Draft

Technical Memorandum

Concerning the Economic Analysis of the Irrigated Lands Regulatory Program

JULY 2010

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Acronyms and Abbreviations

2008 Farm Bill	Food, Conservation, and Energy Act of 2008
CCOF	California Certified Organic Farmer
Central Valley Water Board	Central Valley Regional Water Quality Control Board
COC	constituent of concern
CVPIA	Central Valley Project Improvement Act
CVPM	Central Valley Production Model
DO	dissolved oxygen
DPH	California Department of Public Health
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
ECR	ILRP Existing Conditions Report
EHSS	educational, health, social services
EIR/EIS	Environmental Impact Report/Environmental Impact Statement
EIS	Environmental Impact Statement
EQIP	Environmental Quality Incentives Program
FFGO	Field, Forage, Grain, Other
FIRE	finance, insurance, and real estate
GW	groundwater
I/O	input/output
IDLE	Idle
IID	Imperial Irrigation District
ILRP	Irrigated Lands Regulatory Program
MCL	maximum contaminant level
management practices	water quality management practices
NRCS	Natural Resources Conservation Service
NRCS	Natural Resource Conservation Service
ORVIN	Orchard, Vineyard
PCA	potential contaminating activity
PCBs	polychlorinated biphenyls
PEIR	Draft Program Environmental Impact Report
S&G	surface water and groundwater
SEMI	Semi-agricultural and Incidental
State Water Board	State Water Resources Control Board
SW	surface water
SWAMP	Surface Water Ambient Monitoring Program
UCCE	University of California Cooperative Extension
USGS	U.S. Geological Survey
VEGT	Vegetable, Truck

Chapter 1
Analytical Objectives and Approach

1.1 Analytical Objectives and Approach

The analysis of economic (and fiscal) effects for the long-term Irrigated Lands Regulatory Program (ILRP) focuses on addressing the following three analytical questions.

- How much currently is being spent annually by growers, landowners, and administering entities in the Central Valley on compliance with the ILRP pollution control implementation program?
- What are the expected additional costs, both to growers and administering entities, of compliance with the long-term ILRP alternatives?
- How is imposition of these additional costs expected to affect the economic viability of farming in the Central Valley?

To address these questions, an assessment of four study components (Figure 1-1)—compliance costs, net income effects on growers and landowners, potential impacts on regional farm economies, and effects on government entities associated with administering the program—was conducted.

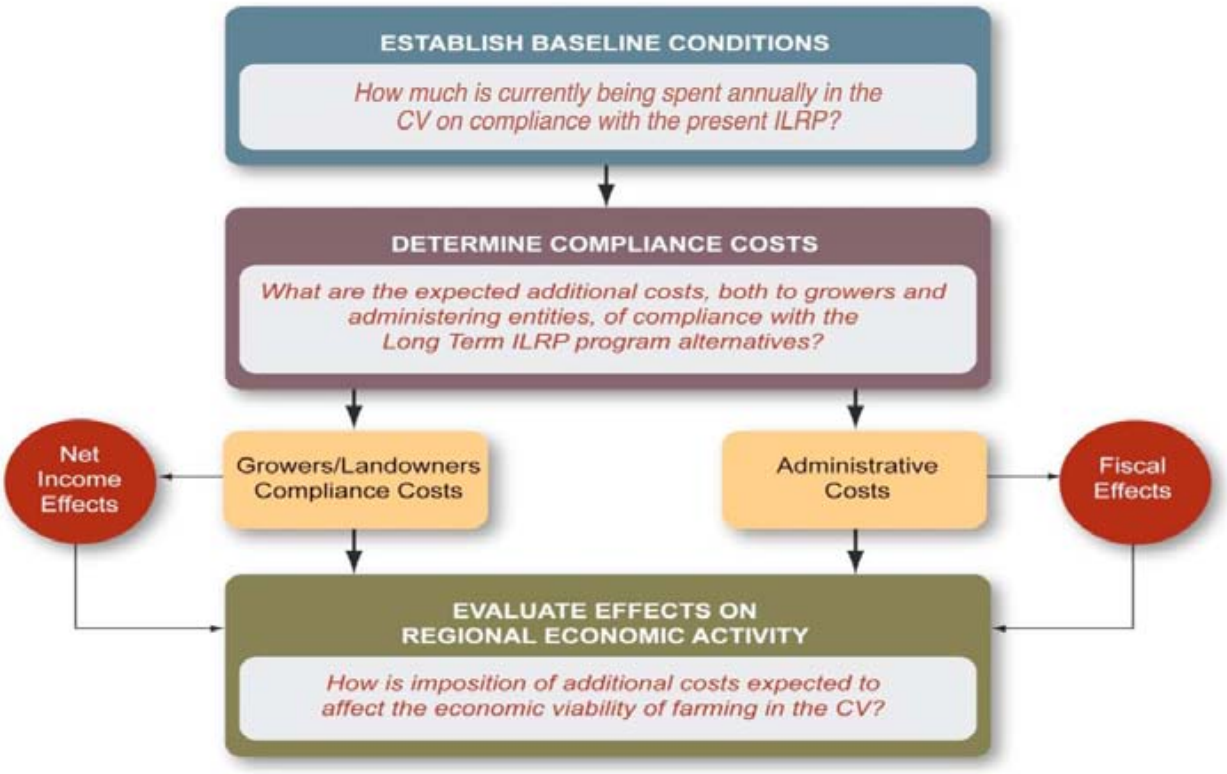

Figure 1-1. Economic Analysis Approach to the Irrigated Lands Regulatory Program

Baseline conditions on compliance costs (i.e., how much has been spent to date on implementing the program?) were characterized using information already collected and compiled for the ILRP

Existing Conditions Report (ECR) (ICF Jones & Stokes 2008). Evaluating program alternative effects involved assessing the incremental costs to growers and landowners of new compliance actions. For some alternatives, new compliance actions included the implementation of additional water quality management practices (management practices) to protect surface water and groundwater. The program alternatives in essence provide different ways to encourage widespread implementation of management practices and include different organizational structures to attain this. The alternatives vary with respect to lead responsibility to oversee the program (Central Valley Regional Water Quality Control Board [Central Valley Water Board] or other lead entity), and grower regulatory responsibility (e.g., preparing water quality plans, recordkeeping, changes in surface water monitoring practices, groundwater monitoring).

1.2 Key Study Assumptions and Limitations

The economic analysis was based on the following alternative-specific assumptions:

- Alternative 1 is the current management practices framework.
- Alternative 2 would be similar to the current framework for surface water, but would include groundwater management practices.
- Alternative 3 would lead to implementation of more widespread practices than Alternatives 1 and 2 because all growers would be required to develop a farm plan, regardless of whether water quality problems have been identified. Under Alternatives 1 and 2, management practices plans would be required where water quality concerns exist.
- Alternative 4 also would lead to more widespread practices than Alternatives 1 and 2, through the development of individual farm plans. Under this alternative, a tiered approach would be used to target known areas of concern. Alternative 4 would include nutrient management and wellhead protection. Nutrient management plans would be prepared for vulnerable areas (e.g., areas with identified nitrate problems). Alternative 4 would allow for regional monitoring.
- Alternative 5 would lead to more widespread practices than Alternatives 1 and 2 and would include nutrient management and wellhead protection for all growers. Individual surface water and groundwater monitoring would be required under this alternative.

Although Alternative 1 represents the continued implementation of current Central Valley Water Board policies, limited information was available to determine the extent of management practice implementation to date. Further, the existing conditions information used as the baseline for analysis dates from the early 2000s. As a result, changes from Alternative 1 relative to existing conditions do not capture implementation that has already occurred at the time of this report, and thus likely overstate the impacts of further implementation of Alternative 1.

Additionally, crop mix in the Central Valley also has changed over the last 6 to 8 years. In general, permanent crops such as orchards and vineyards have expanded in acreage, while certain field crops, especially cotton, have contracted in acreage. These crop mix changes are generally market-driven and, though expected to continue, could also halt or reverse. The effects of water supply shortages, whether related to drought or to regulatory constraints, were not explicitly considered in this analysis.

In addition to the alternative-specific objectives identified above, each of the components of the economic analysis (compliance and management practices costs, farm income and production, and regional economic effects) includes important analytical assumptions that define the study limitations. For the compliance and management cost analysis described in Chapter 2, costs reflect hardware and management changes for all crops based on an assessment of typical irrigation practices and chemical use. As described in Appendix A, a change in the underlying assumptions about land use, the baseline for management practices, farming units and operations, cost allocation and net benefits of management practices, and management practice implementation could substantially alter the study results.

The farm income and production analysis described in Chapter 3 also relies on assumptions concerning the implementation, monitoring, and reporting analysis in the cost analysis in Chapter 2. A regional model of Central Valley irrigated agricultural production formed the basis of the farm income and production analysis. As discussed further in Chapter 3, the model assumes that growers will react to increased costs and other compliance requirements by adjusting crop production as needed to maximize net income and stay in business. Results from the Central Valley were extrapolated to affected areas in the foothills and upper watersheds.

As indicated above, the costs of implementation, especially the cost of management practices, developed in the cost analysis reflect hardware and management changes for all crops based on an assessment of typical irrigation practices and chemical use. It is likely, however, that growers will find or develop less expensive ways to modify their production practices, and therefore direct impacts on their revenues and production would be less than those estimated in Chapter 3.

The analysis of farm income and production, as well as the assessment of regional economic effects, focuses on direct changes to irrigated agriculture. Other linked sectors such as livestock production and food processing are not comprehensively assessed. Potential effects of feed and forage production on livestock are discussed in general terms in Section 3.5.2, Potential Effects on the Livestock Sector, to illustrate the general magnitude and nature of such linked effects.

The analysis of regional economic effects using IMPLAN (Chapter 4) includes the effects of additional spending for compliance, monitoring, and reporting and the effects of losses in irrigated agricultural production and grower profitability. The effects on sectors providing inputs to irrigated crop production are captured in the regional economic impact analysis in Chapter 4. The analysis, however, does not address the potential losses to forward-linked regional economic activities, such as livestock production and food processing, that are dependent on irrigated agricultural products as inputs.

As indicated above, the IMPLAN results presented in Chapter 4 account for indirect and induced effects on suppliers and households, so-called “backward linkages,” caused by changes in agricultural production under the Program alternatives but do not account for “forward-linked” effects. A forward linkage is a connection between an industry producing a good or service that is an input to another production sector within the study area. For example, growers in the study area produce crops that are consumed as forage and feed by the livestock industry in the study area. Also, growers produce crops that are used for food processing within the study area. Losses to forward-linked economic activities would result from the direct losses in value of irrigated crop production. Because the regional economic analysis results presented in Chapter 4 do not include forward-linked effects, total regional impacts are understated.

Reductions in forage and feed crops described in Chapter 3 potentially would result in losses to regional livestock producers, and secondary impacts on other sectors of the economy, to the extent that livestock producers are dependent on regional forage and feed supplies. To address the potential magnitude of forward-linked effects of reduced livestock production, the order-of-magnitude results presented in Section 3.5.2 were carried forward into a limited analysis of regional economic impact effects, as presented in Section 4.5.3, Potential Effects from Changes in Livestock Production.

This limited analysis was intended to illustrate the additional economic effects of a key linked industry, namely the livestock production industry. It is not intended to provide a comprehensive evaluation of forward-linked effects. First, the output of the livestock production industry is further linked to sectors such as meat processing and dairy products. This additional link was not included. Second, crops besides forage and feed also are used as inputs by other sectors within the study area, such as food processing. An assessment of effects on these other forward-linked sectors was not part of this study. Results of the farm income analysis in Chapter 3 indicated that other crops would not be as affected as those linked to the livestock sector, so the forward-linked effects would also be smaller. Nevertheless, the exclusion of these additional forward-linked effects understates the total regional economic impacts of the Program alternatives.

Chapter 2
Compliance and Management Practice Costs

2.1 Summary

This summary covers the development and use of compliance components and associated costs to reduce water quality impacts originating from irrigated agriculture. This analysis is concerned only with impacts associated with irrigated agriculture. Costs that the grower would incur are associated with water quality management practices, farm planning, water quality monitoring, practice tracking, reporting, and education. Costs that the Central Valley Water Board or third-party entity would incur are for administration, information management, analysis and reporting, technical assistance, certification, inspection, and planning.

Costs for water quality management practices were based on land-use type, flow path of the constituent of concern (COC), and whether the constituent of concern is used on a particular land use. In addition, legacy (Group A, dichlorodiphenyltrichloroethane [DDT] etc.) and universal constituents of concern (pH, dissolved oxygen [DO], nutrients, toxicity) were assigned to appropriate land use types. Management practices were assumed to be 100 percent effective. When a practice is assigned to a particular land use, all acres in an affected area are considered. However, where there are existing practices, the areal extent of new practices is reduced appropriately. Cost information for management practices is from existing programs and standard cost guidelines prepared by various agricultural technical support agencies. Existing conditions information was taken from water quality coalition reports, and surveys and information conducted by other agricultural technical support agencies.

Costs for non-management compliance practices were developed by analyzing the service provided and areal extent that the service needed to cover. Cost component information was taken from existing programs implemented by water quality coalitions, agricultural technical support agencies, and other state regulatory agencies. There are two major cost drivers in the non-management practice cost components—additional Central Valley Water Board staff and monitoring. Additional Central Valley Water Board staff is required at various levels in the alternatives and was estimated based on similar Board programs such as the Dairy Program and Central Coast ILRP. Board staff is used to administer the program, inspect farming operations, and review and report on information submitted by growers and plan program components. Monitoring costs are for the collection, analysis, and reporting of water samples. Other compliance costs include farm planning, Board program planning, grower reporting, and data analysis.

2.2 Background and Existing Conditions

Information on watersheds, land uses, COCs, coalitions, and the Central Valley Water Board are contained in the ECR. This section provides background on the type of management practices selected to represent a range of activities suitable for analysis and describes existing conditions for the selected practices.

2.2.1 Management Practices

2.2.1.1 Management Practices Considered for This Analysis

The six water quality management practices listed in Table 2-1 were used in calculating the cost of water quality management practices by watershed and alternative. The method by which each of the management practices reduces impacts on water quality is discussed in the ECR. Although a wide variety of management practices could be used to reduce impacts on water quality, this suite of management practices is deemed sufficient from a programmatic point of view to encompass all flow path and management needs that must be addressed to reduce impacts on water quality. A complete discussion of the practices and their method of action is provided in Chapter 5 of the ECR. These practices also are analyzed for environmental effect in the 2010 Draft Program Environmental Impact Report (PEIR).

Table 2-1. Summary of Water Quality Management Practices Considered for This Analysis

Management Practice	Scope of Practice
Nutrient management	Matches crop need with fertilizer
Irrigation water management	Reduces surface runoff and deep percolation
Tailwater recovery system	Reduces surface water discharge
Pressurized irrigation system	Reduces surface water discharge
Cover crop	Reduces sediment movement, improves infiltration
Buffer strip-sediment trap	Controls sediment movement
Abandoned well protection	Prevents surface water from contaminating groundwater

2.2.1.2 Existing Level of Management Practices

Existing conditions corresponds to the level of water quality management practices that are in the baseline. It is acknowledged that most practices are not implemented to improve water quality but rather to provide for another agronomic or economic need. For example, a surface-irrigated orchard might be converted to a pressurized system to save labor costs and to improve cultural practices. Therefore, adjustments were made to best capture costs attributable only to improvements in water quality. Conceptually, the best source of this type of information would be growers or grower coalitions. Because this information was not widely available, other sources were used to estimate the existing conditions (NRCS 2005; DWR 2001).

Existing conditions were assumed to be uniform across the Central Valley, but not between land use types. For example, all rice was assumed to have tailwater recovery capabilities because of the rice pesticide program and the method of rice water management (Central Valley Water Board 2009); alternately, vineyards are often under pressurized irrigation whereas pasture is often surface irrigated.

Table 2-2 identifies, by land use type, the existing implementation of management practices to determine compliance costs. For example, 60 percent of the citrus and subtropical acreage is assumed to currently use nutrient management. This means that new costs would not need to be considered for these acres. Sources used to estimate existing conditions include the ECR, Irrigation Methods Survey (DWR 2001), the University of California Cooperative Extension, professional

knowledge, and personal communications with agronomic professionals. For this analysis the existing level of practices was set the same for each watershed. This approach was taken because quantitative information for each watershed is not available. In addition, most of the management practices that have been implemented were not done for water quality reasons but rather for agronomic or water supply reasons. There are several exceptions to this, such as rice water recirculation programs. Another aspect of the management practices is that they are considered to be 100 percent effective. Although this may be an oversimplifying assumption, the fact that this program would prescribe significantly more practices than currently are being implemented would dramatically decrease the movement of COCs to water bodies. Also, a reviewer may be tempted to state that the initial condition leads to too many practices; however, regardless of the number of practices currently in place, there are still water quality impacts. To address these impacts, other management practices, in addition to what are in place, need to be implemented.

Table 2-2. Percent of Land Use under a Given Water Quality Management Practice

	Citrus and Subtropical	Deciduous Fruits and Nuts	Field Crops	Grain and Hay	Idle	Pasture	Rice	Semi Agricultural and Incidental	Truck, Nursery, and Berry Crops	Vineyards
Nutrient management	60	60	30	30	0	30	30	0	60	90
Irrigation water management	90	80	70	30	0	30	100	0	50	90
Pressurized irrigation system	90	80	0	0	0	0	0	0	50	90
Tailwater recovery system	0	0	10	10	0	10	100	0	0	90
Cover crop	25	25	0	100	0	100	0	0	0	25
Buffer hedgerow	20	20	10	10	0	10	0	0	20	20

Present levels of abandoned well protections implemented are unknown.
Wetlands are discussed in subsequent sections in Chapter 2.

2.2.1.3 Acreage and Grower Data

The Central Valley Water Board provided information on the enrolled (current ILRP) and total irrigated acres per watershed (Table 2-3). This information was used to determine the fees that the State Water Resources Control Board (State Water Board) collects under Alternative 1 (enrolled acres) and the fees that would be collected under the other alternatives (irrigated acres). Leaching and runoff acres were provided by the Department of Pesticide Regulation (DPR) (Table 3-2) (DPR 2008). Leaching acres were used to determine which watersheds need groundwater management practices. Runoff acres were used to estimate acreage required for control of runoff moving to groundwater. Abandoned well counts are not readily available (Barry 2010) and an estimate of one well per 320 acres in areas considered for leaching was used for this analysis. Management plan acres represent the number of acres within a watershed that are currently under Board-required management plans (Table 2-3).

Table 2-3. Enrolled and Total Irrigated Acreage in the Central Valley Watersheds

Watershed	Enrolled Acres	Irrigated Acres	Management Plan Acres	DPR Leaching	DPR Runoff
Ahwahnee	288	914	0	914	914
American River	69,428	173,756	76,962	6,395	112,025
Butte-Sutter-Yuba	173,438	607,798	462,322	36,330	102,104
Coast Range	108	8,506	0	0	0
Colusa Basin	122,254	605,903	454,435	6,456	20,950
Cosumnes River	116,398	77,433	52,146	0	40,896
Delta-Carbona	241,730	314,821	299,532	45,269	10,853
Delta-Mendota Canal	376,741	450,975	387,171	13,646	2,203
Grapevine	3,869	5,987	0	0	0
Kaweah River	6,228	2,614	389	1,264	2,614
Kern River	2,172	4,720	0	1,292	4,720
Kings River	10,834	2,695	0	0	0
Lake-Napa	36,564	38,617	24,992	0	0
Mariposa	11,434	535	41	0	0
Merced River	683	2,619	0	0	0
North Valley Floor	184,410	235,656	264,032	22,418	22,770
Pit River	90,753	177,082	12,639	0	17,521
San Joaquin River	4	47	0	0	47
San Joaquin Valley Floor	641,645	1,126,599	951,593	393,465	184,689
Shasta-Tehama	118,704	218,854	141,188	24,048	74,782
Solano-Yolo	197,463	522,678	464,679	13,072	12,935
South Valley Floor	1,462,500	3,528,756	433,266	487,467	482,994
Southern Sierra	27,263	1,426	0	626	1,426
Stanislaus River	247	540.3	0	0	0
Sunflower Valley	0	515	0	0	0
Temblor	0	5,694	0	0	0
Tuolumne River	19	1,278	0	0	0
Upper Feather Upper Yuba	57,788	68,792	2,331	473	6,271
Upper Mokelumne–Upper Calaveras	3,945	1	0	0	0
Totals	**3,956,910**	**8,185,811**	**4,027,718**	**1,053,135**	**1,100,714**

DPR = California Department of Pesticide Regulation.

The Central Valley Water Board provided information on the number of enrolled growers by watershed (Table 2-4). Enrolled growers are those currently enrolled in the Board's program and are derived from the management plan acreage. Estimated growers are based on the total acreage in the ECR watersheds. Enrolled growers were used to determine fees in Alternative 1. The estimated growers were used to estimate fees for Alternatives 2–5.

Table 2-4. Enrolled and Total Growers in the Central Valley Watersheds

Watershed	Enrolled Growers	Estimated Growers
Ahwahnee	1	3
American River	596	988
Butte-Sutter-Yuba	1,488	3,456
Coast Range	0	15
Colusa Basin	1,049	3,446
Cosumnes River	1,959	864
Delta-Carbona	2,186	1,887
Delta-Mendota Canal	3,407	2,703
Grapevine	10	10
Kaweah River	38	11
Kern River	13	19
Kings River	66	11
Lake-Napa	314	220
Mariposa	74	2
Merced River	4	11
North Valley Floor	1,192	1,009
Pit River	779	1,007
San Joaquin River	0	0
San Joaquin Valley Floor	4,146	4,824
Shasta-Tehama	1,019	1,245
Solano-Yolo	1,695	2,988
South Valley Floor	4,647	7,430
Southern Sierra	166	6
Stanislaus River	2	2
Sunflower Valley	0	368
Temblor	0	460
Tuolumne River	0	5
Upper Feather Upper Yuba	373	295
Upper Mokelumne–Upper Calaveras	1	1
Totals	25,227	**33,287**

2.3 Assumptions and Application of Water Quality Management Practices

This section covers assumptions regarding when and where to apply management practices. The selection of a particular management practice to apply is based on COCs, land use type, and the extent of existing practices.

2.3.1 When and Where Water Quality Management Practices Are Applied

The implementation of a particular management practice is a function of the land use type, the COC, and whether the constituent is registered for a particular land use (i.e., crop type). There are two categories of management practices—management practices and hardware. Management practices are based on labor to control water quality impacts, and hardware practices rely on equipment or construction to reduce impacts.

Management practices include nutrient and water management (Table 2-1). Hardware practices include cover cropping, sediment traps, tailwater recovery systems, and pressurized irrigation. Tailwater recovery and pressurized irrigation are used when high- and very high–priority COCs are present, cover cropping is used when there are soluble COCs, and sediment traps are used when sediment or sediment-attached COCs are present.

Water quality management practices are applied when there are documented COCs (Figure 2-1, Table 2-5). The practices applied for pesticides were based on the constituent's use by crop type (Footprint 2010; PAN 2010). Therefore, if a constituent is registered for a particular land use type, a management practice is applied to all acres of that land use. If the constituent is a legacy pesticide (one that is no longer used but persists in the area, such as most Group A pesticides and DDT), native (a constituent that occurs naturally in the soil, such as boron and sediment), or ubiquitous in either the soil or through the use of fertilizers (e.g., nutrients, DO, and pH), a management practice is applied to all acres in all land uses. The one land use type excepted from the application for universal constituents is idle land; nutrients, DO, and pH are not considered to originate from this land use type.

Table 2-5. Behavior and Affected Flow Path for Constituents of Concern

	Constituent Behavior and Affected Flow Path		
Constituent[a]	**Movement to Groundwater**	**Sediment Attachment**	**Flow Paths Affected**
Aldrin (Group A)	Low	High	SW
Chlordane (Group A)	Low	High	SW
Endosulfan (Group A)	Low	High	SW
Endrin (Group A)	Low	High	SW
Heptachlor (Group A)	Low	High	SW
Lindane (Group A)	Moderate	Low	S&G
Toxaphene (Group A)	Low	High	SW
Arsenic	Low	High	SW
Azinphos-methyl	Low	High	SW
Bacteria (fecal coliform/E. coli)	High	Low	S&G
Bifenthrin (in sediment)	Low	High	SW
Boron	Low	Low	SW
Cadmium	Low	High	SW
Carbofuran	High	Low	S&G
Chlorpyrifos[b]	Low	High	SW
Copper	Low	High	SW

Constituent[a]	Constituent Behavior and Affected Flow Path		
	Movement to Groundwater	Sediment Attachment	Flow Paths Affected
Cypermethrin	Low	High	SW
DDD	Low	High	SW
DDE	Low	High	SW
DDT	Low	High	SW
Demeton	Moderate	Low	S&G
Diazinon[b]	High	Low	S&G
Dieldrin	Low	High	SW
Dimethoate[b]	Moderate	Low	S&G
Disulfoton	Low	Low	SW
Diuron[b]	Moderate	Low	S&G
DO	High	Low	SW
EC	High	Low	S&G
Esfenvalerate	Low	High	SW
Esfenvalerate/fenvalerate, total	Low	High	SW
Fenproprathin (in sediment)	Low	High	SW
Group A Pesticides	Low	High	SW
Iron	Low	High	SW
Lambda-cyhalothrin	Low	High	SW
Lead	Low	High	SW
Linuron	Moderate	Low	S&G
Malathion[b]	Low	High	SW
Manganese	Low	High	SW
Methomyl	High	Low	S&G
Methyl parathion[b]	Low	High	SW
Molinate/ordram	Moderate	Low	S&G
Molybdenum	Low	High	SW
Nickel	Low	High	SW
Nutrients	High	Low	S&G
PCBs	Low	High	SW
Permethrin	Low	High	SW
pH	High	Low	SW
Sediment	Low	High	SW
Selenium	Low	High	SW
Simazine[b]	High	Low	S&G
Temperature	Low	None	SW
Thiobencarb[b]	Low	High	SW
Toxicity	Low	High	SW
Toxicity (algae)	High	High	SW
Toxicity (minnow, flea, algae, sediment)	Low	High	SW
Zinc	Low	High	SW

Constituent[a]	Constituent Behavior and Affected Flow Path		
	Movement to Groundwater	Sediment Attachment	Flow Paths Affected

GW = groundwater.
S&G = surface water and groundwater.
SW = surface water.
* Listed constituents are in the ECR as Section 303d and other listings.
[a] Listed constituents are in the ECR as Section 303d and other listings.
[b] Considered a high- or very high–priority constituent by the Central Valley Regional Water Quality Control Board.

Table 2-6 provides an overview of the applicability of COCs by land use types. As an example, Table 2-6 shows the applicability of management practices for chlorpyrifos by land use type. Crops with a *1* are registered for use with chlorpyrifos and would require a management practice if chlorpyrifos is a COC in the watershed.

Table 2-6. Constituent of Concern Applicability by Land Use Type

Constituent*	All Land Use	Pesticide Used	Not Registered for Use	Citrus and Subtropical	Deciduous Fruits and Nuts	Field Crops	Grain and Hay	Idle	Pasture	Rice	Semi-agricultural and Incidental	Truck, Nursery, and Berry Crops	Vineyards
Aldrin (Group A)	1	0	1	1	1	1	1	1	1	1	1	1	1
Chlordane (Group A)	1	0	1	1	1	1	1	1	1	1	1	1	1
Endosulfan (Group A)	0	1	0	1	1	1	1	0	1	0	0	1	1
Endrin (Group A)	1	0	1	1	1	1	1	1	1	1	1	1	1
Heptachlor (Group A)	1	0	1	1	1	1	1	1	1	1	1	1	1
Lindane (Group A)	1	0	1	1	1	1	1	1	1	1	1	1	1
Toxaphene (Group A)	1	0	1	1	1	1	1	1	1	1	1	1	1
Arsenic	1	0	0	1	1	1	1	1	1	1	1	1	1
Azinphos-methyl	0	1	0	1	1	0	0	0	0	0	0	1	0
Bacteria (fecal coliform/*E. coli*)	1	0	0	1	1	1	1	1	1	1	1	1	1
Bifenthrin (in sediment)	0	1	0	0	0	1	1	0	0	0	0	1	0
Boron	1	0	0	1	1	1	1	1	1	1	1	1	1
Cadmium	1	0	0	1	1	1	1	1	1	1	1	1	1
Carbofuran	0	1	0	0	0	1	1	0	0	1	0	1	1
Chlorpyrifos	0	1	0	1	1	1	1	0	0	0	0	1	1
Copper	1	0	0	1	1	1	1	1	1	1	1	1	1
Cypermethrin	0	1	0	0	0	1	0	0	0	0	0	1	0
DDD	1	0	1	1	1	1	1	1	1	1	1	1	1
DDE	1	0	1	1	1	1	1	1	1	1	1	1	1
DDT	1	0	1	1	1	1	1	1	1	1	1	1	1
Demeton	1	0	1	1	1	1	1	1	1	1	1	1	1
Diazinon	0	1	0	0	1	1	0	0	0	0	0	1	1
Dieldrin	1	1	1	1	1	1	1	1	1	1	1	1	1
Dimethoate	0	1	0	1	1	1	1	0	0	0	0	1	1

Constituent*	All Land Use	Pesticide Used	Not Registered for Use	Citrus and Subtropical	Deciduous Fruits and Nuts	Field Crops	Grain and Hay	Idle	Pasture	Rice	Semi-agricultural and Incidental	Truck, Nursery, and Berry Crops	Vineyards
Disulfoton	0	1	0	0	0	1	1	0	0	0	0	1	0
Diuron	0	1	0	1	1	1	1	0	0	0	0	1	1
DO	1	0	0	1	1	1	1	1	1	1	1	1	1
EC	1	0	0	1	1	1	1	1	1	1	1	1	1
Esfenvalerate	0	1	0	0	0	1	1	0	0	0	0	1	0
Esfenvalerate/ fenvalerate, total	0	1	0	0	0	1	1	0	0	0	0	1	0
Fenproprathin (in sediment)	0	1	0	0	0	1	0	0	0	0	0	1	0
Group A Pesticides	1	0	1	1	1	1	1	1	1	1	1	1	1
Iron	1	0	0	1	1	1	1	1	1	1	1	1	1
Lambda-cyhalothrin	0	1	0	0	0	1	0	0	0	0	0	1	0
Lead	1	0	0	1	1	1	1	1	1	1	1	1	1
Linuron	0	1	0	0	0	0	0	0	0	0	0	1	0
Malathion	0	1	0	1	1	1	1	0	0	0	0	1	0
Manganese	1	0	0	1	1	1	1	1	1	1	1	1	1
Methomyl	0	1	0	1	1	1	1	0	0	0	0	1	1
Methyl parathion	0	1	0	0	1	1	0	0	0	1	0	1	0
Molinate/ordram	0	1	0	0	0	0	0	0	0	1	0	0	0
Molybdenum	1	0	0	1	1	1	1	1	1	1	1	1	1
Nickel	1	0	0	1	1	1	1	1	1	1	1	1	1
Nutrients	1	0	0	1	1	1	1	1	1	1	1	1	1
PCBs	1	0	1	1	1	1	1	1	1	1	1	1	1
Permethrin	0	1	0	0	1	1	1	0	0	0	0	1	0
pH	1	0	0	1	1	1	1	1	1	1	1	1	1
Sediment	1	0	0	1	1	1	1	1	1	1	1	1	1
Selenium	1	0	0	1	1	1	1	1	1	1	1	1	1
Simazine	0	1	0	1	1	0	0	0	0	0	0	1	1

Constituent*	All Land Use	Pesticide Used	Not Registered for Use	Citrus and Subtropical	Deciduous Fruits and Nuts	Field Crops	Grain and Hay	Idle	Pasture	Rice	Semi-agricultural and Incidental	Truck, Nursery, and Berry Crops	Vineyards
Temperature	1	0	0	1	1	1	1	1	1	1	1	1	1
Thiobencarb	0	1	0	0	0	0	0	0	0	1	0	0	0
Toxicity	1	0	0	1	1	1	1	1	1	1	1	1	1
Toxicity (algae)	1	0	0	0	0	0	0	0	0	0	0	0	0
Toxicity (minnow, flea, algae, sediment)	1	0	0	1	1	1	1	1	1	1	1	1	1
Zinc	1	0	0	1	1	1	1	1	1	1	1	1	1

A value of *1* indicates that the constituent is used for that land use type.

* Listed constituents are in the ECR as 303d and other listings.

Table 2-7provides a summary of the applicability of hardware management practices by COC and land use type. A value of *1* indicates what hardware practice is used for that land use type. Constituents of concern listed in Table 2-6 but not listed in Table 2-7 are managed through nutrient or water management practices.

Table 2-7. Hardware Management Practice Applicability by Constituent

Constituent*	Tailwater Recovery (Field, Pasture, Rice, Grain)	Pressure Irrigation (Citrus, Nuts, Truck, Vines)	Sediment Trap, Hedgerow, or Buffer	Cover Crop or Conservation Tillage
Aldrin	0	0	0	1
Azinphos-methyl	0	0	1	0
Bifenthrin (in sediment)	0	0	1	0
Carbofuran	0	0	0	1
Chlordane	0	0	0	1
Chlorpyrifos	1	1	0	0
Cypermethrin	0	0	1	1
DDD	0	0	1	0
DDE	0	0	1	0
DDT	0	0	1	0
Demeton	0	0	0	1
Diazinon	1	1	0	0
Dieldrin	0	0	1	0
Dimethoate	1	1	0	0
Disulfoton	0	0	0	1
Diuron	1	1	0	0
Endosulfan	0	0	0	1
Endrin	0	0	0	1
Esfenvalerate	0	0	1	0
Esfenvalerate/ fenvalerate, total	0	0	1	0
Fenproprathin (in sediment)	0	0	1	0
Heptachlor	0	0	0	1
Lambda-cyhalothrin	0	0	1	0
Lindane	0	0	0	0
Linuron	0	0	0	1
Malathion	1	0	1	0
Methomyl	0	0	0	1
Methyl parathion	0	0	0	1
Molinate/ordram	0	0	0	0
Molybdenum	0	0	0	0
PCBs	0	0	1	0
Permethrin	0	0	1	0

Constituent*	Tailwater Recovery (Field, Pasture, Rice, Grain)	Pressure Irrigation (Citrus, Nuts, Truck, Vines)	Sediment Trap, Hedgerow, or Buffer	Cover Crop or Conservation Tillage
Sediment	0	0	1	0
Simazine	1	1	0	0
Thiobencarb	1	1	1	0
Toxaphene	0	0	0	1
Toxicity	1	1	0	0
Toxicity (minnow, flea, algae, sediment)	1	1	0	0

* Listed constituents are in the ECR as Section 303d and other listings.

Constituents classified by the Central Valley Water Board as high- or very high–priority (Table 2-7) pesticides were assigned a tailwater recovery system or pressurized irrigation. Other constituents were assumed to be covered by the two management practices (nutrients and water management) or were assigned cover cropping or sediment traps.

Irrigation impacts on groundwater quality are considered in Alternatives 2 through 5. A refined look at the threat to groundwater is required in Alternatives 4 and 5. The DPR Groundwater Protection Area (DPR 2010) results were used as the basis for assigning land to groundwater basins and the various threat tiers. Vulnerable areas for runoff and leaching represent the DPR estimate of lands that are susceptible to leachate moving to groundwater or surface runoff moving to a conduit that would convey constituents to groundwater (Troiano et al. 1999). This information was used in Alternatives 2, 3, 4, and 5 to assign management practices and monitoring to various areas of the Central Valley. The leaching flow path is addressed through the implementation of nutrient and water management practices. The runoff portion is covered through two management practices. One is to reroute runoff with buffer strips (sediment traps), and the other is to prevent surface water inflow to abandoned wells. Well protection was based on one well for every 320 acres of land in the areas that are designated as vulnerable to runoff.

Under all alternatives, water suppliers (irrigation or water districts) were assumed to be in full compliance with existing regulations. Because these entities do not apply high- or very high–priority COCs, their existing level of management practices were assumed to be sufficient to be in compliance with ILRP requirements.

Under Alternative 5 all land use types in watersheds in the study area without COCs were assigned nutrient practices. This practice is required to meet the certified farm plan requirement.

2.3.2 Water Quality Management Practice Cost Calculations

The costs for management practices were calculated for each watershed using the applicable management practices per acre. The existing level of practices was used to limit the number of acres to which a practice or group of practices must be applied.

The following factors can be varied to develop new costs: existing conditions, the applicability of a management practice to either a land use type or a COC, management practice cost, land use acreage, land use type, and whether groundwater is a component of the analysis. Output is compiled

and presented in both total costs and cost per acre. Sample calculations are presented below to represent how costs are determined for watersheds with and without COCs.

Sample calculations are provided in Table 2-8 for the 17,956 acres of deciduous fruits and nuts in the Delta-Carbona watershed with high-priority pesticides and sediment attached COC. In addition this watershed has vulnerable acreage, as identified by the DPR, for both leaching and runoff.

Table 2-8. Sample Cost Calculation for Meeting Water Quality Impacts Resulting from Pesticide, Nutrient, and Sediments Issues on Deciduous Fruits and Nuts in the Delta Carbona Watershed

Management Practices	Cost/Acre ($)	Existing Condition	Applicable Acres	Total Cost ($)
Nutrient Management	7.9	60%	7,812	56,740
Irrigation Water Management	72	80%	3,591	258,566
Pressurized Irrigation	160	80%	3,591	574,592
Sediment Trap, Hedgerow or Buffer	1	20%	14,364	14,364
Cover Cropping	48	25%	13,467	646,416
Total				1,536,315

In the watersheds without COCs the only practices considered are nutrient management and water management, but only if there are acres that are vulnerable to leaching. Costs for management practices are determined in the same manner as shown in Table 2-8, where costs per applicable acre are multiplied by the management practice cost.

In the DPR areas (Table 2-3) there are two additional considerations—protection of abandoned wells and the rerouting of surface runoff away from channels that have a connection to groundwater. Well protection was based on one abandoned well per 320 acres of land. In the DPR areas where there is runoff (Table 2-3), the acreage not served by a tailwater recovery system is considered applicable for the Sediment Trap/Hedgerow/Buffer Strip Management Practice. In addition to the cost of the management practice, a ratio of 1 acre of buffer strip is required for every 30 acres of irrigated lands. The land required for the Sediment Trap/Hedgerow/Buffer Strip management Practice is proportionally distributed on all irrigated lands within the watershed.

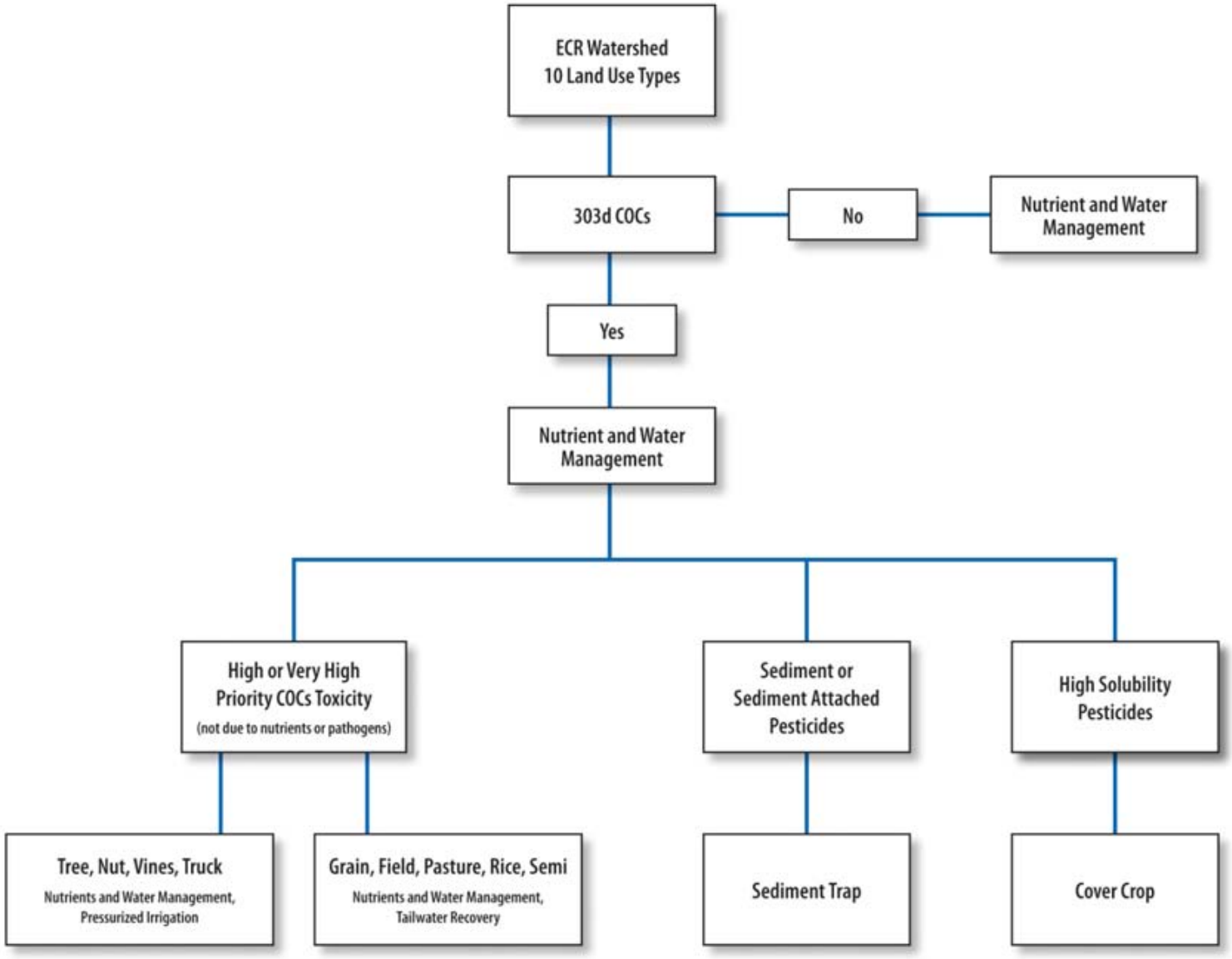

Figure 2-1. Application of Water Quality Management Practices Based on Surface Water Constituents of Concern and Land Use

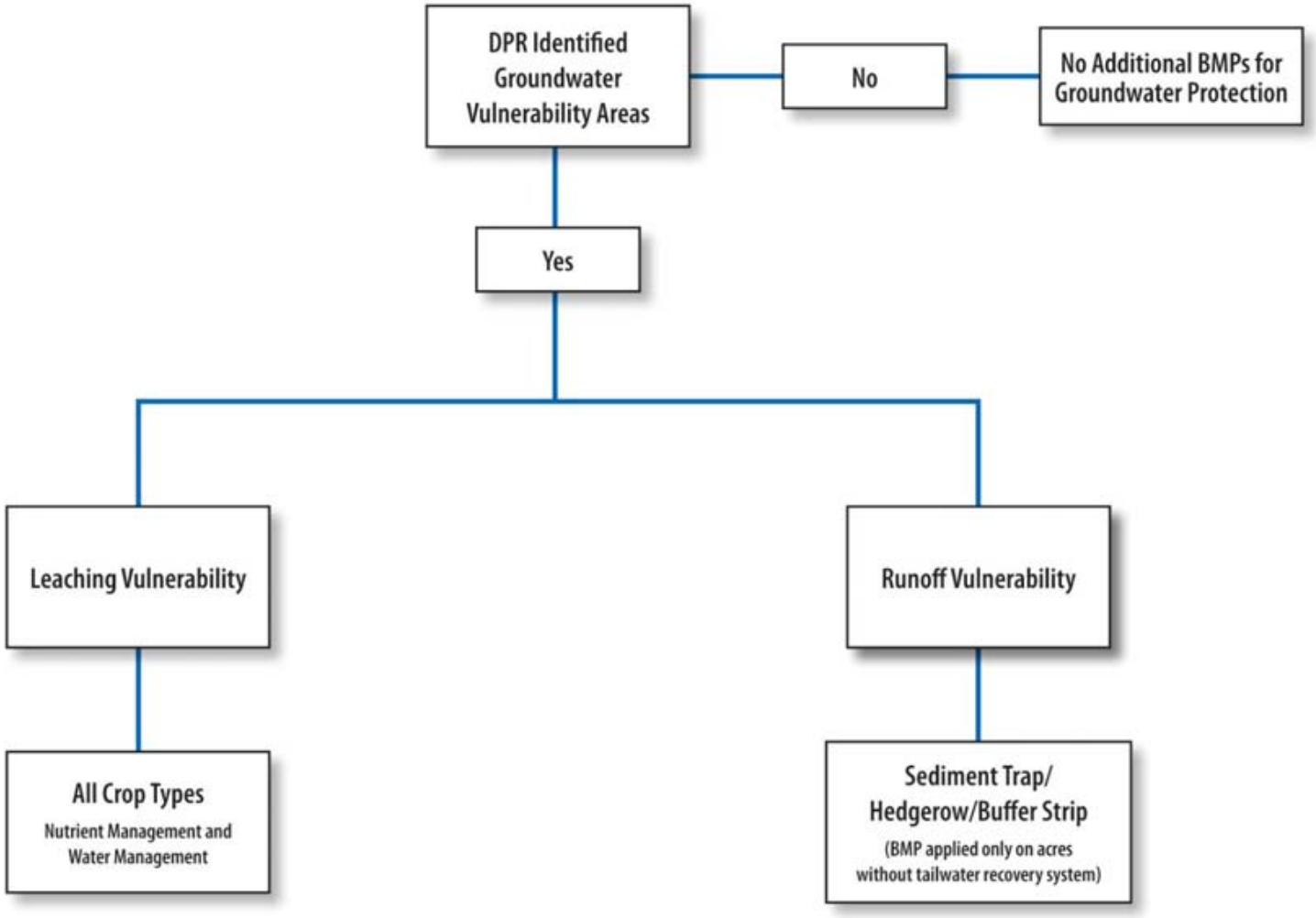

Figure 2-2. Application of Water Quality Management Practices Based on Land Uses That Are Classified by the California Department of Pesticide Regulation as Vulnerable to Leaching to Groundwater

2.4 Cost Information

This section reviews the information and assumptions used to determine costs of implementing management practices and compliance associated with each alternative. Water quality management practices include the costs of implementing a particular practice as determined in Section 2.3. Compliance costs include grower and Central Valley Water Board implementation and administration of the various alternatives. The compliance costs are for planning, administration, monitoring, and progress reports. Costs in Chapter 2 are reported in 2009 dollars.

2.4.1 Scope of Cost Information

Table 2-9 presents cost information for the management practices identified in Table 2-1. These costs were held constant for all operations regardless of location in the valley.

Table 2-9. Costs for Water Quality Management Practices

Management Practice	Cost Range	Source of Information
Nutrient management	$5–$9/acre-year excludes idle land	Blackman 2010; Fry 2010; Kasapligil 2010; and Rathburn 2010.
Irrigation water management	$50–$88/acre-year excludes idle land	Fry 2010; IID 2007.
Tailwater recovery system	$89/acre-year	NRCS 2010; IID 2007.
Pressurized irrigation system	$160/acre-year	NRCS 2010; IID 2007.
Cover crop	$48/acre-year	Tourte and Buchanan 2003a, b, c.
Buffer strip-sediment trap	$1/acre-year	Tourte and Buchanan 2003a, b, c.
Abandoned well protection	$250/well/year	Lewis 2010.

IID = Imperial Irrigation District, NRCS = Natural Resources Conservation Service, UCCE = University of California Cooperative Extension.

2.4.1.1 Monitoring Costs

Monitoring costs include sample collection, analysis, reporting (costs to the landowner or coalition), administration, and Surface Water Ambient Monitoring Program (SWAMP) compatibility (Cone 2010; Chilcotte 2010). Monitoring is broken down by costs of sampling surface water, groundwater, and basic parameters and detailed chemistry, such as pesticides. Table 2-10 presents the monitoring cost for basic constituents and for pesticides. This information was derived from the Kings River Coalition (Cone 2010) and compared with cost information available from private laboratories. These costs were used when an individual grower conducts monitoring. If a coalition conducts monitoring, the costs were based on what the coalitions currently spend on monitoring (Table 2-11).

Sampling covers travel time to collect a sample and deliver it to the laboratory, laboratory analysis and reporting costs, and grower or coalition administration and SWAMP compliance costs. The alternatives have two types of sampling: basic, which covers nitrate and electrical conductivity, and comprehensive, which covers other constituents such as organic compounds and native elements

such as boron or selenium. Sampling location and frequency depend on the alternative. Information sources used for costing included Moss Landing SWAMP, Dellavalle Laboratories, coalition-supplied information, the Central Valley Water Board, DPR, and the U.S. Geological Survey (USGS) (Philips 2010).

Table 2-10. Surface and Groundwater Monitoring Cost Breakdown for Use in All Alternatives

	Frequency of Sampling (1x/y = 1 sample per year)				Surface Water Characterization	Groundwater Characterization
Water Quality Sampling Component	**1X/5yr**	**1X/yr**	**2X/yr**	**5X/yr**		
Equipment	35	35	35	35	35	35
Water quality sample collection (1x/year, labor and vehicle costs)	30	150	300	750	75	75
Water Quality Sampling:						
Water quality lab testing (1x/year, laboratory costs)						
Basic parameters (pH, EC, nitrates, and *E. coli*)	15	75	150	375	75	75
Information management	26	130	260	650	65	65
Total for Basic Sample (discharge or GW)	106	390	745	1,810	250	250
Detailed chemistry (20 COC samples)	300	1,500	3,000	7,500		
Total for basic and with detailed chemistry	406	1,890	3,745	9,310		
Detailed chemistry only (COCs)						
Equipment	35	35	35	35		
Water quality sample collection (1x/year, labor and vehicle costs)	30	150	300	750		
Information management	26	130	260	650		
Detailed chemistry (20 COC samples)	300	1,500	3,000	7,500		
Total for detailed chemistry	391	1,815	3,595	8,935		

Note: Costs include costs to address SWAMP quality assurance/quality control
COC = constituents of concern.
EC = electrical conductivity to measure salinity
GW = groundwater.
X/yr = times per year.

Table 2-11. Estimated Cost per Acre for Current Program

DRAFT Estimated Current Annual Cost for Compliance Actions	Average $/acre
Administration	$0.41
Monitoring	$0.79
State Board Ag Waiver Fees	$0.15
Total	**$1.36**

Table 2-12. Central Valley Water Board Cost for Current Program

Classification	Cost/position	Positions	Total Cost
Environmental Scientist	$129,597	10.7	$1,386,688
Senior Environmental Scientist	$168,441	2	$336,881
Engineering Geologist	$192,154	1.65	$317,054
Senior Engineering Geologist	$248,399	0.2	$49,680
Supervisory Engineering Geologist	$248,399	0.2	$49,680
Water Resource Control Engineer	$191,520	1	$191,520
Senior Water Resources Control Engineer	$247,131	1	$247,131
Supervisory Water Resource Control Engineer	$247,131	1	$247,131
Total		**17.75**	**$2,825,764**

For a groundwater basin with existing domestic wells, sampling costs for groundwater were estimated at $1.26/acre. This estimate was based on information supplied by the Kings River coalition (Cone 2009). The USGS and DPR estimate that areas vulnerable to leaching could be monitored for $875,000 (Quagliaroli 2010) to $1,500,000 annually (Philips 2010). The range is based on the type of constituents monitored.

Tracking and reporting are carried out by growers or by the coalitions to ensure that the required management practices are in place and functioning, and that this information is relayed to either the coalition or the Central Valley Water Board. It was assumed that a grower would need to spend $100 (professional judgment) for tracking or reporting information per surface water and groundwater component.

Surface water or groundwater characterization is necessary to meet the Tier 1 requirements under Alternative 4. Using the Natural Resource Conservation Service (NRCS) time estimates (NRCS 2010), it was assumed that each review would result in a one-time cost of $2,500 (Table 2-13) for evaluation plus testing for water quality. These costs are applied on a per-grower basis. Therefore, a grower who needed to conduct a site-specific evaluation of both surface water and groundwater would be required to spend $5,000 in addition to costs for water quality testing.

Table 2-13. Surface Water and Groundwater Characterization Costs for Alternative 4

Surface Water and Groundwater Characterization Component	Cost of Surface Water Characterization	Cost of Groundwater Characterization
Total chemical characterization costs (from Table 2-10)	$250	$250
Annualized chemical characterization cost (20 years)	$16	$16
Total physical characterization planning (well information, drainage review)	$2,500	$2,500
Annualized physical characterization	$162	$162
Total annual characterization cost	$178	$178

Under Alternative 4, regional groundwater monitoring networks need to be designed. Note that this cost does not include the cost to sample the groundwater. Based on information from the Kings River Coalition (Cone 2009), it was assumed that the annualized cost of this network with a 20-year life would be $2,027 for a 30,000-acre basin (Table 2-14). This amount was applied to the number of leaching acres identified in the DPR Groundwater Protection Areas.

Table 2-14. Groundwater Quality Monitoring Plan Development Cost for Alternative 4

Groundwater Planning Component	Cost
Capital for planning/30,000 acres	$40,000
Annualized cost/30,000 acres	$2,027

Source: Cone 2010.
Note: Based on information from the Kings River.

Alternative 5 potentially requires installation of groundwater wells. Table 2-15 shows the cost estimate for installing a single-screen monitoring well with a 20-year life (Swartz 2010).

Table 2-15. Installation Cost of Groundwater Monitoring Well under Alternative 5

Groundwater Planning Component	Cost
Capital to install monitor well (70-foot depth at $70 per foot; single screen)	$5,000
Annual cost of monitoring well (used if required by groundwater maximum contaminant level)	$253

Inspection costs include Central Valley Water Board staff or contracted personnel traveling to a grower's operation in order to verify adherence to the grower's farm plan. Inspection would include an office visit, record review, and inspection of the grower's operation. Under Alternatives 3, 4, and 5, 5 percent of all growers would be inspected annually.

Certification costs represent Central Valley Water Board staff or contracted personnel reviewing and approving farm plans. This review includes an office exercise and a field visit. This cost estimate was based on what the California Certified Organic Farmer (CCOF) charges growers for their certification service. This information is based on personal communication with Reid (2010).

Managed wetlands are land uses that are designated for habitat. The U.S. Army Corps of Engineers (USACE) Hamilton army airfield wetland restoration feasibility study found that the operation and maintenance costs for a wetland are approximately $200 per acre per year (USACE 2006). This value was assumed to be the cost for wetlands to meet their requirements for management practices.

Administration costs cover any Central Valley Water Board costs required to address regulatory responsibilities. This cost includes enrollment, fee collection, certification, inspection, technical assistance, technical studies, data management, and reporting. An average staff cost of $160,000 per year was used to cost out total staffing costs. This cost includes benefits and overhead. Under Alternative 1, there would be no additional costs above what the Central Valley Water Board is currently spending as described in Table 2-12; all other alternatives have additional Board administration costs. The primary driver of increased costs is for Board staff. Under Alternative 2, these costs would go up to address the consideration of groundwater. Under Alternatives 3 through 5, Board costs would increase considerably because the Board would have a significant role in program implementation. The following staffing assumptions were made for each alternative.

Table 2-16. Total Staffing Assumptions for Each Alternative

Alternative	Staff Number	Staffing Assumption
1	17.25	Existing staff level (Table 2-12)
2	19.75	Staff for groundwater administration
3	400	Central Valley Water Board, Dairy Program staffing plus additional for certification of individual plans
4	56	Central Coast Water Board staff:grower ratio
5	356	Central Valley Water Board, Dairy Program staffing

Farm planning costs address the preparation of a farm plan. The cost was estimated at $2,500 per grower (NRCS 2010) and was assumed to be valid for 20 years. When applicable, annual maintenance would be achieved through nutrient management planning, tracking, and reporting. These costs are covered elsewhere. A farm plan outline is attached at the end of this document.

Education cost covers growers' time and expenses to attend 15 hours of education. Courses would be conducted by professionals at $120/hour, and it was assumed that 10 people would enroll in each class. Attendees were assumed to travel to three 5-hour classes at a distance of 25 miles at $0.50/mile. Growers' time also was assumed to be $120/hour. This estimate was based on personal communication with A. Schroeter (2010) of the Central Coast Regional Board.

Alternative 4 has a requirement that lands be regulated under their potential threat to surface or groundwater. Lands would be classified under three tiers levels for both surface and groundwater. It was assumed that a model would be needed to determine tiers. Costs for the tier analysis were based on the cost to develop the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) model (Table 2-17). This model accounts for nitrate and salt loading by land use type within a defined basin. The model output assesses the potential for a land use type to affect groundwater for both salt and nitrate. This program currently is managed by the Central Valley Water Board, and the model development is being carried out by a consultant. The cost estimate was provided as a personal communication with Dickey (2010).

Table 2-17. Tier Analysis Development Cost Based on the CV SALT Model Development for Alternative 4

Model Development Component	Cost
Total costs for data collection and model calibration (~16% of irrigated area)	$600,000
Cost to complete all areas (assumes initial development covered 16% of area)	$3,150,000
Annualized cost to complete remaining area + annual maintenance of $50,000	$253,977

Costs for wellhead protection on unprotected wells is based on creating a berm to prevent surface water from flowing to the well head. It is assumed that the grower would do this annually at a cost of $250/well (DNRE 2010).

2.5 Water Quality Management Practices and Other Compliance Costs, by Alternative

2.5.1 Scope of the Output

This section describes the cost output for each alternative. The costs of management practices and other compliance components are based on the information developed in the previous sections. Output is by watershed and cost component. Water quality management practices for Alternative 1 cover surface water only, and Alternatives 2 through 5 cover surface and groundwater. The management practices costs for Alternatives 2 through 4 are identical. Because of the requirement for certified farm plans in Alternative 5, the costs for Alternative 5 include a nutrient management component for all acres regardless of COC or groundwater threat.

2.5.2 Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Cost components in this alternative include Central Valley Water Board and third-party administration, and monitoring. Central Valley Water Board costs include administration and the management (collection from third parties, analysis, and reporting) of water quality information. Third-party administration includes working with growers to track practices, administration of water quality monitoring, and reporting of information to the Board. These costs are shown in Table 2-18.

2.5.3 Alternative 2 – Third-Party Lead Entity

This Alternative is essentially Alternative 1 plus additional costs for groundwater monitoring and for growers to report on the implementation of management measures to protect groundwater. An additional 2.5 Central Valley Water Board staff are required to administer the groundwater portion of this alternative. These costs are shown in Table 2-19.

2.5.4 Alternative 3 – Individual Farm Water Quality Management Plans

This alternative is based on the Central Valley Water Board interacting directly with growers. Total Board staffing required to implement the program is 400. Duties covered by Board staff include administration, inspections, certifications, monitoring, and technical assistance. Additional direct grower costs in this alternative include preparation of farm planning, tracking, and reporting. These costs are shown in Table 2-20.

2.5.5 Alternative 4 – Direct Oversight with Regional Monitoring

As with Alternative 3, this alternative is based on the Central Valley Water Board directly interacting with growers. Total Board staffing required to implement this alternative is 56. Additional staff are required for administering groundwater tier analysis, providing technical assistance to growers, inspections, and managing additional monitoring data. These costs are shown in Table 2-21.

2.5.6 Alternative 5 – Direct Oversight with Farm Monitoring

As with Alternatives 3 and 4, this alternative is based on the Central Valley Water Board directly interacting with growers. Total Board staffing required to implement this alternative is 356. Board staff will be required to interact directly with growers and provide technical assistance when requested. Because each operator is responsible for submitting water quality information, there will be a considerable level of monitoring of information on practices and water quality analysis. These costs are shown in Table 2-22.

Table 2-18. Costs by Hydrologic Basin for Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Hydrologic Region	Grower Fees	Local Administration	Planning	Surface Water Monitoring	Tracking	Reporting	Total Compliance Costs	Wetland MPs	Management Practices
Sacramento River	$243,726	$776,665	Local[1]	$1,529,794	Local[1]	Local[1]	$2,550,186	$15,734,182	$156,726,115
San Joaquin River	$437,130	$710,846	Local[1]	$2,498,733	Local[1]	Local[1]	$3,646,710	$0	$239,182,098
Tulare Lake	$273,110	$1,204,829	Local[1]	$2,738,248	Local[1]	Local[1]	$4,216,187	$0	$54,673,020
Totals	$953,966	$2,692,341		$6,766,776			$10,413,083	$15,734,182	$450,581,233

Table 2-19. Costs by Hydrologic Basin for Alternative 2 – Third-Party Lead Entity

Hydrologic Region	Grower Fees	Local Administration	Planning	Inspection	Surface Water Monitoring	Tracking	Reporting	Groundwater Reporting to Third Party	Groundwater Quality Sampling	Total Compliance Costs	Wetland MPs	Management Practices
Sacramento River	$548,227	$776,665	Local[1]	Local[1]	$1,529,794	Local[1]	Local[1]	$1,080,996	$136,596	$4,072,279	$15,734,182	$156,726,115
San Joaquin River	$478,875	$710,846	Local[1]	Local[1]	$2,498,733	Local[1]	Local[1]	$1,100,830	$584,298	$5,373,583	$0	$240,970,414
Tulare Lake	$600,406	$1,204,829	Local[1]	Local[1]	$2,738,248	Local[1]	Local[1]	$3,896	$913,904	$5,461,283	$0	$54,753,440
Totals	$1,627,508	$2,692,341			$6,766,776			$2,185,722	$1,634,798	$14,907,145	$15,734,182	$452,449,969

Central Valley Water Board Annual Costs: $1,798,531

Additional Staff for GW mgt and Program Analysis/Reporting: $372,438. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

MPs = management practices.

[1] Costs for these compliance components are included with local administration.

Table 2-20. Costs by Hydrologic Basin for Alternative 3 – Individual Farm Water Quality Management Plans

Hydrologic Region	Grower Fees	Local Administration	Planning	Inspection	Board Certification of Practices	Monitoring [2]	Tracking	Reporting	Total Compliance Costs	Wetland MPs	Management Practices
Sacramento River	$548,227	$776,665	$1,656,936	$166,127	$134,723	$11,874,774	$1,329,018	$1,329,018	$17,815,488	$15,734,182	$156,726,115
San Joaquin River	$478,875	$1,270,907	$1,393,538	$137,741	$111,703	$9,845,732	$1,101,929	$1,101,929	$15,442,355	$0	$240,970,414
Tulare Lake	$600,406	$1,350,869	$921,496	$101,429	$82,255	$7,250,125	$811,430	$811,430	$11,929,439	$0	$54,753,440
Totals	$1,627,508	$3,398,441	$3,971,970	$405,297	$328,682	$28,970,631	$3,242,376	$3,242,376	$45,187,282	$15,734,182	$452,449,969

Central Valley Water Board Annual Costs: $1,798,531

Other Board Admin Staff: $58,536,858. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

MPs = management practices.

[1] Costs for these compliance components are included with local administration.

[2] This cost is based on professional judgment and assumed to be 10% of Alternative 5 costs.

Table 2-21. Costs by Hydrologic Basin for Alternative 4 – Direct Oversight with Regional Monitoring

Hydrologic Region	Grower Fees	Local Administration	Tier Analysis and Admin	Farm Planning	Inspection	Education	Regional Surface Water Monitoring	Groundwater Monitor Tier 3	Regional Groundwater Network Plan	Regional Groundwater Monitoring	Tracking	Reporting	Total Compliance Costs	Wetland MPs	Management Practices
Sacramento River	$548,227	$776,665	$71,372	$1,684,042	$166,127	$1,741,013	$1,529,794	$1,781,566	$57,361	$733,702	$1,329,018	$1,329,018	$11,747,922	$15,734,182	$156,726,115
San Joaquin River	$478,875	$1,270,907	$65,324	$1,393,538	$137,741	$1,443,527	$2,498,733	$2,600,073	$121,396	$1,624,789	$1,101,929	$1,101,929	$13,838,785	$0	$240,970,414
Tulare Lake	$600,406	$1,350,869	$110,718	$923,307	$101,429	$1,062,973	$2,738,248	$1,498,287	$236,365	$1,194,343	$811,430	$811,430	$11,439,823	$0	$54,753,440
Totals	$1,627,508	$3,398,441	$247,414	$4,000,887	$405,297	$4,247,513	$6,766,776	$5,879,926	$415,122	$3,552,835	$3,242,376	$3,242,376	$37,026,529	$15,734,182	$452,449,969

Central Valley Water Board Annual Costs: $1,798,531

Other Board Admin Staff: $4,676,531. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

MPs = management practices.

Table 2-22. Costs by Hydrologic Basin for Alternative 5 – Direct Oversight with Farm Monitoring

Hydrologic Region	Grower Fees	Local Administration	Tier Analysis and Administration	Farm Planning	Inspection	Surface Water Monitor	Groundwater Monitor 1	Groundwater Monitor 2 (well)	Tracking	Reporting	Total Compliance Costs	Wetland MPs	Management Practices
Sacramento River	$548,227	$776,665	$71,372	$1,684,042	$166,127	$118,747,742	$465,993	$221,737	$1,329,018	$1,329,018	$125,339,941	$15,734,182	$222,377,083
San Joaquin River	$478,875	$1,270,907	$65,324	$1,396,290	$137,741	$98,457,323	$456	$1,339,122	$1,101,929	$1,101,929	$105,349,896	$0	$268,120,244
Tulare Lake	$600,406	$1,350,869	$110,718	$1,028,189	$101,429	$72,501,249	$3,164,576	$494,990	$811,430	$811,430	$80,975,286	$0	$446,118,332
Totals	$1,627,508	$3,398,441	$247,414	$4,108,521	$405,297	$289,706,314	$3,631,026	$2,055,849	$3,242,376	$3,242,376	$311,665,122	$15,734,182	$936,615,659

Central Valley Water Board Annual Costs: $1,798,531

Other Board Admin Staff: $55,482,437. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

[1] Costs for these compliance components are included with local administration.

Chapter 3
Farm Income and Production Analysis

3.1 Introduction

This section evaluates the effect of ILRP Alternatives on irrigated crop production and income for growers on potentially affected lands. The analysis considered the impact of additional operating costs and lands removed from production. The Central Valley Production Model (CVPM) (described below), was used to evaluate the regional changes in irrigated acres and value of crop production that could result from the alternatives. The additional operating costs were described in the previous section, Compliance and Management Practice Costs, and consisted of a combination of irrigation system and management changes, other physical water quality control actions, and monitoring and reporting costs. Only costs that would fall directly on growers, either as required direct expenditures or as fees, were used to assess impacts on farm income and production.

Potential cost savings or other benefits from the irrigation system changes also were considered. These included estimates of savings in a grower's costs for water, fertilizer, and labor and revenue increases resulting from improved crop yield and quality. These benefits were subtracted from the implementation cost of the irrigation system or management changes, so the analysis considered only the net cost to growers of implementing a change.

Alternative 1 represents a continuation of the current program (i.e., Alternative 1 would continue in absence of the long-term ILRP). The analysis compared Alternative 1 to an existing condition of irrigated crop production and income, and the other Alternatives were compared to Alternative 1. Changes in value of irrigated crop production also were used as part of the analysis in the next section, Regional Economic Impacts.

3.2 Methodology and Model Description

Impacts on farm income and production were analyzed by applying the assumed cost and land use changes by Alternative to a model of agricultural production, CVPM, which covers the Central Valley floor. The portions of the study region that fall outside the Central Valley floor were designated here as the upper watersheds and were analyzed by relating them to the nearest, most appropriate CVPM region. This approach provided a reasonable and consistent way to assess impacts on all affected lands even though the upper watershed lands were not modeled in detail by CVPM.

3.2.1 Use of Program Cost Information

Program costs varied by alternative and fell into several general categories, including management practice implementation, nutrient management, groundwater monitoring, administration, and report preparation. For purposes of the farm income and production analysis, costs were estimated by region and crop category, and all were converted to an annualized cost per acre. Depending on the cost category, the annualized cost included amortized capital and construction, operation, maintenance, administration, and fees.

Costs applied either to all irrigated acres within a region, or to only some acres. For example, costs applied to only some lands more narrowly defined based on groundwater quality or specific water quality constituent. These conditions were described in the section above, Compliance and Management Practice Costs.

An alternative's costs were net costs, over and above costs incurred without the alternative being implemented. Costs in Chapter 3 are reported in 2007 dollars.

3.2.2 Basins and Crop Categories Defined

The ECR identified seven irrigated crop categories. For purposes of regional economic impact analysis, these seven categories were aggregated into three. The correspondence of the crop categories is shown in Table 3-1.

Table 3-1. Crop Category Definition

Abbreviated Crop Category	Aggregated Crop Category	Existing Conditions Crop Category*
FFGO	Field, Forage, Grain, Other	Field Crops, Grain and Hay, Irrigated Pasture, Rice
ORVIN	Orchard, Vineyard	Citrus and Subtropical, Deciduous Orchard, Vineyard
VEGT	Vegetable, Truck	Vegetable and Truck[1]

*Idle (IDLE) and Semi-agricultural and Incidental (SEMI) were not included in the aggregated crop categories.
[1]The vegetable and truck category includes nursery.

The ECR also defined three hydrologic basins and 30 watersheds falling within those three basins. The three basins are the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin. Eight of the watersheds are on the Central Valley floor. The regional economic impact analysis used aggregations of counties for its analysis, and the counties represented in each of the three basins are shown in Table 3-2.

Table 3-2. Counties by Basin

Basin	Counties
Sacramento River	Butte, Colusa, El Dorado, Glenn, Lake, Lassen, Modoc, Napa, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Siskiyou, Solano, Sutter, Tehama, Yolo, Yuba
San Joaquin River	Amador, Calaveras, Contra Costa, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tuolumne
Tulare Lake	Fresno, Kern, Kings, Tulare

3.2.3 Central Valley Production Model

The CVPM is a regional model of irrigated agricultural production and economics that simulates the decisions of agricultural producers (farmers) in the Central Valley of California. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. CVPM has been used to assess the impacts on irrigated agriculture of implementing a number of water-related policy changes. Studies or projects that have used CVPM include: Central Valley Project

Improvement Act (CVPIA) Programmatic Environmental Impact Statement (EIS) (Reclamation 1999); CALFED Bay-Delta Program Programmatic Environmental Impact Report/Environmental Impact Statement (EIR/EIS) (CALFED 2000); Upper San Joaquin River Basin Storage Investigation (Reclamation 2008); and preliminary assessments of CALFED surface storage projects (CALFED Bay-Delta Program unpublished). The model can be linked to hydrologic impact analysis in order to show how water supply changes affect agricultural production. It also can be used to assess how crop production, irrigated acreage, and revenue are affected by changes in production costs. A more complete description of the model's original development, calibration, and testing is provided as a technical appendix to Reclamation's Programmatic EIS for the CVPIA (Reclamation 1999).

The model covers 21 crop production regions in the Central Valley and 20 categories of crops. Wetlands are not considered irrigated cropland and therefore not included in the 20 crop categories. Figure 3-1 illustrates the model coverage.

The model's regions already correspond well with the ILRP watersheds in the Central Valley floor. The crop categories in CVPM can be aggregated directly into the smaller number of ILRP categories or into the three categories used for results display and for regional economic impact analysis.

CVPM uses data on land use, crop mix, and crop water use developed by the California Department of Water Resources (DWR) to support its analysis in the California Water Plan Update (DWR 2005). DWR developed water use based on three representative water years: 1998, 2000, and 2001. The data rely primarily on the same periodic land use surveys that form the basis of the ECR land use data, although DWR interpolated its surveys to create a comprehensive land use dataset for each of the three representative years.

County Agricultural Commissioners' Crop Reports provided estimates of prices and yields (California County Agricultural Commissioners, various counties 2000–2004). Crop production costs were drawn from crop production budgets prepared by the University of California (UC) Cooperative Extension Service (UC various years). DWR staff compiled appropriate budgets to create a budget of production costs for a representative crop in each category and region.

The data described above produced a baseline condition for CVPM, referred to in this report as the early 2000s baseline. CVPM was first calibrated to the early 2000s baseline data, and then the compliance and management practice costs, by region, crop, and alternative, were used to increase the annual cost of production within CVPM. As costs of production increased, the less productive and profitable lands were dropped from production, based on the profit-maximizing assumptions of the model. The resulting crop acreage, production, and value provided the basis for comparisons described below.

In addition to any cost-induced change in acreage, acreage lost to specific water quality protection actions like buffer strips was removed. The total of the two effects was the acreage change, by crop and region. The change in value of production also was calculated as a result of these two acreage changes. Note that CVPM estimated a price response as a result of the production change. That is, as aggregate production of a crop declined, its price rose in the model as a result of demand elasticity. This price effect is incorporated into the net revenue results shown below. However, value of production changes was used as input for the regional impact analysis, and was calculated and displayed using fixed prices, consistent with the assumptions needed for that analysis.

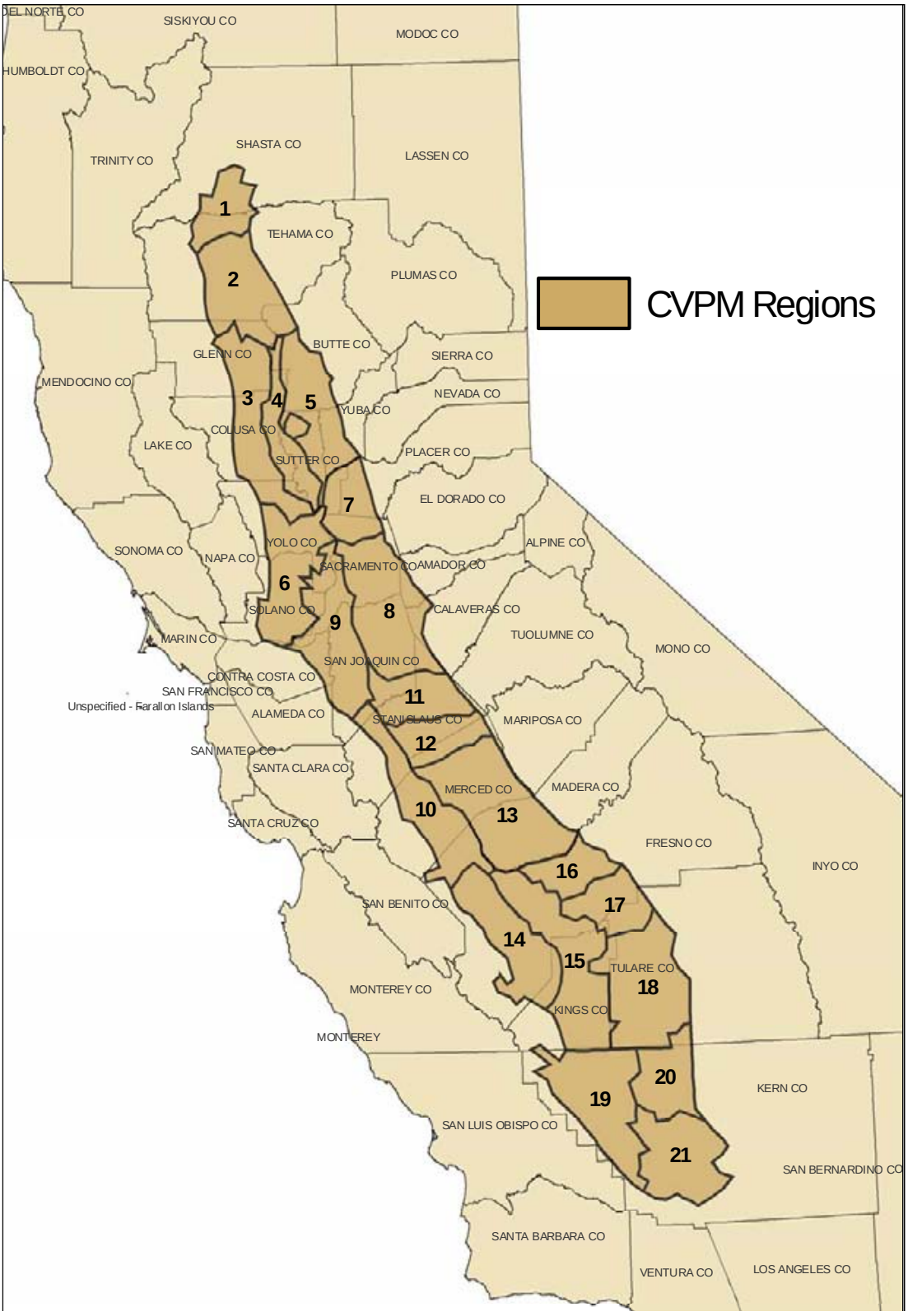

Figure 3-1. Agricultural Areas Modeled by Central Valley Production Model

3.2.4 Evaluation for Lands in Upper Watersheds

CVPM covers about 95 percent of the irrigated acreage in the study area. The remainder lies in the upper watersheds. The upper watersheds with the most irrigated acreage are Pit River, Upper Feather-Upper Yuba, Lake-Napa, and Cosumnes River. The majority of irrigated land in the upper watersheds grows irrigated pasture, grain and hay, and grapes. In order to assess the impact of alternatives on these lands, each upper watersheds was paired with its nearest Central Valley region in CVPM. For each crop in the upper watershed, the percentage change in crop acreage of the corresponding CVPM region was calculated. Then this percentage change was further adjusted by the ratio of increased cost per acre in the upper watershed to the increased cost per acre in the CVPM region. The resulting factor was multiplied by the baseline upper watershed acreage to get the change resulting from the alternative's management practice and compliance cost. Finally, any additional acreage removed for water quality buffers was subtracted to get the total change.

3.3 Existing Conditions Baseline (Early 2000s)

Irrigated acreage reported in the ECR was drawn from crop surveys performed periodically by DWR for counties in the study area. The study area counties were surveyed during 1994 through 2006. These data are summarized by aggregated crop category for the three basins in Table 3-3.

Irrigated acreage from the ECR was used to represent the baseline condition prior to implementation of the Irrigated Lands Conditional Waiver Program (although some of the surveys were completed after the Waiver Program began). Note that subsequent analysis of Alternatives described below estimated changes in acreage using CVPM. Although CVPM uses baseline data from the years 1998, 2000, and 2001, the underlying data also are drawn from the DWR crop surveys and thus are largely consistent with the ECR acreage data.

3.3.1 Irrigated Acreage and Crop Mix

Irrigated acreage was used as a key measure of economic impact on growers. Table 3-3 summarizes the total baseline acreage by basin and the distribution of acreage by crop category within each basin.

Table 3-3. Existing Condition Irrigated Acreage by Crop Category and Basin

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	178,383	447,489	1,660,523	2,286,395
San Joaquin River	209,039	742,901	1,174,088	2,126,028
Tulare Lake	286,991	1,202,700	1,960,888	3,450,579

The crop category FFGO (field, forage, grain, and other) has the largest acreage in each basin. In the FFGO category, rice and irrigated pasture constitute the largest crops in the Sacramento River Basin; cotton and irrigated pasture are the largest crops in both the San Joaquin River and Tulare Lake Basins. Deciduous fruit and nut trees are the largest crops in the ORVIN (orchards and vineyards) category in all three basins.

Irrigated lands in the upper watersheds have a large proportion of lands growing feed and forage crops such as hay, grain, and pasture. Many of these lands are part of integrated livestock operations or provide feed and forage to other producers in their local community. Several of the upper watersheds are important producers of wine grapes, including areas of Lake and Napa Counties and Sierra foothill areas of the Sacramento River and San Joaquin River Basins.

3.3.2 Value of Production

Value of production represents the revenue that growers of irrigated crops receive for selling the crops. The value is measured at the farm gate, not after processing or marketing. Table 3-4 summarizes the value of irrigated crop production in the three basins. For the Central Valley floor the value of irrigated crop production was estimated based on the CVPM data. For the irrigated lands in the upper watershed, per-acre values from CVPM were used with the acreage reported in the ECR to estimate the value of irrigated crop production.

Table 3-4. Existing Condition Value of Irrigated Crop Production (2007$, in millions) by Crop Category and Basin

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	516.5	1,808.9	1,138.3	3,462.7
San Joaquin River	647.6	2,046.0	809.2	3,502.8
Tulare Lake	957.6	3,620.7	1,785.7	6,364.0

Table 3-5 displays the weighted average crop production value per acre by crop category and region. The values indicate that, on average, crops in the FFGO category provide a much smaller value of production per acre than crops in the VEGT (vegetable, truck) and ORVIN category. However, FFGO crops can range in value from less than $200 per acre per year for irrigated pasture to more than $1,000 per acre for rice or cotton. Other forages, grains, and oilseeds fall within this range.

Table 3-5. Existing Condition per-Acre Value of Irrigated Crop Production (2007$) by Crop Category and Basin

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	2,895	4,042	686	1,514
San Joaquin River	3,098	2,754	689	1,648
Tulare Lake	3,337	3,010	911	1,844

The predominance of feed and forage crops in some parts of the study area, particularly the upper watersheds, results in a relatively low value of crop produced per acre. As noted above, these lands are important for dairy, beef cattle, and other livestock production.

3.3.3 Other Characteristics of Agriculture

Table 3-6 summarizes the average size and revenue of farms in the three basins. Farms in the Tulare Lake Basin are larger on average than those in the northern two basins. This is attributable to a

combination of crop mix, economies of scale, and patterns of original land development. Within each basin, farm size varies greatly.

Table 3-6. Gross Farm Income (2007$, in thousands per farm) and Average Acreage by Basin

Basin	Farm Characteristics
Sacramento River	
Gross Farm Income	253.9
Average Farm Size	177.1
San Joaquin River	
Gross Farm Income	309.6
Average Farm Size	195.5
Tulare Lake	
Gross Farm Income	764.0
Average Farm Size	450.0

Source: CVPM database for gross farm income; acreage and farm numbers data collected for the Existing Conditions Report.

Livestock production is an important part of the agricultural sector. Although the ILRP regulates only irrigated lands *per se*, many of these lands provide forage and feed to the livestock industry. Beef cattle, dairy cattle, and horses are especially dependent on forage and feed production. According to Agricultural Commissioners' annual reports for the counties falling substantially in the study area, more than $1.8 billion in beef and dairy cattle were produced annually for the period 2005–2007 (escalated to 2007 dollars). An additional $350 million per year was categorized in the reports as miscellaneous or unspecified livestock production, but likely included significant cattle production.

Aggregate net income by basin was not estimated as part of this analysis. Net income has a number of definitions that are used for different purposes. The definitions vary by, among other things, how they treat taxes and tax credits, whether they count family labor as a cost, and whether and how they estimate depreciation and imputed rents. Rather than estimate the total net income, this analysis estimated only changes in net income that may result from alternatives. The changes resulted from increased costs to growers, reduced revenue to growers (from land that is not kept in production) and costs that would have been spent to produce that revenue, and crop price changes induced by aggregate changes in production.

3.4 Impacts of the Program Alternatives on Agricultural Acreage and Income

In the results presented below, Alternative 1 was compared to the early 2000s existing conditions acreage and revenue. All other Alternatives were compared to Alternative 1.

In the period between the early 2000s and the time of this report, some and perhaps many of the management practices, or their functional equivalents, have been implemented on at least some lands. This analysis took into account the implementation to the extent possible, but extensive data were not available. Costs that could be identified as already incurred since the early 2000s were

subtracted from the costs of implementing practices, but it is likely that additional implementation has occurred beyond what could be identified. As a result, the estimates shown below probably overstate impacts of Alternative 1 implementation, or at least should be viewed as an upper range of potential impacts. This caution does not apply to the later comparisons between Alternatives 2–5 and Alternative 1.

3.4.1 Alternative 1 – Change Relative to Early 2000s Existing Condition

Alternative 1 represents a continuation of the current program. The following results compare Alternative 1 to an existing condition of irrigated crop production and income based on ECR CVPM data representing the early 2000s, prior to significant implementation of the current program.

3.4.1.1 Acreage by Basin and Crop

The change in acreage by crop category between Alternative 1 and the existing condition is reported in Table 3-7. Changes were greatest in the FFGO crop category, with a total reduction of approximately 384 thousand acres across basins, or 97 percent of the total change. The change in acreage in VEGT and ORVIN was considerably smaller, approximately 6 and 4 thousand acres, respectively. Tulare Lake lost relatively little acreage. The Sacramento River and San Joaquin Valley River Basins showed similar levels of change, together approximately 92 percent of total. This was primarily a result of the distribution of lands subject to additional requirements; in Tulare Lake Basin relatively few lands are near designated impaired water bodies. In total, there was a reduction of approximately 395 thousand acres compared to the existing condition.

Table 3-7. Alternative 1: Change in Irrigated Acreage (000) by Crop Category and Basin from Existing Condition

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-3.4	-1.6	-192.5	-197.5
Percent Change	-1.9%	-0.4%	-11.6%	-8.6%
San Joaquin River	-2.6	-1.9	-162.3	-166.8
Percent Change	-1.2%	-0.3%	-13.8%	-7.8%
Tulare Lake	-0.4	-0.4	-29.4	-30.2
Percent Change	-0.1%	-0.0%	-1.5%	-0.9%
Total	-6.4	-3.9	-384.2	-394.5
Percent Change	-0.9%	-0.2%	-8.0%	-5.0%

Totals may not sum as a result of rounding.

Some key analytical assumptions and data limitations contributed to the relatively large estimated change in acreage (and the associated change in value and income described below). The limited information on costs incurred between the early 2000s and today is discussed in Section 3.4 above.

More importantly, management practices assumed to be implemented for the analysis are relatively expensive, especially for lower-revenue crops in the FFGO category. As a result, crops such as irrigated pasture, hay, and some small grains would have difficulty supporting such costs. The analysis indicated large reductions in their acreages in the regions where those costs were incurred.

Irrigated pasture, hay, and other field crops (excluding rice and cotton) accounted for more than 95 percent of the acreage reduction shown in Table 3-7. To the extent growers of these crops could identify less-expensive ways to comply, such as avoiding the use of certain pesticides, the acreage and revenue impacts would be substantially reduced. For example, Appendix A describes how a lower-cost management practice on irrigated pasture would affect direct costs. Further, sensitivity analysis using CVPM indicated that if grower costs per acre for FFGO crops were reduced by 50 percent, the total acreage impact in Alternative 1 would be reduced by 75 percent.

3.4.1.2 Value of Production by Basin and Crop

The change in annual value of production by crop category between Alternative 1 and the existing condition is reported in Table 3-8. Changes were greatest in the FFGO crop category, with a total reduction of approximately $304 million per year across basins, or 90 percent of the total change. The change in value of production in VEGT and ORVIN was considerably less, approximately $19 and $13 million, respectively. Tulare Lake Basin lands changed the least, consistent with the acreage results described above. The Sacramento River and San Joaquin Valley River Basins lost similar amounts of production value , together approximately 90 percent of the total. In all, value of production declined by approximately $336 million per year compared to the existing condition.

Table 3-8. Alternative 1: Change in Value of Production ($000,000) by Crop Category and Basin from Existing Condition

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-9.5	-5.5	-142.9	-157.9
Percent Change	-1.8%	-0.3%	-12.6%	-4.6%
San Joaquin River	-8.6	-5.9	-131.6	-146.2
Percent Change	-1.3%	-0.3%	-16.3%	-4.2%
Tulare Lake	-1.3	-1.2	-29.9	-32.4
Percent Change	-0.1%	-0.0%	-1.7%	-0.5%
Total	-19.3	-12.7	-304.5	-336.5
Percent Change	-0.9%	-0.2%	-8.2%	-2.5%

Totals may not sum as a result of rounding.

3.4.1.3 Net Revenue by Basin and Crop

The change in annual net revenue by crop category between Alternative 1 and the existing condition is reported in Table 3-9. Changes were greatest in the FFGO crop category, with a total reduction of approximately $250 million per year across basins, or 70 percent of the total change. The reduction in net revenue for VEGT and ORVIN was considerably less, approximately $47 and $63 million, respectively. Of the three basins, Tulare Lake Basin lands lost the smallest amount, while the Sacramento River and San Joaquin River Basins combined for approximately 90 percent of total. In total, net revenue declined approximately $360 million per year compared to the existing condition.

Table 3-9. Alternative 1: Change in Net Revenue ($000,000) by Crop Category and Basin from Existing Condition

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-21.5	-25.3	-88.1	-134.9
Percent Change	-14.2%	-2.4%	-13.9%	-11.8%
San Joaquin River	-22.2	-32.1	-131.5	-185.9
Percent Change	-12.2%	-2.8%	-29.4%	-22.8%
Tulare Lake	-3.4	-5.2	-30.7	-39.3
Percent Change	-1.2%	-0.3%	-3.1%	-2.6%
Total	-47.1	-62.6	-250.3	-360.0
Percent Change	-12.3%	-2.4%	-20.7%	-5.3%

Totals may not sum as a result of rounding.

3.4.2 Alternative 2 – Change Relative to Alternative 1

As described above, Alternative 1 represents the continuation of the current Program. Alternative 2 would add costs for groundwater monitoring and reporting. Compliance costs were estimated to increase by about $1 per acre per year over the Alternative 1 level. The following results compare Alternative 2 to Alternative 1.

3.4.2.1 Acreage by Basin and Crop

The changes in acreage by crop category estimated to result from the additional costs and regulations of Alternative 2 are reported in Table 3-10. Changes were greatest in the FFGO crop category, with a total reduction of approximately 10 thousand acres across basins, or 93 percent of total. The change in acreage in VEGT and ORVIN was considerably smaller, approximately 0.1 and 0.6 thousand acres, respectively. Additional monitoring and reporting costs applied to relatively few lands in the Tulare Lake Basin, so its acreage changed little. The Sacramento River and San Joaquin River Basins had much greater proportion of lands subject to the additional monitoring and reporting costs. Approximately 96 percent of total change in acreage occurred in these basins, with the great majority of that occurring in the FFGO crop category. In total, there was a reduction of approximately 11 thousand irrigated acres, or about 0.2 percent, relative to Alternative 1.

Table 3-10. Alternative 2: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.02	-0.02	-1.9	-1.9
Percent Change	-0.0%	-0.0%	-0.2%	-0.1%
San Joaquin River	-0.1	-0.6	-8.2	-8.9
Percent Change	-0.0%	-0.1%	-1.0%	-0.5%
Tulare Lake	-0.01	-0.03	-0.4	-0.4
Percent Change	-0.0%	-0.0%	-0.0%	-0.0%
Total	-0.1	-0.6	-10.5	-11.2
Percent Change	-0.0%	-0.0%	-0.3%	-0.2%

Totals may not sum as a result of rounding.

3.4.2.2 Value of Production by Basin and Crop

As illustrated in Table 3-11, the distribution of change in value of production across basins and crop categories was largely similar to the acreage results. The key difference was that the overall percent change in value, either by basin or in total, was about half the percent change in acreage. This reflected the relatively lower value per acre of production on the FFGO lands, which were disproportionately affected by the costs of the alternative.

Changes to the FFGO crop category were more than $4 million per year across basins, or 60 percent of the total. The change in value of production for VEGT and ORVIN crops was considerably less, approximately $3 and $2.6 million, respectively. In total, a reduction of approximately $7.4 million per year was estimated relative to Alternative 1.

Table 3-11. Alternative 2: Change in Value of Production ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.1	-0.1	-1.1	-1.3
Percent Change	-0.0%	-0.0%	-0.1%	-0.0%
San Joaquin River	-0.2	-2.4	-2.9	-5.5
Percent Change	-0.0%	-0.1%	-0.4%	-0.2%
Tulare Lake	-0.03	-0.1	-0.4	-0.6
Percent Change	-0.0%	-0.0%	-0.0%	-0.0%
Total	-0.3	-2.6	-4.4	-7.4
Percent Change	-0.0%	-0.0%	-0.1%	-0.1%

Totals may not sum as a result of rounding.

3.4.2.3 Net Revenue by Basin and Crop

The losses in net revenue of irrigated land estimated to result from the additional costs and regulations of Alternative 2 are reported in Table 3-12. Net revenue declined by an estimated total of $6.3 million per year, or about 0.1 percent. Changes were greatest in the FFGO crop category, with

a total reduction of approximately $3.4 million per year across basins. The ORVIN category was estimated to decline by $2.5 million and VEGT by only about $0.4 million. San Joaquin River Basin was most affected, accounting for 65 percent of the total reduction.

Table 3-12. Alternative 2: Change in Net Revenue ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.1	-0.4	-0.9	-1.4
Percent Change	-0.1%	0.0%	-0.2%	-0.1%
San Joaquin River	-0.2	-1.9	-2.1	-4.2
Percent Change	-0.1%	-0.2%	-0.7%	-0.4%
Tulare Lake	-0.1	-0.3	-0.3	-0.7
Percent Change	0.0%	0.0%	0.0%	0.0%
Total	-0.4	-2.5	-3.4	-6.3
Percent Change	-0.1%	-0.1%	-0.5%	-0.1%

Totals may not sum as a result of rounding.

3.4.3 Alternative 3 – Change Relative to Alternative 1

Alternative 3 would increase costs to growers by requiring them to prepare individual farm water quality management plans. Compliance costs were estimated to increase by about $8–13 per acre per year over the Alternative 1 level.

3.4.3.1 Acreage by Basin and Crop

The change in acreage by crop category between Alternative 3 and Alternative 1 was quite similar in distribution to the results from Alternative 2, as seen in Table 3-13. Changes were greatest in the FFGO crop category, with a reduction of approximately 50 thousand acres across basins. This was about 96 percent of the total reduction. The change in acreage in VEGT and ORVIN was considerably less, approximately 0.7 and 1.2 thousand acres, respectively. Tulare Lake Basin again changed relatively little because of the small extent of lands subject to the additional costs. In total, a reduction of approximately 52 thousand acres was estimated relative to Alternative 1, or about 0.8 percent of irrigated acreage.

Table 3-13. Alternative 3: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.3	-0.3	-23.2	-23.8
Percent Change	-0.2%	-0.1%	-1.9%	-1.3%
San Joaquin River	-0.3	-0.8	-24.4	-25.6
Percent Change	-0.2%	-0.1%	-2.8%	-1.5%
Tulare Lake	-0.1	-0.1	-2.8	-2.9
Percent Change	-0.0%	-0.0%	-0.2%	-0.1%
Total	-0.7	-1.2	-50.3	-52.3
Percent Change	-0.1%	-0.1%	-1.3%	-0.8%

Totals may not sum as a result of rounding.

3.4.3.2 Value of Production by Basin and Crop

The change in value of production by crop type between Alternative 3 and Alternative 1 is reported in Table 3-14. Total value of irrigated crop production was estimated to fall by about $41 million per year. Changes were greatest in the FFGO crop type, with a total reduction of approximately $34 million across basins, or 84 percent of total. The change in value of production in VEGT and ORVIN was considerably less, approximately $2.2 and $4.6 million, respectively. About $37.5 million (92 percent of the total change) occurred in the Sacramento River and San Joaquin River Basins.

Table 3-14. Alternative 3: Change in Value of Production ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.9	-1.0	-16.4	-18.3
Percent Change	-0.2%	-0.1%	-1.7%	-0.6%
San Joaquin River	-1.0	-3.2	-15.0	-19.2
Percent Change	-0.2%	-0.2%	-2.2%	-0.6%
Tulare Lake	-0.2	-0.4	-2.8	-3.3
Percent Change	-0.0%	-0.0%	-0.2%	-0.1%
Total	-2.1	-4.6	-34.2	-40.9
Percent Change	-0.1%	-0.1%	-1.0%	-0.3%

Totals may not sum as a result of rounding.

3.4.3.3 Net Revenue by Basin and Crop

The losses in net revenue of irrigated land estimated for Alternative 3 are reported in Table 3-15. Net revenue declined by an estimated total of almost $48 million per year, or about 0.7 percent. Changes were greatest in the FFGO crop category, with a total reduction of approximately $29 million per year across basins. The ORVIN category was estimated to decline by about $14 million and VEGT by only about $5 million. Sacramento River and San Joaquin River Basins dominated the losses and accounted for about 90 percent of total net revenue lost.

Table 3-15. Alternative 3: Change in Net Revenue ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-2.1	-5.3	-13.4	-20.8
Percent Change	-1.6%	-0.5%	-2.5%	-1.9%
San Joaquin River	-2.3	-7.5	-12.8	-22.5
Percent Change	-1.4%	-0.7%	-4.0%	-2.7%
Tulare Lake	-0.4	-1.4	-2.6	-4.4
Percent Change	-0.1%	-0.1%	-0.3%	-0.2%
Total	-4.8	-14.2	-28.7	-47.7
Percent Change	-1.4%	-0.6%	-3.0%	-0.7%

Totals may not sum as a result of rounding.

3.4.4 Alternative 4 – Change Relative to Alternative 1

Alternative 4 increases the intensity of water quality monitoring and the resulting cost to growers is higher. Compliance costs were estimated to increase by about $3–5 per acre per year over the Alternative 1 level.

3.4.4.1 Acreage by Basin and Crop

The change in acreage by crop type between Alternative 4 and Alternative 1 is reported in Table 3-16. Changes showed a pattern similar to those in Alternatives 2 and 3. Nearly 93 percent of the total acreage change occurred in the FFGO crop category, and 90 percent of the changes occurred in the San Joaquin River Basins. As in Alternatives 2, the small change in Sacramento River and Tulare Lake Basins resulted from relatively small area of land subject to some of the additional requirements. The change in acreage in VEGT and ORVIN categories was relatively small, approximately 0.3 and 0.8 thousand acres, respectively. In total, the analysis estimated a reduction of approximately 14 thousand acres relative to Alternative 1, or almost 0.2 percent of total irrigated acres.

Table 3-16. Alternative 4: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.1	-0.1	-0.1	-0.3
Percent Change	-0.1%	-0.0%	-0.0%	-0.0%
San Joaquin River	-0.1	-0.7	-11.5	-12.3
Percent Change	-0.1%	-0.1%	-1.3%	-0.7%
Tulare Lake	-0.0	-0.1	-1.0	-1.0
Percent Change	-0.0%	-0.0%	-0.1%	-0.0%
Total	-0.3	-0.8	-12.6	-13.6
Percent Change	-0.0%	-0.0%	-0.3%	-0.2%

Totals may not sum as a result of rounding.

3.4.4.2 Value of Production by Basin and Crop

The change in value of production by crop type between Alternative 4 and Alternative 1 is reported in Table 3-17. Percent change in total value produced was similar to the percent change in acreage. About 74 percent of the total reduction in value occurred in the FFGO category. The change in value of production in VEGT and ORVIN is considerably less, approximately $0.8 and $3.1 million, respectively. The total reduction in value was approximately $14.9 million per year relative to Alternative 1.

Table 3-17. Alternative 4: Change in Value of Production ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.3	-0.3	-3.9	-4.5
Percent Change	-0.1%	-0.0%	-0.4%	-0.1%
San Joaquin River	-0.5	-2.6	-6.1	-9.2
Percent Change	-0.1%	-0.1%	-0.9%	-0.3%
Tulare Lake	-0.1	-0.2	-0.9	-1.2
Percent Change	-0.0%	-0.0%	-0.1%	-0.0%
Total	-0.8	-3.1	-11.0	-14.9
Percent Change	-0.0%	-0.0%	-0.3%	-0.1%

Totals may not sum as a result of rounding.

3.4.4.3 Net Revenue by Basin and Crop

The losses in net revenue of irrigated land estimated for Alternative 4 are reported in Table 3-18. Net revenue declined by more than $16 million per year, or 0.3 percent. Changes were greatest in the FFGO crop category, with a total reduction of approximately $8.8 million per year across basins. The ORVIN category was estimated to decline by about $6 million and VEGT by about $1.5 million. Sacramento River and San Joaquin River Basins dominated the losses and accounted for almost 92 percent of total lost net revenue.

The percent loss in net revenue for both ORVIN and VEGT categories substantially exceeded their percent loss in acreage or value of production. This occurred because crops in those categories could more easily bear the extra costs imposed by Alternative 4, and so did not lose much acreage or value. However, the costs were subtracted from the production value and substantially cut the net revenue.

Table 3-18. Alternative 4: Change in Net Revenue ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-0.6	-1.7	-3.1	-5.5
Percent Change	-0.5%	-0.2%	-0.6%	-0.4%
San Joaquin River	-0.8	-3.7	-5.0	-9.4
Percent Change	-0.5%	-0.3%	-1.6%	-1.0%
Tulare Lake	-0.1	-0.6	-0.8	-1.5
Percent Change	-0.1%	-0.0%	-0.1%	-0.1%
Total	-1.5	-6.0	-8.8	-16.3
Percent Change	-0.4%	-0.3%	-1.1%	-0.3%

Totals may not sum as a result of rounding.

3.4.5 Alternative 5 – Change Relative to Alternative 1

Alternative 5 would represent a substantial increase in cost and in crop acres subject to many of the water quality control requirements. Compliance costs were estimated to increase by about $20–50 per acre per year over the Alternative 1 level.

3.4.5.1 Acreage by Basin and Crop

As seen in Table 3-19, acreage impacts were much greater and were spread more evenly among the three basins under Alternative 5. More than 10 percent of total reductions occurred in the Tulare Lake Basin, with more than 40 percent in each of the other basins. The total acreage out was larger in the Sacramento River Basin than in either of the other basins. Changes to crop categories were not minor as they were in Alternatives 2, 3, and 4. In total, more than 289 thousand acres, or more than 4.4 percent, were estimated to go out of production relative to Alternative 1.

Table 3-19. Alternative 5: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-2.2	-2.4	-136.1	-140.7
Percent Change	-1.2%	-0.5%	-11.3%	-7.4%
San Joaquin River	-1.8	-3.4	-120.6	-125.8
Percent Change	-1.0%	-0.5%	-14.1%	-7.5%
Tulare Lake	-1.2	-3.7	-26.3	-31.1
Percent Change	-0.4%	-0.3%	-1.5%	-1.0%
Total	-5.2	-9.5	-283.0	-297.7
Percent Change	-0.8%	-0.4%	-7.5%	-4.4%

Totals may not sum as a result of rounding.

3.4.5.2 Value of Production by Basin and Crop

The change in value of production by crop type between Alternative 5 and Alternative 1 is reported in Table 3-20. A total of $269 million in crop value was estimated to go out under this alternative, with about 82 percent of that total coming from the FFGO category. The change in value of production in VEGT and ORVIN was considerably less but still important, at approximately $15.9 and $32.6 million, respectively. About 6.4 percent of the FFGO value was estimated to be lost, and the total loss was 2.1 percent.

Table 3-20. Alternative 5: Change in Value of Production ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-6.1	-8.4	-104.0	-118.4
Percent Change	-1.2%	-0.5%	-10.4%	-3.6%
San Joaquin River	-6.1	-11.7	-90.3	-108.1
Percent Change	-1.0%	-0.6%	-13.3%	-3.2%
Tulare Lake	-3.7	-12.5	-26.0	-42.2
Percent Change	-0.4%	-0.3%	-1.5%	-0.7%
Total	-15.9	-32.6	-220.3	-268.7
Percent Change	-0.8%	-0.4%	-6.4%	-2.1%

Totals may not sum as a result of rounding.

3.4.5.3 Net Revenue by Basin and Crop

The change in net revenue between Alternative 5 and Alternative 1 is shown in Table 3-21. Total net revenue was estimated to decline by just over $237 million per year, or more than 14 percent. That included a nearly 21 percent decline in net revenue to the FFGO category and13.6 percent to VEGT. As described for Alternative 4, the percent impact on net revenue was much larger than either the acreage or the value of production percent change. The costs imposed by this alternative reduced net revenue substantially on lands remaining in production in addition to eliminating net revenue on lands going out of production.

Table 3-21. Alternative 5: Change in Net Revenue ($000,000) by Crop Category and Basin from Alternative 1

Basin	VEGT	ORVIN	FFGO	Total
Sacramento River	-13.6	-36.0	-80.9	-130.6
Percent Change	-10.5%	-3.5%	-14.9%	-11.3%
San Joaquin River	-14.9	-44.5	-72.8	-132.1
Percent Change	-9.3%	-4.0%	-23.1%	-15.1%
Tulare Lake	-6.7	-5.8	-13.3	-25.8
Percent Change	-2.4%	-0.3%	-1.4%	-1.4%
Total	-21.8	-74.7	-140.4	-236.9
Percent Change	-13.6%	-4.1%	-20.7%	-14.8%

Totals may not sum as a result of rounding.

3.5 Summary and Discussion

This section provides a summary of the changes in acreage of irrigated agriculture and total production value estimated for each alternative. This section also provides an overview of effects on the livestock sector and identifies potential program funding mechanisms.

3.5.1 Summary Comparison of Alternatives 2–5 to Alternative 1

Tables 3-22 through 3-24 provide a summary comparison of analysis results for Alternatives 2 through 5, all compared to Alternative 1.

Table 3-22. Summary of Changes in Total Irrigated Acreage (000) by Basin from Alternative 1

Basin	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Sacramento River	-1.9	-23.8	-0.3	-140.7
Percent Change	-0.1%	-1.3%	-0.0%	-7.4%
San Joaquin River	-8.9	-25.6	-12.3	-125.8
Percent Change	-0.5%	-1.5%	-0.7%	-7.5%
Tulare Lake	-0.4	-2.9	-1.0	-31.1
Percent Change	-0.0%	-0.1%	-0.0%	-1.0%
Total	-11.2	-52.3	-13.6	-297.7
Percent Change	-0.2%	-0.8%	-0.2%	-4.4%

Totals may not sum as a result of rounding.

Table 3-23. Summary of Changes in Total Value of Production ($000,000) by Basin from Alternative 1

Basin	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Sacramento River	-1.3	-18.3	-4.5	-118.4
Percent Change	-0.0%	-0.6%	-0.1%	-3.6%
San Joaquin River	-5.5	-19.2	-9.2	-108.1
Percent Change	-0.2%	-0.6%	-0.3%	-3.2%
Tulare Lake	-0.6	-3.3	-1.2	-42.2
Percent Change	-0.0%	-0.1%	-0.0%	-0.7%
Total	-7.4	-40.9	-14.9	-268.7
Percent Change	-0.1%	-0.3%	-0.1%	-2.1%

Totals may not sum as a result of rounding.

Table 3-24. Summary of Changes in Total Net Revenue ($000,000) by Basin from Alternative 1

Basin	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Sacramento River	-1.4	-20.8	-5.5	-130.6
Percent Change	-0.1%	-1.9%	-0.4%	-11.3%
San Joaquin River	-4.2	-22.5	-9.4	-132.1
Percent Change	-0.4%	-2.7%	-1.0%	-15.1%
Tulare Lake	-0.7	-4.4	-1.5	-25.8
Percent Change	0.0%	-0.2%	-0.1%	-1.4%
Total	-6.3	-47.7	-16.3	-236.9
Percent Change	-0.1%	-0.7%	-0.3%	-14.8%

Totals may not sum as a result of rounding.

A sensitivity analysis of grower implementation costs in Alternative 1 was described in Section 3.4.1.1 above. That analysis indicated that acreage revenue and net income changes were relatively sensitive to the implementation cost assumptions. The same general conclusion applies to the results for all alternatives. If growers can identify and implement more cost-effective methods to comply with ILRP requirements, impacts on production and income can be reduced substantially, especially for lower-value field and forage crops.

3.5.2 Potential Effects on the Livestock Sector

Alternatives summarized above showed a disproportionate effect on FFGO relative to the other crop categories. In the FFGO category, CVPM results indicated very large reductions in acreage that produces hay and forage for livestock. A detailed analysis of potential effects on livestock production and processing sectors was beyond the scope of this analysis, so a simpler approach was used that compared the value of forage and hay production in the study area to the value of beef and dairy cattle production. The study area was not divided into three basins.

Agricultural Commissioners of counties in the study area reported the value of irrigated hay and pasture was about $1.33 billion on average for 2005–2007, and the value of beef and dairy cattle

was about $1.85 billion (California County Agricultural Commissioners 2005–2007)[1]. According to the IMPLAN model database, described in the section below, 80 percent of the value of hay and forage produced in the study area counties is used in the study area, and 20 percent is exported to other counties or regions. The analysis also allowed 20 percent of any lost production within the study area to be replaced by increased imports of hay into the study area (or reduced exports out of the area). This last assumption represents a limited ability to replace local production with imported hay, and was made to illustrate the upper range of potential effects on livestock producers. Their actual ability to replace local forage and hay would depend on supply response in other regions, transportation costs, and other market conditions.

These estimates and assumptions, if reasonable, implied that for every dollar of lost value of forage and hay production, another 89 cents would be lost in value of livestock. Based on this estimate, Table 3-25 displays the loss in forage and hay value (which is already included in earlier tables as part of the loss to FFGO crop value) and the corresponding additional loss in value of livestock. The losses are order-of-magnitude estimates based on the assumptions described above.

Table 3-25. Potential Changes in Value of Livestock Production in the Study Area Compared to Alternative 1

	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Percent change in forage and hay value produced	-0.063%	-0.8%	-0.3%	-5.5%
Percent change in livestock value produced	-0.056%	-0.7%	-0.2%	-4.9%
Million $ per year of change in livestock value produced	-$1.0	-$13.3	-$4.5	-$90.6

Note: Livestock losses in this table are presented for illustrative purposes. They are not estimated at the same level of detail as the irrigated crop losses but provide a sense of the relative scale of impacts by Alternative.

3.5.3 Available Funding Programs

A number of existing or potential funding sources may be available to offset portions of the cost of implementing the ILRP. Depending on the funding source, the assistance may be provided to growers, local organizations and water suppliers, or implementing agencies. The programs described below are illustrative and are not intended to constitute a comprehensive list of funding sources.

3.5.3.1 Federal Farm Bill

Title II of the 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008, in effect through 2012) authorizes funding for conservation programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program. Both of these programs provide financial and technical assistance for activities that improve water quality on agricultural lands. For example, the NRCS provides financial and technical assistance to growers to improve water quality. The assistance is through the Agricultural Water Enhancement Program, an element of the NRCS

[1] This livestock value does not include the value of beef and dairy products and processing.

EQIP. The program is a voluntary conservation initiative in which NRCS develops partnership agreements with eligible growers.

Farm bills typically are in place for 4 to 5 years. Subsequent farm bills may expand, reduce, eliminate, or replace EQIP. Farm bills or other future legislation may authorize spending for direct grants, loans, or cost-sharing for irrigation practices that improve water quality.

3.5.3.2 State Water Resources Control Board

The Division of Financial Assistance administers water quality improvement programs for the State Water Board. The programs provide grant and loan funding to reduce non-point-source pollution discharge to surface waters.

The Division of Financial Assistance currently administers two programs that improve water quality—the Agricultural Drainage Management Loan Program and the Agricultural Drainage Loan Program. Both of these programs were implemented to address the management of agricultural drainage into surface water. The Agricultural Water Quality Grant Program provides funding to reduce or eliminate the discharge of non-point-source pollution from agricultural lands into surface and groundwater. It is currently funded through bonds authorized by Proposition 84.

The State Water Pollution Control State Revolving Fund Program also has funding authorized through Proposition 84. It provides loan funds to a wide variety of point-source and non-point-source water quality control activities. The State Water Board also administers Clean Water Act funds that can be used for agricultural water quality improvements.

3.5.3.3 Potential Funding Provided by the Safe, Clean, and Reliable Drinking Water Supply Act of 2010

This act was passed by the Legislature as SBX 7-2, and if approved by voters in November of 2010, would provide grant and loan funding for a wide range of water-related activities, including agricultural water quality improvement, watershed protection, and groundwater quality protection. The actual amount and timing of funding availability will depend on its passage, on the issuance of bonds and the release of funds, and on the kinds of programs and projects proposed and approved for funding.

3.5.3.4 Other Funding Programs

Other state and federal funding programs have been available in recent years to address agricultural water quality improvements. Integrated Regional Water Management grants were authorized and funded by Proposition 50 and now by Proposition 84. These are being administered jointly by the State Water Board and DWR. Proposals can include agricultural water quality improvement projects. The Bureau of Reclamation also can provide assistance and cost-sharing for water conservation projects that help discharges.

For a list of recent activities funded from various sources for agricultural water quality improvements see Chapter 5 of the ILRP ECR.

Effect of External Funding on Economic Impacts

Funding received from grants, cost-sharing, or low-interest loans would offset some of the local growers' expenditures for compliance and management practice implementation, and likely would

reduce the losses in irrigated acreage and value of production estimated and described above. Funding that is targeted toward lands, crops, or growers having the greatest potential for losses and economic hardship would be most effective at reducing the impact. Regional economic impacts (see Chapter 4) also would be reduced.

Chapter 4
Regional Economic Impacts

4.1 Introduction

This section describes the analysis of effects of the ILRP alternatives on regional economic conditions. The analysis considers effects of estimated changes in the value of agricultural production and spending to comply with program requirements and to implement management practices.

Three regional input/output (I/O) economics models were developed to assess economic impacts. The geographic areas of the models were delineated based on the counties either fully or partially within the Central Valley Water Board region. The counties in the 20-county Sacramento River Basin model, the 10-county San Joaquin River Basin model, and the four-county Tulare Lake Basin model are identified in Table 4-1. (Note that the models incorporate areas of some counties that are outside the regional boundaries.)

Table 4-1. Counties in the Sacramento River, San Joaquin River, and Tulare Lake Basin Regions

Sacramento River Basin Region		San Joaquin River Basin Region	Tulare Lake Basin Region
Butte	Plumas	Alpine	Fresno
Colusa	Sacramento	Amador	Kern
El Dorado	Shasta	Calaveras	Kings
Glenn	Sierra	Contra Costa	Tulare
Lake	Siskiyou	Madera	
Lassen	Solano	Mariposa	
Modoc	Sutter	Merced	
Napa	Tehama	San Joaquin	
Nevada	Yolo	Stanislaus	
Placer	Yuba	Tuolumne	

4.2 Methodology and Model Description

The three regional economics I/O models were developed using IMPLAN software. The models were used to measure the indirect effects that changes in crop production and regional expenditures from implementing management practices and complying with regulations under the project alternatives would be expected to have on regional economies, in terms of changes in industry output, employment, and income. The models are based on 2007 IMPLAN data.

Originally developed by the U.S. Department of Agriculture Forest Service to assist with land and resource management planning, the IMPLAN I/O software is a widely used model employed to assess the regional economic impacts of private and public projects. I/O analysis is a means of examining relationships within an economy, both between businesses and final consumers. It captures all monetary market transactions for consumption in a given time period. I/O models, such

as the IMPLAN model, allow for assessing the effects of a change in one or several economic activities, such as changes in agricultural production and regulatory costs, on an entire economy.

In general terms, an I/O model is used to estimate the effects of changes in final demand on the regional economy. In the case of the ILRP, the direct effect is the change (decrease or increase) in overall agricultural output estimated by the farm income and production analysis (described in Chapter 3) and the change in expenditures to implement management practices and to comply with regulatory requirements (described in Chapter 2). Because businesses in a local economy are linked together through purchases and sales of goods and services produced in the region, an action that has a direct effect on one industry is likely to have an indirect effect on firms providing production inputs and support services, as the demand for their products also changes. As household income is affected by the changes in regional economic activity, additional induced effects are generated by increased household spending.

Three different economic measures typically are used to describe regional impacts. *Output* (also known as *total industry output*) represents the value of production of goods and services by businesses in the regional economy. This can serve as an overall measure of the local economy and is useful for comparing regions and considering impacts. The second measure is *personal income*, which is the sum of employee compensation, proprietor income, and other property income. Employee compensation represents total payroll costs, including wages and salaries paid to workers plus benefits such as health insurance, as well as retirement payments and non-cash compensation. Proprietor income includes payments received by self-employed individuals as income, such as income received by private business owners, doctors, or lawyers. This measure is useful to show how employees and proprietors of businesses producing the output benefit from those businesses. Other property income consists of payments to individuals in the form of rents received on property, royalties from contracts, dividends paid by corporations, and profits earned by corporations. The third measure is *employment*, which represents the annual average number of employees, whether full- or part-time, of the businesses producing the output.

The base period used to characterize regional economic conditions is 2007, matching the year of data in the IMPLAN databases of the counties making up the three economic regions. Crop production value data from county Agricultural Commissioners' Crop Reports were used to characterize the existing output for three aggregated crop sectors: FFGO, ORVIN, and VEGT. Industry-level output, personal income and employment data from the IMPLAN I/O model databases were used to characterize existing conditions for other industrial sectors in the three economic regions.

To assess the regional economic impacts of the project alternatives, direct effects on agricultural production value by aggregated crop sector and region, as estimated in the farm income and production analysis, were used. The estimates of farm income and production were used as inputs to appropriate agricultural sectors in the three regional I/O models. For each of the alternatives, the procedure was similar for estimating regional economic impacts. After changes in agricultural production value were input to the models, the models were simulated to estimate the indirect, induced, and total effects of the change in agricultural production on the three regional economies. This process was repeated for each of the five project alternatives.

A similar approach was used to estimate the regional economic effects of spending on compliance and management practice implementation. (Note that the regional economic effects generated by increased spending on compliance and management practice implementation, including increased

output, income, and employment, could be considered benefits to the regional economies, but are referred to as effects in this chapter.) Costs for each alternative, which were estimated as part of the compliance and management practice cost assessment, were grouped according to general cost category (e.g., administrative costs, management practice costs). Estimates of total regional compliance and management practice costs for each region and alternative were adjusted based on the predicted reduction in crop acreage in each region under each alternative. (Note that, as described in Chapter 2, compliance and management practice costs were developed on a per-acre basis for categories of costs as the starting point for estimating overall Program costs under each alternative. These per-acre costs then were multiplied by baseline acreages in each region, as represented by early 2000s existing conditions, to arrive at total Program costs for each region and alternative. As described in Chapter 3, the implementation of the alternatives would result in some of the baseline acreage going out of production. As a result, the overall Program costs estimated in Chapter 2 for each alternative would be lower because the per-acre costs would apply to fewer acres in each region than under the early 2000s baseline. For purposes of conducting the regional economic impact analysis, the compliance and management practice costs needed to be adjusted downward by the predicted acreage reductions under each alternative, which resulted in lower overall costs and lower regional economic effects.) Costs then were assigned to appropriate IMPLAN industrial sectors based on a sectoring scheme developed for each cost category. Costs, deflated to 2007 dollars, then were input to the model to estimate indirect, induced, and total effects of changes in compliance and management practice costs on the three regional economies.

In addition to addressing regional economic impacts resulting from changes in agricultural production levels and compliance costs, the analysis addressed an additional source of change in regional economic activity: the reduction in personal consumption and other spending that some growers could face as a result of lower profits. Loss in regional economic activity that results from land going out of production or from crop switching was included in the IMPLAN analysis of gross production value changes, but reduction in profit on lands that remain in production also reduces income that growers and landowners would have had available to spend on other consumption, capital investment, or saving. The actual effect that this loss would have on the regional economy would depend on how much of it would have been spent within the region and on what.

To assess the potential regional economic impacts of reduced grower profits, it was assumed that grower profits would be reduced by the amount growers would spend on compliance and management practice implementation in the three economic regions under each of the Program alternatives. Additionally, it was assumed that 80 percent of forgone profits (i.e., grower compliance costs) otherwise would have been spent within the region. Based on these assumptions, the adjusted grower compliance costs were entered into the IMPLAN household sectors of each regional model, with costs evenly divided among three household income sectors: $75,000–$100,000, $100,000–$150,000, and $150,000+. (Note that the IMPLAN spending patterns for household sectors vary according to household income levels.) The models then were run to generate estimated direct, indirect, and induced output, personal income, and employment impacts for each alternative and region.

Alternative 1 represents a continuation of the current program. The regional economic analysis compared the effects of Alternative 1 to levels of output, personal income, and employment under the 2007 base period. Alternatives 2 through 5 were evaluated by comparing the effects of these alternatives to Alternative 1 output, personal income, and employment levels, which reflect the 2007 levels adjusted by the estimated changes under Alternative 1.

To address the potential magnitude of forward-linked effects of reduced livestock production, the order-of-magnitude results presented in Section 3.5.2 were carried forward into the regional economic impact analysis, as presented in Section 4.5.3, Potential Effects from Changes in Livestock Production. This limited assessment of livestock production effects was based on the results of the agricultural analysis presented Section 3.5.2. The potential forward-linked impacts on livestock producers was estimated by the regional IMPLAN models by inputting the estimated loss of livestock production value under each alternative, as shown in Table 3-25. To avoid double-counting the backward-linked impacts on the FFGO sector, which were already accounted for in the analysis of agricultural production impacts for each alternative, the regional purchase coefficients for the FFGO sectors of each regional model were set to zero before the models were run. (A regional purchase coefficient represents the proportion of local demand for a commodity, such as forage and feed, purchased from local producers.) The models then were run to generate estimated direct, indirect, and induced output, personal income, and employment impacts for each alternative and region.

4.3 Existing Regional Economic Conditions

As discussed previously, existing regional economic conditions are characterized by 2007 levels of industrial output, personal income, and employment.

4.3.1 Total Industry Output

In the Sacramento River Basin region, industrial output is dominated by the value of services and manufacturing. Of the region's $232.4 billion in industrial output, the finance, insurance, and real estate (FIRE) sector accounted for 19 percent of regional output, with educational, health, social services (EHSS) and other services combining to account for 23 percent of output (Table 4-2). Manufacturing followed, accounting for 14 percent of the value of regional production. Agricultural sectors, though important to rural areas of the region, accounted for a small percentage of total regional industrial output in 2007. Combined, the three aggregated crop sectors (FFGO, VEGT, and ORVIN) directly accounted for about 2 percent of regional output, and the livestock, dairy, poultry, and agricultural support services sectors accounted for another 0.5 percent of regional output. Agricultural activities, however, directly and indirectly affect the value of the output of other sectors of the region's economy, such as the manufacturing (including food processing), retail and wholesale trade, and transportation and warehousing sectors.

Table 4-2. Industrial Output by Sector in the Sacramento River Basin, 2007

Sector	Industrial Output[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	1,380.4	0.6%
Vegetable, truck crops	625.2	0.3%
Orchard, vineyard crops	1,943.7	0.8%
Livestock and poultry ranching and farming	748.5	0.3%
Forestry, fishing and hunting	524.6	0.2%
Agriculture and forestry support activities	461.9	0.2%
Mining and utilities	3,966.6	1.7%
Construction	21,817.3	9.4%
Manufacturing	32,522.1	14.0%
Wholesale and retail trade	22,026.7	9.5%
Transportation and warehousing	5,688.9	2.4%
Information	9,422.4	4.1%
Finance, insurance, and real estate	44,680.8	19.2%
All other services	36,411.3	15.7%
Educational, health, and social services	17,509.8	7.5%
Government	32,724.0	14.1%
Total	232,454.2	100.0%

Sources: California County Agricultural Commissioners' Annual Crop Reports for counties in the Sacramento River Basin 2008; Minnesota IMPLAN Group 2008.
[1] 2007 U.S. dollars ($).

Manufacturing was the dominant producer of industrial output in the San Joaquin River Basin in 2007, accounting for 36 percent of the region's $228.6 billion in industrial output (Table 4-3). The services sectors, including the FIRE, EHSS, and other services sectors, also are important to the San Joaquin River Basin region, accounting for a combined 31 percent of regional output. Similar to the Sacramento River Basin region, the San Joaquin River Basin region's agricultural sector is important to local areas within the region, although agriculture directly plays a minor role in the overall value of industrial output in the region. Combined, the three crop sectors accounted for about 2 percent of regional output, with the livestock, dairy, poultry, and agricultural support services sectors accounting for another 2 percent of regional output. However, as in the Sacramento River Basin, agricultural activities in the San Joaquin River Basin directly and indirectly affect the value of the output of other sectors of the region's economy, such as the manufacturing (including food processing), retail and wholesale trade, and transportation and warehousing sectors.

Table 4-3. Industrial Output by Sector in the San Joaquin River Basin, 2007

Sector	Industrial Output[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	849.8	0.4%
Vegetable, truck crops	861.3	0.4%
Orchard, vineyard crops	2,607.3	1.1%
Livestock and poultry ranching and farming	3,306.9	1.4%
Forestry, fishing and hunting	298.8	0.1%
Agriculture and forestry support activities	759.5	0.3%
Mining and utilities	6,584.4	2.9%
Construction	15,399.3	6.7%
Manufacturing	82,747.7	36.2%
Wholesale and retail trade	15,763.0	6.9%
Transportation and warehousing	5,734.7	2.5%
Information	9,985.5	4.4%
Finance, insurance, and real estate	32,694.7	14.3%
All other services	24,732.7	10.8%
Educational, health, and social services	13,244.5	5.8%
Government	12,998.7	5.7%
Total	228,568.8	100.0%

Sources: California County Agricultural Commissioners' Annual Crop Reports for counties in the Sacramento River Basin 2008; Minnesota IMPLAN Group 2008.
[1] 2007 U.S. dollars ($).

In the Tulare Lake Basin region, agriculture contributes a larger share of output relative to overall regional industrial output. As Table 4-4 shows, the three crop sectors combined accounted for about 7 percent of regional output in 2007, with the livestock, dairy, poultry, and agricultural support services sectors accounting for another 5 percent of regional output. The region's agricultural industry also directly and indirectly affects the value of the output of other sectors of the region's economy, such as the manufacturing (including food processing), retail and wholesale trade, and transportation and warehousing sectors. The largest producers of regional industrial output were the services sectors—FIRE, EHSS, and other services—together accounting for 28 percent of regional output. Manufacturing accounted for another 21 percent of 2007 regional output.

Table 4-4. Industrial Output by Sector in the Tulare Lake Basin, 2007

Sector	Industrial Output[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	1,886.7	1.4%
Vegetable, truck crops	2,062.1	1.5%
Orchard, vineyard crops	5,896.4	4.2%
Livestock and poultry ranching and farming	4,266.6	3.1%
Forestry, fishing and hunting	174.4	0.1%
Agriculture and forestry support activities	2,380.8	1.7%
Mining and utilities	9,889.1	7.1%
Construction	9,763.8	7.0%
Manufacturing	29,370.2	21.1%
Wholesale and retail trade	12,150.0	8.7%
Transportation and warehousing	4,125.0	3.0%
Information	2,978.8	2.1%
Finance, insurance, and real estate	14,932.5	10.7%
All other services	15,551.5	11.2%
Educational, health, and social services	8,127.2	5.8%
Government	15,470.8	11.1%
Total	139,025.9	100.0%

Sources: California County Agricultural Commissioners' Annual Crop Reports for counties in the Sacramento River Basin 2008; Minnesota IMPLAN Group 2008.
[1] 2007 U.S. dollars ($).

4.3.2 Personal Income

In 2007, personal income in the Sacramento River Basin region was distributed broadly across the region's economy, with services (FIRE, EHSS, and other services) generating 43 percent and with government producing 24 percent of total regional personal income (Table 4-5). The region's three crop-producing sectors directly accounted for about 1.5 percent of regional income, with the livestock, dairy, poultry, and agricultural support services sectors accounting for 0.5 percent of regional income.

Table 4-5. Personal Income by Sector in the Sacramento River Basin, 2007

Sector	Personal Income[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	422.4	0.3
Vegetable, truck crops	437.7	0.3
Orchard, vineyard crops	1,103.4	0.8
Livestock and poultry ranching and farming	190.7	0.2
Forestry, fishing and hunting	389.7	0.3
Agriculture and forestry support activities	415.0	0.3
Mining and utilities	1,946.4	1.5
Construction	10,811.7	8.1
Manufacturing	8,547.0	6.4
Wholesale and retail trade	12,270.5	9.2
Transportation and warehousing	2,981.4	2.2
Information	4,139.0	3.1
Finance, insurance, and real estate	25,636.7	19.3
All other services	20,618.7	15.5
Educational, health, and social services	11,699.6	8.8
Government	31,488.3	23.7
Total	133,098.2	100.0

Source: Minnesota IMPLAN Group 2008.

[1] Includes employee compensation, proprietor income, and other property income in 2007 U.S. dollars ($).

Services, manufacturing, and government were the largest producers of personal income in the San Joaquin River Basin region in 2007, together accounting for more than two-thirds (69 percent) of total regional personal income (Table 4-6). Wholesale and retail trade, and construction, accounted for another 16 percent of the region's income. The three crop-producing sectors directly generated 3 percent of the region's income, with the livestock, dairy, poultry, and agricultural support services sectors accounting for 2 percent of regional income.

Table 4-6. Personal Income by Sector in the San Joaquin River Basin, 2007

Sector	Personal Income[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	233.2	0.2
Vegetable, truck crops	739.1	0.8
Orchard, vineyard crops	1,595.4	1.7
Livestock and poultry ranching and farming	1,094.7	1.1
Forestry, fishing and hunting	165.9	0.2
Agriculture and forestry support activities	643.9	0.7
Mining and utilities	2,578.3	2.7
Construction	7,401.9	7.7
Manufacturing	12,849.0	13.4
Wholesale and retail trade	8,347.0	8.7
Transportation and warehousing	2,984.7	3.1
Information	4,218.8	4.4
Finance, insurance, and real estate	19,143.5	20.0
All other services	13,477.1	14.1
Educational, health, and social services	8,409.9	8.8
Government	11,828.2	12.4
Total	95,710.6	100.0

Source: Minnesota IMPLAN Group 2008.

[1] Includes employee compensation, proprietor income, and other property income in 2007 U.S. dollars ($).

In the Tulare Lake Basin region, services and government were the largest producers of personal income in 2007. Services (FIRE, EHSS, and other services) accounted for 32 percent of total regional income (Table 4-7). Government followed, generating 22 percent of the region's income. Other important sectors included wholesale and regional trade (10 percent) and manufacturing (8 percent). The crop-producing sectors of the Tulare Lake Basin region's economy directly accounted for about 6 percent of the region's 2007 income. The livestock, dairy, poultry, and agricultural support services sectors accounted for additional 5 percent of regional income.

Table 4-7. Personal Income by Sector in the Tulare Lake Basin, 2007

Sector	Personal Income[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	547.5	0.8
Vegetable, truck crops	1,087.7	1.6
Orchard, vineyard crops	2,132.4	3.2
Livestock and poultry ranching and farming	1,435.0	2.2
Forestry, fishing and hunting	96.9	0.1
Agriculture and forestry support activities	1,967.8	3.0
Mining and utilities	4,297.1	6.5
Construction	4,438.0	6.7
Manufacturing	5,242.9	7.9
Wholesale and retail trade	6,389.2	9.6
Transportation and warehousing	2,043.6	3.1
Information	1,067.9	1.6
Finance, insurance, and real estate	8,135.8	12.3
All other services	8,087.4	12.2
Educational, health, and social services	4,981.5	7.5
Government	14,410.1	21.7
Total	66,360.8	100.0

Source: Minnesota IMPLAN Group 2008.

[1] Includes employee compensation, proprietor income, and other property income in 2007 U.S. dollars ($).

4.3.3 Employment

The services, government, and trade sectors are the dominant employment generators in the Sacramento River Basin region. In 2007, services, including FIRE, EHSS, and other services, generated 46 percent of the region's 1.9 million jobs (Table 4-8). Government and wholesale/retail trade produced 22 percent and 13 percent, respectively, of regional jobs. The agricultural sectors were directly responsible for a relatively small number of the region's jobs, with the three crop sectors accounting for just over 1 percent of the jobs, and the livestock, dairy, poultry, and agricultural support services sectors contributing another 1 percent of regional jobs.

Table 4-8. Jobs by Sector in the Sacramento River Basin, 2007

Sector	Jobs[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	9,835	0.5
Vegetable, truck crops	2,675	0.1
Orchard, vineyard crops	12,859	0.7
Livestock and poultry ranching and farming	4,421	0.2
Forestry, fishing and hunting	2,316	0.1
Agriculture and forestry support activities	14,559	0.8
Mining and utilities	7,093	0.4
Construction	138,534	7.5
Manufacturing	80,251	4.3
Wholesale and retail trade	248,102	13.4
Transportation and warehousing	45,738	2.5
Information	29,404	1.6
Finance, insurance, and real estate	171,788	9.3
All other services	473,489	25.6
Educational, health, and social services	201,539	10.9
Government	409,547	22.1
Total	1,852,150	100.0

Source: Minnesota IMPLAN Group 2008.
[1] Includes part- and full-time employment.

Employment patterns are similar in the San Joaquin River Basin region. In 2007, 46 percent of the region's 1.2 million jobs were generated by the FIRE, EHSS, and other services sectors (Table 4-9). The government and wholesale/retail trade sectors each accounted for 14 percent of the region's jobs. The region's three crop-producing sectors together produced more than 21,000 jobs, which represented about 2 percent of the region's jobs, with the livestock, dairy, poultry, and agricultural support services sectors contributing nearly 3 percent of regional jobs.

Table 4-9. Jobs by Sector in the San Joaquin River Basin, 2007

Sector	Jobs[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	3,446	0.3
Vegetable, truck crops	3,944	0.3
Orchard, vineyard crops	13,661	1.1
Livestock and poultry ranching and farming	14,701	1.2
Forestry, fishing and hunting	1,076	0.1
Agriculture and forestry support activities	27,408	2.3
Mining and utilities	6,994	0.6
Construction	91,207	7.6
Manufacturing	82,521	6.8
Wholesale and retail trade	168,044	14.0
Transportation and warehousing	41,370	3.4
Information	22,233	1.8
Finance, insurance, and real estate	114,333	9.5
All other services	304,752	25.3
Educational, health, and social services	139,337	11.6
Government	169,362	14.1
Total	1,204,389	100.0

Source: Minnesota IMPLAN Group 2008.
[1] Includes part- and full-time employment.

As discussed previously, agriculture directly plays a greater role in the overall economy of the Tulare Lake Basin than it does in the other two economic regions. The three crop-producing sectors accounted for 4 percent of the region's 1.0 million jobs in 2007, but the livestock, dairy, poultry, and agricultural support services sectors produced an even greater share of regional employment, generating 12 percent of total jobs (Table 4-10). Apart from the region's agricultural sectors, services (FIRE, EHSS, and other services) were a large contributor to the region's employment base, accounting for 35 percent of all jobs. Government and wholesale/retail trade were also significant contributors to the regional economy, producing 19 percent and 13 percent, respectively, of the region's jobs.

Table 4-10. Jobs by Sector in the Tulare Lake Basin, 2007

Sector	Jobs[1] ($M)	Percent of Total
Feed, forage, grain, and other crops	8,348	0.8
Vegetable, truck crops	8,529	0.8
Orchard, vineyard crops	25,878	2.5
Livestock and poultry ranching and farming	23,411	2.3
Forestry, fishing and hunting	530	0.1
Agriculture and forestry support activities	99,643	9.6
Mining and utilities	15,836	1.5
Construction	62,938	6.1
Manufacturing	58,492	5.6
Wholesale and retail trade	131,773	12.7
Transportation and warehousing	28,270	2.7
Information	8,888	0.9
Finance, insurance, and real estate	51,542	5.0
All other services	216,962	20.9
Educational, health, and social services	99,328	9.6
Government	196,150	18.9
Total	1,036,518	100.0

Source: Minnesota IMPLAN Group 2008.
[1] Includes part- and full-time employment.

4.4 Regional Economic Impacts of the Program Alternatives

The results of the regional economic impact assessment are described for each of the Program alternatives in the following sections. The effects of Alternative 1 were compared to base period (2007) conditions, whereas the effects of Alternatives 2 through 5 were compared to Alternative 1 conditions.

4.4.1 Alternative 1 – Change Relative to 2007 Base Period Conditions

The effects of Alternative 1 reflect the continuation of the current Program, with changes in industrial output, personal income, and employment compared to 2007 base period levels.

4.4.1.1 Total Industry Output

Under Alternative 1, reductions in annual industrial output directly and indirectly attributable to changes in irrigated agriculture and grower profitability would occur in all regions, largely because of reductions in the value of FFGO crops, particularly in the Sacramento River Basin and San Joaquin River Basin regions. Agriculture-related output reductions would range on an annual basis from $137.4 million in the Tulare Lake Basin region to $564.2 million in the Sacramento River Basin

region (Tables 4-11, 4-12, and 4-13). Output generated by spending to comply with Program regulations and to implement management practices would offset a portion of the loss of output associated with irrigated agriculture, with output increases ranging from $91.0 million in the Tulare Lake Basin region to $303.1 million in the San Joaquin River Basin region.

Considered together, the agriculture-related reductions in output would more than offset the gains generated by compliance spending, with net decreases in total output across all sectors ranging from 0.03 percent in the Tulare Lake Basin region to 0.13 percent in the Sacramento River Basin region relative to base-period levels (Table 4-11, 4-12, and 4-13). At the sector level, net output reductions would be large in the FFGO sectors of both the Sacramento River Basin and San Joaquin River Basin regions, with 9.5 percent and 13.0 percent reductions, respectively. Additionally, reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

Table 4-11. Alternative 1: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Base Period (2007) Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-146.14	14.95	-131.19	-9.50%
Vegetable, truck crops	-9.97	0.10	-9.87	-1.58%
Orchard, vineyard crops	-6.37	0.16	-6.21	-0.32%
Agriculture and forestry support activities	-9.73	0.91	-8.82	-1.91%
All other sectors	-391.94	241.76	-150.18	-0.07%
Total	-564.15	257.88	-306.27	-0.13%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-40.13	4.11	-36.02	-8.53%
Vegetable, truck crops	-5.58	0.06	-5.52	-1.26%
Orchard, vineyard crops	-3.38	0.08	-3.30	-0.30%
Agriculture and forestry support activities	-8.45	0.80	-7.65	-1.84%
All other sectors	-217.32	139.93	-77.39	-0.06%
Total	-274.86	144.98	-129.88	-0.10%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-934.4	95.6	-838.8	-8.53%
Vegetable, truck crops	-34.1	0.4	-33.7	-1.26%
Orchard, vineyard crops	-39.4	1.0	-38.4	-0.30%
Agriculture and forestry support activities	-296.8	27.9	-268.9	-1.85%
All other sectors	-3,060	1,897.6	-1,162.4	-0.06%
Total	-4,364.7	2,022.5	-2,342.2	-0.13%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-12. Alternative 1: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Base Period (2007) Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-133.52	22.83	-110.69	-13.03%
Vegetable, truck crops	-9.51	0.19	-9.32	-1.08%
Orchard, vineyard crops	-6.93	0.22	-6.71	-0.26%
Agriculture and forestry support activities	-11.74	1.80	-9.94	-1.31%
All other sectors	-373.70	278.02	-95.68	-0.04%
Total	-535.4	303.06	-232.34	-0.10%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-37.95	6.49	-31.46	-13.49%
Vegetable, truck crops	-5.19	0.10	-5.09	-0.69%
Orchard, vineyard crops	-3.77	0.12	-3.65	-0.23%
Agriculture and forestry support activities	-9.98	1.53	-8.45	-1.31%
All other sectors	-197.88	154.25	-43.63	-0.05%
Total	-254.77	162.49	-92.28	-0.10%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-560.8	95.9	-464.9	-13.49%
Vegetable, truck crops	-27.7	0.5	-27.2	-0.69%
Orchard, vineyard crops	-31.5	1.0	-30.5	-0.22%
Agriculture and forestry support activities	-423.7	65.1	-358.6	-1.31%
All other sectors	-2,799.2	2,068.2	-731.0	-0.06%
Total	-3,842.9	2,230.7	-1,612.2	-0.13%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-13. Alternative 1: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Base Period (2007) Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-30.44	5.72	-24.72	-1.31%
Vegetable, truck crops	-1.52	0.07	-1.45	-0.07%
Orchard, vineyard crops	-1.41	0.06	-1.35	-0.02%
Agriculture and forestry support activities	-2.78	0.48	-2.30	-0.10%
All other sectors	-101.21	84.70	-16.51	-0.01%
Total	-137.36	91.03	-46.33	-0.03%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-10.25	1.92	-8.33	-1.52%
Vegetable, truck crops	-0.81	0.04	-0.77	-0.07%
Orchard, vineyard crops	-0.75	0.03	-0.72	-0.03%
Agriculture and forestry support activities	-2.30	0.40	-1.90	-0.10%
All other sectors	-53.22	47.50	-5.72	-0.01%
Total	-67.33	49.89	-17.44	-0.03%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-156.2	29.3	-126.9	-1.52%
Vegetable, truck crops	-6.4	0.3	-6.1	-0.07%
Orchard, vineyard crops	-9.0	0.4	-8.6	-0.03%
Agriculture and forestry support activities	-116.2	20.1	-96.1	-0.10%
All other sectors	-823.4	706.9	-116.5	-0.01%
Total	-1,111.2	757.0	-354.2	-0.03%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

4.4.1.2 Personal Income

Under Alternative 1, effects on personal income would be similar to those described for output effects, with decreases in personal income attributable to reduced agricultural production and reduced grower profitability offset to varying degrees by increases in personal income driven by compliance and management practice implementation spending (Tables 4-11, 4-12, and 4-13). On a sector basis, industries dependent on agricultural production, particularly on the production of FFGO crops, would experience reduced income. This is particularly true for the FFGO sector in the San Joaquin River Basin region, where personal income would fall by 13.5 percent, and in the Sacramento River Basin region, where income would decline by 8.5 percent, relative to base-period levels. Across all sectors, personal income generated by compliance and management practice implementation spending would partially offset the negative agricultural effects. Personal income would decrease by a net of $17.4 million in the Tulare Lake Basin, $92.3 million in the San Joaquin River Basin region, and $129.9 million in the Sacramento River Basin region. These reductions

would be relatively small (0.03–0.10 percent) compared to total personal income levels in each region under base period conditions.

4.4.1.3 Employment

Under Alternative 1, reductions in agricultural production and grower profitability would directly and indirectly result in job losses in all three economic regions, with reductions ranging from 1,111 jobs in the Tulare Lake Basin to 4,365 jobs in the Sacramento River Basin region (Tables 4-11, 4-12, and 4-13). Most of the job losses would occur in the FFGO sector as a result of reductions in irrigated field crop acreage. These losses would be somewhat offset, primarily in other industrial sectors, by increased spending driven by program compliance and management practice implementation. Job growth related to this spending would range from 757 jobs in the Tulare Lake Basin region to 2,231 jobs in the San Joaquin River Basin region. When considered together, net employment would decrease by 354 jobs in the Tulare Lake Basin region, 1,612 jobs in the San Joaquin River Basin region, and 2,342 jobs in the Sacramento River Basin region. Compared to base-period employment levels, these changes would be relatively small, with a 0.03 percent decrease in the Tulare Lake Basin region and 0.13 percent decreases in the San Joaquin River Basin and Sacramento River Basin regions.

4.4.2 Alternative 2 – Change Relative to Alternative 1

The annual changes in agricultural production, grower profitability, and compliance and management practice costs under Alternative 2 would be relatively small compared to Alternative 1 levels, resulting in relatively minor regional economic effects. The estimated gross value of agricultural production under Alternative 2 would fall by only 0.1 percent ($7.4 million in 2007 dollars) across the three regions (see Table 3-10, Farm Income and Production Analysis section). Similarly, the increase in compliance and management practice implementation spending under Alternative 2, attributable primarily to added costs for groundwater monitoring and reporting, would not be substantially higher than under Alternative 1, with acreage-adjusted costs increasing by about $2 million in each economic region. As described below, the net result of these changes on regional economies would be relatively minor compared to Alternative 1 conditions.

4.4.2.1 Total Industry Output

Relative to total industrial output levels under Alternative 1, the total net changes in annual output estimated to result from reduced agricultural output and grower profitability and increased compliance spending under Alternative 2 would be less than 0.005 percent for all three of the economic regions, with slight net decreases in the Sacramento River Basin and San Joaquin River Basin regions and a slight increase in the Tulare Lake Basin region (Tables 4-14, 4-15, and 4-16). (For the Tulare Lake River Basin region, this result is primarily because reductions in agricultural production values and grower profitability would be slightly smaller than the increase in compliance spending within the region, relative to Alternative 1 levels. In the Sacramento River Basin and San Joaquin River Basin regions, reductions in agricultural production value and grower profitability would be larger than the increase in compliance spending, leading to net reductions in output.) For the agricultural sectors, the output reductions would be largest in the FFGO sector, but the changes, compared to Alternative 1 levels, would be minor in all regions, ranging from 0.02 percent in the Tulare Lake Basin region to 0.39 percent in the San Joaquin River Basin region. Reductions in the production of FFGO crops, including hay and forage for livestock, could have

adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

Table 4-14. Alternative 2: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-1.17	0.06	-1.11	-0.089%
Vegetable, truck crops	-0.004	0.002	-0.003	0.000%
Orchard, vineyard crops	-0.06	0.002	-0.058	-0.003%
Agriculture and forestry support activities	-0.08	0.004	-0.076	-0.017%
All other sectors	-4.03	4.49	0.46	0.000%
Total	-5.34	4.56	-0.78	0.000%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-0.32	0.02	-0.30	-0.078%
Vegetable, truck crops	-0.003	0.001	-0.002	0.000%
Orchard, vineyard crops	-0.031	0.001	-0.03	-0.003%
Agriculture and forestry support activities	-0.07	0.004	-0.066	-0.016%
All other sectors	-2.54	2.73	0.19	0.000%
Total	-2.96	2.75	-0.21	0.000%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-7.5	0.4	-7.1	-0.079%
Vegetable, truck crops	0.0	0.0	0.0	0.000%
Orchard, vineyard crops	-0.4	0.0	-0.4	-0.003%
Agriculture and forestry support activities	-2.3	0.1	-2.2	-0.015%
All other sectors	-32.2	39.8	7.6	0.000%
Total	-42.4	40.3	-2.1	0.000%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-15. Alternative 2: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-2.93	0.05	-2.88	-0.390%
Vegetable, truck crops	-0.26	0.003	-0.257	-0.030%
Orchard, vineyard crops	-2.46	0.003	-2.457	-0.094%
Agriculture and forestry support activities	-0.54	0.005	-0.535	-0.071%
All other sectors	-7.28	4.55	-2.73	-0.001%
Total	-13.47	4.61	-8.86	-0.004%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-0.83	0.01	-0.82	-0.406%
Vegetable, truck crops	-0.14	0.002	-0.138	-0.019%
Orchard, vineyard crops	-1.30	0.001	-1.299	-0.082%
Agriculture and forestry support activities	-0.46	0.004	-0.456	-0.072%
All other sectors	-3.89	2.62	-1.27	-0.001%
Total	-6.62	2.64	-3.98	-0.004%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-12.3	0.2	-12.1	-0.406%
Vegetable, truck crops	-0.8	0.0	-0.8	-0.020%
Orchard, vineyard crops	-11.2	0.0	-11.2	-0.082%
Agriculture and forestry support activities	-19.4	0.2	-19.2	-0.071%
All other sectors	-53.6	38.2	-15.4	-0.001%
Total	-97.3	38.6	-58.7	-0.005%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-16. Alternative 2: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-0.42	0.007	-0.413	-0.022%
Vegetable, truck crops	-0.03	0.003	-0.027	-0.001%
Orchard, vineyard crops	-0.12	0.002	-0.118	-0.002%
Agriculture and forestry support activities	-0.05	0.001	-0.049	-0.002%
All other sectors	-2.07	2.97	0.90	0.001%
Total	-2.69	2.98	0.29	0.000%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-0.14	0.002	-0.138	-0.026%
Vegetable, truck crops	-0.02	0.001	-0.019	-0.002%
Orchard, vineyard crops	-0.06	0.001	-0.059	-0.003%
Agriculture and forestry support activities	-0.04	0.001	-0.039	-0.002%
All other sectors	-1.09	1.75	0.66	0.001%
Total	-1.35	1.76	0.41	0.001%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-2.1	0.0	-2.1	-0.026%
Vegetable, truck crops	-0.1	0.0	-0.1	-0.001%
Orchard, vineyard crops	-0.8	0.0	-0.8	-0.003%
Agriculture and forestry support activities	-2.2	0.1	-2.1	-0.002%
All other sectors	-17.1	29.5	12.4	0.001%
Total	-22.3	29.6	7.3	0.001%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

4.4.2.2 Personal Income

Under Alternative 2, annual changes in personal income would follow the trend in changes in industry output, with small (less than 0.005 percent) net decreases in income in the Sacramento River Basin and San Joaquin River Basin regions and a slight increase in the Tulare Lake Basin region (Tables 4-14, 4-15, and 4-16). As with output, net personal income changes would be greatest in the FFGO sectors of regional economies; however, the reductions would be relatively minor, ranging from 0.03 percent in the Tulare Lake Basin to 0.41 percent in the San Joaquin River Basin.

4.4.2.3 Employment

As with output and personal income, changes in employment under Alternative 2 would be small relative to Alternative 1 levels of employment. Net changes in employment would include reductions of 59 jobs in the San Joaquin River Basin and two jobs in the Sacramento River Basin regions and an

increase of seven jobs in the Tulare Lake Basin region (Tables 4-14, 4-15, and 4-16). These changes would represent less than 0.01 percent of Alternative 1 employment levels in all regions. Job losses related to decreased agricultural production and grower profitability under Alternative 2 would be greatest in the San Joaquin River Basin, with an estimated 97 jobs lost. This change would be minor in the context of Alternative 1 employment levels.

4.4.3 Alternative 3 – Change Relative to Alternative 1

The annual changes in agricultural production and grower profitability under Alternative 3 would be larger than under Alternative 2 but still would be relatively small compared to Alternative 1 levels, resulting in relatively small regional economic effects. The reduction in the gross value of annual agricultural production under Alternative 3 would be only an estimated 0.3 percent ($40.9 million in 2007 dollars) across the three regions compared to production value under Alternative 1 (see Table 3-13, Farm Income and Production Analysis section). The increase in annual compliance- and management practice–implementation spending under Alternative 3 would be higher than under Alternative 1, attributable primarily to increased costs to growers for preparing individual farm water quality management plans and for substantially higher costs for additional Water Board administrative staff. Relative to Alternative 1, acreage-adjusted costs under Alternative 3 would increase by 19 percent ($84.3 million), ranging from an increase of $16.3 million in the Tulare Lake Basin region to an increase of $35.6 million in the San Joaquin River Basin region. As described below, the net result of these changes on regional economies would vary across the regions and impact indicators but would be positive for personal income and employment because of relatively large increases in compliance- and management practice–implementation spending, which would outweigh the adverse effects of reduced agricultural production and grower profitability. The net changes, however, would be relatively small compared to Alternative 1 conditions.

4.4.3.1 Total Industry Output

Under Alternative 3, annual industrial output losses related to reductions in agricultural production and grower profitability would offset output gains generated by Program compliance spending in two of the three economic regions. The net output reductions, however, would be small compared to Alternative 1 levels, falling by 0.002 percent in the San Joaquin River Basin region and by 0.003 percent in the Sacramento River Basin region (Tables 4-17 and 4-18). In the Tulare Lake Basin region, the net output change would be positive, but the change would represent an increase of only 0.006 percent over the Alternative 1 output level (Table 4-19). Among the agricultural sectors, output reductions would be greatest in the FFGO sectors of the regional economies, ranging from 0.15 percent in the Tulare Lake Basin region to 2.08 percent in the San Joaquin River Basin region. Additionally, reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

Table 4-17. Alternative 3: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-16.81	-0.09	-16.90	-1.353%
Vegetable, truck crops	-1.04	0.04	-1.00	-0.163%
Orchard, vineyard crops	-1.08	0.04	-1.04	-0.054%
Agriculture and forestry support activities	-1.15	1.45	0.30	0.066%
All other sectors	-62.80	73.75	10.95	0.005%
Total	-82.88	75.19	-7.69	-0.003%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-4.61	-0.03	-4.64	-1.201%
Vegetable, truck crops	-0.57	0.02	-0.55	-0.127%
Orchard, vineyard crops	-0.57	0.02	-0.55	-0.050%
Agriculture and forestry support activities	-1.00	1.26	0.26	0.064%
All other sectors	-34.55	51.24	16.69	0.013%
Total	-41.30	52.51	11.21	0.008%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-107.5	-0.6	-108.1	-1.202%
Vegetable, truck crops	-3.4	0.1	-3.3	-0.125%
Orchard, vineyard crops	-6.7	0.3	-6.4	-0.050%
Agriculture and forestry support activities	-34.9	44.3	9.4	0.066%
All other sectors	-495.2	714.5	219.3	0.012%
Total	-647.7	758.6	110.9	0.006%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-18. Alternative 3: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-15.21	-0.16	-15.37	-2.080%
Vegetable, truck crops	-1.17	0.06	-1.11	-0.130%
Orchard, vineyard crops	-3.36	0.05	-3.31	-0.127%
Agriculture and forestry support activities	-1.65	1.23	-0.42	-0.056%
All other sectors	-55.08	70.67	15.59	0.007%
Total	-76.47	71.85	-4.62	-0.002%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-4.32	-0.05	-4.37	-2.166%
Vegetable, truck crops	-0.64	0.04	-0.60	-0.082%
Orchard, vineyard crops	-1.78	0.02	-1.76	-0.111%
Agriculture and forestry support activities	-1.41	1.04	-0.37	-0.058%
All other sectors	-29.15	51.05	21.90	0.024%
Total	-37.30	52.10	14.80	0.015%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-63.9	-0.7	-64.6	-2.167%
Vegetable, truck crops	-3.4	0.2	-3.2	-0.082%
Orchard, vineyard crops	-15.2	0.2	-15.0	-0.110%
Agriculture and forestry support activities	-59.7	44.2	-15.5	-0.057%
All other sectors	-416.1	713.4	297.3	0.026%
Total	-558.3	757.3	199.0	0.017%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-19. Alternative 3: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-2.85	0.01	-2.84	-0.153%
Vegetable, truck crops	-0.21	0.04	-0.17	-0.008%
Orchard, vineyard crops	-0.44	0.02	-0.42	-0.007%
Agriculture and forestry support activities	-0.31	0.90	0.59	0.025%
All other sectors	-21.58	32.13	10.55	0.008%
Total	-25.39	33.10	7.71	0.006%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-0.96	0.01	-0.95	-0.176%
Vegetable, truck crops	-0.11	0.02	-0.09	-0.008%
Orchard, vineyard crops	-0.23	0.01	-0.22	-0.010%
Agriculture and forestry support activities	-0.26	0.75	0.49	0.025%
All other sectors	-11.25	17.71	6.46	0.011%
Total	-12.81	18.50	5.69	0.009%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-14.7	0.1	-14.6	-0.178%
Vegetable, truck crops	-0.9	0.2	-0.7	-0.008%
Orchard, vineyard crops	-2.8	0.1	-2.7	-0.010%
Agriculture and forestry support activities	-13.0	37.8	24.8	0.025%
All other sectors	-179.3	339.7	160.4	0.018%
Total	-210.70	377.9	167.2	0.016%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

4.4.3.2 Personal Income

Similar to output changes, net personal income changes under Alternative 3 would be relatively small compared to personal income levels under Alternative 1. Contrary to net changes in industrial output, however, which were negative for the Sacramento River Basin and San Joaquin River Basin regions under Alternative 3, net personal income changes under Alternative 3 would be positive for all regions. This counterintuitive result occurs because the adverse effects of output reductions in these two regions are concentrated in the FFGO sector, which has a relatively small number of jobs and personal income per million dollars of output compared to other economic sectors that would be positively affected by Program compliance spending.

Across all sectors and regions, annual net personal income gains would range from 0.008 percent in the Sacramento River Basin region to 0.015 percent in the San Joaquin River Basin region (Tables 4-17, 4-18, and 4-19). Reductions in personal income in agricultural sectors would be greatest in the

FFGO sectors, ranging from a 0.18 percent decrease in the Tulare Lake Basin region to a 2.17 percent reduction in the San Joaquin River Basin region.

4.4.3.3 Employment

Relative to Alternative 1 employment levels, net employment changes related to reduced agricultural production and increased compliance spending under Alternative 3 would be small compared total employment in each region. Compared to Alternative 1 employment levels, employment across all sectors would increase by 199 jobs (0.02 percent) in the San Joaquin River basin (Table 4-18), 167 jobs (0.02 percent) in the Tulare Lake Basin region (Table 4-19), and 111 jobs (0.01 percent) in the Sacramento River Basin region (Table 4-17). In the agricultural sectors, employment effects would be greatest in the FFGO sectors of the regional economies, with job losses in these sectors ranging from 0.18 percent in the Tulare Lake Basin region to 2.17 percent in the San Joaquin River Basin region, compared to employment levels under Alternative 1.

4.4.4 Alternative 4 – Change Relative to Alternative 1

Compared to Alternative 1, the annual reductions in agricultural production and grower profitability under Alternative 4 would be larger than under Alternative 2 but smaller than under Alternatives 3 and 5. Similarly, the annual increase in spending on Program compliance and management practice implementation under Alternative 4 would be greater than under Alternative 2 but lower than under Alternatives 3 and 5. The annual gross value of agricultural production under Alternative 4 is estimated to fall by 1.1 percent ($14.9 million in 2007 dollars) across the three regions compared to production value under Alternative 1 (see Table 3-16, Farm Income and Production Analysis section). The annual increase in compliance and management practice implementation spending under Alternative 4, attributable primarily to increased costs for more intensive water quality monitoring and increased State Board administrative staffing costs, would be moderately higher than under Alternative 1, with acreage-adjusted costs increasing by 6.8 percent ($30.6 million). Because the increase in compliance and management practice spending would be higher than the decrease in agricultural production value and grower profitability, the overall net regional effects of Alternative 4 are anticipated to be marginally positive compared to Alternative 1 conditions for two of the three economic regions, although effects would be mixed across the three regions, and agricultural sectors would experience relatively small adverse changes. The net regional economic effects of Alternative 4 are described below.

4.4.4.1 Total Industry Output

Under Alternative 4, annual industrial output changes related to reduced agricultural production and grower profitability would outweigh output gains generated by increased Program compliance spending in two of the three economic regions. The net output reductions, however, would be small compared to Alternative 1 levels, falling by 0.002 percent in the Sacramento River Basin region and by 0.005 percent in the San Joaquin River Basin region (Tables 4-20 and 4-21). In the Tulare Lake Basin region, the net output change would be positive, but the change would represent an increase of only 0.001 percent over the Alternative 1 output level (Table 4-22). Among the agricultural sectors, output would be reduced by a relatively small amount. Effects would be concentrated in the FFGO sectors in the San Joaquin River Basin and Sacramento River Basin regions, where FFGO-sector output would fall by 0.8 percent and 0.3 percent, respectively. Output reductions for the other agricultural sectors would be even smaller, at 0.1 percent or less, compared to Alternative 1 output

levels. Reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

Table 4-20. Alternative 4: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-4.03	0.08	-3.95	-0.316%
Vegetable, truck crops	-0.28	0.01	-0.27	-0.044%
Orchard, vineyard crops	-0.30	0.01	-0.29	-0.015%
Agriculture and forestry support activities	-0.28	1.50	1.22	0.269%
All other sectors	-18.88	18.41	-0.47	-0.000%
Total	-23.77	20.01	-3.76	-0.002%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-1.11	0.02	-1.09	-0.282%
Vegetable, truck crops	-0.16	0.01	-0.15	-0.035%
Orchard, vineyard crops	-0.16	0.01	-0.15	-0.014%
Agriculture and forestry support activities	-0.24	1.30	1.06	0.260%
All other sectors	-10.49	11.63	1.14	0.001%
Total	-12.16	12.97	0.81	0.001%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-25.8	0.5	-25.3	-0.281%
Vegetable, truck crops	-1.0	0.0	-1.0	-0.038%
Orchard, vineyard crops	-1.8	0.1	-1.7	-0.013%
Agriculture and forestry support activities	-8.6	45.7	37.1	0.260%
All other sectors	-151.9	167.2	15.3	0.001%
Total	-189.1	213.5	24.4	0.001%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-21. Alternative 4: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-6.22	0.01	-6.21	-0.840%
Vegetable, truck crops	-0.51	0.02	-0.49	-0.058%
Orchard, vineyard crops	-2.72	0.01	-2.71	-0.104%
Agriculture and forestry support activities	-0.84	1.24	0.40	0.053%
All other sectors	-20.69	19.42	-1.27	-0.001%
Total	-30.98	20.70	-10.28	-0.005%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-1.77	0.002	-1.768	-0.876%
Vegetable, truck crops	-0.28	0.01	-0.27	-0.037%
Orchard, vineyard crops	-1.44	0.01	-1.43	-0.090%
Agriculture and forestry support activities	-0.72	1.05	0.33	0.052%
All other sectors	-10.97	12.23	1.26	0.001%
Total	-15.18	13.30	-1.88	-0.002%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-26.1	0.0	-26.1	-0.876%
Vegetable, truck crops	-1.5	0.1	-1.4	-0.036%
Orchard, vineyard crops	-12.4	0.1	-12.3	-0.090%
Agriculture and forestry support activities	-30.3	44.6	14.3	0.053%
All other sectors	-155.4	175.3	19.9	0.002%
Total	-225.7	220.1	-5.6	0.000%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-22. Alternative 4: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-0.95	0.01	-0.94	-0.050%
Vegetable, truck crops	-0.08	0.02	-0.06	-0.003%
Orchard, vineyard crops	-0.25	0.01	-0.24	-0.004%
Agriculture and forestry support activities	-0.12	0.90	0.78	0.033%
All other sectors	-10.17	12.47	2.30	0.002%
Total	-11.57	13.41	1.84	0.001%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-0.32	0.004	-0.316	-0.059%
Vegetable, truck crops	-0.04	0.01	-0.03	-0.003%
Orchard, vineyard crops	-0.14	0.005	-0.135	-0.006%
Agriculture and forestry support activities	-0.14	0.74	0.60	0.031%
All other sectors	-5.25	7.64	2.39	0.004%
Total	-5.89	8.40	2.51	0.004%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-4.8	0.1	-4.7	-0.057%
Vegetable, truck crops	-0.1	0.1	-0.3	-0.004%
Orchard, vineyard crops	-1.6	0.1	-1.5	-0.006%
Agriculture and forestry support activities	-5.0	37.6	32.6	0.033%
All other sectors	-85.3	124.1	38.8	0.004%
Total	-96.8	162.0	65.2	0.006%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

4.4.4.2 Personal Income

Under Alternative 4, annual net personal income changes would be positive for the Sacramento River Basin and Tulare Lake Basin regions but negative for the San Joaquin River Basin region. Net changes in all three regions, however, would be relatively minor compared to income levels under Alternative 1. In the Sacramento River Basin and Tulare Lake Basin regions, positive personal income changes generated by Program compliance spending would more than offset adverse changes caused by reduced agricultural production and grower profitability, with net income increasing by 0.004 percent in the Tulare Lake Basin region and by 0.001 percent in the Sacramento River Basin region (Tables 4-20 and 4-22). In the San Joaquin River Basin region, the net income change would be negative, with regional income falling by 0.002 percent (Table 4-21). In the agricultural production sectors of the regional economies, personal income reductions would be concentrated in the FFGO sectors of both the San Joaquin River Basin and Sacramento River Basin regions, where personal income would fall by 0.9 percent and 0.3 percent, respectively.

4.4.4.3 Employment

As with personal income effects, employment effects would vary across the three economic regions under Alternative 4, with small net employment gains in the Tulare Lake Basin and Sacramento River Basin regions and a small net employment reduction in the San Joaquin River Basin region. In the Tulare Lake Basin and Sacramento River Basin regions, the adverse employment effects of reduced agricultural production and grower profitability would be more than offset by the positive employment effects of compliance spending under Alternative 4. Net employment gains would be relatively small but would be largest in the Tulare Lake Basin region, where 65 jobs would be gained, a 0.006 percent increase over the Alternative 1 employment level (Table 4-22). In the Sacramento River Basin region, net employment would increase by 24 jobs (0.001 percent) (Table 4-20). Conversely, in the San Joaquin River Basin, net employment would fall by about six jobs, a decrease of less than 0.001 percent (Table 4-21). Among the sectors of the regional economies, small job losses would occur in the agricultural sectors, with losses concentrated in the FFGO sectors of the San Joaquin River Basin and the Sacramento River Basin regions, where 0.9 percent (26 jobs) and 0.3 percent (25 jobs) of the jobs, respectively, in these sectors would be lost relative to Alternative 1 levels.

4.4.5 Alternative 5 – Change Relative to Alternative 1

Compared to Alternative 1, the annual changes in agricultural production and grower profitability under Alternative 5 would be substantially larger than under the other Program alternatives, resulting in much larger output, personal income, and employment effects on the agricultural sectors of all three regional economies, particularly in the San Joaquin River Basin and Sacramento River Basin regions. The estimated annual gross value of agricultural production under Alternative 5 would fall by 2.1 percent ($268.7 million in 2007 dollars) across the three regions compared to production value under Alternative 1 (see Table 3-19, Farm Income and Production Analysis section). The annual increase in compliance- and management practice-implementation spending under Alternative 5 also would be substantially higher than under Alternative 1, with acreage-adjusted costs increasing by 187 percent ($841.7 million). As described below, the net result of these changes on the overall regional economies would be mixed, with the adverse effects of reduced agricultural production and grower profitability offsetting the beneficial effects of increased Program compliance spending in the Sacramento River Basin and San Joaquin River Basin regions, but with the beneficial effects of increased compliance spending outweighing the adverse effects of reduced agricultural production and grower profitability in the Tulare Lake Basin region. Adverse effects, however, would occur in the agricultural economies of all three regions.

4.4.5.1 Total Industry Output

As discussed above, net industrial output in the Sacramento River Basin and San Joaquin River Basin regions would decline under Alternative 5 compared to Alternative 1 levels because the effects of reductions in agricultural production and grower profitability would offset gains generated by Program compliance spending. In the context of regional economies, the changes would be small, with reductions of about 0.4 percent in both regions (Tables 4-23 and 4-24). In the Tulare Lake Basin region, the benefits of compliance spending would offset the adverse agricultural-related effects, with net output increasing by 0.1 percent (Table 4-25).

Percentage reductions in total output for agricultural sectors would be much larger in the San Joaquin River Basin and Sacramento River Basin regions than in the Tulare Lake Basin region, with

reductions concentrated in the FFGO sectors. Output in this sector would be reduced by about 12.0 percent in the San Joaquin River Basin region and by 8.0 percent in the Sacramento River Basin region compared to Alternative 1 output levels; in the Tulare Lake Basin region, the net output change would be about 0.8 percent (Tables 4-23, 4-24, and 4-25). Output also would fall by appreciable amounts in the other agricultural sectors, including the VEGT sector (reductions ranging from 0.2 to 1.0 percent across the three regions) and the ORVIN sector (reductions ranging from 0.2 to 0.5 percent). Reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

Table 4-23. Alternative 5: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-106.36	6.92	-99.44	-7.960%
Vegetable, truck crops	-6.56	0.18	-6.38	-1.037%
Orchard, vineyard crops	-9.14	0.21	-8.93	-0.461%
Agriculture and forestry support activities	-7.47	1.98	-5.49	-1.212%
All other sectors	-385.34	402.03	16.69	0.007%
Total	-514.87	411.32	-103.55	-0.045%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-29.21	1.90	-27.31	-7.068%
Vegetable, truck crops	-3.68	0.10	-3.58	-0.828%
Orchard, vineyard crops	-4.83	0.11	-4.72	-0.429%
Agriculture and forestry support activities	-6.49	1.72	-4.77	-1.171%
All other sectors	-215.47	238.47	23.00	0.018%
Total	-259.68	242.30	-17.38	-0.013%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-680.1	44.2	-635.9	-7.069%
Vegetable, truck crops	-22.5	0.6	-21.9	-0.829%
Orchard, vineyard crops	-56.4	1.3	-55.1	-0.430%
Agriculture and forestry support activities	-227.8	60.4	-167.4	-1.171%
All other sectors	-3,084.3	3,373.6	289.3	0.016%
Total	-4,071.1	3,480.1	-591.0	-0.032%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-24. Alternative 5: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-91.62	3.23	-88.39	-11.959%
Vegetable, truck crops	-6.70	0.19	-6.51	-0.764%
Orchard, vineyard crops	-12.46	0.16	-12.30	-0.473%
Agriculture and forestry support activities	-8.99	1.56	-7.43	-0.991%
All other sectors	-250.30	266.04	15.74	0.007%
Total	-370.07	271.18	-98.89	-0.043%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-26.04	0.92	-25.12	-12.452%
Vegetable, truck crops	-3.66	0.10	-3.56	-0.485%
Orchard, vineyard crops	-6.61	0.08	-6.53	-0.410%
Agriculture and forestry support activities	-7.63	1.33	-6.30	-0.991%
All other sectors	-132.70	156.33	23.63	0.026%
Total	-176.64	158.76	-17.88	-0.019%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-384.9	13.6	-371.3	-12.455%
Vegetable, truck crops	-19.5	0.5	-19.0	-0.485%
Orchard, vineyard crops	-56.5	0.7	-55.8	-0.409%
Agriculture and forestry support activities	-324.5	56.4	-268.1	-0.991%
All other sectors	-1,871.0	2,195.2	324.2	0.028%
Total	-2,656.4	2,266.4	-390.0	-0.032%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

Table 4-25. Alternative 5: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels

Sector	Change Related to Agricultural Impacts	Change Related to Cost Impacts	Total Net Change	Percent Change
Output[1] ($M)				
Feed, forage, grain, and other crops	-26.90	40.95	14.05	0.755%
Vegetable, truck crops	-5.21	0.67	-4.54	-0.220%
Orchard, vineyard crops	-13.52	0.51	-13.01	-0.221%
Agriculture and forestry support activities	-4.56	4.48	-0.08	-0.003%
All other sectors	-593.38	745.84	152.46	0.120%
Total	-643.57	792.45	148.88	0.107%
Personal Income[1, 2] ($M)				
Feed, forage, grain, and other crops	-9.05	13.78	4.73	0.877%
Vegetable, truck crops	-2.36	0.36	-2.00	-0.184%
Orchard, vineyard crops	-6.89	0.27	-6.62	-0.311%
Agriculture and forestry support activities	-3.78	3.70	-0.08	-0.004%
All other sectors	-308.65	422.07	113.42	0.187%
Total	-330.73	440.18	109.45	0.165%
Employment[3] (Number of jobs)				
Feed, forage, grain, and other crops	-138.0	210.1	72.1	0.877%
Vegetable, truck crops	-21.7	2.8	-18.9	-0.222%
Orchard, vineyard crops	-86.6	3.3	-83.3	-0.322%
Agriculture and forestry support activities	-191.0	187.6	-3.4	-0.003%
All other sectors	-4,990.2	6,410.7	1,420.5	0.159%
Total	-5,427.5	6,814.5	1,387.0	0.134%

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

[1] Includes direct, indirect, and induced effects in 2007 U.S. dollars ($).

[2] Personal income includes employee compensation, proprietor income, and other property income.

[3] Includes direct, indirect, and induced full- and part-time jobs.

4.4.5.2 Personal Income

Annual impacts on personal income from implementation of Alternative 5 would be similar to those for industrial output, with net income decreasing in the Sacramento River Basin and San Joaquin River Basin regions and increasing in the Tulare Lake Basin region relative to levels under Alternative 1. The net decrease in income would be largest in the San Joaquin River Basin region, where income would fall by $17.9 million, or by about 0.02 percent of the regional level under Alternative 1 (Table 4-24). The reduction in net income would be similar ($17.4 million) in the Sacramento River Basin region (Table 4-23). Net personal income would increase by an estimated $109.5 (0.17 percent) million in the Tulare Lake Basin region because of large increases in spending on management practice implementation and Water Board staffing (Table 4-25).

In the agricultural economies of the three regions, personal income impacts would be adverse, particularly in the FFGO sectors of the San Joaquin River Basin and Sacramento River Basin regions.

In this sector, personal income would be reduced by 12.5 percent in the San Joaquin River Basin and by 7.1 percent in the Sacramento River Basin regions, compared to income levels under Alternative 1 (Tables 4-23, 4-24, and 4-25). Personal income also would fall in other agricultural sectors, including the VEGT sector, with reductions ranging from 0.18 percent to 0.82 percent, and the ORVIN sector, with reductions ranging from 0.31 percent to 0.43 percent.

4.4.5.3 Employment

Under Alternative 5, employment losses resulting from reduced agricultural output and grower profitability would outweigh employment gains generated by compliance spending in two of the three economic regions, with net losses of 591 jobs (0.03 percent) in the Sacramento River Basin region and 390 jobs (0.03 percent) in the San Joaquin River Basin region (Tables 4-23 and 4-24). In the Tulare Lake Basin region, net employment would increase by 1,387 jobs (0.13 percent) largely because of a substantial increase in spending on management practice implementation and Water Board staffing (Table 4-25).

Job losses in regional agricultural economies would be larger than under the other alternatives, with losses most severe in the FFGO sectors of the Sacramento River Basin and San Joaquin River Basin regions. Employment in this sector would fall by 636 jobs (7.1 percent of the Alternative 1 employment level) in the Sacramento River Basin region, and by 371 jobs (12.5 percent) in the San Joaquin River Basin region (Tables 4-23 and 4-24). While not as severely affected, other crop-producing sectors also would experience job losses. Net employment reductions in the VEGT sector would range from19 jobs in the Tulare Lake Basin region (0.22 percent) to 22 jobs in the Sacramento River Basin region (0.83 percent). In the ORVIN sector, net employment losses would range from 55 jobs (0.43 percent) in the Sacramento River Basin region to 83 jobs (0.32 percent) in the Tulare Lake Basin region.

Under Alternative 5, net impacts on employment in the agriculture and forestry support activities sectors in the San Joaquin River Basin and Sacramento River Basin regions also would be larger than under the other alternatives. Although this sector would not be directly affected by changes in agricultural production, it would be indirectly affected as farm operators decrease their need for acquiring services from this sector, which provides soil preparation, planting, and harvesting services; post-harvest crop support (e.g., cleaning, drying, shelling, sorting, packing); farm labor through farm labor contractors; and contractual farm management services. Impacts on the agriculture and forestry support activities sector would include the net loss of 268 jobs in the San Joaquin River Basin region (1.0 percent of Alternative 1 employment levels) and 167 jobs in the Sacramento River Basin region (1.2 percent) (Tables 4-23 and 4-24). Job losses in this sector would be minor in the Tulare Lake Basin region (Table 4-25).

4.5 Summary and Conclusions

This section provides a summary of the estimated net changes in industrial output, personal income, and employment for each alternative and discusses conclusions of the regional economic assessment of the Program alternatives.

4.5.1 Summary Comparison of Alternatives 2–5 to Alternative 1

Tables 4-26 through 4-28 provide a summary comparison of analysis results for Alternatives 2 through 5, all compared to Alternative 1. These results reflect the net changes generated by changes in agricultural production and changes in compliance cost spending under each alternative.

Table 4-26. Summary of Net Changes in Industrial Output ($M) by Basin from Alternative 1

Basin	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Sacramento River	-0.78	-7.69	-3.76	-103.55
Percent Change	0.000%	-0.003%	-0.002%	-0.045%
San Joaquin River	-8.86	-4.62	-10.28	-98.89
Percent Change	-0.004%	-0.002%	-0.005%	-0.043%
Tulare Lake	0.29	7.71	1.84	148.88
Percent Change	0.000%	0.006%	0.001%	0.107%

Table 4-27. Summary of Net Changes in Personal Income ($M) by Basin from Alternative 1

Basin	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Sacramento River	-0.21	11.21	0.81	-17.38
Percent Change	0.000%	0.008%	0.001%	-0.013%
San Joaquin River	-4.00	14.80	-1.88	-17.88
Percent Change	-0.004%	0.015%	-0.002%	-0.019%
Tulare Lake	0.41	5.69	2.51	109.45
Percent Change	0.001%	0.009%	0.004%	0.165%

Table 4-28. Summary of Net Changes in Employment (Number of Jobs) by Basin from Alternative 1

Basin	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Sacramento River	-2.1	110.9	24.4	-591.0
Percent Change	0.000%	0.006%	0.001%	-0.032%
San Joaquin River	-58.7	199.0	-5.6	-390.0
Percent Change	-0.005%	0.017%	0.000%	-0.032%
Tulare Lake	7.3	167.2	65.2	1,387.0
Percent Change	0.001%	0.016%	0.006%	0.134%

4.5.2 Conclusions

The results of the regional economic analysis show mixed results across Alternatives 2–5, particularly in the Sacramento River Basin and San Joaquin River Basin regions. In the Tulare Lake Basin Region, the beneficial net regional economic effects of increased spending on compliance and management practice implementation would more than offset the negative effects caused by reduced agricultural production and decreased grower profitability under all alternatives, although

the changes would not be large in the context of the overall regional economy. In the Sacramento River Basin and San Joaquin River Basin regions, however, net regional economic effects would be generally positive under Alternatives 3 and 4 and negative under Alternatives 2 and 5, although effects in the San Joaquin River Basin region would also be negative under Alternative 4.

The largest net regional economic effects of Program implementation would occur under Alternatives 3 and 5, with effects driven primarily by substantial changes in Water Board administrative staffing costs under both alternatives and by a large change in management practice costs under Alternative 5. As shown by Tables 4-26 through 4-28, these net changes, as well as those under Alternatives 2 and 4, would be minor in the context of the overall economies of each region, with adverse output, personal income, and employment changes in the Sacramento River Basin and San Joaquin River Basin regions generally below 0.05 percent of Alternative 1 levels and beneficial effects in all regions generally below 0.20 percent of Alternative 1 levels.

As discussed in Chapter 1, Analytical Objectives, Approach and Limitations, the results of the regional economic impact analysis may be biased by certain limitations of using the IMPLAN input-output model to estimate regional economic effects. These limitations likely result in underestimating adverse regional economic effects attributable to potential effects on forward-linked industries. The extent of the underestimation of adverse agriculture-related impacts, however, is not known, but the exclusion of these effects from the analysis underestimates the net adverse effects and overestimates the net beneficial effects of the alternatives. Including these forward-linked effects would be expected to result in more adverse regional economic effects across the alternatives and regions than those summarized in Tables 4-26 through 4-28. The potential implications of including the forward-linked impacts of the alternatives on the study area's livestock sector are discussed in the following section.

4.5.3 Potential Effects from Changes in Livestock Production

Implementation of the Program alternatives would result in disproportionate effects on FFGO crops relative to the other crop categories. As discussed in Chapter 3, Farm Income and Production Analysis, the assessment of net income effects indicates substantial reductions in acreage of lands that produce hay and forage for livestock. Although forward-linked effects are not quantitatively analyzed in this regional economics assessment, effects from Program implementation likely would be largest on the livestock production and processing sectors.

Potential forward-linked effects on the value of livestock production alone are addressed in Section 3.5.2, Potential Effects on the Livestock Sector. This simplified assessment of potential effects on the livestock sector, which was conducted at the study area level, concluded that that for every dollar of lost value of forage and hay production in the study area, another 89 cents would be lost in value of livestock. Based on this estimate, the loss in forage and hay value would result in a corresponding additional loss in the value of livestock production ranging from $1.0 million under Alternative 2 to $90.6 million under Alternative 5 (Table 3-25). (Note that these losses are order-of-magnitude estimates based on the assumptions described in Section 3.5.2).

To carry this simplified assessment of livestock sector effects into the regional impact assessment, estimated changes in livestock production were input to the IMPLAN input-output model for the study area, resulting in the regional economic effects (direct, indirect, and induced) displayed in Table 4-29. These order-of-magnitude results imply that forward-linked effects on the livestock sector could reduce or fully offset the beneficial regional economic effects of Alternatives 3 and 4

and worsen the adverse regional economic effects of Alternatives 2 and 5 summarized in Tables 4-26 through 4-28.

Table 4-29. Potential Regional Economic Effects Resulting from Changes in Value of Livestock Production in the Study Area, Compared to Alternative 1

	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Change in the value of industrial output ($M)	-$2.3	-$30.4	-$10.3	-$207.1
Change in personal income ($M)	-$0.7	-$9.9	-$3.3	-$67.3
Change in employment (jobs)	-15.6	-207.8	-70.3	-1,415.6

Note: Includes the direct, indirect, and induced effects of changes in the value of livestock production, compared to Alternative 1. Effects in this table are presented for illustrative purposes. They are not estimated at the same level of detail as the irrigated crop losses but provide a sense of the relative scale of impacts by alternative.

This analysis was intended to illustrate the additional economic effects of the alternatives on a key linked industry, namely the livestock production industry. It was not intended to provide a comprehensive evaluation of forward-linked effects. First, the output of the livestock production industry is further linked to sectors such as meat processing and dairy products. This additional link was not included. Second, crops besides forage and feed also are used as inputs by other sectors within the study area, such as food processing. An assessment of effects on these other forward-linked sectors was not part of this study. Results of the farm income analysis indicated that other crops would not be as affected as those linked to the livestock sector, so the forward-linked effects would also be smaller. Nevertheless, the exclusion of these additional forward-linked effects understates the total regional economic impacts of the Program alternatives.

Chapter 5
Fiscal Effects

5.1 Introduction

This section describes the effects of the ILRP alternatives on costs to government entities responsible for administering and participating in the Program. The fiscal assessment of direct Program costs is largely based on the cost evaluation described previously in the Compliance and Best Management Practices Costs section of this report. See Section 2.4, Cost Information, for a full discussion of how costs for administering the Program were estimated. All costs presented in this chapter are in 2005 dollars.

Additionally, potential effects of the Program on local agencies that provide water supply services are discussed. Concerns regarding the effects of the Program on nitrates in Central Valley groundwater have been brought forward by residents and environmental justice groups during public scoping meetings and by long-term ILRP Advisory Workgroup members (Central Valley Water Board 2008). The major thrust of these concerns regards costs faced by Central Valley small communities to provide high quality drinking water in the face of nitrate pollution. These concerns, which may be affected to varying extents by the ILRP alternatives, have potential fiscal implications for certain small communities in the Central Valley that provide or fund local water supplies.

5.2 Existing Fiscal Conditions

Currently, all costs to administer the Program in the Central Valley are borne by the Central Valley Water Board. Over recent years, staff costs to administer the Program are estimated to total about $2.8 million annually (17.75 person years of staff time). About 82 percent of these costs are for Central Valley Water Board personnel in Sacramento, 15 percent for personnel in Fresno, and 3 percent for personnel in Redding. Funding for the program is split between the State of California and the grower/operators who are part of the Program. Annual state funding, which comes from the State General Fund, is about $1.8 million, or two-thirds of total Program costs; grower fees paid to the state provide the remaining $954,000, or one-third of Program costs.

No other state or local agencies currently incur costs for administering elements of the existing Program (Laputz pers. comm.)

5.3 Fiscal Effects of the Program Alternatives

5.3.1 Alternative 1 – Change Relative to Existing Conditions

Under Alternative 1, public costs to administer the Program are anticipated to stay the same as under existing conditions. Thus, costs to the Central Valley Water Board that would be financed by state general funds would continue at about $1.8 million per year (Table 5-1). Grower fees would continue to fund the remaining $954,000 in costs. Although other agencies (e.g., counties, the federal

NRCS) may decide to participate in certain elements of the Program (e.g., collecting fees), the Program would not mandate participation by other agencies. As a result, no costs are anticipated for other agencies.

Table 5-1. Estimated Costs to the Central Valley Regional Water Quality Control Board to Administer the Program Alternatives

Alternative	Cost Funded by the State General Fund	Cost Funded by Growers/Operators	Total Cost
Alternative 1	$1,798,530	$953,965[1]	$2,752,495
Alternative 2	$1,798,530	$1,999,945[2]	$3,798,475
Alternative 3	$1,798,530	$63,891,490[3]	$65,690,020
Alternative 4	$1,798,530	$6,956,750[4]	$8,755,280
Alternative 5	$1,798,530	$61,161,110[5]	$62,959,640

Source: Compliance and management practice cost assessment conducted for this study. Costs are shown in 2005 dollars.

Notes:

[1] Includes grower fees shown in Table 2-17.

[2] Includes grower fees and additional Central Valley Water Board costs for groundwater management and program analysis and reporting shown in Table 2-18.

[3] Includes grower fees, local administration costs, Water Board certification of practices costs, and other Central Valley Water Board administrative staff costs shown in Table 2-19.

[4] Includes grower fees, tier analysis and administration costs, inspection costs, and other Central Valley Water Board administrative staff costs shown in Table 2-20.

[5] Includes grower fees, local administration costs, tier analysis and administration costs, inspection costs, and other Central Valley Water Board administrative staff costs shown in Table 2-21.

5.3.2 Alternative 2 – Change Relative to Alternative 1

Under Alternative 2, total costs to the Central Valley Water Board are estimated at $3.8 million, an increase of about $1.0 million over Alternative 1 costs (Table 5-1). It is anticipated that state funding of the program would remain unchanged in the future under the Program alternatives. As a result, costs funded by the State General Fund would remain unchanged from Alternative 1, at about $1.8 million per year. Costs to be funded by private grower/operator fees, however, would grow to about $2.0 million per year, an increase of about $1.0 million over Alternative 1 funding. As a result of private growers/operators absorbing the additional administrative costs, Alternative 2 would result in no fiscal impact on state fiscal conditions. Additionally, as with Alternative 1, no other agencies are mandated to participate in administering elements of the Program under Alternative 2; therefore, no costs are anticipated for other state or local agencies.

5.3.3 Alternative 3 – Change Relative to Alternative 1

Annual costs to the Central Valley Water Board to administer the Program are estimated to grow substantially under Alternative 3, to about $65.7 million, representing an annual increase of $62.9 million over Alternative 1 costs (Table 5-1). Much of this increase would result from the Central Valley Water Board needing to hire additional staff to administer the Program activities under Alternative 3 (Table 2-19). As discussed previously, costs funded by the state are anticipated to remain unchanged from existing funding levels ($1.8 million). As a result, the additional $62.9

million in annual costs would be funded by fees paid by growers/operators. Because private growers/operators would absorb the additional administrative costs, Alternative 3 would result in no fiscal impact on state fiscal conditions. Additionally, no other agencies are mandated to participate in administering elements of the Program under Alternative 3; therefore, no costs are anticipated for other state or local agencies.

5.3.4 Alternative 4 – Change Relative to Alternative 1

Under Alternative 4, annual costs to the Central Valley Water Board to administer the Program are estimated to grow to about $8.8 million, an annual increase of about $6.0 million over Alternative 1 costs (Table 5-1). As discussed previously, costs funded by the state are anticipated to remain unchanged from existing Program funding levels ($1.8 million). As a result, the additional $6.0 million in annual costs would be funded by fees paid by growers/operators. Because private growers/operators would absorb the additional administrative costs, Alternative 4 would result in no fiscal impact on state fiscal conditions. Additionally, no other agencies are mandated to participate in administering elements of the Program under Alternative 4; therefore, no costs are anticipated for other state or local agencies.

5.3.5 Alternative 5 – Change Relative to Alternative 1

Similar to Alternative 3, costs to the Central Valley Water Board to administer the Program are anticipated to increase substantially under Alternative 5, with costs rising to an estimated $63.0 million per year, an annual increase of about $60.2 million over Alternative 1 costs (Table 5-1). Much of this increase would result from the Central Valley Water Board needing to hire additional staff to administer the Program activities under Alternative 5 (Table 2-21). As discussed previously, costs funded by the state are anticipated to remain unchanged from existing Program funding levels ($1.8 million). As a result, the additional $60.2 million in annual costs would be funded by fees paid by growers/operators. Because private growers/operators would absorb the additional administrative costs, Alternative 5 would result in no fiscal impact on state fiscal conditions. Additionally, no other agencies are mandated to participate in administering elements of the Program under Alternative 5; therefore, no costs are anticipated for other state or local agencies.

5.4 Potential Effects of the ILRP on Nitrate-Related Water-Quality Costs of Small Communities

High nitrate levels in public drinking water wells are an important concern for some small communities in the Central Valley, especially to those communities that provide water to residents from a single source such as a domestic drinking water well. (As defined by the California Department of Public Health (DPH), small community water systems include those serving a population of 12,600 persons or less, or that have 4,500 or fewer water connections and individual public schools.) In response to high nitrate levels, some Central Valley communities have drilled new or deeper wells, consolidated supplies with other communities, or installed nitrate treatment systems. All of these responses incur costs for small communities. (Larger community systems can blend water from multiple sources to meet water quality standards.)

One of the goals of the long-term ILRP is to "ensure that irrigated agricultural discharges do not impair Central Valley communities and residents access to safe and reliable drinking water."

Because the program could affect nitrate levels in groundwater supplies, this assessment examines cost information related to approaches to address nitrate problems for potentially affected small communities in the Central Valley that provide water service.

Irrigated agricultural operations apply fertilizers containing nitrogen. Leaching of nitrate from fertilizer application is one of many potential sources of nitrate waste discharge to groundwater supplies in the Central Valley. Using information obtained from long-term ILRP Advisory Workgroup members (environmental justice groups; Balazs [2008]; and DPH [2009 third quarter nitrate exceedance report]), it is estimated that agriculture is a potential contaminating activity (PCA) for 45 small communities with systems that have high nitrate levels (Laputz pers. comm.). Of these communities, 19 of them are currently eligible for Proposition 84 and/or Proposition 50 grants and loans (Table 5-2).

Table 5-2. Small Community Systems with High Nitrate Levels with Agricultural PCA

Systems with DPH source water assessment with agriculture identified as PCA	45
Systems with DPH source water assessment with agriculture identified as PCA and receiving Proposition 84 or 50 funding	19

Source: Laputz pers. comm.
Notes:
PCA = potential contaminating activity.
DPH = California Department of Public Health.

Once a nitrate maximum contaminant level (MCL) is exceeded, responding to the problem can be complicated and expensive for communities. Based on a review of the most recent list of projects being considered for funding under Proposition 84 and past Proposition 50 funding, small communities have proposed one or more of the following responses: drill new wells, consolidate water supplies, remove nitrates in existing water supplies, or conduct feasibility projects (DPH 2009).

One approach to addressing high nitrate levels is well replacement. Costs associated with well replacement include consideration of the geology of the water supply area, well design and depth, well drilling, well development and pumping rate, and wellhead protection (Harter 2003). General cost estimates for replacing a well are identified in Table 5-3, and estimates of ongoing costs to maintain a well and treat a domestic drinking water supply over time are identified in Table 5-4.

Table 5-3. Well Replacement Costs

Well Size (gallons/minute)	General Cost Assumptions
10 to 30 gpm	$25,000 to $50,000 ($37, 500 average)
30 to 100 gpm	$100,000
1000 gpm to 2000 gpm	Can be as high as $1,000,000

Sources: well size—Simmons 2010; general cost assumptions—Newkirk and Darby 2008.
Note: Actual costs should be verified by local drilling company.

Table 5-4. Operation and Maintenance Costs for Wells (Groundwater Source)

Items	Cost Ranges (Newkirk and Darby 2008)
Labor per person	$30,000 to $60,000 per year
Power for <100 gpm size	$3,000 to $5,000 (average $4,000)
Administration/fees	$2,000 per year
Analytical Costs - Groundwater	$2,000 per year with no treatment or compliance issues
Maintenance - Groundwater	$1,000 per year if done by operator
Sources: Simmons 2010; Newkirk and Darby 2008.	

Based on the information in Tables 5-3 and 5-4, estimated costs for well replacement and for 1 year of associated operation and maintenance range between $76,500 and $1.085 million. This cost range compares with average costs of $60,000 to $2.0 million estimated for 204 well replacement projects concerning small community infrastructure improvements for chemical and nitrate contaminates from Proposition 84. Projects identified by Proposition 50 (20 projects) specifically identified for nitrate exceedances ranged from $324,000 to $2,000,000. As suggested by these estimates, the actual costs of funded projects addressing nitrate contamination are generally consistent with the well replacement estimates.

Costs for other types of responses (besides well replacement) to nitrate problems appear to be higher (University of Minnesota 2006). Nitrate treatment projects listed for Proposition 84 funding identify costs ranging from $75,000 to $3.0 million. In the University of Minnesota assessment, well replacement was the preferred method for estimating costs to address nitrate problems. Determining costs for other methods requires the collection and evaluation of substantial area-specific information (e.g., consolidation may be a cost-effective solution where other supplies are nearby, and treatment may be cost-effective provided that communities can maintain the system).

For the 19 communities with nitrate exceedances and agriculture listed as a PCA and that are receiving Proposition 84/50 funding, total project funding is estimated at $18.5 million. For the 26 communities that are not currently receiving funding, costs are estimated at $2.0 to $29.0 million based on the range given in Tables 5-3 and 5-4 for well replacement projects ($76,500–$1.085 million). Considered together, total costs for all 45 communities are estimated to range from $20.5 to $47.5 million. Although the extent to which the Program would affect (reduce) nitrate contamination levels is unknown, the Program likely would have some benefit in terms of reducing the costs to these communities for addressing high nitrate levels in their drinking water supplies.

It is important to note that fertilizer use by agricultural operations is only one of several potential sources of nitrate in groundwater. For this assessment, only systems that DPH considers vulnerable to agricultural operations were considered. Information is not available, however, to characterize whether current agricultural operations are contributing nitrate to these community water systems (e.g., past operations could have caused contamination), and if so to what extent agricultural operations may be responsible. The primary intent of providing this assessment is to demonstrate the Central Valley Water Board's awareness of nitrate-related problems to small Central Valley communities, and to provide background information for considering potential benefits of the Program that are difficult to quantify.

Chapter 6
References Cited

Balazs, C. 2009. *Just Water? Social disparities in nitrate contaminated drinking water in California's Central Valley*. Doctoral Dissertation, University of California. Berkeley, CA.

CALFED Bay-Delta Program. 2000. *Final Programmatic EIR/EIS*. CALFED Bay-Delta Program. Sacramento, CA.

California Certified Organic. 2010. Welcome to CCOF Certification. Available: <http://www.ccof.org/certification.php>. Accessed: April 2010.

California County Agricultural Commissioners. 2000–2004. Annual Crop Reports. Counties of Butte, Colusa, Contra Costa, Fresno, Glenn, Kern, Kings, Madera, Merced, Sacramento, San Benito, San Joaquin, Santa Clara, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Yolo.

California Department of Pesticide Regulation. 2010. Ground Water Protection Program. Available: <http://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm>. Accessed: April 2010.

California Department of Public Health (DPH). 2009. Proposition 84 Section 75022—Second round project priority list small community infrastructure improvements for chemical and nitrate contaminants. January. Available: <http://www.cdph.ca.gov/services/funding/Documents/Prop84/Prop84%20Section75022-Chem-PPL-01-30-09.pdf>.

California Department of Water Resources. 2005. California Water Plan Update 2005. Bulletin 160-05. Sacramento, CA.

California Department of Water Resources. 2001. Land & Water Use Data Collections. 2001 Statewide irrigation methods survey. Available: <http://www.water.ca.gov/landwateruse/lwudatacoll.cfm>. Accessed: April 2010.

Central Valley Regional Water Quality Control Board. 2008. Irrigated Lands Regulatory Program public workshop comments response summary. September 29, 2008. Sacramento, CA.

Central Valley Regional Water Quality Control Board. 2009. *The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region*. Fourth Edition. Revised September 2009 (with Approved Amendments). The Sacramento River Basin and the San Joaquin River Basin. California Regional Water Quality Control Board Central Valley Region. Sacramento, CA. Available: <http://www.swrcb.ca.gov/rwqcb5/water_issues/basin_plans/>. Accessed: July 2010.

Department of Natural Resources and Environment, Michigan. 2010. 50 State SWP Survey. Available: <http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695-201296--,00.html>. Accessed: April 2010.

Footprint. 2010. Creating tools for pesticide risk assessment and management in Europe. Available: <http://sitem.herts.ac.uk/aeru/footprint/en/index.htm>. Accessed: April 2010.

Harter, T. Water Well Design and Construction, 2003, PUBLICATION 8086 University of California, Division of Agriculture and Natural Resources. Available: <http://groundwater.ucdavis.edu/Publications/Harter_FWQFS_8086.pdf>.

Lewis, J. 2010. Abandoned well survey program, Sacramento County. Environmental Compliance Division Abandoned Wells Program. Environmental Management Department. Mather, CA.

Lubell, M. and A. Fulton. 2007. Local diffusion networks act as pathways to sustainable agriculture in the Sacramento River Valley. Available: <http://CaliforniaAgriculture.ucop.edu>. Accessed: April 2010.

Moss Landing Marine Laboratory, 2010. SWAMP monitoring cost and protocol information. Available: <http://swamp.mpsl.mlml.calstate.edu/>. Accessed: April 2010.

Natural Resources Conservation Service, 2005. Environmental quality incentive program, water quality practices. Available: <http://www.nrcs.usda.gov/programs/eqip/>. Accessed: April 2010.

Natural Resources Conservation Service, 2010. Electronic field services technical guides. Available: <http://www.nrcs.usda.gov/technical/efotg/>. Accessed: April 2010.

Newkirk, D. and J. Darby. 2008. Evaluation and Design of Small Water Systems Cost Estimating and SWS Grants/Funding. University of California Davis Press. Davis, CA.

PAN. 2010. Pesticides database – chemicals. Available: <http://www.pesticideinfo.org/Search_Chemicals.jsp>. Accessed: April 2010.

Tourte, L., and M. Buchanan. 2003a. Estimated costs and potential benefits for and annually planted cover crop. UC Cooperative Extension. Available: <http://groups.ucanr.org/signup/Fact%5FSheets/>. Accessed: April 2010.

Tourte, L., and M. Buchanan. 2003b. Estimated costs and potential benefits for a annually planted grassed filter strip. UC Cooperative Extension, Available: <http://groups.ucanr.org/signup/Fact%5FSheets/>. Accessed: April 2010.

Tourte, L. and M. Buchanan. 2003c. Estimated costs and potential benefits for a perennial hedgerow planting. UC Cooperative Extension, Available: <http://groups.ucanr.org/signup/Fact%5FSheets/>. Accessed: April 2010.

Troiano, J., F. Spurlock and J. Marade. 1999. Update of the California Vulnerability Soil Analysis for the Movement of Pesticides to Groundwater: October 14, 1999. State of California Environmental Protection Agency Department of Pesticide Regulation Environmental Monitoring and Assessment Program Environmental Hazards Assessment Program, Available: <http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh0005.pdf>. Accessed: July 2010.

U.S. Army Corps of Engineers (USACE). 2006. Hamilton army airfield wetland restoration feasibility study, Novato, Marin County California. San Francisco District. San Francisco, CA. Available: <http://www.spn.usace.army.mil/hamilton/summary.pdf>. Accessed: July 2010.

U.S. Department of the Interior, Bureau of Reclamation and U.S. Fish and Wildlife Service. 1999. Central Valley Project Improvement Act Programmatic Environmental Impact Statement and Technical Appendices. Mid-Pacific Region. Sacramento, CA.

U.S. Department of the Interior, Bureau of Reclamation. 2008. Upper San Joaquin River Basin Storage Investigation. Plan Formulation Report. Mid-Pacific Region. Sacramento, CA.

University of California, Cooperative Extension Service. 2000–2004. Department of Agricultural and Resource Economics. Cost of Production Studies. Various Crops and Dates. Davis, California. Available: <http://coststudies.ucdavis.edu>. Accessed: April 2010.

University of Minnesota. 2006. Drinking Water Protection Series, Nitrate Contamination—What is the Cost? May. Minnesota Department of Agriculture. St. Paul, MN. Available: <http://www.mda.state.mn.us/en/protecting/waterprotection/drinkingwater.aspx>. Accessed: July 2010.

6.1 Personal Communications

Blackman, K. Orchard crop agronomic crop consultant. Dellavalle Laboratories, Fresno, CA. 2010— Personal communication.

Challendar, B. Water quality, Natural Resources Conservation Service. Davis, CA. 2010— Personal communication.

Chilcotte, J. Senior Environmental Scientist. Surface Water Ambient Monitoring Program, Central Valley Water Board. Sacramento, CA. 2010— Personal communication.

Cone, D. Deputy General Manager. Regional groundwater monitoring, Kings River Coalition District., Fresno, CA. January 4, 2010—email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.

Dickey, J. Principal Soil Scientist and Agronomist. CVSALT model preparation costs. Newfields, LLC, Sacramento CA., 2010— Personal communication.

Fry, B. Nutrient management and farm management planning, Natural Resources Conservation Service. Davis, CA. Date, 2010— Personal communication.

Huggins, D. Water Resource Control Engineer. Surface Water Ambient Monitoring Program, Central Valley Water Board. Davis, CA. 2010— Personal communication.

Kasapligil, D. Vineyard and vegetable crop agronomic crop consultant. Davis, CA. 2010— Personal communication.

Kreggen, A. Regional groundwater monitoring, California Department of Water Resources. Sacramento, CA. 2010— Personal communication.

Laputz, Adam. Engineer. Central Valley Water Board, Sacramento, CA. Transmitting small-community nitrate cost analysis. April 29, 2010—email communication to Megan Smith, ICF International, Sacramento, CA.

Marcus, Barry. 2010. Abandoned wells Sacramento County. Sacramento County Environmental Management Dept., Environmental Compliance Division, Sacramento CA.

Phillips, S. Hydrologist & Groundwater Specialist. Cost estimate for regional groundwater monitoring, U.S. Geological Service, Sacramento, CA. March 1, 2010— email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.

Simmons, H. Provost & Pritchard Consulting. Telephone communication with Central Valley Water Board staff. March 10, 2010.

Quagliaroli, L. Senior Environmental Scientist, Pesticide Programs Division. Annual DPR well network program costs. Department of Pesticide Regulation, Sacramento, CA. February 18, 2010— email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.

Rathburn, H. Row crop agronomic crop consultant, Dellavalle Laboratories. Hanford, CA. 2010— Personal communication.

Reid, C. Policy/Program Director, California Certified Organic Farmers (CCOF) 2010— Communication regarding organic certification, Available: <http://www.ccof.org>. Sacramento, CA.

Schroeter, A. Farm planning and grower education, Central Coast Regional Water Quality Control Board. San Luis Obispo, CA. February 11, 2010— email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.

Troiano, J. Supervising Pesticide Use Specialist. Department of Pesticide Regulation, Abandoned wells. Sacramento, CA February 17, 2010—email communication to Mark Roberson, Sacramento, CA.

Appendix A
Variables Affecting Cost Analysis

This appendix reviews variables used in the analysis that, if changed, would affect the compliance and management costs estimates, and in turn would affect the farm income and production analysis, regional economic impacts, and fiscal effects.

A.1 Land Use Information

The land use coverage for this analysis was based on California Department of Water Resources (DWR) land use survey results for the years 1999–2004. Updating this information to current day likely would show a reduction in low value–crop acreage and conversely an increase in higher value–crop acreage. Because there are more high-value acres in production, there would be less of an economic impact.

A.2 Implemented Management Practices Baseline

Analogous to the land use information issue is the lack of information on the status of implemented management practices. A data set that provides this type of information would improve the accuracy of the analysis. Obviously if data show that there are more practices implemented than what have been accounted for in this analysis, the management practice costs would be reduced. The converse is true.

A.3 Farming Units and Operations

From a land use perspective, agricultural operations of a single operator may be a contiguous operation that includes multiple fields, or an operator may have several fields spread out over multiple locations. If an operation is consolidated, the number of management practices could be reduced. The analysis as presented did not account such a configuration; it was conducted on a per-acre basis.

A.4 Management Practice Cost Allocation and Net Benefit

Typically management practice costs used in this analysis originated from other agronomic objectives. For example, a grower may implement water management practices for conservation or cost reduction purposes, or nutrient management may be used to reduce the cost of an input. As another example, pressurized irrigation may be installed for multiple reasons, including labor savings, water scarcity, or because the grower needs to manipulate soil water content for yield purposes. Other benefits of management practice implementation, such as water and fertilizer savings, were considered in the economic analysis, although there may be additional benefits that

were not included. If additional benefits were considered, management practice costs likely would be reduced.

A.5 Management Practice Implementation

This analysis was prepared to provide a sample of the sensitivity of the costs associated with implementing tailwater recovery systems on pasture lands. Tailwater recovery systems are designed to capture runoff and prevent it from entering downstream water bodies. Tailwater recovery systems are required when high- or very high–priority pesticides (Table 2-5) have been identified as constituents of concern (COC). Table A-1 gives the management practice costs for pasture with and without tailwater recovery systems. Overall, there is a 61% percent reduction in management practice costs when the tailwater recovery systems are removed.

Table A-1. Total Management Practice Costs (2007$) for Pasture Lands with and without the Implementation of Tailwater Recovery Systems

Watershed	Analysis with Tailwater Recovery Systems	Analysis without Tailwater Recovery Systems
Ahwahnee	2,196	2,196
American River	2,162,052	837,404
Butte-Sutter-Yuba	3,548,104	1,374,249
Coast Range	0	0
Colusa Basin	5,065,174	1,975,453
Cosumnes River	51,807	51,807
Delta-Carbona	8,212,285	3,143,676
Delta-Mendota Canal	11,292,128	4,365,874
Grapevine	8,050	8,050
Kaweah	39	39
Kern River	10,034	10,034
Kings	86	86
Lake-Napa	540,505	209,204
Mariposa	0	0
Merced	8,425	8,425
North Valley Floor	5,155,611	1,993,313
Pit River	518,551	518,551
San Joaquin River	0	0
San Joaquin Valley Floor	26,627,914	10,306,397
Shasta-Tehama	5,807,443	2,247,784
Solano-Yolo	10,876,944	4,209,946
South Valley Floor	6,840,286	2,644,659
Southern Sierra	3,102	3,102
Stanislaus	1,398	1,398
Sunflower Valley	1,559	1,559
Tremblor	0	0

Watershed	Analysis with Tailwater Recovery Systems	Analysis without Tailwater Recovery Systems
Tuolumne	2,516	2,516
Upper Feather–Upper Yuba	307,198	118,902
Upper Mokelumne	0	0
Total	**87,043,403**	**34,034,620**

This analysis shows that if a particular land use type does not use high- or very high–priority pesticides, there is the potential for a significant reduction in management practice costs. For example, if no high- or very high–priority pesticides were used on cherries, those acres would not be required to implement pressurized irrigation in watersheds where there are high- or very high–priority COC.