THE BOARD OF SUPERVISORS OF THE COUNTY OF STANISLAUS
BOARD ACTION SUMMARY

DEPT: Environmental Resources

BOARD AGENDA:7.2
AGENDA DATE: July 17, 2018

SUBJECT:

Approval to use $50,000 in Community Development Funds for Expenses Related to the Opposition of the State Water Board – Water Quality Control Plan and Approval of a Formal Resolution of Opposition to the State Water Quality Control Plan

BOARD ACTION AS FOLLOWS: **RESOLUTION NO. 2018-0376**

On motion of Supervisor Withrow, **Seconded by Supervisor** Monteith
and approved by the following vote,
Ayes: Supervisors: Olsen, Chiesa, Withrow, Monteith, and Chairman DeMartini
Noes: Supervisors: None
Excused or Absent: Supervisors: None
Abstaining: Supervisor: None

1) X **Approved as recommended**
2) ______ **Denied**
3) ______ **Approved as amended**
4) ______ **Other:**

MOTION:

ATTEST: Elizabeth A King
ELIZABETH A. KING, Clerk of the Board of Supervisors

File No

THE BOARD OF SUPERVISORS OF THE COUNTY OF STANISLAUS
AGENDA ITEM

DEPT: Environmental Resources

BOARD AGENDA:7.2
AGENDA DATE: July 17, 2018

CONSENT ☐

CEO CONCURRENCE: YES

4/5 Vote Required: Yes

SUBJECT:

Approval to use $50,000 in Community Development Funds for Expenses Related to the Opposition of the State Water Board – Water Quality Control Plan and Approval of a Formal Resolution of Opposition to the State Water Quality Control Plan

STAFF RECOMMENDATION:

1. Approve the use of $50,000 in Community Development funds for expenses related to the opposition of the State Water Board – Water Quality Control Plan.
2. Direct the Auditor-Controller to make the necessary budget adjustments per the attached budget journal.
3. Approve a resolution of opposition to the State Water Quality Control Plan and authorize staff to submit to the State Water Board in opposition to the proposed imposition of 40-percent unimpaired flows in the lower San Joaquin River.

DISCUSSION:

The State Water Board has developed final amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan). The proposed amendments include new and revised flow objectives for the Lower San Joaquin River and its tributaries; the Stanislaus, Tuolumne, and Merced Rivers, for the purported purposes of providing reasonable protection of fish and wildlife beneficial uses, revised salinity water quality objectives for the reasonable protection of southern Delta agricultural beneficial uses, and a program of implementation for achieving the objectives.

As part of Phase 1 of the Bay-Delta Plan amendment process, the Water Board staff has proposed that the tributary streams to the lower San Joaquin River (the Merced, Tuolumne and Stanislaus Rivers) be required to release 40% to 60% of the February through June full natural flow (unimpaired flow) from these watersheds each year. An environmental document, called the Substitute Environmental Document (SED), describes the actions and the potential environmental and economic impacts of the proposal to the region.

The proposed flow objective reduces the reliable surface water supply in the tri-County Merced-Stanislaus-San Joaquin area, severely undercuts the reliable surface water supply in the region and will have a demonstrated devastating, long-term impact on the local and regional economy. Stratecon, Inc., an economics and strategic planning consulting firm specializing in the economics, finance, law, and politics of water resources, was hired by Stanislaus County (and funded by Merced, San Joaquin and Stanislaus counties) to provide an economic impact analysis of the State's unimpaired flow proposal. The Stratecon report, entitled "The Economic Consequences of the Proposed Flow Objective for the Lower San Joaquin River in Merced, San Joaquin and Stanislaus Counties" is attached as a reference (Attachment 3). The entire economic impact report was submitted to the State Water Board in March 2017, in response to the close of the public review and comment period on the SED.

The State Water Resources Control Board (SWRCB) staff severely understates the economic impacts of the proposed flow objectives on the local economies by assuming unsustainable increases in groundwater pumping. In its assessment of the proposed flow objective, they have failed to address the water supply reliability, sustainability and volatility issues confronting the counties. Before implementation of the Sustainable Groundwater Management Act ("SGMA"), when groundwater pumping can increase to partly offset lost surface water supplies, land fallowing will reduce crop revenues by an average annual amount of $58 million, or 60% higher than estimated by the SWRCB plan. Average annual impacts mask the volatility in lost annual crop revenues, where annual losses often exceed $100 million and peak at $245 million. After SGMA implementation, land fallowing will reduce crop revenues by an average annual amount of $107 million, or three times the amount estimated by SWRCB staff. Annual crop revenue losses will then often exceed $250 million and peak at $476 million.

The economic impact of the proposed flow objective is substantial.

Prior to SGMA implementation, the average annual loss of economic output is $102 million per year, 60% greater than the SWRCB estimate. After SGMA, the average annual loss of economic output is $189 million, or three times greater than the SWRCB estimate. Average annual impacts mask the volatility. Before SGMA implementation, annual losses often exceed $200 million and peak at $432 million. After SGMA implementation, annual losses of economic output often exceed $450 million and peak at $842 million.

The SED has been subject to extensive public disclosure and comment since the proposal was introduced in late 2012. In a recent public announcement the Water Board stated that "extensive public participation, including review and comment, was already provided on the prior draft SED documents." The public comment period on the Recirculated SED closed on March 17, 2017, and no additional written comments of the Final SED were accepted.

However, the State Water Board will accept written comments on the revisions to the 2016 Draft Amendments that are reflected in the Proposed Final Amendments found in *Appendix K, Revised Water Quality Control Plan*, of the Final SED. Written comment letters must be received by 12:00 p.m. (Noon) on Friday, July 27, 2018.

Additionally, a resolution formally opposing this State water grab has been prepared for Board of Supervisor consideration.

POLICY ISSUE:

Protecting our water is a significant and critically important element of our Stanislaus County public policy agenda.

FISCAL IMPACT:

Staff is requesting the use of $50,000 in Community Development funds ($10,000 from each of the five Supervisorial Districts) in order to prepare written and oral defense, testimony and educational outreach in opposition to this significant regional water issue. The Community Development Fund has a current balance of $2,339,727.

BOARD OF SUPERVISORS' PRIORITY:

The recommended actions are consistent with the Boards' priority of *Delivering Efficient Public Services and Community Infrastructure* and consistent with the County's Legislative Platform.

STAFFING IMPACT:

The Department of Environmental Services (DER) and the County Water Resources Manager oversees the County's Water Resources Management Program.

CONTACT PERSON:

Jami Aggers, Director, DER	Telephone: 209-525-6770
Walter Ward, Water Resources Manager	Telephone: 209-525-6710
Keith D Boggs, Assistant Executive Officer	Telephone: 209-652-1514

ATTACHMENT(S):

1. Budget Journal
2. Water Board Oppositon Resolution
3. Economic Study by Stratecon Inc.

Database		FMSDBPRD.CO.STANISLAUS.CA.US.PROD	DO NOT CHANGE
Balance Type		Budget	DO NOT CHANGE
Data Access Set		County of Stanislaus	DO NOT CHANGE
Ledger	* List - Text	County of Stanislaus	DO NOT CHANGE
Budget	List - Text	LEGAL BUDGET	DO NOT CHANGE
Category	* List - Text	Budget - Upload	DO NOT CHANGE
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Currency	* List - Text	USD	DO NOT CHANGE
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Batch Name	Text		
Journal Name	Text		
Journal Description	Text	State Water Quality Control Plan	
Journal Reference	Text		
Organization	List - Text	Stanislaus Budget Org	DO NOT CHANGE
Chart Of Accounts		Accounting Flexfield	DO NOT CHANGE

Upl	Fund (4 char) * List - Text	Org (7 char)	Account (5 char)	GL Project (7 char)	Location (6 char)	Misc. (6 char)	Other (5 char)	Debit incr appropriations decr est revenue * Number	Credit decr appropriations incr est revenue * Number	Line Description Text
O	0107	0015292	66370	0000000	000000	000000	00000	50000		Community Dev Funds
Totals:								50000	0	

Tip: This is not the end of the Template. Unprotect the sheet and insert as many rows as needed.

Explanation: $50,000 in Community Development Funds ($10,000 from each district)
For expenses related to opposing the State Water Quality Control Plan

Requesting Department	CEO	Data Entry	Auditors Office Only	
Patrick Cavanah	Tera Chumley			Melody Bughi
Prepared by	Supervisor's Approval	Keyed by	Prepared By	Approved By
7/11/2018	7/12/2018			7/11/2018
Date	Date	Date	Date	Date

THE BOARD OF SUPERVISORS OF THE COUNTY OF STANISLAUS
STATE OF CALIFORNIA

Date: July 17, 2018 2018-0376

On motion of Supervisor Withrow Seconded by Supervisor Monteith

and approved by the following vote,
Ayes: Supervisors: Olsen, Chiesa, Withrow, Monteith, and Chairman DeMartini
Noes: Supervisors: None
Excused or Absent: Supervisors: None
Abstaining: Supervisor: None

THE FOLLOWING RESOLUTION WAS ADOPTED: Item # 7.2

RESOLUTION IN OPPOSITION TO THE PROPOSED AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SAN FRANCISCO BAY/SACRAMENTO-SAN JOAQUIN DELTA ESTUARY (BAY-DELTA PLAN)

Whereas, the State Water Resources Control Board (Water Board) is developing amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and

Whereas, the proposed Water Board amendments include new and revised flow objectives for the Lower San Joaquin River and its tributaries, the Stanislaus, Tuolumne, and Merced Rivers; and

Whereas, the Water Board proposes that these tributary streams be required to release 40% to 60% of the February through June full natural flow (unimpaired flow) each year; and

Whereas, the proposed flow would significantly reduces the reliable surface water supply in the tri-County Merced-Stanislaus-San Joaquin area; and

Whereas, the reduction in reliable surface water supply in the region has a potential devastating, long-term impact on the local economy; and

Whereas, the Water Board failed to address the water supply reliability, sustainability and volatility issues confronting the region.

Now, therefore, be it resolved, the Stanislaus County Board of Supervisors formally opposes the Water Board's unimpaired flow proposal as currently described in the Revised Bay-Delta Water Quality Control Plan and strongly urges that a counter proposal, building on a more collaborative and strategic approach, be actively pursued by all interested and affected parties.

ATTEST: **ELIZABETH A. KING, Clerk**
Stanislaus County Board of Supervisors,
State of California

Elizabeth A King

File No.

The Economic Consequences of the Proposed Flow Objective for the Lower San Joaquin River in Merced, San Joaquin and Stanislaus Counties

By

Rodney T. Smith, Ph.D.
President
Stratecon Inc.

and

Jason M. Bass, CPA, CFA
Founder and Principal, EcoGlobal Natural Resources

Prepared for the Counties of Merced, San Joaquin and Stanislaus

January 6, 2017

EXECUTIVE SUMMARY

The Substitute Environmental Document ("SED"), recently issued by the California State Water Resources Control Board ("SWRCB"), proposes substantial increases in the unimpaired flows of the Merced, Stanislaus and Tuolumne Rivers that will fundamentally alter the water supply portfolios of Merced, San Joaquin and Stanislaus counties (collectively the "Study Area"). The SWRCB's assessment, however, of the potential economic impacts of the SED is narrow in scope and completely fails to account for the water supply reliability, sustainability and volatility challenges that will confront the counties.

Stratecon estimates that the proposed flow objectives would reduce the counties' reliable surface water supplies on average by 60% or about 600,000 acre-feet per year, from 1.0 million acre-feet to just short of 400,000 acre-feet. Stratecon estimates that this loss of reliable water supply is partially offset by an increase in the expected annual yield of unreliable surface water supplies from 290,000 acre-feet per year to 656,000 acre-feet per year. The partial offset is no bargain. The SED would reduce the economic value of surface water rights by 50% and drastically reduce the reliability of the region's water supplies, which will have far reaching adverse impacts on the region's long-term economic stability and growth.

The SWRCB severely understates the potential regional economic impacts of the proposed SED flow objectives. It presumes that the surface water supply reductions would be largely offset by unsustainable increases in regional groundwater pumping. Before implementation of the Sustainable Groundwater Management Act ("SGMA"), when groundwater pumping may increase to partly offset reductions in surface water supplies, Stratecon estimates that land fallowing in response to the SED proposal for a 40% increase in the unimpaired flows of the Merced, Stanislaus and Tuolumne Rivers ("SED 40") would reduce crop revenues in the Study Area an average of $58 million per year (2015$), which is about 45% higher than estimated by the SWRCB after accounting for inflation. Furthermore, SWRCB's focus on average annual impacts masks the expected volatility in Study Area annual crop revenues under the SED. Annual revenues losses frequently exceed $100 million and, at their peak, reach as high as $260 million (2015$).

SGMA implementation will effectively preclude additional groundwater pumping to offset SED surface water supply reductions. Stratecon estimates that resulting land fallowing would reduce regional crop revenues by an average of $100 million per year (2015$), or more than 2.5 times the amount estimated by SWRCB after accounting for inflation. In addition, Stratecon estimates that single year crop revenue losses in the Study Area may frequently exceed $200 million and, at their peak, could reach as high as almost $450 million.

The economic impacts within the Study Area of the proposed SED flow objectives is substantial and derives from a combination of: A) reduced crop production; B) reduced output by enterprises relying on that crop production as key inputs, most notably dairies and livestock producers, as well as enterprises further downstream such cheese production using milk produced locally and beef slaughter and packing using locally produced cattle, as key examples; C) increased costs of pumping incurred by irrigators and communities due to potentially substantial increases in regional ground water depths as a result of increased pumping to offset surface water supply reductions (only before SGMA); D) reduced lake recreation visitor spending; and E) reduced hydropower generation values.

Tables EX-1 and EX-2 summarize the estimated economic output and employment impacts within the Study Area.[1] Table EX-1 summarizes the average annual estimated impacts were implementation of the SED 40 proposal overlaid on the historical hydrology of the San Joaquin River system from 1922 through 2003 ("Study Period"). Table EX-2 summarizes the estimated peak annual economic output and employment impacts after SED 40 implementation. The tables present what are termed "upper bound" estimates of both the economic output and employment effects of:

A) Reductions in the regional production of intermediate and end-market dairy and livestock commodities such as raw milk, fluid milk, cheese, cattle and processed meat, among others, due to anticipated SED-related reductions in regional feed grain (particularly corn silage), hay and pasture crops, primary inputs to the region's dairy and livestock sectors; and
B) Estimated increases in the costs incurred by the Study Area's farmers and communities to pump groundwater due to potential SED 40-related increases in Study Area groundwater depths, accounting for both current pumping and additional potential pumping in response to SED-related reductions in regional surface water supplies.

There is no debate with the SWRCB that the SED's implementation will have economic impacts within the Study Area. However, there is also no crystal ball as to the eventual full nature and extent of those impacts. SWRCB chose to focus its quantification of economic impacts primarily on agricultural production adopting sophisticated models for that purpose while providing cursory or no consideration of numerous other potential impacts including, among others, the impacts of reduced regional agricultural production on regional dairy-related activities. Dairy product production and manufacturing are very large and important components of the Study Area's economy. SWRCB's underlying argument for failing to address many of the SED's potential impacts, including the impacts on the region's dairy sectors, is that there is a lack of information necessary for pinpoint quantification.

Stratecon has taken a different tact. There will be a wide a range of potential regional economic impact outcomes based on: A) alternative considerations for how regional businesses and communities may mitigate the potential impacts of reduced regional agricultural production and increased depths to groundwater; B) how groundwater depths in different areas may be effected by projected increases in groundwater pumping; and C) the incremental costs of pumping water from greater depths. As such, the probability of specific outcomes within that range are extremely difficult to pinpoint. Accordingly, Stratecon doesn't attempt to produce an exact answer as to the potential output and employment impacts of SED effects on the dairy and livestock

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[1] It should be noted that the estimated "upper bound" impacts presented in the tables do not account for additional capital investment in groundwater pumping and treatment infrastructure by irrigators, irrigation districts and municipal water users due to SED-related declines in groundwater elevations and associated expected declines in groundwater quality. They, therefore, may be considered conservative.

production or farmer and community water costs. Instead, Stratecon focuses on developing economic impact estimates assuming that limited opportunities are available to regional dairy and livestock businesses for mitigating reduced local crop production and the high end of estimated potential increases in regional aquifer groundwater depths and observed cost of pumping groundwater, to provide an "upper bound" assessment of the SED 40's potential regional economic impacts. Stratecon finds these impacts highly instructive for the SED evaluation process as to the potential magnitude and severity of the impacts that could occur.

Table EX-1 shows, for example, that the estimated upper bound average annual total lost economic output and employment within the Study Area that may result from the SED 40 before SGMA is approximately $607 million (2015$) and 2,976 jobs, respectively. Table EX-2 shows that in the expected peak year of SED 40 impacts before SGMA, the region's total economic output and employment may fall as much as an estimated approximately $2.75 billion (2015$) and 12,739 jobs, respectively. The tables do not account for recreation or hydropower-related impacts. Stratecon was unable to obtain the data necessary to effectively quantify potential impacts on Study Area recreation spending and associated economic impacts because of SED-related reductions in regional reservoir elevations. However, those impacts are material, particularly during drier hydrologic years. Stratecon did not evaluate the potential economic impacts related to anticipated SED effects on Study Area hydropower generation as Stratecon believes those impacts are relatively small in comparison.

Table EX-1
Average Annual Estimated Economic Impacts

Average During Study Period	Before SGMA			With SGMA		
Impact Category	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs
Reduced Crop Production Irrigation Districts	$ 57,589,316	$ 101,026,280	638	$ 100,024,842	$ 175,842,740	1,101
Reduced Dairy & Livestock Sectors Production (Upper Bound)	$ 213,996,694	$ 374,831,334	1,270	$ 292,327,424	$ 512,033,510	1,735
Increased Irrigation District Costs (Upper Bound)	$ 25,310,496	$ 27,378,418	223	N/A	N/A	N/A
Increased Other Irrigation Costs (Upper Bound)	$ 73,065,124	$ 79,034,700	643	N/A	N/A	N/A
Increased Urban Water Costs (Upper Bound)	$ 23,025,416	$ 24,906,642	203	N/A	N/A	N/A
Total	**$ 392,987,047**	**$ 607,177,374**	**2,976**	**$ 392,352,266**	**$ 687,876,250**	**2,835**

Table Ex-2
Peak Year Estimated Economic Impacts

Peak Year of Impacts During Study Period	Before SGMA			With SGMA		
Impact Category	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs
Reduced Crop Production Irrigation Districts	$ 259,856,755	$ 457,288,570	3,050	$ 449,311,194	$ 787,683,503	4,996
Reduced Dairy & Livestock Sectors Production (Upper Bound)	$ 1,042,793,423	$ 1,826,531,252	6,188	$ 1,387,009,263	$ 2,429,451,230	8,230
Increased Irrigation District Costs (Upper Bound)	$ 101,513,377	$ 109,807,236	893	N/A	N/A	N/A
Increased Other Irrigation Costs (Upper Bound)	$ 270,177,684	$ 292,251,778	2,376	N/A	N/A	N/A
Increased Urban Water Costs (Upper Bound)	$ 89,462,327	$ 96,771,590	787	N/A	N/A	N/A
Total[1]	**$ 1,735,395,477**	**$ 2,751,921,335**	**12,739**	**$ 1,822,286,141**	**$ 3,194,565,527**	**13,206**

1. Represents peak year for all categories combined so may differ from sum of peak year figures for each category.

The expected present value of total lost output in the Study Area equals $14.5 billion over a 40-year horizon (2017-2056). The time profile of lost output reflects the pre-SGMA scenario for 2018 and 2019, a mix of the pre-SGMA and post-SGMA scenarios during the statutory SGMA implementation period (2020-2039) and solely the post-SGMA scenario thereafter.

SED implementation will fundamentally transform the investment landscape for agriculture and related industries within the Study Area. Lost water supplies reduce locally produced inputs for livestock and dairy operations. The volatility in locally produced inputs will more than triple the risk of shortfalls in available local inputs (from 18% to 61%). For operations relying on hay and pasture, expected unused capacity increases from 4% with baseline conditions to 23% under SED implementation before SGMA and 29% after SGMA implementation. For operations relying on grains, expected unused capacity increases from 1% with baseline conditions to 7% under SED implementation before SGMA and 11% after SGMA implementation. This increased risk in unused capacity reduces the economic incentive for investment. The consequences from reduced investment are not quantified in this study.

Table of Contents

Table of Contents Continued

1. INTRODUCTION

Reliable and affordable water service is a critical foundation for a community's economic sustainability and growth. Accordingly, the water policy and financial communities widely recognize water supply reliability as fundamental to water system success. Correspondingly, abrupt and unmitigated cutbacks in water service due to drought, regulatory restrictions on water sources or from inadequate infrastructure undermine the vitality of communities.

Lower San Joaquin River water users have surface water rights that are the backbone of the local economies in Merced, San Joaquin and Stanislaus counties ("Study Area"). Under the "baseline condition" as defined by the State Water Resources Control Board ("SWRCB"), Lower San Joaquin River water rights currently have a reliable annual yield of one million acre-feet ("AF") and an expected annual unreliable yield of 290,000 AF.[2] The annual variability in surface water available to the irrigation and urban water districts reliant on those surface water supplies is largely managed by the conjunctive use of groundwater. Under the baseline, groundwater pumping by these surface water-users hovers around 200,000 AF per year in all hydrologic conditions other than critical water years, when groundwater pumping increases to almost 500,000 AF per year.[3]

San Joaquin River water rights are a key driver of the Study Area's economies. Direct farm employment is seven times more important in Merced County than in California generally and about three times more important in San Joaquin and Stanislaus counties than in California generally.[4] The counties additionally rely heavily on employment generated by businesses operating downstream of the farm sector including dairies, dairy product manufacturers, livestock producers, food processing and agricultural commodity transportation, among others. In addition, population in the Study Area has historically grown 45 percent faster than statewide population. The Department of Finance projects that the rate of population growth in the Study Area will be double the rate of growth in statewide population through 2060.

Two of the many challenges facing the Study Area economies include poverty and groundwater overdraft.

The proportion of the region's population residing in economically disadvantaged or severely disadvantaged communities ("DACs"), as defined by the state, is 81.9 percent in Merced County, 54.2 percent in San Joaquin County and 57.0 percent in Stanislaus County. These high rates compare unfavorably to the statewide rate of 41.5 percent.

Study Area groundwater resources are stressed due to overdraft. In 2014, the Department of Water Resources ("DWR") ranked all four sub-basins in the Study Area as "high priority" for action under the Sustainable Groundwater Management Act ("SGMA"). Accordingly, the existing and growing challenge of overdraft needs to be a front-and-center consideration in the evaluation

[2] See Section 3.

[3] See Section 4.

[4] See Section 2.

of the proposed SED flow objectives as the costs associated with increasing depths to groundwater and declining groundwater quality have already imposed significant financial burdens on regional communities. The potentially large cost impacts of any definitive cutbacks in regional surface water supply availability on the region's households, commercial enterprises and school districts, who have already been hit hard by high drought-related increases in their water costs, will prove untenable in the long run.

The SWRCB's Substitute Environmental Document ("SED") proposes a starting point of leaving 40 percent of the unimpaired flows in the Stanislaus, Tuolumne and Merced Rivers in the rivers during February through June ("SED 40"). The purpose of this study is to evaluate the economic consequences of these proposed flow regulations on the Study Area's local economy.

SWRCB Method v. Stratecon Method

There are four differences in approaches relating to: (i) how water users respond to the loss of surface water, (ii) consideration of the volatility of impacts within the context of water supply reliability and sustainability, (iii) consideration of how the loss of surface water supply would reduce regional well elevations, and (iv) consideration of how impacts in the farm sector impact related downstream industries (such as the dairy and livestock sectors).

<u>Groundwater Pumping and Lost Surface Water Supplies.</u> A critical component of any study of the impact of the proposed flow objective involves specifying how water users may respond to the loss of surface water supplies. The SWRCB analysis is based on a critical assumption:

> Users of Lower San Joaquin River surface water will *fully* offset their loss of surface water by increasing groundwater pumping until groundwater pumping capacity is exhausted.

That is, only that portion of lost surface water supplies that exceeds currently unused groundwater pumping capacity will represent lost local water supplies. The fallowing of crop land only occurs after groundwater pumping capacity is exhausted.

Stratecon turns to evidence of how a reduction in the availability of surface water supplies generates land fallowing and increased groundwater pumping. The almost quarter century of experience of the Westlands Water District provides evidence on how a reduction in an irrigation district's surface water supplies may impact land fallowing, cropping patterns, groundwater pumping and groundwater elevations (see Attachment 1). The Westland's record indicates that increased groundwater pumping offsets half the loss of surface water for a wide range of reductions in available surface water. Therefore, Stratecon's analysis is driven by a different assumption than the SWRCB's:

> Users of Lower San Joaquin River surface water will offset *half* of their loss of surface water by increasing groundwater pumping until groundwater pumping capacity is exhausted.

Accordingly, in many instances land fallowing within the Study Period will occur even before groundwater pumping capacity is exhausted.

SGMA implementation will further limit the ability of increased groundwater pumping to offset any loss of surface water supplies. The Study Area is already in a condition of groundwater overdraft. With the need to reduce groundwater pumping under SGMA, the prospect of increasing groundwater pumping in response to SED will prove illusionary.

<u>Volatility of Impacts.</u> Like any area, the Study Area faces variable hydrologic conditions. Using the history of hydrologic conditions within the Study Area for the period 1922 through 2003, SWRCB staff estimated the availability of surface water for the Study Area irrigation districts reliant on surface water by "water year" type. Generally, the SWRCB projects that the proposed flow objective will only reduce surface water available to the irrigation districts in "critical", "dry" or "below normal" water years. SWRCB staff looked at each water year separately and then took averages over all the years.

In contrast, Stratecon argues that the volatility of impacts has consequences and must be explicitly considered. There are two ways a hiker can perish in the desert: die from thirst or drown in a flash flood. Volatility in available surface water relates directly to supply reliability. Thus, Stratecon considers the implications of reduced supply reliability. The SWRCB staff did not. Increased levels and variability in groundwater pumping raise issues about the sustainability of that pumping. Stratecon considers the impact of the proposed flow objective before and after SGMA implementation. The SWRCB staff did not.

<u>Impacts on Well Elevations.</u> The SWRCB acknowledges that the proposed flow objective will have significant and unavoidable impacts on groundwater resources. It does not quantify those impacts. Therefore, the SWRCB staff implicitly assumes that regional well depths will remain unchanged despite forecasted substantial expansion in groundwater pumping to offset reduced surface water supplies. Stratecon uses evidence from the observed impact of the large variability in the annual delivery of surface water to the Central San Joaquin Water Conservation District on well elevations within the District to assess the potential effect of the proposed flow objective on Study Area well elevations and pumping costs.

<u>Downstream Linkages from Farm Sector</u>. The Study Area's economies have significant dairy and livestock operations. Stratecon examines how the SED impact on crop production impacts downstream dairy and livestock operations. The SWRCB did not.

Stratecon Findings

Surface Water Supply Reliability. The proposed flow objective reduces the reliable surface water supply of the Study Area by 60%, from 1 million AF per year to 399 thousand AF ("TAF") per year. The expected annual yield of the Study Area's unreliable surface water increases from 290 TAF to 656 TAF. Partially offsetting the loss of reliable surface water supplies with an increase in unreliable surface water supplies is not an attractive bargain. The proposed flow objective undercuts severely the reliable water supply that is foundational to the region's long-term capital investment and economic development landscape. The SED would reduce the economic value of surface water rights by 50%.

Groundwater Sustainability. The proposed flow objectives would significantly reduce groundwater recharge from distribution losses and deep percolation in the Study Area. The average annual loss of groundwater recharge is 77,000 AF with greater impacts the drier the hydrologic condition. When SGMA is implemented, the proposed flow objective would reduce allowed groundwater pumping. The expansion of groundwater pumping allowed before SGMA implementation would no longer be viable.

Well Elevations. The proposed flow objective would reduce regional well elevations significantly and especially in dry and critical years before SGMA implementation. Well depths can easily double. This will significantly increase pumping costs for agricultural and municipal water users.

Agriculture. Before SGMA implementation, when groundwater pumping can increase to partly offset lost surface water supplies, land fallowing will reduce crop revenues by an average estimated annual amount of $52 million in 2008 dollars, $58 million in 2015 dollars, or about 45 percent higher than estimated by SWRCB staff. (Consistent with the SWRCB's economic impact evaluation of the SED, all economic impact estimates in this section are presented in 2008 dollar terms ("2008$") in addition to 2015 dollar terms ("2015$") to facilitate comparison to the SWRCB's estimates, which are in 2008$. All inflation adjustments are made based on the Consumer Price Index for the western United States published by the U.S. Bureau of Labor Statistics.) Average annual impacts mask the volatility of lost annual crop revenues, where estimated annual revenue losses often exceed $100 million and may peak as high as $235 million in 2008$, $260 million in 2015$. After SGMA implementation, land fallowing will reduce crop revenues by an estimated average annual amount of approximately $91 million in 2008$, $101 million in 2015$, or 2.5 times the amount estimated by SWRCB staff. Annual revenue losses will then often exceed $200 million and peak at as high as $413 million in 2008$, $457 million in 20015$.

In addition to lost crop revenues, SED 40-related increases in regional groundwater depths in the absence of SGMA implementation will potentially cause a significant increase in farmer irrigation costs and associated decreases in incomes due to increased pumping costs. These costs are estimated at their "upper-bound" to average as much as $31 to $89 million in 2008$, $34 to $98 million in 2015$, with an upper-bound peak of as much as $117 to $336 million in 2008$, $129 to $372 million in 2015$, reflecting a range of observed electrical costs regionally to pump one acre-foot of water one foot in elevation.

The estimates on irrigator cost impacts are deemed "upper bound" as they reflect the assumption that the region's irrigators will face the high end of potential regional groundwater basin depth increases due to the SED in conjunction with the high end of observed regional incremental costs per foot of lift for pumping groundwater. The presentation in this report focuses on the upper-bound of potential impacts also for the Study Area's dairy and livestock sectors as well as the region's communities with respect to the increased costs of groundwater pumping.

SWRCB chose not to quantify the impacts on economic sectors other than farming and simply ignored the potential farmer and community cost impacts of increased groundwater depths due to SED implementation. SWRCB's underlying argument is that there is a lack of information available to provide pinpoint quantifications of the effects of reduced crop production on other sectors of the regional economy like dairy as well as the potential groundwater depth impacts of the SED and associated regional cost effects.

Stratecon has taken a different tact. There would be a wide range of potential regional economic impact outcomes due to SED implementation based on: A) alternative considerations for how regional business and community may mitigate the resulting potential impacts of reduced local agricultural production and increased depths to groundwater; B) how groundwater depths in the region's aquifers may be effected by projected increases in groundwater pumping; and C) the incremental costs of pumping water from greater depths. As such, the probability of specific outcomes within that range are, in truth, extremely difficult to pinpoint. Accordingly, Stratecon doesn't attempt to produce an exact answer as to the potential output and employment impacts of SED effects on regional dairy and livestock production or farmer and community water costs. Instead, Stratecon focuses on developing economic impact estimates assuming there to be limited opportunities available for local dairy and livestock businesses to mitigate for reduced local crop production, and the high end of estimated potential increases in groundwater depths and the observed cost of pumping groundwater, to provide an "upper bound" assessment of the SED 40's potential regional economic impacts.

Dairy Sectors. Before SGMA implementation when groundwater pumping can increase to partly offset lost surface water supplies, land fallowing will result in reduced Study Area dairy-related output and, thus, revenues (including revenues from both milk production and downstream dairy product manufacturing sectors) potentially on the upper bound by as much as $151 million on average annually in 2008$, $173 million on average in 2015$. SWRCB staff did not estimate any dairy sectors impacts. Estimates of average annual impacts mask the volatility of lost annual dairy-related revenues, where upper bound annual revenue losses may often exceed as much as $200 million and peak at as much as $763 million in 2008$, $844 million in 2015$. After SGMA implementation, land fallowing will reduce dairy-related revenues potentially on the upper bound by as much as $212 million on average annually in 2008$, $237 million in 2015$. Annual upper bound revenue losses will then often exceed $200 million and may peak at over $1.0 billion in a single year in 2008$, $1.1 billion in 2015$.

Livestock Sectors. Before SGMA implementation, when groundwater pumping can increase to partly offset lost surface water supplies, land fallowing will result in reduced Study Area livestock-related output and, thus, revenues (including revenues from both livestock production and associated livestock product packing and processing) potentially at the upper bound by as much as $36 million on average annually in 2008$, $41 million in 2015$. SWRCB staff did not estimate any livestock sectors impacts. Average annual impacts mask the volatility of lost annual livestock revenues, where annual revenue losses may often exceed $50 million and peak at the upper bound at as much as $180 million in 2008$, $199 million in 2015$. After SGMA implementation, land fallowing will reduce livestock-related upper bound revenues by as much as

$50 million on average annually in 2008$, $56 million in 2015$. Annual revenue losses may often exceed as much as $70 million and on the upper bound peak at about $239 million in 2008$, $265 million in 2015$.

Other Sectors. SED decreases in regional crop production will not only have downstream impacts on dairy-related and livestock-related revenues but also on other food manufacturers such as tomato processors and snack food producers as well as regional crop and commodity transportation companies. While these impacts may be significant, limitations in available data on these sectors within the region precluded any quantification of these impacts.

Communities. The SWRCB does little to evaluate the potentially significant impacts on the region's domestic, commercial, industrial and municipal water users (collectively "urban" water users) of the SED. The principal anticipated effects of the SED on regional communities in addition to surface water supply losses for those communities such as Modesto and Stockton that rely on surface water from the region's Irrigation Districts for a portion of their water supplies, are the potential impacts to all urban water users of increased groundwater depths. All of region's urban water users rely in some part, or entirely on, groundwater for their community water supplies. Already regional urban water service providers and businesses, households and municipal service providers such as schools operating their own wells are facing significant water cost escalation and reduced access to water due to steadily increasing well depths accelerated by the recent drought. The estimated average annual upper bound direct effect on the region's urban water users due to SED-related increases in groundwater depths is increased annual water costs of about $7.2 million to $21.0 million on average in 2008$, $8.0 to $23.0 million in 2015$. In the peak year of SED-related surface water supply reductions, annual region community water costs are projected at their upper bound to increase by as much as $28.0 to $81.0 million in 2008$ due to increased groundwater depths, $31.0 to $89.0 million in 2015$. This translates to about $56.0 to $160.0 annually in 2008$, $62 to $177 in 2015$, per Study Area household and must be considered conservative as they only account for increased power and maintenance expenses associated with anticipated SED-related increases in regional groundwater depths. The estimates do not account for the anticipated necessary investment in new well infrastructure by communities and individual businesses and households to reach water at greater depths and address anticipated worsening groundwater quality.

Recreation. The SED would negatively impact regional reservoir/lake elevations that will in turn be expected to reduce recreation visitation and associated recreator spending within the Study Area. This reduction in spending would, in turn, have negative regional economic output and employment impacts that begin with visitor serving business sectors such as food & beverage, lodging and fuel services. SWRCB acknowledged these potential impacts but dismissed them as minor. While Stratecon was unable to obtain the data necessary to quantify the potential regional recreation activity effects and associated economic impacts of reduced reservoir elevations from the SED, Stratecon believes that those impacts are material.

An excellent case in point is Woodward Reservoir, an important lake-based recreation destination in Modesto County that will experience SED-related reductions in its surface elevations, particularly during the peak recreation summer months. Woodward has strict water quality standards in place that terminate body contact in the reservoir when elevations decline to their lows following the irrigation season in late summer and early fall. With the recent drought this threshold has most recently been reached in September as opposed to the typical sometime in October. The SED, in drier hydrologic years, would be expected to trigger this body contact threshold earlier than otherwise, all else being equal, which would have a marked impact on recreation at the reservoir and, accordingly, regional recreation-related spending and associated economic output. Other of the region's reservoirs that would see their surface elevations and associated recreation adversely impacted, include Lake Don Pedro in Tuolumne County and Lake McClure in Mariposa County. While Don Pedro and McClure do not have the same body-contact usage thresholds as Woodward, Don Pedro and McClure would be expected to experience visitation reductions as reservoir visitation is strongly correlated to lake surface levels due to aesthetics and access, the latter particularly important for boating.

Hydropower. Hydropower generation on the Merced, Stanislaus and Tuolumne Rivers will also be adversely impacted by the SED. These impacts will be attributed both to generation timing and generation production effects. With respect to the former, lower flexibility to manage reservoir releases for generation under the SED will reduce the ability of regional power system operators to maximize higher valued power generation during peak demand periods (peaking power) over lower valued base load power demand periods. As hydropower can be generated instantaneously with the opening of gates releasing water through generation facilities, it is a superior source for peaking power compared to other electrical generation sources. The SWRCB estimates that under the SED 40, the reduction in hydropower production/timing is valued at less than $1.0 million per year. Accordingly, the resulting impacts on regional power service prices for households and businesses should be small. The underlying assumption is that the cost of the replacement power for the power lost will be reasonable and, accordingly, have little effect when passed through to ratepayers. Stratecon was unable to acquire the necessary data to assess the impact of SED on hydropower.

Economic Impacts. The impacts of the SED on agricultural production, dairy, livestock and other production activities reliant on that agricultural production, agricultural water costs, urban water costs, recreation spending and hydropower values will all have impacts on the Study Area's economic output and employment. These impacts, other than recreation and hydropower, are evaluated using the standard modelling tool IMPLAN. The IMPLAN dataset for the three counties was acquired for the year 2010 consistent with the modelling year used by the SWRCB. The model was then adjusted to reflect certain specific conditions within the Study Area to account for the potential economic impacts on business sectors that operate downstream of, and rely on, production by the region's farm sector such as grain and hay/pasture production for the region's dairy and livestock sectors. These downstream affects were not quantified by the SWRCB but will comprise a substantial component of the total potential economic impacts of the SED due to those sectors' importance to the regional economy and reliance on locally produced feed crops.

<u>Crop Production</u>

Stratecon estimates that the impacts of the SED 40 prior to SGMA implementation on crop production in the Study Area irrigation districts that rely on surface water ("Irrigation Districts") would result in an average regional decline in economic output of $91 million in 2008$, $101 million in 2015$, and in a peak year of surface water supply reductions, potentially as much as $413 million in 2008$, $457 million in 2015$, representing about 3.5% and 16.5% of estimated baseline regional economic output generated directly and secondarily by crop production within the Irrigation Districts, respectively. Stratecon further estimates that the impacts of the SED 40 on agricultural production in the Irrigation Districts would result in an average regional decline in employment of about 632 jobs and in a peak year of surface water supply reductions, potentially as much as approximately 3,060 jobs, representing 3.3% and 16.6% of estimated baseline employment generated directly and secondarily by crop production within the Irrigation Districts, respectively.

Stratecon estimates that the impacts of the SED 40 with SGMA implementation on crop production in the Irrigation Districts would result in an average regional decline in economic output of $159 million in 2008$, $176 million in 2015$, and in a peak year of surface water supply reduction potentially as much as $712 million in 2008$ and $788 million in 2015$, representing about 6.1% and 27.4% of estimated baseline economic output generated directly and secondarily generated by crop production within the Irrigation Districts, respectively. Stratecon further estimates that the impacts of the SED 40 with SGMA implementation on crop production within the Irrigation Districts would result in an average regional decline in employment of about 1,100 jobs and in a peak year of surface water supply reduction potentially as much as almost 5,000 jobs, representing about 5.8% and 26.2% of estimated baseline employment generated directly and secondarily by crop production within the Irrigation Districts, respectively.

Dairy Sectors

Stratecon estimates that the impacts of the SED 40 prior to SGMA implementation on the dairy sectors in the Study Area (including milk production and dairy product manufacturing sectors), which rely heavily on regional grain and hay feed production could result in an upper bound average regional decline in economic output of as much as $273 million in 2008$, $303 million in 2015$, and in a peak year of surface water supply reductions, potentially as much as $1.33billion in 2008$, $1.48 billion representing about 3.6% and 17.7% of estimated baseline economic output generated directly and secondarily by the dairy sectors within the Study Area, respectively. The upper bound represents the assumption that the region's dairies would not be able to substitute reductions in available local feed with outside of region sources due to lack of available supply, unsupportable pricing and high transportation costs. The region's dairies are already grappling with extremely tight margins due to the challenges of ever increasing environmental and other regulatory constraints along with the cost of labor and transportation. According to the owner of one dairy in the region, any material increase in his operation's cost of feed will result in him having to shut down because the economics of the operation will no longer be viable. Stratecon further estimates that the impacts of the SED 40 on dairy activities in the Study Area would result in a upper bound average regional decline in employment of as much as about 1,015 jobs on average and in a peak year of surface water supply reductions, potentially as much as approximately 4,944 jobs, representing about 3.2% and 15.4% of estimated baseline employment generated directly and secondarily by the dairy sectors within the Study Area, respectively.

Stratecon estimates that the impacts of the SED 40 with SGMA implementation on the dairy sectors in the Study Area would result in a upper bound average regional decline in economic output of as much as $374 million in 2008$, $414 million in 2015$, and in a peak year of surface water supply reductions, potentially as much as $1.77 billion in 2008$, $1.96 billion in 2015$, representing about 5.0% and 23.6% of estimated baseline economic output generated directly and secondarily by the dairy sectors within the Study Area, respectively. Stratecon further estimates that the impacts of the SED 40 on dairy activities in the Study Area would result in an upper bound regional decline in employment of as much as about 1,386 jobs on average and in a peak year of surface water supply reductions, potentially as much as approximately 6,576 jobs, representing approximately 4.3% and 20.5% of estimated baseline employment generated directly and secondarily by the dairy sectors within the Study Area, respectively.

Livestock Sectors

Stratecon estimates that the impacts of the SED 40 prior to SGMA implementation on the livestock sectors in the Study Area (including livestock production and livestock packing and processing sectors), which rely heavily on regional grain and hay crop production would result in a upper bound regional decline in economic output of as much as $65 million on average in 2008$, $72 million in 2015$, and in a peak year of surface water supply reductions, potentially as much as almost $317 million in 2008$, $351 million in 2015$, representing about 3.6% and 17.7% of estimated baseline economic output generated directly and secondarily by the livestock sectors within the Study Area, respectively. Stratecon further estimates that the impacts of the SED 40 on livestock output in the Study Area would result in an upper bound regional decline in employment of as much as about 255 jobs on average and in a peak year of surface water supply reductions, potentially as much as approximately 1,244 jobs, representing 3.3% and 15.8% of estimated baseline employment generated directly and secondarily by the livestock sectors within the Study Area, respectively.

Stratecon estimates that the impacts of the SED 40 with SGMA implementation on the livestock sectors in the Study Area would result in an upper bound average regional decline in economic output of as much as about $88 million in 2008$, $98 million in 2015$, and in a peak year of surface water supply reductions, potentially as much as $422 million in 2008$, $466 million in 2015$, representing about 4.9% and 23.3% of estimated baseline economic output generated directly and secondarily by the livestock sector within the Study Area, respectively. Stratecon further estimates that the impacts of the SED 40 on livestock production in the Study Area would result in an upper bound average regional decline in employment of about 349 jobs on average and in a peak year of surface water supply reductions, potentially as much as approximately 1,654 jobs, representing approximately 4.4% and 21.1% of estimated baseline employment generated directly and secondarily by the livestock sectors within the Study Area, respectively.

Increased Water Costs

In the case of the SED 40 before SGMA, not only will the associated crop production losses adversely impact regional output and employment so will the higher anticipated water costs incurred by the region's irrigators and communities due to increased groundwater depths and associated pumping costs. The increases in Study Area water costs will reduce farm and other business incomes as well as household disposable incomes resulting in a regional decline in consumption and associated impacts on output and employment.

Stratecon estimates that the increased cost of water for regional irrigators could result, at their upper bound in average output and job losses within the region of as much as about $96 million in 2008$, $106 million in 2015$ and 866 jobs, respectively, and peak year output and job losses within the region on the upper bound of as much as about $363 million in 1998$, and 3,269 jobs, respectively.

Stratecon further estimates that the increased cost of water for regional communities (households, businesses, etc.) due to increased SED-related groundwater depths could result, at their upper bound, in average output and job losses within the region of as much as about $23 million in 2008$, $25 million in 2015$, and 203 jobs, respectively, and peak year output and job losses within the region on the upper bound of as much as about $87 million in 2008$, $97 million in 2015$ and 787 jobs, respectively. Due to a lack of data, Stratecon did not estimate the potential additional costs due to groundwater depth and potential additional pumping that may be incurred by region communities reliant on surface water of reduced surface water supplies resulting from the SED 40's implementation.

Recreation

The SED 40 is expected to adversely impact surface elevations of many of the Study Area's reservoirs such as Woodward and Modesto Reservoirs as well as reservoirs just adjacent to the area, such as Lake Don Pedro and Lake McClure, that are important outdoor recreation destinations for both residents within and outside the Study Area. These recreators make an important contribution to the Study Area economy, particularly those visitors from outside the area, through local recreation-related spending on lodging, food & beverage and fuel services. Correspondingly, recreation visitation to reservoirs tend to be sensitive to variability in lake water levels. As the SED 40 will have noteworthy impacts on reservoir elevations along the Merced, Stanislaus and Tuolumne Rivers, particularly during peak recreation summer months, it is likely for there to be material reductions on recreation at those reservoirs and associated impacts on regional economic output and employment. Though Stratecon was unable to obtain the visitation and other data necessary to quantify these impacts they may prove to be notable, particularly in years with drier hydrologic conditions when the SED's impacts on reservoir surface elevations could provide most significant.

Hydropower

Though the SED 40 will reduce the flexibility in management of the affected San Joaquin River tributaries for hydropower generation, the resulting anticipated impacts on power generation values and quantity are estimated by SWRCB to be small, less than $1.0 million. While the SWRCB analysis did not specifically analyze the implications for electricity costs incurred by regional power consumers of replacement power supplies, Stratecon agrees that the economic impacts of the SED 40 associated with hydropower effects are likely to be minimal and defers to the SWRCB hydropower impact analysis.

2. STUDY AREA

Any effort to measure the magnitude, significance and severity of the potential economic impacts of the SED on the Study Area necessarily includes a baseline characterization of existing socioeconomic, water supply and water demand conditions within the region. Accordingly, this section provides a broad overview of salient recent historical and current demographic, economic and water use statistics available for the Study Area most relevant to assessing the potential regional economic impacts of anticipated SED-related changes in the region's surface water supply availability.

The specific topics addressed include:

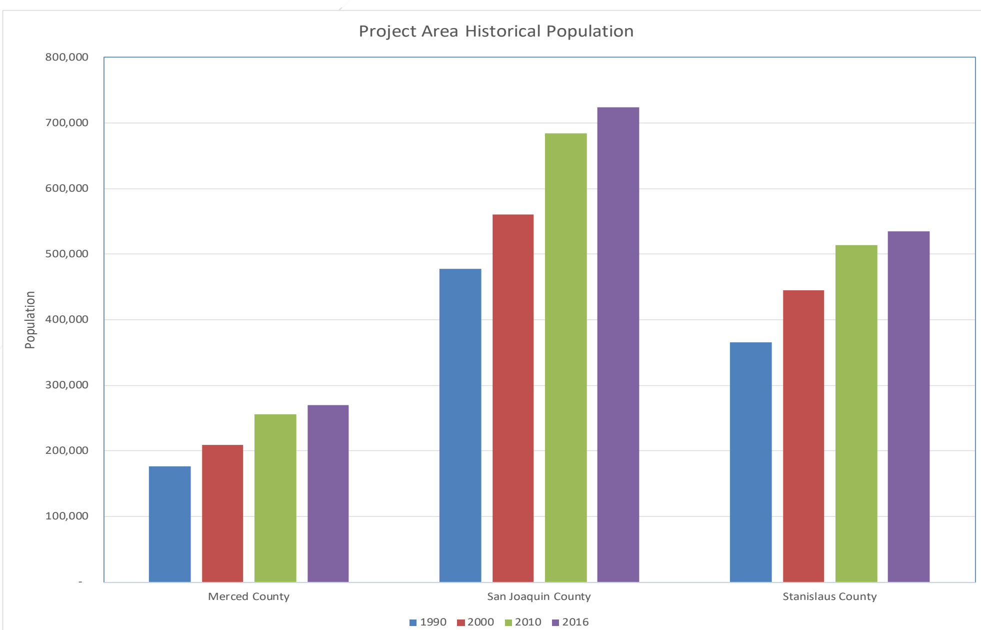
- Population and Housing
- Regional Economy
- Household Incomes (including discussion of disadvantaged communities)
- Poverty
- Regional Farm Economy

Refer to Attachment 2 for additional data on the Study Area's baseline conditions, including crop production information specific to each of the Irrigation Districts.

A. Population and Housing

Figure 2.1 shows the current and past population within the Study Area. Estimated total population within the region in early 2016 was about 1.5 million, up from about 1.0 million in 1990.

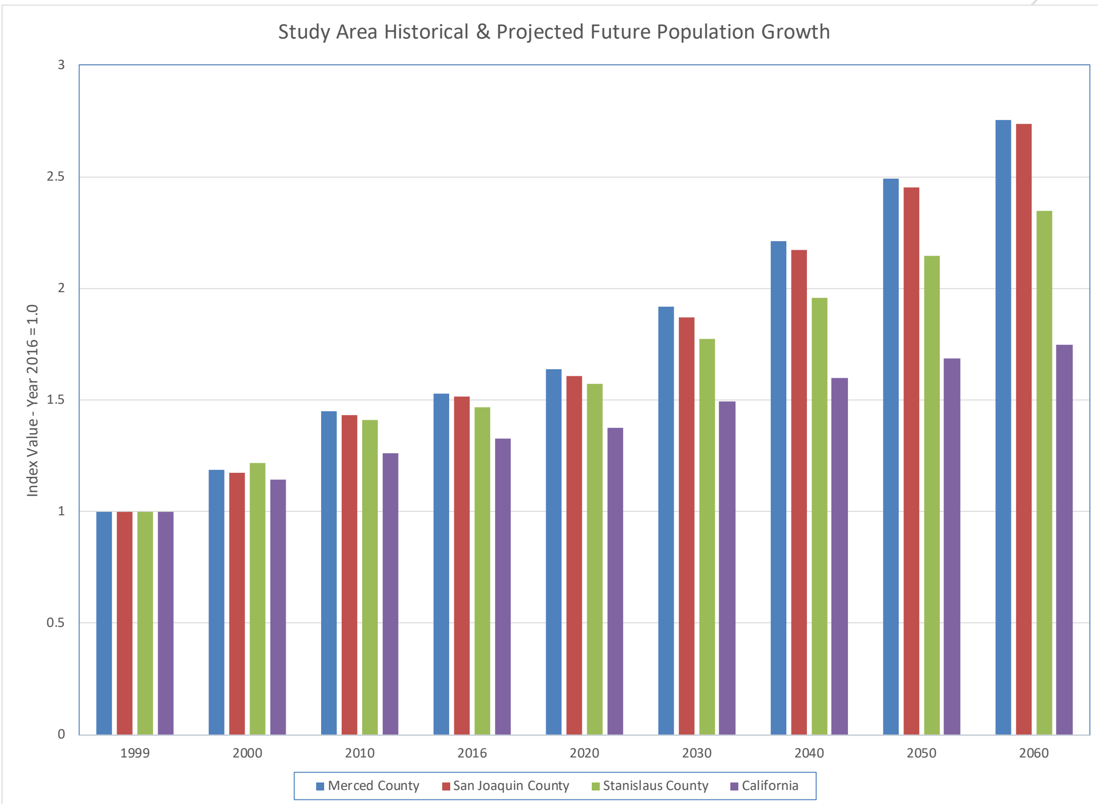
Figure 2.1



The above graphic shows steady recent historical population growth in all three counties. This has had important implications for past growth in regional urban and commercial/industrial water demand, water conservation measures notwithstanding.

Figure 2.2 compares the Study Area's historical and projected future population to that of the State of California. To facilitate the comparison the projected population figures are translated to an index value with each of the Study Area's and the State's 2016 estimated population set to a value of 1.0.

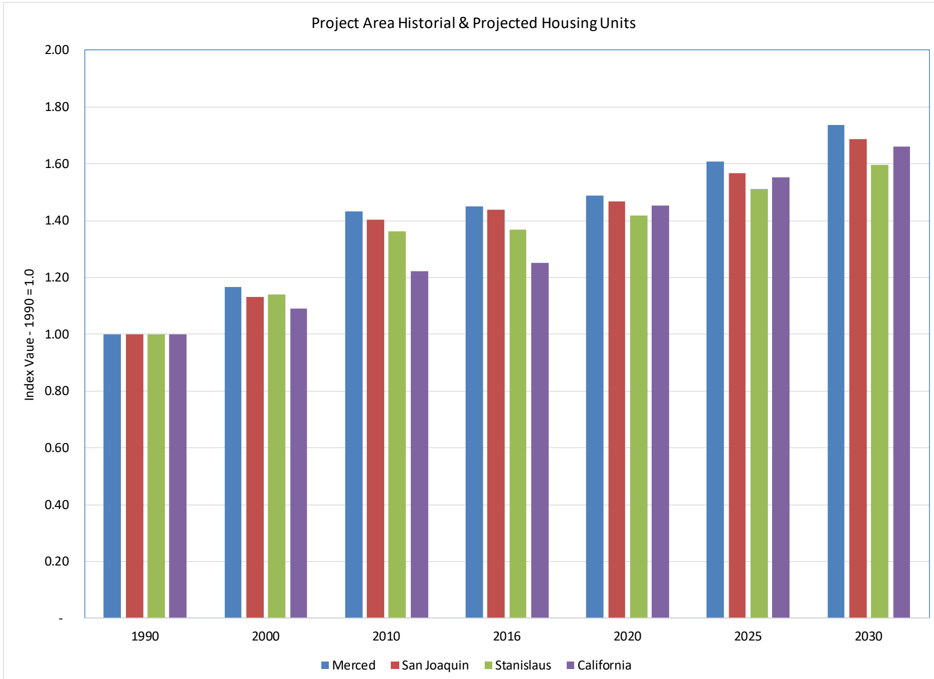
Figure 2.2



The above graphic shows not only that the region's historical population growth has significantly outpaced that of the state but also that future population growth out through the year 2060 is projected to do as well. This will have very important implications for the region's already stressed groundwater supplies as the region's communities rely primarily on groundwater for their water supplies.

Figure 2.3 compares the Study Area's historical and projected future housing inventory to that of the State of California. To facilitate the comparison, the projected population figures are translated to an index value with each of the Study Area's and the state's 2016 estimated population set to a value of 1.0.

Figure 2.3



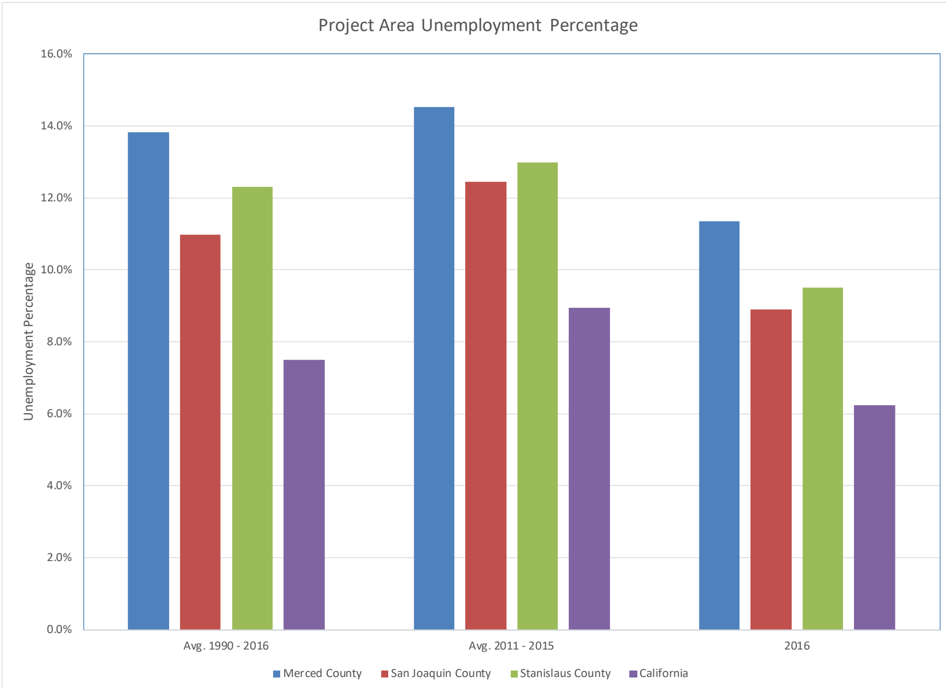
The figure reveals that while the region's historical growth in its housing inventory has somewhat kept pace with its population growth and outpaced the state, future projected housing growth for the region out through the year 2030 is at a pace that is much slower than projected population growth for that same period. This suggests a tightening of the region's housing market, and associated increases in household size (i.e., the number of occupants per household), and occupancy rates (a declining rate of housing vacancy). This trend would be expected to result in rising housing prices for a region that has a disproportionate share of its communities compared to the state that are already designated as economically disadvantaged by the state, as discussed below. Rising housing prices will only exacerbate community affordability challenges with any actions such as the SED that are likely to cause a future material rise in water service cost both for households and businesses.

B. Regional Economy

Generally, the economies of the three Study Area counties are characterized by relatively high rates of unemployment, large agricultural and agricultural-dependent sectors, low household incomes and associated high rates of poverty, helping to explain why so many are designated as economically disadvantaged by the state.

Figure 2.4 compares the average unemployment rate for the Study Area as compared to the state's for the period 1990 through 2016 and the unemployment rate for 2015.

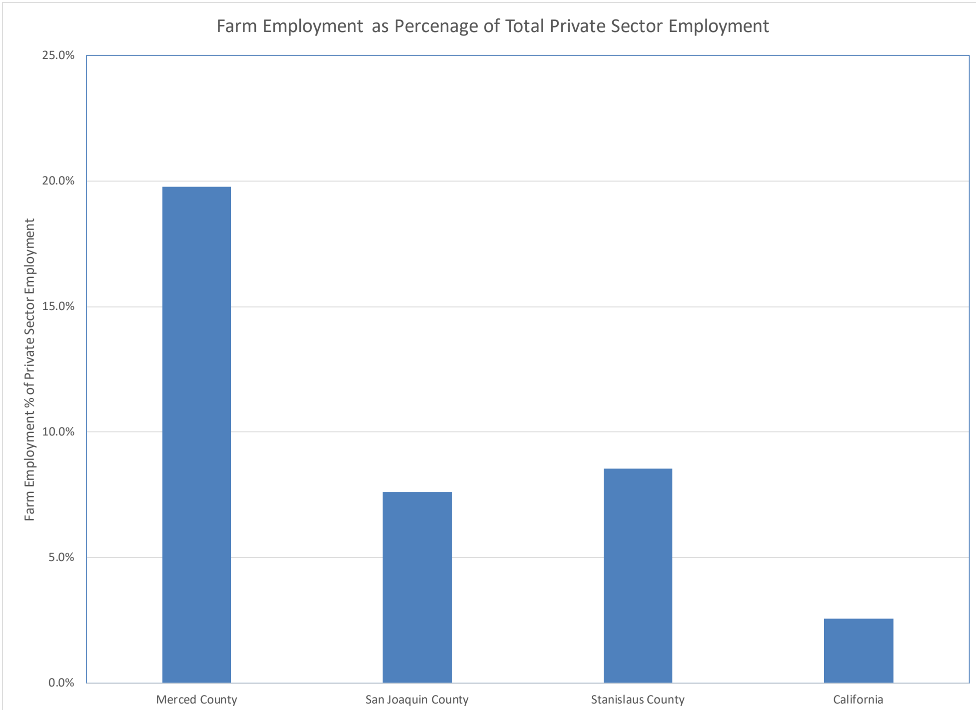
Figure 2.4



The figure shows that Study Area unemployment rate has long been high and continues to be quite a bit higher than the unemployment rate for the state. There are a variety of reasons for the disparity including the region's lack of economic diversity (i.e., reliance on a relatively limited number of sectors). Such a lack of diversification translates to an economy that has greater potential sensitivity/vulnerability to events and regulatory actions that adversely impact specific primary economic sectors on which the regional economy relies such as agriculture.

Figure 2.5 compares the share of current employment in the Study Area within the agricultural sector as compared to the State. The table illustrates the relative importance of that sector to the Study Area's economy, particularly that of Merced County. It is also important to emphasize that the graphic substantially understates the relevance of the agricultural sector to the region's employment base as many related businesses and associated employment in agricultural product transportation, manufacturing (such as dairies, which are a significant contributor to the regional economy) and trade, are down stream of and rely directly on crop and livestock production of the region's agricultural sector.

Figure 2.5

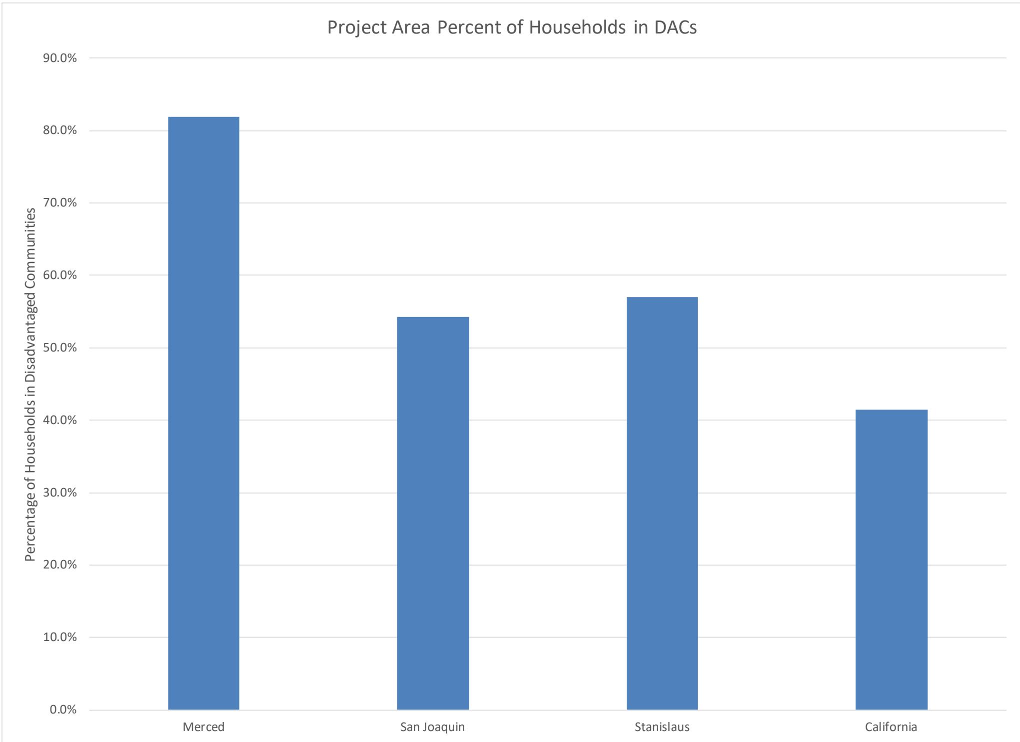


C. Median Household Income

Median household income ("MHI") is frequently used to evaluate community economic conditions within a defined geographic area. In fact, the California Department of Water Resources ("CDWR") for the purposes of water resource development and management planning uses MHI to determine if communities are considered economically disadvantaged and, thus, warrant certain special considerations in the spatial allocation of limited natural and financial resources, mitigating actions or in how cost burdens are allocated ("Disadvantaged Community" or "DAC"). Communities are considered economically disadvantaged by CDWR if their MHI is lower than 80% of the state's MHI and considered severely economically disadvantaged if community MHI is less than 60% of the state's MHI. Figure 2.6 compares the percentage of households in the Study Area that are within DAC communities based on 2014 MHI data.

The figure shows that a much larger share of the region's population resides in DACs than for the state. Merced County has a significant portion of its populace living in DACs, over 80%. DACs in the region include the cities of Merced, Modesto and Stockton, which are the largest incorporated communities in each of the Study Area counties based on population. The extent of lower incomes in the region has important implications for the presumed ability of households in the region to pay (the affordability of) any potential additional costs for water that may result from SED-related reductions in available surface water supplies. In the case of the region's communities, for those that rely entirely on groundwater, these costs will be expected to derive from increased depths to groundwater as the region's irrigators that rely on surface water are anticipated to pump more groundwater from the regions already depleted aquifers to offset SED-related reductions in surface water supplies. And, some communities, such as the City of Modesto, which relies on both surface and ground water, may not only face the cost burden of SED-related increases in groundwater depths but also a large decline in their existing water supplies. On average, Modesto receives about half of its water supplies from the Stanislaus River by way of agreement with and delivery from the Modesto Irrigation District. The remainder of the City 's water supplies are groundwater.

Figure 2.6



D. Poverty

Concurrent with the relatively low MHIs within the Study Area are high rates of poverty, which also brings to the forefront concerns regarding the affordability for regional communities to pay for anticipated increases in water costs resulting from SED implementation.

Figure 2.7

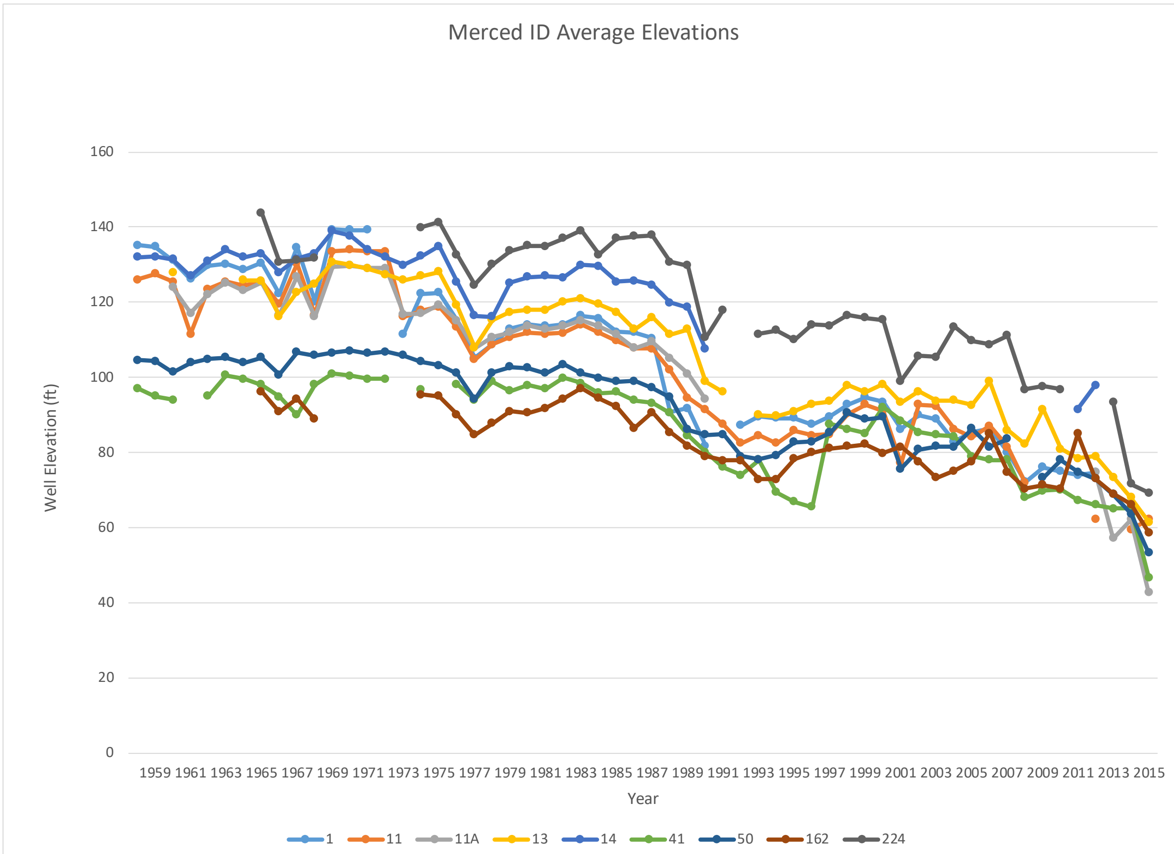
E. Regional Farm Economy

Agriculture is a fundamental component of the Study Area's economy and employment base, and the primary user of the region's surface water supplies. Accordingly, the direct effects of SED surface water supply cutbacks on the regional economy are expected. Farm sector may adjust to SED-related reductions in surface water supply availability and reliability by adopting efficiency and conservation measures and pumping more groundwater.

Study Area farmers have already made significant investments over time in response to water supply challenges in irrigation and other technologies to improve water management efficiencies and meet conservation objectives. They have also generally invested in less water consuming crops. Additional efforts on this front may increasingly prove to have diminishing returns. Furthermore, growing plants need a certain amount of water and no amount of technology can change this immutable fact.

Increased groundwater pumping in a region with already severely over-drafted and declining aquifers provides the same challenges faced by the region's urban communities; rising costs due to increasing well depths. Additional groundwater pumping, which has been the short-term response of many of the region's irrigation districts to drought-related reductions in surface water supplies with the current drought, is not a sustainable model for offsetting SED reductions in surface water supplies. The costs associated with such pumping may rise quickly for the reasons previously discussed. Figure A2.3, which shows the historical trend in elevations for a number of wells in the Merced Irrigation District, is a illustrative example of what has happened already with well depths in the region over time. Significant SED-driven increases in agricultural pumping will only make matters worse and, regardless, will run full stop into pending regulations to stop these types of declines.

Figure 2.8



County Level Agriculture

Table 2.1 summarizes the contribution of the Study Area to California's agricultural economy. The table shows that in 2014 the three Study Area counties were the 5th, 6th and 7th largest producers of farm commodities in the State based on total value of production.

Table 2.1
California County Agricultural Rankings

County	2014 Rank	Total Value of Agricultural Production	Leading Commodities
Tulare	1	$ 8,084,478	Milk, Cattle & Calves, Oranges, Grapes (Table)
Kern	2	$ 7,552,160	Grapes (Table), Almonds, Milk, Tangerines
Fresno	3	$ 7,037,175	Almonds, Milk, Grapes (Raisin), Tomatoes
Monterey	4	$ 4,493,427	Lettuce, Strawberries, Broccoli, Grapes
Merced	5	$ 4,429,987	Milk, Almonds, Cattle & Calves, Chickens
Stanislaus	6	$ 4,397,286	Almonds, Milk, Walnuts, Chickens
San Joaquin	7	$ 3,234,705	Almonds, Milk, Walnuts, Grapes (Wine)
Kings	8	$ 2,471,746	Milk, Cotton, Cattle & Calves, Almonds
Madera	9	$ 2,265,641	Almonds, Milk, Pistachios, Grapes (Raisin)
Ventura	10	$ 2,133,589	Strawberries, Lemons, Raspberries, Celery

Table 2.2 provides a summary of cropping over the past ten years for Merced County. The table show that acreage in production has consistently increased over time driven by increasing production of corn silage and other field crops for livestock feed and growing investment in permanent crops, most notably almonds. Vegetable crop acreage in the County has also shown strong increases. At the same time water intensive irrigated pasture acres have shown a significant decline over time. Merced County's most important commodities based on gross value are milk and almonds. The table shows for example an over 20% increase in the County's production of milk over the past ten years and an almost 20% increase in the acreage of almonds. Almonds account for a significant share of the County's cropping pattern. These levels and trends have important implications for the challenges faced by County's famers with the substantial SED reductions in surface water supplies. The investment in almond orchards and milk production infrastructure, including cows is substantial. Accordingly, this limits the flexibility of regional farmers to respond to changes in their water surface water supplies putting at great risk these investments as foundations of the County's agricultural economy.

Table 2.2
Merced County Cropping Pattern

	Merced County	2005	2010	2014	2015	Change 2005 to 2015
Acres[2]	Field Crops[1]	354,408	365,635	397,473	419,814	18%
	Corn Silage	82,114	90,119	100,394	106,380	30%
	Irrigated Pasture	59,000	30,719	25,030	25,030	-58%
	Tree and Vine	122,706	130,261	132,245	136,617	11%
	Almonds	87,123	98,895	99,907	101,835	17%
	Walnuts	5,948	5,326	5,909	6,123	3%
	Vegetables	47,197	59,910	62,422	63,706	35%
	Seed Crops	2,708	5,072	3,730	5,039	86%
	TOTAL	**586,019**	591,597	620,900	**650,206**	11%
cwt[3]	Milk Production	50,852,947	58,750,476	64,602,204	62,633,664	23%

1. Excludes Pasture and Rangeland
2. Harvested Acres (excludes relatively small acreages for nursery and organic products)
3. cwt = one hundred pounds

Table 2.3 provides a summary over the past ten years of cropping for San Joaquin County. The table shows a similar trend as with Merced County with respect to the steady expansion of acreages of almonds and walnuts. However, acreages in the County over the past five years have been declining for a number of other crops including, in particular, vegetables, resulting in a substantial decline in the region's overall farmed acreage.

Table 2.3
San Joaquin County Cropping Pattern

	San Joaquin County	2005	2010	2014	2015	Change 2005 to 2015
Acres[2]	Field Crops[1]	264,547	411,500	332,000	297,000	12%
	Corn Silage	41,240	57,100	50,200	40,200	-3%
	Irrigated Pasture	14,500	14,500	14,500	14,500	0%
	Tree and Vine	209,230	228,000	255,000	258,000	23%
	Almonds	43,000	48,200	59,200	65,300	52%
	Walnuts	43,200	55,374	62,500	64,100	48%
	Vegetables	84,328	63,900	61,300	58,700	-30%
	Seed Crops	1,969	1,640	1,500	1,170	-41%
	TOTAL	**574,574**	**719,540**	**664,300**	**629,370**	10%
cwt[3]	Milk Production	22,352,000	23,169,000	24,602,000	24,026,000	7%

1. Excludes Pasture and Rangeland
2. Harvested Acres (excludes relatively small acreages for nursery and organic products)
3. cwt = one hundred pounds

Table 2.4 provides a summary over the past ten years of cropping for Stanislaus County. Trends in farmed acreage in Stanislaus County has also been like the other Study Area counties with respect to nut acreage. In 2015, Almonds and walnuts accounted for about 40% of the County's overall cropping pattern. Increases in nut acreages over the past five years have been more than offset by declines in vegetable and field crop acres resulting in an overall decline in the County's acreage.

Table 2.4
Stanislaus County Cropping Pattern

	Stanislaus County	2005	2010	2014	2015	Change 2005 to 2015
Acres[2]	Field Crops[1]	184,000	293,861	237,112	215,033	17%
	Corn Silage	63,500	88,732	90,890	81,040	28%
	Irrigated Pasture	72,000	33,700	32,500	32,500	-55%
	Tree and Vine	152,000	207,999	231,027	240,280	58%
	Almonds	97,300	144,690	164,394	177,719	83%
	Walnuts	26,700	32,035	35,580	34,647	30%
	Vegetables	39,900	71,979	25,608	25,608	-36%
	Seed Crops	525	560	558	472	-10%
	TOTAL	**448,425**	**608,099**	**526,805**	**513,893**	15%
cwt[3]	Milk Production	38,920,000	40,354,000	42,803,000	41,471,000	7%

1. Excludes Pasture and Rangeland
2. Harvested Acres (excludes relatively small acreages for nursery and organic products)
3. cwt = one hundred pounds

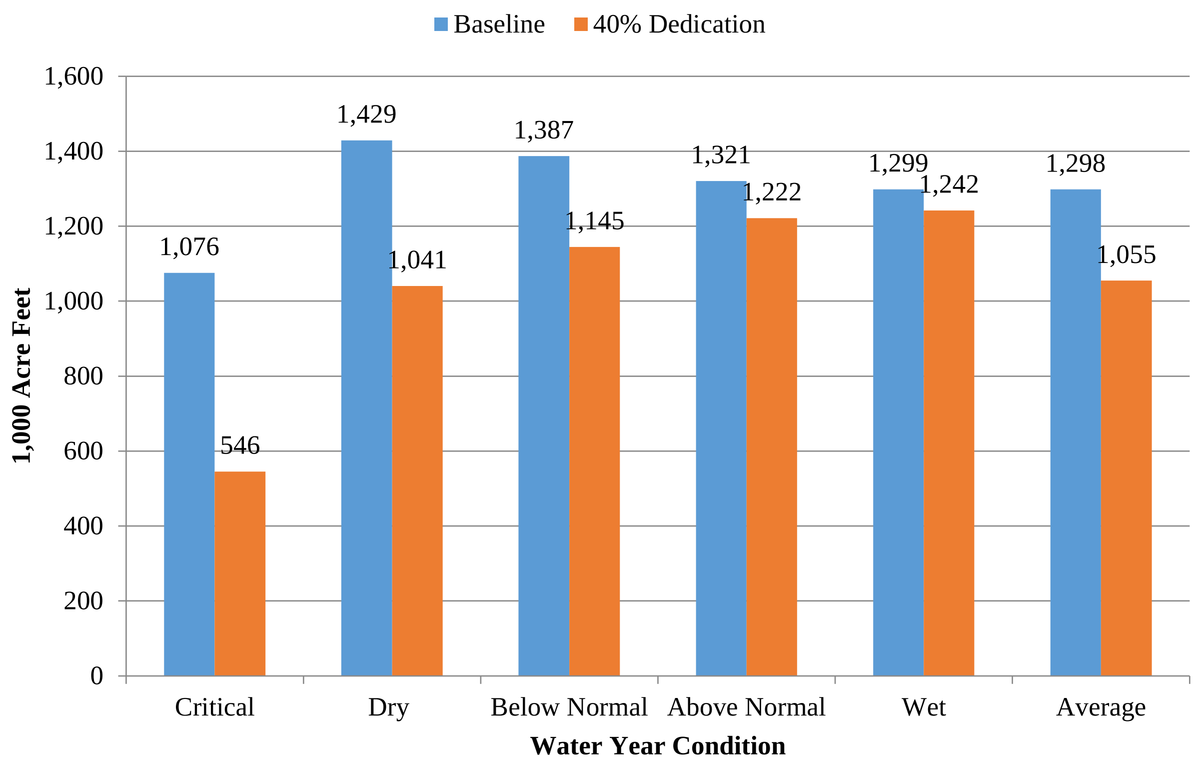
Information regarding the crop production of the Irrigation Districts is contained in Appendix 2.

3. THE WATER SUPPLY IMPACT OF PROPOSED FLOW OBJECTIVES

The proposed flow objectives for the San Joaquin River will fundamentally change the character of surface water rights to the Stanislaus, Tuolumne and Merced rivers. The SWRCB discussion focuses on the average annual impact of the flow objectives by type of water year. The focus on those averages provides, at best, an incomplete characterization of the potential impact of flow objectives on surface water rights. As discussed below, a critical impact of the flow objectives is a major reduction in the reliability of surface water supplies.

Figure 3-1 compares average annual applied surface water in the Study Area under the Baseline versus the 40% dedication of unimpaired flows.[5] The impact on applied surface water is more severe, the more severe are hydrologic conditions.

Figure 3-1
Average Annual Applied Surface Water for Study Area



Supply reliability relates to the amount of water available from a water right with a certain frequency. In assessing the water delivery reliability of the State Water Project, California's Department of Water Resources defines "water delivery reliability" as "the likelihood (probability)

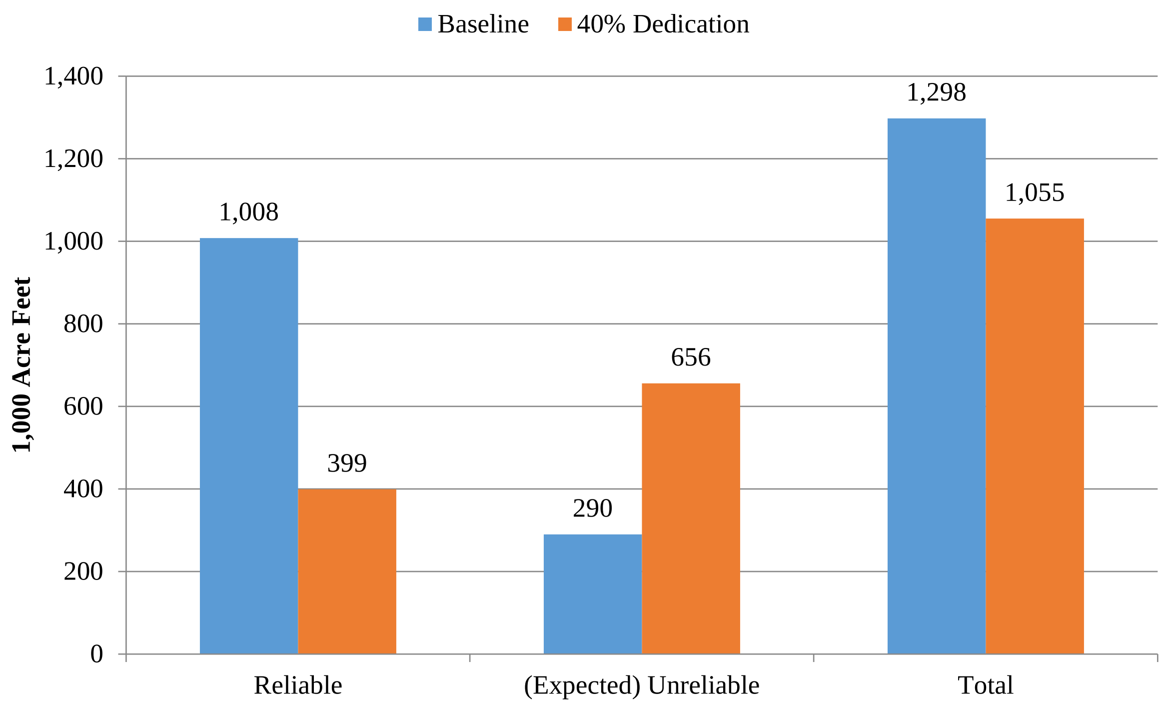
[5] Applied surface water measures the useable yield from surface water rights. Data from SWRCB Spreadsheet "GW and SW Use Analysis 09142016", tab "Applied SW".

that a certain amount of water will be delivered by the SWP in a year."[6] From this perspective, the reliable supply from a water right is measured by the amount of water available with an acceptably small likelihood of interruption.

Stratecon quantifies the reliable supply of surface water rights at the volume of surface water available with only a 10% likelihood of interruption. In other words, the volume of available water will fall short of the reliable supply at an expected frequency of once a decade. Unreliable supply is the volume of water available above the reliable supply.

The 40% dedication of unimpaired flows reduces both the volume of available surface water and its reliability. Figure 3-2 compares the reliable and (expected) unreliable annual applied surface water for the Study Area under the Baseline versus the 40% dedication of unimpaired flows.[7] Under the Baseline, almost 80% of the average annual amount of applied surface water would be a reliable supply. With 40% dedication of unimpaired flows, less than 40% of the average amount of applied surface water would be a reliable supply.

Figure 3-2
Annual Reliable and (Expected) Unreliable Applied Surface Water for Study Area



[6] "The State Water Project, Final Delivery Reliability Report 2013", State of California, Natural Resources Agency, Department of Water Resources, at p. 1.

[7] Applied surface water will exceed reliable supply in 90% of the years. Analysis based on data from SWRCB Spreadsheet "GW and SW Use Analysis 09142016", tab "Applied SW".

In comparison to the Baseline, the 40% dedication of unimpaired flows reduces the Study Area's annual reliable applied surface water from 1 million AF to 400 thousand acre-feet ("TAF") AF, a 60% reduction. The loss of an annual reliable supply of 600 TAF is partly offset by an increase in (expected) annual unreliable supply of 366 TAF. The focus on only the average impact on available applied surface water ignores the significant shift from reliable to unreliable surface water supplies.

Table 3-1 shows the reliable and (expected) unreliable annual applied surface water for the three rivers in the Study Area. For the Stanislaus River, the 40% dedication of unimpaired flows reduces average annual applied surface water by 62 TAF, with a reduction of annual reliable supply by 218 TAF partly offset by an increase in (expected) annual unreliable supply by 156 TAF. For the Tuolumne River, the 40% dedication reduces the average annual applied surface water by 111 TAF, with a reduction of annual reliable supply of 253 TAF partly offset by an increase in (expected) annual unreliable supply of 142 TAF. For the Merced River, the 40% dedication reduces the average annual applied surface water by 138 TAF, with a reduction of annual reliable supply of 253 TAF partly offset by an increase in (expected) annual unreliable supply of 68 TAF.

Table 3-1

Annual Reliable and (Expected) Unreliable Applied Surface Water (TAF)

River	*Scenario*	*Reliable*	*(Expected) Unreliable*	*Total*
Stanislaus	Baseline	329	78	407
	40% Dedication	111	234	345
Tuolumne	Baseline	484	121	605
	40% Dedication	231	263	494
Merced	Baseline	195	91	286
	40% Dedication	57	159	216

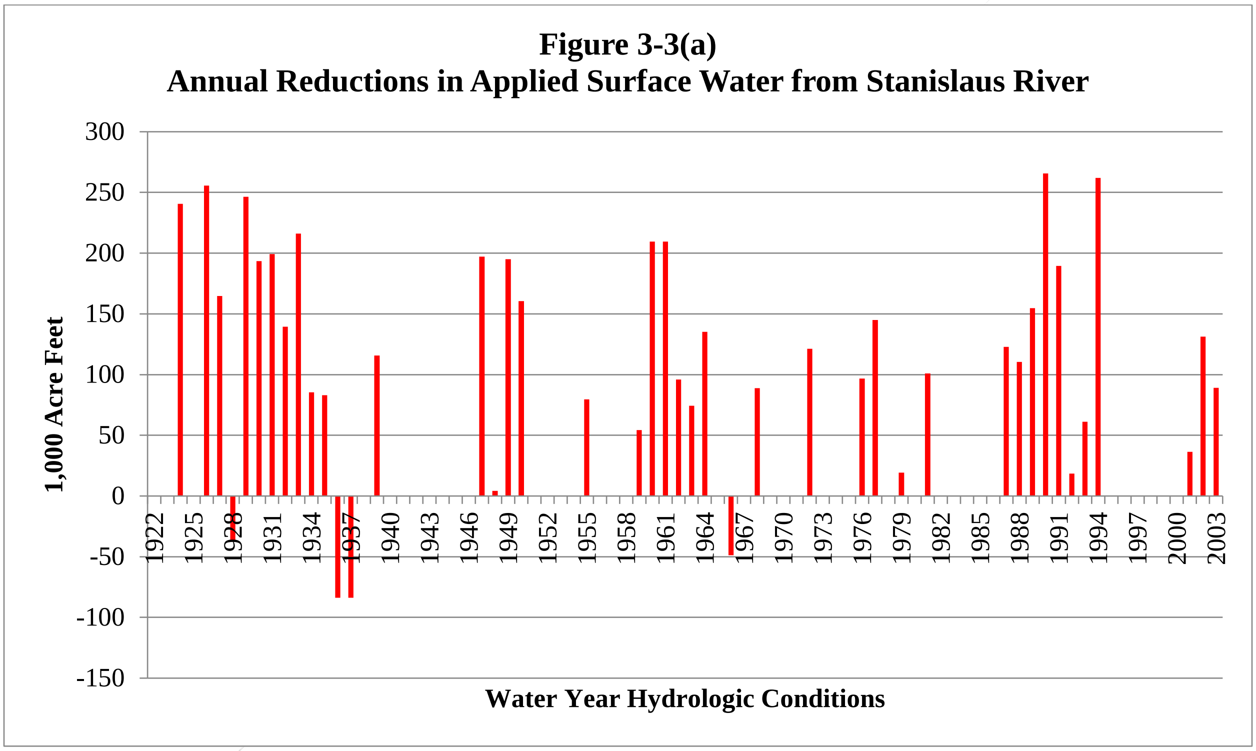
The significant reductions in supply reliability means that owners of water rights from the three rivers will face frequent, severe, and sustained losses of surface water—see Figure 3-3(a) to Figure 3-3(c).[8] The reduction in applied surface water has multi-year successive losses more than 150 TAF on the Stanislaus River, 250 TAF on the Tuolumne River, and 150 TAF on the Merced River. Water losses occur in about half the years included in SWRCB's study (48% on the Stanislaus River, 51% on the Tuolumne River and 52% on the Merced River).[9] The focus on

[8] Analysis based on data on applied surface water under the Baseline versus 40% dedication from SWRCB Spreadsheet "GW and SW Use Analysis 09142016", tab "Applied SW".

[9] The frequencies in the text calculated by the proportion of years in Figure 2-3(a) through Figure 2-3(c) with water losses.

average annual losses even by water year hydrologic conditions as in Figure 3-1 masks how much the 40% dedication of unimpaired flows increases the underlying volatility in available surface water supplies.

Assessing the economic consequences of the changes in the surface water rights on the Stanislaus, Tuolumne and Merced rivers requires more than (i) looking at each water year in isolation and (ii) averaging over the different water years. Using SWRCB's own analysis of available surface water under the Baseline versus a 40% dedication of unimpaired flows, the flow objectives for the San Joaquin River will reduce the volume and more significantly reduce the reliability of surface water supplies. Partially offsetting the loss of reliable surface water supplies with an increase in unreliable surface water supplies is not an attractive bargain.



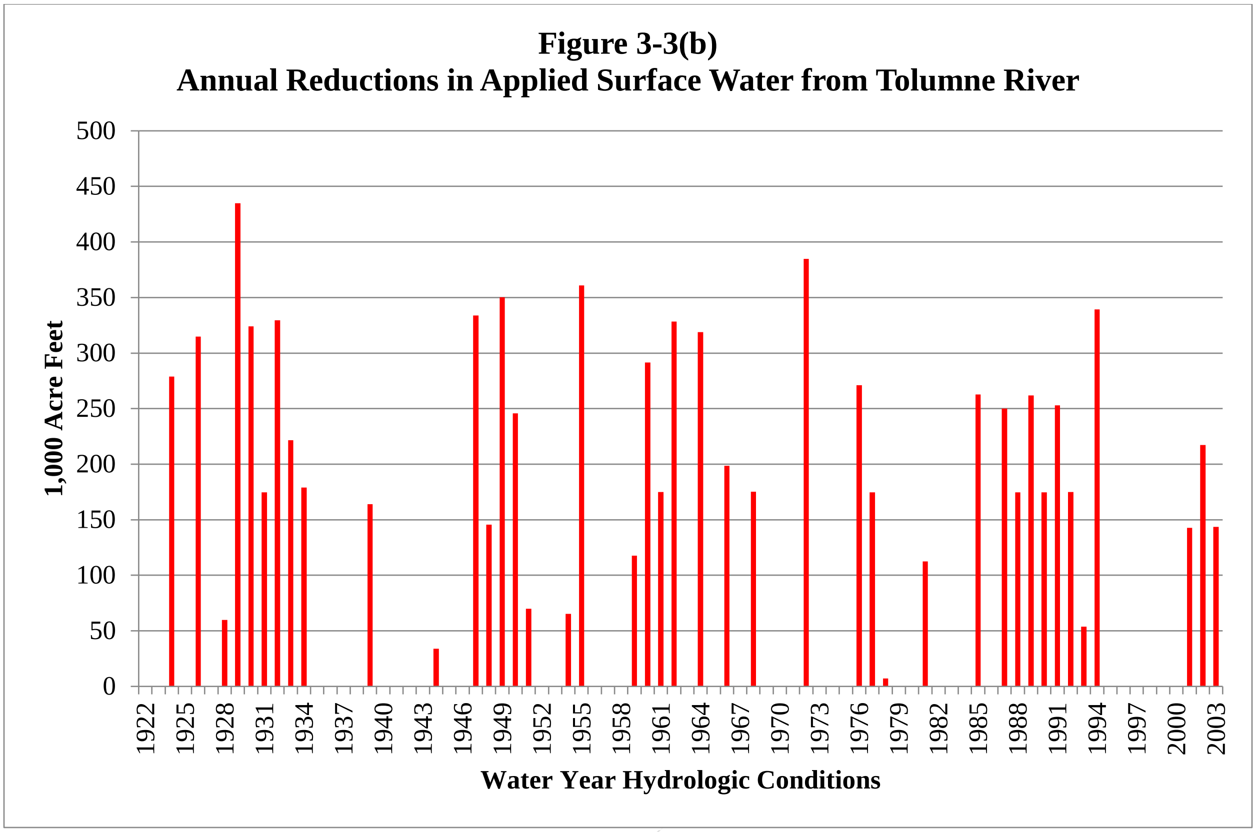


Figure 3-3(b)
Annual Reductions in Applied Surface Water from Tolumne River
1,000 Acre Feet
500
450
400
350
300
250
200
150
100
50
0
1922 1925 1928 1931 1934 1937 1940 1943 1946 1949 1952 1955 1958 1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003
Water Year Hydrologic Conditions

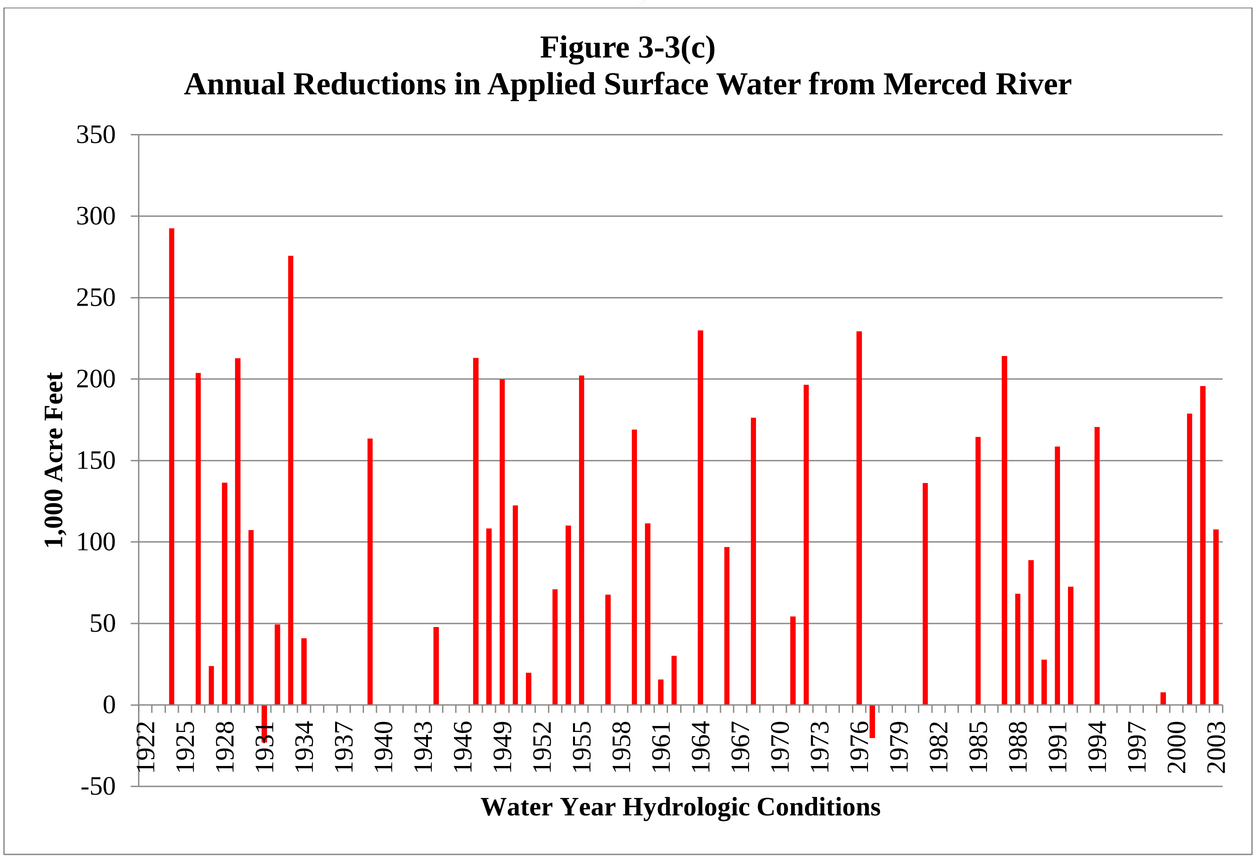


Figure 3-3(c)
Annual Reductions in Applied Surface Water from Merced River
1,000 Acre Feet
350
300
250
200
150
100
50
0
-50
1922 1925 1928 1931 1934 1937 1940 1943 1946 1949 1952 1955 1958 1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003
Water Year Hydrologic Conditions

The reduction in the value of surface water rights is significant. Depending on the relative value of reliable water supplies to unreliable water supplies, implementation of SED 40 reduces the value of surface water rights by 40% to more than 50% due to the loss of reliable water supplies even though partly offset by increased unreliable water supplies (see Table 3-2).[10] With little if any Central Valley Project ("CVP") water available in 2015 and 2016, the prices Westlands Water District paid for transfer water exceeded $1,000/AF, three times the amount Westlands paid in 2013 (when CVP Allocation was 20%) and five times the amount paid during 2000-2012 (when water was more plentiful as CVP Allocations averaged 60%).[11] The annual value of reliable water supplies year in and year out, of course, is less than the value of water in years of peak values. Assuming the annual value of reliable water supplies is in the range of a 10% to 20% discount off the annual value of water in peak years, the relative value of reliable water supplies to unreliable water supplies is about 4x to 5x—near the bottom of Table 3-2.

Table 3.2

Impact of SED 40 Implementation on Value of Surface Water Rights

Relative Value of Reliable/Unreliable Water Supplies	*Lost Economic Value*
2	41%
3	48%
4	52%
5	54%

[10] The percentage reduction in the value of surface water rights from the substitution of unreliable for reliable water supplies depends on the relative value of reliable versus unreliable water supplies. Lost Economic Value equals the Economic Value under the Baseline less the Economic Value under SED 40, expressed as a percentage of the Economic Value under the Baseline. See Figure 3-2 for the quantities of reliable and expected unreliable water supplies under the Baseline and SED 40. In calculating Table 3.2, the value of unreliable supplies was set at $1 and the value of reliable supplies set at the multiple specified in the first column.

[11] "Westlands Again Pays High Price for Supplemental Water Due to Drought," *Journal of Water*, March 2016, http://journalofwater.com/jow/westlands-again-pays-high-price-for-supplemental-water-due-to-drought/.

4. SWRCB ANALYSIS

SED documentation includes chapters and appendices assessing the impact of the proposed flow objective on groundwater resources, agriculture, local economy, service providers, disadvantages communities, recreation, and hydropower resources. This section summarizes the SWRCB conclusions and key underlying assumptions.

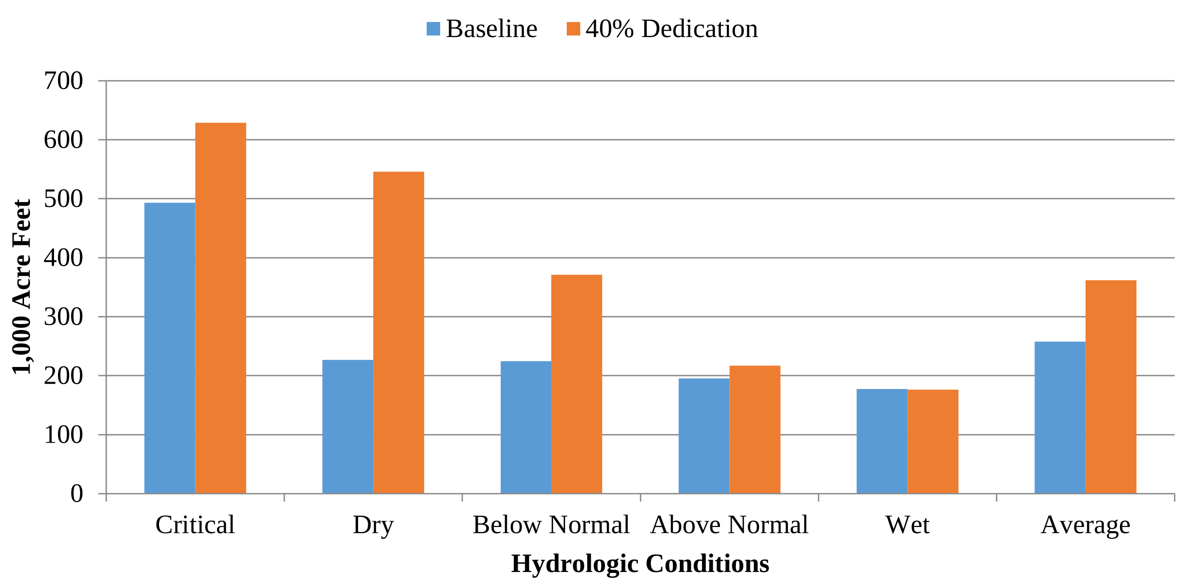
A. Groundwater Resources

There are two impacts of the proposed flow objective on groundwater resources: increased groundwater pumping and reduced groundwater recharge from the use of surface water. Each impact translates into increased stress on the Study Area's groundwater basins.

Groundwater Pumping

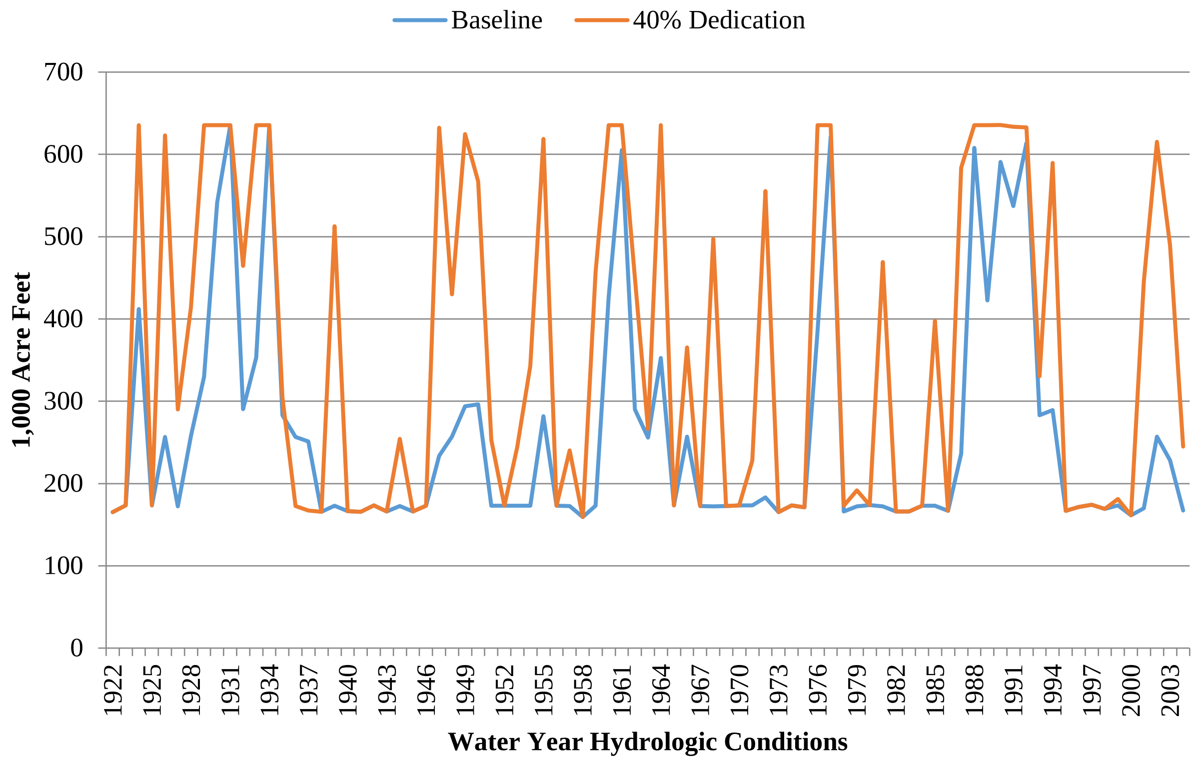
SWRCB staff project that implementation of the proposed flow objective will significantly increase groundwater pumping, especially when hydrologic conditions are critical, dry, or below normal (see Figure 4.1). Under the baseline, groundwater pumping hovers around 200,000 AF per year in all hydrologic conditions other than critical water years, when groundwater pumping increases to almost 500,000 AF per year. Under the proposed flow objective, groundwater pumping exceeds 600,000 AF per year in critical water years, 500,000 AF per year in dry water years, and almost 400,000 AF per year in below normal water years.

Figure 4.1
Average Annual Groundwater Pumping by Surface Water Users in Project Area



SWRCB staff project increased volatility in groundwater pumping (see Figure 4.2). Under the Baseline, groundwater basins are subjected to increased pumping only in years of critical hydrologic conditions. Under the proposed flow objective, the stress from spikes in groundwater pumping are more frequent. As discussed in Section 6, this increased frequency of spikes in groundwater pumping intensifies existing overdraft conditions and will not be viable once the Sustainable Groundwater Management Act is implemented.

Figure 4.2
Groundwater Pumping by Surface Water Users in Study Area



The above structure of how the proposed flow objective transforms the nature of groundwater pumping cascades down to all three rivers. For users of surface water from the Stanislaus River, groundwater pumping increases by 25% during critical years (when groundwater basins are already stressed by spikes in pumping), doubles in dry years and increases by 23% in below normal years (see Figure 4.3). As with the Study Area generally, there is a greater frequency of spikes in groundwater pumping by users of Stanislaus River surface water (Figure 4.4).

For users of surface water from the Tuolumne River, the increases in groundwater pumping are largest during years of dry conditions (49% increase) and below normal conditions (40% increase)—see Figure 4.5. Where baseline average annual groundwater pumping ranges between 80 TAF and 100 TAF under hydrologic conditions other than critical years, average annual groundwater pumping exceeds 130 TAF in below normal conditions and jumps to 150 TAF in critical and dry conditions. SWRCB staff project increased frequency in spikes in groundwater pumping (see Figure 4.6).

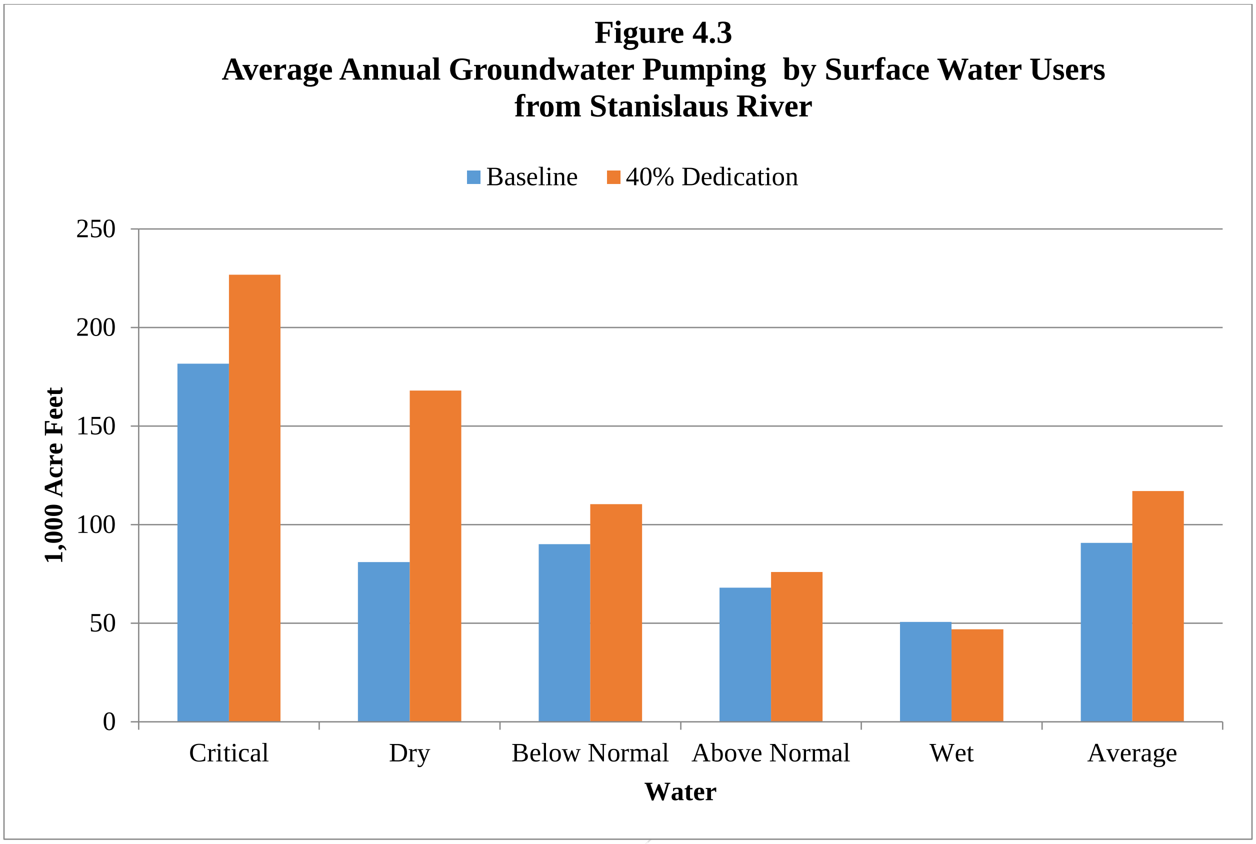


Figure 4.3
Average Annual Groundwater Pumping by Surface Water Users
from Stanislaus River
Baseline
40% Dedication
250
200
150
100
50
0
1,000 Acre Feet
Critical
Dry
Below Normal
Above Normal
Wet
Average
Water

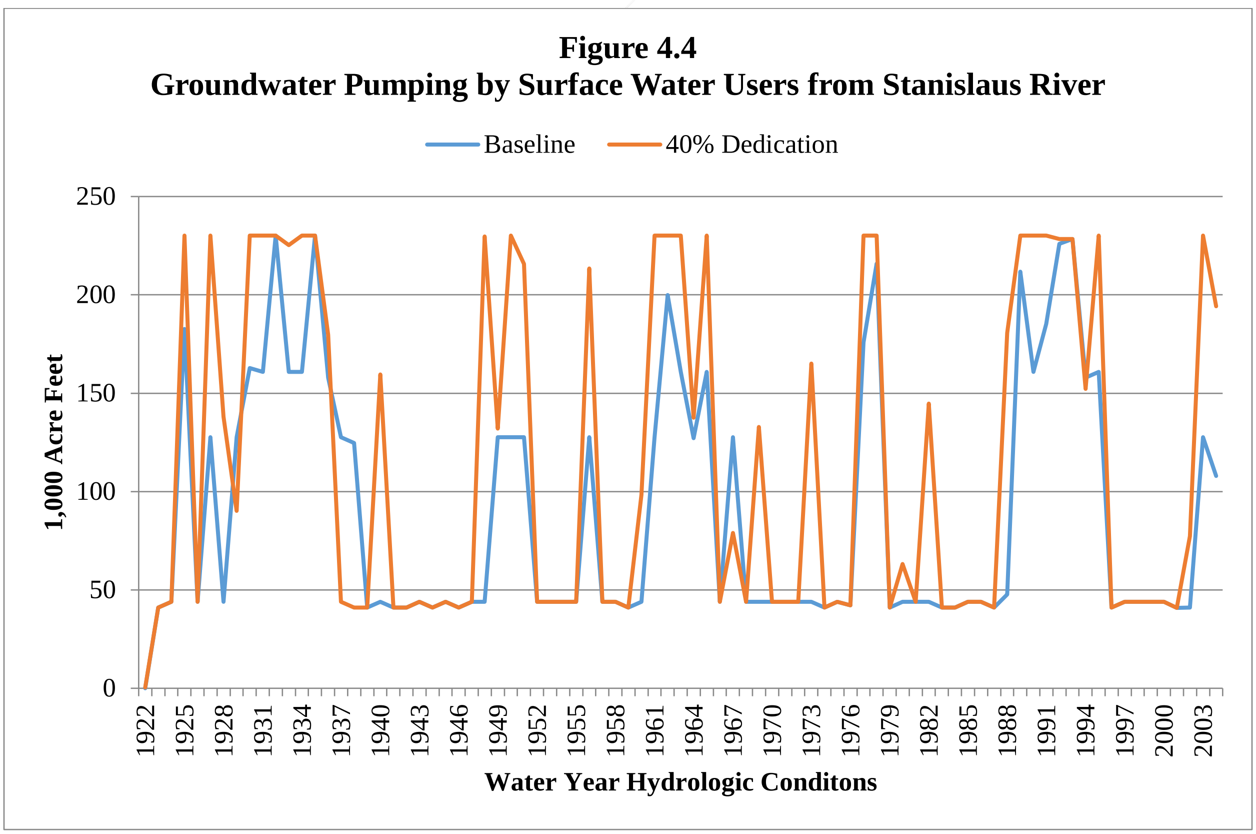


Figure 4.4
Groundwater Pumping by Surface Water Users from Stanislaus River
Baseline
40% Dedication
250
200
150
100
50
0
1,000 Acre Feet
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
Water Year Hydrologic Conditons

Figure 4.5
Average Annual Groundwater Pumping by Surface Water Users from Tuolume River

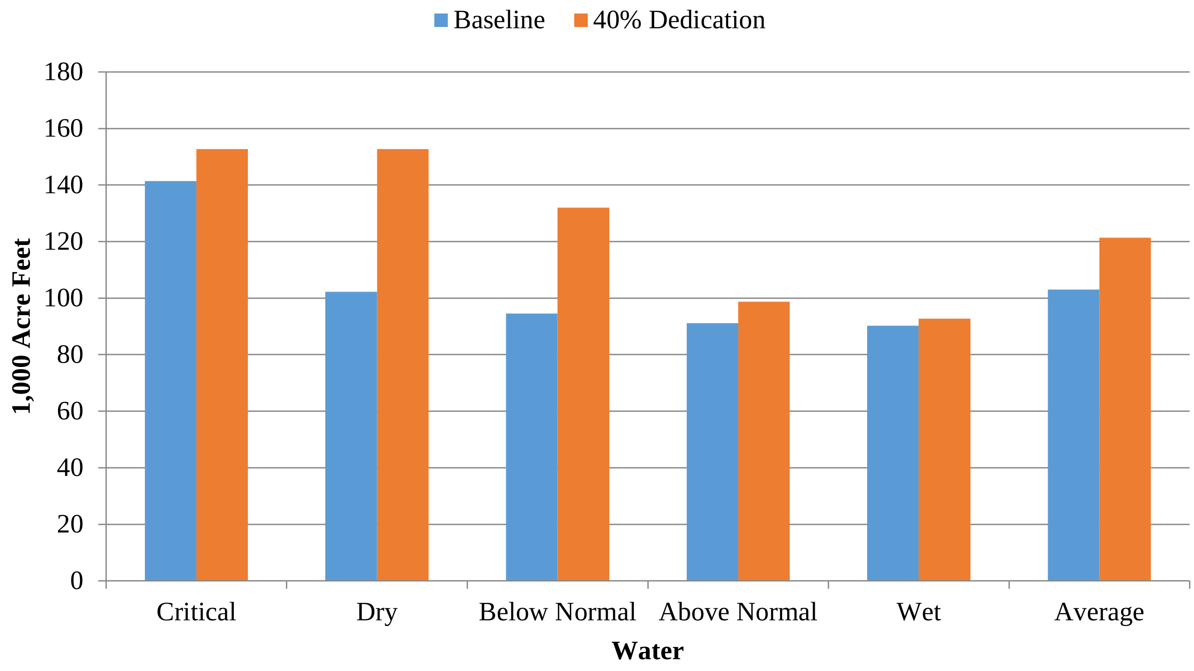
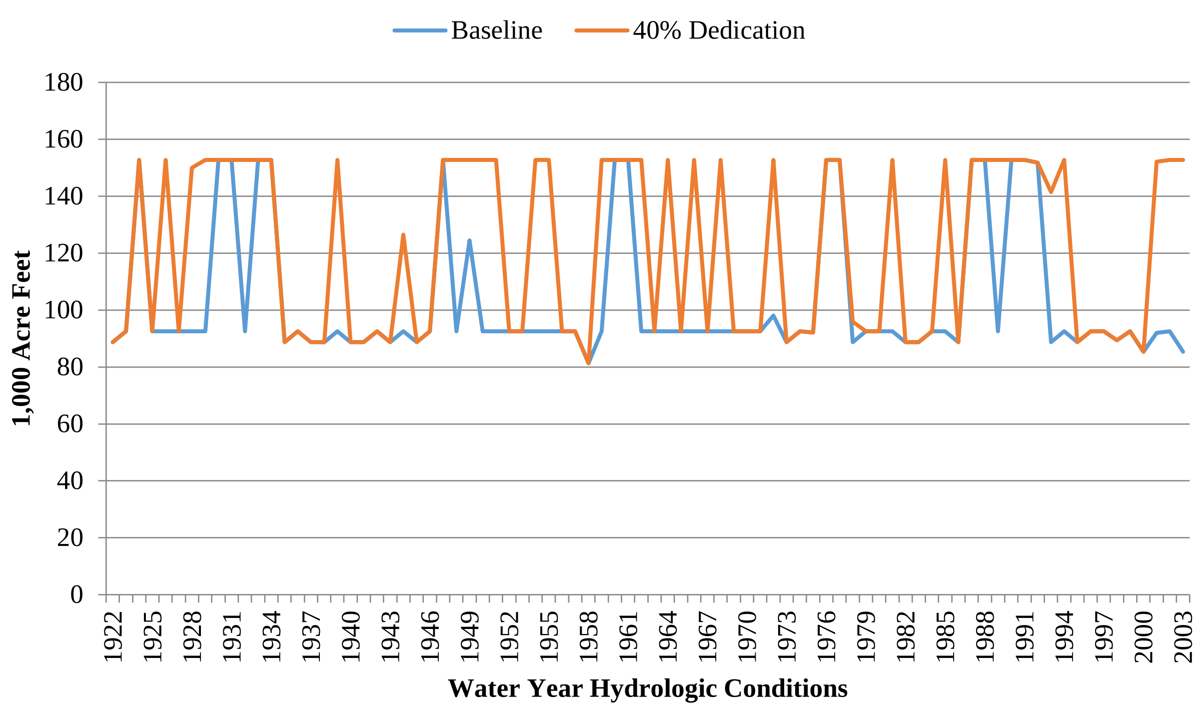
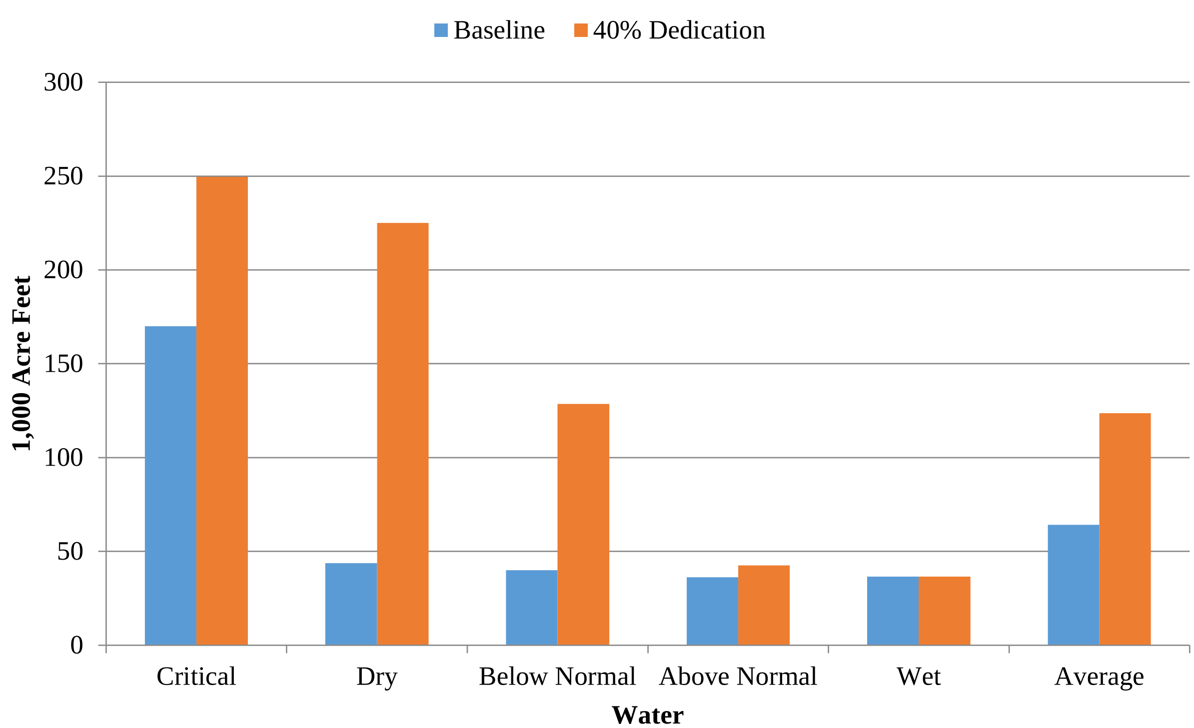


Figure 4.6
Groundwater Pumping by Surface Water Users from Tuolumne River

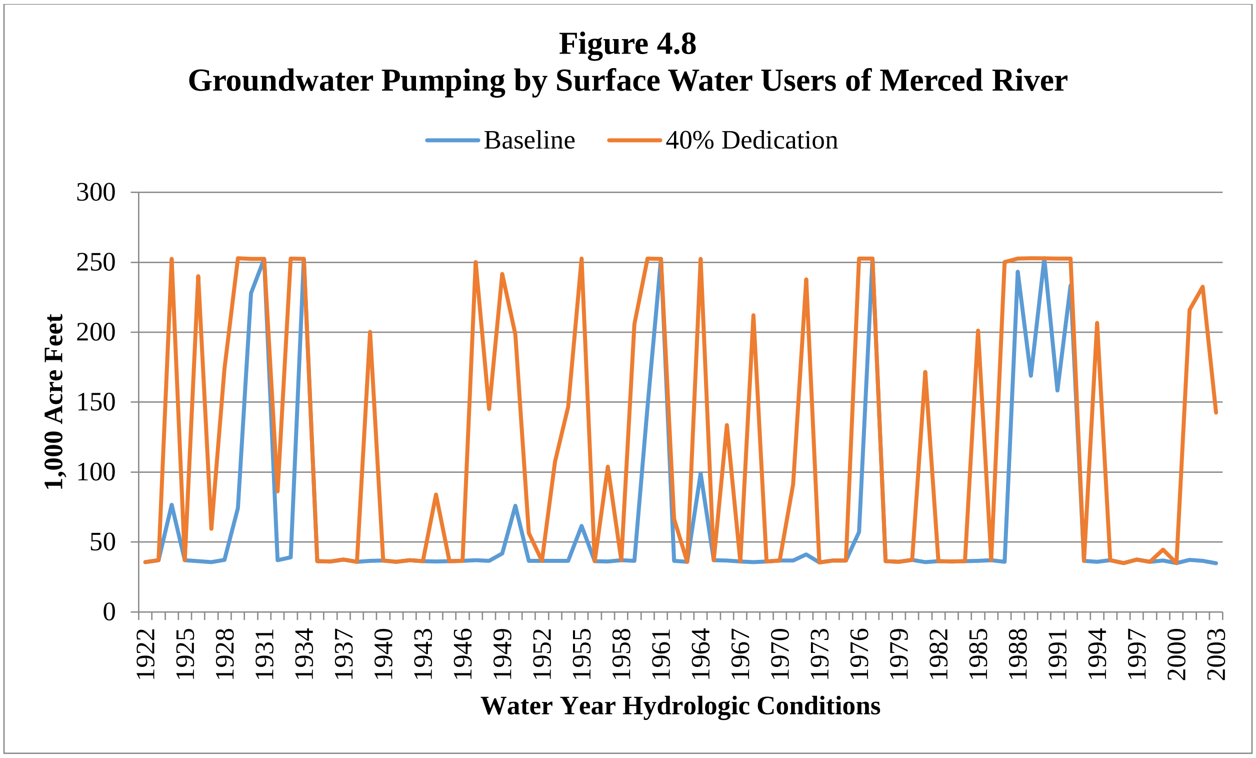


The projections are similar for users of surface water from the Merced River. Under the Baseline, annual groundwater pumping averages less than 50 TAF under all hydrologic conditions other than critical conditions (see Figure 4.7). Average annual groundwater pumping more than triples to 170 TAF in critical years. Implementation of the proposed flow objective increases average annual groundwater pumping by an additional 47% in critical years, 414% in dry years and 222% in below normal years. The proposed flow objectives increase the frequency and spikes in projected groundwater pumping (see Figure 4.8).

Figure 4.7
Average Annual Groundwater Pumping by Surface Water Users from Merced River



In sum, SWRCB projects that the proposed flow objective increases groundwater pumping by surface water users on all three rivers. Under the Baseline, groundwater pumping hovers around relatively low levels in all hydrologic conditions other than critical years. Average annual groundwater pumping spikes during critical years reflecting conjunctive use of groundwater to back stop reductions in available surface water. With the proposed flow objective, groundwater pumping steps up further to offset the loss of available surface water in critical, dry and below normal years.



Reduced Groundwater Recharge

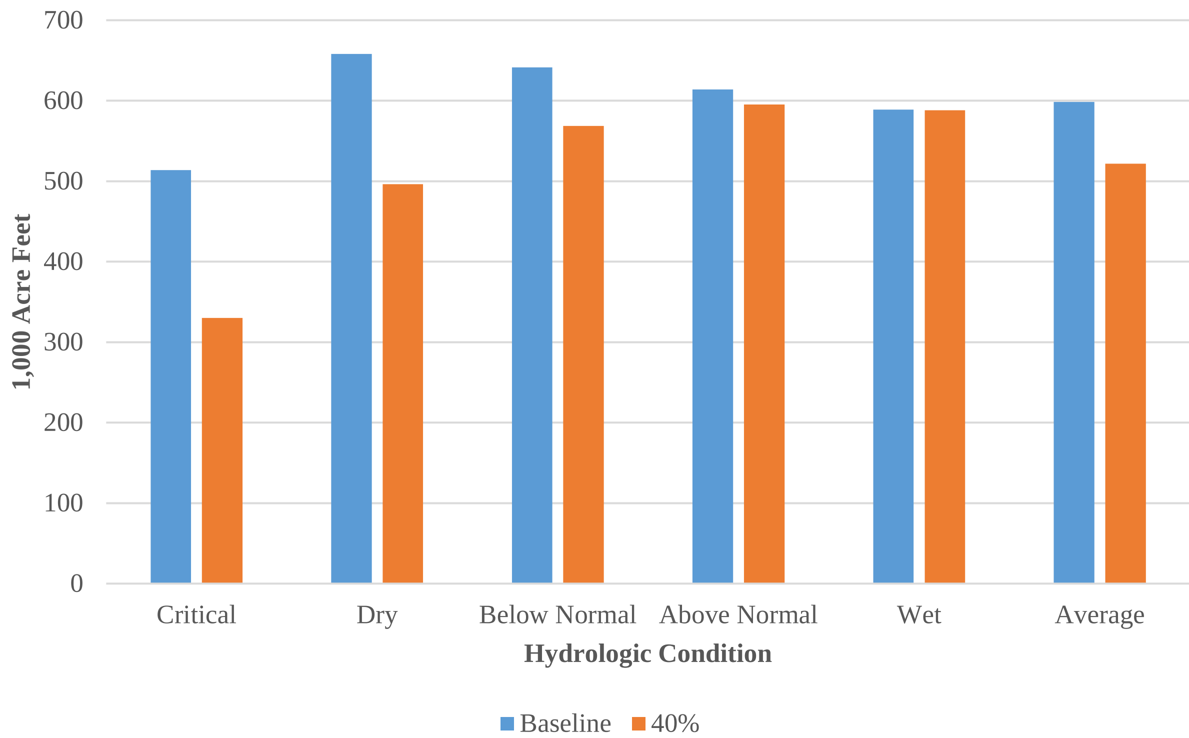
The use of surface water results in groundwater recharge from distribution seepage losses and deep percolation of water applied to crops. By reducing available surface water supplies, the proposed flow objective reduces groundwater recharge. For the entire Study Area, average annual recharge over all hydrologic conditions declines from 598 TAF to 522 TAF (see Figure 4.9). The loss of recharge is greatest during critical and dry years where the average annual loss of recharges is almost 200 TAF and more than 150 TAF respectively. Given the distribution losses and percolation rates from applied water, the lost groundwater recharge is proportional to the amount of lost surface water (see Table 4.1).[12] The volatility in lost recharge mirrors the volatility in lost surface water supplies.

Table 4.1
Proportional Impact of Losses in Applied Surface Water on Groundwater Recharge

District	*Impact of Surface Water on Recharge*
Central San Joaquin Water Conservation District	31%
Stockton East Water District	6%
South San Joaquin Irrigation District	32%
Oakdale Irrigation District	37%
Modesto Irrigation District	29%
Turlock Irrigation District	35%
Merced Irrigation District	32%

[12] The proportional impact in Table 4.1 is the estimated coefficient of statistical models relating annual losses of groundwater recharge for water years 1922-2003 to the annual loss of applied surface water.

Figure 4.9
Average Annual Recharge from Distribution Losses and Deep Percolation in Study Area



B. Agriculture

The SWRCB analysis of the impact of the proposed flow objective is driven by the reduction in farming caused by the reduction in available water supplies. Given the assumption that groundwater pumping increases to offset the loss of surface water until groundwater pumping reaches maximum capacity, SWRCB staff assumes that the proposed flow objective only results in a loss of water supplies when groundwater reaches maximum capacity and cannot expand sufficiently to fully offset the loss of surface water supplies.

Significant reductions in crop acreage only occur during critical years under SWRCB's analysis (see Figure 4.10). In critical years, the average annual crop acreage in the Study Area declines from about 490,000 acres under the baseline to about 410,000 acres under the proposed flow objective. In dry years, the average annual crop acreage in the Study Area declines from about 517,000 acres under the baseline to about 486,000 acres under the proposed flow objective. As was the case with lost surface water supplies, focus on averages even by hydrologic condition obscures the underlying variability in SWRCB's estimated impact of the proposed flow objective on crop acreage (see Figure 4.11).

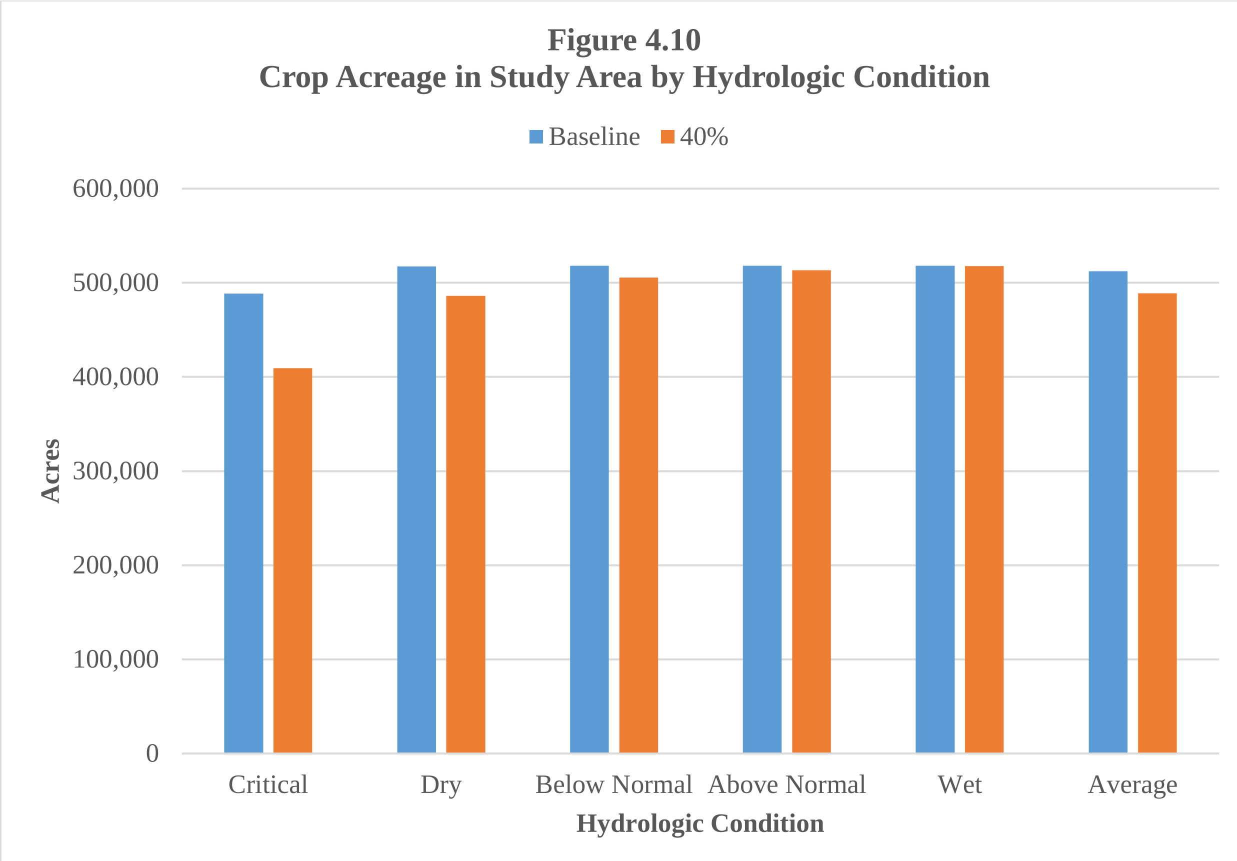


Figure 4.10
Crop Acreage in Study Area by Hydrologic Condition
Baseline
40%
600,000
500,000
400,000
300,000
200,000
100,000
0
Acres
Critical
Dry
Below Normal
Above Normal
Wet
Average
Hydrologic Condition

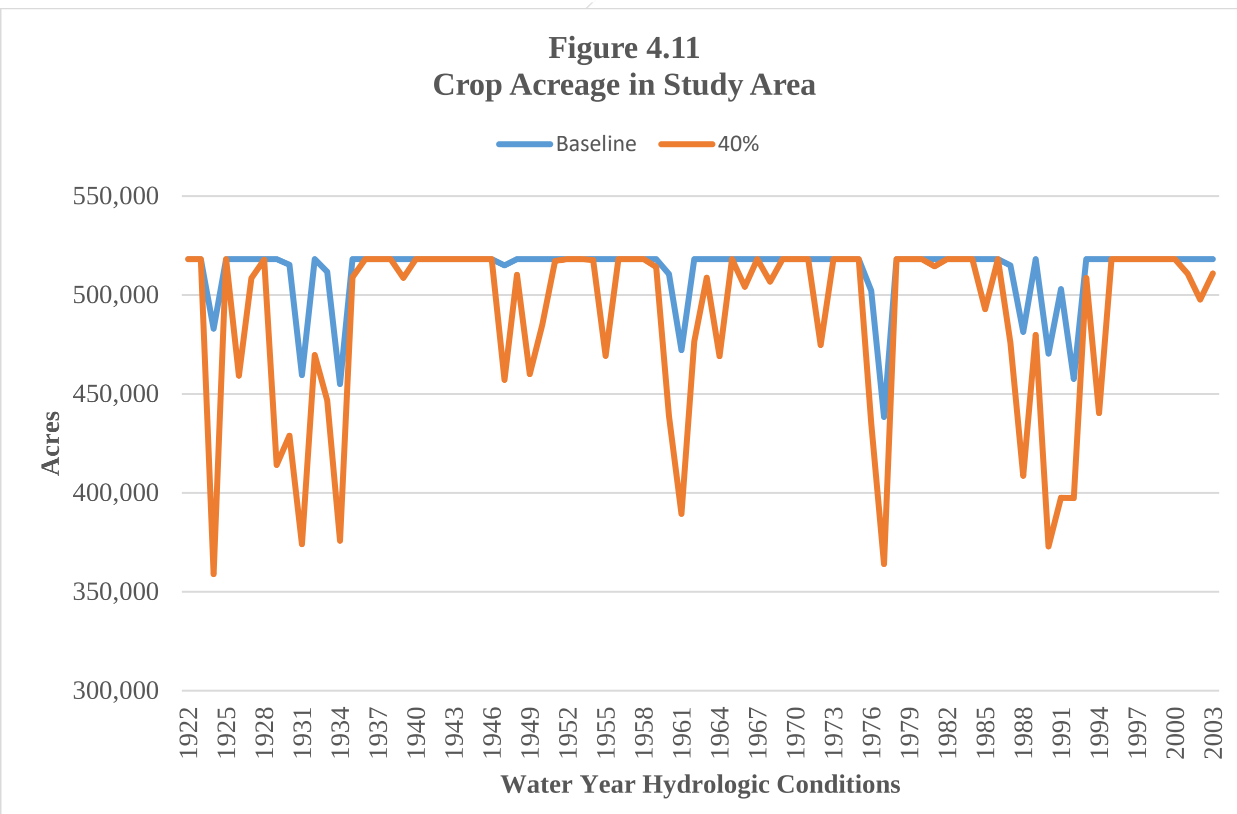


Figure 4.11
Crop Acreage in Study Area
Baseline
40%
550,000
500,000
450,000
400,000
350,000
300,000
Acres
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
Water Year Hydrologic Conditions

The reduction in acreage is concentrated in grains, alfalfa, pasture and other field crops (see Table 4.2).[13] The reduction in acreage in vegetables and tree nuts is minor. This response is consistent with the findings from the Westlands Case Study (see Attachment 1).

Table 4.2
Distribution of Acreage Reductions by Crop and Hydrologic Condition

Hydrologic Condition	*Oil Seed*	*Grains*	*Vegetables*	*Fruit*	*Tree Nuts*	*Cotton*	*Sugar Beets*	*Alfalfa*	*Pasture*	*Other Field*	*Acreage Loss*
Critical	0.1%	22.0%	2.3%	1.2%	2.3%	0.1%	0.0%	16.2%	17.5%	38.3%	79,104
Dry	0.1%	11.6%	1.8%	1.1%	2.2%	0.0%	0.0%	27.2%	39.0%	16.9%	31,158
Below Normal	0.0%	10.5%	1.6%	1.2%	2.2%	0.0%	0.0%	25.7%	45.7%	13.1%	12,537
Above Normal	0.1%	8.6%	1.3%	1.3%	2.1%	0.0%	0.0%	23.4%	55.4%	7.7%	4,837
Wet	0.2%	8.1%	1.2%	1.9%	2.6%	0.0%	0.0%	5.3%	76.9%	3.9%	393
Average	0.1%	18.2%	2.1%	1.2%	2.3%	0.0%	0.0%	19.6%	26.2%	30.3%	23,421

How does one reconcile the average annual loss of about 300,000 acre feet per year of surface water (see Section 3) with the small average annual reductions in crop acreage of 23,421 acres (see Figure 4.10 and Table 4.2)? The answer is found in the SWRCB's assumption that increased groundwater pumping fully offsets the loss of surface water until pumping reaches maximum capacity. In effect, the loss of surface water is fully offset by increased groundwater pumping except in a few years such as when hydrologic conditions are critical.

The SWRCB assumption is not consistent with the experience of Westlands Water District who has been facing volatile surface water supplies since the 1990s (see Attachment 1). Groundwater pumping in Westlands offsets 50% of the change in surface water supplies, not 100%. In its analysis of the impact of the proposed flow objective, Stratecon assumes that groundwater pumping increases to offset half the loss of surface water supplies until pumping reaches its maximum capacity. Thus, Stratecon predicts that implementation of the proposed flow objective will result in more land fallowing than reported in the SED (see Section 6).

The view that use of the SWAP model under predicts land fallowing is illustrated by comparing estimates of drought impacts on crop acreage in the Tulare Lake Basin using the SWAP model with land fallowing in Westlands (see Table 4.3).[14] Crop acreage in Westlands accounts

[13] The percentages in Table 4.2 show the reduction in acreage for a crop relative to the total reduction in crop acreage (the last column) for the hydrologic condition (the first column). For example, during critical years the average annual reduction in crop acreage is 79,104 acres. The annual reduction in alfalfa acreage during critical years averaged 16.2% of 70,104 acres.

[14] Richard Howitt, Josua Medellin Aruara, Duncan MacEvan, Jay Lund and Daniel Sumner, "Economic Analysis of the 2014 Drought for California Agriculture", U.C. Davis Center for Watershed Sciences and eraeconomics, July 23, 2014, Table 4, p. 6 for estimated acreage reductions in Tulare Lake Basin. For Westlands land fallowing, Westlands Water District, District Water Supply Charts, http://wwd.ca.gov/wp-content/uploads/2016/06/Water-Supply-Charts.pdf. About 50,000 acres are fallowed independent of the availability of surface water (see Attachment 1).Therefore, land fallowing due to surface water availability equals acres fallowed less 50,000 acres.

for 19.6% of crop acreage in the Tulare Lake Basin.[15] In 2014, Westlands land fallowing from water availability (170,000 acres) equals 45.5% of the estimate for the drought impact for the entire Tulare Lake Basin, or 2.3 times Westlands share of crop acreage.[16] If the rate of land fallowing in Westlands was comparable to the rate of land fallowing in the Tulare Lake Basin, then actual land fallowing would be 2.3 times the estimated drought impact. For 2015 and 2016, Westlands actual land fallowing due to water availability exceeds the estimated drought impact for the Tulare Lake Basin. While groundwater pumping increases to offset losses of surface water supplies, the SWAP modeling efforts are assuming larger increases in groundwater pumping than occurs in practice.

Table 4.3

Estimated Drought Impacts on Crop Acreage in Tulare Lake Basin and Westlands Land Fallowing (thousand acres)

Year	Drought Impact Tulare Lake Basin	Westlands Land Fallowing	Westlands Land Fallowing Due to Water Availability
2014	373	220	170
2015	123	218	168
2016	108	225	175

C. Local Economy

The SWRCB staff estimates the impact of the proposed flow objective on the local economies of Stanislaus, San Joaquin and Merced counties (see Figure 4.12). The proposed flow objective is estimated to reduce the average annual economic output of the Study Area by $64 million (2008$).[17] Reflecting the fact that (i) the proposed flow objective reduces surface water supplies in critical, dry and below normal years, and (ii) the assumption that increased groundwater pumping will offset the loss of surface water supplies up to a maximum groundwater capacity, the loss of economic output in the Study Area is estimated to occur during below normal years, $50 million (2008$), about $100 million (2008$) in dry years and more than $200 million (2008$) in critical years.

To extent that the ability to expand groundwater pumping to offset the loss of surface water supply is overstated (see prior section), the economic impact of implementation of the proposed flow objective is understated.

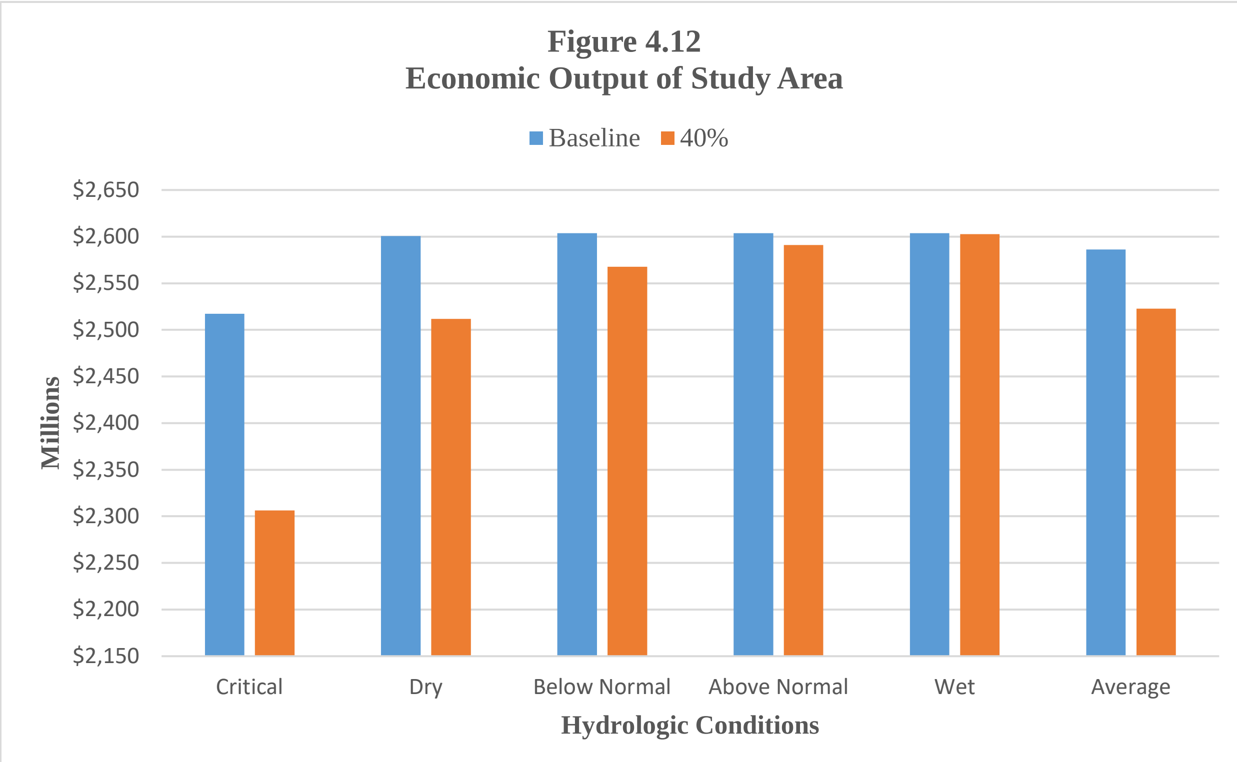
As with the loss of surface water supplies, focus on average impacts even by hydrologic conditions obscures the volatility of the estimated impact of the proposed flow objective on Study

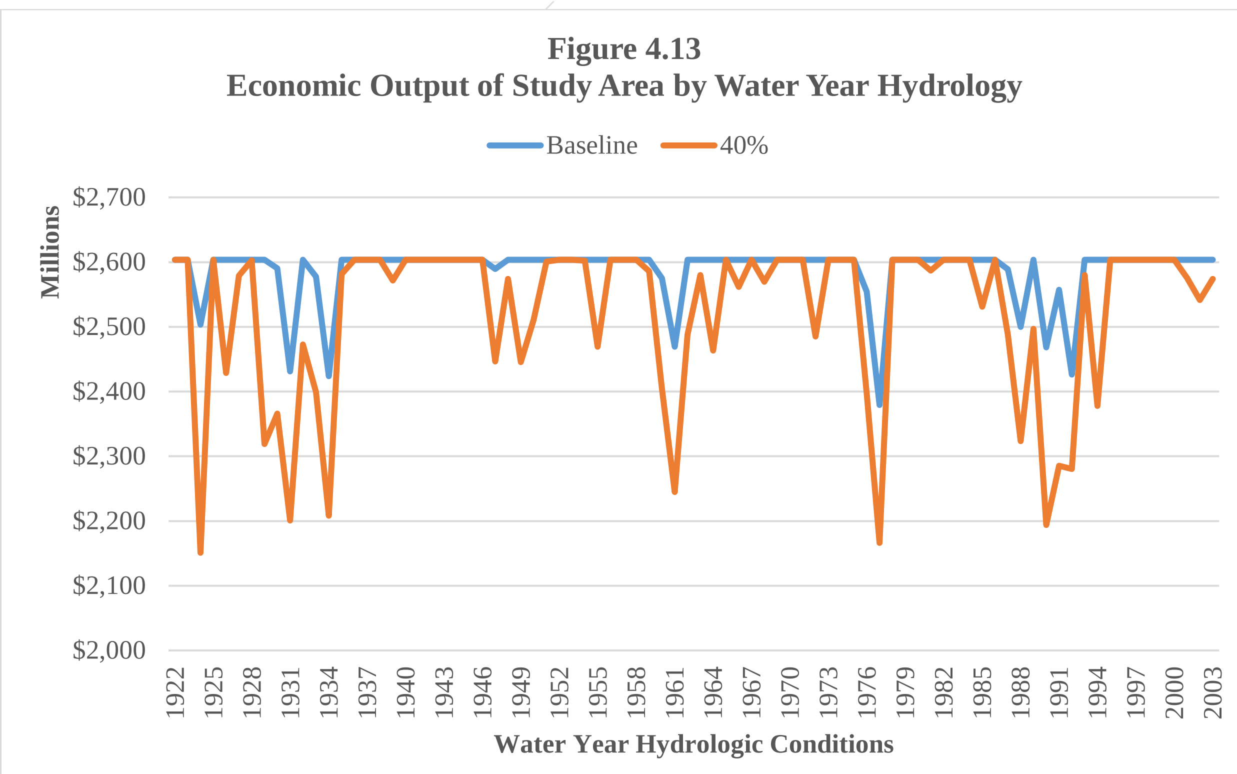
[15] In 2010, crop acreage in the Tulare Lake Basin totaled 2,892,700 acres (California Water Plan Update, Tulare Lake Hydrologic Region, Table TL-13, p. TL-40). Westlands crop acreage in 2010 equaled 568,700 acres (see Westlands Water District, District Water Supply Charts).

[16] 2.3 ≈ 45.5%/19.6%

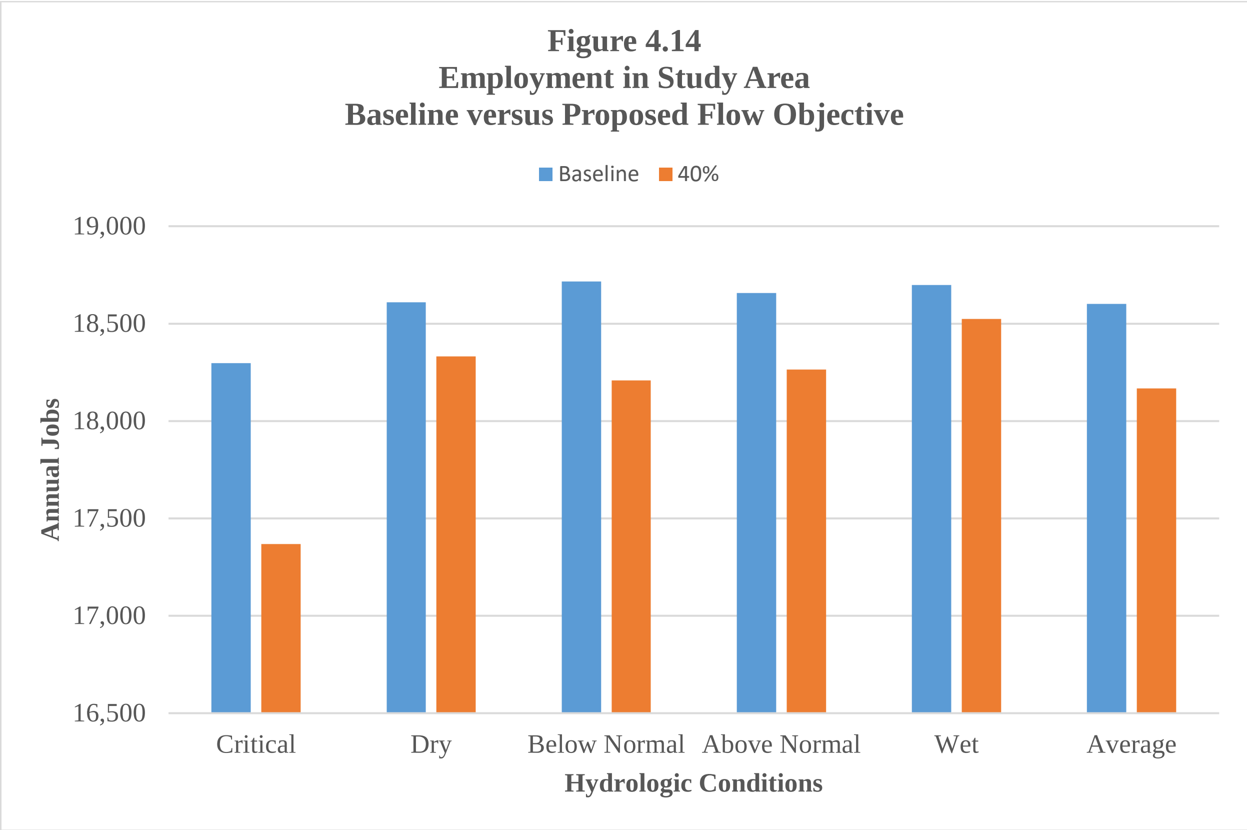
[17] Appendix G, Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results (hereinafter cited "Appendix G"), Table G.5-4, p. G-67.

Area's local economy (see Figure 4.13). The spikes of estimated losses in economic output exceed $300 million (2008$), or *five* times the average annual impact reported in the SWRCB staff report.



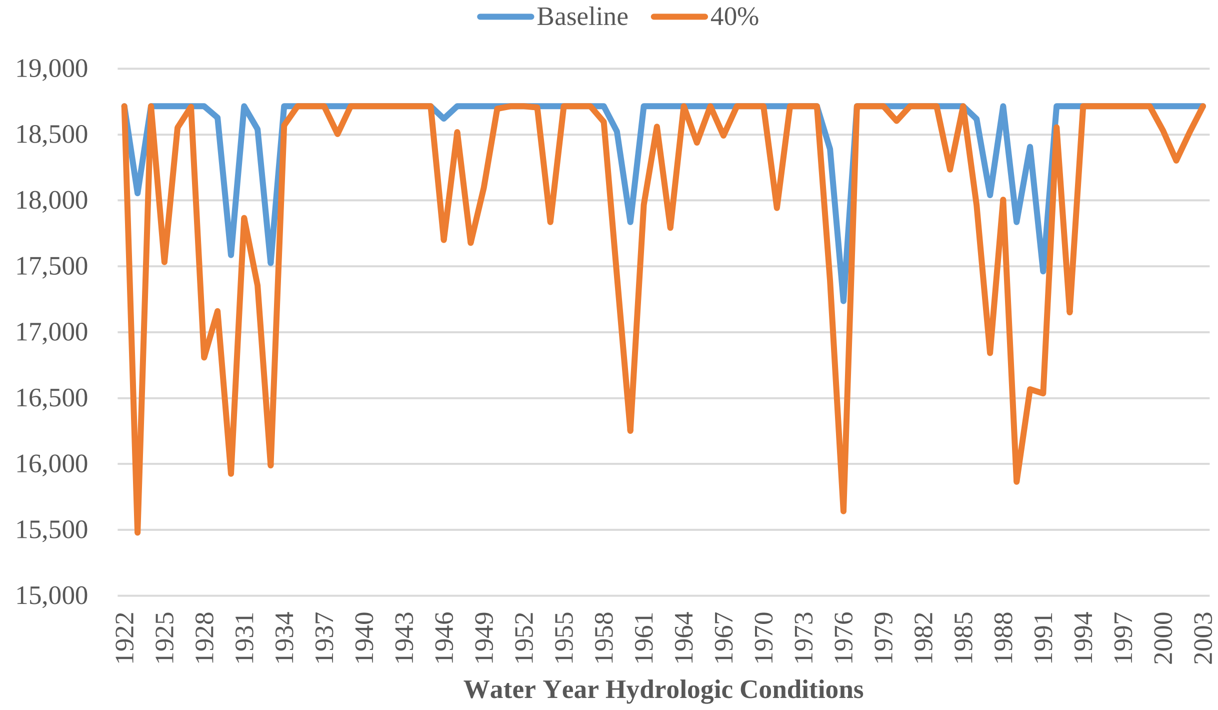


The SWRCB provides estimates of the job losses under their assumptions about the impact of the loss of surface water supplies on groundwater pumping (see Figure 4.14). The proposed flow objective is estimated to reduce jobs in the Study Area by 433.[18] Job losses average 929 in critical years. As with other impacts, focus on average annual impacts by even hydrologic conditions understates the volatility of the impact on the proposed flow objective on jobs in the Study Area (see Figure 4.15). The estimated annual job loss spikes at 1,500, or more than three times the average annual impact reported in the SWRCB staff report.



[18] Appendix G, Table G.5-6, p. G-70.

Figure 4.15
Study Area Jobs by Water Year Hydrology



D. Service Providers

SWRCB staff discussion of the impact of the proposed flow objective on municipal water service providers center on the consequences of increased groundwater pumping for water systems reliant on groundwater. They expect significant and unavoidable impacts from substantial depletion of groundwater resources and need for construction of new or expanded water supply and treatment facilities.[19] They find less than significant that increased groundwater pumping will reduce groundwater quality sufficiently to violate water quality standards in public water systems.[20] They expect significant and unavoidable impacts from increased groundwater pumping will reduce groundwater quality sufficiently to violate water quality standards in domestic wells.[21]

The findings generally reflect a qualitative discussion with two exceptions. First, the conclusion about groundwater quality is based on the absence of water quality violations for a sample of public systems in 2014 when groundwater pumping increased.[22] Second, while well

[19] Chapter 13, Service Providers, Table 13-1, p. 13-3.

[20] *Ibid*, Table 13-1, p. 13-5.

[21] *Ibid*, Table 13-1, p. 13-7.

[22] *Ibid*, Table 13-7, p. 13-19.

elevations are anticipated to fall with increased groundwater pumping, few public water systems have well depths less than 100 feet below the depth to groundwater.[23]

Neither factor is dispositive. Implementation of the proposed flow objective increases the frequency and magnitude of spikes in groundwater pumping relative to baseline (see groundwater resource discussion above). Therefore, to use the recent experience of the drought, which groundwater pumping increases in critical years under the baseline, does not provide any insight into whether implementation of the proposed flow objective will not create groundwater quality problems. In addition, public water systems undertake actions to address violation of water quality standards. Thus, the issue involves whether public water systems must undertake additional actions to meet water quality standards to avoid violations.

The difference between well depths and depth to groundwater does provide a cushion against increased groundwater pumping requiring deepening wells. However, there are many municipal water users not served by public water systems. One needs to assess specific circumstances of (a sample of) well users to assess the situation; something the SWRCB did not do.

[23] *Ibid*, p. 13-67.

5. GROUNDWATER RESOURCES

Reductions in surface water supplies due to the SED will impact groundwater resources in the Study Area by way of: (A) reduced percolation (groundwater recharge) from applied surface water, and (B) increased groundwater pumping to offset the loss of surface water supplies. The SWRCB assessment concludes that implementation of the SED flow objective will result in a significant and unavoidable decline in regional groundwater elevations, depletion of groundwater supplies, substantial interference with groundwater recharge and potential migration of groundwater contamination.[24] Despite these conclusions, however, the SWRCB quantifies none of the impacts.

It is common knowledge that all sub-basins in the Study Area are experiencing steadily declining well elevations (increasing depths to groundwater) and are over drafted (see Table 5.1).[25] Furthermore, other than the Eastern San Joaquin Sub basin, well elevations within the Study Area have declined faster the first approximately 15 years of this century than over the last three decades of the 20th century.[26] Accordingly, any SED-related expansion of groundwater pumping will only exacerbate the existing overdraft conditions resulting in greater depths to groundwater; i.e.; further material declines in regional well elevations.

Table 5.1
Average Annual Decline in Well Elevation and Overdraft in Study Area

Sub basin	Well Level Decline (inches/year)	Well Level Decline (inches/year)	Overdraft (TAF/year)
Eastern San Joaquin	20.0	5.3	88
Modesto	6.0	17.0	11 to 15
Turlock	2.8	20.0	9 to 85
Merced	12.0	27.0	22 to 44
Time Period	1970-2000	2005-2010	

But for a notable exception discussed below, the irrigation districts in the Study Area do not have the historical experience with enough surface water supply variability and associated offsetting variability of their groundwater pumping and the associated effects on well elevations to effectively evaluate the potential regional response to the substantial reductions in surface water supplies associated with SED implementation.[27] The one exception is the historical experience of the Stockton East Water District and Central San Joaquin Water Conservation District with respect to their surface water supplies from New Melones Reservoir, whose past experience with surface water supply variability is instructive on what might be expected with regards to the

[24] Chapter 9, Groundwater Resources, p. 9-4.

[25] *Ibid*, Table 9-4, p. 9-17.

[26] See discussion below of the Eastern San Joaquin Sub basin.

[27] See discussion in Section 2 of water district data and in Section 3 on the reliability of surface water supplies under the baseline.

response of the Study Area's irrigation districts that rely on surface water to SED-related reductions in those districts' surface water supplies. This past experience and that of Westlands, which is located outside of the Study Area, but also is instructive on potential irrigation district response and resulting impacts, within the Study Area to substantial and sustained surface water supply reductions, are referred to herein as "natural experiments" as they are inferences not based on complex models built on a myriad of assumptions but straightforward assessments of what actually has been empirically observed.

A. The New Melones Reservoir Natural Experiment

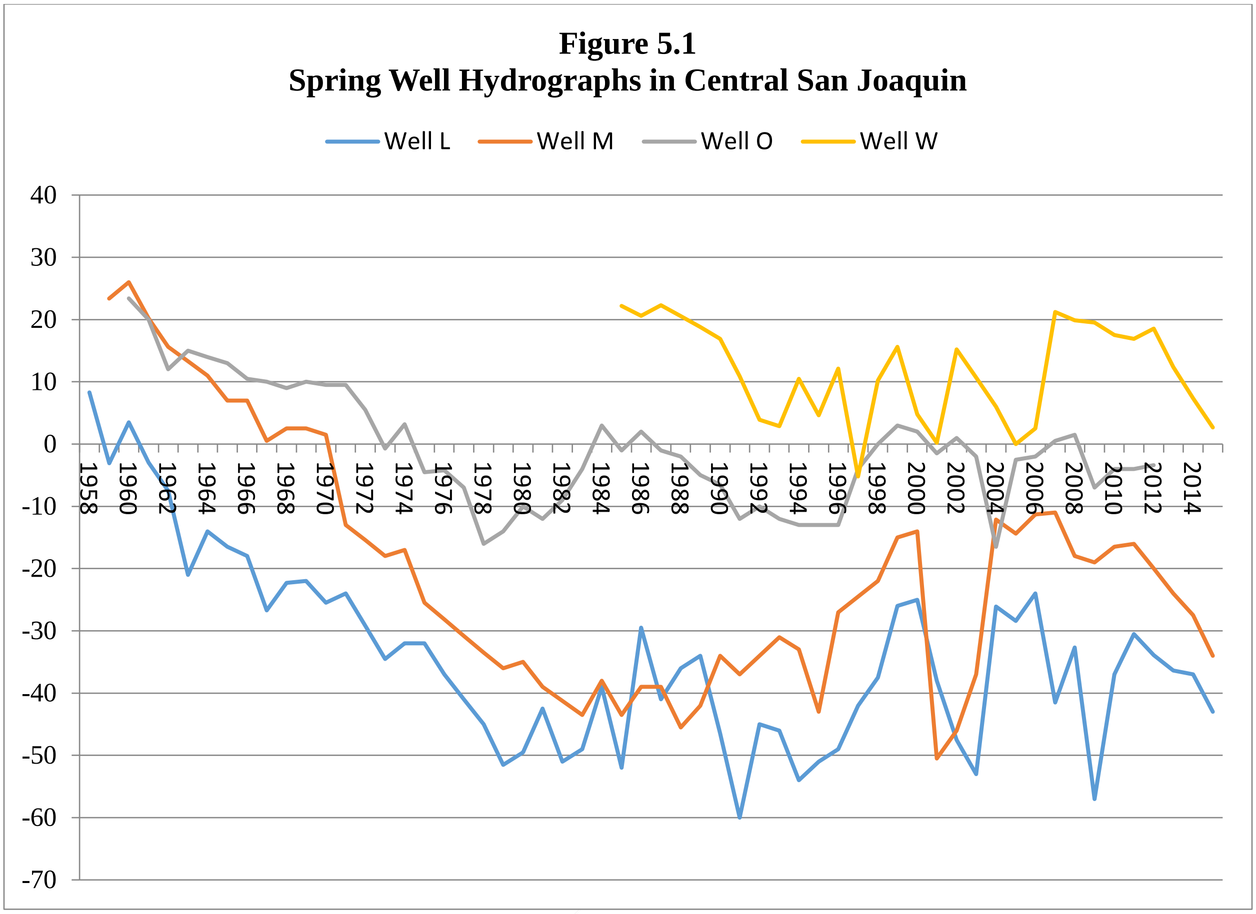
The litigation between Stockton East Water District and Central San Joaquin Water Conservation District versus the United States over water deliveries from New Melones Reservoir represents a "natural experiment" for characterizing the relationship between volatility in surface water availability and associated variability in groundwater pumping and the resulting impacts on local well elevations.[28] As background, Stockton East and Central San Joaquin entered into a water delivery contract with the Bureau of Reclamation for the delivery of up to 155,000 acre feet per year of water from the New Melones Reservoir. The central issue of the litigation came with the passage of the Central Valley Project Improvement Act, and the Bureau of Reclamation's decision that except in wet years it would not be able to deliver the water specified in the contract due to other demands for the water.[29] As discussed below, the Bureau's breach of its contract with the irrigation districts resulted in a volatile surface water supply for Central San Joaquin.

Well elevations in Central San Joaquin have been steadily declining since the late 1950s to the point that the elevations of district wells with long histories have been below sea level for decades (see Figure 5.1 for the historical trend in a sample of the district's wells).[30] In fact, efforts to protect the area's groundwater resources from declining well elevations and from resulting salinity intrusion was a primary reason for the formation of Central San Joaquin Water Conservation District and the contract for water from the New Melones Reservoir.

[28] See the most recent federal appellate decision for discussion, *Stockton East Water District and Central San Joaquin Water Conservation District v. United States*, U.S. Court of Appeals for the Federal Circuit, 2013-5078.

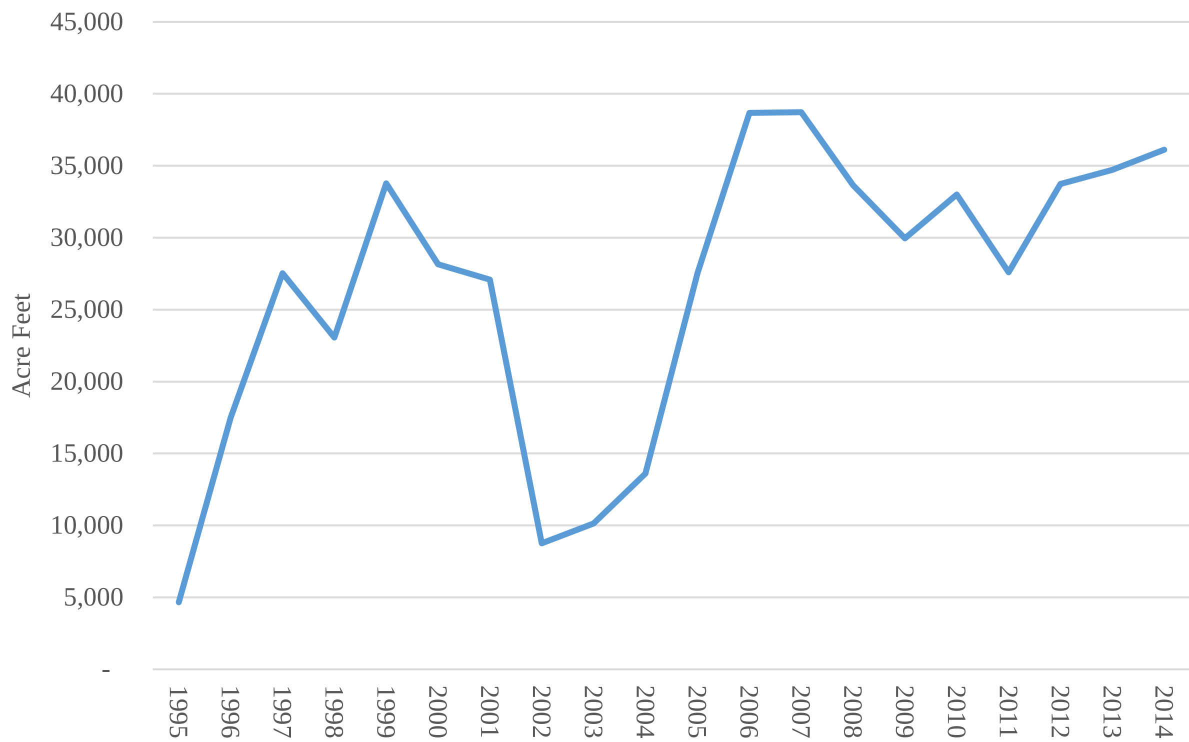
[29] *Ibid, p.*

[30] Figure 5.1 presents the wells in Central San Joaquin presented in San Joaquin County Flood Control and Water Conservation District's Spring 2016 Groundwater Report. The location of the wells can be found in Figure 2-1 Well Hydrograph Locations at p. 2-15.



The declining trend in well elevations bottomed out in the mid-1990s with the commencement of New Melones surface water deliveries (see Figure 5.1). Since then, well elevations have varied up and down from year to year, as has the delivery of surface water (see Figure 5.2).

Figure 5.2
Bureau of Reclamation Water Deliveries to Central San Joaquin



Stratecon conducted a statistical analysis of the historical data for a number of wells within Central San Joaquin to estimate the impact of surface water deliveries on well elevations. Data on groundwater pumping by landowners is not available. The models relate annual well elevations to surface water deliveries (measured in 1,000 acre feet, "TAF"), the annual change in well elevation over time and Stockton rainfall.[31] The analysis indicates that: A) surface water deliveries increased well elevations significantly for Well L, Well M and Well O where there has been a significant declining trend in well elevations; B) surface water deliveries have no effect on the elevation of Well W, which has had no declining trend in elevation over time; C) Stockton rainfall has no impact on elevations for the first three wells in the table and D) the elevation of the relatively stable Well W declines with rainfall.

Table 5.2
Statistical Analysis of Spring Well Hydrograph in Central San Joaquin

Item	*Well L*	*Well M*	*Well O*	*Well W*
Intercept				
Coefficient	-7.29	17.29	17.48	31.21
T-Statistic	-1.72	3.36	6.01	2.65
P-Value	10%	<0.1%	<0.1%	<0.1%

[31] Stockton Rainfall at Fire Station No. 4. Spring 215 Groundwater Report, p. 1-2, data provided by San Joaquin County Flood and Water Conservation District.

Item	*Well L*	*Well M*	*Well O*	*Well W*
Surface Water (TAF)				
Coefficient	1.04	1.52	0.57	-0.00
T-Statistic	7.07	8.43	5.79	-0.01
P-Value	<0.1%	<0.1%	<0.1%	99%
Trend				
Coefficient	-1.21	-1.67	-0.74	-0.19
T-Statistic	-9.94	10.67	-8.42	-0.65
P-Value	<0.1%	<0.1%	<0.1%	52%
Rainfall				
Coefficient	-0.07	-0.18	-0.13	-0.78
T-Statistic	-0.29	-0.62	-0.79	-2.92
P-Value	77%	54%	44%	0.7%
R^2	0.65	0.70	0.61	0.26

T-statistic: ratio of coefficient to the standard deviation of estimated coefficient

P-Value: probability of the estimated coefficient if its true value were zero

B. Impact of Proposed Flow Objective on Well Elevations

Stratecon applied the findings from the New Melones "natural experiment" to estimate the impact of the proposed flow objective on well elevations in the Study Area as a result of the SED at the 40% unimpaired flow levels. As shown by the Central San Joaquin experience, the impact of surface water deliveries is not uniform (undoubtedly reflecting non-uniform aquifer characteristics and water usage patterns). The estimated range of impacts for areas with a declining trend in well elevations is defined by the findings for Wells L, M and O in Central San Joaquin. Before presenting the findings, the discussion addresses why findings from Central San Joaquin may be informative for circumstances elsewhere in the Study Area.

Table 5.3 shows the Spring 2016 elevations for key wells in San Joaquin County.[32] Like Central San Joaquin, well elevations are below sea level in Stockton East. The annual decline in elevations are a little slower in Central San Joaquin than Stockton East.[33] Therefore, application of the findings from the Central San Joaquin "natural experiment" to Stockton East may understate the impact of the proposed flow objectives on well elevations in Stockton East.

The situation of South San Joaquin Irrigation District may be different. Well elevations are currently above sea level with a greater variability in the current annual rate of decline in

[32] Data compiled from Spring 2016 Groundwater Report, San Joaquin County Flood and Water Conservation District.

[33] The San Joaquin County Flood and Water Conservation District computes the annual change by relating well elevation to trend. As discussed above, the declining trend in well elevations in Central San Joaquin bottomed out with the introduction of surface water. As a result, the calculation of annual change in well elevations reported in Table 5.2 includes the impact of the introduction in surface water.

elevations. The circumstances of Well T is most comparable to the circumstances of the most stressed wells in Central San Joaquin. The other wells are most comparable to the least stressed wells in Central San Joaquin.

Table 5.3
Spring 2016 Well Elevations in San Joaquin County

District	*Well*	*Spring 2016 Elevation (feet msl)*	*Depth to Groundwater (feet)*	*Annual Change (feet)*
Central San Joaquin Water Conservation District	L	-42.0	106.1	-0.6
	M	-34.0	132.5	-0.6
	O	-3.4	51.4	-0.3
	W	6.2	118.8	-0.1
South San Joaquin Irrigation District	P	54.0	81.0	-0.4
	T	1.5	73.5	-0.8
	V	21.0	50.0	-0.1
Stockton East Water District	F	-68.0	132.0	-0.9
	G	-13.3	145.5	-0.9
	I	-56.8	129.8	-0.9
	J	-60.6	135.6	-0.8
	X	-1.0	8.5	+0.1

Well elevations in the other sub basins are declining considerably more rapidly and those declines accelerating as compared to the Eastern San Joaquin (see Table 5.1). The rate of decline is slowing in the Eastern San Joaquin. To the extent that declines in surface water availability have greater impacts on sub basins experiencing the most rapid declines in well elevations, application of the findings from the Central San Joaquin "natural experiment" to the other districts in the Study Area may under-estimate, rather than over-estimate, the impact on well elevations of reduced surface water availability due to the SED.

C. Central San Joaquin Water Conservation District

Figure 5.3 shows the impact of the proposed SED flow objective on elevations of Well L, Well M and Well O.[34] The impact on well elevations is greatest in dry years ranging between 20 feet and almost 50 feet (when reduction in available surface water is the greatest) and between almost 10 feet and 20 feet in critical years (when the reduction in available surface water supplies is less than in dry years). The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective may increase the volatility in well elevations (see Figure 5.4). The reduction in well elevations spike between 60 feet to 90 feet.

[34] Reduced well elevation estimated by multiplying the reduction in available surface water (measured in TAF) by the coefficient for the surface water variable in Table 5.2 (rounded values 1.0 for Well L, 1.5 for Well M, and 0.6 for Well O).

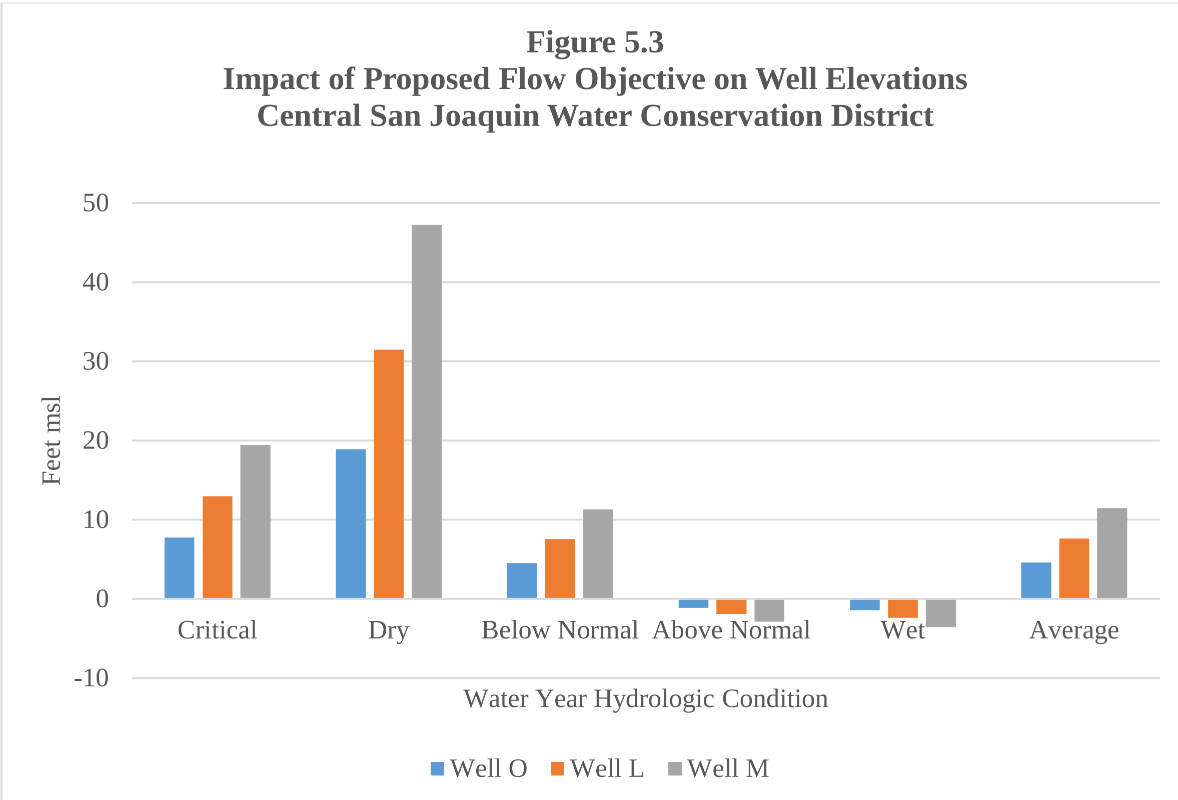


Figure 5.3
Impact of Proposed Flow Objective on Well Elevations
Central San Joaquin Water Conservation District
Feet msl
50
40
30
20
10
0
-10
Critical
Dry
Below Normal
Above Normal
Wet
Average
Water Year Hydrologic Condition
Well O
Well L
Well M

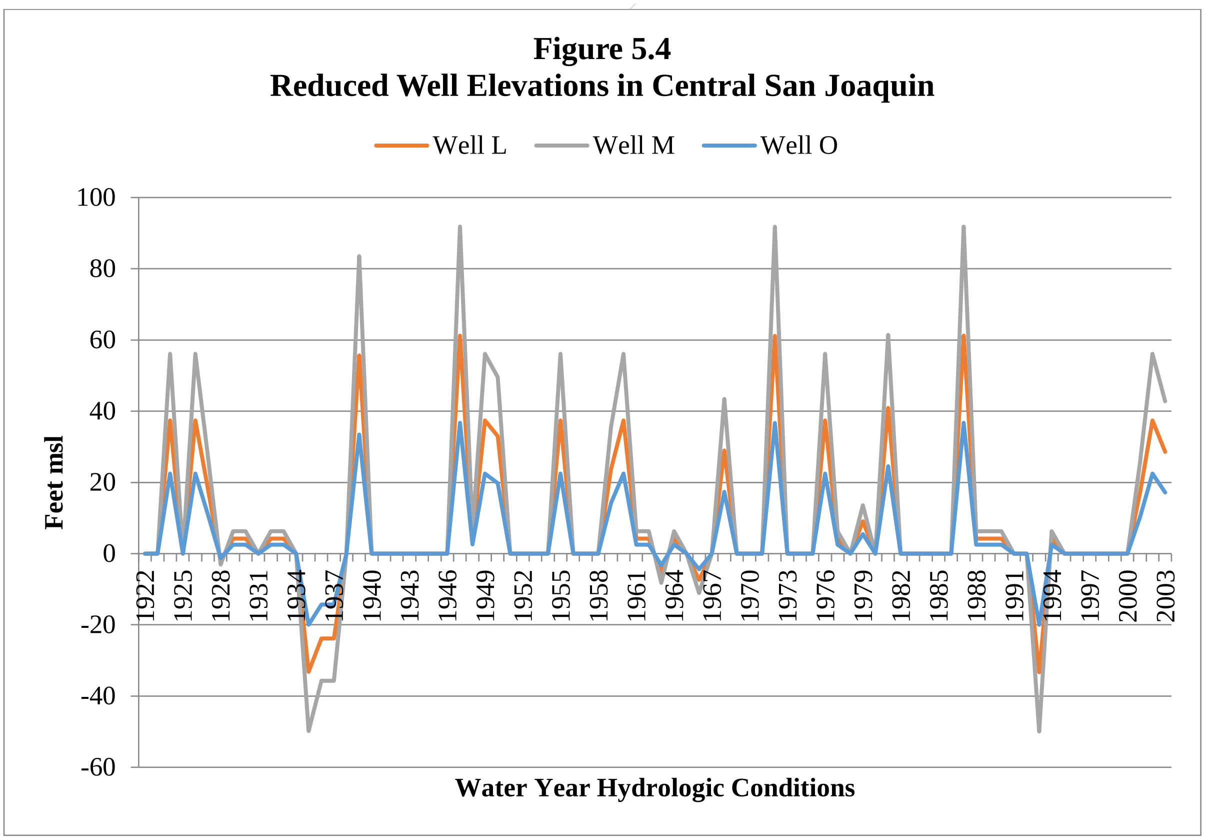
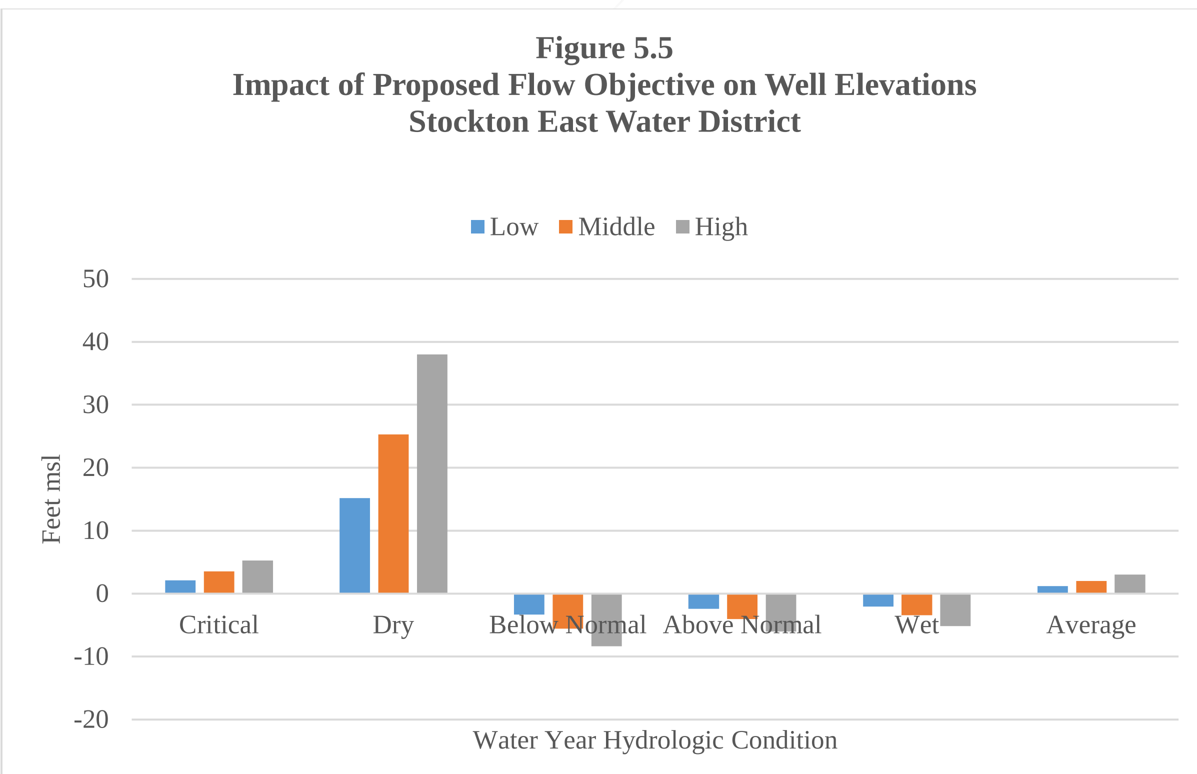


Figure 5.4
Reduced Well Elevations in Central San Joaquin
Well L
Well M
Well O
Feet msl
100
80
60
40
20
0
-20
-40
-60
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
Water Year Hydrologic Conditions

For the other water districts, the range of impacts on well elevations is defined on the low end by Well O impacts, middle by Well L impacts and the high end by Well M impacts. Reduction in well elevations are estimated by multiplying the reduction in available surface water (measured in TAF) by the coefficient for the surface water variable in Table 5.2 (rounded values 1.0 for Well L, 1.5 for Well M, and 0.6 for Well O). The results are adjusted (multiplied) by the irrigated acreage in Central San Joaquin relative to the irrigated acreage in other water districts.[35] In effect, the estimated impacts vary among the districts reflecting differences in the amount of surface water lost per irrigated acre.

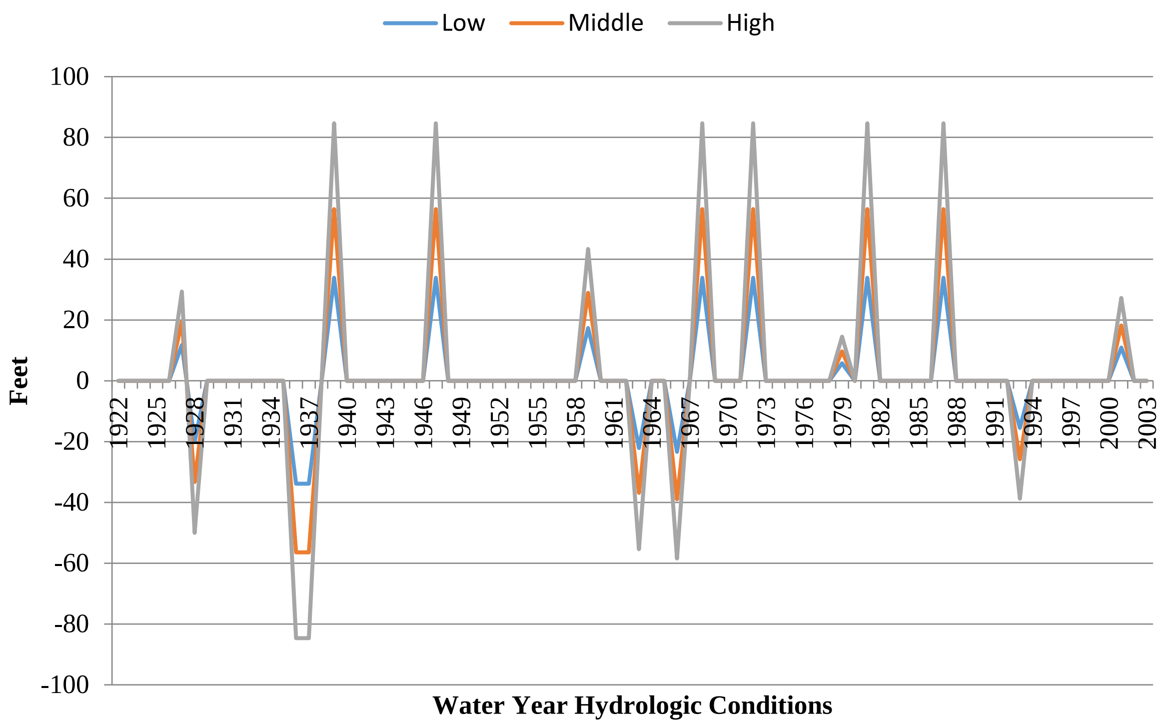
D. Stockton East Water District

Figure 5.5 shows the range of impacts of the proposed flow objective on well elevations in Stockton East. Stockton East suffers smaller losses of surface water per acre than Central San Joaquin. The impact on well elevations is greatest in dry years ranging from between 15 feet and almost 40 feet (when reduction in available surface water is the greatest) and up to 5 feet in critical years (when reduction in available surface water is lower than in critical years). The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective increases the volatility in well elevations (see Figure 5.6). The reduction in well elevations spike between 40 feet to 80 feet.



[35] Source for irrigated acreage, *Appendix G: Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methods and Modeling Results* (hereinafter cited as Appendix G). Table G.4-1, p. G-44.

Figure 5.6
Reduced Well Elevations in Stockton East Water District



E. Southern San Joaquin Irrigation District

Figure 5.7 shows the range of impacts of the proposed flow objective on well elevations. Southern San Joaquin suffers larger losses of surface water per acre than Central San Joaquin. The impact on well elevations is greatest in critical years ranging between 30 feet and 80 feet (when the reduction in available surface water is the greatest) and between 10 feet to 30 feet in dry years (when the reduction in available surface water is lower than in dry years). The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective increases the volatility in well elevations (see Figure 5.8). The reduction in well elevations spike between 60 feet to 120 feet.

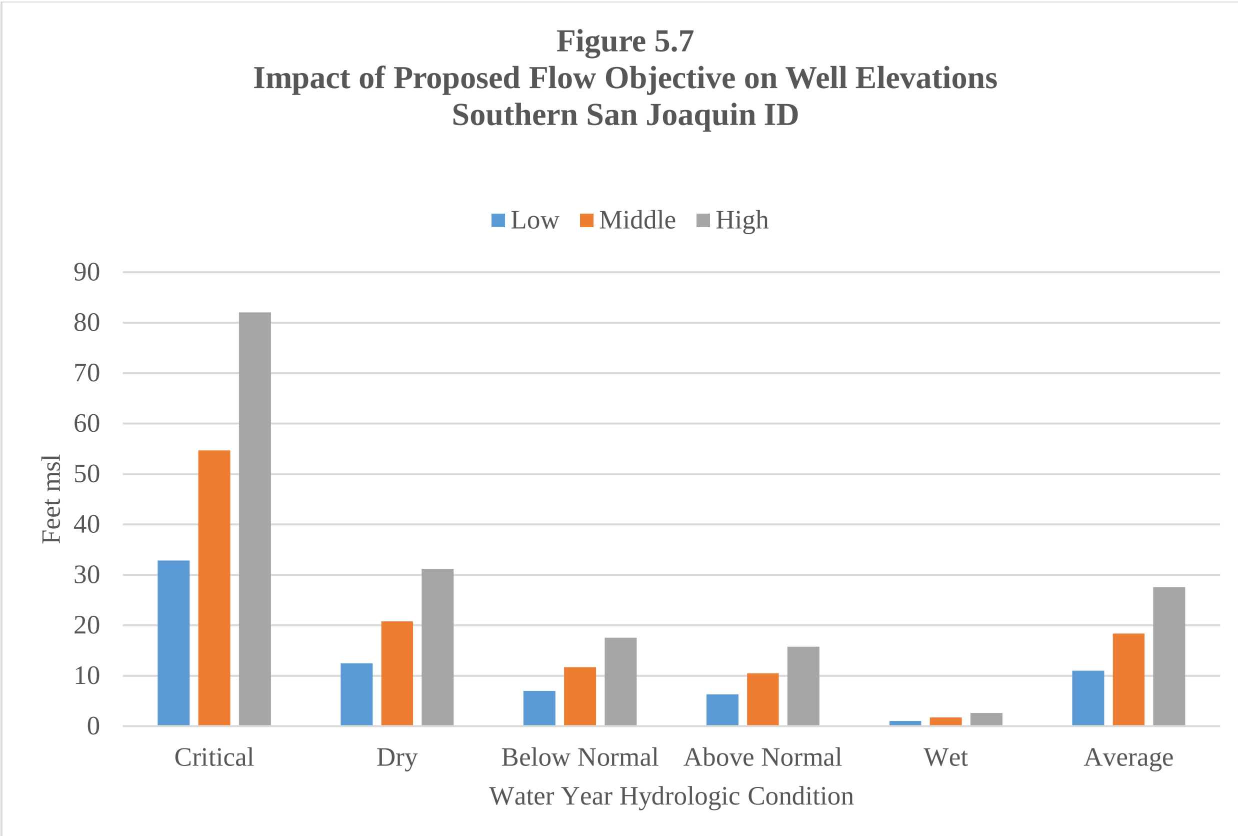


Figure 5.7
Impact of Proposed Flow Objective on Well Elevations
Southern San Joaquin ID
Low
Middle
High
Feet msl
90
80
70
60
50
40
30
20
10
0
Critical
Dry
Below Normal
Above Normal
Wet
Average
Water Year Hydrologic Condition

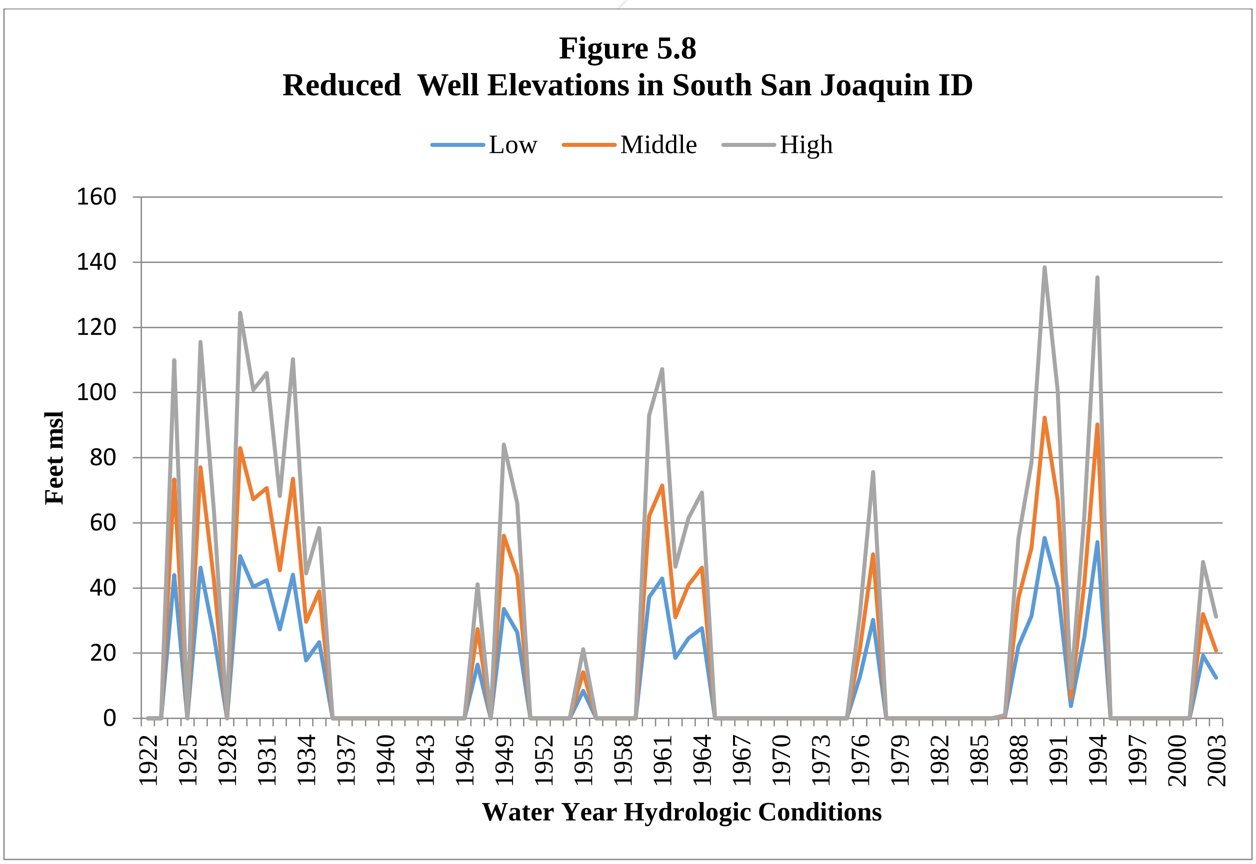
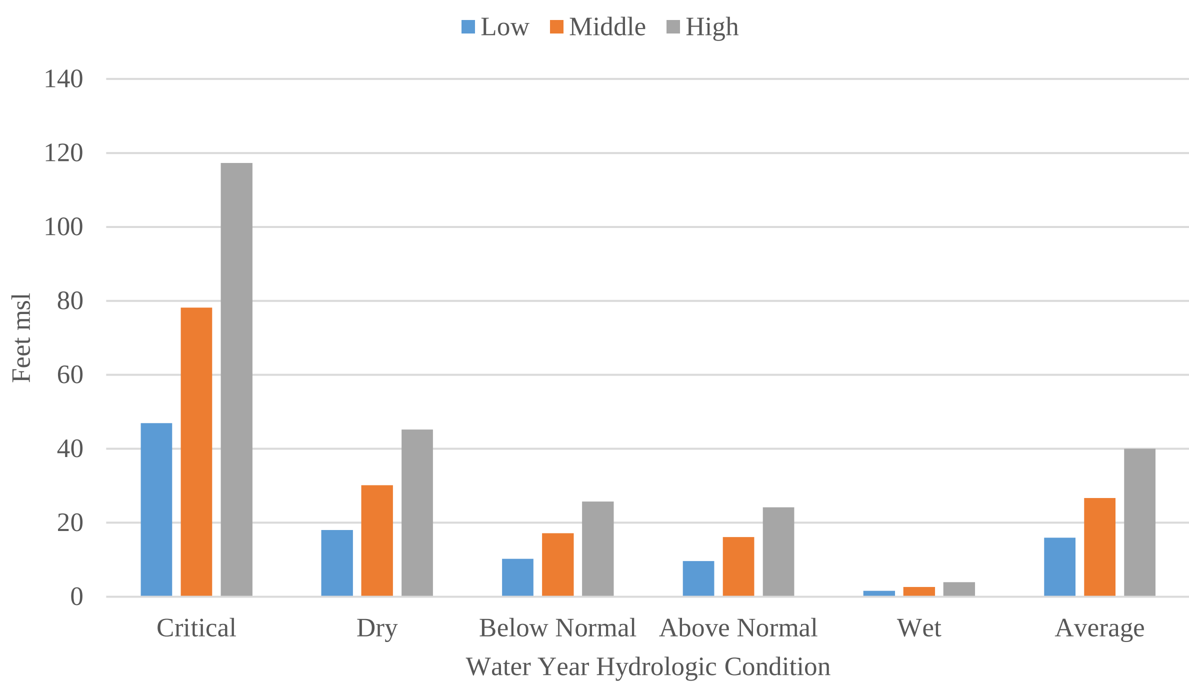


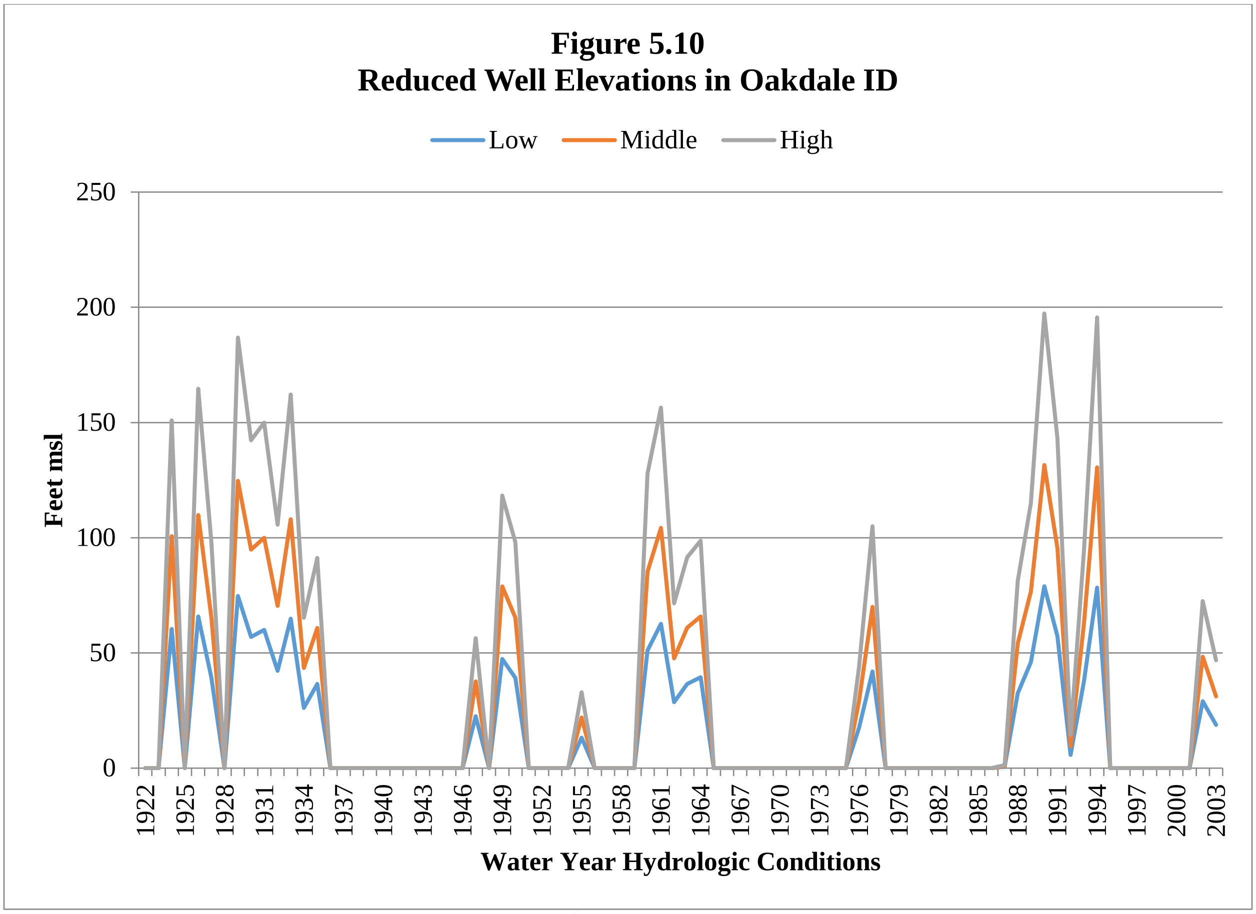
Figure 5.8
Reduced Well Elevations in South San Joaquin ID
Low
Middle
High
Feet msl
160
140
120
100
80
60
40
20
0
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
Water Year Hydrologic Conditions

F. Oakdale Irrigation District

Figure 5.9 shows the range of impacts of the proposed flow objective on well elevations. Oakdale suffers larger losses of surface water per acre than Central San Joaquin. The impact on well elevations is greatest in critical years ranging between 40 feet and 120 feet (when reduction in available surface water is the greatest) and between 20 feet to 40 feet in dry years (when reduction in available surface water is lower than in dry years). The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective increases the volatility in well elevations (see Figure 5.10). The reduction in well elevations spike between 75 feet to 200 feet.

Figure 5.9
Impact of Proposed Flow Objective on Well Elevations
Oakdale Irrigation District





G. Modesto Irrigation District

Figure 5.11 shows the range of impacts of the proposed flow objective on well elevations. Modesto suffers larger losses of surface water per acre than Central San Joaquin. The impact on well elevations is greatest in critical and years ranging between 40 feet and 90 feet. Well elevations decline by 20 feet to 40 feet in below normal years. The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective increases the volatility in well elevations (see Figure 5.12). The reduction in well elevations spike to more than 60 feet to 160 feet.

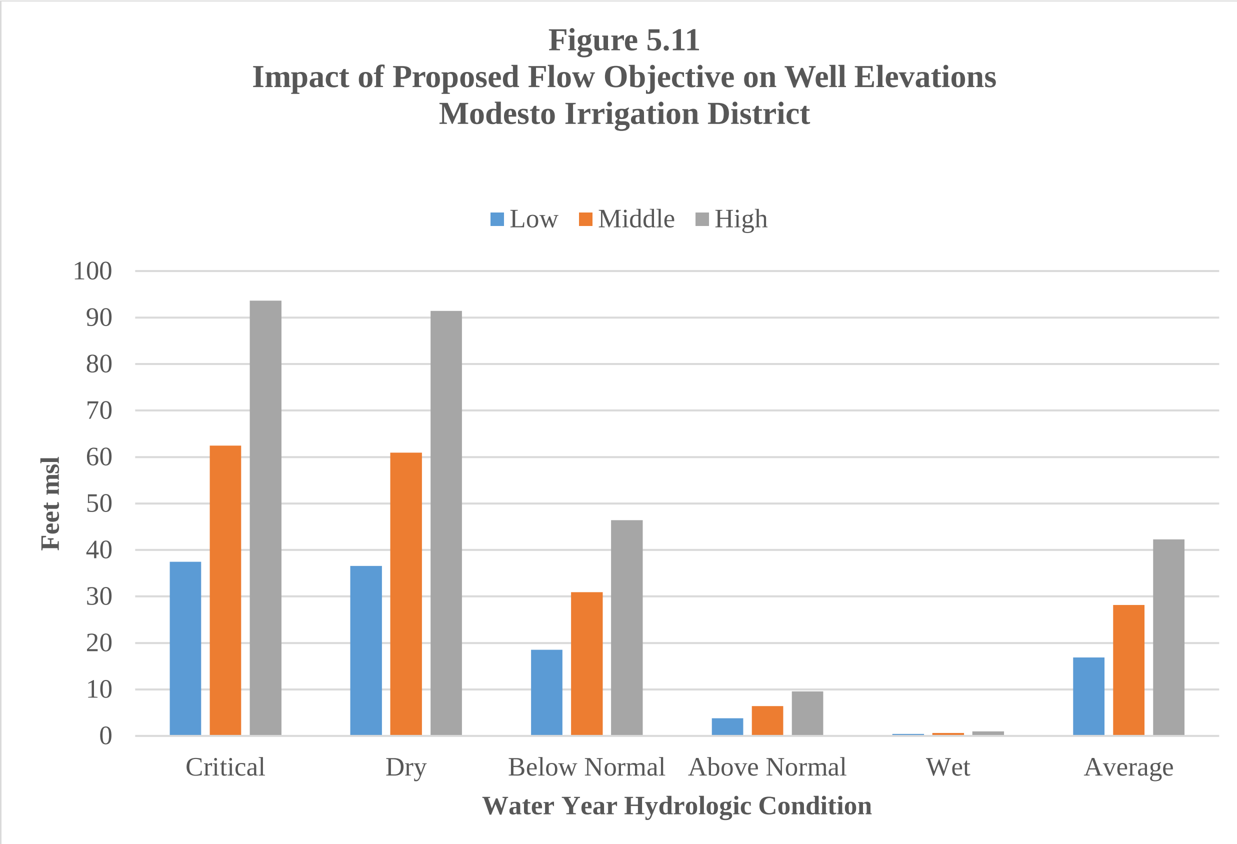


Figure 5.11
Impact of Proposed Flow Objective on Well Elevations
Modesto Irrigation District
Low
Middle
High
100
90
80
70
60
50
40
30
20
10
0
Feet msl
Critical
Dry
Below Normal
Above Normal
Wet
Average
Water Year Hydrologic Condition

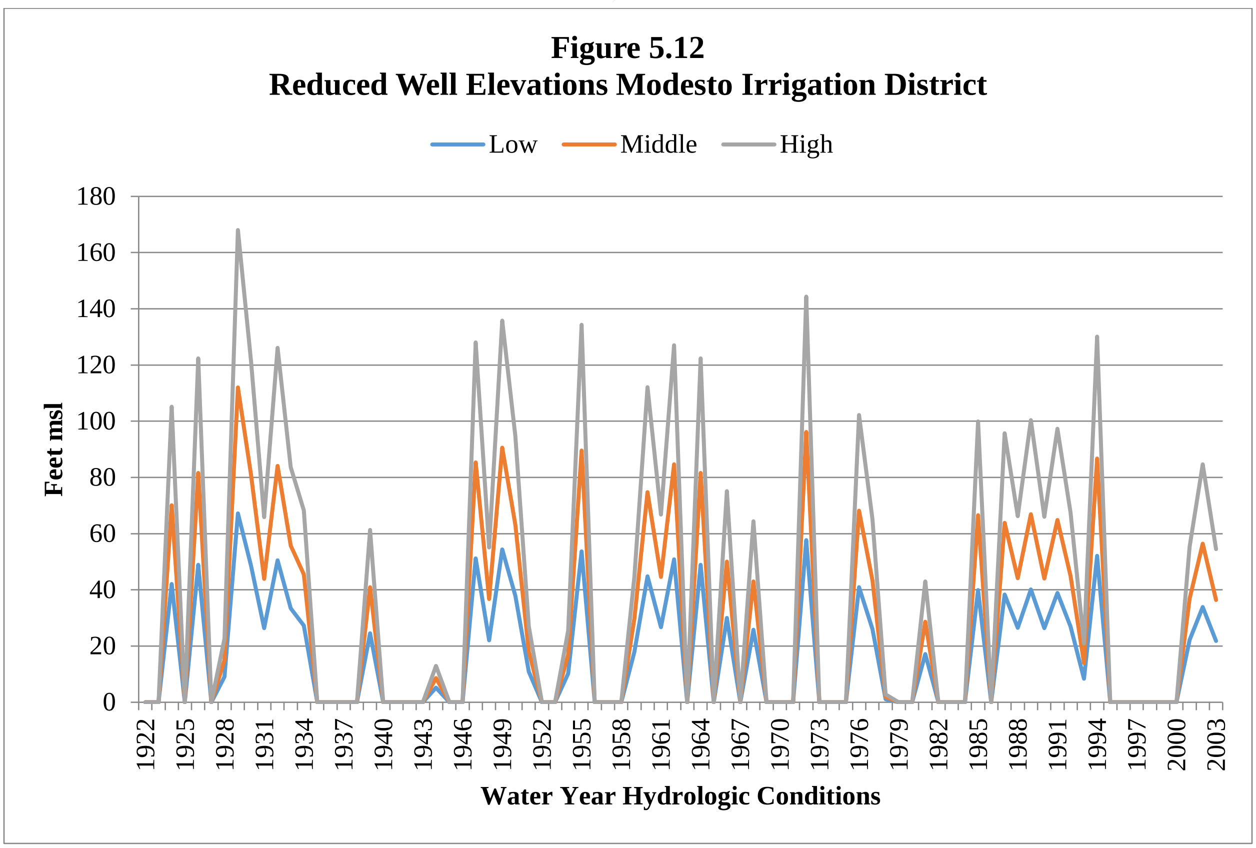
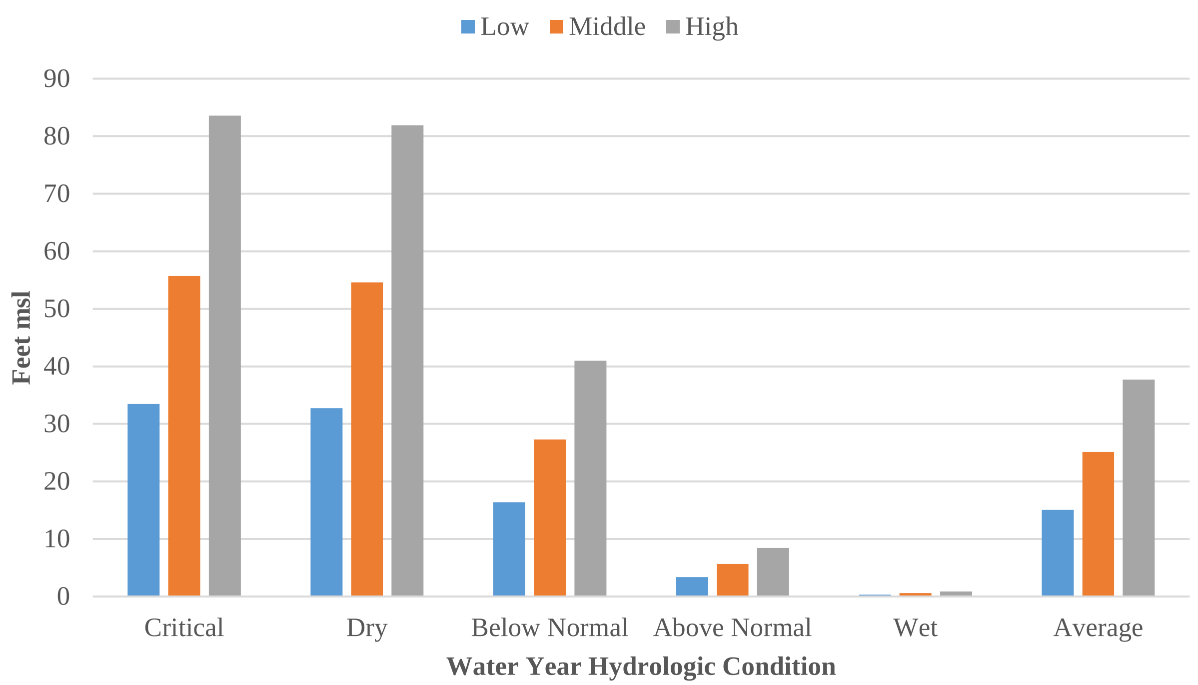


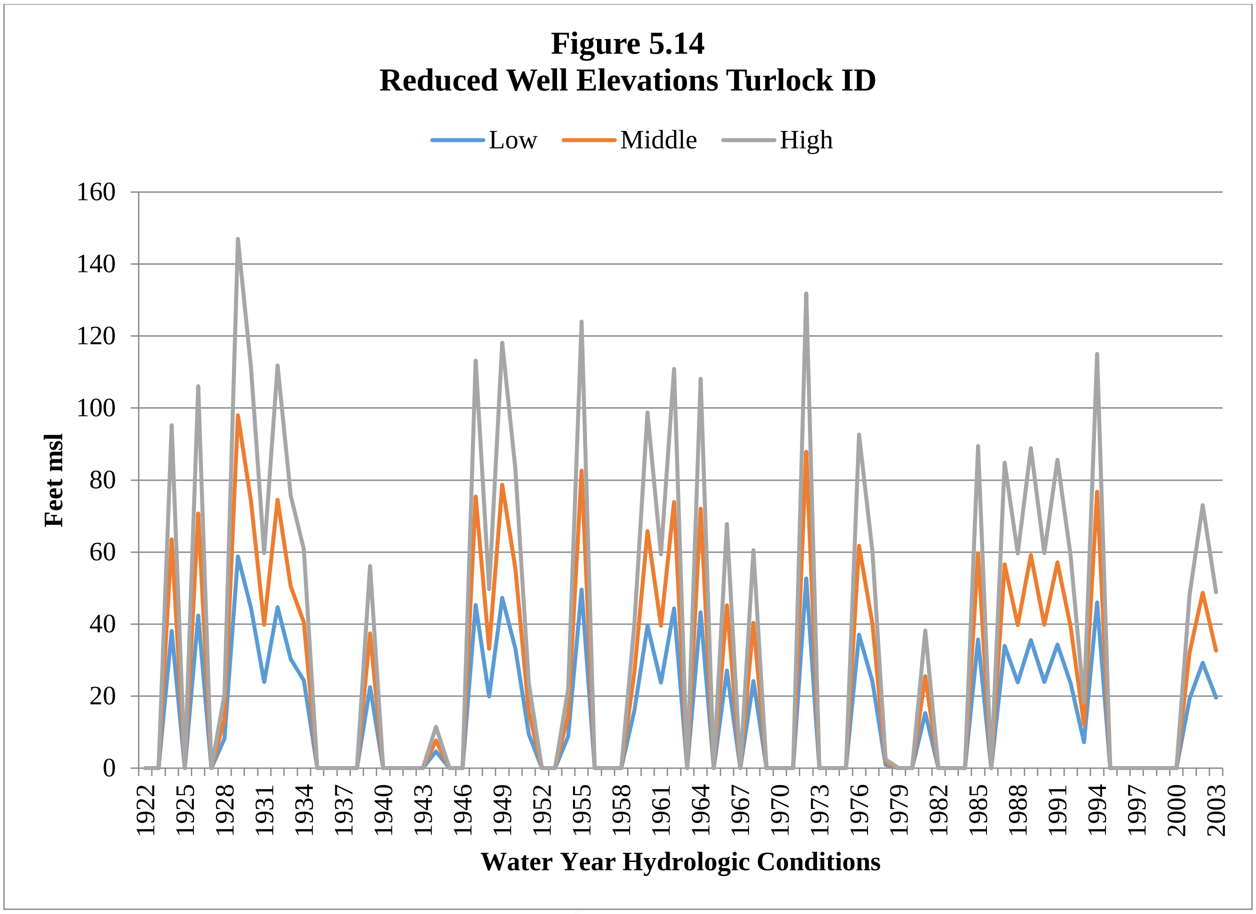
Figure 5.12
Reduced Well Elevations Modesto Irrigation District
Low
Middle
High
180
160
140
120
100
80
60
40
20
0
Feet msl
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
Water Year Hydrologic Conditions

H. Turlock Irrigation District

Figure 5.13 shows the range of impacts of the proposed flow objective on well elevations. Turlock suffers larger losses of surface water per acre than Central San Joaquin. The impact on well elevations is greatest in critical and dry years ranging between 30 feet and 80 feet. Well elevations decline by 16 feet to 40 feet in below normal years. The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective increases the volatility in well elevations (see Figure 5.14). The reduction in well elevations spike to more than 60 feet to 140 feet.

Figure 5.13
Impact of Proposed Flow Objective on Well Elevations in Turlock Irrigation District





I. Merced Irrigation District

Figure 5.15 shows the range of impact of the proposed flow objective on well elevations. Merced suffers larger losses of surface water per acre than Central San Joaquin. The impact on well elevations is greatest in dry years ranging (when reduced surface water is greatest) between 60 feet and 100 feet. Well elevations decline by 35 feet to 80 feet in critical years. Well elevations decline by 20 feet to 60 feet in below normal years. The focus on average impacts even by water year hydrologic conditions fails to capture how much the proposed flow objective increases the volatility in well elevations (see Figure 5.14). The reduction in well elevations spike to more than 80 feet to 200 feet.

Figure 5.15
Impact of Proposed Flow Objective on Well Elevations
Merced Irrigation District

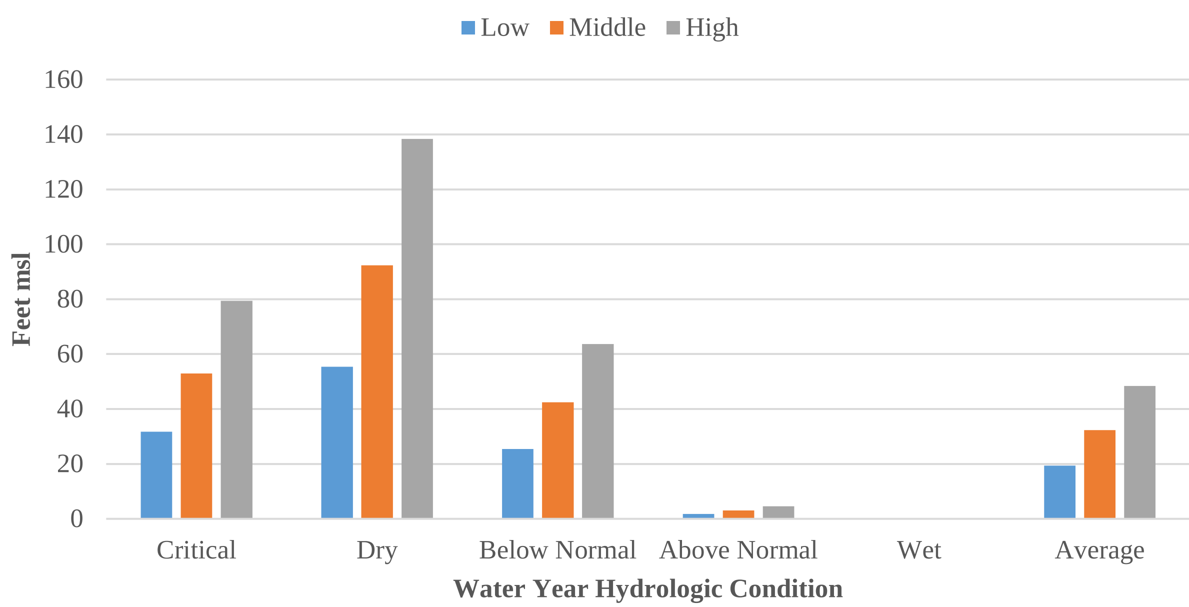
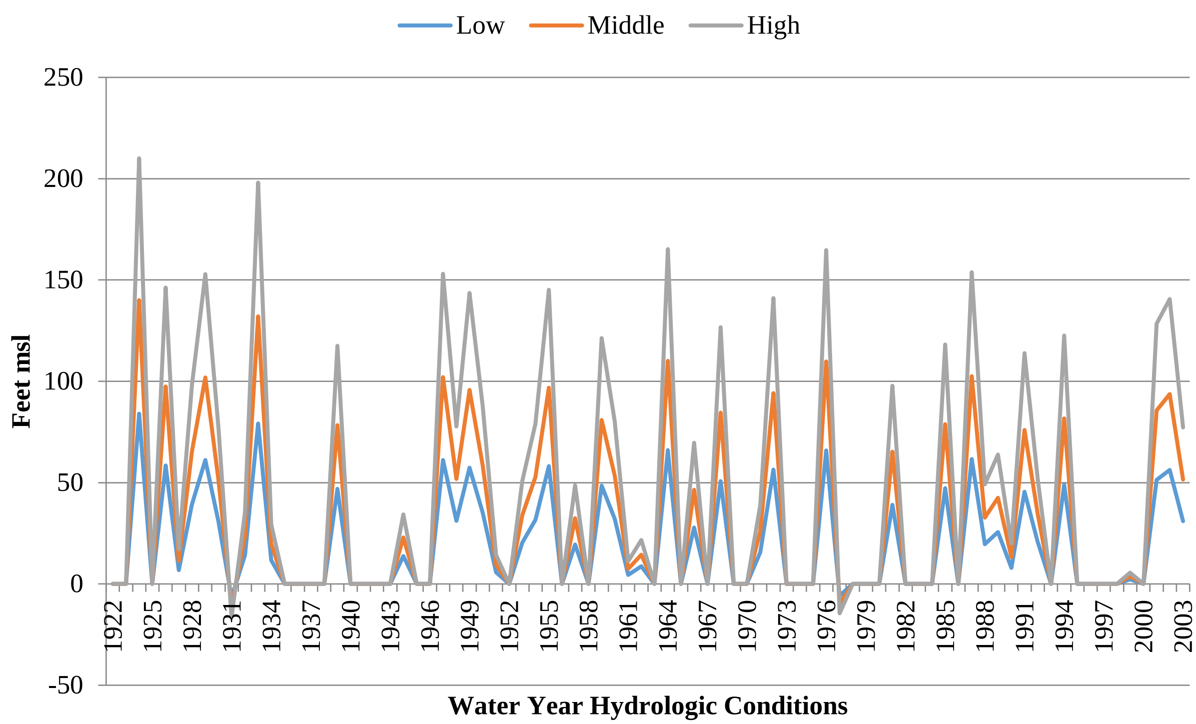


Figure 5.16
Reduction in Well Elevations in Merced Irrigation District



J. Conclusion

The proposed flow objective will lower well elevations in the Study Area significantly. Given the volatility in the annual loss of surface water supplies, the spikes in declining well elevations will be severe. Pumping costs will increase with greater lifts. Wells may have to be deepened to accommodate the severe volatility in elevations that will be outside the range of the operational experience in the Study Area.

6. AGRICULTURE

The potential economic impacts to the Study Area's agricultural economy of fulfilling the SED-mandated unimpaired flow objectives are anticipated to result from: A) reductions in Merced, Stanislaus and Tuolumne River diversions for irrigation; and B) SED-related changes in each river system's water storage facility/reservoir management. The latter, SED-related water storage management changes, and the associated temporal and volume impacts on Merced, Stanislaus and Tuolumne River flows, are expected to primarily impact the Study Area economy through resulting changes in reservoir-based regional recreation activity and hydropower generation. These impacts are discussed in later sections of this report (Sections 8 and 9, respectively).

This section summarizes the potential impacts of the anticipated SED-related reductions in Study Area surface water supplies for irrigation on crop production, crop and associated gross revenues and irrigation groundwater pumping costs. The potential urban water supply-related impacts on the region's communities, including its economically disadvantaged communities, are addressed in Section 7.

The direct impacts associated with SED-related increases in the unimpaired flows of the Merced, Stanislaus and Tuolumne Rivers will be driven primarily by the response to SED reductions in the Study Area's surface water supplies available to those irrigation districts in the Study Area that receive surface water supplies (collectively referred to as the "Irrigation Districts"). As previously discussed, the Irrigation Districts would be expected, all else being equal, to offset any reductions in their surface water supplies through a combination of increased groundwater pumping and reduced crop production (land fallowing[36]). Reductions in crop production would be anticipated as it is not expected that the Irrigation Districts (or their irrigators) would <u>fully</u> offset any SED water supply reductions with groundwater even before considering the pending need to reduce regional groundwater pumping from even current levels to help achieve State-mandated ground water sustainability objectives for the region under pending implementation of the State's Sustainable Groundwater Management Act (or "SGMA"). Ultimately, implementation of measures to achieve the SGMA objectives may substantially eliminate the ability of the Irrigation District farmers to offset much, if any, of their SED surface water supply reductions with additional groundwater. The result of both SED reductions in surface supplies and pending restrictions in groundwater pumping due to the SGMA will squeeze from both sides the Irrigation Districts' water supplies and, necessarily, result in even greater reductions in Irrigation District crop production as compared to a situation of SED implementation but without any specific limitations on groundwater pumping. In its analysis of SED, the SWRCB assumes unfettered groundwater pumping by the Irrigation Districts up to the districts' estimated maximum capacity of groundwater pumping with no account for the SGMA. This, even though the SGMA was established by the State.

[36] While land fallowing refers to the idling of farm land due to reductions in water supplies it also is intended to account land that is not idled but instead deficit irrigated due to those same reductions in water supplies with the resultant same presumed overall economic impact.

The above noted, any increases in Irrigation District groundwater pumping to offset SED surface water supply reductions would be expected to cause regional depths to groundwater to increase (and, correspondingly, well elevations to decline). Increases in groundwater depths will not only lead to higher water costs within the Irrigation Districts, which all rely already on groundwater for a portion of their water supplies but also: A) irrigation districts and irrigators in the Study Area outside of the Irrigation Districts that rely solely on groundwater; and B) the region's communities which almost all rely entirely, and a few in part, on groundwater for their urban water supplies (including water for households, businesses and landscape use). Higher depths to groundwater increase groundwater costs per unit of water pumped due to a combination of factors including the following:

- Increased electricity or other power consumption to lift pumped water further out of the ground;
- Increased pump equipment maintenance due to longer durations for operating wells to yield the same amount of water;
- Increased capital investment in well equipment, either new wells or to deepen existing wells, as some existing wells don't have the depth to reach water at the greater depths anticipated; and
- Overall declines in water quality pumped from greater depth or with greater pressure and associated increases in the amount of water treatment required.

A. Direct Impacts on Irrigation Districts

As previously noted, the Irrigation Districts that rely on surface water supplies from the Merced, Stanislaus and Tuolumne Rivers include:

- South San Joaquin Irrigation District ("SSJID")
- Stockton East Water District ("SEWD")
- Central San Joaquin Water Conservation District ("CSJWCD")
- Oakdale Irrigation District ("OID")
- Modesto Irrigation District ("Modesto ID")
- Turlock Irrigation District ("TID")
- Merced Irrigation District ("Merced ID")

To evaluate the potential agricultural production impacts of the SED within each of the above districts and for a range of water supply conditions, the SWRCB overlaid the Irrigation Districts' respective 2010 cropping patterns, 2009 groundwater pumping capacities and SED unimpaired flow objectives onto each district's surface water supply conditions for every year of the period 1922 through 2003 ("Study Period"). Stratecon adopted this same framework and built directly off the SWRCB's underlying estimates of the relationship between water supplies and cropping patterns within the Irrigation District to estimate the impacts of the SED at the 40% unimpaired flow level ("SED 40") on cropping patterns and associated gross revenues from crop sales ("crop gross revenues") under alternative assumptions regarding the SED's Irrigation District water supply impacts. Stratecon performed this analysis assuming two scenarios on how the districts and their farmers would have responded to the SED surface water supply cutbacks with respect to groundwater pumping in lieu of the SWRCB estimates on the groundwater pumping response.

The first scenario assumes no specific constraints on groundwater pumping other than the capacity of existing well infrastructure as of 2009 (consistent with the SWRCB's analysis) and assumes groundwater pumping levels that are consistent with Stratecon's assessment of Westlands Irrigation District's historical groundwater pumping and land fallowing rates in response to surface water supply reductions (see Attachment 1-1).[37] Stratecon's estimates of groundwater pumping response are lower than the SWRCB's and, correspondingly, Stratecon's estimates of the farmer land fallowing response within the Irrigation Districts to SED-related reductions in surface water supplies higher than SWRCBs. Table 6.1 summarizes the results of this analysis for the Irrigation Districts. Consistent with the SWRCB's assessment of the SED impacts, Stratecon evaluates the impacts on the SEWD and CSJWCD collectively, referred to herein as SEWD/CSJWCD.

Table 6.1

Summary of Lost Gross Crop Revenues (2008$)

Irrigation District	Reduction in Surface Water Supplies	Baseline	40% Unimpaired Flows	Revenue Loss (2008$)	% of Baseline
SSJID	Peak Reduction	$ 227,340,824	$ 180,598,016	$ 46,742,808	21%
	Average	$ 228,801,088	$ 222,053,045	$ 6,748,043	3%
Oakdale ID	Peak Reduction	$ 129,762,737	$ 96,224,934	$ 33,537,802	26%
	Average	$ 128,933,646	$ 123,814,745	$ 5,118,901	4%
SEWD/CSJWCD	Peak Reduction	$ 333,944,545	$ 280,822,511	$ 53,122,035	16%
	Average	$ 333,944,545	$ 327,507,259	$ 6,437,286	2%
Modesto ID	Peak Reduction	$ 136,192,551	$ 101,940,199	$ 34,252,353	25%
	Average	$ 147,767,555	$ 140,310,943	$ 7,456,612	5%
Turlock ID	Peak Reduction	$ 346,000,742	$ 277,006,247	$ 68,994,495	20%
	Average	$ 341,166,439	$ 323,806,519	$ 17,359,920	5%
Merced ID	Peak Reduction	$ 297,937,830	$ 249,481,682	$ 48,456,149	16%
	Average	$ 296,461,839	$ 287,736,625	$ 8,725,214	3%
Total	Peak Reduction	$ 1,429,872,508	$ 1,194,951,895	$ 234,920,613	16%
	Average	$ 1,477,075,112	$ 1,425,229,136	$ 51,845,976	4%

Table 6.1 shows, for example, that during the Study Period in any one year the SED 40 would have resulted in a reduction in crop gross revenues generated by the Modesto Irrigation District by about 25% from approximately $136 million to about $102 million. Over the entire Study Period the estimated average impact of the SED 40 would have been a reduction in gross

[37] To estimate the crop production impacts of the SED 40 for Stratecon's estimates of SED 40 water supply impacts, Stratecon extrapolated directly from the SWRCB's estimates for each Irrigation District of the relative impacts on crop production by crop type as a result of SWRCB's estimates of water supply changes by matching the proportionality of impacts between crop groups modeled by the SWRCB each year of the Study Period.

crop revenues in the Modesto Irrigation District by about 5%. The table further shows that in the Study Period year that the surface water supply reduction would have been at its highest (peak) for the Study Period due to the SED 40, the Irrigation Districts' combined crop revenues would have been an estimated approximately 16% lower than baseline in the absence of the SED 40. This compares to an average reduction in crop gross revenues for the Study Period due to the SED of about 4%. The large difference reveals that the consideration of only averages substantially mutes the indicated inter-year impacts of the SED 40. While the average impacts to crop revenues may not appear particularly severe, there are numerous years where the estimated impacts are substantially larger and could have significant detrimental impacts on the economics of the Irrigation Districts' farmers.

Figure 6.1 shows Stratecon's estimates of lost crop gross revenues due to the SED 40 each year during the Study Period for the Irrigation Districts combined. The graphic reveals many years that those lost crop gross revenues would have been substantial, including many years over $100 million.

Figure 6.1

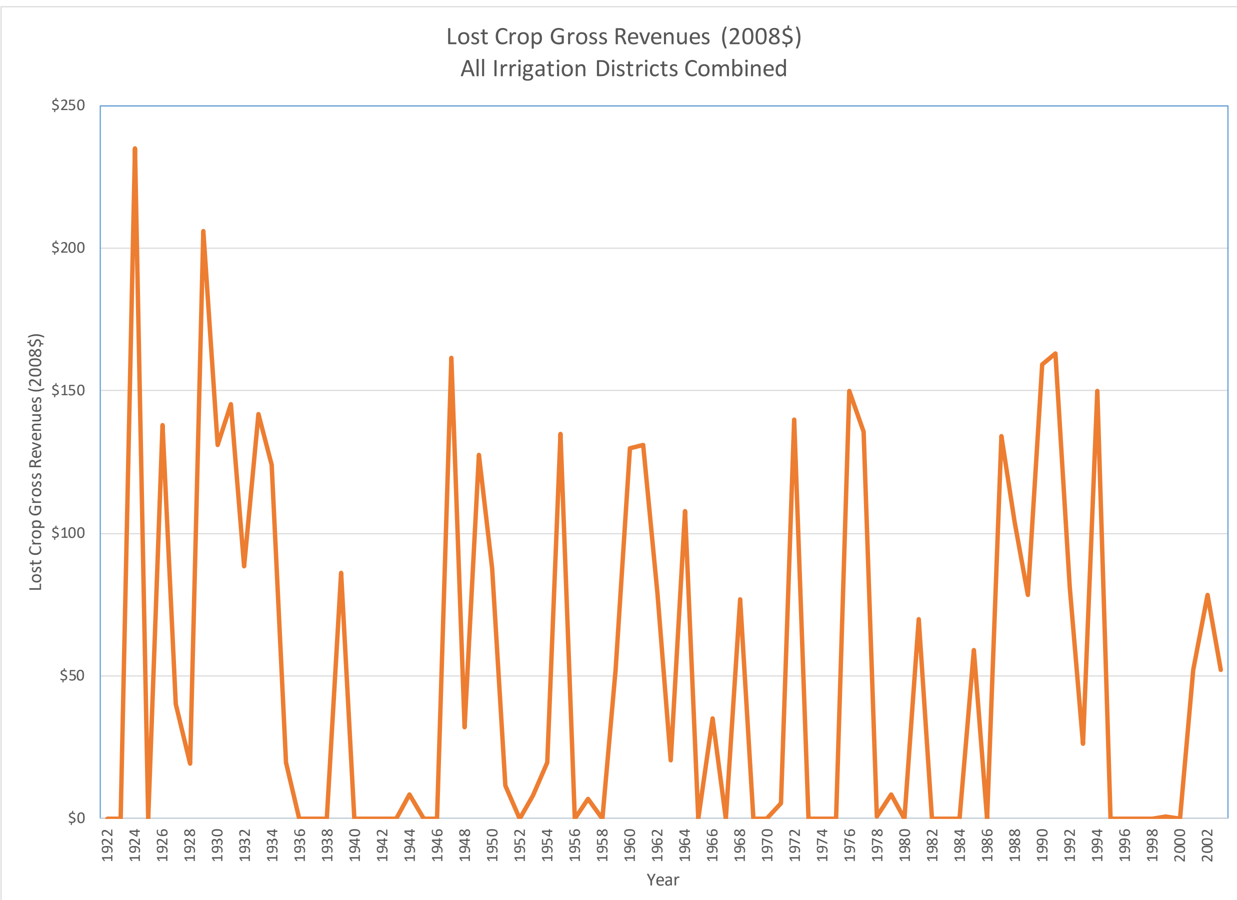


Figure 6.2 presents the same information shown in Figure 6.1 but consolidates it as averages across each water year type during the Study Period (e.g., critically dry, dry, above normal, etc.). The figure clearly shows that the SED 40 impacts on crop production and associated

crop gross revenues within the Irrigation Districts would be most severe during critically dry and dry years. This is to be expected as those are years in which overall Irrigation District surface water supplies are most reduced.

The second scenario assumes that the implementation of measures to meet the SGMA objectives would keep the Irrigation Districts from responding to surface water supply reductions with any groundwater pumping. Accordingly, the second scenario concludes much greater reductions in crop production due to the SED as compared to the first scenario due to the former's more severe assumptions on total water supply reductions. Table 6.2 summarizes the results of this analysis for the Irrigation Districts.

Figure 6.2

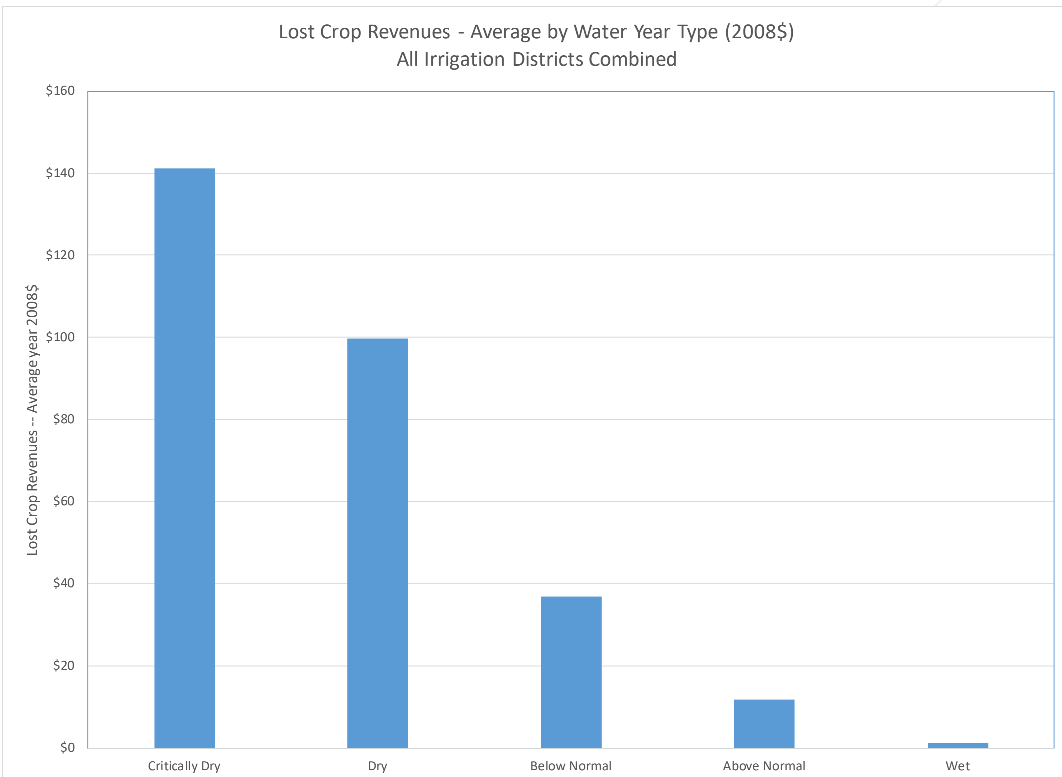


Table 6.2

Summary of Lost Gross Crop Revenues (2008$)

Irrigation District	Reduction in Surface Water Supplies	Baseline	40% Unimpaired Flows	Revenue Loss (2008$)	% of Baseline
SSJID	Peak Reduction	$ 229,523,554	$ 126,662,869	$ 102,860,685	45%
	Average	$ 228,801,088	$ 212,475,927	$ 16,325,161	7%
Oakdale ID	Peak Reduction	$ 129,762,737	$ 82,644,121	$ 47,118,616	36%
	Average	$ 128,933,646	$ 121,470,102	$ 7,463,543	6%
SEWD/CSJWCD	Peak Reduction	$ 333,944,545	$ 227,700,476	$ 106,244,069	32%
	Average	$ 333,944,545	$ 321,069,973	$ 12,874,572	4%
Modesto ID	Peak Reduction	$ 149,761,947	$ 100,011,083	$ 49,750,865	33%
	Average	$ 147,767,555	$ 138,175,570	$ 9,591,985	6%
Turlock ID	Peak Reduction	$ 346,000,742	$ 242,042,147	$ 103,958,595	30%
	Average	$ 341,166,439	$ 318,812,129	$ 22,354,310	7%
Merced ID	Peak Reduction	$ 297,937,830	$ 112,010,174	$ 185,927,656	62%
	Average	$ 296,461,839	$ 274,710,763	$ 21,751,076	7%
Total	Peak Reduction	$ 1,486,931,356	$ 1,080,736,562	$ 406,194,794	27%
	Average	$ 1,477,075,112	$ 1,386,714,464	$ 90,360,648	6%

The Table shows for the Modesto Irrigation District, for example, that in the peak year of surface water supply reductions during the Study Period due to the SED 40 and with SGMA groundwater pumping limits, that the district would have generated an estimated third less (33%) in crop gross revenues. This compares to a 25% loss of crop gross revenues without accounting for the SGMA as discussed above and shown in Table 6.1. Furthermore, the average for the Study period for Modesto with the SED 40 is a 6% annual reduction in crop gross revenues when accounting for the SGMA as compared to 5% without the SGMA, as discussed above and shown in Table 6.1.

Additionally, the table shows that in the peak surface water reduction year for all the Irrigation Districts collectively, crop revenues would have been an estimated approximately 27% lower had the SED 40 been in place along with SGMA restrictions on increased groundwater pumping to offset surface water supplies. This compares to an average for the Study Period of 6%. The large difference reveals again that the consideration of only averages masks the indicated potential impacts of the SED 40. While the average impacts to crop revenues may not appear particularly severe even with SGMA-related groundwater pumping restrictions, there are numerous years where the impacts are substantially larger and could have significant detrimental impacts on the economics of the Irrigation Districts' farmers not only in those specific years but also in the longer run as a result of the response by farm investors, lenders, service providers and other stakeholders in the regional agricultural economy to an overall sizable permanent increase in the risk and uncertainty of farming within the region due to reduced surface water supply reliability and availability

Finally, it should be noted that while Stratecon's estimates of the amount of fallowing and, thus, reductions in crop production by the Irrigation Districts as a result of the SED are in all cases higher than the SWRCB's, Stratecon's fallowing estimates specifically for the SEWD and CSJWCD stand out in particular, as the SWRCB concluded no impacts of the SED 40 on those two districts. This is because the SWRCB analysis assumed that the anticipated reductions in the two districts' surface water supplies would be 100% offset with groundwater pumping by the districts (reflecting the assumption that both districts have the groundwater pumping infrastructure in place and it makes economic and logistical sense for them to pump at that level). No other of the Irrigation District's is assumed by the SWRCB to fully offset their surface water losses with groundwater. On the other hand, Stratecon assumes, as discussed previously, that the SEWD and CSJWCD, like the other Irrigation Districts, will offset 50% of their SED-related reductions in surface water with groundwater resulting in a greater level of fallowing. Accordingly, the Stratecon crop production impact analysis with regard to the two districts is in particularly sharp contrast to the SWRCB's analysis.

Figure 6.3 shows Stratecon's estimates of lost crop gross revenues during the Study Period for the Irrigation Districts combined due to the SED 40 and assuming SGMA groundwater pumping limits. The graphic reveals that those lost crop gross revenues would have been substantial, exceeding $200 million in many years.

Figure 6.3

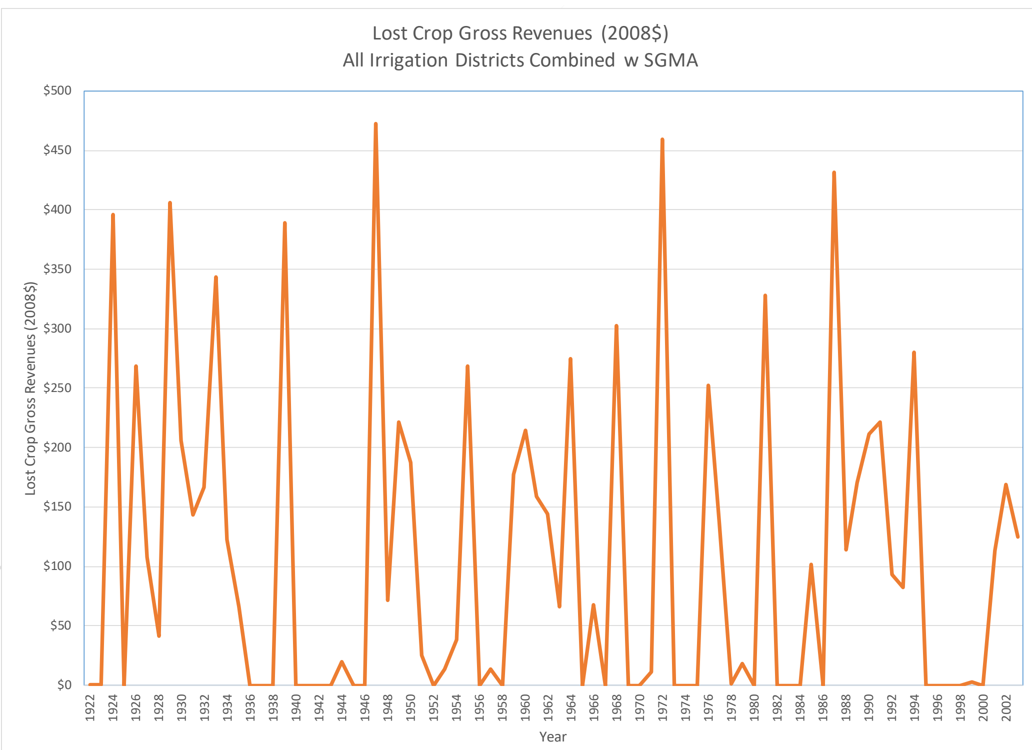
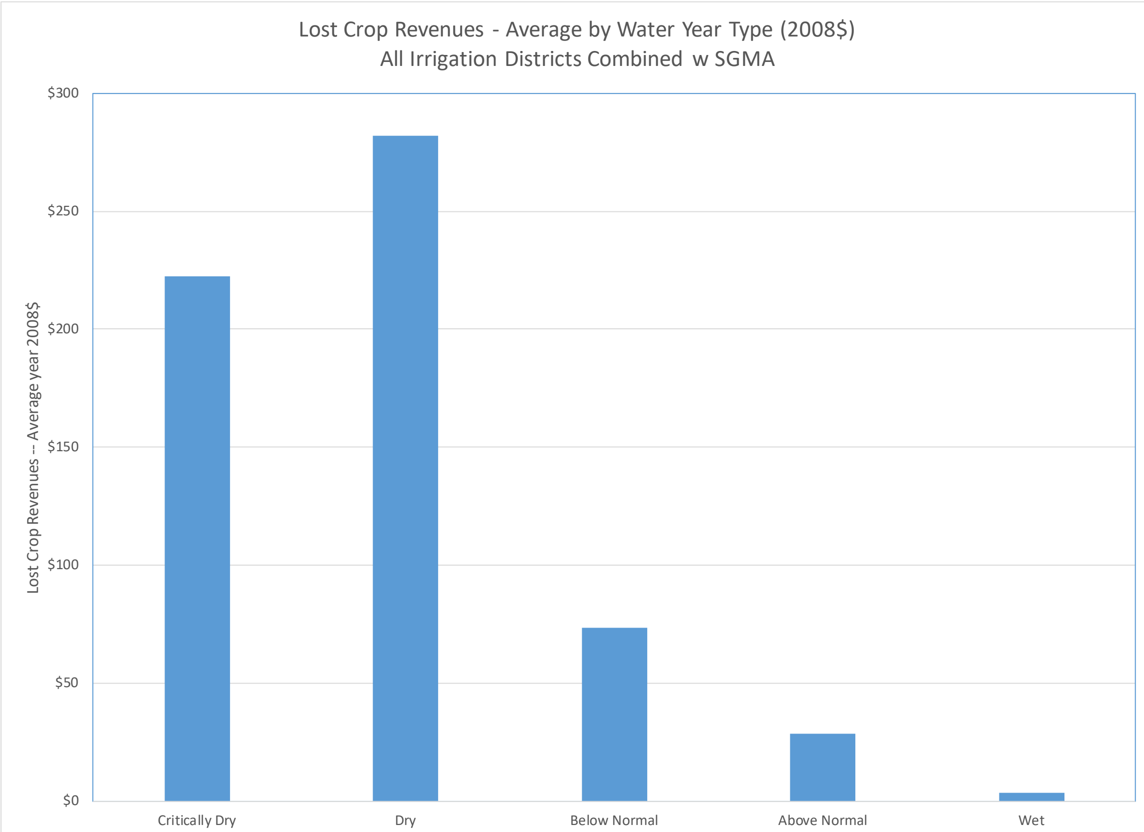


Figure 6.4 presents the same information shown in Figure 6.3 but consolidates it as averages across each water year type during the Study Period (e.g., critically dry, dry, above normal, etc.). The figure clearly shows that the SED 40 impacts with the SGMA on crop

production and associated crop gross revenues within the Irrigation Districts would be most severe during critically dry and dry years.

Figure 6.4



It should additionally be noted for both scenarios that the substantial reduced reliability of surface water supplies under the SED and associated substantial risk of significant water shortages and, thus, crop revenue declines in any given year, is likely to have a chilling impact on regional farm investment and long term average crop production within the Irrigation Districts. This is not captured in the impact analyses by SWRCB or in the above, which examines the short-run, single year potential impacts in each year of the Study Period not the impacts of the potential multi-year experience of farmers faced with a permanent reduction in surface water supplies due to the SED, a situation that is expected to be significantly exacerbated by SGMA constraints on groundwater pumping.

Additional details on the potential impacts of the SED 40 on each district's crop revenues are provided in Attachment 1-3. The estimated lost crop gross revenues presented the above tables and in greater detail in the Attachment are used in a later section of this report to estimate the overall potential economic output and employment impacts of the SED 40 with and without consideration for the potential constraints on regional groundwater pumping of the SGMA.

B. Forward Linkage Effects of SED Impacts on Regional Crop Production

Not only will SED 40 implementation directly cause a reduction in crop production by the Irrigation Districts but have additional, what are termed "downstream", impacts on regional businesses reliant on that crop production including dairies, livestock enterprises, food processors and agricultural commodity transportation enterprises, among others. The challenge in evaluating these impacts is to determine the extent to which dairies, for example, that purchase feed inputs from local farmers may substitute reduced supplies of certain types of feed from local sources with sources outside of the area. While the SWRCB does comment on these potential impacts it does not provide any quantification based on the argument that it is difficult to perform such a calculation. Though it is in fact challenging to quantify impacts on these downstream sectors, an examination of the upper bound of certain of these potential impacts is instructive regarding their potential severity. Such an upper bound would be a situation where the identified downstream sectors are unable to offset declines in local crop production on which they rely with outside-of-the area sources for those crops due to limitations on outside supply and transportation costs as well as general transportation challenges. The result of reductions in crop input supplies would be corresponding potential declines in production by those downstream sectors and associated employment loss. Stratecon focused specifically on the dairy and livestock production and manufacturing sectors, though other economic sectors, including other food processing such as tomato processing and transportation services would also be impacted. Both the Study Area dairy and livestock sectors rely heavily on locally produced hay and grain feed crops. Some of those crops, most notably corn silage, which is an important part of the region's dairy and livestock rations due to its high nutrient load and cattle digestibility characteristics, is very heavy and difficult to store and transport. Accordingly, the region's dairies and livestock producers dependent on local corn silage and hay would have a difficult time replacing offsetting reductions in locally produced corn and other silage and hay products.

To provide an order-of-magnitude estimate of the potential output and employment impacts of the SED 40 on the Study Area's dairy and livestock sectors, Stratecon evaluated the implications of a presumed one-to-one reduction in those sectors' production and, thus, revenues corresponding to the estimated SED 40-related percentage reduction in regional grain and hay production contained within the figures presented in Tables 6.2 and 6.3. For example, if in any year the anticipated reduction in Study Area grain and other crop (hay and pasture) production due to the SED 40 was estimated to be 15% it was assumed, at the upper bound, that the region's dairy and livestock sectors would contract by that same 15%. Accordingly, the approach implicitly assumes that the dairy sector would have no other feed options to offset the reduction of locally produced grain and hay. The analysis then accounts for the additional potential impacts of reduced local dairy production (milk) on local dairy product manufacturing, including notably fluid milk and butter, cheese and frozen dairy dessert manufacturing as it is the singular most important commodity input to dairy product manufacturing. This additional downstream impact on dairy manufacturing is modeled assuming that the impact of the upper bound reduction in Study Area milk production will at its upper bound result in that same percentage reduction in regional dairy product manufacturing. With respect to livestock the downstream effects start with the estimated lost Study Area grain and hay production and the resultant assumed proportional impacts on regional livestock production as an upper bound, which in turn, is presumed to reduce proportionally the supply of livestock available to local livestock slaughter, rendering and processing enterprises and, thus, at the upper bound, also proportionally reduce the output of those enterprises.

Table 6.3 shows Stratecon's estimates of upper bound lost Study Area combined dairy sectors revenues during the Study Period due to the SED 40 before and with SGMA groundwater pumping limits.

Table 6.3

Summary of Upper Bound Lost Dairy Sector Revenues (2008$)		Lost Direct Ouput SED 40%	Percent of Total Sector Output	Lost Direct Ouput SED 40% with SGMA	Percent of Total Sector Output
Total	Peak Reduction	$ 762,879,328	17.7%	$ 1,014,698,281	23.6%
	Average	$ 156,554,166	3.6%	$ 213,858,799	5.0%

The table shows, for example that the Study Area's dairy sectors, upper bound, could experience as much as a nearly 23.6% decline in production and, thus, revenues in any one year under SED 40 implementation with SGMA restrictions on groundwater pumping.

Figure 6.5 shows Stratecon's estimates of upper bound lost dairy sectors revenues during the Study Period due to the SED 40 and assuming SGMA groundwater pumping limits. The graphic reveals many years that those lost dairy sectors revenues would have been substantial, exceeding $50 million in many years.

Figure 6.5

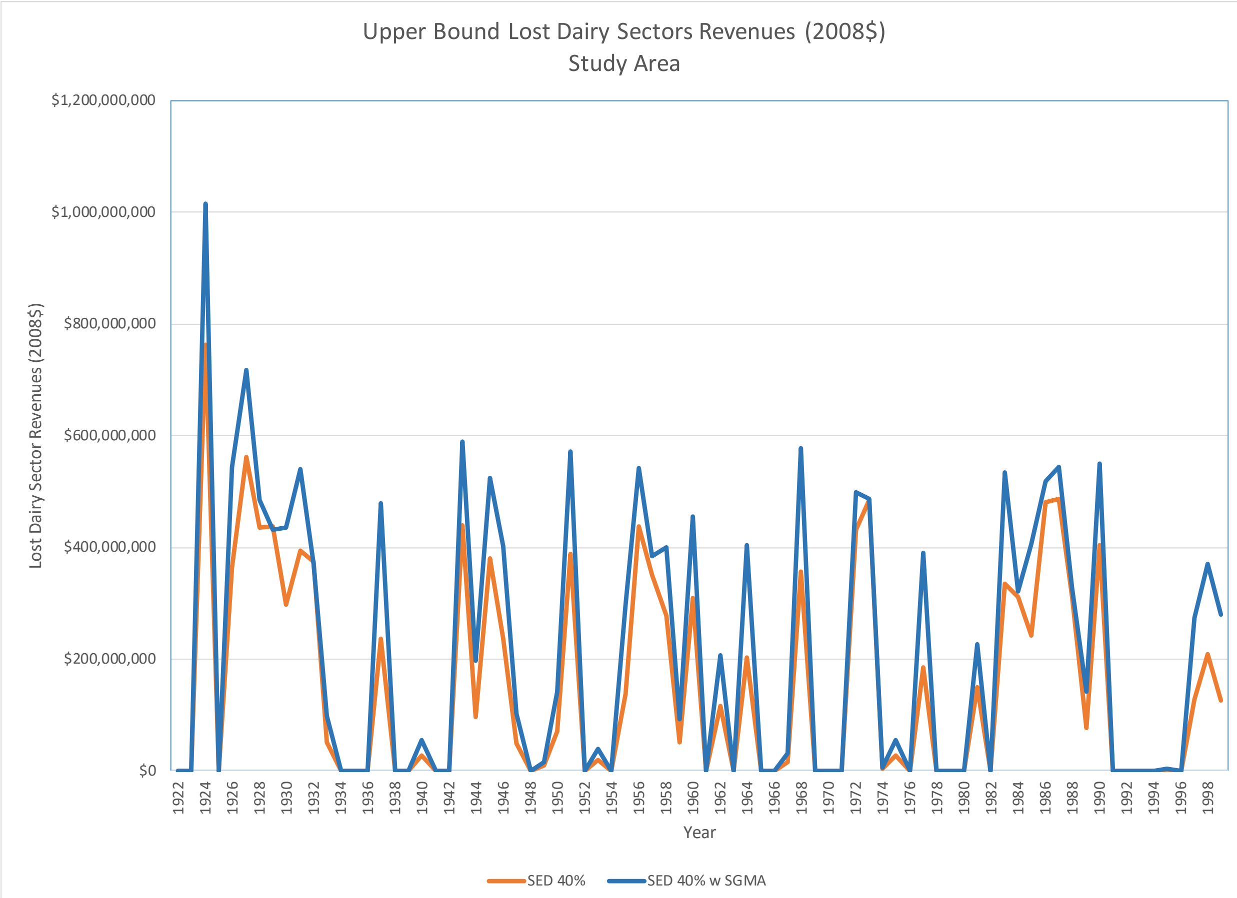


Table 6.4 shows Stratecon's estimates of the upper bound lost Study Area livestock sectors revenues during the Study Period due to the SED 40 before and with SGMA groundwater pumping limits.

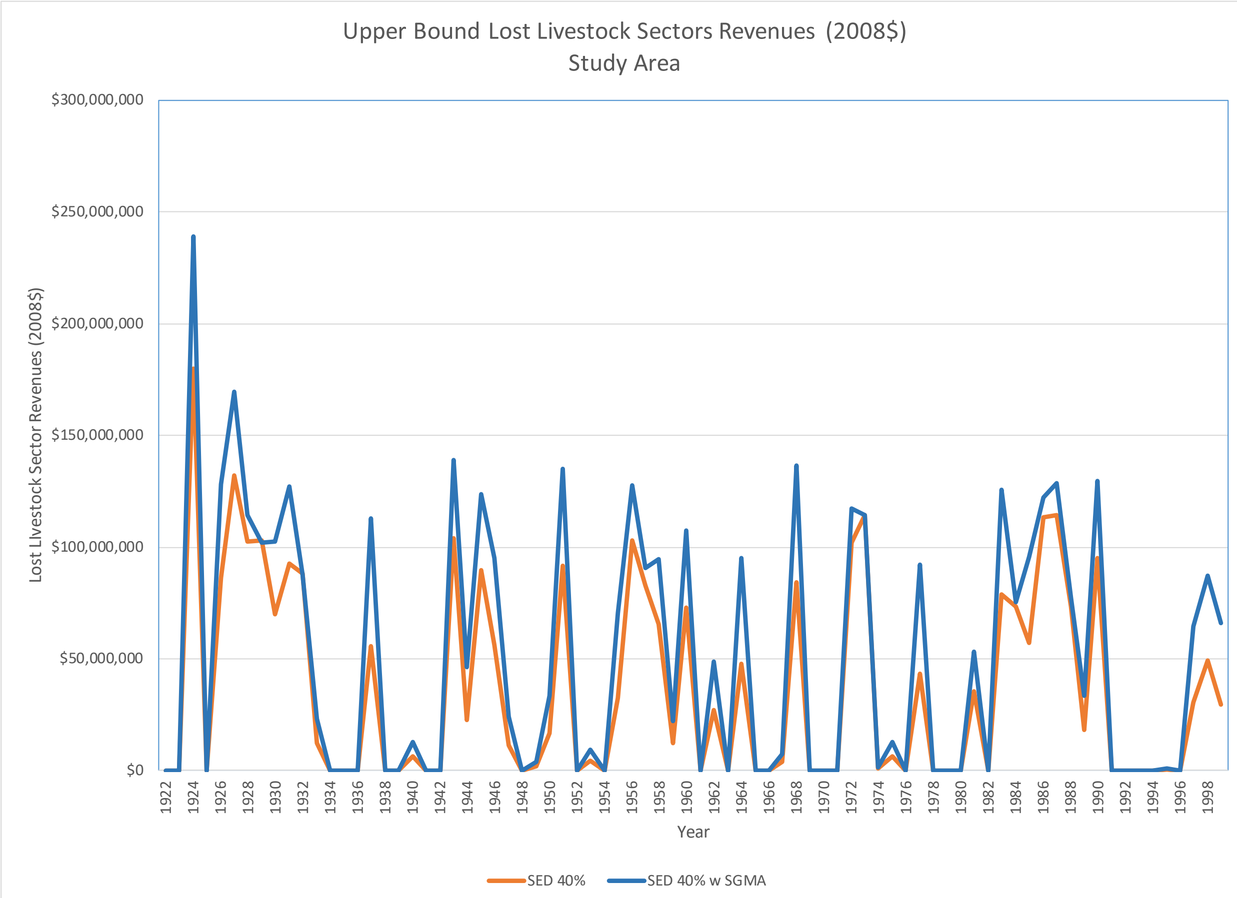
Table 6.4

Summary of Upper Bound Lost Livestock Sector Revenues (2008$)		Lost Output SED 40%	Percent of Total Sector Output	Lost Output SED 40% with SGMA	Percent of Total Sector Output
Total	Peak Reduction	$ 179,846,483	17.7%	$ 239,212,036	23.6%
	Average	$ 36,907,169	3.6%	$ 50,416,562	5.0%

The table shows, for example that the Study Area's livestock sectors, at the upper bound, could experience as much as a nearly 23.6% decline in production and, thus, revenues in any one year under SED 40 implementation with SGMA restrictions on groundwater pumping.

Figure 6.6 shows Stratecon's estimates of the upper bound lost livestock sectors revenues during the Study Period due to the SED 40 and assuming SGMA groundwater pumping limits. The graphic reveals many years that those livestock sectors revenues would have been substantial, exceeding $50 million in many years.

Figure 6.6



C. Indirect Impacts of SED Due to Impacts on Groundwater Elevations

As discussed previously, the increases in groundwater pumping that would be expected to result from SED-related reductions in surface water supplies available to the Study Area irrigation districts ("Irrigation Districts") that rely on surface water from the Merced, Stanislaus and Tuolumne Rivers will result in increased groundwater pumping and, correspondingly, average depths to groundwater, the implementation of ground water pumping restrictions to meet SGMA objectives notwithstanding. The increased average depths to groundwater will in turn result in higher pumping costs for the Irrigation Districts as well as all other irrigation districts and irrigators in the region almost all of whom rely entirely on groundwater for their water supplies.

1. Study Area Irrigation Districts Reliant on Surface Water Supplies

Table 6.5 summarizes the estimated lower and upper bound Study-Period: A) peak single year; and B) average additional cost of groundwater pumping that would have been incurred by each of the Irrigation Districts reliant on surface water supplies assuming the high estimate of potential increases in groundwater depths were to occur with SED 40 implementation, as discussed previously. The pumping cost estimates are based on an assumed range of $0.39 (lower bound) to

$1.12 (upper bound) of combined cost for electricity and well maintenance for each acre foot pumped one foot of elevation. The electricity cost estimates are based on the recent electricity expenses for groundwater pumping experienced by the Cities of Turlock ($0.39) and Modesto ($1.12). The well maintenance costs estimates are based on the assumptions adopted by the SWRCB in its assessment of SED economic impacts. The cost estimates do not account for the additional potential costs that the Irrigation District's might incur to add new wells or extend existing wells to reach groundwater at average depths that have increased due to SED-related increases in groundwater pumping. The costs do not account for the potentially significant additional costs that the Irrigation Districts are likely to incur due to SED-related increases in groundwater depths for pumping and water treatment infrastructure. Though the districts all have a number of deep wells many individual irrigators in the districts that supplement their irrigation with their own pumping do not and may face increased well infrastructure investment to meet their water needs when offsetting SED reductions in their surface water supplies.

Table 6.5

Summary of Cost Impacts of SED 40% Groundwater Depth and Increased Pumping

Irrigation District	Scenario	Depth	Additional Lift Over Baseline[1]	Incremental Cost @0.39 AF/FT	Incremental Cost per Acre	Incremental Cost @1.12 AF/FT	Incremental Cost per Acre
SSJID	Baseline	128.0	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	266.5	138.5	$ 4,832,087	$ 83	$ 13,876,761	$ 237
	Average w SED 40% (High Estimate)	155.6	27.6	$ 959,425	$ 16	$ 2,755,273	$ 47
Oakdale ID	Baseline	88.0	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	285.3	197.3	$ 3,741,017	$ 68	$ 10,743,434	$ 196
	Average w SED 40% (High Estimate)	128.0	40.0	$ 789,338	$ 14	$ 2,266,818	$ 41
SEWD	Baseline	83.3	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	168.0	84.7	$ 1,963,048	$ 41	$ 5,637,472	$ 118
	Average w SED 40% (High Estimate)	86.4	3.1	$ 49,515	$ 3	$ 142,196	$ 10
CSJWCD	Baseline	83.3	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	175.1	91.8	$ 2,090,933	$ 41	$ 6,004,730	$ 118
	Average w SED 40% (High Estimate)	94.8	11.5	$ 281,555	$ 3	$ 808,568	$ 10
Modesto ID	Baseline	90.7	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	258.7	168.0	$ 2,396,881	$ 41	$ 6,883,352	$ 117
	Average w SED 40% (High Estimate)	133.0	42.3	$ 617,133	$ 10	$ 1,772,280	$ 30
Turlock ID	Baseline	90.7	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	237.7	147.0	$ 8,351,666	$ 57	$ 23,984,271	$ 164
	Average w SED 40% (High Estimate)	128.4	37.7	$ 2,139,463	$ 15	$ 6,144,100	$ 42
Merced ID	Baseline	90.7	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	300.8	210.1	$ 23,439,996	$ 240	$ 67,314,861	$ 688
	Average w SED 40% (High Estimate)	139.1	48.4	$ 3,977,047	$ 41	$ 11,421,263	$ 117
Total	Baseline	93.2	0.0	$ -	$ -	$ -	$ -
	Peak w SED 40% (High Estimate)	N/A	N/A	$ 35,348,408	$ 69	$101,513,377	$ 197
	Average w SED 40% (High Estimate)	126.7	33.5	$ 8,813,476	$ 17	$ 25,310,496	$ 49

1. Accounts for years during Study Period that SED 40% is estimated to cause reductions in well depths.

The table suggests that of the irrigation districts reliant on surface water Merced will likely be the most impacted by the SED due to the extent to which the district, as a result, will need to depend on additional groundwater pumping to meet its water supply needs, limitations on pumping due to the SGMA notwithstanding. The table indicates, for example, that the estimated additional cost of pumping incurred by the Merced ID in any one year covering the hydrologic record of the Study Period, due to SED-related increases in groundwater depths and increased pumping, ranges from a lower bound of about $23 million to an upper bound of over $67 million district-wide, which translates to about $240 to $680 per baseline irrigated acre in the district in 2015$. This added cost per acre would represent a significant escalation of costs for the district's farmers and eliminate or put tremendous pressure on existing farmer profitability and even viability in any given year, particularly producers of relatively lower value grain and hay crops. The table further shows that the high estimate average annual impact on cost per acre across the entire Study Period ranges from $17 to $49 in 2015$. As with crop gross revenues, a focus on averages masks the severity of potential impacts in any given year.

Figure 6.7 shows Stratecon's estimates of the upper bound of increased pumping costs during the Study Period for the Irrigation Districts combined due to the range of estimated SED 40-related increases in regional groundwater depths, low, middle and high estimates. The graphic reveals significant inter-year variability in those cost impacts and many years that those added costs would have been substantial.

Figure 6.7

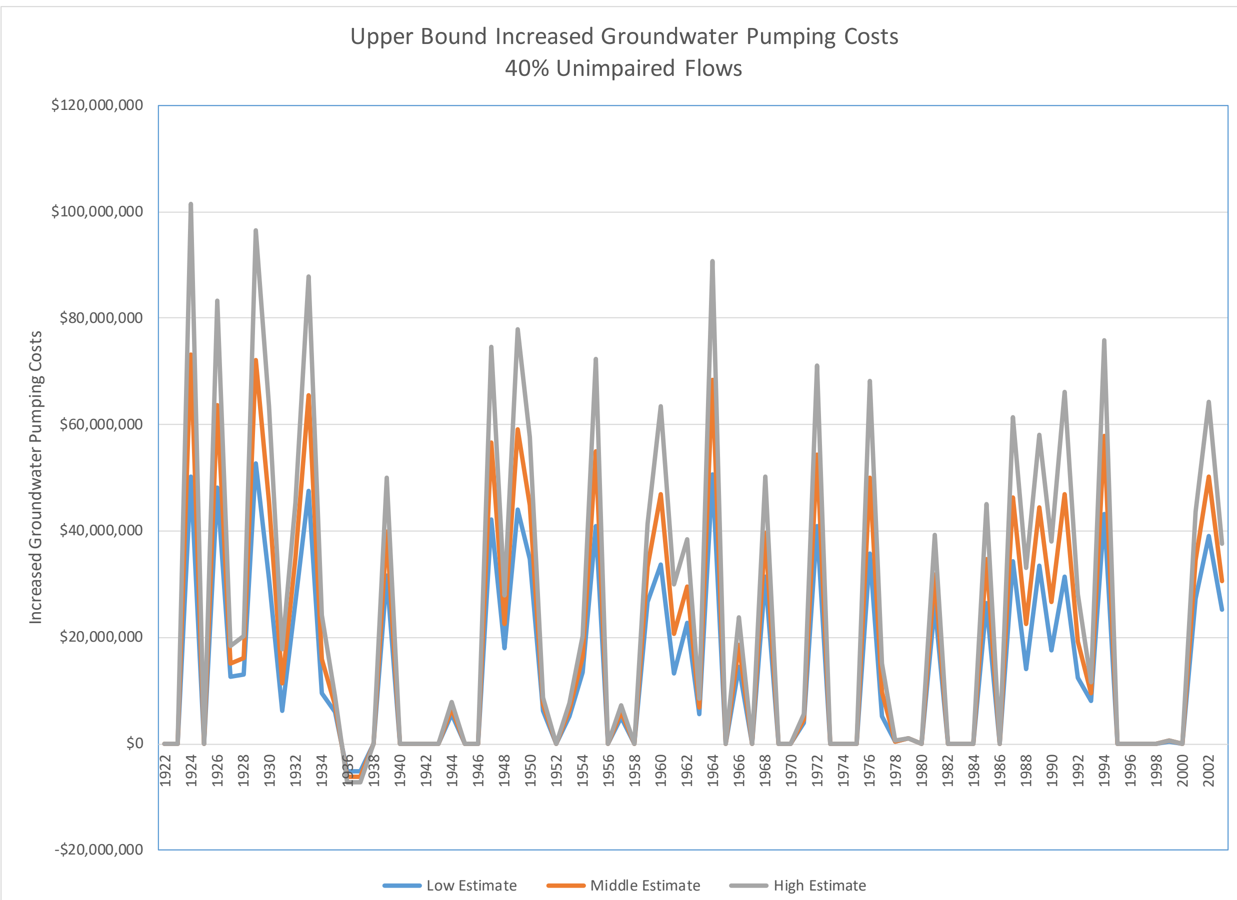
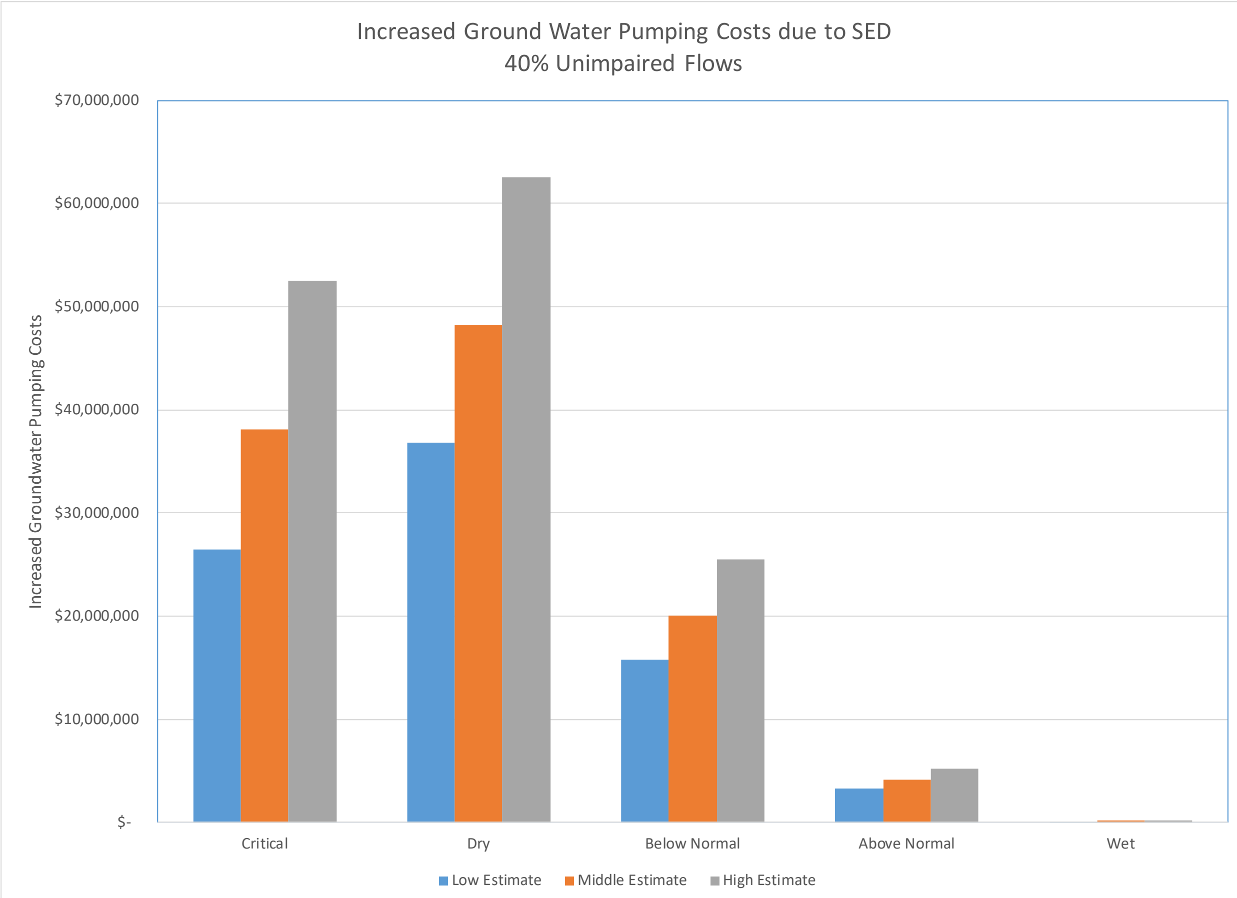


Figure 6.8 presents the same information shown in Figure 6.7 but consolidates it as averages across each water year type during the Study Period (e.g., critically dry, dry, above normal, etc.). The figure clearly shows that the SED 40 impacts groundwater pumping costs within the Irrigation Districts would be most severe during critically dry and dry years. This is to be expected as pumping in low surface water supply years is estimated to be higher than in other years.

Figure 6.8



2. Irrigation outside of the Irrigation Districts.

Irrigation districts and irrigators outside of the Irrigation Districts but within the same water basins as the Irrigation Districts rely entirely on groundwater for their water supplies. Table 6.6 summarizes SWRCB's estimates of the total baseline groundwater pumping by these irrigation districts and irrigators. The table shows total annual baseline pumping of about 1.47 million acre feet on about 531,000 irrigated acres.

Table 6.6

Sub-Basin	Baseline Groundwater Pumping Outside of Irrigation Districts (000's of Acre-Feet)	Irrigated Acres Outside of Irrigation Districts (Acres)
Eastern San Joaquin	476	204,634
Modesto	83	26,675
Turlock	351	117,759
Merced	556	182,363
Total	1,466	531,431

Table 6.7 calculates the estimated groundwater pumping cost impacts of the SED 40 on these irrigators assuming three different associated increases in well depths during the Study Period because of increased Irrigation District pumping: A) the weighted average increase in lift of 33.50 feet; B) the lower bound single year high estimate in increased in lift among the Irrigation Districts (see Table 6.5 peak change in groundwater depth for SEWD); and C) the upper bound single year high estimate increase in lift among the Irrigation Districts (see Table 6.5 peak change in groundwater depth for Merced ID).

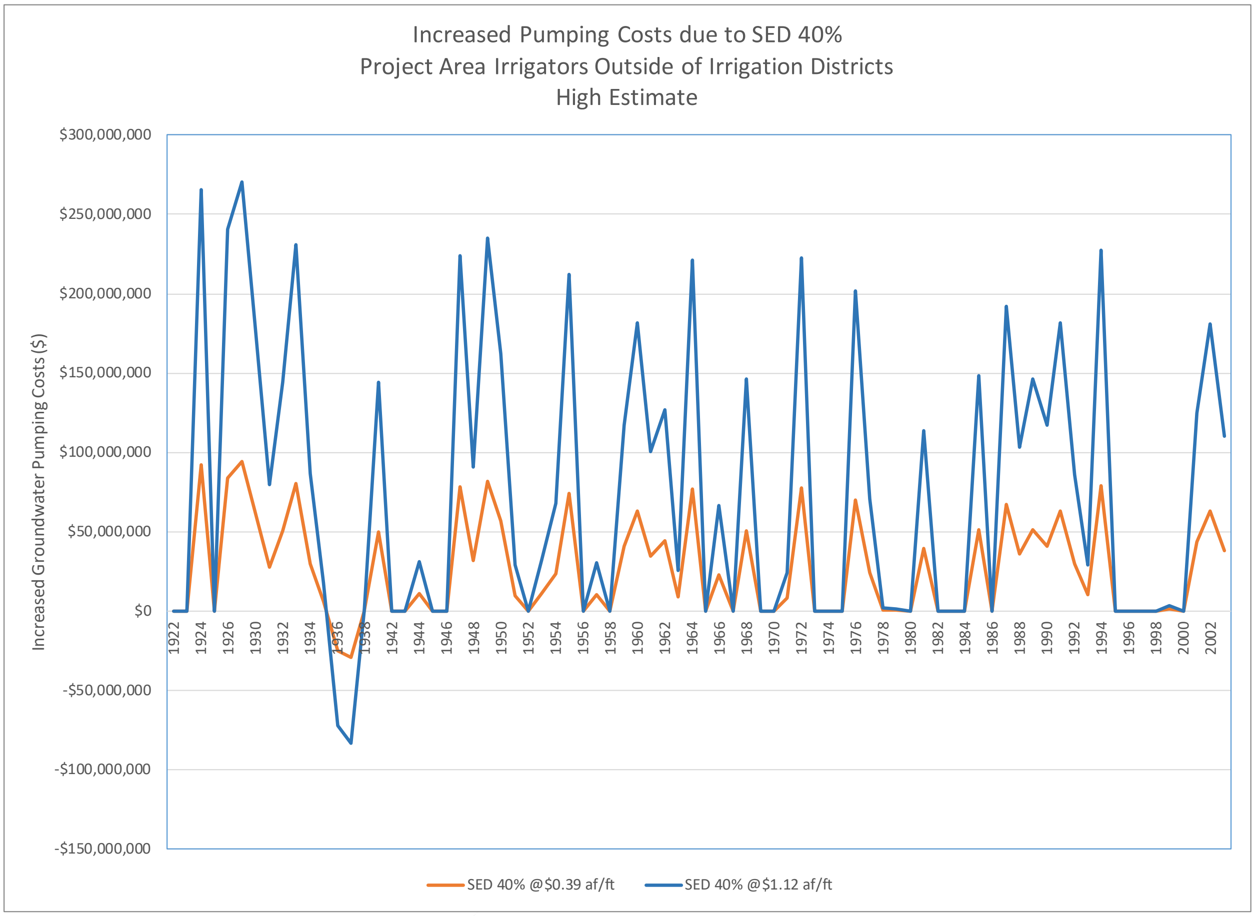
Table 6.7
SED 40 Impact on Outside Irrigation District Groundwater Pumping Costs

	Average	Lower Bound of High Estimate	Upper Bound of High Estimate
Ag. Groundwater Pumping Outside of ID's (000s of acre-feet)	1,466	1,466	1,466
Average Increase in Groundwater Depths (ft)	33.50	84.65	210.09
Cost per AF Pumped Per Foot of Depth	$ 0.39	$ 0.39	$ 0.39
Total Incremental Cost	$ 19,152,690	$ 48,398,792	$ 120,117,244
Total Acreage Irrigated	531,431	531,431	531,431
Average Incremental Cost per Acre	**$ 36.04**	**$ 91.07**	**$ 226.03**
Cost per AF Pumped Per Foot of Depth	$ 1.12	$ 1.12	$ 1.12
Total Incremental Cost	$ 55,002,598	$ 138,991,404	$ 344,952,086
Total Acreage Irrigated	531,431	531,431	531,431
Average Incremental Cost per Acre	**$ 103.50**	**$ 261.54**	**$ 649.10**

The table indicates an average added cost per acre for these irrigators ranging from $36.04 to $103.50 per acre over the Study Period. This is a significant potential increase in the average cost of irrigation, which could have important impacts on the viability of regional farming. In addition, this estimate does not account for inter-year variability in groundwater depth increases due to the SED that could in certain years result in incremental impacts on per-acre groundwater pumping costs that are substantially higher. For example, and as shown in the table, were the average well depth in the region due to the SED increase by 84.7 feet in any one year (see Table 6.5) consistent with the lower bound high estimate of potential well depth increases in any one year of the Study Period among the Irrigation Districts, the average per acre increase in water costs for irrigators in the Study Area outside of the Irrigation Districts would be estimated in a range of about $91 to almost $262. This goes up to $226 to almost $650 per acre were the well depth increases in any year equal to the upper bound high estimate for the Irrigation Districts during the Study Period of about 210.1 feet (see Table 6.5). This level of cost increase would more than wipe out the profits for a large portion of the region's farmers and have a severely adverse impact on the regional economy. Furthermore, even the risk of this outcome would result in a fundamental structural change to the region's economy in the long run as the financial risks of farming for most would become untenable.

Figure 6.9 shows Stratecon's estimates of increased groundwater costs during the Study Period for the irrigators outside of the Irrigation Districts based on the cost per foot of lift ranging from $0.39 to $1.12. The graphic reflects]the high estimates of the potential impacts on groundwater depths for each basin of the Study Area based on the high estimates of groundwater depth impacts for the Irrigation Districts within those basins. For example, the Modesto Basin groundwater depth assumptions are based on the estimated SED 40 impacts on groundwater depths in the Modesto Irrigation District. For the Turlock Basin, Stratecon assumed depth changes consistent with the estimates for the Turlock Irrigation District. For the Merced Basin, Stratecon assumed depth changes consistent with the estimates for the Merced Irrigation District. For the Eastern San Joaquin Basin, Stratecon assumed depth changes consistent with the weighted average groundwater pumping of the Oakdale ID, Stockton East WD and the Central San Joaquin WCD. The graphic reveals significant inter-year variability in the potential pumping cost impacts and many years that those added costs would have been substantial.

Figure 6.9


Increased Pumping Costs due to SED 40%
Project Area Irrigators Outside of Irrigation Districts
High Estimate
Increased Groundwater Pumping Costs ($)
$300,000,000
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
$0
-$50,000,000
-$100,000,000
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SED 40% @$0.39 af/ft
SED 40% @$1.12 af/ft

7. DOMESTIC, COMMERCIAL, MUNICIPAL AND INDUSTRIAL WATER USE

Except for several communities within the Study Area that rely on surface water for a portion of their Domestic, Commercial, Municipal and Industrial water supplies ("DCMI" water supplies), the majority of communities within the Study Area rely entirely on groundwater for their DCMI water supplies. Accordingly, the potential impacts of the SED as it relates to community DCMI water supplies will be both direct as it relates to those communities in the region that rely on surface water for some portion of their DCMI water supplies as well as indirect as it relates to anticipated increases in regional groundwater depths and associated pumping costs due to expected increases in groundwater pumping by irrigators and communities to offset some portion of their SED-related reductions in surface water supplies, potential SGMA-associated pumping limitations aside.

A. Surface DCMI supplies

A number of the Study Area's communities rely heavily on surface water conjunctively with groundwater to meet their overall water supply needs. These communities, which include Stockton and Manteca in San Joaquin County and Modesto in Stanislaus County, among others, receive surface water under contract from the region's Irrigation Districts. In its assessment of potential SED impacts, SWRCB assumed that the region's communities reliant on surface water would not experience any reductions in those supplies as a result of SED under the presumption that the communities' surface water needs would take priority over Irrigation District demands. Accordingly, the SWRCB provided no estimates of the regional economic impacts of reduced Study Area community surface water supplies. However, it is Stratecon's understanding that the region's communities that rely on surface water do not have such priority and, therefore, along with their Irrigation District suppliers, will share in the burden of significant SED-related reductions in their surface water supplies. At the time of this report's preparation, Stratecon did not have the SED water supply impact information needed to accurately assess the potential economic implications of these potential changes in community surface water supplies, which certainly warrant quantification and emphasis. However, it should be understood that Stratecon's (and the SWRCB's) assessment of SED-related reductions incrop production and associated economic impacts implicitly accounts for the economic impacts of the surface water that might be lost by the region's communities due to the SED though only in terms of farm production losses and associated impacts of that reduced water supply, not the increased costs that would be incurred by the affected communities to mitigate for the loss of water and associated impacts. Thus, while the potential economic impacts of reduced community surface water supplies due to the SED are not explicitly quantified by Stratecon, an assessment of the impacts of the loss of this water, regardless of its amount, is embedded elsewhere in Stratecon's overall economic impact analysis and, therefore, reflected in Stratecon's overall impact conclusions.

B. Groundwater DCMI supplies

Already the Study Area is facing significant DCMI water supply challenges due to long term chronic overdraft of its aquifers that over time has reduced community water supply reliability and increased the cost of water. These cost impacts have affected community water systems as well as businesses, school districts and individual homeowners operating their own wells for water supply According to the California Department of Water Resources ("CDWR") the San Joaquin River Basin is one of a number of basins in California that have experienced recent large increases in groundwater depths during the current drought as the combined result of increased pumping and reduced aquifer recharge (natural and artificial). For example, CDWR reports that the Merced Groundwater Basin is already being depleted at a rate of 54,000 acre-feet per year for urban uses and 492,000 acre-feet per year for agricultural uses and that the Turlock Groundwater Basin is being depleted at a rate of 65,000 acre-feet per year for urban uses and 387,000 acre-feet per year for agricultural uses. The result has already been many wells going dry and substantial water quality issues in certain areas. The Planada Community Services District in Merced County, as an example, has recently dealt with major challenges in meeting its community water service needs as several of its wells have gone dry due to the drought and it has had to find emergency funding to put in new wells in response. Planada, a farming town whose population is around 4,500, is designated as a Severely Disadvantaged Community by the State of California due to its very low household incomes. Further, potentially large reductions in groundwater elevations in the area of Planada due to the SED could place untenable additional financial hardship on that community.

With the above as context, SED reductions in surface water supplies will only exacerbate the region's already existing serious problem with urban water supply reliability and rising water costs. The latter will be the result of: A) the need in some cases for the deepening of existing wells or development of new wells to access groundwater such as Planada's, Modesto's and other communities' water systems and individual businesses and households have already experienced with the recent drought; B) additional incremental energy and other costs associated with pumping water from greater depths; C) additional incremental expenses for increased chemical treatment and other actions necessary to resolve anticipated deterioration in water quality resulting from increased well depths and D) water conservation mandates to reduce water demand. Along with Planada and Modesto, a very large portion of the region's communities are designated as DACs, including the cities of Merced and Stockton, the two largest cities in Merced and San Joaquin Counties, respectively. Thus, the economic challenges in many Study Area communities posed by potential necessary increases in water rates or other financing initiatives to offset well-depth-related increases in water costs may prove particularly material and these communities simply may not have the financial and human resources to adequately mitigate for the impacts.

Unfortunately, there is limited information available from many of the region's communities regarding their existing well depths and the incremental costs associated with pumping groundwater. This noted, Table 7.1 provides certain fiscal year 2015 summary water use and average pricing statistics for a number of the region's communities most likely to be highly impacted by SED-related increases in groundwater depths. This information provides a baseline for evaluating the potential implications of added DCMI costs. The table shows, for example, that the average monthly charge for water per connection (including residential, commercial, landscape, etc.) in Planada, a DAC, was about $2.00 per thousand gallons in 2015. Upward pressure on the communities' water costs this year and in the near future term even without the SED is significant due to drought-related response.

Table 7.1
Study Area Community Water Statistics

Community	County	DAC?	Fiscal 2015 Water Use (MG)	Fiscal 2015 Water Service Revenues	Average Charge per 1k gallons
Merced	Merced	Y	7,313	$ 13,238,388	$ 1.81
Le Grand	Merced	Y	105	$ 263,465	$ 2.51
Winton	Merced	Y	575	$ 721,057	$ 1.25
Delhi	Merced	Y	430	$ 751,978	$ 1.75
Atwater	Merced	Y	2,057	$ 3,169,763	$ 1.54
Planada	Merced	Y	293	$ 572,916	$ 1.96
Livingston	Merced	Y	2,101	$ 2,639,298	$ 1.26
Modesto All	Stanislaus	Y[1]	14,113	$ 49,862,608	$ 3.53
Modesto Residential Only	Stanislaus	Y	9,154	$ 37,449,856	$ 4.09
Turlock	Stanislaus	N	5,562	8,527,483	$ 1.53
Turlock Residential Only	Stanislaus	N	3,055	6,751,861	$ 2.21

More detailed information than is presented in Table 7.1 was obtained for the cities of Modesto (a DAC) and Turlock, both in Stanislaus County. Given the recent drought, this data provides some insight to the potential response of Study Area communities to SED-related reductions in regional surface water supplies and associated anticipated increases in well depths.

Table 7.2 summarizes the recent water supply situation in Modesto, which relies on both surface and groundwater to meet its water supply needs.

Table 7.2
Modesto Water Supply

Calendar Year	Surface Supplies	Groundwater Supplies	Total Water Supplies	Average Depth to Groundwater Pumped (feet)	Electrical Power Cost/Million Gallons
2010	30,645	29,228	59,873	56	$209
2011	27,606	31,925	59,531	55	$208
2012	32,776	28,377	61,153	55	$214
2013	34,635	26,783	61,417	56	$220
2014	20,981	35,227	56,208	57	$190
2015	15,401	29,981	45,382	65	$219

The table shows that Modesto most recently has experienced drought-related decreases in its surface water supplies and not actually offset those reductions through increases in its groundwater pumping. To address the drop off in water supply the City has aggressively sought to implement conservation measures. Such measures can only go so far as to mitigating for water supply reductions. With even greater reductions in its surface supplies as a result of the SED the City expects to have no other option than to increase its groundwater pumping. In fact, as the City has grappled with its recent drought-related water supply challenges, it has just funded the addition of a new deep well to its groundwater system at a cost of $1.5 million.

Table 7.3 summarizes the City of Modesto's recent residential water demand. The table shows a decline in household connections and household water use into fiscal year 2016 that corresponds to drought-related residential water use cutbacks/conservation.

Table 7.3
Modesto Residential Water Demand

Fiscal Year July to June	Average # of Residential Connections	Average Residential Customer Revenues	Average Monthly Residential Water Bill	Average Daily Household Consumption (gallons/day)
2008	71,300	35,580,421	$ 41.59	129.31
2009	71,046	36,867,692	$ 43.24	392.15
2010	71,101	36,104,250	$ 42.32	278.76
2011	71,584	36,481,469	$ 42.47	295.74
2012	71,590	37,902,598	$ 44.12	340.69
2013	71,605	39,343,312	$ 45.79	379.57
2014	71,726	39,427,966	$ 45.81	381.66
2015	71,873	37,449,856	$ 43.42	348.96
2016	69,505	35,510,583	$ 42.58	325.16

Table 7.4, which summarizes the City of Modesto's recent commercial, industrial, etc. water demand ("non-residential" water use), reveals a similar decline as residential water use into 2016.

Table 7.4
Modesto Non-Residential Water Demand

Fiscal Year July to June	Average # of Commerial, Industrial and Other Non-Residential Connections	AverageCommerial, Industrial and Other Non-Residential User Revenues	Average Monthly Non-Residential Water Bill	Average Daily Non-Residential Consumption (gallons/day)
2008	4,842	11,930,520	$ 205.32	2,782
2009	4,866	12,382,453	$ 212.08	2,710
2010	4,876	11,455,860	$ 195.78	2,517
2011	4,883	11,638,467	$ 198.62	2,545
2012	4,900	12,575,504	$ 213.86	2,660
2013	4,916	13,091,462	$ 221.93	2,644
2014	4,932	12,963,331	$ 219.06	2,526
2015	4,940	12,412,752	$ 209.41	2,399
2016	4,947	11,385,945	$ 191.79	2,156

Table 7.5 summarizes the recent water supply situation in the City of Turlock, which relies entirely groundwater to meet its water supply needs.

Table 7.5
Modesto Water Supply

Calendar Year	Groundwater Supplies	Average Depth to Groundwater Pumped (feet)	Electrical Power Cost/Million Gallons
2010	7,094	N/A	N/A
2011	6,846	130	N/A
2012	7,012	132	N/A
2013	7,432	132	$161
2014	6,565	149	$161
2015	5,562	160	$178

The table shows that Turlock most recently has experienced drought-related decreases in its groundwater pumping and use in conjunction with increased depth to groundwater.

Table 7.6 summarizes the City of Turlock's recent historical residential water use. The table shows a drop-off in household water consumption from calendar year 2013 into the current drought through 2015. As with the region's other communities, measures to reduce water use and encourage conservation can only go so far in helping to offset rising pumping costs. This is especially true as the Study Area's population is projected to continue its strong growth, well outpacing the rate of growth for the State of California, as previously discussed.

Table 7.6
Turlock Residential Water Demand

Calendar Year	Average # of Residential Connections[1]	Average Residential Customer Revenues	Average Monthly Residential Water Bill	Average Daily Household Consumption (gallons/day)
2011	17,095	5,954,065	$ 29.02	613.9
2012	17,095	5,935,917	$ 28.94	552.9
2013	17,095	6,220,556	$ 30.32	668.6
2014	17,095	6,006,627	$ 29.28	579.7
2015	17,095	6,751,861	$ 32.91	489.6

1. Reported residential connections for 2015 assumed for all other years.

Based on data provided by the Cities of Modesto and Turlock and as previously discussed, the added cost per acre-foot of water pumped per foot of elevation in the region is estimated to range from $0.39 to $1.12. This cost includes expenses for both power (electricity, diesel, etc.) and maintenance. It does not include added costs of capital investment to reach greater depths or costs of added treatment due to the lower quality of water at greater depths.

According to the SWRCB, the annual baseline DCMI pumping from the Study Area's four groundwater sub-basins is 247,000 acre feet. Table 7.7 summarizes the implications for the cost of this groundwater for a range of potential regional well elevation declines based on Stratecon's assessment of the impacts on depth to groundwater of the SED 40.

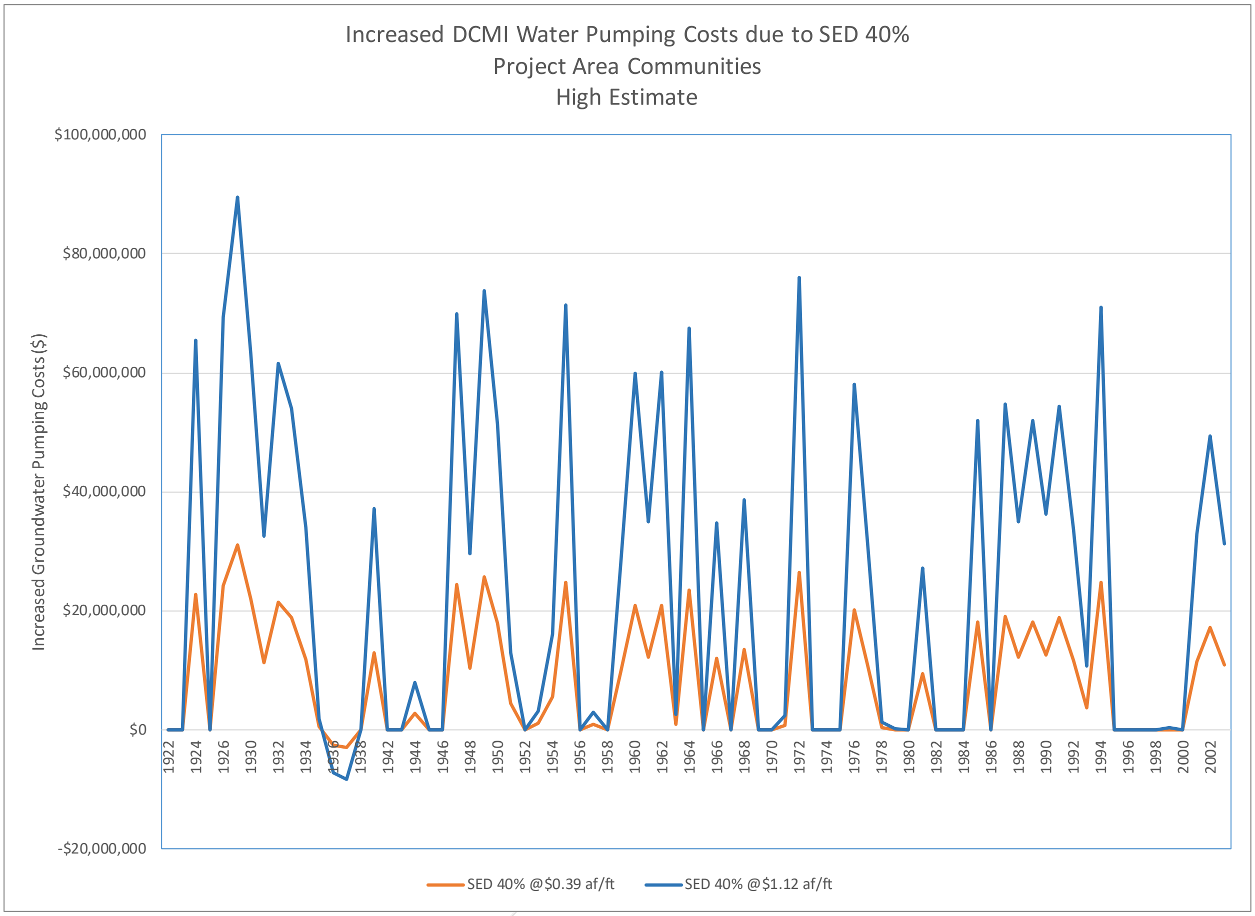
Table 7.7
Water Cost Impacts

	Average		Min of High Estimate		Max of High Estimate	
Total Average DCMI Pumping (Acre-Feet/Yr)		247,000		247,000		247,000
Average Increase in Groundwater Depths (ft)		33.50		84.65		210.09
Cost per AF Pumped Per Foot of Depth	$	0.39	$	0.39	$	0.39
Total Incremental Cost	$	3,226,954	$	8,154,503	$	20,238,035
Total Households in Region		504,842		504,843		504,844
	$	**6.39**	**$**	**16.15**	**$**	**40.09**
Cost per AF Pumped Per Foot of Depth	$	1.12	$	1.12	$	1.12
Total Incremental Cost	$	9,267,440	$	23,418,061	$	58,119,485
Total Households in Region		504,842		504,843		504,844
	$	**18.36**	**$**	**46.39**	**$**	**115.12**

The table shows that for the projected average well depth impact for the Irrigation Districts during the Study Period of about 33.5 feet, the estimated additional cost burden on DCMI water users in the region ranges from about $3.2 to $9.3 million. This translates to about $6.39 to $18.36 per household (about $0.50 to $1.50 a month) within the region to provide some order of magnitude perspective (though of course some of the estimated cost would be incurred by non-residential users of water including commercial users, schools, etc.). Concurrently, within the range of projected well depth increases as a result of SED-related increases in pumping for any one year during the Study Period, the estimated lower and upper bound, high estimate pumping cost impacts range from about $8.2 million to $58.1 million or about $16 to $115 per region household. This again highlights the fact that in many hydrologic years during the study period the impacts on well depths and resulting associated increases on community water costs could be substantial.

Figure 7.1 shows Stratecon's estimates of increased groundwater costs during the Study Period for the Study Area's communities based on the cost per foot of lift ranging from $0.39 to $1.12. The graphic reflects estimates of the lower and upper bound, high estimate potential impacts of the SED 40 on groundwater depths for each basin based on the estimates for the Irrigation Districts within those basins. For example, the Modesto Basin groundwater depth assumptions are based on the estimated SED 40 impacts on groundwater depths in the Modesto Irrigation District. For the Turlock Basin, Stratecon assumed depth changes consistent with the estimates for the Turlock Irrigation District. For the Merced Basin, Stratecon assumed depth changes consistent with the estimates for the Merced Irrigation District. For the Eastern San Joaquin Basin, Stratecon assumed depth changes consistent with the weighted average groundwater pumping of the Oakdale ID, Stockton East WD and the Central San Joaquin WCD. The graphic reveals significant inter-year variability in the pumping cost impacts and many years that those added costs would have been substantial for the region's communities.

Figure 7.1


Increased DCMI Water Pumping Costs due to SED 40%
Project Area Communities
High Estimate
Increased Groundwater Pumping Costs ($)
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
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SED 40% @$0.39 af/ft
SED 40% @$1.12 af/ft

8. RECREATION

The SED 40 would be expected to result in material declines in Study Area reservoir elevations as less spring snow pack run-off will be allowed to be captured by the region's dams and held for later release for irrigation and other purposes. A number of the Study Area reservoirs (Woodward Reservoir and Modesto Reservoir, as primary examples) and reservoirs adjacent to the Study Area operated by the Irrigation Districts (Lake Don Pedro and Lake McClure, as primary examples) are important regional water-based recreation destinations. Accordingly, SED-associated declines in reservoir elevations during the spring and, particularly, summer months, which are peak periods for water-based recreation regionally is expected to have an adverse effect on recreation at the region's reservoirs and, thus, adverse economic impacts due to associated declines in local recreation-associated spending and job creation. This is potentially particularly true of Woodward, which has a strict surface elevation threshold for terminating body contact activities within the reservoir. Historically, this threshold has been reached in October but recently, with the drought, has been triggered in September. Any SED-related reductions in the reservoir's elevations could result in the threshold being reached earlier, particularly in drier years, having a definitive adverse impact on recreation at the reservoir and associated regional recreation-related spending and economic output and employment effects. Stratecon was unable to obtain the data it sought to perform statistical analyses relating the region's lake recreation visitation to lake levels as a basis to estimate the recreation effects of the SED 40. This noted, the SWRCB dismissed those impacts as minor with no empirical foundation for that conclusion. Stratecon believes that while the recreation-related impacts may be substantially less than the impacts associated with crop production and water costs the SED 40's potential recreation-associated economic impacts are likely to be material, particularly during drier hydrologic years when the unimpaired flow requirements will have particularly substantial impacts on summertime reservoir elevations. As such, the SWRCB should explicitly seek to quantify those impacts as part of its programmatic assessment of the SED.

9. HYDROPOWER

The SED's impacts on hydropower generation are estimated by the SWRCB to be less than $1 million attributed to a combination of lost power production and reduced power value. While the SWRCB does not address the implications for regional power consumers (households, businesses, etc.) of the cost of replacement power and associated economic impacts, Stratecon believes those impacts to likely be relatively small. Accordingly, Stratecon defers to the SWRCB evaluation of power production effects and, accordingly, does not evaluate the associated economic impacts.

10. ECONOMIC IMPACTS

The economic impacts of implementation of the SED on the Study Area economy will result primarily from the following:

A. Reduced agricultural production and associated crop revenue generation by the Irrigation Districts due to the SED-related reduction of the districts' surface water supplies and the fact that not all of those surface supply reductions are expected to be offset with increased groundwater pumping (See Section 6).
B. Reduced dairy and livestock sectors production due to a reduction in Irrigation District feed production (See Section 6).
C. Increases in the cost of groundwater for irrigation both within and outside of the Irrigation Districts due to increased groundwater depths resulting from increased Irrigation District groundwater pumping to offset SED reductions in their surface water supplies (See Section 6).
D. Increases in community costs of water, including water costs incurred by the region's Disadvantaged Communities, due to increased groundwater pumping and depths resulting from reduced surface water supplies and increased Irrigation District and community groundwater pumping to offset SED reductions in their surface water supplies (See Section 7).
E. Changes in regional reservoir operations and associated effects on reservoir surface elevations and, correspondingly, recreation visitation and recreation-related local spending (See Section 8).
F. Changes in regional reservoir operations and associated effects on hydropower generation (See Section 9).

Stratecon quantified the impacts of A, B, C and the groundwater depth component of D on the Study Area's economic output and employment using the economic input-output modelling tool IMPLAN.

The application of IMPLAN and associated economic impact indications are as follows.

A. Reduced Agricultural Production by Irrigation Districts

As previously discussed, Stratecon examined the implications of the SED 40 on Study Area agricultural production under two scenarios related to Irrigation District response to the anticipated SED 40 surface water supply reductions (See Section 6). The first assumed that the Irrigation District's would increase their groundwater pumping to offset the water supply reductions. It is assumed that the rate of replacement of surface water lost with groundwater would be consistent with the observed historical response of the Westlands Irrigation District to surface water supply delivery variability. This resulted in estimates of groundwater pumping by the Irrigation Districts during the Study Period were the SED 40 in place that were less than estimated by the SWRCB. Accordingly, Stratecon's analysis concluded greater reductions in overall Irrigation District water supplies during the Study Period due to the unimpaired flow requirements than did the SWRCB and, correspondingly, greater crop land fallowing/idling and associated declines in crop production and gross revenues.

1. SED 40 without SGMA limitations on Groundwater Pumping

Table 10.1 shows Stratecon's estimates of lost gross crop revenues for each of the Irrigation Districts in the peak Study Period year of total supply reductions and on average. These lost gross crop revenues represent the estimated direct economic output losses of the SED 40 without account for potential groundwater pumping restrictions associated with the SGMA. The table shows an average estimated annual loss of direct economic output in 2008$ of $52 million or about 4% of the Irrigation Districts' estimated average economic output. This compares to the SWRCB's estimate of $36 million. Perhaps more importantly, however, the table shows a peak single year expected decline in economic output by the Irrigation Districts in 2008$ of about $235 million or 16% of the Irrigation Districts' direct economic output. The severity of the impacts on output of this single year and other years during the Study Period also with very significant estimated losses of economic output is masked by a focus on the average impacts over the entire Study Period with a number of years with small or no expected impacts due to more favorable hydrological conditions (wet or above normal years).

Table 10.1

Summary of Lost Direct Output (2008$)

Irrigation District	Reduction in Surface Water Supplies	Baseline	40% Unimpaired Flows	Revenue Loss (2008$)	% of Baseline
SSJID	Peak Reduction	$ 227,340,824	$ 180,598,016	$ 46,742,808	21%
	Average	$ 228,801,088	$ 222,053,045	$ 6,748,043	3%
Oakdale ID	Peak Reduction	$ 129,762,737	$ 96,224,934	$ 33,537,802	26%
	Average	$ 128,933,646	$ 123,814,745	$ 5,118,901	4%
SEWD/CSJWCD	Peak Reduction	$ 333,944,545	$ 280,822,511	$ 53,122,035	16%
	Average	$ 333,944,545	$ 327,507,259	$ 6,437,286	2%
Modesto ID	Peak Reduction	$ 136,192,551	$ 101,940,199	$ 34,252,353	25%
	Average	$ 147,767,555	$ 140,310,943	$ 7,456,612	5%
Turlock ID	Peak Reduction	$ 346,000,742	$ 277,006,247	$ 68,994,495	20%
	Average	$ 341,166,439	$ 323,806,519	$ 17,359,920	5%
Merced ID	Peak Reduction	$ 297,937,830	$ 249,481,682	$ 48,456,149	16%
	Average	$ 296,461,839	$ 287,736,625	$ 8,725,214	3%
Total	Peak Reduction	$ 1,429,872,508	$ 1,194,951,895	$ 234,920,613	16%
	Average	$ 1,477,075,112	$ 1,425,229,136	$ 51,845,976	4%

Figure 10.1 shows the substantial inter-year volatility in crop gross revenue losses due to the SED 40. These losses are expected to often exceed $100 million annually.

Figure 10.1

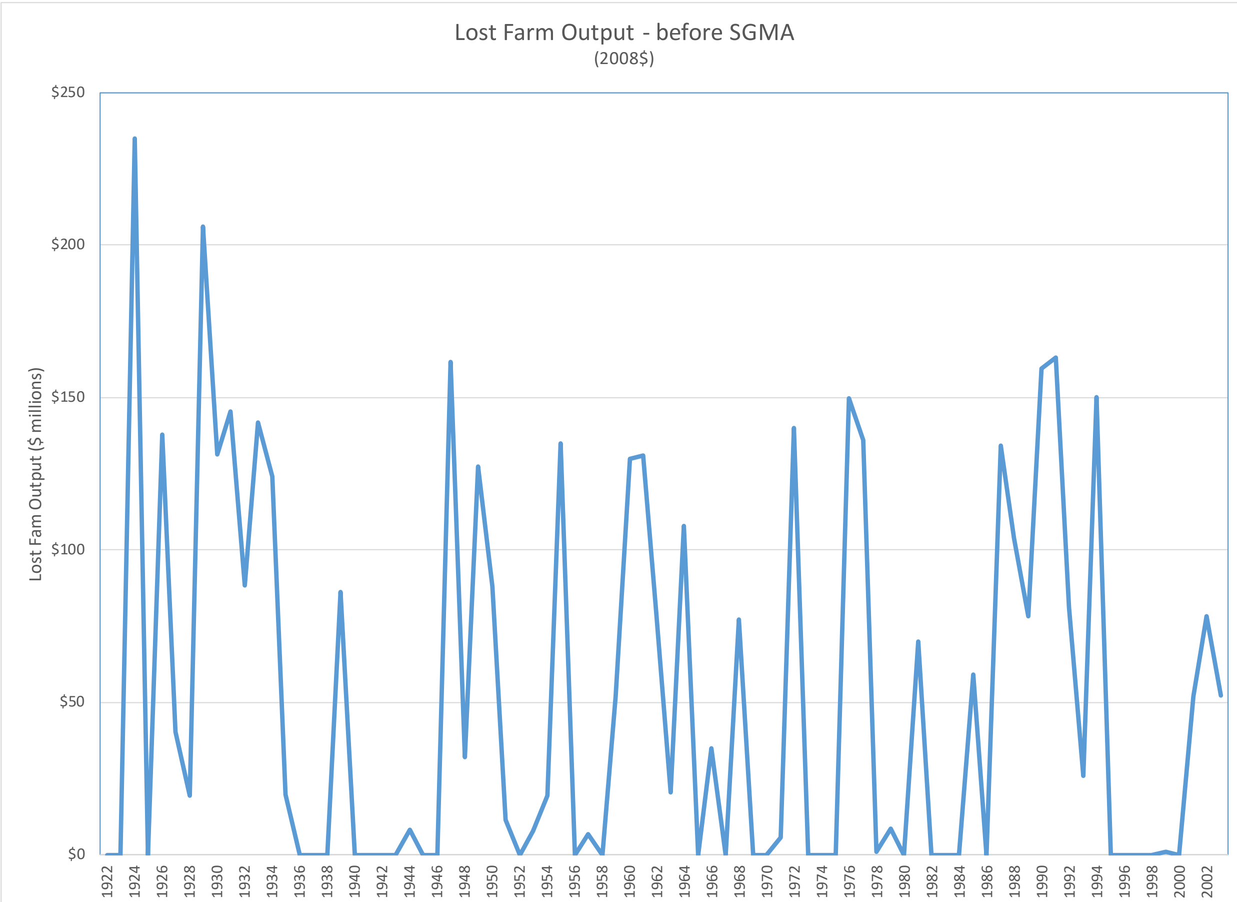


Table 10.2 summarizes the estimated direct farm sector employment impacts in the Irrigation Districts of the direct output impacts shown in Table 10.1. The estimates of employment impacts were derived applying the IMPLAN employment multipliers for the Study Area specific to each of the primary agricultural commodity sectors identified in the IMPLAN model. The table shows an average direct employment loss of about 276 jobs and a peak year employment loss nearing 1,450 jobs, which represents about 18% of the estimated crop production employment within the Irrigation Districts.

Table 10.2

Direct Employment

Irrigation District	Scenario	Baseline	40% Unimpaired Flows Output Loss	% of Baseline
SSJID	Peak Reduction	1,407	297	21%
	Average	1,413	40	3%
Oakdale ID	Peak Reduction	784	201	26%
	Average	779	30	4%
SEWD/CSJWCD	Peak Reduction	1,251	279	22%
	Average	1,251	34	3%
Modesto ID	Peak Reduction	791	237	30%
	Average	846	39	5%
Turlock ID	Peak Reduction	2,241	439	20%
	Average	2,217	88	4%
Merced ID	Peak Reduction	1,753	264	15%
	Average	1,746	45	3%
Total	Peak Reduction	8,014	1,448	18%
	Average	8,250	276	3%

Figure 10.2 shows the substantial inter-year volatility in estimated crop production reduction-related job losses due to the SED 40. These losses are expected in many years to exceed 400.

Figure 10.2

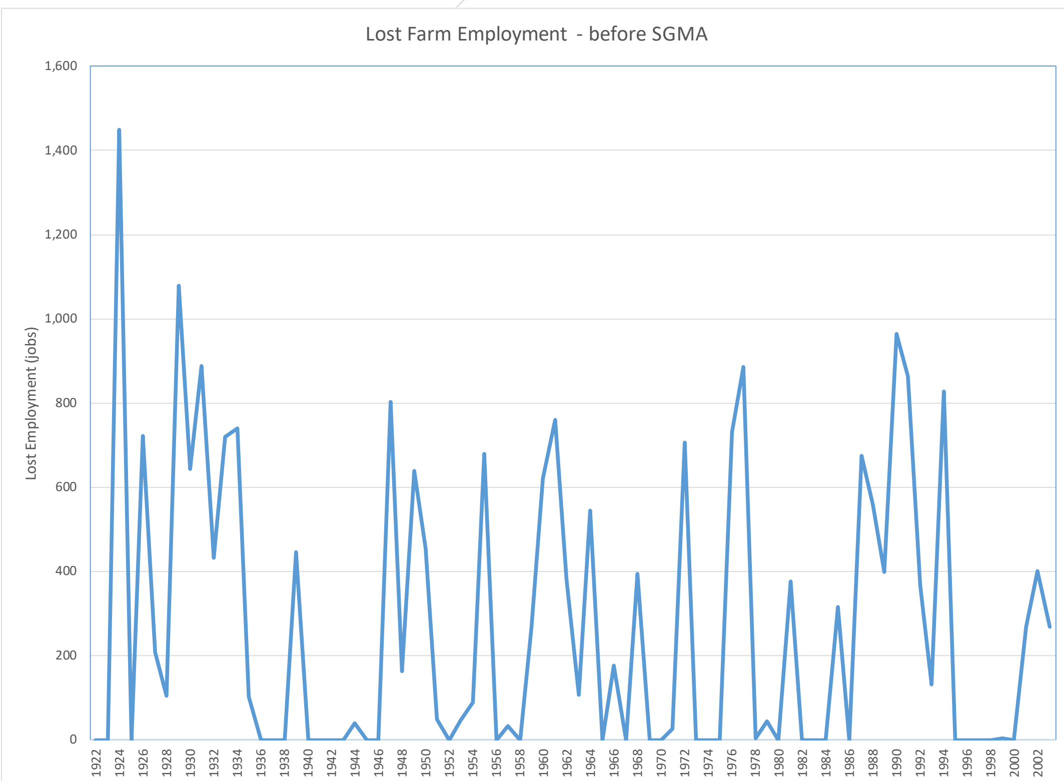


Table 10.3 summarizes the estimated total output impacts associated with the estimated reduction in Irrigation District crop production and, correspondingly, crop gross revenues during the Study Period because of the SED 40. These impacts include both the direct farm sector output impacts as shown in Table 10.1 and the additional secondary impacts because of the direct farm output impacts as farmers spend money in different sectors of the regional economy in support of their crop production activities and farm workers spend their income within the regional economy.

Table 10.3

Total Industrial Output (2008$)

Irrigation District	Scenario	Baseline	40% Unimpaired Flows Output Loss	% of Baseline
SSJID	Peak Reduction	$ 393,634,325	$ 81,848,785	21%
	Average	$ 396,197,635	$ 11,823,938	3%
Oakdale ID	Peak Reduction	$ 226,757,610	$ 59,123,091	26%
	Average	$ 225,296,538	$ 9,022,483	4%
SEWD/CSJWCD	Peak Reduction	$ 593,180,647	$ 94,250,753	16%
	Average	$ 593,180,647	$ 11,421,232	2%
Modesto ID	Peak Reduction	$ 237,398,786	$ 60,380,899	25%
	Average	$ 257,742,179	$ 13,111,388	5%
Turlock ID	Peak Reduction	$ 602,354,262	$ 121,274,862	20%
	Average	$ 593,853,035	$ 30,521,655	5%
Merced ID	Peak Reduction	$ 518,035,414	$ 84,810,822	16%
	Average	$ 515,441,215	$ 15,323,572	3%
Total	Peak Reduction	$ 2,498,712,060	$ 413,406,652	17%
	Average	$ 2,581,711,248	$ 91,203,277	4%

The table shows, for example, that the estimated contribution of the Irrigation Districts to Study Area total economic output averages almost $2.6 billion per year and the average reduction due to the SED 40 over the Study Period is estimated at about $91 million or approximately 4% of that total output contribution. Concurrently, in the peak reduction year during the Study Period for the Irrigation Districts combined the total impact on economic output is estimated at about $413 million or approximately 17% to the total output contribution of the Irrigation Districts.

Figure 10.3 shows the substantial inter-year volatility in total Study Area output losses due to the SED 40's impacts on the Irrigation Districts' farm production. These losses are expected in many years to exceed $200 million.

Figure 10.3

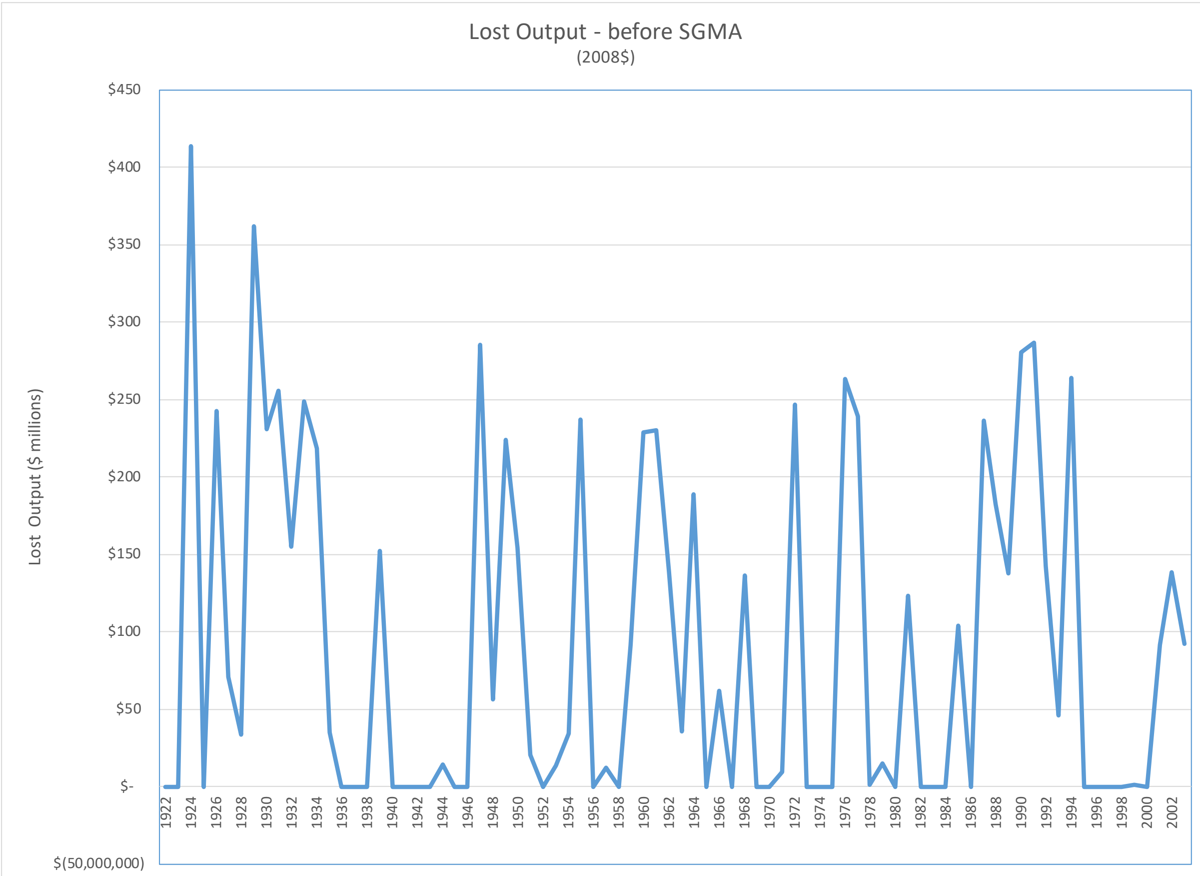


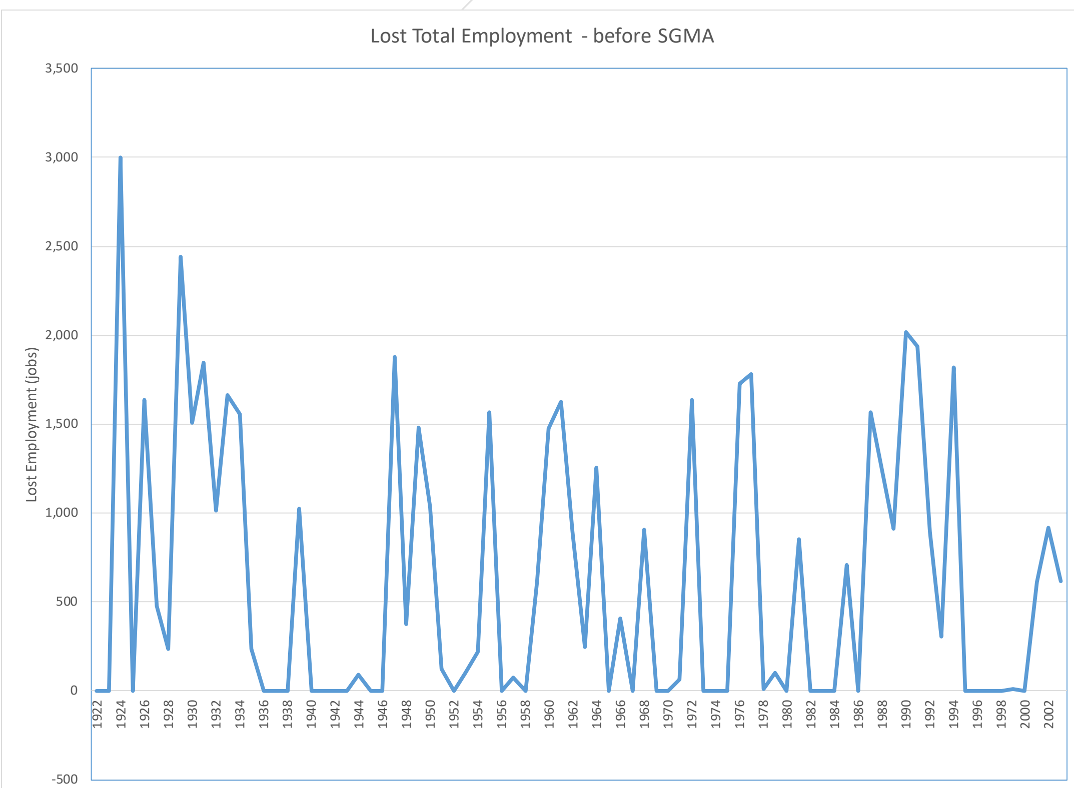
Table 10.4 summarizes the estimated total employment impacts within the Study Area of the SED 40 because of Irrigation District reductions in crop production. The jobs include the direct farm jobs shown in Table 10.2 as well as additional jobs within the economy (secondary employment impacts) associated with Irrigation District spending on non-labor inputs for farming and farm worker spending of their wages. The table shows, for example, that the estimated contribution of the Irrigation Districts to Study Area total employment averages about 19,000 jobs and the average reduction due to the SED 40 over the Study Period is estimated at about 700 or approximately 4% of those total jobs. Concurrently, in the peak water supply reduction year during the Study Period for the Irrigation Districts combined, the total impact on employment is estimated at about 3,000 jobs lost or approximately 17% of the total employment contribution to the Study Area by the Irrigation Districts.

Table 10.4

Irrigation District	Scenario	Baseline	40% Unimpaired Flows Output Loss	% of Baseline
SSJID	Peak Reduction	3,077	629	20%
	Average	3,093	88	3%
Oakdale ID	Peak Reduction	1,714	427	25%
	Average	1,703	64	4%
SEWD/CSJWCD	Peak Reduction	3,776	653	17%
	Average	3,776	79	2%
Modesto ID	Peak Reduction	1,781	469	26%
	Average	1,914	90	5%
Turlcck ID	Peak Reduction	4,681	905	19%
	Average	4,624	205	4%
Merced ID	Peak Reduction	3,882	602	16%
	Average	3,864	105	3%
Total	Peak Reduction	18,419	3,059	17%
	Average	18,975	632	3%

Figure 10.4 shows the substantial inter-year volatility in total Irrigation District output losses due to the SED 40. These losses are expected in many years to exceed 1,000 jobs.

Figure 10.4



3. SED 40 with SGMA Limitations on Groundwater Pumping

Table 10.5 shows Stratecon's estimates of lost gross crop revenues for each of the Irrigation Districts in the peak Study Period year of total supply reductions and on average. These lost gross crop revenues represent the estimated direct economic output losses of the SED 40 accounting for potential groundwater pumping restrictions associated with the SGMA. The table shows an average estimated annual loss of direct economic output in 2008$ of about $90 million or about 6% of the Irrigation Districts' average economic output. This compares to the SWRCB's estimate of $36 million. Perhaps more importantly, however, the table shows a peak single year expected decline in economic output by the Irrigation Districts of about $406 million or 27% of the Irrigation Districts' direct economic output from crop production. The severity of the impacts on output of this single year and other years during the Study Period also with very significant estimated losses of economic output is masked by a focus on the average impacts over the entire Study Period, which includes a number of years with small or no expected impacts due to more favorable hydrological conditions (wet or above normal years).

Table 10.5

Summary of Lost Direct Output (2008$)

Irrigation District	Reduction in Surface Water Supplies	Baseline	40% Unimpaired Flows	Revenue Loss (2008$)	% of Baseline
SSJID	Peak Reduction	$ 229,523,554	$ 126,662,869	$ 102,860,685	45%
	Average	$ 228,801,088	$ 212,475,927	$ 16,325,161	7%
Oakdale ID	Peak Reduction	$ 129,762,737	$ 82,644,121	$ 47,118,616	36%
	Average	$ 128,933,646	$ 121,470,102	$ 7,463,543	6%
SEWD/CSJWCD	Peak Reduction	$ 333,944,545	$ 227,700,476	$ 106,244,069	32%
	Average	$ 333,944,545	$ 321,069,973	$ 12,874,572	4%
Modesto ID	Peak Reduction	$ 149,761,947	$ 100,011,083	$ 49,750,865	33%
	Average	$ 147,767,555	$ 138,175,570	$ 9,591,985	6%
Turlock ID	Peak Reduction	$ 346,000,742	$ 242,042,147	$ 103,958,595	30%
	Average	$ 341,166,439	$ 318,812,129	$ 22,354,310	7%
Merced ID	Peak Reduction	$ 297,937,830	$ 112,010,174	$ 185,927,656	62%
	Average	$ 296,461,839	$ 274,710,763	$ 21,751,076	7%
Total	Peak Reduction	$ 1,486,931,356	$ 1,080,736,562	$ 406,194,794	27%
	Average	$ 1,477,075,112	$ 1,386,714,464	$ 90,360,648	6%

Figure 10.5 shows the substantial inter-year volatility in crop gross revenue losses due to the SED 40 assuming SGMA groundwater pumping restrictions. These losses are expected to often exceed $200 million annually.

Figure 10.5

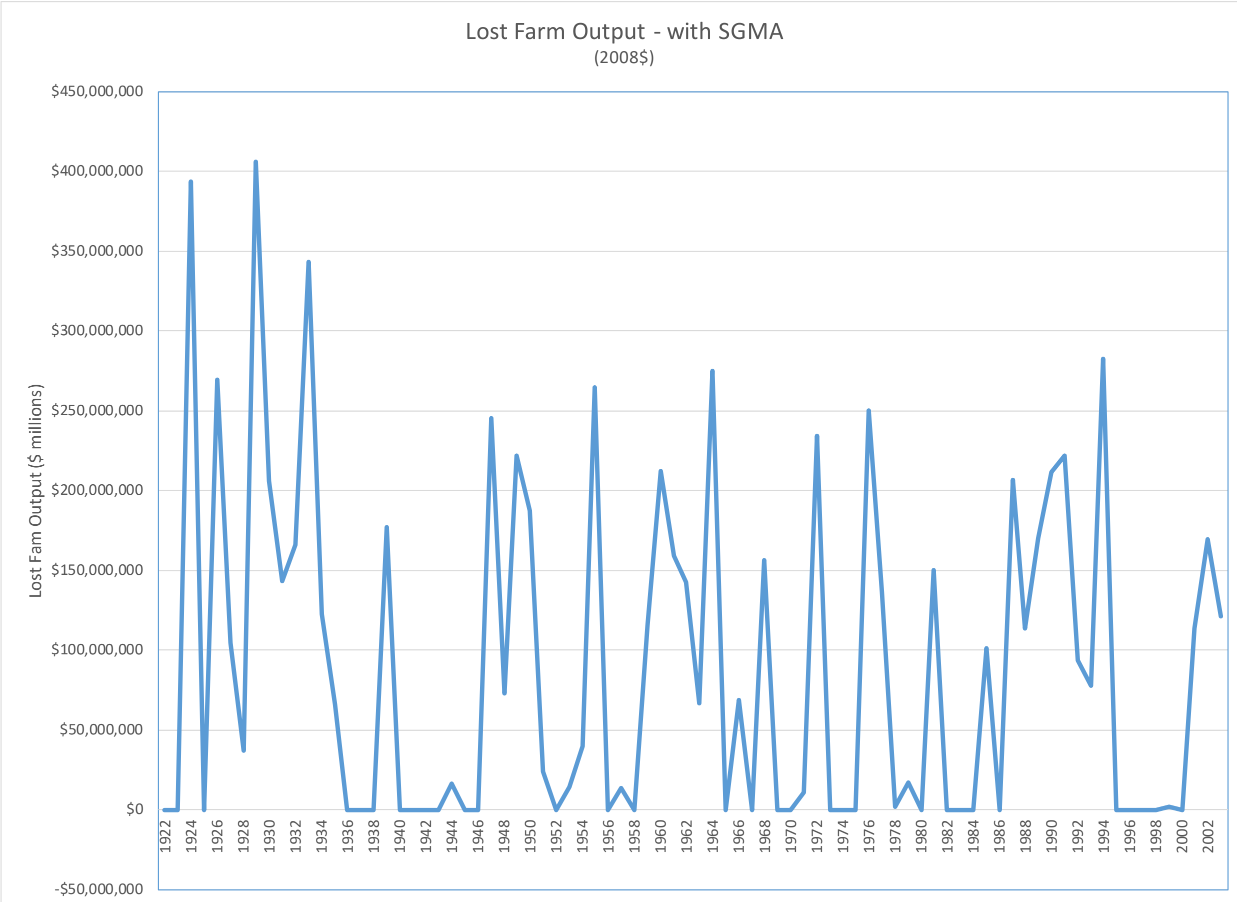


Table 10.6 summarizes the estimated direct farm sector employment impacts in the Irrigation Districts of the direct output impacts shown in Table 10.5. The estimates of employment impacts were derived applying the IMPLAN employment multipliers for the Study Area specific to each of the primary agricultural commodity sectors identified in the IMPLAN model. The table shows an average direct employment loss of about 467 jobs and a peak year employment loss of about 2,200 jobs, which represents about 28% of the estimated crop production employment within the Irrigation Districts.

Table 10.6

Direct Employment

Irrigation District	Scenario	Baseline	40% Unimpaired Flows Output Loss	% of Baseline
SSJID	Peak Reduction	1,417	599	42%
	Average	1,413	91	6%
Oakdale ID	Peak Reduction	784	284	36%
	Average	779	42	5%
SEWD/CSJWCD	Peak Reduction	1,251	558	45%
	Average	1,251	68	5%
Modesto ID	Peak Reduction	855	237	28%
	Average	846	49	6%
Turlock ID	Peak Reduction	2,241	490	22%
	Average	2,217	115	5%
Merced ID	Peak Reduction	1,753	943	54%
	Average	1,746	111	6%
Total	Peak Reduction	8,014	2,205	28%
	Average	8,250	467	6%

Figure 10.6 shows the substantial inter-year volatility in estimated crop production reduction-related job losses due to the SED 40 with SGMA groundwater pumping restrictions. These losses are expected in many years to exceed 1,000.

Table 10.7 summarizes the estimated total output impacts associated with the estimated reduction in Irrigation District crop production and, correspondingly, crop gross revenues during the Study Period because of the SED 40. These impacts include both the direct farm sector output impacts as shown in Table 10.5 and the additional secondary impacts because of the direct farm output impacts as farmers spend money in different sectors of the regional economy in support of their crop production activities and farm workers spend their income within the regional economy.

Figure 10.6

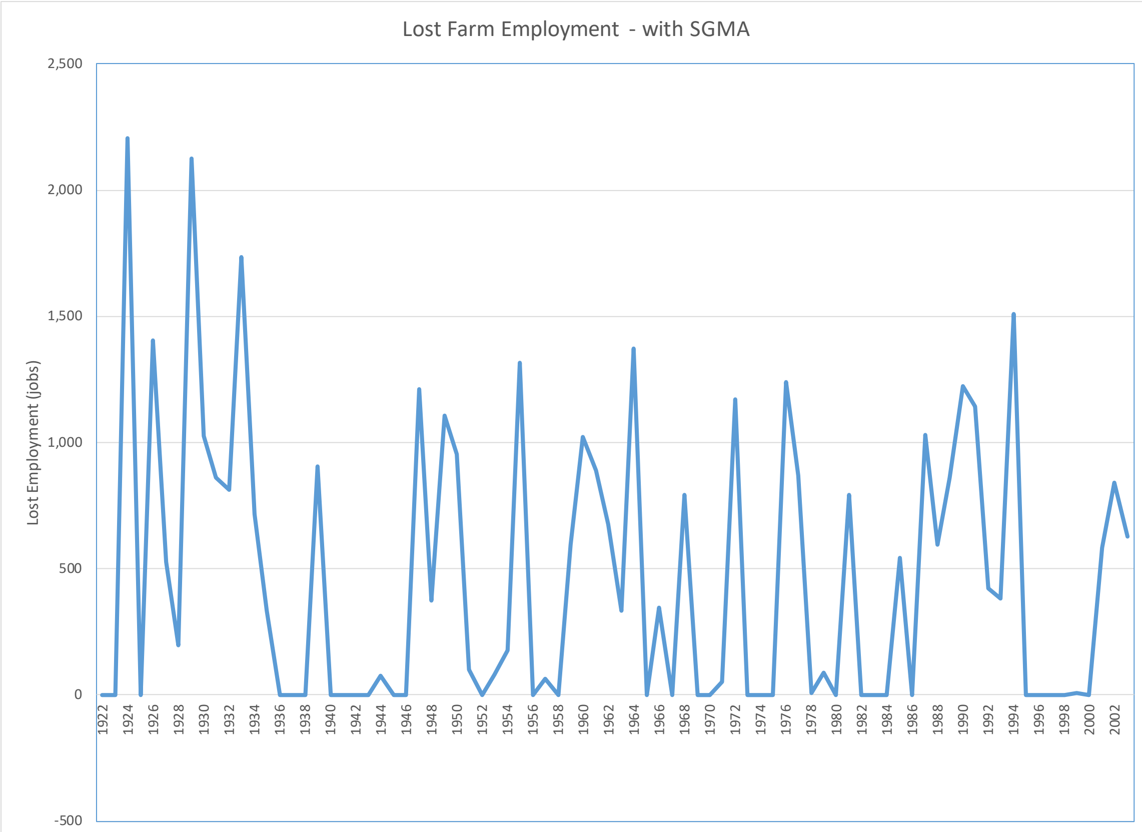


Table 10.7

Total Industrial Output (2008$)

Irrigation District	Scenario	Baseline	40% Unimpaired Flows Output Loss	% of Baseline
SSJID	Peak Reduction	$ 397,462,862	$ 179,548,022	45%
	Average	$ 396,197,635	$ 28,549,078	7%
Oakdale ID	Peak Reduction	$ 226,757,610	$ 83,002,887	37%
	Average	$ 225,296,538	$ 13,139,468	6%
SEWD/CSJWCD	Peak Reduction	$ 593,180,647	$ 188,501,506	32%
	Average	$ 593,180,647	$ 22,842,463	4%
Modesto ID	Peak Reduction	$ 261,247,277	$ 87,342,742	33%
	Average	$ 257,742,179	$ 16,855,846	7%
Turlock ID	Peak Reduction	$ 602,354,262	$ 182,501,504	30%
	Average	$ 593,853,035	$ 39,269,127	7%
Merced ID	Peak Reduction	$ 518,035,414	$ 325,879,007	63%
	Average	$ 515,441,215	$ 38,195,644	7%
Total	Peak Reduction	$ 2,599,038,072	$ 712,096,522	27%
	Average	$ 2,581,711,248	$ 158,827,683	6%

The table shows, for example, that the estimated contribution of the Irrigation Districts to Study Area total economic output averages almost $2.6 billion per year and the average reduction due to the SED 40 over the Study Period accounting for the SGMA is estimated at about $160 million or approximately 6% of that total output contribution. Concurrently, in the peak reduction year during the Study Period for the Irrigation Districts combined, the total impact on economic output is estimated at about $712 million or approximately 27% to the total output contribution of the Irrigation Districts.

Figure 10.7 shows the substantial inter-year volatility in total Irrigation District output losses due to the SED 40 with the SGMA. These losses are expected in many years to exceed $400 million.

Figure 10.7

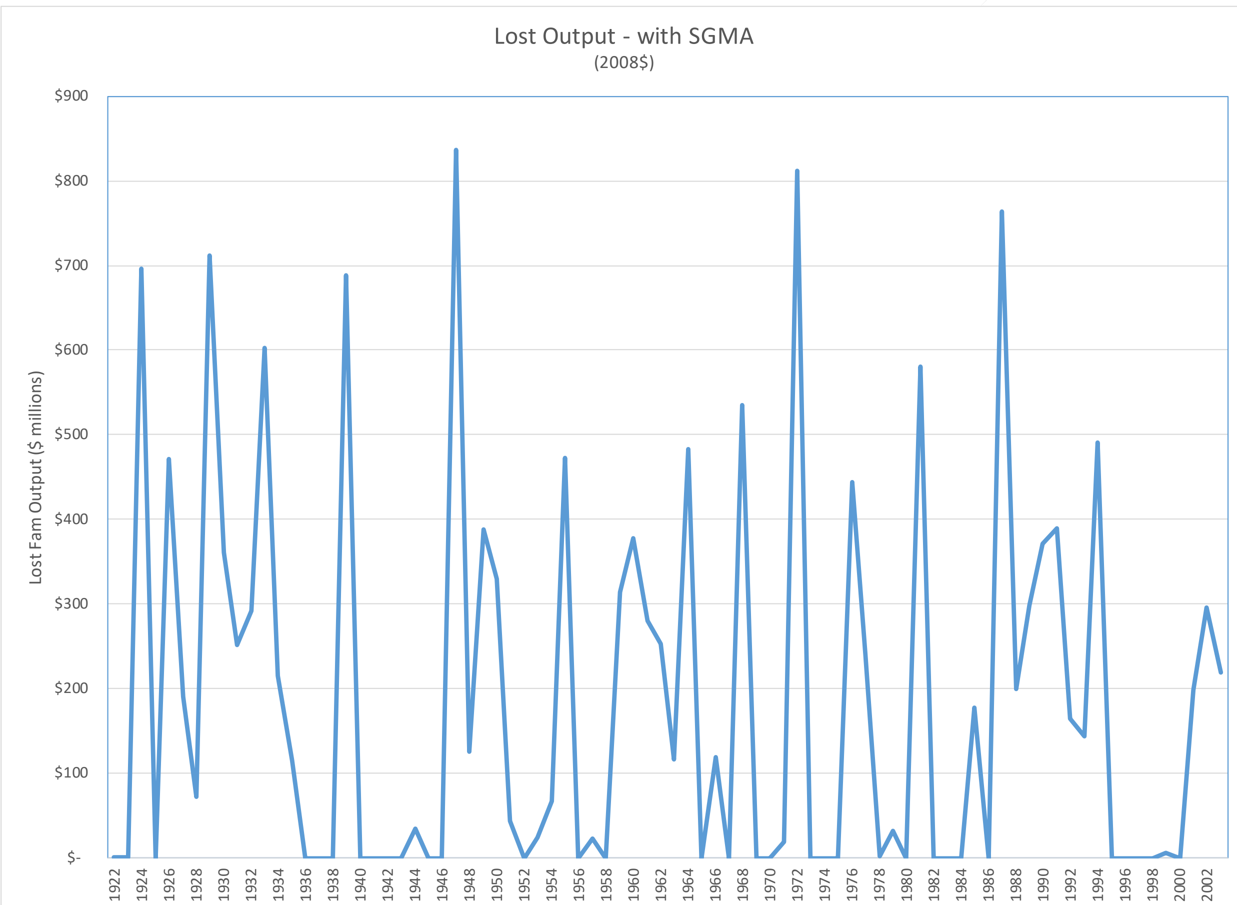


Table 10.8 summarizes the estimated total employment impacts of the SED 40 with the SGMA because of Irrigation District reductions in crop production. The jobs include the direct farm jobs shown in Table 10.6 as well as additional jobs within the Study Area economy (secondary employment impacts) associated with Irrigation District spending on non-labor inputs for farming and farm worker spending of their wages.

Table 10.8

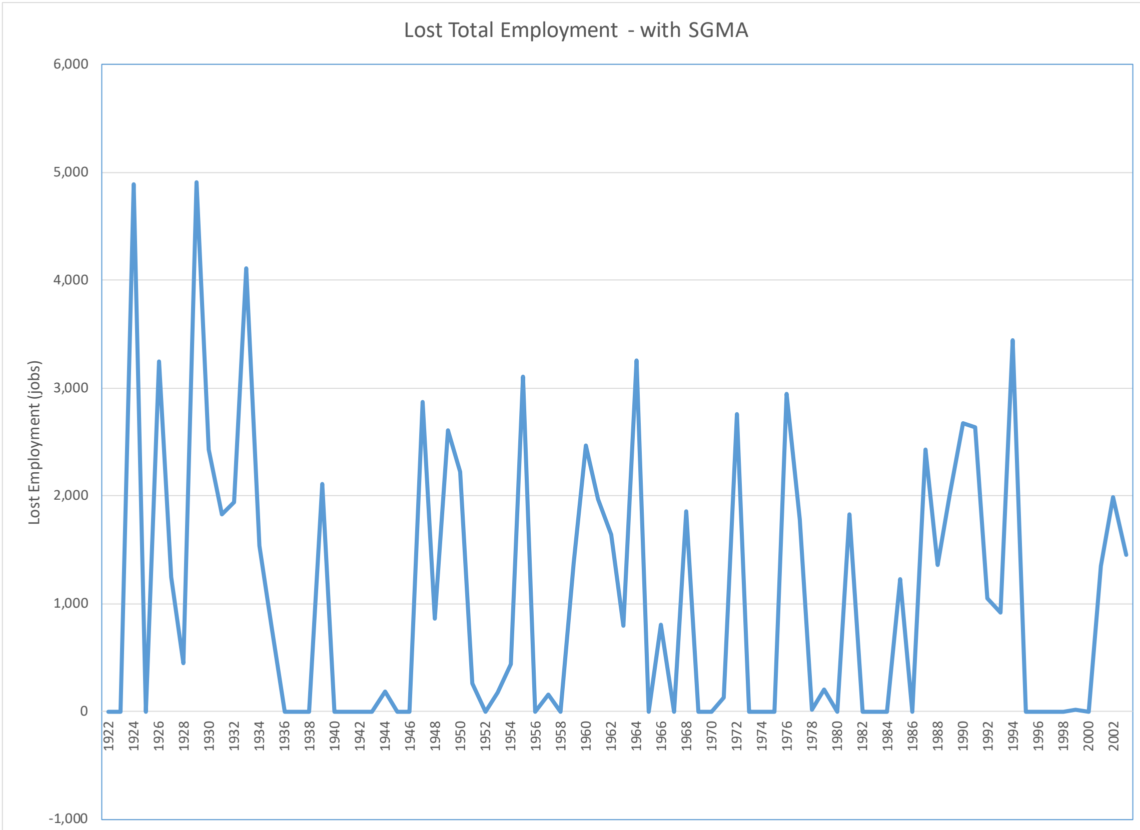
Total Employment

Irrigation District	Scenario	Baseline	40% Unimpaired Flows Output Loss	% of Baseline
SSJID	Peak Reduction	3,102	1,348	43%
	Average	3,093	209	7%
Oakdale ID	Peak Reduction	1,714	606	35%
	Average	1,703	93	5%
SEWD/CSJWCD	Peak Reduction	3,776	1,307	35%
	Average	3,776	158	4%
Modesto ID	Peak Reduction	1,937	583	30%
	Average	1,914	115	6%
Turlcck ID	Peak Reduction	4,681	1,204	26%
	Average	4,624	267	6%
Merced ID	Peak Reduction	3,882	2,259	58%
	Average	3,864	262	7%
Total	Peak Reduction	19,092	4,909	26%
	Average	18,975	1,082	6%

The table shows, for example, that the estimated contribution of the Irrigation Districts to Study Area total employment averages about 19,000 jobs and the average estimated reduction due to the SED 40 over the Study Period is estimated at 1,082 or approximately 6% of those total jobs. Concurrently, in the peak water supply reduction year during the Study Period for the Irrigation Districts combined, the total impact on employment is estimated at about 4,900 jobs lost or approximately 26% of the total crop production employment contribution to the Study Area by the Irrigation Districts.

Figure 10.8 shows the substantial inter-year volatility in total Irrigation District output losses due to the SED 40 accounting for SGMA restrictions on additional groundwater pumping. These losses are expected in many years to exceed 2,000 jobs.

Figure 10.8



B. Reduced Production by Dairy and Livestock Sectors

In addition to the Study Area economic impacts resulting directly from SED 40-related reductions in the Irrigation Districts' crop production and associated crop gross revenues, Stratecon also examined the resulting associated downstream impacts on the region's dairy and livestock production sectors who purchase feed from local grain and hay farmers and in turn provide milk and livestock to the region's dairy product manufacturers and meat processors, among other manufacturing activities. The region's milk production and downstream associated dairy processing sectors are collectively referred to herein as the "dairy sectors." The region's livestock production and downstream associated livestock slaughter, rendering and processing sectors are collectively referred to herein as the "livestock sectors."

4. Direct Output Impacts

Table 10.9 shows Stratecon's estimates of the upper bound average and peak year lost dairy and livestock sectors revenues expected to result from SED 40 reductions in regional feed crop availability both before and with SGMA implementation. These lost revenues represent the estimated upper bound potential direct economic output losses of the SED 40 within both sectors. For example, the table shows an average estimated annual loss of direct economic output in 2008$

for the region's dairy sectors before the SGMA of $156 million or about 3.6% of the region's estimated average dairy sectors economic output and a peak single year expected decline in dairy sectors economic output of about $763 million, about 17.7% of the region's estimated average dairy sectors output. The table also shows an average estimated annual loss of direct economic output in 2008$ for the region's livestock sectors before the SGMA of about $37 million or about 3.6% of the region's estimated average livestock sectors economic output and a peak single year expected decline in livestock sectors economic output of about $180 million, about 17.7% of the region's estimated livestock sectors output.

Table 10.9

Summary of Upper Bound Lost Dairy Sector Output (2008$)		Lost Direct Ouput SED 40%	Percent of Total Sector Output	Lost Direct Ouput SED 40% with SGMA	Percent of Total Sector Output
Total	Peak Reduction	$ 762,879,328	17.7%	$ 1,014,698,281	23.6%
	Average	$ 156,554,166	3.6%	$ 213,858,799	5.0%
Summary of Maximum Lost Livestock Sector Output (2008$)		**Lost Output SED 40%**	**Percent of Total Sector Output**	**Lost Output SED 40% with SGMA**	**Percent of Total Sector Output**
Total	Peak Reduction	$ 179,846,483	17.7%	$ 239,212,036	23.6%
	Average	$ 36,907,169	3.6%	$ 50,416,562	5.0%

Figures 10.9 and 10.10 show the substantial inter-year volatility in anticipated dairy and livestock sectors revenue losses due to the SED 40. Figure 10.9 indicates that dairy sectors direct output losses frequently exceed $100 million. Figure 10.10 indicates that livestock sectors direct output losses frequently exceed $40 million.

Figure 10.9

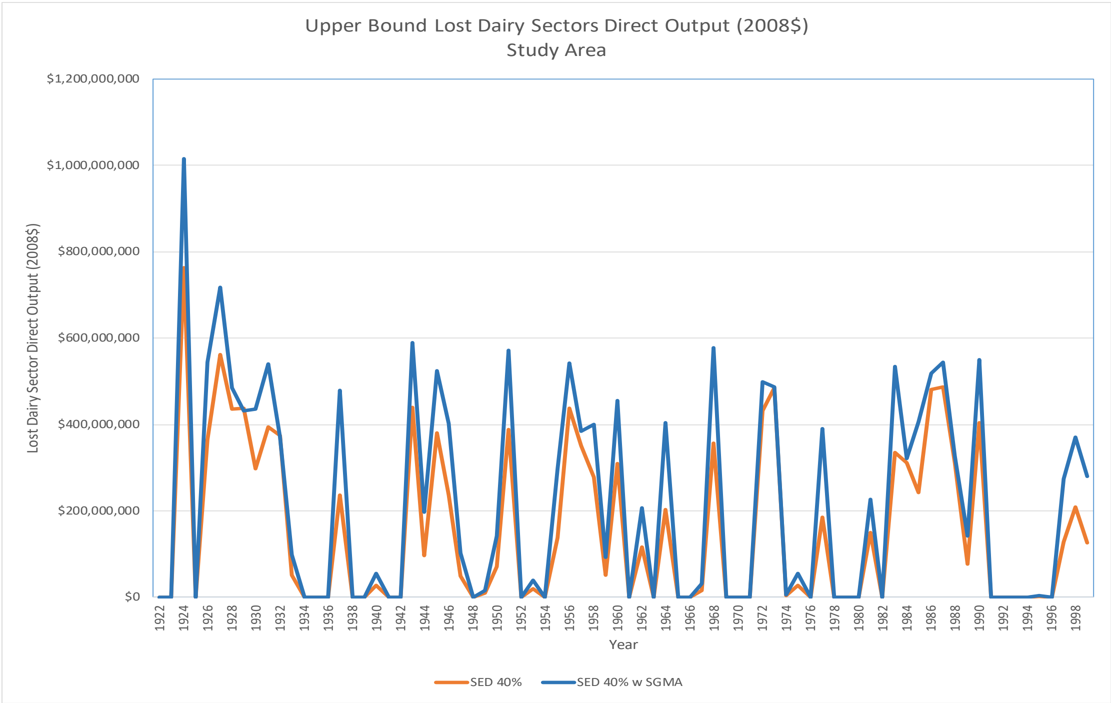
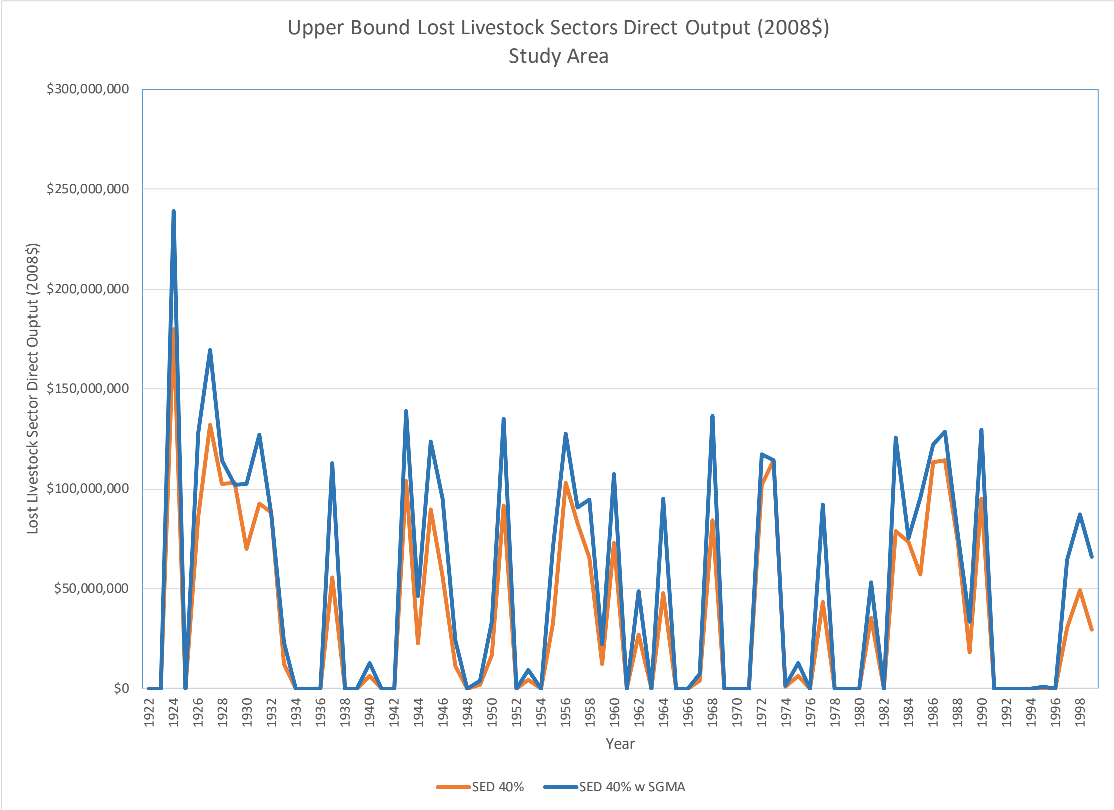


Figure 10.10



5. Direct Employment Impacts

Table 10.10 summarizes the estimated direct dairy and livestock sectors employment impacts of the direct output impacts shown in Table 10.9. These lost jobs represent the estimated upper bound potential direct economic employment losses of the SED 40 within both sectors. For example, the table shows an average estimated annual upper bound potential loss of direct employment for the region's dairy sectors before the SGMA of 415 jobs or about 3.6% of the region's estimated average dairy sectors economic employment and a upper bound peak single year expected decline in dairy sectors employment of about 2,021, about 17.7% of the region's estimated average dairy sectors employment. The table also shows an average estimated annual upper bound loss of direct employment for the region's livestock sectors before the SGMA of about 112 jobs or about 3.6% of the region's estimated average livestock sectors employment and a peak single year expected decline in livestock sectors employment of about 544 jobs, about 17.7% of the region's estimated livestock sectors employment.

Table 10.10

Summary of Upper Bound Lost Dairy Sectors Direct Employment		Lost Direct Employment SED 40%	Percent of Total Sector Employment	Lost Direct Employment SED 40% with SGMA	Percent of Total Sectors Employment
Total	Peak Reduction	2,021	17.7%	2,688	23.6%
	Average	415	3.6%	567	5.0%
Summary of Upper Bound Lost Livestock Sector Direct Employment		**Lost Direct Employment SED 40%**	**Percent of Total Sector Employment**	**Lost Direct Employment SED 40% with SGMA**	**Percent of Total Sector Employment**
Total	Peak Reduction	544	17.7%	724	23.6%
	Average	112	3.6%	152	5.0%

Figures 10.11 and 10.12 show the substantial inter-year volatility in estimated dairy and livestock sectors job losses due to the SED 40. Figure 10.11 indicates that dairy sectors direct employment losses frequently exceed 500 jobs. Figure 10.12 indicates that livestock sectors direct employment losses frequently exceed 150 jobs.

Figure 10.11

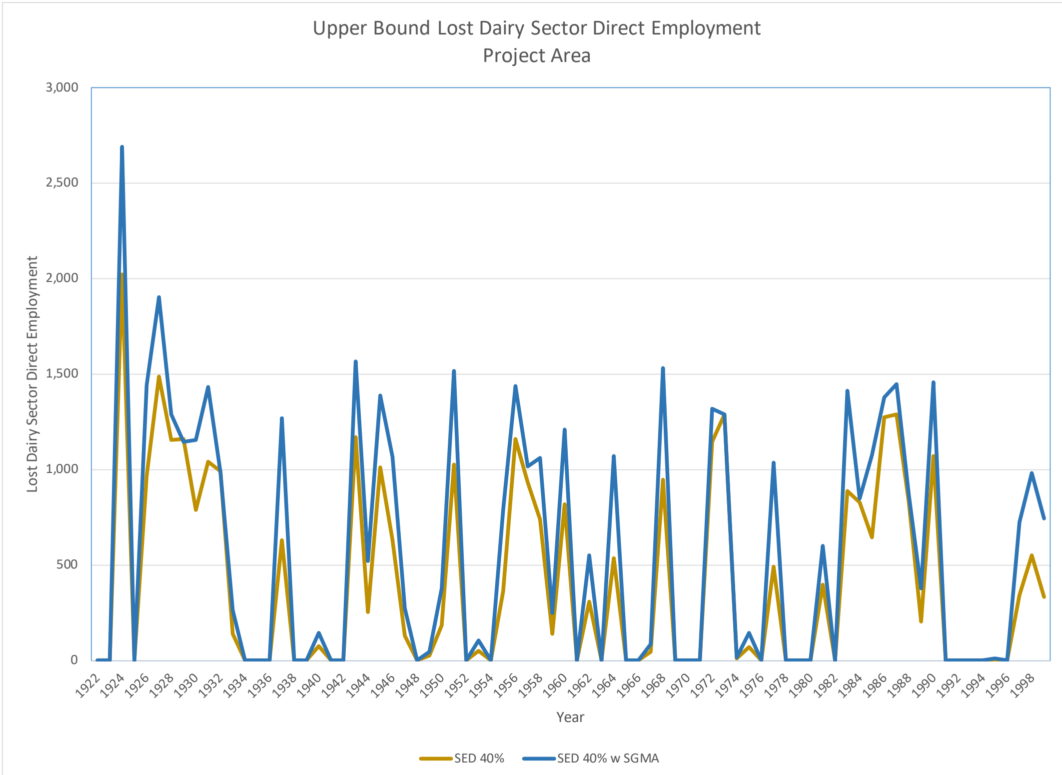
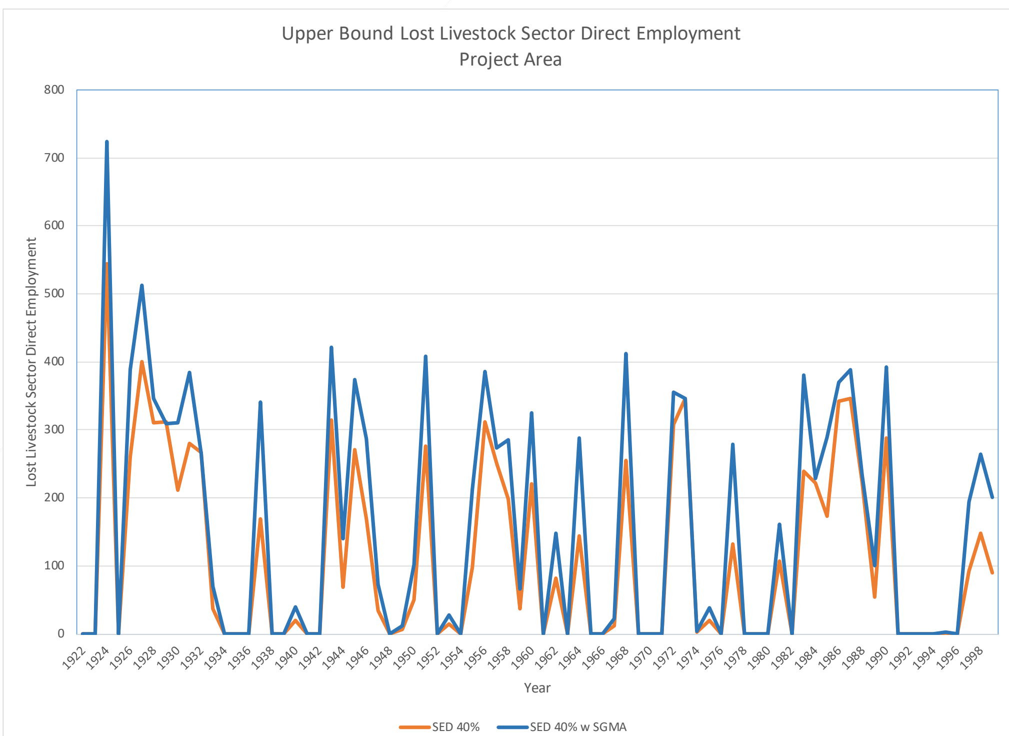


Figure 10.12



6. Total Output Impacts

Table 10.11 summarizes the total estimated Study Area economic output impacts of SED 40-related upper bound potential declines in regional dairy and livestock sectors production. These impacts include both the direct dairy and livestock sectors output impacts as shown in Table 10.10 and the additional secondary impacts because of the direct dairy and livestock sectors impacts as dairy and livestock enterprise operators spend money in different sectors of the regional economy in support of their dairy and livestock production activities, respectively, and workers within those sectors spend their income within the regional economy. To derive these secondary impacts, Stratecon made several adjustments to the IMPLAN model for 2010 for the three county Study Area. These adjustments included:

- Replacing the IMPLAN model's baseline data for output by the region's grain and other crop sectors (the latter includes hay crops) as the IMPLAN grain sector baseline output was substantially lower (~$80 million) than reported within the agricultural statistics for the three counties (~$350 million) and the other crop sector production about 15% lower than reported within the agricultural statistics for the three counties in 2010.
- Adjusting the Study Area's dairy sector (raw milk production) production function to remove the sector's flow through demand for grain and other crops (hay) so that the analysis of the impacts of the SED 40 on the dairy sector would not account for any portion of the impacts on the grain and other crops sectors separately addressed in the analysis of crop production impacts (to avoid double counting).
- Adjusting the Study Area's livestock sector (cattle and other livestock production) production function to remove the sector's flow through demand for grain and other crops (hay) so that the analysis of the impacts of the SED 40 on the livestock sector would not account for any portion of the impacts on the grain and other crops sectors separately addressed in the analysis of crop production impacts (to avoid double counting).
- Combining the four sectors within the IMPLAN model associated with dairy product manufacturing including the fluid milk and butter, cheese, ice cream and frozen dessert sector and ice cream and frozen dessert production sectors – collectively referred to as dairy manufacturing sectors.
- Adjusting the Study Area's dairy manufacturing sectors production function to remove the sectors' flow through demand for raw milk from the dairy sector so that the analysis of the impacts of the SED 40 on the dairy manufacturing sectors would not account for any portion of the impacts on the dairy sector separately addressed in the analysis of dairy sector impacts (to avoid double counting).
- Adjusting the Study Area's livestock slaughtering, rendering and processing sector ("livestock processing sector") production function to remove the sector's flow through demand for livestock (live cattle and other livestock) from the livestock sector so that the analysis of the impacts of the SED 40 on the livestock processing sector would not account for any portion of the impacts on the livestock sector separately addressed in the analysis of livestock sector impacts (to avoid double counting).

Table 10.11

Summary of Lost Output due to Upper Bound Dairy Sectors Production Reductions (2008$)		Lost Incremental Total Ouput SED 40%	Percent of Total Output due to Sector	Lost incremental Total Ouput SED 40% with SGMA	Percent of Total Output due to Sector
Total	Peak Reduction	$ 1,334,302,631	17.7%	$ 1,774,742,790	23.6%
	Average	$ 273,818,712	3.6%	$ 374,046,520	5.0%
Summary of Lost Output due to Upper Bound Livetock Sectors Production Reductions (2008$)		**Lost Incremental Total Ouput SED 40%**	**Percent of Output due to Sector**	**Lost Incremental Total Ouput SED 40% with SGMA**	**Percent of Output due to Sector**
Total	Peak Reduction	$ 316,952,658	17.5%	$ 421,575,610	23.3%
	Average	$ 65,043,392	3.6%	$ 88,851,686	4.9%

Note: Estimated incremental total output losses in addition to lost output due to SED-associated reductions in regional grain and other crop (grain and hay) production

The table shows, for example, that the estimated upper bound average reduction during the Study Period in regional economic output due to the estimated upper bound potential SED 40-related reduction in regional dairy sectors (includes dairy sector (raw milk production) and dairy manufacturing sector combined) production before SGMA implementation is about $274 million or 3.6% of the dairy sectors' estimated total output contribution to the regional economy. Concurrently, in the peak reduction year during the Study Period the upper bound total loss of regional economic output due to declines in dairy sectors production is estimated at about $1.33 billion or 17.7% of the dairy sectors' total estimated contribution to regional output.

The table further shows, for example, that the estimated average reduction during the Study Period in regional economic output due to the upper bound potential SED 40-related reduction in regional livestock sectors production before SGMA implementation is about $65 million or 3.6% of the livestock sectors' total output contribution to the regional economy. Concurrently, in the peak reduction year during the Study Period the upper bound total loss of regional economic output due to declines in in livestock sectors production is estimated at about $317 million or about 17.5% of the livestock sectors' total estimated contribution to regional output.

Figures 10.13 and 10.14 show the substantial inter-year volatility in estimated upper bound dairy and livestock sectors-driven output losses due to the SED 40. Figure 10.13 indicates that the estimated dairy sectors-related output losses frequently exceed $200 million. Figure 10.14 indicates that the estimated livestock sectors-related output losses frequently exceed $100 million.

Figure 10.13

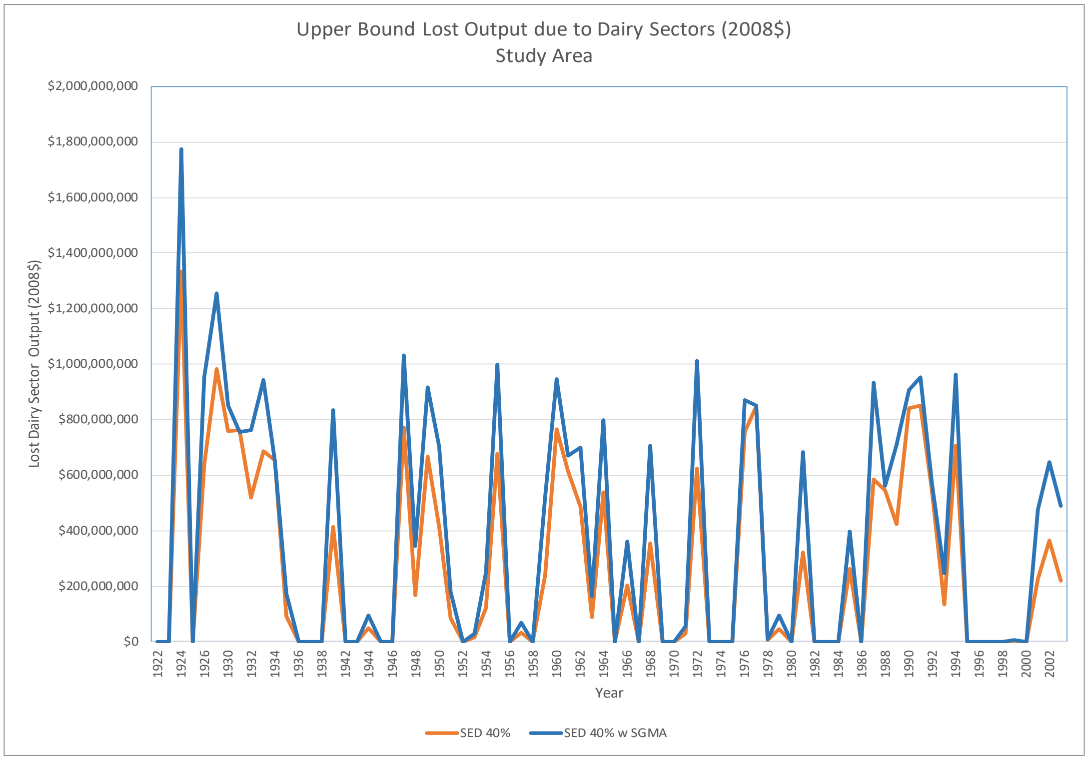
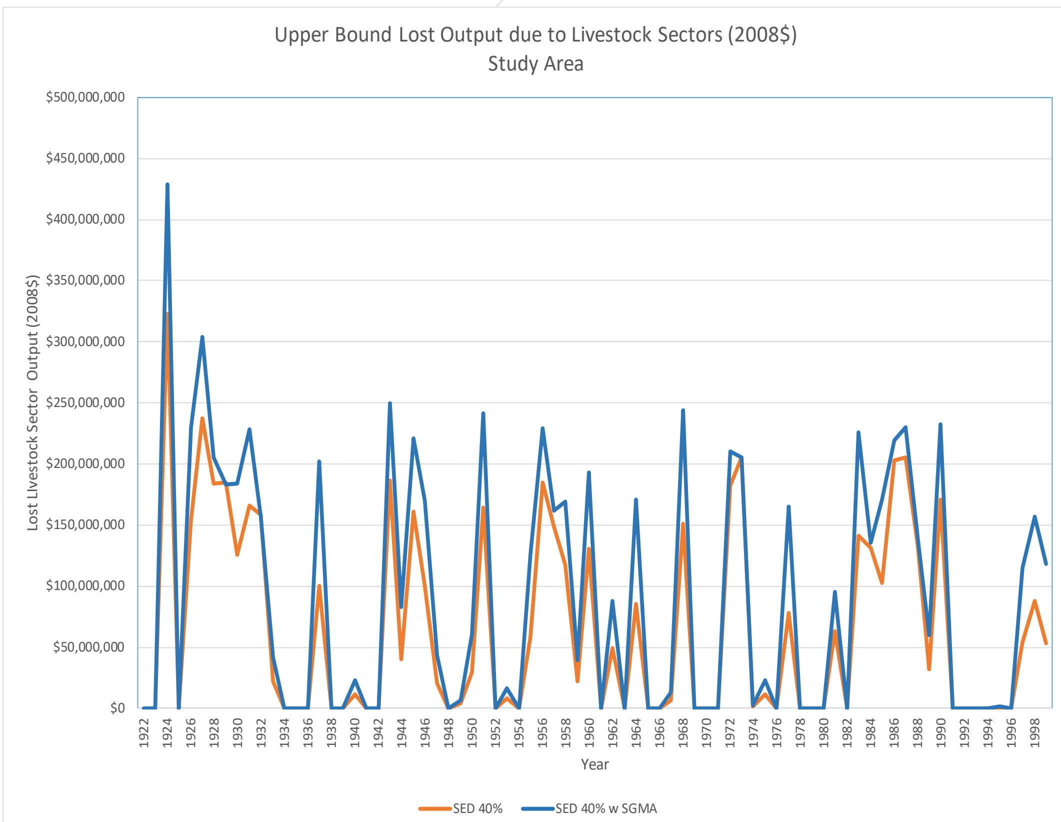


Figure 10.14



7. Total Employment Impacts

Table 10.12 summarizes the total estimated regional employment impacts of the direct output impacts shown in Table 10.9. These lost jobs represent the estimated upper bound potential economic employment losses within the Study Area economy due to the SED 40's impact on the region's dairy and livestock sectors. For example, the table shows an average estimated annual loss of employment associated with the region's dairy sectors before the SGMA of 1,015 jobs or about 3.2% of the region's estimated average dairy sectors economic employment and a peak single year potential upper bound decline in dairy sectors employment of about 4,944 jobs, about 15.4% of the region's estimated average dairy sectors employment. The table also shows an average estimated upper bound potential annual loss of direct employment for the region's livestock sectors before the SGMA of about 255 jobs or about 3.3% of the region's estimated average livestock sectors employment and a peak single year upper bound expected decline in livestock sectors employment of about 1,244 jobs, about 15.8% of the region's estimated livestock sectors employment.

Table 10.12

Summary of Upper Bound Lost Employment due to Dairy Sectors Production Reductions		**Lost Incremental Total Employment SED 40%**	**Percent of Total Sectors-Generated Employment**	**Lost Incremental Total Employment SED 40% with SGMA**	**Percent of Total Sectors-Generated Employment**
Total	Peak Reduction	4,944	15.4%	6,576	20.5%
	Average	1,015	3.2%	1,386	4.3%
Summary of Upper Bound Lost Employment due to Livestock Sectors Production Reductions		**Lost Incremental Total Employment SED 40%**	**Percent of Total Sectors-Generated Employment**	**Lost Incremental Total Employment SED 40% with SGMA**	**Percent of Total Sectors-Generated Employment**
Total	Peak Reduction	1,244	15.8%	1,654	21.1%
	Average	255	3.3%	349	4.4%

Note: Estimated incremental total employment losses in addition to lost employment due to SED-associated reductions in regional grain and hay crop production

Figures 10.15 and 10.16 show the substantial inter-year volatility in estimated regional job losses due to the SED 40's estimated potential upper bound impacts on the dairy and livestock sectors. Figure 10.15 indicates that the employment losses associated with the dairy sectors frequently exceed 500 jobs. Figure 10.16 indicates that livestock sectors direct employment losses frequently exceed 300 jobs.

Figure 10.15

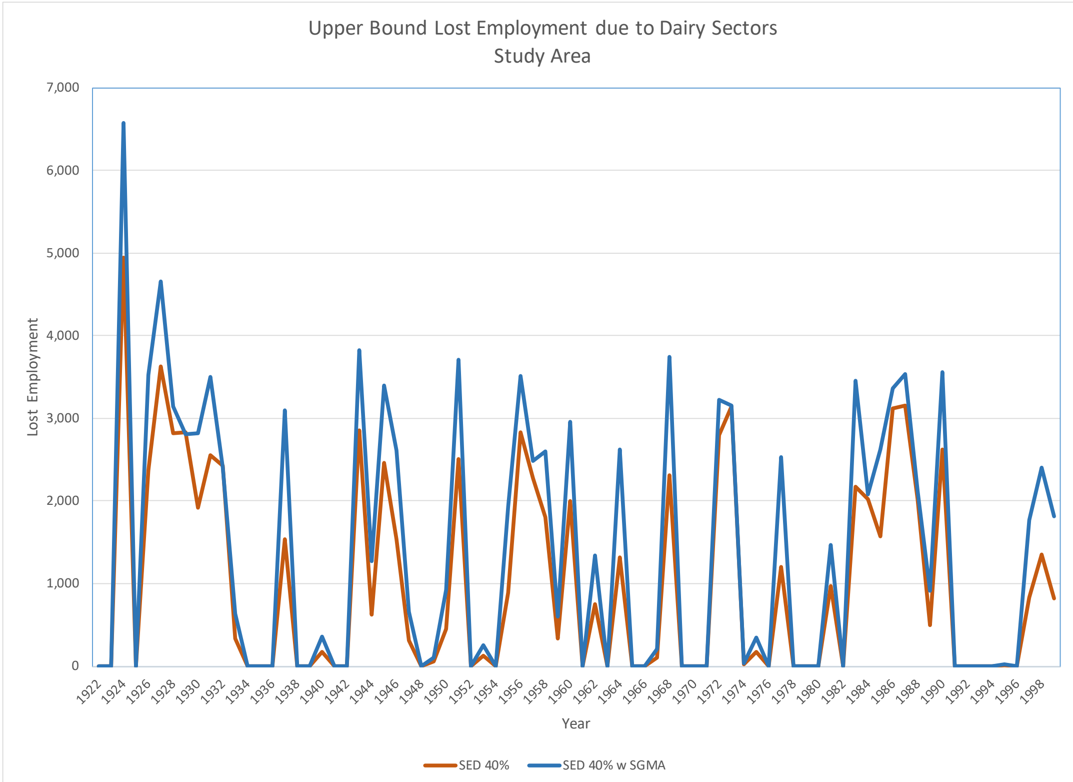
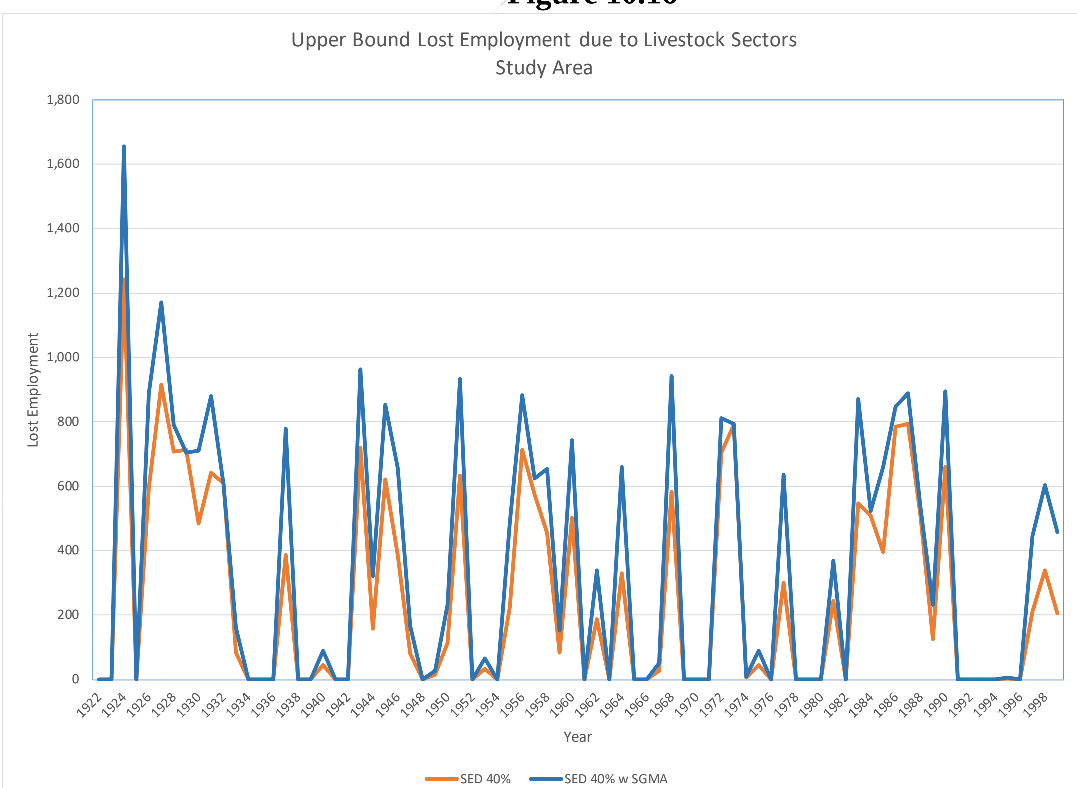


Figure 10.16



C. Increases in Irrigator Groundwater Costs

Implementation of the SED 40 before the SGMA could have substantial impacts on Study Area groundwater depths and, accordingly, groundwater pumping costs. These added costs extend not only to the Irrigation Districts existing pumping and additional pumping to offset lost surface water supplies but also irrigators outside the Irrigation Districts that rely entirely on groundwater for their water supplies. The increases in costs, as discussed and estimated previously, will result in corresponding decreases in farmer profit and farmer disposable incomes. The result will be reduced consumer spending regionally and associated lost regional economic output and employment. To evaluate these impacts Stratecon used the IMPLAN model household sector spending profiles to determine the weighted average regional output and employment impacts (multipliers) of each dollar spent by households. Stratecon then applied these multipliers to the estimated upper bound potential cost impacts on irrigators (lost income) in the Study Area of SED 40-related increases in groundwater depths. This translates the estimated lost income into regional spending and associated economic effects. Table 10.13 summarizes the results of this analysis.

Table 10.13

Upper Bound ID Cost of Irrigator Increased Groundwater Depths	Increased Cost	Total Ouput Impacts	Total Employment Impacts
Peak Increase in Cost	$ 101,513,377	$ 109,807,236	893
Average Increase	$ 25,310,496	$ 27,378,418	223
Upper Bound Outside Irrigator Cost of Increased Groundwater Depths	**Increased Cost**	**Total Ouput Impacts**	**Total Employment Impacts**
Peak Increase in Cost	$ 270,177,684	$ 292,251,778	2,376
Average Increase	$ 73,065,124	$ 79,034,700	643
Total Max Irrigator Cost of Increased Groundwater Depths	**Increased Cost**	**Total Ouput Impacts**	**Total Employment Impacts**
Peak Increase in Cost	$ 367,227,938	$ 397,231,244	3,230
Average Increase	$ 98,375,620	$ 106,413,118	865

The table indicates that the total output and employment impacts of the anticipated SED 40-related increases in irrigator groundwater pumping costs are estimated to be as much as about $106 million and 865 jobs on average per year, respectively, with peak single year impacts of as much as about $397 million and 3,230 jobs.

Figures 10.17 and 10.18 show the substantial inter-year volatility in estimated regional estimated output and job losses due to the SED 40's estimated potential upper bound impacts on irrigator groundwater costs. Figure 10.17 indicates that the output losses frequently exceed $100 million but in one year during the Study Period would have seen an increase due to reduced irrigator pumping costs due to lower groundwater elevations. Figure 10.18 indicates that the job losses frequently exceed 500 but in one year during the Study Period would have seen an increase due to reduced irrigator pumping costs due to lower groundwater elevations.

Figure 10.17

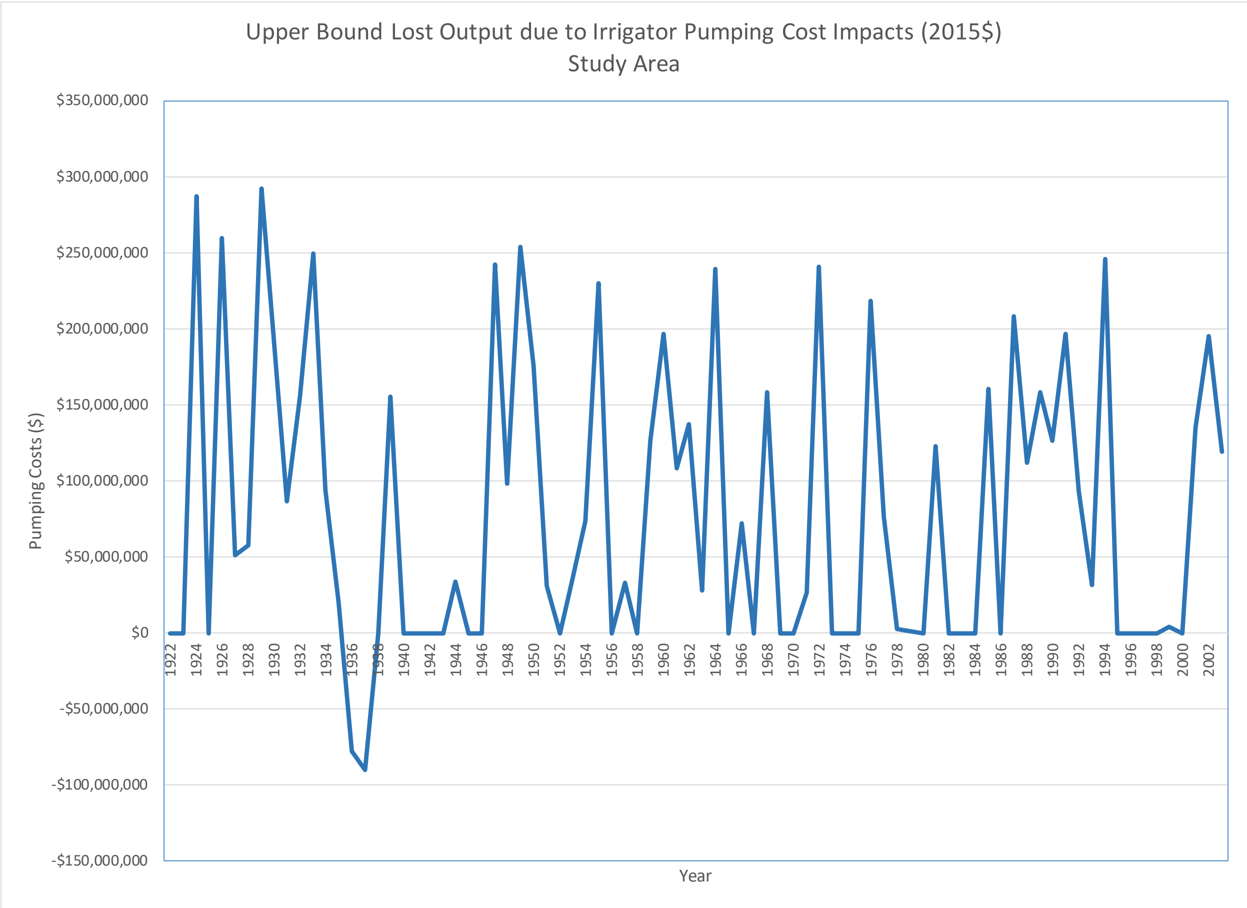
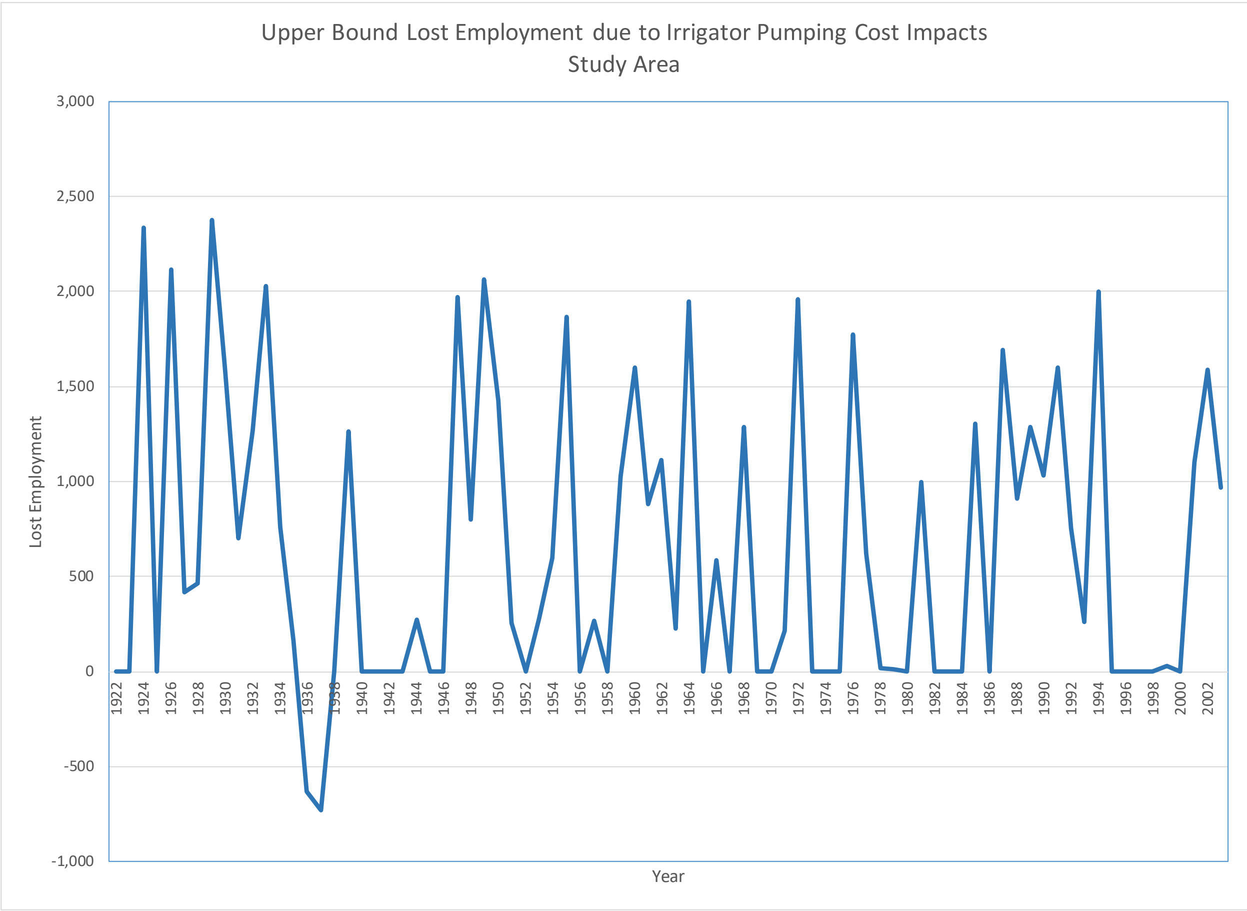


Figure 10.18



D. Increases in Community Groundwater Costs

SED 40-related impacts on groundwater depths and associated pumping costs will extend not only to the Study Area's irrigators but also its communities that rely mostly all, some in part, on groundwater for their water supplies. These added costs would be expected necessarily to ultimately be incurred by households and business and result in corresponding decreases in household disposable incomes and business incomes, respectively. The result will be reduced consumer spending regionally and associated lost regional economic output and employment. To evaluate these impacts Stratecon applied its estimates of the upper bound potential cost impacts on households in the Study Area of the SED 40 to its IMPLAN-based multipliers for regional economic effects of household spending. Table 10.14 summarizes the results of this analysis.

Table 10.14

Upper Bound DCMI Cost of Increased Groundwater Depths	Increased Cost	Total Ouput Impacts	Total Employment Impacts
Peak Increase in Cost	$ 89,462,327	$ 96,771,590	787
Average Increase	$ 23,025,416	$ 24,906,642	203

The table indicates that the upper bound output and employment impacts of the anticipated SED 40-related increases in community groundwater pumping costs are estimated to be as much as about $25 million and 203 jobs on average per year, respectively, with peak single year upper bound impacts of as much as almost $97 million and 787 jobs.

Figures 10.19 and 10.20 show the substantial inter-year volatility in estimated regional estimated output and job losses due to the SED 40's estimated potential upper bound impacts on community groundwater costs. Figure 10.19 indicates that the output losses frequently exceed $20 million but in one year during the Study Period would have seen an increase due to reduced community pumping costs due to lower groundwater elevations. Figure 10.20 indicates that the job losses frequently exceed 100 but in one year during the Study Period would have seen an increase due to reduced community pumping costs due to lower groundwater elevations.

Figure 10.19

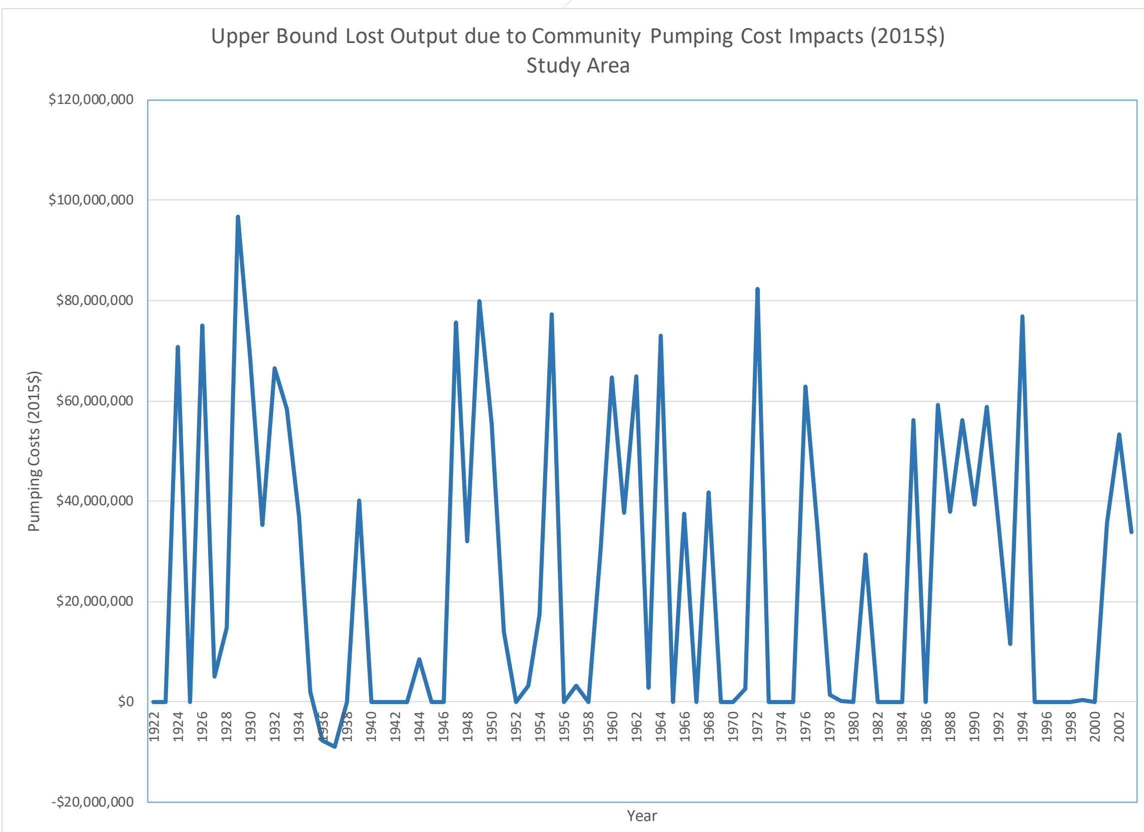
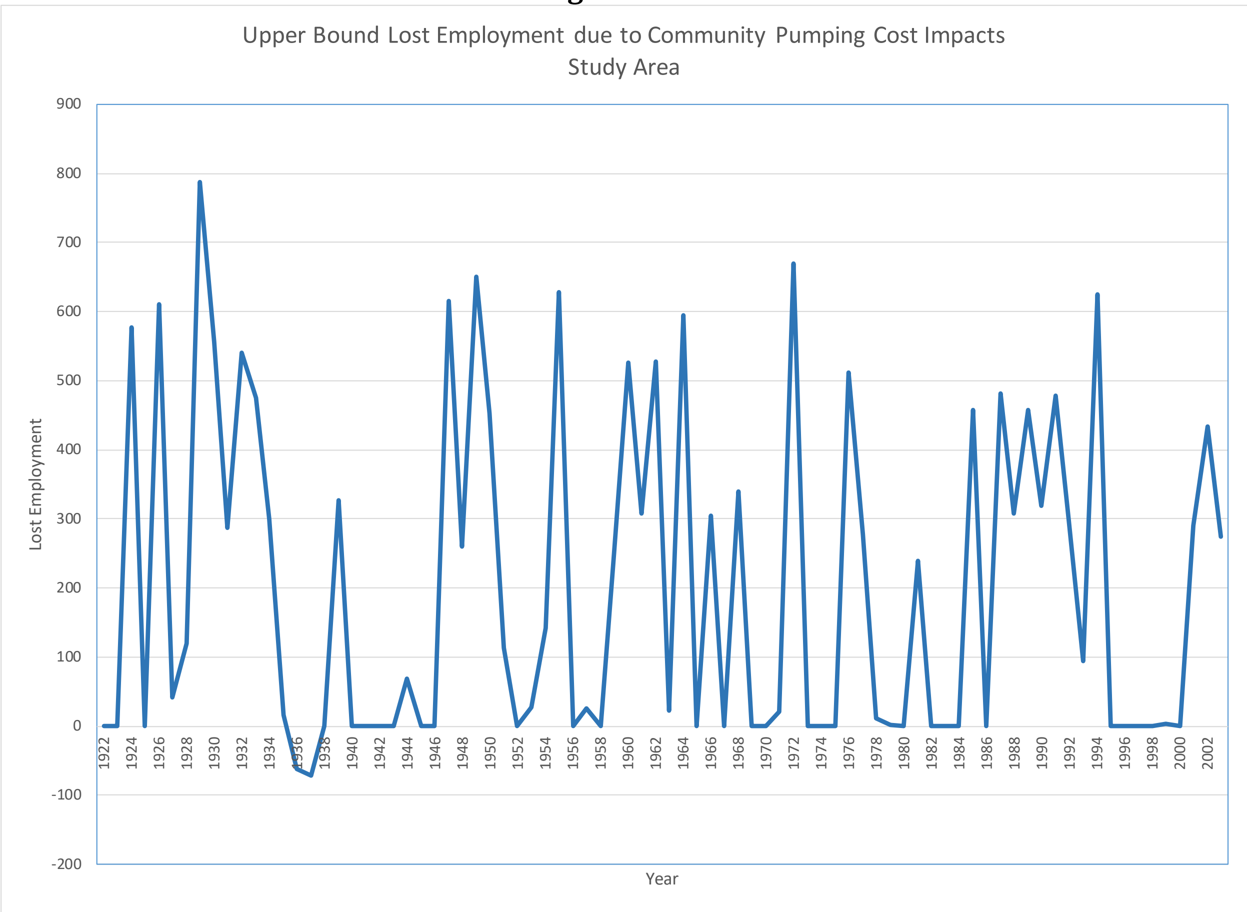


Figure 10.20



E. Conclusion

Tables 10.15 and 10.16 summarize the total upper bound output and employment impacts as estimated by Stratecon due to the SED 40 both before and with SGMA implementation. Table 10.15 shows, for example, that the estimated upper bound average annual total lost economic output and job losses within the Study Area that will result from the SED 40 before SGMA is as much as about $607 million (2015$) and 2,976 jobs, respectively. Table 10.16 shows, for example, that the estimated upper bound peak total lost economic output and job losses within the Study Area that will result from the SED 40 with SGMA is as much as almost $3.2 billion (2015$) and 13,206 jobs, respectively. These impacts don't account for a number of potential SED 40 impact sources including production reductions in sectors other than dairy and livestock downstream of, and that rely on, the farm sectors that will be directly impacted and regional community loss of surface water supplies (though as previously discussed, potential impacts from the loss of the subject surface water are embedded in the impact estimates associated with reduced crop production within the Irrigation Districts).

Table 10.15

Average During Study Period	Before SGMA			With SGMA		
Impact Category	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs
Reduced Crop Production Irrigation Districts	$ 57,589,316	$ 101,026,280	638	$ 100,024,842	$ 175,842,740	1,101
Reduced Dairy & Livestock Sectors Production (Upper Bound)	$ 213,996,694	$ 374,831,334	1,270	$ 292,327,424	$ 512,033,510	1,735
Increased Irrigation District Costs (Upper Bound)	$ 25,310,496	$ 27,378,418	223	N/A	N/A	N/A
Increased Other Irrigation Costs (Upper Bound)	$ 73,065,124	$ 79,034,700	643	N/A	N/A	N/A
Increased Urban Water Costs (Upper Bound)	$ 23,025,416	$ 24,906,642	203	N/A	N/A	N/A
Total	**$ 392,987,047**	**$ 607,177,374**	**2,976**	**$ 392,352,266**	**$ 687,876,250**	**2,835**

Table 10.16

Peak Year of Impacts During Study Period	Before SGMA			With SGMA		
Impact Category	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs	Lost Revenues/ Increased Cost (2015$)	Total Lost Output (2015$)	Total Lost Jobs
Reduced Crop Production Irrigation Districts	$ 259,856,755	$ 457,288,570	3,050	$ 449,311,194	$ 787,683,503	4,996
Reduced Dairy & Livestock Sectors Production (Upper Bound)	$ 1,042,793,423	$ 1,826,531,252	6,188	$ 1,387,009,263	$ 2,429,451,230	8,230
Increased Irrigation District Costs (Upper Bound)	$ 101,513,377	$ 109,807,236	893	N/A	N/A	N/A
Increased Other Irrigation Costs (Upper Bound)	$ 270,177,684	$ 292,251,778	2,376	N/A	N/A	N/A
Increased Urban Water Costs (Upper Bound)	$ 89,462,327	$ 96,771,590	787	N/A	N/A	N/A
Total[1]	**$ 1,735,395,477**	**$ 2,751,921,335**	**12,739**	**$ 1,822,286,141**	**$ 3,194,565,527**	**13,206**

1. Represents peak year for all categories combined so may differ from sum of peak year figures for each category.

11. CONCLUDING OBSERVATIONS

The proposed SED will fundamentally alter the water resource portfolios of Merced, San Joaquin and Stanislaus counties. In its assessment of the impacts of the SED unimpaired flow proposals, SWRCB staff failed to address the resulting water supply reliability, sustainability and volatility issues that will confront the counties.

Instead, the SWRCB economic analysis assumes that groundwater pumping will expand to fully offset the loss of surface water supplies until groundwater pumping capacity is exhausted. This full offset assumption is inconsistent with the evidence from Westlands Water District's actual response to increased variability in, and lower levels of, available surface water supplies. Large increases in groundwater pumping is also inconsistent with the fact that groundwater basins in the Study Area are severely over-drafted, well elevations are on a declining trend and all Study Area sub-basins have been designated as "high priority" for action under SGMA.

The SWRCB staff severely underestimated the economic impacts of the proposed flow objective on the local economies. Land fallowing will initially be 60% higher than predicted by SWRCB staff. Once SGMA is implemented, the impact will be almost three times higher. This will result in substantial declines in regional agricultural production and associated economic output.

The proposed flow objective introduces a new factor into the local economy—increased volatility in surface water supplies. With reliable surface water supplies falling by 60%, the foundation of the regional agricultural and associated sector investment is completely undermined. Water users can manage their losses by engaging in increased conjunctive use of the highly variable surface water supplies with groundwater. Perhaps the 366 TAF increase in the expected annual yield of unreliable surface water supply under the proposed flow objective can be managed conjunctively to yield 180 TAF of firm water supplies. Surface water users and the local economy more generally still stand to lose more than 400 TAF of reliable surface water supplies. This will result in a structural change to the regional economy that will result in lost jobs, income and tax revenues.

The impact of the proposed flow objective on the local economies is obscured by averages. Peak estimated impacts are more than four-fold the averages. Economic risks are severe. The proposed flow objective will change the course of investment and growth far beyond the impacts on which SWRCB focuses, that of relatively small average reductions in lower valued crops such as grains, alfalfa and pasture.

The proposed flow objective will put the local economies in the three counties on the pathway to retrenchment. The large reduction in reliable surface water supplies and long-term cutback in groundwater pumping under SGMA is at odds with the rapid population growth for the region predicted by the Department of Finance and any meaningful associated and necessary economic growth. Disadvantaged and severely disadvantaged communities where most households in the region reside will face water supply challenges comparable to other communities in the Central Valley struggling with the loss of surface water supplies from the Central Valley

Project. Residents in these communities will experience job losses from the reduced farm economy and escalating water rates caused by lost water supplies.

Future Economic Impacts

The future economic impact of the SED on the local economies in the Study Area depends on the timing of SED implementation and SGMA implementation. With the SWRCB currently anticipated to decide by Summer 2017, SED implementation is assumed to start in 2018. Since the Department of Water Resources has designated all sub-basins in the Study Area as high priority and over drafted, SGMA implementation would start in 2020 and must be fully implemented within 20 years (2039).[38] Therefore, the economic impact of the SED would be captured by the pre-SGMA scenario for 2018 and 2019. Thereafter, the economic impact of the SED would be a mix of the pre-SGMA and post-SGMA scenario during the SGMA implementation period (2020-2039) and only the post-SGMA scenario after full implementation.[39]

As discussed in Section 10, the economic impact of SED depends on hydrologic conditions. Stratecon conducted a Monte Carlo study of future hydrologic conditions for a 40-year time horizon starting in 2017 based on the Sequential Index Method.[40] The impact of SED over the 40-year time horizon is measured by the present value of lost economic output.[41]

Figure 11-1 presents how the present value of lost economic output from the SED varies with actual 2017 hydrologic conditions. The expected present value of lost economic output over the 50-year horizon totals $14.49 billion. Depending on actual 2017 hydrologic conditions, the present value of lost economic output revenues range from a low of $10.45 billion (if 2017 hydrologic conditions are the same as water year 1934 and hydrologic conditions in subsequent years follow the sequence in the historical record) to a high of $18.43 billion (if 2017 hydrologic

[38] See Sustainable Groundwater Management Act of 2015, Frequently Asked Questions, Association of California Water Agencies, http://www.acwa.com/sites/default/files/post/groundwater/2014/04/2014-groundwater-faq-2.pdf.

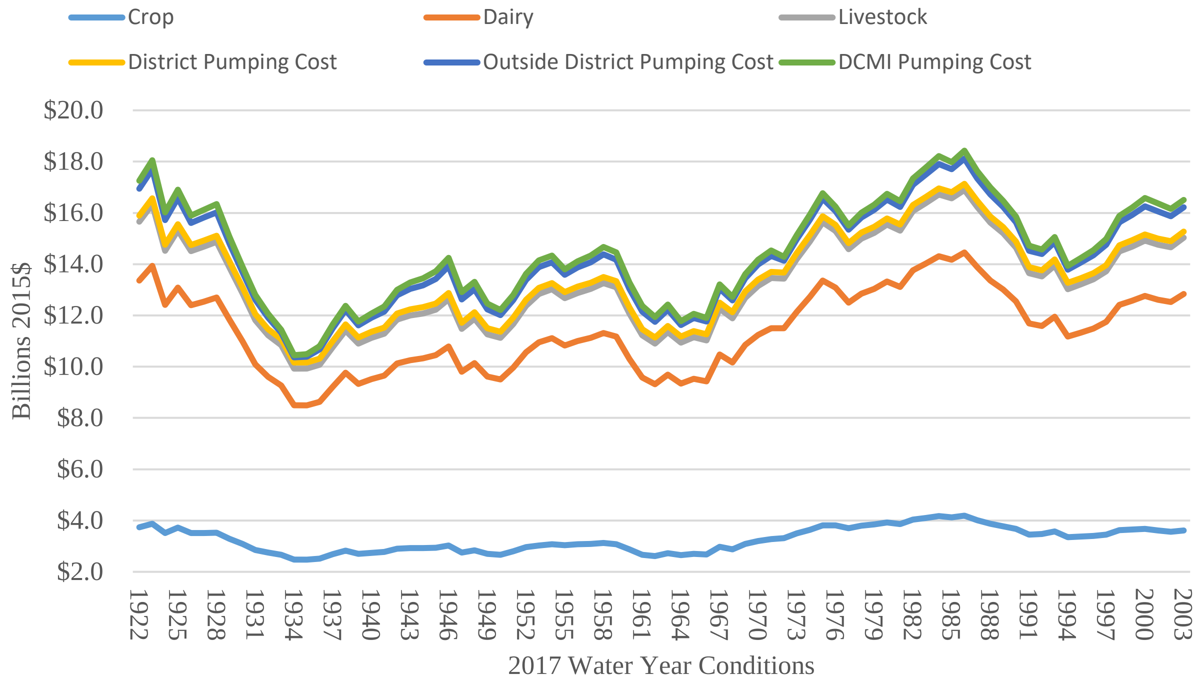
[39] The analysis assumes that SGMA implementation steadily builds up over the 20-year period with a 5% weight given to the post-SGMA scenario in 2020, 10% weight for 2021, with the weight on the post-SGMA scenario growing by 5% each year until a 100% weight is given to the post-SGMA scenario by 2039.

[40] A Monte Carlo study uses repeated random sampling from statistical distributions to obtain numerical results, see ttps://en.wikipedia.org/wiki/Monte_Carlo_method. In this instance, the numerical result is the present value of the annual loss of economic output from the SED. The sequential index method uses the hydrologic record as the statistical distribution for future water year conditions. It assumes that the hydrologic conditions for 2017 are equally likely to be any of the water years in the historic record 1922-2003. Hydrologic conditions in subsequent years follow the sequence of hydrologic conditions in the historic record. When the sequence reaches the last year of the historic record (2003), hydrologic conditions “wrap around” to the water year condition for 1922 and subsequent years for the remainder of the 40-year time horizon.

[41] The calculation uses an interest rate of 5.5%, 100 basis points above the long-term yield on 10-year Treasury Notes. The projections assume that the annual impact of SED is constant in real terms. Therefore, the estimated annual output loss is increased by 2.5% per year, the long-term expected rate of inflation. The discount rate used in the calculation of present value is the real interest rate (2.9%) implied by an interest rate of 5.5% and expected inflation of 2.5%. For discussion of interest rates and expected inflation, see http://hydrowonk.com/blog/2013/01/11/project-evaluation-ii-thoughts-about-interest-rates/.

conditions are the same as water year 1986 and hydrologic conditions in subsequent years follow the sequence in the historical record).

Figure 11-1
Present Value of Lost Economic Output from SED
by 2017 Water Year Condition
(40-Year Valuation Horizon)



The economic loss related to reduced crop output accounts for less than one-fourth the total loss (see Table 11-1). The downstream impact on dairy sectors is the largest source of loss in economic output, accounting 56.0 percent of the total loss. The downstream impact on the livestock sectors accounts for 13.3 percent of the total loss. The lost output from the increased cost of groundwater pumping, while material, represents only 8.1 percent of total losses. This small share reflects the fact that increased groundwater pumping will only occur during the short run until SGMA is fully implemented.

Table 11-1
Composition of Lost Economic Output from SED Implementation

Component	*Expected Present Value (billions 2015$)*	*Share*
Crop Output	$3.26	22.5%
Dairy Sectors	$8.12	56.0%
Livestock Sectors	$1.93	13.3%
Increased Pumping		

Irrigation Districts	$0.24	1.6%
Outside Irrigation Districts	$0.71	4.9%
DCMI	$0.23	1.6%
Total	$14.49	100.0%

Delay in the start of SGMA implementation or a faster period for SGMA to reach full implementation has a secondary effect on the expected present value of lost economic output (see Table 11-2). Delay in the start of SGMA implementation from year 2020 to year 2025 reduces the expected present value of lost economic output by about $300 million (2015$). Faster SGMA implementation increases the expected present value of lost economic output by about $300 million (2015$).

Table 11-2
Expected Present Value of Lost Economic Output from SED and SGMA Timing
(billion 2015$)

Years to Full SGMA Implementation	Year SGMA Initiated	
	2020	2025
10	$14.82	$14.49
15	$14.66	$14.33
20	$14.49	$14.18

SED implementation will fundamentally transform the investment environment for agriculture and related industries. Lost water supplies reduce locally produced inputs for livestock and dairy operations. The volatility in locally produced inputs will more than triple the risk of shortfalls in available local inputs (see Table 11-3).[42] For hay and pasture, expected unused capacity increases from 4% under baseline conditions to 23% under SED implementation before SGMA and 29% after SGMA implementation. For grain, expected unused capacity increases from 1% under baseline conditions to 7% under SED implementation before SGMA and 11% after SGMA implementation. The average unused capacity for hay and pasture inputs when shortfalls happen increase from 4% under baseline conditions to 23% under SED implementation before SGMA and 29% under SED implementation after SGMA. The average unused capacity for grain inputs when shortfalls happen increase from 3% under baseline conditions to 11% under SED implementation before SGMA and 17% under SED implementation after SGMA. Peak unused capacity almost doubles for hay and pasture inputs and increases four-fold for grain inputs.

[42] Local capacity estimated by the maximum amount of locally produced inputs (measured by acreage in alfalfa and irrigated pasture for livestock and silage for dairy). Capacity utilization measured by ratio of crop acreage for each water year hydrologic condition to local capacity. Shortfall risk equals percentage of years crop acreage is less than local maximum. Unused capacity measured by 100% less capacity utilization.

Table 11-3
Risk of Shortfalls in Locally Produced Inputs for Livestock and Dairy

Item	Hay/Pasture			Grain		
	Baseline	SED-Pre SGMA	SED-Post SGMA	Baseline	SED-Pre SGMA	SED-Post SGMA
Shortfall Risk	18%	61%	61%	18%	61%	61%
Average Unused Capacity	4%	23%	29%	1%	7%	11%
Average Unused Capacity When Shortfall	21%	37%	48%	3%	11%	17%
Peak Unused Capacity	53%	89%	94%	11%	43%	56%

This increased risk in unused capacity reduces the economic incentive for investment. The impact on the local economy from the reduced investment is not considered in this study. Therefore, this study understates the economic consequences of SED implementation for the local economies.

Attachment 1

Westlands Water District: A Case Study of the Impact of Reduced Surface Water Supplies on Agriculture and Groundwater

Central Valley Project ("CVP") agricultural water users south of the Delta have experienced substantial and regular reductions in the availability of surface water supplies since the early 1990s. The almost quarter century of experience of the Westlands Water District provides evidence on how reduced availability of surface water impacts land fallowing, cropping patterns, groundwater pumping and groundwater elevations.

CVP Water Allocations

The history of CVP water allocations can be divided into two eras (see Figure A1.1).[43] Before the 1990s, CVP allocations for South of Delta agricultural water users were 100% of contractual entitlements other than during the severe 1977 drought. Water allocations fell again during the early 1990s drought. Despite recovery in hydrologic conditions, CVP water allocations have reached 100% in only three years in the last twenty years. There has been a fundamental change in the availability of CVP surface water.

Availability of Surface Water and Land Fallowing

Reduced availability of surface water has resulted in increased land fallowing (see Figure A1.2).[44] About 50,000 acres are fallowed annually regardless of the availability of surface water (this represents about once in a decade fallowing as part of rotational cropping plans). Land fallowing varies between 50,000 acres and 100,000 acres for CVP allocations above 40%. The amount of fallowing at least doubles when CVP allocations fall below 40%.

Availability of Surface Water and Cropping Patterns

Westlands cropping patterns respond to the availability of surface water (see Figure A1.3).[45] A 10 percentage point increase in CVP water allocations expands acreage in field crops by 7.2%, hay crops and pasture by 7.1%, fruit by 4.3%, vegetables by 2.3% and trees and vines by

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[43] Summary of Water Supply Allocations, http://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf

[44] Westlands Water District, District Water Supply Charts, http://wwd.ca.gov/wp-content/uploads/2016/06/Water-Supply-Charts.pdf.

[45] Chart A1-3 summarizes the findings of a statistical study of Westland cropping patterns (see Attachment 1-1).

0.1%. Acreage in double cropping increases by 13.5%. Acreage not harvested and fallowed declines, respectively, by 23.8% and 13.5%.

Availability of Surface Water and Groundwater Pumping

The availability of CVP surface water has a large effect on groundwater pumping by Westlands landowners (see Figure A1.4).[46] A 10 percentage point increase in CVP allocations reduces groundwater pumping by about 60,000 AF. With a CVP contractual entitlement of 1,195,000 acre feet, groundwater pumping falls by 50% of the increase in available surface water supplies.[47]

Impact on Well Elevations

Well elevations in Westlands are driven by groundwater pumping and local rainfall (see Table A1.1).[48] Well elevations fall by 0.90 feet per 10,000 acre-feet of groundwater pumping. Well elevations increase with local rainfall at the rate of 3.29 feet per inch of rainfall. Both of these estimated effects are statistically significant as reflected in the high T-statistics and low P-values. The annual variation in groundwater pumping and local rainfall generally explains the annual variation in the annual change in well elevations in Westlands (see Figure A1.5).

Table A1.1
Statistical Model of Annual Change in Average Well Elevations in Westlands
(1988-2015)

Item	*Coefficient*	*T-Statistic**	*P-Value***
Intercept	-18.93	-0.92	36.6%
Groundwater Pumping (10,000 acre-feet)	-0.90	-3.44	0.2%
Local Rainfall (inches)	3.29	2.26	3.3%
$R^2 = 0.52$			

***** ratio of coefficient to the standard deviation of estimated coefficient

** probability of the estimated coefficient if its true value were zero

A sustained 10 percentage point reduction in CVP allocations will have a large impact on well elevations. As discussed above, groundwater pumping increases by 60,000 acre-feet per year

[46] Deep Groundwater Conditions Report, Westlands Water District, April 2016, p. 10.

[47] A 10 percentage point increase in CVP allocation results in a 119,500 acre-foot increase in available CVP surface water supplies, which is approximately half the estimated impact of a 10 percentage point increase in CVP allocation on groundwater pumping (-59,761.7 acre feet).

[48] Deep Groundwater Conditions Report, p. 10 for change in annual average well elevations in Westlands. Data based on measured elevations in wells not operating in December of each year. Local rainfall measured at Fresno Yosemite International Airport.

in the face of this surface water supply reduction. Average well elevations will fall by 5.4 feet per year for the duration of the supply loss.[49] Within a decade, well elevations will be 54 feet lower.

Lessons from the Westlands Case Study

The fall in the level and increased variability in Westlands' CVP allocations provides evidence on the impact of surface water availability on land fallowing, cropping patterns, groundwater pumping and well elevations. Landowners respond to reduced surface water along many dimensions: land fallowing, cropping patterns and increased groundwater pumping. The quantitative impacts from variability in surface water supplies are material and statistically significant.

The circumstances of Westlands, of course, may not be strictly comparable to the circumstances of the Study Area. Groundwater elevations in Westlands are lower than in the Study Area. Differences in the quality of surface water and groundwater may differ. Westlands has been an active participant in the water transfer market. In contrast, the districts in the Study Area have not, although that undoubtedly reflects the historical reliability of their surface water rights backstopped by groundwater during critical years. Adjusting the evidence from the Westlands experience for differences in circumstances between Westlands and the Study Area requires a major investigation outside the scope of the Stratecon study. Nonetheless, the Westlands experience provides information on the actual impacts of variability in available surface water supplies. In contrast, the SWRCB assumption that lost surface water supplies are fully offset by increased groundwater pumping until capacity is exhausted lacks any empirical foundation.

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[49] 5.4 feet = -0.90 x 6

Figure A1.1
CVP Allocation History
South of Delta Agricultural Water Users

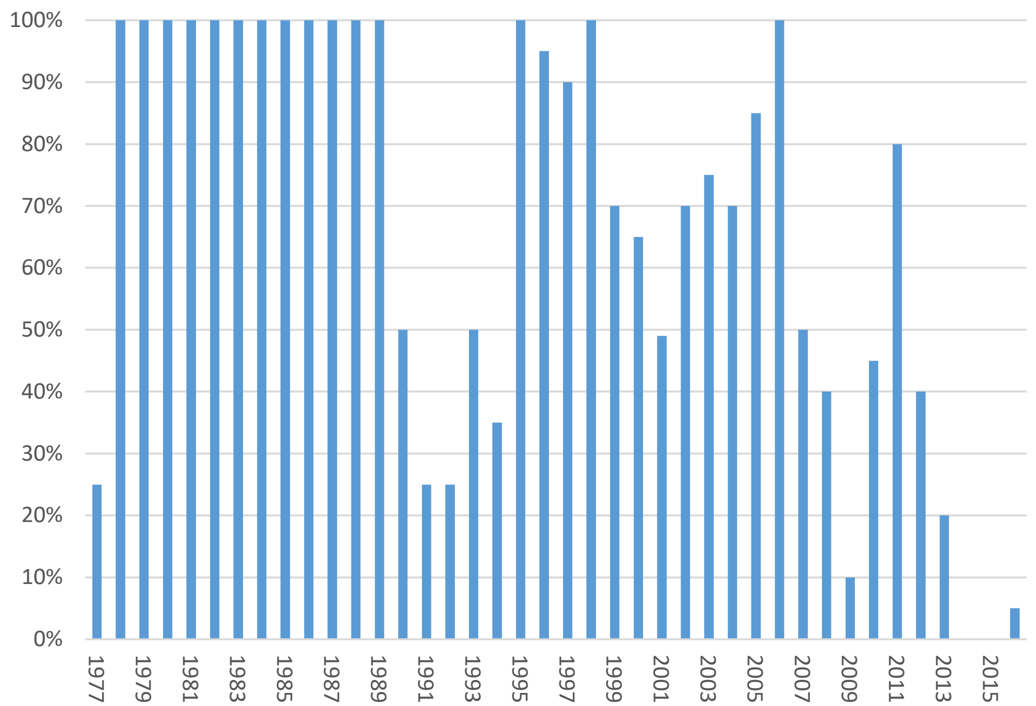
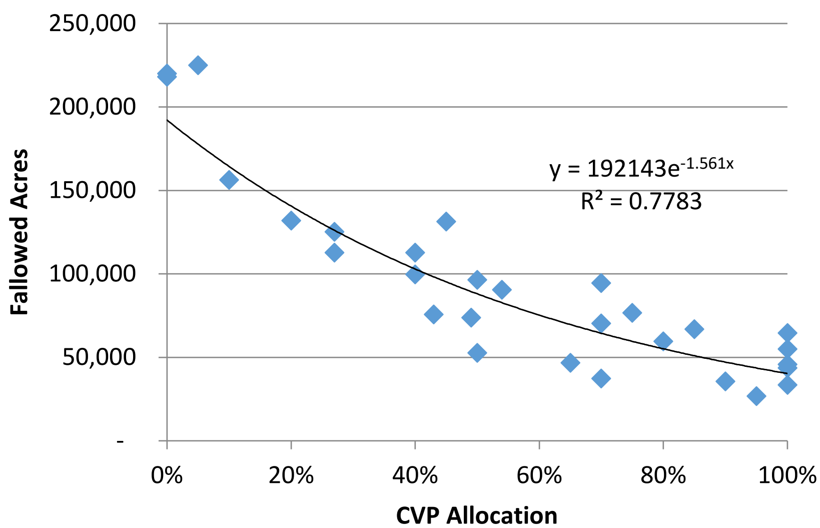


Figure A1.2
Westlands Land Fallowing vs CVP Allocation



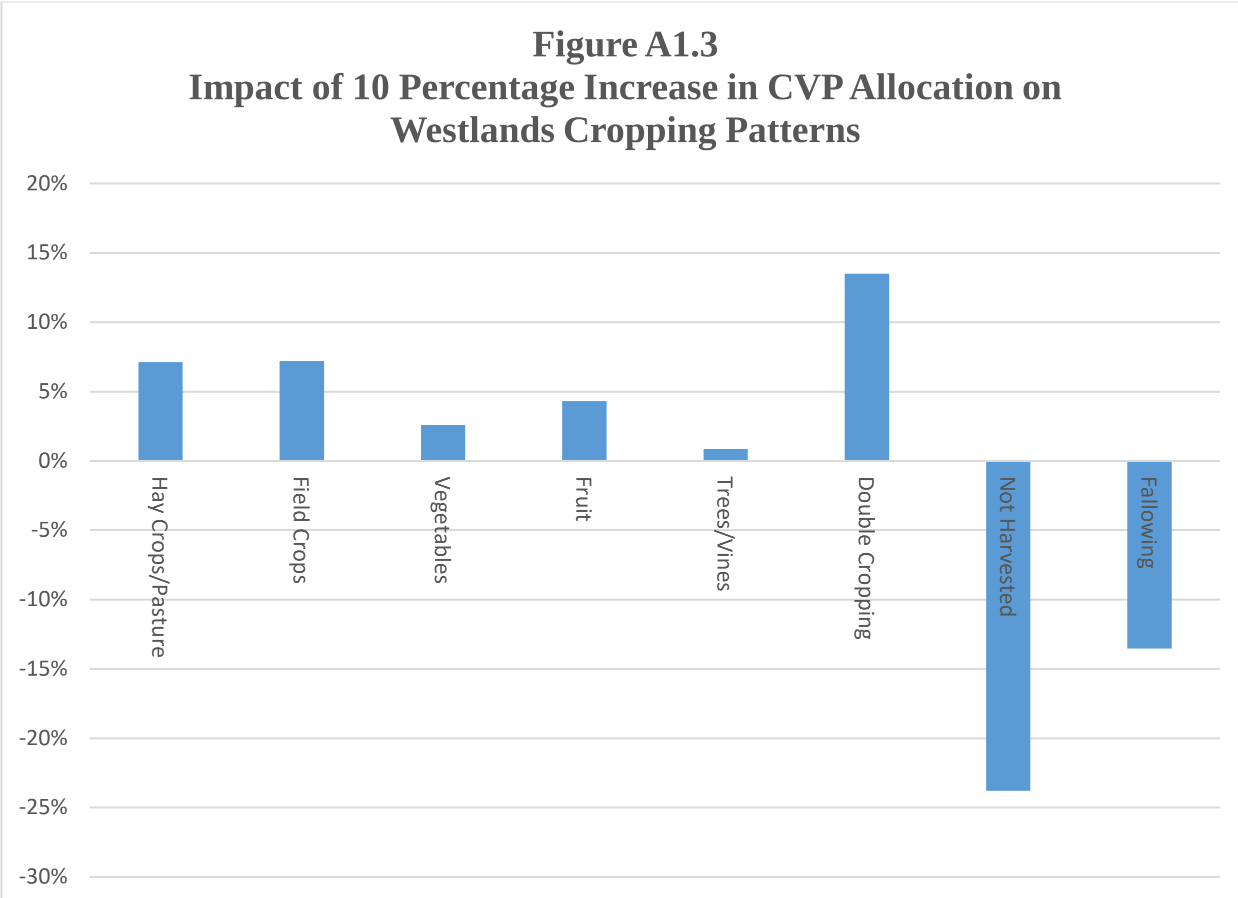


Figure A1.3
Impact of 10 Percentage Increase in CVP Allocation on Westlands Cropping Patterns
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
-30%
Hay Crops/Pasture
Field Crops
Vegetables
Fruit
Trees/Vines
Double Cropping
Not Harvested
Fallowing

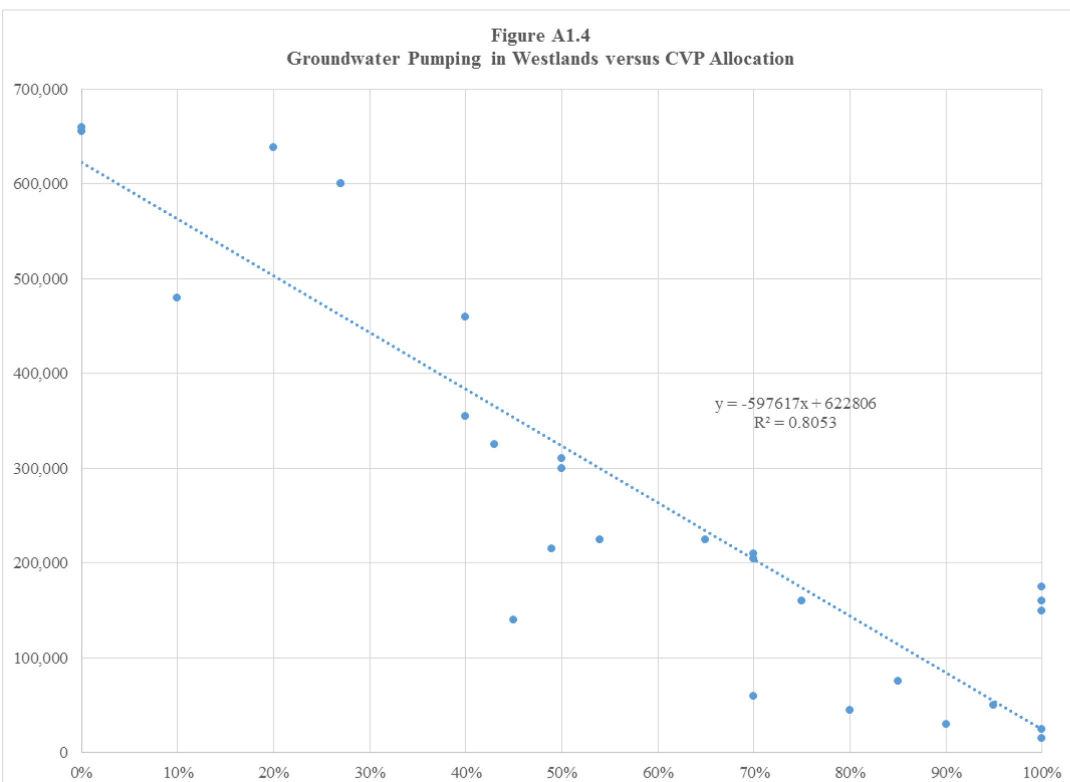


Figure A1.4
Groundwater Pumping in Westlands versus CVP Allocation
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
y = -597617x + 622806
R² = 0.8053

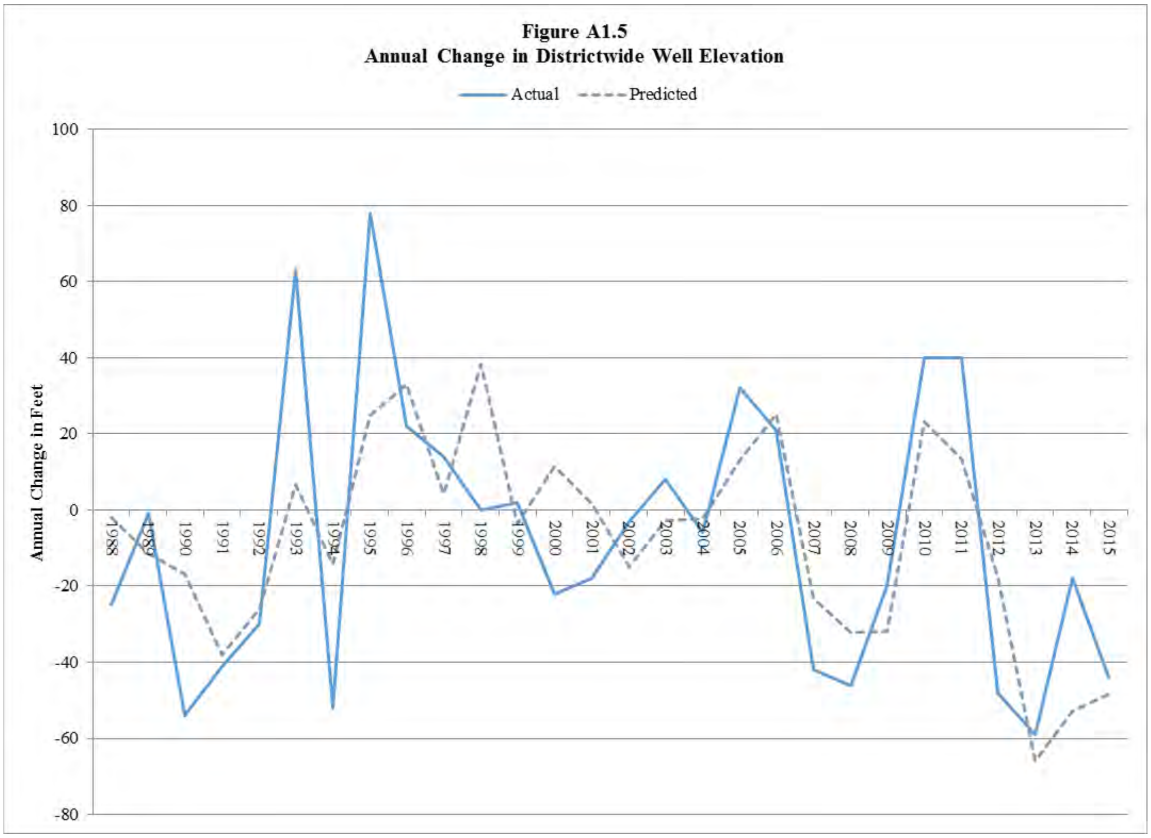


Figure A1.5
Annual Change in Districtwide Well Elevation
Actual
Predicted
Annual Change in Feet
100
80
60
40
20
0
-20
-40
-60
-80
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015

Attachment 1-1
Statistical Study of Westland's Annual Cropping Patterns

This attachment presents the statistical analysis identifying the impact of CVP water allocations on Westlands cropping patterns. The models explain the annual acreage in major crop categories by CVP water allocations and trend (see table). The dependent variables are the natural logarithm of acreage. Therefore, the coefficients for CVP water allocations measure the proportionate impact on acreage from a change in the level of the CVP water allocation. The coefficient for the trend variable measures the annual growth in acreage. R^2 measures the proportion of the annual variation in (the natural logarithm) of acreage is explained by the annual variation in CVP water allocations and trend growth.

Statistical Models of Westlands Cropping Patterns
(2000-2015)

Crop Category	*Intercept*	*CVP Allocation*	*Trend*	R^2
Hay Crops/Pasture	8.36 (21.7) [<0.01%]	0.71 (2.04) [5.2%]	0.03 (2.45) [2.2%]	0.22
Field Crops	12.4 (93.9) [<0.01%]	0.72 (5.55) [<0.01%]	-0.04 (-7.35) [<0.01%]	0.86
Vegetables	11.74 (149.9) [<0.01%]	0.26 (3.36) [0.3%]	-0.00 (-0.51) [61.5%]	0.40
Fruit	9.74 (54.0) [<0.01%]	0.43 (2.46) [2.1%]	-0.01 (-1.03) [31.1%]	0.33
Trees/Vines	9.60 (156.3) [<0.01%]	0.09 (1.41) [17.1%]	0.09 (37.4) [<0.01%]	0.99
Double Cropping*	8.86 (37.37) [<-.01%]	1.35 (5.57) [<0.01%]	-0.05 (-2.93) [0.01%]	0.89
Not Harvested	8.69 (14.62) [<0.01%]	-2.38 (-4.09) [38.9%]	0.17 (2.52) [<0.01%]	0.55
Fallowing	11.87 (63.26) [<0.01%]	-1.35 (-7.35) [<0.01%]	0.01 (1.37) [18.1%]	0.77

* Sample period: 2000-2015. Westlands started collecting data on double cropping at the request of the Bureau of Reclamation in 2000.

Note: T-Statistics in parentheses and P-Values in brackets.

Attachment 2
Background Data on Baseline Conditions of Study Area

The following provides additional data underlying the baseline conditions assessment in Section 2 of the report.

A. Population

Table A2.1 provides historical population estimates for each of the three counties as reported by the California State Department of Finance ("CDoF"). The table shows that the total population for the Study Area in early 2016 was estimated at over 1.5 million, approximately 50% higher than in 1990. This compares to total estimated population growth for the State during the same period of about 33%. Correspondingly, the Study Area counties' population grew at a compound average annual rate of 1.5% to 1.6%, as compared to 1.1% for the State, respectively, during the approximately 25-year period of study.

Table A2.1
Population

County	1990	2000	2010	2016	Compound Annual Growth 1990-2016
Merced	176,300	209,522	255,399	269,280	1.6%
San Joaquin	477,700	560,634	684,057	723,761	1.6%
Stanislaus	365,100	444,967	514,003	534,902	1.5%
Total	1,019,100	1,215,123	1,453,459	1,527,943	1.6%
California	29,558,000	33,721,583	37,223,900	39,255,883	1.1%

Figure A2.1 illustrates the recent historical trend in the Study Area counties' separate and collective population growth since 1990 as compared to the State as a whole. To facilitate comparison between the counties and State, all values are converted to an index with the 1990 index value set to 1.0. The figure clearly shows that the population in the Study Area grew faster than the State during the period, especially since 2000, which has had important implications for regional water demand.

Figure A2.1

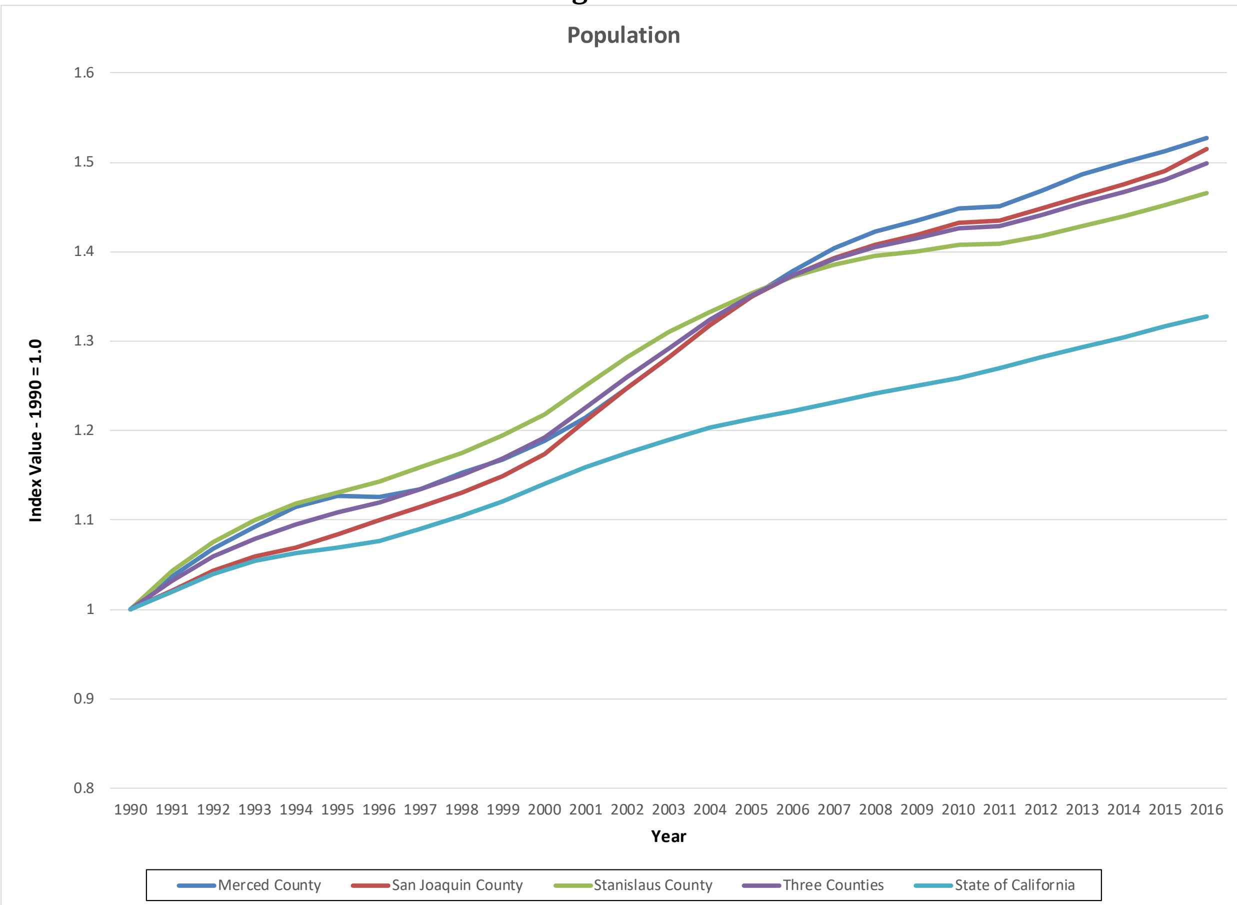


Table A2.2 provides historical population estimates for the largest city by population in each of the three Study Area counties as reported by CDoF. The table shows that the population of the cities of Merced (Merced County) and Stockton (San Joaquin County) grew at compound average annual rates of about 1.6% from 1990 through 2016, in line with the overall growth for that period in Merced and San Joaquin Counties, respectively, as shown in Table 1. Population rates of growth in the smaller communities of these two counties lies in a range both higher and lower than the county averages.

Separately, the City of Modesto, where about 40% of Stanislaus County's population resides, experienced slower overall population growth during the period of study, 1.0%, than Stanislaus County as a whole. Accordingly, Stanislaus County's historical population has grown at a rate similar to the other two Study Area counties has been driven by relatively high population growth outside of Modesto. In fact, the County's communities other than Modesto have experienced compound annual population growth during the study period that is higher than the County's overall population rate of growth. Further, it is the smaller Stanislaus County incorporated communities such as Newman, Riverbank and Patterson, as examples, that have experienced the highest rates of growth in the County. All three of these communities had more than double the estimated population in early 2016 as compared to 1990.

Table A2.2
Population Select Cities

City	County	1990	2000	2010	2016	Percentage of 2016 County Population	Compound Annual Growth 1990-2016
Merced	Merced	55,700	63,667	78,860	83,962	31%	1.6%
Stockton	San Joaquin	209,700	242,827	291,275	315,592	44%	1.6%
Modesto	Stanislaus	162,100	187,816	201,911	211,903	40%	1.0%

Table A2.3 summarizes recent population growth projections for the Study Area counties and the State of California through 2060 as reported by the CDoF. The table shows that the population growth of the Study Area going out approximately 40 years into the future is projected to be more than double the rate for the State. This has important implications for future regional DCMI (Domestic, Commercial, Municipal and Industrial) demand for water regionally, which relies mostly on groundwater supplies, particularly with consideration for pending regulations to stabilize declining regional groundwater levels in conjunction with possible SED-associated reductions in surface water supplies.

Table A2.3
Population Projections

County	Actual (Est.)	Projections					
	2016	2020	2030	2040	2050	2060	Annual Growth 2016-60
Merced	269,280	288,991	337,798	389,934	439,075	485,712	1.3%
San Joaquin	723,761	766,644	893,354	1,037,761	1,171,439	1,306,271	1.4%
Stanislaus	534,902	573,794	648,076	714,910	783,005	856,717	1.1%
Total	1,527,943	1,629,429	1,879,228	2,142,605	2,393,519	2,648,700	1.3%
California	39,255,883	40,619,346	44,085,600	47,233,240	49,779,362	51,663,771	0.6%

B. Housing

As would be expected, housing development in the Study Area has tracked closely the region’s population growth, though, as with the State overall, growth in the number of housing units within the Study Area counties, particularly in the past decade, has lagged behind its population growth. The result has been a combination of declining vacancies and increased average household occupancies (see Table A2.4 for historical housing statistics). For example, in Merced County housing vacancies at the start of 2016 were 6.1% down from over 9.0% in 2010. Concurrently, during the same period average household sizes in the County increased slightly.

Table A2.4
Housing

County	1990	2000	2010	2016	Compound Annual Growth 1990-2016
Merced	58,410	68,103	83,728	84,660	1.4%
San Joaquin	166,274	188,139	233,449	239,405	1.4%
Stanislaus	132,027	150,389	179,826	180,777	1.2%
Total	356,711	406,631	497,003	504,842	1.3%
California	11,182,513	12,186,125	13,669,076	13,981,826	0.9%

Table A2.5 summarizes projections out through the 2030 on housing development in the Study Area as reported by CDoF. The table indicates projected growth in regional housing lags the projected rates of population growth (see Table 3), suggesting anticipated further declines in vacancies and/or increases in average household sizes. The table also shows that the future projected rates of increase in the housing inventory of all three Study Area counties is forecast at more than double the projected rate for the California. This may be in part driven by the region's proximity to the San Francisco Bay Area, one of the most supply constrained and high cost housing markets in the country. Relatively inexpensive housing within the region as compared to the San Francisco Bay Area combined with improved regional transportation infrastructure, is a key driver of population growth and associated housing demand within the Study Area.

Table A2.5
Housing Projections

County	2016	2020	2025	2030	Compound Annual Growth 2016-2030
Merced	84,660	86,866	93,920	101,393	1.3%
San Joaquin	239,405	243,902	260,405	280,423	1.1%
Stanislaus	180,777	187,358	199,366	210,875	1.1%
Total	504,842	518,126	553,691	592,691	1.2%
California	13,981,826	13,864,699	14,449,955	15,021,712	0.5%

C. Economy

Generally, the economies of the three Study Area counties in comparison to the rest of California are characterized by relatively high rates of unemployment, large agricultural and agricultural-dependent sectors, low household incomes and associated high rates of poverty. The following provides general economic information for each of the three counties that helps to illustrate these characterizations.

1. Unemployment

The rate of unemployment in an area is a key metric for measuring the economic conditions within that area. Table A2.6 summarizes the historical unemployment rate in each of the three

Study Area counties as compared to California based on data provided by the California Employment Development Department ("CEDD"). The table shows that the unemployment rate in all three counties has historically been significantly higher than the for California, often more than double in the case of Stanislaus County

Table A2.6
Historical Unemployment

Year	Merced County	San Joaquin County	Stanislaus County	California
1990	12.9%	9.9%	11.9%	5.8%
1991	15.5%	12.0%	14.7%	7.7%
1992	17.3%	14.1%	16.4%	9.3%
1993	17.3%	14.1%	16.8%	9.5%
1994	16.1%	12.8%	15.8%	8.6%
1995	17.0%	12.3%	15.4%	7.9%
1996	16.6%	11.4%	14.3%	7.3%
1997	15.7%	10.8%	13.2%	6.4%
1998	15.1%	10.6%	12.3%	5.9%
1999	13.4%	8.8%	10.6%	5.2%
2000	9.7%	7.0%	7.8%	4.9%
2001	10.2%	7.5%	8.4%	5.4%
2002	10.9%	8.8%	9.6%	6.7%
2003	11.4%	9.1%	9.8%	6.8%
2004	10.9%	8.7%	9.2%	6.2%
2005	10.0%	7.9%	8.4%	5.4%
2006	9.4%	7.4%	8.0%	4.9%
2007	10.1%	8.1%	8.7%	5.4%
2008	12.6%	10.4%	11.1%	7.3%
2009	16.6%	14.9%	15.5%	11.1%
2010	17.9%	16.5%	16.9%	12.2%
2011	17.6%	16.2%	16.5%	11.7%
2012	16.3%	14.4%	14.9%	10.4%
2013	14.5%	12.3%	12.9%	8.9%
2014	12.8%	10.5%	11.1%	7.5%
2015	11.3%	8.9%	9.5%	6.2%

2. Employment

While the unemployment rate in the three Study Area counties has historically been substantially higher than for the State, employment growth regionally has, for extended periods, outpaced that of the State. That said, during the most recent period coming through the end of, and then out of, the most recent recession, employment growth in San Joaquin County has been higher and in Merced and Stanislaus Counties slightly lower as compared to the State (see Table A2.7 which provides data provided by the CEDD). The fact that unemployment remains relatively high across the Study Area despite job growth indicates that while job growth in the region might be considered fairly robust, it is not keeping pace with regional population growth.

Table A2.7
Historical Employment

Year	Merced County	San Joaquin County	Stanislaus County	California
1990	67,044	204,600	159,118	14,264,618
1991	65,217	203,651	156,339	13,960,485
1992	68,652	205,813	160,351	13,881,509
1993	68,882	207,922	161,666	13,818,087
1994	70,141	209,344	162,764	13,945,782
1995	68,605	210,513	162,466	14,048,843
1996	68,222	212,960	166,799	14,301,361
1997	70,247	218,162	171,713	14,786,588
1998	72,225	220,933	176,638	15,185,715
1999	72,442	227,970	180,605	15,556,782
2000	81,704	241,118	191,752	16,033,633
2001	82,446	246,205	196,248	16,197,501
2002	85,278	250,053	198,073	16,108,618
2003	85,787	253,439	200,013	16,103,008
2004	87,003	256,936	203,135	16,304,474
2005	88,902	261,344	207,611	16,583,884
2006	88,690	262,590	206,480	16,790,468
2007	89,804	265,311	207,226	16,932,015
2008	89,250	262,265	206,026	16,854,316
2009	87,873	253,315	198,110	16,181,532
2010	93,208	259,983	202,215	16,092,641
2011	94,512	261,030	202,390	16,259,012
2012	96,393	267,466	206,271	16,628,276
2013	98,258	275,277	210,328	17,001,707
2014	100,257	280,884	215,022	17,419,245
2015	102,035	288,811	219,665	17,799,336
Annual Growth (1990 - 2015)	1.7%	1.4%	1.3%	0.9%
Annual Growth (2010 - 2015)	1.8%	2.1%	1.7%	2.0%

Figure A2.2 illustrates the trend in the Study Area counties' employment growth since 1990 as compared to the State as a whole. To facilitate comparison between the counties and with the State, all values are converted to an index with the 1990 index value set to 1.0. The figure clearly shows that over the period employment in the region has risen faster than for the State, especially since 2000.

Figure A2.2

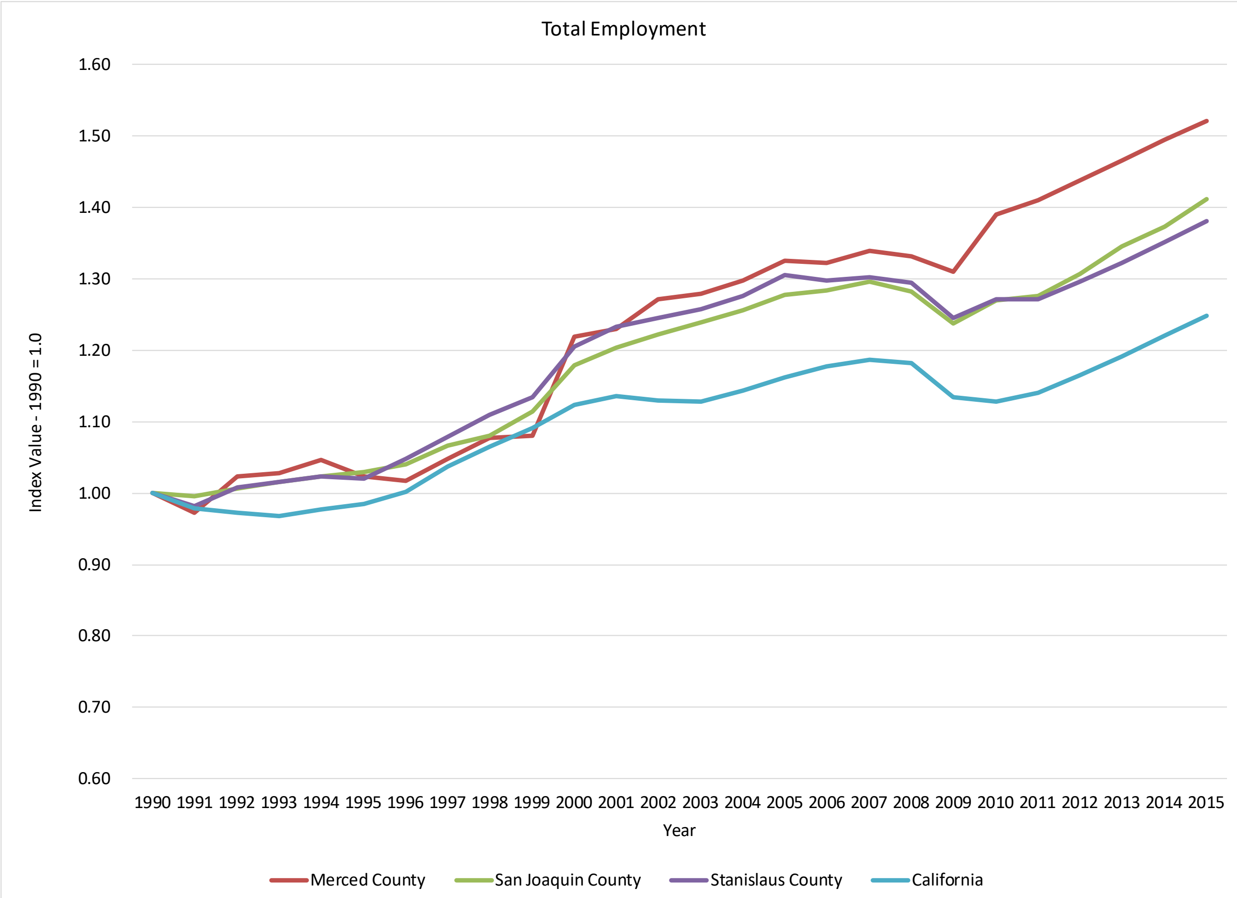


Table A2.8 summarizes the estimated breakdown of farm versus non-farm employment in the Study Area and for the State in 2015 as reported by the CEDD. Non-farm employment is all employment excluding public/government sector employment and farm employment. The table shows the importance to regional employment of the farm sector in the Study Area as compared to the State. Merced County, in particular, relies on farming as a substantial source of employment. As farming is the primary consumer of surface water within the Study Area, there is little question that the substantial reduction of surface water supplies for irrigation resulting from the SED will have a material adverse impact on the Study Area economy.

Table A2.8
Farm v. Non-Farm Employment

Geography	Total Farm Employment	Total Non-Farm Employment	Farm as Employment Percentage of Total
Merced County	15,200	61,600	19.8%
San Joaquin County	17,400	211,000	7.6%
Stanislaus County	15,200	162,600	8.5%
California	423,573	16,053,031	2.6%

It is important to note that the figures in Table A2.8 substantially understate the importance of agriculture to the Study Area's economy since a large portion of the region's non-farm employment is associated with manufacturing, wholesale trade and transportation involving regionally produced farm commodities. Examples include firms that process, package and distribute fruits and vegetables and others that purchase/use local feed in support of livestock-related activities such as cheese production. Table A2.9 provides examples of some of the larger of the agriculture-related companies operating in the Study Area as reported by the CEDD that are important contributors to the region's employment base, and thus economy.

Table A2.9
Downstream Companies

Company	# of Employees	Sector	Business Activity
Merced County			
Foster Farms	1,000 - 4,999	Manufacturing	Poultry Production and Processing
Hilmar Cheese	500 - 999	Manufacturing	Cheese Production
Live Oak Farms	250 - 499	Wholesale Trade	Merchant Wholesale of Fresh Fruits and Vegetables
Gallo Cattle	250 - 499	Manufacturing	Cheese Production
Liberty Packing Company	250-499	Transportation	Packing and Transport of Farm Products
E & J Gallo Winery	100 - 249	Manufacturing	Wine Production
San Joaquin County			
Leprino Foods Company	1,000 - 4,999	Manufacturing	Cheese Production
Morada Produce Company	500 -999	Wholesale Trade	Merchant Wholesale of Fresh Fruits and Vegetables
O - G Packing & Cold Storage	1,000 - 4,999	Wholesale Trade	Merchant Wholesale of Fresh Fruits and Vegetables
Pacific Coast Producers	1,000 - 4,999	Manufacturing	Canning and Food Processing
Stanislaus			
Cabo Rossi Wineries	1,000 - 4,999	Manufacturing	Wine Production
Del Monte Foods	1,000 - 4,999	Manufacturer	Canning and Food Processing
Con Agra Foods	1,000 - 4,999	Manufacturing	Canning and Food Processing
Ecco Domani	1,000 - 4,999	Manufacturer	Wine Production
Foster Farms	1,000 - 4,999	Manufacturer	Poultry Production and Processing
Frito-Lay	500 - 999	Manufacturer	Merchant Wholesale of Nuts, Potato Chips, etc.

3. Median Household Income

Median household income ("MHI") is metric frequently used to evaluate economic conditions within a defined geographic area. In fact, the California Department of Water Resources ("CDWR") for the purposes of water resource development and management planning uses MHI to determine if communities are considered economically disadvantaged and, thus, warrant certain special considerations in the spatial allocation of limited natural and financial resources, mitigating actions or in how cost burdens are allocated ("Disadvantaged Community" or "DAC"). Communities are considered economically disadvantaged if their MHI is lower than 80% of the State's MHI and considered severely economically disadvantaged if community MHI is less than 60% of the State's MHI. While the CDWR does not apply this household income evaluation at the county level, Table A2.10 indicates that Merced County collectively would be considered a DAC based on the MHI criteria. Concurrently, San Joaquin and Stanislaus Counties have median household incomes slightly higher than the 80% threshold.

Table A2.10
County Household Income

Geography	2014 Median Houshold Income	As Percent of State Median Household Income
Merced County	$ 44,084	72%
San Joaquin County	$ 51,659	84%
Stanislaus County	$ 51,084	83%
California	$ 61,489	100%

Given the indications of Table A2.10 and the unemployment statistics previously presented (see Table A2.6), it is not surprising that a larger portion of households in the Study Area reside in DACs than is the case of the entire State of California. Table A2.11 presents this comparison.

Table A2.11
Disadvantaged Communities

County	Total Households	Total Households within Disadvantaged Communities	As Percent of Total Households	Total Households within Severely Disadvantaged Communities	As Percent of Total Households	Total Households within Disadvantaged and Severely Disadvantaged Communities	As Percent of Total Households
Merced	76,516	57,398	75.0%	5,249	6.9%	62,647	81.9%
San Joaquin	217,343	114,546	52.7%	3,291	1.5%	117,837	54.2%
Stanislaus	168,090	91,090	54.2%	4,741	2.8%	95,831	57.0%
California							~41.5%

The table shows that over 80 percent of households in Merced County are located in DACs as compared to about half that number for the State. While San Joaquin and Stanislaus counties have a lower percentage of their households within DACs than does Merced County, that percentage is still above 50%. This has important implications for the presumed ability of households in the region to pay any potential additional costs for water that will be required by SED-related reductions in available surface water supplies.

4. Poverty

Consistent with the DAC assessment and the indications of other measures of economic conditions within the Study Area discussed above, poverty levels in Merced, San Joaquin and Stanislaus counties exceed those for the State. Table A2.12 summarizes poverty rates for 2015 within the Study Area as reported by the U.S. Census Bureau. The table shows, for example, that 26.7%, or over $1/4^{th}$, of the population of Merced County was living below the poverty line in 2015. This compares to 15.3% for the State.

Table A2.12
Poverty

Geography	% of Population Below Poverty Line	% of Population under 18 Yrs of Age Below Poverty Line
Merced County County	26.70%	38.50%
San Joaquin County	17.40%	23.90%
Stanislaus County	19.70%	27.70%
California	15.30%	21.20%

5. Farm Economy and Water Use

The farm sectors of each of the Study Area counties rely on a combination of surface and groundwater source for their irrigation water supplies. While many independent famers and smaller irrigation districts within the Study Area have limited data on water use, the bigger districts do to varying degrees. Historical water use and cropping pattern information for the region's irrigation districts that rely on surface water supplies is instructive on the potential response of those districts to the SED, particularly shifts in water use and cropping during the current drought. The following summarizes available recent historical water use and cropping information for large Study Area irrigation districts. The data shows that the region's irrigation districts respond to changes in surface water supply availability with a mix of additional groundwater pumping, changes in cropping and on-farm measures such as deficit irrigation. It is also important to note that other than with the most recent drought, the region's larger irrigation districts have not experienced substantial surface water supply variability. Accordingly, it is difficult to anticipate long-run responses to permanent surface water supply reductions due to the SED based on the historical observed responses of regional irrigation districts to limited and short term water supply variability.

Oakdale Irrigation District

Table A2.13 summarizes recent historical cropping pattern and water supply data for the Oakdale Irrigation District. The table indicates that the district's cropped acreage has recently risen and that drought-related reductions in surface water supplies have been addressed through increased groundwater pumping.

Table A2.13
Oakdale ID

Year	2005	2010	2014	2015
Total Cropped Acres	49,681	50,827	59,008	N/A
Pasture	31,158	29,845	28,064	↓
Oats and Corn	7,623	8,150	7,954	↓
Almonds	3,544	5,825	16,080	↓
Walnuts	1,983	2,508	3,310	↓
Total Surface Diversions (Acre-Ft)	223,867	216,957	199,945	↓
Total Pumped Groundwater (Acre-Ft)	18,019	23,673	64,164	↓
Total Surface and Groundwater (Acre-Ft)	241,886	240,630	264,109	↓

Modesto Irrigation District

Table A2.14 summarizes recent historical cropping pattern and water supply data for the Modesto Irrigation District. The district's cropped acreage has held steady at least through 2014 and that at least a portion of its drought-related reductions in surface water supplies have been addressed through increased groundwater pumping. Cropping pattern shifts away from high water consuming filed crops such as pasture and hay together with improved water supply management may explain how, for example, the District's farmers in 2014 absorbed an approximately 15% reduction in their water supply as compared to 2010.

Table A2.14
Modesto ID

Year	2005	2010	2014	2015
Total Cropped Acres	67,129	66,287	66,397	N/A
Pasture	10,030	8,234	6,970	↓
Corn Silage	3,261	8,997	8,449	↓
Almonds	18,957	20,772	24,067	↓
Walnuts	8,327	8,086	8,700	↓
Total Surface Diversions (Acre-Ft)	326,943	261,888	174,447	149,526
Total Pumped Groundwater (Acre-Ft)	17,653	12,054	58,186	61,540
Total Surface and Groundwater (Acre-Ft)	344,596	273,942	232,633	211,066

Turlock Irrigation District

Table A2.15 summarizes recent historical cropping pattern and water supply data for the Turlock Irrigation District. The table indicates that the district's acreage has held steady the past six years however, the district has responded to recent substantial drought-related reductions in its surface water supplies with significant reductions in double-cropping. In fact, the district reported over 45,000 acres of second crop production in 2013 composed mostly of corn. In 2015, with 30% less surface water supplies as compared to 2013 due to the drought the district reported no double cropping while pumping less groundwater than in 2013.

Table A2.15

Turlock ID

Year	2010	2011	2012	2013	2014	2015
Total Acres	145,521	145,600	144,426	145,024	144,031	143,205
Total Cropped Acres (Includes Double Cropping)	193,377	194,953	193,594	192,583	148,741	143,205
Total Surface Diversions (Acre-Ft)	531,610	537,282	446,668	460,482	319,695	281,484
Total Pumped Groundwater (Acre-Ft)	64,476	66,062	113,130	113,395	89,702	93,395
Total Surface and Groundwater (Acre-Ft)	596,086	603,344	559,798	573,877	409,397	374,879
Average Acre-Feet per Acre	3.1	3.1	2.9	3.0	2.8	2.6

Figure A2.3 presents the data in Table A2.15 graphically. The district's crop production acres including double-cropping has dropped the past few years in conjunction with drought-related reductions in surface water supplies without offsetting increases in groundwater pumping.

Figure A2.3

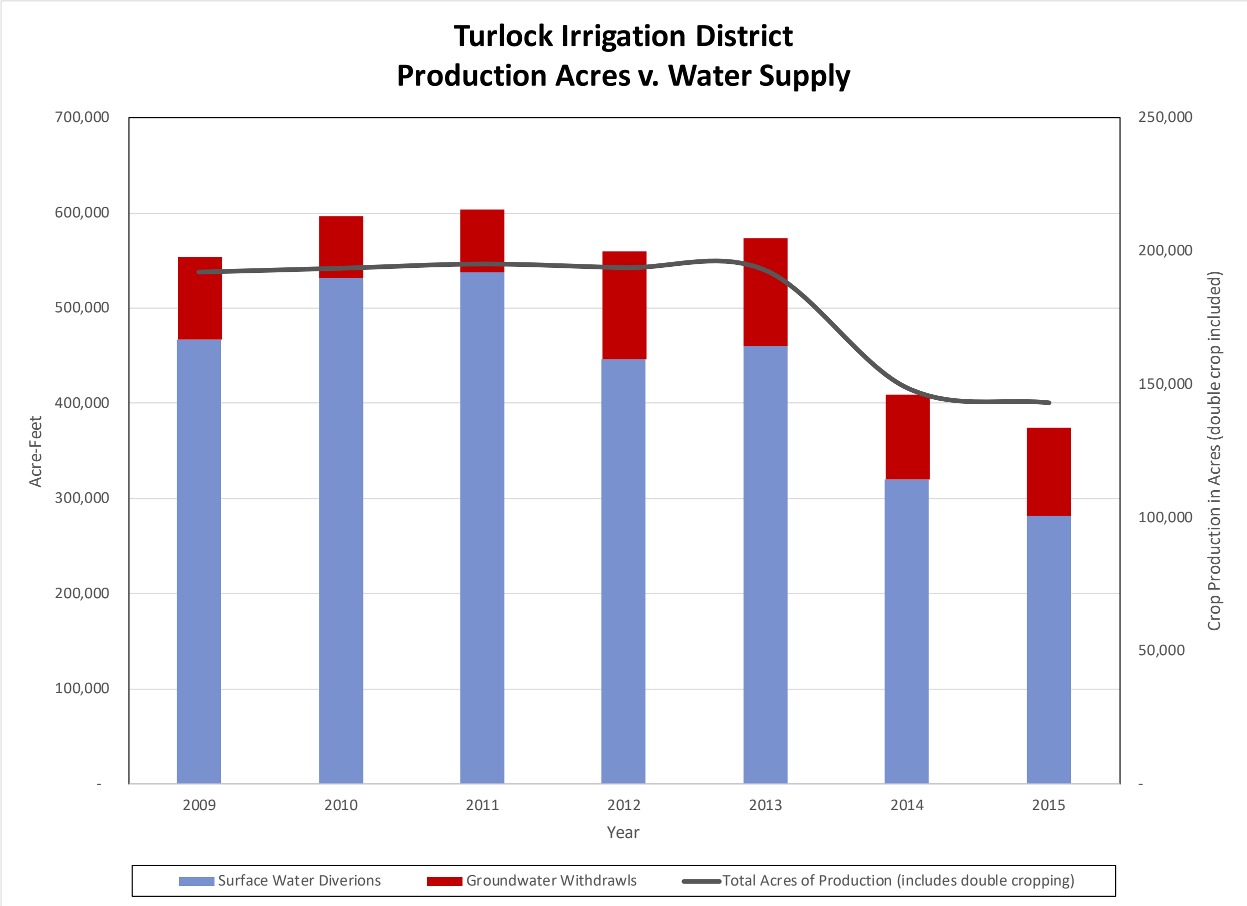
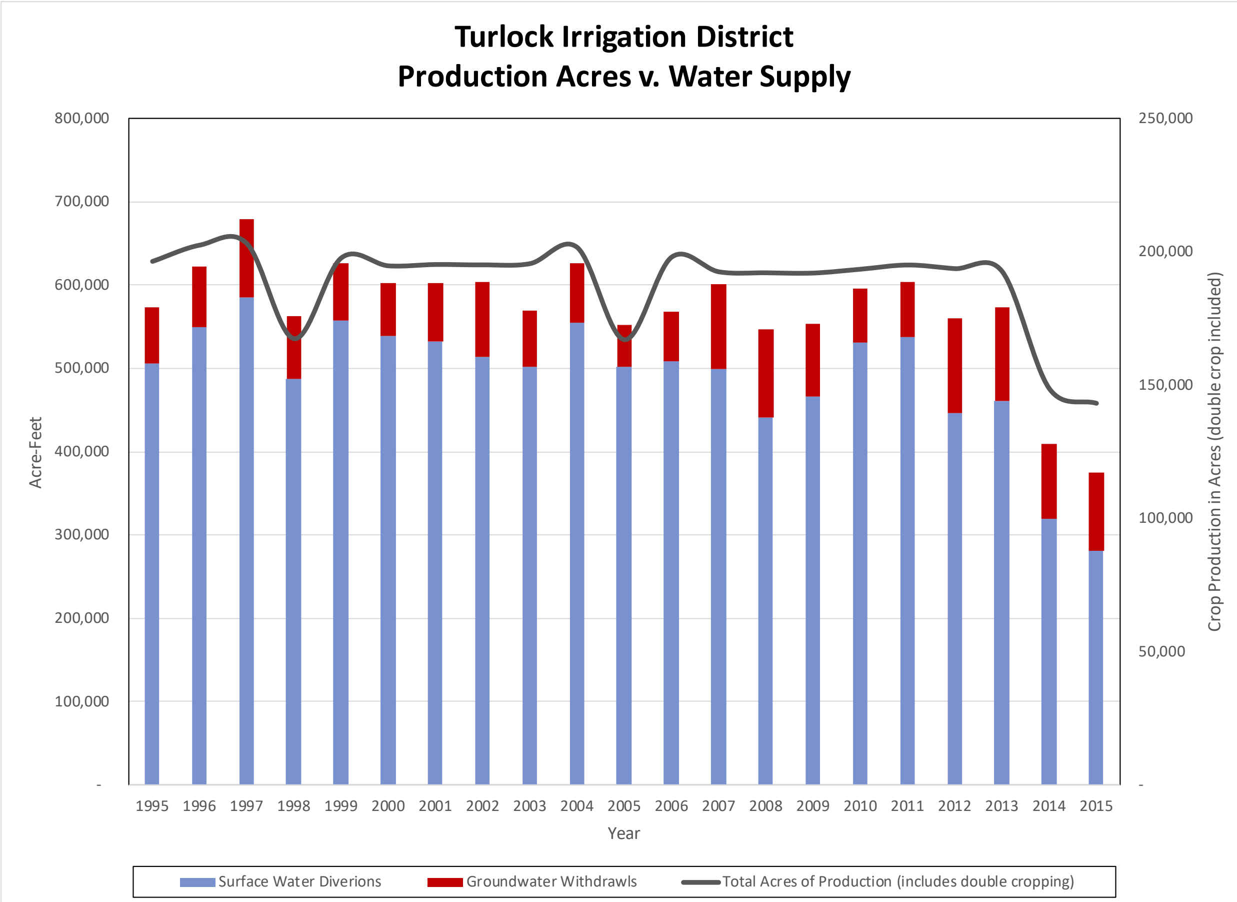


Figure A2.4 extends the graphic in Figure A2.3 back through 1995. The graphic reveals several additional instances (1998 and 2005) where the District responded in year-over-year declines in its surface water supplies with a reduction in crop production and not increased groundwater pumping.

Figure A2.4



South San Joaquin Irrigation District

Table A2.16 summarizes recent historical cropping pattern and water supply data for the South San Joaquin Irrigation District. The district's cropped acreage has held steady at least through 2014 and appears to manage what has been fairly limited variability in its surface water supplies through increased groundwater pumping.

Table A2.16
South San Joaquin ID

Year	2005	2010	2014	2015
Total Cropped Acres	51,998	50,368	51,035	N/A
Semi-Permanent	5,944	4,757	4,465	
Annual	6,240	6,758	6,653	
Almonds	32,774	32,923	33,868	
Other Permanent	7,041	5,929	7,113	
Total Surface Diversions (Acre-Ft)	204,761	223,462	213,060	
Total Pumped Groundwater (Acre-Ft)	48,328	41,081	68,611	
Total Surface and Groundwater (Acre-Ft)	253,089	264,543	281,671	

Merced Irrigation District

Table A2.17 summarizes recent historical cropping pattern and water supply data for the Merced Irrigation District. The district's cropped acreage that the District's surface water supplies dropped to near zero in 2015 due to drought conditions and that the district largely offset this decline with groundwater pumping. Such a significant amount of groundwater pumping is not sustainable and, thus, not a model for how the district might respond to the substantial surface water supply cutbacks under the SED. Furthermore, the degree to which Merced's surface water supplies were reduced in 2015 speaks to the importance for considering reliability and volatility in evaluating the potential impacts of the SED. An impact evaluation based on long term averages fundamentally ignores this volatility.

Table A2.17

Year	2007	2010	2014	2015
Total Irrigated Acres	Waiting for Accurate Data			
Alfalfa				
Pasture				
Corn and Corn Silage				
Almonds				
Walnuts				
Total Surface Deliveries (Acre-Ft)	250,740	272,560	103,068	2,544
Total Pumped Groundwater (Acre-Ft)	160,101	127,717	336,693	392,171
Total Surface and Groundwater (Acre-Ft)	410,841	400,277	439,761	394,715

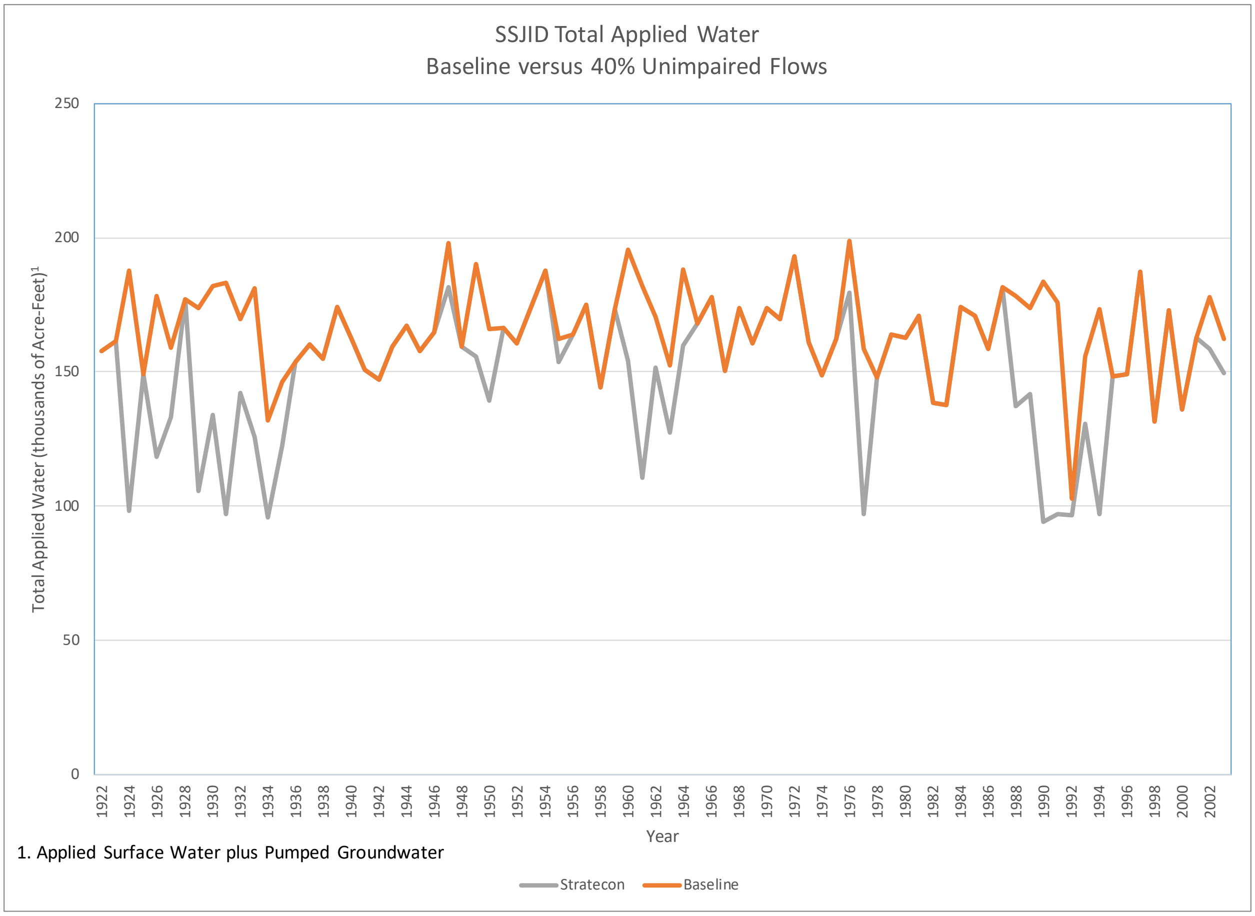
Attachment 3
Estimated SED 40 Impacts on Groundwater Pumping and Crop Gross Revenues

Irrigation District level detail on Estimated SED 40 impacts on groundwater pumping and crop gross revenues due to surface water supply reductions.

1. SSJID

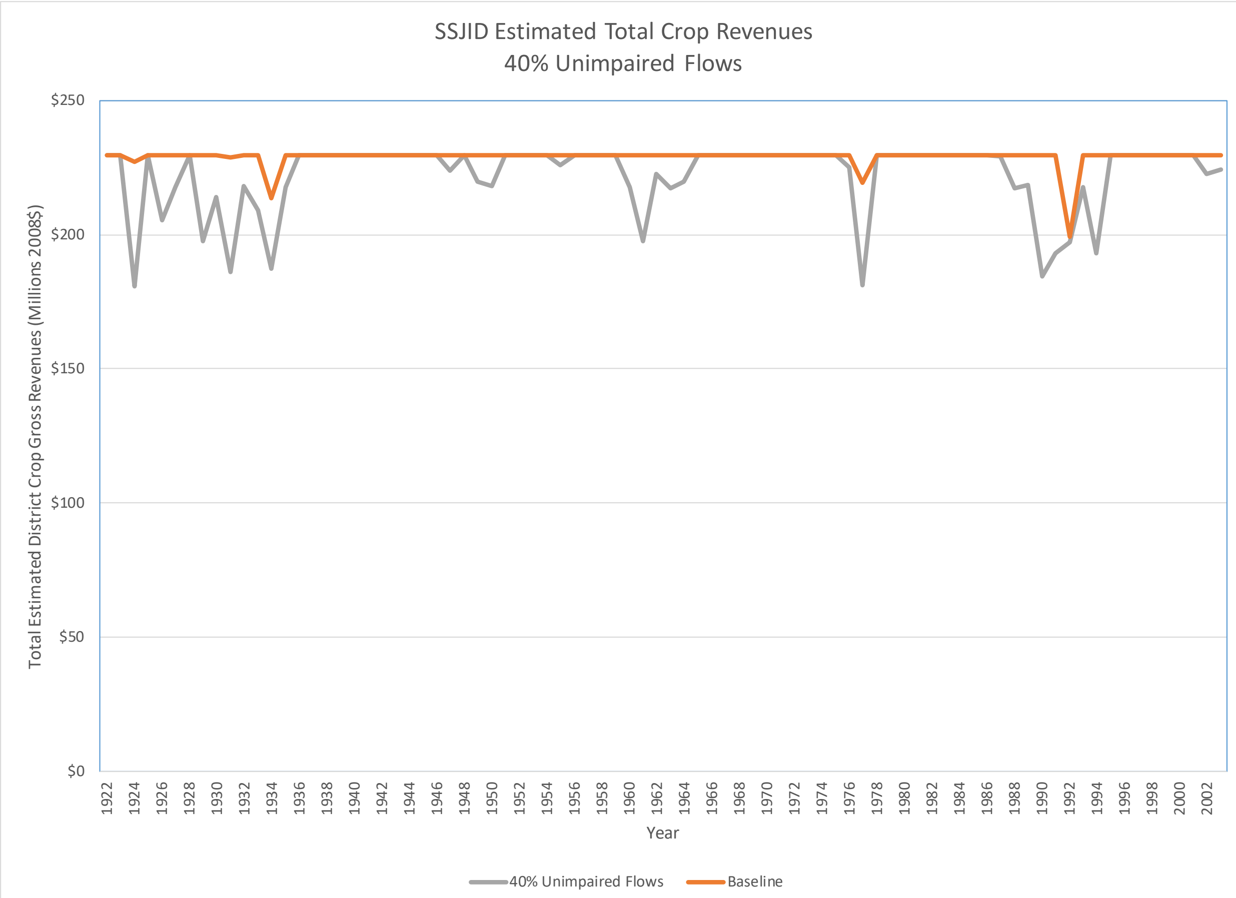
Figure A3.1 summarizes the estimated water supply impacts within the SSJID during the Study Period were the SED in place at the SED 40. The figure shows that in many years during the Study Period, there would have been no anticipated impact on the availability of water for the district and, accordingly, the district's overall water supplies because of the SED 40; i.e., the combined total surface and groundwater supplies under the SED 40 would have been equal to those combined totals in the absence of the SED 40. Generally, this is the case in years that are designated by SWRCB to be wet years, above normal precipitation years and even below normal precipitation years depending on prior year precipitation conditions. Concurrently, the figure shows several years during the study Period where SSJID's water supplies with the SED 40 in place would have been lower than the district's baseline water supplies in the absence of the SED. These are years generally designated by SWRCB as dry or critically dry. In these years, it is estimated that SED reductions in the district's surface water supplies would not have been fully offset by additional groundwater pumping. In 1977, for example, designated a critically dry year by the SWRCB that followed another critically dry year, it is estimated that the applied water in the district would have been about 97,000 acre-feet with the SED in place, down almost 40% from the baseline 159,000 acre-feet that would have been available to the district in the absence of the SED that year. The difference would have resulted in a reduction in crop production that year by the district.

Figure A3.1



In each of the years shown in Figure A3.1 that the SSJID's water supplies would have been reduced below baseline due to the SED there would have been expected reductions in cropping and associated crop sales revenues (gross revenues). Figure A3.2 illustrates the years when the crop gross revenues generated by the district during the Study Period would have been lower than baseline were the SED in place. The revenue figures are in common 2008 dollar terms consistent with the SWRCB's SED assessment. The difference between the two lines, where they diverge, represents the estimated lost revenues associated with the SED in that year.

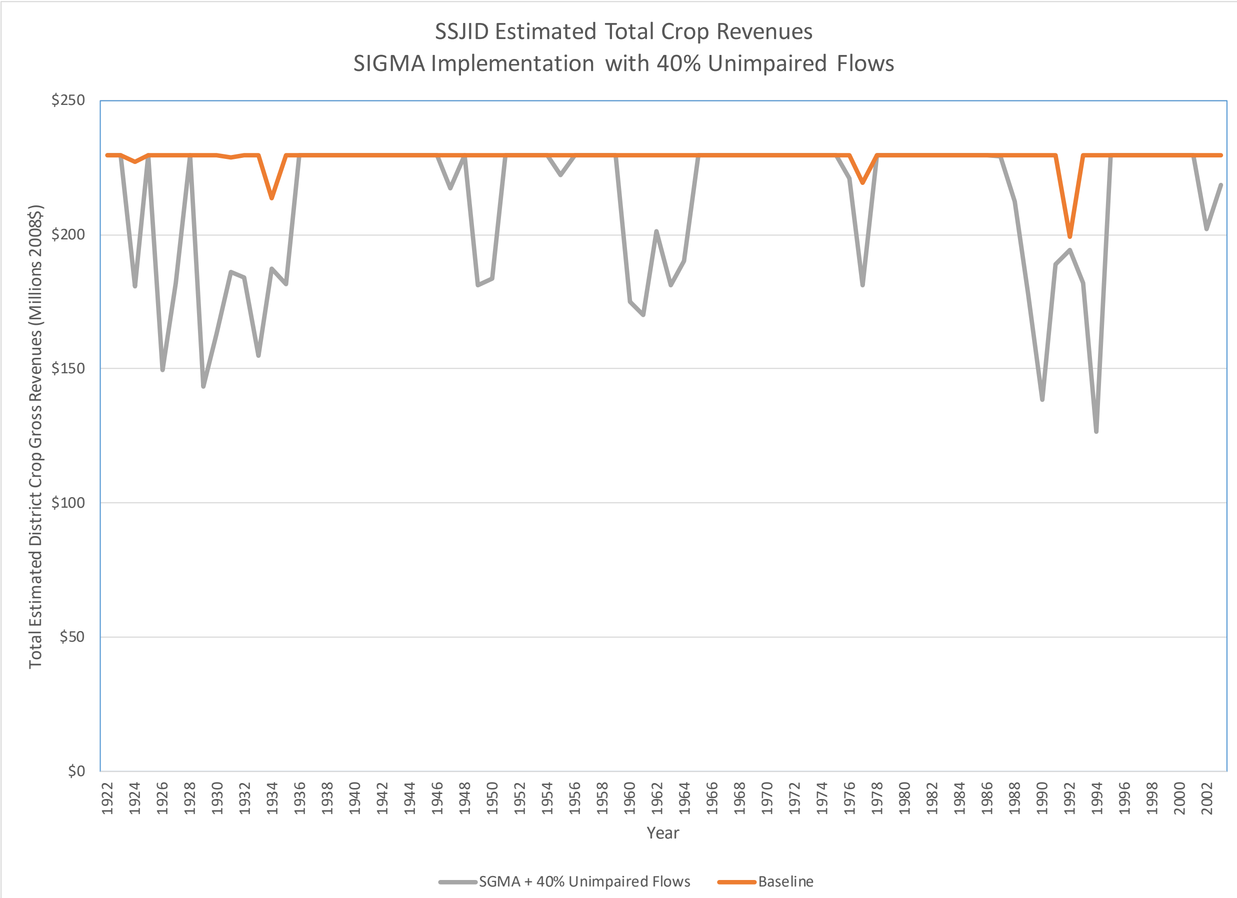
Figure A3.2



The figure shows that the magnitude of lost revenues in years that would have experienced below baseline water supplies due to the SED are less than for water supply shown in Figure A3.2. This is because the analysis of the fallowing of crops due to SED water supply reductions reflects the fact that in the face of water supply reductions farmers tend to fallow relatively lower-valued, higher water consuming annual crops such as pasture in much greater proportion than higher valued crops such as almonds.

Figure A3.3 revisits the crop gross revenue analysis presented in Figure A3.2 with the imposition of the SGMA and associated assumption that in years that the district's surface water supplies would have been reduced below baseline due to the SED 40 the district would not have been able to offset any of those surface supply reductions with groundwater. The result is much more significant impacts on crop gross revenues due to the SED surface water supply reductions as can be observed by a comparison of the larger differences between the two lines in Figure A3.3 where the lines diverge as compared to in Figure A3.2.

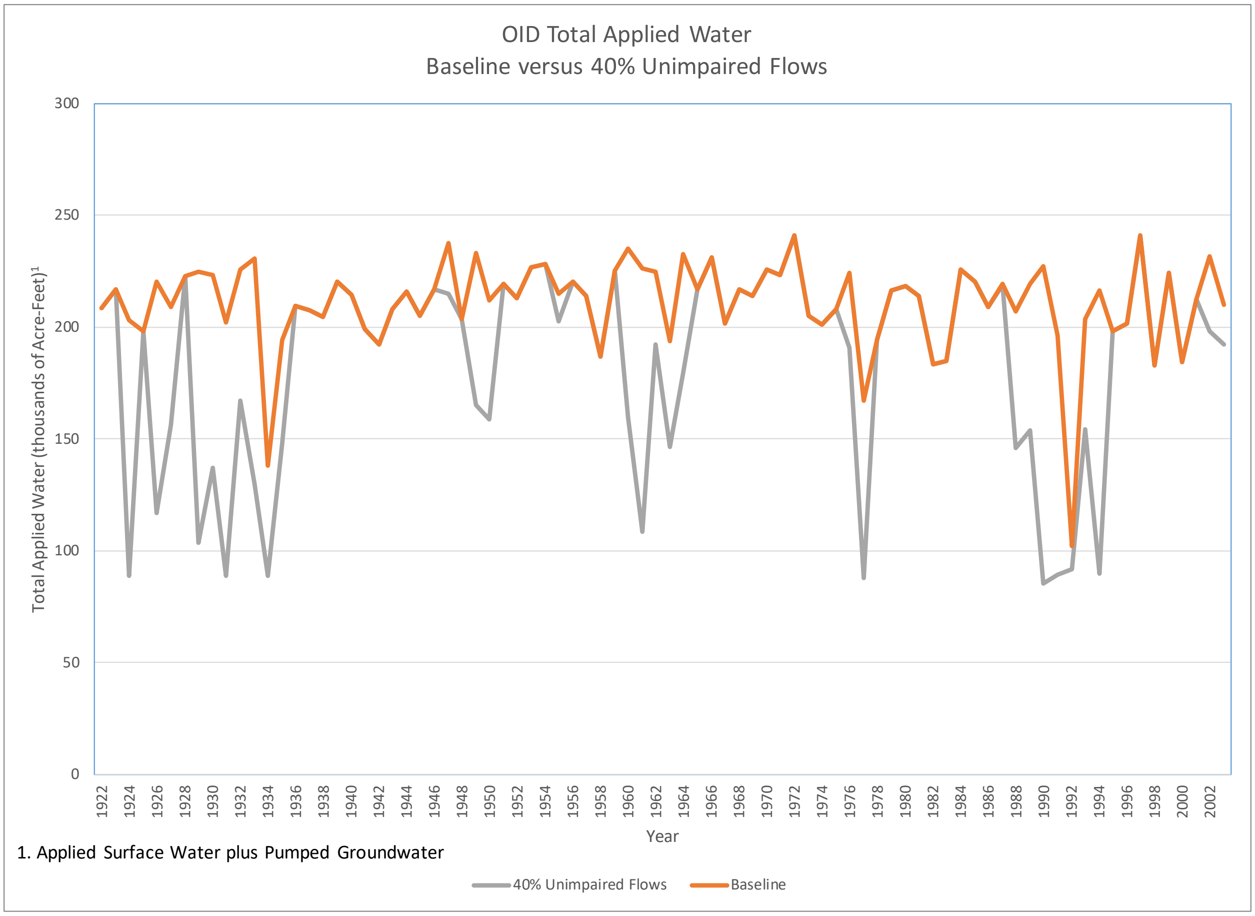
Figure A3.3



2. OID

Figure A3.4 summarizes the estimated water supply impacts within the OID during the Study Period were the SED in place at the SED 40. The figure shows that in many years during the Study Period, there would have been no anticipated impact on the availability of water for the district and, accordingly, the district's overall water supplies because of the SED 40; i.e., the combined total surface and groundwater supplies under the SED 40 would have been equal to those combined totals in the absence of the SED 40. Concurrently, the figure shows several years during the study Period where OID's water supplies with the SED 40 in place would have been lower than the district's baseline water supplies in the absence of the SED. In these years, it is estimated that SED reductions in the district's surface water supplies would not have been fully offset by additional groundwater pumping. In 1977, for example, designated a critically dry year by the SWRCB that followed another critically dry year, it is estimated that the applied water in the district would have been about 88,000 acre-feet with the SED in place, down about 47% from the baseline 167,000 acre-feet that would have been available to the district in the absence of the SED that year. The difference would have resulted in a reduction in crop production that year by the district.

Figure A3.4



In each of the years shown in Figure A3.4 that OID's water supplies would have been reduced below baseline due to the SED there would have been expected reductions in cropping and associated crop sales revenues (gross revenues). Figure A3.5 illustrates the years when the crop gross revenues generated by the district during the Study Period would have been lower than baseline were the SED in place. The revenue figures are in common 2008 dollar terms consistent with the SWRCB's SED assessment. The difference between the two lines, where they diverge, represents the estimated lost revenues associated with the SED in that year.

Figure A3.5

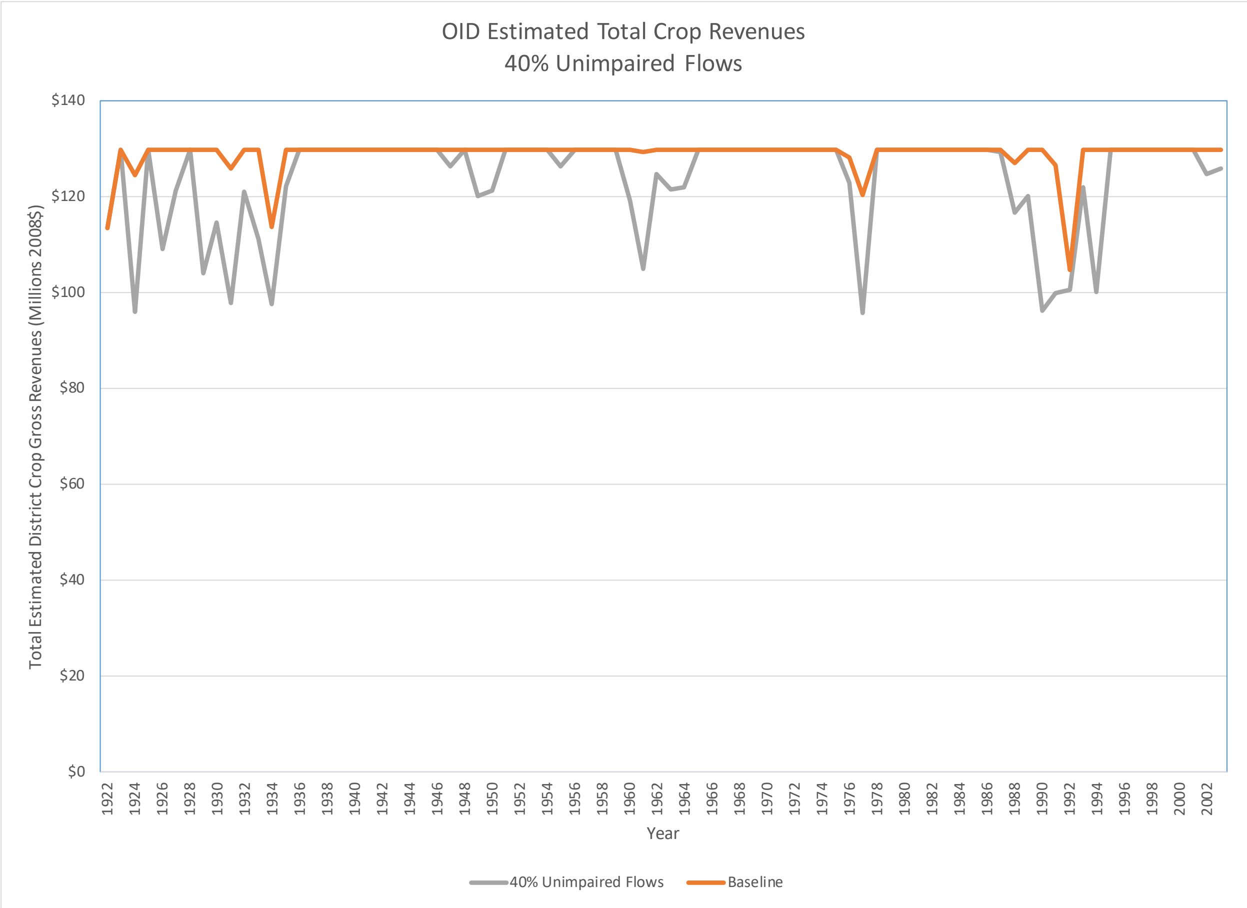
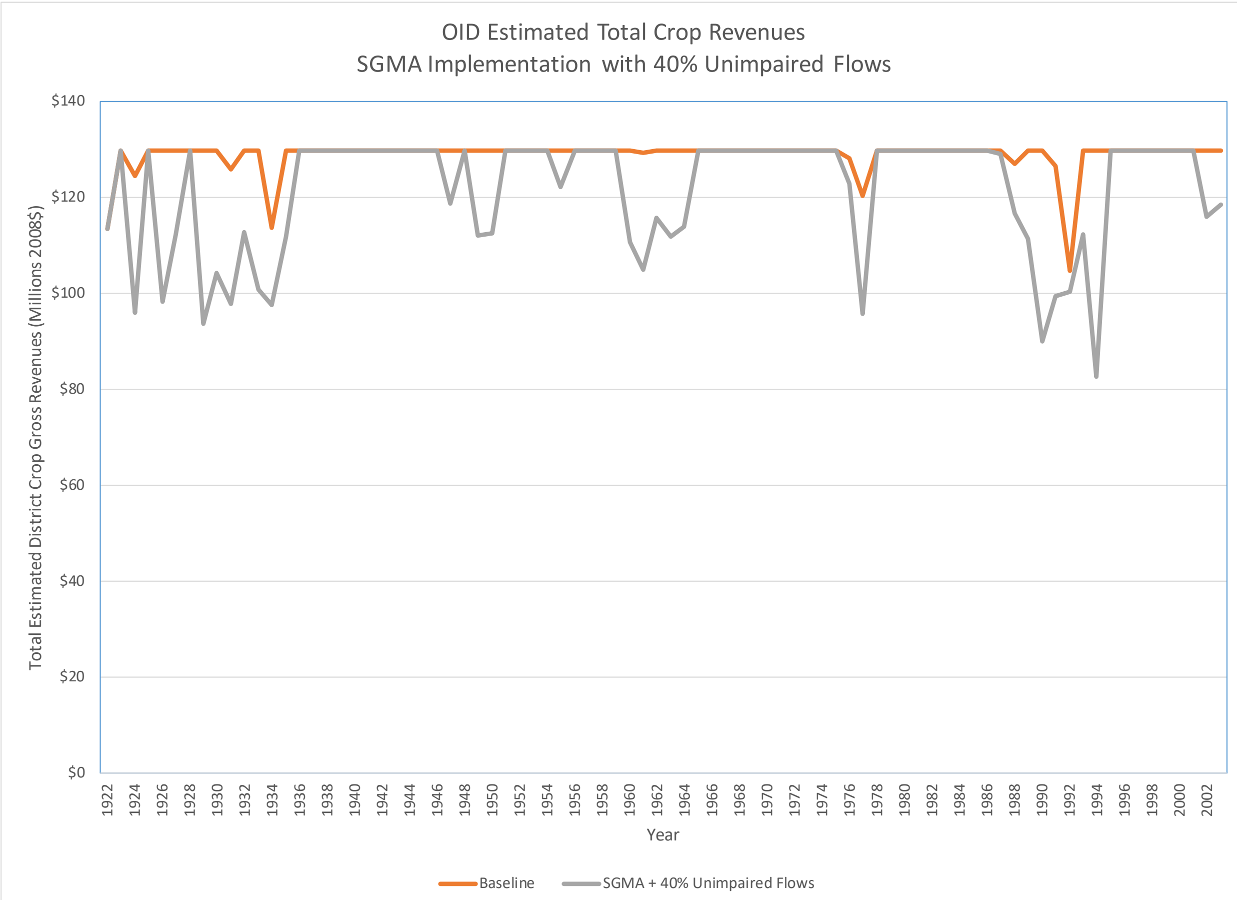


Figure A3.6 revisits the crop gross revenue analysis presented in Figure A3.5 with the imposition of the SGMA and associated assumption that in years that the district's surface water supplies would have been reduced below baseline due to the SED 40 the district would not have been able to offset any of those surface supply reductions with groundwater. The result shows some additional impacts on crop gross revenues due to the SED surface water supply reductions as can be observed by a comparison of the differences between the two lines in Figure A3.6 where the lines diverge as compared to in Figure A3.5. The magnitude of the additional impacts appears less significant compared to the SSJID case because of OID's lower reliance on groundwater in general as compared to SSJID.

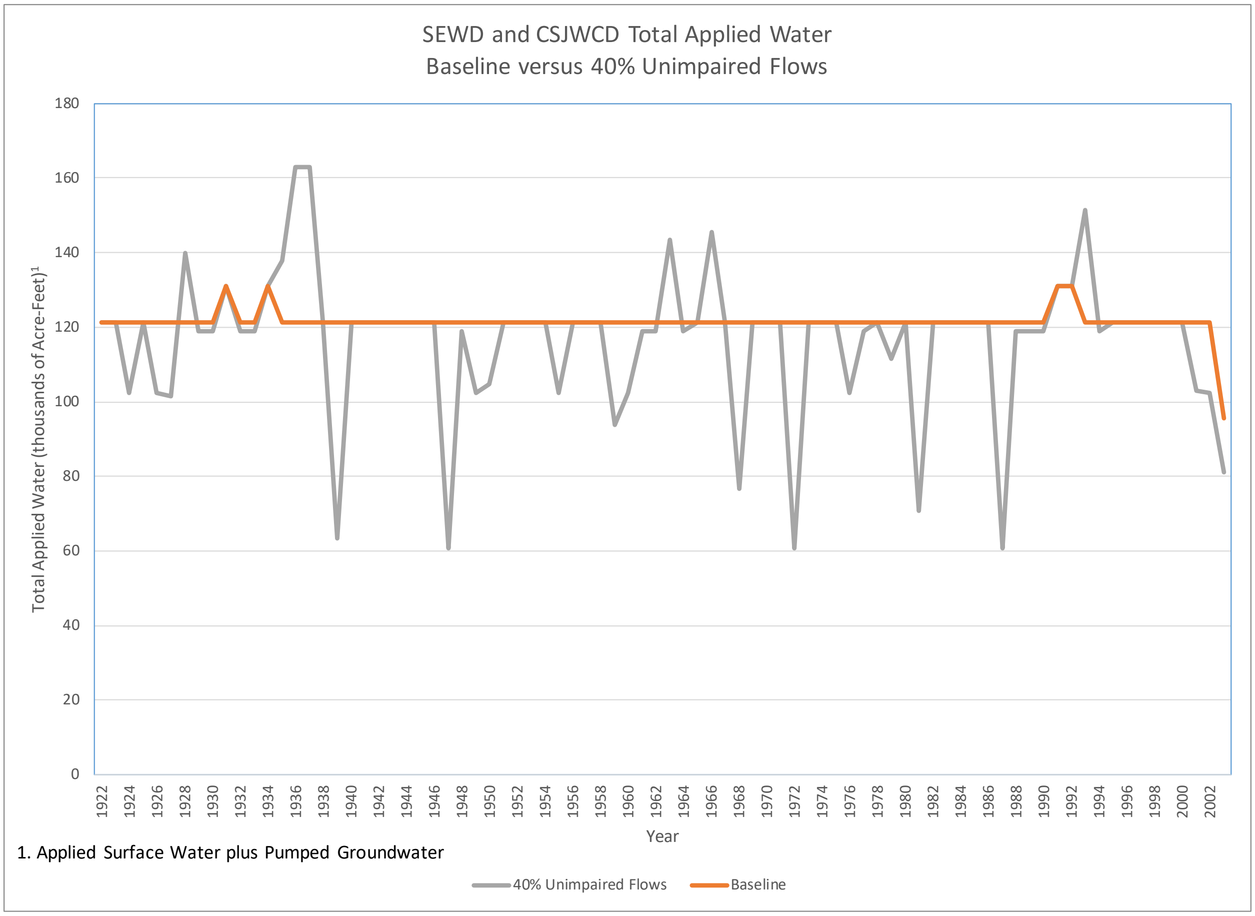
Figure A3.6



3. SEWD/CSJWCD

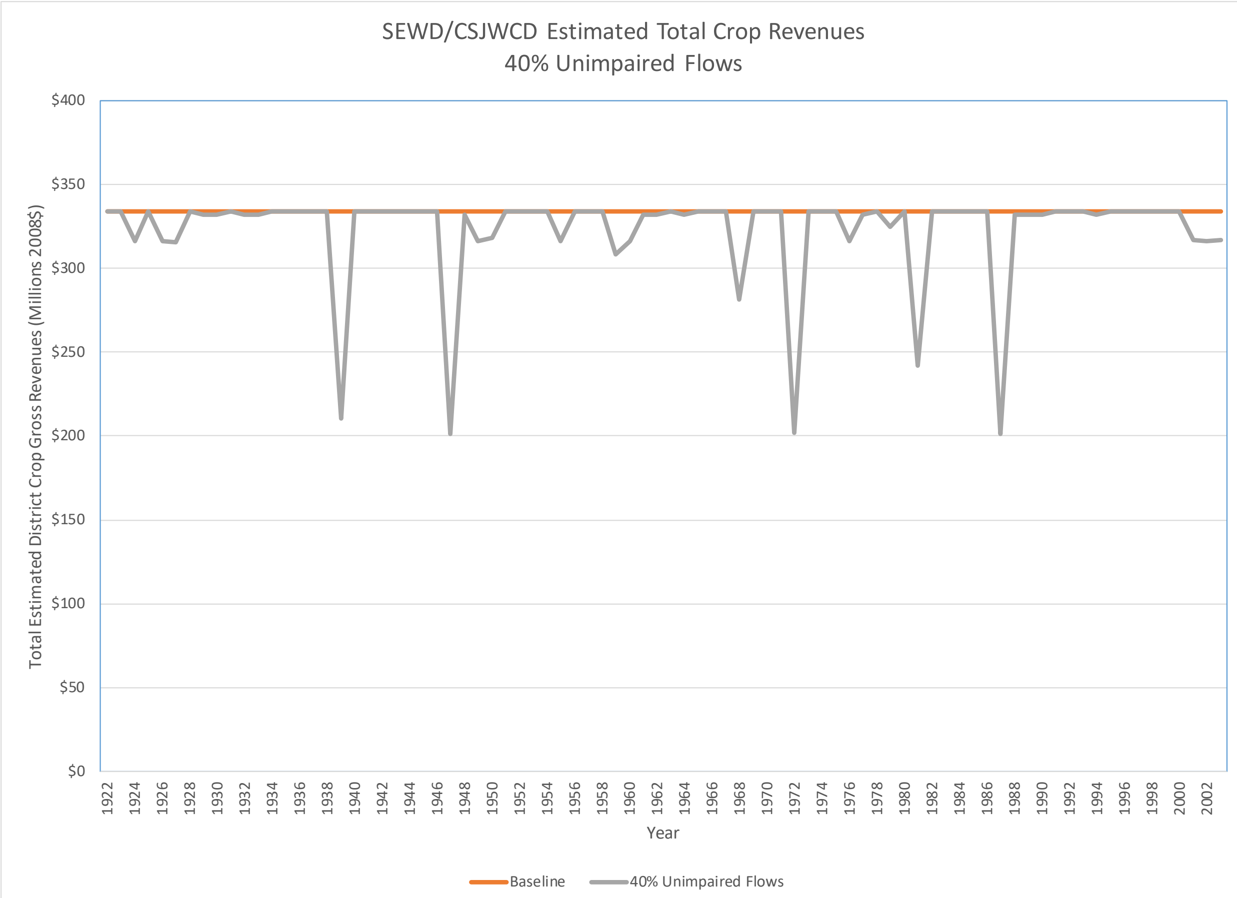
Figure A3.7 summarizes the estimated water supply impacts within SEWD and CSJWCD combined during the Study Period were the SED in place at the SED 40. The figure shows that in many years during the Study Period there would have been no impacts on the availability of surface water for the districts and, accordingly, the district's overall water supplies because of the SED 40. Concurrently, the figure shows a near equal number of years during the study Period where OID's water supplies with the SED 40 in place would have been lower or, in fact, higher than the district's baseline water supplies in the absence of the SED. In the years with lower supplies, it is estimated that SED reductions in the district's surface water supplies would not have been fully offset by additional groundwater pumping. In 1987, for example, designated a critically dry year by the SWRCB that actually followed a wet year, it is estimated that the applied water in the district would have been about 61,000 acre-feet with the SED in place, down about 50% from the baseline 121,000 acre-feet that would have been available to the district in the absence of the SED that year. The difference would have resulted in a reduction in crop production that year by the district.

Figure A3.7



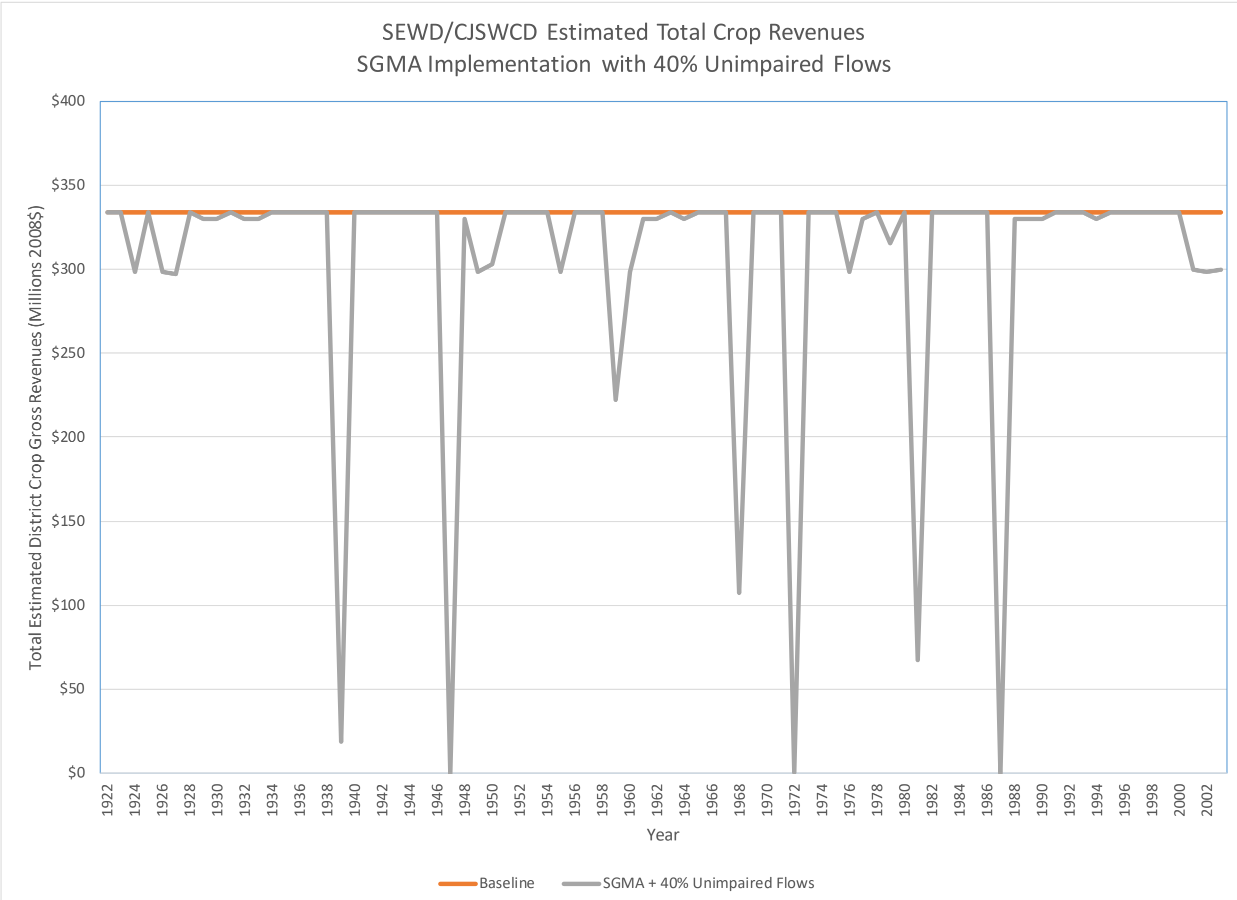
In each of the years shown in Figure A3.7 that SEWD/CSJWCD water supplies would have been reduced below baseline due to the SED there would have been expected reductions in cropping and associated crop sales revenues (gross revenues). Figure A3.8 illustrates the years when the crop gross revenues generated by the districts during the Study Period would have been lower than baseline were the SED in place. The revenue figures are in common 2008 dollar terms consistent with the SWRCB's SED assessment. The difference between the two lines, where they diverge, represents the estimated lost revenues associated with the SED in that year.

Figure A3.8



The figure shows some instances of fairly substantial decreases in the districts' crop gross revenues in four years during the Study Period in excess of 30%. Figure A3.9 revisits the crop gross revenue analysis presented in Figure A3.8 with the imposition of the SGMA and associated assumption that in years that the district's surface water supplies would have been reduced below baseline due to the SED 40 the district would not have been able to offset any of those surface supply reductions with groundwater. The result show significant additional impacts on crop gross revenues due to the SED surface water supply reductions as can be observed by a comparison of the differences between the two lines in Figure A3.9 where the lines diverge as compared to in Figure A3.8. In fact, Figure A3.9 shows for three years during the Study Period that in theory the districts' crop gross revenues will be driven to zero due to a complete lack of local water supply.

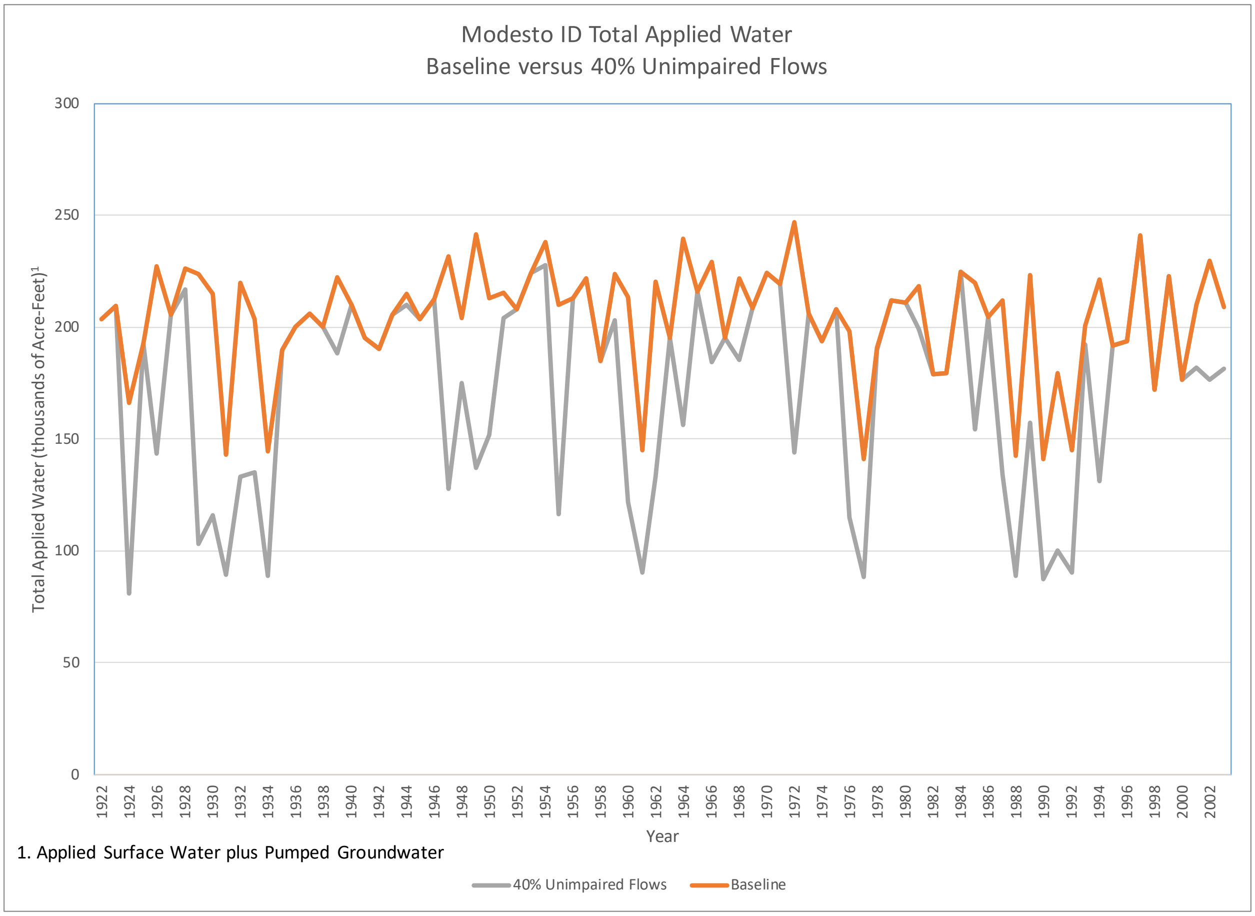
Figure A3.9



4. Modesto ID

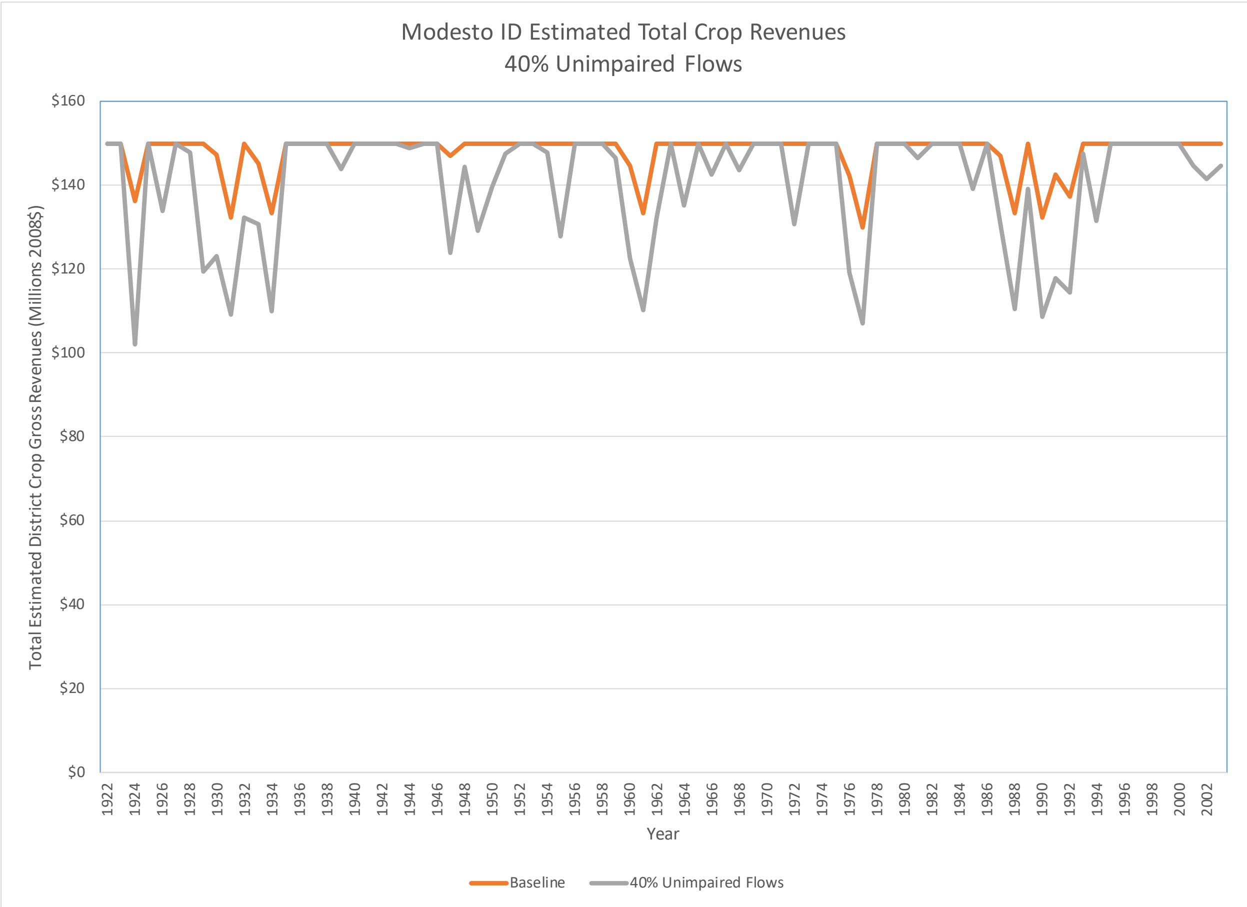
Figure A3.10 summarizes the estimated water supply impacts within the Modesto ID during the Study Period were the SED in place at the SED 40. The figure shows that the baseline water supply during the Study Period is highly variable due to the lack of district groundwater pumping infrastructure and, thus, limited ability to respond to normal inter-year surface water supply changes with offsetting groundwater pumping. The figure further shows many years during the Study Period that the SED would have caused substantial reductions in the district's water supplies below the baseline. In 1977, for example, designated a critically dry year by the SWRCB that followed another critically dry year, it is estimated that the applied water in the district would have been about 88,000 acre-feet with the SED in place, down almost 40% from the baseline 141,000 acre-feet that would have been available to the district in the absence of the SED that year. The difference would have resulted in a reduction in crop production that year by the district.

Figure A3.10



In each of the years shown in Figure A3.10 that the Modesto ID's water supplies would have been reduced below baseline due to the SED there would have been expected reductions in cropping and associated crop sales revenues (gross revenues). Figure A3.11 illustrates the years when the crop gross revenues generated by the district during the Study Period would have been lower than baseline were the SED in place. The revenue figures are in common 2008 dollar terms consistent with the SWRCB's SED assessment. The difference between the two lines, where they diverge, represents the estimated lost revenues associated with the SED in that year.

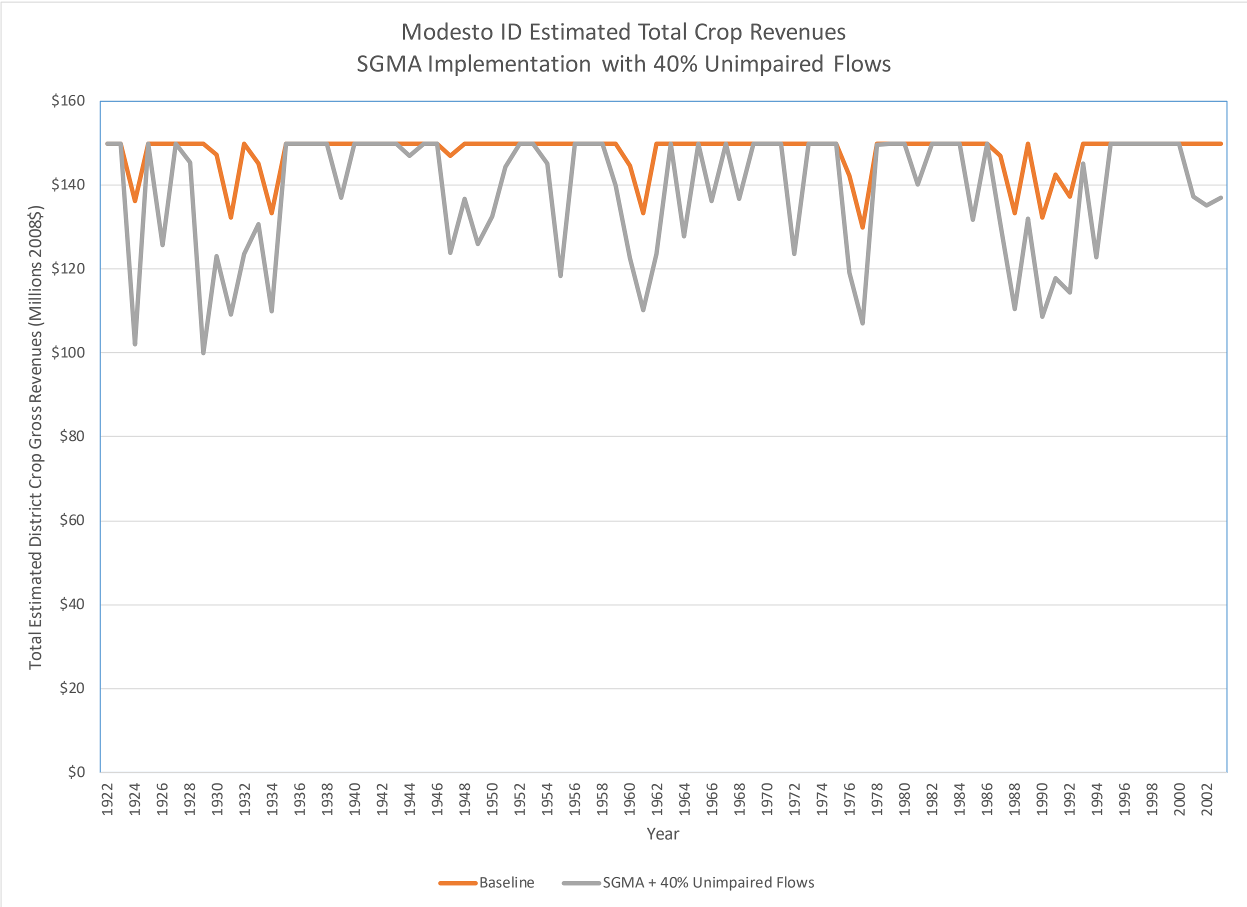
Figure A3.11



The figure shows that the magnitude of lost revenues in years that would have experienced below baseline water supplies due to the SED are less than for water supply shown in Figure A3.10. This is because the analysis of the fallowing of crops due to SED water supply reductions reflects the fact that in the face of water supply reductions farmers tend to fallow relatively lower-valued, higher water consuming annual crops such as pasture in much greater proportion than higher valued crops such as almonds.

Figure A3.12 revisits the crop gross revenue analysis presented in Figure A3.11 with the imposition of the SGMA and associated assumption that in years that the district's surface water supplies would have been reduced below baseline due to the SED 40 the district would not have been able to offset any of those surface supply reductions with groundwater. The result is much more significant impacts on crop gross revenues due to the SED surface water supply reductions as can be observed by a comparison of the larger differences between the two lines in Figure A3.12 where the lines diverge as compared to in Figure A3.11.

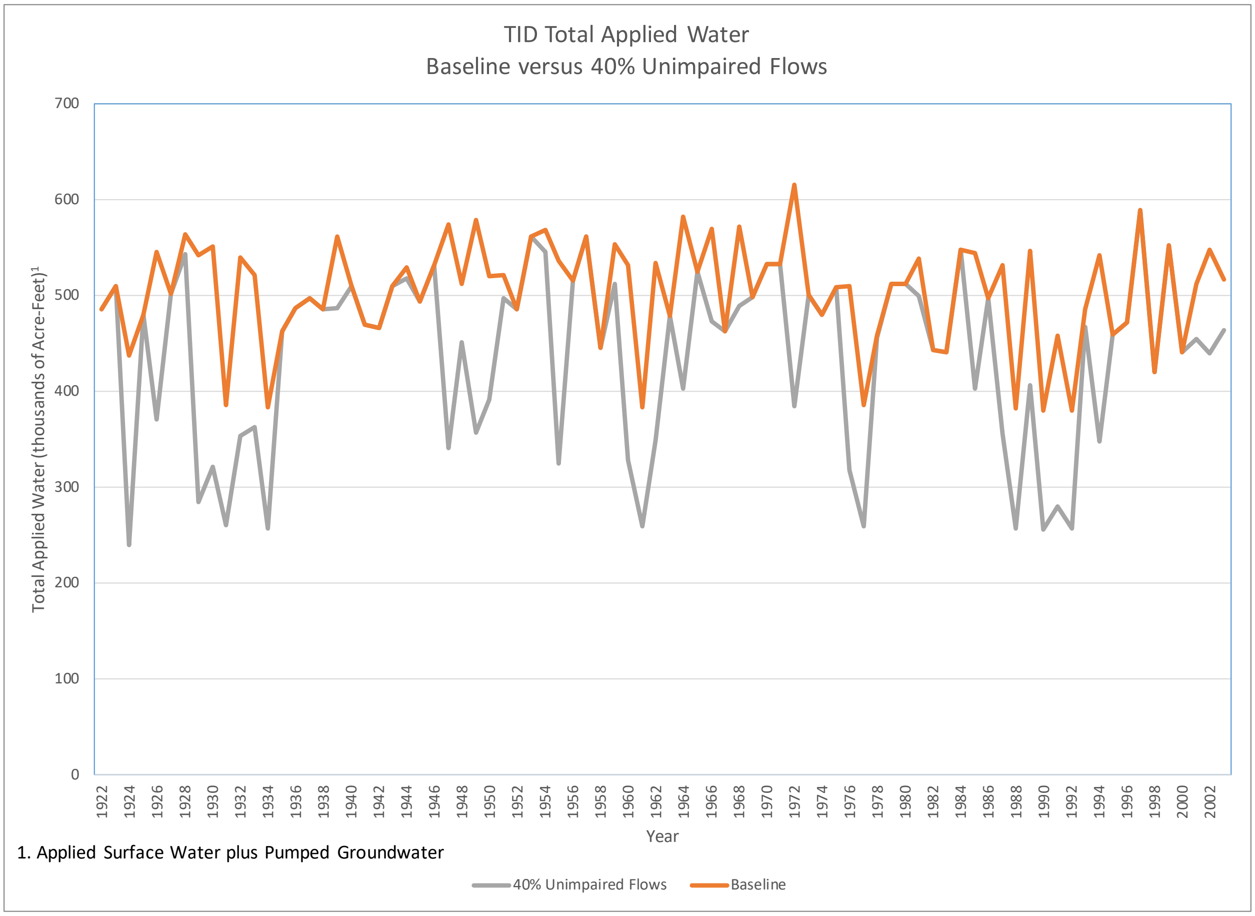
Figure A3.12



5. TID

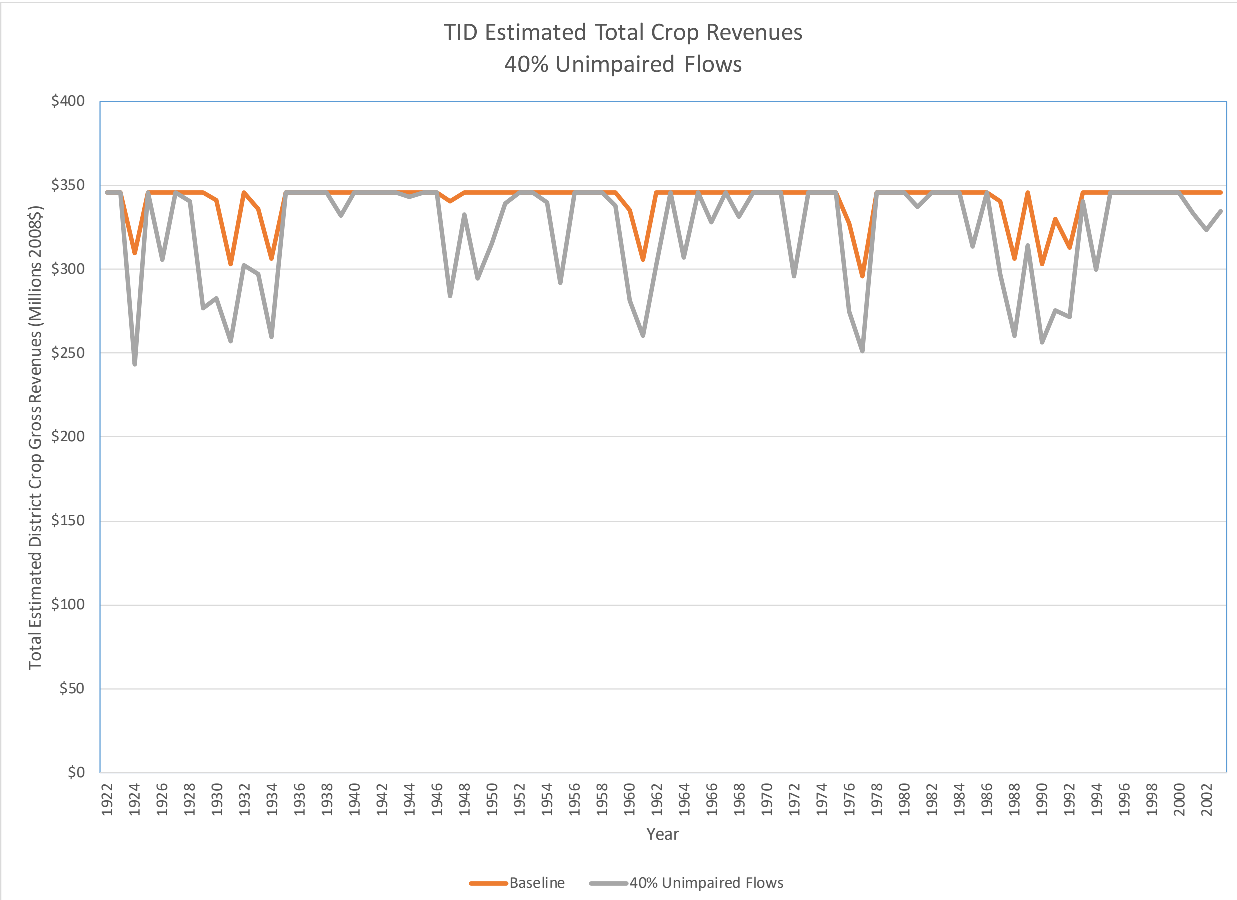
Figure A3.13 summarizes the estimated water supply impacts within TID during the Study Period were the SED 40 in place. The figure shows that the district's baseline water supply during the Study Period is highly variable due to the lack of district groundwater pumping infrastructure and, thus, limited ability to respond to normal inter-year surface water supply changes with offsetting groundwater pumping. The figure further shows many years during the Study Period that the SED would have caused substantial reductions in the district's water supplies below the baseline. In 1977, for example, designated a critically dry year by the SWRCB that followed another critically dry year, it is estimated that the applied water in the district would have been about 259,000 acre-feet with the SED in place, down almost 1/3rd, 33%, from the baseline 385,000 acre-feet that would have been available to the district in the absence of the SED that year. The difference would have resulted in a reduction in the district's crop production and associated crop gross revenues.

Figure A3.13



In each of the years shown in Figure A3.13 that the Modesto ID's water supplies would have been reduced below baseline due to the SED there would have been expected reductions in cropping and associated crop gross revenues. Figure A3.14 illustrates the years when the crop gross revenues generated by the district during the Study Period would have been lower than baseline were the SED in place. The revenue figures are in common 2008 dollar terms consistent with the SWRCB's SED assessment. The difference between the two lines, where they diverge, represents the estimated lost revenues associated with the SED in that year.

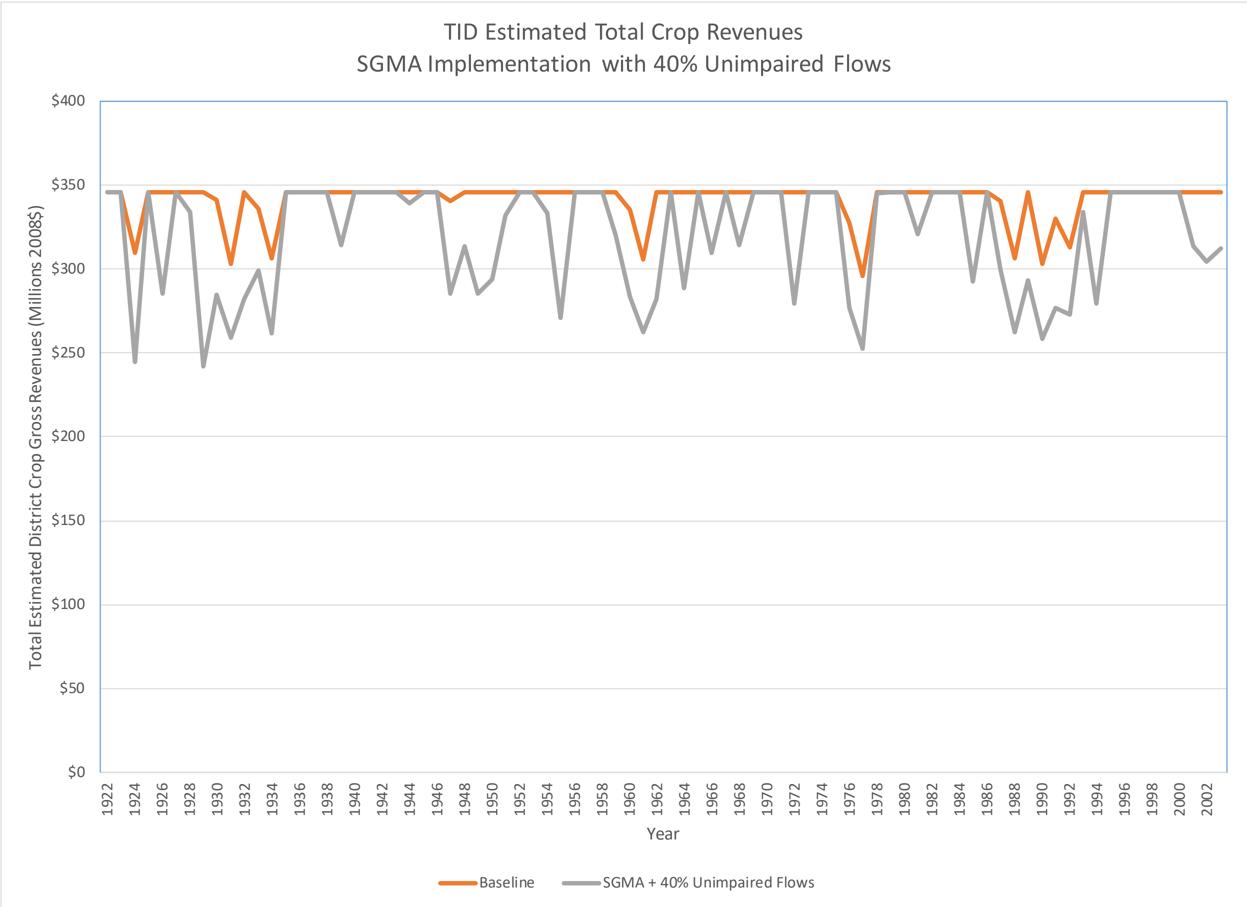
Figure A3.14



The figure shows that the magnitude of lost revenues in years that would have experienced below baseline water supplies due to the SED are less than for water supply shown in Figure A3.10. This is because the analysis of the fallowing of crops due to SED water supply reductions reflects the fact that in the face of water supply reductions farmers tend to fallow relatively lower-valued, higher water consuming annual crops such as pasture in much greater proportion than higher valued crops such as almonds.

Figure A3.15 revisits the crop gross revenue analysis presented in Figure A3.14 with the imposition of the SGMA and associated assumption that in years that the district's surface water supplies would have been reduced below baseline due to the SED 40 the district would not have been able to offset any of those surface supply reductions with groundwater. The result is greater impacts on crop gross revenues due to the SED surface water supply reductions as can be observed by a comparison of the larger differences between the two lines in Figure A3.15 where the lines diverge as compared to in Figure A3.14. However, the impact of SGMA on the crop revenue results is not as significant as for some of the other districts as TID is relatively less reliant on groundwater to manage is surface water supply variability.

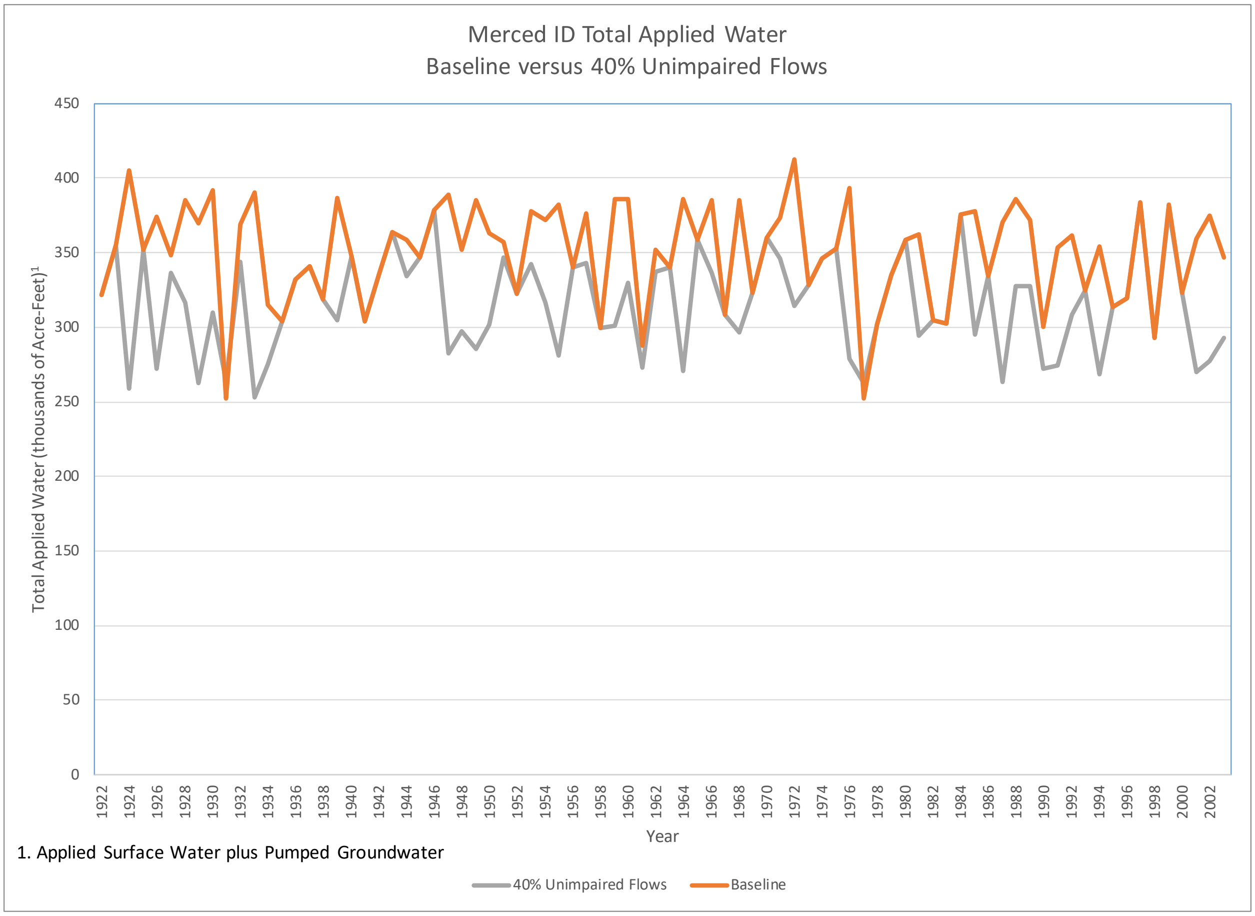
Figure A3.15



6. Merced ID

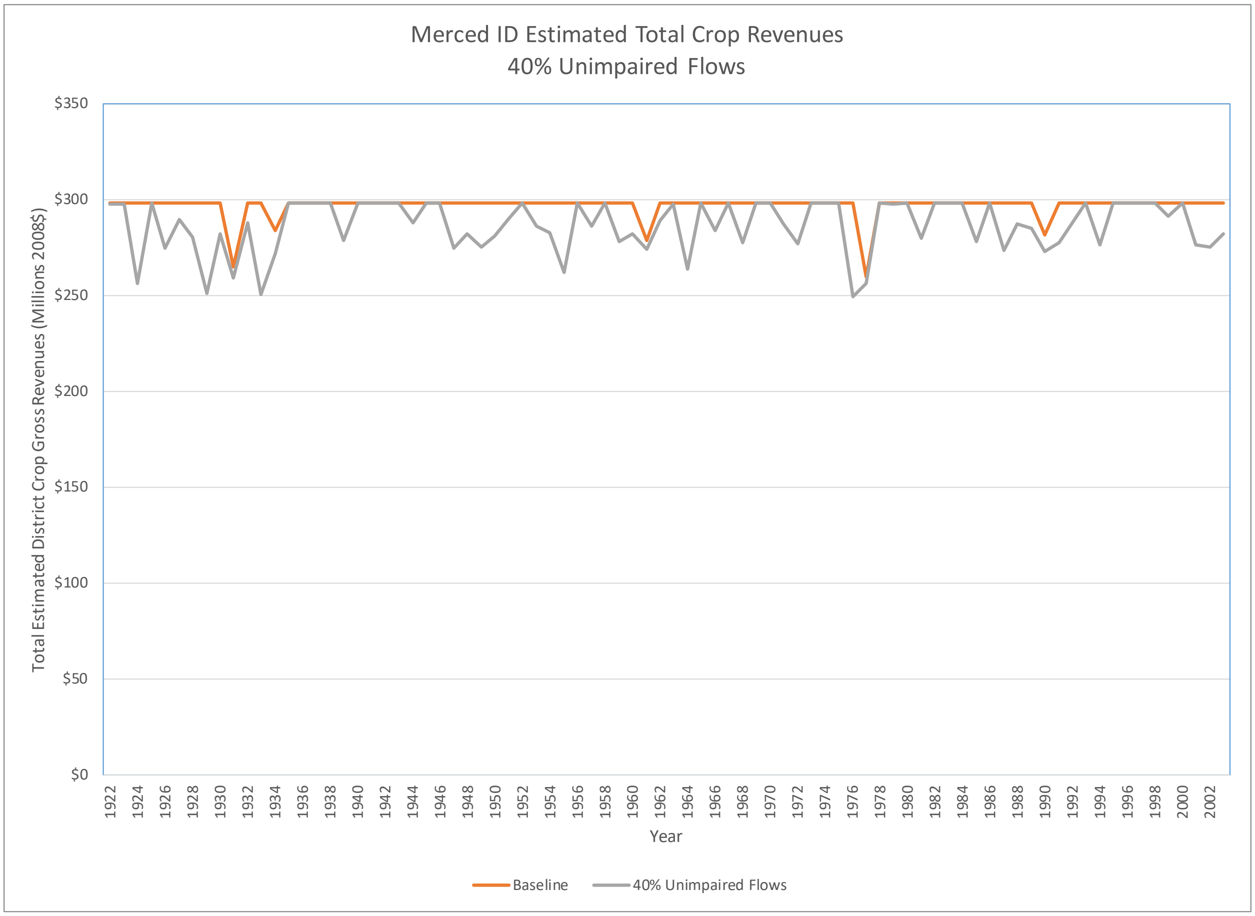
Figure A3.16 summarizes the estimated water supply impacts within Merced ID during the Study Period were the SED 40 in place. The figure shows that the district's baseline water supply during the Study Period is highly variable. The figure further shows many years during the Study Period that the SED would have caused substantial reductions in the district's water supplies below the baseline. In 1947, for example, designated a critically dry year by the SWRCB that followed another critically dry year, it is estimated that the applied water in the district would have been about 282,000 acre-feet with the SED in place, down almost 28% from the baseline 389,000 acre-feet that would have been available to the district in the absence of the SED that year. The difference would have resulted in a reduction in the district's crop production and associated crop gross revenues.

Figure A3.16



In each of the years shown in Figure A3.16 that the Merced ID's water supplies would have been reduced below baseline due to the SED there would have been expected reductions in cropping and associated crop gross revenues. Figure A3.17 illustrates the years when the crop gross revenues generated by the district during the Study Period would have been lower than baseline were the SED in place. The revenue figures are in common 2008 dollar terms consistent with the SWRCB's SED assessment. The difference between the two lines, where they diverge, represents the estimated lost revenues associated with the SED in that year.

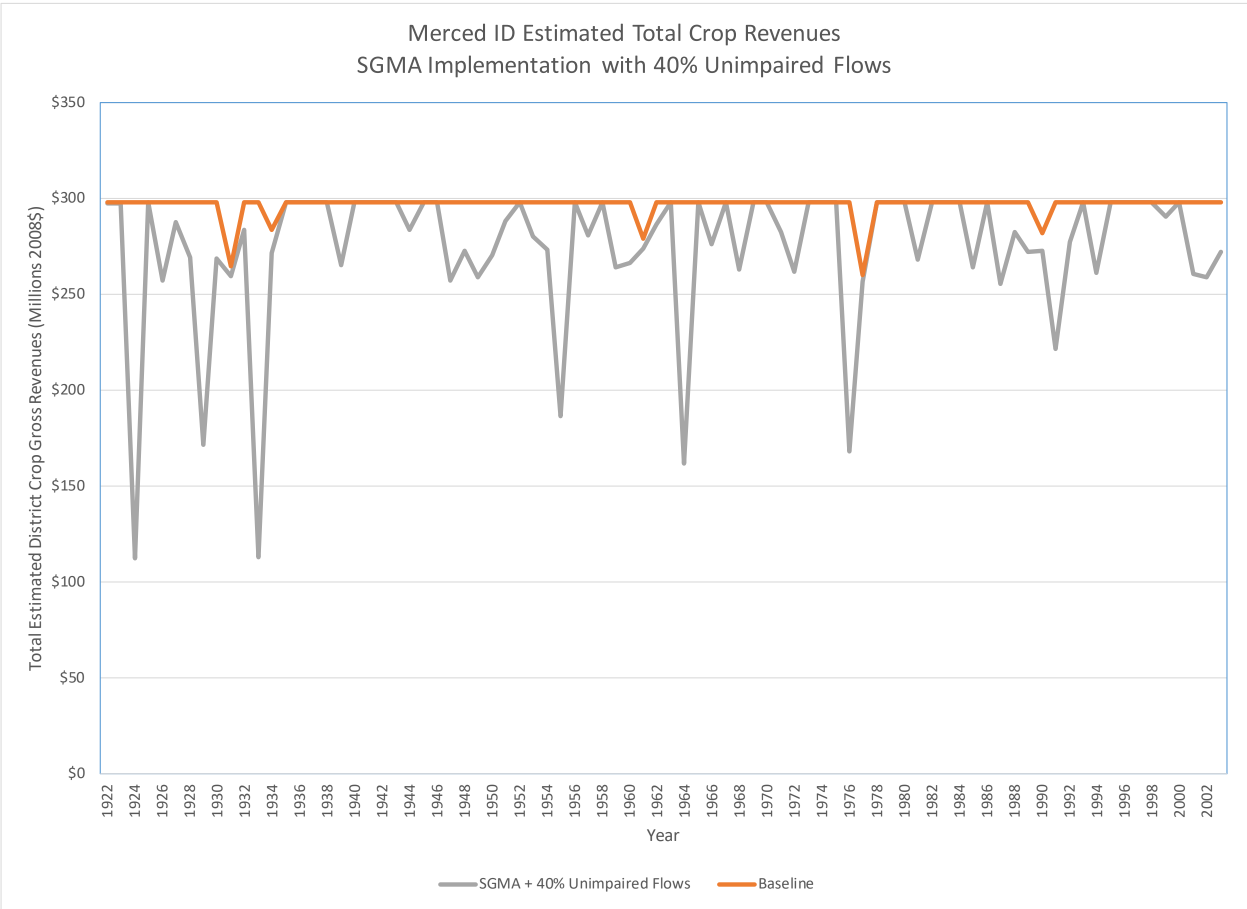
Figure A3.17



The figure shows that the magnitude of lost revenues in years that would have experienced below baseline water supplies due to the SED are less than for water supply shown in Figure A3.16. This is because the analysis of the fallowing of crops due to SED water supply reductions reflects the fact that in the face of water supply reductions farmers tend to fallow relatively lower-valued, higher water consuming annual crops such as pasture in much greater proportion than higher valued crops such as almonds.

Figure A3.18 revisits the crop gross revenue analysis presented in Figure A3.17 with the imposition of the SGMA and associated assumption that in years that the district's surface water supplies would have been reduced below baseline due to the SED 40 the district would not have been able to offset any of those surface supply reductions with groundwater. The result is substantially greater impacts on crop gross revenues due to the SED surface water supply reductions as can be observed by a comparison of the larger differences between the two lines in Figure A3.18 where the lines diverge as compared to in Figure A3.17. The much greater impact reveals the substantial reliance of the Merced ID on groundwater to offset surface water supply variability.

Figure A3.18

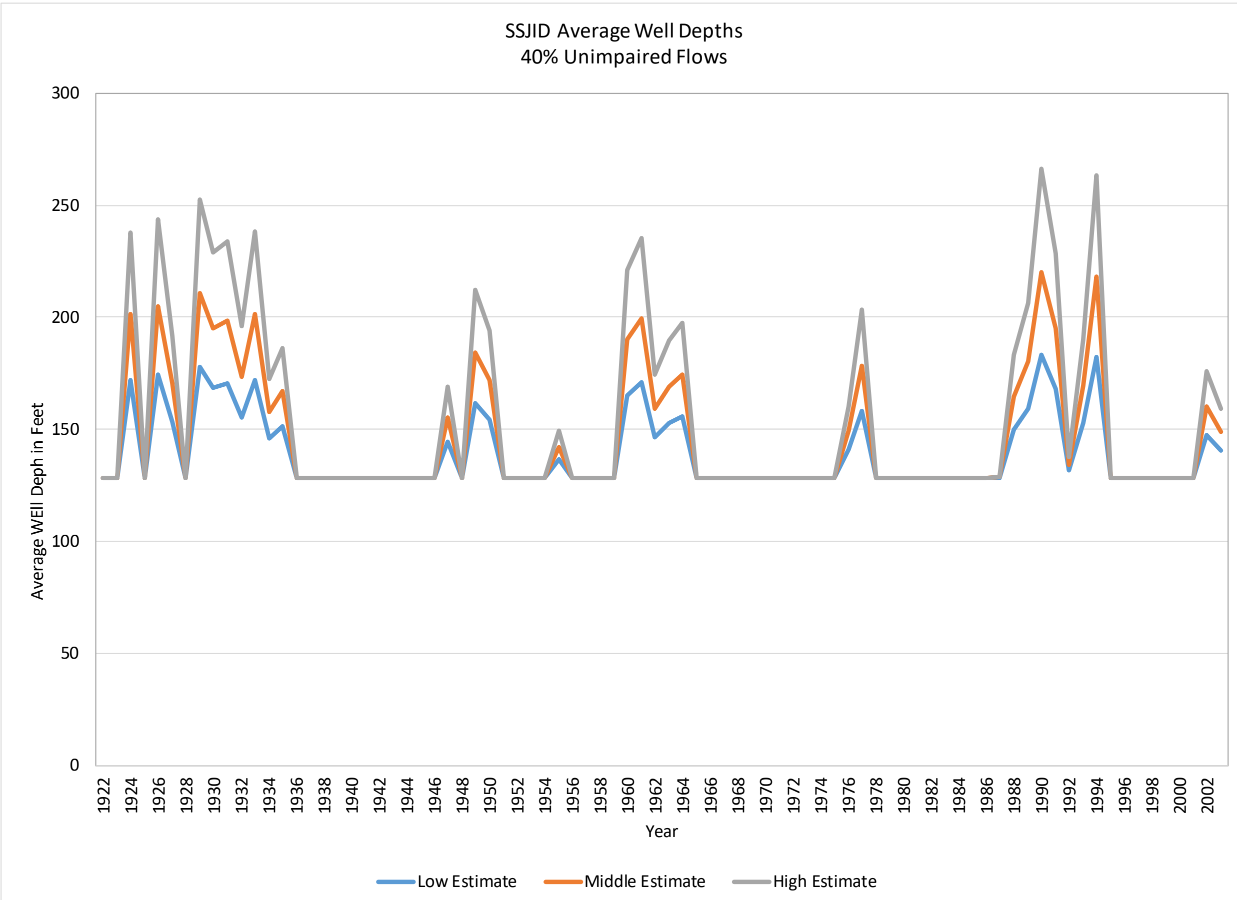


The following examines the groundwater depth and pumping cost impacts of the SED 40 were it in place during the Study Period for each of the Study Area irrigation districts that rely on surface water.

- SSJID

Figure A3.19 characterizes the estimated low, medium and high potential impacts on groundwater depths within the SSJID during the Study Period because of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

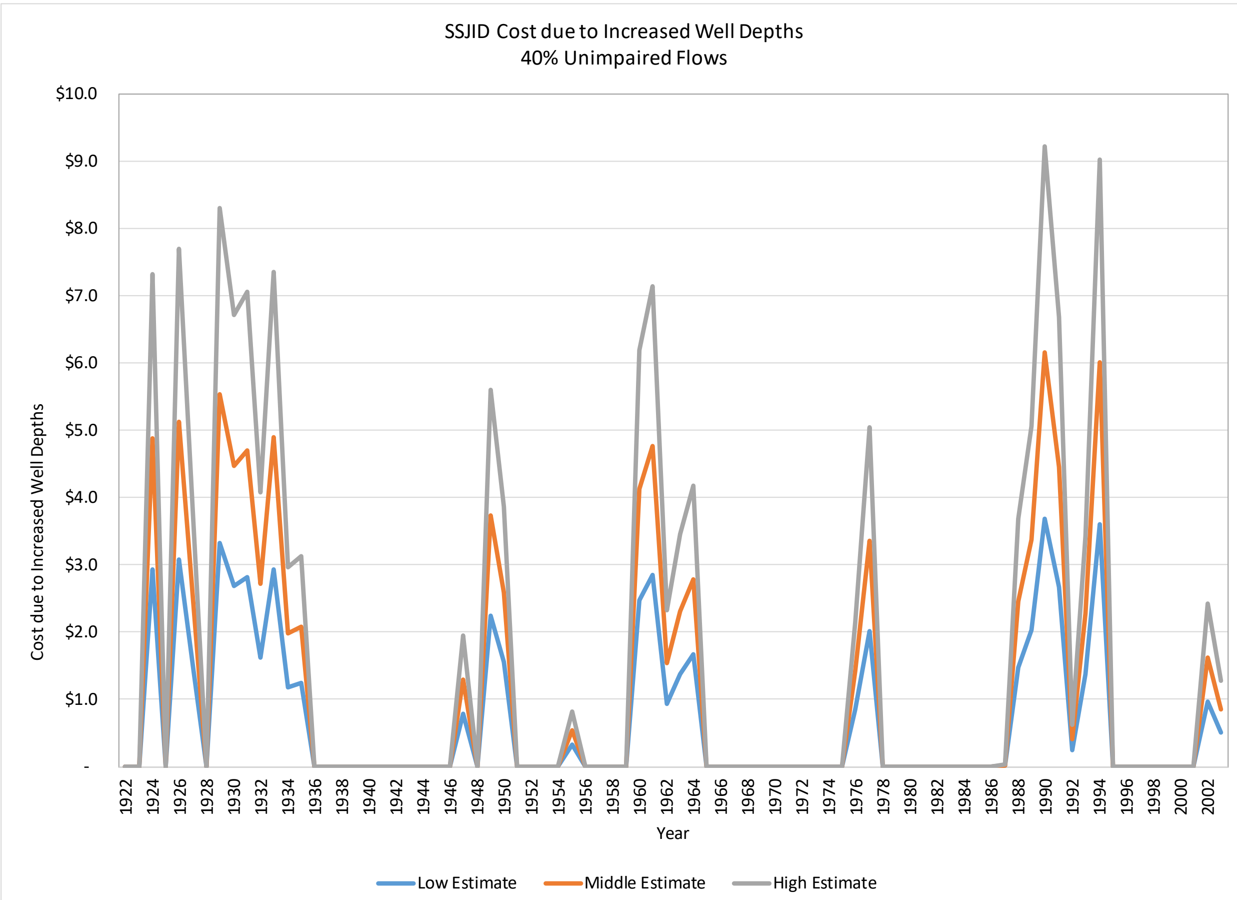
Figure A3.19



The figure shows potentially significant increases in the district's average depth to groundwater and accordingly, groundwater lifts as a result of SED 40 implementation for a number of the years during the Study Period. This includes in several of the Study Period years a near doubling of the average depths to groundwater based on the high estimate for increased lifts.

Figure A3.20 shows the estimated pumping cost incurred by the district and its farmers during the Study Period as a result of the anticipated increases in well depths shown in Figure A3.19.

Figure A3.20

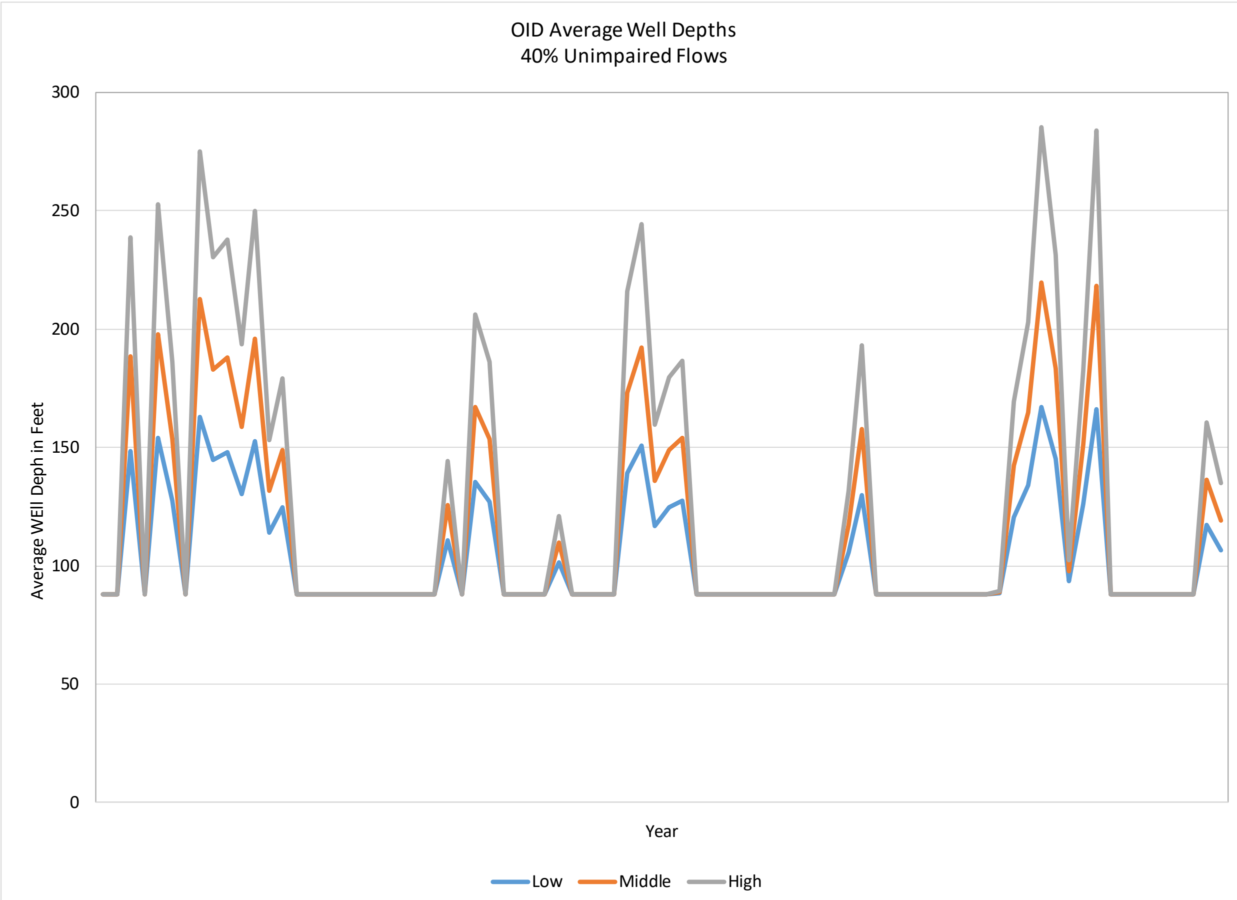


The figure shows increased costs of pumping in SSJID as much as $9.0 million in some years based on the high estimate for those years of increased pumping lifts due to increased pumping resulting from the SED 40.

- OID

Figure A3.21 characterizes the estimated low, medium and high potential impacts on groundwater depths within the OID during the Study Period because of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

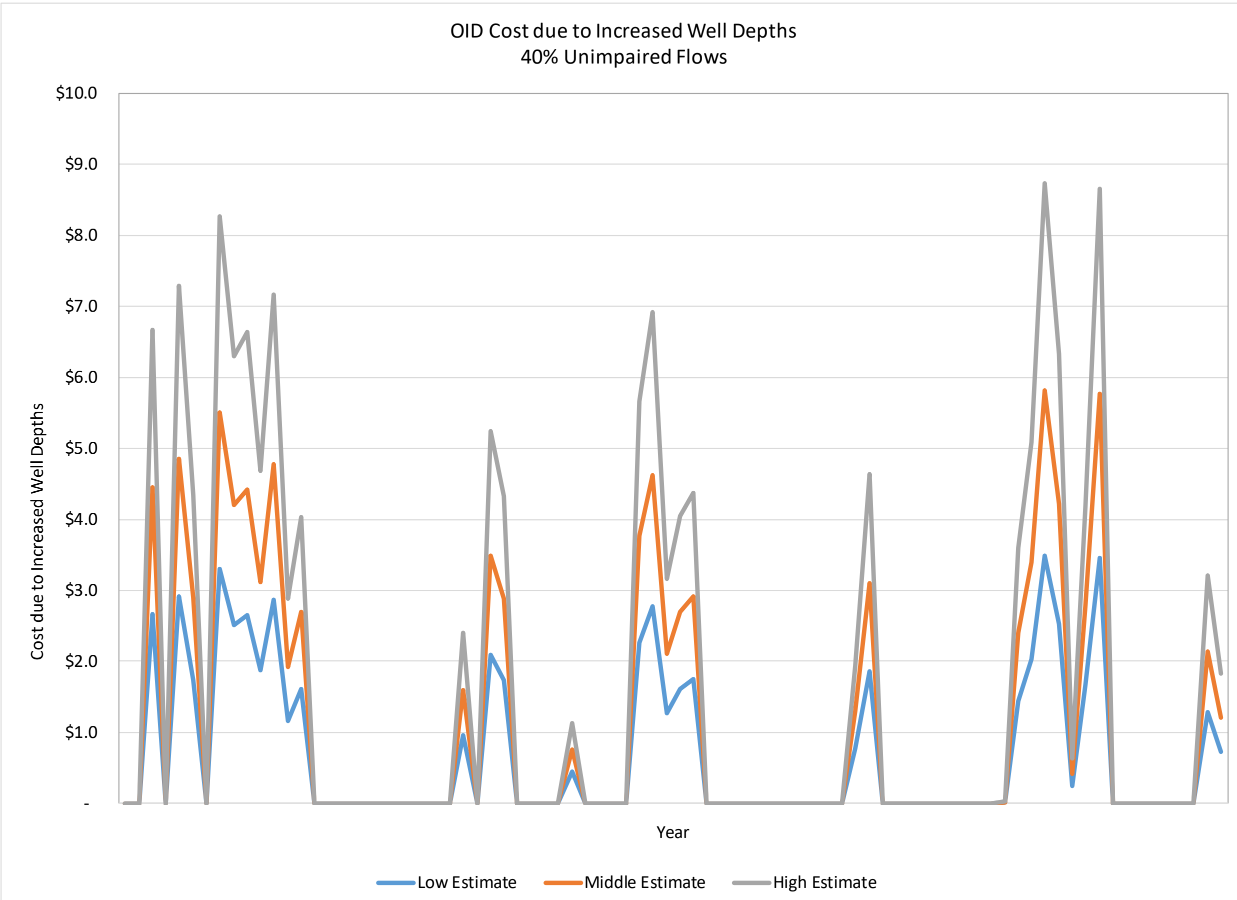
Figure A3.21



The figure shows potentially significant increases in the district's average depth to groundwater and accordingly, groundwater lifts as a result of SED 40 implementation for a number of the years during the Study Period. This includes in several of the Study Period years a more than doubling of the average depths to groundwater based on the high estimate for increased lifts.

Figure A3.22 shows the estimated pumping cost incurred by the district and its farmers during the Study Period as a result of the anticipated increases in well depths shown in Figure A3.21 based on the same assumptions and limitations assumed for SSJID above.

Figure A3.22

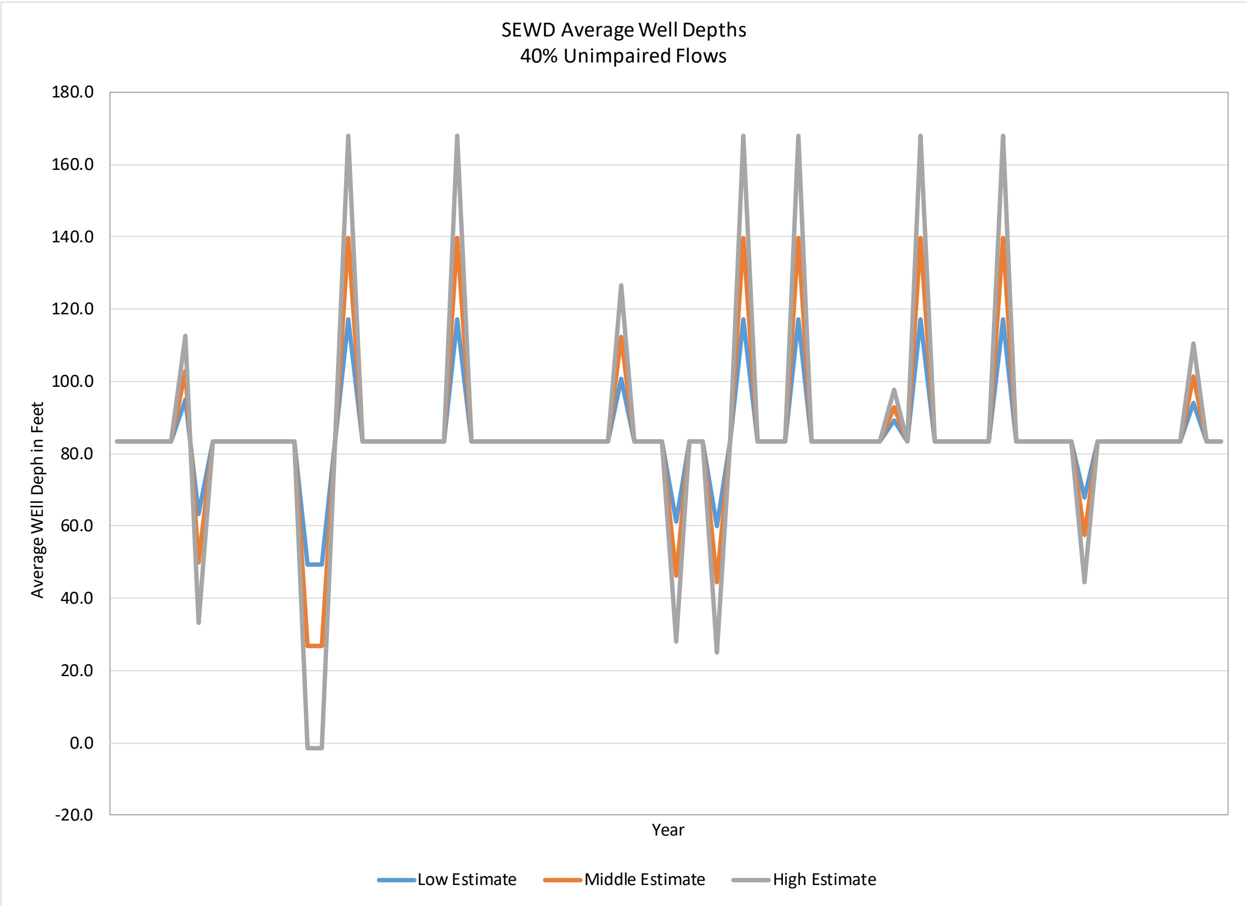


The figure shows increased costs of pumping in SSJID as much as $9.0 million in some years based on the high estimate for those years of increased pumping lifts due to increased pumping resulting from the SED 40.

- SEWD

Figure A3.23 characterizes the estimated low, medium and high potential impacts on groundwater depths within the SEWD during the Study Period because of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

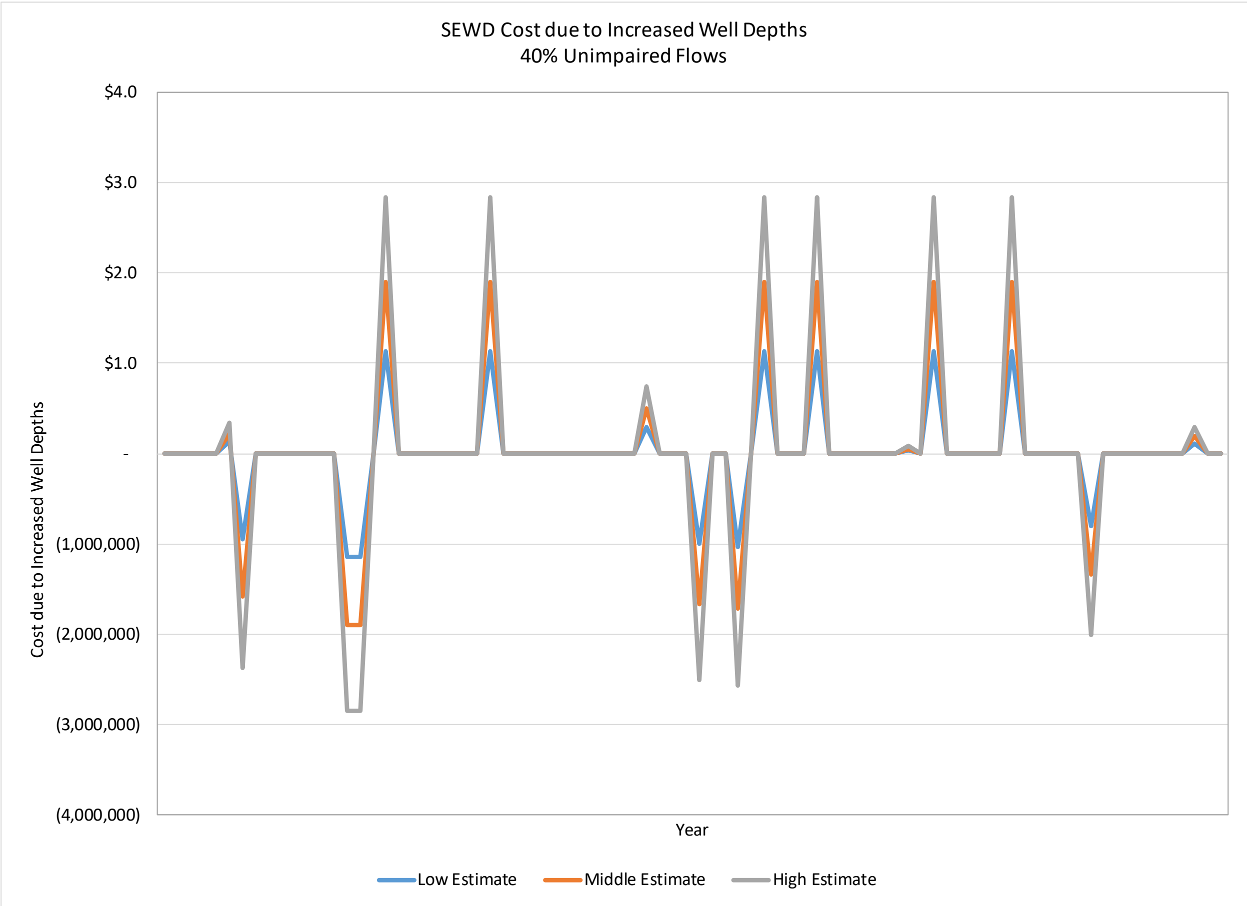
Figure A3.23



The figure shows potentially significant increases in the district's average depth to groundwater and accordingly, groundwater lifts as a result of SED 40 implementation for a number of the years during the Study Period. This includes a number of the Study Period years a more than doubling of the average depths to groundwater based on the high estimate for increased lifts. Concurrently, as SEWD's surface water supplies would be expected to increase over baseline in some years under the SED 40, the expected impact will actually be a reduction of district average groundwater depths certain of those years.

Figure A3.24 shows the estimated additional and reduced pumping costs incurred by the district and its farmers during the Study Period as a result of the anticipated increases and decreases, respectively in well depths shown in Figure A3.23.

Figure A3.24

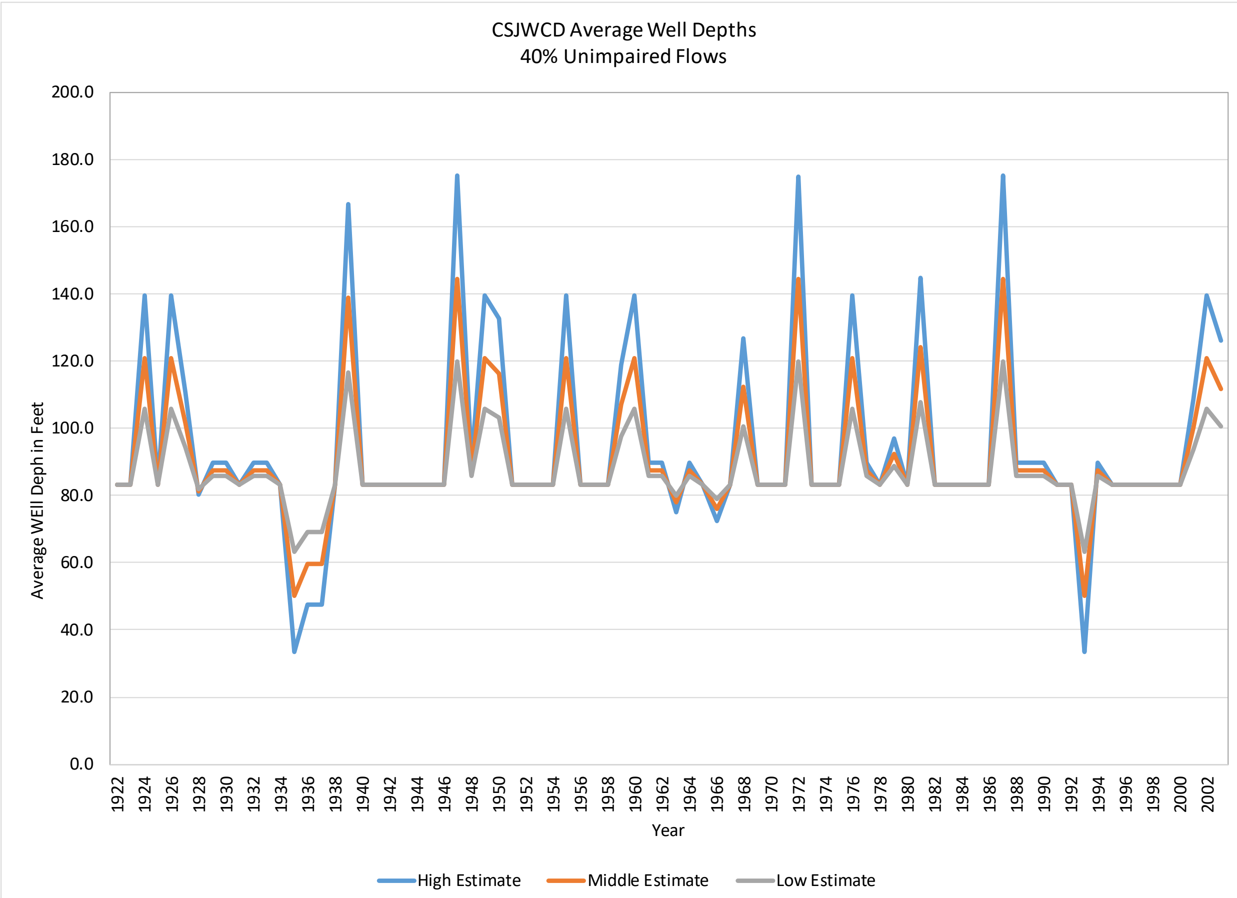


The figure shows increased costs of pumping in SEWD by as much as almost 3.0 million in some years based on the high estimate for those years of increased pumping lifts due to increased pumping resulting from the SED 40. The figure also shows, conversely, estimated decreases in pumping costs by nearly $3.0 million with anticipated SED-related well depth declines in some years.

- CSJWCD

Figure A3.25 characterizes the estimated low, medium and high potential impacts on groundwater depths within the CSJWCD during the Study Period because of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

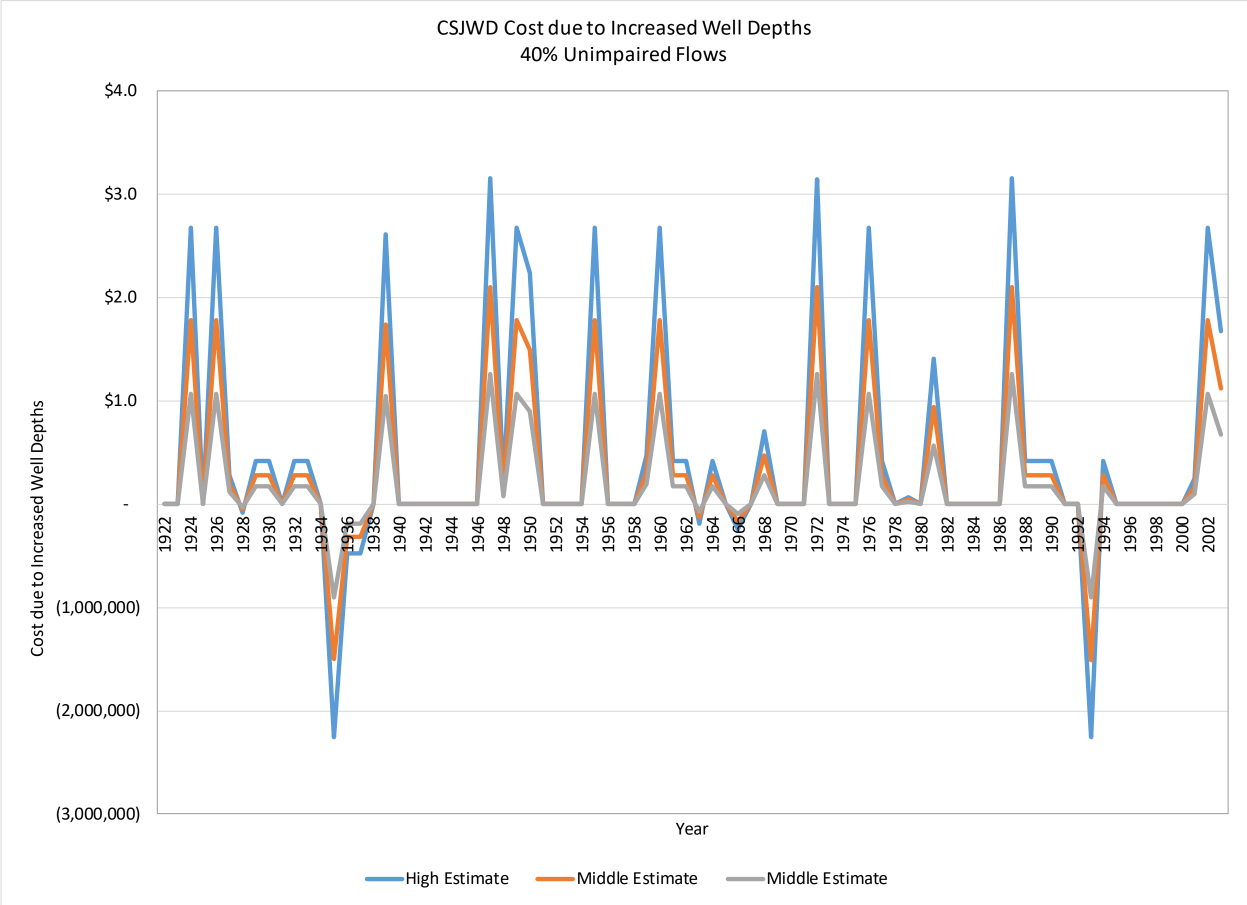
Figure A3.25



The figure shows potentially significant increases in the district's average depth to groundwater and accordingly, groundwater lifts as a result of SED 40 implementation for a number of the years during the Study Period. This includes in several of the Study Period years a more than doubling of the average depths to groundwater based on the high estimate for increased lifts. Concurrently, as CSJWCD's surface water supplies would be expected to increase over baseline in some years under the SED 40 as with the SEWD, the expected impact will actually be a reduction of district average groundwater depths in those years. The frequency and magnitude of years with reduced groundwater depths is lower for CSJWCD than for SEWD (see Figure A3.23

Figure A3.26 shows the estimated additional pumping cost incurred by the district and its farmers during the Study Period because of the anticipated increases in well depths shown in Figure A3.25.

Figure A3.25

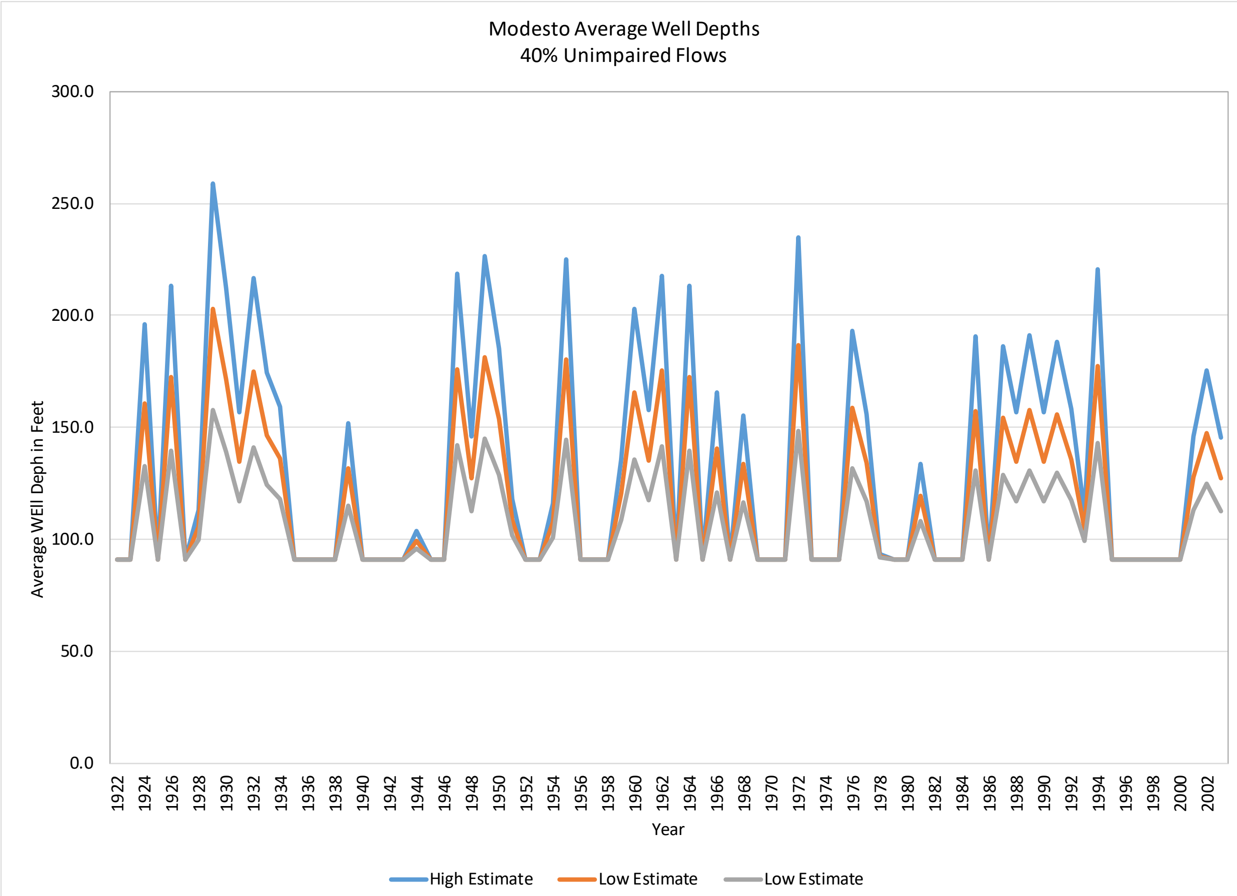


The figure shows increased costs of pumping in CSJWCD by over $3.0 million in some years based on the high estimate for those years of increased pumping lifts due to increased pumping resulting from the SED 40. The figure also shows, conversely, estimated decreases in pumping costs by$2.0 million in two of the Study Period years when there would have been anticipated SED-related well depth declines.

- Modesto ID

Figure A3.26 characterizes the estimated low, medium and high potential impacts on groundwater depths within the Modesto ID during the Study Period as a result of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

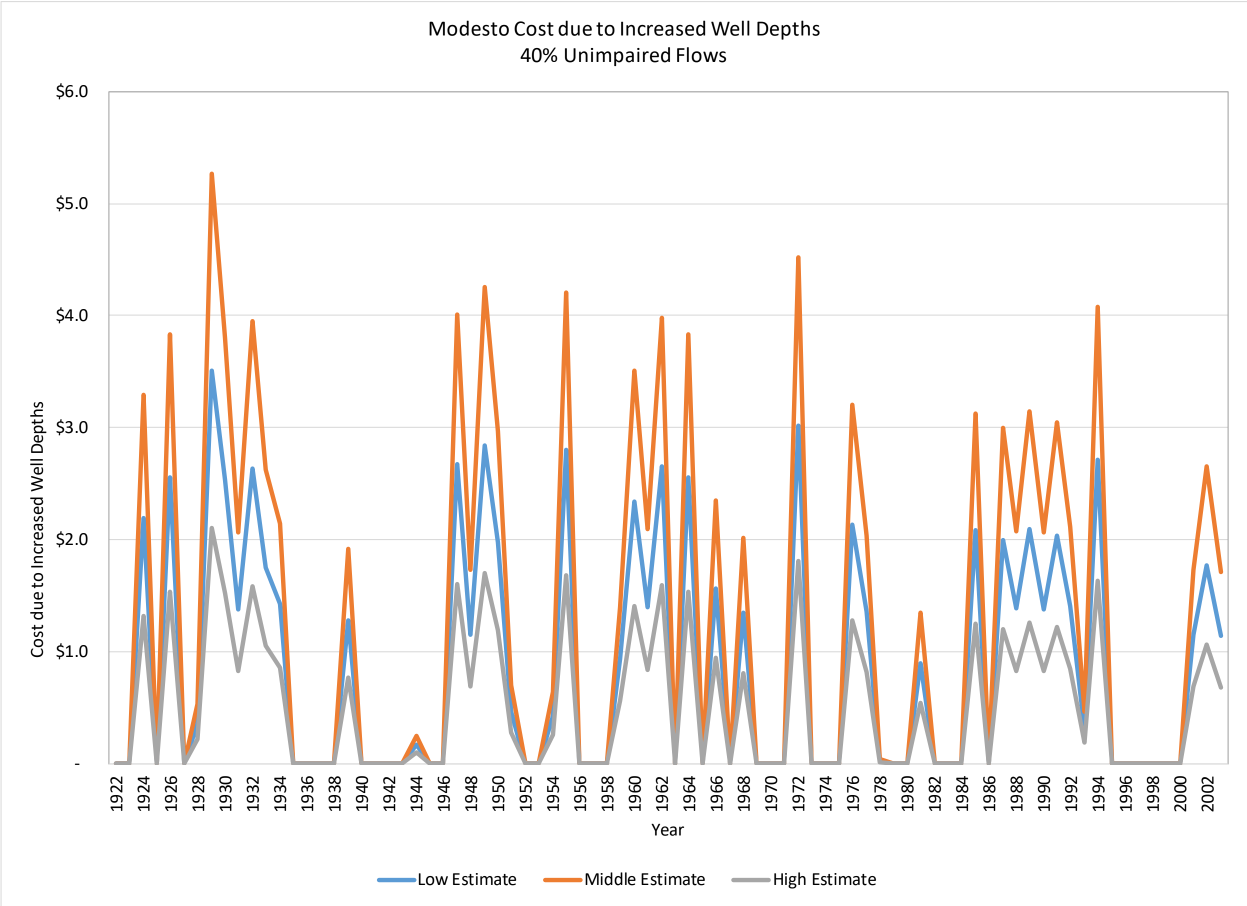
Figure A3.26



The figure shows potentially significant increases in the district's average depth to groundwater the majority of the Study Period years and, accordingly, groundwater lifts, as a result of SED 40 implementation. This includes in several of the Study Period years well more than a doubling of the average depths to groundwater based on the high estimate for increased lifts.

Figure A3.27 shows the estimated additional pumping cost that would have been incurred by the district and its farmers during the Study Period as a result of the estimated increases in well depths shown in Figure A3.28.

Figure A3.27

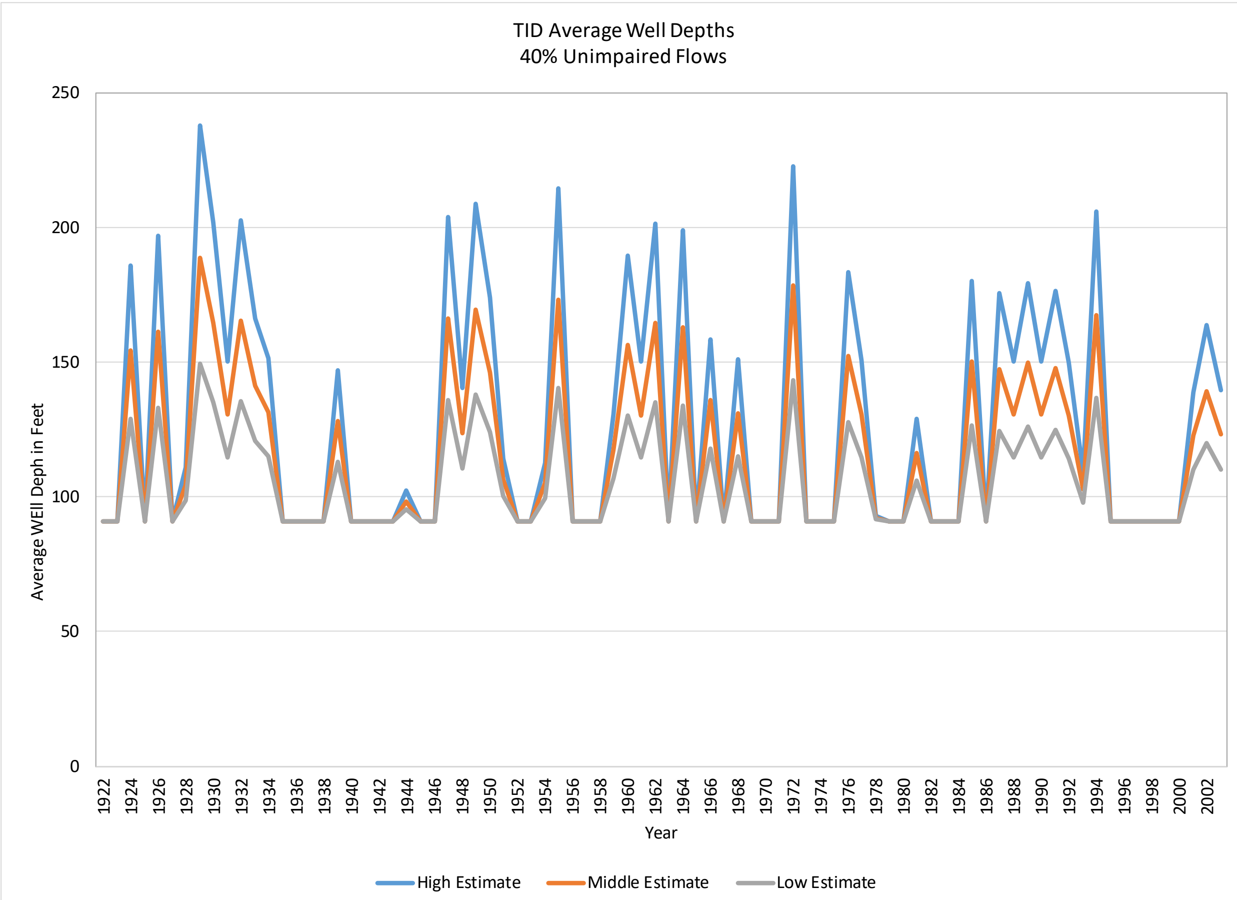


The figure shows increased costs of pumping in Modesto ID by as much as $5.0 million based on the high estimate for those years of increased pumping lifts due to increased pumping resulting from the SED 40.

- TID

Figure A3.28 characterizes the estimated low, medium and high potential impacts on groundwater depths within the TID during the Study Period because of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

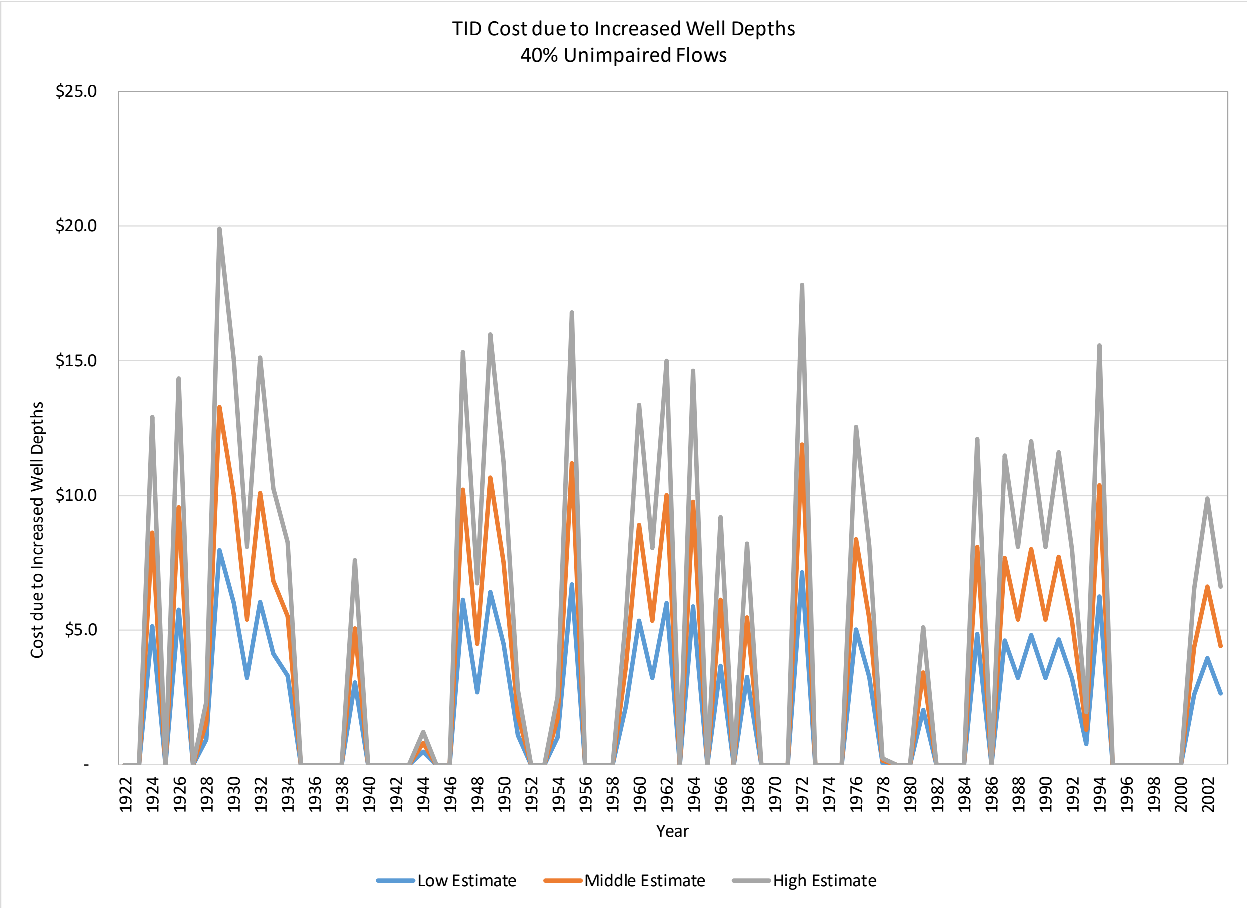
Figure A3.28



The figure shows potentially significant increases in the district's average depth to groundwater the majority of the Study Period years and, accordingly, groundwater lifts, as a result of SED 40 implementation. This includes a number of the Study Period years well more than a doubling of the average depths to groundwater based on the high estimate for increased lifts.

Figure A3.29 shows the estimated additional pumping cost that would have been incurred by the district and its farmers during the Study Period because of the estimated increases in well depths shown in Figure A3.28.

Figure A3.29

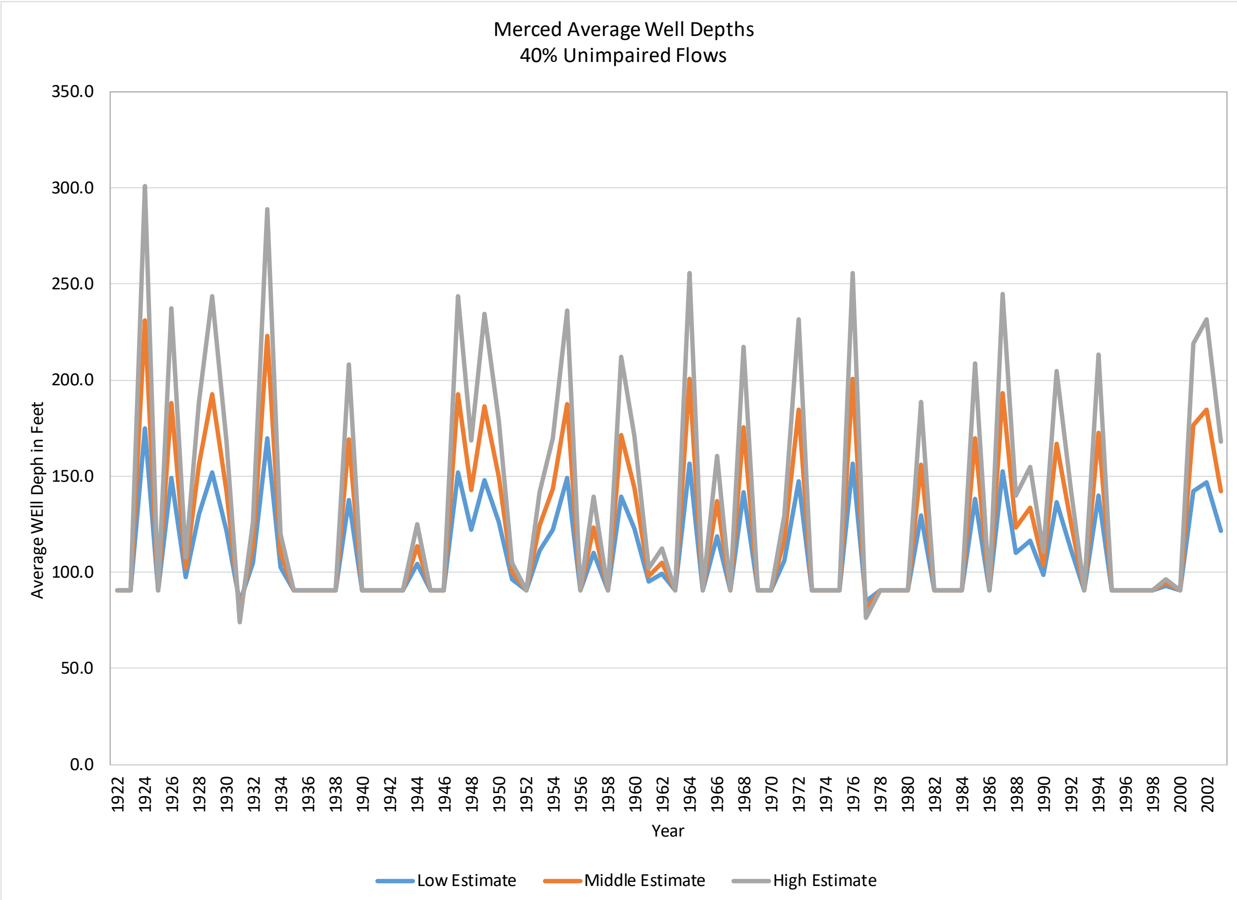


The figure shows increased costs of pumping in TID by as much as $20.0 million in one year and above $15.0 million in several years during the Study Period based on the high estimate for the increased pumping lifts due to increased pumping resulting from the SED 40.

- Merced ID

Figure A3.30 characterizes the estimated low, medium and high potential impacts on groundwater depths within the Merced ID during the Study Period because of the district's SED-related increases in groundwater pumping to offset reduced surface water supplies assuming the SED 40 was implemented.

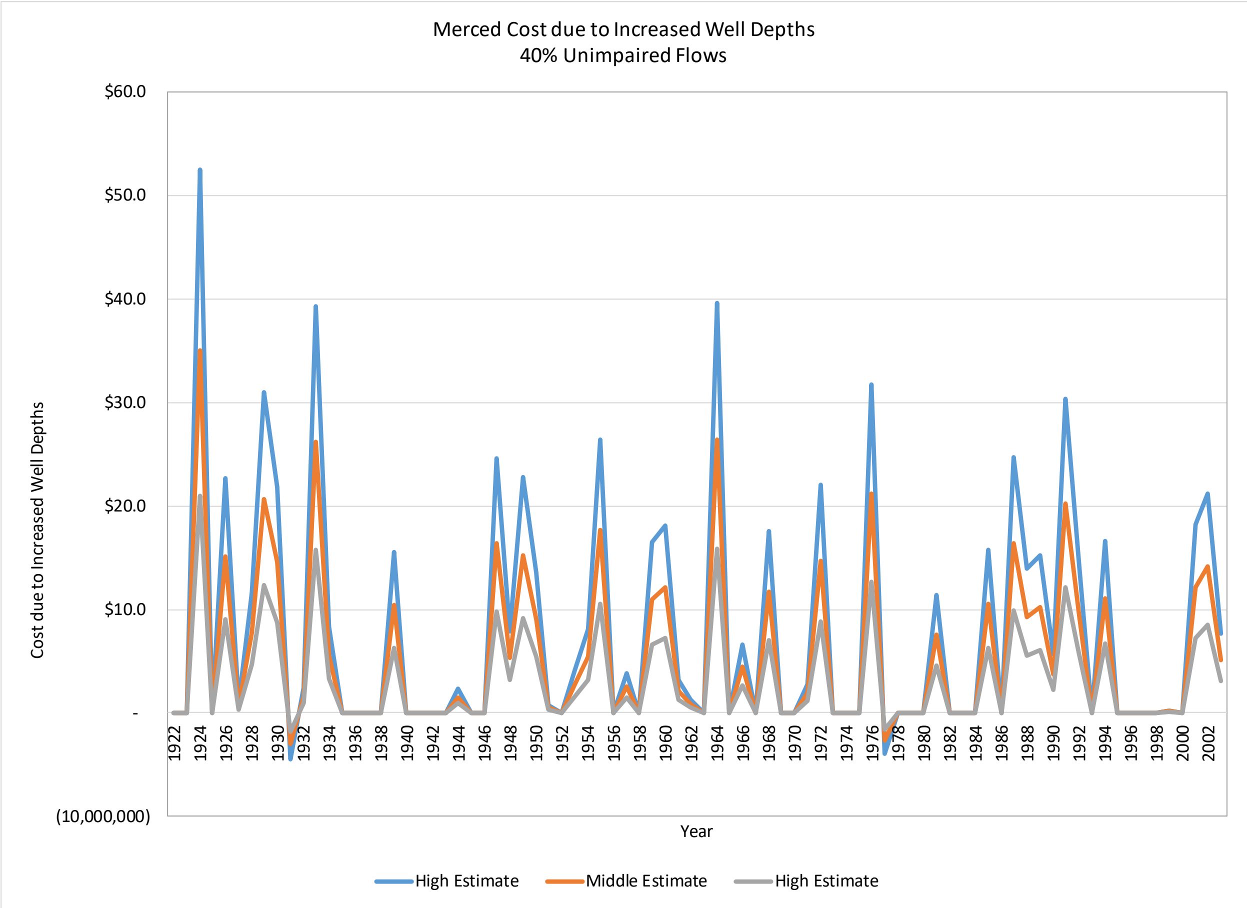
Figure A3.30



The figure shows potentially significant increases in the district's average depth to groundwater the majority of the Study Period years and, accordingly, groundwater lifts, as a result of SED 40 implementation. This includes one of the Study Period years with a threefold estimated increase in well depths based on the high estimate for increased average groundwater depths and many of the Study Period years with at least a doubling of the average depths to groundwater based on the high and middle estimates for increased lifts.

Figure A3.31 shows the estimated additional pumping cost that would have been incurred by the district and its farmers during the Study Period as a result of the estimated increases in well depths shown in Figure A3.30.

Figure A3.31



The figure shows increased costs of pumping in Merced ID by as much as $40.0 million in one year and in the $30 to $0 million in a number of additional years during the Study Period based on the high estimate for the increased pumping lifts due to increased pumping resulting from the SED 40.