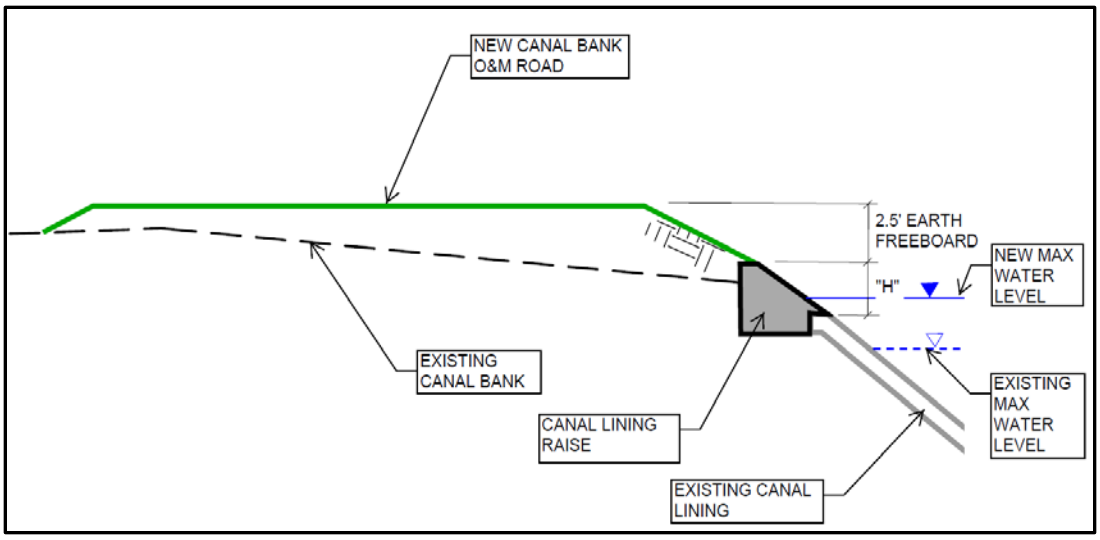


Figure 6-2. Canal Lining Raise in Segment 1 and Segment 4b of the Recommended Plan

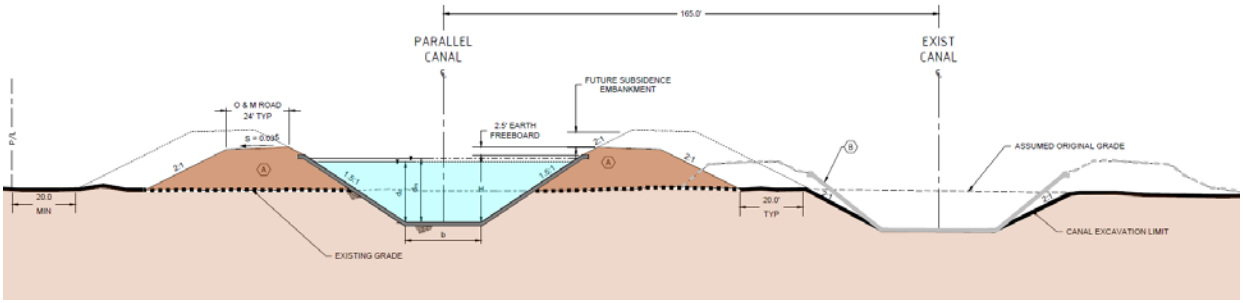


Figure 6-3. Trapezoidal Cross Section of Realigned Canal Segments in the Recommended Plan

Construction Sequencing

The canal realignment portion of the Recommended Plan would be constructed as follows:

1. Construct the new canal section from Ave. 56 (MP 109.47) to MP 115.94 with excavated prism material, construct the new White River Check Structure, and line the newly constructed canal.

2. The newly constructed canal from MP 109.47 to MP 115.94 put into operations with temporary tie in on the northern end.

3. Excavate material from the old FKC banks and haul material from MP 109.47 to White River Check (MP 112.9) north to construct canal realignment prism from Ave. 96 (MP 103.66) to MP 109.47.

4. Construct the new canal section from MP 103.66 to MP 109.47 with excavated prism material, and the hauled material from Step 3 or other potential borrow area near the Deer Creek Check. Line the canal section from MP 103.66 to MP 109.47.

5. The newly constructed canal from MP 103.66 to MP 109.47 put into operations with temporary tie on the northern end and connected to the canal section from MP 109.47 to MP 115.94.

6. Construct the canal section from MP 96.3 to Ave. 128 (MP 99.37) with excavated prism material, and line the newly constructed section.

7. The newly constructed canal from MP 96.3 to MP 99.37 put into operations with temporary tie in at the southern end.

8. Excavate material from the old FKC banks and haul material from MP 96.3 to MP 99.37 south to construct canal realignment prism from MP 99.37 to MP 103.66.

9. Construct the new canal section from MP 99.37 to MP 103.66 with excavated prism material, and the hauled material from Step 8. Line the canal section from MP 99.37 to MP 103.66. Construct the new Deer Creek Check Structure.

10. New Canal Realignment completed and in operation.

For a detailed discussion on construction sequencing, refer to Appendix D Recommended Plan Design and Cost Summary.

Turnouts

The Recommended Plan includes feature to address water delivery at existing turnouts, based in part, on input provided by Friant Division long-term contractors. The Recommended Plan incorporates design concepts for pressurized and gravity systems to ensure compatibility between the canal and the contractors' distribution systems, maintain water delivery capability during constructions, control overflow, and enhance operational flexibility.

Pressurized Turnout Modifications

In the Middle Reach, many of the 21 pressurized distribution systems have subsided at different rates than the land under the canal, causing varying differential head conditions from those used in the original system designs. All alternatives have been developed to achieve the proposed HGL, which is higher than the current water surface in the FKC. Increasing the HGL would increase head on the suction side of the pumping plants, which would increase the delivery head on district distribution systems. The removal and replacement of current pump stations at a location compatible with the current design was considered and dropped because of significant costs.

The water elevation in the new realigned canal would often be above the elevation of the top decks of existing pump stations. If a pump station were to unexpectedly shutdown, the incoming flow from the adjacent canal could overflow the pump station and flood the facility and surrounding land, resulting in equipment and property damage. To avoid the potential risk associated with unexpected shutdowns, the Recommended Plan includes small delivery pools at each pump station turnout in the canal realignment section. As shown in Figure 6-4, the delivery pool would be created by preserving small portions of the existing FKC to serve as a forebay for the existing turnout pump station. Water would flow from the new realigned canal through a new pipe to the delivery pool. The new canal realignment would be modified at the location of each pump station turnout and be customized to meet the specific needs of each pressurized delivery system. A list of the modifications proposed to the pump station turnouts is provided in Table 6-1.

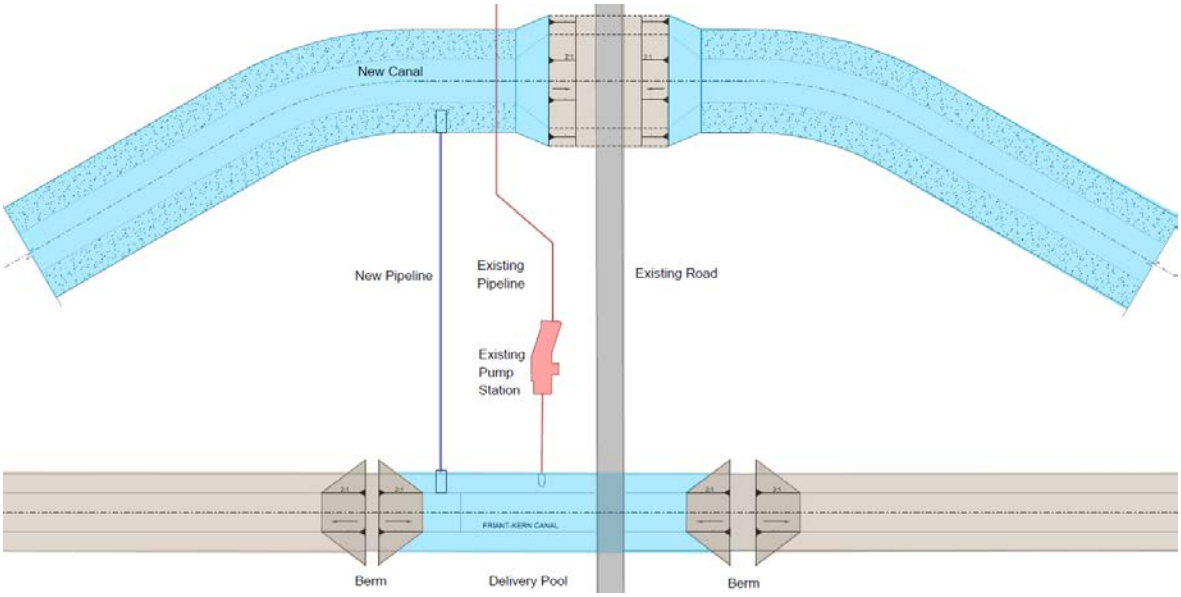


Figure 6-4. Example Pressurized System Turnout Design in the Recommended Plan

Table 6-1. Modifications at Pump Station Turnouts in the Recommended Plan

Pump Station Turnout	Canal Side	MP	Modification
LID-10th W	West	91.12	Raise Top Deck
TPDWD-Teapot Dome	East	99.35	New Delivery Pool Turnout
SID-S2	West	102.65	New Delivery Pool Turnout
TBID-Terra Bella	East	103.64	New Delivery Pool Turnout
SID-S3	West	104.96	New Delivery Pool Turnout
SID-S4	West	107.35	New Delivery Pool Turnout
DEID – 68 West	West	107.84	New Delivery Pool Turnout
DEID-56 EAST	East	109.46	New Delivery Pool Turnout (Shared)
DEID-56 West	West	109.46	New Delivery Pool Turnout (Shared)
DEID-40 North	East	111.56	New Delivery Pool Turnout (Shared)
DEID-40 West	West	111.56	New Delivery Pool Turnout (Shared)
KTWD-1	East	111.96	New Delivery Pool Turnout
KTWD-2	East	113.6	New Delivery Pool Turnout (Shared)
DEID-24 East	East	113.62	New Delivery Pool Turnout (Shared)
DEID-24 West	West	113.62	New Delivery Pool Turnout (Shared)
DEID-8th West	West	115.95	Raise Top Deck
DEID-#1 West	East	116.93	Raise Top Deck
SSJMUD-Bassett	West	117.44	Raise Top Deck
KTWD-3	East	117.96	Raise Top Deck
DEID-9th West	West	118.45	Raise Top Deck
SSJMUD-Airport	West	120.06	Unmodified

Gravity Turnout Modifications

There are 17 gravity systems located in the Middle Reach, each of which were individually analyzed to determine an appropriate design approach. The analysis revealed that all existing gravity turnouts can either be preserved and reused or connected to new turnouts and pipelines on the new canal realignment. A summary of actions for gravity turnouts under the Recommended Plan is provided in Table 6-2.

Table 6-2. Modifications at Gravity Turnouts Under the Recommended Plan

Gravity Turnout	Canal Side	MP	Modification
SPUD-STRATHMORE	West	89.35	Raise Top Deck
LID-10th E	East	91.12	Raise Top Deck
LTRID-4	West	92.13	Raise Top Deck
PID-P1	West	93.85	Raise Top Deck
PID-Porter Slough	West	94.92	Raise Top Deck
PID-P2	East	95.50	Raise Top Deck
LTRID-Woods Central Ditch	West	95.78	Raise Top Deck
PID-P3	East	96.39	New Gravity Turnout on Canal Realignment
LTRID-Tipton Ditch	West	96.87	New Gravity Turnout on Canal Realignment
LTRID-Poplar Ditch N&S	West & East	97.37	New Gravity Turnout on Canal Realignment
PID-P5	East	97.86	New Gravity Turnout on Canal Realignment
LTRID-Casa Blanca Ditch	West	98.62	New Gravity Turnout on Canal Realignment
SID-S1	West	100.64	New Gravity Turnout on Canal Realignment
TBID-DCTRA Pits	East	102.65	New Gravity Turnout on Canal Realignment
DEID	West	112.36	New Gravity Turnout on Canal Realignment
LWER	East	119.55	Unmodified
LWER	East	121.49	Unmodified

Checks and Siphons

The Recommended Plan project area includes five existing check structures located at 5th Avenue (MP 88.2), Tule River (MP 95.7), Deer Creek (MP 102.7), White River (MP 112.9), and Lake Woollomes (MP 121.5). Check Structures are essential to the operation of the FKC. These structures house radial gates that maintain the water level in the upstream canal segments to provide enough head to maintain submergence of turnouts. Table 6-3 provides a description of the existing check structures, and appurtenance facility, as well as the proposed modifications for each. The Recommended Plan would include new check structures at Deer Creek and White River. Additionally, there are 5 existing siphons, 3 in Segment 1 that will not require modification, and siphons at Deer Creek and White River that will require replacement.

Table 6-3. Modifications at Existing Check Structures Recommended Plan

Description	Gate Type	MP	Modification
Fifth Avenue Check	Radial Gates	88.22	No Modification
Tule River Wasteway	Radial Gates	95.64	No Modification
Tule River Check and Siphon	Radial Gates	95.66	No Modification
Deer Creek Wasteway	Radial Gates	102.69	Abandon Existing – Replace on New Realigned Canal
Deer Creek Check and Siphon	Radial Gates	102.69	Abandon Existing – Replace on New Realigned Canal
White River Wasteway	Radial Gates	112.9	Abandon Existing – Replace on New Realigned Canal
White River Check and Siphon	Radial Gates	112.9	Abandon Existing – Replace on New Realigned Canal
Lake Woollomes Check	Radial Gates	121.5	No Modification

Road Crossings

The Middle Reach of the FKC has approximately 45 existing bridge crossings, some of which will require replacement to accommodate the project. The majority of existing bridges are cast-in-place concrete type with a system of reinforced concrete "T" beams, or girders supporting a concrete roadway deck, and supported by a concrete pier wall in the center of the FKC and concrete abutments with monolithic wingwalls on either side of the canal. There are 2 proposed measures to accommodate all roadway crossings in the Middle Reach either leave in place or replace bridge with concrete box siphon.

The leave in place measure would generally consist of minimal to no modifications to the existing bridges. This is typically the case with existing bridges in the enlarged sections of the existing canal in Segments 1 and 4.

The concrete box siphon measure would be applied in the new realigned canal roadway crossings in Segments 2, 3, and part of 4. Along these segments County and State bridges would be removed and the crossings would be replaced with concrete box siphons. The concrete box siphons would generally consist of a buried cast-in-place concrete triple box siphon with each of the three boxes estimated to be 19 feet tall by 19 feet wide.

Canal lining transitions approximately 50 feet long would be provided at the siphon entrance and exit to transition from the trapezoidal open canal geometry to the square box geometry. The length of the siphons would vary by location but would range from 100 to 200 feet The concrete box siphons are designed to accommodate potential subsidence by considering future soil loading and extension of the concrete headwalls at the entrance and outlets. Figure 6-5 shows the concrete box siphon concept.

At each new siphon the adjacent existing bridge over the current FKC would be demolished and the abandoned portion of the FKC would be filled to road grade and the paved road surface reconstructed on earth fill. Table 6-4 provides a summary of the existing bridges and measures proposed for the roadway crossings in the Middle Reach.

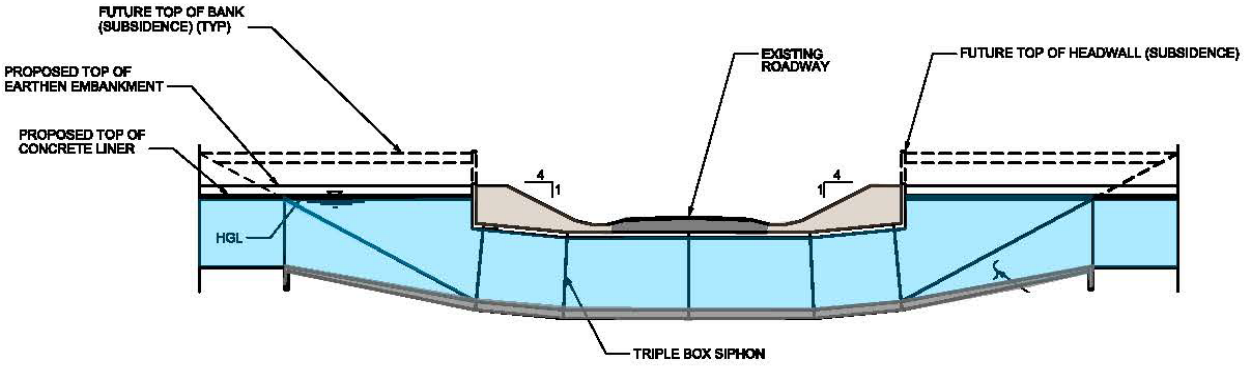


Figure 6-5. Typical Siphon Road Crossing

Table 6-4. Road Crossing Actions in the Recommended Plan

Name	MP	Modification
6th Avenue Bridge	88.67	No Modifications
7th Avenue Bridge	89.17	No Modifications
Road 232 Bridge	89.45	No Modifications
Frazier Highway/ Ave 196 Bridge	89.95	No Modifications
8th Avenue Bridge	89.95	No Modifications
Avenue 192 Bridge	90.23`	No Modifications
Avenue 188 Bridge	91.10	No Modifications
State Highway 65 Northbound Bridge (Double Bridge)	91.51	No Modifications
Welcome Avenue Bridge (Avenue 184)	91.60	No Modifications
Avenue 182 Bridge	91.85	No Modifications
Avenue 178 Bridge	92.35	No Modifications
W Linda Vista Avenue	92.85	No Modifications
W North Grand Avenue Bridge	93.55	No Modifications
N Westwood Street Bridge	94.01	No Modifications
W Henderson Avenue Bridge	95.12	No Modifications
Avenue 152 Bridge	96.26	Concrete Box Siphon

Table 6-4. Road Crossing Actions in the Recommended Plan (contd.)

Name	MP	Modification
Avenue 144 Bridge (Highway 190)	97.35	Concrete Box Siphon
Avenue 136 Bridge	98.35	Concrete Box Siphon
Avenue 128 Bridge	99.37	Concrete Box Siphon
Hesse Avenue Bridge	100.64	Concrete Box Siphon
Avenue 112 Bridge	101.64	Concrete Box Siphon
Timber Farm Bridge	102.14	None
Road Terra Bella Avenue (J24)	103.65	Concrete Box Siphon
Road 208 Bridge	103.72	Concrete Box Siphon
Avenue 88 Bridge	104.95	Concrete Box Siphon
Avenue 80 Bridge	106.72	Concrete Box Siphon
Farm Bridge	106.75	None
Road 192 Bridge	107.32	Concrete Box Siphon
Avenue 64 Bridge	108.42	None
Avenue 56 Bridge	109.45	Concrete Box Siphon
Avenue 48 Bridge	110.55	Concrete Box Siphon
Avenue 40 Bridge	111.55	Concrete Box Siphon (Shared)
Road 184 Bridge	111.66	Concrete Box Siphon (Shared)
Avenue 32 Bridge	112.57	Concrete Box Siphon
Avenue 24 Bridge	113.59	Concrete Box Siphon
Avenue 16 Bridge	114.71	Concrete Box Siphon
Avenue 8 Bridge	115.91	No Modifications
Timber Farm (Avenue 4) Bridge (2 Bridges)	116.41	No Modifications
County Road Avenue 0 Bridge	116.91	No Modifications
Cecil Avenue Bridge	117.92	No Modifications
9th Avenue Bridge	118.44	No Modifications
Garces Highway Bridge	118.94	No Modifications
Timber Farm Bridge	119.46	No Modifications
Woollomes Avenue Bridge	120.02	No Modifications

Utilities

Numerous utilities located in, along, and across the FKC would be affected by implementation of the Recommended Plan. The utilities include pipeline overcrossings, overhead power lines, adjacent wells, irrigation crossings under the existing canal, and utilities connected to bridges. Depending on the location and extent of canal modifications, the utilities will either be relocated or entirely replaced, as determined in the final design. Table 6-5 summarizes utility quantities that would require modification for the Recommended Plan. These quantities should be considered approximate until field locating confirms actual locations. Additional detailed information on utilities is provided in Appendix D.

Table 6-5. Preliminary Estimate of Modifications to Utilities for the Recommended Plan

Utility Modification	Quantity
Parallel Overhead Powerline Relocations	~1 mile
Overhead Electrical Crossing Modifications	20 crossings
Adjacent Groundwater Well Abandonments	10 wells
Drainage Culvert Conflicts	4 Conflicts
Pipeline Overcrossing Replacements	5 replacements
Pipeline Undercrossing Replacements	5 replacements
Utility Crossings at Bridges	20 crossings

Estimated Quantities and Cost

A list of items that will be included in the summary of quantities and costs is included in Table 6-6. A cost estimate is provided in Table 6-7.

Table 6-6. Recommended Plan Alternative Summary of Estimated Quantities

	-	Seg 1: 5th Ave. to Tule	Seg 2: Tule to Deer Creek	Seg 3: Deer Creek to White River	Seg 4: White River to Ave. 8	Seg 4: Ave. 8 to Woollomes	-
Design Flow (Design Maximum) (cfs)	-	4,500	4,000	4,000	3,500	3,500	-
From MP to MP	-	88.2-96.67	95.67-102.7	102.7-112.9	112.9-115.94	115.94-121.5	-
Total Canal Miles	-	7.47	7.0	10.2	3.04	5.56	-
Description ***NEW CANAL***	***Unit***	***Quantity***	***Quantity***	***Quantity***	***Quantity***	***Quantity***	***Total***
Excavation	CY	125,000	1,813,350	2,558,850	330,750	75,000	**4,902,950**
Compacted Canal Embankment construction	CY	100,000	1,727,000	2,437,000	315,000	60,000	**4,639,000**
Concrete Lining	SY	4,200	396,905	632,657	184,000	2,800	**1,220,562**
Concrete for Structures	SY	-	19,976	30,682	6,501	-	**57,159**
Reinforcing Steel	lbs	-	3,822,812	5,945,669	117,035	-	**9,885,516**
Ladders	EA	105	99	144	46	-	**394**
Aggregate base O&M road surfacing	SY	104,221	98,653	105,011	47,000	77,067	**431,952**
CHECK STRUCTURES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
New Check/Siphon Structure	-	-	1	1	-	-	**2**
Existing Check Structures Demolition and Disposal	-	-	1	1	-	-	**2**

Table 6-6. Recommended Plan Alternative Summary of Estimated Quantities (contd.)

		Seg 1: 5th Ave. to Tule	Seg 2: Tule to Deer Creek	Seg 3: Deer Creek to White River	Seg 4: White River to Ave. 8	Seg 4: Ave 8 to Woollomes	
ROAD CROSSINGS – BRIDGES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Bridge Replacement on Existing Canal – County or State Bridges	EA	-	-	-	-	-	-
Bridge Replacement on Existing Canal – Farm Bridges	EA	-	-	-	-	-	-
Existing Bridge Demolition	EA	-	7	12	2	-	21
ROAD CROSSINGS – SIPHONS	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Siphon Construction on New Canal	EA	-	6	11	-	-	17
TURNOUTS	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Raise/Modify Existing Turnout Top Deck and Actuators	EA	7	1	-	-	5	13
Turnouts on New Canal	EA	-	9	8	1	-	18
Delivery Pools	EA	-	2	7	1	-	10
UTILITIES	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Parallel Overhead Powerline Relocations	Feet	-	800	4,400	-	-	5,200
Overhead Electrical Lines	EA	-	7	11	1	-	20
Adjacent Groundwater Well Abandonments	EA	-	4	6	-	-	10
Culvert Extensions (Each End)	EA	-	2	2	0	-	4
Pipeline Overcrossing Replacements (8" to 12")	EA	-	1	2	2	-	5
Impacted Utility Crossings (Attached to Existing Bridge sizes range from 4" to 24")	EA	-	5	11	4	-	20
LAND ACQUISITION	**Unit**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Quantity**	**Total**
Impacted Parcels	EA	69	17	25	20	8	139
Permanent Land Acquisition (ROW)	Acre	-	138	230	62	-	430

Key:
- = Not Applicable or zero
cfs = cubic feet per second
CY = cubic yard
EA = each
Lbs = pounds
LF = linear feet
LS = lump sum
MI = mile
MP = milepost
O&M = operations and maintenance
ROW = Right of Way
SY = square yard

Table 6-7. Recommended Plan Alternative Cost Estimate

Item	Reference	Cost	Notes/ Inclusions
Segment 1 - 5th Ave to Tule	from estimate	$7,434,215	
Segment 2 - Tule to Deer Creek (New Bypass Canal)	from estimate	$71,146,020	
Segment 3 - Deer Creek to White River (New Bypass Canal)	from estimate	$106,108,628	
Segment 4a - White River to Garces Hwy (New Bypass Canal)	from estimate	$18,320,084	
Segment 4b - Garces Hwy to Woollomes (Widen Existing Canal)	from estimate	$4,027,327	
Construction Allowances, Mobilization, Startup, Commission, and Owner Training	from estimate	$6,315,222	
Subtotal		$213,351,496	
Contract Cost Allowance - Design Contingency	17%	$36,239,754	
Contract Cost		**$250,000,000**	Rounded
Construction Contingencies	20%	$50,000,000	
FIELD COST		**$300,000,000**	Rounded
Land Purchase - Construction Phase and ROW		$20,000,000	Based on market research
Environmental Mitigation	5%	$29,000,000	From separate estimate
Engineering, Permitting, and Construction Management	20%	$60,000,000	Calculated as % of Field Cost
Legal and Administrative	2%	$6,800,000	Calculated as % of Field Cost
Non-Contract Costs		**$115,000,000**	Rounded
TOTAL CONSTRUCTION COST		**$415,000,000**	Rounded
Interest During Construction	3% Discount Rate	$25,562,071	4 year construction period
TOTAL CAPITAL COST		**$440,000,000**	Rounded
Annualized Capital Costs		$16,697,158	2.875% (FY19) over 50 years
Additional Annualized O&M Costs		$967,676	Excludes current O&M costs; 2.875% (FY19) over 50 years
TOTAL ANNUALIZED COST		**$17,500,000**	Rounded

Feasibility Determination for the Recommended Plan

A determination of feasibility is based on a review of four tests of feasibility: technical, environmental, economic and financial.

Technical Feasibility

Technical feasibility consists of engineering, operations, and constructability analyses verifying that it would be physically and technically possible to construct, operate, and maintain the Recommended Plan. The Recommended Plan is technically feasible, and includes features to address constructability and long-term operations, as demonstrated above. A Design, Engineering, and Cost (DEC) review will be performed on the Recommended Plan described in this chapter and Appendix D to identify additional information that is required to determine technical feasibility.

Environmental Feasibility

Environmental feasibility consists of analyses verifying that constructing or operating the project would not result in unacceptable environmental consequences or require costs that would adversely affect economic feasibility. Generally, environmental feasibility is based on the completion of NEPA compliance and environmental permitting processes. These processes are underway and are expected to be completed during 2020.

To date, several evaluations have been completed to inform environmental feasibility of the Project. An environmental constraints analysis was performed and applied to the evaluation of Initial Alternatives and selection of Feasibility Alternatives. An Environmental Assessment (EA)/Initial Study (IS) was prepared to evaluate potential environmental effects associated with the Canal Enlargement and Parallel Canal Feasibility Alternatives. The EA/IS identified the following resource areas may that have potentially significant impacts resulting from construction of the Feasibility Alternatives: agriculture/land use, air quality/Green House Gases, biological, cultural and tribal, hydrology, and water quality. Reclamation has determined that a joint Environmental Impact Statement/Environmental Impact Report (EIS/R) will be prepared because the Project could result in significant impacts, is a major undertaking and private land acquisition will be required.

Three cultural resources reports have been completed to support Section 106 compliance for geotechnical investigations of the Project. To date, the findings of two of these reports have been concurred on and the third is currently under review by the California Office of Historic Preservation. Additionally, a Section 106 technical memorandum was prepared in support of immediate repair activities from MP 103 to MP 107 and those findings have also been concurred on by the California Office of Historic Preservation.

Work is progressing on preparation of Section 106 reporting for the complete Project. Reclamation has established an Area of Potential Effect (APE) that accounts for potential direct

and indirect effects of the Recommended Plan. Pedestrian surveys have been completed for all property within the Reclamation ROW, publicly accessible direct and direct APE have been completed, and a records search with a 1-mile search area of the entire project area from Mile Post 88 to 121 has been completed. The effects analysis is underway, the Section 106 report is in preparation, and a historic property treatment plan is in the early stages of development.

For biological resources, two Section 7 consultations have been completed for geotechnical investigations of the Project. The schedule for the Section 7 compliance consultation with the US Fish and Wildlife Services for the complete Project has been set. An aquatic resources delineation report for the Project is in preparation, and habitat characterization and assessment of potential biological in the Project area is in progress.

Environmental Mitigation Cost Estimates

The Feasibility Alternatives cost estimates presented in Chapter 5 included an allowance for environmental mitigation (which includes cultural resources mitigation) at 5 percent of the field cost. More detailed environmental mitigation cost estimates have been developed and incorporated into the cost estimate for the Recommended Plan.

The design and environmental analyses conducted to date for the project indicate that cost elements associated with environmental mitigation can be grouped into three main categories: 1) biological mitigation, 2) cultural mitigation, and 3) air quality mitigation. It is recognized that potential impacts of other project elements not yet defined, such as borrow pits, construction staging areas, and installation of construction access roads, could result in additional mitigation requirements. Details for each of these three main categories are summarized below.

- Biological Mitigation; general preconstruction surveys, San Joaquin Kit Fox pre-construction surveys, worker environmental awareness training (WEAT), environmental compliance monitoring during construction, fish salvage during canal tie-ins, and compensatory mitigation for San Joaquin Kit Fox.

- Cultural Mitigation; data recordation and mitigation for above-ground bridges and the FKC, WEAT, Construction monitoring for archeological and paleontological resources, and tribal monitoring in the vicinity of Deer Creek and White River.

- Air Quality Mitigation; preparation of a fugitive dust plan, and Voluntary Emission Reduction Agreement (VERA) with the San Joaquin Valley Air Pollution Control District.

Table 6-8 provides a budget estimate for each of the cost elements listed above, grouped into the three main categories. The following assumptions were used in developing these cost estimates:

- Construction monitoring for cultural resources, tribal resources, San Joaquin Kit Fox, and other biological resources for 3 years

- San Joaquin Kit Fox compensatory mitigation approach similar to the California High Speed Rail Project. Mitigation ratios of 2.0 to 1 for natural habitat; .and 0.1 to 1 for developed habitat.
- San Joaquin Kit Fox compensatory mitigation cost $15,000 per acre
- VERA approach similar to Reclamation's 2017 Reach 2B Mendota Pool Bypass Project

Table 6-8 Estimated Environmental Mitigation Cost

Item	Cost Estimate
Biological Mitigation	
General Pre-construction surveys	$133,000
San Joaquin Kit Fox pre-construction surveys	$1,464,000
WEAT	$20,000
During-construction compliance monitoring	$3,337,000
Fish Salvage	$279,000
Compensatory San Joaquin Kit Fox mitigation	$13,895,000
Subtotal, Biological Mitigation	**$19,128,000**
Cultural Mitigation	
Data recordation and mitigation for above-ground bridges and the FKC,	$150,000
WEAT	$20,000
Construction monitoring for archeological and paleontological resources	$2,246,000
Tribal monitoring in the vicinity of Deer Creek and White River	$1,123,000
Subtotal, Cultural Mitigation	**$3,539,000**
Air Quality Mitigation	
Fugitive dust plan	$100,000
VERA	$6,000,000
Subtotal, Air Quality Mitigation	**$6,100,000**
Total Estimated Mitigation Cost	**$28,767,000**

Economic Feasibility

As discussed in Chapter 5 the monetary benefits of the Feasibility Alternatives were determined using a 100-year planning horizon, that anticipates the regional subsidence will continue to cause a decrease in capacity of the FKC. The benefits of the Feasibility Alternatives presented in Chapter 5 are based on the differences in the delivery reduction in comparison to the No Action Alternative. The Recommended Plan is a design refinement of the Parallel Canal Feasibility Alternative that resulted in lower costs without reducing the estimated benefits. Table 6-9 shows the planning horizon analysis for the Recommended Plan. Computations are made for each year

in the planning horizon. For ease of presentation, the tables report annual results for years 1 through 10 and then every decade following until year 100, the end of the planning horizon. The table provides the net present value of reduced water supply over the planning horizon.

A summary of benefits associated with water deliveries and costs of the Recommended Plan is provided in Table 6-10. As shown in Table 6-9, the calculated B-C ratio for the Recommended Plan is 2.0.

Table 6-9. Recommended Plan Horizon Analysis

Year	Average Annual Deliveries (TAF)	Average Annual No Action Affected Water Supply (TAF)	Reschedule in Millerton (TAF)	Percent Groundwater Pumping (%)	Assumed Groundwater Pumping (TAF)	Average Annual Reduction in Supply (TAF)	Value of Water Lost ($M)	Groundwater Pumping Cost ($M)	Annual Value of Water ($M)
1	410.2	41.3	15.6	90%	23.2	2.6	$271	$221	$5.8
2	408.2	46.1	17.3	80%	23.0	5.8	$271	$224	$6.7
3	406.2	50.9	19.0	70%	22.3	9.5	$271	$226	$7.6
4	404.2	55.6	20.8	60%	20.9	13.9	$271	$229	$8.6
5	402.2	0.0	0.0	50%	0.0	0.0	$271	$229	$0.0
6	400.2	0.0	0.0	40%	0.0	0.0	$271	$229	$0.0
7	398.2	0.0	0.0	30%	0.0	0.0	$271	$229	$0.0
8	396.2	0.0	0.0	20%	0.0	0.0	$271	$229	$0.0
9	394.2	0.0	0.0	10%	0.0	0.0	$271	$229	$0.0
10	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
20	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
30	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
40	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
50	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
60	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
70	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
80	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
90	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
100	392.2	0.0	0.0	0%	0.0	0.0	$271	$229	$0.0
								Net Present Value	$28

Table 6-10. Benefit Cost Analysis of Recommended Plan

Item	Recommended Plan
Value of reduced water delivery in the No Action Alternative[1,2]	$923
Value of reduce water delivery in the Project Alternative[1,2]	$28
Net Benefit[1,2]	$895
Net Present Value of Total Capital and Life Cycle Costs [1,3]	$451
Cost Range of Net Present Value of Total Capital [1,4]	($375 - $527)
B-C Ratio[5]	2.0

Notes:
[1] All costs are in millions of dollars
[2] Net Present Value based on 100-year project life
[3] Construction Cost of Initial Alternatives
[4] +/- 25% applied to field cost
[5] B-C Ratio based on Net Present Value of Total Capital and Life Cycle Costs (Total Construction Cost + IDC + OM&R)

Financial Feasibility

Financial feasibility consists of examining and evaluating project beneficiaries' ability to pay their allocated portion of the Recommended Plan, consistent with applicable law. Funding for the Project is expected to be derived from Federal and non-Federal sources. On the basis of WIIN Act authorizations, the Project is eligible for Federal funding of up to 50 percent of Project costs. FWA has been pursuing and evaluating multiple sources of funding to provide the non-Federal cost share, including potential funding from the State of California and financing through the FWA or member agencies. A summary of Federal and non-Federal funding under the SJRRS Act and the WIIN Act is shown in Table 6-11.

Table 6-11. Eligible Project Funding

Authorization	Federal Funds	Non-Federal Funds	Total
SJRSS Act	$18,900,000	$0	$18,900,000
WIIN Act	$198,050,000	$198,050000	$396,100,000
Total	$216,950,000	$198,050000	$415,000,000

Risk and Uncertainty

As described above, the Recommended Plan is economically feasible. However, as also described above and in Chapter 5, several assumptions have been made that can affect estimated project benefits and the resulting B-C ratio. In the economic analysis of the Recommended Plan, most assumptions regarding uncertainty were made that would result in conservative (i.e. lower

benefit) estimates. This section describes how uncertainty regarding assumptions could affect estimated project benefits and the B-C ratios of the Recommended Plan. The evaluations presented below provide a reasonable range of expected outcomes under uncertainty.

Future Water Value

The economic analysis of the Recommended Plan is based on the estimated current value of agricultural water in the eastern San Joaquin Valley (representative of the Friant Division of the CVP). These values were developed by the CWC in 2015 through application of the State-Wide Agricultural Production (SWAP) model based on CALSIM II simulations of CVP and SWP operations that reflect water rights, contracts, and regulatory requirements, and the continued unrestricted availability of groundwater. The CWC classified the values of water estimated under projected 2030 land-use conditions as current values. The economic analyses of the Recommend Plan applied the 2030 (current) water values on a constant basis throughout the 100-year planning horizon. This analysis assumes that water values would not increase in response to reduced water supply availability due to SJRRS and SGMA implementation, changes in commodity values, changes in irrigation technology, or other factors.

The value of surface water in the eastern San Joaquin Valley has increased over the past several years as the percentage of land planted to permanent crops has increased, irrigation technology improvements have been implemented, more land has been brought into production, surface water supply reliability in the San Joaquin Valley have decreased, the reliance on groundwater has grown, and groundwater depth has increased. As described in Chapter 1, the State of California enacted SGMA in 2014, which requires the development and implementation of sustainable groundwater management practices. SGMA mandates that GSPs be developed by 2020 and groundwater sustainability be achieved by 2040 for “high priority basins”. The entire Friant Division of the CVP overlies groundwater basins that are designated as “high priority basins”, therefore it is expected that full SGMA compliance in the eastern San Joaquin Valley will be achieved by 2040. It is expected that water values in the eastern San Joaquin Valley will change over time in response to changes in water supply availability, particularly in response to SGMA implementation, because groundwater use will be limited to amounts that do not cause undesirable effects such as additional subsidence.

In 2015, the CWC also prepared estimates of future agricultural water value in California based on the same land uses, water rights, contracts and regulatory requirements as those included in the 2030 analysis, plus assumed groundwater availability limitations due to SGMA implementation. The resulting values are significantly greater than those based on 2030 conditions. While it is not certain that actual water values will result as projected, these estimates provide an indication of the potential future value of agricultural water supply in the eastern San Joaquin Valley once SGMA compliance is achieved. A comparison of 2030 (non-SGMA) and 2040 (with SGMA) values is provided in Table 6-12. For the economic analysis of the Recommend Plan, the 2030 values provided by the CWC in 2015 were escalated to a 2018 price level using once the U.S. Bureau of Economic Analysis GDP Deflator. The same escalation was applied to the 2040 values for use in this uncertainty analysis.

Table 6-12. Estimated Water Values in the Eastern San Joaquin Valley

Year	Estimated Consumptive Use Water Value ($/AF)	
	2015 Price Level	2018 Price Level
2030	$256	$271
2040	$511	$540

Source: CWC WSIP Technical Reference Document

If the value of agricultural water in the eastern San Joaquin Valley increases from the current value of $271/af to $540/af by the year 2040 in the planning horizon analysis and then remained constant at that value for the remaining of the planning horizon with all other variables unchanged, the net benefits of the Recommended Plan would increase by $808M and the B-C ratio would increase to 3.8.

Date Future Subsidence Stops

The economic analysis of the No Action Alternative and Recommended Plan is based on a projection of continued subsidence in response to gradually reduced groundwater pumping between 2018 and 2040 to levels that achieve SGMA requirements. The groundwater model simulations, which were based on a range of pumping reductions to achieve SGMA compliance by 2040, show that subsidence would continue at a generally consistent rate through 2030, then slow between 2030 and 2040 when actions to achieve SGMA requirements would be fully implemented. Groundwater model results also reveal that additional land subsidence would continue through 2070 as a result of residual consolidation of subsurface formations. As noted previously, GSAs in the region are in the process of developing their SGMA compliance plans and therefore is not precisely known how regional subsidence would occur.

If land subsidence occurs as projected from 2018 to 2040 and no additional subsidence occurs after 2040 and all other variables remain unchanged, the net benefits of the Recommended Plan would decrease by $104M and the B-C ratio would decrease to 1.8.

Design for Projected Future Subsidence

All analysis of the Recommended Plan is based on a 2018 topography and assumes the project will be built to the design capacity based on that ground surface. The analysis also included an evaluation of costs and required land acquisition of the Recommended Plan based on providing the design capacity at projected land conditions in the year 2040, based on land subsidence estimates developed using the groundwater analysis described above. The total increase in costs to accommodate future subsidence in the Recommended Plan is estimated at an additional $48M.

If the Recommended Plan includes features to provide the design capacity at the projected future land surface in 2040 and all other variables remain unchanged, the net benefits of the Recommended Plan would remain unchanged and, due to the increase in total construction cost, the B-C ratio would decrease to 1.8.

Millerton Reoperation

The economic analysis of the Recommended Plan assumes that affected water supplies could be rescheduled in Millerton Lake to subsequent months when the Friant Division contractor has sufficient water demand and capacity is available in the FKC. The only constraint applied to this operational assumption in the Recommended Plan was that the reoperation of affected water supply in Millerton Lake could not affect existing flood control requirements and operations. The analysis did not consider potential limitations to storing Class 2 water in Millerton Lake longer than the contractual maximum of 30 days. The analysis also assumes that water users could increase the use of non-CVP water supplies when canal capacity limits deliveries and would have perfect foresight of hydrologic conditions to predict when such changes would be required. Due to these assumptions, the analysis likely overestimates the amount of affected water supply that could be rescheduled, and therefore likely underestimates the water supply impact of the No Action Alternative. While it is not possible to precisely estimate the extent to which water users and Reclamation could optimize the use of Millerton Lake and the FKC to reschedule allocated water supplies, it is expected that no more than 70 percent of the affected water supply could be available for rescheduling in Millerton Lake and delivery in any given month.

If the amount of affected water supply that available be rescheduled in Millerton Lake is limited to 70 percent and all other variables remain unchanged, the net benefits of the Recommended Plan would increase by $121M and the B-C ratio would increase to 2.3.

Construction Duration Due to Funding Availability

The economic analysis of the Recommended Plan assumes a construction duration of four years, and the availability of funding to enable uninterrupted construction of all plan features. In the economic analysis, this assumption is reflected in the planning horizon analysis in the benefits provided by the project in the first three years and costs associated with construction and IDC. If the availability of funds is delayed, the rate of construction would be reduced, and the duration of construction would increase.

If availability of funding to implement the Recommended Plan required that the construction duration increase from three years to six years all other variables remain unchanged, the net benefits of the Recommended Plan would decrease by $19M and the B-C ratio would decrease to 1.95.

Reduced Deliveries in the Subsidence Section of the Canal

As described in Chapter 2, the reduced capacity of the FKC caused by subsidence limits flows can be conveyed for downstream deliveries, resulting in reduced water supplies to downstream Friant Division long-term contractors. The benefits of the Recommended Plan are based on avoiding reduced downstream deliveries that would occur in the No Action Alternative. In addition, subsidence in the Middle Reach of the FKC has decreased, and will further decrease, available head (water level) at water turnouts in the subsided reach and in some upstream portions of the FKC. The water diversion capacity of up to 6 gravity turnouts downstream from

Tule River Check Structure and the upstream from Deer Creek Check Structure is reduced and will further decline in the No Action Alternative as subsidence continues. It is likely that modifications would be required to some or all of these gravity turnouts to maintain continued delivery of allocated CVP contract supplies. While specific improvements have not been evaluated, or valued, it is expected that temporary permanent, pumps would be installed to assure access to contract water supplies. The timing of pump installation and use in the No Action Alternative would depend on site specific conditions for each contractor and CVP water supply availability. The Recommended Plan will return the HGL to restore the ability of these turnouts to deliver water at their designed capacity. If the reduced deliveries immediately upstream of the subsided section of the canal were valued, the quantified benefits of the Recommended Plan would be greater than those presented in this Report.

Summary of Risk and Uncertainty Findings

A summary of risk and uncertainty factors on project costs and benefits is provided in Table 6.13. Although the identified risk and uncertainty factors have the potential to increase or decrease project costs and benefits, none have been identified that could be expected to reduce the benefit cost ratio to less than one.

Table 6.13. Summary of Risk and Uncertainty Effect on Economic Feasibility of the Recommended Plan

Risk and Uncertainty Factor	**Change in Net Benefits from Recommended Plan ($M)**	**Benefit-Cost Ratio Based on Risk and Uncertainty Factor**
Recommended Plan	No change	2.0
Potentially Greater Future Water Value	808	3.8
Potential Less Future Subsidence	-104	1.8
Project Design for Projected Future Subsidence	No change	1.8
Ability to Operate Affected Water Supply in Millerton Lake	121	2.3
Potential Extended Construction Duration Due to Funding Availability	-19	2.0
Reduced Water Deliveries in the Subsided Portion of the FKC	Increase – not quantified	Increase – not quantified

Implementation Requirements

Implementation of the Recommended Plan would include major activities for design, environmental compliance and permitting, land acquisition, financing, and construction and O&M. It is anticipated that FWA would to lead all of these activities in close coordination with Reclamation. A schedule for implementation is shown in Figure 6-6, and brief descriptions of major activities is provided in the following sections.

Design Activities

FWA, in coordination with Reclamation, has begun to advance design of the Recommended Plan. This will include several the following key steps:

- DEC Review of the Recommended Plan
- Preparation of a 30 percent design report
- Geotechnical investigations to support final design
- Preparation of 60 percent, 90 percent, and 100 percent designs
- Establishing agreements with key project partners and stakeholders (e.g. Tulare County, SCE, So Cal Gas, Kern County) related to planning design, and construction activities.
- Preparing detailed plans, specifications, and bid packages.

Environmental Compliance and Permitting

Reclamation is initiating environmental compliance and permitting activities, in coordination with the FWA, to conduct and complete required NEPA and CEQA environmental compliance and all necessary permitting before implementation of the Project. Several key activities include the following:

- Required environmental compliance under NEPA and CEQA will involve preparation of a joint EIS/EIR document and issuance of a Record of Decision (ROD) and Notice of Determination (NOD), on the following schedule:
    - Notice of Intent/Notice of Preparation (NOI/NOP) - November, 2019
    - The Draft EIS/EIR release for public review - late January/early February, 2020
    - The Final EIS/EIR released to public - May, 2020
    - The Record of Decision (ROD) - October 2020

- Permitting requirements of Federal, state, and local laws, policies and environmental regulations.
- Implementation of mitigation measures may proceed before, or consistent with construction of project physical features.

Land Acquisition

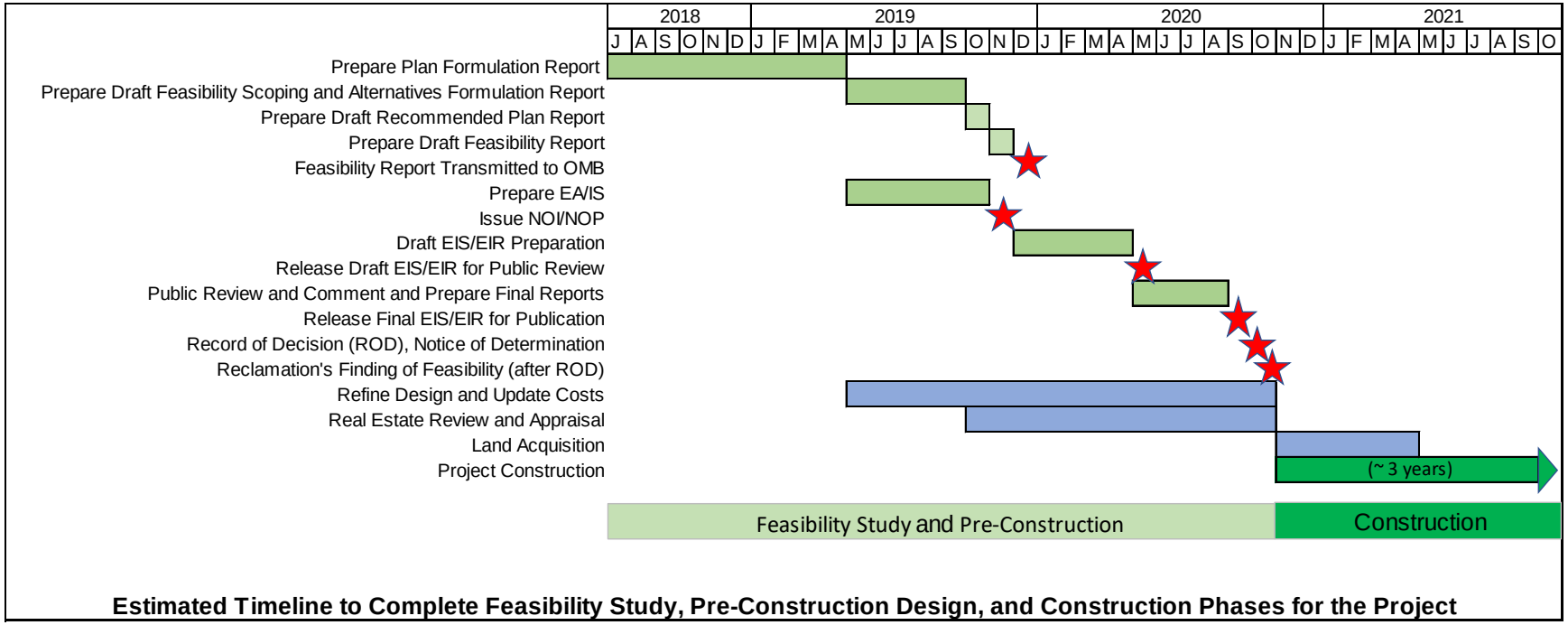
Following completion of NEPA and CEQA compliance requirements, FWA would initiate activities in coordination with Reclamation to complete the acquisition of required lands, easements, and ROW.

Financing

Funding for the project would be obtained through Federal appropriations and non-Federal sources prior to the initiation of construction. If all project funds are not available at the time of construction initiation, the Project would be segmented into construction packages that could be accomplished with available funding to address the most urgent capacity correction portions of the Project.

Project Construction and Transfer to O&M Status

After the completion of environmental compliance and permitting, design, land acquisition, and financing, project implementation efforts would transition to the preparing and executing construction contracts, starting implementation of mitigation measures and/or construction activities, completing construction activities, commissioning new facilities, and finally, operating and maintenance responsibilities. FWA, in coordination with Reclamation, would solicit and award one or more construction contracts based that can be accomplished with available funds and right of way. As shown in Figure 6-6, construction is estimated to occur over a 3-year period, assuming all necessary funding and right of way is available.



Estimated Timeline to Complete Feasibility Study, Pre-Construction Design, and Construction Phases for the Project

Figure 6-6. Friant-Kern Canal Middle Reach Capacity Correction Project Feasibility Study

Federal and Non-Federal Responsibilities

If a project is recommended for implementation, Federal and non-Federal obligations and requirements would be contained in a Project Cooperation Agreement (PCA).

Federal Responsibilities

If recommended for implementation, Reclamation would complete the required environmental analyses and documentation for NEPA. This includes other Federal laws, policies, and plans that may affect the implementation of any plan authorized for construction (e.g. Federal Endangered Species Act, National Historic Preservation Act Section 106). Reclamation would review and approve project designs, approve bid packages, approve the plan for Real Estate Acquisition, Administer Federal Funding, and monitor construction progress and closeout.

Non-Federal Responsibilities

Before implementation the FWA would perform items of local and state cooperation specific to the project. This would include the completion of environmental documentation for CEQA and acquiring relevant local and state permits. The FWA would also lead the completion of design of the project, acquire ROW, and obtain necessary non-Federal funding. In additional FWA would award construction contract(s), manage the construction of the project. Once completed FWA will continue with long-term O&M requirements as agreed upon with Reclamation.

Chapter 7
Findings

This Study includes development, evaluation, and comparison of alternatives consistent with the Federal PR&G (CEQ 2013). In coordination with this report, a Final EIS/R will be prepared consistent with NEPA and CEQA. This chapter summarizes major findings and conclusions of this Study.

Need for Project

The reduced capacity of FKC Middle Reach has resulted in water delivery impacts on Friant Division long-term contractors, reduced ability of the FKC to convey flood waters during wet periods, and reduced ability to implement provisions of the Water Management Goal as described in Paragraph 16 of the San Joaquin River Restoration Settlement (Settlement). The reduced delivery of water via the Friant-Kern Canal under long-term Friant Division contracts, the Recovered Water Account (RWA), and Unreleased Restoration Flows (URFs) also reduces funding necessary to implement the Restoration Goal provisions of the Settlement as described in Paragraph 11.

The purpose of the Project is to restore the conveyance capacity of the FKC Middle Reach to such capacity as previously designed and constructed by Reclamation, as provided for in the San Joaquin River Restoration Settlement Act (Public Law 111-11, Title X, Part III(a)(1)). The purpose of this Study is to describe the formulation, evaluation, and comparison of alternatives that address Project planning objectives and identify a Recommended Plan consistent with Federal authorizations and requirements. Information developed through the Study will be used in preparation of required environmental compliance documentation.

Recommended Plan

As required by the PR&G, the plan that produces the greatest net public benefit is identified as the Recommended Plan and is typically selected for recommendation to the Secretary of the Interior for consideration and approval (CEQ 2013). The identification of the Recommended Plan based upon the evaluation and comparisons described in Chapter 5. The Recommended Plan is described in detail in Chapter 6 and summarized below.

Recommended Plan Major Components

Major components of the Recommended Plan include:

- **Canal Enlargement** — The existing canal would be enlarged by raising the lining one to four feet from MP 88.2 to MP 95.7 and MP 119.0 to MP 121.5.

- **Canal Realignment** — A new realigned canal would be the exclusive water conveyance and delivery mechanism and most of the existing FKC would be demolished, filled in, and taken out of service. The realignment would stretch from MP 96.3 to MP 115.94.

- **Turnouts** — The approach to the turnouts varies by location and configuration. Turnouts in the canal enlargement portion would not be modified. In the canal realignment portion gravity turnouts would be replaced and new delivery pool turnouts would be constructed for pressurized turnouts along the canal realignment potion.

- **Checks and Siphons** — New or replacement check structures, wasteways and siphons would be required at the Deer Creek and White River crossings

- **Road Crossings** — Road crossings would either be left in place or replaced with a concrete box siphon, depending on the location.

- **Utilities** — Depending on the location and extent of canal modifications, the utilities like overhead power lines, adjacent wells, and elevated pipeline canal crossings would either be relocated or entirely replaced.

Costs and benefits

A summary of the B-C analysis is presented in Table 7-1 below.

Table 7-1. Benefit Cost Analysis of Recommended Plan

Item	Recommended Plan
Value of reduced water delivery in the No Action Alternative[1,2]	$923
Value of reduce water delivery in the Project Alternative[1,2]	$28
Net Benefit[1,2]	$895
Net Present Value of Total Capital and Life Cycle Costs [1,3]	$451
Cost Range of Net Present Value of Total Capital [1,4]	($375 - $527)
B-C Ratio[5]	2.0

Notes:
[1] All costs are in millions of dollars
[2] Net Present Value based on 100-year project life
[3] Construction Cost of Initial Alternatives
[4] +/- 25% applied to field cost
[5] B-C Ratio based on Net Present Value of Total Capital and Life Cycle Costs (Total Construction Cost + IDC + OM&R)

Feasibility of the Recommended Plan

Feasibility of the Recommended Plan is summarized below.

- The Recommended Plan was found to be technically feasible and constructible. The Recommended Plan could be implemented with a balance or surplus of material. Designs and cost estimates for the Recommended Plan have been developed to a feasibility-level and will be verified through the DEC Review process.

- The Recommended Plan was found to be economically feasible on the basis that monetized benefits for avoided water supply shortages exceed project costs. As evaluated in this report, Recommended Plan produces a B-C ratio of 2.0.

    - The B-C ratio was calculated using a planning horizon benefits analysis over the project service life of 100 years, and feasibility-level construction costs, IDC, and, life cycle costs.

    - Regional subsidence is expected to continue and cause a decrease in the capacity of the FKC in the No Action Alternative and the performance of the Recommended Plan. Benefits of the Recommended Plan are based on differences in delivery reduction value, or avoided water shortages, in comparison to the No Action Alternative.

- Environmental compliance and permitting processes are under way. An environmental constraints analysis and EA/IS were prepared and an EIS/R is in development. Cultural and biological resources analysis are ongoing and will be incorporated into the EIS/R. The Record of Decision for the EIS/R is anticipated for October 2020.

- More detailed environmental mitigation cost estimates for biological mitigation, cultural mitigation, and air quality mitigation have been developed and incorporated into the cost estimate for the Recommended Plan.

- Funding for the Project is expected to be derived from Federal and non-Federal sources, potentially including the WIIN Act and financing through FWA member agencies.

Risks and Uncertainty

- The design of features in the Recommended Plan is based on the surveyed land surface in 2018. Because additional subsidence is expected to occur in the region over the next several years while compliance with SGMA is achieved, the design for Recommended Plan was evaluated based on a projected land surface in 2040. The resulting design based on 2040 land surface would increase the cost of the Recommended Plan by approximately $48 million and reduce the B-C ratio to 1.8.

- The effect of uncertainty on net benefits and the B-C ratio resulting from several factors, such as future water value, the date subsidence would stop, reoperation of affected water

deliveries in Millerton Lake, and lengthened construction duration was evaluated. The resulting B-C ratios would range from 1.95 to 3.8.

- The performance of the Recommended Plan was evaluated using historical operations and does not consider potential future water deliver requirements that could exceed historical peak flows in the FKC. The net benefits and B-C ratio of the Recommend Plan would increase if future operational objectives include deliveries that exceed historical peak flows.

Federal Interest

This Report demonstrates Federal interest in the Recommended Plan. The Recommended Plan was identified as the NED Plan among two Feasibility Alternatives and produces a B-C ratio of 2.0. Federal participation for design and construction is authorized in Part III of the Settlement Act, and the Project is eligible for Federal funding pursuant to the WIIN Act.

Environmental Compliance and Regulatory Requirements for Project Implementation

The Final EIS/R will satisfy NEPA and CEQA requirements by providing a meaningful analysis of all issues relevant to the physical, biological, cultural and human environments. Implementation of the Recommended Plan will also be subject to additional Federal, State, and local laws, policies, and environmental regulations. All Federal, State, and local agencies with permitting or approval authority over any aspect of project implementation will be expected to use the information that will be included in the Final EIS to meet most, if not all, of their information needs, to make decisions, and/or issue permits with respect to the authorized project.

Findings

The following findings are made based on the evaluation of Feasibility Alternatives:

- The Recommended Plan has been found to be technically and economically feasible, and appears to be environmental feasible based on evaluations completed to date in support of NEPA compliance and permitting. Financial feasibility will be determined as Federal and non-Federal financing is identified.

- Uncertainty evaluations have demonstrated that the B-C ratio would remain greater than one under a variety of potential conditions that could affect costs and benefits of the Recommended Plan.

- Implementation of the Recommended Plan would restore the ability of the FKC to convey flood waters during wet periods and implement provisions of the Water

Management Goal as described in Paragraph 16 of the San Joaquin River Restoration Settlement. The restored capacity of the FKC would avoid water shortages, and resulting reduced revenue, associated with delivery of water under long-term Friant Division contracts, the Recovered Water Account (RWA), Unreleased Restoration Flows (URFs) and other available water supplies.

- Restoring the capacity of the FKC would support greater conjunctive management of Friant Division resulting in increasing groundwater storage and improved management of Friant Division water supplies in Millerton Lake.

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Chapter 8
Recommendations

This section presents describes recommendations for action by the Secretary or through Congressional action in support of implementing the Recommended Plan and identifies Federal and Non-Federal roles for implementing the Recommended Plan.

Recommendations

As the Recommended Plan is being reviewed for Congressional recommendation and appropriations, the following items should be considered:

- Approve the Recommended Plan, as described in this Report.
- Allow Reclamation to increase the construction cost to allow for escalation from stated price levels (2018) to the notice to proceed for each contract or work package, based upon Reclamation's Construction Cost Trends publication, or similar source.
- Appropriate funds such that pre-construction activities are completed within 2 years and construction is completed within 3 years following construction initiation to avoid cost overruns and ensure timely completion.
- Allow the Federal Government to accept title to any non-Federal property within the Project boundaries.

Federal Role

Under the Recommended Plan, the Federal Government would have the following roles and responsibilities:

- Complete a Final EIS, all federal permitting, and prepare a ROD.
- Identify Federal funding requirements
- Review and approve Project designs, environmental compliance and permitting documentation, and land acquisition services proved by FWA
- Perform DEC review of the Recommended Plan
- Perform value engineering and constructability review of Project design documents

- Review and approval of construction bid packages and selection of a construction contractor.
- Provide administrative and technical support during planning, design, and construction.
- Accept transferred title of acquired lands and constructed Project.

Non-Federal Role

Under the Recommended Plan, the following roles apply to non-Federal entities:

- Complete investigation and design of all project facilities, including mitigation requirements.
- As the CEQA lead, FWA would complete a final EIS/R and all state permitting.
- Acquire lands necessary for implementation of the Recommended Plan.
- Construct all project facilities.
- Transfer acquired lands and constructed facilities to Reclamation.

Chapter 9 References

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Chapter 9
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Audubon | CALIFORNIA

December 18, 2019

Pixley Irrigation District Groundwater Sustainability Agency
357 E. Olive Avenue
Tipton, CA 93272

Sent via email to pixleygsp@ltrid.org

Re: Comments on Draft Groundwater Sustainability Plan for Pixley Irrigation District Groundwater Sustainability Agency

Dear Mr. Eric Limas,

Audubon California appreciates the opportunity to provide public comment on the draft Groundwater Sustainability Plan (GSP) for Pixley Irrigation District Groundwater Sustainability Agency (Pixley ID GSA).

Audubon California is a statewide nonprofit organization with a mission to protect birds and the places they need. Our organization has a long history of solutions-focused work in the Central Valley in collaboration with state and federal agencies, water districts, non-profits, and landowners. We are commenting on draft GSPs to provide technical information and to identify areas of opportunity to partner with landowners or GSAs to achieve groundwater and wildlife habitat benefits.

Audubon California is reviewing GSPs as a stakeholder for the environment with a particular focus on wetlands. Over 90 percent of historic wetlands in the Central Valley have been replaced with agriculture or urban development. The remaining wetlands are a critical component of the Pacific Flyway, supporting millions of migratory waterfowl, hundreds of thousands of shorebirds, and state listed species like the Tricolored Blackbird and Greater Sandhill Crane. Central Valley wetlands are part of California's commitment to national and international Pacific Flyway agreements and provide significant public trust benefits, including habitat for migratory birds, recharge of overdrafted aquifers, carbon sequestration, and recreation opportunities for birders, hunters, and disadvantaged communities.

Reflecting the critical importance of wetlands in the Tulare Basin planning region that includes Pixley ID GSA, the Central Valley Joint Venture set a wetland restoration target of 11,000 acres to sustain waterfowl populations. The Central Valley Joint Venture is a collaboration of 19 public and private entities, including Audubon, that sets science based bird population and habitat restoration objectives to support the goals of an international treaty between the United States, Canada, and Mexico, the North American Waterfowl Management Plan. The habitat restoration goals in the Tulare Basin planning region point to an already existing habitat deficit to supply the food energy needed for waterfowl and shorebird populations. Any loss of managed wetlands will undermine Central Valley Joint Venture goals and only increase the existing habitat deficit.

Out of approximately 69,500 acres within Pixley ID GSA 755 acres are actively managed wetlands as part of Pixley National Wildlife Refuge (NWR), which is a 7,405 acre refuge of wetland and upland habitat owned and managed by the United States Fish and Wildlife Service. The managed wetlands on

Pixley NWR provide public trust benefits, including habitat for migratory waterfowl, shorebirds, and listed species like the Tricolored Blackbird and Greater Sandhill Crane. Disconnected from natural water sources as a consequence of surface water diversions and groundwater overpumping, wetland managers must now utilize limited surface water deliveries or pump groundwater to provide flooded habitat. Lowering of groundwater levels that make extraction unsustainable is making proper wetland management increasingly challenging. Pixley NWR pumps approximately 1,280 acre-feet of groundwater annually to provision 755 acres of wetland habitat, and target management would utilize 6,000 acre-feet per year as mandated by the Central Valley Project Improvement Act. The current 755 acres of managed wetlands within Pixley ID GSA comprise approximately 1% of serviced acres, extracting a small amount of groundwater for the outsized benefits they provide. Not only do these lands provide important habitat for waterbirds and wildlife, they provide multiple benefits to the basin such as groundwater recharge and water filtration.

Overall, the draft GSP for Pixley ID GSA does not adequately characterize and consider Pixley NWR and its managed wetlands. Managed wetlands should be identified as beneficial users of groundwater and should be included in the subbasin water budget. Land use maps should be updated to reflect the boundaries of Pixley NWR. Audubon California commends Pixley ID GSA for including environmental benefits as a consideration in recharge projects and siting of land transition, and we encourage the GSA to pursue benefits to Pixley NWR in its future projects.

Page-by-page comments on the Pixley ID GSA draft GSP are detailed below. We welcome any follow up questions and look forward to seeing the issues raised below addressed in the final GSP submission in January 2020.

B.1 P 1-2. Executive Summary. The Executive Summary describes the Tule Subbasin as one of the top producing agricultural regions in the area. Additionally, this section states "[t]he overdraft conditions have caused issues for those reliant on groundwater pumping, which include municipal, domestic, and agricultural users." Environmental users, including managed wetlands, that rely on groundwater pumping should be added to this list and included as beneficial users throughout the GSP.

B.2 P 1-8. 1.4.3.1 Pixley ID Management Area. The GSP identifies the majority of land within the Pixley Irrigation District as used for agricultural and rural purposes. Important habitat areas, including Pixley National Wildlife Refuge (Pixley NWR), are land uses in the management area, and these established habitat areas should be added to this section.

B.3 P 1-10. Figure 1-5: Federal, State, County, and Tribal Jurisdictional Boundaries. This figure inaccurately identifies the boundaries of federal land, the Pixley National Wildlife Refuge, within the management area. There are over 900 acres of the refuge located along Road 80 and between Avenue 96 and Avenue 88 that are not included in this figure. Please revise the map in Figure 1-5 (see U.S. Fish and Wildlife Service Cadastral Geodatabase, updated July 2019). Additionally, parts of Allensworth Ecological Reserve and Allensworth State Park are located adjacent and near the management area. These state lands should be properly identified in this figure.

B.4 P 1-11. Land Use. Based on Table 1-1 (P 1-12) the "riparian" category, which includes Pixley National Wildlife Refuge (see Figure 1-6), is as much as 10% of the total GSA acreage. Therefore, managed habitat that includes the Pixley National Wildlife Refuge should be included as a primary land use of the GSA area.

B.5 P 1-13. 1.4.6 Water Use Sector and Water Use Type. Existing land use designations in the management area include managed habitat that relies completely on groundwater pumping (see comment on P 1-8 and P 1-11). A fourth water use sector should be identified to include managed habitat. Additionally the *Tule Subbasin Settings* report does not provide any estimate of water use for managed habitat. This should be identified as a data gap and prioritized for reconciliation.

B.6 P 1-15. 1.4.6.3 Managed Recharge. Figure 1-8 shows a large recharge basin on the west-side of the management area and along the north bank of Deer Creek. This area is within the Pixley National Wildlife Refuge. As recharge projects are further developed and a system of accounting is implemented it will be important to acknowledge the refuge as providing recharge and the refuge should be credited accordingly.

B.7 P 1-17. Figure 1-10. Potentially Groundwater Dependent Ecosystems within the Pixley ID GSA. This figure does not show any of the Pixley NWR or other habitat lands identified in the prior figures (e.g. Figure 1-5). Considering the history of the Central Valley and current habitat types in this area, land on the Pixley NWR would qualify as potential GDEs. Further evaluation and ground-truthing is needed to properly identify GDEs in this area. Additionally, this section notes "that the average depth to groundwater relative to the root zone for groundwater dependent plants is well below those plants' roots systems." It is important to note that groundwater depth fluctuates annually as well as seasonally and should be considered when determining the extent of GDEs in this management area.

B.8 P 1-35. 1.5.1 Beneficial Users. Beneficial uses of groundwater in the Tule Subbasin are identified as being for "various irrigated and non-irrigated agricultural activities (including but not limited to grazing, vineyards, and orchards); rural domestic/residential wells; municipal and industrial supply; and aquatic ecosystems associated with rivers and streams." This list should also include managed wetlands and specifically call out the Pixley NWR. Managed wetlands in this area provide critical habitat for thousands of waterfowl and shorebirds, as well as state listed species like the Tricolored Blackbird and Greater Sandhill Crane.

B.9 P 1-41. Exhibit 1-1 Tulare County Proposed Land Use Map. This map does not include protected lands. Please amend this map to include the land use designation for managed habitat, i.e. Pixley NWR.

B.10 P 2-7. 2.2.6.5 Aquifer Primary Uses. Chapter 2.1.7.5 of the *Tule Subbasin Setting* describes the predominant beneficial uses of groundwater "as agricultural irrigation, with other uses including municipal water supply, private domestic water supply, and livestock washing and watering." This list should include 'managed habitats that are important to the Pacific Flyway.' The Pixley National Wildlife Refuge heavily relies on pumped groundwater to provide wetland habitat for migratory birds.

B.11 P 2-10. 2.3.7 Groundwater Dependent Ecosystems. The first paragraph in this section points out that the *Tule Subbasin Setting* provides justification for not designating any GDEs in the Tule Subbasin. However, in section 1.4.4 (P 1-10) Figure 1-5 identifies the entire Pixley NWR as a GDE, while Figure 1-10 shows very little GDEs. This is inconsistent and confusing. Please provide clarification on how GDEs are identified and update any relevant maps.

B.12 P 2-10. Water Budget. The historical and current water budgets in the *Tule Subbasin Setting* do not include any water demand for managed habitat, in particular for Pixley NWR which completely relies on groundwater pumping. Please revise accordingly. Furthermore, the projected water budgets should show full Level 4 demand for Pixley NWR. Level 2 water for Pixley NWR is 1,280 acre-feet/year and

Incremental Level 4 water is 4,720 acre-feet/year, for a total demand of 6,000 acre-feet/year. The projected budget should reflect the total amount of 6,000 acre-feet/year.

B.12 P 2-24. 2.4.3 Current Water Budget. The 'Current' water budget in the *Tule Subbasin Setting* report, that includes the Pixley ID GSA specific water budget, does not include any water use by the Pixley National Wildlife Refuge. Records show Pixley NWR received (pumped) all Level 2 water (1,280 acre-feet) in 2013, 2014, and 2016. In the least, the 'Current' water budget should include the Level 2 water pumped by Pixely NWR. The amount pumped by the refuge is approximately equivalent to the municipal pumping in the management area and therefore is a significant beneficial user in the basin.

B.12 P 2-26. 2.4.5 Projected Water Budget. The 'Projected' budget of the *Tule Subbasin Setting* should include full Level 4 water for Pixley NWR, 6,000 acre-feet/year, as either pumped water, surface water, or a combination. (See comment on P 2-10)

B.13 P 3-20. 3.5.2.5.3 Affects on Beneficial Uses. As noted in previous comments (see comments on P 1-2 and P 1-35) managed habitat is a beneficial user. Therefore, any potential impacts to these lands should be appropriately evaluated, and projects and management actions should be developed to minimize these impacts.

B.14 P 4-7. 4.2.3.1 Chronic Lowering of Groundwater Levels. This sections states "[t]he Agency will monitor groundwater levels at RMS within management areas shown on Figure 4-1." It is recommended that to evaluate the potential adverse impacts of lowering groundwater levels (e.g. increased spending to pump water from lowering water tables), the Pixley ID GSA engage with the U.S. Fish and Wildlife Service to coordinate efforts to monitor wells located on the Pixley NWR.

B.15 P 5-1. Agency Projects and Management Actions. Pixley ID GSA identifies a list of project and management actions to achieve sustainability that includes "water optimization, surface water development, managed aquifer recharge and banking, and agriculture land retirement." We commend Pixley ID GSA on their serious approach to developing solutions to the groundwater overdraft in their area, including planning efforts to develop wildlife-friendly recharge. We look forward to continuing to collaborate to design, site, permit, and implement recharge projects in Pixley ID GSA that can also provide important wildlife habitat.

B.16 P 5-1. Agency Groundwater Accounting Action. Groundwater pumping by Pixley NWR should be more explicitly recognized in the current and projected water budgets to ensure the development of a groundwater accounting system that accurately reflects water use in the management area. Pixley ID GSA needs to recognize the federal requirement that more water will be used on the refuge (e.g. full Level 4). Overall, pumping on the refuge is minimal compared to the whole and any pumping cap should not extend to the refuge. The refuge provides outsized benefits by creating important habitat for waterbirds and wildlife, and it can provide multiple benefits to the basin, such as groundwater recharge and water filtration.

B.17 P 5-3. In establishing key components of a groundwater accounting system, the Pixley National Wildlife Refuge should not have any caps on pumping. Pixley NWR should have similar access to banking mechanisms and policies and should not have any fees imposed for its federally mandated water needs.

B.18 P 5-4. 5.2.1.5 Quantification of Water Budget Impact. This section states "[t]he projected water budget impact of this Action is based on the current estimated consumptive use of the Agency in the Water Budget summarized in Section 2: Basin Setting." None of the water budgets include managed habitat

demand. Please update the water budgets to reflect the Full Level 4 water demand for the refuge and then re-evaluate associated impacts of this Action.

B.18 P 5-14. 5.2.3 Surface Water Development Projects. Any federal water available to the Pixley ID GSA boundary should also include meeting the Level 2 (1,280 acre-feet/year) water requirements for the refuge. These same surface water projects could help meet the refuge's full Level 4 demand (6,000 acre-feet/year) and should be included in future water demands.

B.19 P 5-19. Managed Aquifer Recharge and Banking Projects. Managed aquifer recharge, banking, and temporary storage projects can also provide a co-benefit of habitat value if designed with wildlife features. We commend the inclusion of the creation of intermittent environmental habitat as a desired outcome of various recharge activities (see bullet #4). Managed habitat areas may offer ideal opportunities for recharge or temporary storage of water, especially during high flow events that can negatively impact cultivated land. Managed habitat lands have existing water management infrastructure, providing an ideal location for early adoption of water projects at lower cost because water control structures are already in place. Including habitat as an added priority of the GSA's recharge activities can also lead to non-target benefits (e.g. flood protection or recreation opportunities), broader cooperation among stakeholder groups, and more sources of funding to support these multi-purpose projects.

B.20 P 5-23. Agricultural Land Retirement Projects. Strategic siting of where lands are retired and others are kept in production should consider the potential benefits to wildlife. Areas surrounding protected areas, such as Pixley National Wildlife Refuge, should be prioritized for land retirement first, especially if they are marginal farming ground.

B.21 P 6-4. These sections describe the proposed actions for assessing Land Based Assessment Fees, Transitional Pumping Fees, and Over-Pumping Penalties. To support project and operating costs these fees are likely justifiable. It is recommended that no fees be assed to any wetlands areas, particularly on Pixley National Wildlife Refuge. The current acreage of managed wetlands require a tiny fraction of the overall water demands of the 69,500 acres of serviced land and water allocations are mandated under the Central Valley Project Improvement Act for Pixley NWR. Most importantly, managed wetlands provide habitat benefits of state and international significance and are a critical link in the Pacific Flyway. These wetlands need continued water supplies to provide habitat for thousands of waterfowl, shorebirds, and state listed species like the Tricolored Blackbird and Greater Sandhill Crane.

Thank you for your consideration of Audubon California's comments. If you would like to discuss this matter further, please do not hesitate to contact me at (916) 737-5707 or via email at sarthur@audubon.org.

Sincerely,

Samantha Arthur
Working Lands Program Director
Audubon California

United States Department of the Interior

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IN REPLY REFER TO:
SCC-100
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DEC 16 2019

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Subject: Comments on Tulare Subbasin Groundwater Sustainability Plans

Dear Tule Subbasin Groundwater Sustainability Agencies:

The United States Bureau of Reclamation (Reclamation) provides these comments on the draft groundwater sustainability plans submitted by the addressee Groundwater Sustainability Agencies (GSA) in the Tule Subbasin.

We commend and appreciate your efforts, time, and energy devoted to the very difficult task of developing groundwater sustainability plans (GSP) to comply with the Sustainable Groundwater Management Act of 2014.

The mission 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. In the Friant Division, one of the most critical features of infrastructure that allows us to meet our mission is the Friant-Kern Canal, which, has been operated and maintained by the Friant Water Users Authority and subsequently the Friant Water Authority (FWA) since 1986. The Friant-Kern Canal delivers water to numerous water and irrigation districts, as well as cities, and about 15,000 family farms, and the very existence and inspiration of the canal was to, among other things, combat issues such as subsidence by conveying surface water to incentivize farmers to pump less ground

water. For decades, the Friant Division system has performed as intended and the farms and towns on the eastside of the San Joaquin Valley have flourished.

However, after the last prolonged drought that ended in 2017, it was discovered that about 60% of the Friant-Kern Canal delivery capacity had been lost due to severe land subsidence. The clearest explanation for this subsidence, is that it was caused largely by the over-pumping of groundwater on lands not currently served by surface water that lie within your respective GSAs. At the current detrimental rate of subsidence, FWA estimates that the Friant-Kern Canal will be operating at 30% capacity within three years. This is a trajectory that we ought naught allow to continue unchecked, and proactive measures need to be taken now to mitigate and prevent this cause and effect phenomenon.

For these and other reasons, as title holder and owner of the Friant-Kern Canal, we substantially concur with the comment letter submitted to the GSAs of the Tule Subbasin by the FWA on December 16, 2019 (attached) and look forward to the coordination and collaboration necessary to adopt appropriate management actions and plans to properly deal with staving off subsidence and its detrimental effects to the Friant-Kern Canal. C.1

If you should have any questions on this matter, please contact me at (559) 262-0300 or by cellphone at (559) 260-8714, by electronic mail at mjackson@usbr.gov or for the hearing impaired at TTY (800) 877-8339.

Sincerely,

Michael P. Jackson

Michael P. Jackson, P.E.
Area Manager

Enclosure
Friant Water Authority Comment letter dated December 16, 2019

cc: Mr. Jason Phillips, CEO
Friant Water Authority
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Lindsay, CA 93247
(w/enclosure)

State of California – Natural Resources Agency
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

December 17, 2019

Via Mail and Electronic Mail

Eric Limas, General Manager
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Subject: Comments on the Pixley Irrigation District and Lower Tule River Irrigation District Groundwater Sustainability Plans

Dear Mr. Limas:

The California Department of Fish and Wildlife (Department) Central Region is providing comments on the Pixley Irrigation District (ID) and Lower Tule River ID Draft Groundwater Sustainability Plans (GSPs) prepared by Pixley Irrigation District and Lower Tule River Irrigation District Groundwater Sustainability Agencies (GSAs), respectively, pursuant to the Sustainable Groundwater Management Act (SGMA). The Department combined comments for both GSPs because they were prepared by the same consultant and present the same information. As trustee agency for the State's fish and wildlife resources, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & Game Code §§ 711.7 and 1802).

Development and implementation of Groundwater Sustainability Plans under SGMA represents a new era of California groundwater management. The Department has an interest in the sustainable management of groundwater, as many sensitive ecosystems and species depend on groundwater and interconnected surface waters. SGMA and its implementing regulations afford ecosystems and species specific statutory and regulatory consideration, including the following as pertinent to Groundwater Sustainability Plans:

- Groundwater Sustainability Plans shall identify and consider impacts to groundwater dependent ecosystems (GDE's) pursuant to 23 California Code of Regulations (CCR) § 354.16(g) and Water Code § 10727.4(l);

- Groundwater Sustainability Agencies shall consider all beneficial uses and users of groundwater, including environmental users of groundwater pursuant to Water Code § 10723.2 (e); and Groundwater Sustainability Plans shall identify and consider potential effects on all beneficial uses and users of groundwater pursuant to 23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3);

- Groundwater Sustainability Plans shall establish sustainable management criteria that avoid undesirable results within 20 years of the applicable statutory deadline, including depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water pursuant to 23 CCR § 354.22 *et seq*. and Water Code §§ 10721(x)(6) and 10727.2(b) and describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters pursuant to 23 CCR § 354.34(c)(6)(D); and

- Groundwater Sustainability Plans shall account for groundwater extraction for all Water Use Sectors including managed wetlands, managed recharge, and native vegetation pursuant to 23 CCR §§ 351(al) and 354.18(b)(3).

Furthermore, the Public Trust Doctrine imposes a related but distinct obligation to consider how groundwater management affects public trust resources, including navigable surface waters and fisheries. Groundwater hydrologically connected to navigable surface waters and surface waters tributary to navigable surface waters are also subject to the Public Trust Doctrine to the extent that groundwater extractions or diversions affect or may affect public trust uses (*Environmental Law Foundation v. State Water Resources Control Board* (2018), 26 Cal. App. 5th 844). Accordingly, groundwater plans should consider potential impacts to and appropriate protections for navigable interconnected surface waters and their tributaries, and interconnected surface waters that support fisheries, including the level of groundwater contribution to those waters.

In the context of SGMA statutes and regulations and Public Trust Doctrine considerations, the Department values SGMA groundwater planning that carefully considers and protects groundwater dependent ecosystems and fish and wildlife beneficial uses and users of groundwater and interconnected surface waters.

COMMENT OVERVIEW

The Department supports ecosystem preservation in compliance with SGMA and its implementing regulations based on Department expertise and best available information and science.

The Department recommends the GSPs provide additional information and analysis that considers all environmental beneficial uses and users of groundwater in its sustainability management criteria and better characterize or consider surface water-groundwater connectivity. In addition, the Department is providing comments and recommendations below.

COMMENTS AND RECOMMENDATIONS

The Department comments are as follows:

1. **Comment #1 Environmental Beneficial Uses and Users**. Section 1 Introduction to the Pixley Irrigation District GSA Groundwater Sustainability Plan and Introduction to the Lower Tule River Irrigation District GSA Groundwater Sustainability Plan. Subsection 1.5.1 Beneficial Users (page 1-35 for Pixley ID GSP and page 1-37 for Lower Tule ID GSP). The GSP acknowledges D.1 environmental beneficial uses and users of groundwater but does not describe or consider their reliance on groundwater.

    a. *Issue*: Pursuant to 23 CCR § 354.10(a), GSPs are to include in the Notice and Communication Section a "description of the beneficial uses and users of groundwater in the basin." In both GSPs, the narrative cites 'aquatic ecosystems associated with rivers and streams' among the beneficial groundwater uses supported by the Tule Subbasin Users (page 1-35 for Pixley ID GSP and page 1-37 for Lower Tule ID GSP). Both Pixley ID and Lower Tule ID GSAs characterize Subbasin native vegetation land uses inclusive of ~7,000 acres and ~2,000 acres of riparian vegetation respectively (Table 1-1). The GSPs also promote a sustainability goal endorsing "sustainability in a manner that facilitates the highest degree of collective economic, societal, *environmental*, cultural, and communal welfare" (page 3-1). Apart from these acknowledgements, neither plan describes environmental beneficial users that may rely on groundwater, nor do they consider impacts to these users (see Comment #4), likely because they dismiss the likelihood of GDEs and Interconnected Surface Waters in the Subbasin (see Comments #2, #3).

    b. *Recommendation:* The Department recommends elaborating on potential environmental beneficial uses and users of groundwater by including a detailed description on how these users, such as GDEs and the species therein, may rely on groundwater and may be impacted by Sustainable Management Criteria pursuant to 23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3). The Critical Species LookBook (TNC 2019) is a resource to help identify threatened and endangered species in any basin subject to SGMA and to help understand species relationships to groundwater. The LookBook also offers narrative on species and habitat groundwater dependence that can be a model for

describing environmental beneficial uses and users of groundwater in the GSP.

2. **Comment #2 Interconnected Surface Waters.** Section 2 Tule Subbasin Setting. Subsections 2.2.4 Surface Water Features and 2.3.6 Interconnected Surface Waters. The interconnected surface water (ISW) analysis lacks sufficient information to justify an absence of interconnected streams in the Subbasin. D.2

   a. *Issue:* The surface water interconnectivity analysis is based on limited data and poorly justifies the conclusion that there are no interconnected surface waters in the basin. Pursuant to 23 CCR § 354.16(f), a GSP shall identify "interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems" within the GSP's 'Groundwater Conditions' section. The GSPs reference multiple discussions on surface water in various locations within the GSP and its attachments and appendices to conclude that there are no ISW in the Subbasin due to depth to groundwater (pages 2-4, 2-10, and *Tule Subbasin Setting* Figure 2-26) (Coordination Agreement, Attachment 2; Appendix A). For example, on page 2-10, *Section 2.3.6 Interconnected Surface Waters* references *Section 2.2.4 Surface Water Features,* which identifies and characterizes the surface waters in the Subbasin without discussing interconnectivity. There is also a reference on page 2-10 to *Subsections 2.1.5* and *2.2.7* of the *Tule Subbasin Setting* attachment, which discuss surface water features and GDEs, respectively, yet do not address surface water groundwater interconnectivity explicitly. Within *Section 2.3.6*, the text concludes based on the above references that, as presently assessed, "there is no indication of interconnected surface water systems" (page 2-10). None of the cross-references provided demonstrate a thorough analyses of available data that would defend the conclusion of no ISW.

   Though the GSP does not cite *Section 2.2.6 Interconnected Surface Waters* of the *Tule Subbasin Setting*, this section characterizes primary surface waters in the Tule Subbasin as rarely flowing out of the Subbasin, and based on this observation, concludes that there are no ISW in the Subbasin (*Tule Subbasin Setting,* Page 19). The implication is that if a river loses so much water that it stops flowing, it is unlikely to be supported by shallow groundwater. Importantly, surface waters that are losing can still be interconnected with groundwater (Barlow and Leake 2012), and rivers can oscillate between interconnected and disconnected. Based on the geology presented, it seems likely that many of the main surface waters in the basin are disconnected from groundwater, however there may be interspersed aquicludes from localized lacustrine deposits

(page 2-2) that could support shallow groundwater near rivers and underlying GDEs (see Comment #3).

Furthermore, the *Tule Subbasin Setting* identifies uncertainty around a "lack of aquifer-specific groundwater levels with adequate spatial distribution to enable preparation of representative groundwater level maps of each aquifer in parts of the Subbasin" (*Tule Subbasin Setting,* Page 14). The GSPs emphasize this groundwater monitoring data gap again in the monitoring chapter (page 4-13). Accordingly, there are opportunities to improve groundwater level data resolution and more thoroughly analyze the potential for interconnectivity using depth to groundwater data for riparian areas.

For these reasons, the GSP does not thoroughly substantiate their conclusion that there are no ISW in the basin.

b. *Recommendation:* The Department recommends the GSP define a clear and expeditious path to improved shallow groundwater and surface water monitoring for periodic re-analysis of surface water-groundwater interconnectivity (see Comment #5).

3. **Comment #3 Groundwater-Dependent Ecosystems**. Section 1 Introduction to the Pixley Irrigation District GSA Groundwater Sustainability Plan and Introduction to the Lower Tule River Irrigation District GSA Groundwater Sustainability Plan. Subsection 1.4.8.1 Potentially Groundwater Dependent Ecosystems (page 1-17 and Figure 1-10 for Pixley ID GSP and page 1-18 and Figure 1-10 for Lower Tule ID GSP). Section 2 Basin Setting. Subsection 2.3.7 Groundwater Dependent Ecosystems (page 2-10 for both GSPs). Attachment 2 Tule Subbasin Coordination Agreement Draft Tule Subbasin Setting. Chapter 2 Tule Subbasin Setting. Section 2.2 Groundwater Conditions, Subsection 2.2.7 Groundwater Dependent Ecosystems (page 19) and Figure 2-26. The GDE identification section, pursuant to 23 CCR § 354.16 (g), is based on limited information to identify ecosystems that may depend on groundwater and risks the exclusion of potential GDEs. (Note: There appears to be an editorial error on page 2-10 of the Pixley ID GSP where it states that Figure 1-5 in Section 1.4.4 displays potential GDEs, but instead shows Jurisdictional Boundaries for Pixley National Wildlife Refuge. Similarly, Figure 1-7 does not present GDEs as stated on page 2-10 for the Lower Tule ID GSP, but shows Water Use Sectors instead. Both these Figure references were assumed to mean Figure 1-10 for each respective GSP.) D.3

a. *Issue*: The GSP relies solely on the Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset to identify potential GDEs, then dismisses the likelihood of any GDEs occurring based on an average depth-to-groundwater in the subbasin that exceeds potential

rooting depths (page 2-10). (Note: the GDE maps provided in Figure 1-10 is difficult to decipher.) The GDE section cites *Section 2.2.7 Groundwater Dependent Ecosystems* of the *Tule Subbasin Setting* attachment to support the conclusion that GDEs are unlikely to exist in the Plan Area. The *Tule Subbasin Setting* offers a depth-to-groundwater discussion in which areas with a depth to groundwater greater than 25 feet in January 2015 are unlikely to support GDEs (page 19). This approach relies on a single-point-in-time baseline hydrology, specifically a point in time that is several years into a historic drought when groundwater levels were trending significantly lower due to reduced surface water availability. Exclusion of potential GDEs based on this singular groundwater elevation measurement is fallible because it does not consider representative climate conditions (i.e., seasons and a range of water type years) and it does not account for GDEs that can survive a finite period of time without groundwater access (Naumburg et al. 2005), but that rely on groundwater table recovery periods for long term survival.

b. *Recommendations:* The Department recommends the GSP consider the following for information gathering related to GDEs:

   i. Depth to Groundwater: If the GSP does indeed analyze GDEs based on a depth to groundwater analysis as suggested in the *Tule Subbasin Setting* (page 19), the Department recommends the GSP develop a hydrologically robust baseline from which to identify GDEs that relies on multiple, climatically representative years of groundwater elevation, that accounts for the inter-seasonal and inter-annual variability of GDE water demand and that is based on a clear understanding of shallow groundwater. A robust hydrologic baseline will help account for GDEs that can survive a finite period of time without groundwater access (Naumburg et al. 2005), but that rely on groundwater table recovery periods for long term survival.

   ii. Field Verification: The Department also recommends: 1) refining the identification/removal of potential GDEs through field verification, 2) improving readability of GDE maps, 3) identifying groundwater dependent fish and wildlife species in the basin, 4) identifying and implementing appropriate monitoring approaches to track environmental beneficial users over time, 5) designing a monitoring program that is capable of capturing early signs of adverse impacts to GDEs, and 6) developing appropriate mitigation plans to reverse negative observed impacts to GDEs (e.g., stressed phreatophyte vegetation [see Comment #1]).

iii. Include Additional References for Evaluation: The Department recognizes that NCCAG (Klausmeyer et al. 2018) provided by California Department of Water Resources (CDWR) is a good starting reference for GDE's; however, the Department recommends the GSP include additional resources (including local knowledge) for evaluating GDE locations. The Department recommends consulting other references, including but not limited to the following tools and other resources: the California Department of Fish and Wildlife (CDFW) Vegetation Classification and Mapping Program (VegCAMP) (CDFW 2019A); the CDFW California Natural Diversity Database (CNDDB) (2019B); the California Native Plant Society (CNPS) Manual of California Vegetation (CNPS 2019A); the CNPS California Protected Areas Database (CNPS 2019B); the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (2018); the USFWS online mapping tool for listed species critical habitat (2019); the U.S. Forest Service CALVEG ecological grouping classification and assessment system (2019); and other publications by Klausmeyer et al. (2019), Rohde et al. (2018), The Nature Conservancy (TNC) (2014, 2019), and Witham et al. (2014).

4. **Comment #4 Sustainable Management Criteria.** Section 3 Sustainable Management Criteria (starting on page 3-1). Sustainable Management Criteria (SMC) demonstrate no consideration of undesirable results for environmental beneficial uses and users of groundwater and Minimum Thresholds (MTs) do not reflect a 'Critically Overdrafted' Basin status. D.4

a. *Issues:*

i. SMC may risk adverse impacts to GDEs by tolerating sustained, groundwater decline, but there are no analyses on effects of undesirable results to environmental beneficial uses and users of groundwater pursuant to 23 CCR § 354.26(b)(3). For example, the potential effects on beneficial uses listed for the chronic lowering of groundwater in the *Coordination Agreement* comprise only impacts to wells and operational costs for groundwater extraction (*Coordination Agreement,* Section 4.3.1. Chronic Lowering of Groundwater Levels, page 37). The discussion on the effects of Undesirable Results (URs) on beneficial users in the GSPs themselves focus again on the cost of mitigating impacts to wells, etc., and do not mention potential impacts to environmental beneficial users (pages 3-20 to 3-21).

ii. The Tule Subbasin is designated as 'Critically Overdrafted,' meaning "continuation of present water management practices [in

the basin] would probably result in significant adverse overdraft-related environmental, social, or economic impacts" (CDWR "Critically Overdrafted") (CDWR 2019). Furthermore, the GSPs state, "The overdraft conditions have caused issues for those reliant on groundwater pumping, which include municipal, domestic, and agriculture users. Other issues generated from the overdraft include areas of land subsidence, which predominantly occur in the northwestern portion of the Agency" (page 1-2). Despite the Subbasin's legacy of adverse impact and designated 'Critically Overdrafted' status, the GSPs establish MTs that allow for a decline in groundwater elevations replicating that of the greatest historical decline witnessed between 2007 and 2016 (page 3-13, Table 3-7). Therefore, the MTs allow for sustained groundwater table decline by mirroring the historical trends that led to the subbasin's Critically Overdrafted status. Conceptually, there is a disconnect between the subbasin's 'Critically Overdrafted' designation and sustainable management criteria the allow for continued groundwater level decline.

iii. As stated above, the Tule Subbasin is characterized by CDWR as 'Critically Overdrafted,' meaning "continuation of present water management practices [in the basin] would probably result in significant adverse overdraft-related environmental, social, or economic impacts" (CDWR 2019). The Tule Subbasin has experienced significant land subsidence in the central and western portions of the basin. As shown on Figure A1-8 (Tule Subbasin Monitoring Plan), InSAR subsidence records indicates that the western and central portions of the basin have encountered up to 2.75 feet of compaction. Within the *Tule Subbasin Monitoring Plan* and the GSPs, subsidence has been primarily attributed to the lowering of groundwater levels within aquifer assemblages that contain fine grained material (i.e. Corcoran Clay). When water is withdrawn (i.e., pumped) from an aquifer, the fluid pressure in pore space, also known as pore pressure, is reduced and the weight of the overlying materials must be increasingly supported by the granular mineral skeleton of the aquifer system. When effective stress exceeds pre-consolidation stress of the aquifer system, rearrangement of the mineral grains may occur and result in permanent compaction and inelastic deformation. The SMCs provided in the plan allow for the continued chronic lowering of groundwater levels, which, as detailed within the GSPs, strongly influences and promotes land subsidence. Additionally, the GSPs set MTs that allow for representative monitoring sites in some locations to reach thresholds of up to 8.72 feet of compaction over a 20-year window. With the proposed lenient MTs for groundwater

levels and land subsidence, there is no clear path for corrective measures to decrease land subsidence issues within the basin

b. *Recommendations:* The Department recommends the GSA reevaluate SMC with the following suggestions:

   i. Clarify how species and habitat groundwater needs were considered in the identification of SMC and identify specific potential adverse impacts on environmental beneficial users of groundwater and causal relationships with groundwater pumping (e.g., terrestrial GDE stress/loss, increased instream temperatures, etc.).

   ii. Revise MTs to reflect a 'Critically Overdrafted' subbasin designation by seeking: 1) to improve current groundwater elevation conditions rather than allow for continued aquifer depletions over the next two decades, and 2) to establish MOs and MTs that depend on subbasin action to reduce land subsidence and that empower the groundwater basin to improve trends of groundwater decline and land subsidence issues over the next two decades.

5. **Comment #5 Monitoring Network.** Section 4 Monitoring Networks (starting page 4-1, and Figure 4-1). The number and distribution of shallow groundwater monitoring wells in the Plan Areas and along the surface waters in the Tule Subbasin are insufficient for analysis of shallow groundwater trends and groundwater-surface water interconnectivity. D.5

   a. *Issue:* Existing shallow groundwater monitoring wells may be insufficient to characterize shallow groundwater and surface water-groundwater interactions along the primary surface waters in the Pixley ID and Lower Tule ID Plan Areas – Deer Creek and Tule River, respectively – or to monitor impacts to environmental beneficial uses and users of shallow groundwater and interconnected surface waters such as GDEs [23 CCR § 354.34(2)].

   The GSP acknowledges groundwater elevation data gaps in several locations and intends to install new monitoring wells (page 4-12 for Pixley ID GSP, page 4-13 for Lower Tule ID GSP; *Tule Subbasin Setting,* page 14). Five to six Representative Monitoring Site (RMS) wells measure groundwater in the upper aquifer in the Pixley ID and Lower Tule ID GSA jurisdictions (*Tule Subbasin Setting*, Figure A1-2). Several existing RMS locations and proposed Upper Aquifer new monitoring wells fall near potential GDEs and surface waters. Additional upper aquifer monitoring coverage would improve the understanding of shallow groundwater. Shallow groundwater data are critical to understanding groundwater

management impacts on fish and wildlife beneficial uses and users of groundwater, including GDEs and potential interconnected surface water habitats, that are impacted disproportionately by shallow groundwater trends.

b. *Recommendation*: The Department recommends installing additional shallow groundwater monitoring wells near potential GDEs in the Subbasin and along interconnected surface waters, potentially pairing multiple-completion wells with streamflow gages for improved understanding of surface water-groundwater interconnectivity.

OTHER COMMENTS: Implementation of Future Project Actions Related to SGMA

SGMA exempts the preparation and adoption of GSPs from the California Environmental Quality Act (CEQA) (WC § 10728.6); however, SGMA specifically states that implementation of project actions taken pursuant to SGMA are not exempt from CEQA (WC § 10728.6). The Department is California's Trustee Agency for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). The Department, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (*Id.*, § 1802). Similarly, for purposes of CEQA, the Department is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

The Department is also a Responsible Agency under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381), and the Department expects that it may need to exercise regulatory authority as provided by the Fish and Game Code for implementation of projects related to the GSP that are also subject to CEQA. These projects may be subject to the Department's lake and streambed alteration regulatory authority (i.e., Fish & G. Code, § 1600 et seq.). Notification pursuant to Fish and Game Code § 1602 is warranted if a project will (a) substantially divert or obstruct the natural flow of any river, stream, or lake; (b) substantially change or use any material from the bed, bank, or channel of any river, stream, or lake (including the removal of riparian vegetation); and/or (c) deposit debris, waste or other materials that could pass into any river, stream, or lake. Likewise, to the extent that implementation of any project may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required. The Department is required to comply with CEQA in its issuance of a Lake or Streambed Alteration Agreement or an Incidental Take Permit.

Water Rights: The implementation of SGMA does not alter or determine surface or groundwater rights (WC § 10720.5). It is the intent of SGMA to respect overlying and other proprietary rights to groundwater, consistent with section 1200 of the Water Code (Section 1(b)(4) of AB 1739). The capture of unallocated stream flows to artificially recharge groundwater aquifers are subject to appropriation and approval by the State Water Resources Control Board (SWRCB) pursuant to Water Code § 1200 et seq. The Department, as Trustee Agency, is consulted by SWRCB during the water rights process to provide terms and conditions designed to protect fish and wildlife prior to appropriation of the State's water resources. Certain fish and wildlife are reliant upon aquatic and riparian ecosystems, which in turn are reliant upon adequate flows of water. The Department therefore has a material interest in assuring that adequate water flows within streams for the protection, maintenance and proper stewardship of those resources. The Department provides, as available, biological expertise to review and comment on environmental documents and impacts arising from project activities.

CONCLUSION

In conclusion, the Pixley Irrigation District and Lower Tule River Draft GSPs need to address all SGMA statutes and regulations, and the Department recommends the GSPs seriously consider fish and wildlife beneficial uses and interconnected surface waters. The Department recommends that the GSPs consider the above comments before the GSPs are submitted to CDWR. The Department appreciates the opportunity to provide comments on the Pixley and Lower Tule River Irrigation Districts Draft GSPs. If you have any further questions, please contact Dr. Andrew Gordus, Staff Toxicologist, at Andy.Gordus@wildlife.ca.gov or (559) 243-4014 x 239.

Sincerely,

Julie A. Vance
Regional Manager, Central Region

Enclosures (Literature Cited)

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COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA

December 13, 2019

Pixley Irrigation District Groundwater Sustainability Agency
357 E. Olive Ave.
Tipton, CA 93272

Submitted electronically to:

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Division 2 board member, Bill DeGroot
Division 3 board member, Randall Parreira
Division 4 board member, Russell Schott (Vice – President)
Division 5 board member, Frank Junio (President)
General Manager, Eric Limas
CC'd:
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Department of Water Resources Deputy Director, Taryn Ravazzini
Department of Water Resources Tule Subbasin, Mike McKenzie
State Water Resources Control Board Chair, Joaquin Esquivel
State Water Resources Control Board, Natalie Stork
CalEPA Deputy Secretary, Kristin Peer

RE: Comments on the Draft Pixley Irrigation District Groundwater Sustainability Plan (PID GSP)

Dear Pixley Irrigation District Groundwater Sustainability Agency:

The Community Water Center (CWC) would like to offer several comments and recommendations in response to the Pixley Irrigation District Groundwater Sustainability Agency (PID GSA) draft Groundwater Sustainability Plan (GSP) that was first released on September 16th, 2019, and then rereleased without public notice on October 27th, 2019.

Community Water Center (CWC) is a 501(c)3 nonprofit that acts as a catalyst for community-driven water solutions through organizing, education, and advocacy. CWC seeks to build and enhance leadership capacity and local community power around water issues, create a regional movement for water justice in California, and enable every community to have access to safe, clean, and affordable drinking water. CWC has supported Sustainable Groundwater Management Act (SGMA) implementation through hosting several technical capacity building workshops, developing educational materials, community GSP review meetings, and GSA meetings.

The comments and recommendations are provided in an effort to protect the drinking water sources of the vulnerable, and often underrepresented, groundwater users that CWC works with. These beneficial

users of groundwater include: domestic well owners, community water systems, public water systems, and severely disadvantaged (SDAC) or disadvantaged communities (DAC). The submitted comments are intended to assist PID GSA in developing a groundwater sustainability plan that accomplishes the following objectives:

1. Understands disadvantaged communities' unique vulnerabilities and adequately addresses their drinking water needs;
2. Avoids developing groundwater management actions that cause negative impacts to drinking water supplies or cause a disparate impact on low-income communities of color; and
3. Achieves the objectives required by the SGMA regulations and California's Human Right to Drinking Water in order to ensure the PID GSP adequately addresses the requirements necessary for GSP approval by the Department of Water Resources (DWR).

The Department of Water Resources (DWR) will be considering AB 685, which established the Human Right to Water as state law, when reviewing and approving GSPs. The Human Right to Water is a California law that recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." GSPs that do not support access to sufficient and affordable quantities of drinking water, or GSPs that impact access to safe drinking water, may require costly and time-consuming revisions prior to approval from DWR.

We are unfortunately very concerned that, without significant changes which we lay out in this comment letter, the proposed GSP will have significant negative impacts for access to safe and sustainable drinking water in our most vulnerable populations within the GSA -- low-income communities and domestic well owners. We urge PID GSA to make changes to better protect the beneficial uses for low-income communities of color that live within the GSA. Detailed comments and recommendations for individual sections of the GSP are included below. CWC conducted a focused technical review of certain sections of the GSP. Findings of this review are included as attachments to this letter and some of these findings are incorporated and/or referenced in this comment letter.

Here is a summary of a few key comments and recommendations:

Water Budget

Revise the basin setting and water budget of the draft PID GSP to address key missing information and inconsistencies with the data and assumptions used in the development of these sections in order to better articulate and quantify the needs of drinking water users within the GSA.

Groundwater Levels

Undertake a drinking water well impact analysis that adequately quantifies and captures well impacts at the minimum thresholds (MT), measurable objectives (MO), and proposed undesirable results (UR). Describe how the approach to develop MTs/MOs is protective of diverse drinking water users, including domestic well owners and small community water systems.

Groundwater Quality

Clearly identify and describe the current level of contamination at each representative monitoring well and revise sustainable criteria to be protective of drinking water users. Provide a detailed explanation of how the proposed water quality MT approach and monitoring network will result in protection of groundwater for S/DACs and other drinking water beneficial users.

Projects and Management Actions - Well Impact Prevention/Mitigation Program

If PID GSA defines its sustainability criteria in a way that allows for the dewatering of drinking water wells, it must provide a robust drinking water protection program to prevent impacts to drinking water users and mitigate the drinking water impacts that occur.

Thank you for reviewing this letter and for the consideration of our comments on the draft GSP. We look forward to working with the PID GSA to ensure that the GSP is protective of the drinking water sources of vulnerable, and often underrepresented, groundwater stakeholders. Please do not hesitate to contact us with any questions or concerns, or if you would like to meet to further discuss these important sets of issues.

Sincerely,

Adriana Renteria

Community Water Center

COMMUNITY WATER CENTER
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GSP Section 1: Introduction to the PID GSA GSP

PID GSA Plan Area

The description of the plan area should be improved by including the location of public water systems serving SDCAs, DACs and domestic well communities and does not describe their dependence on groundwater as required by §354.8[1]. Without this information, the plan area is not properly characterized and does not acknowledge the extent of groundwater dependence of these communities. In order to develop a GSP that addresses the needs of all beneficial users, it is critical that the location and groundwater needs of these communities are explicitly addressed early on in the GSP. In order to improve this section, we recommend the following:

E.1

- **Include a map indicating the location of public water systems serving SDACs and/or DACs as well as domestic well communities.** In order to contextualize the subsequent sections of the GSP, it is critical that the geographic locations of these communities be included. Maps overlaying the location of these communities should also be included in subsequent sections of the GSP, including but not limited to when describing management areas, threshold regions, or potential recharge locations.

Notice and Communication

Public engagement, when done well, goes far beyond the usual participants to include those members of the community whose voices have traditionally been left out of political and policy debates[2]. It invites citizens to get involved in deliberation, dialogue, and action on public issues that are important to them. More importantly, it helps leaders and decision-makers have a better understanding of the perspectives, opinions, and concerns of citizens and stakeholders, especially the underrepresented ones.

We are very disappointed with the approach LTRID GSA undertook to develop the Draft GSP. The current draft GSP provides limited information regarding how communication and updates related Plan implementation will take place and how this will be accomplished.SGMA explicitly requires the consideration of all beneficial users of groundwater and the process LTRID utilized to develop the Draft GSP did not adequately engage domestic well owners, small community water systems, or other groundwater beneficial users. In addition to the lack of consideration and engagement of all beneficial users, we have some serious concerns with the lack of transparency and adherence to Brown Act requirements. For future revisions of the GSP and to improve ongoing groundwater planning efforts, we recommend the following changes:

E.2

- **Properly notice all public meetings, including the Groundwater Planning Commission, and send out both agendas and all meeting materials within 72 hours of the proposed meeting.** Throughout the development of the Draft GSP, there were several months where the Groundwater Planning Commission did not release an agenda or properly notice the meetings. As this was a public meeting space for both LTRID GSA and Pixley Irrigation District (PID) GSA to develop policy recommendations for the GSPs, it was an important meeting for stakeholders to

[1] § 354.8. Description of Plan Area.
[2] DWR. (2018) Stakeholder Communication and Engagement.

be aware of and be able to participate. Through several exchanges, CWC urged LTRID and PID GSAs to release agendas for these meetings and though we appreciate that they are now being sent out, this is an issue that should not have taken months to correct. In addition to not sending out agendas for these meetings, several meeting materials were only released to those on the advisory committee even after several stakeholders requested copies. Without properly noticing meetings or sharing meeting materials or draft documents, the public is not able to meaningfully engage in this important process.

E.3 • **Ensure there is a public comment period at minimum at the beginning of all public meetings.** The Groundwater Planning Commission was structured in a way where there were no public comments taken either at the beginning of the meeting or during key decision making points. It is critical to ensure that the public has a space to voice their concerns or recommendations and properly participate in this process.

E.4 • **Properly notice the release of all important materials, including revisions to the GSP, and share with all interested parties.** LTRID first released the draft GSP on September 19, 2019 and then released a revised version of the GSP on 2 October, 2019. Expecting the public to review multiple versions of the draft GSP, particularly without proper notification, is a significant burden and an impediment to meaningful public participation. Though we appreciate that many of the changes in the rereleased GSP were redlined, not all of the changes were noted (including those in embedded tables such as Tables 3-5 and 3-9 and Figure 3-1). This is confusing and misleading.

E.5 • **Structure documents in ways that are easier for the public to review and interpret and ensure that any inconsistencies between documents are revised.** Because of the way the documents are structured, information for each GSP in the Tule Subbasin is spread across four documents. Specifically, key information (including information pertaining to the Basin Setting, Sustainable Management Criteria [SMCs]), Monitoring Network, Water Budget, and Projects and Management Actions [P&MAs]) are presented in multiple documents and are often inconsistent. In order to review the content of the GSP, the public must review four individual documents and attempt to reconcile the differences between the documents in order to understand the GSAs' intended plans. GSPs are intended to be public documents that can be reviewed and understand by a broad audience, with an emphasis on "plain language" descriptions.

E.6 • **Engage domestic well owners and the small community water systems by offering presentations and holding community meetings to share information about the GSP development process and solicit feedback from key beneficial users of groundwater.** Though LTRID GSA did hold several landowner meetings for agricultural stakeholders within the irrigation district boundaries, the GSA did not hold any meetings to meaningfully receive feedback from drinking water users. Additionally, these meetings took place during work hours when many community members are not able to participate. The Community Service Districts (CSD) and Public Utilities Districts (PUDs) were also not adequately engaged through this process.

E.7 • **Host GSP workshops and public outreach meetings in the evening so community members are able to attend.** The landowner meetings LTRID GSA hosted for agricultural water users within

the district took place from 9am-12pm which is not accessible for community members who work at that time.

E.8 • **Utilize existing community venues for community meetings, workshops and events to provide information.** For example, consider conducting short presentations during CSD and PUD water board meetings and school district board meetings. Venues should be carefully selected in order to meet the needs of the targeted audience.

E.9 • **Identify community social media (Facebook, Instagram, etc.) groups, pages and websites and post information.** Develop media advisories, press releases and work with local media outlets, such as local radio stations, television stations, and local newspapers to captivate a broader audience that are not being reached via the electronic-based outreach currently used.

E.10 • **Identify, and work with key community leaders /trusted messengers to distribute information and encourage community participation.**

E.11 • **Provide bilingual (English and Spanish) information and materials on the website, via email and consider inserting short notices (notices must include key messages, visuals and information that is relevant to the average water user) in water bills and/or community newsletters.** The Dymally-Alatorre Bilingual Services Act requires that public agencies serving over 10% of non-English speaking constituents provide appropriate translation services[3]. At a minimum, this information should be provided during plan updates, and prior to critical decisions. In particular, the draft GSP released during the formal comment period should include materials highlighting key summaries of the GSP. Critical decision points can also include the adoption of groundwater fees, or the approval of new groundwater projects or management actions.

E.12 • **Partner with other educational programs to leverage resources and explore opportunities to educate different generational groups.**

GSP Section 2: Tule Subbasin Setting

The GSP water budget requirements are intended to quantify the water budget in sufficient detail in order to build local understanding of how historical changes have affected the six sustainability indicators in the basin. Ultimately, this information is intended to be used to predict how these same variables may affect or guide future management actions[4]. Another important reason for providing adequate water budget information is to demonstrate that the GSP adheres to all SGMA and GSP regulation requirements and can demonstrate the ability to achieve the sustainability goal within 20 years, and maintain sustainability over the 50 year planning and implementation horizon. The description of the water budget in the draft GSP (and Coordination Agreement) is not fully transparent and it is not clear how drinking water users will be protected when sustainable yield allocations are implemented. The basin setting and water budget of the draft PID GSP are missing key information on data and assumptions used in the development of these sections as well as several inconsistencies. We recommend the following changes:

[3] California Government Code Section 7290.
[4] DWR, 2016. Best Management Practices for the Sustainable Management of Groundwater, Modeling (BMP #5), December 2016.

E.13 • **Clarify which values for average annual historical overdraft were used and clarify why the three different documents have used different values.** The revised draft GSP identifies that the subbasin overdraft over the historical period is estimated to be approximately 170,000 acre-feet per acre-feet per year (AFY), but does not clearly specify the historical time period this reflects (Sections 2.4.2.4 and 1.2). Table 2-3 of the Subbasin Setting shows the average annual overdraft for the subbasin for the period of water Year 1987 to 2017 as -160,00 AFY. Section 2.3.2.4 of the Subbasin Setting states that "The average annual change in groundwater storage over the period from 1990/91 to 2009/10, which represents average hydrologic conditions within the Tule Subbasin, was approximately -115,300 acre-ft/yr. This value represents the average annual historical overdraft of the subbasin."

E.14 • **Clarify the discrepancy that the PID GSA does not contribute to overdraft conditions.** Section 2.4.2.4 of the draft GSP states that "The Agency historically does not contribute to the subbasin overdraft conditions, providing an annual net contribution to groundwater of an estimated 18,160 acre-feet per year on average acre-feet per year." However, Table 2 of Appendix A to the Subbasin Setting shows that on average, the PID GSA has historically had a 43,000 AFY groundwater storage deficit.

E.15 • **Clarify the methods used to develop the historical water budget and the groundwater flow model-projected water budget and if the methods are different, describe how the two methods relate to each other in terms of common assumptions, uncertainties, and inherent differences.** The Coordination Agreement is not clear regarding the method used to develop the historical water budget. It does not specify whether a spreadsheet model, the numerical groundwater flow model, or another method used to develop the historical water budget.

E.16 • **Revise the draft GSP to include summary information on land use and crop evapotranspiration information and detail how the irrigation efficiency value was determined over the various model time periods so that the validity of the crop demand can be assessed.** An average irrigation efficiency of 0.79 was used for the water budget. The value used for estimating crop water demand is a reasonable average for current irrigation methods in the San Joaquin Valley but irrigation efficiencies were likely lower during the earlier periods of the historical water budget.[5] However, the GSP notes that irrigation efficiency varies by crop and year, but no information is provided on how the value used was determined or its uncertainty and affects on water budget uncertainty.

E.17 • **Revise the draft GSP to include information on rural population estimates and density so that the public can assess whether it is reasonable to exclude rural residential demands from the water budget. Also include a discussion of the water use by livestock operations and other public water systems and how it is represented in the water budget.** The two communities in the PID GSA, Pixley PUD and Teviston CSD, rely entirely on groundwater for drinking water. Specific data from these small community water systems were not reported, but water budget results show groundwater pumping from these agencies averages 800 AFY for the historical period (Tables 1a and 2 of the Appendix A of the Tule Subbasin Setting). This is less than 1% of the agricultural pumping in the PID GSA area. Additionally, there are numerous livestock operations (dairies in particular) in the PID GSA area and the draft GSP identifies theCalifornia

[5] Sandoval-Solis, Samuel, 2013, Map of Application Efficiencies for Hydrologic Regions of the State of California, http://watermanagement.ucdavis.edu/research/application-efficiency/maps/

Dairies, Inc. as a major public water systems that are reliant on groundwater[6]. However, the draft GSP does not include a discussion of the magnitude of the water demand for these operations or if these operations have a significant impact on the water budget.

E.18 • **Revise the draft GSP to include a more detailed discussion of how subsurface flow was determined and the level of uncertainty inherent in its estimation.** The draft GSP acknowledges that there is uncertainty in many of the water budget components. Section 2.3.1 of the Tule Subbasin Setting notes that there is a 0.2% difference in average annual surface water inflows and outflows leading to a conclusion that the surface water budget is a good representation of actual conditions. However, there is no discussion of uncertainty in the groundwater budget. The groundwater budget includes estimates of subsurface inflow and outflow and two methods used to estimate this flow component are described. However, it is not clear which of the two described methods were used in the water budget.

E.19 • **Revise the projected water budget to include an estimated increase in municipal pumping or include a justification for maintaining the municipal pumping at a constant rate.** The hydrology and land use time series used for the projected water budget is not described. A constant value of 1,100 AFY was specified for the M&I pumping in the projected water budget (Appendix A of the Tule Subbasin Setting). The municipal pumping in the historic water budget increased from 700 to 1,100 AFY, which implies that municipal pumping will continue to increase in the future, especially given planned future growth of the three small communities.

E.20 • **Revise the draft GSP to include information on the range of model inputs that were used in evaluating the uncertainty of the projected water budget.** The projected future water budget was used to estimate sustainable yield for the entire subbasin. To address uncertainty in the projected water budget and the underlying numerical model, the model was run multiple times with variations in aquifer properties, consumptive use, and mountain front recharge. Of the 240 model runs, 175 model runs resulted in a projected average annual change in storage of no more than 5,000 AFY (i.e., sustainable or nearly sustainable conditions). The time period of 2040-2050 was used to estimate sustainable yield because all P&MAs are expected to have been implemented at that time. Sustainable yield was estimated as the median value from the 175 runs with sustainable or nearly sustainable conditions.

E.21 • **Revise the draft GSP to clearly and consistently define and describe the sustainable yield estimates and allocation methods within the subbasin and within the PID GSA. Include a description of how the sustainable yield value and the allocation method will affect municipal and rural groundwater drinking water users in the PID GSA area.** There are significant discrepancies between the draft GSP and the Coordination Agreement regarding the reported subbasin sustainable yield value and how that yield will be allocated to the individual GSAs and groundwater users within the PID GSA. The Tule Subbasin Setting (Section 2.3.2.6) reports that the sustainable yield is 130,000 AFY, which will be allocated using a subbasin wide crop consumptive use rate. In contrast, the draft GSP reports that the sustainable yield is 258,000 AFY

[6] Based on the community water system boundaries obtained from the Tracking California, the California Dairies, Inc. water system is located in the LTRID, just north of the PID GSA. Based on this same information source, the Calgren Renewable Fuels community water system is located within the PID GSA, but is not identified in the GSP. Community Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer.

based on the historical period 1987-2017, which was a period when groundwater levels were declining and does not represent sustainable conditions. The draft GSP discussion of the allocation of the sustainable yield says the allocations will be based on the proportion of the subbasin represented by each GSA (Section 2.4.2.6). The draft GSP further states that this method will also be used to allocate the PID GSA portion of sustainable yield to individual groundwater users; this is also not consistent with the method described in the draft Subbasin Setting. Without clearly describing how the sustainable yield was developed or what the correct value is, it is not clear how the PID GSA will be able to achieve sustainability by 2040.

GSP Section 3: Sustainable Management Criteria

Groundwater Levels

CWC's technical review of the Draft PID GSP identified several data gaps and potential significant impacts to public water systems and domestic wells. The current GSP does not adequately consider the groundwater impacts that may affect the supply and beneficial uses of groundwater as required by GSP regulations Section 354.16. As currently written, the GSP is insufficient and is at risk of being deemed inadequate by DWR. In order to address these concerns, we recommend the following revisions:

E.22

- **Clarify the rationale for the water level decline used to develop MTs/MOs and explain how this water level decline is reasonable and sustainable for DACs and domestic well communities in the PID GSA.** Using the proposed sustainable management criteria, CWC undertook an analysis of the proposed drinking water impacts for the communities of Pixley and Teviston, and the surrounding domestic well households. Based on our assessment of the drinking water impacts (CWC, Figure 2A and 2B), water level declines could result in significant impacts to drinking water users. Across the five PID GSA water level RMWs, water levels would be expected to drop by an average of nearly 52 feet from current conditions if water levels reach the MOs and by approximately 92 feet if water levels reach the MTs. The groundwater level MTs in the vicinity of these communities are an average of approximately 70 feet lower than current conditions. In the area of Teviston, the MT is approximately 90 feet lower than current conditions. At its MO, this well would experience approximately 43 feet of water level decline from current conditions (CWC, Figure 2A). Water levels at RMW 25N01 located just three miles east of Pixley would drop by 130 feet at its MO and 176 feet at its MT. Given that the subbasin is in critical overdraft, the GSP should explain how the projected additional water level declines of more than 90 feet within DACs and more than 170 feet in close proximity to a DAC will result in sustainable conditions for beneficial users

  In addition to water level decline in the two communities, the draft GSP would also have significant impacts on domestic well users. Our assessment took available well construction information and compared the well screens of the domestic wells located within a 1.5-mile radii of the RMW to the proposed MTs for the RMWs. In our assessment, a well is identified as fully dewatered if the MT is below or at the bottom of the well screen interval and a well is identified as partially dewatered at if the MT is below or at the midpoint of the well screen interval. Approximately half of the domestic wells within the PID GSA area are located within the 1.5

miles of an RMW. If water levels reach MTs, approximately 40% of these domestic wells would be expected to be fully dewatered and an additional 33% of these wells would be expected to be partially dewatered. This rough assessment of domestic well impacts does not capture impacts for all domestic wells and therefore the PID GSA should undertake a drinking water well impact analysis. Based on the draft PID GSP water budgets, rural domestic and small water system demand is very low compared to agricultural water uses and thus does not contribute substantially to the overdraft conditions. Nonetheless, the risks imposed on these drinking water users are overlooked and neglected, creating a disproportionate impact.

E.23

- **Undertake a drinking water well impact analysis that adequately quantifies and captures well impacts at the minimum thresholds, measurable objectives, and proposed undesirable results.** Though Section 3.5.2.5.3 of the draft GSP states that the sustainability indicators were developed in a way that considered the impacts to beneficial users, the draft GSP does not clearly and transparently present an assessment of these identified impacts, including and in particular, the impacts of the proposed MOs/MTs on domestic wells, small water systems, and DACs. As required by 23 CCR §354.28, these assessments should be included in the GSP in order for the public and DWR to fully evaluate the ability of the proposed SMCs and monitoring program to protect beneficial users within the PID GSA area. Therefore, an impact analysis should be performed to evaluate the potential impacts to wells associated with the water level MOs/MTs and presented in the GSP. The locations of potentially impacted wells should be identified and presented in maps in the GSP so that the public and DWR may assess the well impacts specific to DACs and other sensitive users within the PID GSA area. The GSP should also consider and quantify both the potential dewatering of wells and the pumping costs associated with the increased lift at the projected lower water levels, in order to more fully and transparently consider the impacts to beneficial users. This analysis should be included in the annual reporting process. Analysis should include:
    - Locations of potentially impacted wells overlayed on a map so the public can better assess well impacts specific to DACs, small water systems, or other beneficial users of water,
    - Quantify the number of potentially impacted wells broken down by well type (ag, domestic, small water system, city),
    - Quantify the costs associated with impacted wells including lowering pumps, well replacement and increased pumping costs associated with the increased lift at the projected water levels.

E.24

- **Describe how the approach to develop MTs/MOs is protective of diverse drinking water users.** The PID GSA area includes over 130 domestic wells, and two DWR designated DACs (Pixley and Teviston) with a collective population of over 5,080 people. The PID GSA area also includes three public water systems, including two small community water systems that serve over 3,000 people. Despite this broad and diverse dependence on groundwater for drinking water use, the approach to setting water level MOs/MTs and URs does not explicitly take these drinking water beneficial users into account. The Draft PID GSP does not present the impact of the proposed MOs/MTs on domestic wells, DACs and other key communities within the PID GSA area, nor does it present an assessment of how many and which domestic wells are expected to go dry if the MOs/MTs are reached. As required by 23 CCR § 354.28, these assessments should be

included in the GSP in order for the public and DWR to be able to fully evaluate how the MTs may affect the interests of beneficial uses and users.

E.25 • **Clarify how the projected water level decline before reaching the UR is not significant and unreasonable as described in 23 CCR § 354.26.** In particular, clarify how the UR are protective and adequately capturing the impacts to DACs and domestic well owners. The proposed UR does not clearly indicate how the proposed water level MTs will preserve the quality of life or support population growth, given the lack of consideration for drinking water beneficial users in the subbasin, in particular domestic well users and DACs reliant on groundwater. This approach is not protective of all users within the basin, particularly DAC community members who do not have the financial resources to address well impacts themselves. In addition to not having the resources to construct deeper wells, low income communities also do not have the resources to implement water treatment systems that require expensive operation and maintenance costs. Moreover, deeper wells and water treatment systems result in a significant increase in energy, operation, and maintenance expenses that can reflect back on water bills that are already overpriced in small water systems and above the California water affordability threshold of 1.5% of MHI[7].

E.26 • **Analyse how groundwater gradients will influence water quality and water levels at each minimum threshold.** As described above, if water levels reach the MTs at the RMWs, water levels would drop by an average of approximately 70 feet at the RWMs near Pixley and Teviston. However, as shown on CWC Figure 2B, the amount of decline is not consistent throughout the PID GSA area. At RMW 25N01, located in the northeast portion of the PID GSA, water levels would drop by over 170 feet, and at RMW 28J02, located on the southwest side of the PID GSA, water levels would drop by about 35 feet. The insets in Figures 2A and 2B show the estimated water level declines at the RMWs overlaid on the draft Fall 2017 groundwater elevation contour map (Figure 2-18). Steep water level gradients are present in the northern portion of the PID GSA, including an apparent large cone of depression northwest of Pixley. If water levels are managed to MOs or MTs, based on the range of expected water level declines, significant changes to groundwater flow gradients could occur. In addition to dewatering wells, changes to groundwater flow gradients could potentially result in changes to water quality. Therefore, it is recommended that the impacts to groundwater gradients at the proposed MOs and MTs be analyzed and described in the GSP, in addition to the likely impacts to drinking water wells.

E.27 • **Identify the SMCs set by the Tri-County Water Authority (TCWA) GSA in the northwest corner of PID GSA and include a discussion of how the TCWA SMCs will affect water levels within the PID GSA.** A small pocket of the TCWA GSA's area is located inside the boundaries of the PID GSA, in the northwest corner of the PID GSA. The PID GSA has not identified any water level RMWs in the north western portion of its boundary, but the TCWA has two water level RMWs within this area.

E.28 • **Develop and include a plan that outlines steps that will be taken is a drinking water well goes dry as a results of the PID GSA's management actions and projects.**

E.29 • **Develop a protective minimum threshold near vulnerable communities, including domestic wells, to avoid localized impacts and ensure the protection of these important water sources.** Near small community water systems and domestic well users, PID GSA should reconsider the

[7] Affordability threshold from the State Water Board's Drinking Water State Revolving Fund.

approach of setting water level MTs as the current proposal leaves key beneficial users in the subbasin, specifically domestic well users and S/DACs vulnerable to significant impacts. It is important to protect vulnerable communities access to a reliable source of water, thus minimum thresholds for groundwater levels should be set at a level above the screen of the shallowest domestic well. If PID GSA decides to define and reach its sustainability criteria in a way that allows for the dewatering of drinking water wells, it must provide a robust drinking water protection program to prevent impacts to drinking water users and mitigate drinking water impacts that occur. Recommendations for this type of program are included in the Management Actions and Projects section of this letter.

Groundwater Quality

We are pleased that the draft GSP establishes MTs/MOs based on maximum contaminant levels (MCLs) for contaminants of concern for municipal use. There are however a few areas in regards to groundwater quality sustainable management criteria that are not clear and could cause significant impacts to drinking water users if not adequately addressed. Public water systems are required by state law to be in compliance with water quality objectives. Increased contamination levels, or the presence of new contaminants the system or home previously was not impacted by, cause water systems to utilize more expensive treatment methods and/or the need to purchase additional alternative supplies as blending may become more difficult or impossible. Communities reliant on domestic wells who are aware of contamination in their water and use a point of use/point of entry (POU/POE) filtration systems may no longer be able to use their devices if contaminate levels rise too high. Increased contamination levels result in unreasonable impacts to access to safe and affordable water and is thus inconsistent with SGMA and the Human Right to Water. In order to avoid these challenges, we recommend the following changes:

E.30 • **Clearly and transparently describe the basis for the sustainable management criteria.** The water quality SMCs presented in Tables 3-5 and 3-9 of the draft GSP are not consistent with the processes for determining IMs, MOs, and MTs described in Sections 3.5.1.3.1 and 3.5.2.3.1 of the draft GSP, which state that the MOs are "a change above the baseline groundwater quality to not exceed 10% of long term 10 year running average" and the MTs are "a change above the baseline groundwater quality to not exceed 15% of long term 10 year running average." However, the majority of SMC values presented in Tables 3-5 and 3-9 are not calculated based on this method. For nitrate as N, conductivity (except for two RMWs), and pH, the presented MT and MOs are equal to each other and appear to be based on the Basin Plan Objectives listed in Table 2 of the Tule Subbasin Monitoring Plan. Based on the discrepancies in the draft GSP, it is not clear what method was used to develop the water quality SMCs and what the PID GSA intends to use to define water quality sustainability.

E.31 • **Clarify what is intended by methodology for developing MTs/MOs and explain how ever-increasing water quality concentrations are sustainable and protective of beneficial users and uses, including domestic well owners and small community water systems.** The baseline methodology for developing MOs and MTs uses a 10-year running average, which implies that the MOs and MTs will be recalculated for each reporting period and thus ever-increasing water

quality concentrations will remain within the MTs as long as the rate of increase stays within a 15% increase over the running average. Additionally, the MO and MT values presented in the draft GSP are exactly the same for pH, nitrate as N, arsenic, and chromium.

E.32 • **Revise the Undesirable Results for groundwater quality to be revised as follows:**
  - Any degradation above the MCL; or
  - If under the MCL, a degradation of more than 25%, or approaching 75% of the MCL
  - If over the MCL and any further degradation

The above criteria are to be measured at least annually and apply where 15% of monitoring wells exceed criteria for two consecutive years at the same wells. Any UR that is determined to be a health hazard by a county, State or Federal agency should be immediately addressed even if it does not meet the above criteria.

E.33 • **Revise the draft GSP to explain how the proposed SMCs will be protective of drinking water users located in agricultural areas, specifically rural residential domestic well users.** It appears that water quality SMCs will be applied for different COCs based on management areas. However, the draft GSP does not explain how managing for selected COCs in agricultural areas will be protective of drinking water users, and vice versa.

E.34 • **Revise the arsenic MOs/MTs to be in alignment with state drinking water regulations.** The arsenic MO and MT for the Pixley PUD CCR listed in the tables are 15.95 ppb and 16.7 ppb, respectively. These values both exceed the MCL for arsenic of 10 ppb. The 2018 baseline for arsenic in the Teviston CSD CCR is 4.6 ppb per Table 3-5, and the MO in the same table is more than 15.95 ppb, which is more than triple (347%) of the baseline value, and in excess of the MCL for arsenic. This is inconsistent with the MO/MT method described and because the value exceeds the MCL, water produced by the Teviston CSD would not be compliant with regulatory requirements for potable water served to the public. These SMC for arsenic are inappropriate, inconsistent with regulations, and do not represent water quality sustainability.

E.35 • **Provide an analysis of water quality data in the GSA to describe how the contaminants of concern (COC) list was determined and explain which contaminants were not included.** The Coordination Agreement identifies nitrate, pesticides, 1,2-dibromo-3-chloropropane (DBCP), and 1,2,3-tricholoropropane (TCP) in the upper aquifer as COCs and arsenic, manganese, and hydrogen sulfide as COCs for the lower aquifer (Section 2.1.7.4 of the Tule Subbasin Setting). However, the draft GSP includes a shorter list of COCs for the PID GSA (Table 3-4) and does not provide an explanation of how this list of COCs was determined for the PID GSA area. Based on an analysis of available data the GSA should determine and explain inclusion or exclusion of a particular contaminate in the GSP and monitoring program. As part of the data review also identify any water quality data gaps that need to be addressed by the GSA.

E.36 • **Revise the draft GSP to include a more comprehensive discussion of water quality related to the two National Priority List sites, including those issues that may impact drinking water beneficial users, including DACs.** Section 2.2.6.4 of the draft GSP discusses aquifer water quality, and states “While the majority of these sites are associated with leaking underground storage tanks [LUSTs], there is two National Priority List [NPL] sites within the GSA; one in the community of Tipton and the other being in the community of Pixley. Problems associated with point source contamination sites are highly localized”. However, only one NPL site is identified within the PID GSA area in Table 2-1, and the COCs related to the NPL site near the DACs within

the PID GSA area are not discussed in the draft GSP. The only water quality constituent examined in the draft GSP is nitrate.

E.37 • **Revise the draft GSP to fully consider all available water quality data in its analysis of groundwater conditions and the hydrogeologic conceptual model.** Section 5.3 of the draft Tule Subbasin Monitoring Plan lists the data sources included in the DataManagement System (DMS), including DWR Water Library, California Statewide Groundwater Elevation Monitoring (CASGEM), Groundwater Ambient Monitoring & Assessment (GAMA), California State Water Resource Control Board (SWRCB) Drinking Water Branch, Regional Water Quality Control Board (RWQCB) Annual Reports, DWR Groundwater Information Center Interactive Map Application (GICIMA), and Tule Basin Water Quality Coalition (TBWQC). However, based on Figure 2-15 of the Tule Subbasin Setting that shows nitrate concentrations, TBWQC is the only data source used in the analysis.

E.38 • **Revise the draft GSP to include specific discussions of the water quality conditions and trends for applicable constituents and uses and include an evaluation of the change in water quality constituent concentrations relative to change in water levels, particularly over drought periods, to evaluate the potential relationship between water quality and groundwater management activities.**[8] As stated in the Tule Subbasin Setting, "Nitrate (NO3) concentrations in the GSA area range from less than 6 mg/L [milligrams per liter] to greater than 101 mg/L with higher concentrations in the northwestern portion of the GSA (see Figures 2-15, Tule Subbasin Setting)" (Section 2.2.6.4). The Tule Subbasin Setting further acknowledges that "While nitrate is not an issue for agricultural irrigation or dairy supply, elevated nitrate in groundwater from small domestic supply wells could limit the beneficial use of water where these wells are impacted" (Section 2.2.4). As shown on the 2018 isocontour map for nitrate as N in Exhibit 3-2 of the draft GSP, high nitrate as N concentrations (>10 mg/L) are present in the eastern edge of PID GSA. However, despite this identified risk to drinking water beneficial users, the draft GSP does not include analysis of potential impacts to beneficial users of groundwater, particular DACs and small community systems.

E.39 • **Revise the draft GSP to have an analysis and discussion of the spatial relationship between the presence of the Corcoran Clay and arsenic concentrations in the GSP.** As stated in the Tule Subbasin Setting, "In the Tule Subbasin, the Corcoran Clay is as much as 150 ft thick beneath the Tulare Lake bed but becomes progressively thinner to the east, eventually pinching out immediately east of Highway 99 (Lofgren and Klausing, 1969)" (Section 2.1.2). As shown on the 2018 isocontour map for arsenic in Exhibit 3-2 of the draft GSP, high arsenic concentrations (>10 ug/L) are present in the western and central parts of the PID GSA, including within the community of Pixley (a DAC). Arsenic concentrations have been shown in some areas of the Central Valley to have a relationship to the dewatering of the Corcoran Clay.[9] However, the draft GSP does not include relevant discussion on the spatial relationship between water quality and Corcoran Clay. DWR's best management practices include more guidance on this topic.[10]

[8] Stanford, 2019. A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act, Spring 2019.
[9] Smith, Ryan et al. "Overpumping leads to California groundwater arsenic threat." Nature communications vol. 9,1 2089. 5 Jun. 2018, doi:10.1038/s41467-018-04475-3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5988660/
[10] DWR, 2017. Best Management Practices for the Sustainable Management of Groundwater, Sustainable Management Criteria (BMP #6), Draft November 2017.

E.40 • **Revise Tables 3-5 and 3-9 of the draft GSP to use the proper units for conductivity which are micro Siemens per centimeter (µS/cm).** Tables currently use units of µm/cm [micro meters per centimeter] which are not a valid unit for conductivity.

E.41 • **Evaluate the potential impacts of subsidence on DACs, community water systems, and domestic well users.** As shown on Figure 2-25 of the Tule Subbasin Setting, land subsidence from 2015 to 2018 is more significant in the PID GSA area than the rest of the subbasin. In addition to causing water quality impacts, subsidence can have adverse impacts including damaging well infrastructure and buildings. For many small community water systems and domestic well owners, these impacts can be very costly and lead to lack of access to safe and affordable drinking water.

E.42 • **Revise the GSP to establish MOs and MTs for conductivity for the two water system CCR RMS.** Conductivity can have an effect on non-health based characteristics of drinking water quality, and thus secondary MCLs have been established. It is recommended that SMCs for conductivity be applied across all RMS. The MTs for conductivity for the two RMS wells (E0259438 and 724662) are lower than their MOs. The MT for arsenic for one of the water system CCR RMSs (TCSD CCR) is lower than its MO. Water quality MOs are typically lower than MTs. The draft GSP should clarify what the intended MOs and MTs are for conductivity and arsenic and how they will be applied given the values presented in the draft GSP.

E.43 • **Consider working with local and regional water agencies or the county to implement groundwater quality remediation projects that could improve both quality as well as levels and to ensure groundwater management does not cause further degradation of groundwater quality.** The strategic governance structure of GSAs can uniquely leverage resources, provide local empowerment, centralize information, and help define a regional approach to groundwater quality management unlike any other regional organization. When implemented effectively, GSAs have the potential to be instrumental in reducing levels of contaminants in their regions, thus reducing the cost of providing safe drinking water to residents. GSAs are the regional agency that can best comprehensively monitor and minimize negative impacts of declining groundwater levels and degraded groundwater quality that would directly impact rural domestic well users and S/DACs within their jurisdictions. When potential projects are proposed, PID GSA should consider how projects could potentially both positively and negatively impact groundwater quality conditions and should take leadership in coordinating regional solutions.

GSP Section 4: Monitoring Networks

Robust monitoring networks are critical to ensuring that the GSP is on track to meet sustainability goals. GSAs undertaking recharge, significant changes in pumping volume or location, conjunctive management or other forms of active management as part of GSP implementation, must consider the interests of beneficial users, including domestic well owners and S/DACs. As currently developed, the monitoring network does not adequately monitor how groundwater management actions related to groundwater levels could impact vulnerable communities. We recommend the following changes:

E.44 • **Provide an explanation of whether and how the CCR data are representative of groundwater Conditions.** The RMWs include two wells as well as the Consumer Confidence Reports (CCRs) for

the Teviston CSD and Pixley PUD (Tables 3-5 and 3-9). The water quality analysis included in CCR reporting is based on drinking water served to the public after treatment, rather than the raw water extracted from the ground. The draft GSP does not specify the treatment level for these water systems, and therefore it is unclear how the data presented in the CCRs represents the water quality conditions of the groundwater. In order to better understand and monitor groundwater quality conditions in the GSA, additional sampling to understand raw water quality conditions are needed.

E.45 • **Evaluate and demonstrate how the proposed water quality monitoring network is sufficient to monitor for impacts to domestic well users in the PID GSA area and expand the monitoring network to address these gaps.** CWC Figure 4 shows the locations of the water quality RMS (based on draft GSP Table 4-2), DACs, public water systems, and domestic wells in the PID GSA. The RMS are generally located near DACs and community water systems, but provide minimal coverage for the domestic well users that are well distributed across the northern portions of the PID GSA area. The proposed network of water quality and water level RMWs appear to be insufficient to monitor impacts to groundwater for drinking water beneficial users, particularly domestic well users. Without adequate monitoring that capture shallow aquifer impacts for both levels and quality, domestic well users may be vulnerable to lack of access to safe water. This monitoring is required by 23 CCR § 354.34 therefore, PID GSA should develop plans to fill the data gaps for these sensitive communities and specify where the location of these new RMW will be located and if they will be used for groundwater level or quality MTs/MOs.

E.46 • **Revise the draft GSP to consistently identify the number and location of the water quality RMS within the PID GSA area.** The lists of the water quality RMS appear to be inconsistent between certain tables and figures in the draft GSP. Figure 3-1 of the draft GSP shows five RMS wells, and only two of them appear match the RMS wells listed in Table 3-5 and 3-9. Table 3-5 and 3-9 identify the CCRs for two water systems as RMS, but Table 4-2 identify two RMS wells for these two water systems instead. Figure A1-7 of the Tule Subbasin Monitoring Plan shows the water quality monitoring network for the subbasin, and includes at least four wells within the PID GSP area.

E.47 • **Revise the draft GSP to include maps of the proposed monitoring network overlayed with the two communities (Pixley and Teviston) and domestic well locations.** Without adequte maps, DWR and the public will not be able to adequately review monitoring gaps. See CWC Figures in the Attachments of this letter for examples of monitoring maps we developed to evaluate this GSP.

E.48 • **Revise the draft GSP to clarify and correct inconsistencies between the GSP and the Tule Subbasin Monitoring Plan, include a clear description of the monitoring schedule for all COCs identified in the GSPs, and revise the monitoring schedule to sample all COC for each RMS at least annually.** Based on Section 4.2.3.4 of the draft GSP, degraded water quality will be monitored as described in the Tule Subbasin Monitoring Plan. However, the Tule Subbasin Monitoring Plan states that "Annual water quality monitoring of the wells shown on Figure A1-7 will include laboratory analysis for nitrate as N only (see Table A1-5)" and "Every five years, samples from the wells shown on Figure A1-7 will be analyzed for an expanded list of analytes. In addition to nitrate, samples will be analyzed for total dissolved solids (TDS) and major cations

and anions (see Table A1-5)" (Section 2.4.1 of the Tule Subbasin Monitoring Plan). Table A1-5 shows the constituents that will be monitored for groundwater quality trends. Other COCs identified to be monitored in Table 3-4 of the draft GSP, such as arsenic and chromium, are not included in the annual sampling or five-year sampling list in the Tule Subbasin Monitoring Plan. Given that the MOs and MTs may be applied based on a 10-year average concentration, each RMS should be sampled for all COCs at least annually.

E.49 • **Clarify how the PID GSA intends to establish SMCs for RMS not identified as specific wells.** The MO and MT methods identified in Sections 3.5.1.3.1 and 3.5.2.3.1 of the draft GSP specify that the SMCs are calculated for "each RMS well." However, based on Tables 4-2, 3-5, and 3-9, the GSA intends to use water system CCRs as RMS in addition to the three identified RMS wells.

E.50 • **Clarify how URs will be evaluated within the PID GSA area given that there are several non-well RMS.** The Coordination Agreement defines the URs for degraded water quality as "unreasonable long term changes of groundwater quality above the minimum thresholds at greater than 50% of GSA Management Area RMS wells caused by groundwater pumping and/or groundwater recharge" (Section 4.3.3.2)

E.51 • **Clarify which form of nitrogen will be monitored for purposes of compliance with the SMCs.** Table 3-4 identifies "Nitrogen as N" as a COC. However, Tables 3-5 and 3-9 list "Nitrate as N" as a COC.

E.52 • **Develop long-term access agreements for RMWs owners and operators and identify who the owners are (Section 4.2.3.4).** It is understood that the PID GSA will be mostly relying on water quality data collected by others for purposes of its long-term sustainability monitoring and compliance, in particular, a number of the water quality RMWs are owned by small community water systems or a private owner. As shown in Table A1-1 of the Tule Subbasin Monitoring Plan, a number of existing monitoring wells lack owner information. Small water systems often have limited resources and can be less consistent with their water quality and other reporting, despite the regulatory requirements in place. Small water systems are also more prone to significant changes such as closure or acquisition and consolidation into larger systems. Collecting data from private wells is also not a reliable approach due to access challenges, lack of well construction information, and unreliable accounting of pumping or non-pumping measurements. The GSP should specifically identify the RMW owners and operators, include signed long-term access agreements, and identify a plan to obtain adequate monitoring data, should for any reason the well owners not grant access to the wells or provide associated data to the PID GSA. In order to maintain consistency for future sustainability analyses, the PID GSA could also consider conducting its own water quality analysis of wells and establish access agreements to water quality RMWs.

E.53 • **Clarify how pH will be measured.** Because pH is not measured as a concentration of chemicals, the baseline methodology for MOs and MTs should not be applied in the same manner.

E.54 • **Clarify how much data will be considered sufficient for purposes of calculating the 10-year baseline and describe what methodology will be used if baseline values are nondetect.** While the draft GSP indicates that 2020 water quality data will be included in a future calculation of the MOs/MTs, the plan does not describe what will be considered sufficient.

E.55 • **Clarify how the GSA plans to align groundwater monitoring efforts and the sustainable management criteria with any emerging contaminants of concern and new MCLs.**

GSP Section 5: Projects and Management Actions

The current projects and management actions (P&MAs) in the draft GSP do not provide enough information for the public and DWR to evaluate if they are adequate in helping PID GSA achieve sustainability. This section is incomplete and does not meet requirements indicated by 23 CCR § 354.44. Proposed projects also fail to consider impacts to drinking water including potential groundwater quality impacts to domestic wells and small community water systems. Without properly considering drinking water users, this list of potential projects have the possibility to impact DAC's access to safe and affordable drinking water. We recommend the following changes:

E.56 • **Revise the groundwater accounting system to identify the accounting plan or mechanism for each type of user that will be used to create individually tailored allocations. At a minimum identify key policies that will be incorporated into the groundwater accounting system that will ensure that DACs, small water systems, and domestic well users will have access to safe, clean, affordable, and accessible drinking water.** According to Section 5.2.1 of the draft GSP, tools such as monitoring, debiting, crediting, and carry-over policies and mechanisms will be used to track groundwater use, track water credits (groundwater and/or surface water), and develop water budgets for individual landowners. However, the draft GSP does not clearly describe how these tools will be applied to different water users, including agriculture, M&I, and domestic well users.

E.57 • **Clarify if future pumping restrictions will be placed on communities and under what conditions. Revise this section to ensure communities will not be subject to future pumping restrictions.** Section 5.2.6 states that "the CSDs and PUDs were developed as a separate management area and subject to the local control and management of the public entities that provide water service" and acknowledges that "These areas are Severely Disadvantaged Communities and a reliable water supply for these communities is vital," and that "[their] water use will be reviewed through periodic updates to the Plan and compared to the available sustainable yield for the community and pumping limits acceptable to the Agency, as allowed under the regulatory code of SGMA." This implies that the PID GSA may implement pumping restrictions on the water systems but does not clearly identify how and under what conditions pumping restrictions could be implemented.

E.58 • **Revise the P&MAs to clarify whether a reduction in pumping will be implemented and by how much. If groundwater pumping is estimated to increase, describe how this contributes to reaching groundwater sustainability given the severely overdraft conditions of the subbasin.** Based on Table 2-7 (Planning Transitional Pumping), there will be a decrease of 0.5 acre-feet/acre (AF/ac) in pumping every five years through 2040, until the sustainable yield is met. The same proposed reduction in groundwater use during plan implementation is shown in Table 5-1 of the draft GSP. However, Table 4 in Appendix A of the Tule Subbasin Setting, which provides the projected future groundwater budget for the PID GSA, shows that groundwater pumping will actually increase during this period.

E.59 • **Revise the draft GSP to clarify inconsistencies between the P&MA section and the Tule Subbasin Setting.** The P&MAs identified in the draft GSP are inconsistent with those identified in Table 2-6 of the Tule Subbasin Setting. The P&MAs identified in the Tule Subbasin Setting Table 2-6 were reportedly incorporated into the groundwater flow model to develop the projected water budget, which was used as the basis for establishing sustainable yield estimates and water level MOs and MTs.

E.60 • **Revise P&MAs to include all details required by required by 23 CCR § 354.44 and explicitly describe how such risks to water quality will be evaluated and monitored as a part of the development of the specific recharge projects. As future specific projects are developed, the details should be clearly communicated to the public through an active stakeholder outreach and communication process that proactively seeks to include members of DACs.** The draft GSP does not identify specific locations, anticipated size of recharge projects, estimated volume of storage and other benefits, or estimated costs for such projects, and thus limited information is available for the public to review regarding these P&MAs.

E.61 • **Revise Section 5.2.5 to include details on the planned fallowing and describe how this project was factored into the groundwater flow model, water budget and planned transitional pumping projections.** Table 2-7 of the Tule Subbasin Setting presents the "Planned Transitional Pumping" for the PID GSA that was incorporated into the projected water budget for the subbasin and groundwater flow model. Based on this, fallowing is planned over the 2020-2040 transitional pumping step down period. From this table it is not clear if the PID GSA intends to fallow a total of 5,000 acres over the 20-year period, or to fallow a total of 20,000 AFY. Additionally, the fallowing of lands is not described in Section 5.2.5 (Agricultural Land Retirement Projects) of the draft GSP or shown as a P&MA in Table 2-6 of the Tule Subbasin Setting.

E.62 • **Assess the impacts and identify the benefits of the water supply augmentation projects near DACs and small water systems.** The draft GSP does not describe how future recharge projects will be monitored, or include a discussion of potential water quality impacts that can result from these projects. It is important to consider that, depending on the source water used, recharge projects have the ability to improve or degrade groundwater quality. In addition, recharge projects have the potential to mobilize contaminants, including by mobilizing surface and shallow soil contaminants through percolation, spreading existing contaminant plumes by altering the groundwater flow gradient, and mobilizing naturally occurring compounds through changes in geochemistry due to the introduction of a different water type, among other mechanisms. As recommended in the 2019 Stanford A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act, "In addition to complying with any regulatory requirements, GSAs undertaking recharge or other active management actions should consider developing a sufficient understanding of the interactions between subsurface geology, geochemistry and GSP projects in their basin. The development of sufficient monitoring networks, capable of detecting changes in groundwater quality conditions related to active management, will be critical to understanding these interactions." Identifying the potential impacts and benefits that might occur because of these projects is critical in order to proactive plan to avoid undesirable impacts to drinking water users.

E.63

- **Develop criteria for recharge projects that prevent unintended impacts to drinking water.** Groundwater recharge projects can have multiple benefits such as increasing groundwater storage and levels, as well as diluting contaminant plumes and improving groundwater quality. However, if not properly designed, recharge projects may mobilize nitrates, pesticides, and fertilizers, as well as naturally occurring contaminants, and can lead to the further degradation of groundwater quality, impacting drinking water wells. Currently, it is unclear if these proposed projects include precautions of groundwater quality degradation or if groundwater quality is included in the monitoring plan of these projects. In order to develop recharge projects that move the subbasin towards sustainability, avoid the further degradation of groundwater, and improve drinking water conditions, we recommend the following considerations for this recharge criteria[11]:

  1. When selecting sites for on-farm recharge projects, GSAs can work with growers who are implementing some or all of the following in order to minimize the mobilization of pesticides and fertilizers:

     - Using best management practices that optimize chemical use so residuals do not enter recharge water;
     - Growing crops that require fewer fertilizers (e.g. legumes);
     - Recharging during winter months (when less/no fertilizer is being used);
     - Minimizing fall applications of fertilizers and pesticides;
     - Not surrounded by dairy operations.

  2. When implementing on-farm recharge projects, recharge on the same plot of land annually for a consecutive number of years in order to most effectively flush out and dilute residual contaminants (especially nitrate) left behind from previous applications. Continued flushing will also help reduce bicarbonate, calcium, and organic carbon transport which will limit their impact on the dissolution and release of uranium and/or arsenic.

  3. Prior to implementing any recharge project, identify all nearby drinking water wells (both public supply and private wells). Additional monitoring wells that collect groundwater quality samples may need to be installed in key areas to protect public health.

  4. Prior to implementing any recharge project, collect data to characterize the upper soil zone and groundwater quality, including the amount of fertilizer applied and any naturally occurring contaminants present in the soil. Monitor and adjust the quality of water being recharged in order to limit the mobilization of naturally occurring contaminants (e.g. monitoring oxygen, pH, electrical conductivity, and nitrate levels).

[11]Community Water Center. Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act. https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858

5. Consider recharging through excavated points, ditches/canals, and other designated recharge basins in order to bypass soil layers with naturally occurring contaminants, pesticides, and/or nitrate.

E.64 Missing Drinking Water Well Mitigation Program

As noted previously, our review indicated that the usability of over 73% of domestic wells near the representative monitoring wells in the PID GSA area would be expected to be significantly impacted if water levels reach the proposed MTs. Moreover, based on the draft GSP water budget, rural domestic and small water system demand does not contribute substantially to the overdraft conditions, yet the risks imposed on these drinking water users are overlooked and neglected, creating a disproportionate impact on already vulnerable communities. Without any clear actions regarding establishing a groundwater allocation or addressing reductions in groundwater pumping, drinking water users could face significant impacts, particularly if the region faces another drought. If LTRID GSA defines its sustainability criteria in a way that allows for the dewatering of drinking water wells, it must provide a robust drinking water protection program to prevent impacts to drinking water users and mitigate the drinking water impacts that occur.

A GSP which lacks a mitigation program to curtail the effects of projects and management actions on the safety, quality, affordability, or availability of domestic water, violates both SGMA itself and the Human Right to Water. The Human Right to Water (AB 685) (HR2W) was signed in 2012 and added § 106.3 to the California Water Code, declaring it, "the established policy of the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."[12]

The HR2W applies to all state agencies, requiring they, "...shall consider this state policy when revising, adopting, or establishing policies, regulations, and grant criteria when those policies, regulations, and criteria are pertinent to the uses of water...".[13] Both the State Water Resources Control Board (SWRCB) and the Department of Water Resources (DWR), are required to consider HR2W when revising, adopting, or establishing policies, regulations, and grant criteria that may impact the uses of water for domestic purposes. Furthermore, DWR is expressly compelled to review GSPs for compliance with the HR2W by 23 CCR §350.4(g).

The California legislature has recognized that water used for domestic purposes has priority over all other uses since 1913.[14] Reserving top priority for domestic water use was later codified in 1943, in Water Code § 106, which declares it the, "established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation."[15] More recently, the passage of the Safe and Affordable Drinking Water Act by Governor Newsom[16] indicates a clear state-level commitment to providing safe and affordable drinking water to California's most vulnerable residents. Poor implementation of SGMA would threaten the success of the Safe and

[12] WAT § 106.3 (a).
[13] WAT § 106.3(b).
[14] California Water Commission Act of 1913 § 20.
[15] WAT§ 106; This policy is also noted in the Legislative Counsel's Digest for AB 685.
[16] SB 200, Monning (2019).

Affordable Drinking Water Fund and would run counter to Governor Newsom's vision of providing safe water to all.

To ensure compliance with the legislature's long established position, and in accordance with 23 CCR §350.4(g), the HR2W requires that DWR must consider the effects on domestic water users when reviewing and approving GSPs.[17]

A carefully designed and implemented Drinking Water Well Impact Mitigation Program can support a statewide goal of ensuring access to clean, safe, reliable, and affordable drinking water. Including this type of program in a GSP also helps to create a groundwater management plan that understands DACs' unique social and economic vulnerabilities, is sensitive to their drinking water needs, and avoids causing a further disparate impact on low-income communities.

A Drinking Water Well Mitigation Program could include a combination of different strategies including: replacing impacted wells with new, deeper wells, connecting domestic well users to a nearby public water system, or providing interim bottled water. Key considerations and recommendations, including examples from existing well mitigation program, will be shared with the PID GSA separately.

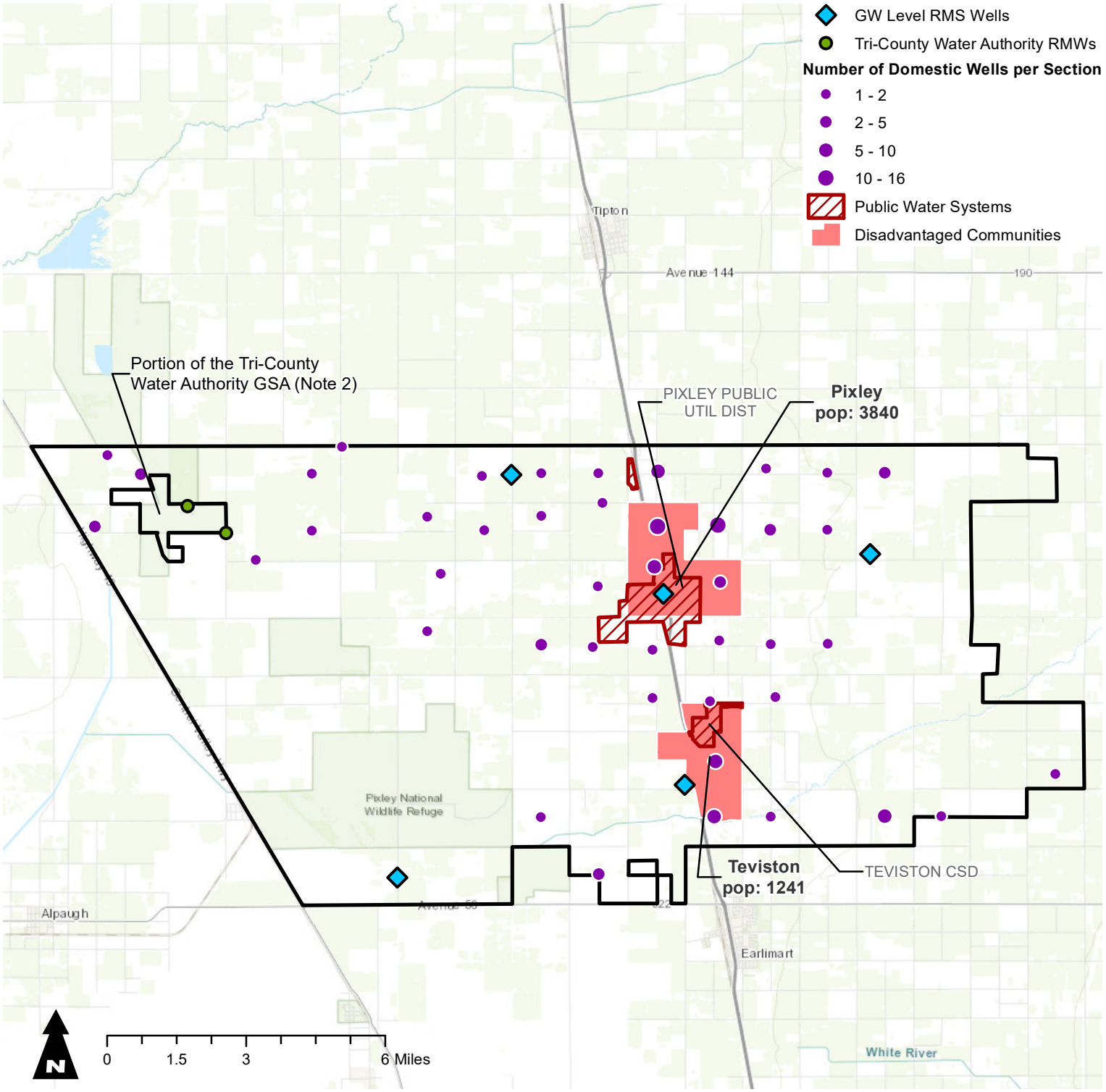
Attachments to this Letter

1. CWC Figure 1— Representative Monitoring Network for GW Levels Relative to Domestic Wells, DACs, and Community Water Systems
2. CWC Figure 2A— Estimated Water Level Decline at Measurable Objectives and Domestic Wells
3. CWC Figure 2B— Estimated Water Level Decline at Minimum Thresholds and Domestic Wells
4. CWC Figure 3— Water Level Minimum Thresholds and Domestic Wells
5. CWC Figure 4— Representative Monitoring Network for GW Quality Relative to
6. Domestic Wells, DACs, and Community Water Systems

[17] *See generally,* WAT § 106.3 (b).

Figure 1 - Representative Monitoring Network for GW Levels Relative to Domestic Wells, DACs, and Community Water Systems

Pixley Irrigation District GSA



Notes

1. All locations are approximate.
2. The portion of the Tri-County Water Authority GSA located within the boundary of the PID GSA includes two water level RMWs.

References

1. Domestic Well Densities: Research to develop the CWC Vulnerability Tool draft as of August 6, 2019. The dataset excludes private wells located in areas served by public water systems, based on the Water Boundary Tool (WBT).
2. Disadvantaged community data: downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/.
3. Public Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer. Includes community and non-community water systems.
4. Information of the Representative Monitoring Site for groundwater level in the draft GSP is conflicting. RMS wells are located by combining information from Figure 2-34, Table 1A-1, and Table 1A-3 in draft Tule Subbasin Monitoring Plan, dated August 2019. The MOs and MTs are from Table 3-2 and Table 3-7 in the draft Pixley Irrigation GSA GSP - Public Review Draft dated September 2019.

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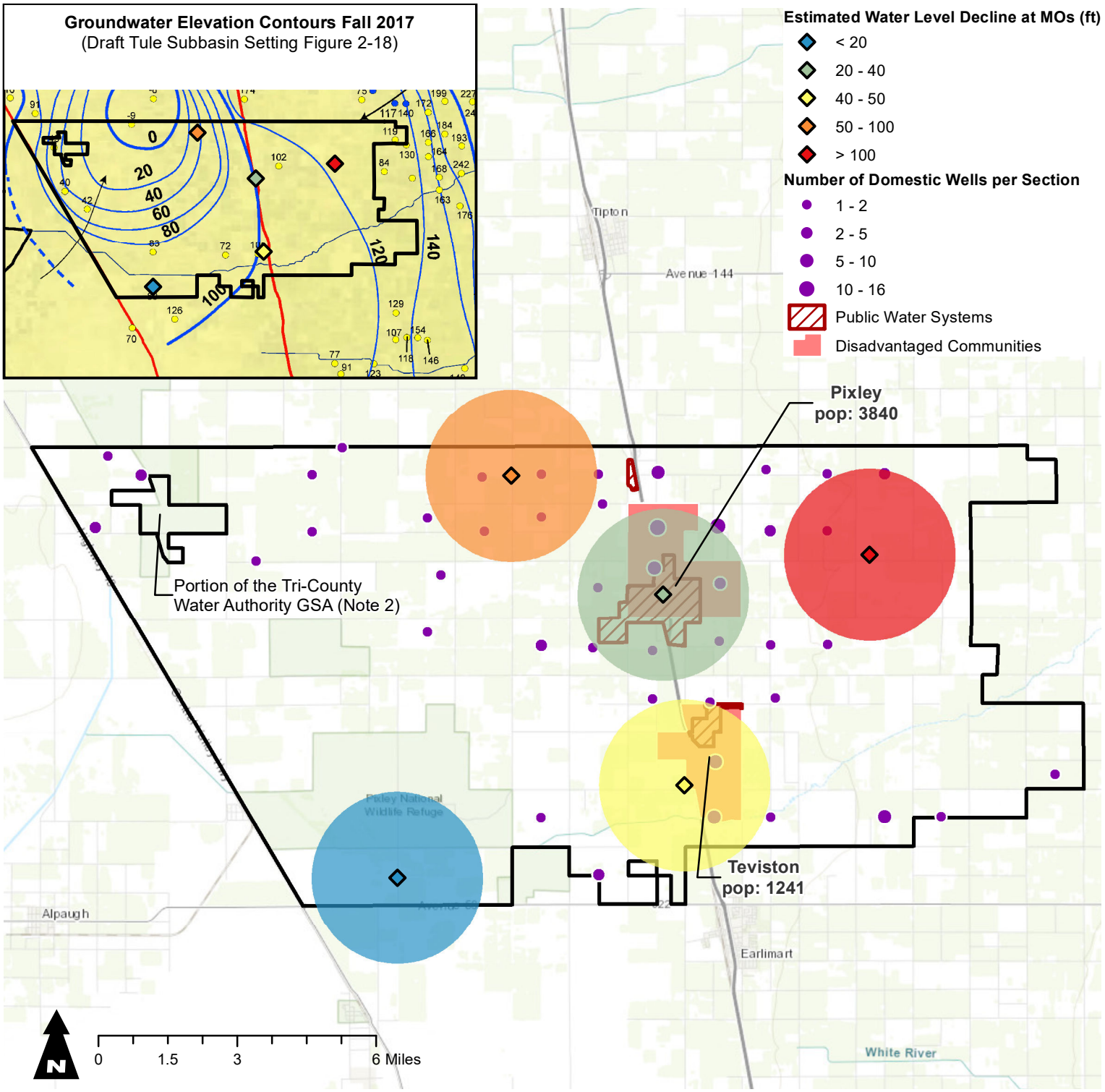
Figure 2A - Estimated Water Level Decline at Measurable Objectives and Domestic Wells

Pixley Irrigation District GSA



Notes

1. All locations are approximate.
2. The portion of the Tri-County Water Authority GSA located within the boundary of the PID GSA includes two water level RMWs.

References

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2. Disadvantaged community data (place, tract, and block group): downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/.
3. Public Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer. Includes community and non-community water systems.
4. Groundwater level representative monitoring wells are the wells assigned with MTs and MOs according to the draft Pixley Irrigation District GSA GSP - Public Review Drafts dated September 2019. The MO values are from Table 3-2 in the draft GSP. The Fall 2017 groundwater elevation contours are from Figure 2-17 of the draft Tule Subbasin Setting, dated August 2019.

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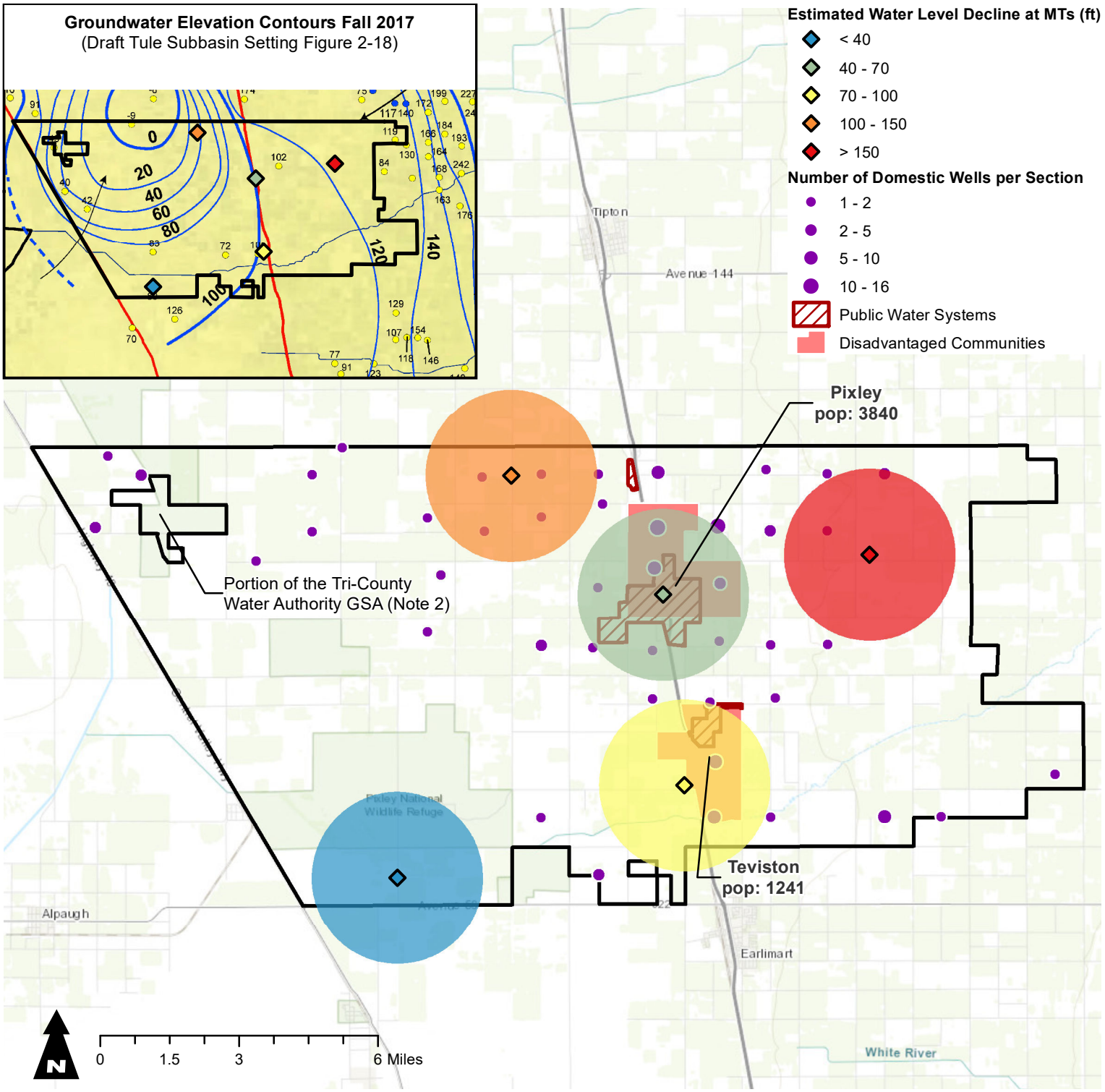
Figure 2B - Estimated Water Level Decline at Minimum Thresholds and Domestic Wells

Pixley Irrigation District GSA



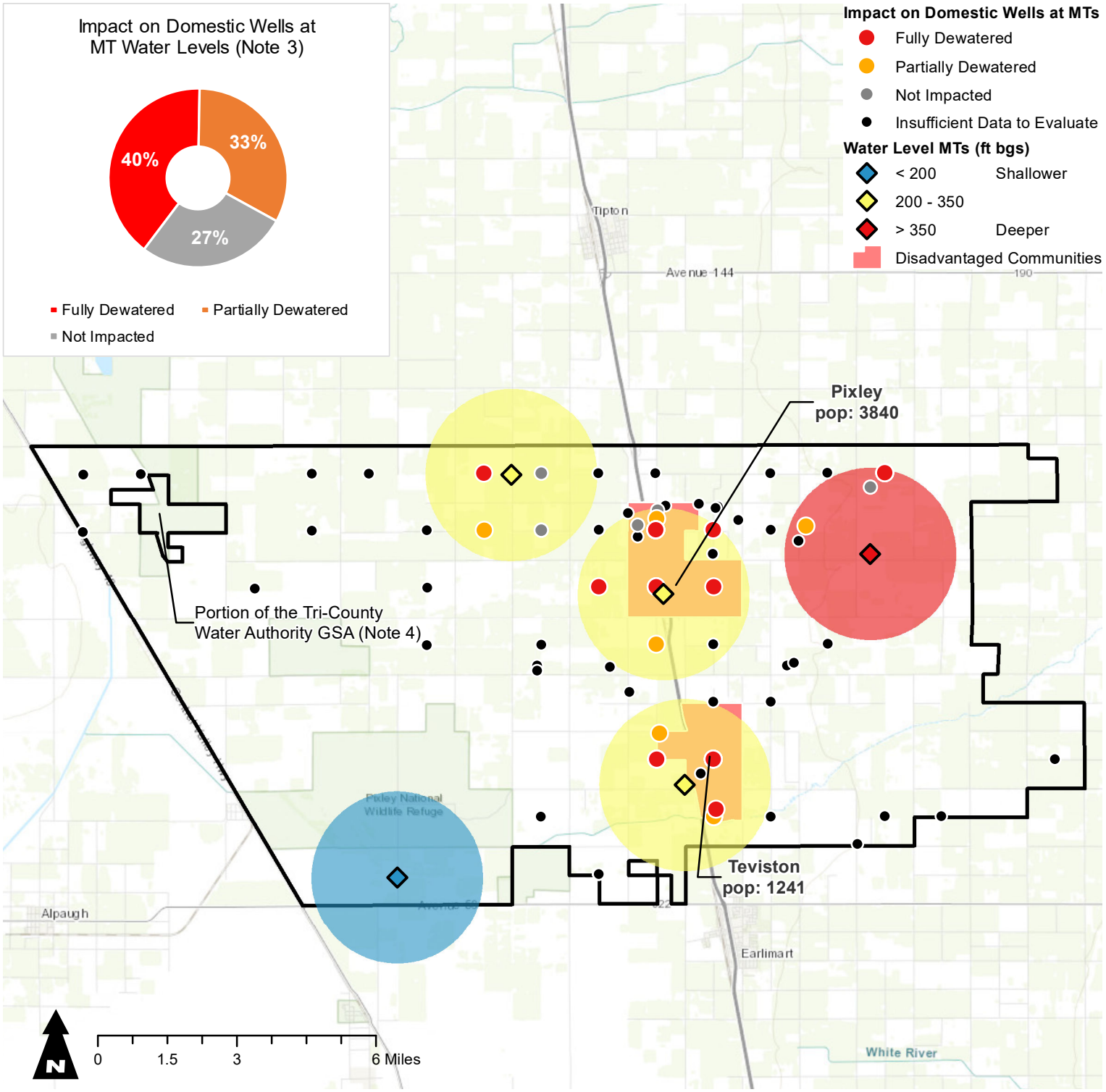
Notes

1. All locations are approximate.
2. The portion of the Tri-County Water Authority GSA located within the boundary of the PID GSA includes two water level RMWs.

References

1. Domestic Well Densities: Research to develop the CWC Vulnerability Tool draft as of August 6, 2019. The dataset excludes private wells located in areas served by public water systems, based on the Water Boundary Tool (WBT).
2. Disadvantaged community data (place, tract, and block group): downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/.
3. Public Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer. Includes community and non-community water systems.
4. Groundwater level representative monitoring wells are the wells assigned with MTs and MOs according to the draft Pixley Irrigation District GSA GSP - Public Review Drafts dated September 2019. The MT values are from Table 3-7 in the draft GSP. The Fall 2017 groundwater elevation contours are from Figure 2-17 of the draft Tule Subbasin Setting, dated August 2019.

Figure 3 - Water Level Minimum Thresholds and Domestic Wells
Pixley Irrigation District GSA



Notes
1. All locations are approximate.
2. For this assessment, the proposed MTs in ft above sea level were converted to depth below ground surface values, based on the ground surface elevation of RMS wells.
3. Where available, bottom of screen interval of a domestic well was used for this assessment, and bottom of well depth was used for the remaining domestic wells. A well is identified as fully dewatered if the MT is below the bottom of the well screen interval; a well is identified as partially dewatered if the MT is below the midpoint of well screen interval. Wells with insufficient data and/or wells outside of the 1.5-mile radius were not evaluated.
4. The portion of the Tri-County Water Authority GSA located within the boundary of the PID GSA includes two water level RMWs.

References
1. Domestic Well data: Research to develop the CWC Vulnerability Tool draft as of May 16, 2019.
2. Disadvantaged community data: downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/. Last updated in 2016.
3. MT values are from Table 3-7 in draft Pixley Irrigation District GSA GSP- Public Review Drafts dated September 2019.

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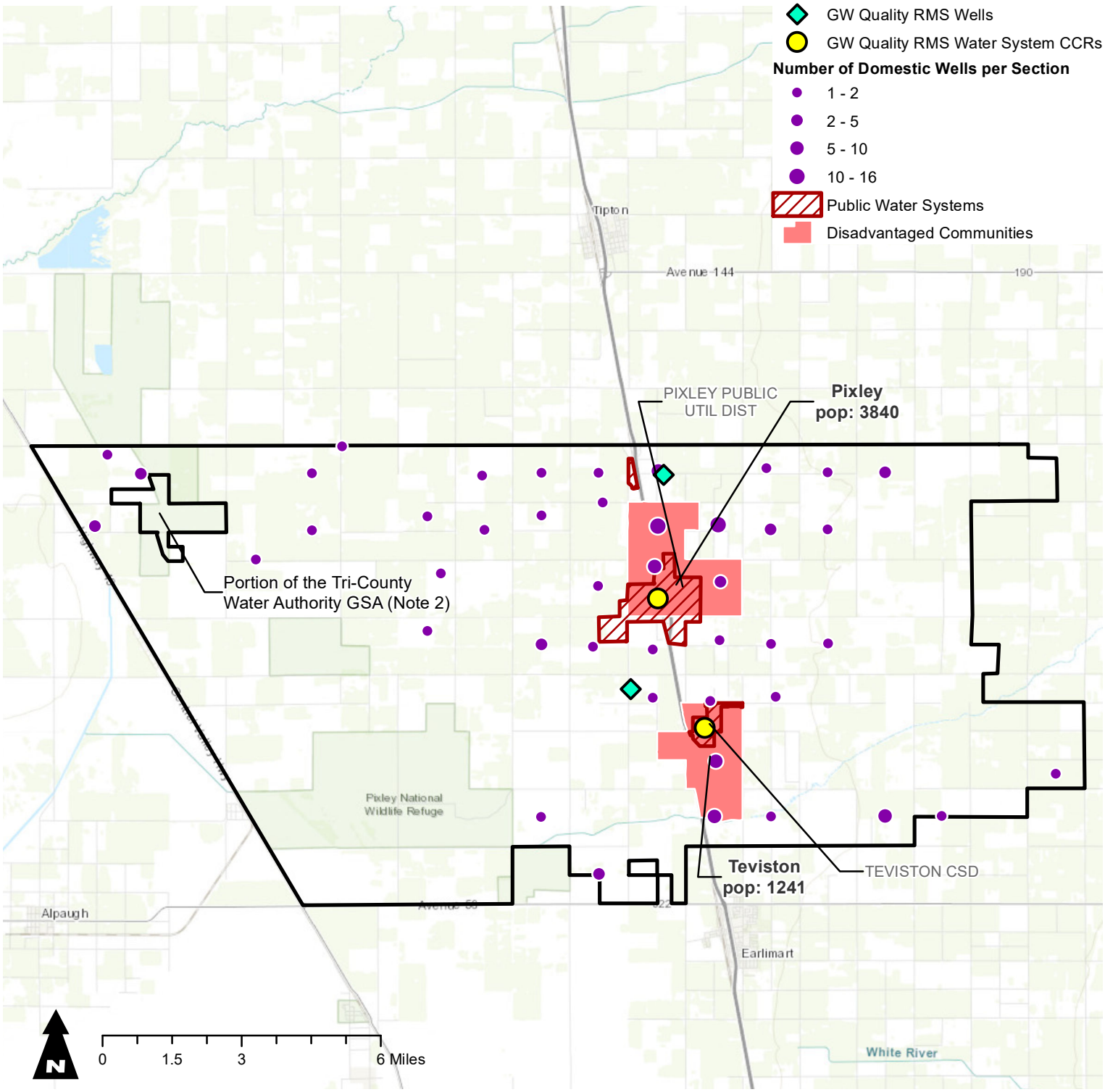
Figure 4 - Representative Monitoring Network for GW Quality Relative to Domestic Wells, DACs, and Community Water Systems

Pixley Irrigation District GSA



Notes

1. All locations are approximate.
2. A portion of the Tri-County Water Authority GSA is located within the boundary of the PID GSA.

References

1. Domestic Well Densities: Research to develop the CWC Vulnerability Tool draft as of August 6, 2019. The dataset excludes private wells located in areas served by public water systems, based on the Water Boundary Tool (WBT).
2. Disadvantaged community data (place, tract, and block group): downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/.
3. Public Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer. Includes community and non-community water systems.
4. Representative Monitoring Site wells for groundwater qulity are from Table 3-9 in draft Pixley Irrigation District GSA GSP, - Public Review Draft dated September 2019. Two community CCR reports, according to the draft GSP, will be utilized for monitoring water quality in Teviston CSD and Pixley PUD.

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December 16, 2019

Alpaugh GSA
Delano Earlimart Irrigation District GSA
Eastern Tule GSA
Lower Tule River Irrigation District GSA
Pixley Irrigation District GSA
Tri-County Water Authority GSA

Re: **Comments on Tule Subbasin Groundwater Sustainability Plans**

To: The Directors and Staff of the Referenced Groundwater Sustainability Agencies

The Friant Water Authority (FWA), which operates the 152-mile long Friant-Kern Canal (FKC or Canal) on behalf of the United States Department of Interior's Bureau of Reclamation (Reclamation) and which Canal conveys contract water to 34 water agencies and municipalities that in turn serve tens of thousands of residential customers and over 1 million acres of farmland, respectfully submits this comment letter on the Groundwater Sustainability Plans (GSPs) that have been drafted by each of the Groundwater Sustainability Agencies (GSAs) addressed in this letter pursuant to the Sustainable Groundwater Management Act (SGMA).[1]

As a preliminary matter, we commend the various boards, staff members and technical consultants for the efforts that have gone into the preparation of the draft GSPs and for the transparent and collaborative manner in which the GSAs have engaged with stakeholders such as FWA. We are in this together, and your leadership to date, as evidenced by the outreach to our agency, has been exemplary. With the exception of the issues noted below, FWA fully supports the adoption and implementation of the GSPs. To that end, FWA looks forward to continuing our collaboration in order to achieve the "Sustainability Goal" of the Tule Subbasin, which, as defined in the Tule Subbasin Coordination Agreement (Coordination Agreement), is "the absence of significant and unreasonable undesirable results associated with groundwater pumping."[2]

In our initial comment letter of May 28, 2019, we notified each GSA that FWA would be carefully reviewing the draft GSPs in terms of the description and definition of undesirable results with respect to subsidence impacts to the Canal, and noted that while SGMA established a 20-year planning period to bring the Tule Subbasin into sustainability, the continuation of unmitigated land subsidence impacts to the Canal would be unacceptable and that feasible solutions must be identified. With that

[1] Water Code § 10720 and following.
[2] Coordination Agreement, § 4.2.

outcome in mind, we provide our specific comments on the draft GSPs, particularly the GSP of the Eastern Tule GSA (ETGSA).

We support the stated intent in the Coordination Agreement as to the purpose of avoiding undesirable results in the context of land subsidence: "the avoidance of an undesirable result of land subsidence is to protect critical infrastructure for the beneficial uses within the Tule Subbasin, including excessive costs to fix, repair, or otherwise retrofit such infrastructure and may also result in an interim loss of benefits to the users of such infrastructure."[3] It cannot be disputed that the FKC is one of if not THE most critical infrastructure facility in the Tule Subbasin with respect to the conveyance of water for beneficial use. It also cannot be disputed, as documented in the GSPs, that groundwater pumping in the vicinity of the Canal has resulted in upwards of 9 feet of land subsidence in recent decades - several feet of which has occurred in recent years even after the adoption of SGMA.[4] Because the Canal's conveyance system relies on a "gravity" design, this subsidence has reduced the conveyance capacity of the Canal to 40% of its original capacity (from 4,000 to 1,650 cubic-feet per second (cfs)) in these subsided areas. The resulting constriction in the Canal is precluding the delivery of significant amounts of water to Friant Division Contractors (Friant Districts) below the subsided areas and also affects the ability to Friant Districts above the constricted area to engage in exchanges or transfers of water.

As a result of the persistent overdraft conditions in the Tule Subbasin, FWA, at considerable expense, is developing plans, undertaking environmental review, and pursuing permitting to address these existing subsidence impacts by restoring capacity through a project referred to as the "Friant-Kern Canal Middle Reach Capacity Correction Project" (Project). The current engineering estimates place the cost of the Project in excess of $500 million.

With this well-documented and undisputed background in mind, including the extensive information, analysis and modeling in the GSPs and their supporting technical appendices, FWA must express its dissatisfaction with both the proposed "minimum thresholds" for subsidence and the criteria used to define "undesirable results" with respect to future subsidence as applied to the FKC. Specifically, the draft GSPs provide for **up to three feet of additional subsidence along the Canal** caused by transitional pumping/use **BEFORE** the identified ***minimum thresholds*** are exceeded. This impact will be compounded by the reliance of the GSPs on the definition of undesirable results in the Coordination Agreement, which provides as follows:

> § 4.3.4.2 Criteria to Define Undesirable Results: "*the criteria for an undesirable result for land subsidence is defined as the unreasonable subsidence below minimum thresholds at* ***greater than 50% of GSA Management Area RMS*** *resulting in significant impacts to critical infrastructure*." (Emphasis added.)

Figure 5-1 of the GSP for the ETGSA identifies seven Representative Monitoring Sites (RMS) along the most severely subsided portion of the FKC covering a distance of approximately 12 miles measured from the Tule River at Avenue 152 to Avenue 80. Using the proposed criteria for defining an undesirable result, the "transitional" overdraft pumping will be permitted to potentially cause 3 additional feet of

[3] Coordination Agreement, § 4.3.4.3.
[4] ETGSA GSP, § 4.3.5; see also FWA's Friant-Kern Canal Fact Sheet (attached).

subsidence over at least a 4-6 mile area (the distance of 4 of 7 RMS (i.e., more than 50% of the Representative Monitoring Sites)) BEFORE being deemed an undesirable result.[5] This is not acceptable to FWA unless there is concurrent and corresponding mitigation in the form of compensation to FWA and the Friant Districts to pay for the damages resulting from such pumping as discussed further below.[6]

F.1 If the GSAs agree to incorporate the prompt adoption of management actions that would provide reasonable compensation to address "interim" subsidence (i.e., the continuation of subsidence until the proposed "minimum thresholds" are reached), then FWA would not object to the GSPs maintaining these objectives, not as minimum thresholds that must be exceeded before management action is taken, but rather, as a basis for ***additional*** management actions, including greater compensation for damages to the Canal and Friant Districts and potential additional reductions in groundwater pumping to achieve sustainability sooner and avoid further impacts to the Canal if these so-called minimum thresholds are exceeded.

F.2 In addition to establishing a uniform zero-tolerance for additional subsidence impacts to the Canal absent appropriate compensation/mitigation, the criteria for monitoring any continued undesirable results for land subsidence as pertaining to the Canal need to be site specific and should be based on any additional subsidence detected at a single RMS location. Furthermore, because the FKC is critical infrastructure, FWA recommends that the Tule Subbasin GSPs incorporate additional RMS along the FKC for the entire length of the Tule Subbasin and that such RMS locations be spaced not more than one mile apart. Some of the Friant Districts are adding such monitoring sites for their own water banking/recharge projects near the FKC, and we would encourage the GSAs to incorporate these facilities as part of their subsidence monitoring management actions with respect to the FKC.

While the GSPs do not calculate the amount of capacity loss to the Canal from the contemplated 3 additional feet of subsidence that is predicted over the first 15 years of the GSPs, FWA estimates this capacity reduction to be on order of 460 cubic feet per second (cfs), which would result in a conveyance capacity of 1,140 cfs (based on current deficient conditions) and put the Canal capacity at 2,860 cfs below the original design capacity of 4,000 cfs. FWA further estimates that the 3 additional feet of subsidence contemplated under the GSPs will result in further reduced water deliveries to Friant Districts below the impacted area on the order of at least 30,000 to 40,000 acre feet (AF) per year, in addition to the already significant inability to convey water during wet years such as 2017 and 2019 where FWA estimates that upwards of 300,000 AF could have been delivered to Friant Districts but for the capacity restrictions caused by subsidence due to overdraft groundwater pumping in the Tule Subbasin. Under such conditions, Friant Districts' imported surface water supplies through the FKC will be even further restricted, which in turn will diminish their ability to contribute to the sustainable management of their own respective subbasins in the future.

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[5] See ETGSA GSP, § 5.8.3.1.2 (Quantified Minimum Thresholds).

[6] See Civil Code section 3479: "**Anything which is injurious to** health, including, but not limited to … an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, or unlawfully obstructs **the free passage or use**, in the customary manner, **of any** …**canal** … **is a nuisance**." (Emphasis added.) It is FWA's position that any pumping activity causing further subsidence to the Canal constitutes a nuisance unless appropriate compensation/mitigation is provided.

F.3 FWA is encouraged that the GSP for ETGSA establishes a "Friant-Kern Canal Subsidence Management Area." However, neither that Plan nor any of the other GSPs establish specific management actions or mitigation to address the continued subsidence impacts to the Canal despite the fact that the GSPs contemplate continued overdraft conditions (aka "transitional pumping/use") through the implementation period of 2040.[7]

F.4 For the above reasons, **all** further subsidence along the Canal as contemplated in the GSPs should be considered significant and unreasonable and deemed to substantially interfere with surface land uses unless appropriate mitigation is provided to fairly compensate FWA and the Friant Districts for such interference.[8] Accordingly, the GSPs should be revised to mandate the prompt adoption of management actions (following adoption of the GSP) that provide for such equitable compensation as a condition of the transitional groundwater pumping permitted under each GSP in areas where such pumping can reasonably be demonstrated to cause continued subsidence impacts to the Canal.

Given the acknowledged effects of continued subsidence proximate to the FKC, these immediate management actions to mitigate such impacts are required. To this end, concurrent with the adoption of the final GSPs, as amended to address the comments provided herein, FWA respectfully request that the Board of each GSA direct staff to continue to work with FWA and Friant Districts to promptly develop and bring back for adoption management actions that would establish mechanisms to mitigate future subsidence impacts in the form of compensation to FWA and Friant Districts to pay for the costs of repairs to the FKC resulting from the transitional pumping/use permitted under the GSPs as well as the reduced water deliveries to Friant Districts until such repairs are completed. This mitigation could come in the form of fees or charges imposed on groundwater pumping and/or assessments or charges spread over the lands benefitting from groundwater pumping permitted under the GSPs that have caused, and can reasonably be demonstrated will continue to cause, undesirable results to the Friant-Kern Canal.

On behalf of FWA, I appreciate your consideration of these comments. FWA staff looks forward to continued collaboration on prompt and appropriate actions that will help us move forward with our mandate to restore critically needed capacity to the Friant-Kern Canal.

Sincerely,

Jason Phillips, CEO

Attachment: FWA Subsidence Fact Sheet

[7] We acknowledge that the Delano-Earlimart GSP does contain management actions that assert it will achieve sustainability, but because the plan still anticipates that future subsidence will occur, more attention to address FWA's concerns regarding compensation for continuing subsidence impacts to the FKC is still warranted.
[8] See Water Code § 10721(x)(5).

Hancock
Farmland
Services

A Manulife Investment Management Company

Pixley Irrigation District Groundwater Sustainability Agency
357 E. Olive Ave.,
Tipton, CA 93272

December 19, 2019

Dear Mr. Eric Limas:

Hancock Farmland Services (HFS) would like to thank you for all of the work that has been put into the Draft Pixley Irrigation District (PID) Groundwater Sustainability Plan (GSP), including the Rules and Operation Policies quick reference guide. HFS offers the following comments in an effort to Improve the Draft GSP and maximize grower-tools for compliance upon implementation:

Allocation of Native Yield

G.1 The GSP references native yield in terms of acre-feet per gross acre for water budget purposes. If referencing it this way is necessary, the GSP should clarify that these calculations are for initial water budget purposes ONLY, are non-precedent setting, and not a determination of individual landowner allocations or groundwater rights. Alternatively, native yield could be described only as a total volume of water, for example xxx,xxx acre-feet and not associated with a given gross or net area.

G.2 In the event that allocations of any sort are distilled to a landowner or property level, HFS encourages the GSAs in the basin to initiate a stakeholder-driven process to develop a methodology for establishing landowner-level allocations that are coordinated across the basin. The allocation methodology should be consistent with various legal considerations drawn from applicable case law and attempt to be consistent with groundwater rights, recognizing that GSAs do not have statutory authority to make a final determination of water rights. An equal-per-gross acre approach to allocations is not likely to be consistent with established water rights doctrine, which must recognize many equitable considerations, in addition to acreage owned, to determine a legally defensible allocation. Further information regarding allocation methodology can be found in *Groundwater Pumping Allocations Under California's Sustainable Groundwater Management Act – EDF and NCWL, dated July, 2018*

G.3 HFS specifically asks for the opportunity to provide input on the methodology used to define allocation methodologies, such as using historical pumping data. The plan states that if data is available and is agreed upon, historical data may inform allocation policy, but it does not state who must find It agreeable. The Board? Landowners?

Markets

G.4 Markets are essential in facilitating the highest and best use of a limited resource and In giving landowners the most flexibility to minimize the economic Impacts of pumping restrictions. To enable a market that works for all landowners in the subbasin, it is Imperative that all pumpers know exactly how much marketable

Hancock Farmland Services

A Manulife Investment Management Company

water they have for use or transfer. Unless it is deemed necessary to prevent undesirable results, markets should not place geographic or jurisdictional limitation on transfers within a subbasin and should allow for carry-over of allocations from one year to the next. GSAs must find a way to Incentivize additional Investment, such as on-farm recharge, and allow flexibility for recharge or banked water to be freely transferrable (subject to the rights and condition of use associated with the source water and the avoidance of undesirable results.)

Refinement and Validation of Consumptive Use Calculations Based on ET Measurement

G.5 HFS supports use of efficient and accurate systems to determine groundwater use. GSAs using remote sensing to calculate crop ET as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower-provided information to be included into the ET calculation and calibration. These methodologies should be developed in consultation with the vendor providing ET data to ensure it is applicable and useful in creating the best available data set. Additionally, GSAs and/or MAs should establish criteria and procedures to address apparent inaccuracies in the ET calculations. An obvious use of the procedure would be in instances where the grower can demonstrate that applied water, plus precipitation, is less than the calculated ET. In these instances, and subject to any requirements established by the GSA, the grower's use of groundwater should be reduced to the applied water total as the ET calculation should not be greater than applied water.

Sincerely,

Molly Thurman

Molly Thurman
Water Resource Manager
661 204 0568
mthurman@hnrg.com

P.O. Box 846 • Lindsay, CA 93247 • Phone: (559) 562-2581 • Fax: (559) 562-3882 • www.lsid.org

Eastern Tule GSA
Lower Tule River Irrigation District GSA
Pixley Irrigation District GSA
Delano-Earlimart Irrigation District GSA
Tri-County Water Authority GSA
Alpaugh GSA

RE: Public Comments to Tule Basin Groundwater Sustainability Plans (GSP)

To: Directors and Staff of the Referenced Groundwater Sustainability Agencies

H.1 Lindsay Strathmore Irrigation District supports the comment letter dated December 16, 2019, submitted on behalf of Friant Water Authority concerning your Groundwater Sustainability Plans (GSP) for the Tule Subbasin. By and through this letter, the District adopts each comment and objection in that letter as its own, along with any exhibits or attachments to that letter, and incorporates herein by this reference all such comments, objections, and documents.

H.2 The District specifically wants to emphasize the importance of addressing and resolving the ongoing subsidence issues with the Friant-Kern Canal that are caused or exacerbated by groundwater pumping in the Tule Subbasin. Allowing for three (3) additional feet of subsidence along the Friant-Kern Canal is unacceptable without adequate mitigation. Nor is it acceptable to further handicap this issue by requiring more than 50% of the seven (7) monitoring sites to show three (3) feet of subsidence before considering this matter an undesirable result. To prevent further water supply loss and economic injury to the Friant Contractors, the District urges you to meaningfully address and resolve the issue of subsidence in your GSPs, including undertaking the actions suggested by Friant Water Authority.

Sincerely,

Craig N. Wallace

Craig N. Wallace
General Manager
Lindsay-Strathmore Irrigation District

cc. LSID Board of Directors
Friant Water Authority
District Legal Counsel

TULARE COUNTY FARM BUREAU

Mission: to promote and enhance the viability of Tulare County agriculture.

October 30, 2019

Pixley Groundwater Sustainability Agency
357 E. Olive Avenue
Tipton, CA 93272

Re: GSP Comments

To Whom It May Concern:

Tulare County Farm Bureau represents approximately 1,500 farm and ranch members in the county. We are committed to serving as a resource to our farm community, and work to surface and address problems and identify solutions for our members.

We want to thank your GSA management team for the many years of hard work, planning, and organization that has occurred to bring us to this point. We appreciate the work that has been assumed by many irrigation districts, water agencies, paid and volunteer leaders, which have been thrust into these roles to help our basins collectively solve the undesirable conditions set forth in SGMA law, enacted in 2015.

Our over-arching comments are:

I.1 ➢ Groundwater sustainability plans should remain a fluid, living, breathing, adaptive document which provides operational flexibility for the management team to use in maximizing water resources for the farm and rural communities impacted by the GSP implementation

I.2 ➢ Water pumped from this sub basin should be applied here, care should be given to avoid impacts to our sustainability and safe yield. We discourage exportation of waters out of the sub-basin where it would negatively impact local landowners.

I.3 ➢ Plans should seek to address disparity amongst the landowners, and serve the white area and non-white area lands as equitable as possible. We encourage cautious and investigative due diligence in the development of a water market, or any model which may place certain landowners at a competitive disadvantage.

I.4 ➢ We encourage strategies which will protect agriculture land from fallowing, or retirement.

I.5 ➢ We encourage incentives that will promote marginal or impaired land being used for recharge and the landowner receiving a financial incentive for making these changes in their cropping strategies.

I.6 ➢ We encourage plans to look at broad long-range and short-term ideas that will maximize bringing new non-native water supplies into our hydrologic basin for recharge, and to increase the supply available.

I.7 ➢ We support GSPs that seek to study, investigate, and monitor basin conditions before significant disruptive management changes are required of landowners in their jurisdictions.

I.8 ➢ We support sustainability goals that help unify each sub-basin and provide additional benefits for the cultivation of crops here in the Tulare Lake basin hydrologic region. We encourage projects to be advanced that promote maintaining agricultural acreage while minimizing the need to idle farmland.

I.9 ➢ We support rigorous and relevant education to growers and landowners in the GSA's territory with frequent updates and opportunities for public outreach and feedback.

Sincerely,

Tricia Stever Blattler

TRICIA STEVER BLATTLER
Executive Director

737 North Ben Maddox Way • Visalia, CA 93292 • Mailing: PO Box 748 • Visalia, CA 93279 • (559) 732-8301 • (559) 732-7029 FAX
E-mail: tcfb@tulcofb.org • Web: www.tulcofb.org • Join Farm Bureau: www.joinfb.org

Pixley District Draft GSP - summary of Tulare County notes

Draft Copy	Tulare County Notes	
Pg 1-9. Within the Pixley ID GSA boundary are the following CSDs and PUDs: • Pixley PUD • Teviston CSD Each of these communities have separate community water systems that are operated by either CSD or a PUD organized under state law to provide domestic water service.	Assuming the County has land use authority in these CSDs and PUDs, the MOU between PID and the PUDs should not impact the County's authorities over growth and well permitting. However, it is plausible that a groundwater availability restriction could be placed upon any development as a condition of service by the PUD. That would be a consideration on a case-by-case basis, based upon whether CEQA compliance is necessary (e.g. requiring any type of water supply sufficiency determination). Yes, the County maintains land use authority in LAFCo designated PUD and CSD boundaries. Future development applications would rely on the PUD or CSD to provide a will serve letter. The County maintains and does not abdicate its authority regarding the application of land use and zoning regulations as feasible and appropriate through the administration of the County general plan, zoning ordinance, and ordinance code.	J.1
Pg 1-13. 1.4.6. Water Use Sector and Water Use Type. **Urban/Industrial**: Urban and industrial water use is assigned to household and commercial water use in the two (2) communities, rural domestic household use, and the limited industrial use of water – primarily associated with packing houses and agricultural facilities – that resides both within and outside of incorporated areas Industrial use is also assigned	These would be potentially impact any choice to continue to lower the groundwater levels while slowly reducing the consumptive use. The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations.	J.2

Pg 1-17. Table 1-2: Wells within Pixley ID GSA by Well Use Type	This is a decent number (though it may be reporting low – check against County records). Thus, impacts to domestic wells should be addressed. See the comment on the next page that seemed to not mention rural domestic wells as part of the 'groundwater dependent human community'.	J.3
Pg 1-18. 1.4.8.2 Groundwater Dependent Communities. With groundwater as the primary source of municipal and industrial water within the Agency, communities are sensitive to groundwater depths relative to the depth of their water supply wells. Continued lowering of the groundwater levels could result in well failure and the loss of a community's primary source of water. **Figure 1-7: Water Use Sector and Water Use Type** from **Section 1.4.6 Water Use Sector and Water Use Type** of this Plan provides a map of Agencies various community areas that rely on groundwater as their primary source of water.	The referenced figure (Fig 1-7) does not show nor note the widespread rural domestic wells that also fit this category. These rural domestic wells also could see well failures - not just the small community systems noted.	J.4
Pg 1-25. Land Use. UDBs establish a 20-year growth boundary that is consistent with the General Plan's time horizon and delineate an area around incorporated cities or unincorporated communities wherein urban development is allowed and services are likely to be extended. The most recent version of these plans, as well as the UDBs and/or UABs that they define, include: • Pixley Community Plan Update (2015) o UDB for Pixley • Teviston Hamlet Plan 2017 o HBD for Teviston	The Budget for the PID subset (see end of this GSP) - hold municipal pumping at 'current' levels. Growth needs to be allowed to continue to 2070 - the GSPs full sustainability period. But, the Budget at the end of this GSP has the 'current' Muni pumping at 1,100 af/yr, and the future Muni pumping still at 1,100 af/yr. While the policies may apply to the 20-year horizon (2040) they need to be assumed to continue to 2070 – with growth at some rate continued until that point also. The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update. References to the Pixley Community Plan and Teviston Hamlet Plan are correct. Section 1.4.12 should also include at a minimum Tulare County General Plan Figure	J.5

	4-1 Regional Planning Framework in Exhibits 1-1 thru 1-2. The discussion of selected Tulare County General Plan Water Supply related policies (Water Resources and Supply Pg. 1-26) is limited and does not include the full range of adopted policies and implementation strategies that could be referenced as follows: WR-1.1 Groundwater Withdrawal WR-1.2 Groundwater MonitoringWR-1.3 Water Export Outside County WR-1.4 Conversion of Agricultural Water Resources WR-1.5 Expand Use of Reclaimed Wastewater WR-1.6 Expand Use of Reclaimed Water WR-1.7 Collection of Additional Groundwater Information WR-1.8 Groundwater Basin Management WR-1.9 Collection of Additional Surface Water Information WR-1.10 Channel Modification WR-1.11 Groundwater OverdraftWR-2.1 Protect Water Quality WR-2.2 National Pollutant Discharge Elimination System (NPDES) Enforcement WR-2.3 Best Management Practices (BMPs) WR-2.4 Construction Site Sediment Control WR-2.5 Major Drainage Management WR-2.6 Degraded Water Resources WR-2.7 Industrial and Agricultural Sources WR-2.8 Point Source Control WR-2.9 Private Wells WR-3.1 Develop Additional Water Sources WR-3.2 Develop an Integrated Regional Water Management Plan WR-3.3 Adequate Water Availability WR-3.5 Use of Native and Drought Tolerant Landscaping WR-3.4 Water Resource Planning WR-3.6 Water Use Efficiency WR-3.7 Emergency Water Conservation Plan WR-3.8 Educational Programs	J.5

	WR-3.9 Establish Critical Water Supply Areas WR-3.10 Diversion of Surface Water WR-3.11 Policy Impacts to Water Resources WR-3.12 Joint Water Projects with Neighboring Counties WR-3.13 Coordination of Watershed Management on Public Land- PF-1.4 Available Infrastructure PF-2.2 Modification of Community UDB PF-2.7 Improvement Standards in Communities PF-3.2 Modification of HDB - Hamlet PF-3.3 Hamlet Plans PF-3.5 Improvement Standards in Hamlets PF-4.22 Reuse of Abandoned Improvements in a CACUDB PF-4.23 Reuse of Abandoned Improvements in a CACUAB PF-4.6 Orderly Expansion of City Boundaries PF-5.2 Criteria for New Towns (Planned Communities) PF-6.4 UDBs and Interagency Coordination ED-2.10 Supporting Agricultural Industry AG-1.17 Agricultural Water Resources ERM-1.8 Open Space Buffers ERM-1.13 Pesticides ERM-2.7 Minimize Adverse ERM-5.17 Activity Prioritization ERM-5.20 Allowable Uses on Timber Production Lands ERM-5.8 Watercourse Development ERM-5.7 Public Water Access ERM-7.3 Protection of Soils on Slopes Impacts PFS-1.2 Maintain Existing Levels of Services PFS-1.3 Impact Mitigation PFS-1.4 Standards of Approval PFS-1.5 Funding for Public Facilities PFS-1.6 Funding Mechanisms PFS-1.7 Coordination with Service Providers PFS-1.8 Funding for Service Providers PFS-1.9 New Special Districts PFS-1.16 Joint Planning Efforts PFS-2.1 Water Supply PFS-2.2 Adequate Systems

J.5

	PFS-2.3 Well Testing PFS-2.4 Water Connections PFS-2.5 New Systems or Individual Wells PFS-3.1 Private Sewage Disposal Standards PFS-3.2 Adequate Capacity PFS-3.3 New Development Requirements PFS-3.4 Alternative Rural Wastewater Systems PFS-3.5 Wastewater System Failures PFS-3.6 Care of Individual Systems PFS-3.7 Financing PFS-4.4 Stormwater Retention Facilities PFS-4.6 Agency Coordination PFS-4.7 NPDES Enforcement SL-1.3 Watercourses HS-2.7 Subsidence HS-4.4 Contamination Prevention HS-4.6 Pesticide Control HS-5.9 Floodplain Development Restrictions HS-5.10 Flood Control Design HS-5.11 Natural Design HS-5.12 Consultation Policies and Protocols HS-6.7 Water Supply System HS-6.8 Private Water Supply RVLP-1.1 Development Intensity RVLP-1.2 Existing Parcels and Approvals RVLP-1.3 Tulare County Agriculture Zones RVLP-1.4 Determination of Agriculture Land RVLP-1.5 Non Conforming Uses RVLP-1.6 Checklist Support Housing Policy 2.12 Housing Policy 2.21 Housing Policy 2.25 Housing Policy 2.26 Housing Policy 2.27 Housing Policy 2.28 Housing Policy 4.13 LU-7.16 Water Conservation LU-7.21 Disadvantaged Legacy Communities Implementation LU # 1 Implementation PF # 11 Implementation RVLP # 1 Implementation RVLP # 2 Implementation ED # 4 Implementation ED # 5

	Implementation ERM # 17 Implementation ERM # 18 Implementation ERM # 27 Implementation ERM # 29 Implementation ERM #41 Implementation ERM # 44 Implementation ERM # 52 Implementation PFS # 1 Implementation PFS # 2 Implementation PFS # 3 Implementation PFS # 5 Implementation PFS # 6 Implementation PFS # 7 Implementation WR # 1 Implementation WR # 2 Implementation WR # 3 Implementation WR # 4 Implementation WR # 5 Implementation WR # 6 Implementation WR # 7 Implementation WR # 8 Implementation WR # 9 Implementation WR # 10 Implementation WR # 11 Implementation WR # 12 Implementation WR # 13 Implementation WR # 14 Implementation WR # 15 Implementation WR # 16 Implementation WR # 17 Implementation WR # 18 Implementation WR # 19 Implementation WR # 20 Implementation WR # 21 Implementation WR # 22 Implementation WR # 23 Implementation WR # 24 Implementation WR # 25 Implementation WR # 26 Implementation WR # 27	J.5
Pg 1-31. Water Resources and Supply Water resources and supply are addressed under the Infrastructure section of the Poplar-Cotton CP. Municipal water services are supplied to the community by the Poplar CSD utilizing two underground wells for supplying municipal water	The specific PID budget in the appendix (at the end of this GSA) shows no increased gw pumping over current conditions throughout the 70-year horizon. So, if growth is expected by the County or Pixley, even with	J.6

to the community for residential and commercial usage. Pixley CSD utilizes four (4) underground wells for supplying municipal water to the community for residential and commercial usage. The Pixley CP addresses policies related to land development in the *Goals, Objective and Policies Specific to Pixley* section of the GP.	conservation, increased demand for water would be expected. While the policies may apply to the 20-year horizon (2040) they need to be assumed to continue to 2070 – with growth at some rate continued until that point also. The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations. The adopted Pixley Community plan Update and the Teviston Hamlet plan, in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.6
Pg. 1-31. Land Uses. Exhibit 1-3: Teviston Proposed Land Use Map displays the future proposed land uses within Teviston as shown in the Community Plan Update.	Similar situation as with Pixley and any planned growth not reflected in the PID GSA budget at the end of this GSP. See previous comment Pg 1-31.	J.6
Pg. 1-32. 1.4.14. Water supply assumptions within the recently adopted General and Community Plans active within Pixley ID GSA's jurisdiction generally provide global estimation of future water supplies and demands.	The first paragraph under Section 1.4.14 includes a statement about the GSP reflecting 'future demands'. Yet, in the budget for the PID GSA area, municipal demands are held at 'current' conditions. I would expect the County's plans for these communities assumes some growth and associated increase in demand - even if not a consumptive demand (e.g. just meeting domestic indoor needs). The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for	J.6

	groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations. The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.6
Pg. 1-33. This GSP provides for a sustainable groundwater management approach that appropriately observes the land use designations maintained by the county and has considered the relative impact that current land uses may have on existing groundwater supply and demand. Pixley ID anticipates an active role in the future development and facilitation of the Tulare County's respective land use plans.	Not sure what 'active role' for Pixley ID means beyond advisory. The County maintains land use authority in LAFCo designated PUD and CSD boundaries. Future development applications would rely on the PUD or CSD to provide a will serve letter. The County maintains and does not abdicate its authority regarding the application of land use and zoning regulations as feasible and appropriate through the administration of the County general plan, zoning ordinance, and ordinance code.	J.1
Pg 1-33. Second paragraph. The projects and management actions proposed provide a framework by which the opportunity to use lands according to existing land use designations as permitted by land use designations and zoning ordinances remains unaltered, subject to the sustainable use of groundwater. However, the assumptions made by Pixley ID GSA in this GSP anticipate a shift in water demand due to the implementation of certain projects and management actions that ultimately reduces the total volume of groundwater supply available for extraction on an annual basis and, therefore, current actual land uses reliant upon these groundwater supplies may change during the Plan's implementation horizon.	This includes the key word 'unaltered' and seems to protect the County's planned growth from being restrained due to the GSP The County maintains and does not abdicate its authority regarding the application of land use and zoning regulations as feasible and appropriate through the administration of the County general plan, zoning ordinance, and ordinance code.	J.1
Pg. 1-34. 1.4.16. The Agency does not anticipate significant or adverse impacts resulting from the implementation of land use plans adjacent to the Tule Subbasin being this		

Plan does not rely on adjacent basins land use for successful implementation.		
Pg. 1-37. The two separate special districts that serve the rural communities that comprise the three Municipal Management Areas are not within the boundaries of the Pixley Irrigation District. The Agency and each of these municipal water agencies entered into MOUs to provide coverage of the CSD/PUD jurisdiction under SGMA. Under the terms of the MOUs the communities collectively select a non-voting representative to the GPC to provide direct representation of their specific interests.	The County will continue to monitor the municipal and domestic user interests. This could lead to decisions being made that adversely impact these beneficial users (though maybe the MOU addresses this - I did not read the MOU).	J.7
Pg 2-1. Introduction. The GSAs in the Tule subbasin have jointly prepared a comprehensive Basin Setting, the *Tule Subbasin Setting*[1], as **Attachment 2** to the *Tule Subbasin Coordination Agreement*[2] (Agreement and Attachments attached hereto as Appendix A).	While the policies may apply to the 20-year horizon (2040) they need to be assumed to continue to 2070 – with growth at some rate continued until that point also. The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations. The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.2
Pg 2-13. 2.4.1.1.5 Municipal Deliveries from Wells For the period of 1986/87- 2016/17, municipal pumping within the Agency on an average annual basis was estimated to be approximately 800 acre-feet/yr (see **Table 1a** of **Appendix D,** *Tule Subbasin Setting*).	The stated value of 800 is the 'average' value for this period. Using an average value for Muni pumping is misleading, since Muni use generally increases with growth - unlike ag use which varies greater with crop trends and annual hydrology/rainfall. This should just show the range and indicate that current use is 1,100 af/yr (see Ch2 of Tule Subbasin Setting Rpt, Appendix D table 1-a for PID GSA)	J.6

	See Comment Pg 2-1 above.	J.6
Pg 2-20. 2.4.2.2.1 Municipal Groundwater Pumping. For the period of 1986/87- 2016/17, municipal groundwater pumping within the Agency on an average annual basis was estimated to be approximately 800 acre-feet/yr (see **Table 2** of **Appendix D**, Tule Subbasin Setting).	See comment Pg 2-13.2.4.1.1.5 above. This is an average value for the entire period. It should reflect current pumping, and show the historic pumping as a range.	J.8
Pg 2-26. 2.4.5 Projected Water Budget Projected surface and groundwater budgets for the Agency over the same time period (2020-2070) are provided in **Table 3a**, **3b** and **4**, of the *Tule Subbasin Setting.*	The LTRID GSA specific 'projected budgets' in the settings report show municipal pumping to be equal to current conditions. That does not accommodate potential growth in the various communities (e.g. Pixley). The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.6
Pg 2-27. Municipal Management Areas (bullet point)	Will the GSA recognize any future expansion of this management area as the associated communities may annex additional lands for growth? Or, are the boundaries as established fixed for the long-term future? The GSA states these areas reflect recent County planning - even that has a limited growth horizon compared to the SGMA horizon. , The 20-year horizon (2040) needs to recognize anticipated growth all the way to 2070. There should be a statement reflecting that special district boundaries (PUD's and CSD's) are determined by LAFCo, and Urban Boundaries such as UDB's are determined by the County. The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.9
Pg 3-20. 3.5.2.5.3 Affects on Beneficial Uses. Each minimum threshold established for the various sustainability indicators considered the avoidance of unreasonable impacts to the beneficial users. □ **Well failures** (*e.g. collapsed casing due to excessive groundwater level decline or land*	Domestic well owners are not explicitly cited as beneficial users, though should be. Unclear if some domestic well failures are expected, and, if so, how such impacts to these de minimis users would be mitigated. Also, it is not clear what objective or subjective criteria were used in relation to the term 'minimize'.	J.10

subsidence): Minimum Thresholds established for groundwater levels to minimize loss of existing wells. □ **Increased capital costs to wells**	Does this include domestic well users? It is not explicit but could be implied.	J.10
Pg. 5-1 Introduction. [End of first paragraph]…by achieving one or more of the following criteria:	The criteria should include 'maintaining or improving groundwater supplies and quality for domestic and municipal users'. The County also is very concerned about the economic implications of diminished ag operations. The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations. The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.11
Pg 5-2. Third bullet point. Establish a cap for groundwater consumptive use to help facilitate a gradual reduced volume of local groundwater use during the Plan Implementation Period;	This cap should recognize the need for existing and potentially increased groundwater for urban needs. With the state's landscape restrictions, likely most increases in groundwater use will be non-consumptive (e.g. limited landscape needs). So should not cause a burden to the basin. But, the County also does not want the GSA to cap urban use in a manner that is not consistent with current County GP policies. The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of	J.12

	water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations. The adopted plans in the GSA use the projected growth rate of 1.3% consistent with the adopted Tulare County General Plan 2030 Update.	J.12
Pg 5-3. First full bullet point and sixth bullet point. Determination of the gradual method for reducing total groundwater use until sustainable levels are reached; … Use of charges and fees to finance the system's operation, Agency administration, monitoring, and mitigation measures (in the form of projects, payments, and/or claims);	This seems focused on groundwater use for agriculture, but it is not explicitly stated. There should not be reductions imposed on the DAC and SDAC communities, and there should be recognition of minor growth in groundwater pumping into the future. Are mitigation measures defined further? See Pg 5-2 comment.	J.13
Pg 5-5. As additional projects and management actions are implemented or are not implemented by the landowners and member agencies, adjustments to this gradual ramp down schedule will be made by the Agency to ensure sustainability is achieved by the end of the Plan Implementation period.	The planned ramp down is expected to result in continued lowering of groundwater levels that could impact domestic and small community water system wells. Is there a mitigation program to address any wells that go dry because of the GSA's managed ramp-down? The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. The potential limitation of water extraction may impede the ability to provide the requisite volume of water to sustain existing or expanded urban municipal services and or agricultural demands excepting any de minimus determinations.	J.14
Pg 5.8. Groundwater elevation and land subsidence programs; □ Well rehabilitation and deepening programs; □ Municipal service connection programs; □ Clean drinking water and in-home treatment programs; and □ Infrastructure rehabilitation programs.	The 'mitigation' terminology in the last sentence and the associated bullets seem to imply that impacted domestic and small system wells would be addressed. Though details are not clear. Please clarify.	J.15

The costs associated with various types of mitigation programs have not yet been assessed.		
Pg 5-24. 5.2.5.1 General Summary Note that the land which is retired could also be utilized for groundwater recharge if a water supply is available at the physical site location.	The GSA may want to consider retirement programs focused in areas with higher concentrations of domestic wells, so as to have a more direct benefit to stabilizing groundwater levels for these users. However, if the area is used for recharge, the GSA should evaluate recharge projects to not exacerbate any drinking water concerns by migrating contaminants into the aquifer zone used for drinking water. **Implementation WR # 24** The County shall protect groundwater recharge areas in the County by carefully regulating the type of development within these areas. Regulations may include, but are not limited to, the limitation of structural coverage and impervious surfaces and prohibition of uses with the potential to discharge harmful pollutants, increase erosion, or create other impacts degrading water quality or affecting groundwater supply.	J.16
Pg 5-28. 5.2.6 Municipal Management Area Projects and Management Actions The Municipal Management Area may implement the projects and actions described above, but specifically will provide the Agency the following information for determining the net groundwater usage of the Community during the initial Plan implementation period of January 2020 to January 2026:	What is the County's role in this effort? How will growth be recognized, since it currently is not in the PID individual budget for municipal pumping? Agreed.	J.17
Pg 6-4. 6.3.3 Transitional Pumping Fees As described, a certain amount of pumping above the safe yield will be allowed during the transitional period. For every acre-foot of water pumped above the safe yield, the water user will pay fees, as outlined in the table below. The fees collected will be used to help fund the implementation of projects identified in Section 5.1 of the Plan. These costs could include feasibility studies, environmental documentation, engineering studies and designs and project construction among other activities.	Are the community systems are not subject to the fees - at least as long as they are participating in the GSP implementation as expected. *Deminimis* domestic users wouldn't be subject to the fee. Also, fees should be used to mitigate impacts to domestic or municipal wells due to planned continued overdraft. Otherwise, there may be liability for such mitigation costs.	J.18
Appendix A. Projected Future Pixley Irrigation District GSA Surface Water Budget – Table 3a	This table shows the static municipal pumping into the future. The total Tule Basin value goes up over this same time period (see	J.6

	prior Table 2-9 in this Settings report), but not for this PID GSA subset. That appears to reflect zero assumed growth in this GSA.	J.6

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December 17, 2019

Pixley ID GSP
Eric Limas, General Manager
357 East Olive Avenue
Tipton, CA 93272

Re: PIXID Groundwater Sustainability Plan

Dear Mr. Limas,

Westchester Group Investment Management (WGIM) offers the following comments on the Draft Pixley Irrigation District (PIXID) Groundwater Sustainability Plan (GSP):

Allocation of Native Yield

K.1 The GSP references native yield in terms of acre-feet per gross acre for water budget purposes and provides some background on how this allocation was developed and explains that this is not a determination of individual water rights. While we appreciate the background on using this method, , the GSP should also clarify that these calculations are for initial water budget purposes K.2 ONLY, and are non-precedent setting. WGIM encourages LTRID GSA and other GSAs in the basin to initiate a stakeholder-driven process to develop a methodology for establishing landowner-level allocations that are coordinated across the basin. The allocation methodology should be consistent with various legal considerations drawn from applicable case law and attempt to be consistent with groundwater rights, recognizing that GSAs do not have statutory authority to make a final determination of water rights. An equal-per-gross acre approach to allocations is not likely to be consistent with established water rights doctrine, which must recognize many equitable considerations, in addition to acreage owned, to determine a legally defensible allocation. Further information regarding allocation methodology can be found in *Groundwater Pumping Allocations Under California's Sustainable Groundwater Management Act – EDF and NCWL, dated July, 2018.*

Pumping Restrictions

K.3 We understand that there are instances where it may be necessary to restrict pumping in order to achieve basin-wide sustainability and address local subsidence. Indeed, we appreciate the initial ramp-down procedure to address pumping restrictions that has been proposed. That being said, we feel the GSA should implement pumping restrictions supported by the best available data and

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appropriate analytical tools, that avoid undesirable results and prevent sudden disruptions in economic activity.

As with native yield allocations, initial pumping allowances and ramp down schedules should be coordinated and consistent across the entire basin so that similarly situated pumpers in the basin are treated equitably.

Measurement and Data Management

K.4 GSAs should develop a coordinated basin-wide data management system ("DMS") that is capable of tracking groundwater and surface water use at the landowner, field, or parcel level, and a coordinated methodology for measuring landowner-level use of groundwater. The DMS should also include, or be capable of interfacing with, a groundwater market platform that allows for individual users to conduct transactions.

Markets will be most effective if there is confidence in the accuracy of the measurements taken, consistency in the data sources relied upon, and flexibility to allow for transactions across the basin. For instance, GSAs using remote sensing to calculate crop evapotranspiration ("ET") as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower provided information to be included into the ET calculation and calibration. Additionally, GSAs should establish criteria and procedures to address any apparent inaccuracies in the ET calculations (e.g., if calculated ET is greater than applied water and precipitation).

Again, we acknowledge and support the efforts the GSA has made regarding recharge and banking, and we look forward to working with the GSA to continue to refine recharge and banking policies as they continue to evolve

Refinement and Validation of Consumptive Use Calculations Based on ET Measurement

K.5 WGIM supports use of efficient and accurate systems to determine groundwater use. GSAs using remote sensing to calculate crop ET as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower-provided information to be included into the ET calculation and calibration. These methodologies should be developed in consultation with the vendor providing ET data to ensure it is applicable and useful in creating the best available data set. Additionally, the GSA should establish criteria and procedures to address apparent inaccuracies in the ET calculations. An obvious use of the procedure would be in instances where the grower can demonstrate that applied water, plus precipitation, is less than the calculated ET. In these instances, and subject to any requirements established by the GSA,

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the grower's use of groundwater should be reduced to the applied water total as the ET calculation should not be greater than applied water.

Sincerely,

Brian L. Hauss
Vice President