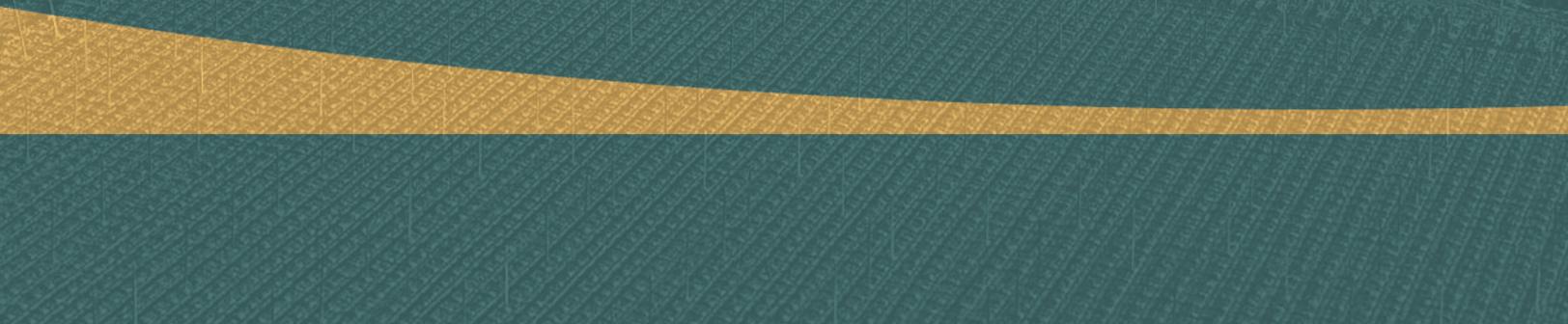


# Attachment 8H

## Regional Economic Analysis for the State Systemwide Investment Approach





# CENTRAL VALLEY FLOOD MANAGEMENT PLANNING PROGRAM

---



## 2012 Central Valley Flood Protection Plan

---

# Attachment 8H: Regional Economic Analysis for the State Systemwide Investment Approach

June 2012

*This page left blank intentionally.*

# Table of Contents

- 1.0 Introduction..... 1-1
  - 1.1 Purpose of this Attachment ..... 1-1
  - 1.2 Background ..... 1-1
  - 1.3 CVFPP Planning Areas ..... 1-2
  - 1.4 2012 CVFPP Planning Goals ..... 1-4
  - 1.5 2012 CVFPP Planning Approaches ..... 1-4
  - 1.6 Report Organization ..... 1-5
  
- 2.0 Result Summary and Findings ..... 2-1
  - 2.1 Employment Effects of State Systemwide Investment Approach ..... 2-1
    - 2.1.1 Project Construction ..... 2-2
    - 2.1.2 Avoided Business Losses ..... 2-2
  - 2.2 Industry Output Effects of State Systemwide Investment Approach ..... 2-3
    - 2.2.1 Project Construction ..... 2-4
    - 2.2.2 Avoided Business Losses ..... 2-4
  
- 3.0 Methodology ..... 3-1
  - 3.1 Economic Impact Analysis with Input-Output Modeling ..... 3-1
    - 3.1.1 Concept ..... 3-1
    - 3.1.2 I-O Modeling Limitations ..... 3-3
    - 3.1.3 I-O Model Selection for 2012 CVFPP ..... 3-3
    - 3.1.4 IMPLAN ..... 3-4
  - 3.2 Regional Economic Analysis for the 2012 CVFPP ..... 3-5
  - 3.3 Economic Effects of Project Construction..... 3-9
    - 3.3.1 Out-of-Region Investment..... 3-9
    - 3.3.2 Direct Impacts..... 3-10
    - 3.3.3 Indirect and Induced Impacts..... 3-12
  - 3.4 Economic Effects of Flood Damage Reduction ..... 3-13
    - 3.4.1 Avoided Structure and Content Damages ..... 3-13
    - 3.4.2 Avoided Agricultural Production and Commodity Damages ..... 3-15
    - 3.4.3 Avoided Loss of Business Production..... 3-15

3.5	Other Potential Regional Economic Impact Effects .....	3-17
4.0	Results and Discussion .....	4-1
4.1	Economic Effects of Project Construction.....	4-1
4.1.1	SSIA Construction Cost Estimates .....	4-1
4.1.2	Employment and Industry Output Effects .....	4-2
4.2	Economic Effects of Avoided Business Interruption .....	4-6
4.2.1	Annual Expected Avoided Business Loss.....	4-6
4.2.2	Employment and Industry Output Effects .....	4-7
4.3	Assumptions and Limitations.....	4-10
4.3.1	Employment Effects.....	4-10
4.3.2	Project Construction .....	4-11
4.3.3	Avoided Business Losses.....	4-11
4.3.4	Other Economic Effects Not Analyzed.....	4-12
5.0	Other Regional Economic Impact Effects.....	5-1
5.1	Property Value Impacts .....	5-1
5.2	Fiscal Impacts on Municipalities .....	5-1
5.3	Regional Economic Competitiveness and Diversity .....	5-2
6.0	References .....	6-1
7.0	Acronyms and Abbreviations.....	7-1

## List of Tables

Table 2-1.	Summary of Annual SSIA Project Construction (20-Year Period) Employment Effects (Jobs per Year) – Low and High Construction Expenditure Estimates.....	2-2
Table 2-2.	Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Employment Effects (Jobs per Year) .....	2-3
Table 2-3.	Summary of Annual SSIA Project Construction (20-Year Period) Industry Output Effects (2011 Dollars, Million per Year) – Low and High Construction Expenditure Estimates .....	2-4

Table 2-4. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Industry Output Effects (2011 Dollars, Million per Year) ..... 2-5

Table 3-1. Regional Economic Analysis Regions, Counties, and Impact Areas ..... 3-6

Table 3-2. Proportions of Avoided Business Loss for Aggregated IMPLAN Economic Sectors ..... 3-16

Table 4-1. SSIA Project Construction Expenditure (2011 Dollar, Millions) and Annual (20-Year Period) IMPLAN Inputs – Low and High Construction Expenditure Estimates..... 4-2

Table 4-2. Summary of Annual SSIA Project Construction (20-Year Period) Employment and Industry Output (2011 Dollars, Million per Year) Effects – Low and High Construction Expenditure Estimates..... 4-4

Table 4-3. Summary of Annual SSIA Project Construction Industry Output Total Effect as Percentage of Total Regional Output<sup>3</sup> – Low and High Construction Expenditure Estimates (2011 Dollars, Million per Year) ..... 4-6

Table 4-4. SSIA Expected Annual (Long-Term Average) Avoided Business Losses (2011 Dollars, Million per Year) by Regional Economic Impact Analysis Regions..... 4-7

Table 4-5. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Employment and Industry Output Effects (2011 Dollars, Million per Year) ..... 4-8

Table 4-6. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Industry Output Total Effect as Percentage of Total Regional Output (2011 Dollars, Million per Year) ..... 4-10

## List of Figures

Figure 1-1. Central Valley Flood Protection Plan Planning Areas..... 1-3

**2012 Central Valley Flood Protection Plan  
Attachment 8H: Regional Economic Analysis**

Figure 1-2. Formulation Process for State Systemwide Investment Approach ..... 1-5

Figure 3-1. Components of Industry Output..... 3-3

Figure 3-2. Regional Economic Impact Analysis Regions ..... 3-7

Figure 3-3. Economic Analysis Diagram..... 3-8

Figure 4-1. Annual Employment Effects of SSIA Project Construction Expenditure – High Estimate (20-Year Period)..... 4-5

Figure 4-2. Annual Industry Output (2011 Dollars, Million per Year) Effects of SSIA Project Construction Expenditure – High Estimate (20-Year Period) ..... 4-5

Figure 4-3. Expected Annual (Long-Term Average) Employment Effects of SSIA Avoided Business Losses ..... 4-9

Figure 4-4. Expected Annual (Long-Term Average) Industry Output (2011 Dollars, Million per Year) Effects of SSIA Avoided Business Losses ..... 4-9

# 1.0 Introduction

This section states the purpose of this attachment, gives background information (including a description of planning areas, goals, and approaches), and provides an overview of the report organization.

## 1.1 Purpose of this Attachment

This attachment documents findings of a regional economic analysis evaluating the State Systemwide Investment Approach (SSIA) presented in the 2012 Central Valley Flood Protection Plan (CVFPP) compared to No Project (described in Attachment 7: Plan Formulation).

## 1.2 Background

As authorized by Senate Bill 5, also known as the Central Valley Flood Protection Act of 2008, the California Department of Water Resources (DWR) has prepared a sustainable, integrated flood management plan called the CVFPP, for adoption by the Central Valley Flood Protection Board (Board). The 2012 CVFPP provides a systemwide approach to protecting lands currently protected from flooding by existing facilities of the State Plan of Flood Control (SPFC), and will be updated every 5 years.

As part of development of the CVFPP, a series of technical analyses were conducted to evaluate hydrologic, hydraulic, geotechnical, economic, ecosystem, and related conditions within the flood management system and to support formulation of system improvements. These analyses were conducted in the Sacramento River Basin, San Joaquin River Basin, and Sacramento-San Joaquin Delta (Delta).

### 1.3 CVFPP Planning Areas

For planning and analysis purposes, and consistent with legislative direction, two geographical planning areas were important for CVFPP development (Figure 1-1):

- **SPFC Planning Area** – This area is defined by the lands currently receiving flood protection from facilities of the SPFC (see *State Plan of Flood Control Descriptive Document* (DWR, 2010)). The State of California’s (State) flood management responsibility is limited to this area.
- **Systemwide Planning Area** – This area includes the lands that are subject to flooding under the current facilities and operation of the Sacramento-San Joaquin River Flood Management System (California Water Code Section 9611). The SPFC Planning Area is completely contained within the Systemwide Planning Area which includes the Sacramento River Basin, San Joaquin River Basin, and Delta regions.

Planning and development for the CVFPP occurs differently in these planning areas. The CVFPP focused on SPFC facilities; therefore, evaluations and analyses were conducted at a greater level of detail within the SPFC Planning Area than in the Systemwide Planning Area.

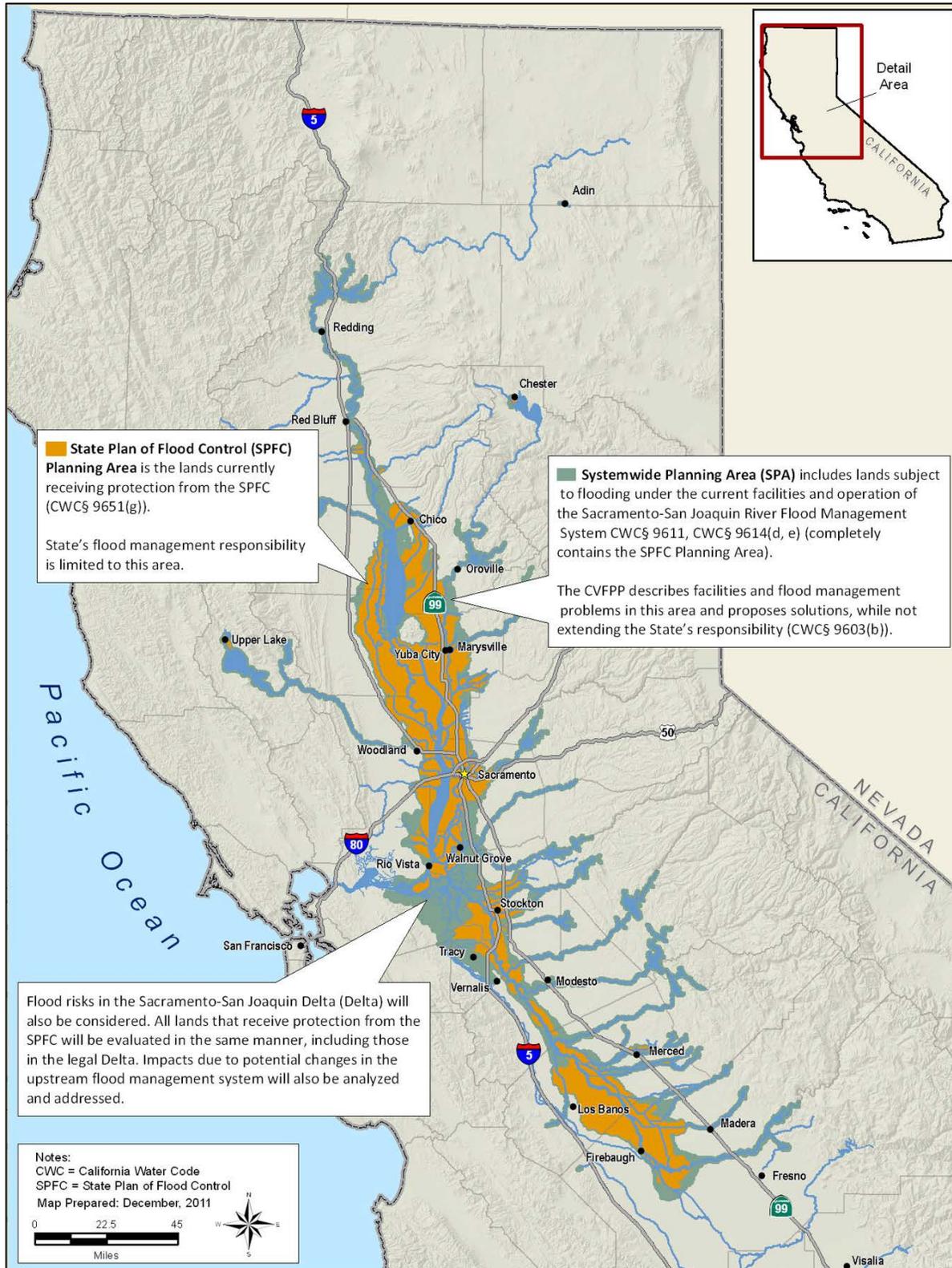


Figure 1-1. Central Valley Flood Protection Plan Planning Areas

## 1.4 2012 CVFPP Planning Goals

To help direct CVFPP development to meet legislative requirements and address identified flood-management-related problems and opportunities, a primary and four supporting goals were developed:

- **Primary Goal** – Improve Flood Risk Management
- **Supporting Goals:**
  - Improve Operations and Maintenance
  - Promote Ecosystem Functions
  - Improve Institutional Support
  - Promote Multi-Benefit Projects

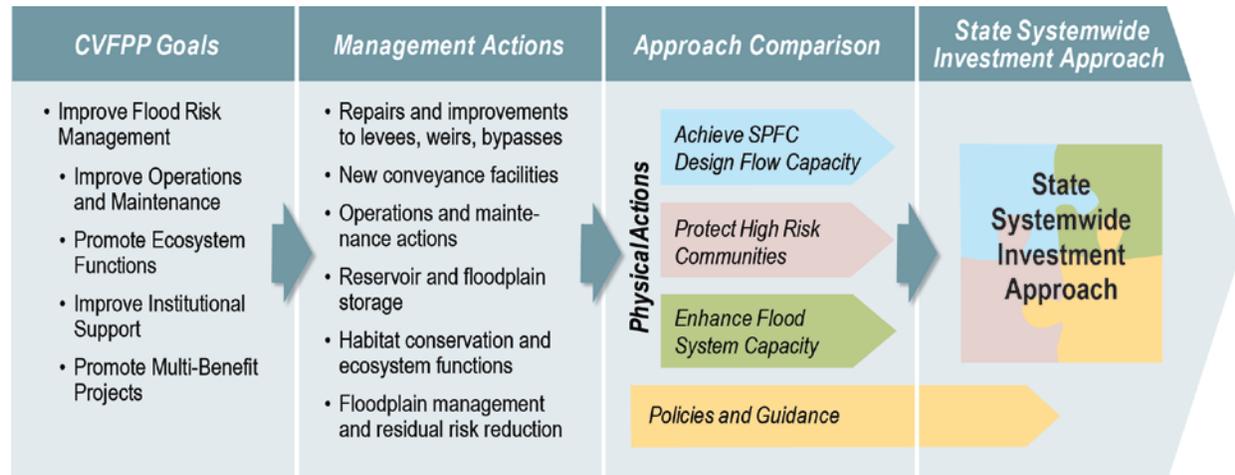
## 1.5 2012 CVFPP Planning Approaches

In addition to **No Project**, three fundamentally different approaches to flood management were initially compared to explore potential improvements in the Central Valley. These approaches are not alternatives; rather, they bracket a range of potential actions and help explore trade-offs in costs, benefits, and other factors important in decision making. The approaches are as follows:

- **Achieve SPFC Design Flow Capacity** – Address capacity inadequacies and other adverse conditions associated with existing SPFC facilities, without making major changes to the footprint or operation of those facilities.
- **Protect High Risk Communities** – Focus on protecting life safety for populations at highest risk, including urban areas and small communities.
- **Enhance Flood System Capacity** – Seek various opportunities to achieve multiple benefits through enhancing flood system storage and conveyance capacity.

Comparing these approaches helped identify the advantages and disadvantages of different combinations of management actions, and demonstrated opportunities to address the CVFPP goals to different degrees.

Based on this evaluation, a **State Systemwide Investment Approach** was developed that encompasses aspects of each of the approaches to balance achievement of the goals from a systemwide perspective, and includes integrated conservation elements. Figure 1-2 illustrates this plan formulation process.



**Figure 1-2. Formulation Process for State Systemwide Investment Approach**

## 1.6 Report Organization

Organization of this document is as follows:

- Section 1 introduces and describes the purpose of this report.
- Section 2 summarizes results and findings for the regional economic impact analysis.
- Section 3 describes the methodology used in this analysis.
- Section 4 provides complete results for the regional economic impact analysis.
- Section 5 contains references for the sources cited in this document.
- Section 6 lists abbreviations and acronyms used in this document.

*This page left blank intentionally.*

## 2.0 Result Summary and Findings

A summary of the findings of the regional economic impact analysis for the SSIA is presented and described below. The regional economic analysis assesses potential employment and industry output effects associated with implementation of the SSIA. Assumptions and limitations and complete results for the of the regional economic impact analysis are presented in Section 4. The SSIA will affect the regional economy in two primary ways:

1. Implementation of the SSIA will improve flood management, resulting in reduced flood damages and business losses. Avoided business losses will result in direct, indirect, and induced employment and industry output effects.
2. Construction expenditures to improve flood protection facilities in the Sacramento and San Joaquin river basins will stimulate regional economies resulting in direct, indirect, and induced employment and industry output effects.

### 2.1 Employment Effects of State Systemwide Investment Approach

Annual employment effects of the SSIA are estimated for project construction and avoided business losses for the Sacramento and San Joaquin river basins using Impact Analysis for Planning (IMPLAN)<sup>1</sup>. The total employment effect for each basin is the sum of the direct, indirect, and induced employment effects, which are defined as:

- Direct employment: Jobs<sup>2</sup> created in industry sector(s) of initial spending as a result of initial spending.
- Indirect employment: Jobs created as a result of purchases of goods, services, energy, and labor from supporting industries by the industry sector(s) where initial spending occurred.
- Induced employment: Jobs created when households who see increased income, as a result of direct and indirect employment effects, purchase goods and services, such as groceries and healthcare.

---

<sup>1</sup> IMPLAN is computer-driven system of software and data commonly used to perform input-output based economic impact analyses.

<sup>2</sup> Employment values represent annual full-time, part-time, and temporary positions.

### 2.1.1 Project Construction

Table 2-1 summarizes the estimated annual employment (equivalent annual full-time jobs) effects of project construction for the Sacramento and San Joaquin river basins, for the 2012 CVFPP SSIA low and high construction expenditure estimates. These values are annual statistics computed by IMPLAN, based on a 20-year construction period. The total employment effect for each basin is the sum of the direct, indirect, and induced employment effects for SSIA construction activities. Table 2-1 shows that the Sacramento River Basin would experience greater total employment effects than the San Joaquin River Basin. This is because of the larger magnitude of SSIA investments in the Sacramento River Basin compared to the San Joaquin River Basin, which is commensurate with population and assets at risk in each basin.

**Table 2-1. Summary of Annual SSIA Project Construction<sup>1</sup> (20-Year Period) Employment Effects (Jobs per Year)<sup>2,3</sup>– Low and High Construction Expenditure Estimates**

Employment Effects	Sacramento River Basin		San Joaquin River Basin		Total	
	Low	High	Low	High	Low	High
Direct Employment	2,527	3,052	429	537	2,955	3,588
Indirect Employment	736	888	119	149	855	1,037
Induced Employment	1,311	1,582	204	256	1,515	1,838
Total Employment	4,573	5,522	752	942	5,326	6,463

Notes:

<sup>1</sup> Project construction expenditure estimates include FloodSAFE Early Implementation Program projects under construction.

<sup>2</sup> Annual SSIA project construction employment effects are temporary and limited to 20-year construction period, and are based on the low and high project construction cost estimates of \$13.9 billion and \$16.9 billion (2011 dollars), respectively. Construction expenditures were uniformly distributed over the 20-year construction period.

<sup>3</sup> Employment values represent annual full-time, part-time, and temporary positions.

### 2.1.2 Avoided Business Losses

Table 2-2 summarizes the estimated annual employment (equivalent annual full-time jobs) effects of avoided business losses for the Sacramento and San Joaquin river basins, for the 2012 CVFPP SSIA. Business losses are based on expected annual statistics computed by Hydrologic Engineering Center Flood Damage Reduction Analysis software (HEC-FDA), and IMPLAN. The total employment effect for each basin is the sum of the direct, indirect, and induced employment effects for that basin’s constituent impact areas related to avoided business losses expected with flood management improvements under the SSIA. Table 2-2 shows that the Sacramento River Basin would experience greater total employment effects than the San Joaquin River Basin. This is because of the larger magnitude

of assets at risk in the Sacramento River Basin compared to the San Joaquin River Basin.

**Table 2-2. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Employment Effects (Jobs per Year)<sup>1,2</sup>**

Employment Effects	Sacramento River Basin	San Joaquin River Basin	Total
Direct Employment	558	6	564
Indirect Employment	69	1	70
Induced Employment	246	2	248
Total Employment	873	9	882

Notes:

<sup>1</sup> Expected annual SSIA avoided business loss employment effects represent temporary effects in a given year based on the long-term average of avoided business losses originating from probable flood events. A 500-year flood event in a given year would likely result in substantially more employment effects than displayed here, while a 10-year flood event would likely result in fewer employment effects.

<sup>2</sup> Employment values represent annual full-time, part-time, and temporary positions.

## 2.2 Industry Output Effects of State Systemwide Investment Approach

Annual industry output effects of the SSIA are estimated for project construction and avoided business losses for the Sacramento and San Joaquin river basins using IMPLAN. Industry output is the monetary value of goods and services produced in a region, which includes the value of intermediate inputs (i.e., goods and services) used in the production process and value added. The change in total industry output for each basin is the sum of the direct, indirect, and induced output effects, which are defined as:

- Direct output effects: industry output created in industry sector(s) of initial spending as a result of initial spending.
- Indirect output effects: industry output created as a result of purchases of goods, services, energy, and labor from supporting industries by the industry sector(s) where initial spending occurred.
- Induced output effects: industry output created when households see increased income as a result of direct and indirect employment creation, purchase goods and services, such as groceries and healthcare.

### 2.2.1 Project Construction

Table 2-3 summarizes the estimated annual output effects of project construction for the Sacramento and San Joaquin river basins for the 2012 CVFPP SSIA low and high construction expenditure estimates. These values are annual statistics computed by IMPLAN. The total output effect for each basin is the sum of the direct, indirect, and induced output effects for SSIA construction activities. The Sacramento River Basin would experience greater total economic output than the San Joaquin River Basin. This is because of the larger magnitude of SSIA investments in the Sacramento River Basin compared to the San Joaquin River Basin, commensurate with population and assets at risk in each basin.

**Table 2-3. Summary of Annual SSIA Project Construction<sup>1</sup> (20-Year Period) Industry Output Effects (2011 Dollars, Million per Year)<sup>2</sup> – Low and High Construction Expenditure Estimates**

Industry Output Effects	Sacramento River Basin		San Joaquin River Basin		Total	
	Low	High	Low	High	Low	High
Direct Effect	\$379	\$458	\$62	\$78	\$441	\$535
Indirect Effect	\$101	\$122	\$15	\$19	\$116	\$141
Induced Effect	\$167	\$202	\$24	\$30	\$191	\$232
Total Effect	\$647	\$781	\$101	\$127	\$748	\$908

Note:

<sup>1</sup> Project construction expenditure estimates include FloodSAFE Early Implementation Program projects under construction.

<sup>2</sup> Annual SSIA project construction industry output effects are temporary and limited to 20-year construction period, and are based on the low and high project construction cost estimates of \$13.9 billion and \$16.9 billion, respectively. Construction expenditures were uniformly distributed over the 20-year construction period.

### 2.2.2 Avoided Business Losses

Table 2-4 summarizes the estimated annual output effects of avoided business losses for the Sacramento and San Joaquin river basins, for the 2012 CVFPP SSIA. These values are based on expected annual statistics computed by HEC-FDA and IMPLAN. The total output effect for each basin is the sum of the direct, indirect, and induced output effects for that basin’s constituent impact areas related to avoided business losses expected with flood management improvements and the SSIA. The Sacramento River Basin would experience greater total economic output than the San Joaquin River Basin. This is because of the larger magnitude of assets at risk in the Sacramento River Basin compared to the San Joaquin River Basin.

**Table 2-4. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Industry Output Effects (2011 Dollars, Million per Year) <sup>1</sup>**

<b>Industry Output Effects</b>	<b>Sacramento River Basin</b>	<b>San Joaquin River Basin</b>	<b>Total</b>
Direct Effect	\$61	\$0.64	\$62
Indirect Effect	\$10	\$0.12	\$10
Induced Effect	\$32	\$0.26	\$32
<b>Total Effect</b>	<b>\$103</b>	<b>\$1.03</b>	<b>\$104</b>

Note:

<sup>1</sup> Expected annual SSIA avoided business loss industry output effects represent temporary effects in a given year based on the long-term average of avoided business losses originating from probable flood events. A 500-year flood event in a given year would likely result in substantially more employment effects than displayed here, while a 10-year flood event would likely result in fewer employment effects.

*This page left blank intentionally.*

## 3.0 Methodology

This regional economic impact analysis estimates the effects of the proposed flood management improvements on regional economic activity, specifically employment and industry output. This section describes the regional economic impact analysis methodology and its application to the 2012 CVFPP, which was guided by the following documents:

- DWR. 2008. Economic Analysis Guidebook
- U.S. Water Resources Council. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
- U.S. Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook
- USACE. 2011. Regional Economic Development Procedures Handbook

### 3.1 Economic Impact Analysis with Input-Output Modeling

Various approaches have historically been used to assess the effect a change in production or expenditure will have on a region's economy. The most common approach has arguably been the use of input-output (I-O) models. The use of I-O models in economic impact analyses has increased dramatically with the advent of ready-made regional models. Ready-made models reduce both the time and cost of using I-O models for economic input assessment.

#### 3.1.1 Concept

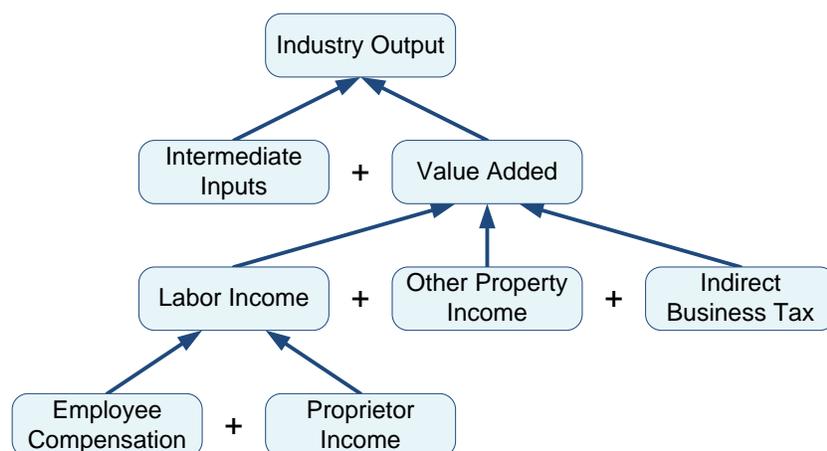
I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within an economy (or study area). An I-O model uses a matrix representation of a region's economy to predict the effect that changes in one industry will have on others as well as consumers, government, and foreign suppliers in the economy. I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally produced goods and services. The resulting mathematical

formulas allow I-O models to simulate or predict the economic impacts of a change in one or several economic activities on an entire economy. It is a static, linear model of all purchases and sales, or linkages, between sectors of an economy.

The measurement of linkages within a regional economy is based on the concept of a multiplier. A multiplier is a single number that quantifies the total economic effect resulting from initial spending, or output in a sector. For example, an output multiplier of 1.7 for the “widget” production sector indicates that every \$100,000 of widgets produced (the initial spending, or output in this industry) supports a total of \$170,000 in business sales throughout the economy (total output of all linked industries), including the initial \$100,000 in widget output. Many types of multipliers can be produced by an I-O model, including specific multipliers for estimating impacts on industry output, employment, and value added – the main metrics of I-O analysis results. Each of these metrics is defined and described below.

- **Industry output** is the value of goods and services produced in a region, which includes the value of intermediate inputs (i.e., goods and services) used in the production process and value added. Intermediate inputs may or may not originate from a region. For example, direct industry output for construction refers to the value of construction, although some of the intermediate inputs used in the construction process may be imported into the region.
- **Value added** is the difference between industry output and the cost of intermediate inputs, and consists of four components (1) employee compensation, (2) proprietor income, (3) other property income, and (4) indirect business tax. Labor income represents the sum of employee compensation and proprietor income.
- **Employment** is measured by the number of annual full-time, part-time, and temporary positions. Estimated changes in employment are tied to economic relationships between industry output and labor productivity, regardless of availability and fluidity in the local labor force.

Components of industry output are displayed in Figure 3-1.



**Figure 3-1. Components of Industry Output**

### 3.1.2 I-O Modeling Limitations

While I-O models are useful in providing ballpark estimates of very short-run responses to changes in production/expenditures, their key limitations are linearity, absence of behavioral considerations, absence of markets and prices, and lack of formal constraints.

The limitations of I-O models are also the key advantages of Computable General Equilibrium (CGE) modeling. A CGE model is a nonlinear model of individual behavioral response to price signals, subject to labor, capital, and natural resources constraints (Rose, 2006). These advantages come with increased modeling complexity, much greater data needs, and time resources for operation. Therefore, while the use of CGE modeling is increasing, resource and data constraints make its use impractical at the multi-region level, and the use of I-O modeling is a practical choice for a large study area.

### 3.1.3 I-O Model Selection for 2012 CVFPP

In the United States, the three most widely used ready-made models are the IMPLAN<sup>3</sup> model initially produced by the U.S. Department of Agriculture Forest Service, the REMI model produced by Regional Economic Models Inc., and the RIMS II model developed by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). The REMI model is dynamic and the most flexible, but requires detailed data that are prohibitive for high-level systemwide assessments. RIMS II has a relatively less data requirement but is not as flexible, which limits its use for more detailed analysis over a long study period. Given the limitations of REMI

<sup>3</sup> The current IMPLAN I-O database and model are maintained and sold by Minnesota IMPLAN Group (MIG Inc.).

and RIMS II, IMPLAN was selected to model regional economic effects associated with the SSIA.

### 3.1.4 IMPLAN

IMPLAN (a computer-driven system of software and data commonly used to perform I-O based economic impact analysis) regional multipliers were used to assess the regional economic impacts associated with the CVFPP. The economic data needed to construct the central I-O table are extracted from various sources generated by the Department of Commerce, the Bureau of Labor Statistics, and other federal and State agencies.

Data are collected for 528 distinct industry sectors of the national economy, commonly known as North American Industry Classification (NAICS) (formerly Standard Industry Codes (SIC)). Industry sectors are classified on the basis of the primary commodity or service produced. National data are de-aggregated to produce data sets for each county in the United States, allowing analysis at the county level and for geographic aggregations such as clusters of contiguous counties, states, or groups of states.

IMPLAN predicts changes in industry output, value added, and employment as direct, indirect, and induced economic effects for affected industries within the study area, where:

$$\text{Total Effects} = \text{Direct Effects} + \text{Indirect Effects} + \text{Induced Effects}$$

- **Direct Economic Effects** refer to the response of a given industry (i.e., changes in output, income, and employment) based on final demand for that industry.
- **Indirect Effects** refer to changes in output, income, and employment resulting from the iterations of industries purchasing from other industries caused by the direct economic effects.
- **Induced Economic Effects** refer to changes in output, income, and employment caused by the expenditures associated with changes in household income generated by direct and indirect economic effects.

For this study, the 2009 California State IMPLAN dataset was used in the analysis, and no adjustments were made to the regional data (Minnesota IMPLAN Group, 2009).

## 3.2 Regional Economic Analysis for the 2012 CVFPP

The regional economic analysis for the 2012 CVFPP is focused on the effects of the SSIA. The SSIA is likely to affect the regional economy in two primary ways: (1) proposed flood management improvement will reduce business losses, and (2) improvements to flood protection facilities will introduce construction expenditure in the regional economy.

Most of these regional economic effects resulting from the implementation of the SSIA will occur within the counties (shown in Table 3-1) where the impact areas targeted by the proposed flood management improvements are located. These impact areas are the HEC-FDA zones used to estimate direct flood damages, which is documented in Attachment 8F: Flood Damage Analysis. The affected counties are grouped into four impact analysis regions based primarily on the location of major urban centers and county boundaries (see Figure 3-2). The four impact analysis regions are: Upper Sacramento, Lower Sacramento, Lower San Joaquin, and Upper San Joaquin.

Specific I-O regional economic models were developed within IMPLAN to assess regional economic impacts associated with each of these four regions to assess effects of the avoided business losses under the SSIA, and project construction expenditure. For each region, IMPLAN estimates direct, indirect, and induced employment (equivalent annual full-time jobs) and industry output (2011 dollars) impacts expected with implementation of the SSIA.

Figure 3-3 displays the relationship of flood damage analyses and the project construction cost estimate to this regional economic impact analysis. Flood damage analysis estimates structure and content damage, agricultural crop damages, and business income loss (documented in Attachment 8F: Flood Damage Analysis), and life loss potential (documented in Attachment 8G: Life Risk Analysis). SSIA construction costs are detailed in Attachment 8J: Cost Estimates. Expected annual avoided business losses were used in this analysis to estimate regional economic effects of the SSIA. Regional economic effects related to structure and content damages, and agricultural production damages were not quantified in this analysis, as discussed below. Estimation of regional economic effects related to life loss potential is not in the scope of this analysis.

**Table 3-1. Regional Economic Analysis Regions, Counties, and Impact Areas**

<b>Regional Economic Impact Analysis Regions</b>	<b>Counties</b>	<b>HEC-FDA* Impact Areas</b>
<b>Upper Sacramento</b>	Tehama	SAC-02
	Glenn	SAC-03, SAC-04, SAC-06
	Butte	SAC-01, SAC-05, SAC-20, SAC-18
	Colusa	SAC-07, SAC-09, SAC-08, SAC-10
	Sutter	SAC-11, SAC-21, SAC-22, SAC-24, SAC-25, SAC-30, SAC-32, SAC-33, SAC-34
	Yuba	SAC-23, SAC-26, SAC-27, SAC-28, SAC-29
<b>Lower Sacramento</b>	Yolo	SAC-12, SAC-13, SAC-14, SAC-15, SAC-16, SAC-17, SAC-35, SAC-38, SAC-39, SAC-41, SAC-42, SAC-43, SAC-46
	Sacramento	SAC-36, SAC-37, SAC-40, SAC-44, SAC-45, SAC-47, SAC-48, SAC-49, SAC-50, SAC-51, SAC-52, SAC-53, SAC-54, SAC-57, SAC-58, SAC-63
	Solano	SAC-55, SAC-56, SAC-59, SAC-60, SAC-61, SAC-62
<b>Lower San Joaquin</b>	San Joaquin	SJ-28, SJ-29, SJ-30, SJ-31, SJ-32, SJ-33, SJ-34, SJ-35, SJ-36, SJ-37, SJ-38, SJ-39, SJ-40, SJ-41, SJ-42, STK-01, STK-06, STK-07, STK-08, STK-09
<b>Upper San Joaquin</b>	Stanislaus	SJ-21, SJ-22, SJ-23, SJ-24, SJ-25, SJ-26, SJ-27, SJ-43
	Merced	SJ-09, SJ-10, SJ-14, SJ-15, SJ-16, SJ-17, SJ-18, SJ-19, SJ-20
	Fresno	SJ-01, SJ-02, SJ-03, SJ-04, SJ-07, SJ-08
	Madera	SJ-05, SJ-06, SJ-11, SJ-12, SJ-13

Note:

\*Hydrologic Engineering Center Flood Damage Reduction Analysis software program

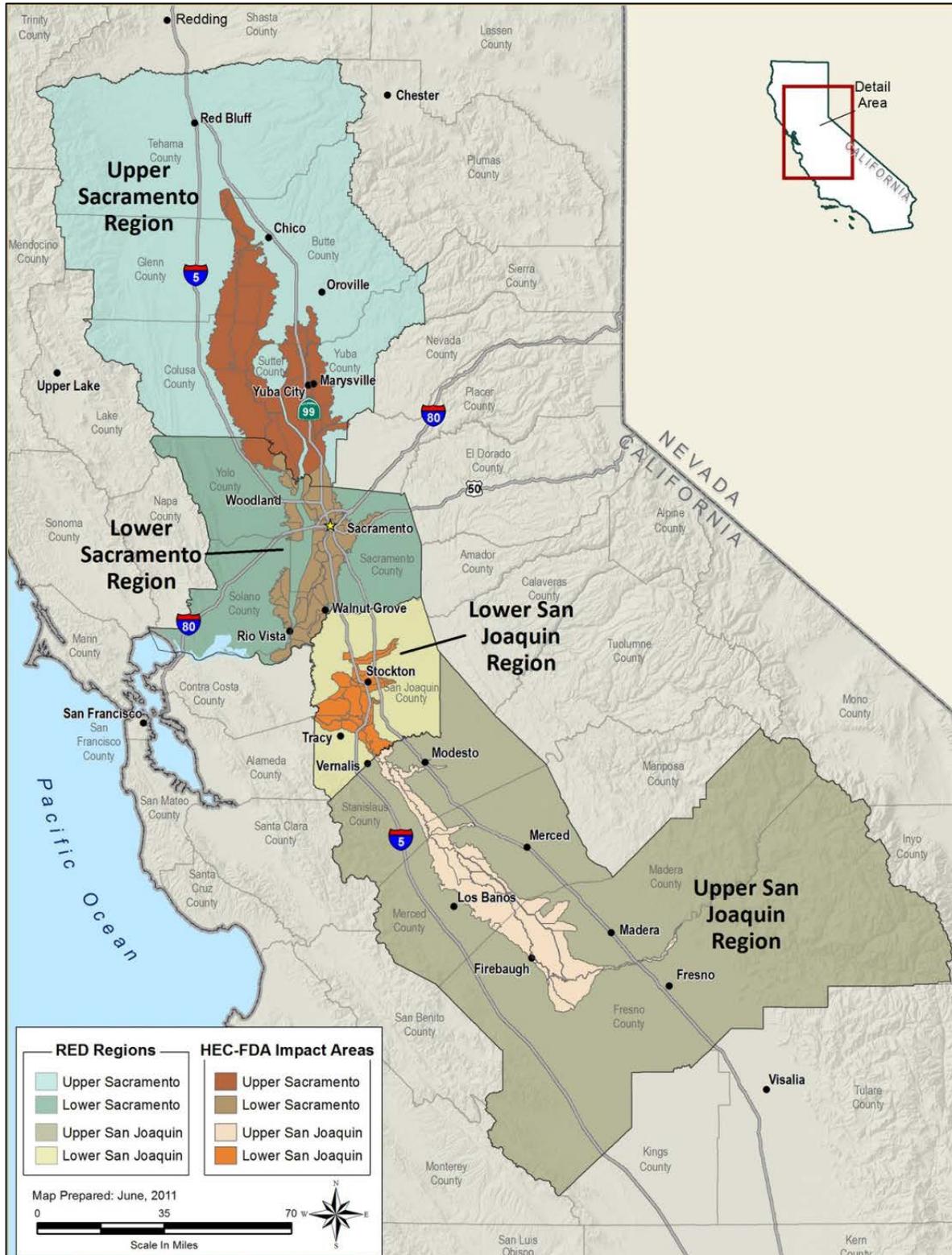


Figure 3-2. Regional Economic Impact Analysis Regions

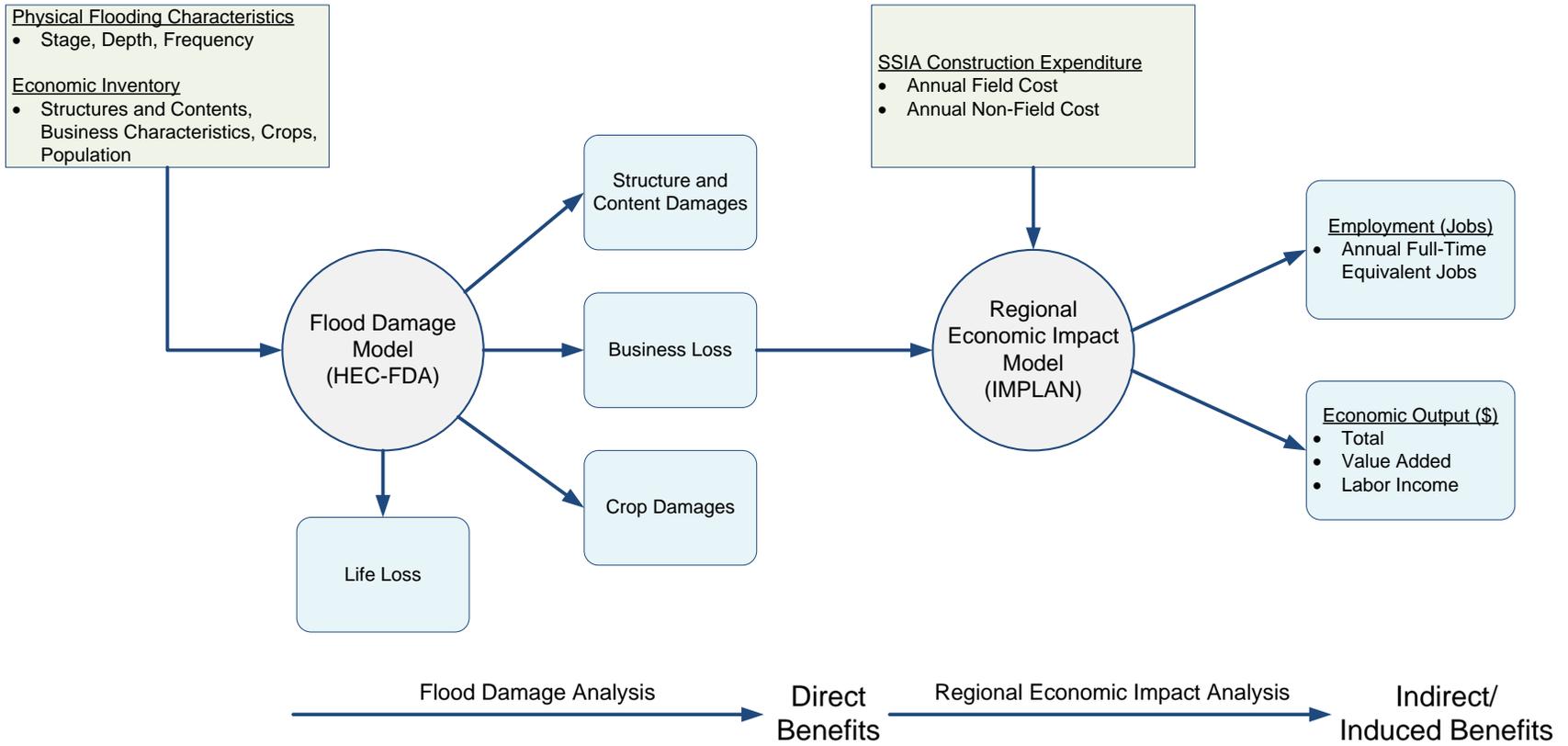


Figure 3-3. Economic Analysis Diagram

### 3.3 Economic Effects of Project Construction

Preliminary construction cost estimates for the SSIA have been completed for the CVFPP, and documented in Attachment 8J: Cost Estimates. Construction expenditures related to the SSIA are expected to take place over 20 years. Construction expenditures will primarily and most directly benefit each regional economic impact analysis region's construction sectors. The magnitude of the project's economic impact, within a region, is determined by (1) out-of-region investment; (2) the proportion of the work performed and the resulting labor, equipment, and materials that originate from within each region. Spending is assumed to benefit the businesses and residents in the region where the spending occurs if funding is from outside the region. It is likely that some direct spending could "leak out" of the region and be used to acquire labor, equipment, or materials from another region, thus benefiting the economy in that other region. For this analysis, it is assumed that such leakages are insignificant.

In addition, direct spending will generate indirect and induced economic impacts on other sectors of the region's economy. The nature of out-of-region investment; direct, indirect, and induced economic effects; and the approach used to quantify each effect and their magnitude are discussed below.

#### 3.3.1 Out-of-Region Investment

Development of the SSIA will require substantial capital investment costs both during the construction period and over the project's subsequent life and repayment period. The origin of the funding for both the capital investment and subsequent repayment will affect the extent that future construction and operation of the SSIA project will represent *net* new spending to the region. SSIA implementation projects assumed the local or regional funded share of the construction cost would be approximately 8 percent, with the State and federal government paying for the remaining 46 and 46 percent, respectively. This cost share was used in the analysis.

Construction paid for by the local or regional cost share would not represent any *net* new economic activity for the region since there would be a corresponding and likely offsetting decrease in economic activity. The positive effects of local increased spending to the region's construction sector will be offset by reduced spending elsewhere within the local economy that would otherwise have occurred if that money was not used for SSIA project construction. However, the out of region, State and federally funded portions of the project's construction cost would represent new spending and income for the region's economy.

### 3.3.2 Direct Impacts

The SSIA cost estimate, provided in Attachment 8J: Cost Estimates, includes two types of costs, (1) “field” costs (i.e., onsite construction spending) and, (2) “non-field costs” (i.e., “soft” costs for offsite project development and implementation as well as project-related land and mitigation costs). Both types of costs are evenly distributed over a 20-year construction period by region. The annualized construction cost estimates (by region) were used in IMPLAN to determine the direct, indirect, and induced economic effects of the project construction activity on employment and output.

The initial direct spending in a region related to each of these types of costs is considered the direct economic impact, which has employment and output effects tied to it. The source of funding for project construction costs has key importance in determining the magnitude of economic impacts.

#### ***Field Costs***

The project’s field costs can be expected to represent a major direct regional economic effect of the project construction. Field costs consist of onsite construction expenditures for materials, equipment, and labor.

For the purposes of this regional economic impact analysis it is assumed that all of the project’s field cost spending will be performed with material, equipment, and labor sourced from within the same region that the construction activity is located. In other words, the regional economic impact analysis assumes that there is no significant leakage of field cost construction-related spending out of each region’s economy. Full field-costs in each regional economic impact analysis region are considered direct new spending, before consideration of out-of-region investment.

This assumption is considered practical for several reasons. First, the nature of the levee construction and improvement work is relatively straightforward and would not require skills, materials, or equipment that would necessarily need to be imported from outside the county-based regional economic impact analysis regions. Second, each of the county-based regional economic impact analysis regions is relatively large and therefore expected to have sufficient quantities of construction labor, materials, and equipment to meet the project’s needs.

Field- costs for labor, materials and equipment were input into the three – digit NAICS<sup>4</sup> aggregated IMPLAN sector Construction (IMPLAN Code 34), as this sector was determined to be most representative of the construction work necessary for the flood management improvement and environmental mitigation work.

#### ***Non-Field Costs***

In addition to the project’s field cost, non-field costs are expected to also contribute new economic activity to the regions’ economies. Non-field costs include the various technical work necessary for project design and construction (i.e., legal services, environmental compliance, engineering, design, and construction management). Most of this technical work can be performed off site and, given the SSIA’s magnitude and complexity, will require specialized technical skills. Environmental mitigation, cultural resource mitigation, and land acquisition or easement right-of-way purchases are also considered non-field costs for the SSIA cost estimate, and were dealt with differently from legal service, environmental compliance, engineering, design, and construction management costs.

As most of the technical work for non-field costs for legal services, environmental compliance, engineering, design, and construction management can be performed off site and requires specialized technical skills, it is likely that not all non-field-cost-related spending would occur in each regional economic impact analysis region. Consequently, it is assumed that approximately half of this technical work would likely be performed by government agencies or private firms located outside the region, or leaked to areas outside the four regional economic impact analysis regions. The other half is assumed to be performed by the specialized government agencies and private businesses located near the California State Capitol, Sacramento, and within the Lower Sacramento regional economic impact region. Half of non-field costs for legal services, environmental compliance, engineering, design, and construction management expected for each regional economic impact analysis region are attributed as the direct effect to the Lower Sacramento regional economic impact region.

A portion of the environmental mitigation-related spending may occur within each regional economic impact analysis region. Land improvements are expected for environmental mitigation that will likely involve similar construction activities as those necessary for levee improvements and setbacks. For this reason, half of environmental mitigation costs were

---

<sup>4</sup> NAICS is the North American Industry Classification System and is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

assumed to be treated as field costs, and as a direct effect to occur within the regional economic impact analysis region that the environmental mitigation takes place.

Cultural resource mitigation costs likely require specialized skills and are small in proportion of the overall SSIA cost estimate for each regional economic impact analysis region. Considering the small magnitude of the cultural resource mitigation cost, no direct effect of cultural resource mitigation, or indirect and induced effects were quantified.

Land acquisition and easement right-of-way purchases are other non-field cost items. Payments for land purchases or right of ways generally represent monetary reallocation that may or may not result in any new spending within the region. Payments to property owners living outside the region will be highly unlikely to increase their spending within the region. Even landowners living within the region may be likely to reinvest new income from any land or easement sales and consequently this would be a transfer within the region and not result in any substantial new spending within the region. Consequently, for the purposes of the regional economic impact analysis, it is conservatively assumed that none of the land acquisition and easement spending would result in direct regional economic impact effects.

Project spending for non-field costs, or offsite construction-related spending (i.e., legal services, environmental compliance, engineering, design, and construction management), was attributed solely to the Lower Sacramento regional economic impact region and input into the three-digit NAICS aggregated IMPLAN sector, Professional, Scientific and Technological Services (IMPLAN Code 367).

### **3.3.3 Indirect and Induced Impacts**

IMPLAN estimated the total regional economic response of SSIA project construction using the 2009 IMPLAN California counties dataset. A matrix representation of a region's economy was used to predict the effect of changes in one industry on others (indirect effect) and changes in household income (induced effect) through multipliers, taking into account inter-industry linkages and leakages outside the region. Indirect and induced impacts of project construction on employment and output related to the SSIA were estimated. The results of the project construction analysis are presented in Section 4.

### 3.4 Economic Effects of Flood Damage Reduction

Several types of potential direct flood-related economic impacts were estimated in Attachment 8F: Flood Damage Analysis, based on the known condition of the regions' flood damage reduction facilities and expected conditions related to flood management improvements under the SSIA. Given the type and location of existing structures and agricultural commodities within the floodplain, and expected hydrological and physical factors, the extent and incidence of the future flood conditions were applied to determine:

- Physical damages to structures and contents
- Physical damages to agricultural production and commodities
- Business income losses from flood-related operating disruptions

In these three cases, the benefit of the project stems from the avoidance of each flood-related damage. Each of the above avoided direct flood-related damages may result in indirect and induced effects throughout each regional economy.

For this regional economic impact analysis, indirect and induced economic effects were not quantified for avoided structure and content, and agricultural production damages, as well as avoided loss of life. These effects may be considered in future State basin-wide feasibility studies and to support regional planning activities. Only avoided potential business losses indirect, and induced effects on employment and output were quantified. Regional economic impacts associated with avoided potential structure and content damages, agricultural production and commodity damages, and loss of business production are described below.

#### 3.4.1 Avoided Structure and Content Damages

Conceptually, assuming no flood insurance, estimated structural and content damages can also be viewed as an adverse income effect for those local households and other property owners incurring damages. The rationale is that flood damages can either be considered a reduction in *net* worth if property is not replaced or repaired, thereby affecting spending patterns; or, if property owners pay to repair or replace the damaged property, this increased property cost represents a *net* loss in discretionary income available to purchase new goods and services. This reduction in discretionary income, in turn, would have regional economic effects due to associated decreased spending in the local economy.

The adverse income effects described above cannot be considered distinctly from reconstruction efforts that would inject substantial money into the local economy. It is likely that most home and property owners would seek to reconstruct and/or replace their damaged items, such as automobiles, furniture, and business supplies. Expenditures on reconstruction efforts would induce significant spending in the local economy, thereby stimulating regional economic activity. Conceptually, these effects would serve to offset a portion of the adverse income effects described above. Further, if damages were covered by homeowner and other property insurance, then it is likely that new money from outside the region would be available to make repairs and replace damaged property, resulting in economic benefits to the region.

In order to estimate regional economic effects of reconstruction and replacement, the extent of avoided reconstruction/replacement would be based on two key factors, listed below. For the 2012 CVFPP, available information did not support this detailed analysis.

1. **Insurance coverage and availability of public assistance to reconstruct damaged structures or replace contents** – Spending of owners' equity and /or future income for uninsured reconstruction/replacement is a transfer of spending between sectors in a regional economy and would result in no significant regional economic impacts. The insured, or eligible for public assistance, portion of the damages determines the proportion of spending to reconstruct/replace that will be paid for with new money coming into the region; therefore, resulting in a positive regional economic impact due to reconstruction/replacement after flooding. To determine the extent of reconstruction/replacement, it is necessary to estimate the portion of this spending originating from insurance coverage or public assistance.
2. **Portion of residents that are permanently displaced or that relocate out of the region** – Residents that experience flood damages to their property may be permanently displaced or may choose to relocate out of the flood-prone region. If residents are permanently displaced or relocate out of the region, then reconstruction of structures and replacement of contents will not take place in the region in which the flood damages were experienced. To determine the extent of reconstruction/replacement, it is necessary to determine the portion of residents that are permanently displaced or that relocate out of the region.

The estimation of the effect of avoided structure and content damages requires detailed information on these two factors in order to accurately

estimate the potentially offsetting nature of these damage and reconstruction and replacement effects. For the 2012 CVFPP, available information did not support this detailed analysis. These analyses may be completed for future State basin-wide feasibility studies to support regional planning activities.

### **3.4.2 Avoided Agricultural Production and Commodity Damages**

Avoided agricultural production and commodity damages, which represent an avoided loss of agricultural output within a region, are a direct economic effect to the region. This direct economic effect in agricultural production has a multiplier effect throughout the regional economy, impacting jobs and output in other supporting sectors. Direct agricultural production damages expected to be avoided with implementation of the SSIA were estimated and documented in Attachment 8F: Flood Damage Analysis.

This analysis did not estimate the indirect and induced effects, or ripple effects, of direct, avoided agriculture damages because direct agriculture damages estimated in the flood damage analysis are based on a net income approach which only allows induced economic effects to be estimated with IMPLAN.

### **3.4.3 Avoided Loss of Business Production**

The focus of the quantitative component of the regional economic impact analysis for flood damage reduction is on the potential regional economic losses associated with decreased business activity caused by flooding. Flooding in the Central Valley region would force some local businesses located in the floodplain to temporarily or permanently close, resulting in a decline in business production, which would have adverse ripple effects throughout the regional economy. No permanent business closures were considered in this analysis because detailed information and analyses to understand the proportion of businesses to permanently close were not available. The avoided business losses are based on estimated periods of business interruption as a result of flooding, and relationships between these businesses and total economic production in the study area. Business losses were estimated for each impact area and are documented in Attachment 8F: Flood Damage Analysis.

Direct, indirect, and induced effects of avoided business losses were quantified using IMPLAN, based on the distribution of business losses among business types. This analysis was conducted by identifying losses to specific sectors of the economy and using IMPLAN to estimate how those losses impact the rest of the regional economy.

**Direct Impacts**

To estimate the direct impact of avoided business losses related to the SSIA, avoided business losses were aggregated by regional economic impact analysis region and input into each regional IMPLAN model as local direct industry effects, based on the estimated distribution of business losses. Regional avoided business losses were input into IMPLAN sectors based on estimated proportions of expected annual business losses for each of three-digit NAICS aggregated IMPLAN sectors. These proportions are listed in Table 3-2, and were developed by assessing the distribution of business losses for five flood frequencies (i.e. 10-, 50-, 100-, 200, and 500-year events) for the Sacramento and San Joaquin river basins separately.

**Table 3-2. Proportions of Avoided Business Loss for Aggregated IMPLAN Economic Sectors**

Three-Digit NAICS <sup>1</sup> Aggregated Sectors	IMPLAN Code	Flood Damage Analysis Occupancy Type(s) Description <sup>2</sup>	Lower & Upper Sacramento Regions	Lower & Upper San Joaquin Regions
Government and Non-NAICS	427	Government and Miscellaneous Public Structures	40%	20%
Professional – Scientific & Technical Services	367	Office Structures	25%	35%
Electrical Equipment and Appliances	259	Light Industrial Structures	15%	25%
Miscellaneous Retailers	330	Retail and Miscellaneous Structures	5%	5%
Repair and Maintenance	414	Auto Service Structures	5%	5%
Warehousing and Storage	340	Warehouse and Miscellaneous Industrial Structures	5%	-
Fabricated Metal Production	181	Heavy Manufacturing Structures	5%	5%
Food Services and Drinking Places	413	Restaurant and Fast Food Restaurant Structures	-	5%
TOTAL			100%	100%

Notes:

<sup>1</sup> NAICS is the North American Industry Classification System and is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

<sup>2</sup> Business losses were estimated for non-residential structures. The occupancy type(s) descriptions listed here represent the type of commercial, industrial, and public structures that expected business losses were estimated for. See Attachment 8F: Flood Damage Analysis for details.

***Indirect and Induced Impacts***

The total regional economic effects of avoided business production losses under the SSIA were estimated using the 2009 IMPLAN California counties dataset. A matrix representation of a region's economy was used to predict the effect of changes in one industry on others (indirect effect) and changes in household income (induced effect) through multipliers. Indirect and induced impacts of avoided business losses on employment and industry output related to the SSIA were estimated and presented in Section 4.

**3.5 Other Potential Regional Economic Impact Effects**

In addition to effects associated with project construction and avoided business losses, numerous other regional economic effects will occur (e.g., property values, fiscal impacts on municipalities, and regional economic competitiveness and diversity). However, these effects are only described qualitatively in this attachment because of the limitation of available information to support these detailed analyses. In addition, some of these effects have relatively minor magnitude of effects compared to project construction and avoided business losses. These other effects are discussed in Section 5.

*This page left blank intentionally.*

## 4.0 Results and Discussion

This section presents the results of the regional economic impact analysis for the SSIA. The regional economic impact results are organized into two components, corresponding to unique economic effects anticipated under the SSIA: (1) effects of project construction expenditure, and (2) avoided business losses.

### 4.1 Economic Effects of Project Construction

Implementation of the proposed SSIA would result in substantial construction-related expenditures and generate demand for construction labor and support services, which would provide temporary short-term benefits to each regional economy. Expenditures on construction goods, materials, and equipment that are made within a region would generate additional economic benefits as spending ripples through the local economy via inter-industry linkages. In addition, SSIA project implementation would support a substantial construction labor force hired to physically construct projects in each region, as well as a professional and technical labor force, to provide design, construction management, and oversight services.

#### 4.1.1 SSIA Construction Cost Estimates

The estimated total cost for the SSIA is approximately \$13.9 billion to \$16.9 billion (2011 dollars), documented in Attachment 8J: Cost Estimates. Of this total, it is estimated that \$6.7 billion to \$8.1 billion would be for field costs and \$7.3 billion to \$8.8 billion for non-field costs.

Implementation of the SSIA is expected to take place over a 20-year construction period. These construction parameters represent the direct project construction effects of the SSIA. IMPLAN was used to generate annual estimates of the regions' economic responses to proposed construction activities.

The total direct effects of project construction were translated into uniform annual values across the 20-year construction period for each region. The estimated annual values for the low and high estimates represent the direct inputs into each IMPLAN model developed for Lower and Upper Sacramento and Lower and Upper San Joaquin regional economic impact analysis regions. Table 4-1 displays low and high estimates total

construction costs, and related annual field and non-field cost inputs into IMPLAN by region.

**Table 4-1. SSIA Project Construction Expenditure<sup>1</sup> (2011 Dollar, Millions) and Annual<sup>2</sup> (20-Year Period) IMPLAN Inputs – Low and High Construction Expenditure Estimates**

Regional Economic Impact Analysis Regions	Low and High Construction Expenditure Estimate	Construction Activity Costs		
		Total Cost <sup>3</sup>	Annual Field Cost	Annual Non-Field <sup>4</sup> Cost
Upper Sacramento	Low	\$4,380	\$109	\$ -
	High	\$5,350	\$133	\$ -
Lower Sacramento	Low	\$7,160	\$193	\$77
	High	\$8,560	\$230	\$94
Lower San Joaquin	Low	\$1,310	\$29	\$ -
	High	\$1,670	\$38	\$ -
Upper San Joaquin	Low	\$1,080	\$33	\$ -
	High	\$1,330	\$40	\$ -
Total Regional Economic Impact Study Area	Low	\$13,930	\$364	\$77
	High	\$16,910	\$441	\$94

Notes:

<sup>1</sup> Project construction expenditure estimates include FloodSAFE Early Implementation Program projects under construction.

<sup>2</sup> Annual field and non-field costs are evenly distributed over the 20-year construction period and represent new money to each region based on the State and federal cost share, with 8 percent locally funded construction costs excluded.

<sup>3</sup> Total cost is the basis for annualized field and non-field costs and are not direct inputs into IMPLAN.

<sup>4</sup> Non-field costs, or costs for professional and technical services, were assumed to primarily be spent in the Lower Sacramento region due to concentration of professional, technical, and government services within the region and assumed capacity to meet construction activity demand relative to other regional economic impact analysis regions.

#### 4.1.2 Employment and Industry Output Effects

A summary of the regional economic impacts of project construction is presented in Table 4-2. The values reported for industry output, value-added, and labor income represent monetary impacts and are reported in 2011 dollars. Because output incorporates the value of goods and materials used in the production process, it does not reflect the net economic value to the region. More pertinent to each region is the value added by local workers and businesses in the form of labor earnings, other property income, and indirect business taxes. Employment impacts represent the

change in the number of equivalent annual full-time jobs in each region. Figures 4-1 and 4-2 display employment and industry output effects, by regional economic impact analysis region, for the high construction expenditure estimate. Table 4-3 displays total industry output effects for the high and low construction expenditure estimates as a percentage of total regional output by region.

The results of the regional economic analysis show positive economic impacts for each region during project construction. During construction, the industries that would primarily benefit from construction activities would be the local construction industry, as well as those industries providing construction goods and materials. Construction suppliers, such as building stores, concrete/cement plants, and heavy equipment manufacturing, would realize many of the indirect construction benefits generated by the project. Purchases by local workers would also generate induced benefits to local retailers, such as gas stations, food stores, restaurants, and hotels/motels.

**2012 Central Valley Flood Protection Plan  
Attachment 8H: Regional Economic Analysis**

**Table 4-2. Summary of Annual SSIA Project Construction<sup>1,2</sup> (20-Year Period) Employment and Industry Output (2011 Dollars, Million per Year) Effects – Low and High Construction Expenditure Estimates**

Regional Economic Impact Analysis Regions	Economic Effect	Employment				Industry Output <sup>6</sup>			
		Jobs <sup>3</sup>		Labor Income <sup>4</sup>		Value Added <sup>5</sup>		Total Output	
		Low	High	Low	High	Low	High	Low	High
Upper Sacramento	Direct Effect	764	933	\$44	\$54	\$52	\$63	\$109	\$133
	Indirect Effect	189	230	\$9	\$10	\$13	\$16	\$22	\$27
	Induced Effect	311	380	\$13	\$16	\$22	\$27	\$36	\$44
	Total Effect	1,263	1,543	\$65	\$80	\$87	\$107	\$167	\$204
Lower Sacramento	Direct Effect	1,763	2,119	\$127	\$152	\$148	\$178	\$270	\$324
	Indirect Effect	547	658	\$30	\$37	\$47	\$57	\$79	\$95
	Induced Effect	1,000	1,202	\$48	\$58	\$85	\$102	\$131	\$158
	Total Effect	3,310	3,978	\$205	\$247	\$280	\$337	\$480	\$577
Lower San Joaquin	Direct Effect	199	254	\$12	\$15	\$14	\$18	\$29	\$38
	Indirect Effect	54	69	\$3	\$3	\$4	\$5	\$7	\$9
	Induced Effect	98	125	\$4	\$5	\$7	\$9	\$12	\$15
	Total Effect	352	448	\$19	\$24	\$26	\$33	\$48	\$61
Upper San Joaquin	Direct Effect	230	283	\$13	\$16	\$16	\$19	\$33	\$40
	Indirect Effect	65	80	\$3	\$4	\$5	\$6	\$8	\$10
	Induced Effect	106	130	\$4	\$5	\$8	\$9	\$12	\$15
	Total Effect	401	494	\$21	\$25	\$28	\$35	\$53	\$65
Regional Economic Impact Study Area	Direct Effect	2,955	3,588	\$196	\$238	\$230	\$279	\$441	\$535
	Indirect Effect	855	1,037	\$45	\$54	\$69	\$84	\$116	\$141
	Induced Effect	1,515	1,838	\$70	\$84	\$122	\$148	\$191	\$232
	Total Effect	5,326	6,463	\$310	\$376	\$421	\$511	\$748	\$908

Notes:

<sup>1</sup> Project construction expenditure estimates include FloodSAFE Early Implementation Program projects under construction.

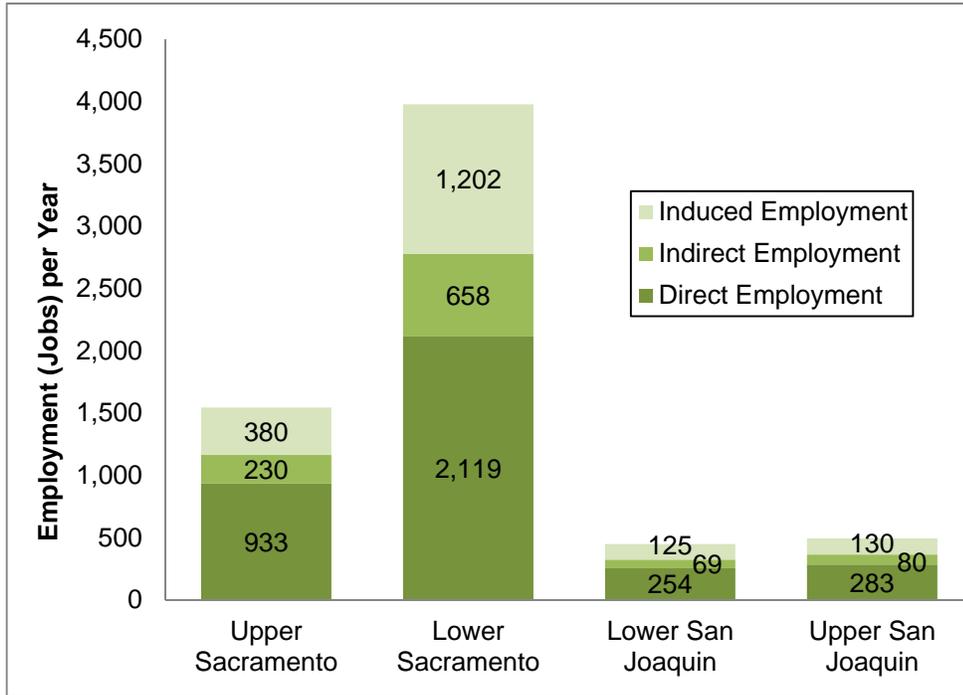
<sup>2</sup> Annual SSIA project construction industry employment and output effects are temporary and limited to 20-year construction period.

<sup>3</sup> Employment values represent annual full-time, part-time, and temporary positions.

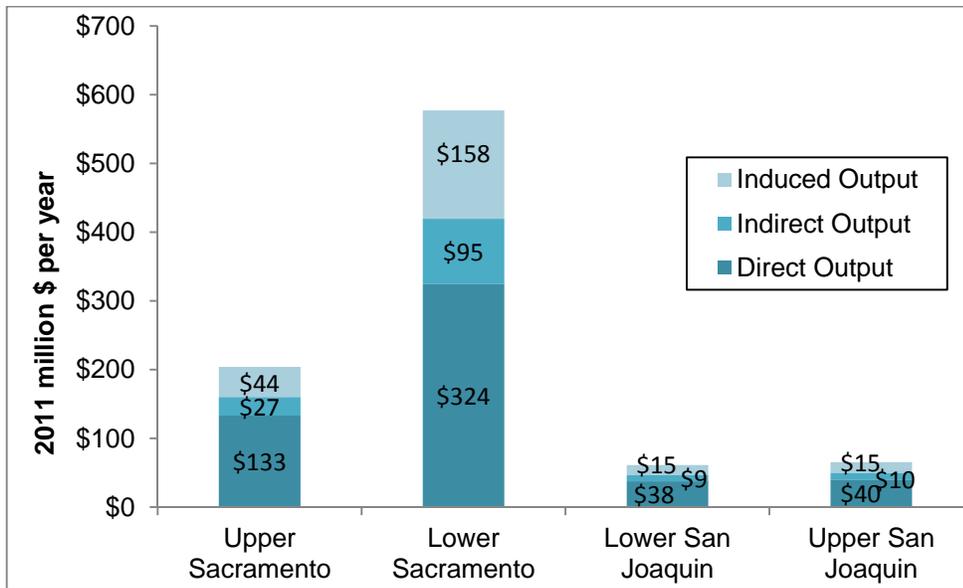
<sup>4</sup> Labor income represents the sum of employment income, including employee compensation (wages and benefits), and proprietor income.

<sup>5</sup> Value added is the difference between industry total output and the cost of intermediate inputs, and consists of four components – employee compensation, proprietor income, other property income, and indirect business tax.

<sup>6</sup> Output represents the total value of industry production.



**Figure 4-1. Annual Employment Effects of SSIA Project Construction Expenditure – High Estimate (20-Year Period)**



**Figure 4-2. Annual Industry Output (2011 Dollars, Million per Year) Effects of SSIA Project Construction Expenditure – High Estimate (20-Year Period)**

**Table 4-3. Summary of Annual SSIA Project Construction<sup>1</sup> Industry Output Total Effect<sup>2</sup> as Percentage of Total Regional Output<sup>3</sup> – Low and High Construction Expenditure Estimates (2011 Dollars, Million per Year)**

Regional Economic Impact Analysis Regions	Low		High	
	Construction Expenditure Output Effect (Total Effect <sup>2</sup> )	Percentage of Total Regional Output <sup>3</sup>	Construction Expenditure Output Effect (Total Effect <sup>2</sup> )	Percentage of Total Regional Output <sup>3</sup>
Upper Sacramento	\$167	0.66%	\$204	0.80%
Lower Sacramento	\$480	0.34%	\$577	0.41%
Lower San Joaquin	\$48	0.13%	\$61	0.16%
Upper San Joaquin	\$53	0.05%	\$65	0.06%
Regional Economic Impact Study Area	\$748	0.24%	\$908	0.29%

Notes:

<sup>1</sup> Project construction expenditure estimates include FloodSAFE Early Implementation Program projects under construction.

<sup>2</sup> Total effect is the sum of direct, indirect, and induced effects.

<sup>3</sup> Total regional output is based on 2009 California county IMPLAN dataset.

## 4.2 Economic Effects of Avoided Business Interruption

Flooding in commercial and industrial areas, as well as government centers, would force businesses to temporarily (and possibly permanently) discontinue operations. At a minimum, businesses would not be able to operate until structures have been dewatered, and health and safety inspections allow normal business operations to resume. The resumption of business activity would also be tied to the return of households to the local area, particularly for retail and other population-serving industries.

### 4.2.1 Annual Expected Avoided Business Loss

From a regional perspective, not all business production subject to flooding would be lost. Some portion of lost business production would simply be transferred to other parts of the study area; however, businesses that are not subject to flooding do not have unlimited capacity, and in fact, are limited by available labor and infrastructure. The analysis of potential business production impacts takes into account both business interruption and substitute production effects. A detailed description of the process and assumptions used to estimate direct business production impacts is outlined in Attachment 8F: Flood Damage Analysis. Table 4-4 displays avoided business losses by analysis region.

**Table 4-4. SSIA Expected Annual (Long-Term Average) Avoided Business Losses<sup>1,2</sup> (2011 Dollars, Million per Year) by Regional Economic Impact Analysis Regions**

<b>Regional Economic Impact Analysis Regions</b>	<b>Expected Annual Avoided Business Losses<sup>1</sup></b>
Upper Sacramento	\$10.93
Lower Sacramento	\$50.13
Lower San Joaquin	\$0.60
Upper San Joaquin	\$0.04
Total Regional Economic Impact Study Area	\$61.70

Note:

<sup>1</sup> Expected annual avoided business losses were estimated in Attachment 8F: Flood Damage Analysis by impact areas and were then aggregated by regional economic impact areas.

<sup>2</sup> Expected annual avoided business losses estimated in Attachment 8F: Flood Damage Analysis were adjusted to 2011 price levels using Consumer Price Index: All Urban Consumers.

#### 4.2.2 Employment and Industry Output Effects

A summary of the direct, indirect, and induced, regional economic impacts of avoided business losses is presented in Table 4-5. The values reported for industry output, value-added, and labor income represent monetary impacts and are reported in 2011 dollars. Because output incorporates the value of goods and materials used in the production process, it does not reflect the net economic value to the region. More pertinent to each region is the value added by local workers and businesses in the form of labor earnings, other property income, and indirect business taxes. Employment impacts represent the change in the number of equivalent annual full-time jobs in each region. Figures 4-3 and 4-4 display employment and industry output effects by each regional economic impact analysis region.

The results of the regional economic analysis show positive economic impacts for each region related to avoided business losses. Industries located in the floodplain would be the most affected in terms of potential declines in business production associated with flood events.

Table 4-5 displays total industry output effects as a percentage of total regional output by region. The largest avoided economic losses within the Lower and Upper Sacramento regional economic impact analysis regions are expected to occur in government and other non-NAICs industries.

Other prominently affected industries include professional and technical services and light manufacturing.

Within the Lower and Upper San Joaquin regional economic impact analysis regions, the largest avoided economic losses are expected in light manufacturing. Other prominently affected industries include government and non-NAICs, and professional and technical services.

**Table 4-5. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Employment and Industry Output Effects (2011 Dollars, Million per Year)**

Regional Economic Impact Analysis Regions	Economic Effect	Employment		Industry Output <sup>4</sup>	
		Jobs <sup>1</sup>	Labor Income <sup>2</sup>	Value Added <sup>3</sup>	Total Output
Upper Sacramento	Direct Effect	116	\$6.01	\$7.33	\$10.93
	Indirect Effect	11	\$0.49	\$0.84	\$1.40
	Induced Effect	38	\$1.55	\$2.72	\$4.37
	Total Effect	164	\$8.06	\$10.89	\$16.70
Lower Sacramento	Direct Effect	443	\$29.91	\$36.33	\$50.13
	Indirect Effect	58	\$3.25	\$5.34	\$8.63
	Induced Effect	208	\$10.09	\$17.64	\$27.38
	Total Effect	709	\$43.24	\$59.31	\$86.14
Lower San Joaquin	Direct Effect	5.4	\$0.28	\$0.36	\$0.60
	Indirect Effect	0.8	\$0.04	\$0.07	\$0.12
	Induced Effect	2.1	\$0.09	\$0.16	\$0.25
	Total Effect	8.3	\$0.40	\$0.59	\$0.97
Upper San Joaquin	Direct Effect	0.3	\$0.02	\$0.02	\$0.04
	Indirect Effect	0.1	\$0.00	\$0.00	\$0.01
	Induced Effect	0.1	\$0.01	\$0.01	\$0.01
	Total Effect	0.5	\$0.02	\$0.04	\$0.06
Regional Economic Impact Study Area	Direct Effect	564	\$36.21	\$44.04	\$61.70
	Indirect Effect	70	\$3.78	\$6.26	\$10.15
	Induced Effect	248	\$11.74	\$20.53	\$32.01
	Total Effect	882	\$51.73	\$70.82	\$103.86

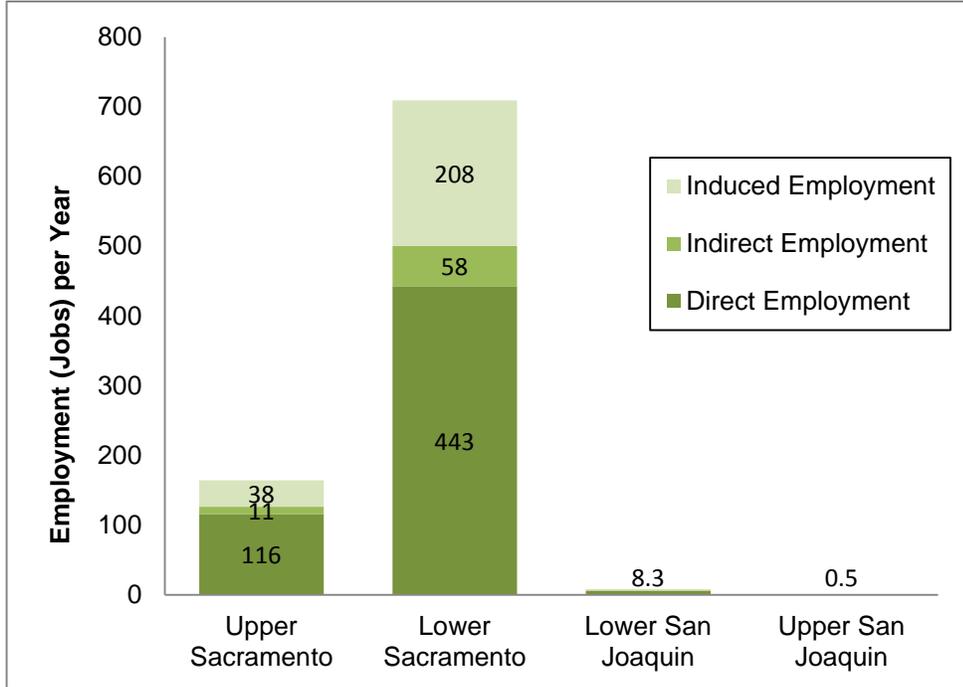
Notes:

<sup>1</sup> Employment values represent annual full-time, part-time, and temporary positions.

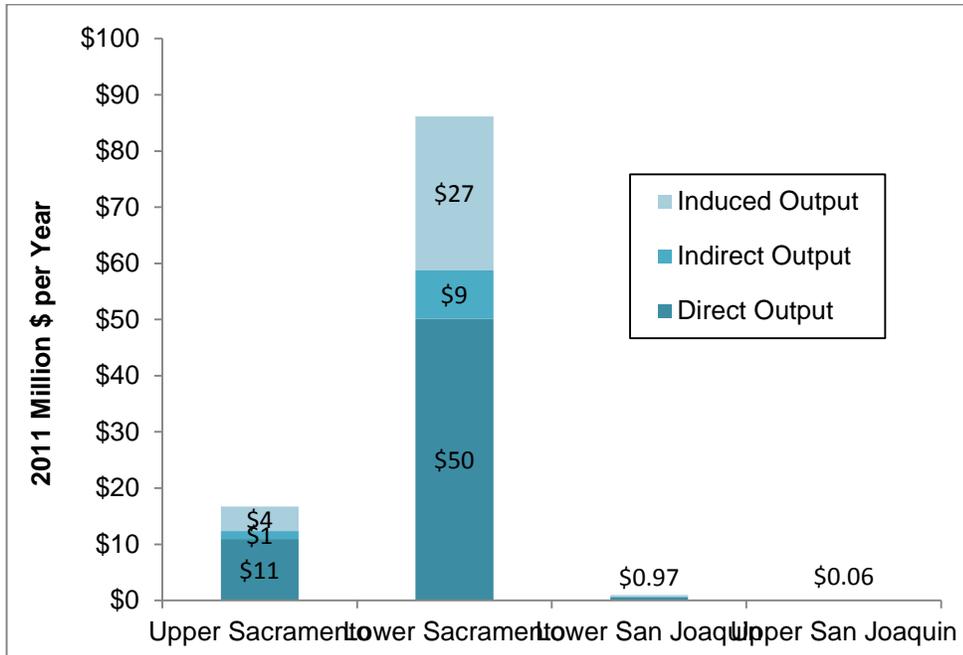
<sup>2</sup> Labor income represents the sum of employment income, including employee compensation (wages and benefits), and proprietor income.

<sup>3</sup> Value added is the difference between industry total output and the cost of intermediate inputs, and consists of four components – employee compensation, proprietor income, other property income, and indirect business tax.

<sup>4</sup> Output represents the total value of industry production.



**Figure 4-3. Expected Annual (Long-Term Average) Employment Effects of SSIA Avoided Business Losses**



**Figure 4-4. Expected Annual (Long-Term Average) Industry Output (2011 Dollars, Million per Year) Effects of SSIA Avoided Business Losses**

**Table 4-6. Summary of Expected Annual (Long-Term Average) SSIA Avoided Business Loss Industry Output Total Effect<sup>1</sup> as Percentage of Total Regional Output<sup>2</sup> (2011 Dollars, Million per Year)**

Regional Economic Impact Analysis Regions	Avoided Loss of Output (Total Effect <sup>1</sup> )	Percentage of Total Regional Output <sup>2</sup>
Upper Sacramento	\$16.70	0.06%
Lower Sacramento	\$86.14	0.06%
Lower San Joaquin	\$0.97	0.00%
Upper San Joaquin	\$0.06	0.00%
Regional Economic Impact Study Area	\$103.87	0.03%

Notes:

<sup>1</sup> Total effect is the sum of direct, indirect, and induced effects.

<sup>2</sup> Total regional output is based on 2009 California county IMPLAN dataset.

### 4.3 Assumptions and Limitations

The results of the regional economic analysis are affected by technical considerations and modeling assumptions that include the following for employment effects, project construction, avoided business losses, and other economic effects not analyzed.

#### 4.3.1 Employment Effects

Employment values represent annual full-time, part time, and temporary positions that can be converted to full-time annual equivalent jobs with ratios based on national averages from the BEA. Full-time annual equivalent jobs represent positions that involve 2,080 hours of work in a standard year. It is expected that the application of full-time annual equivalent conversion ratios to employment value results of this analysis would result in approximately a ten percent reduction in the number of jobs reported.

Estimated changes in employment are tied to economic relationships between industry output and labor productivity, regardless of availability and fluidity in the local labor force. In reality, hiring decisions are complex and typically take into account the duration of anticipated changes in production. Jobs reported for this analysis may be new, or created, jobs within each region or jobs simply supported in the industries affected by implementation of the SSIA. Project construction and flooding are short-term events that may not necessarily result in hiring of new employees;

instead, existing employee work patterns may be adjusted in response to fluctuations in demands.

### 4.3.2 Project Construction

Because the IMPLAN model is based on annual data, construction expenditures expected in each region were translated into annual values. Annual data were not developed based on project schedule and phasing, which reflect construction material, equipment, and labor requirements of the SSIA over time. Rather, construction expenditures were uniformly distributed over the 20-year construction period. Consequently, annual construction expenditures based on project schedule and phasing may be different from the uniform distribution of annual expenditures. The implications of this is that in a given year throughout the 20-year construction period, employment and output effects may be higher or lower than those displayed here, based on the expected construction activities to take place in a given year.

Project construction estimates include FloodSAFE Early Implementation Program projects that are under construction. Therefore, a portion of project construction employment and industry output effects may already be realized in regions where project construction has occurred.

Project construction impacts are based on the estimate of current construction costs and were not adjusted to account for escalation of costs.

Project construction will be funded by a mix of federal, State, and local funds. Project construction paid for with local funds will result in minimal if any *net* economic effects on the regional economy. This is because the positive effects of increased spending to the region's construction sector will be offset by reduced spending elsewhere within the region's economy. Consequently, it is project construction spending funded by federal and State funds that will contribute "new" money to the region's economy. SSIA implementation projects assumed 46 percent, 46 percent, and 8 percent of project construction costs to be funded by federal, State, and local funds, respectively. This cost share was used in this analysis. If the local cost share for project construction is lower or higher than 8 percent, employment and output effects would be lower or higher than those displayed here, respectively.

### 4.3.3 Avoided Business Losses

Avoided business loss impacts are expected annual effects and represent temporary effects in a given year, based on expected (long-term average) avoided business losses. A 500-year flood event in a given year would likely result in substantially more employment effects than displayed here,

while a 10-year flood event would likely result in fewer employment effects, if any at all. Outlays for emergency services may help offset some portion of the adverse economic effects associated with business loss damages in a flood event.

Business activities are tied to residents in a local area, particularly for retail and other population-serving industries. During a flood event it is likely that residents in a local area will temporarily, and potentially permanently, relocate from a flooded area, which would change the demand for business goods and services. For this analysis, permanent relocations were not analyzed, nor their effects on demand for business related goods and services were considered.

During a flood event, businesses would likely temporarily or permanently suspend business operations. Temporary business interruption is the basis for business losses estimated in Attachment 8F: Flood Damage Analysis, and the economic impacts displayed here. No permanent business closures were considered in this analysis because detailed information and analyses to understand the proportion of businesses to permanently close were not available.

Not all business production subject to flooding would be lost. Some portion of lost business production would simply be transferred to other parts of the study area; however, businesses that are not subject to flooding do not have unlimited capacity, and in fact, are limited by available labor and infrastructure. The analysis of potential business production impacts takes into account substitute production effects. For more details, please see Attachment 8F: Flood Damage Analysis.

Business loss insurance would offset some portion of the adverse economic effects associated with business loss damages in a flood event. No business loss insurance was considered in this analysis because detailed information and analyses to understand the proportion of businesses to receive business loss insurance and the value of coverage were not available.

#### **4.3.4 Other Economic Effects Not Analyzed**

Regional economic effects related to avoided structure and content damages expected with implementation of the SSIA were not quantified in this analysis because detailed information and analyses were not available for determining the potentially offsetting nature of flood damages and reconstruction and replacement effects.

Direct agricultural production damages expected to be avoided with implementation of the SSIA were estimated and documented in Attachment 8F: Flood Damage Analysis. This analysis did not estimate the indirect and

induced effects, or ripple effects, of direct, avoided agriculture damages because direct agriculture damages estimated in the flood damage analysis are based on a net income approach which only allows induced economic effects to be estimated with IMPLAN.

Regional economic effects related to transportation and energy disruptions, emergency services, and population displacement due to flooding were not analyzed for this high level regional economic impact analysis. These analyses may be completed for future State basin-wide feasibility studies to support regional planning activities.

Regional economic effects of recreation disruptions during project construction were not analyzed for this high level regional economic impact analysis. Recreation disruptions during project construction may be analyzed for future State basin-wide feasibility studies to support regional planning activities.

*This page left blank intentionally.*

## 5.0 Other Regional Economic Impact Effects

This section describes other potential regional economic effects of the SSIA that were not quantified in Section 4. For the 2012 CVFPP, available information did not support detailed analyses for these effects. These analyses may be completed for future State basin-wide feasibility studies. These effects include:

- Property values
- Fiscal impacts on municipalities
- Regional economic competitiveness and diversity

### 5.1 Property Value Impacts

The values of inundated residential, commercial, and industrial properties would all be adversely affected by floods (residential, commercial, and industrial structures at risk of flooding are documented in Attachment 8F: Flood Damage Analysis). The immediate extent of lost value would depend on such factors as the level of inundation and the time required for dewatering. Property values would likely decline if flood damage forced permanent abandonment of the structures or otherwise caused significant damage. Future values would be based on the buyers' willingness to pay for the properties, which would depend, in part, on flood damage reduction measures implemented following major flood events. Neither the diminution nor the future values of properties could be estimated for this study.

### 5.2 Fiscal Impacts on Municipalities

The fiscal effects of the SSIA on municipalities would be due to changes in sales tax, property tax, and income tax revenues, as well as the local government expenditures made during emergency responses during flood events.

During construction, the SSIA would generate sales tax revenues attributed to the local purchase of construction goods, materials, and equipment subject to sales taxes. Sales taxes would also be augmented by local

purchases made by construction workers and federal workers supported by project payrolls. Indirectly, businesses that supply construction goods and materials and serve the project labor force would also generate sales tax revenues through inter-industry purchases and expenditures made to support standard business operations. The latter effects are captured in the estimates of indirect business taxes that are included in the estimated value added reported by IMPLAN (refer to Section 4). Other components of indirect business taxes captured in the IMPLAN results include excise taxes, property taxes, fees, and licenses paid by local businesses. Finally, project payrolls would generate State and federal income taxes paid by workers. Although most income taxes do not go directly to local municipalities, income tax revenues can provide local benefits through inter-governmental transfers of fiscal revenues.

During and after flood events, both local sales and income tax revenues would likely decrease as a result of lost business production and reduced household spending. However, the primary fiscal effect on local governments would likely be a reduction in property tax revenues. In the short term, coinciding with the flood event and subsequent reconstruction efforts, the property tax base in the inundated region could be substantially reduced as a result of structural and property damages. Depending on the duration of reconstruction efforts, the assessed value of damaged properties may decline substantially, resulting in reductions in the locally assessed value of properties and corresponding effects on property tax revenues. These adverse tax effects would likely be temporary, lasting until reconstruction efforts are complete. Implementation of the SSIA would reduce the chance of flooding, therefore reducing these potential negative financial effects on municipalities.

### **5.3 Regional Economic Competitiveness and Diversity**

In the short term, the floods considered for this study could potentially cause drastic losses of lives as well as property. In those events, and during the cleanup and restoration periods, the area would be less competitive than otherwise because of reduced outputs, employment, and income. In the long run, however, it is likely that businesses looking to move from other locations or deciding on whether to remain in each region would continue to analyze the factors most important for such decisions, such as proximity to markets, labor, and required raw materials, costs of electricity, natural gas, water, telephone services, transportation infrastructure, and taxes.

In the short and long run, economic and industrial diversity in each region may adversely be affected by floods. If certain industries in the area are

## 5.0 Other Regional Economic Impact Effects

concentrated in the impact areas, many of those businesses are likely to close temporarily and potentially permanently. Consequently, the aggregate output of those businesses will decline in the near term. In the long term, however, assuming those impacted businesses reopen, it is more likely that each region will continue to diversify. Available data, however, do not permit the estimation of those impacts.

*This page left blank intentionally.*

## 6.0 References

- California Department of Water Resources (DWR). 2008. Economic Analysis Guidebook. January.
- . 2010. State Plan of Flood Control Descriptive Document. November.
- DWR. *See* California Department of Water Resources.
- Minnesota IMPLAN Group. 2009. 2009 IMPLAN dataset for California Counties.
- Rose, A. 2006. Regional Models and Data to Analyze Disaster Mitigation and Resilience. School of Public Policy, Planning and Development, and Center for Risk and Economic Analysis of Terrorism Events. University of Southern California, Los Angeles, November 9.
- USACE. *See* U.S. Army Corps of Engineers.
- U.S. Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. Washington D.C., April 22. Available at: <http://140.194.76.129/publications/eng-regs/er1105-2-100/toc.htm>
- . 2011. Regional Economic Development Procedures Handbook. Institute of Water Resources, Alexandria, Virginia. May 2011.
- U.S. Water Resources Council. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. U.S. Water Resources Council. U.S. Government Printing Office, Alexandria, Virginia. March 10.

*This page left blank intentionally.*

## 7.0 Acronyms and Abbreviations

BEA.....	U.S. Department of Commerce Bureau of Economic Analysis
Board .....	Central Valley Flood Protection Board
CGE .....	Computable General Equilibrium
CVFPP .....	Central Valley Flood Protection Plan
Delta.....	Sacramento-San Joaquin Delta
DWR .....	California Department of Water Resources
HEC-FDA .....	Hydrologic Engineering Center Flood Damage Reduction Analysis Software
IMPLAN.....	IMPact Analysis for PLANning
I-O.....	input-output
NAICS .....	North American Industry Classification
SIC .....	Standard Industry Codes
SPFC .....	State Plan of Flood Control
SSIA.....	State Systemwide Investment Approach

*This page left blank intentionally.*



