Economic Sustainability Plan for the Sacramento-San Joaquin Delta

Delta Protection Commission

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Delta Protection Commission

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Acronyms & Abbreviations

AAR	Association of American Railroads
ACE	Altamont Commuter Express
ACS	The American Community Survey
The Act	Delta Reform Act of 2009
AIC	Agricultural Issues Center
AWAF	Abandoned Watercraft Abatement Fund
BART	Bay Area Rapid Transit
BDCP	Bay Delta Conservation Plan
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
BNSF	Burlington Northern Santa Fe Railway
CalEMA	California Emergency Management Agency
Caltrans	California Department of Transportation
CBDA	California Bay-Delta Authority
CCWD	Contra Costa Water District
CDBG	Community Development Block Grant
CDEC	California Data Exchange Center
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
Cfs	Cubic Feet per Second
CM	Conservation Measure
CPI	Consumer Price Index
CTTC	California Trade and Tourism Commission
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CWC	California Water Code
The Delta	The Sacramento–San Joaquin Delta
DAPC	The Delta Area Planning Council
DBW	Department of Boating and Waterways
DDRMT	Delta Dredging and Reuse Management Team
Delta Conservancy	The Sacramento–San Joaquin Delta Conservancy
DFG	Department of Fish and Game
DHCCP	Delta Habitat Conservation and Conveyance Plan
DMMO	Dredge Material Management Office
DMV	Department of Motor Vehicles
DPC	Delta Protection Commission
DRMS	Delta Risk Management Strategy
DSC	Delta Stewardship Council
DTVT	Daily total vehicle trips
DWR	Department of Water Resources
EDI	Economic Development Initiative
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Federal Endangered Species Act
ESP	Economic Sustainability Plan
EPA	Environmental Protection Agency
FDPA	Flood Desaster Protection Act of 1973

FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FMPP	California Farmland Mapping and Monitoring Program
FY	Fiscal Year
GED	General Educational Development
GIS	Geographic Information System
GRP	Gross Regional Product
HMP	Hazard Mitigation Plan
HTE	Hultgren-Tillis Engineers
ICS	Incident Command System
IEP	Inter-Agency Ecological Program
IRP	Independent Review Panel
IRR	Internal Rate of Return
JPA	Joint-Powers Authority
LED	Local Employment Dynamics
LEHD	Longitudinal Employer-Household Dynamics
LiDAR	Light Detection and Ranging
LMA	Locke Management Association
LTMS	Long-Term Management Strategy
MACS	Multi-Agency Coordination System
MGD	Million Gallons Per Day
MLLW	Mean Lower Low Water
MOU	Memorandum of Understanding
MW	Megawatt
MWD	Metropolitan Water District of Southern California
NAICS	North American Industry Classification System
NAIP	National Agriculture Imagery Program
NASS	National Agricultural Statistics Service
NBA	North Bay Aqueduct
NETS	National Establishment Time Series
NFIP	National Flood Insurance Program
NGO	Non-Governmental Organization
NIMS	National Incident Management System
NRC	National Research Council
NCCPA	California Natural Communities Conservation Planning Act
NP	Non-Project
NPDES	National Pollutant Discharge Elimination System
NP-NU	Non-Project Non-Urban
NULE	Non-Urban Levee Evaluations
PG&E	Pacific Gas and Electric Company
PL	Public Law
POD	Pelagic Organism Decline
PPIC	Public Policy Institute of California
PWC	Personal Watercraft
RESIN	Resilient and Sustainable Infrastructure Networks
ROA	Restoration Opportunity Area
ROW	Right of Way
SA	Study Area
SAFCA	Sacramento Area Flood Control Agency
SB	Senate Bill
SEMS	Standardized Emergency Management System

SFHA	Special Flood Hazard Area
SHRA	Sacramento Housing and Redevelopment Agency
SJAFCA	San Joaquin Area Flood Control Agency
SPK	The Sacramento District of U.S. Army Corps of Engineers.
SRA	State Recreation Area
SWP	State Water Project
SWRCB	State Water Resources Control Board
TNC	The Nature Conservancy
TRPA	Tahoe Regional Planning Agency
UC	University of California
ULDC	Urban Levee Design Criteria
ULE	Urban Levee Evaluations
UOP	University of the Pacific
UPL	Urban Project Levee
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WSAFCA	West Sacramento Area Flood Control Agency

Glossary of Key Terms

Appellation
A designated region of winegrowing (e.g., the Clarksburg appellation in Yolo County, which has 10 wineries and 11,000 acres of vineyards).

Bay Delta Conservation Plan
The Bay Delta Conservation Plan is being prepared through a collaboration of state, federal, and local water agencies, state and federal fish agencies, environmental organizations, and other interested parties with the goal of protecting and restoring the ecological health of California's Sacramento–San Joaquin River Delta and providing a more reliable water supply.

Bay-Delta Accord
CALFED Bay Delta Accord is an agreement developed by state and federal agencies with stakeholders. It initiated a long-term planning process to improve the Delta and increase the reliability of its water supply.

CALFED
CALFED coordinates with 25 state and federal agencies to improve California's water supply and the health of the San Francisco Bay/Sacramento–San Joaquin River Delta.

California Bay-Delta Authority
Created in 2003, this body oversees the implementation of the CALFED program. It is comprised of state and federal agency representatives, public members, a member of the Bay-Delta Public Advisory Board, ex-officio legislative members, and members at large. The California Bay-Delta Act of 2003 established the Authority as CALFED's governance structure.

California Emergency Management Agency
Responsible for the coordination of overall state agency response to major disasters in support of local government.

California Natural Resources Agency
Previously called the California Resources Agency. Pertinent to the Delta, departments within the agency include Department of Boating and Waterways, Department of Conservation, Department of Fish and Game, Department of Forestry and Fire Protection, Department of Parks and Recreation, and Department of Water Resources.

California Water Resources Development Bond Act
Also known as the Burns-Porter Act, this bill was narrowly passed by California voters in 1960. It approved funding for the State Water Project.

California Trade and Tourism Commission
Among its many activities and services, CTTC maintains data and survey numbers on tourism and the economic impact of tourism within the State of California.

Central Valley Flood Protection Plan
Established by Senate Bill 5 in 2008. It is to be an integrated flood-management plan for the Sacramento–San Joaquin River Flood Management System, and its development is overseen by the California Department of Water Resources (DWR). The plan is required by law to be complete by Jan. 1, 2012.

Central Valley Project
A network of 20 dams plus reservoirs, aqueducts, canals, and pumping stations to provide flood control, water storage, and water delivery throughout California's central valley, stretching from the Klamath River in the north state to the Kern River near Bakersfield. Begun in 1933, the CVP is an ongoing project.

Delta Primary Zone
The lower elevation and largely water-covered and agricultural lands in the "core" of the Legal Delta, approximately 500,000 acres of waterways, levees, and farmed lands

extending over portions of five counties: Solano, Yolo, Sacramento, San Joaquin, and Contra Costa

Delta Secondary Zone

The higher elevation and already-developed area outside the Primary Zone and within the Legal Delta

The Legal Delta

The entire region of the Delta including both the Primary Zone and the Secondary Zone

Delta Area Planning Council

Established in the early 1970s and funded by Delta. It adopted a plan for the region which supported agricultural and recreational land uses.

Delta Community Area Plan (1983)

Designates most of the Delta as permanent agricultural land in 80-, 40-, and 20-acre parcels

Delta Legacy Communities

A handful of selected Delta towns that have high cultural, historic, or ambiance value that give the Delta a distinctive sense of place. Examples are Clarksburg, Courtland, Isleton, Locke, Ryde, and Walnut Grove. A goal of the Economic Sustainability Plan is to promote economic development/sustainability in these Legacy Communities in a way that will capitalize on and preserve each community's unique characteristics.

Delta Protection Act of 1992

This act established the Delta Protection Commission, defined the Primary Zone and the Secondary Zone of the Delta. The Delta Protection Act requires the DPC to prepare, adopt, review, and maintain a comprehensive long-term resource management plan for land uses within the Primary Zone.

Delta Protection Commission

Established by the California Legislature in 1992, membership includes state agencies, local counties and cities, and Delta water agencies. The DPC was charged with preparing a land-use and resource-management plan for the Primary Zone of the Delta, addressing agriculture, recreation, and wildlife habitat on land areas. Action of local governments in the Primary Zone can be appealed to the DPC. The commission has no authority over state or federal agencies or their programs or projects.

Delta Protection Commission Land Use and Resource Management Plan

The Delta Protection Act requires the DPC to prepare, adopt, review, and maintain a comprehensive long-term resource management plan for land uses within the Primary Zone. The original plan was drafted, reviewed, and adopted by the DPC on February 23, 1995. The policies of the plan were adopted as regulations in December 2000. The DPC established a planning advisory committee, which began meeting in September 2008 and revised the plan; DPC adopted the revisions in 2010.

Delta Reform Act of 2009

This act established the Delta Stewardship Council (DSC) and directs completion of its Delta Plan by January 1, 2012.

Delta Stewardship Council

The primary responsibility of the Delta Stewardship Council is to develop, adopt, and implement by January 1, 2012, a legally enforceable, comprehensive, long-term management plan for the Sacramento–San Joaquin Delta and the Suisun Marsh—the Delta Plan—that will achieve the coequal goals of "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem" and does this "in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."

Delta Vision Blue-Ribbon Task Force

A Blue-Ribbon Task Force of seven appointed citizens that supervised preparation of a Delta Vision for adoption and submittal to the Delta Vision Committee (2006-2008)

Delta Vision Strategic Plan:
The result of the Blue-Ribbon Task Force, the plan was presented to the governor in 2008. It contained seven over-arching goals, the first of which was to "Legally acknowledge the coequal goals of restoring the Delta ecosystem and creating a more reliable water supply for California." Other goals target ecosystem restoration, water conservation, water conveyance and storage, risk reduction and levee investment, and a new governance structure to achieve the goals.

Department of Water Resources
Located within the Resources Agency, oversees the state's water management, flood protection, the State Water Project, and water planning.

Direct effects
In economic impact assessment, direct effects are the changes in sales (output), wages (personal income), and jobs (employment) related exclusively to each sector. This includes all sales and costs incurred by both visitors and residents.

Employment
In economic impact assessment employment demonstrates the number of full- and part-time jobs generated on an annual basis.

Hazard Mitigation Plan (FEMA)
This levee standard provides for a 16-foot crown width, a 1-foot freeboard above the 100-year water surface elevation, minimum 1.5-to-1 waterside slopes, and minimum 2-to-1 landslides slopes.

Indirect effects
In economic impact assessment, indirect effects represent the iterative impacts of inter-industry transactions as supplying industries respond to the increased demands from the direct recipient of these revenues. An example of indirect effects would include a hotel increasing its purchase of linen to meet the demand of people staying overnight in the Delta.

Induced effects
In economic impact assessment induced effects reflect household consumption expenditures of direct and indirect sector employees. Examples of induced benefits include employee's expenditures on items such as retail purchases, housing, medical services, banking, and insurance.

Isolated Conveyance Facility
A canal or pipeline that transports water between two different locations while keeping it separate from Delta water.

Johnston-Baker-Andal-Boatwright Delta Protection Act of 1992
The act created the Delta Protection Commission and divided the Legal Delta into two zones—the Primary Zone and the Secondary Zone.

Labor Income
Labor income is also referred to as personal income or employee compensation. It includes wages, salaries, benefits, and all other employer contributions. This measures the financial value of associated employment.

Levee
Structures built adjacent to rivers in the Sacramento–San Joaquin Delta for flood control and water conveyance. There are nearly 1,000 miles of levees in the Legal Delta.

Locke Management Association
Created as a form of governance for the town of Locke. Membership of the board is equally balanced between building owners, government representatives, and representatives of local Chinese cultural groups.

Non-project levees
Levees built and maintained by local reclamation districts.

Output

Output is sometimes referred to as revenue or sales. Output accounts for the total changes in the value of production in an industry for a given time period. This includes revenue from all sources of income to determine current activity levels.

PL 84-99

A standard for levee construction. In 1987, the U.S. Army Corps of Engineers set the federal Delta-specific standards for levees in Public Law 84-99 sets the federal Delta-specific standards for levees in 1987. It provides for a crown width of 16 feet, freeboard of 1.5 feet over the 100-year water surface elevation, a minimum waterside slope of 2-to-1, and landside slopes that vary as a function of the depth of peat and the height of the levee such that the static factor of safety on slope stability is not less than 1.25

Project levees

Project levees were constructed by the U.S. Army Corps of Engineers as part of federal-state flood control projects and were turned over to the state for operations and maintenance. The state has in turn generally passed on the responsibility for routine maintenance to local reclamation districts, although the Paterno Decision confirmed the state's continued basic liability with respect to these levees.

Sacramento–San Joaquin Delta Conservancy

Legislation enacted in 2009 created the conservancy to act as a primary state agency to implement ecosystem restoration in the Legal Delta and to support environmental protection and the economic well-being of Delta residents.

State Water Project

Approved by voters in 1960, the State Water Project provides water for 25 million Californians (two-thirds of the state's population) and 750,000 acres of irrigated farmland. Approved by voters in 1960, the State Water Project is a water storage and delivery system of 34 storage facilities, reservoirs, and lakes; 20 pumping plants, 4 pumping-generation plants; 5 hydroelectric power plants, and 700 miles of open canals and pipelines. It is maintained and operated by the California Department of Water Resources.

Total effects

In economic impact assessment, total effects are the sum of the direct, indirect, and induced effects

Urban Levee Design Criteria

The ULDC is generally consistent with the SPK practice and has the same geometric requirements. However, the ULDC goes much further in defining required practice in a number of other areas including seismic loadings, encroachments, penetrations and vegetation.

Value Added

Value added, represents the distinct value added to a product during the production process.

Chapter 1: Introduction

The Sacramento-San Joaquin River Delta is a unique place of economic, environmental, historic, and cultural significance. The land and water resources of the Delta support significant agricultural and recreation economies, and the Delta also has an important role as an infrastructure hub for water, energy, and transportation. The region's rich history boasts of bustling, river-based commerce before the automobile age, and its cultural uniqueness includes the only rural town in America build by early Chinese immigrants. As the largest estuary on the west coast of the Americas, the Delta also is a place of striking natural beauty and ecological significance that is struggling with serious environmental degradation problems. Although surrounded by growing cities, the Delta remains a highly-productive agricultural area with rural charms, landscapes, and waterscapes not found elsewhere in California.

In recent years, there has been great concern over increasing environmental degradation in the Delta and over court decisions that reduced the quantity of water delivered to southern California through the state and federal water project intakes in the south Delta to protect endangered fish. Combined with additional concerns about the stability of the Delta's levee system, these concerns led the California legislature to pass the Delta Reform Act of 2009. The Act created the Delta Stewardship Council and charged it with developing a Delta Plan to achieve the coequal goals of "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem."

Recognizing the potential impact of the Delta Plan on the people and economy of the Delta, the Delta Reform Act stated that the coequal goals of water supply reliability and restoring the Delta ecosystem "shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." Among the measures to address this goal, the Delta Protection Commission was tasked with developing this Economic Sustainability Plan to inform the Delta Stewardship Council's development of the Delta Plan.

The Legislature established the following guidelines for the Economic Sustainability Plan in the Delta Reform Act of 2009.

The economic sustainability plan shall include information and recommendations that inform the Delta Stewardship Council's policies regarding the socioeconomic sustainability of the Delta region. (b) The economic sustainability plan shall include, but not be limited to, all of the following:

1) Public safety recommendations, such as flood protection recommendations.
2) The economic goals, policies, and objectives in local general plans and other local economic efforts, including recommendations on continued socioeconomic sustainability of agriculture and its infrastructure and legacy communities in the Delta.
3) Comments and recommendations to the Department of Water Resources concerning its periodic update of the flood management plan for the Delta.
4) Identification of ways to encourage recreational investment along the key river corridors, as appropriate.

Since a key purpose of this Economic Sustainability Plan is to inform the Delta Plan under development by the Delta Stewardship Council, this report analyzes the impact of key policies being considered for the plan on the economic sustainability of the Delta. Many of the most significant proposals for the Delta are being developed in the Bay Delta Conservation Plan

(BDCP). The policy proposals can be grouped into four categories: 1) water conveyance, 2) habitat creation, 3) levees, and 4) land use regulation. The report also considers many aspects of economic sustainability in the Delta that are unrelated to these water policy proposals including economic development recommendations in the 2008 Delta Vision Strategic Plan.

Thus, in addition to the goals stated in legislation, the following goals have also been established as critical to developing information and recommendations to support economic sustainability in the Delta.

- Provide a thorough analysis of the baseline and trends for key sectors of the Delta economy.
- Identify the linkages between the Delta economy and the regional and state economy.
- Provide the most complete available assessment of the condition of Delta levees.
- Develop a vision for economic sustainability of Delta Legacy Communities.
- Create a detailed model of the effects of water policy proposals on Delta agriculture.
- Assess the effect of water policy proposals on the recreation and tourism economy, other economic sectors, and key Delta infrastructure.
- Integrate the findings into a general set of economic sustainability recommendations and strategies for the Delta.
- Integrate the findings into a specific set of recommendations on the issues under consideration by the Delta Stewardship Council for inclusion in the Delta Plan.

Many of these goals involve new research and analysis to support Delta decision making. The last two goals integrate these findings into specific recommendations for policy and economic development and make up the Economic Sustainability Plan.

In order to be adopted into the Stewardship Council's Delta Plan, the recommendations in the Economic Sustainability Plan must be consistent with the coequal goals of improving water supply reliability and protecting, restoring, and enhancing the Delta ecosystem. The legislature also stated that the "coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." Thus, the Economic Sustainability Plan can provide important guidance on evaluating the degree to which proposed actions to address the coequal goals support or conflict with the objective of protecting and enhancing the Delta.

The concept of economic sustainability and the objective to "protect and enhance the unique cultural, recreational, natural resources, and agricultural values of the California Delta as an evolving place" can be interpreted in different ways. In economic terms, there was consensus among Delta Protection Commission Stakeholders that a minimum requirement is to maintain the economic value of the entire Delta economy in the future. The Fifth Staff Draft of the Delta Stewardship Council's Delta Plan uses a stronger definition of economic sustainability where growth in one sector is not a substitute for deterioration in another area. Specifically, the Fifth Staff Draft Delta Plan defines performance measures for economic sustainability as maintaining or increasing gross revenues in each of three key sectors: agriculture, recreation, and ecotourism/agritourism. The peer review panel for the ESP found this to be too strong and recommended that sustainability should allow for the growth in one sector to substitute for decline in another sector. The ESP follows these guidelines and considers the potential for substitution between sectors in developing recommendations. In addition, there is broad agreement that this objective requires the protection of the cultural and historical heritage and the long-term economic viability of the Delta's historical Legacy Communities.

Limitations of the Plan

While the list of goals is lengthy, there are a few related issues that are outside the scope of this assessment. As an economic sustainability plan, the focus of the report is the long-run prospects of ongoing economic activities, not short-term impacts from investments or events. In addition, the assessment is limited to the economic impacts in the Delta region and the impact of activities that originate or primarily take place within the Delta. Thus, it is important to emphasize the following two limitations.

1. *The report does not assess short-run economic impacts of proposed capital spending.*

   Many of the policy proposals evaluated in the report—including levee upgrades, isolated water conveyance facilities, and habitat restoration projects—involve millions or billions of dollars in capital investment. The construction activity for these investments would create a substantial short-run burst of economic activity in the Delta region, creating local jobs and income. Although these short-run impacts are not part of our economic sustainability assessment, other reports may address these issues in the future.[1] We caution readers that the regional economic impacts of a capital investment are not necessarily proportional to the size of the expenditure, as different projects have very different cost compositions, varying levels of local expenditures, and therefore highly variable regional impacts. For example, levee improvements could be designed and constructed with expertise and equipment inside the Delta, whereas a larger share of spending for design and equipment needed for complex, isolated conveyance tunnels would necessarily occur outside the Delta. In addition, the construction process itself would disrupt traffic and existing economic activity in the Delta in complex ways that have not been sufficiently described.

2. *The report is not a comprehensive cost-benefit analysis of Delta water conveyance options*.

   New water conveyance facilities are the most significant and controversial proposal for the Delta. As the work plan for this project was developed, the main proposal in the BDCP was a 15,000-cfs tunnel conveyance, but the process was being opened up to consider a much broader variety of options to improve the reliability of conveyance. The 15,000-cfs tunnel remains the leading proposal and is the only alternative to through-Delta conveyance examined in this report due to the infeasibility of analyzing so many alternatives and the lack of detailed descriptions for the alternatives. Some qualitative inferences can be made about different size conveyance based on the 15,000 cfs analysis, but more detailed analysis is not feasible at this time. In addition, all of the water conveyance proposals have costs and benefits that extend far outside the Delta. This report assesses the effect of the tunnel conveyance on the Delta economy, which is an important input to a comprehensive cost-benefit analysis with a statewide focus. In a few places, out-of-Delta impacts are considered when they have implications for the operation of in-Delta assets such as water conveyance that could have important implications for the Delta economy.

[1] At the September 27, 2011 BDCP meeting, "Employment Impacts for Proposed Bay Delta Water Conveyance Tunnel Options" was presented. The analysis is reasonable, and the presentation includes the appropriate qualifications and caveats, just as this report is stating the limitations up front. The presentation did not include impacts for alternative options such as large levee upgrades, investments in alternative water supplies such as efficiency improvements, water recycling, and desalination. In addition, the presentation does not consider the negative employment impacts of the substantial increase in water rates this project would create.
http://baydeltaconservationplan.com/Libraries/News/Employment_Impacts_for_Proposed_Bay_Delta_Conveyance_Tunnel_Options.sflb.ashx

3. *The report is not a comprehensive cost-benefit analysis of ecosystem improvement and restoration proposals.*

   The intrinsic value of a healthy Bay-Delta estuarine ecosystem is high and a restored ecosystem would also enhance some market economic values outside the Delta, such as commercial and sport salmon fishing. These are values that would be incorporated into a comprehensive cost-benefit analysis of ecosystem measures, but are outside the scope of our analysis on the Delta economy.

With respect to these last two limitations, comprehensively evaluating the statewide costs and benefits of proposed water supply infrastructure and ecosystem restoration proposals is not the role of the Delta Protection Commission or the Economic Sustainability Plan (ESP). It is the role of the agencies that will make the decisions about what goes into the Delta Stewardship Council's Delta Plan. This includes the Delta Stewardship Council itself as well as the state and federal agencies involved in developing the Bay Delta Conservation Plan (BDCP). At this point, neither of the draft Delta Plan or the working groups of the BDCP contains any plans for comprehensive benefit-cost analysis to inform decision making.[2] There are many guides to conducting such an analysis, including, but not limited to, the Department of Water Resources' Economic Analysis Guidebook (2008).[3] The analysis in the Economic Sustainability Plan could be used as a component or first step towards this broader analysis.

The independent review panel for the ESP also strongly recommended a comprehensive cost-benefit analysis be conducted by the Stewardship Council. The review panel is correct that the absence of such an analysis weakens the support for the recommendations of the ESP. However, it is important to note that a lack of cost-benefit analysis also means that the recommendations in every Delta Plan including those produced by the BDCP and the Stewardship Council are not supported by the best available economic science. Despite some problems discussed later in the ESP, the Delta Risk Management Strategy Phase 2 (2011) produced by the Department of Water Resources is a benefit-cost analysis that finds that an improved levees scenario has the highest cost-benefit ratio analyzes, including isolated conveyance assumed to cost less than half current estimates. There are problems with the DRMS Phase 2 study that are discussed in chapter 5 of this report, but most of these issues would favor a levee strategy over conveyance. The best approach towards a credible cost-benefit analysis is to build on the existing DRMS phase 2 analysis with updated scenarios informed by an independent peer review as was conducted for DRMS phase 1.

Geographic Focus of the Study

The boundaries of the Legal Delta are shown in Figure 1. The Delta Protection Act of 1992 defined the Delta boundaries including the Primary and Secondary Zone and created the Delta Protection Commission, charging it with developing a Land Use and Resource Management Plan for the Primary Zone. The majority of the Delta's 738,000 acres of land is in the rural and agricultural Primary Zone. The population of the Primary Zone is approximately 12,000 and has remained steady in the nearly 20 years since the passage of the Delta Protection Act.

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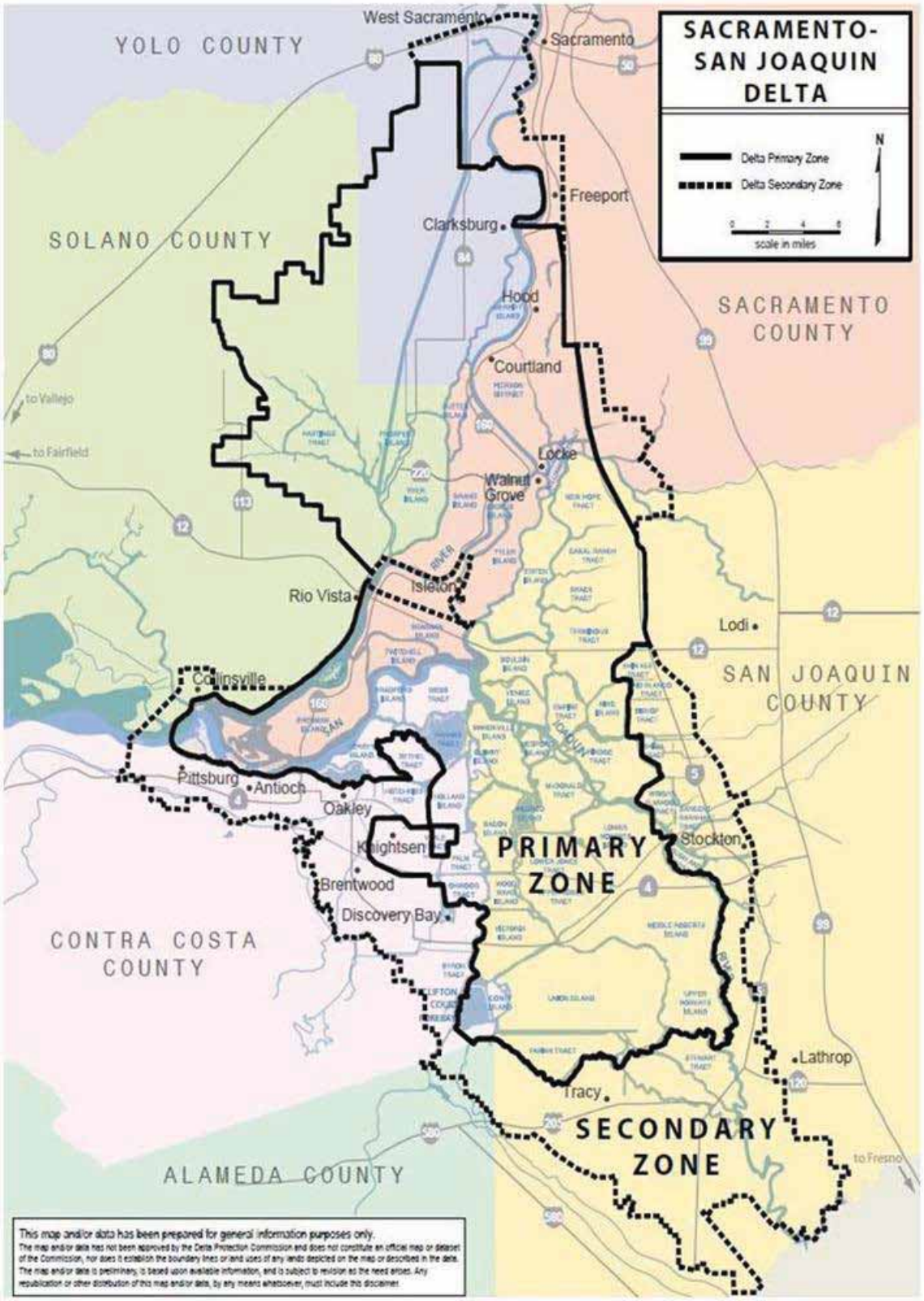
[2] In response to a question at the September 27, 2011 BDCP meeting, Deputy Resources Secretary Meral said a more comprehensive economic analysis was beginning, although it was unclear whether it would be a full cost-benefit analysis and what alternatives would be analyzed. At this time, there is no related BDCP workgroup or official announcement of this project, its scope and timeframe.

[3] California Department of Water Resources (CDWR). 2008. *Economic Analysis Guidebook*. http://www.water.ca.gov/economics/downloads/Guidebook_June_08/EconGuidebook.pdf.

Figure 1 Map of the Primary and Secondary Zones of the Sacramento San Joaquin Delta



Source: Delta Protection Commission. Accessed 2011-06-30

The Legal Delta including both the Primary Zone and Secondary Zone, contains significant portions of five counties, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo, and a small rural corner of Alameda County. The Delta includes parts of several large cities including Antioch, Pittsburg, Stockton, Sacramento, Tracy, and West Sacramento. The Legal Delta has a population of 571,000, according to the 2010 Census, which has increased by about 200,000 people—more than 50 percent—in the 20 years since the 1990 Census. All of the population growth, and virtually all of the Delta's urbanized land, is located within the Delta's Secondary Zone.

The Delta's economy, like its population, is primarily urban and service oriented. However, the Delta Reform Act of 2009 and the Delta Protection Act of 1992 are primarily concerned with the natural resources of the Delta and the economic activity sustained by those resources such as agriculture and outdoor recreation. In addition, the resources of the Delta support significant water, energy, and transportation infrastructure that serve the Delta, regional and state economies, and an important commercial and recreational salmon fishery throughout the state.

Chapter 2 of this report gives an overview of the entire Delta economy and socio-economic trends. Detailed study is reserved for the resource-related industries and sectors that could be significantly affected by the Delta Reform Act: agriculture, recreation and tourism, and the infrastructure services that depend on the levees, land, and water resources of the Delta. These resources are concentrated in the Primary Zone. Despite the urban nature of the Secondary Zone, it has important economic linkages with the Primary Zone and its resources.

The Legal Delta, both primary and secondary, includes portions of several counties and cities and does not conform to the usual boundaries that define economic data and models. This creates several challenges for this project, and an effort was made to approximate the Legal Delta boundaries with Census block groups, tracts, zip codes, and geocoded establishment data when available. However, the boundaries of what constitutes the Primary Zone or a given community can change based on the data source being utilized. The report authors have tried to be clear throughout the report regarding the definitions, but readers should be aware that variations in data reported reflect the differences in data sources available for a rural area that spans five counties.

Organization of the Report

There are three parts of the report that follow this Introduction. Part One presents critical background and overview information. Part One includes a broad overview of economic and demographic data for the Delta; an assessment of the current state of Delta levees, emergency response, and financial resources available to improve the levees; a very brief review of Delta ecosystem issues, and a review of key laws and land-use plans and how they interact in the Delta. Part Two analyzes specific industry sectors in the Delta, the baseline and trends of these industries, and the expected effects of various policy proposals. Part Three discusses integrative, cross-cutting issues including a chapter that explores the future of Legacy Communities. The final chapter in Part Three concludes the report by presenting a set of recommended strategies and policies to support economic sustainability in the Delta.

Part One: Background and Context for the Economic Sustainability Plan

Chapter 2: Overview of the People and Economy of the Delta

2.1 Overview and Key Findings

This chapter provides an overview of the key demographic and economic conditions and trends in the Sacramento-San Joaquin Delta, including detailed information for both the Primary and Secondary Zones. The chapter is intended to provide baseline information to support the creation of an Economic Sustainability Plan for the Delta.

The analysis focuses primarily on data-driven results and information based largely on government data sources, which are documented throughout. To the extent possible, the findings rely on the most up-to-date and geographically-refined data available, including block-level data from the 2010 Decennial Census. It is important to note that the analysis relies on a variety of disparate data sources with differing geographic reporting areas (see Appendix B). The detailed data and calculations documenting the findings presented in this chapter are also provided (see Appendix B).

This section highlights key socioeconomic indicators for the Primary, Secondary, and Legal Delta. Overall, the data review suggests that the Delta is a relatively diverse, growing, and economically integrated region that in many respects is out-performing the state as a whole. However, within this larger context, the Delta's Primary Zone functions as a distinct sub-region with a demographic and economic profile that differs in many ways from both the region and state. Although most of these differences stem from the more rural and sparsely populated nature of the Primary Zone, some are indicative of a less diversified and underperforming economy. The key indicators underlying these conclusions are summarized below.

- **Population Growth**: While the Legal Delta has experienced relatively robust population growth over the last 20 years, increasing by about 54 percent since 1990 compared to 25 percent statewide, the Primary Zone population has remained essentially unchanged. The impressive growth rate of the Legal Delta is largely attributable to its position on the fringe of large metropolitan areas in Northern California. However, the Primary Zone does not appear to be participating in this regional or statewide growth, in part because it lacks the public infrastructure and services necessary to support robust growth and in part because there are restrictive land use regulations on new development. In particular, the Central and Southern Delta (south of Walnut Grove and including the SR12 corridor east of Rio Vista) has contracted since 2000, with total population falling by approximately 500 people, a decrease of roughly 6.5 percent.

- **Age, Race, and Ethnicity**: While the Legal Delta is made up of a relatively young and racially and ethnically diverse population, the Primary Delta is older and predominantly White and non-Hispanic. In the Legal Delta, approximately 43 percent of residents describe themselves as non-White and approximately 81 percent are younger than 55 years of age, similar to the 39 percent and 79 percent statewide, respectively. In contrast, only about 25 percent of Primary Zone residents describe themselves as non-White and about 62 percent are younger than 55 years of age. The Primary Zone's below-average household size (with about 70 percent of households containing fewer than three people compared to about 54 percent statewide) is consistent with the older age profile, suggesting a relatively high share of households without children. Demographic trends in the larger Legal Delta reflect birth and migration patterns emanating from Northern California's growing urban centers, but these patterns appear to be having less of an impact on the Primary Zone. Since 2000, the age distribution of the population in the Legal Delta has not changed dramatically, likely

because of an influx of younger people in the Secondary Zone. In contrast, the age distribution in the Primary Zone has shifted older, with people age 55 and up accounting for a significantly greater share of the population, up from about 24 percent in 2000 to 38 percent today.

- **Employment**: While the Legal Delta possesses a relatively diversified and stable economy, with no one sector accounting for more than 13 percent of employment, the Primary Zone is a highly resource-driven economy with a heavy reliance on agriculture and, to a lesser degree, recreation. The Legal Delta's four top employment sectors—retail, education, health care, and accommodations and food services—account for about 44 percent of all jobs, with a relatively equal distribution among each. In contrast, agriculture alone makes up about 44 percent of total employment in the Primary Zone.

- **Industry Clusters:** Location quotients were calculated for employment and gross regional product to identify key industry clusters in the Delta. The analysis identified three key industries for the Delta economy in both the Primary and Secondary Zones:
  - Agriculture
  - Transportation, Warehousing, and Utilities
  - Construction, Housing, and Real Estate

- **Export Sectors**: Exports represent a key measure of a region's economic base because they bring new money into a region instead of re-circulating existing income.[4] While the proportion of economic output represented by exports in the Legal Delta is relatively high compared to the state as a whole (33 percent versus 24 percent in California), the Sacramento River Corridor is distinctly export-oriented, with exports making up approximately 64 percent of output.

2.2 The People of the Delta

The demographic attributes and unique capacities of Delta residents will have important implications for the region's economic development prospects. This section explores the demographic conditions and trends in the Delta, focusing on such factors as population growth, age, education, household characteristics, labor force participation, and commute patterns. The analysis distinguishes between the Delta's Primary and Secondary Zones. A more detailed discussion of these trends for selected Delta Legacy Communities is provided separately.

2.2.1 Demographic Conditions and Trends

2.2.1.1 Population

There has been significant population growth within the Legal Delta since 1990, almost entirely attributable to the expanding urban areas contained within the Secondary Zone. Specifically, the Secondary Zone contains an estimated 560,000 residents according to the 2010 Decennial Census, up from about 360,000 in 1990, a 56 percent increase (the state as a whole increased by 25 percent during this period). In contrast, the Census reports roughly 12,000 residents living in the Primary Zone in 2010, about the same number as 20 years ago.[5] Currently, the population within the Primary Delta represents about 2 percent of the Legal Delta's total and this proportion appears to be shrinking.

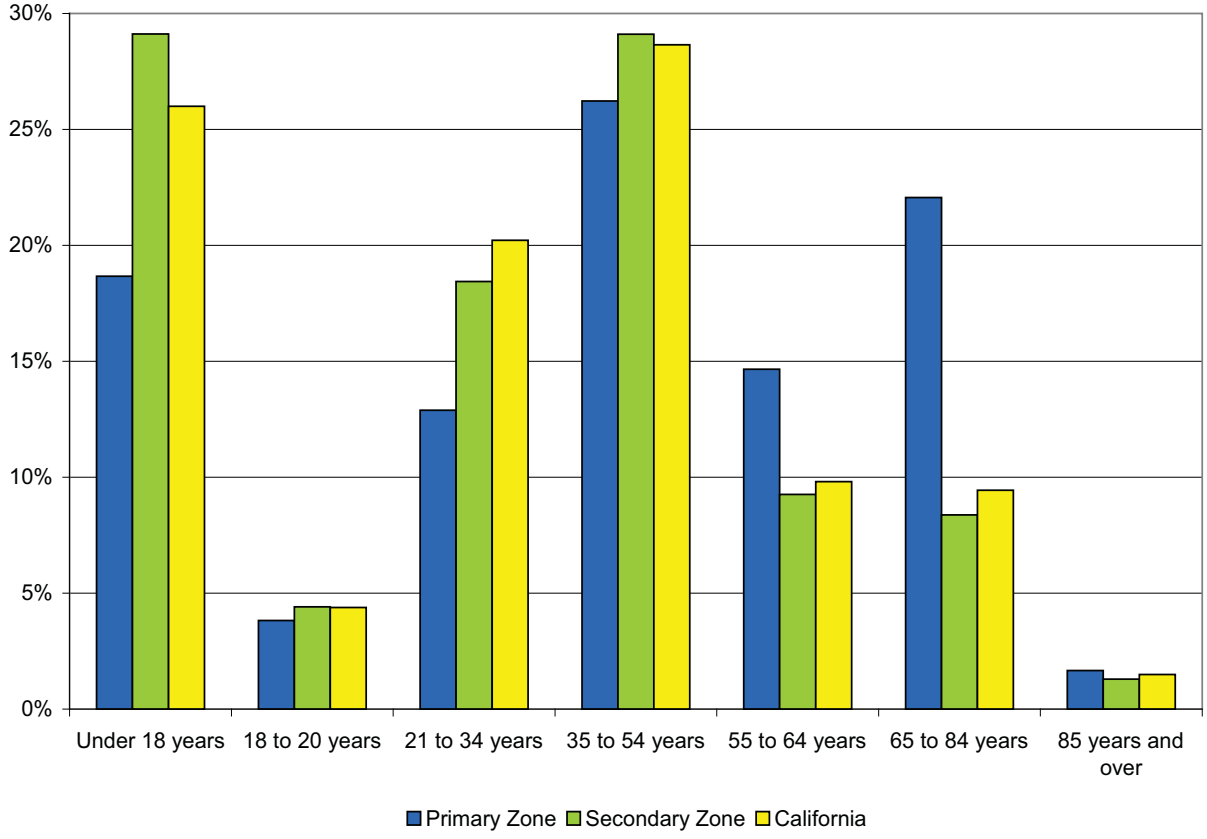
[4] In the context of this study, the term "exports" refers to goods and services provided to areas outside of the Delta, rather than to international markets exclusively.
[5] Note that changing Census boundaries limit the precision of block-level trend analysis.

The Primary Zone encompasses about 67 percent of the Legal Delta's total land area. It is a highly rural and sparsely populated area surrounded by relatively fast-growing urban areas in or adjacent to the Secondary Zone.[6] A variety of inter-related factors are preventing growth in the Secondary Zone from spreading to the Primary Zone, most notably regulatory prohibitions, lack of public infrastructure, and economic feasibility. The relatively fast growth in the Secondary Zone is largely attributable to its role in accommodating spill-over growth from large, land-constrained urban centers in the San Francisco, Sacramento, and Stockton metropolitan areas.

2.2.1.2 Age and Household Composition

Overall, the age and household composition of the resident population in the Legal Delta is similar to California as a whole, albeit with slightly younger and larger families. Almost half of the population (47 percent) is in the 21 to 54 year age group, the prime income generating cohort, mirroring the state (49 percent). The Legal Delta has a slightly higher proportion of youth than California as a whole, with about 29 percent below 18 years (compared to 26 percent statewide). In addition, about 72 percent of all households in the Legal Delta contain families (i.e., relatives) and 49 percent contain three or more people, compared to 68 percent and 46 percent, respectively, for the state as a whole.

Figure 2 Age Distribution in the Delta



Source: 2005-9 American Community Survey, Census Bureau

[6] Based on an estimated 491,592 acres in the Primary Zone and 243,798 acres in the Secondary Zone (Framework Study).

The age and household composition of residents in the Primary Zone is indicative of a region populated by older individuals without children living in relatively small households. The Primary Zone population in the 21 to 34 years age group comprises only 13 percent of the total population (compared to 20 percent in California) while population in the 65 to 84 years age group makes up 22 percent of total population (compared to 9 percent in California). Meanwhile, about 70 percent of the households contain two or fewer people, compared to 54 percent statewide. Combined, these data suggest a resident population with lower household consumption (small households without children) and income generation (retirees) than both the Legal Delta and state.

2.2.1.3 Race and Ethnicity

The population of the Primary Zone is generally Caucasian, with residents identifying themselves as White making up approximately 75 percent of the population. About 7 percent of the Primary Zone population reports being of Asian descent. The relatively urbanized Secondary Zone is somewhat more diverse, with greater shares of the population identifying themselves as Asian (13 percent) and African American (11 percent). By comparison, the California population is about 61 percent White, 12 percent Asian, and 6 percent African American.

Figure 3 Race in the Primary Zone

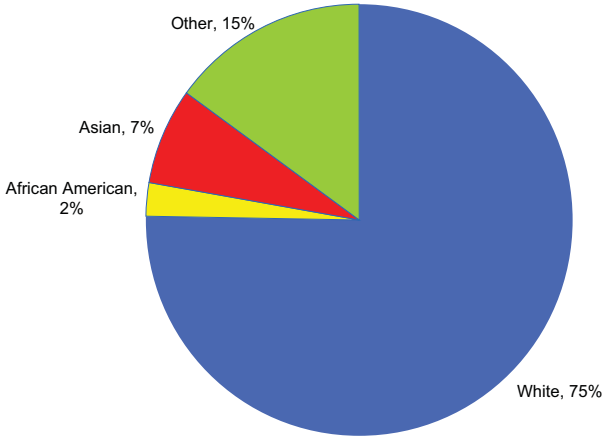
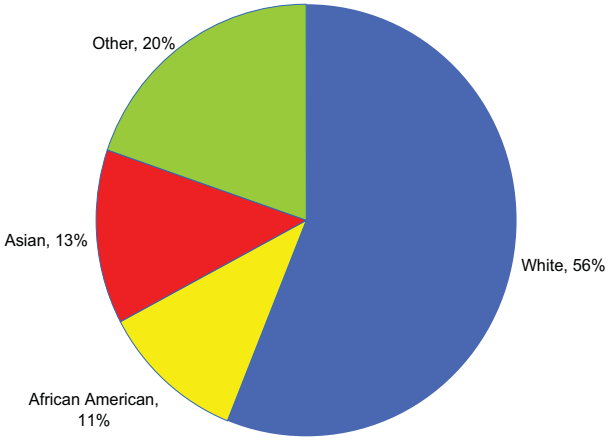


Figure 4 Race in the Secondary Zone



Source: 2005-9 American Community Survey, Census Bureau

Across all race categories, approximately 26 percent of the Primary Zone population and 30 percent of the Secondary Zone populations report being of Hispanic origin, smaller shares of the total population than in California overall, where Hispanics make up roughly 36 percent of the population.

2.2.1.4 Educational Attainment

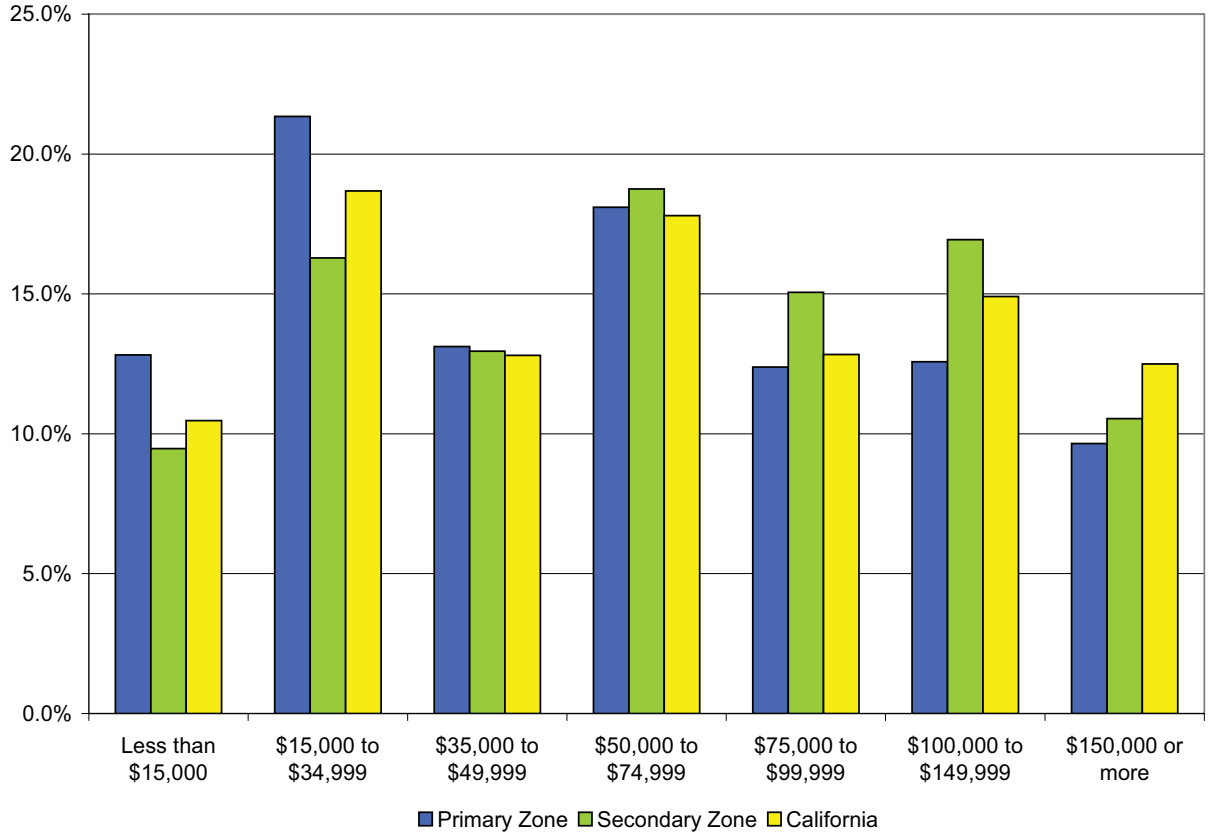
In general the residents of the Legal Delta are well educated compared with Californians as a whole, with several caveats. For example, the Legal Delta has fewer high school drop-outs than the state overall, at 17 percent compared to 20 percent. However, about 32 percent of Legal Delta residents have successfully obtained some form of post-secondary (higher) education degree, compared to 37 percent statewide. Interestingly, the Primary Zone has slightly higher education levels than the Secondary Zone with 36 percent completing post-secondary training

and 9 percent holding a graduate or professional degree (compared to 31 percent and 6 percent, respectively, in the Secondary Zone).

2.2.1.5 Income

The household income distribution in the Primary Zone is generally similar to California overall. While a slightly greater proportion of Primary Zone households have a total household income of less than $35,000 (34 percent versus 29 percent in California), a similar proportion of Primary Zone households have income between $35,000 and $100,000, compared to California overall. A greater share of California's households earn more than $100,000, explaining the higher average household income in California. Household incomes in the Secondary Zone are more concentrated in the $50,000 to $150,000 range, as compared with the Primary Zone and California overall.

Figure 5 Income Distribution in the Delta



Source: 2005-9 American Community Survey, Census Bureau

2.2.2 Housing Trends

2.2.2.1 New Development

Despite the lack of population growth, there has been some residential development in the Primary Zone. Between 1990 and 2010, the number of housing units increased by about 10 percent, from approximately 4,500 to nearly 5,000. The discrepancy between population and housing growth generally reflects declining household size, increased vacancies, and second-home construction (e.g., vacation homes). By comparison, the Secondary Zone gained more than 66,000 net new housing units during this same period, an increase of nearly 50 percent, a slightly slower growth rate than population. This trend is consistent with the above-average household size in this region.

2.2.2.2 Ownership

Approximately 71 percent of the occupied housing units in the Primary Zone are inhabited by owners. While this is significantly greater than in California overall, where only about 58 percent of homes are owner-occupied, this is generally consistent with home ownership rates observed in more rural areas, where rental housing is scarce. In the Secondary Zone, which is more urban, owner-occupied housing units make up about 66 percent of occupied housing units.

2.2.2.3 Foreclosures

Given the Secondary Zone's position on the edge of several large metropolitan areas, it was particularly vulnerable to the sub-prime-led foreclosure crisis that disproportionately hit a number of California communities on the urban fringe. Data concerning foreclosures occurring between May 2010 and April 2011, obtained from RealtyTrac, substantiate this trend. These data show that the Secondary Zone has a foreclosure rate of 9.8 percent, compared to only 4.2 percent in the Primary Zone. Also, the foreclosure rate in the Secondary Zone is notably higher than the five-county region (8.5 percent) and the state (5.8 percent).

2.2.3 Labor Force Participation and Commute Patterns

Only about 54 percent of the Primary Zone population is in the labor force (employed or seeking work), and approximately 24 percent of the zone's residents are above retirement age. The unemployment rate in the Primary Zone (7 percent) is slightly lower than in California (8 percent), according to data from 2005 through 2009. In the Secondary Zone, a greater share of the population is in the workforce (64 percent), which is fairly consistent with California overall. However, unemployment in the Secondary Zone is higher (10 percent) than in the Primary Zone and California, according to data from 2005 through 2009.

It is also interesting to note that the Legal Delta has a low ratio of jobs to workers compared to the Primary Zone. Despite this fact, workers and residents in both the Legal Delta and the Primary Zone have relatively complex commute patterns, which suggest that residents generally work elsewhere. In the Primary Zone, roughly 88 percent of employed residents work outside of the Primary Zone. For example, the employed residents of the Primary Zone commute to Sacramento (6 percent), Stockton (6 percent), Rio Vista (3 percent), and San Francisco (3 percent). The employed residents of the Secondary Zone work in Stockton (14 percent), Sacramento (7 percent), San Francisco (4 percent), Antioch (4 percent), and other locations.

The employed residents of the Primary Zone work primarily in agriculture (12 percent), education (11 percent), construction (10 percent), and health care (8 percent). Of the employed

Primary Zone residents, approximately 63 percent are employed by for-profit enterprises, 20 percent are employed by government entities, 10 percent are self-employed, and 7 percent are employed by not-for-profit organizations. The employed residents of the Secondary Zone are less concentrated in agriculture (1.3 percent), construction (9.1 percent), and educational services (7.6 percent) and more concentrated in health care (12.7 percent) and retail trade (12.4 percent).

Together the labor force participation and commute patterns suggest that Primary Zone workers commonly out-commute to jobs in education, construction, and health care, while the in-commuters occupy lower-skilled jobs in agriculture and manufacturing. Despite a healthy ratio of jobs to residents, the Primary Zone serves as a "bedroom community" for professionals commuting to Stockton, Sacramento, and other nearby urban areas.

2.3 Baseline Economic Conditions and Trends in the Delta

An effective Economic Sustainability Plan for the Delta must be based on a solid understanding of the economic conditions and key drivers. Consequently, to further assess economic development, this analysis evaluates employment, output, and trade flows in the Delta to ascertain economic fundamentals and growth prospects. The analysis draws on a variety of data sources and relies on common economic development tools and metrics, including location quotients and export-orientation analysis.

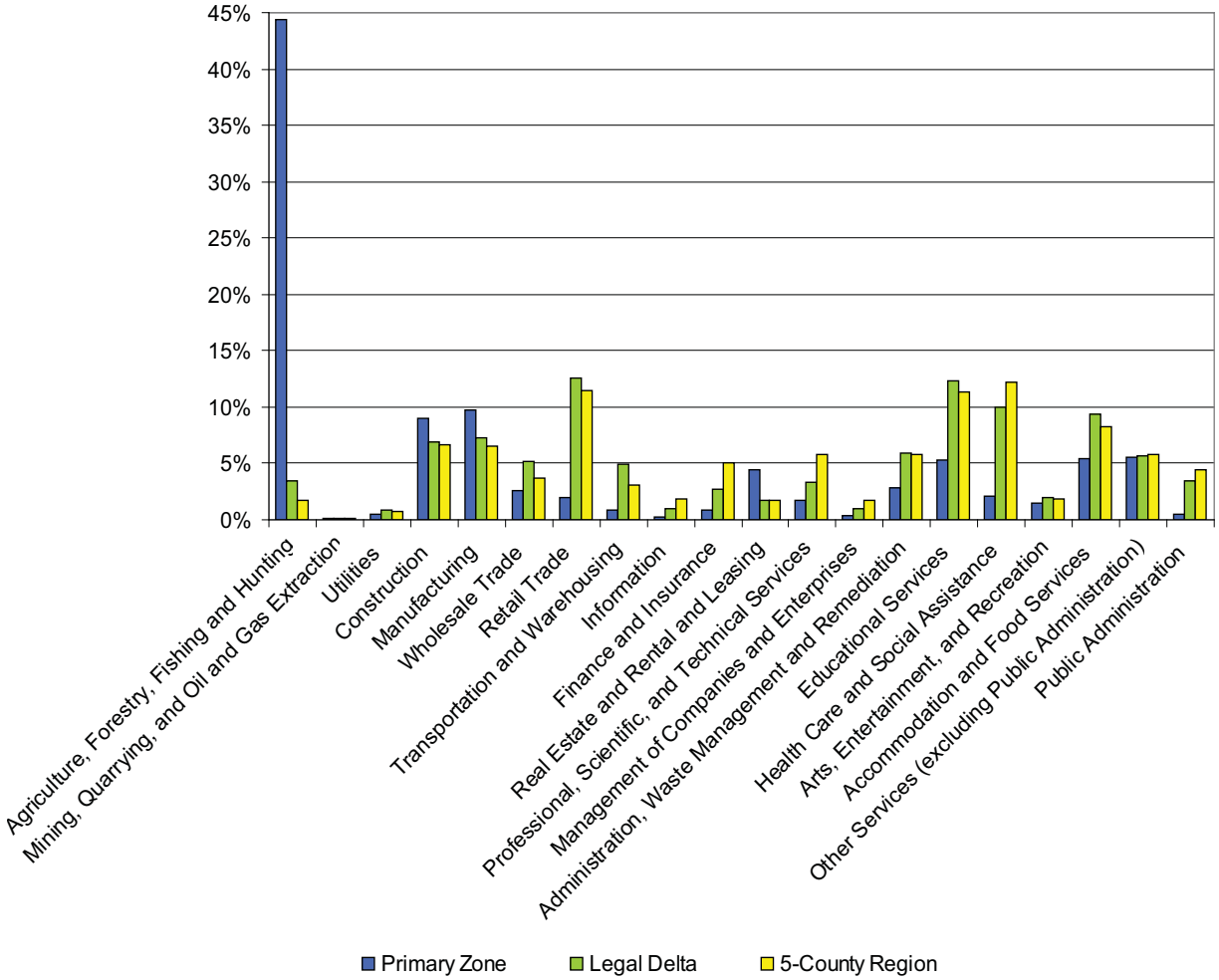
2.3.1 Employment by Sector

According to data from the Bureau of Economic Analysis, there are 1.826 million jobs in the five-county Delta region (Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties). Overall, nearly 23 percent of employment in the region is categorized as proprietor employment (i.e., self-employed), including nearly 38 percent of farm employment.

The Bureau of Economic Analysis's comprehensive employment data are unavailable for the Primary Zone of the Delta. However, the U.S. Census Bureau, through its Local Employment Dynamics-Longitudinal Employer-Household Dynamics (LED-LEHD) program, provides data within unique geographies such as the Delta zones but excludes most self-employed workers. Adjusting the LED-LEHD estimate upward to account for the additional share of employment reported by the Bureau of Economic Analysis in the five-county region, this analysis estimates that there are roughly 200,000 jobs in the Legal Delta. In addition, the LED-LEHD program reports approximately 4,360 jobs in the Primary Zone, which suggests total employment of nearly 6,500 jobs (approximately 3 percent of the Legal Delta) after the adjustment for undercounting.

Overall, the Legal Delta appears to have a relatively balanced level of employment across a number of sectors, in sharp contrast to the Primary Zone. Specifically, four sectors, retail (13 percent), education (12 percent), health care and social services (10 percent), and accommodation and food service (9 percent), averaged about 44 percent of total jobs between 2007 and 2009.

Figure 6 Distribution of Employment by Industry in the Delta Region (2007-9)



Source: Center for Economic Studies (LED-LEHD), Census Bureau

Employment in the Primary Zone of the Delta is highly concentrated in the agricultural sector, which accounts for over 44 percent of all jobs. Over the seven-year period from 2002 to 2009, agriculture accounted for almost 58 percent of total employment in the region. Other important industries include manufacturing and construction, which account for 10 and 9 percent of Primary Zone jobs, respectively. Together, these three industries comprised more than 60 percent of Primary Zone jobs. Recreation-related industries, which generally include the retail; arts, entertainment, and recreation; and accommodation and food services sectors, account for roughly 9 percent of jobs in the Primary Zone.

2.3.2 Location Quotient Analysis

Location quotient analysis is a method commonly used to identify strengths in a local economy. The technique identifies concentrations in a local economy relative to a larger reference economy. In this analysis, the location quotient compares distributions of employment by industry to determine if there are industries that comprise a greater proportion of employment in the local economy relative to the state economy. Specifically, this analysis compares the employment composition of the Primary Zone and Legal Delta to employment composition in California.

In the Primary Zone, the location quotient analysis points to relatively high employment concentrations in the following sectors:

- Agriculture, forestry, fishing, and hunting[7]
- Real estate and rental and leasing[8]
- Construction[9]
- Mining, quarrying, and oil and gas extraction[10]
- Manufacturing[11]

In the Legal Delta, the location quotient analysis points to relatively high employment concentrations in the following sectors:

- Transportation and warehousing[12]
- Agriculture, forestry, fishing, and hunting
- Construction
- Educational services[13]
- Utilities[14]

Figure 7 presents location quotients for employment in the Delta versus the State of California. A location quotient of 1.0 indicates that employment in the local area is the same share of total employment as in the state as a whole. If the location quotient is more than 1.0, local employment in the sector is concentrated compared with the state. As shown, the location quotient for agricultural employment in the Primary Zone is nearly 20, indicating extraordinarily high employment in this sector relative to total employment, as compared with the state.

Employment in the real estate sector is also relatively concentrated in the Primary Zone. Real Estate is closely tied to recreation, with several visitor-serving businesses in the Delta categorized as real estate entities. Real estate businesses in the Primary Zone range from marinas to self-storage facilities to independent real estate brokers. While this industry comprises only about 4 percent of jobs in the Primary Zone, that is more than two times the industry's share of employment in the state.

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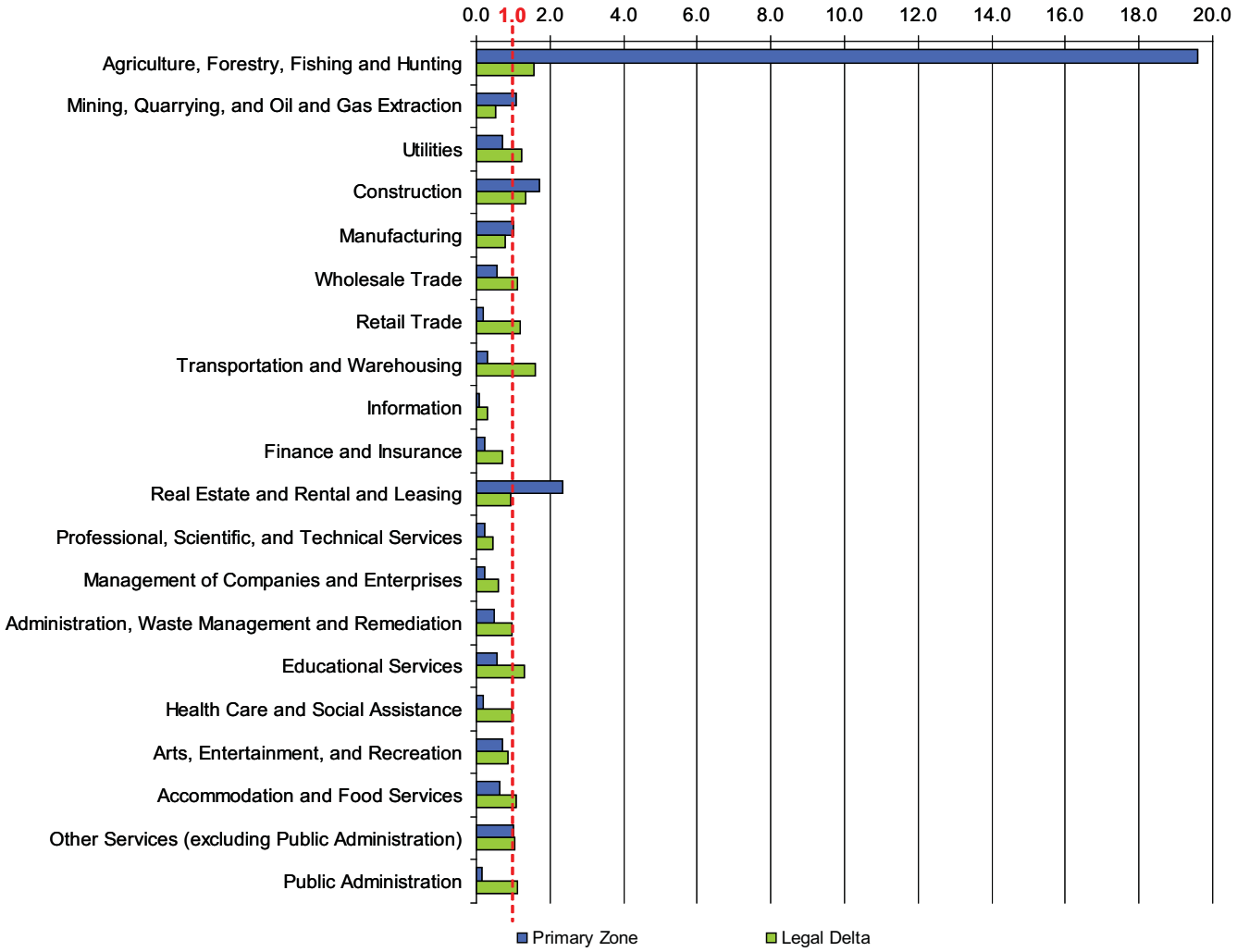
[7] The agriculture, forestry, fishing and hunting sector comprises establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats. (BLS)
[8] The real estate and rental and leasing sector comprises establishments primarily engaged in renting, leasing, or otherwise allowing the use of tangible or intangible assets, and establishments providing related services. (BLS)
[9] The construction sector comprises establishments primarily engaged in the construction of buildings or engineering projects (e.g., highways and utility systems). (BLS)
[10] The mining sector comprises establishments that extract naturally occurring mineral solids, such as coal and ores; liquid minerals, such as crude petroleum; and gases, such as natural gas. (BLS)
[11] The Manufacturing sector comprises establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. (BLS)
[12] The transportation and warehousing sector includes industries providing transportation of passengers and cargo, warehousing and storage for goods, scenic and sightseeing transportation, and support activities related to modes of transportation. (BLS)
[13] The educational services sector comprises establishments that provide instruction and training in a wide variety of subjects. This instruction and training is provided by specialized establishments, such as schools, colleges, universities, and training centers. (BLS)
[14] The utilities sector comprises establishments engaged in the provision of the following utility services: electric power, natural gas, steam supply, water supply, and sewage removal. (BLS)

Figure 7 Location Quotient for Employment in the Delta Versus California



Source: Center for Economic Studies (LED-LEHD), Census Bureau

Construction businesses also cluster in the Primary Zone. Firms in this industry are primarily engaged in residential construction. Construction firms in the Primary Zone are frequently found at the urban-rural fringe, where large parcels of land are available proximate to dense populations. Employment in this sector makes up about 9 percent of employment in the Primary Zone, versus about 5 percent of employment in California.

While mining, quarrying, and oil and gas extraction supports a relatively low level of employment in the Delta, this sector's share of total employment is greater in the Primary Zone than statewide. With a location quotient of 1.1, employment in the mining, quarrying, and oil and gas extraction sector is notable, likely due to the natural gas production, pipelines, and storage in the area.

Manufacturing, with its close ties to agriculture and recreation, is also an important employer in the Primary Zone. The manufacturing sector includes businesses with operations that range from agricultural implement fabrication to wine production to boat construction.

An additional location quotient analysis of the gross regional product (GRP) in the Legal Delta compared to the state reveals the importance of the utilities sector in the Delta.[15] While employment in this industry is somewhat concentrated in this sector in the Legal Delta, it is particularly notable that utilities account for nearly 5 percent of the gross regional product of the Legal Delta, versus only about 2 percent of the California economy. Of the 21 sectors analyzed for GRP location quotients, the top five industry clusters in the Legal Delta are: Utilities, Transportation and Warehousing, Imputed Rental Value for Owner-Occupied Housing, Construction, and Agriculture. Given the focus on the recreation economy in Delta planning efforts, it is notable that the Arts, Entertainment and Recreation sector's location quotient of 0.31 is in a three-way tie for the last place with the Information and Management sectors.

Considering all the various measures of industry concentration, there are three critical clusters for the Delta economy in both the Primary and Secondary Zones:

- Agriculture
- Transportation, Warehousing, and Utilities
- Construction, Housing, and Real Estate

All three of these critical areas could be significantly affected by Delta planning efforts. Given the importance of agriculture in the Primary Zone, the Economic Sustainability Plan includes a focused analysis of this sector in Chapter 7. The Delta recreation economy is addressed by Chapter 8, because of its relationship to the Delta environment. Utilities and other infrastructure-related activities are discussed in Chapter 9.

2.3.3 Export Orientation

IMPLAN, a regional economic model that describes economic relationships between industries, is a valuable tool for evaluation of trade and exports in the Delta. This analysis relies on data from IMPLAN to consider the degree to which specific Delta industries are export-oriented, thereby bringing new money into the regional economy. A key measure of a region's economic base is the amount or percentage of economic activity, services, or sales that are exported outside of the local area. Exports from the Delta bring new dollars into an economy rather than re-circulating existing dollars.

IMPLAN data are available by U.S. Postal Service ZIP codes, which are not perfectly consistent with Delta boundaries, particularly in the Primary Zone. The Economic Sustainability Plan considers two geographies comprised of ZIP codes, including the ZIP codes that best represent the economy of the Legal Delta and ZIP codes in the Sacramento River Corridor (see Appendix B). Based on IMPLAN data for these geographies, exports represent about 33 percent of total output in the Legal Delta and 64 percent in the Sacramento River Corridor, compared to 24 percent in the state as a whole. These data suggest that economic output in the Delta is heavily biased towards producing goods and services for consumption elsewhere. Not surprisingly, agriculture is a highly export-oriented sector with exports accounting for 83 percent of total output in this sector in the Sacramento River Corridor. Utilities and manufacturing are also significant export-driven industries in the Delta.

[15] Location quotient analysis of gross regional product relies on data from IMPLAN (see Appendix B).

Chapter 3: The Delta Ecosystem and Economic Sustainability

The history of the Sacramento-San Joaquin Delta and its ecosystem, its current status and value, and the various proposals to repair or restore the ecosystem are covered in numerous reports and technical papers. A good overview, which includes 12 pages of technical references, is provided by the Delta Ecosystem White Paper, dated October 18, 2010, prepared for the Delta Stewardship Council.[16] The executive summary states that:

> *"The Delta and Suisun Marsh ecosystem, as a large component of the San Francisco Estuary, was once one of the most biologically productive and diverse ecosystems on the west coast, supporting a wide array of native plant and wildlife species and providing important habitat for many migratory species. The Delta ecosystem is now in peril. As a result of human activity to reclaim farmland, protect areas from flood, and provide water for agriculture and communities; discharge of wastes from agriculture, industry, and urban areas; and the introduction of harmful invasive species, the Delta has been modified in ways that adversely influence ecosystem function and compromise its ability to support a healthy ecosystem. These changes not only affect the species that live there, but also the ecosystem services that benefit humans, such as improved water quality, agricultural productivity, healthy commercial and sport fisheries, flood protection, and recreation."*

The purpose of this chapter is to list key considerations as background to a more focused assessment of the evolving Delta economy centered on agriculture, recreation and tourism, and infrastructure. While a healthy ecosystem has intrinsic economic values, as stated in Chapter 1, our focus is on the more tangible economic impacts on the economy of the Delta. Ecosystem restoration will have a variety of impacts on the Delta economy, both positive and negative.

3.1 Brief Background

In the early 19th century the Delta was composed of intertidal wetlands, riparian forest and scrub, nontidal wetlands and grasslands, floodplains, and seasonal wetlands, all contained within an intricate network of branching waterways, as shown in Figure 11. Following the Gold Rush, encouraged by state and federal legislation, most of the Delta was drained and leveed for agricultural purposes. This transformation was largely completed by the early 20th century, resulting in the geometry of the Delta that we know today. Other changes include the introduction of an enormous quantity of mining debris in the second half of the 19th century prior to the ban on hydraulic mining on federal lands and the subsequent widening and deepening of the lower Sacramento River by the federal government in order to facilitate the flushing of mining debris through the Delta; the dredging of the Sacramento and Stockton deep-water ship channels; the diversion of waters upstream from the Delta by various local, state, and federal irrigation projects; the regulation of river flows by the construction of dams for both flood control and irrigation purposes; and the extraction of water from the South Delta by the federal Central Valley Project and the State Water Project.

The consequence of all this alteration of the natural environment has been substantial modification of the ecosystem, judged by most observers to be in a decline that has steepened in recent years. As one measure, salmon runs continued in the millions for some years even after the first large dams were built but have greatly declined in recent years. Of particular note is the "pelagic organism decline" (POD) of the first decade of the current century. This has been the subject of exhaustive study and a comprehensive report prepared by the Inter-Agency

[16] http://www.deltacouncil.ca.gov/delta-plan

Ecological Program (IEP).[17] While there are many differing opinions about the principal reasons for this decline, a common observation is that the Delta has gradually been transformed from an estuarine environment to more that of a weedy lake that favors invasive species over native species.

3.2 Stressors

Good discussions of the "stressors" or "drivers" of the Delta ecosystem can be found in the IEP report on the POD and in the review performed by the Independent Science Board at the request of the DSC.[18] Because of the continuing debate over the relative importance of individual stressors or combination of stressors, we do not attempt a formal ranking of stressors but we do attempt to sort and list them, below, in a rational manner in order to inform subsequent discussion. Interactions between the listed stressors can be as important, or more important, than any of them in isolation. This is part of the reason that it is so difficult to complete a satisfactory effects analysis for any one or a combination of conservation measures.

A. Climate and flow

   a. Climate variability, including both the magnitude of winter and spring freshwater pulses and oceanic conditions

   b. Flow regime, the loss of natural flows through the Delta: reduced flows out of the San Joaquin and cross-flows that result from Sacramento River water being drawn to the export pumps in the South Delta

B. Landscape and vegetation: in particular the loss of connectivity, complexity, and variability

C. The measures that result from A and B: salinity, temperature, turbidity, natural nutrients

D. Introduced substances: unnatural nutrients, contaminants, disease

E. Harvest: entrainment, predation, fishing

One of the reasons that there is continuing debate about the relative importance of these stressors is that, as explained in the landmark paper on altered flow regimes by Bunn and Arthington,[19] the necessary detailed observations were not made during the decline of most rivers and estuaries to allow the development of robust detailed correlations of causes and effects on a scientific basis. Bunn and Arthington express the hope that that will be done as these ecological systems are restored, and that that will guide adaptive management of restoration efforts; in the meantime there is a need to go forward in accordance with broader principles and best management practices.

[17] http://science.calwater.ca.gov/pod/pod_index.html
[18] http://deltacouncil.ca.gov/docs/2011-01-26/final-memo-phil-isenberg-delta-isb-addressing-multiple-stressors-and-multiple-goals-
[19] Stuart E. Bunn and Angela H. Arthington, Basic Principles and Ecological Consequences of Altered Flow Regimes for Aquatic Biodiversity", Environmental Management, Vol. 30, No. 4 (2002), pp. 492–507

3.3 Possible conservation and ecosystem restoration measures

Possible conservation and ecosystem restoration measures are being studied by the Bay Delta Conservation Plan (BDCP),[20] the Department of Fish and Game in connection with their Ecosystem Restoration Plan,[21] and the Delta Conservancy as part of its Strategic Plan development. Flow and water quality standards, which might have a very significant impact on the Delta ecosystem, are also under consideration by the State Water Resources Control Board.

While there is continuing debate over the importance of restoring more natural flows through the Delta, it seems clear that ecosystem restoration should start with a solution to the existing conveyance problems that makes a significant improvement in natural flows through the Delta. But many additional conservation measures might need to be taken to fully achieve the coequal goals. The broad principles that should be followed are relatively clear and should include restoring connectivity, complexity, and variability to the Delta ecosystem on a landscape scale (i.e., throughout the Delta) rather than on a piecemeal basis. It must also be recognized that the Delta ecosystem is not a closed system and that the ocean-bay-Delta-rivers system must be addressed as a whole.

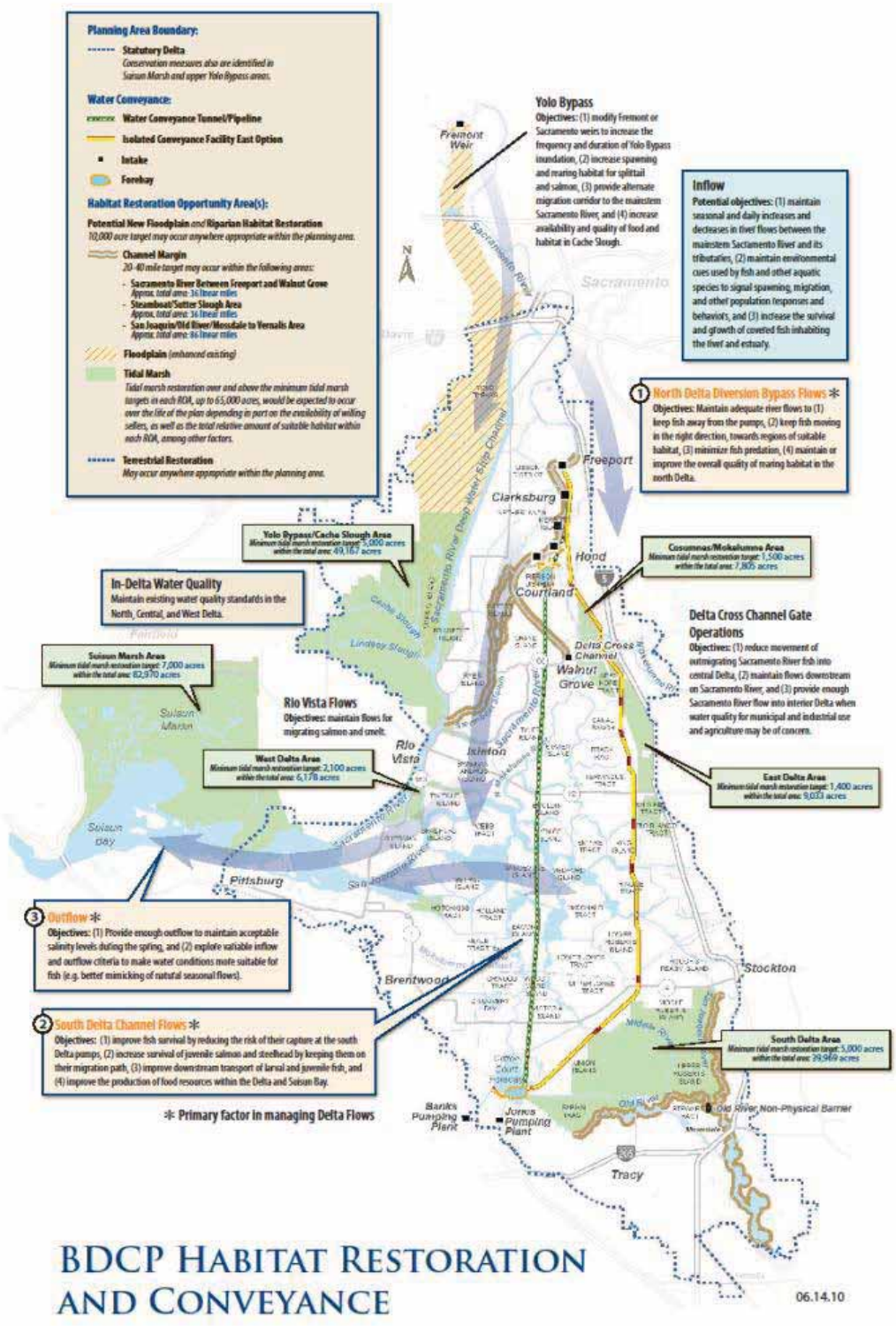
Most of the options under consideration by the BDCP attempt to improve flows in the Delta by moving part or all of the intakes from the south Delta to the north Delta rather than reducing the amount of water exported to the state and federal water projects. Moving the intakes would improve natural flows by minimizing the “reverse flows” that presently occur in the Old and Middle Rivers when the south Delta pumps are operated at high levels. However, the gain that might result by lower fish losses at the South Bay pumps is offset to at least some extent by possible adverse impacts on salmonids in the Sacramento River. In order to deal with that issue, it is expected the operational rules for any north Delta intakes will require significant bypass flows that will limit the amount of water than can be conveyed through tunnels to the South Delta. Thus, significant through-Delta flows will still be required, resulting in a dual conveyance system of moving freshwater around the Delta in an isolated facility in tandem with the current system of through-Delta conveyance.

The net effect is that it does not appear that the conveyance measures that are part of the BDCP will by themselves have a significant effect on achieving ecological recovery of the Bay-Delta estuary. Thus, the BDCP relies on a number of additional conservation measures to promote ecological recovery. Nineteen such measures were included in the November 2010 working draft of BDCP[22] and are illustrated in the aquatic habitat restoration map[23] that is shown as Figure 8.

The most prominent and costly elements of the BDCP restoration proposals are the isolated conveyance facility and the extensive areas that are targeted for tidal marsh restoration, including areas in the interior Delta that were not necessarily tidal marshes in the historic Delta. The BDCP has estimated that just the construction cost of this plan will be $15 billion or more.

[20] http://baydeltaconservationplan.com/Home.aspx
[21] http://www.dfg.ca.gov/erp/
[22] BDCP, Working Draft, Chapter 3, November 18, 2010, http://baydeltaconservationplan.com/BDCPPlanningProcess/DocumentsAndDrafts.aspx
[23] http://baydeltaconservationplan.com/BDCPPlanningProcess/BrochuresAndFactSheets.aspx

Figure 8 BDCP Habitat Restoration[24]



[24] For a better resolution image see http://forecast.pacific.edu/desp-figs.html

3.4 Potential Impacts of Ecosystem Restoration on the Delta Economy

Improvements to the Delta ecosystem could have positive and negative effects on the Delta economy and quality of life. Potential positive effects include the following.

- Improving fisheries could help commercial and recreational fishing economies, although most of the economic benefit of improved salmon runs would be outside the Delta.
- Some habitat measures could increase flood protection.
- Increased freshwater flows would benefit water quality for a variety of in-Delta uses.
- Reducing contaminants would benefit water quality for a variety of in-Delta uses.
- Improved riparian habitat would improve the aesthetics of the Delta and make it a more desirable place for recreation.
- Other habitat measures could increase opportunities for wildlife viewing and related tourist activities.

However, some ecological improvements, including those listed below, would have negative effects on the Delta economy and quality of life.

- Habitat restoration could eliminate large amounts of farmland, reducing agricultural production, the Delta's largest industry.
- Some ecological restoration strategies could increase salinity, harming in-Delta uses of water.
- Some ecological restoration strategies could increase organic carbon levels in Delta water, causing problems for municipal and industrial users.
- Increased mosquito/vector problems from marsh restoration increases the risk of disease and creates a nuisance that makes the Delta less desirable for living, recreation, and tourism.
- Some marsh restoration could increase seepage and risk for levees on nearby islands.
- Some restoration measures are very expensive and will require large commitments of public financial resources from strained public budgets.

Some conservation measures would have mostly positive effects, whereas others could have large negative effects. In many instances, potential negative effects could be reduced through careful planning.

3.5 Ranking Ecosystem Restoration Proposals for Economic Sustainability in the Delta

The following conservation or ecosystem restoration measures appear to have the merit of complementing any increases in the natural flows through the Delta without adversely affecting existing agricultural and recreational uses in the Delta. Indeed, successful implementation of these measures would be expected to benefit recreation and potential eco-tourism.

- Restore sunken islands including Franks Tract and Western Sherman Island as tidal marsh and/or tule marsh.
- Restore the mid-channel berms which are in danger of being lost at many locations.
- Encourage the growth of native vegetation on the water side of all Delta levees, which will not only provide significant ecological benefits but also recreational and tourism benefits. At selected locations, this vegetation may be extended into the existing waterways on berms or up widened levees to create riparian habitat.
- Restore some measures of complexity to the Delta waterways: in addition to creating more natural channel margins as discussed above, make use of both set-back levees and berms to create more natural slough geometries and increase the variability of flows and residence times by modifying channel geometries by dredging and fill placement as appropriate.
- Restore historic floodplains upstream of the Delta in order to provide both flood management and ecosystem benefits.

Other conservation measures will impose some economic costs on the Delta, however, these costs can sometimes be avoided or mitigated through management and flexibility. In addition, there could be some off-setting benefits to recreation or flood control. The following list is an example of conservation measures with in-Delta economic costs that could be managed or mitigated.

- Encourage more farms to adopt habitat-friendly agricultural practices such as those already employed by The Nature Conservancy on Staten Island as well as many other farmers throughout the Delta.
- Construct new and improve existing flood bypasses.

Other proposed measures in the BDCP have potentially large negative effects on many aspects of the Delta economy with little or no offsetting benefits.[25] Not only do they take prime agricultural land out of production for uncertain ecosystem benefits, but they threaten to add significantly to water treatment costs, as discussed in Chapter 9 on Infrastructure, raise major concerns about the control of disease-carrying vectors, and have more negative than positive impacts on recreation and tourism. The most costly of these measures are:

- Isolated water conveyance facilities to move freshwater around the Delta via a tunnel or canal
- Creation of new tidal marsh areas, particularly in the interior Delta

The sizing of isolated conveyance and extent of tidal marsh restoration continue to be under evaluation. Reducing the capacity of isolated conveyance and the acreage targets for tidal marsh restoration would reduce negative effects on the Delta economy, although not necessarily in direct proportion to the changes in capacity or acres. The economic impacts of these measures are discussed in greater detail in subsequent chapters, particularly chapters in Part Two.

[25] Spending to operate and maintain the facilities will create some positive on-going economic activity in the Delta. However, much of that new spending is for energy, primarily increased electricity demand, which is a very arguable local economic benefit.

Chapter 4: Review of Key Policies and Planning Processes

Shortly after statehood in 1850, California started studying its water resources. From the early 1900s, plans were developed and implemented to move water from the water-rich north to the water-poor south through the Delta and to provide irrigation water for the San Joaquin Valley. Since the late 1970s regional governance of the Delta, hub of the California water system, has been implemented at the local, regional, and state levels. The current governance proposal retains local control over most actions, retains the Delta Protection Commission with limited authority over some local land-use decisions, and introduces the new Delta Stewardship Council as coordinator of all state-level programs including water quality, water supply, habitat enhancement, public access and recreation, and land use. While multiple local, state and federal regulatory programs affect the Delta economy and Delta land uses, this chapter focuses on the current and required local and state programs that most directly impact the Delta.

Water Conveyance

As early as 1919, a statewide water development project envisioned moving Sacramento River water through the San Joaquin Valley and over the Tehachapis to Southern California. A plan to implement such a project was approved in a 1933 $170 million bond act but the state turned over the lead to the federal government and the initial stages of the project including the construction of Shasta Dam, a pumping plant in the South Delta and the Delta Mendota Canal were completed in the 1950s as the federal Central Valley Project (CVP). A series of bills to expand the project was passed in the late 1950s and were funded by the 1960 California Water Resources Development Bond Act. This led in the 1960s to the State Water Project (SWP) which included the construction of Oroville Dam, a second pumping plant in the South Delta, the California Aqueduct , the pumping plant to lift water over the Tehachapis and terminal reservoirs in Southern California. The construction at this time also included the San Luis reservoir and canal which are components of the CVP and supply the Westlands Water District. In the early 1980s, legislation was proposed to construct a peripheral canal to convey water around the Delta to export pumps near Tracy to serve both the CVP and the SWP. The project was divisive and ultimately rejected by voters in June 1982.

Several years of drought, followed by downturns in Delta fisheries, led Governor Pete Wilson and Secretary of the Interior Bruce Babbitt to bring state and federal agencies to a joint CALFED process to address California and Delta water issues in 1994. The CALFED project resulted in a Record of Decision in 2000, which included multiple actions needed to address water and ecosystem management in the Delta and its watershed. The legislature established a state oversight body, the California Bay-Delta Authority. That body was later disbanded, and the CALFED program was folded into the California Natural Resources Agency. In 2006, the governor and legislature appointed a cabinet committee and a Delta Vision Blue-Ribbon Task Force to advise the cabinet committee. In 2007, the Task Force presented its Delta Vision and in 2008 prepared a strategic plan. In late 2009, the legislature enacted and the governor signed a package of laws to implement the recommendations creating the new Delta Stewardship Council, a Delta Conservancy, and modified the legislation authorizing the Delta Protection Commission (DPC), among other actions. Concurrently, work commenced around 2006 on an effort to obtain incidental take permits that would protect operations of the CVP and the SWP from repeated lawsuits based on the Endangered Species Act. This effort, known as the Bay Delta Conservation Plan (BDCP), is described in more detail below as is the Delta Vision process.

Governance

In the early 1970s, as agricultural lands in the Delta counties came under pressure for development from residential and other users, the five Delta counties came together to develop a regional strategy for future development of the Delta. The Delta Area Planning Council (DAPC), created through a Memorandum of Understanding and funded by the counties, adopted a plan for the region which supported agricultural and recreational land uses. Funding for the Delta Area Planning Council dwindled in the late 1980s and interest in state-level planning and coordination increased in the late 1980s.

In 1992, after the state conducted studies and hearings about the need to plan for the future of the Delta and the protection of its critical natural resources, the legislature approved the Johnston-Baker-Andal-Boatwright Delta Protection Act of 1992, authored by two assemblymembers and two senators, and signed into law by Governor Pete Wilson. The act created the DPC with membership from state agencies, local counties and cities, and Delta water agencies. Within the Legal Delta, defined in 1959 (Water Code Section 12220), the act divided the area into two zones: the Secondary Zone, which is the higher elevation and already-developed outer area of the Legal Delta, and the Primary Zone, the lower elevation and largely water-covered and agricultural lands in the “core” of the Legal Delta. The DPC was charged with preparing a land-use and resource-management plan for the Primary Zone of the Delta, addressing agriculture, recreation, and wildlife habitat on land areas. Control over the waters of the Delta remained with state and federal agencies. Action of local governments in the Primary Zone can be appealed to the DPC. Land uses in the Secondary Zone remain solely under the authority of local governments. The DPC has no authority over state or federal agencies or their programs or projects.[26]

4.1 County General Plans and the Delta

General plans, first authorized in California in 1927, must now include seven elements: land use, open space, conservation, housing, circulation, noise, and safety. Each general plan is a comprehensive long-term plan for the physical development of the county or city serving as a "blueprint" for development. More guidance is outlined in specific plans and in each county or city’s zoning code; zoning codes are required to be in conformance with general plans. In 1993, each of the counties with lands within the Primary Zone supported agriculture, wildlife habitat, and recreation on Primary Zone lands. The unincorporated communities in the Primary Zone each have their own community plans/special area plans. These communities are Clarksburg in Yolo County, and Courtland, Locke, and Walnut Grove in Sacramento County. The City of Isleton is the only incorporated city in the Primary Zone and has its own general plan. Local government general plans do not apply to state or federal projects.

After the DPC adopted its original Land Use and Resource Management Plan for the Primary Zone of the Delta, each county and city was required to ensure that its general plan was consistent with the DPC’s plan. All of the county and city general plans covering the Primary Zone were determined to be consistent with the DPC’s plan although each county addresses these land uses and their protection in ways reflecting their community values and local history.

[26] Please see Chapter 1 for a map of the Primary and Secondary Zones of the Sacramento-San Joaquin Delta.

4.1.1 Contra Costa County

Contra Costa County has adopted an urban limit line; the Primary Zone within Contra Costa County is outside the urban limit line due to flood hazards, soil subsistence, lack of infrastructure, and lack of services. The areas to the north and east are designated Delta Recreation and Resources areas and portions of the Primary Zone are designated General Agriculture. The urban limit line will be reviewed in 2016.

4.1.1.1 General Plan (2005)

Contra Costa County has a program, the Contra Costa County Land Preservation Plan Ordinance, to maintain a specific ratio between developed land and open space land: 65 percent of the county will be preserved for agriculture, open space, wetlands, parks, and other nonurban uses, and 35 percent may be used for urban development. This ratio was originally adopted by the voters in November 1990 and renewed by voters in November 2006. The Primary Zone is within the area to remain in open space and low-intensity uses.

The Contra Costa General Plan uses several zoning codes to identify and protect the unique Delta land uses and characteristics of the Primary Zone lands in Contra Costa County. The general plan designates most Delta islands and nearby tracts as a special Delta Recreation and Resources Zone. The designation recognizes the location in the 100-year flood plan, the limited services, and the value as agricultural land, as wildlife habitat, and for low-intensity recreation. In these areas, the county allows agricultural uses, and with a use permit, recreation uses such as marinas, hunting clubs, campgrounds, and other forms of outdoor recreation. Minimum parcel size is 20 acres. Publicly-owned park land and all golf courses are designated Parks and Recreation. Transportation and utility corridors are designated Public Facilities. Water area uses include docks, boating, and fishing. Publicly-owned land, wetlands, tidelands, and areas of significant ecological resources are designated Open Space. The areas west of Veale and Hotchkiss Tracts are designated Agricultural Land. The existing parcels are mostly between 10 and 50 acres. Jersey Island is designated Public/Semi-Public and has been used for disposal of treated wastewater.

Agricultural Core: The agricultural core is comprised of prime soils which are considered the very best soils for farming a variety of crops. The agricultural core is east, south, and west of the city of Brentwood. Intensive row crops are being grown on much of this land, and a portion of the agricultural core is within the 100-year flood plain. The purpose of the agricultural core designation is to preserve and protect the most productive farmlands of the county, and the designation requires a higher minimum parcel size; “ranchette” development is discouraged. Ranchettes are rural residential lots as small as one to two acres, often five or ten acres. Uses are the same as in the Agricultural Land designation; however wineries and olive oil mills are appropriate in the agricultural core with a use permit. Residential density is one unit per 40 acres.

Policy 3-54 requires all management and development actions in the Primary Zone to be consistent with the goals, policies, and provisions of the Land Use and Resource Management Plan for the Primary Zone of the Delta.

4.1.1.2 East County Area Plan

An area plan for a portion of the Primary Zone in East Contra Costa County was adopted in 1985 and includes: Holland, Palm, Orwood Tracts, and Coney Island. Allowed uses include public and private outdoor recreation, equestrian facilities, wind energy systems, single family

residences on larger lots, quarries, oil and gas wells, pipelines and transmission lines, vet/kennels, and public uses.

4.1.1.3 City of Oakley

The City of Oakley was incorporated in 1999. In 2004 the DPC reviewed the city's general plan for consistency with the DPC's Plan. The only area of the City of Oakley in the Delta Primary Zone is a 200-foot-wide band of water-covered lands along the shoreline. The water-covered area includes Antioch/Oakley Regional Shoreline (fishing and picnic facilities at the base of the Antioch Bridge) and the new Big Break Regional Shoreline. Both facilities are owned and managed by the East Bay Regional Park District. The city's general plan was found consistent with the DPC's plan.

4.1.1.4 Knightsen

Within the Primary Zone in Contra Costa County is one unincorporated community, Knightsen. Located at the intersection of Knightsen Avenue and Delta Road, east of Brentwood and south of Oakley, Knightsen was founded in 1888 at a station on the Atchison, Topeka and Santa Fe Railway line. The community, represented by an appointed Knightsen Town Municipal Council, is home to an elementary school, a post office, and a couple of commercial enterprises. The surrounding community is agricultural. Due to its history and characteristics, Knightsen has been discussed as a potential Legacy Community. (See Chapter 10 for more information.)

4.1.2 Sacramento County

The county has an urban limit line; the Delta is outside the urban limit line. Within the Primary Zone, there are several unincorporated communities with residential and commercial development as well as scattered areas of residential development along waterways. County decision makers are advised by the Delta Municipal Advisory Council made up of Delta residents.

4.1.2.1 General Plan (1993, currently being updated)

The Sacramento County General Plan was adopted in December 1993. The general plan defines areas of future growth in the county; these areas are out of the Delta. However, seven of the eleven Legacy Communities identified in the 2009 Sacramento-San Joaquin River Delta Reform Act (PRC Section 32301(f) are located within unincorporated Sacramento County. Land uses and future development in Freeport, Courtland, Locke, and Walnut Grove are subject to General Plan policies and typical zoning standards and to the land use and design standards in the Special Planning Area and Neighborhood Preservation Area Ordinances. The December 9, 1992 Land Use Diagram shows that the urban services boundary does not pass west of I–5. The land use diagram shows most of the Delta area designated as Agricultural Cropland. Areas of low-density residential use (1 to 12 dwelling units per acre) are located in the existing communities of Hood, Courtland, Locke, and Walnut Grove. Small areas are identified for Intensive Industrial and Extensive Industrial use south of Walnut Grove, along Twin Cities and River roads, and near Hood. The diagram shows recreational uses at the north tip of Sherman Island, Brannan Island State Park, the eastern portion of Andrus Island, the shoreline west of Isleton, and the area between the Delta Cross Channel and Locke. Several areas are identified as Natural Reserves including Lost Slough, Sherman Island Wildlife Area, the west tip of Grand Island, Stone Lakes, Delta Meadows, and the levees along Snodgrass, Sevenmile, and Steamboat sloughs.

The December 9, 1992 agricultural element of the general plan promotes protection of agricultural land, requires mitigation to provide in-kind protection when agricultural land is developed, promotes 300- to 500-foot-wide buffers between agricultural and non-agricultural

uses; and sets minimum parcel sizes of 40 acres for soil classes I and II and 80 acres for soil classes III and IV.

The county does not accept applications to amend the land use diagram from recreational or agricultural cropland to any residential category, commercial and office, or industrial use unless the site is in the established Delta communities of Hood, Courtland, Locke, or Walnut Grove, or is a small expansion which supports the agricultural and recreational economies of the Delta.

The open space element of the general plan outlines strategies to protect critical open space resources of the county including acquisition of key areas and implementation programs to secure permanent open space, thus fixing the urban service boundary, and establishing open space linkages (natural land corridors).

The conservation element protects key resources including water and soil. Development is to be diverted from prime soil or soils of statewide importance; conversion of more than 50 acres of prime or statewide importance soils is deemed to have a significant environmental impact under the California Environmental Quality Act (CEQA); no golf courses are allowed on prime lands outside the urban service area boundary.

Issues currently under consideration in the updated general plan include revitalization of commercial corridors, inclusion of a new economic development element, analysis of future growth within the urban policy area and the urban services boundary, and smart growth principles.

4.1.2.2 The Delta Community Area Plan[27]

The Delta Community Area Plan (1983) designates most of the Delta as permanent agricultural land in 80-, 40-, and 20-acre parcels. Agricultural residential parcels are one and two acres. The communities of Hood, Courtland, and Walnut Grove are identified as locations for future residential development and commercial growth; residential development in the agricultural areas is discouraged.

Some water-covered areas are designated Delta Waterways and some as natural areas (Dolan Island, waterways near the tip of Sherman Island, a portion of Sevenmile and Snodgrass sloughs, and the south fork of the Mokelumne River), scenic areas (Steamboat, Sutter, and Georgiana sloughs), and restricted areas (Steamboat, Snodgrass, and Sevenmile sloughs). The area around Stone Lakes, much of Snodgrass Slough, the Delta Meadows area, the southwest tip of Grand Island, and Brannan Island State Park are designated Recreation Reserve. The islands at the tip of Sherman Island are designated Recreation with a Flood overlay.

Special plans have been prepared for the communities of Courtland, Hood, Locke, Walnut Grove, and Ryde and for the Lower Andrus Island Special Planning Area. These communities are the residential, commercial, processing, and retail centers in the Delta and have water and sewage treatment facilities and fire protection. These plans are codified in special zoning codes for Walnut Grove (1989) and Locke (2005).

Sacramento County is currently evaluating new Winery, Farm Stand, and Farm Stay Ordinances to set standards for agricultural industries and to promote agricultural tourism and to provide new economic development opportunities. The winery ordinance would allow small wineries (less than 15,000 cases produced annually) by right in the General Agricultural (AG)

[27] Please refer to Chapter 10 for maps of the Hood, Courtland, and Walnut Grove communities.

zones and some Agricultural-Residential zones; large wineries (51,001+ cases annually) located General Agriculture zones will be subject to the approval of a conditional use permit.

The farm stand ordinance will allow the sale of food products that are locally grown in General Agriculture zones, and some Agricultural-Residential zones.

The farm stay ordinance will facilitate the operation of farm stays, expand the understanding of the role of agriculture in the County, and provide farmers with an opportunity to diversify income potential. No more than five guest rooms would be allowed per farm stay operation.

4.1.3 San Joaquin County

San Joaquin County promotes future growth within the existing cities and existing unincorporated communities. There are no unincorporated communities in San Joaquin County's portion of the Primary Zone; there are some permanent residents living at the large recreational development at Tower Park Marina in Terminous where Highway 12 meets Potato Slough.

4.1.3.1 General Plan (1992, currently being updated)

The county's general plan recognizes that the county will grow substantially in the future, but states that rural areas will accommodate minimal growth because open space and agricultural preservation are paramount in these areas. The County General Plan Map designates most of the Delta as General Agriculture. The waterways and channel islands are designated Resource Conservation. The general plan recognizes the Delta as an area of international importance and a major recreational, wildlife, agricultural, and economic resource.

There are two regional parks and one area designated Commercial Recreation at Terminous (Tower Park Marina). Commercial Recreation is defined as major development of at least 100 acres with potential of more than 500 people on a site. The general plan allows smaller areas of commercial recreation in agricultural areas because of specific location needs, such as direct access to natural resources. Typical uses include marinas, recreational vehicle parks, and golf courses. Commercial Recreation areas outside communities must have a public wastewater treatment system serving the entire planned area. The general plan states that recreational values of the Delta are to be protected, and that along the waterways, opportunities should be provided for bank fishing, boating, water skiing, hiking, bicycling, horseback riding, picnicking, and nature study. Waterway development and development on Delta islands is allowed to protect the natural beauty, the fisheries, wildlife, riparian vegetation, and the navigability of the water. The plan limits development on the Delta islands to water-dependent uses, recreation, and agricultural uses.

The open space policies of the general plan state that the Resource Conservation designation shall be used to protect significant resource areas, and that areas with serious development constraints, such as the Delta, should be predominantly maintained as open space. Policies also designate several Delta roads as scenic routes.

Agricultural lands make up the majority of the Primary Zone in San Joaquin County. The General Agriculture designation addresses areas where soils are capable of producing a wide variety of crops, where parcel sizes are large enough to support commercial agricultural activities, and where there is an existing commitment to commercial agriculture. In areas designated General Agriculture, development density is a maximum of one primary dwelling unit per 20 acres; additional dwelling units for farm employee housing and farm labor camps may be

permitted. Minimum parcel sizes are 20 to 40 acres where irrigation water is available, 80 to 160 acres where water is not available for irrigation.

Uses allowed in the General Agriculture designation include crop production, feed and grain storage and sales, aerial crop spraying, and animal raising and sales. Additional activities such as resource recovery, dairy and canning operations, stockyards, and animal feed lots and sale yards require permits. The general plan prohibits further fragmentation of land designated for agricultural use. Parcels for home sites may be created, provided that the general plan density is not exceeded; a parcel may be created for a use granted by permit in the AG zone. Non-agricultural land uses at the edge of agricultural areas are required to incorporate adequate buffers (e.g., fences and setbacks) to prevent conflicts with adjoining agricultural operations.

4.1.4 Solano County

Development in Solano County is directed by county and city policies into the existing cities: Vacaville, Fairfield, Rio Vista, Vallejo, Suisun City, Dixon, and Benicia. Much of the land in the Primary Zone is above sea level and distant from the sloughs and rivers that provide riparian water for agriculture. There is also very little recreational development in the Primary Zone in Solano County. Portions of Prospect Island are designated Open Space: Marsh. An orderly growth initiative, Proposition A, passed in 1984, prohibits the Board of Supervisors from changing the general plan designation on agricultural lands, except in very limited circumstances. In 2008 voters adopted Measure T, which extends the Orderly Growth Initiative through 2028. There are no unincorporated communities in the Primary Zone in Solano County.

4.1.4.1 General Plan (2008)

Delta lands are designated Intensive Agriculture, if irrigated, and Extensive Agriculture, if not irrigated. Irrigated land is 80-acre minimum parcel or 40-acre minimum parcel for highly productive areas (orchard or vineyard). Unirrigated land is 160-acre minimum parcel size. The parcel sizes are based on the concept of “farmable unit,” defined as the size of parcels a farmer would consider leasing or purchasing for different agricultural purposes.

The general plan calls for protection of wetlands and riparian vegetation through formation and retention of parcels of sufficient size to preserve wetlands and protection of these lands from effects of development.

The general plan emphasizes the preservation of agricultural resources, opportunities for value-added agricultural activities, and agritourism, all to enhance agricultural economic viability.

4.1.4.2 City of Rio Vista[28]

General Plan 2001, adopted July 2002, includes policies that state “the City shall continue to support prohibitions/restriction on development within the Delta Protection Commission’s Primary and Secondary Zones.” (Policy 3.7.A (page 3-20) and that “The City shall seek to remove lands from the existing Sphere of Influence that are currently within the boundaries of the Delta and any lands that are placed in an open space land trust.“ (Policy 3.7.B, page 3-20). Within the current boundary of the Primary Zone, the General Plan depicts existing land uses included: airport, sewage treatment plant, heavy commercial/light industrial uses, and landfill. A triangular area northeast of Airport Road, the boundary of the Primary Zone, and bounded by the Sacramento River, is designated SA, Study Area. Most of the land uses were in place in 1993, and only minor modifications have been approved since then. General Plan 2001 supports study of a future replacement for the current bridge across the Sacramento River and

[28] Please refer to Chapter 10 for maps of the City of Rio Vista with respect to the Primary Zone.

supports use of Airport Road as a future means to move additional traffic above the capacity of State Highway 12. The General Plan does not support a bypass of the City of Rio Vista to the north or the south.

4.1.5 Yolo County

About half of Yolo County land within the Primary Zone is in the Yolo Bypass, a flood basin which is part of the federal flood control project between Collinsville and Red Bluff. The Yolo Bypass is west of the Port of Sacramento Deep Water Ship Channel and bounded by a levee located along the Yolo County-Solano County boundary. The eastern portion of Yolo County includes the unincorporated community of Clarksburg, Merritt Island, and agricultural lands in Reclamation districts 999 and 307.

4.1.5.1 2030 Countywide General Plan (2009)

The general plan designates Delta lands as A-1, Agricultural General Zone, and A-P, Agricultural Preserve for lands in Williamson Act contracts. AG policies in the county's general plan are protective of agricultural uses. New residential, suburban, commercial, and industrial uses are prohibited, unless directly related to and incidental to agriculture. Residential uses in agricultural areas are limited to farm owners or employees, and are directed toward lands unsuited for agricultural use. The general plan includes an Agriculture and Economic Development Element in support of agriculture, the primary economic driver of Yolo County. The element identifies wine grapes as the largest single crop in the fruit and nut category and describes the 64,640-acre Clarksburg appellation, which has 10 wineries and 11,000 acres of vineyards. The Agriculture and Economic Development Element also describes the key factors supporting agriculture: soil, important farmlands, water, crops, and agricultural infrastructure. The element supports compatibility with the Delta Plan (AG-6.1-4) and seeks to support and enhance the existing rural economy. The section on economic development emphasizes tourism and describes how services for tourists will also benefit local residents, and supports expansion of tourism "in a manner consistent with Yolo County's agricultural and open space emphasis."

4.1.5.2 Clarksburg General Plan[29]

There is one unincorporated community in the Primary Zone in Yolo County. A special plan has been prepared for the community of Clarksburg. The plan outlines areas for new residential growth, although the community has no community water or sewage disposal systems. No significant intensification of commercial and residential land use is proposed. The plan includes an urban limit line.

4.1.5.3 Clarksburg Agricultural District

In 2008, a new 40,000-acre agricultural district was adopted for Clarksburg, which supported wine grape growing, agricultural tourism, river- and Delta-related tourism, a historic mill site with boutique wineries, and creation of one wine appellation to include Clarksburg and Merritt Island Appellations. While this area is only 9 percent of the county's active farmland, it produces almost 22 percent of the total value of the county's top five crops. The county is considering an array of possible tools that could be applied within the district including new regulatory standards, marketing assistance, lowering fees, allowing additional on-site housing, and designating economic focus points. The overlay district supports agricultural business development and expansion, including processing, commercial sales, and agricultural tourism. The county is evaluating agricultural commercial and agricultural industrial sites of about 100 acres in the Clarksburg area.

[29] Please refer to Chapter 10 for maps the Clarksburg community.

4.2 Delta Protection Commission Land Use and Resource Management Plan

In the 1980s, the State Lands Commission prepared a study of the Delta and its challenges. Subsequently the state senate created a Delta subcommittee to survey stakeholders and issue a report. Sen. Patrick Johnston worked with several other legislators during a two-year legislation-drafting process that culminated in passage of the Delta Protection Act of 1992. The act established the Delta Protection Commission (DPC), a state entity to plan for and guide the conservation and enhancement of the natural resources of the Delta, while sustaining agriculture and meeting increased recreational demand. The act defines a Primary Zone, which comprises the principal jurisdiction of the DPC, the largely agricultural, water, and open space areas in the center of the Legal Delta. The Secondary Zone is the area outside the Primary Zone and within the “Legal Delta (Water Code Section 12220)”; the Secondary Zone is not within the planning area of the DPC.

The Delta Protection Act requires the DPC to prepare, adopt, review, and maintain a comprehensive long-term resource management plan for land uses within the Primary Zone. The plan describes the needs and goals for the Delta and presents a statement of the policies, standards, and elements of the plan. Within 180 days of the adoption of the plan (or any amendments) by the commission, all local governments are required to submit proposed amendments to their general plans to the DPC. The amendments are required to ensure that local government general plans are consistent with the DPC’s plan. The plan applies to land uses, not to water supply or water quality, and generally addresses local government issues and actions, not those of state or federal agencies. After adoption of the plan, local government actions could be appealed to the DPC for review of consistency with the land use plan. The DPC has no authority over state or federal agency projects or programs.

The Primary Zone includes approximately 500,000 acres of waterways, levees, and farmed lands extending over portions of five counties: Solano, Yolo, Sacramento, San Joaquin, and Contra Costa. The peat soil in the central Delta and the mineral soils in the higher elevations support a strong agricultural economy. The Delta lands currently have access to the 1,000 miles of rivers and sloughs throughout the region for irrigation water. These waterways provide habitats for many aquatic species and the uplands provide year-round and seasonal habitats and are popular for recreation. The goals of the plan are to "protect, maintain, and where possible, enhance and restore the overall quality of the Delta environment, including but not limited to agriculture, wildlife habitats, and recreational activities; assure orderly, balanced conservation and development of Delta land resources and improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety."

The plan was drafted, reviewed, and adopted by the DPC on February 23, 1995. The policies of the Plan were adopted as regulations in December 2000. To ensure that the plan remained current, the DPC established a planning advisory committee that began meeting in September 2008. The committee, which represented a broad spectrum of Delta interests, met over several months and prepared draft revisions to the plan in December 2008. The revisions were presented at public workshops throughout the Delta and to the DPC in March 2009. After holding multiple public hearings, the DPC adopted revisions to the plan on February 26, 2010.

The plan consists of three sections: Part I, the Introduction; Part II, Elements; and Part III, Program Implementation. Each element includes an introductory discussion, which provides the framework from which the goals and policies are derived. Policies are the directions for action the local governments must embrace and support through local general plans. The elements address land use, agriculture, natural resources, recreation, and access (including marine

patrol, boater education, and safety programs), water, levees, and utilities and infrastructure. Legislation passed in 2009 modified the membership of the DPC and added new tasks including preparation of a Delta Economic Sustainability Plan for submittal to the Delta Stewardship Council.

4.3 State of California Planning for the Delta

Since 1991 the governor's office has directed state agencies to work together and with federal agencies to identify problems and possible solutions to Delta issues such as ensuring water supplies for export to the Central Valley, Southern California, and the Bay Area. Also since 1991, Cabinet secretaries were convened as the Governor's Water Council, Club Fed was created to provide coordination on Delta water issues, and CALFED was created by the Bay-Delta Accord, all resulting in the Record of Decision, adopted in 2000, outlining a plan of action for the Delta and its watershed. A new agency, the California Bay Delta Authority, was created by the California state legislature to implement the Record of Decision, reorganize, and then move to existing state agencies, but for multiple reasons, including lack of financial support from the federal government, this process was not brought to fruition. Governor Arnold Schwarzenegger then authorized a new planning process in 2006 under the Delta Vision Blue Ribbon Task Force.

4.3.1 Delta Vision

In 2006, Governor Schwarzenegger established a two-year planning process for the Delta through Executive Order S-17-06. A Blue Ribbon Task force of seven appointed citizens supervised preparation of a Delta Vision for adoption and submittal to the Delta Vision Committee. The Delta Vision Committee—five cabinet secretaries for resources, environmental protection, business, transportation and housing, public utilities commission and food and agriculture—submitted a report based on the Delta Vision to the governor at the end of 2008. Also participating in the process were a 43-member Stakeholder Coordination Group, work groups, and state agency staffs. Phil Isenberg, Chair of the Blue Ribbon Task Force, was subsequently appointed Chair of the Delta Stewardship Council.

The Delta Vision, completed in October 2008, includes 12 visions recommendations based on seven goals. Within each goal, the Delta Vision includes strategies and recommended actions to implement those strategies. Many of the actions were incorporated into the suite of legislation passed by the California legislature in 2009. The Delta Vision goals include:

- Goal 1: Legally acknowledge the coequal goals of restoring the Delta ecosystem and creating a more reliable water supply for California
- Goal 2: Recognize and enhance the unique cultural, recreational, and agricultural values of the California Delta as an evolving place, an action critical to achieving the coequal goals
- Goal 3: Restore the Delta ecosystem as the heart of a healthy estuary
- Goal 4: Promote statewide water conservation, efficiency, and sustainable use
- Goal 5: Build facilities to improve the existing water conveyance system and expand statewide storage, and operate both to achieve the coequal goals
- Goal 6: Reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and strategic levee investments
- Goal 7 Establish a new governance structure with the authority, responsibility, accountability, science support, and secure funding to achieve these goals

Within Goal 2, the Delta Vision more specifically recommended the following actions.

- Application for federal designation of the Delta as a National Heritage Area and expansion of the State Recreation Area network in the Delta
- Establishment of market incentives and infrastructure to protect, refocus, and enhance the economic and public values of the Delta agriculture
- Develop a regional economic plan to support increased investment in agriculture, recreation, tourism, and other resilient land uses
- Establishment of a Delta Investment Fund to provide funds for regional economic development and adaption
- Adoption of land use policies that enhance the Delta's unique values and that are compatible with public safety, levee, and infrastructure strategies in Goal 6

These specific strategies in Goal 2 are considered in more detail in subsequent chapters.

4.3.2 Sacramento-San Joaquin Delta Conservancy

The 2009 suite of legislation created the Sacramento-San Joaquin Delta Conservancy to act as a primary state agency to implement ecosystem restoration in the Legal Delta and to support environmental protection and the economic well-being of Delta residents. The Delta Conservancy can also fund projects in the Suisun Marsh, west of the Legal Delta. The 12 tasks assigned to the Delta Conservancy are listed below.

1. Protect and enhance habitat and habitat restoration.
2. Protect and preserve Delta agriculture and working landscapes.
3. Provide increased opportunities for tourism and recreation.
4. Promote Delta Legacy Communities and economic vitality in the Delta in coordination with the Delta Protection Commission.
5. Increase the resilience of the Delta to the effects of natural disasters such as floods and earthquakes, in coordination with the Delta Protection Commission.
6. Protect and improve water quality.
7. Assist the Delta regional economy through the operation of the Delta Conservancy's program.
8. Identify priority projects and initiatives for which funding is needed.
9. Protect, conserve, and restore the region's physical, agricultural, cultural, historical, and living resources.
10. Assist local entities in the implementation of their habitat conservation plans and natural community conservation plans.
11. Facilitate protection and safe-harbor agreements under the federal Endangered Species Act of 1973 and the California Endangered Species Act for adjacent land owners and local public agencies.
12. Promote environmental education.

The Conservancy is governed by a board consisting of 11 voting members and two non-voting members (State Senate member and State Assembly member), and 10 liaison advisors representing local, state, and federal environmental and economic interests in the Delta. Members are appointed by each of the five Delta county boards of supervisors, by the governor, and by the California Senate and Assembly. The liaison advisors are appointed by their respective agencies or organizations. The Delta Conservancy adopted an interim strategic plan in January 2011 and will adopt a final strategic plan by January 2013.

4.3.3 Delta Reform Act of 2009

The Delta Reform Act of 2009 (SB X7 1, Steinberg) includes multiple actions and programs. The act establishes the seven-member Delta Stewardship Council and directs completion of its Delta plan by January 1, 2012.

In addition, the Delta Stewardship Council is directed to appoint an independent science board, engage the federal government, and start Delta ecosystem restoration projects. The act also requires improved reporting of water diversions and uses, imposes penalties for those violating water rights laws, improves monitoring and reporting to the State Water Board, authorizes the State Water Board to initiate statutory adjudications, requires appointment of a Delta Watermaster, and expands water rights fee authority.

The act sets a statewide target of 20 percent reduction in urban per capita water use by 2020 and requires most agricultural water supplies to prepare and adopt water management plans by 2012. The act creates a new Sacramento-San Joaquin Delta Conservancy for the Delta and the Suisun Marsh. In addition, the act reconstituted the DPC and required preparation of a regional economic sustainability plan.

The act moves the state toward a groundwater basin monitoring program by 2012. The Act requires the State Water Board to develop new flow criteria for the Delta ecosystem to protect public trust resources, and to develop a schedule to complete instream flow studies for the Delta watershed by 2012 and for rivers and streams outside the Sacramento River watershed by 2018.

4.3.4 Delta Stewardship Council Delta Plan

The primary responsibility of the Delta Stewardship Council is to develop, adopt, and implement by January 1, 2012, a legally enforceable, comprehensive, long-term management plan for the Sacramento-San Joaquin Delta and the Suisun Marsh—the Delta Plan—that will achieve the coequal goals of “providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem” and does this “in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.”

The Delta Stewardship Council is to achieve the following objectives.

a) Manage the Delta’s water and environmental resources and the water resources of the state over the long term.
b) Protect and enhance the unique cultural, recreational, and agricultural values of the Delta as an evolving place.
c) Restore the Delta ecosystem, including fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem.
d) Promote statewide water conservation, water-use efficiency, and sustainable water use.
e) Improve water quality to protect human health and the environment consistent with achieving water-quality objectives in the Delta.
f) Improve the water conveyance system and expand statewide water storage.
g) Reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and investments in flood protection.
h) Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives.

The 2012 Delta Plan is to be a long-term management plan and will be updated every five years. Some elements of the Delta Plan will have regulatory effects. Any plan, project, or

program that meets certain criteria will be subject to regulations included in the Delta Plan, and the project proponents must certify consistency with the Delta Plan.

The Delta Plan will include a series of non-regulatory recommendations to be considered by other agencies, the legislature, or the governor.

The Delta Plan will present a view of the diversity of the water supply system and its components, including demands for water and how water is currently used, together with the need for an improved Delta ecosystem. The planning time frame is year 2100, using monitoring and adjusting of decisions, "adaptive management," informed by the best available science. Additional components of the Delta Plan include emergency response plans for each of the Delta counties and for the state and federal water projects, the DPC's Economic Sustainability Plan for the Delta, and the Department of Parks and Recreation's Delta Recreation Plan (released May 2011). A proposed financing plan will also be included in the Delta Plan; legislative action will be required to implement a financing plan.

The Delta Plan will also include regulatory policies and recommendations for actions that will contribute to enhanced water supply reliability, reduce reliance on water exports from the Delta in meeting California's future water supply needs, help restore the Delta ecosystem, reduce flood risk, and improve the collection of water use data and other information that will guide the next Delta Plan update. For the current draft of the Delta Plan, see http://deltacouncil.ca.gov/

4.4 Bay Delta Conservation Plan

The Bay Delta Conservation Plan (BDCP) is being prepared through a collaboration of state, federal, and local water agencies, state and federal fish agencies, environmental organizations, and other interested parties with the goal of protecting and restoring the ecological health of the Delta and providing a more reliable water supply. The BDCP is being developed in compliance with the Federal Endangered Species Act (ESA) and the California Natural Communities Conservation Planning Act (NCCPA) and will, if completed, provide the basis for the issuance of endangered species permits for the operation of the state and federal water projects for the next 50 years.

This multi-stakeholder Habitat Conservation Plan/Natural Communities Conservation Plan process has been underway since 2006. The BDCP and a companion program known as the Delta Habitat Conservation and Conveyance Plan (DHCCP), which involves design of improved conveyance facilities and preparation of environmental documents to cover construction of the preferred alternative, is financed entirely by the State and Federal Water Contractors, the agencies that receive water deliveries from the SWP and the CVP. However, the BDCP and DHCCP processes are managed by the California Resources Agency and the Department of Water Resources. Delta stakeholders have been excluded from much of the BDCP process, and continue to be excluded from the BDCP management committee despite efforts by the Brown administration in 2011 to be more inclusive through the creation of working groups.

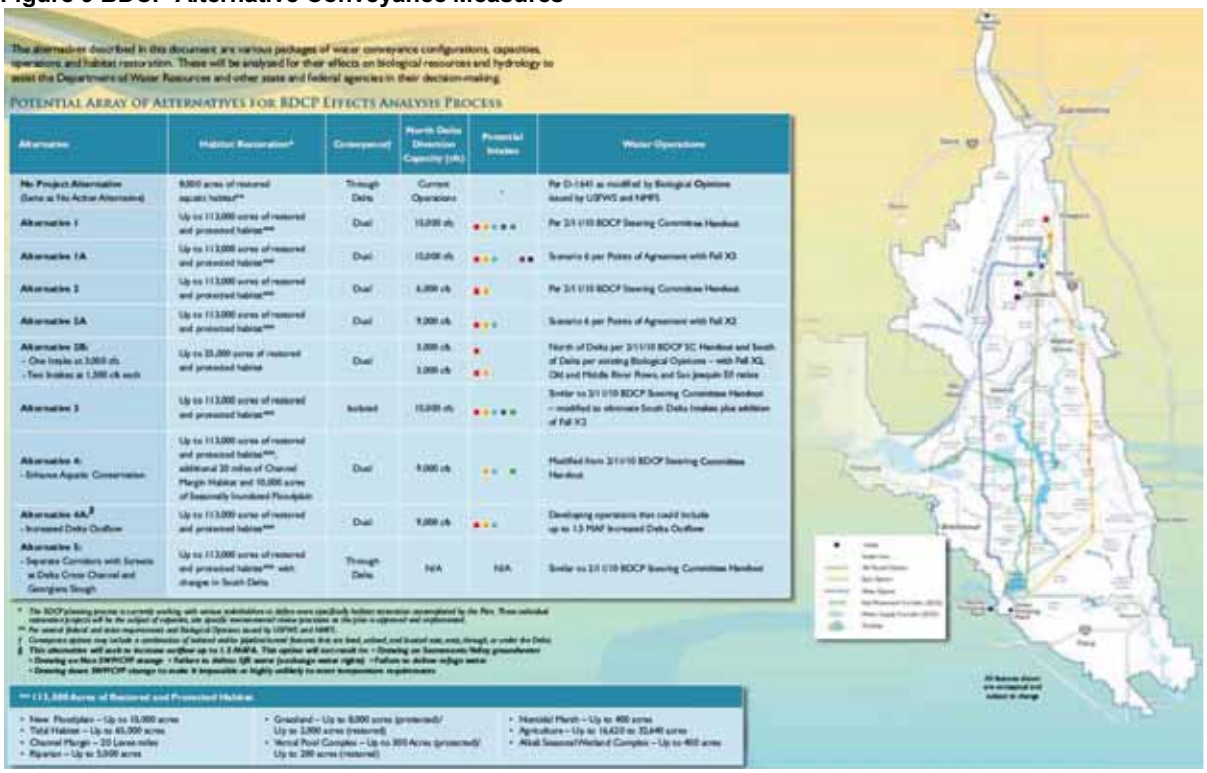
The goal was to have a completed BDCP and a record of decision by the end of 2010 but that deadline was not met. Instead, a working draft was issued in November 2010 to show progress and illustrate the current state of the plan.

The over 1,100-page November 2010 draft addresses impacts to 11 species of fish, 6 species of mammals, 12 species of birds, 2 species of reptiles, 3 species of amphibians, 8 species of invertebrates, and 21 species of plants.. For the aquatic species, the draft addresses multiple

stressors including: habitat loss and modification, food limitations, altered flows, passage impediments and barriers, water quality, entrainment, predators, illegal harvest, stranding, and dredging. A principal conclusion in the draft is that addressing the identified stressors will require creation of thousands of acres of aquatic habitat and construction of multiple new intakes in the North Delta and movement of export water around the Delta to the conveyance canals.[30]

The November 2010 Draft was reviewed by a panel appointed by the National Research Council at the request of Senator Feinstein and the Secretary for the Interior. The panel released its findings in May 2011.[31] This review criticized the BDCP for rushing to a preferred alternative – an isolated conveyance around the Delta – before evaluating different approaches to determine how well they achieve preferred outcomes; for failing to incorporate the best available scientific information about the Delta ecosystem; for ignoring the freshwater flow needs of the Delta ecosystem and San Francisco Bay and omitting any consideration of water conservation as part of the plan for lacking a clear overarching strategy or clear goals and objectives.

Figure 9 BDCP Alternative Conveyance Measures[32]



However, by the time the NRC review was released, the management of the BDCP and DHCCP processes had been taken over by the new Brown administration and the processes had been reorganized to some extent. The new administration promised more transparency in decision

[30] The November 2010 draft is available on the BDCP web site: http://baydeltaconservationplan.com/BDCPPlanningProcess/DocumentsAndDrafts.aspx
[31] http://www.nap.edu/catalog.php?record_id=13148
[32] For a better resolution image see http://forecast.pacific.edu/desp-figs.html. Source: BDCP Alternatives Factsheet, August 2011 Update. Accessed at: http://bdcpweb.com/Libraries/2011_Working_Groups/08-11-BDCP-EIR-EISFACTSHEET_V5.sflb.ashx

making and is working to address the criticisms made by the NRC panel. Their current goal is to issue a public draft of the EIR/EIS by June 2012 and to obtain a record of decision by February 2013. Five alternatives for improved conveyance, which actually expand to ten when alternatives within alternatives are considered,[33] are currently being examined in the EIR/EIS process. However, only the "preferred alternative" of the November 2010 draft, which consists of five new 3,000 cfs intakes on the Sacramento River in the North Delta and twin tunnels under the Delta, is being subjected to a complete effects analysis.[34]

The selection of the alternatives that are under study and the possibility of completing satisfactory studies on this new schedule has been questioned by an influential group environmental NGOs[35] amongst others and the BDCP remains an evolving work in progress at this time.

4.5 Conclusions

Water is extremely valuable to all Californians. Adequate water supplies are critically important to agriculture and industry, and for urban health and resource protection. Northern California is a significant source of the state's water projects' exports , and this water moves through the Sacramento-San Joaquin Delta. USGS notes that of the 22 million acre feet of annual discharge generated in the Sacramento River Basin, 11.6 million acre feet are used in basin and six million acre feet are exported to the water projects. Many programs and plans have been developed over the last 100 years to transport this water to agricultural and urban users in other parts of the state. All these programs and plans included elements to protect the riparian water rights of upstream rights holders and Delta water rights holders. These water rights are key to the longevity and vitality of Delta agriculture and the Delta region as a whole.

In recent decades, much effort has been made to promote the health of the Delta by a variety of agencies, commissions, and other governmental bodies. Today, local and state agencies have long-standing policies and programs to protect and enhance the natural resources, recreational values, and wildlife habitats in the Delta Primary Zone—the agricultural, riparian, and water-based area in the core of the Delta. Other state and federal programs are in place to protect Delta resources and support local government plans that have been in place since the early 1980s. Stewardship of Delta water resources continues to evolve as issues such as sustainability, water supply and quality, habitat, and access become more complex.

Local planning efforts continue to evolve to address the needs of each jurisdiction as economic, political and environmental forces affect local land uses and societal changes. The state programs currently under development should evaluate the needs and impacts on each county as well as the Delta as a region in order to direct appropriate resources to address the economic needs and impacts identified in the Delta.

[33] http://baydeltaconservationplan.com/News/News.aspx: Conveyance Presentation_September 2011_ FINAL.pdf: 08-11-BDCP-EIR-EISFactSheet_v5.pdf
[34] Page A-60 in *Appendix A: Conceptual Foundation and Analytical Framework for Effects Analysis, Administrative Draft Bay Delta Conservation Plan*. September 2011. Accessed at: http://www.deltacouncil.ca.gov/sites/default/files/documents/files/App_A_Conceptual_Foundation_Analytical%20Framework_092911_v_DSP.pdf
[35] Letter of August 23 from American Rivers et al. to Jerry Meral and David Nawi; letter of September 30 from American Rivers et al. to John Laird and David Hayes, see http://aquafornia.com/archives/55439

Chapter 5: Flood, Earthquake and Sea-Level Rise Risk Management

5.1 Overview and Key Findings

The present-day Delta is defined geographically and hydraulically by levees, creating a landscape that differs from that of the historic, natural Delta. In place since the early 20th century, the current-day levee system provides flood control, channels water for urban and agricultural uses, and creates an environment unique in California. According to the Delta Reform Act of 2009, it is the policy of the state to "protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities" and also to "improve flood protection by structural and non-structural means to ensure and increased level of public health and safety."[36] These goals require a robust levee system supplemented by a superior emergency flood-fighting and public safety system for limiting or preventing losses when floods or earthquakes present a threat to levee stability.

For the purposes of this plan, an up-to-date map of Delta levees was created. This map serves as the basis for an updated tabulation of levee lengths, which shows that in the Legal Delta, there are just under 1,000 miles of permanently maintained levees, of which 380 miles are project levees constructed or improved by the U.S. Army Corps of Engineers (USACE), and an additional 63 miles are urban non-project levees, as defined by recent state legislation. Within the overall total, there are 613 miles of "lowland" levees, defined as those levees that protect lands in the Delta that are below sea level. The lowland levees are the levees that are most critical to the preservation of the Delta and to achieving the coequal goals of water supply reliability and ecosystem restoration. Of these lowland levees, 143 miles are project levees located largely along the Sacramento River. The remaining 470 miles of non-project lowland levees need to be maintained and enhanced primarily by the state and the local reclamation districts.

Of the 470 miles of non-project, lowland levees, less than 100 miles fall below FEMA's Hazard Mitigation Plan (HMP) "standard" and another 100 miles or so are already at or about the Corps of Engineers Delta-specific PL 84-99 standard. While the first priority should be to bring all Delta levees up to at least the HMP standard, it has been the goal of the state and federal governments, working through the Department of Water Resources (DWR), the U.S. Army Corps of Engineers (USACE), and the local reclamation districts, to meet the higher Delta-specific PL 84-99 standard since 1982 when DWR and USACE produced a joint report on the Delta levees which recommended the basis for this standard. Funds currently available from the Federal government, voter-approved state bond measures, and local cost shares should bring all Delta levees close to achieving this goal. When funds currently in the immediate pipeline have been expended, more than $698 million will have been invested in improvements to the Delta levees since 1973. These improvements have created significantly improved Delta levees through modern engineering and construction, making obsolete the historic data that is still sometimes used for planning or predicting rates of levee failure.

Three approaches can help all jurisdictions and planners further reduce the risks resulting from the failure of the Delta levees. These approaches are: (1) build even more robust levees, (2) improve regular maintenance and inspections, flood-fighting and emergency response following earthquakes, and (3) improve preparedness for dealing with failures after they occur. In connection with the first approach, the big question with respect to the lowland levees in

[36] Delta Reform Act, 2009, W.C. 29702 (b), (d)

particular is not whether they should be improved to the Delta-specific PL 84-99 standard—that is already happening—but whether they should be improved to a higher standard in order to address hazards posed by floods, earthquakes, and sea-level rise. These improvements would also allow for planting vegetation on the water side of the levees—an essential component Delta ecosystem repair. These further-improved levees would have wider crowns to provide for two-way traffic and could easily be further widened at selected locations to allow the construction of new tourist and recreational facilities out of the statutory floodplain. Improvement of most lowland levees and selected additional levees to this higher standard is estimated to have base engineering and construction costs of $1-2 billion. Enhancements for ecosystem restoration and other purposes and program management could increase the cost to as much as $4 billion. In addition, it is suggested that $50 million per year should be provided for continuing maintenance and inspections and emergency preparedness, response and recovery and that a single Delta region-centric agency should assume the responsibility for allocating this funding. Three broad sources of ongoing, long term funding and economic justifications for the investments are discussed later in this chapter.

These estimated costs are not dissimilar to that of the "Fortress Delta" strategy described in the 2007 "Envisioning Futures" report by the PPIC as one of the alternatives for increasing water supply. Provision of water supply reliability through improvement of the levee system now appears to be significantly cheaper than the proposed isolated conveyance. Regardless, a further-improved levee system will make a significant contribution to the achievement of the coequal goals of water supply reliability and ecosystem restoration that were stated in the Delta Reform Act rather than impeding it.

5.2 Background

The history of the Delta levees is relatively well-known (Thompson, 1957;[37] The Delta Atlas, 1995;[38] Mount and Twiss, 2005;[39] DRMS, 2009'[40] Delta Stewardship Council Flood Risk White Paper, 2010;[41] Zuckerman, 2011[42]) and is not repeated in its entirety here. Some of the levees in the Delta are flood-control project levees, built by the federal government and turned over to the state for maintenance, but most of the Delta levees were built or re-constructed and are maintained by local reclamation districts. There are only a few levees that are not maintained by local reclamation districts and are thus privately owned and maintained. The state has also passed responsibility for maintenance of most of the flood-control project levees to the local reclamation districts although it directly maintains some of the levees on the Sacramento River. Regardless of the state now relying on local reclamation districts for the execution of much of the work on Delta levees, much of this work is supported with state funds in recognition of the state's long-term interests and obligations. These obligations flow in part from the state's acceptance of the grant of federal lands in accordance with the Swamp and Overflowed Lands Acts. For example, in Kimball v. Reclamation Fund Commissioners,[43] the Supreme Court of

[37] Thompson, J., *Settlement Geography of the Sacramento-San Joaquin Delta*, *California,* Ph.D. dissertation, Stanford University, 1957.
[38] http://baydeltaoffice.water.ca.gov/DeltaAtlas/index.cfm
[39] Mount, J.F. and R. Twiss, *Subsidence, sea level rise, seismicity in the Sacramento-San Joaquin Delta*, San Francisco Estuary and Watershed Science, v. 3, article 5, 2005.
[40] California Department of Water Resources, Delta Risk Management Strategy Final Phase 1 Report, 2009, http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/phase1_information.cfm
[41] Delta Stewardship Council, Flood Risk White Paper, 2010, http://deltacouncil.ca.gov/delta-plan.
[42] Zuckerman, T., Comments on the Third Staff Draft of the Delta Plan, Delta Stewardship Council, 2011, http://deltacouncil.ca.gov/public-comments/read/195
[43] 45 Cal. 344, 1873

California held that he, Kimball "must be held to have known, when he took the title, that the state, by accepting the grant, had assumed an obligation to reclaim the land, and that it had already inaugurated a system for that purpose. He was bound in law to take notice of the public statues above mentioned, and must be deemed to have accepted the title in subordination to the paramount right and duty of the state to cause the land to be reclaimed. He cannot now, therefore, be permitted to set up his own wishes, nor his private interests, in opposition to the performance, by the state, of the obligation which it assumed to the Federal Government."

A good summary of the history and current status of the Delta levees is also provided in a technical memorandum prepared for the Department of Water Resources (DWR) by outside consultants,[44] and referenced subsequently as the DWR Technical Memorandum (2011). The Technical Memorandum finds that the existing Delta levees comprise a system and that it is misleading to evaluate the value of individual levees or islands without considering the benefits that the overall system of levees provides, and that the Delta levees now protect much more than agriculture. In this respect the draft Technical Memorandum is simply repeating points made in the CALFED Levee System Integrity Program Plan,[45] which said:

> *The benefits of an improved Delta Levee system include greater protection to the Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and conveyance benefits. The wide range of beneficiaries of the Delta Levee System Integrity program include Delta local agencies; landowners; farmers; boaters; wildlife; and operators of railroads, state highway, utilities, and water distribution facilities. Delta Water users and exporters also benefit from increased protection to water quality. Federal interests benefit from improvements to conveyance, navigation, commerce, and the environment, and from reduced flood damage.*

In the language of the draft Technical Memorandum:

> *While some reports propose leaving islands flooded or state that it is too expensive to continue a state grants program for levee maintenance, the fact remains that a large portion of the state economy is dependent on export water, which in turn is dependent upon the Delta levees for preservation of water quality and for conveyance. If a decision were made today to address this single issue, it would require more than a decade before an alternative conveyance could be in place. During all of that time the purity and availability of export flow would remain dependent on the Delta levee system. Delta levees provide protection for a wide variety of benefits. If levees fail and several islands were flooded, adverse consequences would be expected far beyond direct loss due to flooding on islands and tracts. Most island surfaces are so far below sea level that the resulting deep water would contrast markedly with the 1850 "natural" Delta. The water body created by a levee failure may be good habitat for some species and poor habitat for others. Tidal exchange from Suisun and San Francisco Bays would be increased and Delta salinity would be likely to rise at least during dry seasons and dry years. Water supply conveyance to remaining Delta islands, to Contra Costa County, and to the State*

[44] California Department of Water Resources, Staff DRAFT, "Background/Reference Memoranda, Delta Region Integrated Flood Management Key Considerations and Statewide Implications," July 15, 2011. This document was released for limited public review on July 15, 2011. Both the technical memorandum and the related "Framework for Department of Water Resources Investments in Delta Integrated Flood Management" are in draft form and are subject to change, but the basic findings of the technical memorandum are unlikely to change and several of its findings are mentioned herein.
[45] http://calwater.ca.gov/content/Documents/library/305-1.pdf

Water Project and the Central Valley Project may be disrupted by salinity intrusion some of the time. Infrastructure systems, including Delta highways and pipelines, might be blocked. Delta towns and their economic activity might be jeopardized. Adjacent islands would become much more vulnerable due to seepage or increased wave action.

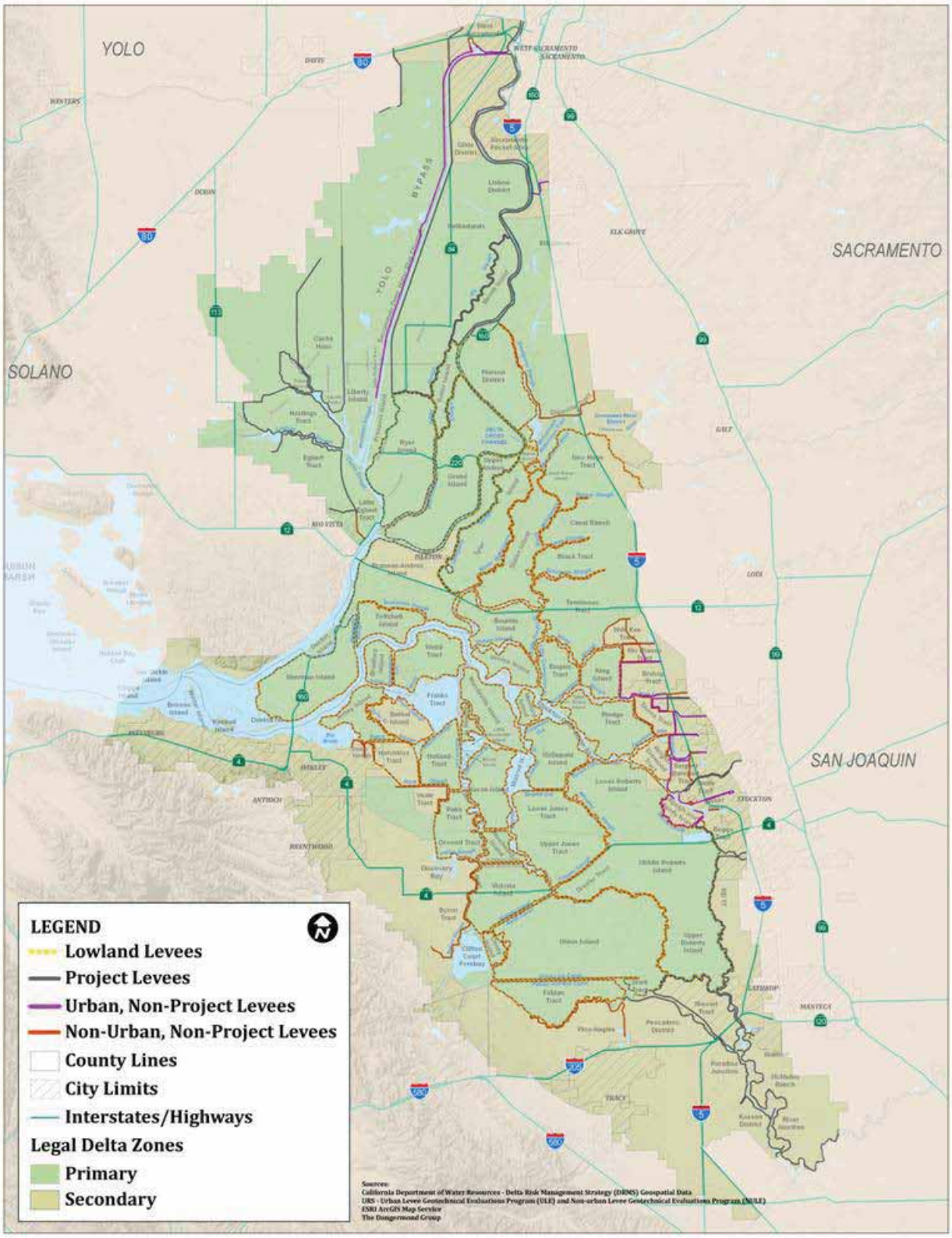
The principal Delta levees that are currently being maintained are shown in Figure 10 and are listed in Table 1. Previous listing of Delta levees have been provided in the Table 6 of the Delta Atlas and in Table 3 of The CALFED Levee System Integrity Program Plan, but these listings and any accompanying maps are not available in electronic form and the accuracy of some of the mileages involved is questioned by reclamation district engineers. Therefore, in order to provide a table that was consistent with a current map, an updated listing was prepared as part of this study. DWR does not maintain a centralized GIS system, but with the help of DWR staff three different GIS data sets, all based on the 2007 LiDAR surveys conducted for DWR, were obtained from two different offices of URS Corporation. The most complete of these was labeled "Division of Flood Management" and this was used as starting point in developing an updated map. However, because many embankments which do not represent levees that are currently being maintained, are height-limited levees, or are dry-land levees that are not considered to be primary flood control levees, these were deleted. It should be noted, however, that some dry-land levees may potentially perform important functions in reducing losses in the emergency response phase should there be a failure and such levees should be included as elements of the overall flood protection system. Canal embankments were also not mapped as levees in this data set but the embankments on either side of the Delta Cross Channel and the northern side of the Contra Costa Canal on Hotchkiss Tract have been counted as flood-control levees in our compilation. In a GIS system all lines are modeled as segments whose lengths can be calculated automatically so that the total lengths around each island or tract can readily be obtained and these are the lengths that are shown in Table 1. Thus the map in Figure 10 and the lengths listed in Table 1 are consistent with each other. To the extent possible, the lengths have been cross-checked with ground survey data provided by reclamation district engineers.[46]

By way of comparison with Figure 10, a reconstruction of the historic Delta based on Atwater (1982)[47] is shown in Figure 11. Figure 11 shows that the historic Delta contained no large expanses of open water, but instead was comprised of a dendritic system of channels and sloughs that traversed generally marshy terrain. Natural levees, created along the edges of major waterways, were overtopped only in high water events and supported riparian and even upland vegetation. When the modern Delta was created by diking and dredging in the late 19th century and very early 20th centuries, some of the man-made levees were constructed over the natural levees, but many were not. Those waterways that were created by dredging do not have bordering levees that were founded on natural levees. In many other cases the modern levees were not sited directly over the natural levees. Sketches developed by KSN Inc. illustrating the history of development of both the dredger cuts and other modern levees are shown as Figures 12 and 13.

[46] Copies of Figure 10 and some of the subsequent figures in this chapter are not particularly legible when reproduced at normal report size but high resolution copies may be obtained by following the instructions on the DPC web site. These figures have been designed for use as wall posters with dimensions of about 3 by 4 feet.

[47] Atwater, B., Geologic Maps of the Sacramento-San Joaquin Delta, California, USGS Miscellaneous Field Studies Map MF-1401, 1982.

Figure 10 Delta Levees[48]



[48] For high resolution image see http://forecast.pacific.edu/desp-figs.html

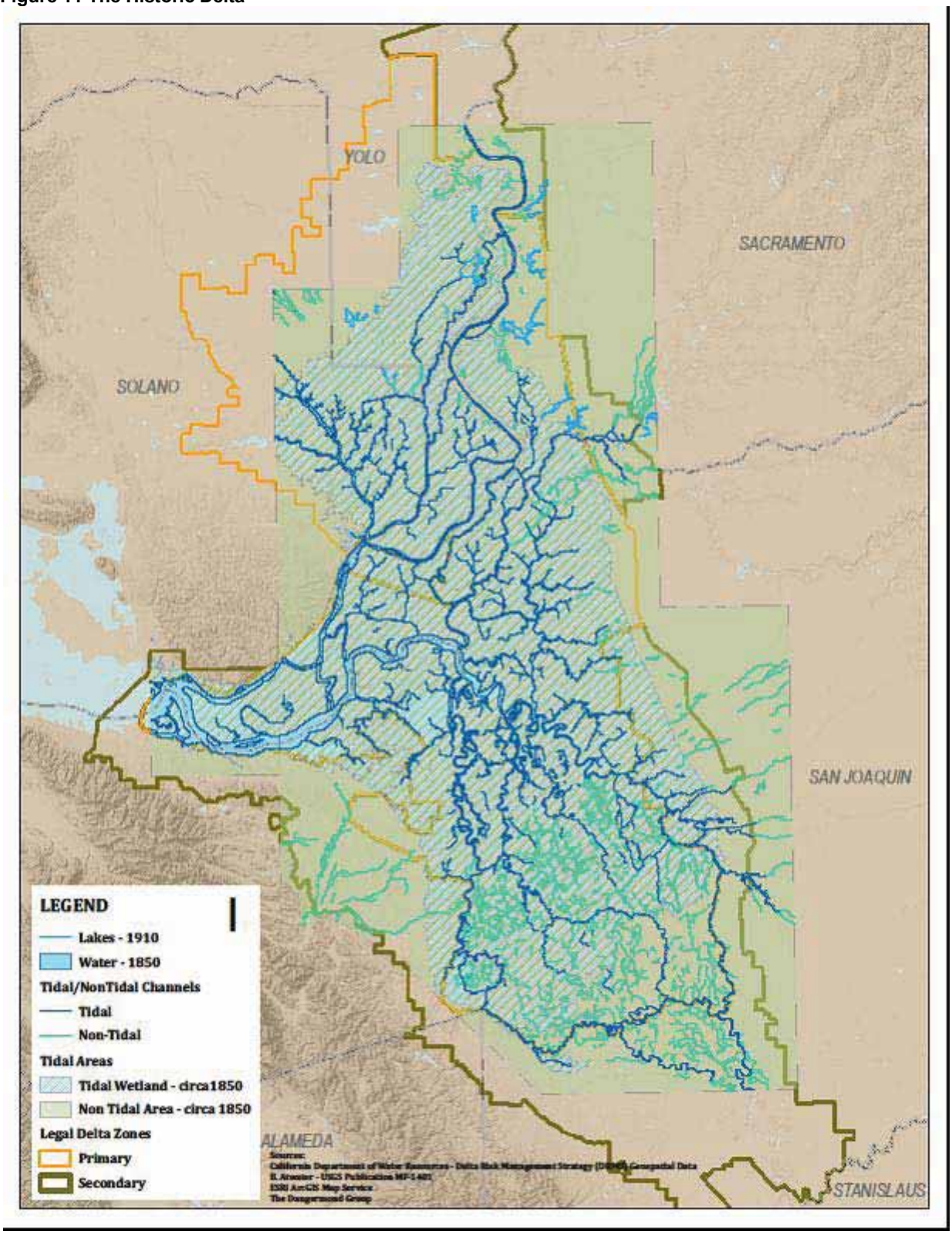
Table 1 Delta Levees (Part 1 of 2)

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(I)
List Number	**District Number**	**Reclamation District**	**Miles of Levee**				
			Project	**Urban NP**	**NP-NU**	**Total**	**Lowland**
1	556	Andrus Island	11.2	0.0	0.0	11.2	Yes
2	2126	Atlas Tract	0.0	2.3	0.0	2.3	No
3	2028	Bacon Island	0.0	0.0	14.3	14.3	Yes
4		Bear Creek	3.3	0.0	0.0	3.3	No
5		Bethel Island	0.0	0.0	11.5	11.5	Yes
6	2042	Bishop Tract	0.0	6.5	1.6	8.1	No
7	404	Boggs Tract	4.0	0.6	0.6	5.2	No
8	756	Bouldin Island	0.0	0.0	18.0	18.0	Yes
9	2033	Brack Tract	0.0	0.0	10.0	10.0	Yes
10	2059	Bradford Island	0.0	0.0	7.4	7.4	Yes
11	317/407	Brannan-Andrus	17.5	0.0	10.1	27.6	Yes
12	800	Byron Tract	0.0	0.0	9.5	9.5	No
13	2098	Cache Haas	10.9	0.0	0.0	10.9	No
14	2086	Canal Ranch	0.0	0.0	7.5	7.5	Yes
15	2117	Coney Island	0.0	0.0	5.5	5.5	Yes
16	2111	Dead Horse Is.	0.0	0.0	2.6	2.6	Yes
17	2137	Dutch Slough	0.0	0.0	4.1	4.1	No
19	536	Egbert Tract	10.6	0.0	1.8	12.4	No
20	813	Ehrheart	1.8	0.0	3.0	4.8	No
21	2029	Empire Tract	0.0	0.0	10.5	10.5	Yes
22	773	Fabian Tract	0.0	0.0	18.8	18.8	Yes
23	2113	Fay Island	0.0	0.0	1.6	1.6	Yes
24	1002	Glanville Tract	0.0	0.0	7.1	7.1	No
25	765	Glide	1.7	0.0	0.0	1.7	No
26	3	Grand Island	28.7	0.0	0.0	28.7	Yes
27	2060	Hastings Tract	15.6	0.0	0.0	15.6	No
28	999	Netherlands	32.2	0.0	0.0	32.2	No
29	2025	Holland Tract	0.0	0.0	11.0	11.0	Yes
30	799	Hotchkiss Tract	0.0	0.0	8.8	8.8	Yes
31	830	Jersey Island	0.0	0.0	15.5	15.5	Yes
32	2038/2039	Jones Tract	0.0	0.0	18.4	18.4	Yes
33	2085	Kasson	6.3	0.0	0.0	6.3	No
34	2044	King Island	0.0	0.0	9.1	9.1	Yes
35	369	Libby McNeil	1.0	0.0	2.8	3.8	Yes
36	1608	Lincoln Village	0.0	3.3	0.6	3.9	No
37	307	Lisbon	6.6	0.0	0.0	6.6	No
38		Maintenance Area 9	12.6	1.5	0.0	14.1	No
39	2027	Mandeville Island	0.0	0.0	14.3	14.3	Yes
40	2030	McDonald Island	0.0	0.0	13.7	13.7	Yes
41	2075	McMullin	7.4	0.0	0.0	7.4	No
42	2041	Medford Island	0.0	0.0	5.9	5.9	Yes
43	150	Merritt Island	17.7	0.0	0.0	17.7	No
44	2107	Mossdale 2	4.3	0.0	0.0	4.3	No
45	17	Mossdale Tract	15.8	0.0	0.0	15.8	No
46	348	New Hope Tract	0.0	0.0	15.1	15.1	Yes
47	2064	Palm-Orwood Tract	0.0	0.0	14.4	14.4	Yes
48	2095	Paradise	4.9	0.0	0.0	4.9	No

Table 2 Delta Levees (Part 2 of 2)

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(I)
List Number	**District Number**	**Reclamation District**	**Miles of Levee**				
			Project	**Urban NP**	**NP-NU**	**Total**	**Lowland**
49	2058	Pesadero Tract	6.6	0.0	0	6.6	No
50	2104	Peters	6.8	0.0	0.0	6.8	No
51	551	Pierson District	6.8	0.0	7.3	14.1	Yes
52	1007	Pico-Naglee Tract	0.0	0.0	9.5	9.5	No
53	2090	Quimby Island	0.0	0.0	7.0	7.0	Yes
54	755	Randall	1.8	0.0	0.0	1.8	No
55	744	Rec District	3.9	0.0	0.0	3.9	No
56	673	Rec District	0.2	0.0	0.0	0.2	No
57	2037	Rindge Tract	0.0	0.0	15.8	15.8	Yes
58	2114	Rio Blanco Tract	0.0	1.8	4.1	5.9	No
59	2064	River Junction	9.7	0.0	0.0	9.7	No
60	524/544/684	Roberts Island	16.4	0.0	34.1	50.5	Yes
61		Rough/Ready Island	0.0	5.5	0.0	5.5	No
62	501	Ryer Island	20.2	0.0	0.0	20.2	Yes
63	2074	Sargent Barnhart	2.1	2.9	2.5	7.5	No
64	341	Sherman Island	9.6	0.0	9.9	19.5	Yes
65	2115	Shima Tract	0.0	7.0	7.3	14.3	No
66		Shin Kee Tract	0.0	0.0	7.0	7	No
67	1614	Smith Tract	5.9	3.3	1.0	10.2	No
68	2089	Stark	2.8	0.0	0.8	3.6	Yes
69	38	Staten Island	0.0	0.0	25.4	25.4	Yes
70	2062	Stewart Tract	12.2	0.0	0.0	12.2	No
71	349	Sutter Island	12.4	0.0	0.0	12.4	Yes
72	548	Terminous Tract	0.0	0.0	16.1	16.1	Yes
73	1601	Twitchell Island	2.5	0.0	9.3	11.8	Yes
74	563	Tyler Island	12.1	0.0	10.3	22.4	Yes
75	1	Union Island	1.1	0.0	28.8	29.9	Yes
76	2065	Veale Tract	0.0	0.0	5.0	5	No
77	2023	Venice Island	0.0	0.0	12.4	12.4	Yes
78	2040	Victoria Island	0.0	0.0	15.1	15.1	Yes
79	554	Walnut Grove East	0.9	0.0	2.5	3.4	Yes
80	2094	Walthall	3.2	0.0	0.0	3.2	No
81	2026	Webb Tract	0.0	0.0	12.9	12.9	Yes
82	828	Weber	0.0	1.7	0.6	2.3	No
83	900	West Sacramento	15.0	26.6	1.6	43.2	No
84	2096	Wetherbee	0.2	0.0	0.0	0.2	No
85	2072	Woodward Island	0.0	0.0	8.9	8.9	Yes
86	2119	Wright-Elmwood Tract	0.0	0.0	7.1	7.1	Yes
87	2068	Yolano	8.8	0.0	0.0	8.8	No
88		Yolo Bypass Unit 4	4.2	0.0	0.0	4.2	No
	Lowland Total		143.2	0.0	470.5	613.7	
	Grand Total		379.5	63.0	537.4	979.9	

Figure 11 The Historic Delta[49]



[49] For high resolution image see http://forecast.pacific.edu/desp-figs.html

It is well known that many of the Delta islands have subsided since they were first diked so that most of the land surfaces within these islands are now below sea level. However, the rates of subsidence have decreased markedly in recent years. That issue is discussed in more detail in Appendix E. Reasonably current land surface elevations interpreted from DWR's 2007 LiDAR surveys are shown in Figure 14.[50] The mostly deeply subsided land is about 30 feet below sea level, but only a fraction of the Legal Delta is more than 15 feet below sea level, as shown by the dark blue coloring in Figure 14. The subsidence has been restricted to the areas of the western and central Delta that are underlain by peat. There are also extensive areas to the north and the south within the Legal Delta that have not been affected by subsidence.

Figure 12 Construction of Delta Levees

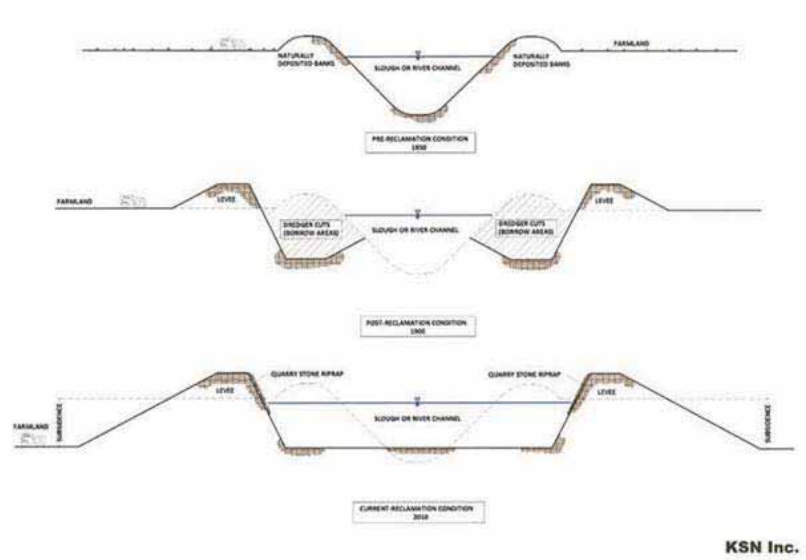
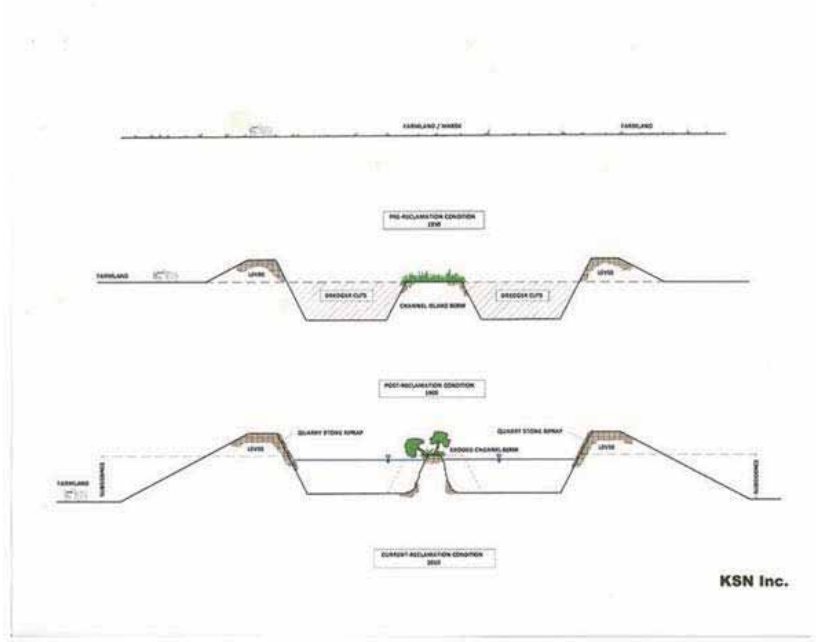
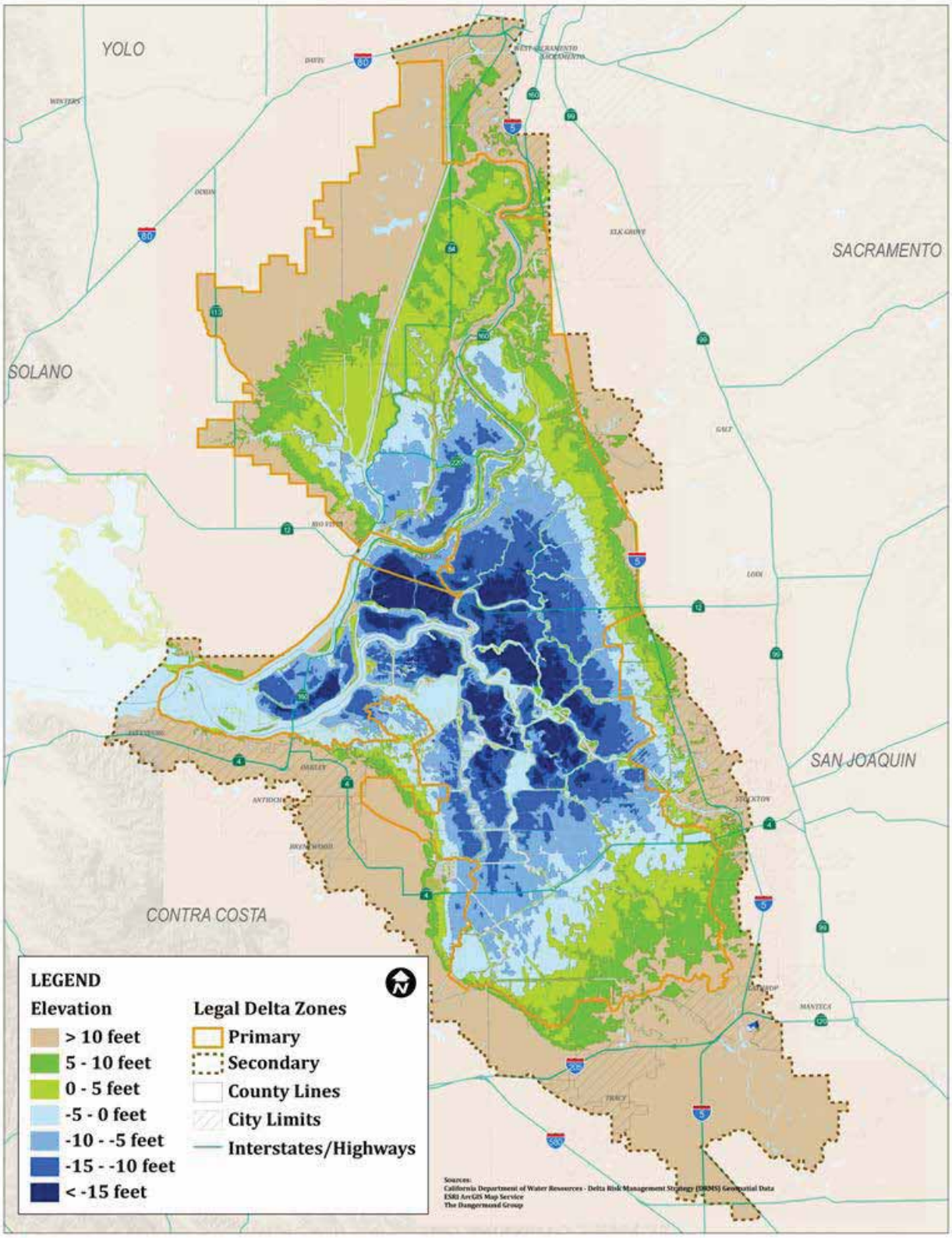


Figure 13 Construction of Dredger Cuts



[50] Based on DRMS GIS data set developed by URS Corporation and provided by DWR.

Figure 14 Current Elevations of Delta Land Surface[51]



[51] For high resolution image see http://forecast.pacific.edu/desp-figs.html

There is a popular impression that there are 1,100 miles of Delta levees all in poor condition. This has led to concern that there is a high probability of widespread failures in the event of flooding, earthquakes, or sea-level rise. While most Delta levees need further improvement, many miles of the Delta levees are actually in quite good condition.[52] Only the levees within the Legal Delta that are currently being maintained and are candidates for further improvement are shown in Figure 10. Levees such as those around Liberty Island and Prospect Island, which lie within the Yolo Bypass, and the levees around the McCormack-Williamson Tract, which have always been height limited and are slated for removal, are not shown. With the removal of levees that are not being maintained and dry-land levees, the total length of the Delta levees is 980 miles, that is, just under 1,000 miles. The division of these levees into project, non-project urban, and other non-project levees and their significance is explained in the following sections. While the levees can be broken into different classifications, it is important to recognize that they all work together as a system. The draft DWR Technical Memorandum (2011) states: "The Delta's system of levees … and interconnected channels operate as a single, multi-function, flood management system. The failure of one levee can increase the risk of other levee failures, increasing the need for levee maintenance on adjoining islands in an effort to prevent additional levee failures. In addition, the large benefits to regions outside the Delta make it difficult to consider one island or tract separately from all others."

5.3 Status of Delta Levees

5.3.1 Categories of Levees

5.3.1.1 Project Levees

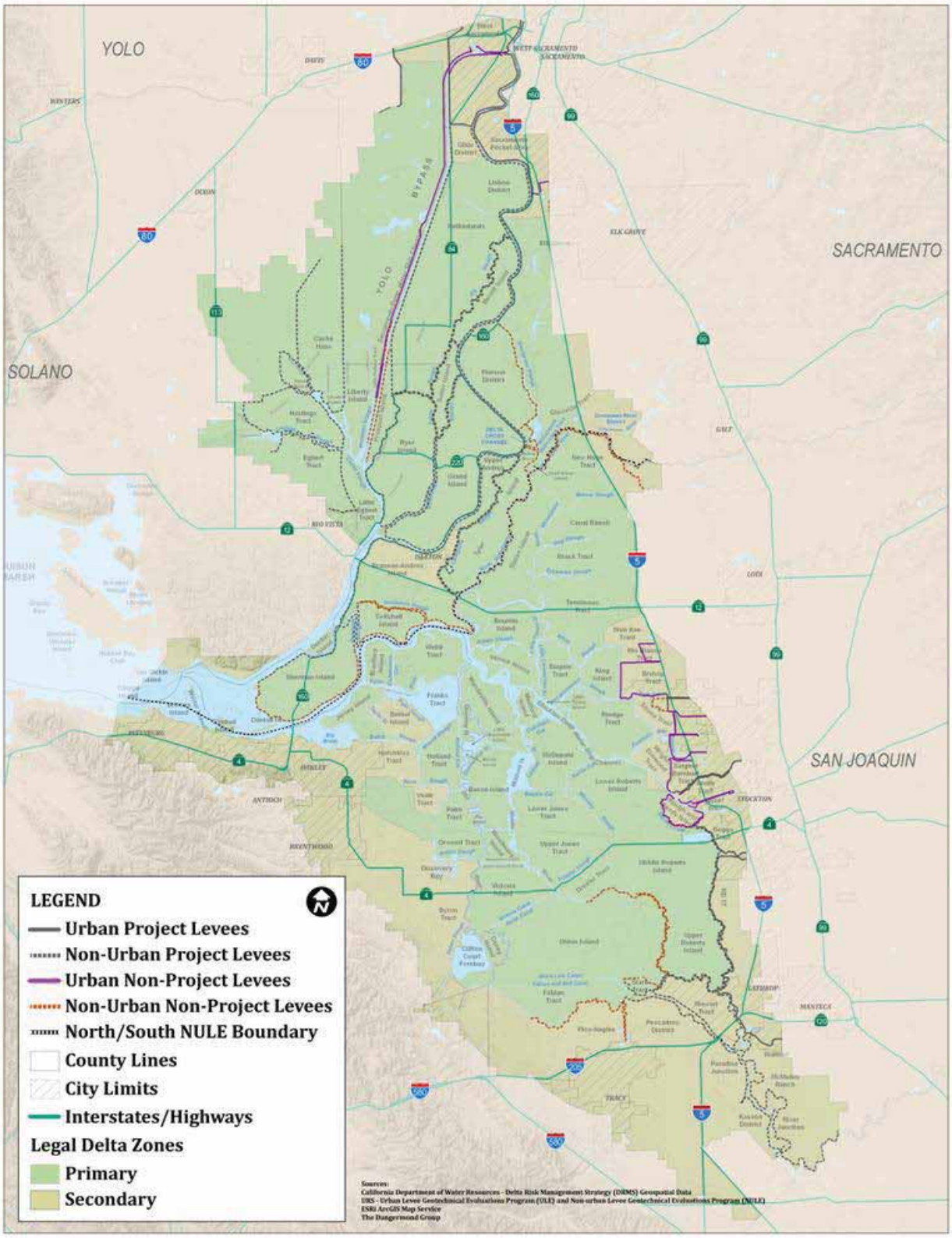
Project levees were constructed or improved by the U.S. Army Corps of Engineers (USACE) as part of federal-state flood-control projects and were turned over to the state for operations and maintenance. The state has in turn generally passed on the responsibility for routine maintenance to local reclamation districts, although the Paterno Decision[53] confirmed the state's continued basic liability with respect to these levees. The State Plan of Flood Control Descriptive Document, dated November 2010, delineates project levees and provides the names of the local maintenance agencies. Project levees within the Delta, as delineated in the GIS data set obtained through DWR, are identified in Figure 10. These levees were built to standards that generally exceed the PL 84-99 criteria described below.

5.3.1.2 Urban Levees

SB 5,[54] enacted in 2007, calls for a minimum of 200-year flood protection for urban and urbanizing areas in the Sacramento-San Joaquin Valley. SB 5 also limits the conditions for further development if this level of flood protection has not been achieved, conditions have not been imposed on the development to provide this level of flood protection, or adequate progress towards achieving this level of protection cannot be shown. DWR is developing criteria for these urban levees that will generally be more stringent than the current criteria for project levees. These criteria are discussed below.

[52] Selected photographs taken during a period of relatively high water in March 2011 are shown in Appendix C.
[53] *Paterno v. State of California* (2003) 113 Cal.App.4th 998.
[54] SB 5 (Machado) was the centerpiece of a far-reaching flood-control package of legislation. It requires the Department of Water Resources to prepare a Central Valley Flood Protection Plan and allows local jurisdictions to prepare their own plans only if they include specified elements that are consistent with the state plan.

Figure 15 Urban and Non-Urban Levee Evaluation Programs[55]



[55] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Recognizing the need for higher levels of flood protection, the major urban areas in the Sacramento-San Joaquin Valley have each formed a Joint Powers Authority (JPA) to implement levee improvements, in part using funds from the DWR Early Implementation Program. Three of these JPAs overlap the Legal Delta—West Sacramento Area Flood Control Agency (WSAFCA), Sacramento Area Flood Control Agency (SAFCA), and San Joaquin Area Flood Control Agency (SJAFCA).

Prompted by the Paterno Decision and SB 5, DWR is undertaking a major investigation of both riverine and Delta levees that is divided into two components, the Urban Levee Evaluations (ULE), and the Non-Urban Levee Evaluations (NULE) (Inamine et al., 2010).[56] These evaluations include detailed site investigations and some analyses and are intended to inform the Central Valley Flood Protection Plan (CVFPP) as to the likely level of effort that will be required for final design and the construction of improvements. Those levees within the legal Delta that are included in ULE and NULE, as identified in a GIS data set specifically obtained through DWR for this purpose, are shown in Figure 15,[57] superimposed on the mapping of project and non-project levees. Some of these DWR-designated urban levees are project levees and some are not. Because there are special requirements for urban levees, as well as special sources of funding for improvements, the urban levees that are not also project levees are identified in Figure 10 and Table 1. There are a total of 122 miles of urban levees in the Delta of which 63 miles are non-project levees.

5.3.1.3 Other Special Levees

While the Delta levees were originally constructed to protect agricultural lands and the small communities that developed primarily along the shipping routes up the Sacramento River, they now are critically important to preserving water quality, to through-Delta conveyance of water, and to the vast array of infrastructure that criss-cross the Delta. The islands that are critical to these functions are discussed and illustrated in Appendix D. It may be seen in Appendix D that most, if not all, islands are also critical to something else besides agriculture and the Legacy Communities. It should also be noted that the mapping of infrastructure in Appendix D is taken from DRMS and is not necessarily complete. For security and other reasons, some data such as the location of liquid fuel pipelines and fiber-optic cables are closely held and are not included on publically available maps. Urban infrastructure in the Secondary Zone is also not shown.

5.3.1.4 Summary and Discussion

As may be seen in Table 1, just under 1,000 miles of levees are currently being maintained within the Legal Delta. But of these, 443 miles are either project or urban levees. If these levees are subtracted from the total of 980 miles, there are only 537 miles that need to be maintained and perhaps improved primarily by the state and the reclamation districts. The DWR draft Technical Memorandum (2011) makes a distinction between non-project levees that have special status in the California Water Code and are eligible for state assistance and other levees that might be owned by public agencies or private entities that are not eligible for state assistance. The technical memorandum indicates that those levees eligible for state assistance are shown on page 38 of the Delta Atlas.[58]

If urban areas and levees that are primarily flood-control levees in the north and south Delta are excluded from the total count, there are only 613 miles of “lowland” levees which protect lands

[56] Inamine, M. et al., California’s Levee Evaluation Program, US Society of Dams, 30th Conference, Sacramento, April 2010.

[57] Based on GIS data set provided by DWR and URS Corporation.

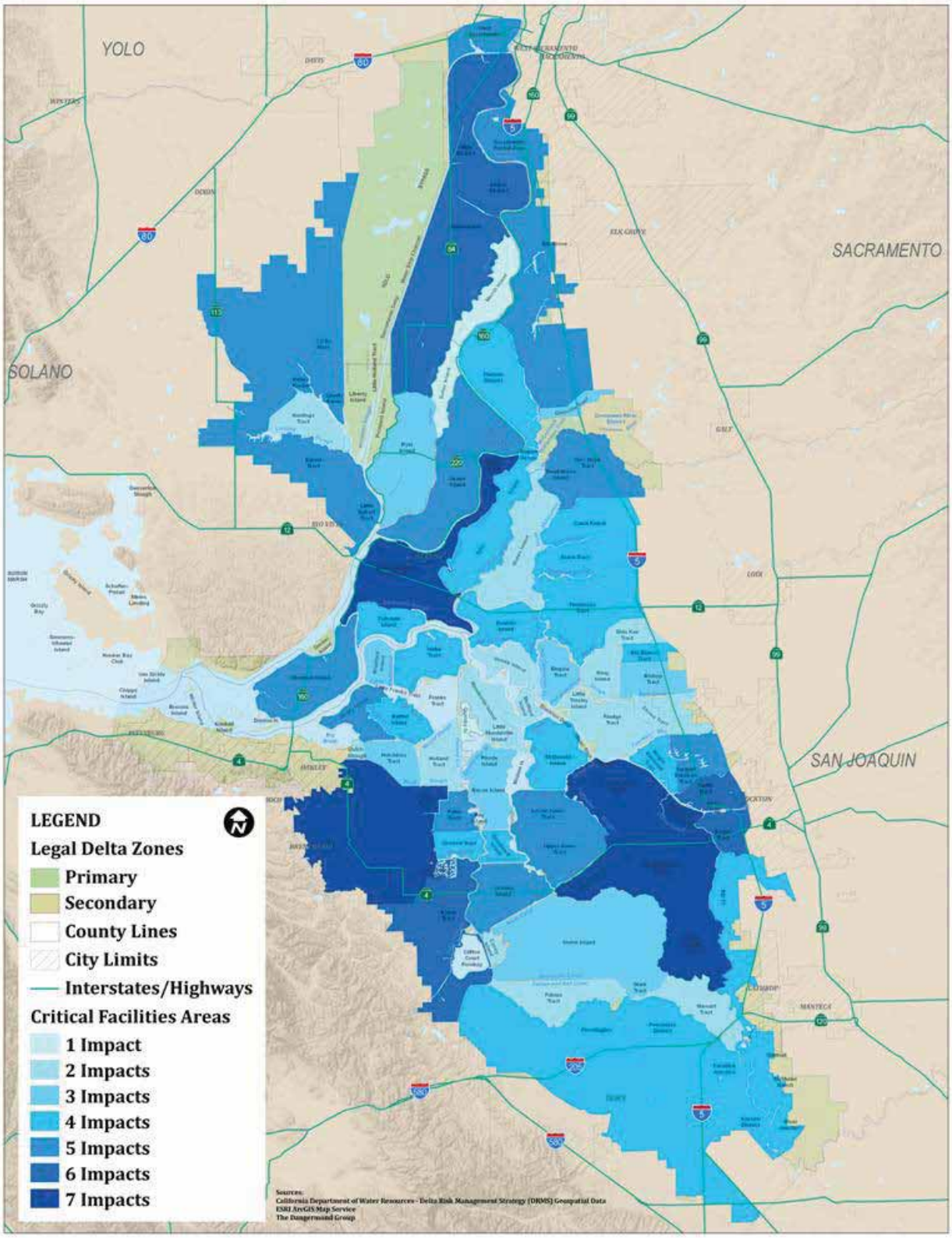
[58] http://baydeltaoffice.water.ca.gov/DeltaAtlas/index.cfm

below sea level. These are levees that are largely founded on peat and thus surround lands that have subsided. They are identified in Figure 10 by yellow dotted lines that are superimposed on either the black or red lines. Of these lowland levees, 143 miles are project levees, primarily located along the Sacramento River. That leaves approximately 470 miles of lowland levees that need to be maintained and enhanced primarily by the state and the local reclamation districts. Even this number errs on the high side because we have counted levee miles by island or tract and some islands or tracts that we have included in the "lowland" count, like Roberts Island for instance, have substantial areas above sea level. Thus, not all lowland levees are equally important but their definition is a significant step in prioritizing the relative importance of the various Delta levees. The 470-mile length might also be reduced by combining some of the existing islands and tracts into larger polders. Of this sub-set of the lowland levees, over 100 miles already exceed the PL 84-99 standard that is discussed below, leaving perhaps 350 miles in need of improvement to the PL 84-99 standard.[59] While the project and urban levees may have issues with encroachments, penetrations, and vegetation and otherwise be in need of improvement, there are other mechanisms for dealing with these issues, and the project and urban levees are fundamentally flood-control levees rather than levees that are key to protecting water quality, the conveyance of water through the Delta, and protecting and enhancing the Delta as a place.

The definition of certain levees in Table 1 as "lowland" levees is not exact and at present has no legal significance. Most of the levees that have been called out as lowland levees are in the Primary Zone, although Bethel Island and Hotchkiss Tract have been included because they are two of the eight western island and tracts that are judged to be critical for preventing salinity intrusion; Wright-Elwood Tract also has been included because of its importance in protecting already urbanized areas to the east. The definition of these lowland levees is very useful for planning purposes because it is the islands that have significant land areas below sea level that are most exposed to the increasing risk posed by possible sea-level rise and that also serve to prevent salinity intrusion. Unlike islands and tracts where the land surface is above sea level, these islands cannot be drained naturally and have to be pumped out after first repairing the levee. Further, failure and flooding of even one of these islands potentially increases both the wave action and the seepage forces on the adjacent islands so that if the island is not repaired and drained promptly, progressive failure of additional islands may occur. Clear evidence of the effect of a single flooded island on adjacent islands was provided by the fact that levee integrity on Woodward and Victoria Islands was compromised by the failure and flooding of Upper Jones Tract in 2004.[60] Thus, the maintenance and improvement of the lowland levees are critical to the achievement of the coequal goals set forth in the Delta Reform Act of 2009. The concept of defining lowland levees is similar in purpose to the designation in the 2008 PPIC report[61] of 34 islands as core or significant islands.

[59] Based on discussions with reclamation district engineers. These estimates will be refined and formalized in the 5-year plans that are now required as a prerequisite for state funding but the preparation of these 5-year plans has been delayed by delays in releasing the funding to develop them.
[60] Neudeck,Christopher, KSN, Inc., personal communication.
[61] Lund, J., et al., *Comparing Futures for the Sacramento-San Joaquin Delta*, Public Policy Institute of California, San Francisco, CA, August 2008.

Figure 16 All Islands Containing Critical Facilities[62]



[62] For high resolution image see http://forecast.pacific.edu/desp-figs.html

All of the islands shown in Appendix D, which have levees protecting infrastructure or critical facilities of one form or another, are superimposed in Figure 16. Figure 16 is not necessarily complete and does not attempt to weight the relative value of the various kinds of infrastructure, but it illustrates the widespread distribution of significant infrastructure in the Delta and shows that most, if not all, islands or tracts house significant infrastructure or border important shipping or conveyance pathways.

5.3.2 Levee Standards

A detailed discussion of the various standards that might apply to Delta levees was given by Betchart (2008).[63] Betchart's list can be simplified into the five standards listed below. Because the Delta is a unique place with unique soil conditions, some levee standards that are applicable elsewhere are not applicable in the Delta. These unique considerations are discussed in Appendix E.

Hazard Mitigation Plan (HMP)
The Hazard Mitigation Plan (HMP) "standard" is not an engineering standard but is a simple geometric levee description that was devised by FEMA in order to establish minimum requirements for federal disaster relief. It provides for a 16-foot crown width, a 1-foot freeboard above the 100-year water surface elevation, minimum 1.5-to-1 waterside slopes, and minimum 2-to-1 landslides slopes. Most existing Delta levees generally meet this standard, but because Delta levees built of or over peat are subject to on-going settlement, there is continuing argument over how literally this standard should be interpreted. The current regulatory position is stated in a MOU signed in February 2010 between Cal EMA and FEMA, as discussed by Betchart (2011).[64] However, notwithstanding its importance to disaster-relief funding, no engineer familiar with the Delta considers the HMP geometry to be adequate for even basic flood protection, and the reclamation districts are generally working towards full compliance with the higher PL 84-99 standard. While there are some miles of levees that, pending further improvement, waver around the HMP geometry, there are at present only about 50 miles that fall below HMP,[65] and even those levees fall short only by about a foot of elevation. As noted in the DWR Technical Memorandum, while achieving the HMP geometry is not really a goal from an engineering perspective, consistently meeting it is not only a first step towards the real short-term goal, which is PL 84-99, but is also important from the point of view of the state in maximizing federal assistance following any disaster.

While levee standards are generally thought of in engineering terms and vegetation on levees is discouraged, the treatment of levee vegetation is critical in the Delta (and elsewhere in California) where preservation or restoration of riparian habitat is an important goal. Vegetation management guidelines for local, non-project Delta levees that were adopted in 1994 require that the crown and the landside slope and a ten-foot strip along the landside toe must be cleared of visually obstructive vegetation, although mature trees may be retained. All vegetation except for grasses must be removed from the top five feet of the waterside slope. The guidelines suggest that naturally growing vegetation below the cleared area should be pruned or removed only to the extent necessary to insure levee safety and ease of inspection.

[63] Betchart, W., Delta Levees – Types, Uses and Policy Options, Prepared for Delta Vision, August 2008.
[64] Betchart, W., Memo to Delta Levees and Habitat Advisory Committee with attached MOU, 2011.
[65] Based on discussions with reclamation district engineers. See previous footnote regarding the development of 5-year plans.

Public Law (PL) 84-99

Among other actions, Public Law 84-99 allows the Corps of Engineers to rehabilitate flood protection systems during a disaster. In order to qualify, the flood system must have already been enrolled into the Corps' Rehabilitation and Inspection Program. In 1987, the Sacramento District of USACE established a Delta-specific standard for levees, based on the Bulletin 192-82 joint DWR-USACE study that is described below, but with the requirement for 1.5 feet of freeboard reduced to being over the 100-year water surface elevation rather than the 300-year water surface elevation. Within the legal Delta this standard plus various maintenance and inspection requirements must be met in order to qualify for rehabilitation under PL 84-99. The Corps was careful to note that "the recommended guidelines are Delta-Specific and they are not intended to establish design standards for the 537 miles of non-federal levees in the Sacramento-San Joaquin Legal Delta, but to provide uniform procedures to be used by the Corps of Engineers in determining eligibility under PL 84-99, as amended." In the preceding Bulletin 192-82 study it had been stated that "while the Corps' design has accounted for small earthquakes, the lack of actual experience of the impacts of earthquakes on Delta soils leaves some doubt that levees, even after rehabilitation, could withstand an earthquake of Richter magnitude 5 or greater if the epicenter occurred in the Delta, or of magnitude 8 on the San Andreas or Hayward faults." Thus, earthquakes were considered but not fully accounted for.

While sometimes referred to as the PL 84-99 Ag standard, this standard actually applies to both agricultural and urban levees within the Legal Delta. The standard adds a stability requirement to what is otherwise principally a geometric standard. It provides for a crown width of 16 feet, freeboard of 1.5 feet over the 100-year water surface elevation, a minimum waterside slope of 2-to-1, and landside slopes that vary as a function of the depth of peat and the height of the levee such that the static factor of safety on slope stability is not less than 1.25. Very approximately, the landslide slope can be 2-to-1 for levee heights no greater than 5 feet, can be 3-to-1 for levee heights no greater than 10 feet, can be 4-to-1 for levee heights no greater than 20 feet, and has to be 5-to-1 for levee heights of 25 feet or greater. Alternately, the minimum factor of safety can be achieved by construction of a landside toe berm. While this standard only calls for a minimum crown width of 16 feet, some reclamation districts are already planning for or are constructing improved levees with a 22-foot crown width, adequate for a two-lane, all-weather road. This allows for two-way traffic in emergency situations and is much to be encouraged. While this standard does not fully address earthquake loadings, the flatter slopes and/or landslide berms that are required for levees built over peat means that they are fundamentally less likely to suffer major distress as a result of earthquake loadings. This Delta-specific standard leads to the result that levees in the western and central Delta which overlie peat are likely to be less susceptible to damage in earthquakes than levees in the north and south Delta, which both overlie more sandy soils and tend to be composed of sandy soils and thus are more susceptible to liquefaction. While the Delta-specific PL 84-99 standard includes no specific guidelines on vegetation, it is assumed that the Corps national standards on levee vegetation, which basically ban all significant vegetation on both land and watersides, apply unless a specific variance from those standards is obtained. This question is currently the subject of a significant debate between the State of California and USACE, with the state arguing for the positive engineering and environmental benefits of vegetation on the waterside slopes of levees. The state's position is indicated by the proposed provisions for urban levees which are noted below.

Sacramento District (SPK)

While not directly applicable to Delta levees, the Geotechnical Levee Practice of the Sacramento District of USACE (designated SPK) has some relevance because it informs both the Urban and Non-Urban Levee Evaluation programs and the DWR Urban Levee Design

Criteria that are presently being developed. This SPK Practice calls for a minimum crown width of 20 feet for main-line levees and minimum water and landside slopes of 3-to-1. Existing levees, with landside slopes as steep as 2-to-1, may be retained in rehabilitation projects if their historic performance has been satisfactory. This move to 3-to-1 slopes is driven by maintenance issues as much as slope stability and seepage issues. The practice also suggests minimum requirements for geotechnical investigations and analyses. Although it describes recommended standard practice, it also makes it clear (and this aspect is often overlooked) that the responsible engineers should use appropriate judgment as a function of site-specific conditions and experience.

Urban Levee Design Criteria (ULDC)

DWR was directed by SB 5 to develop appropriate standards for urban levees, and version four of the Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento-San Joaquin Valley was published in December 2010. These criteria are now being finalized as the Urban Levee Design Criteria which will eventually become a state regulation. The ULDC is generally consistent with the SPK Practice and has the same geometric requirements. However, the ULDC goes much further in defining required practice in a number of other areas including seismic loadings, encroachments, penetrations and vegetation. With regard to vegetation, the draft ULDC language generally prohibits vegetation in accordance with the USACE national policy but allows woody vegetation on portions of the waterside slope and riverbank or berm for a newly constructed levee if a specially-designed waterside planting berm is added or the levee section is otherwise widened. In the case of the repair or improvement of existing levees, the draft ULDC language allows trees and other vegetation to be preserved over the long term if they provide important or critical habitat or erosion protection, soil reinforcement or sediment recruitment. In order to mitigate possible adverse effects of roots, where feasible the overall width of the levee should be widened landward by at least 15 feet or an effective root or seepage barrier shall be installed within the upper 10–15 feet below the levee crown. For other levees with pre-existing vegetation, the UDLC requires inspection and thinning in accordance with the Central Valley Flood System Improvement Framework. It is suggested that these provisions are generally applicable to Delta levees.

Proposed Higher Delta Levees Standard

With the exception of the ULDC, which addresses design and/or quick repair of levees for 200-year return period earthquakes, none of the above standards explicitly address seismically-resistant design, or design for greater than 100-year water surface elevations and possible sea-level rise. The 1983 Delta Levees Investigation (see Section5.3.3.1 below) did suggest that Delta levees should be designed for 300-year water surface elevations but that suggestion has not been included in subsequent standards or revisions. Although updated estimates of water surface elevations from the Central Valley Flood Protection Plan are still pending, it is commonly believed that water surface elevations in much of the Delta are strongly influenced by tides and that 300- or even 500-year water surface elevations are only a foot or two higher than 100-year elevations. Pyke (2011)[66] has suggested that an appropriate standard for the design of Delta levees might be to design for 500-year flood and earthquake loadings. Likely, adoption of the ULDC requirement for three feet of freeboard over the 100-year water surface elevation coupled with superior flood-fighting would effectively provide 500-year flood protection. Building to this standard and increasing the crown width to a minimum of 22 feet would increase the cost only marginally over the cost of complying with the Delta-specific PL 84-99 standard and this “PL 84-99 plus” standard may be sufficient for many Delta levees long-term. If the levee in question

[66] Pyke, R., Comments of the First Staff Draft of the Delta Plan, Delta Stewardship Council, February 2011, http://deltacouncil.ca.gov/public-comments/read/143?page=1

does not contain or is not underlain by loose sands that are susceptible to liquefaction, these PL 84-99 plus levees should be considered to be seismically robust. However, in order to more fully address earthquake loadings, possible sea-level rise and to provide the option for adding vegetation on the water side of levees, a higher Delta levees standard is required. This standard should particularly be required of most of the lowland levees which face the biggest hazard due to possible sea-level rise and are also the most critical to salinity intrusion, but it might be selectively applied to other Delta levees.

As an example of a levee with increased seismic resistance that also meets other objectives, the cross-section of a proposed seismically-resistant levee taken from a report by Hultgren-Tillis Engineers (HTE) for Reclamation District 2026 (Webb Tract)[67] is shown in Figure 17. Even when assuming that some liquefaction might occur both in the embankment and the foundation, this study indicates that deformations would be limited by the addition of a landslide buttress, as shown in the figure. A key feature of the design shown in Figure 17 is the wide crest. Wider crests not only provide a more robust levee, but also allow for more efficient emergency levee patrol and response when it includes an all-weather traffic surface. Levees with wider crests are also the most economical way to provide for possible sea-level rise. While it is the policy of the state to plan for 55 inches of sea-level rise by the year 2100, the probability of that magnitude of sea-level rise is actually very small. While it is not cost-effective or rational to construct levees to those elevations today, the provision of a wider crest with an all-weather traffic surface today has at least three benefits: providing a more robust levee immediately; allowing more room and accessibility for patrol, flood-fighting or emergency response following earthquakes; and allowing a choice of methods for raising the crest elevation in the event of need in flood events and in the long term case of actual sea-level rise. In addition, the provision of a wider crest also allows for retaining or planting vegetation on the waterside of the levee in accordance with the ULDC guidelines. Such planting should be an essential component of any comprehensive plan to repair the Delta ecosystem. Local widening of these levees would also allow for the construction of new recreational and tourist facilities out of the flood plain.

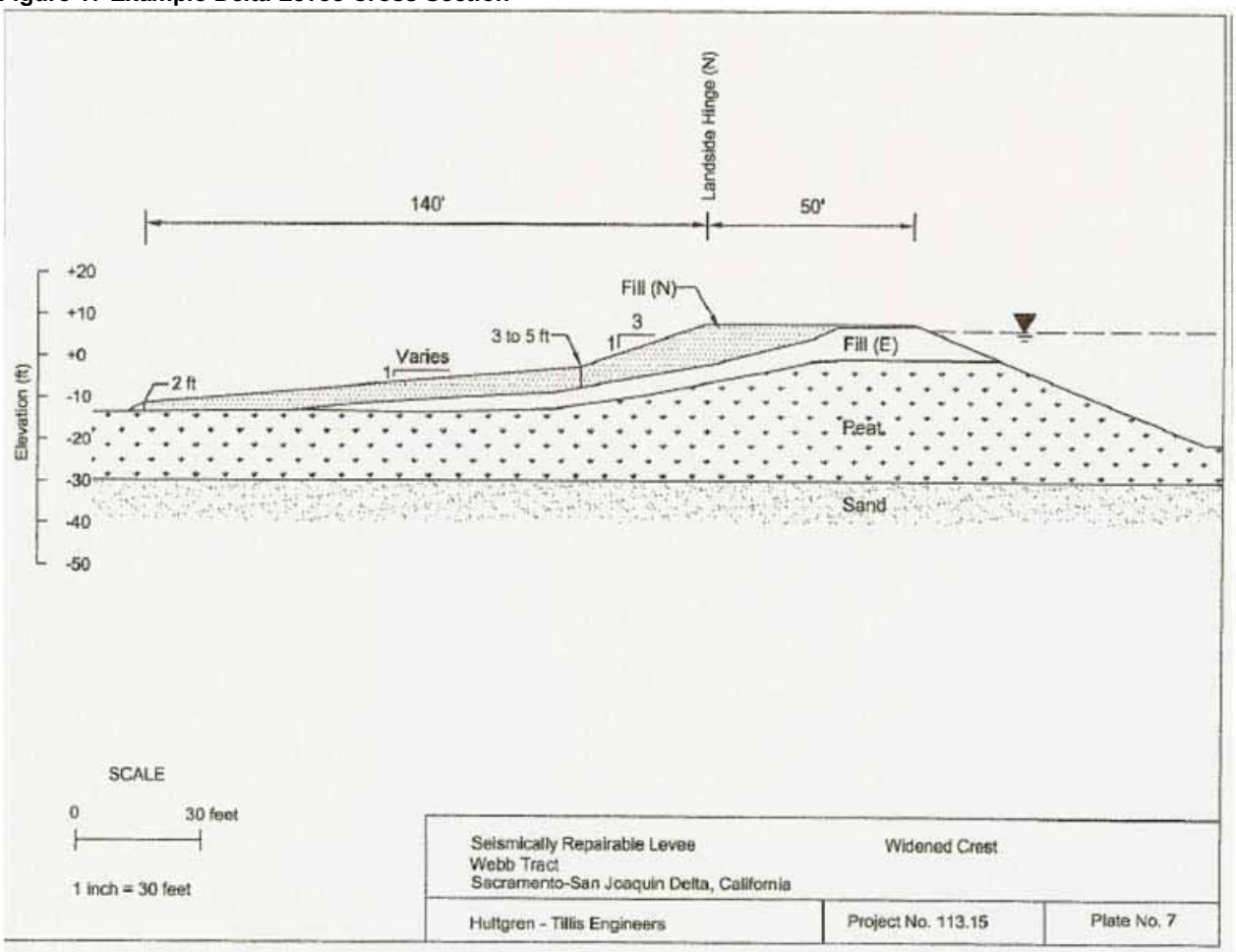
HTE estimated that this design would cost approximately $2 million per mile in 2009. HTE also looked at more elaborate designs which included either or both of a slurry trench wall or an internal drain. Those designs added up to $5 million per mile to the incremental cost but we believe that the additional features are not generally required and that an average cost of $2-3 million per mile is a reasonable estimate at this time. While the HTE report was only conceptual in nature, the cost estimates were conservative estimates based on recent actual construction costs for lesser improvements. HTE estimated that the fill required would range from 125,000 to 150,000 cubic yards per mile. That translates to a cost per cubic yard of $13-16 per cubic yard. The actual cost of just the fill has consistently been around $6 per cubic yard for some time so that HTE more than doubled that figure to provide for the need for some additional rip-rap, an all-weather two land road, road and the need to move siphons, pumps and drains, and so on. We applied an additional contingency of 50 percent to obtain the figure of $2-3 million per mile. This figure easily accommodates engineering as well as construction costs when performed at the local level.

If it is assumed that anywhere from 300-600 miles of levees need to be upgraded to this standard, the basic engineering and construction cost would be in the order of $1-2 billion although the overall program cost might well be higher.

[67] Hultgren-Tillis Engineers, Geotechnical Evaluation, Seismically Repairable Levee, Webb Tract, Report to Reclamation District 2026, December 2009.

By comparison the 2007 PPIC report "Envisioning Futures"[68] listed in Table 8.2 an alternative labeled Fortress Delta (Dutch standards) which had a total cost greater than $4 billion and in Appendix E it is explained that was based on an estimated cost of $10 million per mile, applied to 300 to 500 miles of levees. The $10 million per mile figure was obtained by taking a $5 million per mile figure based on "recent informal estimates by water managers … including significant structural work" and doubling it because "Dutch levels of levee protection … would probably involve changes in many islands and channels, straining current construction and levee material capacity". If it is assumed that "structural work" means including a slurry trench wall or internal drain then the $5 million per mile estimate is not inconsistent with the HTE estimates and these measures are in fact likely to be required to obtain "Dutch levels of levee protection" since currently Dutch levees are variously designed for 2,500 to 10,000 year levels of protection. However, the societal and economic considerations in the Netherlands are even more demanding than those in the Delta and we believe that a lesser upgrade to something like a 500 or 1000-year level of protection coupled with improved and more effective inspection and flood fighting capabilities is appropriate for the Delta.

Figure 17 Example Delta Levee Cross Section



[68] Lund, J., et al., *Envisioning Futures for the Sacramento-San Joaquin Delta*, Public Policy Institute of California, San Francisco, CA, 2007.

5.3.3 Previous Studies of Delta Levees

5.3.3.1 Delta Levees Investigation, DWR Bulletin 192-82

In 1976 the legislature directed DWR to prepare a plan for the preservation of the Delta levees. After a joint study with USACE, a definitive plan for the improvement of all Delta levees was completed six years later and published as Bulletin 192-82,[69] which recommended a levee standard similar to the current Delta-specific PL 84-99 standard but with a requirement for 1.5 feet of freeboard over the 300-year water surface elevation. The forward to the report, signed by Ronald Robie, then Director of DWR, states in part:

> *Now is the time for a decision. The most significant element in a decision on what action to take is how much can we afford and who will pay? These questions can only be answered by the Legislature, the local landowners, and the Congress.*
>
> *There is a danger that taking a short-term view of Delta flooding problems will merely pass the tough issues on to the next generation. Short-run economic decisions may serve to subsidize private interest as the expense of the general public. The great challenge for the Delta is to find an equitable way of financing a very uncertain long-term future. The political process is the traditional arena for handling these kinds of issues and is the right forum for the next step in Delta deliberations.*
>
> *These policy issues must be addressed today. In the event the Legislature determines that a major responsibility for levee restoration should fall upon the State, a bond issue or other form of capital financing must be developed and approved by the people.*

At that time, it was estimated that improving all levees to the proposed Bulletin 192-82 standard would cost $930 million if implemented immediately. However, although funding of the subventions program continued at a relatively low level, financing was never put in place to implement this more significant levee-improvement plan.

5.3.3.2 CALFED Levee System Integrity Program

A similar study, called the CALFED Levee System Integrity Program, was subsequently conducted as part of the CALFED program.[70] The executive summary of the Levee System Integrity Program Plan, dated July 2000, contains the following statements:

> *The benefits of an improved Delta Levee system include greater protection to the Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and conveyance benefits. The wide range of beneficiaries of the Delta Levee System Integrity program include Delta local agencies; landowners; farmers; boaters; wildlife; and operators of railroads, state highway, utilities, and water distribution facilities. Delta Water users and exporters also benefit from increased protection to water quality. Federal interests benefit from improvements to conveyance, navigation, commerce, and the environment, and from reduced flood damage.*
>
> *Recognizing these potential benefits, state and local agencies formed a partnership to reconstruct Delta levees. This effort has resulted in a steady improvement in the Delta levee system. The success of the Delta in the 1997 and 1998 flood events illustrates the value of the approximately $100 million of improvements made with SB 34 funds and*

[69] Delta Levees Investigation, Department of Water Resources, Bulletin 192-82, December 1982.
[70] Op. cit.

> *over $10 million in emergency PL 84-99 work performed for the U.S. Army Corps of Engineers. These funds, in addition to local funds, have resulted in over $160 million in improvements to Delta levees since the SB program's inception in 1988.*

However, the summary continues with:

> *Many Delta levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect. As mandated by the California State legislature and adopted by CALFED, the physical characteristics of the Delta should be preserved essentially in their present form. This is necessary to protect the beneficial uses of the Delta. The key to preserving the Delta's physical characteristics and to achieving CALFED's objectives is the levee system. Over the next 30 years CALFED will invest billions of dollars in the Delta. The levees must protect this investment.*
>
> *The existing levee program (*the subventions program*) was intended to improve Delta levees up to the California/Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan (HMP) Standard. As of January 1998, 36 of 62 (58%) Delta islands and tracts were in compliance with the HMP standard. This has resulted in a significant improvement in the ability to protect the beneficial uses of the Delta. However, as CALFED invests in the Delta, more is at risk. Therefore CALFED has chosen to improve the Delta levees to a higher level.*
>
> *The CALFED Levee program will institute a program that is cost-shared among the beneficial users to reconstruct Delta levees to the Corps' PL 84-99 Delta Specific Standard. This action will increase levee reliability and reduce emergency repair costs. In addition, levee districts meeting this standard are eligible for federal emergency assistance under PL 84-99.*

The plan to improve the levees to the PL 84-99 standard was not new. It had been recommended in Bulletin 192-82. The CALFED study estimated that the cost of improving all the Delta levees to the PL 84-99 standard ranged from $367 million to $1.051 billion, not inconsistent with the $930 million estimated in 1982. But again, no funding materialized until in 2006, in the wake of the Paterno Decision, Propositions 84 and 1E provided for up to $615 million to be spent on Delta levees.[71] The slow pace of disbursement of these funds is discussed subsequently but, in effect, this was the funding that had been recommended first by Bulletin 182-92 and then by CALFED.

The CALFED plan also discussed the fact that funding for levee work is insufficient, inconsistent, and often delayed; that dredging is required to increase channel capacity and to provide material for levee reconstruction, habitat restoration and creation, and subsidence control, but that dredging had been curtailed due to regulatory constraints, causing dredging equipment and trained manpower to leave the Delta; that emergency response capabilities need to be continuously refined and funding increased; that levee reconstruction and maintenance sometimes conflicts with management of terrestrial and aquatic habitat resources; that obtaining permits for levee work can sometimes be difficult and time consuming; and that while subsidence may adversely affect levee integrity, this can be corrected.

With respect to seismic loadings, the plan said:

[71] Some sources indicate that $775 million was intended to be spent on Delta levees but the draft DWR Technical memorandum indicates that only $615 million was made available by these propositions.

> *Some CALFED stakeholders are concerned that earthquakes may pose a catastrophic threat to Delta levees, that seismic forces could cause multiple levee failures in a short time, and that such a catastrophe could overwhelm the current emergency response system.*
>
> *CALFED agrees that earthquakes pose a potential threat. In addition, Delta levees are at risk from floods, seepage, subsidence, and other threats. To address this concern, CALFED has begun a risk assessment to quantify these risks and to develop a risk management strategy.*

The plan listed 10 possible risk management options which included improving emergency response capabilities and reducing the fragility of the levees and indicated that the final Risk Management Plan might include a combination of the 10 options. CALFED never completed the Risk Management Plan, and the effort evolved into the Department of Water Resources' Delta Risk Management Strategy.

With respect to emergency response, Appendix F, Emergency Management and Response, in the CALFED Record of Decision issued in 2000, stated:

> *Lack of specific funding sources and obstacles within federal public assistance re-imbursement rules have hindered direct involvement in flood fight activities by counties, cities and State agencies. Creation of funding to support a delta levee emergency response plan would eliminate past hesitation and inefficiencies….*
>
> *A detailed response plan should be developed for the Delta that would allow an immediate, simultaneous response to a serious incident (such as a major flood or an earthquake) by all levels of government within a single integrated organizational structure.*

5.3.3.3 Delta Risk Management Strategy

AB 1200 (authored by John Laird, the current California Secretary for Natural Resources) required that DWR evaluate the potential impacts on water supplies derived from the Delta based on 50-, 100-, and 200-year projections for each of the following possible impacts: subsidence, earthquakes, floods, climate change and sea-level rise, or a combination of these impacts. This legislation had the effect of changing the CALFED recommended study into what became the Delta Risk Management Strategy (DRMS) and the Risk Management Plan envisioned by CALFED has never been completed.

DRMS was conducted for the Department of Water Resources (DWR) by a team of consultants led by URS Corporation and Jack R. Benjamin & Associates.[72] The study was designed to have two phases. The first phase was an assessment of the then-current (2005) risks to the Delta and the second phase was to have been a projection of future risks assuming various scenarios. The Phase One draft generated a great volume of critical comments, and the effort required to respond to them cut into the available funding for Phase 2. The Phase 1 Risk Analysis Report was released in 2009, but the report on the modified Phase 2 study has only just been released.

[72] http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/

Although led by very competent principal investigators, the DRMS effort was always hampered by being schedule-driven rather than quality driven. The DRMS Phase One report was extensively reviewed, including a review by an independent review panel (IRP) assembled by the Cal-Fed Science Program. The reviews were generally critical of the study. After revisions had been made, the IRP review[73] concluded that "the revised DRMS Phase 1 report is now appropriate for use in DRMS Phase 2 and serves as a useful tool to inform policymakers and others concerning possible resource allocations and strategies for addressing risks in the Delta." But the IRP expressed concerns:

> "*This conclusion, however, is subject to some important caveats. First, the IRP cautions users of this revised DRMS Phase 1 report that future estimates of consequences must be viewed as projections that can provide relative indicators of directions of effects, not predictions to be interpreted literally. Second, anyone using the results of the DRMS scenarios must be aware that ecosystem effects are not fully captured in the analysis....*"

Although the DRMS developed a good framework for assessing risks to the Delta levees, the effort had data gaps that were never filled, as acknowledged in the note on page 1-1 of the report. Gaps such of these in data and knowledge tend to drive the estimates of fragilities down, and the risks up. However, despite the warning from the IRP, the numerical results from the DRMS Phase 1 report are widely quoted and used in other studies, painting a more pessimistic picture of the Delta levee system than is warranted. Just one example of the questionable results is presented by the last map in the DRMS Executive Summary depicting a high probability of flooding for Sargent-Barnhart Tract, which houses Stockton's most expensive neighborhood, known as Brookside. This tract has had modern levees that meet 200-year urban standards and is shown as having a mean annual probability of failure of greater than 7 percent, while the adjacent Wright-Elmwood Tract, which is undeveloped and has relatively poorer levees, is shown as having a mean annual probability of failure of only 1-3 percent. In addition, recent improvements have been made to many urban levees in addition to recent and on-going improvements to non-urban levees under the Delta levees subventions and special projects programs and these improvements are not reflected in the DRMS Phase 1 assessment.

The DRMS Phase 2 study focuses on risk reduction as opposed to risk analysis and evaluates the costs and benefits of four alternative scenarios for levee improvement and conveyance. Although Phase 2 was not released until June 2011, the forward to the report notes that it was completed in 2009, which explains why it utilizes costs for isolated conveyance that are less than half more current cost estimates.

As discussed below, the awkward construction of scenarios limit the value of the final conclusions of the Phase 2 report. However, the DRMS phase 2 report is still a wealth of detailed information regarding individual components of the scenarios and the economic consequences of flood and earthquake events in the Delta. In fact, the key findings relative to the two types of levee upgrades that were considered (and are listed below) are not inconsistent with the present study.

- *Most of the Delta levees already meet the HMP standard.*
- *Some of the levees in the central Delta (project levees) already meet the PL 84-99 standards.*

[73] The independent review panel (IRP) comments on the DRMS Phase I draft report are published on the state's archived CALFED website: http://calwater.ca.gov/science/drms/drms_irp.html.

- *The cost of upgrading 764 miles of selected non-project levees (levees that do not meet PL 84-99 standards) in the central Delta to PL 84-99 standards is about $1.2 billion.*
- *The cost of upgrading 187 miles of selected levees around urban centers to UPL standards is $750 million.*
- *Upgrading levees to meet the target standards will reduce the probability of failure due to flooding. However, these upgrades do not guarantee that the upgraded levees, particularly those upgraded to PL 84-99 standards, will not fail during a 100-year flood. The 1.5 feet of freeboard is insufficient for regions subject to high winds during floods.*
- *Upgrading levees to meet the PL 84-99 and UPL standards does not reduce the seismic risk of levee failure.*

Elsewhere the report says that "upgrading the levees to the Pl 84-99 and UPL standards would do little to reduce the risk of failure under seismic loading." However, curiously, the report says nothing about what it would take to further upgrade the critical levees so that they are more robust under seismic loadings.

However, a January 2008 progress report to the Legislature required by AB 1200[74] reported that a Seismically Improved Levees "building block" was one of three high-ranking building blocks that were the basis for the DRMS Phase 2 trial scenarios. The "Improved Levees" scenario in the AB 1200 progress report featured 100 miles of seismically resistant levee upgrades to south Delta islands, a significant difference from the "Improved Levees" scenario in the final report that did not include levee improvements beyond the PL 84-99 standard. The January 2008 report did not report quantitative results, but described the rankings of the scenarios on page 24:

> "The ranking of the preliminary DRMS scenarios is shown in the following table. These rankings were developed by DWR and DFG staff based on DRMS analyses, with adjustments based on the BDCP analyses. Scenario 1 (Improved Levees) ranks moderate for reducing risk and is the least expensive of the three. Scenario 2 (Armored Pathway) and Scenario 3 (Isolated Conveyance Facility) rank high and very high respectively for reducing risk, but also cost more than Scenario 1."

Because information on seismic levee upgrades were not in the final DRMS phase 2 report, we requested a copy of the preliminary quantitative results described in the ranking above from DWR in a December 15, 2011 letter. On January 9, 2012, DWR responded and provided a copy of the August 20, 2007 preliminary draft of DRMS Phase 2. The preliminary draft confirmed that Scenario 1 (Improved Levees) was evaluated as the least expensive, but the quantitative risk reduction results in the preliminary draft were the opposite of what was reported in the AB 1200 report to the Legislature. Specifically, Table 18-13 in the preliminary draft evaluated the risk reduction benefits of Scenario 1 (Improved Levees) as $7.9 billion, nearly 40% higher than the $5.7 billion in risk reduction benefits from scenario 2 or scenario 3 (isolated conveyance facility). While the AB 1200 progress report states that adjustments were made based on the BDCP analysis, the quantitative results show that the adjustment was to reverse the risk reduction rankings of the alternatives to match the proposed isolated conveyance strategy in the BDCP. DWR did not explain why seismic levee upgrades were dropped from

[74] "Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta." A Report Pursuant to Requirements of Assembly Bill 1200, Laird. Department of Water Resources & Department of Fish and Game. January 2008.
http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/docs/AB1200_Report_to_Legislature.pdf

subsequent revised analysis conducted for the final DRMS phase 2 when the strategy performed best on both cost and risk reduction criteria in the preliminary analysis.

The 4 scenarios that were evaluated in the final, public DRMS phase 2 report illustrate the extreme cost of strategies that focus on individual risk-reduction strategies for each infrastructure system rather than seismic upgrades to the existing levee system. For example, Scenario 1, "Improved Levees," in the public DRMS phase 2 report assumes that the levees are not robust under seismic loadings and estimates the cost of hardening the state highways that cross the Delta, by putting them on piles like the elevated section of the Yolo Causeway, and the BNSF railway and the Mokelumne Aqueducts, either by building seismically-resistant embankments with a 50-foot crown width on either side of the existing railway and aqueducts, or by placing the railway and aqueducts on a single embankment with a 180-foot crown width. The cost of these hardening measures was estimated to be $6.1 billion for the highways and $3.3-3.9 billion for the infrastructure corridor. Adding these figures to the cost of improving levees to the PL 84-99 standard and selected ecosystem enhancements resulted in a stated total capital cost for Scenario 1 of $10.4 billion, as reported in Table 1 of the executive summary. Thus, the "Improved Levees" scenario is not a broad improvement of Delta levees as described in this report, but has 60 percent of the total cost allocated to putting a few state highways on piers, a strategy that the report notes does not generate benefits equal to the costs and creates numerous problems for the network of local Delta roads. It should be titled an "elevated highways" scenario since that is its most prominent feature, as highways do not have to be elevated for the type of improved levees strategy described in the ESP.

Likewise Scenario 2, which is titled "Through Delta Conveyance (Armored Pathway)," ignores the possibility of a general upgrade to levees that are more robust under seismic loading and instead assumes the construction of 115 miles of new seismically-resistant setback levees, at a cost of $38 million per mile. The total capital cost of the scenario is $15.6 billion, because this strategy is also paired with $5 billion in costs to put roads on piers.

Scenarios 3 and 4 examine isolated and dual conveyance, and greatly misrepresent the costs of these strategies as being comparable to or cheaper than through Delta conveyance strategies. First, they utilize out-of-date costs for isolated conveyance that are under $5 billion compared to current estimates of $12 billion or more. Second, these scenarios also reduce cost by not including the $3.3 billion armored infrastructure corridor included in Scenarios 1 and 2. As a result, the costs and composition of the four illustrative scenarios are constructed in such a way that the final conclusions are of little value.

Despite the limitations created by the scenario composition, the DRMS Phase 2 results still have interesting implications. In addition, the consequences analysis is very comprehensive and provides more details on the distribution of the costs of consequences of floods and earthquakes than were provided in Phase 1. Below are some key findings from the DRMS Phase 2[75]:

[75] These findings are not what is highlighted by the Department of Water Resources in the Executive Summary of DRMS phase 2, but are easily found and calculated from the results tables in the analysis. The benefit-cost ratios are easily calculated from Table 1 in the executive summary, Table 18-2a shows that "Statewide Costs" are 38% of the total cost of a Delta earthquake, and water export disruption is 51.5% of statewide costs, thus both water exports and state highway damage are about 20% of total costs from the largest earthquake. The same table shows that water export interruptions are virtually none of the cost from smaller, more common flood events.

- Improving levees had the highest benefit-cost ratio of any Delta risk reduction strategy, including isolated water conveyance that was assumed to cost only $4.9 billion.

- Water exports account for only 20% of the economic costs from a large earthquake event that would flood between 10 and 30 Delta islands.

- Water exports account for less than 2% of the economic costs of more-common flood events due to high water and storms.

- Water exports account for 0% of the loss of life from any type of flood hazard event.

These findings have enormous implications for risk management in the Delta. Both the preliminary and final draft of DRMS Phase 2 found improving levees has the highest economic benefit per dollar invested and lowest total cost. Levee upgrades perform well in cost-benefit analysis of Delta options, because they reduce risk in all areas including water conveyance, other infrastructure, and in-Delta property. In contrast, isolated conveyance only protects water exports which DRMS clearly identifies as a minority of the economic risks.

This study concludes that most lowland Delta levees and selected other levees can be made robust under seismic loadings for a base engineering and construction cost of $1-2 billion. Even if the total program cost were $4 billion as suggested by PPIC (2007), a true “improved levees” scenario would have much lower costs than the version in DRMS and would perform much better in reducing the costs of in-Delta flood losses as well as out-of-Delta losses from water supply reliability and therefore have higher benefits. Although it is impossible to draw conclusions without a complete analysis, a true “improved levees” scenario would likely have a much higher benefit-cost ratio than the other scenarios considered in DRMS phase 2.

5.3.3.4 Delta Islands and Levees Feasibility Study

Meanwhile, the successor to the Bulletin 192-82 and CALFED studies is the USACE Delta Islands and Levees Feasibility Study, which is an on-going effort in collaboration with DWR.[76] The official description of the study is:

> *This feasibility study is USACE’s mechanism to participate in a cost-shared solution to a variety of water resources needs for which we have the authority. Results of state planning efforts will be used to help define problems, opportunities, and specific planning objectives. The feasibility study will address ecosystem restoration and flood risk management, and may also investigate related issues such as water quality and water supply. USACE and DWR signed a Feasibility Cost Sharing Agreement (FCSA) in May 2006.*

The initial public findings and outreach are not expected until later this year. Thus, three joint state-federal efforts over the last 30 years have had significant positive impact in that they have generated the concept of improving Delta levees to the PL 84-99 standard and have supported the continuation of the funding that is provided under the subventions program and the additional funding that was authorized under Propositions 84 and 1E and the CALFED Levee Stability program. However, they have not yet led to a strategy which will make the Delta sustainable longer-term facing the hazards due to floods, earthquakes, and possible sea-level rise.

[76] http://www.spk.usace.army.mil/projects/civil/Delta/News.html

This study is an element of the broader USACE CALFED Levee Stability Program created by the CALFED Bay-Delta Authorization Act of 2004. This program includes several short-term projects to be implemented by the Corps pending completion of the long-term feasibility study. A report to Congress issued in May 2006 identified 54 projects in the Delta for implementation as funding is available under the Corps Small Flood Control Projects authority. These projects included reconstruction of levees to the PL84-99 standard, enhancement of the stability of levees of particular importance to the system, and projects to protect critical infrastructure. Some of these projects have been initiated with funding provided in years subsequent to the completion of the report.

The CALFED Levee Stability Program also included short-term goals of developing best management practices to control subsidence, developing a Delta Levee Emergency Management and Response Plan, and developing a strategy for assessing the consequences of Delta levee failure from floods, seepage, subsidence, and earthquakes. Initial funding for the USACE response plan was used in 2010-11 to attempt to duplicate San Joaquin County flood contingency maps throughout the Delta.

5.4 Risk Reduction Strategies

There are three basic approaches to addressing the risks posed to the Delta levees by floods and earthquakes. One is to simply make the up-front investment to improve the existing levees so that they are more robust; a second is to make the preparations in advance for improved flood-fighting and/or emergency repairs after an earthquake so that breaches do not occur; the third is to make preparations in advance for minimizing the extent and depth of flood waters if breaches do occur, and rapid repair of breaches and draining of any flooded islands so that the consequences are minimized. These three approaches are discussed in more detail in the following sections, and are followed by a discussion of economic justification for investing in risk reduction strategies.

5.4.1 Improve the robustness of the existing levees

This is the standard approach to reducing risk: invest up-front in making everything more robust. As discussed earlier, a series of reports over three decades have concluded that Delta levees should be improved to the Delta-specific PL 84-99 standard. However, the Department of Water Resources has released a draft "Framework for DWR Investments in Delta Integrated Flood Management,"[77] a document that was only released for public comment on July 15, 2011, but had already been forwarded to the Delta Stewardship Council, that states or implies that the HMP "standard" provides an adequate basic level of protection against floods and earthquakes for Delta levees. The exact language of the draft Framework is:

> *As funding is available, DWR intends to cooperate with local public agencies to develop local plans to improve levees within the Delta levee network to at least the HMP standard. Some levees may warrant additional investment to provide a level of protection beyond the HMP standard, but these projects likely would need to be justified based on one of the other categories of benefit described in this section.*

Apparently on the basis of this language, the 5th staff draft of the Delta Plan, in Table 7-1, indicates that levees built only to the HMP "standard" are acceptable for protection of

[77] California Department of Water Resources, DRAFT V3 DHF and SMB, "A Framework for Department of Water Resources Investments in Delta Integrated Flood Management," February 14, 2011.

agricultural lands. However, the HMP "standard" is not an engineering standard. It is a minimum configuration agreed to by the state and federal governments for the purpose of defining a serious levee in order to protect the federal government from facing possible exposure to the cost of repairing levees that are height limited or not seriously being maintained. Since 1982, the minimum standard for engineered levees in the Delta has been the Delta-specific standard that was recommended in Bulletin 192-82 and subsequently adopted by the Corps of Engineers as the PL 84-99 standard for Delta levees. This Delta-specific PL 84-99 standard was also adopted in the CALFED Levee System Integrity Program Plan as the minimum standard for Delta levees. That plan specifically said:

> *The CALFED Levee program will institute a program that is cost-shared among the beneficial users to reconstruct Delta levees to the Corps' PL 84-99 Delta Specific Standard. This action will increase levee reliability and reduce emergency repair costs. In addition, levee districts meeting this standard are eligible for federal emergency assistance under PL 84-99*.

The 2006 USACE CALFED Levee Stability Program Report to Congress also identifies the PL 84-99 standard as the "primary emphasis of the short-term strategy and the authorized $90 million Federal funds" in reference to the 54 projects identified for immediate action pending completion of the long-term plan. The draft Framework and the draft Delta Plan would roll back 30 years of joint state-federal co-operation without sufficient justification. The draft Framework is inconsistent with DWR's own draft Technical Memorandum (2011) that is cited in the Framework document, not to mention CALFED and Bulletin 192-82. Given that it is possible, even likely, that FEMA will raise the minimum levee standard required for reimbursement after a disaster from the HMP standard to the PL 84-99 or some higher standard, the proposed policy change means the state would be forgoing the opportunity for significant federal financial assistance to sustain and enhance the Delta. As discussed in more detail below in Section 5.4.4, the call in the draft Framework for economic justification for improvements to levees from HMP to PL 84-99 standards can easily be economically justified for most, and possibly all, Delta levees. Thus, implementing the DWR Framework could delay necessary investments and increase administrative costs that reduce available resources and increase risk.

In stark contrast to the DWR proposal for a lower Delta levee standard, this Plan argues that many Delta levees should be improved beyond PL 84-99 levels to a higher Delta levee standard described in Section 5.3.2. The argument for making this additional investment is pretty straight-forward: even the Delta-specific PL 84-99 standard does not provide adequate protection from more extreme floods and earthquakes and does not provide a basis for adaption should sea level rise at an enhanced rate. Assuming a cost of $2–3 million per mile for 300 to 600 miles of levees, the $1–2 billion minimum investment that would be required to improve most lowland levees and selected other levees to this higher standard is small compared to the value of the land that they protect, the recreational benefits that they provide, the value of the infrastructure that crosses the Delta, and the increased reliability of water conveyance through the Delta. Furthermore, the cost is substantially lower than improving water supply reliability with isolated conveyance.

5.4.2 Improve inspections, maintenance, and emergency preparedness and response to prevent failures

As discussed above and in Appendix E, very few levee failures have actually occurred without warning. There is normally a few days to a few weeks warning of high water and/or wind events that pose increased threats to levee stability in the Delta. Even in the case of the uncontrolled Consumnes River there is a thirty-six hour window between occurrence of the precipitation

event and the arrival of flood waters in the Delta. Earthquakes occur without warning, but the consequences of even a moderate-to-large earthquake that affects the Delta are more likely to be some slumping rather than immediate breaches. Even sunny-day failures may be preceded by signs of trouble that provide reaction time. The history and characteristics of flood fighting operations makes it clearly cost-effective to invest in emergency preparedness and modern investigative techniques to head off failures before they occur. In this regard, emergency flood-fight operations have been traditionally treated as something outside of the standard descriptions of the elements of the flood control system and as something secondary at best. However, emergency flood fighting operations aimed at preventing levee failure, or reducing the flood extent, depth and/or duration should be considered as an integral part of the flood control system along with physical infrastructure.

Below are some of the measures that might improve this kind of emergency preparedness.

- Complete flood contingency maps and preliminary engineering designs for the entire Delta that would both improve response to threats to levee stability and pre-identify specific options for reducing the extent, depth, and/or duration of flood waters in the event of a breach. This pre-planning would serve as the basis for more intelligent placement and composition of flood fight stockpiles with not only generally needed resources but also resources needed to implement specific, pre-identified, engineering actions to contain flood waters for that part of the Delta.
- Include in the stockpile system newer types of temporary means for raising levees, such as “Aquatubes” or “Aquafences,” and materials for controlling excessive seepage, blocking highway underpasses or gaps in secondary levees, and placing emergency berms. Aquatubes, and similar new devices, allow for temporary increases in the levee height when a particularly severe flood threatens or after an earthquake. These devices can quickly raise the crest of a levee, or secondary berm, over much greater lengths than can be accomplished with conventional sandbags. Other examples of new products include the “rapid repair of levee breaches” bladders developed and tested by USACE to seal incipient breaches or underpasses, and sheet pile which has been studied recently as a substitute to rock and fill for repairing breaches. These new products and techniques should be explored and added to the final Delta stockpile depot system developed out of the flood contingency mapping process.
- Set in place plans and procedures for improvised emergency repairs to levees following an earthquake. This might include borrowing from landside toe-berms as suggested above. This would reduce current reliance on the limited dredge resources in the Delta and allow more rapid response to multiple, simultaneous, threats to levee stability.
- Use newer technology, such as that developed at the University of Texas at Austin by Professor Kenneth Stokoe for monitoring highway and airfield pavements, to conduct periodic inspections of the levees. This technique senses small changes in the levee, such as those caused by rodent burrowing, and thus flags locations that require more detailed inspection.
- Install simple fiber-optic cables at the toes of levees as suggest by Professor Jason de Jong of UC Davis in order to sense deformations. Again, this technique flags locations that require more detailed inspection and, in the event of an earthquake or terrorist activity, would immediately identify trouble spots for emergency managers and national security personnel.
- Implement the recommendations of the SB27 Task Force report when released.

Improved federal, state, county, and community coordination is equally important in preventing failures. Notwithstanding improvements in coordination that are currently being worked on, the suggestion made elsewhere that responsibility for maintenance of emergency-response plans, protocols, and systems jointly developed by Delta jurisdictions responsible for flood response be turned over to a Delta-region authority with an appropriate funding base appears to have great merit.

5.4.3 Improve both immediate response and longer-term recovery after failures

In general, emergency response following a breach involves two elements. The first of these is very immediate and involves controlling the spread of flood waters, evacuating threatened people and livestock, and minimizing damage. In the riverine environment this might involve blocking freeway underpasses or otherwise reinforcing secondary levees and making relief cuts through levees to drain floodwaters back into the river system at a lower point on the river. To be effective, these actions require detailed emergency planning and preparation as exemplified in the flood contingency mapping concept (see www.sjmap.org/oesmg for a description of this concept with examples).

However, while this kind of planning and preparation should be made for all the Delta islands and tracts, the emphasis for islands with deep subsidence should be on planning for efficient dewatering and protection of interior levees since it is impossible in these cases to reduce or stop the flow of water until the island is flooded and water levels equalize. Once that has happened, the breach can be repaired and the island more efficiently pumped out and restored to a stable condition. As illustrated by the repair of the 2004 Upper Jones Tract failure, unnecessary delays and expense can occur unless the repair of the breach is planned and executed properly. In that case larger rocks were used to initially plug the breach but there were insufficient fines to limit continuing seepage to an acceptable rate. That resulted in construction of a waterside berm with provision for the planting vegetation on a bench in part as mitigation for encroachment into the channel, as may be seen in Figure C7 in Appendix C. Thus forward planning and stockpiling of suitable materials for repair of levee breaches is very desirable. In the absence of a one-stop permitting mechanism, it also seems very desirable that this forward planning includes establishment of a fast-track procedure for acquiring any necessary permits or authorizations. Speedy repair of breaches and pumping out of flooded islands not only minimizes damage and losses on the island in question but also the losses that occur as a result of enhanced seepage into adjacent islands.

5.4.4 Current planning efforts

5.4.4.1 High-Level Coordination

In response to the passage of Senate Bill (SB) 27 in 2009, the California Emergency Management Agency, Cal EMA, organized a Delta Multi-Hazard Coordination Task Force. Since funding was never provided by the legislature, this task force operated on limited funding to develop a draft report that outlines a strategy for improving Delta flood response and creating more effective regional response systems. This strategy includes the establishment of a permanent emergency response protocol to ensure that response to threats to levee integrity is promptly initiated without the delayed response occasioned by budgetary or bureaucratic issues seen in past floods. This planning effort appears to overlap with DWR-USACE activities that are already under way, but it is the only report developed jointly by the emergency managers of Delta counties and State agencies actually responsible for directing emergency response. The final Task Force report has not yet been released but is expected early in 2012.

An important concept arising from the SB27 discussions is the need to treat the Sacramento-San Joaquin Delta as a single integrated area of operations for purposes of emergency planning and actual response and coordination rather than as the fragmented background to the current reliance on political and administrative boundaries to define distinct areas of operations.

5.4.4.2 DWR Emergency Planning

The current DWR studies were initiated by the Metropolitan Water District of Southern California (MWD) which, commencing in February 2006, undertook a study of two options for minimizing the interruption of exports resulting from a hypothetical 50 levee breaches/20 flooded islands scenario. The pre-event scenario involved advance construction of levee and river-flow barriers to block saltwater from entering the south Delta in a major emergency. It was estimated to cost $330-485 million. The post-event strategy allowed saltwater to enter the entire Delta, followed by the creation of an emergency freshwater pathway to the export pumps. The cost estimate for this strategy was about $50 million for pre-positioning of materials, with an ultimate cost of perhaps $200 million. MWD then elected in April 2007 to pursue the second alternative in association with the State Water Contractors and DWR using funds from propositions 84 and 1E to the maximum extent possible.

By January 2008 DWR was reporting on progress on the adopted strategy. At that time, contracts had been signed for the delivery of 240,000 tons of rock to three stockpiles in Rio Vista, Hood, and the Port of Stockton by June 2008. A planned second phase would have increased the quantity of rock at each location and added additional “breach closure materials.”

That work has now apparently been subsumed into the development of a broader program which is intended to guide DWR’s activities during an emergency.[78] This program includes three components:

1. Development of a plan for flood emergency preparedness response and recovery in the Delta. This plan consists of three elements:

    A. In association with USACE, development of a GIS-based flood contingency maps and associated data.

    B. Development of strategies for minimizing the delay in restoring fresh water to the export pumps. This includes advanced modeling of salinity intrusion and risk assessments. Although no results have been officially reported, it is understood that these studies suggest that the Delta flushes out more rapidly than had previously been expected, and that exports could be resumed in a maximum of six months, but more likely in a shorter period, even if multiple islands have been flooded. These studies are expected to produce tools that can be used to guide short-term water conveyance and upstream reservoir operations and prioritization of possible placement of emergency rock barriers and levee repairs.

    C. Definition of the roles and responsibilities of DWR emergency response personnel and coordination with other agencies.

2. Coordination and integration of DWR’s plan with the plans of other Delta flood response agencies.

[78] Delta Flood Emergency Preparedness, Response and Recovery Program, An Overview, DWR Brochure, June 2011, and presentation to Delta Stewardship Council, September 23, 2011.

3. Development and implementation of flood emergency response facilities in the Delta. Implementation of this item requires additional legislation to allow redirection of bond funding for this purpose.

5.4.4.3 County-Level Planning

Work is continuing on various county emergency response plans but these are more oriented to immediate response and public safety than to repair of levee breaches and de-watering of flooded islands, except in the case of San Joaquin County where flood contingency mapping has been undertaken since 1998 where flood fight operations have been addressed in detail. There are many elements of these different county plans, such as the flood maps and guide developed by San Joaquin County[79] that could be usefully extended to cover the entire Delta within the more integrated, regional, approach to planning advocated by the SB27 Task Force. It would be desirable to have a single integrated Delta-wide emergency response plan that identifies the actions that need to be taken by the individual counties only as sub-sets of a coordinated regional response.

5.4.5 Discussion of Alternate Risk Reduction Strategies

In summary, while some progress is being made on all three approaches to risk reduction, much of the DWR effort appears to be directed to the third approach, responding to failures after they have happened, instead of preventing them. The current round of DWR studies should be certainly be completed, but going forward much more emphasis should be given to the issues raised by Baldwin (2011)[80], most notably that a regional emergency response agency is required to ensure that improved emergency response plans and systems are adequately maintained into the future, and that the regional emergency response agency should place much more emphasis on preparation for flood-fighting and emergency response following earthquakes, as discussed herein in Section 5.4.2. Such a regional agency would not have direct response responsibilities in order to not disrupt the existing system established under the California Standardized Emergency Management System (SEMS).

5.4.6 Economics of Risk Reduction Strategies

Figure 16 indicates that there are few, if any, islands in the Delta that are in purely agricultural use. However, even the discussions of agricultural value focus only on property value or net profits to farmers, ignoring all the other income and economic activity created by farm employees, suppliers, and related enterprises. For many islands, the energy and transportation infrastructure, homes and businesses far exceed the agricultural value. Even if a flooded island were purely agricultural, permanent flooding would have adverse impacts on the levees of adjacent islands through wave action and enhanced seepage. In addition to the agricultural and infrastructure losses and stress on adjacent levees, though Delta conveyance of water is impacted in the short term, and if islands were to be left in a flooded condition, both in-Delta and out-of-Delta uses of water would be impacted by other water quality issues such as increases in organic carbon. As noted by both Healey and Mount (2007)[81] and Suddeth (2011),[82] the ecological benefits of additional flooded islands are uncertain, whereas many agricultural islands (particularly those with low-value crops that are said to be not worth saving) provide

[79] http://sjmap.org/oesmg/gfcm/Flood_Map_Guide_Final_6-1-10.pdf
[80] Baldwin, R., San Joaquin County Comments on the First Staff Draft of the Delta Plan, 2011, http://deltacouncil.ca.gov/public-comments/read/143?page=1
[81] Healey, M., and J. Mount, Delta Levees and Ecosystem Function, Memorandum to John Kirlin, Executive Director of Delta Vision, November 2007.
[82] Suddeth. R., Policy Implications of Permanently Flooded Islands in the Sacramento-San Joaquin Delta, UC Davis Center for Watershed Sciences, 2011, http://watershed.ucdavis.edu/pdf/.

critical habitat to migrating birds along the Pacific flyway. According to the draft DWR Technical Memorandum, the Delta levees presently provide a home for as many as 500 species, including several rare and endangered species, in its current configuration. Thus, although the current Delta is not as productive and valuable an ecosystem as the historic Delta, it still has considerable ecological value. As discussed elsewhere in this report, creating large open water areas would impact recreation and tourism because most Delta boaters are attracted to the Delta for its meandering, wind-protected channels. Finally, flooded islands also have much higher evaporation rates than agricultural lands so that there is a net loss of water from the system.[83] The following is a summary list of the economic assets and values protected by Delta levees:

- Net farm profits (capitalized into farmland values)
- Residential and commercial structures
- Flood protection of nearby islands/levees (reduced flood-control costs)
- Critical infrastructure such as fuel pipelines, natural gas wells and storage, electricity transmission lines, highways and roads, railroads, deep-water shipping channels, communications infrastructure (TV/radio/phone towers)
- Other income generated by agriculture production (ripple effects)
- Water quality for municipal and industrial users in and outside the Delta
- Wildlife habitat
- Water conveyance
- Water supply (reduced freshwater consumption)
- Recreational values (primarily boating channels and hunting areas)
- Public safety, and prevention of loss of life
- Lost opportunity for future beneficial uses

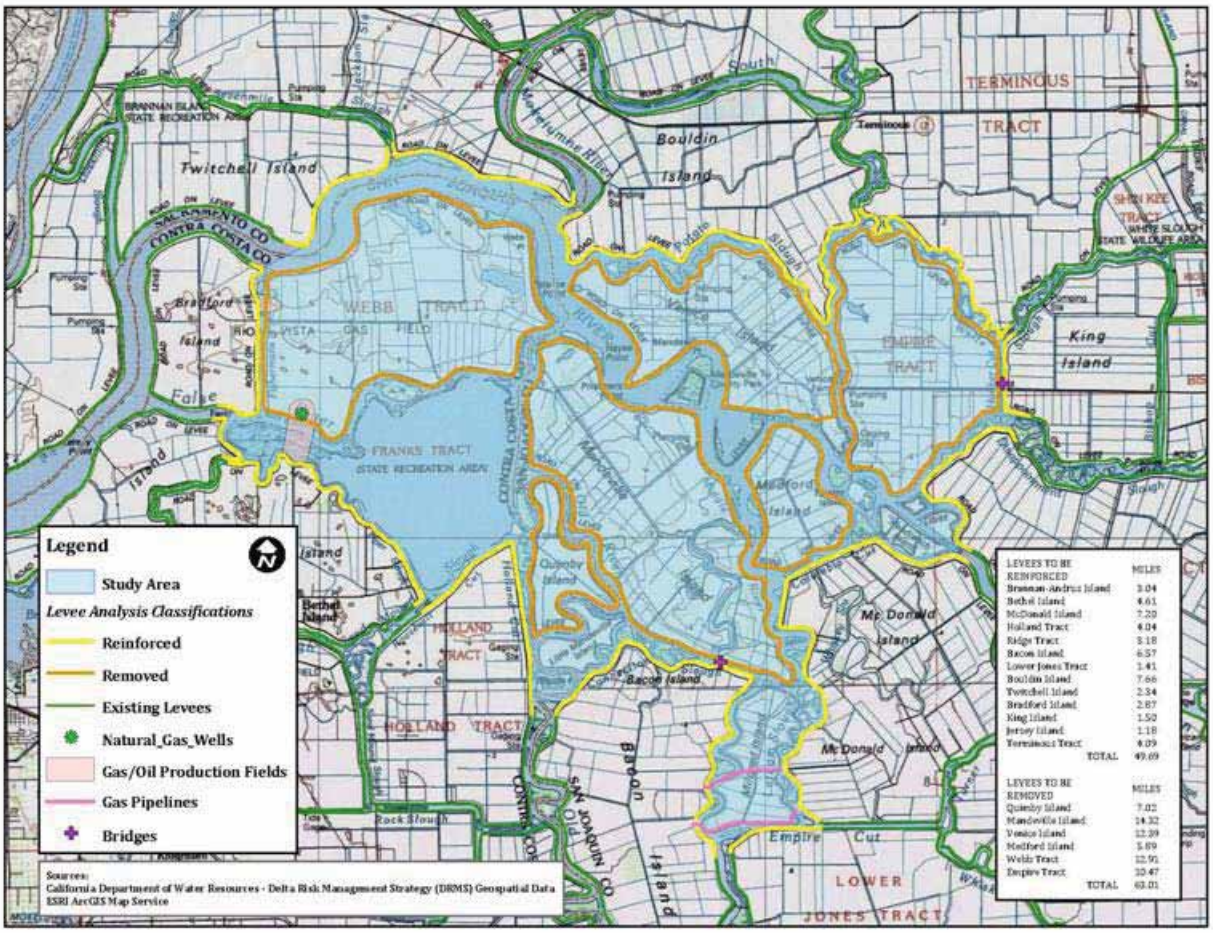
A start on a more comprehensive assessment of the economics of levee upgrades, repairing breaches and draining flooded islands was made by Suddeth et al. (2008) and refined in Suddeth et al. (2010). In this very influential study, Suddeth et al. calculated the net expected costs for 34 subsided Delta islands and three scenarios using levee failure probabilities estimated in DRMS Phase 1: no upgrades from the 2005 conditions estimated by DRMS; upgrades to the Delta-specific PL 84-99 standard; and upgrades to that standard plus an additional 1 foot of freeboard. In addition to an estimate of agricultural land value for each island, the analysis included the value of structures on the islands. The analysis considered the estimated costs of repairing breaches and draining flooded islands and the costs of not repairing islands, which included the cost of rebuilding or re-locating roads and the cost of fortifying nearby islands, in order to make decisions on whether or not to recover flooded islands. In terms of the bullet list above, Suddeth et al. account for most of the first four value categories, but their model does not address the more difficult to measure impacts in the rest of the list including the potential loss of life.

The independent review panel for the ESP expressed concerns about the island by island cost-benefit approach utilized by Suddeth et. al. because Delta levees work as a system as described in this report. In addition, it should be noted that the Department of Water Resources itself has warned against utilizing the DRMS data in the manner employed by Suddeth et. al. For example, the January 2008 progress report to the legislature made these statements regarding the quantification of risks in the DRMS report “Results should be considered on a regional basis rather than for any individual island or levee reach,” and “The results should be

[83] Sacramento Valley Water Use Survey 1977, DWR Bulletin 168, October 1978.

used for a broad understanding of the condition of the entire Delta, and should not be used as a basis for design for any specific location."[84] Because of the influence of the Suddeth et. al. paper, we ignore these general warnings about the approach and consider the details of the island-by-island cost-benefit approach.

Figure 18 The Suddeth et al. (2010) Inland Sea[85]



In their initial analysis, Suddeth et al. find that it is not "economically optimal" to upgrade levees to the PL 84-99 standard, and only cost-effective to repair 18 to 23 of the 34 islands if they fail. However, this result is very dependent on the assumed costs, values, and failure probabilities, and sensitivity analysis in the article show significant changes when assumptions are adjusted to more realistic values. For example, the initial analysis assumes most agricultural land is worth $2,500 per acre based on a simulation of net profits, when current appraisals for Delta farmland are $6,000 per acre and nearby cropland without Delta flood risk is valued at $10-12,000 per acre. In addition, estimated probabilities of levee failure were taken from DRMS which a previous section explains are thought to err significantly on the conservative side. While the cost estimates that were used for levee upgrades to PL 84-99 were reasonable, it was assumed that

[84] See the last two bullet points on page 13 of "Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta." A Report Pursuant to Requirements of Assembly Bill 1200, Laird. Department of Water Resources & Department of Fish and Game. January 2008.
http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/docs/AB1200_Report_to_Legislature.pdf

[85] For high resolution image see http://forecast.pacific.edu/desp-figs.html

each upgrade only reduced the probability of failure by 10 percent. In contrast, DRMS phase 2 report estimated a 24 percent decline in failure probabilities from PL 84-99 upgrade, and improvements might well be even greater, especially if the levee system is upgraded to uniform compliance with the PL 84-99 standard. In addition, the estimated cost of reinforcing the surrounding islands (and thus limiting the propagation of failures) is low, and other costs associated with leaving islands flooded (including the adverse effects on recreation and water quality) were neglected.

Fortunately, the most recent version (2010) of the paper includes some much needed sensitivity analysis to the study assumptions. In the most interesting scenario, the authors tripled their assumed property values and “Do Not Repair” costs in what they call an “extreme case.” In our view, this scenario is not extreme at all, but uses far more accurate values for two key variables. The results show nine islands that are not repaired, including six contiguous islands in the Central Delta and three small islands scattered in other areas. The results are displayed in Figure 9 of Suddeth et al. and the six central Delta islands are displayed in Figure 18 above.

These six islands in the Central Delta are the most likely candidates for conversion to open water, because they are relatively free of people, property and infrastructure and support mostly low-value crops. Thus, we have included this open water scenario as a policy scenario in subsequent chapters to more fully assess the potential effects to areas not considered by Suddeth et al. such as recreation and several categories of infrastructure. More details are found in subsequent chapters but we preview the results here to complete the present discussion.

The total length of the levees around the six islands is 63 miles, and the total length of the surrounding levees that would have to be improved to a higher standard to deal with higher wave heights and seepage is approximately 50 miles. If Webb Tract, which is one of the eight western islands called out for their importance to protecting against salinity intrusion, and Empire Tract, which houses the new City of Stockton water intake, were to be omitted from the list, the length of the levees removed would drop to 43 miles. The length of levees that would need to be improved, however, would only drop to approximately 45 miles. In our judgment, the cost of reinforcing the surrounding levees to cope with higher wave height and seepage forces would likely be much greater than the $1-2 million per mile cost of improving the levees on the existing islands, thus on the basis of the cost of improving and maintaining levees alone, the creation of this inland sea cannot be economically justified. But there are also additional factors that must be considered. First, Suddeth et al. did not account for major new water supply facilities for the City of Stockton that are being completed on Empire Tract. Accounting for this facility, Empire Tract would surely be excluded from the “do not repair” list, and the water quality problems from permanent flooding of nearby Medford, Venice, and Mandeville Islands would increase due to the nearby intake. Second, this open-water area is in the heart of the Delta’s most popular area for boating recreation and is surrounded by about half of the Delta’s marinas. The recreation experts on our study team, and numerous interviews with Delta recreationists unanimously agreed that this large open-water area would have a large negative effect on the Delta boating economy, for the boating attraction is the Delta’s unique meandering channels protected from wind and waves. Third, although these islands are free of major highways and railroads, almost all of them border the Stockton Deep-water Shipping Channel, and their permanent flooding would create several problems for the Port including the need for increased dredging that is already constrained by a tight time window for environmental reasons. As discussed in the infrastructure chapter, expanding the Port of Stockton is at the center of the region’s economic development, transportation, and air pollution reduction plans.

Taking into account these additional costs, Quimby Island is the only one of these six that might reasonably be considered for a “do not repair” list and eventual conversion to open water. Using this framework, the other three small islands that might be considered for “do not repair” status are Coney, Fay, and Dead Horse. The levee lengths on these islands range from 1.6 miles on Fay to 7 miles on Quimby for a grand total of 16.7 levee miles on the four candidate islands that may be expendable among the hundreds of miles of Delta levees. Even if upgrading and repairing these islands were not technically cost-effective, there would still be some benefits from the investment so that the net savings from letting the 16.7 miles of levees go would be relatively small. In our view, these very small potential savings are not worth the cost, delays, risk, and complexity created by requiring island-by-island, project-by-project justification of every upgrade from the HMP to the PL 84-99 standard as proposed in the DWR Draft Framework.

Given that federal assistance for costly repairs to islands is linked to achieving the Delta-specific PL 84-99 standard, the decision of whether to repair islands in the case of a breach is parallel and virtually the equivalent of whether the levees should be upgraded to the Delta-specific PL 84-99 standard. Thus, the above discussion summarizes the economic argument for our recommendation to upgrade all Delta levees to the Delta-specific PL 84-99 standard.

A second question is whether upgrading Delta lowland levees to a new higher Delta standard is economically justified. The primary economic justification for this additional upgrade is that it is a cost-effective and more financially feasible alternative to other proposals that address the coequal goals of water supply reliability and ecosystem restoration. A robust, seismically-resistant levee system would make a large improvement to water supply reliability. According to this study, $1–2 billion would be sufficient to achieve this higher standard with costs potentially increasing to $4 billion to allow for program management costs and ecosystem enhancements. This is much less expensive than the $12 billion cost estimate of isolated or dual conveyance, although dual conveyance would result in somewhat higher water exports. Water exporters have expressed concerns about whether the $12 billion isolated conveyance is cost-effective and have yet to develop a viable finance plan. Not only are upgraded levees less costly, but they provide a much broader set of benefits. While water exporters would have to pay all the costs of isolated conveyance, they could share the much lower costs of levee upgrades with others.

Water supply is not the only major infrastructure in the Delta that requires protection from seismic risk. Although they were not the focus of the 2009 Delta Reform Act, transportation, energy, and in-Delta water supplies are also critical infrastructure vulnerable to a seismic event. Upgraded levees are a cost-effective joint solution to the problem, rather than a more costly system by system approach. The infeasibility and extreme cost of the system-by-system approach is evidenced by the earlier discussion of the DRMS Phase 2 trial scenarios. Individually protecting Delta highways by building on piers cost $6 billion, individually protecting energy and aqueducts in a south Delta infrastructure corridor cost $4 billion, and individually protecting water exports costs $12 billion. The total cost of individualized solution approach is in excess of $20 billion, and some systems, not to mention in-Delta lives and property, have received no additional protection with the system-by-system approach.

This proposal to make the Delta levees more resistant to earthquake loadings is a logical extension of other seismic retrofit work that has been conducted in the Bay-Delta region since the 1989 Loma Prieta earthquake. These upgrades have already been performed for highways and bridges, dams, water supply systems, and the BART system. The Delta levees are the last major infrastructure element in the Bay-Delta region that needs to be upgraded to modern seismic standards. In order to put the proposed spending of a further $1-4 billion on Delta

levees in perspective, it is noted that the Water System Improvement Program of the San Francisco Public Utilities Commission, which is basically a seismic upgrade of the Hetch-Hetchy aqueduct system, is costing $4.6 billion.[86]

Improvement of lowland levees to this standard means that they might also meet the Urban Levee Design Standard but that does not mean that it would be appropriate to construct higher-density housing behind them. It would not. The argument advanced by some that improvement of the Delta levees to a higher standard would lead to urbanization assumes a set of other regulatory controls would disappear and that a market would suddenly appear for an urbanized Delta. The Delta Protection Commission, Stewardship Council, and five county general plans are all highly protective of a rural, agricultural Delta and have regulatory authority that would limit significant urbanization. It is true that the additional flood protection would support some reinvestment and revitalization of Legacy Communities, and might facilitate the construction of some limited new recreation and tourism facilities to support enhanced recreation. However, this is a benefit to improved levees, not a cost. Existing law requires that the Delta be protected and enhanced, albeit as an evolving place, and our professional assessment is that most lowland levees need to be improved to this higher standard in order to accomplish this and that it is economically realistic to do so.

Although the details and reasoning is a little different, the recommendation of improved levees in this study is similar to the “Fortress Delta” alternative in the 2007 PPIC report, “Envisioning Futures for the Sacramento-San Joaquin Delta.[87] Although the PPIC evaluation showed that the “Fortress Delta” was the best of the “freshwater Delta” solutions, it was rejected from further consideration in the screening analysis due to “extreme costs.” The alternatives that passed the initial PPIC screening for further consideration either involved a peripheral canal estimated to cost $2–3 billion and ecosystem alternatives that do not satisfy the coequal goal of water supply reliability. Given that isolated conveyance is now estimated to cost $12-15 billion, and water supply reliability state law, our proposal for enhancing Delta levees is little more than suggesting that the 2007 PPIC rejection of the “Fortress Delta” alternative should be reconsidered in light of new information and developments.

5.5 Levee Improvement Strategies and Funding

Commencing in 1973, funding has been provided by the State of California to assist the Delta reclamation districts under two programs.

The Delta Levees Maintenance Subventions Program provides financial assistance to local levee-maintaining agencies for the maintenance and repair of levees in the Delta. It is authorized in the California Water Code, Sections 12980 through 12995. It has been in effect since passage of the Way Bill in 1973, which has since been modified periodically by legislation. One of these modifications provides for the inclusion of project levees in the program as long as more than 50 percent of the island is in the Primary Zone of the Delta, CWC 12980(f). Project levees in the Secondary Zone are not eligible for subventions funding. The intent of the legislation, as stated in the Water Code, is to preserve the Delta as it exists at the present time. A summary of expenditures under the subventions program is included as Table 3.[88] Through FY 2009-2010 the state has provided $147 million against a local share of $118 million for a total of $265 million. Details of the current procedures for prioritizing subvention funding and the required local cost shares are provided in the draft DWR Technical Memorandum (2011).

[86] http://sfwater.org/index.aspx?page=115
[87] http://www.ppic.org/main/publication.asp?i=671
[88] Provided by DWR and also included in the DWR Technical Memorandum.

The Delta Levees Special Flood Control Projects provides financial assistance to local levee-maintaining agencies for rehabilitation of levees in the Delta. The program was established by the California Legislature under SB 34, SB 1065, and AB 360. The special projects program is authorized in the California Water Code, Sections 12300 through 12314. This program initially focused on flood-control projects and related habitat projects for eight western Delta Islands—Bethel, Bradford, Holland, Hotchkiss, Jersey, Sherman, Twitchell, and Webb Islands—and for the Towns of Thornton and Walnut Grove; in 1996 it was extended to the rest of the Delta. Details regarding the current prioritization of special projects funding and the required local cost shares are also provided in the draft DWR Technical Memorandum. Also, special project bond funding has been authorized for the protection of the Mokelumne Aqueduct, for those levees whose failure would jeopardize water conveyance through the Delta, and projects that reduce subsidence and assist in restoring the ecosystem of the Delta.

Table 3 Delta Levee Subventions Maintenance Program State & Local Cost Share 1973-2010

	STATE						
Fiscal Years	Maintenance Reimburs.	Priority 1	Priority2	Priority 3	Total Reimburs.	Local Share	**Sub-Total**
	(1)	(2)	(3)	(3)			
	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	**$1,000**
1973-74	200				200	272	472
1974-75	175				175	483	658
1975-76	-				-	-	-
1976-77	190				190	395	585
1977-78	175				175	486	661
1978-79	175				175	323	498
1979-80	-				-	-	-
1980-81	-				-	-	-
1981-82	1,421				1,421	2,091	3512
1982-83	1,334				1,334	1,929	3263
1983-84	1,384				1,384	3,803	5187
1984-85	1,817				1,817	2,279	4096
1985-86	1,335				1,335	1,628	2963
1986-87	1,736				1,736	2,097	3833
1987-88	1,882				1,882	1,501	3383
1988-89	1,295	3,705			5,000	4,371	9371
1989-90	1,913	3,407			5,320	8,668	13988
1990-91	1,610	3,689			5,299	8,404	13703
1991-92	2,266	159			2,425	10,449	12874
1992-93	1,823				1,823	4,244	6067
1993-94	1,774	2,916	376	15	5,081	2,070	7151
1994-95	2,371	2,770			5,141	2,233	7374
1995-96	1,449	2,097			3,546	1,602	5148
1996-97	1,758	1,790			3,548	2,158	5706
1997-98	4,432	2,647			7,079	2,974	10053
1998-99	3,412	1,738			5,150	2,341	7491
1999-00	3,085	3,194	58		6,337	2,715	9052
2000-01	4,954	3,053	55		8,062	3,371	11433
2001-02	3,777	1,784			5,561	2,515	8076
2002-03	3,554	1,446			5,000	4,666	9666
2003-04	4,029	1,996			6,025	6,102	12127
2004-05	4,698	1,227			5,925	6,476	12401
2005-06	5,364	358			5,722	4,220	9942
2006-07	4,485	1,505			5,990	6,647	12637
2007-08	5,645	8,503	2,148		16,296	6,210	22506
2008-09	6,810	4,515	545		11,870	4,799	16669
2009-10	7,254	2,131	41		9,426	3880	13306
	89,582	**54,630**	**3,223**	**15**	**147,450**	**118,402**	**265,852**

(1) Excess maintenance over the maintenance cap and DFG costs are included in the maintenance.
(2) Priority 1 includes HMP and Bulletin 192-82 work.
(3) Priority 2 is priority 1 excess cost over $100,000 per mile cap. Priority 3 is land use changes

A summary of expenditures under the special projects program is included as Table 4.[89] The figure for FY 2009-10 includes $35 million specially designated by the legislature for improvements to the five islands that protect the Mokelumne Aqueduct, $32 million for HMP projects, and about $26 million for Delta-specific PL 84-99 projects. The expenditures for FY 2007-8, 2008-9, and 2009-10 are larger than in previous years because of bond funding approved by the voters in Propositions 84[90] and 1E.[91] Through FY 2009-10, a total of $237 million will have been expended through the special projects program.

Table 4 Delta Levee Program Special Projects State Expenditure 1989-2010

Fiscal Year	Planning & Engineering	Levee Construction	Habitat Enhancement	Total Expenditures
1989-1990	$15,000	$0	$0	$15,000
1990-1991	$5,210,000	$810,000	$0	$6,020,000
1991-1992	$709,400	$4,085,000	$0	$4,794,400
1992-1993	$668,500	$4,148,000	$0	$4,816,500
1993-1994	$140,000	$6,318,054	$0	$6,458,054
1994-1995	$300,505	$1,896,518	$0	$2,197,023
1995-1996	$30,000	$1,419,370	$0	$1,449,370
1996-1997	$513,618	$4,117,720	$0	$4,631,338
1997-1998	$609	$3,201,434	$0	$3,202,043
1998-1999	$0	$2,233,787	$4,035,000	$6,268,787
1999-2000	$80,555	$1,994,673	$4,009,134	$6,084,362
2000-2001	$199,613	$4,183,526	$3,837,381	$8,220,520
2001-2002	$0	$1,333,548	$1,138,797	$2,472,345
2002-2003	$800,985	$6,645,234	$6,961,843	$14,408,062
2003-2004	$95,979	$704,381	$1,118,243	$1,918,603
2004-2005	$188,044	$2,408,507	$972,500	$3,569,051
2005-2006	$553,989	$8,510,163	$446,193	$9,510,345
2006-2007	$922,127	$8,209,557	$59,500	$9,191,184
2007-2008	$1,606,681	$18,449,127	$144,000	$20,199,808
2008-2009	$4,115,986	$18,608,588	$0	$22,724,574
2009-2010	$2,346,311	$91,274,764	$6,117,538	$99,738,613
Totals:	**$18,497,902**	**$190,551,951**	**$28,840,129**	**$237,889,982**

Note: Funds for projects in FY 2008-2009 and FY 2009-2010 have been encumbered but in most cases have yet to be released due to recent, state-wide budgetary uncertainty.

An additional $195 million is currently available from USACE through the CALFED Levee Stability Program. The USACE funding was authorized by the CALFED Bay Delta Authorization Act of 2004 which provided for USACE participation in the then CALFED program. These funds

[89] Provided by DWR and also included the DWR Technical Memorandum.

[90] The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84) authorizes $5.388 billion in general obligation bonds to fund safe drinking water, water quality and supply, flood control, waterway and natural resource protection, water pollution and contamination control, state and local park improvements, public access to natural resources, and water conservation efforts.

[91] The Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1E) authorizes $4.09 billion in general obligation bonds to rebuild and repair California's most vulnerable flood-control structures to protect homes and prevent loss of life from flood-related disasters, including levee failures, flash floods, and mudslides and to protect California's drinking water supply system by rebuilding Delta levees that are vulnerable to earthquakes and storms. Proposition 84 enhances these efforts with an additional $800 million for flood-control projects.

are specifically for raising levees to the Delta-specific PL 84-99 standard which was the goal of that program. Fifty-four specific projects were identified for the short-term plan of action which includes not only work on existing levees but projects to protect critical infrastructure such as the Stockton regional waste water facility.

The total investment in Delta levees since the inception of these programs will be $698 million plus the local shares for the special projects and the CALFED Levee Stability Program once the funding in the pipeline is expended. The fact that over $351 million of this has already been spent is reflected in the generally improved condition of the levees. Also, because levees tend to fail at their weakest point, such as where they were constructed over old sloughs, many levees have already failed and then been repaired and improved at their weakest point, with the result that the present levee system is more robust than it was before the breaches. Also, concurrent with the cessation of dredging, there has been increased placement of rock riprap on the water side of the levees. Taken together, these three observations mean that historic data on the rate of levee breaches is no longer relevant, and out-of-date data compiled on the previously weaker system should not be repeated in current reports and discussions.

Table 4-1 of the DWR Technical Memorandum provides a breakdown of the funds appropriated for expenditure in the Delta from Propositions 84 and 1E. These funds total $615 million. Table 4-2 of the DWR Technical memorandum provides a breakdown of both the funds committed and the funds expended to February 2010. A total of $293 million had been committed to the subventions and special projects programs and $70 million had actually been expended at that point. The total funds committed amounted to $492 million and the total funds expended amount to $166 million, so that significant funds have been committed or expended for other purposes which include contracts, program delivery, emergency, the urban and non-urban levee evaluation programs, the Sacramento bank restoration program, and bond servicing costs. Approximately $123 million remain uncommitted. $135 million was also allocated in Proposition 84 for improving flood emergency response of which approximately $40 million has been expended by DWR. The State is just beginning to issue bond funds to other local and State agencies with responsibility for flood response in the Central Valley through grants. Priority of this new grant series is to the Delta and local efforts through the Delta Protection Commission are underway to develop a regional, joint, approach for application of funds and subsequent implementation of approved projects.

Improvement of Delta levees from at or about the HMP standard to the Delta-specific PL 84-99 standard costs in the order of $1-2 million per mile,[92] the biggest variable being whether suitable borrow material is available on-island or whether it has to be trucked or barged from adjacent islands. With the funds that are in the immediate pipeline plus the remaining bond funds, all the lowland Delta levees and most other Delta levees should be improved so that they are at or about the Delta-specific PL 84-99 standard. Indeed, if expenditure of the bond funds had not been delayed by state spending freezes and other issues, this standard could have been generally met already. Even after all Delta levees have been brought up to the PL 84-99 standard, some continuing funding will still be necessary to take care of unexpected settlements and other maintenance, but this funding might be at a reduced level. For budget purposes it is suggested that a sum in the order of $20 million per year should be allocated for this purpose, but, as discussed subsequently, the year-to-year spending might vary and should be balanced against funding for continuing emergency preparedness activities, maintenance of current and improved emergency response plans, protocols, and systems, and the setting aside of funds for

[92] Based on discussions with reclamation district engineers and DRMS Phase 2 report.

to ensure prompt future emergency response to threats to levee stability and recovery of impacted areas.

As noted above, both the subventions program and the special projects program make provision for the enhancement of fish and wildlife habitat in conjunction with levee improvements. Several alternatives for accomplishing this are illustrated in Figure 6 of the CALFED Levee System Integrity Program Plan including the construction of new waterside berms and the widening or rolling back of the existing levees. These improvements cost much less than the kind of setback levees discussed in the DRMS Phase 2 report, which involves construction of entirely new levees on virgin ground, and might typically cost in the order of an additional $1-2 million per mile. The existing funding provides for a certain amount of this kind of enhancement but if the Delta Conservancy Strategic Plan and the Delta Plan call for more extensive enhancements of this kind, additional funding will be needed.

The cost of improvement of most lowland levees and selected additional levees to a higher Delta-specific standard that will provide 200-year plus protection for floods, earthquakes and sea-level rise and that will incorporate ecologically friendly vegetation on the water side is more difficult to estimate precisely. After improvement to the Delta-specific PL 84-99 standard, levees that do not contain saturated, loose sands may come close to meeting this standard although they would still benefit from wider crowns. Additional width also makes planting on the water side, which is desirable for a number of reasons and may be required by the Delta Plan, much more feasible. Determination of which levees do require additional improvement will require more detailed studies, but prioritization of further improvements is relatively straightforward and does not necessarily require risk analyses or cost-benefit studies. Regardless of whether or not they contain sands susceptible to liquefaction, most lowland levees should be improved to this higher standard because they face the most immediate threat from possible sea-level rise and help prevent salinity intrusion. Certain other levees which are judged to be critical to protecting infrastructure might also be improved to this higher standard if they are shown to contain sands that are susceptible to liquefaction. Figure 16 provides an initial indication of which islands and tracts might be considered to have relatively high priority for further improvements. These further improvements might cost in the order of an additional $2-3 million per mile. If it is assumed that this improvement is required over 300–600 miles of non-project, non-urban levees, the total cost might be as low as $1 billion. However, for general planning and budgeting purposes, it might be desirable to use a higher number like $2 billion. The biggest variable in these estimates is whether or not suitable fill is available on the same island or has to be trucked or barged in. That in turn is both a function of the availability of the materials and the cooperation of the landowners, for on-island borrowing may take some land out of agricultural production. The above estimates assume a combination of on- and off-island borrow sources. If only on-island borrow is used, these cost might be reduced by as much as 50 percent. Alternately, if the regulatory impediments to dredging in the Delta are resolved, good-quality fill material could be obtained for a cost comparable to that of on-island borrow. While there are other potential uses for the dredge spoils that will result from either deepening of the deep-water ship channels or from maintenance dredging, their use for levee improvements would provide a means to keep down the cost of those improvements. These figures also assume that design and construction are executed by the local reclamation districts. If managed directly by DWR or USACE, these costs should be multiplied by a factor of as much as 2 or 3. Costs for non-urban and non-project levee improvements are much lower than costs for improvements to urban levees, which have to factor in encroachments and penetrations and where there is often no land available for widening the levees. This has resulted in the widespread use of deep-cutoff walls that are installed through the existing levees. In addition, there are significant bureaucratic issues which add to the cost, especially when there are many landowners involved. This results

in the “soft costs” being as much as 50 percent of the actual construction costs on these projects. Although the possible need to take a strip of agricultural land on the Delta islands and the need to move existing drainage channels, siphons, and pumps are still issues, the cost implications are much smaller for Delta levees and only a relatively small number of landowners have to be accommodated.

The estimated cost of $1-2 billion for improving Delta levees beyond the PL 84-99 standard that is given above not only assumes that the work would be executed by the reclamation districts but also that engineering and permitting costs are no greater than they are at present. This figure also provides only for basic levee construction on existing alignments, not for planting and other environmentally-friendly enhancements. While planting vegetation on the water side of widened levees would add little to this cost, the creation of waterside berms or rolling the levee back as previously discussed in connection with improvements to the PL 84-99 standard might add 50 to 100 percent to the cost. Construction of setback levees on a new alignment would involve land acquisition issues and add significantly to the cost, especially where the setback levee is constructed over peat that has not previously been consolidated.

There are special considerations for levees that protect Legacy Communities in the Delta. Detailed estimation of the likely cost of improving those levees awaits policy decisions that have not yet been made. However, if the levees on the relevant islands are upgraded to the proposed new Delta standard, the Legacy Communities, and also industrial/commercial facilities that serve Delta agriculture such as wineries, crush-pads, and cold storage facilities, would automatically be afforded superior flood protection and special “ring levees” should not be required. In many cases superior flood protection is in fact already provided to these communities and facilities by the existing project levees. For instance, the project levee that borders the Sacramento River in Walnut Creek East already has a wide crown, exceeding 50 feet at some locations, in order to accommodate a two-lane highway with parking on either side. While some additional improvements might be required elsewhere to protect legacy communities, the issue is more one of non-compliance with vegetation and encroachment and calculated seepage gradient requirements that are included in various USACE and FEMA guidelines and policies, rather than real flood risk. This issue could be addressed much more cost-effectively by granting variations from national policies rather than requiring unnecessary construction which might destroy the communities that are trying to be protected.

There are three potential sources of funding from within the Delta for maintenance, improvements, and emergency response: (1) the traditional funding from the landowners, who also make in-kind contributions to inspection and maintenance; (2) the owners of the infrastructure that passes through the Delta; and (3) the agencies that convey water through the Delta. The Delta Stewardship Council has proposed the creation of a new agency, the Delta Flood Risk Management Assessment District, with fee assessment authority. Local government officials in the Delta have expressed concerns about this proposal, and have expressed a preference for a joint powers authority (JPA) of the five counties or the Delta Protection Commission take on this role. Regardless of the entity, and leaving politics aside and just looking at this as an engineering management and risk reduction issue, it would be beneficial for a Delta region-centric entity to allocate the funding of Delta levee improvements once the present bond funding is exhausted, or even sooner. This entity should also be the entity that is responsible for maintaining emergency preparedness and response plans, protocols, and systems jointly put in place by Delta jurisdictions responsible under the SEMS for flood response because of the trade-off that has been previously discussed of investments in levee improvements and the need to effectively maintain improved regional emergency preparedness and response systems and protocols. Only if funding of both levee improvements and

emergency preparedness response and recovery is controlled by a single entity whose prime concern is the protection and enhancement of the Delta in addition to consistency with the coequal goals, will it be possible to make a rational and efficient allocation of the available funds.

In addition to the funding of the improvement of selected levees to the higher Delta-specific standard, continuing funding will be required for maintenance of the existing levees and for emergency preparedness response and recovery. It has been suggested above that $20 million per year might be an appropriate sum for continuing maintenance of all Delta levees, but this figure might vary from year to year as more or less money is put into emergency preparedness response and recovery. A total sum in the order of $50 million per year might be appropriate to cover both maintenance and inspection and emergency preparedness. Some fraction of this sum should be set aside each year to provide for emergency response to threats to levee stability, response to reduce the extent, depth, and/or duration of flood waters in the event of a breach, and recovery of impacted areas to supplement any funding protocol or fund that the state has established for that purpose or to replenish such a fund following its use in an emergency. To put this sum into perspective, although the total cost should not be borne by either highway users or water conveyance alone, if it were borne by highway users, there would need to be a toll of $2 on each use of the state highways in the Delta and if it were borne by the state and federal water contractors, there would need to be an additional charge of $10 per acre-foot, assuming average exports of 5 maf. It would also be entirely reasonable that the state and federal governments contribute funding to this entity. If it is the policy of the state to protect and enhance the Delta because that is judged to be of benefit to the region and the state, then it becomes the state's responsibility to provide funding that could, for instance, be directed primarily to widening levees so that they can accommodate vegetation on the water side and allow construction of improved recreational and tourism facilities that benefit the entire region and beyond. Outside its operation of the Central Valley Project, the federal government has interests and obligations that include the continuing downstream effects of hydraulic mining on federal lands, navigable waterways, and national economic security.

Implementation of the necessary improvements to Delta levees would be greatly helped by reducing or eliminating regulatory impediments to action by the creation of a one-stop permitting system for selected activities within the Delta including dredging, levee construction, and ecosystem restoration.

5.6 Periodic Update of the Flood Management Plan for the Delta

One of the four specific directives regarding the Economic Sustainability Plan that was given in the 2009 legislation is to include "comments and recommendations to the Department of Water Resources concerning its periodic update of the flood management plan for the Delta." These recommendations are:

1. Update the expected maximum water surface elevations in the Delta taking into account both the findings and the recommendations of the Central Valley Flood Protection Plan and climate change considerations. This should be done as soon as possible without waiting for the 2017 update of the Central Valley Flood Protection Plan.

2. Make provision in the Central Valley Flood Protection Plan and otherwise for re-activation of historic flood plains upstream from the Delta and by additional flood bypasses, such as the proposed Lower San Joaquin River Flood Bypass, in order to reduce peak water surface elevations in the Delta.

3. Reaffirm that it is the policy of the state to improve and maintain all non-project levees to at least the Delta-specific PL 84-99 standard.

4. Establish an additional policy to improve most “lowland” levees and selected other levees to a higher Delta-specific standard that more fully addresses the risks due to earthquakes, extreme floods, and sea-level rise, allows for improved flood fighting and emergency response, provides improved protection for legacy communities, and allows for growth of vegetation on the water side of levees to improve habitat. Define this standard in more detail as necessary.

5. Cooperate with other state and federal agencies to facilitate the renewed use of appropriate dredging in the Delta.

6. Establish as state policy that in the future any flooded islands will be recovered and that existing flooded islands should be restored as tidal habitat in order to reduce the loadings on adjacent islands in addition to providing ecosystem benefits.

7. In regard to emergency response, establish the Sacramento-San Joaquin Delta as a single, integrated, geographical area of operations for purposes of emergency planning and actual response to include establishing a regional mechanism for effective maintenance of Delta regional plans, protocols, and systems developed jointly by Delta jurisdictions.

8. Integrate the strategy and recommendations of the SB27 Task Force into appropriate State policy documents and establish funding mechanisms for implementing those recommendations through specific emergency preparedness projects designed to address the overall preparedness strategy of that report.

9. Identify emergency flood-fight operations as an integral part of the flood control system to ensure that appropriate attention and resources are maintained for this important element of loss reduction into the future.

10. Support the plan of action for improving Delta emergency response included as an appendix, Appendix M, to this report which includes measures to improve evacuation and public safety response as well as flood fight operations.

5.7 Responses to Independent Review Panel

The Independent Review Panel organized by the Delta Science Program on behalf of the Delta Stewardship Council and the Delta Protection Commission made a total of 8 suggestions to the authors for further improving the Economic Sustainability Plan of which 5 related to levees. These suggestions and brief responses are provided below.

1. In terms of the public safety aspects of the Plan, we recommend that the authors provide guidance for evacuation planning and effective communication/education about the risk of flooding.

The treatment of evacuation planning and communication/education was admittedly brief in the previous version of the report but that was because the emphasis of the report was on economic sustainability, not life safety. Reference was made, however, to continuing planning studies in these areas and that discussion has been expanded this version. An appendix, Appendix M, has also been added as noted in Item 10 of the recommendations to DWR.

2. We recommend that the authors expand their discussion regarding the consequences of levee failure and clearly identify which areas have the highest potential and which areas have the lowest or no potential for life loss. This information would be helpful in for prioritizing levee upgrades and developing appropriate standards for upgrades.

Clearly the legacy communities in the Delta have the highest potential for loss of life in the event of levee breaches and flooding but the levees that immediately protect these communities are mostly, if not all, project levees that are in relatively good condition. It is true that levees elsewhere on the islands that contain legacy communities may not be in such good condition but in addition to the fact that there would be time for warnings and evacuations, the legacy communities tend to be located on the higher parts of the islands involved so that flood waters might not in fact reach these communities even if no special actions are taken. If necessary relief cuts can be made to ensure that the legacy communities are not flooded. Further definition of the details of the exposure of the legacy communities and detailed plans for emergency response are part of the ongoing work on emergency preparedness and response that is noted above.

3. We recommend that the authors investigate and evaluate what the Department of Water Resources (DWR) is doing with regard to both riverine and Delta levees. We are referring to what DWR calls their Urban Levee Evaluations (ULE), and the Non-Urban Levee Evaluations (NULE). If levees in the California Delta provide for public safety, as opposed to only agriculture, we further recommend the authors discuss and justify why Delta levees should be designed to a lower standard that ULE or NULE levees in the Sacramento-San Joaquin Valley.

The authors are fully aware of the ULE and NULE programs being conducted by the Department of Water Resources (DWR). These are, however, only evaluation programs and do not involve the setting of standards or detailed remedial design. The ULE and NULE programs are intended to provide input to the development of the Central Valley Flood Protection Plan which may go further on levee standards and prioritization of the needed improvements. In a separate but related effort, DWR is close to completing the Urban Levee Design Criteria (ULDC) which was called for by SB 5. Dr Pyke has been an active participant on the committee that is developing the ULDC. However, these criteria apply only to “urban” levees, that is, levees protecting a population of more than 10,000 people or “urbanizing” levees, expected to protect more than 10,000 people by the year 2025. There are some urban levees in the secondary zone of the Delta and these levees either already meet the ULDC standard or are currently being improved to that standard. There are no urban or urbanizing levees in the primary zone of the Delta but our report suggests that many of the “lowland” levees in the primary zone of the Delta do need to be improved with a widened section in order to address the risks posed by more extreme floods, earthquakes and possible sea-level rise. These “fat levees” would meet or exceed the ULDC requirements. Thus, we are proposing that the key Delta levees be improved to a standard that meets or exceeds the ULDC requirements although the primary driver of this need is somewhat different, being for economic sustainability reasons rather than life safety reasons. But Delta “lowland” levees improved in order to protect vital infrastructure, existing and expanded agriculture, recreation and tourism, and the unique historic and cultural values of the Delta, which includes the legacy communities, will also provide superior life safety protection for residents both in the legacy communities and elsewhere on the Delta islands and tracts.

4. We recommend that the cost estimate of a "fat levee" concept be better substantiated as in our opinion the current estimate of the cost of design and construction is overly optimistic. At a minimum, we recommend that a realistic upper bound be presented, assuming that the federal government is a partner and that right-of-way and borrow material acquisition are involved.

Additional data on our cost estimates was provided to the review panel and is included in this revised report. We are confident that the overall program cost estimate makes adequate provision for some federal government involvement and right-of-way and borrow material acquisition. We do not pretend that our costs estimates would be applicable if the program of improvement was totally managed by either the state or federal governments. Costs elsewhere are simply not applicable to the Delta "lowland" levees. In particular post-Katrina levee re-construction or improvements in New Orleans are not applicable for reasons that include but are not limited to:
1. Management of the program by the US Army Corps of Engineers (USACE);
2. The tight deadline imposed by Congress which placed unreasonable demands on USACE;
3. Severely restricted right-of-ways in many locations;
4. Foundations conditions consisting or swamp and marsh deposits which are worse than the Delta peats; and
5. The almost complete lack of locally available materials.

None of these conditions apply in the Delta lowland. It is true that some of these conditions are faced by the urban levees in the secondary zone of the Delta and the project levees in the North and South Delta but those improvements have or will have separate sources of funding and are not included in our estimate of the cost of improving "lowland" levees in order to provide for the preservation of and the economic sustainability of the Delta. Examples of program cost escalation such as the post-Katrina improvements in New Orleans, the Boston Central Artery / Tunnel, or closer to home, the New East Bay Bridge, are also not applicable to the improvement of lowland levees which is a relatively straight-forward design and construction challenge that should neither be schedule-driven nor subject to multiple design changes.

5. We suggest that the authors provide a discussion of how the lack of formal inclusion of risk and uncertainty in the analyses impacts their findings. We are not suggesting that the authors attempt a formal risk-based analysis at this time, given the availability of the DRMS analysis. However, the authors may wish to provide qualitative information relative to areas of greatest uncertainty in their estimates.

The two areas of greatest uncertainty relative to levees have already been addressed *quantitatively* in the report. One of these is the number of miles of "lowland" levees that need to be improved beyond the Delta-specific PL 84-99 standard. Existing levees that do not contain liquefiable materials likely need to be improved only to what is called the "PL 84-99 plus" standard in the report, with a 22-foot crown and 3 feet freeboard over the 100-year water surface elevation. However, that determination cannot be made without more detailed site investigation. Thus we have based our cost estimates on a range of 300-600 miles of upgrades to the "fat levee" standard. The second area of uncertainty involves the cost per mile of upgrades to the "fat levee" standard. Based on the work cited in the report by Hultgren-Tillis Engineers (HTE), we have used a figure of $2-3 million per mile for basic engineering and construction costs, applying a 50 percent contingency to HTE's estimate of $2 million per mile. Extension of the range of miles and the range of cost per mile gives a basic engineering and construction cost of $0.6-1.8 billion and we have rounded that up to $1-2 billion. Because of concerns that these costs might be inflated by some state and federal government involvement

and the attribution of the cost of some environmental restoration measures to the levee program, we have doubled the upper limit of this range to suggest a total program cost of $4 billion. That doubling attempts to account for the greatest single uncertainty in this work – how such improvements would be funded and managed. We do not deny that costs could be even higher if the program is totally mismanaged but we assert that it could be comfortably completed for less than $4 billion if it is managed even somewhat less than optimally. In responding in this way we are not ignoring the uncertainties in design loadings, variable foundation conditions, variable composition of the existing levees and the possibility of construction imperfections, but we believe that these can be accommodated by using a robust design, namely a very broad levee section, and that these uncertainties are covered in the estimated $1-2 billion for basic engineering and construction costs. We note that the greatest uncertainties are not in engineering design and construction but in program management and politics.

Part Two: Analysis of Key Economic Sectors in the Delta

Chapter 6: Framework for Analysis

This chapter describes a framework of policy scenarios that will be considered in chapters 7– 9 which contain detailed analyses of key components of the Delta economy: agriculture; recreation and tourism; and infrastructure including energy, transportation and water systems. The first two areas were called out in Delta Protection Commission's Framework Study as the key drivers of the Delta economy. Additional research for chapter 2 of this report identified Transportation, Warehousing, and Utilities as an additional economic driver for the Legal Delta, and this sector is closely tied to energy, transportation and water infrastructure. In addition, infrastructure by definition underlies all parts of the Delta economy. The research and outreach for this report has revealed the importance of the Delta as a regional and state infrastructure hub and Delta policies currently under development have significant implications for a broad range of infrastructure. This chapter discusses the framework that will be utilized for the detailed analysis of the key sectors, and defines the scenarios for policy choices that will be made in the Delta in four important areas: water conveyance, habitat enhancement, levee and flood control investment, and land-use regulation.

Each of the following three chapters follows a common framework. First is a data-driven description of the current baseline and trends for the sector, which may include reference to other significant reports on the sector. Second is discussion of the likely outcomes for the economic sector under the baseline policy scenario, followed by recommendations that might improve economic sustainability under the baseline scenario. Third, each chapter includes an evaluation of the positive and negative impacts of alternative policy choices on economic sustainability in each area. Some topics, such as taking land out of agricultural production, are suited for a detailed quantitative analysis. Other topics, such as how the creation of tidal marsh could affect Delta tourism and recreation, will necessarily rely on more qualitative analysis and expert opinion. Finally, each chapter will include discussion of additional issues or proposals as appropriate, including relevant strategies outlined in the Delta Vision strategic plan. In some chapters, there will be discussion of additional issues or proposals. For example, the recreation chapter will discuss a recent recreation plan developed by California State Parks.

6.1 Baseline Scenario

The baseline analytical scenario is the vision that includes few major policy changes. However, it is not a "status quo" scenario as some significant human and environmental changes are likely in the Delta between now and 2050. Population growth will continue in the Delta counties, some agricultural land will be developed in the secondary zone within city boundaries, sea level is expected to increase by a foot, tertiary treatment will become operational at most municipal wastewater plants discharging into the Delta and improve water quality, and significant investment in levees will occur.

As discussed in Chapter 2, the population of the region surrounding the Delta is growing. The 2010 Census found the population in the five Delta counties was 3,767,312 and grew at a 1.4 percent annual rate over the decade, slightly faster than the 1 percent annual growth rate for the state of California. Based on the 2010 Census results, the forecasting firm Global Insight projects the five-county population will reach 5.57 million in 2040, a growth rate that projects to 6.1 million in 2050. Higher projections from the California Department of Finance, most recently updated in 2007, put the 2050 population at 6.9 million. Despite this growth, the population of the Primary Zone of the Delta has remained steady, and is projected to remain constant in the baseline scenario. In contrast, the Secondary Zone will continue to experience significant growth within the boundaries of its incorporated cities.

For the four policy choices, the baseline scenario is as follows. The baseline scenarios are not recommended policy choices, but simply represent the most logical starting place for the analysis. Baseline conditions could be recommended for some policy choices, but not others.

- *Baseline Water Conveyance*: Through-Delta Conveyance. Under this scenario, water would continue to be conveyed to the south Delta pumps through Delta channels. The level of water diversions would be constrained to less than 5 million acre feet per year in compliance with the current biological opinions.
- *Baseline Habitat Conservation Measures*: None. None of the habitat conservation measures outlined in the BDCP drafts would be implemented in the baseline scenario. The positive and negative impacts of each of the major conservation measures will be assessed individually in the other scenarios.
- *Baseline Flood Control*: All levees upgraded to PL 84-99. As discussed in Chapter 5, the upgrade of most Delta levees to PL 84-99 standards is a reasonable expectation with currently identified resources and on-going maintenance. Most levee breaks would be repaired to original conditions and islands restored. Unincorporated towns in the Primary Zone would remain in the 100-year flood plain, significantly constraining development. Urban areas in the Secondary Zone such as West Sacramento would successfully achieve 200-year flood protection status in accordance with current plans.
- *Baseline Land Use Policy*: Current Policy. Delta Protection Commission guidelines remain in place over the Primary Zone, and land-use planning and regulation would remain under the jurisdiction of local governments. The Delta Stewardship Council does not take an active regulatory role in regards to Delta land use.

6.2 Isolated Conveyance Scenario

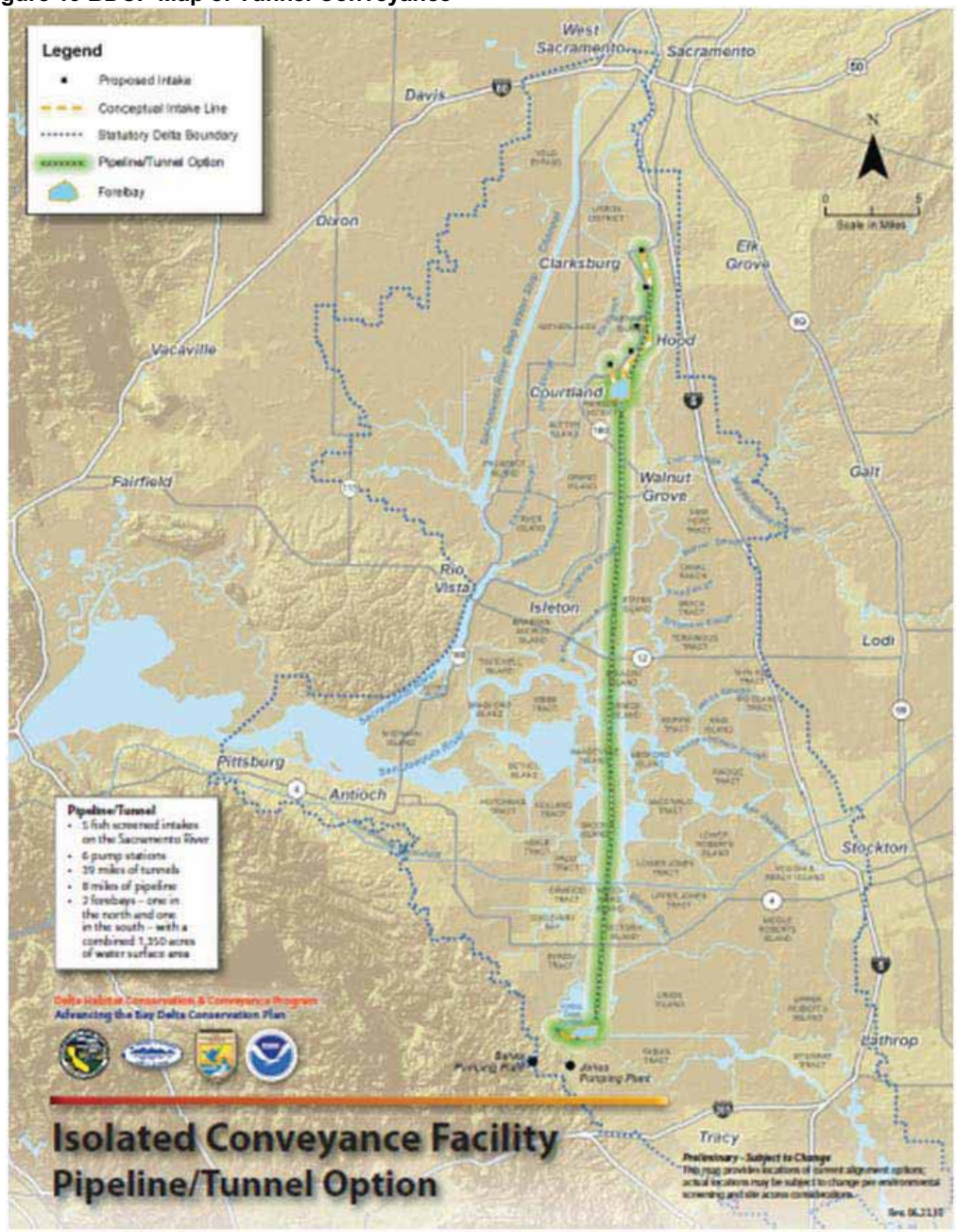
The leading proposal for new water conveyance facilities in the Delta is a 15,000 cfs (cubic feet per second) tunnel extending from the Sacramento River near Hood to the CVP and SWP pumps near Tracy. The facility would include a pair of 34-mile long, 33 ft. diameter tunnels running between a new intermediate forebay near Courtland to a new forebay adjacent to the existing Clifton Court Forebay near Tracy. Five new water intakes would be built along the Sacramento River between Clarksburg and Courtland, and another 13 miles of pipeline would be required to convey water from the five intakes to the intermediate forebay. Each of the five intakes and the intermediate forebay would have pumping plants with a combined 210 MW electrical load.

According to the operational criteria described in the latest BDCP documents, the new conveyance would increase average water exports from the Delta in 2025 from 4.7 maf with through-Delta conveyance under the existing biological opinions to 5.4 to 5.9 maf. The footprint of a tunnel is significantly less than a surface canal, it will still consume roughly 8,000 acres, mostly agricultural land in Sacramento and San Joaquin counties. The new intake facilities will significantly alter the shoreline of the Sacramento River between Clarksburg and Courtland.

The goals for in-Delta agricultural, municipal, and industrial water quality are among the most important provisions for the Delta economy. Both the November 2010 draft BDCP and a May 2011 revised operation documents state that existing D-1641 water quality standards will be met in the north and west Delta with the measuring point moved slightly upstream in the Sacramento River. Notably, none of the BDCP operations descriptions make any commitments to water quality in the central or southern Delta, the areas at most risk from increasing salinity impacts from isolated conveyance. The uncertainty surrounding Delta water quality impacts and the

importance of the issue to the Delta economy makes it one of the most difficult issues to assess in the economic sustainability plan.

Figure 19 BDCP Map of Tunnel Conveyance[93]



While alternative sizing and other options for water conveyance are under development and consideration, none of these options has been described in sufficient detail at this time to be included in this analysis. Thus, the tunnel conveyance described in the most recent BDCP is the only alternative to through-Delta conveyance that will be considered in this report. As alternatives—such as a smaller 3,000 cfs isolated conveyance facility—are developed in more detail, additional analysis would be warranted.

[93] For a better resolution image see http://forecast.pacific.edu/desp-figs.html

Box 1 Financing Isolated Conveyance: Potential Risks for Delta Communities and Taxpayers

While the impacts on the state and federal water projects is generally beyond the scope of this plan, the financial feasibility of water contractors' plans to pay for the proposed isolated conveyance is of critical importance to economic sustainability in the Delta. There are significant questions as to whether isolated conveyance is financially feasible, especially if operated under the proposed operating criteria that would not significantly increase water exports. Despite years of work on the BDCP, there is still no finance plan while the cost estimates continue to rise.

Inadequate financing could create serious problems such as 1) pressure to increase water exports from the Delta beyond agreed upon environmental and in-Delta water quality protections, 2) pressure to divert funds from Delta mitigation, habitat improvement, and flood control programs, 3) subsidies that divert general tax revenues from other public needs, 4) increased pressure for transfers of water from San Joaquin Valley agriculture to urban customers that could adversely affect the San Joaquin Valley agricultural economy over and above losses to Delta agriculture, and 5) the risk of a costly stranded asset that unnecessarily burdens water ratepayers for decades.

6.3 Habitat Conservation Scenarios

In addition to isolated water conveyance, the BDCP proposes 18 additional conservation measures. Similar conservation measures are under consideration by the Delta Stewardship Council for the Delta Plan, and some of these measures are also included in the Ecosystem Restoration Program proposed by the Department of Fish and Game. In this report, we use the draft BDCP descriptions of the conservation measures, because they are more detailed and thereby better suited to the analysis.

The individual conservation measures could have negative or positive impacts on different aspects of the Delta economy. Our analysis will not examine all 18 measures, but focus on four major proposals that would change the current use of 1,000 acres or more of Delta land. For simplicity, the measures will be considered individually rather than as a package at this initial stage. The four major conservation measures include:

- *Yolo Bypass Fisheries Enhancements*: Requires thousands of acres in new flowage easements. More frequent flooding and improved fish passage in the Yolo bypass will benefit fish and flood control, but will reduce agricultural production.
- *San Joaquin River Floodplain Restoration*: Creation of new seasonally-inundated floodplain habitat along the San Joaquin River between Vernalis and Stockton using setback levees. Approximately 10,000 acres of land would be in the new floodplain.
- *Tidal Habitat Restoration*: Up to 65,000 acres in agricultural land converted to tidal habitat in designated zones throughout the Delta. This scenario requires breaching levees and restoring subsided islands to shallow water habitat. If fully implemented, this strategy would affect the most agricultural land and have the highest capital costs. Preliminary cost estimates are $1.5 billion or more than $23,000 per acre of tidal marsh created.
- *Natural Communities Protection*: There are several elements to this conservation measure including the acquisition of 8,000 acres of rangeland for conversion to natural grasslands, acquiring agricultural easements or purchases on 32,000 acres that would be restricted to "wildlife friendly" agriculture, and the conversion of 700 acres of rangeland to vernal pools and alkali wetlands.

For all of these measures, it is important to note that there are alternatives to the BDCP proposals being developed, and that the BDCP proposals are continuing to be refined in work

groups. For example, there is an alternative to the San Joaquin River floodplain proposal in BDCP for an enhanced flood bypass at Paradise Cut. The alternative proposal has been negotiated between environmental groups and local landowners and reclamation districts. Another example is Yolo County's efforts to work with the BDCP's Yolo Fisheries Enhancement Working Group to reduce the agricultural impacts and develop mitigation measures.

6.4 Levee Scenarios

Investment in levees and other flood control measures could be more or less than described in the baseline scenario. Some have proposed creating large expanses of open water habitat in the Delta through the intentional flooding of Delta islands or an explicit policy of not repairing islands when and if they flood in the future. On the other hand, an increased level of levee investment within the Primary Zone could bring some areas to 100-year or 200-year levels of flood protection and allow increased opportunities for economic development.

Six Island Open Water Scenario
There have been proposals to transform large expanses of the Delta to open water. Proponents argue that open water could provide environmental benefits to native fishes, and that it isn't cost-effective to repair or upgrade levees around most Delta islands. The most expansive proposals would transform 20 or more Delta islands to open water, and are illustrated in the "eco-friendly" Delta map in a recent report from the Public Policy Institute of California. As discussed in detail in an appendix, the Suddeth, Mount and Lund (2010) analysis understates the benefits and overstates the costs of maintaining Delta islands. In addition, this strategy faces substantial legal and political hurdles that make the more expansive open water scenarios exceedingly unlikely. A very expansive open water scenario is clearly incompatible with economic sustainability in the Delta, and there is little point in evaluating it in detail.

However, a smaller open-water scenario is likely to be considered as a possible component of the Stewardship Council's Delta plan and is more economically, legally, and politically viable. A smaller scenario is illustrated in a recent letter from Jeff Mount to the Delta Stewardship Council, and in Figure 9 of the Suddeth, Mount and Lund (2010) paper. [94] The result comes from running the Suddeth, Mount, and Lund analysis with assumed property values that more closely match market values and a more accurate infrastructure costs, but still does not capture all of the economic benefits provided by the levees. Thus, this scenario can be considered a reasonable upper-bound on the extent of open water that could be economically justified in the Delta. Most notably, the figures illustrate six contiguous islands in the Central Delta as open water. These islands are the most attractive candidates for open-water habitat because they are very sparsely populated, mostly grow low-value agricultural crops, and are not crossed by completed major physical infrastructure such as highways, railroads, or natural gas pipelines.

While the lack of physical infrastructure and population substantially reduces the cost of permanent flooding compared to nearby islands like Bouldin and McDonald, eliminating these islands would still entail significant economic costs. These costs would include but are not limited to the elimination of about 10,000 acres of farmland and some recreational facilities, increased dredging costs for the Stockton Deepwater Ship Channel, and significant reinforcement of nearly 50 miles of adjacent levees that would be subject to increased pressure from waves and under seepage.

Increase to Higher Standard Levees in Targeted Areas

[94] http://watershed.ucdavis.edu/pdf/Suddeth-Mount-et-al-2010-SFEWS.pdf

In this scenario, areas surrounding strategically targeted areas would have levees upgraded beyond the PL 84-99 standard. As explained in Chapter 5, these could be upgrades to increase seismic resistance, or they could be targeted upgrades to support at least 100-year flood protection in and around Legacy Communities to allow development and investment consistent with the rural character of the Delta. This scenario would also further the statewide goal of increased water supply reliability, would allow the growth of natural vegetation on the water side of the levees as part of an overall ecosystem restoration plan, provide a basis for addressing possible sea-level rise, and would provide increased protection for the critical infrastructure that passes through the Delta.

6.5 Regulatory Scenarios

In the following chapters, we take an initial pass at envisioning how adjustments to the land-use regulatory framework could affect economic sustainability in the Delta. The draft Delta Plan under development by the Delta Stewardship Council envisions expanded land-use regulations in the Legal Delta to support the coequal goals of water supply reliability and ecosystem restoration. In contrast, some of the Delta counties are interested in reducing the restrictions in the current Delta Protection Commission guidelines in concert with increased flood control investments.

Increasing the regulatory power of the Delta Stewardship Council could affect economic sustainability in the Delta. As the Stewardship Council's fifth draft plan is written, most proposed investment in the Legal Delta outside the spheres of influence of incorporated cities could be regulated by the Delta Stewardship Council. In particular, any location that is a potential location for a conservation measure or water conveyance facility in the future is explicitly called out in the Delta Plan for increased regulation. Compared to the current regulatory framework, the proposal would increase the level of regulation in the Primary Zone and expand the regulatory reach of state agencies in the Delta into much of the Secondary Zone. The policy would restrict and increase the cost and risk of property improvements for many Delta residents, businesses, and local governments beyond that experienced in other areas of the state making the Delta a comparatively less attractive area for new investment. The new regulatory policies are described in Chapter 4 of the Delta Plan which is currently in its fifth draft with a sixth draft expected in a few weeks. These new regulations could have profound implications for the Delta economy, although implementation details and how they will work in practice are still uncertain.

While the trend is towards increasing regulation at the state level, some local governments around the Delta are interested in reducing regulation to promote economic development. The signs of stagnation within existing communities are thought by some to be caused by excessive regulation that discourages new investment. One mechanism proposed for reducing regulation is to shift some of the Delta Legacy Communities from the Primary to the Secondary Zone, an unlikely change since it would require an act of the state legislature which seems more inclined to expand the area within the Primary Zone rather than reduce it.

In addition to the Delta Protection Commission Plan and County General Plans, it is important to note that all of these areas have been remapped into the FEMA 100-year flood zone, or are in the process of being added to the 100-year flood zone. Thus, reduced regulation would have little impact unless it were combined with increased flood-control investments and technical evaluations to achieve designation for 100-year flood protection or potentially 200-year urban flood protection in the designated area. In some areas outside the Delta, development generates resources finance flood-control investments, but in the Delta Legacy Communities the scale of development required to finance levee upgrades would be inconsistent with the

rural character of the Delta, County General Plans, not to mention the plans of state agencies such as the Delta Protection Commission and Delta Stewardship Council. Thus, some of the analytical chapters consider the increased flood control and reduced land-use regulation scenarios as a package rather than individually.

6.6 Delta Vision Strategies

As discussed in Chapter 4, the October 2008 Delta Vision Strategic Plan provided a list of strategies and actions to support their second goal, "Recognize and enhance the unique cultural, recreational and agricultural values of the California Delta as an evolving place, an action critical to achieving the coequal goals." The specific actions were:

- Apply for designation of the Delta as a federally recognized National Heritage Area.
- Expand the State Park and Recreation Area network in the Delta.
- Establish special Delta designations within existing federal and state agricultural support programs, primarily regional labeling and marketing programs.
- Conduct research and development for agricultural sustainability in the Delta, focusing on developing agricultural practices consistent with habitat and ecosystem restoration.
- Establish new markets for innovative agricultural practices such as carbon sequestration credits and conservation easements.
- Charge the Delta Protection Commission with creating a regional economic development plan that addresses agriculture, recreation, tourism, and innovative land use.
- Establish enterprise zones that use tax incentives to spur investment at the major "gateways" to the Delta.
- Establish a Delta Investment Fund for regional economic development and adaptation. Initiate the fund with state funding, and structure it to accept revenues from federal, state, local, and private sources.
- Adopt land-use policies that enhance the Delta's unique values and that are compatible with the public safety, levee, and infrastructure strategies.

For some of the strategies, action is in progress or complete such as the feasibility study for Natural Heritage areas,[95] a recent report from the UC Agricultural Issues Center that assessed the viability of some alternative and innovative agricultural approaches in the Delta,[96] and the preparation of this Economic Sustainability Plan.

The state budget and larger fiscal trends have presented significant challenges for some of the other strategies. While State Parks has developed a plan for the Delta, fiscal pressures have put all the state parks and recreation areas in the Delta on the closure list, the opposite of expanding the network. Enterprise zones were initially targeted for elimination in the 2011-12 state budget. Although enterprise zones survived this year's budget cuts, actions continue to reduced and reform enterprise zones, and the prospect for approving significant new enterprise zones is low. Regardless, much of the Delta is already in Enterprise Zones, including virtually all of the Delta in San Joaquin County.

Other strategies are discussed when appropriate in the analytical chapters, and promising strategies will be reinforced in the final recommendations including specific priorities and strategies for the Delta Investment Fund.

[95] http://www.delta.ca.gov/heritage.htm
[96] http://aic.ucdavis.edu/publications/AIC_Delta_study_final.pdf

Chapter 7: Agriculture

7.1 Overview and Key findings

- Close to 80 percent of all farmland in the Delta is classified as Prime Farmland, the California Farmland Mapping and Monitoring Program's highest designated tier.
- Total cropped acreage in 2010 was 423,727 acres, not including approximately 38,000 acres of grazing land.
- The top five Delta crops in terms of acreage are: 1) Corn, 2) Alfalfa, 3) Processing Tomatoes, 4) Wheat, and 5) Wine Grapes.
- Total crop value in 2009 was approximately $702 million. Truck and vineyard crops account for 59 percent of crop revenues on 18 percent of acreage.
- The top five Delta crops in terms of value are: 1) Processing Tomatoes, 2) Wine Grapes, 3) Corn, 4) Alfalfa, and 5) Asparagus.
- The highest per-acre values in the Delta come from truck crops mainly situated in the southern Delta and deciduous crops principally located in the northern Delta.
- The approximately $702 million in Delta crop production and $93 million in Delta animal and animal product revenue has an economic impact of 9,681 jobs, $683 million in value added and $1.416 billion in output in the five Delta counties. Across all of California, the economic impact of Delta agriculture is 12,934 jobs, $819 million in value added, and $1.643 billion in output.
- When related value-added manufacturing such as wineries, canneries, and dairy products are included with the impact of Delta agriculture, the total economic impact of Delta agriculture is 13,179 jobs, $1.059 billion in value-added, and nearly $2.647 billion in economic output in the five Delta counties. Including value-added manufacturing, the statewide impact of Delta agriculture is 25,125 jobs, $2.135 billion in value-added, and $5.372 billion in economic output.
- The 10-year land allocation forecast in the baseline scenario predicts a future increase in vineyards, deciduous, and truck crops, and decreases in grain and pasture crops. Field crops will continue to account for 50 percent or more Delta agriculture acreage for the foreseeable future. This shift of 5 percent of land to higher value crops could lead to an approximately $111 million gain in crop revenues.
- The potential impact of policy changes on Delta salinity is highly uncertain at this time and depends on decisions on water quality standards and the effect of isolated conveyance. A preliminary estimate of losses from increased salinity is between $20 million and $80 million per year. The loss of farmland to construct the conveyance facility is estimated to generate an additional $10 to $15 million in crop losses per year.
- The agricultural impacts of most of the BDCP conservation measures are difficult to quantify due to the lack of precision in site specification and other details. Broad ranges of potential annual crop losses have been calculated from the land requirements and descriptions of easement costs in the draft BDCP.
    - Tidal habitat restoration losses range from $18 to $77 million annually with lower losses when restoration is targeted to Suisun Marsh.
    - Natural Communities Protection losses are estimated to range from $5 to $25 million annually.

- San Joaquin River Floodplain crop losses are estimated at $5 to $20 million annually, and could be reduced significantly by implementing an alternative proposal to expand an existing bypass at Paradise Cut.
- Yolo Bypass Fishery Enhancements could generate crop losses between $7 and $10 million annually..

7.2 Current Status and Trends

7.2.1 Mapping Delta Agriculture

Delta agriculture is part of a complex and constantly-changing landscape, and it presents many challenges to precise measurement. Over the past few years, studies and data-collection by a range of state and federal agencies have yielded results which provide a detailed overview of the Delta's diverse agricultural backdrop. The use of empirical techniques such as satellite imaging, digitization of farm records, field surveys, and public review have accumulated a wealth of information pertinent to policymaking. None of the data sources described below is complete in itself, but collectively leveraged they create the best available picture of Delta agriculture and its broad role in the Delta economy.

7.2.1.1 Land Use Data

Field Borders

California law requires full reporting of agricultural pesticide use. Each Delta county collects information from farmers on all crop fields in which pesticide applications are conducted. Through the use of geographic information system (GIS) software, four of the Delta counties digitally map that data to form a mosaic of agricultural fields within their borders. This data is extremely useful, as it provides recent data on fields intended for actual use and harvest, and includes specific information on the crops each land manager intends to grow in the coming year. This data enables analysis of Delta agriculture at an extremely granular level, that of the individual crop field. Approximately 90 percent of Delta acreage in this study is represented at this level. One challenge presented by this data is that though the vast majority of crop fields have some form of pesticide application, the small percentage that do not is not included and must be estimated by other means.

National Agricultural Statistics Service

For the two counties which do not digitally map their field borders, satellite remote sensing data captured and made available by the National Agricultural Statistics Service (NASS) provides good information. The data collected by this agency is applied in a wide range of agricultural applications, and the accuracy of the methods used to determine crop type is quantified in detail. Though less accurate than direct field borders reporting, this data shows agriculture not permitted for pesticide use, and provides a means to survey Delta land not covered by field borders.

Farmland Mapping and Monitoring Program

For estimates of total farmland acreage, GIS data collected by the California Farmland Mapping and Monitoring Program (FMMP) was employed. This state program uses a combination of satellite imagery, public review, and field surveys to produce a complete map of the state's agricultural lands. FMMP maps were leveraged by making use of their categorization of grazing land. Though grazing land is not actively farmed, it is sometimes incorrectly captured in the NASS data as active pastureland; close examination of areas marked by FMMP as grazing land eliminated such errors.

National Agriculture Imagery Program
Public aerial photography provided by the National Agriculture Imagery Program is used to resolve major inconsistencies between the previously described data sources. While it is impossible to eliminate the more minute discrepancies, for large acreage areas in which conflicts are noted, NAIP photos allow a direct look at the area in question in order to ascertain into what land use category a parcel should be attributed.

UC Berkeley Resilient and Sustainable Infrastructure Networks (RESIN)
The RESIN project at Berkeley mapped areas of the Delta region expected to undergo urbanization in the future. These were used to determine the extent of urbanization expected to occur on agricultural lands, and those effects are included in the long-term forecasts of agricultural land allocation presented in Section 7.5.

7.2.1.2 Revenues, Profits, and Costs Data

County Crop Reports
In order to determine aggregate revenues from Delta crop production, crop yield and price figures published in each county's 2009 crop report were used. These were the most recent figures available at the time the data was compiled. Though the values used in reporting are collected through a variety of sources and represent average yields for the entire county, they offer the most practical means of determining total revenues from Delta agriculture. Where possible, outside sources were consulted to obtain more accurate values for Delta-specific agriculture.

University of California Cost and Return Studies
The University of California Cooperative Extension prepares extremely detailed studies on the costs and returns associated with establishing and maintaining various crops in different regions of the state. Where available, this analysis drew from the UC Cooperative Extension studies conducted in Delta regions to calculate various costs and profits expected from different agricultural operations in the Delta region.

7.2.2 Crop Categories

In order to facilitate presentation and analysis of Delta agriculture, it is necessary to categorize crops into a limited number of discrete categories. In addition to enabling the use of econometric techniques for forecasting future land use, these categories allow for the broader overview of Delta agriculture presented in the tables and maps throughout this report. Examples of major Delta crops from each category are outlined in Table 5 below, and the full crop category table is included in Appendix G.[97]

[97] In response to a suggestion by the California Department of Food and Agriculture at both a DPC meeting and a comment letter on an earlier draft, alfalfa was moved from the pasture to field crop category in this draft. In addition to the significant change of reclassifying alfalfa, some additional adjustments were also made to low acreage crops so that the groups were more consistent across value, salt tolerance, and crop type.

Table 5 Crop Category Examples

Deciduous	*Almond, Cherry, Pear, Walnut*
Field	*Alfalfa, Corn, Rice*
Grain	*Barley, Oats, Wheat*
Pasture	*Pastureland, Clover*
Truck	*Tomato, Asparagus, Potato, Blueberry*
Vineyard	*Grapes*

7.2.3 Delta Agricultural Acreage

Total Farmland Acreage

All agricultural production in the Delta is dependent on high-quality farmland able to support it. Adequate soil quality, moisture, and temperatures are just a few of the characteristics necessary to support sustainable high yields. FMMP mapping uses a tiered system of farmland categories which provide a comprehensive view of agriculture suitability around the Delta. Since FMMP surveys are updated every two years, they also allow observation of the continuing effects of urban growth and expansion on agricultural farmland. The table and figure below offer a snapshot of Delta farmland in 2008, the most recent year from which FMMP maps are available. The total size of available farmland in the Delta is 500,383 acres, with almost 80 percent of the total acreage designated in the FMMP's top tier of Prime Farmland.

Table 6 Total Farmland Acreage, 2008

County		Class	
San Joaquin	267,741	Prime Farmland	396,554
Sacramento	71,722	Farmland of Statewide Importance	33,360
Yolo	54,644		
Solano	53,509	Unique Farmland	29,525
Contra Costa	49,685	Farmland of Local Importance	40,944
Alameda	3,082		
Total	**500,383**	**Total**	**500,383**

Harvested Acreage and Crop Allocation

This analysis places the total number of Delta acres in agricultural production in 2010 at 461,380 acres. Acreage includes all irrigated crops and pastureland, and grazing land. Table 7 depicts the total acreage of each crop category by county, as well as totals for the entire Delta. Table 8 depicts the largest crops by total acreage.

Table 7 Delta Agricultural Acreage, 2010

Crop Category	*San Joaquin*	*Sacramento*	*Yolo*[1]	*Solano*[1]	*Contra Costa*[2]	*Alameda*[2]	TOTAL
Deciduous	7,127	6,902	816	486	1,426	82	**16,839**
Field	127,912	33,178	13,082	16,097	22,591	789	**213,649**
Grain	21,222	7,589	9,141	14,295	14,196	2,262	**68,705**
Pasture	3,724	3,957	7,465	19,738	6,243	223	**41,350**
Truck	43,158	3,661	3,789	1,755	248	4	**52,615**
Vineyard	10,477	8,295	9,194	1,528	1,074	1	**30,569**
Grazing Land[3]	433	2,846	11,499	18,600	2,284	1,991	**37,653**
TOTAL	**214,053**	**66,428**	**54,986**	**72,499**	**48,062**	**5,352**	**461,380**

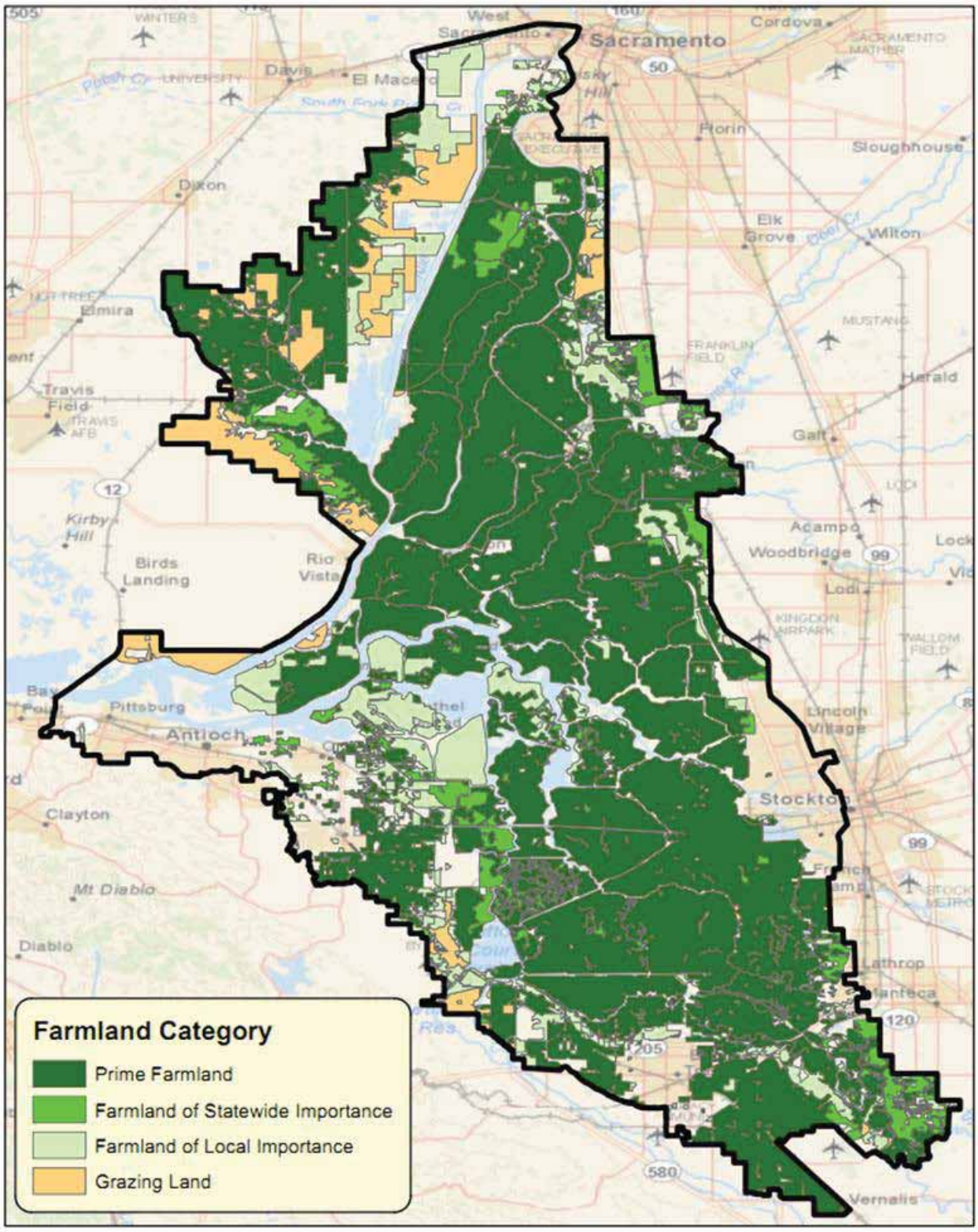
[1] Pasture acreage adjusted using NASS estimates.
[2] NASS data used due to lack of recorded field borders.
[3] Grazing land acreage estimated from FMMP data.

Table 8 Top 20 Delta Crops by Acreage, 2009

	Crop	Acreage	Value
1.	Corn	105,362	$92,975,715
2.	Alfalfa	91,978	$66,027,076
3.	Processing Tomatoes	38,123	$117,242,615
4.	Wheat	34,151	$17,549,215
5.	Wine Grapes	30,148	$104,990,142
6.	Oats	15,847	$4,195,540
7.	Safflower	8,874	$3,312,014
8.	Asparagus	7,217	$50,050,037
9.	Pear	5,912	$36,746,649
10.	Bean, Dried	5,493	$3,990,318
11.	Rice	4,874	$6,822,488
12.	Ryegrass	4,398	$1,061,436
13.	Cucumber	3,737	$7,866,553
14.	Turf	3,633	$31,643,344
15.	Potato	3,353	$28,605,465
16.	Almond	3,121	$8,776,101
17.	Sudangrass	3,025	$1,398,634
18.	Walnut	2,512	$9,453,874
19.	Pumpkin	2,103	$7,926,038
20.	Watermelon	1,717	$7,953,590

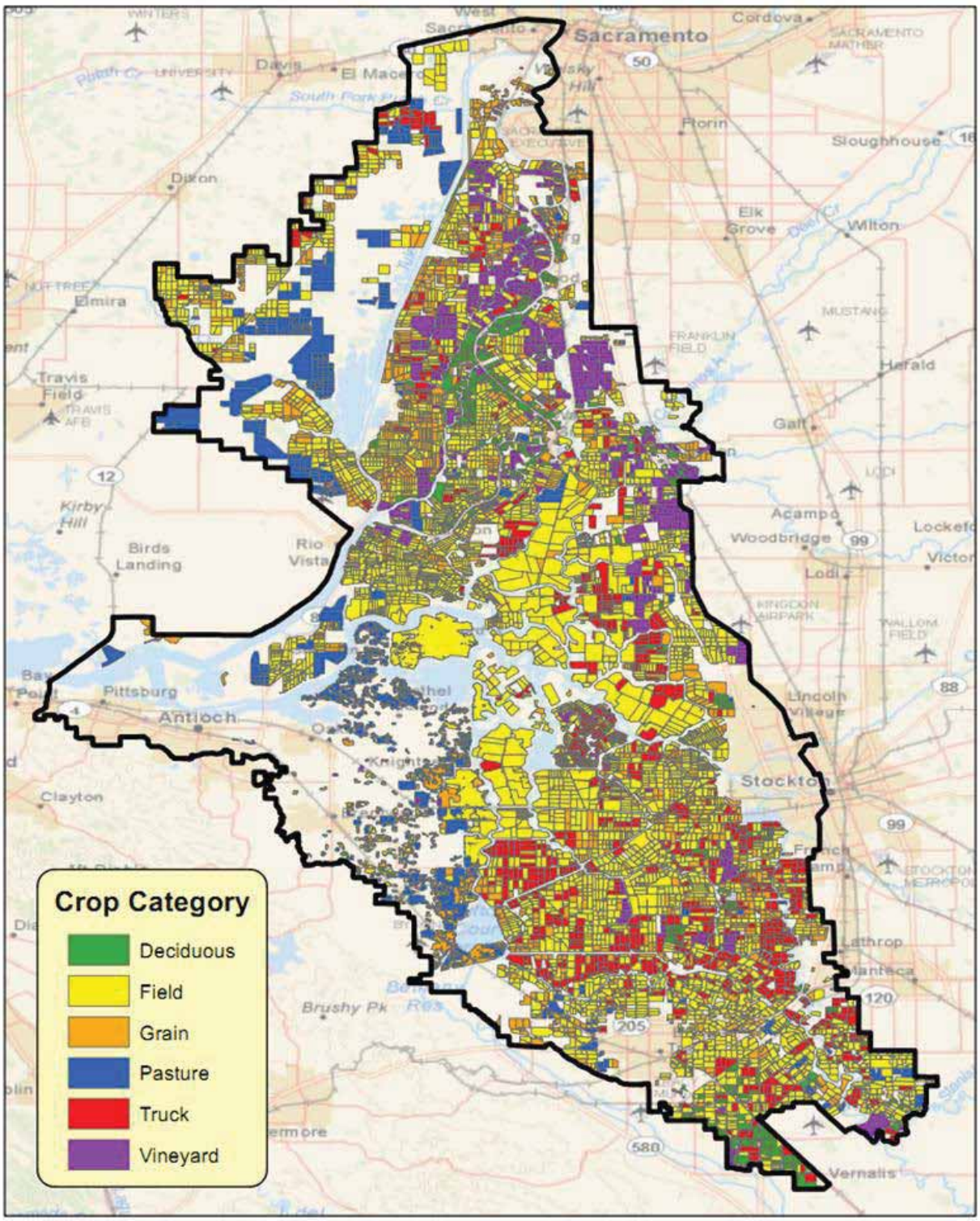
Note: 2009 acreages used in order to provide accompanying value estimates, which were not available for 2010.

Figure 20 FMMP Delta Farmland Coverage[98]



[98] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Figure 21 Agricultural Land Cover, 2010[99]



[99] Note: Grazing Land indicated on previous figure. For high resolution image see http://forecast.pacific.edu/desp-figs.html

7.2.4 Delta Agricultural Revenues

Total Delta agriculture revenues can be calculated using the acreage analysis described above and multiplying the 2009 acreage of each individual crop by the yield and unit price reported in that year's county crop reports. This produces a total of $702 million in revenues from Delta agriculture in 2009. Tables 9 and 10 depict total revenue by crop category in each county and the top revenue-generating Delta crops.

Table 9 Delta Agricultural Revenues, 2009 (in $1000s)

Crop Category	*San Joaquin*	*Sacramento*	*Yolo*	*Solano* [1]	*Contra Costa* [2]	*Alameda* [3]	TOTAL
Deciduous	25,118	41,738	3,345	1,347	8,667	355	**80,570**
Field	107,001	22,071	9,341	12,418	21,398	398	**172,627**
Grain	15,535	3,276	2,587	7,512	288	1,059	**30,257**
Pasture	741	438	411	1,717	1,013	270	**4,590**
Truck	248,982	20,847	15,987	8,949	13,871	17	**308,653**
Vineyard	32,099	28,474	32,718	5,042	6,657	3	**104,993**
Grazing Land[4]	9	57	230	372	46	40	**754**
TOTAL	**429,485**	**116,901**	**64,619**	**37,357**	**51,940**	**2,142**	**702,444**

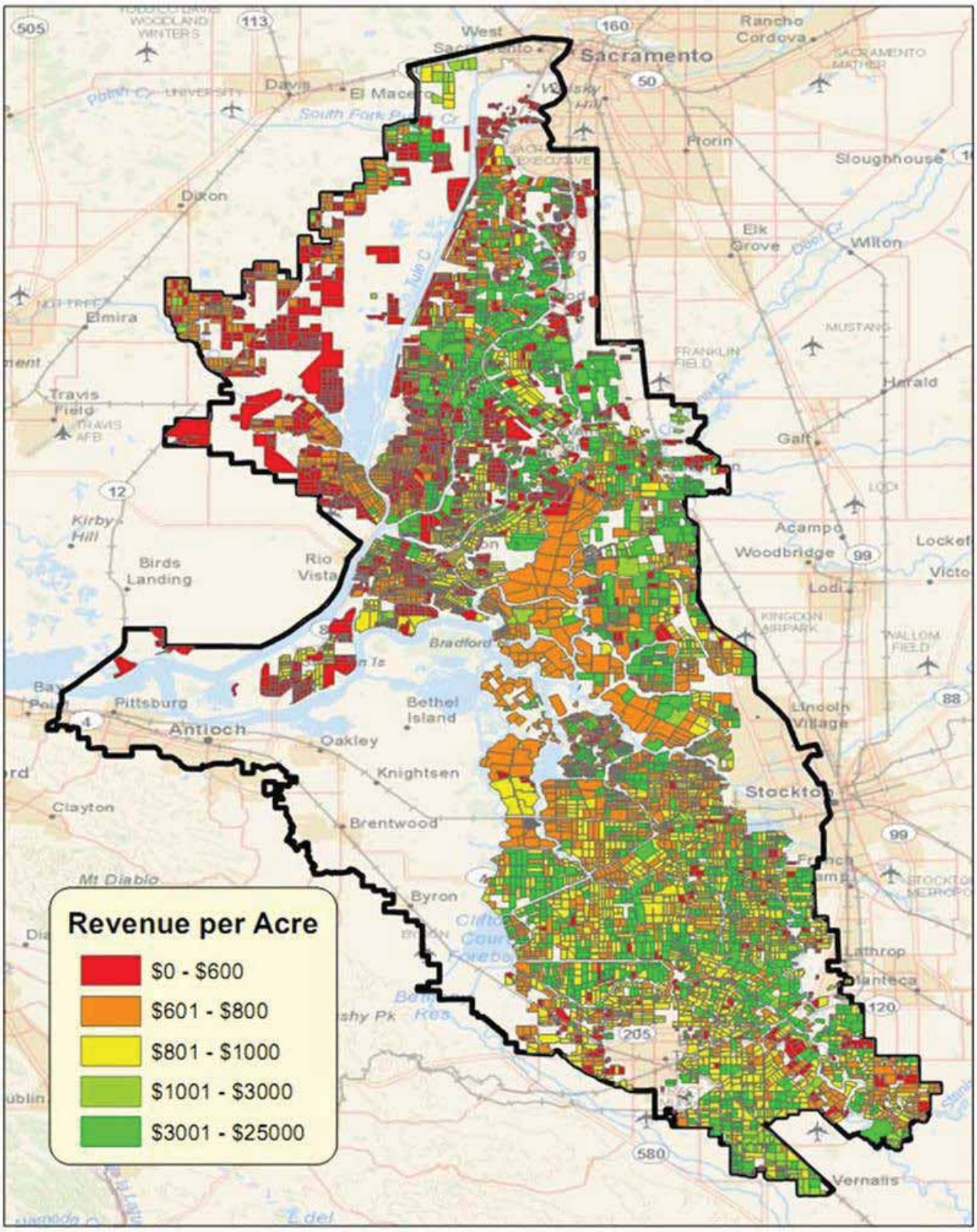
[1] Crop value calculations use 2010 field borders acreage.
[2] Values for non-grazing land include all reported county crop report acreage due to lack of reported field borders.
[3] Values computed using 2010 NASS acreage estimates and average crop category values.
[4] Grazing land acreage estimated from 2008 FMMP data and valued at $20 an acre.

Table 10 Top 20 Delta Crops by Value, 2009

	Crop	Value	Acreage
1.	Processing Tomatoes	$117,242,615	38,123
2.	Wine Grapes	$104,990,142	30,148
3.	Corn	$92,975,715	105,362
4.	Alfalfa	$66,027,076	91,978
5.	Asparagus	$50,050,037	7,217
6.	Pear	$36,746,649	5,912
7.	Turf	$31,643,344	3,633
8.	Potato	$28,605,465	3,353
9.	Blueberry	$25,255,917	1,097
10.	Wheat	$17,549,215	34,151
11.	Cherry	$11,490,843	1,855
12.	Almond	$8,776,101	3,121
13.	Walnut	$9,453,874	2,902
14.	Watermelon	$7,953,590	1,717
15.	Pumpkin	$7,926,038	2,104
16.	Cucumber	$7,866,553	3,529
17.	Rice	$6,822,488	4,874
18.	Pepper	$6,247,592	1,289
19.	Apple	$4,455,826	846
20.	Oat	$4,195,540	15,847

Note: Kern County crop report value used for turf value, as no Delta counties report turf separately from other nursery crops.

Figure 22 Average Revenues per Acre[100]



[100] Using Field Borders Data, Contra Costa County is not included in the figure because data was not available in this format. For high resolution image see http://forecast.pacific.edu/desp-figs.html

7.3 Economic Impact of Delta Agriculture

The previous sections focused on the value and composition of crop production in Delta agriculture. To calculate the economic impact of agriculture in the Delta, two additional areas needed to be considered: 1) the value of animal agriculture in the Delta, and 2) the output of local food and beverage manufacturing firms that are located in the region because of Delta crop output. The section concludes with a brief discussion of impact analysis and policy analysis and how to interpret the results, and a discussion and comparison with related estimates by the Department of Water Resources.

7.3.1 Animal Production in the Delta

Animal and animal product output in the Delta is more difficult to estimate than crop production. It is clear that the Delta is not as oriented towards crop production as many other areas in the Central Valley, although a significant amount of its crop production is alfalfa and field crops that are consumed by animal enterprises outside the Delta. Other reports by the Department of Water Resources and the Delta Stewardship Council White Papers have estimated animal-related output in the Delta at about $90 million per year, significantly less than crop production. Estimates produced for this study are very similar. Enterprise data from Dun and Bradstreet and NETS were used to identify dairy, cattle, and other animal production enterprises located within the legal Delta, and this figure was compared to the total number in the counties. The percentage of animal enterprises in each county located in the Delta was applied to the total animal production in the crop reports for each of the five Delta counties, resulting in an estimate of $93 million in animal output, shown in Table 11.

Table 11 Animal Output in the Delta

Animal Output	Value
Cattle	$24,097,110
Sheep, Poultry, other Livestock	$3,160,977
Milk	$64,322,406
Wool	$94,628
Apiculture	$1,712,879
Total Animal and Animal Products	**$93,388,000**

7.3.2 Value Added Processing: Food and Beverage Manufacturing

The value of farm production is typically measured as the revenue earned by farm operations for selling crops. “Farm gate” values are reported in County Crop Reports and are the measures of agricultural revenues used in this chapter and most other discussions of agricultural values. Some farm products are not transformed significantly, and therefore have little additional value added to them between the farm and when they are shipped out of the region, or received by retailers or food service providers for sale to local consumers. Tree nuts such as almonds and walnuts, cotton, and many fresh fruits and vegetables are examples of high-value agricultural crops that have little additional value added to them before they are exported from the state or region. In contrast, wine grapes, processing tomatoes and milk are examples of farm products that have significant processing and value added by local food and beverage manufacturers.

Food and beverage manufacturing is an important economic sector in California and the five Delta Counties. Some of that manufacturing only exists in the region because of local farm

output, whereas many food and beverage manufacturing enterprises such as bakeries are located in a region to serve the local market or for other reasons. Wineries, most fruit and vegetable canneries such as tomato paste, and most dairy product manufacturing such as cheese, butter, and fluid milk in California is closely linked to local farm production.[101] Wine grapes also have a large associated tourist economy. Thus, valuing wine grapes to the California economy at the "farm gate" significantly understates their true value to the economy.

Comparing data for food and beverage manufacturing from the 2007 Economic Census to 2007 farm production in California for the associated farm products illustrates the point.[102] The value of wine grape production at the farm gate in 2007 was $1.855 billion according to the California Department of Food and Agriculture, but the value of shipments from California wineries was $10.764 billion, 5.8 times the agricultural value of the wine grapes harvested on 480,000 acres in California in 2007 (or $22,400 of output per acre). The Delta is about 5 percent of California's wine grape production. Milk was the highest value California farm product in 2007 at $7.33 billion in agricultural production. Virtually all of that milk was used by various segments of California's dairy product manufacturing industry (NAICS 3115, includes fluid milk, cheese, ice cream, etc.) which recorded a value of shipments of $12.467 billion in 2007, 1.7 times the value of raw milk in agricultural reports. Roughly 2 million acres of irrigated crops in California supported the dairy industry, about 10 percent of which is in the Delta, although a significant amount of feed is also imported from other states. Disaggregated data on processing tomatoes is unavailable as it is combined in NAICS code with all fruit and vegetable canning, but data from major tomato processor Morning Star suggests that the value of shipments in the tomato paste production is roughly 2 times the value of processing tomatoes purchased from local farms.[103] Thus, the $849 million in processing tomatoes produced in 2007 would be conservatively supporting about $1.7 billion in canned tomato products production,[104] from about 300,000 acres of production of which a little more than 10 percent is in the Delta.

The point is that all of the four most significant crops in the Delta—alfalfa, corn, processing tomatoes, and wine grapes—are supporting a significant value-added chain in the region and state. In contrast, crops such as nuts, cotton, and even produce such as lettuce, melons, and broccoli may have higher farm gate values and agricultural revenue per acre, but less economic value is added to the crop in the region or state between the farm and consumers. Almonds have slightly higher agricultural receipts than wine grapes in California, but wine grapes generate more than five times the income of almonds. Processing tomatoes and cotton have similar agricultural receipts, but processing tomatoes generate more than double the income for the state. Thus, when measuring and comparing the contribution of various regions to the state's economy, an approach that focuses solely on agricultural receipts is easy to calculate but is too narrow and will significantly undervalue the Delta's contribution relative to areas further south in the Valley that receive water exported from the Delta.

To be conservative in the modeling, only food and beverage manufacturing where a clear link to regional production could be identified and reasonably estimated are used in the economic

[101] It should be noted that relatively "low value" alfalfa and corn silage production in California is an important part of the dairy product value chain as well.
[102] 2007 is the most recent year for which the value of shipments data is available at the 5-digit NAICS level that identifies wineries as a separate manufacturing category, NAICS 31213.
[103] See exhibit 2 and exhibit 8 in this presentation, http://www.morningstarco.com/statdocs/2010%20Exhibits%20Brochure.pdf
[104] Morning Star is known for low cost tomato paste production; other higher valued canned tomato products are likely adding more value than bulk tomato paste production, which absorbs roughly 75 percent of California's processing tomato production, according to Morning Star.

impact analysis, and all analysis is presented with and without the related manufacturing component. Although Delta crops are definitely consumed in large quantities by dairies outside the Delta, these dairies also use grain and alfalfa transported significant distances and could increase the use of these imported feeds if necessary, although at higher cost. Thus, dairy production outside the Legal Delta is not attributed to Delta agriculture in proportion to the Delta's contribution to dairy cattle feed. Some additional value-added processing to cattle production and fruits and vegetables other than tomatoes and cattle are excluded due to measurement difficulties. The complexity of the industry and limited data makes it difficult to precisely estimate the entire value-chain and linkages, but this analysis is important to capture the overall scale and contribution of agricultural production to the region.

As discussed above, our estimate of value-added manufacturing focuses on three industries: wineries, tomato canning, and dairy product manufacturing. Delta wine grapes are roughly 5 percent of California production by both weight and value. The prices are similar to state averages, much higher than other areas of the Central Valley but much lower than premier growing areas such as Napa and Sonoma. Winery capacity in the Delta and the five Delta counties is small relative to local production, but Napa and Modesto winery capacity is very high relative to local production. The data and interviews with local producers support that most Delta wine grape production is contracted to large Napa County wineries or Modesto-based Gallo. Using state and regional shares of wine grape production from the Delta, and county winery output estimates from IMPLAN, we estimate that $181 million of winery output in the five Delta counties is dependent on Delta wine grapes, and $541 million of winery output in adjacent counties (Napa and Stanislaus) is sourced from the Delta. The $117 million in processing tomato output is estimated to support $234 million in cannery output based on the Morning Star input data.

Delta farms produce less than 1 percent of California's milk, but produce roughly 10 percent of the state's alfalfa and forage crops, critical and increasingly scarce and costly inputs to the dairy industry. Although there are few dairies in the Delta, maps of dairy cow concentration in the San Joaquin Valley indicate large nearby clusters between Highway 99 and I-5 between Manteca and Merced, and in southeast San Joaquin County near Escalon.[105] Clearly the Delta is more critical to the state's industry than the milk production data shows, but quantifying its importance is difficult since Dairy producers can import feed and adjust the mix of feeds in cow rations in response to scarce local feed sources. One could argue Delta agriculture supports anywhere from 1 percent ($137 million) to 10 percent ($1.37 billion) of California's dairy product industry. As a rough estimate in this range, we link 5 percent ($687 million) of California dairy product manufacturing to Delta agriculture, a similar contribution as winery production, and attribute half of this total ($344 million) to dairy products produced in the five Delta counties, which is a little less than half of all dairy product manufacturing in the Delta counties.[106]

7.3.3 Economic Impact Estimates

The IMPLAN 3 model calibrated to 2008 regional and statewide economic data was used to estimate the overall economic impact of Delta agriculture. See Appendix F for a description of the IMPLAN model and formal definitions of terms such as direct, indirect, and induced effects. Following a methodology initially proposed by UC-Davis agricultural economists, the default

[105] EPA Dairy Cow Concentration Map. http://www.epa.gov/region9/ag/dairy/images/CED0601309_2.gif
[106] There is one very large cheese manufacturer of note in the legal Delta, Leprino Foods in Tracy.

IMPLAN production functions were adjusted to account for the unusually high use of contract labor in California agriculture.[107]

Table 12 Agriculture Related Output Used for the IMPLAN model

Industry	Output Value (millions $)
1 Oilseed farming	3.3
2 Grain farming	135.9
3 Vegetable and melon farming	250.1
4 Fruit farming	191.7
5 Tree nut farming	20.1
10 All other crop farming	101.5
11 Cattle ranching and farming	27.2
12 Dairy cattle and milk production	64.3
14 Animal production, except cattle and poultry and eggs	1.8
Food/Beverage Manufacturing in expanded analysis	
54 Fruit and vegetable canning, pickling, and drying	234 in Delta counties & statewide
55-58 Dairy Products Manufacturing	344 in Delta counties 687 statewide
72 Wineries	180.5 in Delta counties 722 statewide

For the five-county economic impact model, Delta agricultural production and Delta-dependent food processing and winery production was distributed across IMPLAN production sectors according to Table 12. In the initial model, only the impacts of the $795 million in direct agricultural production were modeled. As shown in Table 13 (A), the approximately $702 million in Delta crop production and $93 million in Delta animal and animal product revenue has an economic impact of 9,681 jobs, $683 million in value added and $1.416 billion in output in the five Delta counties. Table 14 (A) shows that across all of California, the economic impact of Delta agriculture is 12,934 jobs, $819 million in value added, and $1.642 billion in output. This equates to an employment multiplier of 12.2 jobs per million dollars in output in the five Delta Counties and 16.2 jobs per million dollars in output when evaluated statewide. These multipliers are very consistent, if not low, compared to other studies. In a recent essay published by UC-Davis, Howitt et al. (2011) states that agricultural employment multipliers typically range from 16 to 27 jobs per million dollars.[108]

To get a more complete picture of the full economic impact of Delta agriculture, the impact of linked food and beverage manufacturing for wineries, tomato canning and dairy products were included as described in the previous section. These upward linkages must be estimated separately, because the indirect effects of the IMPLAN model only includes backwards linkages from purchased inputs. To avoid double counting impacts from the initial stage, the indirect effects attributed to the purchase of crops as inputs were netted out of the results. For example,

[107] The production functions were adjusted to ensure that virtually all (97 percent) of the output of the agricultural service sector was utilized by the regional agriculture industry, a common sense adjustment and a methodology that recently yielded good predictions of the employment effects of the 2009 drought in the San Joaquin Valley.

[108] Howitt, R.E., D. MacEwan and J Medellin-Azuara, “Drought, Jobs, and Controversy: Revisiting 2009,” *ARE Update*, 14 (6) (2011): 1-4.

for wineries, the indirect effects associated with purchasing wine grapes were estimated and removed from the total to avoid double counting the impact of growing wine grapes. The total five-county economic impacts are displayed in Table 13 (C). Delta agriculture supported 13,179 jobs, $1.059 billion in value-added, and $2.647 billion in output in the five Delta counties. For the California economic impact model, the additional $541 million of Delta dependent winery production and $344 million in dairy product production from adjacent counties and was added to the totals. The economic impact rises from this extra production, and also because the indirect and induced effects grow when considered on a statewide rather than five-county basis. Table 14 (C) shows that across the State of California, Delta agriculture supports nearly 25,125 jobs, over $2.135 billion in value added, and over $5.372 billion in output.[109] Even when using this more expansive view of impacts, the employment multipliers are 16 to 32 jobs per million dollars of agricultural production, similar to the range described as typical by Howitt et al. (2011).

Caution is advised before using the more expansive multipliers to estimate the potential long-range socio-economic impacts of the policy changes described in this chapter. These are current economic impact estimates for Delta agriculture, and do not take into account potential substitution or adjustment strategies that may be employed. For example, wineries or canneries could purchase inputs from different sources if Delta tomatoes or wine grapes became unavailable, so the multipliers from the broader scenario including food processing would be too large for analyzing long-range policy impacts, particularly at the statewide level.

Table 13 Economic Impact of Delta Agriculture on Five Delta Counties

Impact Type	Employment	Labor Income	Value Added	Output
(A) Delta Crop and Animal Production Impacts				
Direct Effect	4,132	$146,710,832	$361,683,700	$815,797,504
Indirect Effect	4,051	$155,957,376	$192,082,400	$380,246,048
Induced Effect	1,499	$69,450,720	$129,108,300	$219,740,912
Total Effect	9,681	$372,118,912	$682,874,400	$1,415,784,448
(B) Delta Agriculture Processing Impacts				
Direct Effect	609	$82,201,128	$109,578,400	$665,876,520
Indirect Effect	2,000	$98,387,163	$190,347,240	$434,962,236
Induced Effect	888	$41,268,532	$76,653,590	$130,501,340
Total Effect	3,498	$221,856,824	$376,579,120	$1,231,340,096
(C) Total Delta Agriculture Impacts				
Direct Effect	4,741	$228,911,960	$471,262,100	$1,481,674,024
Indirect Effect	6,051	$254,344,539	$382,429,640	$815,208,284
Induced Effect	2,387	$110,719,252	$205,761,890	$350,242,252
Total Effect	13,179	$593,975,736	$1,059,453,520	$2,647,124,544

[109] The Department of Water Resources has called these estimates inflated and inflammatory in comments, including to the Delta Stewardship Council. The accusation is strange since DWR's own estimate of Delta agricultural production of $817.6 million is higher than in this study. Interestingly, DWR has not estimated any employment impacts of Delta agriculture, but used employment multipliers of 50-60 jobs per million dollars of agricultural output in the San Joaquin Valley in their highly publicized 2009 drought reports. If DWR were to apply similar multipliers to their estimate of Delta agricultural output, they would estimate that Delta agriculture creates 41,000 to 49,000 jobs, far higher than the estimates in this report.

Table 14 Economic Impact of Delta Agriculture on California

Impact Type	Employment	Labor Income	Value Added	Output
(A) Delta Crop and Animal Production Impacts				
Direct Effect	5,104	$158,528,784	$361,683,600	$815,797,504
Indirect Effect	5,502	$207,782,128	$241,993,300	$447,518,752
Induced Effect	2,328	$119,379,712	$215,517,800	$379,519,392
Total Effect	12,934	$485,690,624	$819,194,800	$1,642,835,712
(B) Delta Agriculture Processing Impacts				
Direct Effect	1,457	$188,053,130	$273,482,330	$1,506,051,552
Indirect Effect	7,066	$389,934,316	$702,163,970	$1,623,701,672
Induced Effect	3,669	$188,538,768	$340,253,880	$599,425,808
Total Effect	12,191	$766,526,200	$1,315,900,600	$3,729,179,040
(C) Total Delta Agriculture Impacts				
Direct Effect	6,561	$346,581,914	$635,165,930	$2,321,849,056
Indirect Effect	12,568	$597,716,444	$944,157,270	$2,071,220,424
Induced Effect	5,997	$307,918,480	$555,771,680	$978,945,200
Total Effect	25,125	$1,252,216,824	$2,135,095,400	$5,372,014,752

7.4 Other Agriculture Issues

There has been significant interest in alternative forms of agriculture in the Delta, as well as new approaches to increase agricultural revenue. Many of the ideas have been proposed in Delta Vision and other Delta related plans and reports. Ideas include increased agritourism, regional branding and marketing of Delta crops, growing crops for biofuels, subsidence-reversal agriculture, and growing crops for carbon sequestration purposes and the marketing of carbon credits. Some of the ideas are promoted for the dual benefits of ecosystem restoration and reducing flood risks, whereas others are primarily seen as a way to enhance local agricultural income.

Most of these options were evaluated in a recent report by the UC Davis Agricultural Issues Center (AIC) developed for the California Department of Food and Agriculture and presented to the Delta Stewardship Council. In virtually all cases, the AIC report determined that the ideas have very limited potential to develop a significant market in the Delta. For example, most Delta crops are commodities such as corn and processing tomatoes for which branding is not effective.

Agritourism, defined as recreational, educational, and other visits to working farms, is a small but fast growing source of income for farms in the region. As discussed in the Appendix of the recreation and tourism chapter,[110] agritourism was estimated by USDA to generate $4 million in income for farms in the five Delta counties in 2007. Assuming agritourism in the Delta is proportional to overall agriculture in the county, a roughly 25 percent share, agritourism generated roughly $1 million in revenue in 2007. An inventory of agritourism enterprises in California maintained by UC cooperative extension (http://www.calagtour.org/) identifies 91 agritourism operations in the five Delta counties, and 12 (13 percent) of these are located in the Delta. Over half of the Delta agritourism enterprises were in Contra Costa County where there is a cluster of U-pick orchards and other farms open to tourists around Brentwood. Only one of the

[110] Appendix H

20 agritourism locations in San Joaquin County was in the Delta, but it was a very large attraction at Dell'Osso Family Farm adjacent to Interstate 5 near Lathrop that is estimated to draw over 100,000 visitors each fall to its corn maze and other attractions. Currently, it appears that agritourism is only significant in the suburban edges of the Delta secondary zone, and it is probably best suited to these areas. Agritourism is discussed in more detail as a potential growth strategy for tourism and Legacy Communities in subsequent chapter.

A January 2011 report prepared for the Nature Conservancy examines the potential of carbon capture wetland farms and low carbon agriculture in the Delta.[111] Although carbon capture wetland farms could generate environmental benefits and potentially reverse subsidence on Delta islands, the report casts doubt on whether carbon capture farming is economically viable, although the authors encourage large-scale demonstration projects to further research the potential. Specifically, the authors state:

> "Our analysis illustrates that Carbon Capture Wetland Farms are unlikely to provide a clear incentive to both landowners and investors without either fairly high carbon prices or some type of grant or payment scheme to subsidize some of the costs of conversion and annual management." (p. 106)

The report also details other problems including increased methylmercury, organic carbon, and mosquitos that could have negative impacts on various aspects of the Delta economy. The report discusses other low carbon changes to agriculture including conversion to rice growing and reduced tillage practices that may be more economically feasible. The authors encourage large-scale demonstration projects to more fully research the potential of carbon capture wetland farms.

7.5 Modeling Crop Choice in the Delta

A multinomial logit model is used to estimate farmers crop choice at the field level in the Delta. Since its development in the early 1970s, the multinomial logit model has been extensively used to statistically model choices between multiple options, and has been applied to myriad settings including occupational choice, health care choices, and crop choices among others.[112] Professor Daniel McFadden of UC Berkeley was a significant contributor to the development of the multinomial logit and related models for which he was awarded the Nobel Prize in Economic Sciences in 2000. In addition to crop choice, the approach has been used to study a variety of problems in agriculture over the past three decades including studies of irrigation technology choices (Caswell and Zilberman, 1985), and crop management practices (Wu, Adams, Kling, and Tanaka, 2004; Wu and Babcock 1998).[113]

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[111] A. Merrill, S. Siegel, B. Morris, A. Ferguson, G. Young, C. Ingram, P. Bachand, Holly Shepley, Maia Singer, Noah Hume, "Greenhouse Gas Reduction and Environmental Benefits in the Sacramento-San Joaquin Delta: Advancing Carbon Capture Wetland Farms and Exploring Potential for Low Carbon Agriculture," prepared for The Nature Conservancy, Sacramento, California, 2010. Available at: http://www.stillwatersci.com/

[112] Maddala, G.S., *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge University Press, 1993.

[113] Caswell, M.F. and D. Zilberman, "The choice of irrigation technologies in California," *American Journal of Agricultural Economics* (1985), 67: 224-34.
Wu, J. and B. A. Babcock, "The choice of tillage, rotation, and soil testing practices: Economic and environmental implications," *American Journal of Agricultural Economics* (1998), 80: 494-511.

The multinomial logit model is used to predict agricultural land allocation, conditional on its current land use and other exogenous variables, including soil quality, a multi-year average of irrigation water salinity, temperature, slope, elevation, field size, and dummy variables for year and conservation zone to capture fixed effects. The model generates estimates of the probability of observing a given crop type in each specified field over a long-term time horizon. It was trained on a dataset of over 6,000 individual crop fields for which annual crop data was tabulated for each year from 2002 through 2010, excluding 2005 for which reliable data was not available. All of the explanatory variables were statistically significant and of the expected signs. More details on the model input data and output results are provided in Appendix G. The impact on Delta crop allocations under various scenarios is described in tables on the following pages.

There is significant urbanization pressure in the Secondary Zone of the Delta, so the model was run with and without the inclusion of land that is expected to be developed by 2050. We determined this area using the urbanization probability maps generated by the UC Berkeley RESIN project with some minor adjustments to the high and very high probability categories to conform to the sphere of influence of cities in the Secondary Zone and discussions with city officials and local developers with knowledge of land development plans. Table 15 depicts the agricultural crop acreage expected to convert to urbanized land, while Figure 23 displays the affected fields. All of these fields are excluded in the forecast with urbanization effects.

Overall, urbanization will reduce agricultural production in the Delta due to the loss of land. However, it should be noted that the Delta's location in the heart of the growing Northern California megaregion surrounded by growing cities creates opportunity for the majority of farmland that remains in production. Wu, Fisher, and Pasqual (2011) find that the revenue opportunities created by urbanization could outweigh the negative impacts on farm infrastructure and production costs due to growing market opportunities for higher-value crops such as vineyards, fresh vegetables, and nursery products.[114] In a later section of this report, we also discuss the presence and growth of agritourism around the urban fringe.

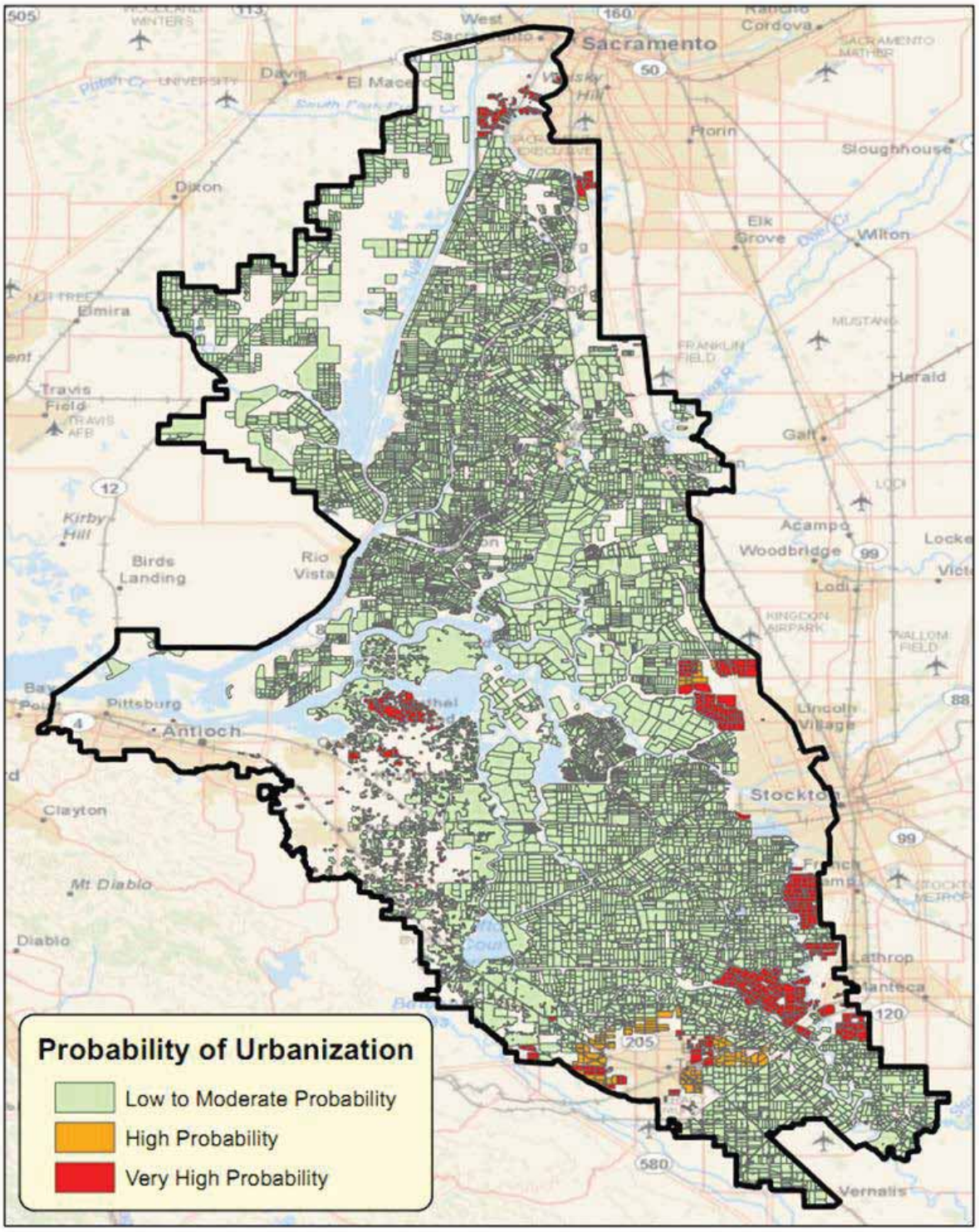
Table 15 Crop Acreage with High or Very High Probability of Urbanization

Crop Category	High Probability	Very High Probability	Total
Deciduous	72	588	660
Field	3,598	8,210	11,808
Grain	597	6,095	6,692
Pasture	531	703	1,234
Truck	604	5,111	5,715
Vineyard	1	515	516
All Crops	**5,403**	**21,222**	**26,625**

Wu, J., R.M. Adams, C.L. Kling, and K. Tanaka, "From micro-level decisions to landscape changes: An assessment of agricultural conservation policies," *American Journal of Agricultural Economics* (2004), 86: 26-41.

[114] Wu, J., M. Fisher, and U. Pasqual, "Urbanization and the Viability of Local Agricultural Economies," *Land Economics* (2011), 87: 109-125.

Figure 23 Crop Fields with High or Very High Probability of Urbanization[115]



[115] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Table 16 Long-run Land Allocation Forecast

Scenario	*Deciduous*	*Field*	*Grain*	*Pasture*	*Truck*	*Vineyard*
Current Land Allocation	3.97%	50.42%	16.21%	9.76%	12.42%	7.21%
Baseline Forecast	5.12%	51.11%	11.46%	6.80%	17.74%	7.76%
Forecast with Urbanization Effects	5.26%	51.13%	11.02%	7.08%	17.24%	8.26%
Forecast with Urbanization Effects vs. Current Allocation						
Land Allocation Change	1.29%	0.71%	-5.19%	-2.68%	4.83%	1.04%
Relative Crop Allocation Change	32.34%	1.41%	-32.01%	-27.45%	38.87%	14.46%
Forecast with Urbanization Effects vs. Baseline Forecast						
Land Allocation Change	0.14%	0.02%	-0.44%	0.28%	-0.50%	0.50%
Relative Crop Allocation Change	2.66%	0.05%	-3.81%	4.10%	-2.81%	6.41%

The results of the long-run land allocation forecast are contained in Table 16 above. Significant growth is predicted in truck, deciduous, and vineyard crops, with the largest decline among grain and pasture crops. Forecasted revenue changes are illustrated in Table 17 below. It indicates a trend towards increased planting of high-value crops, which would lead to an estimated $111 million increase in total agriculture revenue assuming current crop acreage and average crop class revenue using 2009 prices. Taking into account the 26,625 acres expected to undergo urbanization, annual revenues are expected to increase by $68 million, a decline of $43 million per year compared to the baseline.

Table 17 Long-run Agricultural Revenue Forecast

Crop Category	Average Revenue per Acre	Forecasted Acreage Change			Forecasted Revenue Change		
		Baseline	*Urbanization*	*Urbanization vs. Baseline*	*Baseline*	*Urbanization*	*Urbanization vs. Baseline*
Deciduous	$4,612	4,869	4,046	-823	$22,455,695	$18,660,853	-$3,794,841
Field	$780	2,921	-10,595	-13,516	$2,278,075	-$8,264,247	-$10,542,321
Grain	$426	-20,138	-24,926	-4,788	-$8,578,785	-$10,618,569	-$2,039,784
Pasture	$116	-12,532	-13,236	-704	-$1,453,712	-$1,535,376	-$81,664
Truck	$3,903	22,566	15,862	-6,704	$88,076,852	$61,909,659	-$26,167,192
Vineyard	$3,566	2,314	2,222	-91	$8,251,441	$7,925,330	-$326,111
				Total Revenue Change	**$111,029,565**	**$68,077,651**	**-$42,951,914**

Many future crop allocations are possible, and these results depict the most likely allocation calculated by the model. It predicts a modest (approximately 5 percent) shift towards higher-value crops over several decades, with field crops holding steady at over 50 percent of Delta cropland over time. Some comments have pointed to a decline in higher-value truck crops in the Delta to cast doubt on the model results. However, that recent decline is due to the rapid loss of tens of thousands of acres in the Delta's signature asparagus crop which has declined to a mere 7,000 acres from reported levels near 70,000 acres in the 1960s. The California Asparagus Board reports acreage was relatively stable during the 1990s, then dropped from 37,000 acres statewide in 2000 to a mere 12,000 acres in 2010, with a little over half of the acreage in the Delta. Asparagus is a labor-intensive crop, and increased competition from the growth of lower-cost producers in Peru and Mexico has impacted California producers.

However, other truck crops including tomatoes, peppers, cucumbers, pumpkins and blueberries have shown modest growth in recent years, and it is hard to see asparagus production in the Delta dropping all the way to zero given its iconic status at local festivals, growing consumption,

and the demand for the fresh market. Even in the unlikely prospect that asparagus were to completely disappear from the Delta, the lower bound of zero production would soon stop the downward trend.

Thus, the 16,000 acre increase in truck crops predicted by the model is plausible, certainly over the 2050 planning horizon of this study. In contrast, other comments and recent trends suggest the prediction for 2,000 acres of additional vineyards is too small given current trends. In comments received from Delta farmers, most expected the most rapid growth in vineyards, as much as another 20,000 acres over the next one to two decades. Current trends and the 64,000 acres of available land in the growing Clarksburg American Viticultural Area suggest this is possible, if not probable. Overall, the 5 percent shift from lower-value crops such as grains to higher-value crops is a reasonable, if not conservative, forecast through 2050. Markets will change and projections are, of course, uncertain and could be more or less than predicted. Nevertheless, the trend towards higher-value crops is consistent with broad trends throughout the Central Valley, although the shift to higher-value crops in other areas has been dominated by growth in tree nuts. However, the shift towards permanent crops in the rest of the Valley and growing urbanization around the Delta creates a market opportunity for increased specialization in truck and vineyard crops in the Delta. In spite of this, truck crops and vineyards, with the notable exception of asparagus, are sensitive to salinity.

7.6 Impact of Policy Scenarios

7.6.1 Background on Salinity and Delta Agriculture

The impact of salinity and potential salinity changes on Delta agriculture is a contentious topic.[116] There are two current proposals that could affect salinity in the Delta:

A proposal to increase the salinity levels allowed in the south Delta from 700 ec to 1000 ec during the growing season, and from 1000 ec to 1400 ec at other times, a 40-42 percent increase. This is known as the D-1641 standard, and the proposed change is currently being considered by the State Water Resources Control Board (SWRCB). The Department of Water Resources and State and Federal Water Contractors support the change, whereas the Central and South Delta Water Agencies oppose the change.

A proposal to shift from through-Delta conveyance to “dual conveyance” utilizing an isolated conveyance facility as proposed in the draft BDCP. The operation of dual conveyance is the subject of continued modeling, but the intention would be to use the isolated conveyance as much as possible while still maintaining south Delta water quality standards. Under the current through-Delta conveyance, salinity levels in the south Delta vary substantially from year to year, and are often much lower than the current 700 ec standard while running at or above the standard in dry years. Thus, under dual conveyance that diverts more water around the Delta in wet years, it is expected that south Delta salinity will run close to the D-1641 standard most of the time, making “every year a drought” in the words of a Delta farmer. The effect could be an increase in the average level of salinity of 25-50 percent even if the 700 ec standard is always met, and a potential doubling in average salinity levels if dual conveyance were combined with an increase of the D-1641 standard to 1000 ec.[117]

[116] In the report, for consistency among databases, salinity is measured by electroconductivity (ec) in units of micro Siemens per centimeter.
[117] Modeling by William Fleenor reported in the 2007 PPIC report indicates that ec would rarely if ever exceed 1000 ec with a dual conveyance system.

In addition to the current proposals, concerns have been expressed by Delta agriculture interests that isolated conveyance could lead to future increases in salinity that would exceed the levels discussed above. They point to emergency declarations by the Governor during periods of drought that temporarily suspend water quality standards and current efforts to weaken environmental and water quality protections through legislation and the courts. The pressures on water quality standards could increase if a $12 billion isolated conveyance facility is built as water exporters attempt to maximize the value of the isolated facility they are financing, and the commitment to maintaining Delta levees could decrease.

The 2007 PPIC "Envisioning Futures" report estimated the potential impacts of a peripheral canal on Delta agriculture by modeling a tenfold and twentyfold increase in Delta salinity, far greater than the salinity increases contemplated in this chapter. In contrast, the same PPIC report estimates a similar isolated facility operated in a dual conveyance system would rarely if ever exceed 1000 ec as discussed above.

Perhaps the most contentious issue isn't the level of salinity changes, but whether salinity will have significant impacts on Delta agriculture at proposed levels. In focus groups, Delta farmers have told us that they monitor salinity levels closely in their current operations, and that some already incur significant costs in chemicals and drainage systems to deal with current levels of salinity. In contrast, the Department of Water Resources and water contractors argue that there would be no loss to Delta agriculture, even if the SWRCB adopted a 1000 ec standard in the south Delta. For example, Department of Water Resources' comments to an earlier draft of this report state,

> *"The salinity objective established by the State Water Resources Control Board is determined by the most salt-sensitive crop grown in the Delta—beans. The EC value has been determined to provide full yields for these most salt-sensitive crops when best-management is practiced by farmers. If the SWP with the isolated facility is operated to meet this objective, then water quality conditions in the Delta would be adequate to allow full crops yields for all crops grown in the Delta and no loss of revenue would occur at all."*[118]

The position that there is no impact on Delta agriculture from proposed increases to Delta salinity levels is based on a report by Hoffman (2010).[119] Hoffman uses well-established yield functions for crops typically grown in the south Delta to estimate potential loss to Delta farmers from changes to salinity. The yield functions depend on the leaching fraction of the soil. Yield loss can occur at low levels of salinity when leaching fractions are low, and crops can tolerate higher salinity in irrigation water when leaching fractions are high. The Hoffman (2010) report states (p. 51),

> "The leaching fraction in the South Delta is difficult to estimate because measurements of soil salinity or salt concentration of drainage water are not measured routinely."

[118] See page 42 of comments at http://www.delta.ca.gov/res/docs/ESP%20Comments%20-%20DWR.pdf.
[119] "Salt Tolerance of Crops in the Southern Sacramento-San Joaquin Delta," Final Report, January 5, 2010, by Glenn Hoffman. Prepared for the California EPA and the State Water Resource Control Board. http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/final_study_report.pdf

In his calculations, Hoffman generally assumes leaching fractions of 0.15 or above. This is supported by deriving leaching fractions from water samples collected from tile drains in an area in the southwest corner of the south Delta, and a 1976 study of soil salinity in nine locations of the south Delta by Meyer et al.[120] Hoffman's assumed leaching fractions are strongly contested by Delta water agencies.[121] Delta water agencies point out that Hoffman is using tile drains from an area in the southwest corner of the Delta characterized by clay soils and low water tables not typically found in the Delta, and that the sample points used by Meyer are also not broadly representative of the area. They contend that high water tables and soil permeability conditions in most of the south Delta produce low leaching fractions and high sensitivity to irrigation water salinity, and provided a report by Dr. G.T. Orlob that calculated yield loss for soils with a leaching fraction of .05 and estimates this soil type characterizes roughly 40 percent of south Delta cropland.[122] The Orlob report estimates the following percent yield decrements for crops in this soil type where applied water salinity is 1000 ec: beans, -68 percent; corn, -34 percent; alfalfa, -19 percent; tomatoes, -21 percent;, fruit and nuts, -61 percent; and grapes, -29 percent. Similar to Hoffman, Orlob estimates virtually no impact on yields if leaching fractions are 0.18.

A simple comparison of south Delta soil maps and the sampling locations utilized by Hoffman confirms that they are not a representative sample of the region. Thus, Hoffman's conclusion regarding the 1000 ec standard is based on an untested hypothesis about soil conditions in the south Delta. The hypothesis could be tested by conducting the appropriate soil tests on a truly representative sample of cropland in the south Delta, but that data is not available. The empirical analysis in this report can be seen as an alternative approach to testing the hypothesis with existing crop production data. If salinity below 1000 ec has no impact on crop yields in the Delta, then an empirical study should show no relationship between salinity and crop choice controlling for the environmental conditions of the field and other factors.

Incorporating measurements of salinity throughout the Delta as an exogenous variable in the multinomial logit model allows for capturing the marginal impacts on crop choice of changes in salinity. These observations can then be used to predict how the agricultural composition of the southern Delta would change if it were subjected to various scenarios of increasing salinity. The average revenues of the different crop classes are then used to estimate total impacts on the Delta's annual agricultural revenue. The model inputs and results are described in more depth in Appendix G.

To our knowledge, the only other economic study to model the impact of salinity on Delta agriculture is the 2007 PPIC report.[123] In contrast to the econometric approach of this report, they build a Delta Agricultural Production Model using the positive mathematical programming approach.[124] The Hoffman yield functions are built into the model, and the report states regarding current salinity levels, "most of the stations have an EC less than 1 mS/cm, which in

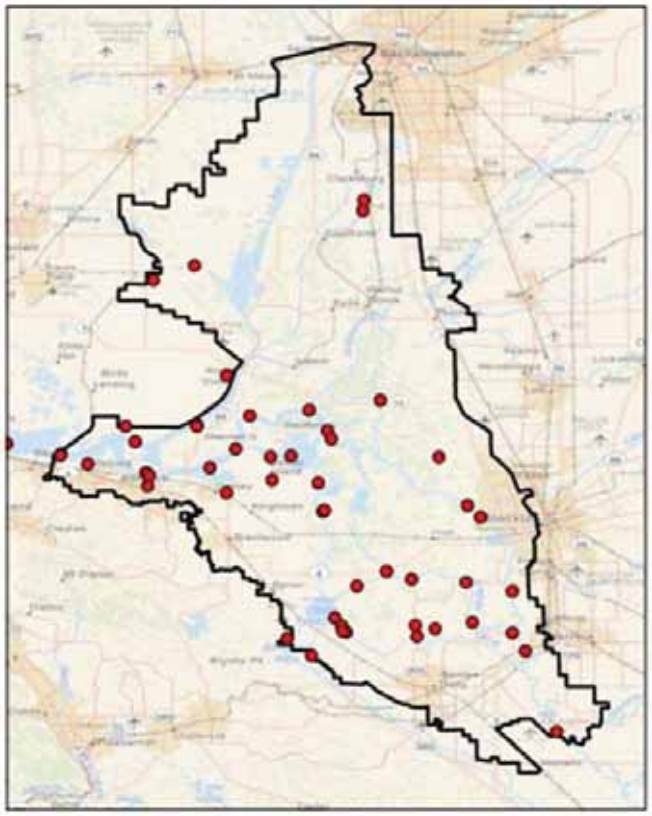
[120] Meyer, J. L., Carlton, A., Kegel, F., Ayers, R. S., "South Delta Salinity Status Report," University of California, Davis, CA, 1976, 16 p.
[121] Personal communication with John Herrick, July 5, 2011. See also a presentation to the State Water Board: http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/060611wrkshp/sdwa.pdf, and comments on the Hoffman report to the State Board, http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/cmmnts052311/john_herrick.pdf.
[122] G.T. Orlob, *Impact of San Joaquin River Quality on Crop Yields in the South Delta,* 1987.
[123] Details of the model are in Appendix D, http://www.ppic.org/content/pubs/report/R_207JLR.pdf.
[124] Howitt, R.E. 1995. Positive Mathematical Programming. *American Journal of Agricultural Economics* 77: 329-342.

practice means no effect on agricultural production." Thus, the study is assuming leaching fractions above 0.15 as in the Hoffman report. Nevertheless, the study predicts potentially large impacts of salinity from a peripheral canal and other strategies to increase salinity, ranging from 25-60 percent declines in Delta agricultural revenue, and 8-40 percent declines in irrigated acreage as water quality in some areas could decline to levels unsuitable for any crop. If the same model were applied to dual conveyance that would keep salinity at or below the 1000 ec threshold, it would predict virtually no loss in agricultural output in parallel to the argument of the Department of Water Resources, because the Hoffman threshold functions for crop yield are built in.

7.6.1.1 Salinity Data

For the purposes of baseline salinity modeling, salinity data has been collected for over 50 sites in the Delta region. An analysis of salinity impacts required the creation of a variable representing average salinity on an annual basis. Based on information gained in a working group and further consultation with Delta farmers, a decision was made to use a value for the average salinity observed between May and August, when sensitive crops are most vulnerable to salinity changes in the Delta. Salinity is represented using measures of electroconductivity (ec), in units of micro Siemens per centimeter.

Figure 24 Salinity Observation Stations[125]



The modeling also required the ability to map salinity values to each individual crop field. In order to predict these values, salinity measurements were averaged across all observation sites in a three-mile radius of each crop field. The measurement value of the nearest station was used for fields without multiple monitoring stations within that radius. This generated

[125] For high resolution image see http://forecast.pacific.edu/desp-figs.html

standardized estimations of salinity for fields throughout the Delta using a replicable technique. A map of the salinity observation stations used as inputs is depicted in Figure 24, and the sources of the station data are described below.

Interagency Ecological Program (IEP)
The IEP samples discrete water-quality data at 19 sites throughout the Delta. The sites are chosen in an attempt to represent the major inflows and outflows of the Delta, with new data sampled monthly. All reported observations undergo a detailed quality assurance process prior to being made publicly available. Sampling sites are mapped in GIS using longitudinal and latitudinal coordinates provided by the IEP.

California Data Exchange Center (CDEC)
Additional salinity data is collected from 45 Delta water monitoring stations reported through the CDEC. The sites are maintained by a variety of organizations, including the California Department of Water Resources, the U.S. Bureau of Reclamation, and the U.S. Geological Survey. The sites are sampled daily, and the monthly average is taken based on reported daily values.

Tables in Appendix G provide more detail about how average salinity varies across space and years in the Delta. It is important to emphasize that the data is presented here as a season long average, and thus masks important spikes that often occur during years when the average is considerably lower. The ten-year sample for which detailed information is provided includes six dry years with very high salinity from 2001–2002, 2004, and 2007–2009. Salinity was significantly lower in other years. During 2008, average salinity levels in most of the Delta were 60 percent to 80 percent higher than in 2006. In the north Delta, average salinity is less than 200 ec in most years and there is relatively less variation between years. In contrast, the south Delta averaged 646 ec in 2008 and 408 ec in 2006, with some areas averaging 800 ec or more in 2008 and 2009. Thus, the south Delta experiences significantly higher levels of salinity and more variation than the north Delta. This reflects many factors, including the significant differences in water quality between the Sacramento and San Joaquin Rivers.

7.6.1.2 Salinity Modeling

As discussed earlier and shown in the model results in Appendix G, the multinomial logit model found salinity to have a statistically significant impact on crop choice in the Delta. Since virtually all of the fields in the sample have irrigation water supplies below the 1000 ec, the finding does not support the assumption that there are no agricultural impacts below 1000 ec as argued by the Department of Water Resources and others.

For preliminary calculations of impacts, scenarios were established for percentage increases in salinity for the southern Delta regions, comprising fields within BDCP conservation zones 6 through 9. In reality, salinity would not increase uniformly across the region, and future simulations of the model with more spatially precise estimates of salinity changes could generate more accurate and detailed results. However, the current predictions in Table 18 below are a good initial estimate of the magnitude of agricultural revenue impacts that could be generated by crop shifting from salinity changes.

Table 18 Forecasted Crop Revenue Impacts from Increasing Delta Salinity

		Forecast Acreage					Total Revenue				
Crop Category	Crop Category Avg. Revenue per Acre	Baseline	25% Salinity Increase	50% Salinity Increase	100% Salinity Increase	200% Salinity Increase	Baseline	25% Salinity Increase	50% Salinity Increase	100% Salinity Increase	200% Salinity Increase
	[a]	[b]	[c]	[d]	[e]	[f]	[g]	[h]	[i]	[j]	[k]
Deciduous	$4,612	6,954	5,971	5,051	3,486	1,499	$32,071,848	$27,538,252	$23,295,212	$16,077,432	$6,913,388
Field	$780	80,752	83,621	85,246	85,011	74,848	$62,986,560	$65,224,380	$66,491,880	$66,308,580	$58,381,440
Grain	$426	15,925	19,197	22,734	30,335	45,892	$6,784,050	$8,177,922	$9,684,684	$12,922,710	$19,549,992
Pasture	$116	2,963	3,757	4,667	6,810	12,056	$343,708	$435,812	$541,372	$789,960	$1,398,496
Truck	$3,903	29,804	24,460	19,843	12,741	5,029	$116,325,012	$95,467,380	$77,447,229	$49,728,123	$19,628,187
Vineyard	$3,566	3,519	2,911	2,376	1,534	594	$12,548,754	$10,380,626	$8,472,816	$5,470,244	$2,118,204
				Total Revenue			**$231,059,932**	**$207,224,372**	**$185,933,193**	**$151,297,049**	**$107,989,707**
				Scenario Revenue Losses				**-$23,835,560**	**-$45,126,739**	**-$79,762,883**	**-$123,070,225**

Notes:

Modeled regions include 2010 field borders acreage located w ithin specified BDCP conservation zones.

[a] is the average crop class revenue per acre based on 2009 yield and price data from county crop reports.

[a] is the forecasted acreage of each crop class under the specified baseline salinity conditions.

[c]- [f] are the forecasted acreage of each crop class assuming a 25-200% increase in salinity levels

[g] = [a] * [b]

[h] = [a] * [c]

[i] = [a] * [d]

[j] = [a] * [e]

[k] = [a] * [f]

The model predicts a large shift from high-value truck and vineyard crops to lower-value grain and pasture crops should salinity levels rise in the south Delta. This shift would have significant revenue impacts on Delta agriculture. The forecasted shifts in crop distribution are intuitive, as they reflect the salt sensitivity of the dominant Delta crops in each crop category. Processing tomatoes, the dominant truck crop in the Delta, are salt-sensitive, as are wine grapes. Both are expected to decline, while salt-tolerant grain and low-value pasture crops are expected to increase in acreage. Deciduous crops are largely salt-sensitive and are also expected to face decreasing acreage in the south Delta under forecasted salinity increases.

As shown in Table 18, a 25 to 50 percent increase in south Delta salinity could cause a $24 million to $45 million reduction in crop revenue, and the roughly 40 percent proposed increase in south Delta salinity standards falls in this range. The model projects an $80 million revenue loss from a doubling of south Delta salinity, and the potential for larger losses if salinity were to increase further is illustrated by a $123 million loss.

It is important to note that the estimated revenue losses in Table 18 are solely due to crop shifts, and the model does not estimate any potential impacts from yield declines as salinity increases. Further, it does not move any land out of agricultural production as salinity increases, it merely assigns it to lower value categories, and does not account for accumulation of salinity over time. Thus, the losses could be even higher if accounting for these effects, especially for the higher levels of salinity increase. On the other hand, the losses in Table 18 probably include a few upland areas in the Delta that would be little impacted by increased salinity in Delta channels, and these could be areas with higher concentrations of high-value deciduous crops. As discussed earlier, as more spatially disaggregated data on potential salinity changes become available, the estimated effects could be adjusted to take advantage of that data.

7.6.1.3 Agricultural Revenue Impacts of Isolated Conveyance

As discussed above, the potential revenue impacts of introducing an isolated conveyance facility operated as dual conveyance in combination with continued through-Delta conveyance is closely linked to south Delta salinity standards. If south Delta salinity standards remain at their current levels, the water quality impacts of dual conveyance could be as low as $20 million per year. If an isolated conveyance is introduced and salinity standards are relaxed, the model predicts up to $80 million in lost agricultural revenue per year. There still is significant uncertainty regarding the exact impacts of isolated conveyance, but $20 million to $80 million in annual revenue impacts is a reasonable range based on this modeling. The $20 million to $80 million annual decline is significantly different than the estimates of no loss based on the threshold yield functions and untested assumptions regarding soil leaching fractions.

In addition to water quality impacts, the footprint of an isolated conveyance facility will also take a significant amount of land out of agricultural production, especially in the north Delta. The November 2010 draft BDCP estimates that roughly 8,000 acres will still be required for a tunnel conveyance system, even though the land requirements are much lower than a surface canal. Most of the affected acres are in relatively high-value agricultural lands in the north Delta that currently average about $2,000 per acre per year in revenue. Using detailed acreages allocated across crop classes in the draft BDCP, the land consumption of the isolated conveyance project would result in an additional $10 to $15 million annual loss to Delta agricultural revenues. A surface canal would impact roughly four times the amount of agricultural land.

7.6.2 Agricultural Revenue Impacts from Habitat Conservation Scenarios

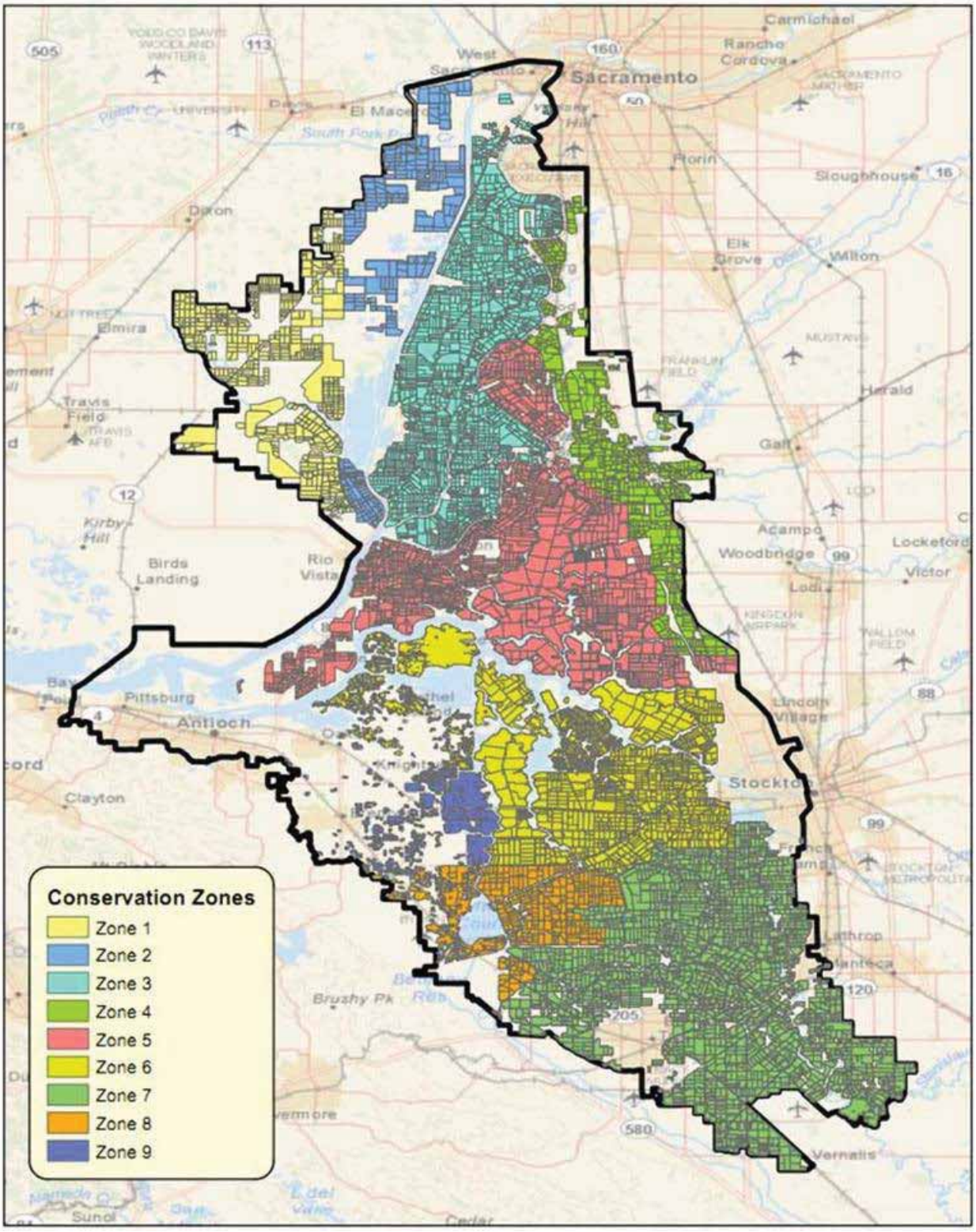
As outlined in Chapter 6, this report seeks to address impacts of four major conservation measures proposed by the BDCP. An extremely precise examination of agriculture impacts is not currently possible due to the lack of specificity provided in the BDCP as to where lands would potentially be conserved or restored. The best spatial approximation of targeted areas is provided by the BDCP's delineation of Conservation Zones and Restoration Opportunity Areas (ROAs) for which conservation investments are proposed. Replicating the spatial extent of these zones and analyzing the agricultural landscape of each gives an estimate of the impacts on agriculture that each conservation measure would entail.

Table 19 below illustrates the total agricultural acreage and average revenue generated by crops fields in each of the BDCP's conservation zones. In addition, a list of the conservation measures with significant impacts in each conservation zone is provided. A map of Delta crop fields and their associated conservation zone is included in Figure 25.

Table 19 Agricultural Composition of BDCP Conservation Zones

Conservation Zone	Agricultural Acreage (2010)	Revenue per Acre (2009)	Relevant Conservation Measures
1	31,030	$463	CM3, CM4
2	14,064	$802	CM2, CM3, CM4
3	59,011	$1,474	CM6
4	26,441	$2,075	CM3, CM4, CM6
5	75,239	$1,838	CM3, CM4, CM6
6	71,219	$1,885	
7	89,716	$1,823	CM3, CM4, CM6
8	27,595	NA	
9	15,809	NA	

Figure 25 BDCP Conservation Zones[126]



[126] For high resolution image see http://forecast.pacific.edu/desp-figs.html

7.6.2.1 Yolo Bypass Fisheries Enhancement

Major impacts on agriculture from Yolo Bypass Fisheries Enhancement will come from the potential acquisition of lands through fee-title or conservation and flood easements. The largest source of revenue in the affected conservation zone comes from rice fields located along the northern region of the Yolo Bypass, and the use of rangeland could also be impacted. Table 20 estimates current Yolo Bypass crop production excluding grazing land, which might add another $500,000 to the total of $27.1 million. Total agricultural revenue in the Legal Delta area is currently estimated at about $11 million. However, the majority of high-value rice fields is located in the area of the Yolo Bypass north of the Legal Delta, and is estimated to generate almost $16 million in annual revenue and could experience the most significant direct impacts. Given that it is impossible to enhance the Yolo Bypass fishery flows in the legal Delta without simultaneously affecting the area outside the legal Delta, we consider impacts beyond the legal Delta for this conservation measure.

The November 2010 draft BDCP estimates that new flowage easements would be required for 21,500 acres on the eastern bypass or as much as 48,000 acres assuming western tributary flows also flooded the central and western portions of the bypass. Current documents from the BDCP working group are focused on the Fremont Weir Gated Channel operations with an impact on 17,000 acres, and most important, would inundate 7,000 to 10,000 acres in most years after March 1, which gets into the time period where flooding interferes with agricultural planting.[127]

Yolo County is working with UC-Davis on an analysis of the agricultural impacts of more frequent flooding of the Yolo Bypass for fish habitat. The study has more detailed crop, yield and price data than is currently available.[128]

The November 2010 draft BDCP estimates new flowage easements would average 25 percent of property value on 21,500 acres in the bypass, using the current agricultural revenue that implies a roughly $7 million annual decline in crop revenue. If, as in the September 2011 discussion document, roughly 10,000 acres were flooded to preclude production in about 60 percent of years, average lost agricultural revenue could be as high as $10 million. Thus, our rough estimate of potential lost agricultural revenue from Yolo Bypass Fishery enhancements is $7 million to $10 million.

Yolo County is working with the BDCP Yolo Bypass Fishery Enhancement Working Group to develop a proposed project that minimizes or avoids impacts to existing land uses, and provides full mitigation for tax revenue and economic impacts. Like other preliminary cost estimates for habitat measures, the estimated impacts could change as plans change over time.

[127] Potential Operation Pattern for Fremont Weir Gated Channel, or “Notch,” September 23, 2011 Draft for Discussion Purposes. Available at www.baydeltaconservationplan.com.

[128] Garnache, C. and R.E. Howitt. 2011 “Analyzing the Tradeoffs Between Agriculture and Native Species: The Case of the Yolo Bypass Floodplain.” Selected Paper prepared for presentation at the AERE 2011 Summer Conference, Seatlle, June 9-10, 2011.

Table 20 Yolo Bypass Crop Acreage and Revenue, 2009[129]

	Inside Legal Delta		*Outside Legal Delta*	
Crop Category	**Acres**	**Value**	**Acres**	**Value**
Deciduous	73	$314,000	0	$0
Field	5,026	$3,961,837	7,760	$11,087,862
Grain	1,179	$394,461	370	$145,050
Pasture	4,415	$241,030	0	$0
Truck	1,875	$6,321,309	1,500	$4,634,129
Vineyard	0	$0	0	$0
Total	**12,568**	**$11,232,637**	**9,630**	**$15,867,041**
YOLO BYPASS TOTAL			**22,198**	**$27,099,678**

7.6.2.2 Natural Communities Protection

The Natural Communities Protection strategy has several elements. The most significant for agricultural production in the Delta would be the conversion of 8,000 acres of grazing land to native grasslands, and the creation of nearly 33,000 acres of agricultural habitat through fee-title purchases or easement acquisition. Since grazing lands crop value is roughly $20 per acre, the loss of 8,000 acres would amount to only $160,000 per year. However, that measure probably understates the total impact on cattle production in the region, as this would represent a roughly 30 percent loss in the current grazing land that supports cattle production estimated at $24 million per year. The increase in irrigated pasture that could be created through the 32,000 acres of "agricultural habitat" protection could offset this loss and thereby minimize any impact on the cattle industry.

The most significant part of this conservation strategy is the acquisition of nearly 33,000 acres in "wildlife friendly" agricultural easements. The draft BDCP does not give specific information about implementation, but offers some general guidelines that can be used to anticipate impacts. Pages 2-130-132 of the November 2010 draft BDCP identify alfalfa, irrigated pasture, and rice as crops that provide high habitat values, and orchards and vineyards as crops that provide little habitat value. Other cultivated annual crops such as corn, tomatoes, grains, and other truck crops are described as providing seasonal habitat value with high variation among crop types. The high habitat value crops generate average revenue of $100 to $1,400 per acre, whereas the low habitat value crop types generate average revenues of $3,500 to $4,500 per acre. The draft BDCP estimates the costs of land and easement acquisition of cultivated habitat at $8,000 per acre ($260 million for 32,600 acres) which suggests that at least some permanent crops will be targeted for acquisition given current land prices.

Roughly 13,000 acres of the "agricultural habitat" is targeted for Conservation Zones 1 and 2 which include most of the Cache Slough area in Solano County and the Yolo Bypass. These areas average less than $1,000 per acre in crop value and are already mostly planted in the preferred crop types for habitat. Thus, the creation of "agricultural habitat" in this area would presumably lock in current cropping patterns, and have little impact on agricultural revenue compared to current levels.

[129] Yolo bypass crop production varies widely from year to year and as explained earlier, our field level data does not include fields that did not have pesticide use filing (e.g. organic). Detailed studies in progress by UC-Davis will likely have more detailed and complete data.

Approximately 10,000 acres of agricultural habitat is targeted for Conservation Zone 4, in the northeast Delta, and Conservation Zone 7, the south Delta. These areas have average revenues of approximately $2,000 per acre, among the highest value croplands in the Delta. Vineyards are a significant part of CZ4, and there is much potential growth for this region. Presumably, the objective of this conservation measure would be to stop or reduce vineyards in this region in favor of pasture, alfalfa, or corn as grown by the Nature Conservancy on Staten Island. In the south Delta, there are some vineyards as well as significant numbers of truck crops that might be viewed as less wildlife friendly. The anticipated easement costs suggests a displacement of $300 to $400 per year in net profit, which might translate to roughly $1000 per year in net production.

Overall, the natural communities and agricultural habitat protection is among the most difficult to value the agricultural revenue impacts. Considering the discussion above, an agricultural revenue loss of $5 million to $25 million per year is a reasonable estimate at full implementation. The use of more limited term easements or a conservation reserve program model instead of fee-simple and permanent easement purchases might be considered. This would reduce the impact on the agricultural economy by allowing Delta agriculture more flexibility to respond to future market changes.

7.6.2.3 San Joaquin River Floodplain Restoration

The November 2010 draft BDCP calls for the restoration of 10,000 acres of seasonally-inundated floodplain habitat over a 40-year period, with 1,000 acres restored in the first 15 years. No specific regions are outlined, though the BDCP notes that “the most promising opportunities for large-scale restoration are in the south Delta along the San Joaquin River, Old River, and Middle River channels…” These areas fall almost entirely within conservation zone 7, which is largely occupied by high-value alfalfa and tomato crops and has an average per-acre revenue of $1,823. In addition, the identified areas are almost entirely in agricultural production, and a large proportion of the restored floodplain would almost certainly affect land currently in production. Based on current production, the San Joaquin River Floodplain Restoration could reduce annual agricultural revenue by $15 million to $20 million per year.

An alternative proposal focused on enhancing the flood bypass at Paradise Cut has been developed cooperatively between environmental groups and local Delta landowners. This proposal would generate significant flood control and ecosystem benefits while limiting agricultural impacts to 2,000 acres, thereby reducing agricultural impacts by up to 80 percent. The alternative proposal is recommended in the fourth draft of the Delta Stewardship Council’s Delta Plan. The details of these plans are very uncertain at this time, and BDCP planning does not seem to be as well developed as it is for Yolo Bypass Fishery Enhancements at this point. Given the uncertainty, the estimate of potential lost agricultural revenue ranges between $3 million and $20 million per year depending on what plans are implemented.

7.6.2.4 Tidal Habitat Restoration

Of the major conservation measures addressed in this report, tidal habitat restoration has the most clearly defined geographic areas and restoration targets. Tidal habitat also has by far the largest potential economic impact on agriculture due to the high acreage targets and the fact that it eliminates all agricultural uses rather than limits agricultural activity with measures such as conservation easements. The agricultural fields contained in each Restoration Opportunity Area (ROA) are shown in Figure 26, with their acreage and value in each region depicted in Table 21 below. The BDCP outlines various restoration targets to be achieved over the next 40 years, with a final target of 65,000 restored acres in the Delta and Suisun Marsh. In addition,

there are minimum values for acreage in each of the four ROAs which must be restored, as shown in Table 21. A minimum of 7,000 acres is targeted for Suisun Marsh, which lowers the maximum target for tidal habitat in the Delta to 58,000 acres.

Table 21 Agricultural Composition of BDCP Restoration Opportunity Area

Restoration Opportunity Area (ROA)	Total Acreage	Agricultural Acreage (2010)*	Minimum Restoration Target (Acres)	Revenue per Acre (2009)
Cache Slough Complex	49,167	19,854	5,000	$491
Cosumnes/Mokelumne River	7,805	7,840	1,500	$2,175
South Delta	39,969	34,914	5,000	$2,151
West Delta	6,178	2,587	2,100	$1,279
TOTAL	**103,119**	**65,195**	**13,600**	**$2,014**

*Values may be slightly inflated due to large fields centered within the ROA which extend past its borders.

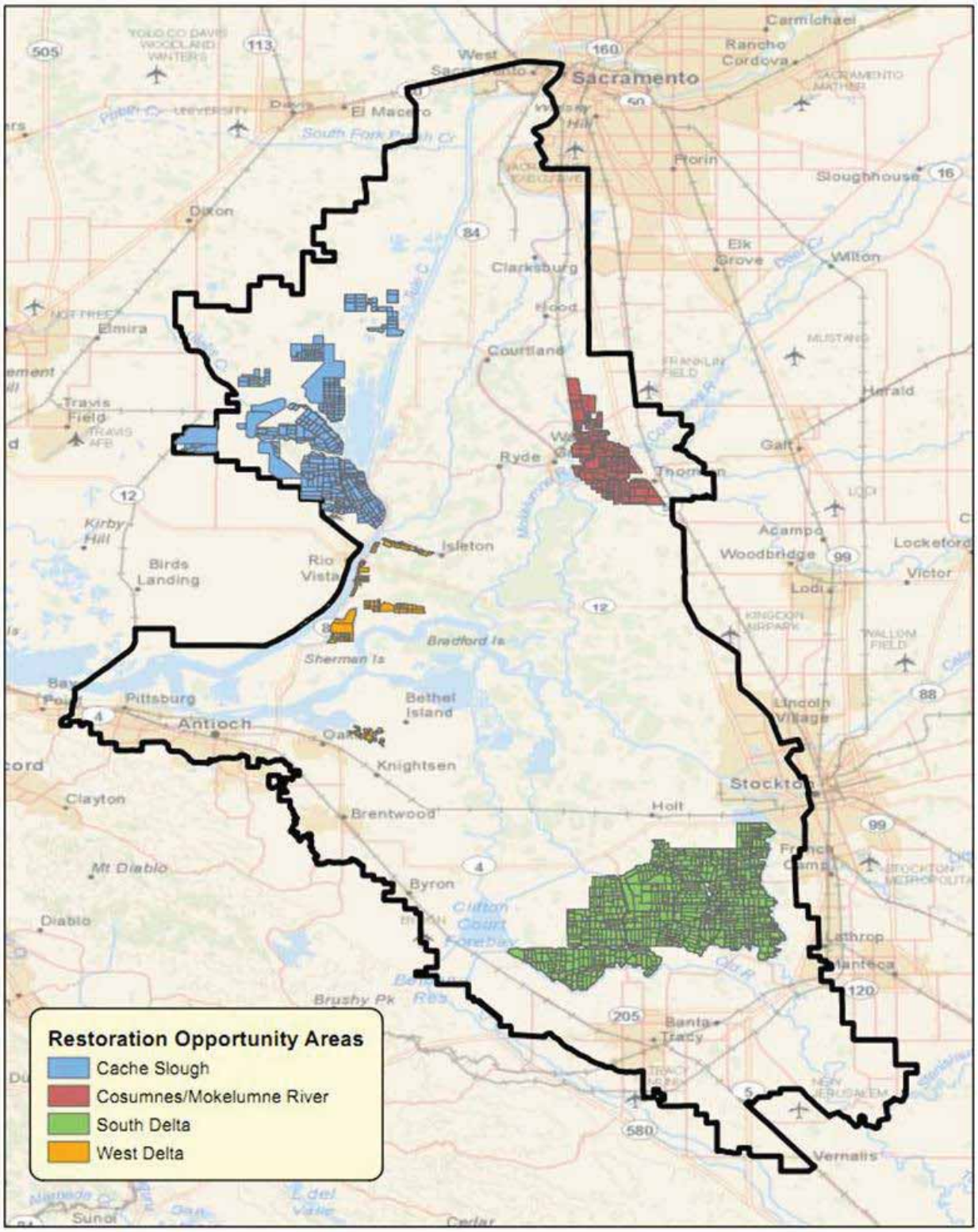
As can be seen in Table 21, in some regions even the minimum restoration targets will require the acquisition of land currently used in crop production. In addition, both the Cosumnes/Mokelumne River ROA and the South Delta ROA are centered in some of the highest revenue agricultural areas of the Delta. Even if over 50,000 acres were restored in Suisun Marsh so that only the minimum restoration targets were reached in the four Delta ROAs, total agricultural revenue loss would be about $18 million per year with nearly $11 million of the total loss occurring in the south Delta. If only the minimum were restored in Suisun Marsh and the remaining 58,000 acres were proportionally distributed across the Delta, the estimated revenue loss would reach $77 million per year with about a $46 million loss in the South Delta.

Tidal marsh restoration in Cache Slough has been discussed for decades because restoration in the area would have little impact on the current through-Delta conveyance of fresh water, and it has desirable environmental and elevation characteristics. Table 21 indicates that its lower revenue per acre might make it a target area for economic reasons, although representatives from Solano County have said that the low revenues per acre can be partially attributed to the regulatory and planning “cloud” that has been over the area for years and discouraged investment in higher-value crops. A March 2008 report by Kurt Richter of the University California Agricultural Issues Center[130] provides a detailed tract by tract analysis of the potential impacts of tidal habitat restoration proposals in Cache Slough and Suisun Marsh that go beyond the direct loss of agricultural production.

The report finds that the least costly way to attain the ecological restoration goals for Cache Slough area would be to convert Hastings Island, Egbert Tract and Little Egbert Tract to tidal habitat. These three areas “would provide over 17,000 acres of habitat and remove $9.6 million from the agricultural economy in Solano County (2006 dollars).” The report also notes that restoration of these three areas “will require that the levees around Ryer Island, North Ryer Island and Hass Slough be moved or redesigned since the new system will increase the threat of underseepage,” and notes other concerns related to waterfowl habitat and water quality.

[130] Richter, K.R., “The Potential Impact of the Delta and Suisun Marsh Habitat Restoration Plans on Agricultural Production in Solano County,” University of California Agricultural Issues Center, March 14, 2008.

Figure 26 BDCP Restoration Opportunity Areas[131]



[131] For high resolution image see http://forecast.pacific.edu/desp-figs.html

The wide range of potential agriculture losses ranging from $18 million to $77 million annually illustrate the risk and uncertainty this conservation strategy poses for Delta agriculture. Compared to the other conservation measures, the tidal marsh restoration strategy entails the largest necessary direct impacts on Delta agricultural production, and also has some of the highest direct implementation costs for BDCP. The BDCP currently states that the majority of these targeted lands will be determined "based on land availability, biological value, and practicability considerations." The absence of agricultural impacts from the described methodology is a notable omission considering the potential implications for the Delta economy. Targeting criteria that avoids high-value agriculture lands and reduced target acreages, particularly in the south Delta, should be considered.

7.6.2.5 Summary and Additional Concerns Regarding Habitat and Agriculture

Considered together, the four habitat conservation measures here could reduce agricultural output in the Delta between $33 million and $137 million per year. The wide range shows the importance of considering agricultural impacts when designing conservation measures. The $33 million revenue loss scenario shows that it is possible for significant habitat restoration to be compatible with economic sustainability of Delta agriculture if it is carefully planned to minimize impacts. However, the potential for $137 million in direct losses to agricultural output shows that habitat restoration could also have severe negative impacts on the Delta economy.

There are additional risks to Delta agriculture from habitat restoration measures in addition to the direct losses to agricultural production described in this section. The following list of additional concerns is taken from a letter from Deputy Natural Resources Secretary Jerry Meral inviting participants to a September 13, 2011 meeting on the potential impacts of the BDCP habitat projects on agriculture.

- Increased risk of levee failure due to changes in levee configurations with tidal habitat restoration actions
- Water quality and salinity issues for agricultural irrigation as a potential result of water facilities operations and tidal habitat restoration
- Water elevation changes at agricultural intakes as a result of water facilities operations
- Effects on agricultural land from adjacent restored tidal habitat, such as seepage
- Neighbor effects of increased endangered wildlife species on BDCP preserves next to agricultural lands
- Increased presence of listed fish species at agricultural diversions and potential regulatory effects where aquatic habitat restoration increases listed fish densities
- Weed control on habitat lands
- Mosquito and vector control issues

In addition to these impacts, participants in the meeting raised concerns about the potential for decreased property values even if land is not being restored, and increased crop loss from feeding and predation of wildlife such as birds attracted to nearby restored habitats.

7.6.3 Loss of Agricultural Value from Open Water Scenario

The central Delta open water scenario discussed in Chapter 6 would result in a loss of agricultural production on the flooded islands. The impacts can be quantified simply by looking at the agricultural farmland currently in production on each island. If the six islands were flooded, almost 13,000 acres would be lost, with a corresponding loss of around $11 million dollars in direct revenues per year. The islands are largely composed of low-value field crops, with average revenue per acre significantly below that of the Delta as a whole. A summary of the affected islands is depicted below in Table 22. As discussed in Chapters 4 and 6, it is highly unlikely that Empire Tract would be flooded due to new water supply infrastructure for the City of Stockton.

Table 22 Six Island Agricultural Composition

Island	Agricultural Acreage (2010)	Total Revenue (2009)	Revenue per Acre (2009)
Mandeville	2,345	$2,198,583	$1,117
Medford	365	$279,797	$715
Quimby	629	$487,720	$776
Venice	2,587	$2,008,844	$765
Webb	4,469	$3,467,869	$776
Empire	2,521	$2,539,318	$1,031
TOTAL	**12,916**	**$10,982,131**	**$981**

7.6.4 Impact of Land Use Regulatory Changes on Delta Agriculture

The “covered actions” provisions of 5th Draft of the Delta Plan have raised concerns about increased regulatory costs or constraints on Delta agriculture. For example, on page 54, the Delta Plan attempts to clarify what are “covered actions” regulated by the Delta Plan by saying, “Routine agricultural practices are unlikely to be considered a covered action unless they have a significant impact on the achievement of the coequal goals or flood risk.” The statement has created concerns that increased regulation could affect investment to supporting farm structures such as packing sheds or regulating the planting of permanent or crops that are deemed to be less wildlife friendly. There are also concerns about potential impacts on property values.

Chapter 8: Recreation and Tourism

8.1 Overview and Key Findings

- Recreation is an integral part of the Delta, complementing its multiple resources and contributing to the economic vitality of the region. Residents of nearby areas visit virtually every day, generating a total of roughly 12 million visitor days of use annually and a direct economic impact of more than a quarter of a billion dollars in spending.
- The Sacramento-San Joaquin Delta is an area where a diversity of recreation experiences is evident, from boating in open water or through winding tree-covered channels, to hunting or wildlife viewing, studying local California history, or tasting award-winning local wines.
- Several physical and operational constraints have an impact on current facilities and recreation access, including sediment accumulation, water gates, screens, and barriers, invasive species, waterway obstructions, water quality, lack of boat-in destinations and access points, user group conflicts, private land trespass, and complex regulations.
- While a percentage of visitors to the Delta come from elsewhere, the majority of visitors are from Northern California. These visitors represent the focal market for Delta recreation growth opportunities in the future, and their places of origin define the Market Area for this study. The total Market Area had a population estimate of approximately 11.9 million in 2010, with projections of 17.6 million by 2050.
- Recreation visitation for 2010 is estimated to be approximately 8 million *resource-related* (e.g., boating and fishing) visitor days of use per year, 2 million *urban parks-related* (e.g., golf, picnic, and turf sports), and 2 million *right-of-way-related* (e.g., bicycling and driving for pleasure) recreation visitors/year. The total number of activity days is conservatively estimated at approximately 12 million/year.[132]
- An up-to-date visitor survey with new primary data, particularly on non-boating and non-fishing recreation, is needed to better document existing recreation visitation and spending.
- Employment within the Primary Zone in recreation-related economic sectors—including marinas, water craft rental, boat dealers, and boat building and repair—has been relatively flat over the past 20 years.
- The principle changes and trends that could affect the present recreation use and demand over the next 50–90 years are: physical changes to the Delta due to water conveyance management changes and rising sea levels, increasing population and development growth, increasing agritourism, non-consumptive resources-based recreation, habitat-related recreation, and the likely desire for closer-to-home recreation.
- The current direct spending in the Delta region from *resource-related* and *right-of-way/tourism-related* trips and related non-trip spending is estimated at roughly $312 million inside the Delta (in 2011 dollars). Additional economic impacts associated with urban recreation are not quantified, but are likely significant.
- Delta recreation and tourism supports over 3,000 jobs in the five Delta counties. These jobs provide about $100 million in labor income and a total of $175 million in value added to the regional economy.
- Delta recreation and tourism supports over 5,300 jobs across all of California, and contributes about $353 million in value added.

[132] Estimates are based on limited data combined with professional judgment.

- State Parks' *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* offers a strong framework for needs and opportunities for the provision of recreation and tourism in the Delta by state agencies.
- When attracting visitors and expanding recreation access to waterways and landside recreation improvements, potential negative impacts on agriculture from increased tourism and recreation can be minimized by focusing recreation uses and activities through expansion of existing recreation sites, development in Legacy Communities, creating buffer areas adjacent to agriculture, and increasing public safety enforcement.
- Growth of recreation in the Delta can be fostered through five location-based strategies, which would emphasize increased public access and related private development:
  - Delta waterways, specialized by boating type;
  - Dispersed, small points of interest and activity areas such as marinas, farmer's markets, wineries, restaurants;
  - Focal point complexes such as Legacy Communities or Bethel Island/Jersey Island/Big Break;
  - Natural habitat areas; and
  - The edges of existing and emerging urban areas that surround the Delta such as Stockton, Tracy, Rio Vista, and Lathrop.
- If resource quality and recreational facilities are maintained such that the Delta retains its current level of competitiveness as a recreation destination, baseline forecasts for visitation show increases of 3.4 million visitor days, or about 35 percent, over 40 years. If this Plan is implemented, recreation visitation in the Delta (including resource-related recreation, right-of-way recreation, and tourism) would increase over baseline.
- Assuming that current visitor spending patterns remain unchanged and Delta business growth accommodates recreation-related spending increases, baseline visitation growth is estimated to increase spending in the Delta roughly $78 million (2011$) to about $329 million (2011$) by 2050. Plan implementation could increase the economic impact of recreation over the baseline.
- Possible policy scenarios are qualitatively evaluated as to their primary elements and their potential positive and negative impacts on recreation.
  - Scenarios evaluated may affect recreation visitation by either decreasing visitation or increasing visitation over the baseline scenario, with the expected largest potential for negative impacts from increased regulatory changes or the six-island flooding and the largest potential for positive impacts from the habitat conservation scenario.
  - Visitation changes would also affect recreation-related spending in the Delta, as compared with the baseline forecast. It is anticipated that the magnitude of these potential changes is smaller in magnitude than the potential economic impacts to the agricultural economy.
  - The largest anticipated potential negative impacts would result from regulation changes, six-island flooding, salinity increases in the central and south Delta, large tidal marsh creation in the south Delta, and intake and pumping stations near Clarksburg and Courtland.
  - Positive impacts could result overall through project enhancements to fishing, wildlife viewing and nature study, and Delta-as-a-Place.
- A significant operational constraint for future growth in recreation demand is that there currently exists no Delta brand, overall marketing strategy, or significant-scale focal point area. An existing organization should be designated as a Delta recreation and tourism marketing and economic development facilitator.

- Recommended Implementation Strategies include consistency planning and regulation refinement, public/private coordination and partnerships, multi-agency coordination, strategic levee protection, Delta-wide marketing, and financing.

8.2 Introduction

The Delta is a significant natural place in California—a mixture of meandering rivers, sloughs, back bays, shipping channels, small communities, historic sites, and agricultural islands with farm markets and wineries. It is a vast area, covering over half a million acres, with about 60 larger tracts and islands and over 650 linear miles of waterways and channels.

The Delta links California's Central Valley with the San Francisco Bay. It is surrounded by cities (some of which have historic roots) and urbanizing areas at the edge of the Delta, and its two primary rivers, the Sacramento and the San Joaquin.

Approximately 12 million people live within close proximity of the Delta, yet most do not see it as a vital water source for the state, as a rich biological resource, or as an important agricultural production area, although it is all of these. For most, the Delta is best known for the recreation opportunities found there.

The Delta gives visitors a place to slow down and relax, to taste earth's bounty, and to leave the urban areas behind. It is called California's boating paradise, and is one of the state's most important fishing and waterfowl hunting resources, a place with natural habitats for bird watching and nature study, and a scenic place to meander and explore by boat or car.

Recreation is an integral part of the Delta, complementing its multiple resources and contributing to the economic vitality and livability of the region. Residents of nearby areas visit virtually every day, generating a total of roughly 12 million visitor days of use annually and a direct economic impact of more than a quarter of a billion dollars in spending.

8.3 Current Status and Trends

8.3.1 Understanding 'Delta as a Place' Today

The Delta is difficult to characterize as both a region and, likewise, a recreation destination. Unlike well-known water recreation destinations such as Lake Tahoe or Shasta Lake, the Delta is not a single entity and cannot easily be conceived in its entirety. It has highly varied physical attributes and covers a vast and varied landscape that can be viewed and accessed from activity points that are so disparate, it is possible to repeatedly visit the Delta and still have little understanding of exactly what the Delta is or how large it is.

Extending more than 50 miles from north to south, the Delta is sometimes centered on a wide river, though more often it is a network of narrow channels, sloughs, and islands. It presents itself from two distinct vantage points, each of which represents a completely different character. One view is from the water, where the landscape typically lies, unseen, behind tall levees and riparian vegetation, with only distant mountains visible. From the perspective of thicket-edged sloughs, narrow rock-faced channels, or spreading, open waterways, there is little landside context. The other view of the Delta, the landside perspective, largely precludes the water environment, which can be glimpsed primarily from levee-top roads and bridges. The predominant visual character landside is the agricultural landscape, which is as varied as the waterscape hidden on the other side of the levees.

This setting creates a place of paradox; it is a region that can be unapproachable and unapparent to visitors. For those who do not already know and visit the Delta, it can be a place that exists in name alone. Many people drive through the Delta without a clear sense of being in it and less notion of where it begins and where it ends.

Defining the Delta for visitors and recreation users is a necessary and yet difficult task. Because of the scope of the disparate environment, recreation destinations appear as a network of smaller recreation locations, each one suited to a different type of activity. To windsurfers, the open and windy waters of the larger channels flowing along the western side of Sherman Island might define the Delta. Sailors coming up from San Francisco Bay would define the Delta as offering protected deeper channels and coves. Water skiers and wake boarders might define the Delta by its protected narrower and straighter channels to the south, near Discovery Bay. Fishermen will be attracted to other aspects of the Delta, with differing characteristics, as varied as the fish they are seeking. So, too, kayakers, canoeists, pleasure cruisers, house-boaters, birders, hunters, and others, each seeking an aspect of the Delta specific to their interests and pursuits, will define the Delta in their own specific terms.

Recreationists from the landside may see a completely different Delta. Shoreline fishermen share the environment seen by those on the water and from the few recreation sites on land such as campgrounds and picnic areas. Hunters working fields and the edges of sloughs might never see open waterways as they seek game. For the vast majority of visitors to the Delta who never reach the water's edge, the landscape will be essentially one of agricultural fields, levee roads with river views, wineries and produce outlets, and sometimes, a Legacy Community's historical or cultural landmarks.

8.3.2 Existing Physical Conditions

8.3.2.1 Resource and Facility Analysis

Existing Facilities

In the Delta, people seeking recreation experiences primarily go to private enterprises, including marinas, restaurants, retail establishments, wineries, and farm stands. Public recreation facilities exist, but they are limited and many are natural resources-based, restricted-use areas such as the Department of Fish and Game's Wildlife Areas and Stone Lakes National Wildlife Refuge. Private nonprofit organizations such as The Nature Conservancy, Yolo Basin Foundation, and Solano Land Trust also provide recreation opportunities, which generally are related to habitat areas.

Private Facilities

Marinas are a common Delta access point for water recreation. Of the 95 marinas surveyed in 2001 as part of *The 2002 Sacramento-San Joaquin Delta Boating Needs Assessment,*[133] 92 were private and three were public facilities. Of the 92 private facilities, 87 were open to the public and five were private membership-based yacht clubs. These 92 private marinas provided a number of facilities to the Delta boater, including boat slips, launch ramps, parking, restrooms, restaurants, picnic facilities, camping sites, pumpouts, used oil collection centers, recycling centers, and fuel stations. Current data regarding business establishments in the Delta indicate that the number of marinas has not changed significantly since the early 2000s. Figure 27 provides a map of recreation zones and Figure 28 shows recreation facilities. Table 23 summarizes all facilities, as of 2002, by recreation zone with additional information about these zones.

[133] DBW 2002

Table 23 Summary of Facilities and Resources by Recreation Zone

	Recreation Zones						
	Northern Delta Gateway (North)	Bypass (Northwest)	Delta Hub (Central)	Delta Breezeway (West)	San Joaquin Delta Corridor (East)	Southern Delta Reaches (South)	Total
Linear Miles of Contiguous Waterways	61	58	132	152	122	110	635
Number of Marinas	8	1	12	56	13	5	95
Boat Slips	988	76	1,271	5,990	2,786	563	11,674
Transient Tie-Ups	20	18	69	115	69	18	309
Launch Ramps	3	1	9	27	11	4	55
Marina Parking Spaces	522	38	918	4,826	1,989	432	8,725
Day-Use Picnic Sites	40	0	52	183	26	23	324
Camp/RV Sites	54	0	247	1,501	327	53	2,182
Fuel Stations[134]	3	0	7	28	12	6	56
Source: DBW 2002, Table 2-1, Page 2-5							

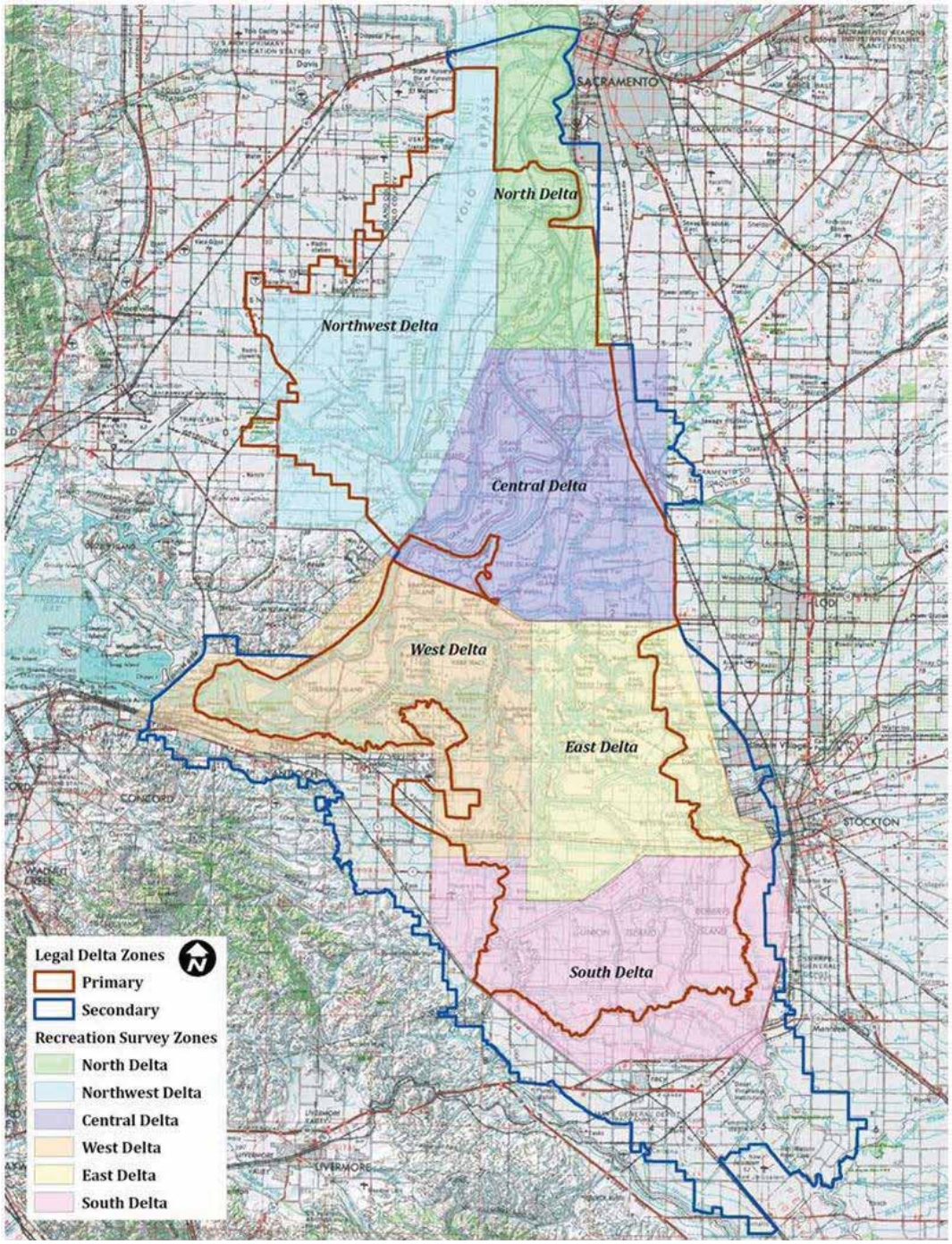
The Delta's other major private recreation facilities are the numerous private hunting clubs, which typically are associated with agricultural lands. Very little information exists on the number of these facilities or the number of hunters who utilize them. In a 1997 survey, the Delta Protection Commission identified 23 private hunting facilities, most in Yolo County. Conversations with hunters indicate that many additional formal and informal hunting clubs are located throughout the Delta.

Private nonprofit organizations such as The Nature Conservancy and the Solano Land Trust also provide for some public recreation on facilities that they manage. The Cosumnes River Preserve includes lands owned by both public and not-for-profit organizations such as Bureau of Land Management, Department of Fish and Game (DFG), Department of Water Resources (DWR), The Nature Conservancy (TNC), Ducks Unlimited, Sacramento County, and the State Lands Commission. The preserve has a visitor center with picnic areas, interpretive displays, restrooms, and three designated hiking trails and allows bird watching, photography, hiking, and paddling.

[134] A phone and internet survey was completed as part of this project to update the total number of marinas, camping facilities, fuel stations, and other facility numbers. Section 8.3.2.1 and Appendix I include details about those facility numbers. However, the numbers in Table 23 are left as is, as those were taken directly from the DBW 2002 survey, still provide a general magnitude of totals, are broken down by recreation zones, and all numbers have not been updated.

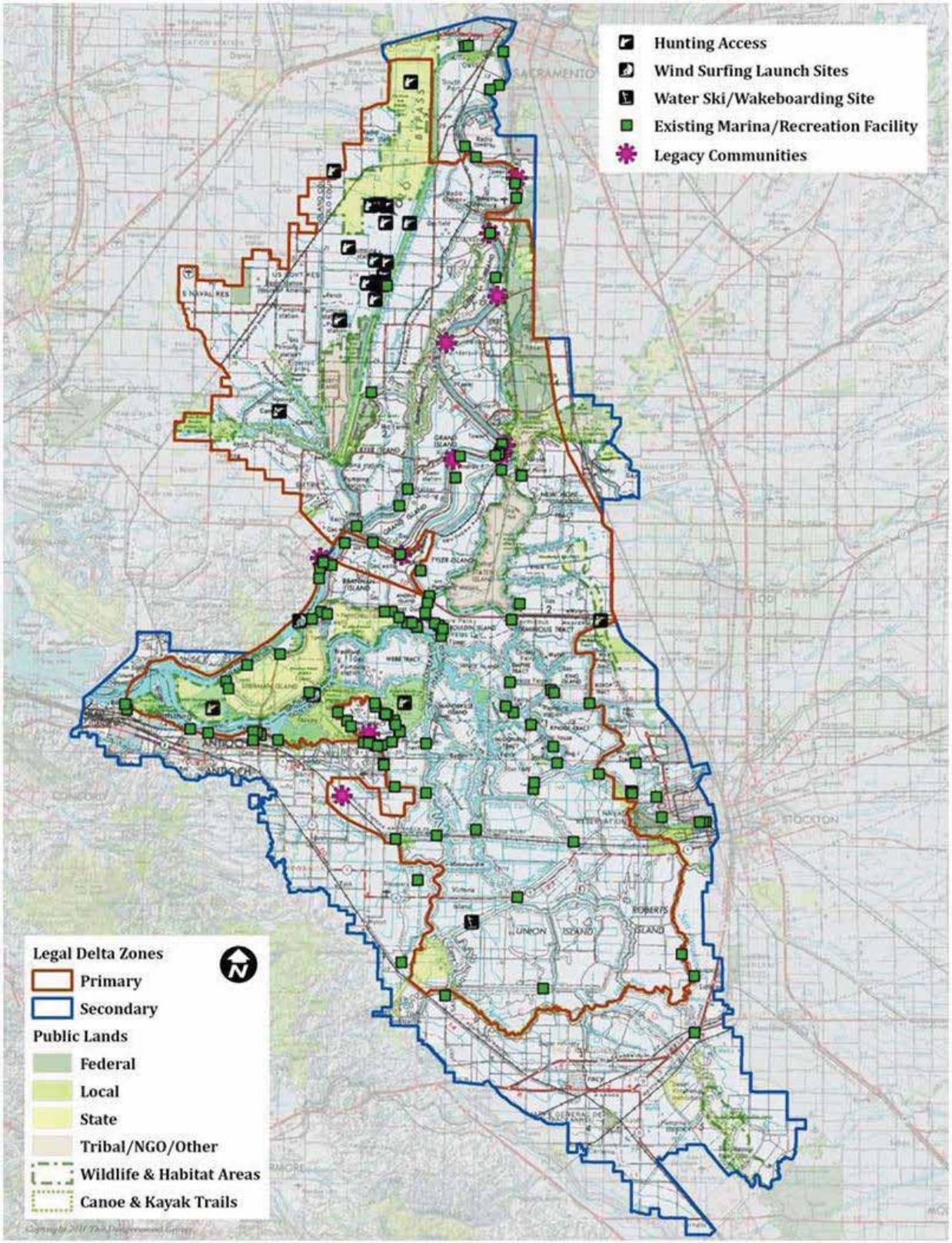
Additional private facilities include those catering to Delta-as-a-Place recreationists and tourists, including restaurants, agricultural stands, and wineries. A recent study found 25 attractions/historic places, 17 farmers markets, and nine wineries/tasting rooms (Figure 29).

Figure 27 Delta Recreation Zones[135]



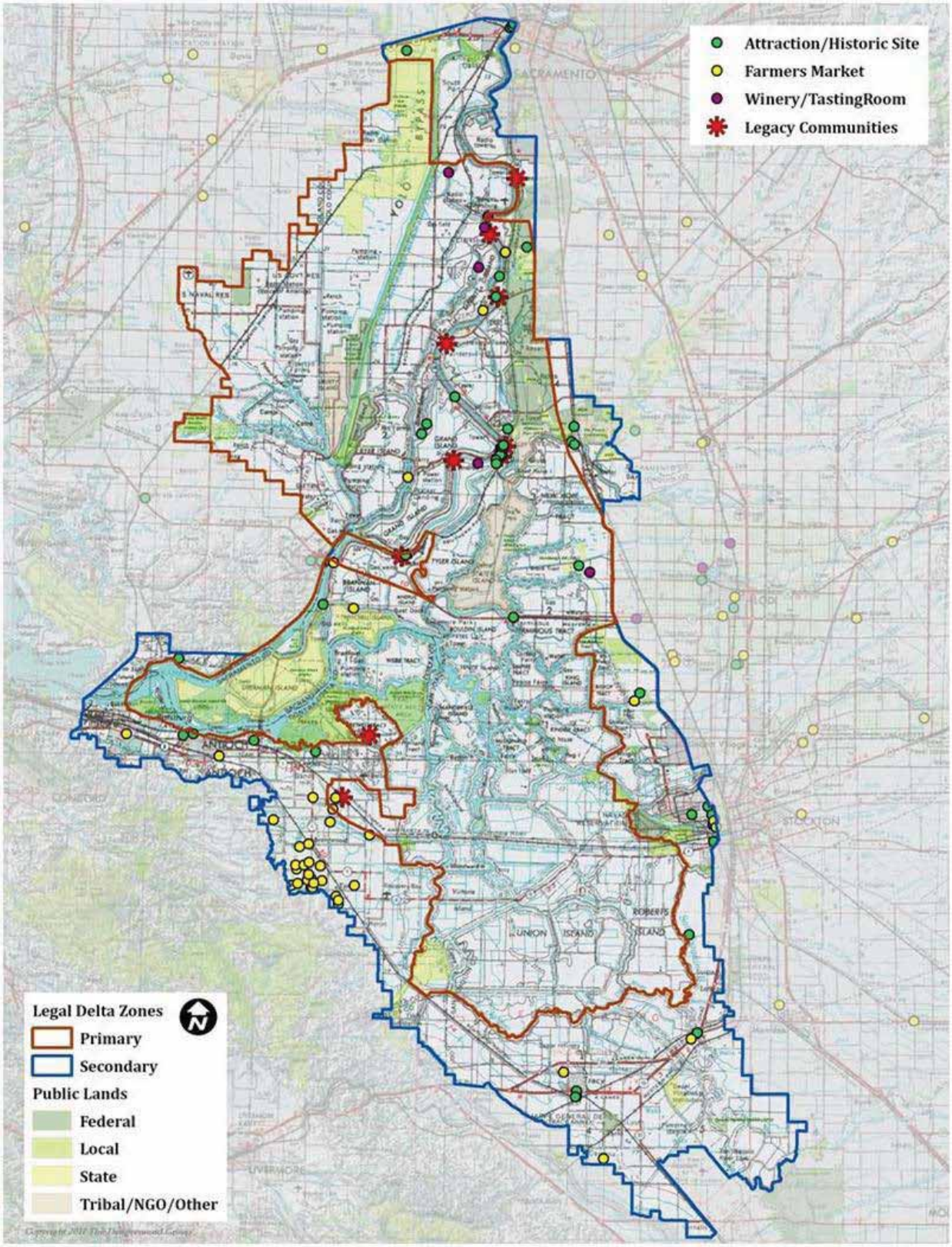
[135] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Figure 28 Delta Recreation Facilities[136]



[136] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Figure 29 Delta Tourism Facilities[137]



[137] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Public Facilities

There are a number of publicly-owned lands in the Delta, covering almost 40,000 acres. A percentage of these lands is open to public recreation access, including hiking, day use, fishing, hunting, and wildlife viewing. Stone Lakes National Wildlife Refuge is the largest public facility, with 6,200 service-managed acres within its 18,000-acre boundary, but provides limited public access in the form of waterfowl hunting, guided hikes, special events, bird watching, and canoe/kayak tours. Stone Lakes is in the process of opening a new trails and visitor facility, the Blue Heron Trails Visitor Contact Station, which will feature a universally accessible trail, interpretation, an unstructured play area, restroom, and outdoor amphitheater. It is scheduled to open in November 2011.

Brannon Island State Recreation Area provides some of the best public facilities in the Delta, including three group picnic sites, 300 general picnic sites, 78 miles of non-motorized trails, grassy areas, a campground with 102 developed sites, six group camping sites, a boat launch ramp, sewage/bilge pumpouts, non-motorized boat access, a swimming area, and berths and tie-ups for transient boats.[138,139] The Department of Fish and Game owns and manages a number of Wildlife Areas, including Acker Island, Lower Sherman Island, Sherman Island, Woodbridge Ecological Reserve, and Yolo Bypass Wildlife Area. These facilities provide for a variety of activities, from bird watching tours to hunting, fishing, wildlife viewing, and education.

A number of public access trails exist or are in development, including the American Discovery Trail, Mokelumne Coast-to-Crest Trail, and the Great Delta Trail. These trails currently support or will provide public access for a variety of recreation activities, including hiking and biking. Additionally, State Highway 160 is a designated State Scenic Highway. A number of water trails have also been proposed.

There are also a number of local and regional parks within the Delta, including those provided by the cities of Tracy, Stockton, and Lathrop, the counties of Sacramento, San Joaquin, and Yolo, and regional providers such as East Bay Regional Parks District. These parks and facilities include Antioch Marina, Antioch Public Boat Ramp, Big Break Regional Shoreline, Garcia Bend Park Launch Ramp, Louis Park Boat Launching Facility, Morelli Park Boat Launching Facility, Sandy Beach Park and Boat Launch Facility, Hogback Island Access, and Sherman Island Public Access Facility. Figure 28 above shows some of these public facilities.

Recreation Enterprises in the Delta

A variety of data on business enterprises in the Delta describe economic activity attributable to recreation and tourism. As seen in Table 24 below, nearly 100 business enterprises within the Primary Zone are recreation-related. In the Secondary Zone, there are nearly 1,500 recreation-related enterprises, though many businesses likely provide for broad urban and non-local recreation opportunities in addition to serving Delta recreation.

[138] State Parks 2010, p. 20-21.
[139] This site is on the State Parks closure list and may be closed to public access as of July 1, 2012.

Table 24 Data for Recreation-Related Enterprises within the Legal Delta in 2008[140]

	Primary Zone	Secondary Zone
Industry	**Number of Establishments**	**Number of Establishments**
Boat Building	1	19
Recreational Vehicle Dealers	0	4
Boat Dealers	8	30
Scenic and Sightseeing	0	2
Performing Arts, Spectator Sports, and Related Industries	4	208
Museums, Historical Sites, and Similar Institutions	1	16
Amusement, Gambling, and Recreation Industries (including marinas)	34	255
Accommodation	22	148
Food Services and Drinking Places	26	778
Total	96	1,460
Source: NETS; UOP		

Many enterprises within the Delta, especially the marinas, offer more than one service. The chart above lists enterprises based on their primary business classification and the numbers may undercount certain services. For instance, several marinas also have restaurants, campgrounds, and a convenience store, provide boat repair services, and have fuel docks. In order to provide a picture of the facilities and services that are offered by enterprises within the Delta, further research was done of individual establishments, as detailed in Appendix I. Through this process, the following facilities or services were identified.[141]

Table 25 Businesses Offering Recreation-Related Facilities and Services within the Delta

	Number of Facilities or Services
Marinas	112
Camping/RV Facilities	64
Restaurants[142]	81
Fuel Docks	45
Boat Builders	16
Boat Dealers	35
Boat Repair Facilities	49
Source: NETS, UOP	

Within the recreation-related businesses, the detail for “Accommodations” was further expanded and is presented in Table 25. There are very few choices for recreation travelers for overnight accommodation within the Primary Zone. The only establishment that provides rooms within the Primary Zone is the Ryde Hotel. There are a number of additional hotels, motels, and bed and breakfasts within the Secondary Zone; however, they seem to primarily cater to travelers

[140] Boat repair services were also examined. In total there are 37 establishments offering boat repair services - five in the primary zone and 32 in the secondary zone. These establishments are included in Table 25 under Marinas, Boat Dealers and Boat Builders.
[141] Note that numbers between Tables 24 and 25 cannot be directly compared as Table 24 lists each individual business only once, while Table 25 may count the same business multiple times if it provides multiple services.
[142] Restaurants listed here include those associated with marinas, in the Primary Zone, or located in Legacy Communities.

through the area, rather than Delta recreationists. Also, as listed above in Table 25, there are approximately 2,100 campsites within the Delta.

Table 26 Accommodations within the Delta (excluding campsites)

	Hotels, Motels, and B&Bs	
	Number of Establishments	**Number of Rooms**
Primary Zone	1	32
Isleton and Rio Vista	4	56
Secondary Zone	70	4,451
Delta Total	75	4,539
Note: There are also 84 small cabins available for rent in campgrounds, and 31 additional rooms available for special events, primarily weddings at Grand Island Mansion.		
Source: NETS, UOP		

Physical Constraints

There are several physical constraints related to Delta recreation which are detailed in *The Aquatic Recreation Component of the Delta Recreation Strategy Plan.*[143] The following constraints have an impact on current facilities and recreation access and are described in more detail below.

- Sediment accumulation in channels and waterways/shallow water
- Water gates, screens, and barriers
- Invasive aquatic vegetation that congests waterways, negatively affects water quality, destroys wildlife habitat, and clogs water supply pumps
- Waterway obstructions such as snags, submerged debris, abandoned vessels, and floating objects
- Water quality
- Lack of boating destinations, particularly beach frontages
- Highly sensitive habitat areas which restrict public access
- User group conflicts
- Private lands and agriculture-recreation conflicts
- Lack of fishing access from the shore and boat launches
- Water management, regulation, and other issues

Sediment Accumulation in Channels, Waterways, and Marinas

Sediment deposits and siltation affect both Delta waterways and marinas. For instance, silt can accumulate from three to eight feet in a given year at marina facilities along the Sacramento River. Sedimentation has led to the closure of marinas and boating facilities in severely-clogged channels.

The stringent regulations and lengthy, complex permit requirements for dredging silt out of channels and marinas burdens marina owners and boating facility operators. Marina operators have stated that dredging-related regulations should be streamlined or better coordinated among regulatory agencies to provide marina owners more flexibility in the removal of silt materials. In addition, channel dredging for levee maintenance is currently being slowed by the same regulation/permitting constraints.

[143] DPC 2006, pp. 56-69

The U.S. Army Corps of Engineers is spearheading a multiple-agency process called the Delta Dredged Sediment Long-Term Management Strategy (LTMS)[144] that aims to, among other goals, clarify the permitting process relative to Delta dredging and reuse projects. They are working to create an effective multi-agency task force called the Delta Dredging and Reuse Management Team (DDRMT), similar to the inter-agency Dredge Material Management Office (DMMO) which exists in San Francisco Bay. They are also working on drafting a Joint Permit Application.[145]

Water Gates, Screens, and Barriers

The Delta Cross Channel and gates, located in Walnut Grove, is an important link for recreational boaters. Although originally built just for water management, it allows, when open, for direct access to some of the most popular boating areas in the Delta. In recent years, it has been open most days per year, but operation periods are variable and boaters typically do not know in advance whether it will be open or not. It addition, its dimensions do not allow for use by larger boats or sailboats.

Other gates, screens, and barriers that exist throughout the Delta include Montezuma Slough Salinity Gates, South Delta Temporary Barriers (operated by DWR), and a wide variety of bridges and drawbridges. The proposed Two-Gates project has been developed by the U.S. Bureau of Reclamation and the Department of Water Resources. This project would install gates on Old River and Connection Slough in order to manipulate the flow of turbid water to keep Delta smelt away from export facilities.[146] This proposed project, currently on hold, would install temporary barriers along the two waterways, which are heavily used by boaters. As currently proposed, the gates would be closed at all times during certain times of the year, prohibiting boat passage.

Invasive Aquatic Vegetation

Two non-native plants that have invaded the Delta are water hyacinth and *Egeria densa*. Water hyacinths float on the surface as well as root along shorelines, while *Egeria densa* is a subsurface water weed. By the 1980s severe infestations of water hyacinth had clogged navigation channels and marinas, creating problems for marina owners, safety hazards for boaters, and issues for the native ecosystem. *Egeria densa* forms dense, submerged mats of vegetation, which can accentuate the process of siltation (discussed above), be dangerous for swimmers, and create operational problems for both boaters and water infrastructure. DBW has primary responsbility for removing water hyacinth and *Egeria densa*, though the program is underfunded compared to the magnitude of the problem. More recently, South American Spongeplant (*Limnobium laevigatum*), a floating plant similar to water hyacinth, has been found in California waterways and is being watched by local and state agencies for potential infestations.[147] DBW does not currently have authorization to remove or treat Spongeplant.

Waterway Obstructions

Prior studies have repeatedly cited water obstructions as a significant problem for boaters. The Franks Tract area has been identified as an especially dangerous area for boating because it

[144] For more information, see http://www.deltaltms.com/index.htm
[145] http://www.deltaltms.com/DredDispReusePer.htm
[146] http://www.usbr.gov/mp/2gates/docs/2-Gates_Factsheet_latest.pdf and http://www.water.ca.gov/deltainit/docs/TwoGatesProject.pdf
[147] Akers, Patrick. Aquatic Weed Integrated Vegetation Management Plan – Contra Costa Delta. Updated 10/9/2010. Found at http://www.delta.ca.gov/res/docs/Spongeplant%207%2028%2011.pdf

was once a levee-protected island and now, although flooded, is shallow and obstructed by submerged levees and vegetation debris.

Snags, debris, floating logs, and abandoned vessels in the river and sloughs are very dangerous to boaters throughout the Delta. Until about 20 years ago, U.S. Army Corps of Engineers was responsible for keeping the waterways clear but no longer provides that service. The responsibility has fallen to local county sheriffs' departments, which lack the manpower, proper equipment, and funding to adequately provide obstruction-removal services and to remove the seasonal "crop" of flotsam that follows winter high-water flows. Some local assistance funding for the removal of abandoned recreational vessels and other navigational hazards is provided through the Department of Boating and Waterways' Abandoned Watercraft Abatement Fund (AWAF) grant program, though needs exceed funding availability.

Water Quality
Surveys of boaters utilizing the Delta have frequently revealed water quality as the top or one of the top-mentioned concerns or issues. In a survey conducted as part of the S*acramento-San Joaquin Delta Boating Needs Assessement,*[148] 74 percent of large-boat owners and 79 percent of small-boat owners identified water quality as an attribute of concern in the Delta. Concerns associated with water quality included risks or perceived risks related to body contact, possible sewage contamination, aquatic weeds, and water clarity. Boater perceptions of water quality may also differ from water quality best suited for native fish species (i.e., turbidity). In a 2009 study, 70 percent of boaters were concerned about water quality for drinking while 63 percent of boaters were concerned about water quality for swimming.[149]

Boating Destinations
Surveys of boaters also have found a high desire for more boat-in destinations within the Delta.[150] These requests tend to take three different forms.

1. Major boat-in, mooring, and camping attractions such as the Delta Meadows.
2. Numerous smaller day-use areas with restrooms, picnic, and beach facilities.
3. Additional convenience docks adjacent to Legacy Communities such as that established adjacent to Walnut Grove.

These facilities can create problems for adjacent agricultural interests. If development of such new areas is contemplated, they should be placed adjacent to public lands or in areas that avoid the risk of trespass, vandalism, and other conflicts.

Highly Sensitive Habitat Areas
There are several existing proposals (e.g., Delta Plan, Ecosystem Restoration Program) to expand and enhance habitat areas in certain waterways and islands. Conflicts can occur between recreational boating and habitat interests, depending on the boating activity, speed, motor, seasons, and frequency. Additionally, conflicts may result if the public is precluded from recreational access in these proposed restored-habitat areas.

8.3.3 Existing Operations Conditions

There are several operations-condition issues and constraints that were also described in *The Aquatic Recreation Component of the Delta Recreation Strategy Plan.*[151] A summary of the

[148] DBW 2002, p. 4-23
[149] DBW 2009, p. 134
[150] DBW 2002, p. 3-12 – 3-14
[151] DPC 2006, pp. 56-69

potential operational constraints discussed include user group conflicts, water management related constraints, and regulation and law enforcement issues. Most of these issues are compounded by the lack of an overall responsible agency throughout the Delta, due to the overlapping jurisdictions of several counties and cities.

User Group Conflicts
The diversity of boating activities in the Delta, from high-speed wakeboarding and personal watercraft (PWC) usage to fishing and non-motorized craft (e.g., canoe, kayak) results in conflicts between some user groups. Such conflicts are normally just a lack of common courtesy, rather than citable offenses. However, when one responsible entity manages water recreation use, basic rules and regulations can be established to avoid conflicts. A single responsible entity or common set of regulations does not generally exist in the Delta, with the exception of "No Wake Zones" adjacent to marinas. In addition, marine patrol is fractured between ten different agencies over five counties. Safety laws are the primary concern, along with enforcement of pollution laws, speed violations, negligent operators, equipment violations, lack of life jackets, alcohol consumption, and poaching.

Private Lands/Agriculture-Recreation Conflicts
Another serious and common problem is trespass on private property. Frequently, trespass violations stem from recreationists' misunderstanding of what property is public and what is private. Clear signage, however, does not deter some who desire to use a specific area.

Water Management
The lack of jurisdictional coordination, with no single agency ultimately responsible for management, has left an absence of adequate, coordinated waterway maintenance and security in order to enforce regulations and control user group conflicts. Additionally, there is a lack of information sources about the Delta to assist recreation users who are unfamiliar with the Delta.

Regulation
The regulatory structure in the Delta is complex, with local, state, and federal regulatory agencies imposing many overlapping layers of law on private businesses. Many of these policies and plans are summarized in Chapter 4. In many cases, regulations that are created to protect the Delta environment also inhibit the functioning of recreation-related businesses, or the development of new businesses. One example is the number of agencies that have input into the permitting process required to dredge a marina. Those can include up to three federal agencies, seven state agencies, and three local agencies; the process can take upwards of two years.[152]

Other issues
Other primary issues and operational risks that affect recreation and its economic potential include aging marinas and other infrastructure, lack of dredging, threatened public parks closures, continued lack of adequate levels of public funding for law enforcement and operations and maintenance of public facilities, development encroachment, flood and earthquake risk, rising sea level, water conveyance management changes, and increasing traffic.

[152] DPC 2006, p. 59

8.3.4 Visitation and Demand

8.3.4.1 Defining Market Area

In order to describe the economic impact of recreation on the Delta economy, the market area for Delta recreationists needs to be defined. Planners need to understand what percentage of users come from which areas, such as Delta counties, surrounding counties, Southern California, the western region of the United States, and beyond national borders.

In *The Sacramento-San Joaquin Delta Boating Needs Assessment,* the concepts of the Delta Primary and Secondary Market Areas were introduced.[153] A survey of statewide registered boat owners found that 77 percent of respondents who reported they had recently boated in the Delta resided within approximately 75 miles of the Delta.[154] This area was designated as the Primary Market Area for the Delta and included the counties of Alameda, Calaveras, Contra Costa, Marin, Napa, Sacramento, San Francisco, San Joaquin, San Mateo, Santa Clara, Santa Cruz, Solano, and Stanislaus. The study further defined a Secondary Market Area which represented the point of origin of another 8 percent of all Delta boating trips. The Secondary Market Area includes the counties of Amador, Colusa, El Dorado, Lake, Mariposa, Mendocino, Merced, Monterey, Placer, San Benito, Sonoma, Sutter, Tuolumne, and Yolo. Combined, the Primary and Secondary Market Areas represent approximately 85 percent of all Delta boating visitors (Figure 30).

Although this concept was developed for boating recreation, it is applicable to Delta recreation as a whole. While some visitors to the Delta do come from Southern California, out-of-state, and international locations, the majority of visitors are from Northern California. These visitors represent the focal market for Delta recreation growth opportunities in the future. Population statistics and trends for the Market Area are presented in Table 27. Activity participation numbers and demand models will focus on this area. In summary, the total Market Area had a population estimate of approximately 12 million in 2010, with projections of 17.6 million by 2050.

Table 27 Population Projections for the Primary and Secondary Market Areas

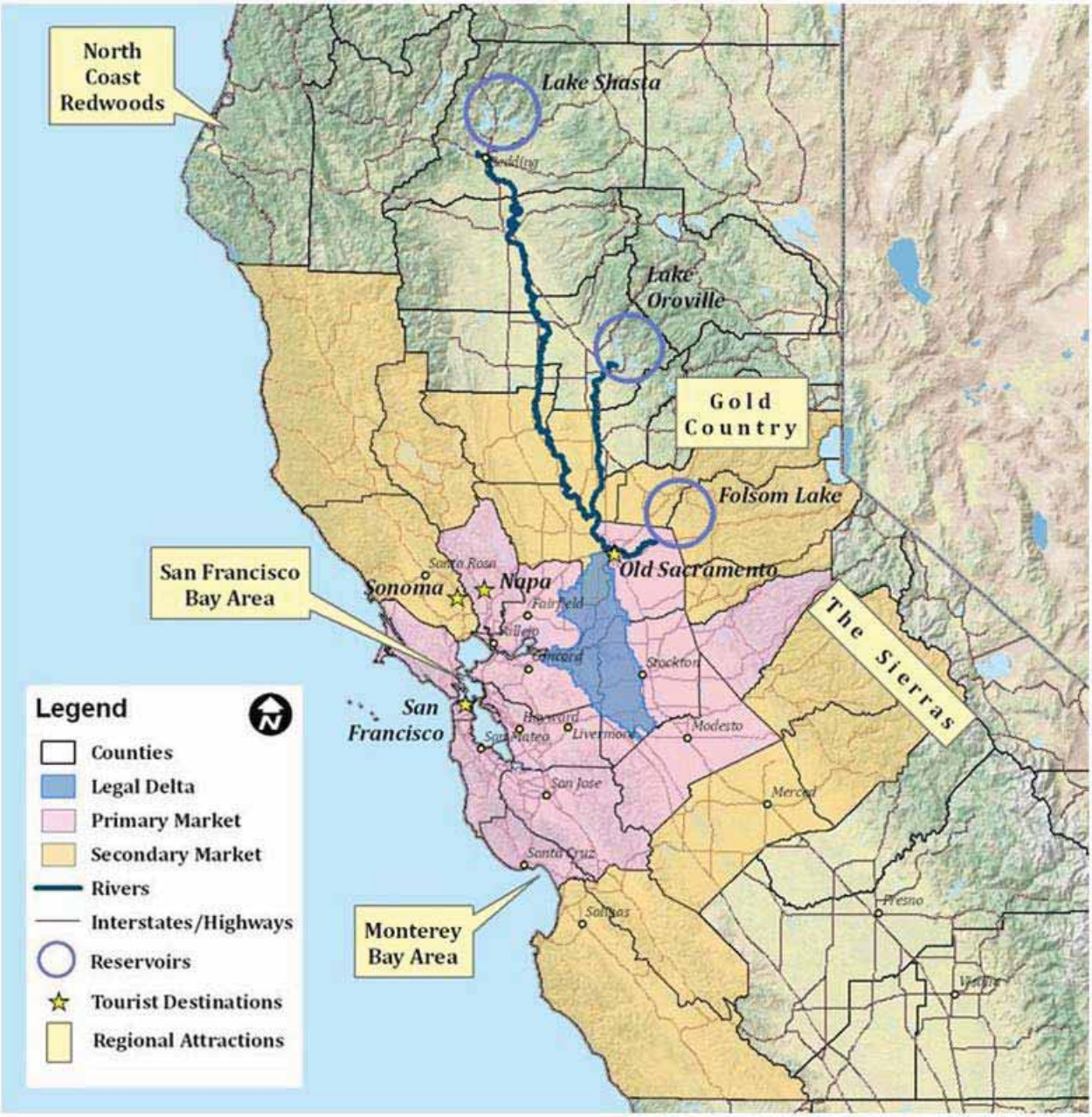
	2010	2020	2030	2040	2050
Market Area Population (millions)	11.9	13.4	14.9	16.3	17.6
Growth Rate		12.7%	10.8%	9.3%	7.9%
Source: Global Insight Forecast, 2010 Census Results					

Within the Market Area for Delta recreation, other recreation areas actively compete for participants and their dollars. Residents of the Market Area have several different natural resource-oriented destinations within Northern California that they could visit. Boaters can visit several reservoirs throughout Northern California, including Shasta Lake, Lake Oroville, and Folsom Lake, or can recreate on the San Francisco Bay. Anglers can fish in the numerous reservoirs, but also in the streams and rivers feeding those lakes and reservoirs, such as the Feather River, American River, and Sacramento River. People visiting historic or cultural areas can also visit Old Sacramento, Gold Country, or San Francisco. Wine tourists can visit Napa,

[153] DBW 2002, p. 6-4 - 6-6
[154] A more recent statewide survey of boaters supports this overall Market Area conclusion, noting that boaters from the Central Valley, Sacramento Basin, and San Francisco Bay Area boated more days per year on the Delta than boaters from other regions of the state (DBW et. al 2011, p. 86-87).

Sonoma, or the Sierra foothills. Other recreation and tourist destinations in Northern California include the Monterey Bay area, San Francisco Bay area, the Sierras, and north coast redwoods.

Figure 30 Delta Market Area and Competing Regions[155]



8.3.4.2 Statewide Recreation Survey/Study Summaries

In order to present an update on the current status and overall trends of recreation and tourism in the Delta, a multitude of sources is reviewed, ranging from U.S. Fish and Wildlife Service to Delta Protection Commission publications. Unfortunately, no one study or survey presents a complete picture of current recreation and tourism visitation and economic impact in the Delta. Summary information from relevant studies is presented below.

[155] For high resolution image see http://forecast.pacific.edu/desp-figs.html

State Parks Surveys Recreation Demand Overview

State Parks completes a *Survey on Public Opinions and Attitudes on Outdoor Recreation in California* approximately every five years to comply with federal grant regulations and to "provide a comprehensive view of the outdoor recreation patterns and preferences of Californians."[156] This survey instrument represents the best, most recently available data on recreation preferences of Californians. Statewide demand and participation rates for a sample of specific recreation activities that occur in the Delta are listed in Table 28.

Table 28 Summary of 2008 Survey of Public Opinions on Outdoor Recreation in California Demand and Participation Rates for Selected Activities Statewide in California

Activity Type	Participation Rate	Average Annual Participation in Days
Walking for fitness or pleasure	74%	73
Bicycling on paved surfaces	36 %	38
Wildlife viewing, bird watching, viewing natural scenery	46%	27
Outdoor Photography	33%	26
Driving for pleasure, sightseeing, driving through natural scenery	60%	22
Bicycling on unpaved surfaces and trails	16%	20
Hunting	4%	17
Day hiking on trails	47%	16
Sail boating	6%	14
Fishing – freshwater	21%	13
Swimming in freshwater lakes, rivers and/or streams	31%	10
RV/trailer camping with hookups	11%	9
Motor boating, personal watercraft	15%	9
Visiting historic or cultural sites	55%	8
Picnicking in picnic areas	67%	7
Attending outdoor cultural events	56%	7
Camping in developed sites with facilities	39%	7
Visiting outdoor nature museums, zoos, gardens, or arboretums	58%	6
Paddle sports	15%	5
Source: State Parks		

The most popular activities by participation rates are walking for fitness and pleasure, picnicking, and driving for pleasure, followed by visiting outdoor nature museums, attending outdoor cultural events, and visiting historic or cultural sites. The activities which enjoy the highest participation rates (i.e., people who participate tend to participate more often) are walking for fitness or pleasure, bicycling on paved surfaces, wildlife viewing, outdoor photography, driving for pleasure, and bicycling on unpaved surfaces and trails. State Parks also breaks down participation rates by region, but these regions do not overlap well with the defined Market Area. Thus, only statewide data is reported.

[156] State Parks 2009

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation–California* presents findings from a survey completed every five years to measure the importance of wildlife-based recreation. The survey indicates that in 2006, approximately 7 percent of the total population in California participated in either hunting or fishing activities, while 21 percent of the population participated in wildlife watching. The results of the survey are summarized in Table 29. Both participation rates and average annual days of participation per year are lower than in the State Parks survey, which may be due to differing methodologies. USFWS also collects information on average trip expenditures.

Table 29 Summary of 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Activities in California by Residents and Nonresidents

Activity Type	Participation Rate	Average Annual Days of Participation	Average Trip Expenditures Per Day Per Participant (2006$)
Fishing (Anglers)	6%	11	$62
Hunting (Hunters)	1%	12	$68
Wildlife Watching (Away From Home Participants)	21%	16	$44

Department of Boating and Waterways

The Department of Boating and Waterways (DBW) *2007-2009 California Boater Survey* reports on a statewide assessment of boating habits and environmental awareness of boaters. The survey reported that in 2007, 17.8 percent of boat owners surveyed boated in the Sacramento-San Joaquin Delta as least once a year, using their boats on average 20.9 days in that location.[157] Comparatively, in 2009, 26.8 percent of those surveyed boated in the Delta, using their boats on average 25.4 days per year.[158] The report does not discuss any reasons for the discrepancies in numbers, or any conclusions as to whether the increase in 2009 rates represents an increase in Delta recreation, or is a reflection of sampling differences.[159] However, the participation rates reported in these surveys are of comparable magnitude to the 23 percent participation of boaters statewide that reported recreating in the Delta in a 1997 survey (see *Sacramento-San Joaquin Delta Recreation Survey* in Section 8.3.4.3). The average number of days of participation, however, is much higher than those reported on statewide or national surveys (see above) for fishing or boating.

State Registration and License Numbers

Another way to assess potential recreation demand is through an analysis of state registration and license numbers. These numbers represent actual numbers, rather than estimates of participation rates, and can help predict potential demand.

Registered Vessels

In California, owners of any sail-powered vessels over eight feet in length and any motor-driven vessel (regardless of length) that is not documented by the U.S. Coast Guard must register their boat with the Department of Motor Vehicles (DMV). Vessels propelled solely by oars or paddles

[157] DBW 2011, p. 24
[158] Ibid, p. 86
[159] The study does, however, point out that surveys were not completed by a random sample of boaters, but rather boaters who were approached on the docks, or at boat shows. The report states, “Thus, all findings are best viewed as particular to the given sample (i.e. those boaters who participated) rather than representative of the entire population of interest (i.e. all California boaters).” DBW 2011, p. 14

(e.g., kayak, canoes) do not have to be registered.[160] In 2010, statewide, DMV reported 810,008 vessel registrations. As registrations are also reported by county, the Primary and Secondary Market Areas can be highlighted. In 2010, there were 214,163 vessels registered within the Primary Market Area and an additional 103,408 within the Secondary Market Area.[161]

Resident Sport Fishing

In 2009, 1,179,312 resident sport fishing licenses statewide were issued by the Department of Fish and Game (DFG).[162] It is difficult to identify licenses by county, as DFG reports figures based on the county in which the license was sold, not by the origin county of the purchaser. However, DFG required all anglers who fished within the tidal influences of the Bay-Delta and downstream of dams within the watershed to purchase a Bay-Delta Sport Fishing Enhancement Stamp from 2004 to 2009. In 2009, 284,641 anglers purchased that stamp. Although a portion of anglers who purchased that stamp may have only fished upstream of the Delta, those numbers seem to provide a general magnitude snapshot of anglers in the Delta (i.e., approximately 275,000 anglers recreated in the Delta in 2009). Using this number, combined with estimates from both USFWS and State Parks that anglers fish, on average, 12 days per year, results in approximately 3.3 million fishing activity days in the Delta in 2010. Note, however, that this number does not differentiate between shore anglers or those who fish from a boat.

Hunting

In 2009, the state issued 1,056,556 game bird hunting licenses and 1,683,445 general hunting licenses, which is approximately 6 percent of the adult California population. The hunting percentage tracks well with demand numbers from State Parks.

8.3.4.3 Delta-Specific Recreation Survey/Study Summaries

There are several Delta-specific surveys that have been completed over the past 20 years regarding recreation, including Sacramento-San Joaquin Delta Outdoor Recreation Survey,[163] North Delta Recreation Use Survey,[164] Sacramento-San Joaquin Delta Boating Needs Assessment,[165] and Sacramento San-Joaquin Delta Recreation Survey.[166] The more recent are summarized below.

Unfortunately, there have been no recent comprehensive visitor surveys within the Delta focused on Delta recreationist's activities and spending patterns. Also, most surveys that have been done have only focused on boaters and anglers, the highest percentage of recreationists in the Delta, but not the only ones. This lack of primary data hampers planning and marketing efforts.

[160] A DBW study estimated a total of over 1.7 million non-motorized boats (a category which includes inflatables, kayaks, canoes, rowing boats, sailboards/kiteboards, small sailboats, and others) in California in 2006 (DBW 2009, p. 2-1 – 2-2).
[161] http://www.dbw.ca.gov/PDF/VesselReg/Vessel10.pdf
[162] http://www.dfg.ca.gov/licensing/
[163] DWR 1980
[164] DWR 1997
[165] DBW 2002
[166] State Parks 1997

Sacramento-San Joaquin Delta Boating Needs Assessment

As part of *The 2002 Sacramento-San Joaquin Delta Boating Needs Assessment,*[167] California boat owners were surveyed regarding their preferences and facility needs for boating in the Delta. The survey group was broken down into owners of large boats (equal to or greater than 26 feet in length) and small boats (less than 26 feet in length). In this statewide survey, 52 percent of all owners of large boats had boated in the Delta, with 68 percent of those having been in the previous two years. Conversely, only 40 percent of all small-boat owners had been boating in the Delta, with 61 percent of those having done so in the two previous years.[168]

Combined with the survey information, the 2002 study also completed a demand forecast analysis of annual boating-related visitor days, estimated at 6.4 to 6.6 million in 2000 with a projected growth to 8 million by 2020.[169] This survey information provides the best estimate of boating-related recreation activity days in the Delta. However, it does not estimate the amount of expenditures for the boaters in the Delta. And, while boating and companion activities (fishing from a boat, swimming from the boat, etc.) represents one of the highest percentage of existing recreation uses in the Delta, it is not a full picture of all recreation.

Sacramento-San Joaquin Delta Recreation Survey

In 1997, State Parks published the *Sacramento-San Joaquin Delta Recreation Survey,* which separately surveyed boat owners and licensed anglers regarding their use of the Delta resources and how much money they spent recreating in the Delta.

The survey found that 23.5 percent of registered boat owners in California recreated in the Delta, spending an average of $11.75 outside the Delta and $17.20 inside the Delta (1996 dollars), a total of $28.95 per day per person. The survey also found 23 percent of licensed anglers in the state fish in the Delta, spending an average of $15.91 outside the Delta and $13.57 inside the Delta (1996 dollars), a total of $29.48 per day per person. The top five other recreation activities that boaters indicated they participated in included (in order of preference) sightseeing, viewing wildlife, fishing from shore, picnicking, and walking for pleasure. The top five non-fishing activities which anglers engaged in while in the Delta were sightseeing, boating, viewing wildlife, swimming, and walking for pleasure.

8.3.4.4 Delta Recreation and Tourism Visitation Estimates

There are few counts of visitor attendance in the Delta. Those that exist are limited and only represent a fraction of what is estimated to be the actual visitor count. Visitation numbers that were reported equal less than one million visitors and are presented in Table 30.

[167] DBW 2002
[168] For large boat owners, 52% of 68% translates to about 35% overall boater participation. For small boat owners, 40% x 61% = 24.4% of overall boaters. While the small boat participation number is similar to that described in State Parks survey (Section 8.3.4.3) and the recent DBW survey (Section 8.3.4.2), the large boater participation rates are higher.
[169] DBW 2002, Table 6-11

Table 30 Summary of Actual Visitation to the Delta

Site	Numbers
Brannon Island SRA (day use, 2009)	88,459
Brannon Island SRA (camping, 2009)	36,069
Delta Meadows State Park (day use, 2009)	18,933
Delta Meadows State Park (camping, 2009)	2,155
Franks Tract SRA	24,305
Stone Lakes National Wildlife Refuge (USFWS) (approx.)	7,000
Cosumnes River Preserve (approx.)	70,000
Lower Sherman Island (DFG) (approx.)	5,000
White Slough Wildlife Area (DFG) (approx.)	12,000
Yolo Basin Wildlife Area (USFWS) (approx., includes student tours)	30,000
Sherman Island (Sacramento County)	25,000
Hogback Island Fishing Access (Sacramento County)	10,800
Clarksburg Boat Launch (Yolo County)	1,713
Belden's Landing (Solano County)	15,642
Sandy Beach Park (Solano County)	100,611
Dos Reis Park (San Joaquin County)	25,815
Mossdale Crossing Regional Park (San Joaquin County)	23,630
Oak Grove Regional Park (San Joaquin County)	84,058
Westgate Landing (San Joaquin County)	10,283
Isleton Crawdad Festival (approx.)	200,000
Rio Vista Bass Derby and Festival (approx.)	12,000
Totals	**796,480**
Sources: State Parks 2010, personal communications	

8.3.4.5 Visitation Estimates by Recreation Activity Types

As actual visitor counts and current visitor survey data are lacking, visitation must be estimated. One way to estimate visitation is by looking at overall participation estimates based on survey data such as that collected by State Parks. These participation estimates can then be related to the Market Area population to derive estimates. However, participation rates vary over time as recreation activities become more or less popular.

The subsection: *State Parks Surveys Recreation Demand Overview* in Section 8.3.4.2 presented information regarding participation in selected activities that occur in the Delta from the most recent State Parks *Survey on Public Opinions and Attitudes on Outdoor Recreation in California.* As this survey has been taken approximately every five years, it is also a useful tool in looking at activity participation rate changes over time. In general, the activity types in which Californians participate and the level of participation have varied over time in specific activities, including freshwater fishing, backpacking, wildlife viewing, sports, swimming in a pool, etc. Over various surveys, State Parks has changed certain categories, listing 42 activity categories in 1992, to 55 in 2002, and 39 in 2008. It is difficult to track trends in individual activity categories due to changes in survey methodologies and questions. However, the percentage breakdown between three broad clusters of recreation activities has tended to remain relatively constant.

Resource-related recreation includes that which occurs in resource-related areas, including state and national parks, forest service lands, nature areas, reservoirs, rivers, the ocean, mountains, etc. Types of resource-related recreation include wildlife viewing, hunting, fishing, boating, beach activities, camping, skiing, snowboarding, and swimming in lakes, rivers, and the

ocean. Since 1992, approximately 25–30 percent of all recreation has been resource related in California.

Urban Parks-related recreation includes those activities that generally take place in developed parks, such as using play equipment, swimming in a pool, using open turf areas, golf, tennis, and team sports. Since 1992, urban parks-related recreation has represented approximately 16–23 percent of all recreation activity days.

Right of Way/Tourism-related recreation represents the largest levels of participation over time and includes hiking, jogging, walking, bicycling on paved surfaces, driving for pleasure, off-highway vehicle use, and other road- and trail-based recreation. Since 1992, this type of recreation has represented approximately 48–58 percent of all activity days in California, with walking for fitness and pleasure generally the highest ranked activity, by both percentage of participants and number of days of participation.

In the Delta, there is some level of use in each of the three recreation categories: Resource-related, urban parks-related, and right-of-way/tourism-related. As one of the more unique resource attraction areas in the state, it is only logical that primary uses would be resource-related activities. These include all variety of boating, camping, nature study/bird watching, hunting, and fishing. As described above, an estimate of 6.4 million boating visitor days per year (including fishing from a boat) was completed in 2000.[170] As part of the study, projections were made that this use would grow by 1 percent a year, but with the recent recession's impact, on motor boating in particular, as well as the overall lack of investment in facilities and upgrades over the past 20 years, the 2000 count likely reflects today's usage level. None of the remaining activities has had Delta-only surveys or counts, but from review of known visitation to specific sites, data regarding permits and licenses, it is estimated that these remaining uses account for roughly 1.5 million visitor days of use annually. When combined with boating, this gives a total of approximately 8 million resource-related visitor days of use per year.

The cities bordering the Delta have taken advantage of the Delta's waterways and scenic resources by locating both resource-related facilities and standard city parks on the edges of the Delta. For instance, Sacramento's Garcia Bend Park, on the Sacramento River, combines boat launching, bank fishing, and levee-top trails with organized sports, children's play, and informal park day uses. Stockton has located its largest city park and a major recreation-related redevelopment area adjacent to Delta waterways. There are approximately 300 acres of urban park and recreation areas bordering Delta resources located in the various communities which surround the Delta. On average throughout California, urban parks receive approximately 10,000 visits per acre per year.[171] Estimated conservatively, 2 million visitor days of urban parks-related use occurs within the Primary and Secondary Zones.

Driving for pleasure in the Delta is very popular and is a prime example of the right of way/tourism-related recreation use. This recreation category also includes bicycling, hiking, and walking. The winding roadways, interesting bridges, scenic views of waterways and agricultural areas, Legacy Communities, and historic structures all contribute to its visual appeal. The ability to buy fresh fruits and vegetables straight from the grower, visit a winery and sample their product, stop and pick up a freshly made deli sandwich or an ice cream at a 50-year-old grocery store all deepen the Delta experience. To many, the resources are part of the charm—the

[170] DBW 2002
[171] Dangermond 1993, Table 15.2, p. 219

historical town of Locke, the wildlife preserves, or even the beautiful oak tree canopies shading the roadway.

There have not been any use-participation estimates or surveys for this recreation activity in the Delta. However, the total participation in driving for pleasure in the Market Area can be estimated at 160 million annual participation days[172] (note that driving for pleasure is frequently combined with other recreation activities). As discussed above, the Market Area has a number of competing destinations including Monterey/Santa Cruz, Bay Area, Coast, Redwoods, Wine Country, Gold Country, and the Sierra Nevada. Assuming the Delta is able to capture 1–2 percent of that overall market, driving for pleasure and associated activities (e.g., visiting historic sites and farm stands, etc.) in the Delta generates significant visitation. Using these estimates, right-of-way-related recreation is approximately 2 million visitor days per year.

Combining the above estimates (8 million resource-related and 2 million right-of-way-related) would result in a total of 10 million annual visits in the Delta, plus 2 million in urban parks around the edge. In the 1990s, State Parks estimated an annual use of 12 million days in the Delta. Since that time, population in the Market Area has increased; however, there have been limited investments in new facilities or upgrades to existing facilities. The constraints outlined in Sections 8.3.2 and 8.3.3 above have not been resolved, and in some cases have been only exacerbated over time (e.g., lack of dredging, water quality). Additionally, the recession of 2007-2009 has negatively affected recreation and tourism, as well as boat registrations. Absent new research, this 12 million visits per year estimate seems to be a reasonable, conservative working number until additional primary data collection is performed.

8.3.4.6 Market Demand-Based Delta Visitation Estimates

Visitor estimations can be tested based on calculations of demand generated from population numbers using participation rates and frequencies. In summary, first, participation rates for various Delta activities were determined. Using these participation rates and estimates for activity days of participation (described above) and adjusting for multiple activities in a day, demand numbers (expressed as visitor days) for the Market Area can be estimated. Following that, a determination of what percentage of market demand the Delta will capture versus other recreation opportunity areas available to the Market Area is made. These estimates result in a range of 8.2–15.2 million recreation visitor activity days per year in 2010. In Appendix H, the model for demand-based participation is presented.

These recreation activities can also be broken down into the categories described above: Resource-related, urban parks-related, and right-of-way/tourism-related. The urban parks-related category was not included in these estimates, which was previously estimated to be another 2 million activity days per year. Resource-related activities result in a range of 4.5–10.7 million activity days per year, while right-of-way/tourism-related activities result in a range of 1.7–2.5 million activity days per year. These ranges are similar in magnitude to those discussed above and are summarized in Table 31.

[172] 12 million population x 60 percent participation x 22 average days (taken from Table 28)

Table 31 Summary of Visitation Estimates to the Delta

Type	Estimate of Visitor Days (2010) (millions)		
Activity Type Estimates		**Estimate**	
Resource Related		8.0	
Right-of-Way Related		2.0	
Urban Parks Related		2.0	
Total		12.0	
Demand Based Estimates	**Low Estimate**	**Medium Estimate**	**High Estimate**
Resource Related	4.5	7.6	10.7
Right-of-Way Related	1.7	2.1	2.5
Urban Parks Related*	N/A	2.0	N/A
Totals	8.2	11.7	15.2

Sources: U.S. Census, State Parks 2009, The Dangermond Group, EPS
* Demand for urban parks is not estimated by the visitor market analysis.

These estimates are based on limited available data and profession judgment of the planning team. New primary data from an up-to-date visitor survey is needed to better document existing recreation visitation and spending, including non-boating and non-fishing recreationists, and should be undertaken as a first step in future Delta recreation planning and marketing efforts.

8.3.5 Economic Impact/Benefits

8.3.5.1 Current Economic Impact Model

The economic impact of Delta recreation is first assessed based on estimated medium visitation levels and trip-related spending, with non-trip spending added subsequently. As described in Section 8.3.4, it is estimated that the Delta currently receives approximately 7.6 million resource-related visitor days and 2.1 million right-of-way/tourism days (market demand-based estimates). This analysis estimates that average per-day expenditures for the resource-related and right-of-way/tourism recreation activities range from about $27 to $76 (2011$) depending on the activity type, of which about $13 to $34 is spent in the Delta. Based on these per-day spending levels and the estimated Delta visitation, direct spending in the Delta economy attributable to resource-related and right-of-way/tourism recreation is estimated at approximately $251 million (2011$).

This visitation-based economic impact estimate focuses on resource-related recreation, including boating, fishing, hunting, and other activities (e.g., wildlife viewing), and right-of-way/tourism activities, including hiking, biking, driving for pleasure, and cultural activities. The analysis does not account for activities at the urban fringe, including urban park recreation (e.g., team sports). Resource-related and right-of-way/tourism activities are believed to account for the majority of economic impacts of recreation occurring in the Delta.

Table 32 Estimated Resource-Related and Right-of-Way/Tourism Visitation to the Delta by Activity

Activity	**Visitor Days**	Percent of Total
Boating, Fishing, and Camping	6.4 Million	66%
Hunting	500,000	5%
Other Resource-Related and ROW Activities	900,000	9%
Driving for Pleasure and Tourism	1.9 Million	20%
Total Delta	9.7 Million	100%

Sources: Sacramento-San Joaquin Delta Boating Needs Assessment (2000); The Dangermond Group
Note: Activity categories reflect similarities in economic spending patterns.

The economic impact of recreation within the Delta is calculated by multiplying activity-specific visitor days by per-day expenditure estimates. A visitor day is defined to be a day at a recreation site by a single person doing any and all activities. While visitors may participate in multiple activities, the analysis defines a primary activity to avoid double-counting visitors. The analysis relies on the distribution of visitation by primary activity shown in Table 32.

The analysis relies on average expenditures reported by boaters (including anglers), hunters, and recreationists participating in wildlife-associated activities to estimate spending in the Delta. Specifically, the analysis uses spending data from the Sacramento-San Joaquin Delta Recreation Survey[173] and the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.[174] The analysis considers expenditures outside and inside the Delta, based on boating and fishing expenditure patterns reported by the Sacramento-San Joaquin Delta Recreation Survey. Daily spending estimates from the Sacramento-San Joaquin Delta Recreation Survey are updated to reflect real spending increases observed by the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation between 1996 and 2006. The analysis assumes that resource-related and some right-of way activities (e.g., biking and hiking) spending is generally consistent with expenditure patterns reported for wildlife viewing trips in the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Driving-for-pleasure spending is also based on National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, though these data are adjusted to reflect lower levels of spending on lodging and recreational activities for driving-for-pleasure visits. All spending estimates are inflated to 2011 dollars using the Bureau of Labor Statistics Consumer Price Index (CPI).

Table 33 Estimated Per-Day Per Visitor Expenditure by Activity (2011$)

	Expenditure Outside Delta	Expenditure Inside Delta	Total Expenditure
Boating, Fishing, and Camping			
Accommodation	$2.76	$5.25	$8.00
Food	$5.25	$8.34	$13.58
Supplies	$8.76	$11.34	$20.10
Other	$3.99	$5.46	$9.45
Total	$20.75	$30.38	$51.13
Hunting			
Accommodation	$12.30	$9.06	$21.36
Food	$3.88	$3.92	$7.80
Supplies	$20.21	$14.24	$34.45
Other	$5.70	$6.93	$12.63
Total	$42.08	$34.15	$76.24
Other Resource-Related and ROW Activities			
Accommodation	$6.31	$4.65	$10.97
Food	$6.38	$6.45	$12.83
Supplies	$6.04	$4.25	$10.29
Other	$1.45	$1.77	$3.22
Total	$20.19	$17.12	$37.31
Driving for Pleasure and Tourism			
Accommodation	$1.58	$1.16	$2.74
Food	$6.38	$6.45	$12.83
Supplies	$6.04	$4.25	$10.29
Other	$0.73	$0.88	$1.61
Total	$14.72	$12.75	$27.47

Sources: Sacramento-San Joaquin Delta Recreation Survey (1997); National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (1996 and 2006). *Note that "Accommodation" includes spending at campsites.*

[173] State Parks 1997
[174] USFWS 1996 and USFWS 2006

The analysis estimates direct trip-related economic impacts from resource-related and right-of-way/tourism recreation by multiplying medium estimates for activity-specific visitor days by the per-day expenditure estimates. Current direct impacts are estimated at $251 million inside the Delta (2011 dollars), as shown in Table 33.

Table 34 Estimated Direct Delta Recreation Trip Spending Impacts by Activity (2011$)

	Expenditure Inside Delta
Boating, Fishing, and Camping	
Accommodation	$33,572,000
Food	$53,354,000
Supplies	$72,571,000
Other	$34,929,000
Total	$194,426,000
Hunting	
Accommodation	$4,822,000
Food	$2,087,000
Supplies	$7,579,000
Other	$3,690,000
Total	$18,177,000
Other Resource-Related and ROW Activities	
Accommodation	$3,110,000
Food	$4,312,000
Supplies	$2,843,000
Other	$1,183,000
Total	$11,449,000
Driving for Pleasure and Tourism	
Accommodation	$2,456,000
Food	$13,621,000
Supplies	$8,980,000
Other	$1,868,000
Total	$26,925,000
Resource-Related and ROW/Tourism Total	
Accommodation	$43,960,000
Food	$73,374,000
Supplies	$91,973,000
Other	$41,670,000
Total	$250,978,000

While visitor spending occurs in a wide variety of categories, the bulk of visitor spending is likely to occur at recreation facilities, overnight accommodations, restaurants and bars, food and beverage stores, gas stations, and convenience stores. Comparing the estimated expenditure levels with total Delta revenue estimates for these industries shows that Delta recreation and tourism generates a large share of sales for these industries. For example, our estimates show that Delta recreation accounts for 90 percent of recreation sector spending, 58 percent of accommodation spending, 16 percent of sporting goods retail spending (including book and hobby stores), 12 percent of gas station sales, and 7 percent of restaurant and bar spending in the legal Delta.[175]

In addition, non-trip recreation spending can be attributed to the recreational opportunities in the Delta. In particular, the recreation impact analysis considers boat dealer, boat repair, and boat

[175] Industry and retail data from IMPLAN and ESRI, respectively.

storage business revenues in the Delta. The analysis quantifies retail boat sales and repair service revenues using establishment-level micro data from Hoover's and NETS. These data provide an estimate of total annual boat sales and repair service revenues at Delta business establishments. The analysis reveals that boat sales and services generate roughly $44 million per year for Delta businesses. In addition, the analysis estimates revenues associated with boat storage at $17 million per year in the Delta. This figure reflects year-round storage of 7,200 boats at an average monthly cost of $200 per boat.[176] In total, the analysis estimates current non-trip recreation spending in the Delta at about $61 million annually.

Combining trip-related and non-trip recreation spending in the Delta, the analysis estimates current annual direct spending on Delta recreation is approximately $312 million. Table 35 maps the $312 million in spending into more specific expenditure categories that are used for the economic impact analysis with IMPLAN.

Table 35 Estimated Direct Delta Recreation Trip Spending by IMPLAN sectors

Trip-Related Recreation Spending		
Hotels and motels	$	26,699,278
Other accommodations (i.e., campgrounds)	$	17,799,518
Food services and drinking places	$	63,364,613
Retail - Food and beverage stores	$	28,153,123
Retail - Gasoline	$	65,485,709
Retail - Sporting goods, hobby, book, and music	$	7,969,036
Other amusement and recreation industries (i.e., marinas)	$	34,806,041
Retail - General merchandise	$	6,862,926
Non-Trip Recreation Spending		
Retail - Motor vehicle and parts (i.e., boat dealers)	$	44,000,000
Other amusement and recreation industries (i.e., marinas)	$	17,000,000
Total	**$**	**312,140,244**

Table 36 summarizes the economic impact of recreation on the five-county Delta region as modeled with IMPLAN. Delta recreation and tourism supports about 3,063 jobs in the region including nearly 1,100 in restaurants and bars, 268 in hotels and motels, and 388 jobs at marinas. These jobs provide about $100 million in labor income, and a total of $175 million in value added to the regional economy. Based on a descriptive analysis of job location in the Delta in earlier chapters, it appears that the majority of these jobs are located in the Secondary Zone.

[176] Storage of 7,200 boats reflects 60 percent occupancy of the Delta's roughly 12,000 boat slips. Some boats may be transferred to dry storage during winter months. Occupancy data and storage rates were collected through an informal survey of Delta marina/boat storage facilities.

Table 36 Economic Impact of Delta Recreation and Tourism on Five Delta Counties

Impact Type	Employment	Labor Income	Value Added	Output
Trip-Related Recreation and Tourism Impacts				
Direct Effect	1,954	$52,553,680	$ 86,648,100	$166,731,376
Indirect Effect	395	$20,301,232	$ 34,425,490	$ 64,612,876
Induced Effect	367	$16,665,778	$ 30,962,200	$ 52,752,976
Total Effect	2,716	$89,520,688	$152,035,800	$284,097,216
Non-Trip Recreation and Tourism Impacts				
Direct Effect	217	$8,579,242	$12,625,960	$25,404,000
Indirect Effect	70	$3,468,025	$6,087,784	$11,016,298
Induced Effect	61	$2,752,687	$5,112,832	$8,711,717
Total Effect	348	$14,799,954	$23,826,570	$45,132,016
Total Recreation and Tourism Impacts				
Direct Effect	2,171	$61,132,922	$99,274,060	$192,135,376
Indirect Effect	465	$23,769,257	$40,513,274	$75,629,174
Induced Effect	428	$19,418,465	$36,075,032	$61,464,693
Total Effect	3,064	$104,320,642	$175,862,370	$329,229,232

Table 37 shows the statewide impacts of Delta recreation and tourism. For these impacts, we estimate an additional $205 million in recreation-related spending outside the Delta for supplies and travel. Statewide, Delta recreation and tourism supported over 5,300 jobs and $353 million in value added.

Table 37 Economic Impact of Delta Recreation and Tourism on California

Impact Type	Employment	Labor Income	Value Added	Output
Trip-Related Recreation and Tourism Impacts				
Direct Effect	3,144	$93,460,048	$154,608,500	$289,795,104
Indirect Effect	860	$50,102,816	$85,391,670	$161,296,176
Induced Effect	932	$46,813,804	$84,487,100	$148,968,112
Total Effect	4,936	$190,376,672	$324,487,300	$600,059,392
Non-Trip Recreation and Tourism Impacts				
Direct Effect	217	$8,584,650	$12,658,490	$25,404,000
Indirect Effect	81	$4,783,381	$8,298,579	$15,090,834
Induced Effect	83	$4,359,787	$7,867,653	$13,861,138
Total Effect	381	$17,727,818	$28,824,720	$54,355,972
Total Recreation and Tourism Impacts				
Direct Effect	3,361	$102,044,698	$167,266,990	$315,199,104
Indirect Effect	940	$54,886,197	$93,690,249	$176,387,010
Induced Effect	1,015	$51,173,591	$92,354,753	$162,829,250
Total Effect	5,317	$208,104,490	$353,312,020	$654,415,364

8.3.5.2 The Economic Impact of Recreational Boating and Fishing in the Delta

As a follow-up to the 1997 State Parks survey, Goldman et al. produced a report, The Economic Impact of Recreational Boating and Fishing in the Delta.[177] Using data from the 1997 survey on numbers of anglers and registered boat owners and their reported expenditures, Goldman et al. estimated the expenditures of registered boaters at $247 million in the Delta, generating $445 million in total output, $183 million in income, $279 million in value added, and 8,058 jobs in the overall Delta region. For licensed anglers, expenditures totaled $186 million in the Delta, generating $336 million in total output, $138 million in income, $209 million in value added, and 6,152 jobs in the overall Delta region. The authors note that the impacts from boating and fishing can not be aggregated, as many boaters fished, and many anglers boated. The authors also note that these numbers do not include the many other recreationists who participate in Delta-based activities such as driving for pleasure, non-registered boaters (i.e., kayaks and canoes), non-licensed anglers, hunters who do not boat, etc., and so is not a complete picture of the economic impacts of Delta recreation.

While the estimates of total recreation spending in the Delta are similar between the ESP and the Goldman study, at about $250 million (Goldman's boating estimate), there are two primary reasons why the Goldman study estimates significantly higher total regional employment and output attributable to recreation in the Delta. These factors are (1) the change over time in output per worker and (2) the method of accounting for direct output. Goldman's economic data is from 1994 when each nominal dollar of spending supported more employment than it does today. Specifically, the Goldman study indicates that total output of roughly $55,000 from Delta boating activities supports one job in the regional economy, while in today's economy the ESP finds that it takes approximately $105,000 in boating-related output to support one job. Furthermore, the Goldman study appears to count the full value of boater spending as production output value, whereas the ESP measures output in retail industries using the retail margin (i.e., the addition to the price of a product when the product is sold through a retailer). In the ESP, the $251 million estimate of in-Delta spending translates to approximately $167 million in direct output, whereas the Goldman study seems to treat the full value of sales revenue (e.g., $247 million of in-Delta boater spending) as direct output. Accounting for this difference, the Goldman study and the ESP reveal a very similar economic output multiplier within the regional economy.

8.3.6 Trends

The current status in Delta recreation shows a place of diverse recreation experiences, with approximately 12 million annual visitors, having an economic impact on the region of over $300 million. Yet, this recreation mecca is also suffering from economic conditions, physical and operational constraints, pressures on water supply, regulations that restrict development, and other internal and external issues. These trends must be taken into account when projecting the Delta's recreation potential over the next 50 years, as must the Delta's recreation history.

One way of estimating recreation use over the next 50 years is to look back in time. Fifty years ago (1960s), people engaged in virtually all the recreation activities they now enjoy. User survey data exists going back a little over 50 years. There are approximately 35 different outdoor recreation activities identified by State Parks with data collected nearly every five years over the 50-year period. Most of the activities track their growth with population, but some are decreasing in percentage of the total, while others have increased.

[177] Goldman et al., 1998

As discussed previously, the one factor that is relatively constant is the percentage breakdown between the three broad clusters of recreation activities: resource-related, urban parks-related, and right-of-way/tourism-related, i.e., 20 percent (16-23 percent) of activities take place in urban developed parks and golf courses; 50 percent (48-58 percent) are right-of-way related, including jogging, walking, bicycling, and driving for pleasure; and the remaining 30 percent (25-30 percent) occur in resource-related areas including state and national parks, forest service lands, nature areas, reservoirs, and rivers. These percentages have remained relatively constant over time, regardless of demographic changes. Another rather constant factor to consider is that approximately 70-80 percent of the total recreation use is simple, close to home, and with very little expenditure required for special equipment.

Therefore, it is anticipated that the outdoor recreation uses we find today will still exist, that the predominance of the activities will be simple, close to home, and require little expenditures, and that around 20 percent of the use will be developed urban park-related, 50 percent right-of-way-related, and 30 percent resource-related.

The Delta may likely become even more important for these types of uses because the populations that encircle it are expanding. Elsewhere, close-by outdoor recreation opportunities are rapidly disappearing. But the combination of land use protections, flood vulnerability, and rich agriculture land provide the likelihood that the Delta will still remain relatively unchanged in coming years.

In the Delta, the present uses are highly related to the availability and condition of private facilities. Most of the boating and fishing activities rely upon private marinas, even though the activities occur on public waterways. Most of the hunting in the Delta also occurs at private hunting clubs. Most Delta-as-a-Place destinations are related to wineries, farm stands, and commercial establishments in the Legacy Communities.

Developed local and state resource-related recreation areas in the Delta are quite limited, when compared to other areas in the state. Most public lands are nature and wildlife reserves, supporting nature study and bird-watching and, in some cases, hunting, but their public access facilities are either secondary to their mission or still primarily in the planning stages. They appear to have capacity to accommodate increased use over time. Some urban parks have been developed along the edges of the Delta, primarily in Stockton.

Another way to look at trends is through latent (i.e., unmet) demand revealed by survey data. State Parks survey data reports on latent demand by activity category.[178] The following activities were found by State Parks to be the top five activities that adults would like to participate in more often:

1. Walking for fitness or pleasure
2. Camping in developed sites
3. Bicycling on paved surfaces
4. Day hiking on trails
5. Picnicking in picnic areas

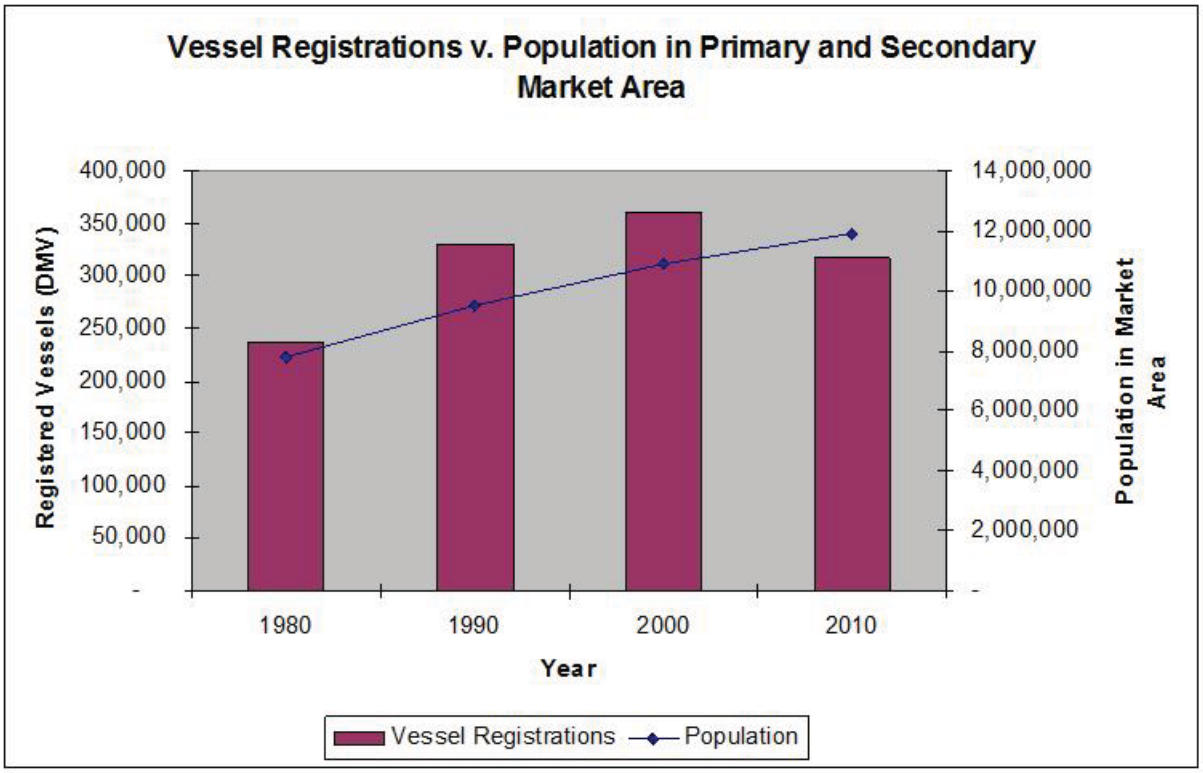
All of these activities take place in the Delta and represent an opportunity for growing visitation, if facilities were available and attractive.

[178] State Parks 2009, p. 36

USFWS reported on trends since 1996 in fishing, hunting, and wildlife viewing. Overall in California, fishing has declined 36 percent since 1996, while hunting has declined 45 percent (though it has been flat since 2001).[179] Conversely, away-from-home wildlife watching is up 23 percent since 1996. These data seem to represent a trend away from consumptive recreation (i.e., hunting and fishing) and towards non-consumptive wildlife recreation (i.e., bird watching and nature photography). State Parks figures also support these trends. Recreational programming and facilities in the Delta should respond to this trend.

The subsection on *Department of Boating and Waterways* in Section 8.3.4.2 above highlighted current (2010) boat registration numbers. Vessel registrations are down substantially since 2000 in both the state and the Primary and Secondary Market Area. In 2000, vessel registrations were at 902,447 statewide, and 359,541 in the Market Area, compared to 2010 numbers of 810,008 statewide and 317,571 in the Market Area. These numbers represent a decrease of 11 percent statewide and 13 percent in the Market Area. The 2010 number, however, is likely affected by the ongoing "great recession" and increasing costs of fuel and it cannot yet be determined if it represents a new trend. Figure 31 below shows boat registrations versus population over the past 40 years in the Market Area.

Figure 31 Vessel Registration v. Population in Primary and Secondary Market Area, 1980-2010



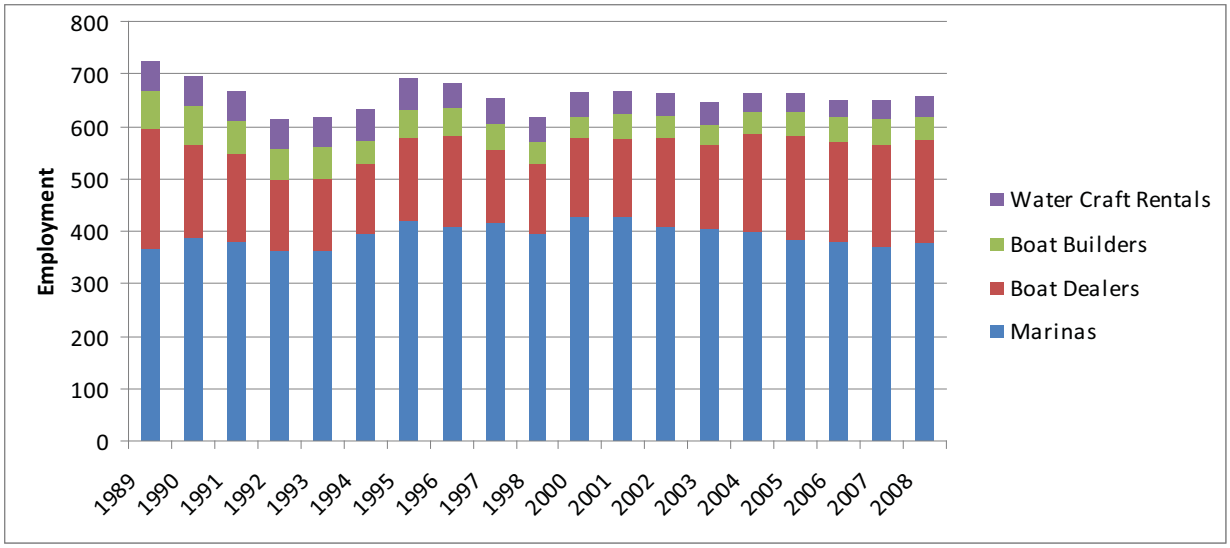
While boat registrations were increasing at a faster pace than population growth through the 1980s, they have increased at a slower pace than population growth since then, and as mentioned above, have decreased overall since 2000. As boating is the dominant recreational activity in the Delta, these trends indicate that motorized and sail boating may not keep pace with population growth over the next 50 years.

[179] USFWS 2006

Trends in non-motorized boating, however, seem to counter those of motorized boating, with DBW estimating that California households owning non-motorized boats increased from 7.11 percent of households in 2002 to 8.46 percent in 2010, with kayaks accounting for almost one-half of estimated participation.[180] Overall, the report concludes that "the number of non-motorized boating participants is expected to continue to increase".[181] This report also notes that per-trip expenditures for non-motorized boaters are less than per-trip expenditures for motorized boaters,[182] a conclusion which has implications for continuing economic sustainability.

Available business enterprise-based data reveal stagnation in the Delta's recreation economy. Over the past 20 years, employment in marina enterprises has been relatively flat. In 1990, the database counts 95 marina-related establishments, 90 in 2000, and 93 in 2008. Likewise, employment by water-based recreation-related establishments has remained relatively constant over the past 20 years, as demonstrated by Figure 32.

Figure 32 Employment in Legal Delta for Water-Based Recreation Sectors, 1989-2008



Source: NETS

There are several other external or societal trends that could affect the present recreation use and demand over the next 50 years.

- Physical changes to the Delta related to habitat restoration and water deliveries, which will likely result in increased habitat acres and water surfaces with a potential decline in agriculture acreage
- Increasing population and development growth surrounding the Delta, forming a larger urban ring around significant portions, with probable exceptions for valuable, healthy near-urban ecosystems and productive agricultural lands
- Increasing population seeking out various forms of outdoor resource-related recreation, increasing the significance of the Delta as a contrast to local urbanized areas
- An increasing interest in maintaining close-to-urban agriculture to supply fresh fruits and vegetables

[180] DBW 2009, p. 9-1 – 9-6
[181] Ibid, p. 9-11
[182] Ibid, p. 4-5

- Increasing concerns over "nature deficit disorder" among young people and greater interest in youth access to meaningful natural experiences
- Health concerns, such as obesity, and the need for more exercise activities
- Continued decline and stagnation of existing facilities without new capital investments

8.3.7 State Parks Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh[183]

Under SBx7-1, State Parks was directed to prepare a proposal "to expand within the Delta the network of state recreation areas, combining existing and newly designated areas."[184] The resulting *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* discusses existing demand, existing resources, trends, and recommendations and outcomes. By its legislative mandate, the report focuses on public sector resources and state agencies. In this report, State Parks introduces the concept of a Gateway-Basecamp-Adventure strategy. A Gateway is defined as a "community on the edge…providing information to visitors about recreation opportunities available in an area and equipping them with supplies for the adventure."[185] A Basecamp is a "park, resort, or town…providing services, as well as facilities."[186] One would depart for an "Adventure" or activity from a gateway or basecamp. Gateways, basecamps, and adventure areas State Parks recommends are linked by scenic highways and biking, hiking, and boating trails. Around this strategy, State Parks discusses the importance of partnerships, and recommends building a Delta brand, providing direction, diversifying activities, and minimizing costs by seizing multi-use opportunities.

Using the Gateway-Basecamp-Adventure strategy, State Parks recommends improvements to existing State Parks within and along the edge of the Delta, and describes four potential future State Parks in the Delta-Suisun Marsh Region: Barker Slough, Elkhorn Basin, Wright-Elmwood Tract, and South Delta.[187] State Parks also provides recommendations for other state agencies, including DFG, DBW, Caltrans, DWR, the State Lands Commission, Delta Protection Commission, Delta Conservancy, and Coastal Conservancy. Other recommendations include completing the recreation trails system in the Delta and for DPC to continue to pursue a National Heritage Area designation.[188]

Important to this Economic Sustainability Plan, State Parks also recommends ways to increase recreation contribution to the Delta economy.

- Promote recreation to increase spending
- Increase the variety of recreation available
- Encourage visitors to stay longer and experience additional activities
- Offer a mix of both affordable and higher cost recreation activities
- Increase spending for supplies and equipment in Gateways
- Enhance and promote scenic highways and trails

State Parks *Recreation Proposal for the Sacramento San Joaquin Delta and Suisun Marsh* offers a strong framework for needs and opportunities for the provision of recreation and tourism in the Delta by state agencies. However, the report concludes, "Recreation and tourism can also help sustain the region's economy and enhance its quality of life. This report's

[183] State Parks 2011
[184] Water Code Section 85301(c)(1)
[185] State Parks 2011, p. 6
[186] Ibid
[187] Ibid, p. 22-24
[188] Ibid, p. 26-29

recommendations may remain just a glittering vision, however, without new funds for recreation."[189]

8.3.8 Key Findings

- The Sacramento-San Joaquin Delta is an area where a diversity of recreation experiences is evident, from boating in open water or through winding tree-covered channels, to hunting or wildlife viewing, studying local California history, or tasting award-winning local wines. Several physical and operational constraints have an impact on current facilities and recreation access, including sediment accumulation, water gates, screens, and barriers, invasive species, waterway obstructions, water quality, lack of boat-in destinations and access points, user group conflicts, private land trespass, and complex regulations.
- While a percentage of visitors to the Delta come from elsewhere, the majority of visitors are from Northern California. These visitors represent the focal market for Delta recreation growth opportunities in the future, and their places of origin define the market area for this study. The total Market Area had a population estimate of approximately 11.9 million in 2010, with projections of 17.6 million by 2050.
- Recreation visitation for 2010 is estimated to be approximately 8 million *resource-related* (e.g., boating and fishing) visitor days of use per year, 2 million *urban parks-related* (e.g., golf, picnic, and turf sports), and 2 million *right-of-way-related* (e.g., bicycling and driving for pleasure) recreation visitors/year. The total number of activity days is conservatively estimated at approximately 12 million/year.[190]
- An up-to-date visitor survey with new primary data, particularly on non-boating and non-fishing recreation, is needed to better document existing recreation visitation and spending. Employment in recreation-related economic sectors, including marinas, water craft rental, boat dealers, and boat building and repair, within the Primary Zone has been relatively flat over the past 20 years.
- The principal changes and trends that could affect the present recreation use and demand over the next 50-90 years are: physical changes to the Delta due to water conveyance management changes and rising sea levels, increasing population and development growth, increasing agritourism, non-consumptive resources-based recreation, and habitat-related recreation, and the likely desire for closer to home recreation.
- The current direct spending in the Delta region from *resource-related* and *right-of-way/tourism-related* trips and related non-trip spending is estimated at roughly $312 million inside the Delta (in 2011 dollars). Additional economic impacts associated with urban recreation are not quantified, but are likely significant.
- Delta recreation and tourism supports over 3,000 jobs in the five Delta counties. These jobs provide about $100 million in labor income, and a total of $175 million in value added to the regional economy.
- Delta recreation and tourism supports over 5,300 jobs across all of California, and contributes about $353 million in value added.
- State Parks *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* offers a strong framework for needs and opportunities for the provision of recreation and tourism in the Delta by state agencies.

[189] Ibid, p. 34
[190] Estimates are based on limited available data combined with professional judgment.

8.4 Outcomes and Strategies

The prior section discussed the current status of recreation in the Delta, including existing facilities and estimates for existing visitation and economic impacts. There was also a short discussion on current trends. In this section, a plan is developed for a strategy for economic sustainability for Delta recreation and tourism.

The proposed recreation portion of the Delta Economic Sustainability Plan brings together information regarding baseline conditions described in Chapter 6 with three topic areas—constraints/issues, influences on the Delta as an evolving place, and potential responses—as a means of determining how the Delta might evolve over time. Principles, goals and physical strategies are then applied in order to develop the proposed recreation plan.

8.4.1 Opportunities and Constraints

There are many current and future potential constraints and issues which will shape recreation potential in the Delta. Several existing physical and operational items were described in Sections 8.3.2 and 8.3.3 of this chapter. Those that would have the most significant impacts on future planning scenarios are expanded below.

8.4.1.1 Limited Access and Visibility

The Delta is a recreation landscape of two faces: one seen from the water and the other experienced largely from a car or in one of the Legacy Communities. For all its hundreds of miles of waterways, the waters of the Delta can be publicly accessed in a relatively few places. Dotted with private marinas and few public parks, boats can only reach Delta waters from these boat slips and ramps, as well as from private docks and remote put-in spots outside the Delta. Transient tie-ups or places to temporarily tie up a boat are also limited. Similarly, there are relatively few landside recreation facilities that offer public fishing, camping, or picnicking, and overnight hospitality options are relatively few. With few communities, parks, trails, and public destinations, the vast land area for the most part is accessible only through the windshield.

8.4.1.2 No Distinct Delta Identity

For the same reason the Delta lacks a distinct identity as place, it lacks both an operational and marketing identity. Unlike a known brand like “Monterey,” “Delta” lacks brand recognition. In addition, it lacks a strong identifying focal point area, like Fisherman’s Wharf and the Monterey Bay Aquarium. For all its beauty, allure, and recreational diversity, the Delta functions as a largely underutilized destination, unknown to many in the larger Sacramento and Bay areas and the state, and not easily discoverable to those who do not already know and use the area.

8.4.1.3 Two Contrasting Physical Environments

The Delta comprises two contrasting physical environments that bump against one another, sometimes harmoniously and sometimes in conflict. Many agricultural islands, hidden from the waterways by levees, lie significantly below river level. This physical, visual, and land use juxtaposition makes the edge between the two environments problematic and limits access to waterways.

Boating use occurs on public waterways that abut, for the most part, privately-owned agricultural or residential property. It is the inclination of boaters to occasionally beach their boats and access the shoreline, which can result in trespass and potential damage to private property. Boat wakes can damage levees. Levees, subject to erosion, are often lined with armor, which discourages landing by boaters and precludes shoreline recreation use other than incidental bank fishing by landside fishermen. The resulting environment allows for boat passage but

virtually no shoreline recreation use in these areas, a significant deterrent to expanded boating use. Aesthetic values of unvegetated riprap levees are low, further diminishing their appeal.

8.4.1.4 Private Marina Limitations

Most boat access to Delta waterways is provided through private marinas and boat launch ramps; state and local public launch facilities are provided to a limited degree. There are relatively few opportunities for overnight stays for boaters without self-contained facilities. Over the years, the private marina market has adjusted to provide for the demand for boat storage slip space, which is the primary revenue source for marina operators. Launch ramps and parking space for trailered boats is available in limited supply at marinas as boat launch revenues generally are not a significant revenue source and land for parking is limited landside of the levees.

Marinas face siltation of their boat basins, and costs and regulatory hurdles to maintenance are significant. Many marinas and resorts are aging and suffer from deferred maintenance, diminishing their appeal to new users.

A further limiting factor to increased use by visitors trailering boats to the Delta is its “hidden” quality. Boat put-in locations are often not easily seen and must be sought out by the first-time visitor. Many facilities are located in out-of-the-way locations. Further, given the narrow spaces many marinas occupy, with parking and roadways built atop narrow levees, launching and parking maneuvers can be challenging, even for experienced operators. Boating use has tended to be relatively local in nature and therefore primarily a day-use activity, which limits economic activity generated by recreation.

8.4.1.5 Other Facility Limitations

In addition to private marinas that only offer slip rentals, launching, and related services, some private resorts offer camping and day-use facilities. Resorts of this kind are limited, revenue potential is also limited, and these resorts operate on at a tight margin. There are some state and local parks that also offer similar facilities, however, such landside recreation amenities are relatively rare in the Delta.

Traditionally, in the Delta, recreation improvements have been largely provided by the private sector, and public investment in land and facilities has been small. Declining public recreation budgets have contributed to declining maintenance and facility quality and no schedule for expanded development. State and local agencies have developed multiple plans for expanding Delta recreation that have remained unfunded for many years. The most recent plan by State Parks, *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh*, states that no funding is available for implementation and the largest State Park in the Delta, Brannon Island State Recreation Area, is currently on the proposed closure list.

8.4.1.6 Waterway Concerns

An additional constraint to expanded boating use in the Delta is its geography. By its nature, a labyrinth of waterways that lacks obvious navigational landmarks, the boater unfamiliar with it can easily become lost. Although increasing use of GPS devices reduces this risk, many inexperienced boaters continue to be reluctant to tackle Delta navigation.

Similarly, Delta waterways can be unpredictable in depth and contain unseen underwater hazards that can discourage the uninitiated boater. Snags, sandbars, and submerged levees are common hazards that can catch the casual boater.

Water quality is also an issue to some boaters and shoreline users in the Delta. With limited clarity and concern over water quality, some are deterred from engaging in water contact in the Delta. Velocity of currents makes swimming more hazardous in some locations. Many boat owners avoid saline water, and salt water intrusion could render increasing areas of the Delta off limits to these boaters. Invasive aquatic plants, including water hyacinth and *Egeria densa*, further reduce access and appeal to boaters and fishermen by impeding navigation and damaging boat motors.

8.4.1.7 Regulatory Environment

While most local jurisdictions, including counties and cities, have policies that encourage recreation in the Delta, they also have regulations which preclude or severely limit new development or services, or redevelopment of existing facilities. So, while protecting the atmosphere of the Delta-as-a-Place, these same policies also inhibit economic growth and sustainability. Additionally, several state and federal agencies have regulatory authority over changes to Delta facilities. The effects are felt from businesses in Legacy Communities to isolated wineries to marinas and other pubic and private recreation facilities. For instance, permits for a new marina or even a marina upgrade may require input from the local county, the State Department of Boating and Waterways, Delta Protection Commission, State Lands Commission, Reclamation Board, State Department of Fish and Game, Regional Water Quality Control Board, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. These many layers of regulations are, at best, costly, time consuming, and confusing, and, at worst, completely prohibitive to new recreation developments or enhancements.

8.4.2 Opportunities and Influences

This Plan is charged with working within the context of the Delta as an evolving place. The existing baseline conditions, as well as its constraints and issues, will affect that evolution. The following key opportunities and influences will also help shape that future.

8.4.2.1 Increasing Demand

By 2050, population in the counties surrounding the Delta is projected to grow by 50–60 percent. As population and gasoline prices increase, there will be a growing focus on recreation opportunities close to population centers. The Delta is not only close to major population centers, but accessible via the interstate and state highway network that surrounds and bisects it. Increasingly, past experience would indicate, the Delta, will become a primary source of open space and recreation activity for the greater Northern California region.

If so, existing boating access and landside recreation opportunities today will be inadequate to attract and accommodate this growing demand. New opportunities to experience the existing and restored natural habitats of the Delta will likely attract new visitors. Similarly, increased agritourism should create demand for expanded overnight visits to Legacy Communities and the growing wine region. Recreation, wildlife viewing, and agritourism will likely grow together, fueling the interest in the Delta and reinforcing its emerging identity as “place”. A synergy between these uses will create new opportunities for visitation and economic activity in the Delta.

8.4.2.2 Physical Capacity of Delta Waterways

Current levels of boating and fishing fall far short of the physical capacity of the Delta waterways for recreation. Within the great size and diversity of Delta waterways, there is significant capacity for additional boating use and diversity in the future. Population growth will expand the demand for all forms of recreation in the Delta. These uses can be accommodated through

expanded points of access via land- and water-based facilities. These facilities in some cases would require conversion of land from other uses.

8.4.2.3 Public Lands

Nearly all public lands that have been acquired in recent years within the Delta have been set aside as wildlife habitat but provide little or no public recreation use or access. There may be significant opportunities to include appropriate public use that would be compatible with habitat-management objectives. Renewed funding for implementation of agency recreation plans, such as State Parks' *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh*, could provide a significant expansion of access and facilities that could boost recreation use.

8.4.2.4 Quality of Life

The Delta appeals to both residents and visitors not only because various Delta features combine to create a unique aesthetic, but also because the tangible attributes and the intangible Delta aesthetic add value to their lives. Planners can anticipate that residents and recreationists will express strong viewpoints on suggested plans or changes that would have an impact on the Delta's quality-of-life features, and that residents and visitors will want these quality-of-life values incorporated in planning efforts.

8.4.2.5 Delta-as-a-Place

The Delta must be a better-defined destination for visitors. Increased programming, special events, festivals, and marketing have the potential to significantly increase visitation and recreation use Delta-wide. Linking the vitality and tourist appeal within Legacy Communities would boost overall Delta recreation and attract a new segment of visitors. Joint marketing of events in these communities tied to farm trail, wine trail, and boat trail tourism would be a further means of increasing visitation, visitor spending, and economic activity. These steps, adjunct to traditional Delta recreation enhancements, would boost the identity of the Delta as a destination with multiple attractions and enhance Delta branding and recognition.

The Delta-as-a-Place identity would also be enhanced by efforts to identify and establish Gateways and edges to the Delta that reinforce its unique landscape character, particularly along the primary east-west highway corridors.

8.4.2.6 Market Area Development

Projected population growth within communities on the edge of the Delta may likely create additional demand for recreation offerings. Urban water-front recreation improvements such as those built by the City of Stockton over the last few years will provide capacity for new visitors to participate in leisure activities. This trend could continue if communities such as Rio Vista, Tracy, and Lathrop orient planned development towards the Delta, interconnecting recreation corridors on the periphery of the Delta, and contributing to buffer zones between urbanized areas and the Delta to provide additional recreation opportunities.

Development of Delta-edge and cross-Delta trails, connection of open space areas, and capturing land and water views within the Delta can further add to the growing fabric of Delta recreation and access and the capacity to accommodate additional visitors.

8.4.2.7 Agriculture Trends

Evolutions occurring in agriculture include increases in wine grapes and wineries, a growing interest in developing a coordinated "farm trails" effort with the goal of increasing agritourism and direct sale of agriculture products, and the desire to "brand" Delta agriculture products. These three efforts could influence Delta recreation economics.

8.4.2.8 Recreation Activity Trends

Recreation use patterns continue to evolve. Basic recreation activities are generally constant, but trends occur within the activity. For instance, in boating, there are two trends where large craft are increasing faster than small craft, and participation in non-motorized boating is increasing at a faster rate than motorized. Other trends involve the provision of high-end camping, recreation-oriented urban redevelopment and development centers, and increased interest in small rural communities.

8.4.2.9 Coequal Goals and Risk Management

The efforts and ultimate implementation to meet the coequal goals of protecting, restoring, and enhancing the Delta ecosystem and creating a reliable water supply will influence future recreation developments and activities in the Delta. Studies of and responses to numerous potential concerns including land subsidence, earthquakes, rising seas, and changing precipitation patterns could also influence the future of recreation and tourism in the Delta.

8.4.2.10 Future Prominence

As growth in the region and the state continues over the coming decades, the Delta has the potential to emerge as a recreation resource of increasing value and appeal and its prominence as a destination will expand accordingly. Increasing water-oriented recreation demand and the associated demand for landside recreation activities can combine with the growing appeal of agritourism and locally-grown food and wine to reinforce the identity of the Delta as a unique and desirable recreation destination for the northern California region.

8.4.3 Potential Responses

The potential response to the constraints, issues, and influences should shape the Delta's Recreation Economic Sustainability Plan. In the past, various federal, state, and local agencies, as well as nonprofit and for-profit entities have each contributed pieces of the total recreation picture in a somewhat uncoordinated fashion.

California State Parks, in the *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh*[191] lays out a coordinated response for the various state agencies involved in the Delta. It also speaks to the need for both itself and other state agencies to partner with local agencies, nonprofits, and private businesses.

One of the most successful and easily understood examples of creating a recreation destination in California is the Monterey Old Fisherman's Wharf which, in a small area, attracts in excess of six million visitors annually. It is a merger of public and private efforts wherein agencies created a synergistic setting for private enterprise. The city built the wharf, marina infrastructure, parking lots, and access roads, the State Department of Boating and Waterways provided marina development loans, and State Parks contributed an adjacent visitor center and historic building restorations.[192] The private sector created and operates the restaurants and shops along with providing fishing, whale watching, and other recreation activities. The Fisherman's Wharf Association helps to coordinate and market the wharf. State Parks continues to operate Monterey State Historic Park, a collection of historic houses and buildings, with interpretation, educational programs, and special events support from the nonprofit Monterey State Historic Park Association.[193,194]

[191] State Parks 2011
[192] http://montereywharf.com/index.php?page=history
[193] http://www.parks.ca.gov/default.asp?page_id=575
[194] http://www.montereystatehistoricparkassociation.org/index.html

Private enterprise is both the existing and future driver of economic sustainability in the Delta, but its future success level can be shaped by the public facility contributions and regulatory environment. This Plan recommends developing a synergistic response between state and local agencies, nonprofits, and the private sector.

The implementation of the ESP will be very complex. Overcoming the multiple steps, regulations, and planning processes by either agencies or individuals can be difficult for normal projects. But, the multiplicity of agencies and interlocking safeguards and regulations in the Delta multiplies the difficulties. It is recommended that a facilitator organization be named to assist implementation efforts, to coordinate funding, and to stimulate funding for vital actions. A more in-depth discussion is presented in Chapter 11 of this report.

8.4.4 Recreation Enhancement Principles and Goals

It is recommended that the following principles and goals be used to guide development of planning scenarios for future Delta recreation. These principles and goals were developed to minimize current constraints and to take advantage of current and future opportunities. This Plan was developed with the following guidelines at the forefront.

- Avoid developing recreation facilities within high flood risk areas or areas inaccessible during emergency flood events.
- Avoid conflicts with vital habitat resources.
- Respect and protect agriculture areas. Avoid locating recreation sites in areas that would create conflicts with agriculture and instead site, when possible, in more compatible areas such as around the edges of the Delta, in combination with Legacy Communities, and by expanding existing areas.
- Respect and protect hunting activities by avoiding spatial and/or timing conflicts with other activities.
- Create positive park, open space, and trail edges that buffer the Delta from encroaching urban and suburban areas.
- Encourage both commercial and public recreation facilities—including marinas, food service, overnight accommodations, and standard community park developments—within or on the edge of Legacy Communities and existing recreation areas.
- Develop appropriate visitor-serving access facilities at wildlife areas providing nature study, bird-watching, and environmental education. Include interpretive signage to educate the public about the natural resources values of the Delta and their need for protection.
- Recognize private enterprise's primary role in providing recreation facilities and encourage and facilitate appropriate expansion to keep up with increasing populations and changing demand.
- Support programs to assist existing private recreation providers, such as identifying or providing loan funds, coordinating marina dredging and permitting, and helping them respond to sea-level changes.
- Recognize the multiplicity of public agencies and nonprofit entities which provide recreation in the Delta and encourage coordination in planning for, and provision of, recreation opportunities.
- Utilize State Parks Basecamp, Gateway, and Adventure concepts, as described in the *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh,* which

encourages the concentration of new facilities within and near existing recreation areas while developing and enhancing the attractiveness of points of interest in appropriate locations throughout the Delta.[195]

- Promote the creation of recreation destinations as focal points of the Delta. Such multi-interest complexes should each highlight Delta values by incorporating one or more Legacy Communities, marina resorts, public and private recreation basecamp areas, natural wildlife areas, and trails. The complexes should be based upon existing community values and highlight existing Delta and community resources.
- Encourage the creation of settings for private enterprise development through the development of ancillary public facilities such as trails, event venues, community docks, etc.
- Advocate for overnight extended stay within or adjacent to the Delta through program offerings, multiple points of interest, and available accommodations.
- Increase the public's awareness of the Delta as a desirable recreation destination through better regional coordination, advertising and signage, marketing, and promotional-scale events.
- Identify and develop appropriate opportunities for small boat-in day-use areas, as well as larger destinations akin to Delta Meadows for boaters. Such areas should provide basic facilities for boaters, such as docks, tie-ups, restrooms, as well as opportunities to participate in many different forms of recreation.
- Develop appropriate locations throughout the Delta for a network of hard-surface non-motorized, multi-use trails, as well as boat trails for both motorized and non-motorized craft, including completing planning and implementation of the Great Delta Trail,[196] and trails recommendations from State Parks.[197]
- Ensure appropriate and coordinated response to operational issues including exotic aquatic vegetation control, boater safety enforcement, waterway maintenance, abandoned and derelict boat removal, boating hazard control, etc.
- Provide additional on-shore access facilities for shore fishing and motorized and non-motorized boat launching.

8.4.5 Recreation Enhancement Strategy

8.4.5.1 Basic Approach

Planning Interrelationships

The Delta Stewardship Council Delta Plan provides recommendations for the Delta as an Evolving Place. Relative to this Economic Sustainability Plan, the Delta Plan recommends that "ways to encourage recreational investment along the key river corridors be identified."[198] State Parks, in its recreation proposal for the Delta,[199] looks at the Delta and Suisun Marsh as a whole, including State Recreation Areas, wildlife areas, and other state facilities. The scope of this Economic Sustainability Plan for recreation encompasses the entire Legal Delta, with a

[195] State Parks 2011
[196] DPC 2010
[197] State Parks 2011
[198] DSC August 2011 p. 197 (Fifth Staff Draft)
[199] State Parks 2011

focus on the Primary Zone, but will also include Legacy Communities, marinas, agritourism, and other private enterprise activities.

It is anticipated that the final Delta Plan, State Parks' recreation proposal, and the DPC's Land Use and Resources Management Plan may need to be refined for consistency with this Plan. Ultimately, any refinements to a final recommended action plan need to be supported by both the recreation and resident community of the Delta.

Components

State Parks' recreation proposal coordinates with and provides recommendations for each of the state agencies involved in various portions of the recreation sector in the Delta. It does not, however, provide recommendations for local agencies and private enterprises. Private enterprise presently constitutes nearly all of the economic activity related to recreation in the Delta. Therefore, this Plan examines all three sectors and the potential synergies between state agencies, local agencies, and the private sector.

Catalysts

A key strategy for achieving synergies between the public and private sectors is to plan for relationships wherein public agency facilities interrelate, complement, and create catalyst settings for private enterprise activities, while at the same time providing public services. These services can include both recreation facilities as well as vital infrastructure to support both public and private areas. Catalyst settings should be created whereby joint public-private efforts could support an expanding and diversifying menu of recreation and cultural attractions and events, as well as overnight accommodations, restaurants, retail, and other services.

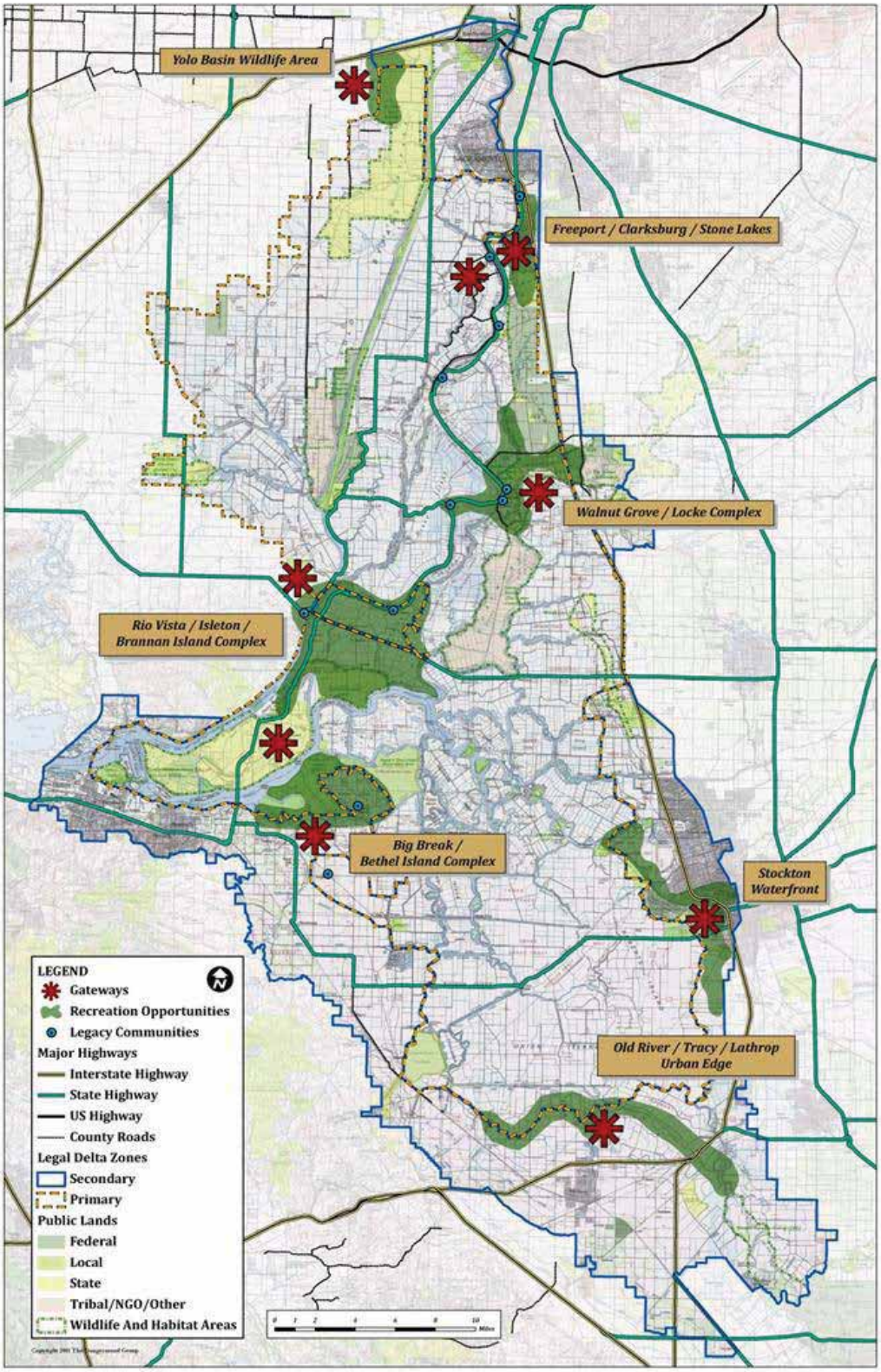
Location

Concept locations for where catalyst settings, facilities, and activities could be accomplished are proposed below. The locations are primarily focused around the edges of the Delta and in and around Legacy Communities. These recommended locations are based upon the principles and goals previously discussed, and consist of the following five concepts (See Figure 33).

1. Delta waterways
2. Dispersed, small points of interest and activity areas
3. Focal point destinations
4. Public access to existing and planned natural habitat areas
5. Delta-urban edges (the edges of existing and emerging urban areas that surround the Delta) such as Stockton, Tracy, Rio Vista, and Lathrop

Each concept and how it relates to influences and proposed locations is described in greater detail below.

Figure 33 Recreation Enhancement Strategy Plan[200]



[200] For high resolution image see http://forecast.pacific.edu/desp-figs.html

8.4.5.2 Delta Waterways

The primary location for recreation in the Delta is, of course, the waterways. These waterways are diverse—narrow, wide, tree-lined or channelized, windy or quiet. Boaters have, over time, selected areas for their specialty activities such as windsurfing, waterskiing, cruising, paddling, etc. For instance, the waters flowing along the northwestern side of Sherman Island are a mecca to windsurfers and kiteboarders. Specialty needs are associated with most of these diverse activities.

The Delta Protection Commission's 2006 *Aquatic Recreation Component of the Delta Recreation Strategy Plan* is still very applicable. It recognized the existing use areas, access points, and marinas, and provided recommendations regarding their enhancement, refurbishment, and expansion. In addition, the report recommended three priority new enhancements.

It recommends that non-motorized boating trails be established in six different locations on waterways where habitat values are primary and where such use would not conflict with power-boating activities. A second recommendation is that major boat-to destinations, similar to Delta Meadows, be established in other parts of the Delta. Further study is required to determine where these might be appropriate, but four possible areas were provided. The third recommendation was that smaller boat-in day-use areas with adequate facilities and transient tie-ups be established in appropriate locations throughout the Delta. Suggested elements and features for these areas, as well as location criteria, are provided within the report, but no specific locations are identified.

In addition, the report indicated the need for continued navigability of waterways, as well as provision of new and expanded facilities in the future. These included more boat launching ramps, marina slips, boating support facilities, public access to waterways for anglers, and convenience docks related to Legacy Communities and points of interest.

The 2006 *Aquatic Recreation Component of the Delta Recreation Strategy Plan* predates the present, more comprehensive legislatively mandated Delta planning efforts. The above elements to the plan are still relevant and applicable, but some of the new influences on the Delta's evolution will require additional responses as related to Delta waterways recreation.

- The efforts of creating a sustainable, healthy ecosystem will likely create additional waterways that should be reserved for the increasing interest in non-motorized boating.
- Plans to create salmonid-friendly edges to the lower Sacramento River could influence the location of, and facilities for, windsurfing and board sailing activities in this strategic location.
- Reliable water supply facility studies should be coordinated with recreation potentials in order to avoid impacts and to potentially provide additional recreation opportunities.
- Potential risk management strategies including setback levees should be studied for possible joint use for waterway-related recreation. Such strategies may require relocations of existing access facilities and it is recommended that such relocations, if necessary, take the opportunity to provide complete, up-to-date facilities.

8.4.5.3 Dispersed Points of Interest and Activity Areas

The Delta's diverse points of interest and activity areas are dispersed throughout its vast landscape. These features grant the Delta a distinctive character, especially in contrast with the surrounding urban and even rural agriculture landscapes. Overall, this aspect has come to be referred to as Delta-as-a-Place. These diverse points of interest—the small Legacy

Communities, the loose network of marinas scattered throughout the area, the farm stands, wineries, and surrounding agricultural landscapes, winding waterways, and intriguing riparian landscapes—underscore the need to protect, enhance, and expand the elements that give the Delta its charm and sense of place. The sheer number and diversity of things to see and do is a valuable feature.

The expansion, over time, of additional areas will be accomplished primarily through private enterprise responding to opportunities such as farm markets, wineries, art galleries, restaurants, etc. On the public side, the Department of Water Resources[201] identified, in a past study, approximately 40 small day-use, launching, and fishing access locations that were economically viable, but which were never developed. State Parks has identified 13 park and facilities expansions and development.[202] Federal, state, and nonprofit wildlife entities have planned facilities for increasing and managing public access and use.

Policies should be developed to encourage private development of additional appropriate facilities in non-conflicting locations and funding needs to be identified to accomplish appropriate public agency-planned improvements.

8.4.5.4 Focal Point Destinations

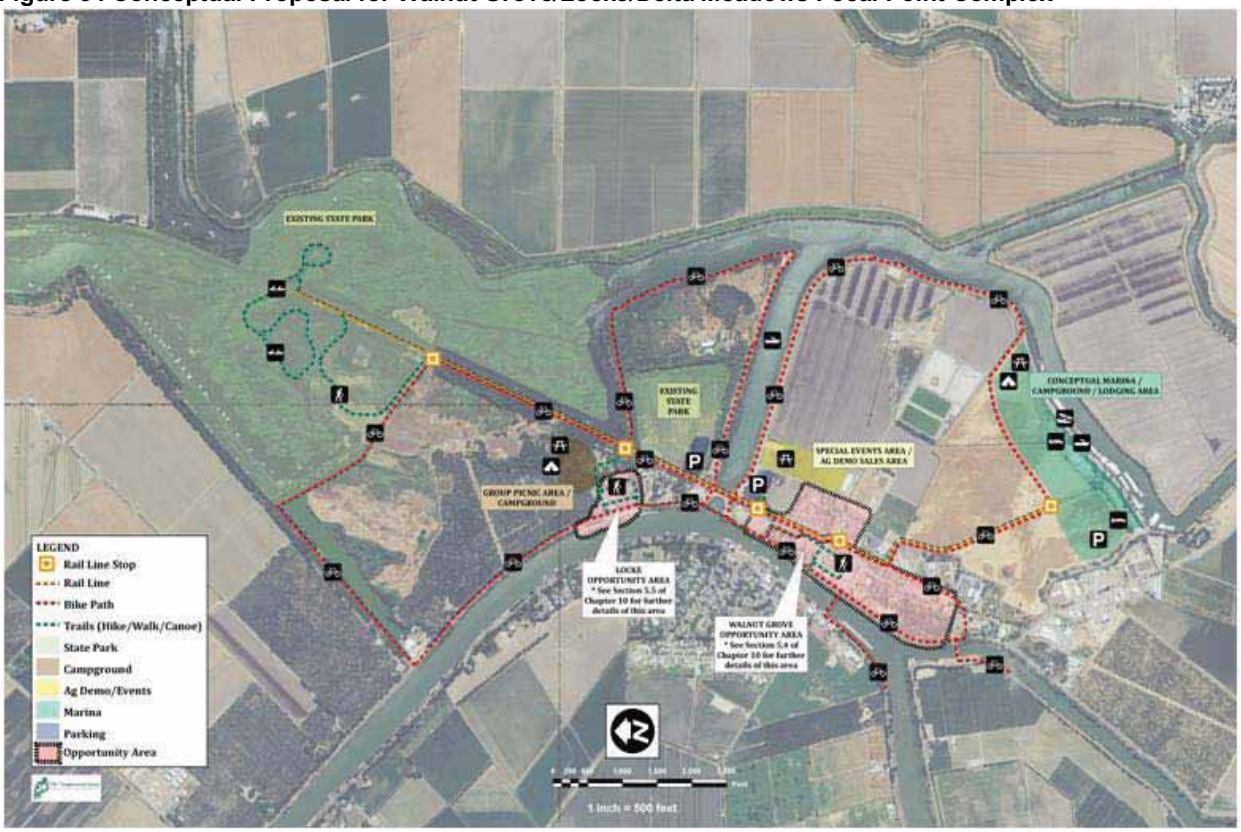
An important way to expand recreational capacity, increase visitor spending and lengths of stay, and draw new visitors to the Delta is to create destination complexes, similar to State Parks' Gateway-Basecamp-Adventure concepts.[203] By concentrating multiple recreation opportunities in an interconnected location, these complexes would provide focal points to visitors, particularly new visitors, and also present opportunities for businesses to develop economically viable operations. These complexes should include, and build upon, the primary values of the Delta.

Three locations have been identified that already have complexes of the values of natural areas, parks, Legacy Communities, marinas, historic features, and trail potentials. They are: (1) Walnut Grove/Locke/Cosumnes River Preserve, (2) Brannan Island/Rio Vista/Isleton, and (3) Bethel Island/Jersey Island/Big Break. In addition, an emerging complex along the edges of Stockton also has the potential to be developed into a focal point destination.

The first focal point destination is proposed to include the Legacy Communities of Locke, Walnut Grove, Ryde, Cortland, and Hood, as well as Delta Meadows, the Cosumnes River Preserve, and Staten Island. Figure 34 below presents a conceptual drawing of proposed features. Additional public facilities should include developed day-use and camping facilities at Delta Meadows, events venues, further improvements/restorations at Locke, and wildlife viewing/nature study opportunities. A network of water and land trails would knit together the complex and give it a sense of cohesion. A segment of the historic railway connection between Old Sacramento and the Delta could be used to foster the growth of critical mass at this complex, making it more attractive for investment. Chapter 10 discusses some strategies for the Legacy Communities, but additional features and activities could be evaluated to assist in creating viable settings for private enterprise operations.

[201] DWR 1981
[202] State Parks 2011
[203] Ibid, p. 6

Figure 34 Conceptual Proposal for Walnut Grove/Locke/Delta Meadows Focal Point Complex[204]



The Brannan Island/Rio Vista focal point destination complex is proposed to include Isleton, the emerging Delta Discovery Center and Farmer's Market, and the marina complex around the junction of the San Joaquin and Old Mokelumne Rivers. Possible habitat areas on Twitchell and Sherman Islands, the windsurfing oriented Sacramento County Regional Park on Sherman Island, and Brannan Island State Recreation Area could be knit together with the communities and marinas with a network of trails. Development of additional features to create settings for private enterprise should also be evaluated for this proposed destination complex.

The Bethel Island focal point would include its marina and existing businesses, Big Break Regional Park, and a natural-lands conversion of Jersey Island. As with the other proposed complexes, these areas could potentially be tied together and enhanced with both landside and water trails.

The proposed focal point along Stockton's edge has a different character and does not include a Legacy Community or a major natural landscape feature. The planning and emerging development for the area, however, create a Delta-related focal point area because the recent designation of the westerly portion of Wright-Elmwood Tract as open space and a possible State Recreation Area, in partnership with local agencies, provides the opportunity for additional park, trail, and habitat restoration improvements.

8.4.5.5 Natural Habitat Areas

The fourth location-based recreation enhancement strategy is the association of appropriate visitor access to natural habitat areas with and on the edges of the Delta. Three existing natural

[204] For high resolution image see http://forecast.pacific.edu/desp-figs.html

habitat areas have the potential of providing expanded environmental education and nature-appreciation opportunities: the Jepson Prairie/Calhoun Cut area at the head of Cache Creek, the Yolo Basin Wildlife Area east of Davis, and the Stone Lakes State Park and National Wildlife Refuge. These three natural habitat areas, in combination with the previously identified focal point areas, are important assets of the greater Delta. They all have the need for improved visitor access and interpretive facilities.[205]

8.4.5.6 Delta-Urban Edges

The final location-based recreation enhancement strategy is the establishment of Delta-serving and urban recreation areas, as well as natural habitat zones, around the edges of the Delta. These should be located between the Delta and adjacent urban areas—from Stockton around to Antioch and Bethel Island, including the north edge of Tracy and Lathrop, and in selected locations such as Rio Vista. It is recommended that criteria be developed to assist in locating this interface zone (open space corridor) generally in conjunction with existing urban limit lines, in an area that would optimize its value for habitat enhancement with active park nodes and interconnecting trails.

8.4.6 Baseline Visitation Potential

A market demand-based model of visitation for current conditions was developed as a baseline. This model is based on population, participation rates, activity days, and market capture rates. The same model can be used to predict visitation in the future, making adjustments to participation rates and market demand capture rates based on assumptions discussed above, as well as on general recreation trends that may influence recreation participation rates in the future, also discussed above. General assumptions for this baseline scenario forecast follow.

- Market Area population will increase by approximately 50 percent between 2010 and 2050.
- It is estimated that approximately 20 percent of the future recreation use will trend towards developed urban park-related, 30 percent right-of-way-related, and 50 percent resource-related.
- There is a trend away from consumptive recreation (e.g., hunting and fishing) and towards non-consumptive wildlife recreation (e.g., bird watching and nature photography).
- Increasing participation in agritourism is likely.
- Gas prices will continue to increase, with a responding trend towards recreating closer to home.
- Boating trends will shift towards non-motorized boats (i.e., more canoe/kayaks) in protected waterways.
- The proposed Great Delta Trail will be completed.

Based on these trends, quantitative visitor-day projections have been developed for the baseline scenario and are presented in Table 38. Note that this scenario does not represent status quo (i.e., disinvestment and stagnating visitation), but represents a conservatively optimistic perspective which includes the assumptions that follow.

- Visitation is based on overall trends described above.
- There will be increased investment to address deferred maintenance of existing facilities.
- There is enough capacity within existing waterways to capture growth.

[205] As described in Section 8.3.2.1, Stone Lakes National Wildlife Refuge is in the process of building expanded visitor-serving facilities.

- In most instances, growth in recreation activities will keep pace with population increases, with additional growth in wildlife-related, non-consumptive activities, and slowing growth in motor boating, fishing, and hunting.
- If disinvestment in facilities and stagnation continue, visitation may not keep pace with population growth, as has been seen over the past 20 years.

Table 38 Summary of Predicted Visitor Days under Baseline Scenario (in millions)

Activity Type	2010	2020	2030	2040	2050
Resource Related	7.6	8.3	8.9	9.5	10.0
Right-of-Way/Tourism Related	2.1	2.4	2.6	2.9	3.1

If the proposed plan is implemented, additional visitation is predicted to occur beyond baseline. General assumptions from the principles outlined above for this plan implementation scenario forecast follow.

- All activities increase slightly in the Delta due to implementation by an operating facilitating organization in marketing and promotional special events and festivals.
- An additional increase in Legacy Community and tourism, related to focal point development focused around the communities.
- Additional increases would be realized due to habitat conservation and increased levee protection.

8.4.7 Economic Potential

8.4.7.1 Recreation Spending

Based on a quantitative framework, estimates have been made of potential future recreation levels and associated spending in the Delta. As discussed above, recreation participation trends and Delta competitiveness over the next 40 years were considered. Again, the baseline forecast assumes that resource quality and recreational facilities are maintained such that the Delta retains its current level of competitiveness as a recreation destination.

Under the baseline scenario, recreation visitation in the Delta (including resource-related recreation, ROW recreation, and tourism) increases by roughly 3.4 million visitor days, or about 35 percent, over 40 years. Assuming that current visitor spending patterns remain unchanged and Delta business growth accommodates recreation-related spending increases, baseline visitation growth is estimated to increase spending in the Delta by roughly $78 million (2011$) to about $329 million (2011$) by 2050. Under the plan implementation scenario, recreation visitation and associated economic impacts in the Delta (including resource-related recreation, ROW recreation, and tourism) would increase over baseline.

8.4.8 Key Findings

- When attracting visitors and expanding recreation access to waterways and landside recreation improvements, potential negative impacts on agriculture from increased tourism and recreation can be minimized by focusing recreation uses and activities through expansion of existing recreation sites, development in Legacy Communities, creating buffer areas adjacent to agriculture, and increasing public safety enforcement.
- The future growth of recreation in the Delta consists of five location-based strategies which would emphasize:
  - Delta waterways, specialized by boating type;
  - Dispersed, small points of interest and activity areas such as marinas, farmer's markets, wineries, restaurants;

- Focal point complexes such as Legacy Communities or Bethel Island/Jersey Island/Big Break;
- Natural habitat areas; and
- The edges of existing and emerging urban areas that surround the Delta such as Stockton, Tracy, Rio Vista, and Lathrop.

- If resource quality and recreational facilities are maintained such that the Delta retains its current level of competitiveness as a recreation destination, baseline forecasts for visitation show increases of 3.4 million visitor days, or about 35 percent, over 40 years. If this Plan is implemented, recreation visitation in the Delta could increase beyond baseline.
- Assuming that current visitor spending patterns remain unchanged and Delta business growth accommodates recreation-related spending increases, baseline visitation growth is estimated to increase spending in the Delta roughly $78 million (2011$) to about $329 million (2011$) by 2050. Plan implementation could increase the economic impact of recreation over the baseline.

8.5 Impact of Policy Scenarios

Four possible policy scenarios are qualitatively evaluated as to their primary elements and their potential positive and negative influences on recreation for purposes of discovering major areas of potential concern.

8.5.1 Policy Scenarios Influences on Recreation Potential

8.5.1.1 Assumptions Under All Scenarios

In Chapter 6, different policy scenarios were presented on which to base analysis for future economic impacts. Although not explicitly discussed, it is assumed that the purpose of any of the scenarios other than the baseline is to achieve the stated purpose of the Delta Reform Act and that the policies would achieve the coequal goals of water conveyance and habitat protection. Thus, under all scenarios, it is assumed explicitly as follows.

- Water quality in the Delta will improve overall (though salinity intrusion may still be a factor).
- Fisheries will be improved.
- Any project will be mitigated appropriately (suggestions to follow in later sections) for potential significant impacts to recreation, the Legacy Communities, and the economic sustainability of the Delta.
- Water exports from the Delta will continue.

8.5.1.2 Isolated Conveyance Scenario

In Chapter 6, the Isolated Conveyance Scenario was described and included the following features.

Five new water intakes would be built along the Sacramento River between Clarksburg and Courtland.

A new forebay would be constructed near Courtland where water from the five intakes would be collected and then pumped into an isolated conveyance pipeline under the Delta, extending to a new afterbay near the Clifton Court Forebay.

Land would be removed from agriculture uses for the intake-pumping stations and the forebay and afterbay.

Approximately 8,000 acres of agricultural land would be utilized in Sacramento and San Joaquin counties.

This scenario would affect existing and future recreation uses in a number of ways, some potentially positive and others negative, including the following.

- Since the water intakes would be upstream from the confluence of the Sacramento and San Joaquin rivers, it is expected that salinity in the water at the confluence of the two rivers and further south will increase. Water quality would decrease in the resulting relative stagnant waterways. This change in water salinity and quality will likely affect fishing, boating, and hunting in the lower Delta.
- The pumping intake stations will introduce an “industrial” quality along approximately five to ten miles of the Sacramento River, creating significant visual impacts to this rural, scenic stretch of river. In addition, the sound and night lighting related to these facilities will change the setting of the existing Legacy Communities. Together these features will reduce the Delta-as-a-Place character and the value of the Delta as a tourism destination.
- Moving the intake of fresh water to the north will likely have a beneficial effect on fisheries by allowing a more natural outflow of the remaining water out to sea. This move could improve fishing in parts of the Delta.
- It is unknown how the loss of agricultural lands would affect hunting opportunities, based upon long-term land use of the lands needed for construction.

8.5.1.3 Habitat Conservation Scenario

The habitat conservation scenario was described in Chapter 6 with changes resulting from the following project elements.

- More frequent flooding and improved fish passage along 22,000 to 48,000 acres in the Yolo Bypass with the intention to improve fisheries
- Creating approximately 10,000 acres of new floodplain along the San Joaquin River using setback levees
- Restoring tidal marsh habitat on up to 65,000 acres in agricultural land throughout the Delta
- Natural Communities Protection, including converting 8,000 acres of rangeland to natural grasslands, restricting 32,000 acres of agriculture to “wildlife friendly” practices, and converting 700 acres of rangeland to vernal pools and alkali wetlands
- Restoring approximately 20 miles of channel margin along North Delta waterways through setback levees and shallow water habitat

The number of potential influences on future recreation from this scenario may include any of the following.

- Creating the larger acreage (50,000± acres) of tidal marsh at the south end of the Delta could have devastating effects on salinity in the South Delta, as well as create strong currents in the channels leading to this area. Both would have significant impacts on boating and fishing. In addition, likely changes to agriculture lands could reduce hunting opportunities.
- Specifics regarding channel margin improvements are not described. Most of these impacts can be avoided or mitigated through appropriate design. Potential conflicts could arise from reducing or eliminating windsurfer access, creating use restrictions on other forms of boating, eliminating state and county park facilities with access to the river, and restricting shore fishing.
- The conversion of agricultural lands to habitat could decrease hunting opportunities if farmland conversions are of lands also used for hunting.
- Details regarding the San Joaquin River floodway are not described. If adequate in width, it could accommodate natural vegetation, trails, and recreation opportunities similar to the American River Parkway. If limited in carrying capacity, it could be restrictive regarding these recreation elements as is the Yolo bypass between Davis and West Sacramento.

- Wildlife viewing/photography and paddle sports and other nature-associated recreation will likely be positively influenced, if restored habitat areas also include public access facilities.
- Yolo Bypass fisheries amendments may negatively impact existing hunting clubs in the area.
- Increased fishing will likely occur due to better fisheries.
- Boating overall could increase with increased habitat and water quality.
- Camping would increase to support increasing nature-related recreation, if new sites and successful synergies can be established.

8.5.1.4 Flood Control Scenario

The flood control scenario was described in Chapter 6, with two general possibilities:

1. Flooding six central Delta islands: Webb, Venice, Empire, Mandeville, Medford, and Quimby, and leaving them in open water
2. Increasing levee upgrades, including levee upgrades around the Legacy Communities

The number of potential influences on future recreation from the flooded-island scenario may include the considerations listed below.

- The winding, protected, freshwater channels and waterways are the primary appeal of the Delta to boaters. Substituting a large open body of water at this proposed location will severely affect the existing boating use, and have very little offsetting use. The existing uses in this area are fishing, water skiing, personal watercraft use, speed boating, house-boating, cruising, and, to a limited degree, windsurfing.
- While a large open body of water would have severe negative effects on all these users, the open water area could arguably be more conducive to sailing. There are a number of factors, however, that will minimize sailing as a potential substitute use.
  - The flooded islands, if similar to existing flooded islands, will have water hazards, snags, and partially-submerged debris, making them dangerous to less knowledgeable boaters.
  - Most Delta boaters are from the Bay area, where sailing is far superior and closer with many adequate local marinas which, at present, are not fully occupied.
  - Those boaters in the Sacramento metropolitan area who enjoy sailing are primarily berthed at Folsom Lake, which has more favorable winds and higher water quality than found in the six-island area.
  - Sail boat densities on the water are lower than motor boat densities.

Approximately 40 percent of all the marinas in the Delta are clustered around or near this potential area and another 5 percent are along the San Joaquin River from Pittsburg to Antioch. These marinas are also, on average, larger than those in other parts of the Delta. The resulting negative impact to the largest single recreation activity in the Delta could be very severe. See Figure 35 which overlays existing marinas and recreation facilities over the six-island flood scenario.

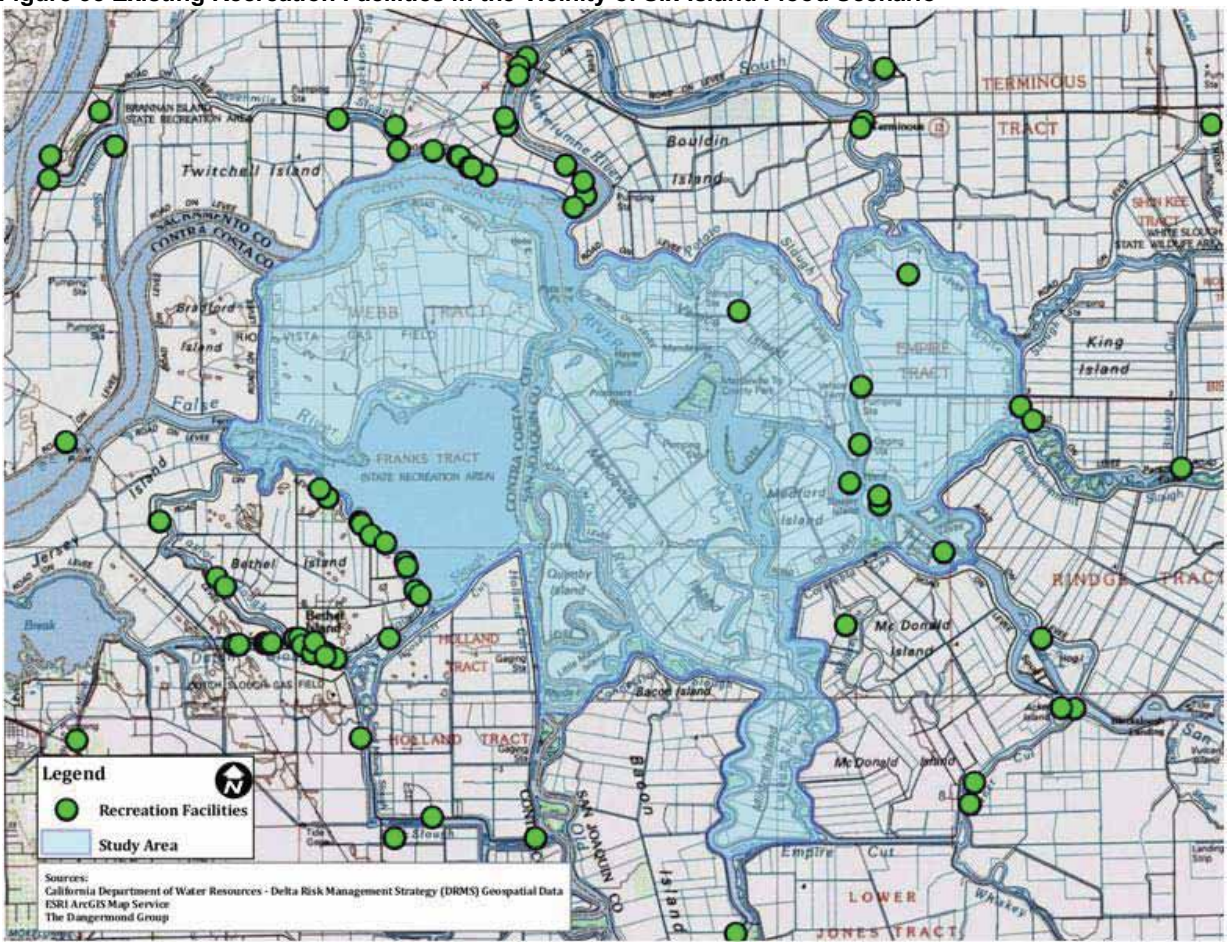
This open water will have unknown changes to fisheries, which will affect anglers.

The elimination of hunt clubs on those islands will reduce hunting.

The increased levee upgrade scenario may have a number of potential influences on future recreation, including the following impacts.

- Better protection of marinas, allowing investment in facilities
- Increased protection of Legacy Communities, resulting in more right-of-way/tourism activity
- Unknown changes to fisheries

Figure 35 Existing Recreation Facilities in the Vicinity of Six-Island Flood Scenario[206]



8.5.1.5 Regulatory Changes Scenario

Proposed regulatory changes are not known at this time. The following potentials could have a negative effect on recreation.

Increased Regulation

- Regulations against water, sewer, and building developments would make it difficult for both existing and new enterprises to locate within the Delta or to respond to changing market demands. These restrictions could adversely affect park expansions, marinas and related resorts, Legacy Communities, wineries, and direct sale of agriculture products, most likely creating further stagnation in recreation and tourism visitation.
- Blanket prohibitions against further development within the Secondary Zone could have an unfavorable influence on the park and recreation values around the edges of the Delta.
- Continuing and/or increasing restrictions and regulations on dredging and vegetation controls in and around marinas could have severe negative influences on such recreation providers.

Decreased Regulation

- The reduction or removal of land use, historic preservation and agriculture protection regulations could affect the scenic values of the Delta and subsequent tourism use.

[206] For high resolution image see http://forecast.pacific.edu/desp-figs.html

8.5.1.6 Policy Scenarios Influences Summary

Table 39 presents a summary of predicted potential influences to recreation and tourism by the policy scenarios described above, with range estimates of potential impacts to visitation in 2050, as compared to the baseline scenario presented in Section 8.4. These predictions reflect a combination of data and professional judgment of the researchers, and are intended to provide a general sense of the expected scale of the impact relative to current levels. Note that these impacts are presented in relationship to population growth, so a "Flat" trend would keep pace with population growth, while "Increase" would grow faster than population. "Decrease" would grow slower than population and may or may not represent an actual decrease in raw numbers of visitor days.

Table 39 Predicted Trends in Major Recreation Categories under Policy Scenarios Conditions

	Policy Scenarios				
Activity Type	**Isolated Conveyance**	**Habitat Conservation**	**Flood Control – Six Islands**	**Flood Control – Increased Levees**	**Regulatory Changes**
Resource Related					
Boating	Decrease	Increase	Decrease	Flat	Decrease
Fishing	Flat	Increase	Decrease	Flat	Decrease
Hunting	Decrease	Flat/Decrease	Decrease	Flat	Flat
Wildlife Viewing/Outdoor Photography	Flat	Increase	Flat	Flat	Flat
Camping	Decrease	Increase	Decrease	Flat	Flat
Right-of-Way/Tourism Related	Decrease	Flat	Flat	Increase	Decrease
Urban Parks Related	Flat	Flat	Flat	Flat	Decrease
Overall	Decrease	Increase	Decrease	Flat	Decrease

- The isolated conveyance scenario could lower recreation spending in the Delta.
- The habitat conservation scenario could increase recreation spending in the Delta.
- The six-island open water scenario could lower recreation spending in the Delta.
- The increased levee scenario could increase recreation spending in the Delta.
- The increased land use restrictions scenario could lower recreation spending in the Delta.

The probable future condition of the Delta will not, however, occur as a result of a single policy scenario, but of necessity, will be a combination solution. Among these various scenarios, there is an opportunity to avoid the largest potential negative impacts and to emphasize positive solutions.

8.5.2 Impact Analysis

This report has analyzed existing recreation uses and projected a baseline forward to 2050. It also has analyzed the negative and positive influences to the baseline from various elements of proposed scenarios. Analysis has also been made of actions that could be taken to increase recreation visitation over the baseline, or to mitigate for some unavoidable impacts. The Recreation Enhancement Plan outlined in this report describes such actions. The following summarizes the largest potentially negative future impacts and the possible positive influences to economic sustainability for recreation in the Delta.

8.5.2.1 Negative Impacts

Of all the potential negative impacts, our analysis indicates that the following five items are the most significant. They are listed in order of magnitude. These major items are most likely

significant enough that major changes to the project would be required, rather than simple mitigation measures.

1. *Regulation Changes.* If increased and burdensome land use regulations prohibited most or all permits for remodeling or constructing commercial and recreation facilities, they would have the largest negative impact on recreation use in the Delta. At best, it would bring growth in recreation to a standstill in all but hunting and wildlife viewing/outdoor photography. It is quite likely that an actual decline in recreation levels would occur as facilities continue to age and become out of date.
2. *Six-Island Flooding.* As previously described, the purposeful flooding of the six islands, basically north and east of the existing open water area of Frank's Tract, could result in a major reduction of boating in the Delta. Over 50 percent of the Delta's marinas are located within or in close proximity to this area, and would suffer both direct and indirect negative impacts. Boating, fishing, hunting, camping, and tourism-related activities are all anticipated to be negatively affected.
3. *Salinity Increases in the Central and South Delta.* This possibility is based upon the concern that an isolated conveyance which removes all export water at the north end of the Delta will create increased water stagnation and salinity in the central and south Delta. If that occurs, it would affect boating, fishing, and camping.
4. *Large Tidal Marsh in South Delta.* A large-scale tidal marsh area in the south Delta would likely increase salinity and strong currents in the waterways leading to the south Delta. It would affect boating and fishing, and may impact hunting due to the loss of agriculture properties jointly used for hunting.
5. *Intake and Pumping Stations—Clarksburg to Courtland.* These pumping stations, if placed along the river at this location, could seriously impact the Delta-as-a-Place recreation and tourism. This is one of the primary entry and destination areas in the Delta; the industrial scale, noise, and night lighting could transform its character.

In addition, there are other lesser impacts as previously described. These can most likely be mitigated through careful planning.

8.5.2.2 Positive Influences

There could be positive influences to recreation within future scenario predictions. Specifically, three elements of certain scenarios would likely have the most positive influence on recreation use.

1. *Fishing Enhancements.* The various fishery enhancements proposed in the habitat conversion and isolated conveyance scenarios are expected to help restore fisheries, and thereby elevate fishing use.
2. *Wildlife Viewing/Nature Study.* The proposed expansion of natural preserves and wildlife-friendly agriculture would increase the opportunities for wildlife viewing and nature study.
3. *Delta-As-A-Place Enhancement.* The increase in wildlife viewing opportunities will likely have a synergistic effect on the Delta-as-a-Place visitation.

8.6 Implementation Strategies

There are a number of key strategies that should be utilized in order to assist in the implementation of the recreation portion of the ESP. Some of these strategies and actions are described below. Many could be funded through the Delta Investment Fund or Delta Conservancy Fund.

8.6.1 Consistency and Regulation Refinement

Consistency refinements between the Delta Plan, the ESP, State Parks recreation proposal, and local city and county plans may be necessary after the adoption of the Delta Plan. In addition, specific plans may be required for recreational areas along with regulation refinements to facilitate implementation of their development. Priority for specific plan development should be given to two focal point areas, Walnut Grove/Locke and Rio Vista/Isleton/Brannon Island, because of their Delta-wide catalyst and branding potentials.

8.6.2 Public/Private Coordination and Partnerships

Nearly all recreation opportunities in the Delta are provided by private enterprise and are dependent on basic public investments in roadways, levees, and other infrastructure improvements. Public investment in synergistic recreation improvements can expand services to the public while creating settings for additional or expanded private facilities. Such coordinated action will be important in facilitating actions within Legacy Communities and edge communities, as well as with dispersed recreation points throughout the Delta.

8.6.3 Multi-Agency Coordination

Developing and expanding the major recreation complexes recommended in the ESP require cooperation and coordination between two or more agencies, which can forge unique relationships with those communities bordering the Delta. For example, coordination of Delta protection limits and urban limit lines can facilitate the creation of Delta buffering park/open space/trail areas. State and local park agencies can form joint powers authority to aid in implementation of development in other areas. A JPA may allow appropriate coordination and a more expedited implementation schedule.

8.6.4 Strategic Levee Protection

Obtaining adequate flood protection is of the utmost importance in order to foster additional meaningful economic activity in the Delta. New and improved levees are necessary to encourage new investment and reinvestment in the Legacy Communities and recommended recreation areas. Strategic levee enhancements and/or the construction of ring levees in order to protect key assets should be carried out using any existing or new funding sources.

8.6.5 Delta-wide Marketing

Among the opportunities and constraints discussed previously is the lack of a Delta brand or overall marketing strategy. The average potential visitor has to overcome a number of barriers in order to recreate in the Delta: it is hard to see “the Delta,” there’s no main entrance or focal point for information and activities, and facilities are sparse, spread out, and hard to access. The California Trade and Tourism Commission (CTTC) places the Delta in the Central Valley (as one of 12 travel regions CTTC promotes throughout the state) rather than promoting the Delta as its own unique travel region.[207]

As early as 30 years ago, 41 economically feasible recreation improvements, studied by the Department of Water Resources, were not developed because of the lack of an entity that could be responsible for their care. As a part of this report, major recreation improvements have been identified that could stimulate visitation and economic benefits. A responsive, Delta-focused public recreation, planning, development, and management facilitator organization is vital to accomplishment of such a program. To be effective, this organization needs an assured funding

[207] The twelve regions are North Coast, Shasta Cascade, Gold Country, San Francisco Bay Area, Central Valley, High Sierra, Central Coast, Los Angeles, Orange County, San Diego, Inland Empire, and Deserts. http://www.visitcalifornia.com/Explore/

source that can be relied upon for both development and operation. The organization also needs to have the authority to assist in marketing the Delta, to facilitate actions by private enterprise, and to assist with, or manage, the operation of state and local recreation facilities. This organization is discussed further in Chapter 11.

8.6.6 Financing Strategies

There are several steps outlined above that need to occur before development of any new major recreation areas described in this Plan can occur. Each step, including ensuring consistency among plans, developing specific area plans and streamlining regulations to accomplish them, levee enhancements, as well as organization, administration, development and operation, all will require funding and will take time. Concurrent with this planning, however, there are several recommended strategies that could be initiated as soon as funding could be made available, and which would all affect positive economic changes within the Delta. Several suggestions follow which could affect many different areas and services.

Agritourism/Legacy Communities
A "Delta farm trails" should be established to market the farmer's market, direct sale, wineries, and related Legacy Community businesses. A grant could be provided to an existing Delta-wide nonprofit to develop brochures, marketing, and a signage program, and to help willing farms with necessary improvements. These farm trails could be joined and co-marketed with existing wildlife viewing programs and opportunities.

Department of Boating and Waterways
Additional funding could be provided to the Department of Boating and Waterways existing programs to remove abandoned vessels, combat invasive species (including water hyacinth, *Egeria densa,* and South American Spongeplant (*Limnobium laevigatum*) (with accompanying authorization to treat), and develop more waterway access for fishing and boating, including non-motorized boating access and community convenience docks. Funding also could be provided to DBW to create designated boating and canoe/kayak water trails, including planning, and developing access points, as well as additional grant and low-interest loan funds to allow private enterprise upgrades and development.

Department of Parks and Recreation
Immediate funding could be provided for State Parks to complete planning and development of Delta Meadows State Park, with connections to Locke and other heritage and natural resources in the area. Additionally, planned[208] upgrades to Brannon Island could be completed, with funding to allow the park to remain open. Additional funding could be provided for further implementation of recommendations in the *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh.*[209]

Delta Protection Commission
Funding could be provided to DPC to match federal funds for initial implementation of the NHA, if it is recommended and approved. Funding could also be provided for planning and implementation of beginning segments of the Great Delta Trail, especially those segments on existing public lands.

[208] State Parks 2011, p. 22-23
[209] Ibid, p. 22-24

Delta Conservancy
Funding to the Delta Conservancy Fund would allow the Conservancy to offer grant funding to local agencies, nonprofit organizations, and private entrepreneurs which provide recreation and tourism services in the Delta. These funds could be used to improve visitor centers and services at natural habitat areas, make Gateway entry improvements, and expand visitor service offerings.

Local Governments
Funding could be provided to local governments to enable them to participate fully in ongoing planning processes. In addition, designated funds could allow counties and cities to dedicate staff to entitlement processing or creating one-stop permitting centers for the Delta. It could also allow local governments to participate in a Delta-wide economic development process or a JPA.

8.6.7 Key Findings

- Possible policy scenarios are qualitatively evaluated as to their primary elements and their potential positive and negative impacts on recreation.
    - Scenarios evaluated may affect recreation visitation by either decreasing visitation or increasing visitation over the baseline scenario, with the expected largest potential for negative impacts from increased regulatory changes or the six-island flooding and the largest potential for positive impacts from the habitat conservation scenario.
    - Visitation changes would also affect recreation-related spending in the Delta, as compared with the baseline forecast. It is anticipated that the magnitude of these potential changes is smaller in magnitude than the potential economic impacts to the agricultural economy.
    - The largest anticipated potential negative impacts would results from regulation changes, six-island flooding, salinity increases in the central and south Delta, creation of a large tidal marsh in the south Delta, and intake and pumping stations near Clarksburg and Courtland.
    - Positive impacts could result overall through project enhancements to fishing, wildlife viewing, and nature study, and Delta-as-a-Place.
- A significant operational constraint for future growth in recreation demand is that there currently exists no Delta brand, overall marketing strategy, or significant-scale focal point area. An existing organization should be designated as a Delta recreation and tourism marketing and economic development facilitator.

Recommended Implementation Strategies include consistent planning and regulation refinement, public/private coordination and partnerships, multi-agency coordination, strategic levee protection, Delta-wide marketing, and financing.

Chapter 9: Infrastructure

9.1 Overview and Key Findings

The Delta is located in the geographic center of the Northern California megaregion and serves as an infrastructure hub for the megaregion as well as the local, regional and state economies. While the Delta's importance to the state water system is well-known, its importance to energy, transportation, and in-Delta municipal and industrial water supplies is less appreciated. This chapter focuses on infrastructure that directly serves communities within the Legal Delta and the adjacent region, but it also includes analysis of infrastructure that serves the megaregion and other regions.

An idea of the variety and extent of infrastructure in the Delta is provided by Figure 36.[210] This chapter reviews and analyzes the range of infrastructure within the framework detailed in Chapter Six across three critical categories: (1) transportation; (2) energy; and (3) water resources.

The key findings are:

- Levee investments must fully consider the value of infrastructure. Ignoring or incompletely assessing the value and cost of infrastructure could lead to dangerous underinvestment in levees and create risks for energy, transportation, and water supply infrastructure of critical local, regional, and state-wide significance.
- All owners and operators of infrastructure that depend on Delta levees do not currently contribute to levee system investment and maintenance. Some infrastructure owners contribute but others do not.
- Extraction of water from the Delta is critical to the economy. Declining water quality as result of increased salts or organic carbon would significantly increase costs for households, business, and industry in and around the Delta.
- Infrastructure demands within and around the Delta will require significant future investment. It will be necessary to ensure development of the infrastructure in the Delta is aligned with economic sustainability strategies.
- Development of the Delta's transportation infrastructure in general, but especially its ports and marine facilities, will support greater interregional integration, competitiveness, and economic development.
- Delta water quality is potentially threatened by isolated conveyance, some of the conservation measures, and the six-island open-water scenario. However, other proposals such as the Lower San Joaquin River Bypass support multiple goals. The bypass would reduce peak water surface elevations in the San Joaquin River adjacent to Lathrop and Stockton and provide ecosystem benefits from activating floodplains that increase organic carbon for a short duration and during high flows, which would minimize impacts on water quality.

[210] Based on DRMS GIS data set developed by URS Corporation and provided by DWR.

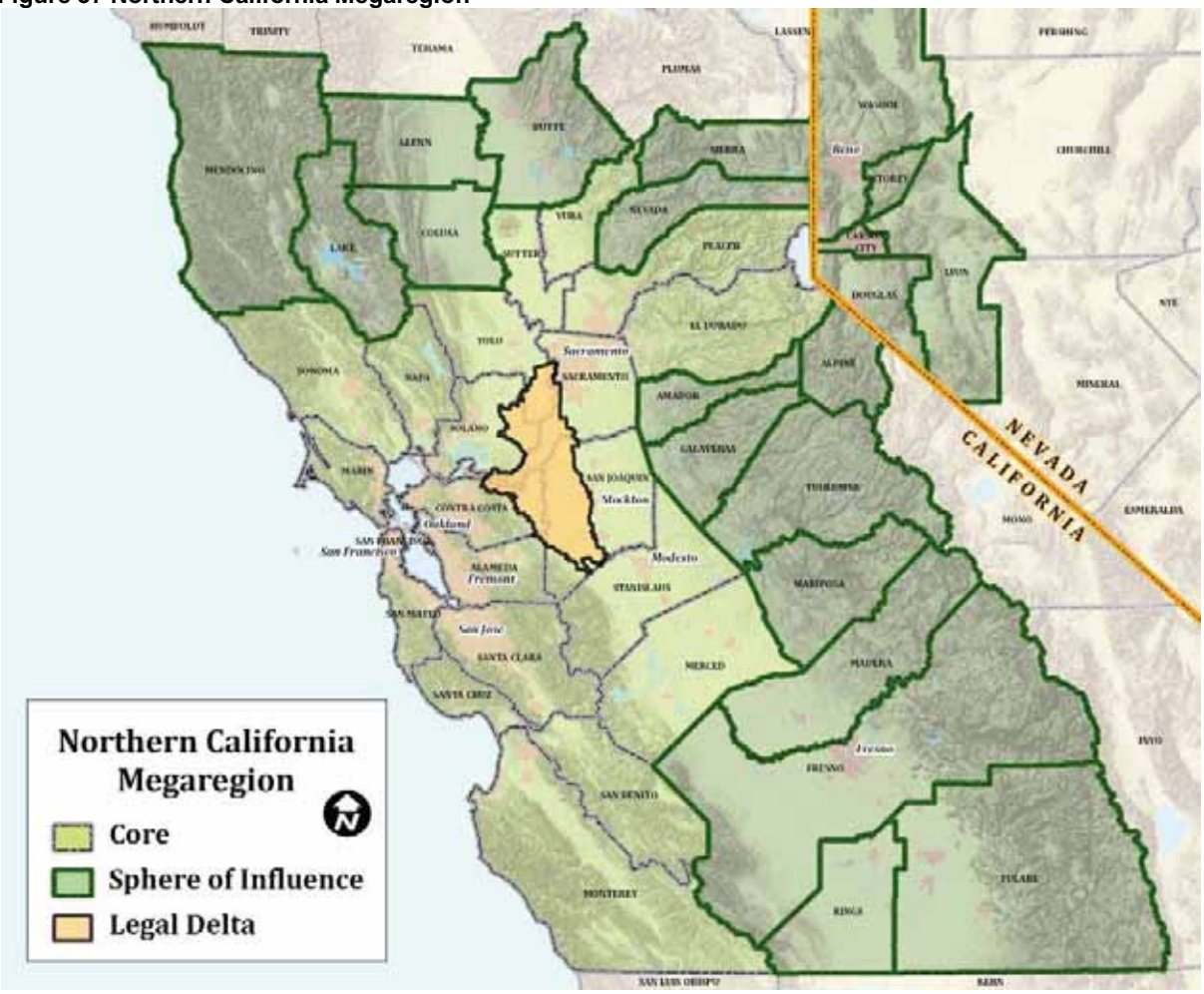
Figure 36 Select Delta Infrastructure[211]

[211] For high resolution image see http://forecast.pacific.edu/desp-figs.html

9.2 An Infrastructure Hub for the Northern California Megaregion

The Delta is in the center of the Northern California megaregion; the region is depicted in Figure 37.[212] This is one of 11 emerging megaregions in the U.S. identified as drivers of national growth in the 21st century.[213] In 2010, the Northern California megaregion's population totaled 14.6 million people. While 80 percent of that population was located within the megaregion's 21-county "core," that core accounted for less than 39 percent of the megaregion's total area.[214] In 2010, the megaregion's gross regional product exceeded $780 billion.[215]

Figure 37 Northern California Megaregion[216]



[212] The 41-county Northern California megaregion referred to herein is defined by the analysis of G. Metcalf and E. Terplan, "The Northern California Megaregion," SPUR Urbanist, November 1, 2007.
[213] For further details and references on U.S. megaregions see the America 2050 website: www.America2050.org
[214] Population and land area based on U.S. Census Bureau, *Census 2010 Summary File 1*. 2010 Census. Accessed August 12, 2011 at factfinder2.census.gov
[215] Based on Bureau of Economic Analysis, *BEA regional economic accounts*. Accessed August 12, 2011 at www.bea.gov/regional/
[216] For high resolution image see http://forecast.pacific.edu/desp-figs.html. The geography of the Northern California megaregion is based on G. Metcalf and E. Terplan, "The Northern California Megaregion," SPUR Urbanist, November 2, 2007. Accessed at www.spur.org/publications/library/article/mappingthenortherncaliforniamegaregion11012007

The Northern California megaregion has followed a common development path, characterized by initial nodes being followed by suburbanization and infilling between nodes. This pattern has generated considerable urban development around the Delta and within the Secondary Zone of the Delta itself. However, as detailed in Chapter 4 and 10, a range of planning and land use restrictions have limited urban encroachment in the Primary Zone. Therefore, the Delta's comparatively rural nature and its centrality to the megaregion have combined to reinforce the Delta's historic role as a regional infrastructure hub.

Megaregions like the Northern California megaregion are envisioned to become more cohesive in coming decades as technology and globalization enhances integration of core metropolitan areas and their broader sphere of influence. However, if these agglomeration advantages are to be realized it is critical that the megaregion's infrastructure facilitates integration of the range of economic function contained within its "megazone."[217] The Delta's infrastructure services are thereby poised to play an important role in development of the Northern California megaregion's advantages in the global economy in the coming decades.[218]

9.3 Transportation

Since the discovery of gold in 1848, the Delta has served as a key transportation hub linking the coastal cities of the San Francisco Bay area with the inland cities of the Central Valley and beyond. Contemporary Delta transportation has evolved to provide a critical array of intra- and interregional infrastructure linking the area's population and its diverse concentration of agriculture, manufacturing, distribution, warehousing, and retailers.[219] Through its transportation corridors the Delta also facilitates public safety, a healthy business climate, and recreational opportunities. As such, the Delta's transportation infrastructure provides important capacity for long-term sustainable growth in the Delta and beyond by facilitating the efficient movement of people and goods. However, access provided by the Delta's transportation infrastructure requires systemic maintenance and investment if it is to enhance and sustain its relevance in a global environment of increasingly efficient, multi-modal, and integrated transportation.

9.3.1 Road Transportation

There are three state highways in the Delta's Primary Zone (SR 4, SR 12, and SR 160). These highways are principal road transit routes through that region. In addition, the Delta's Secondary Zone hosts three Interstate freeways (I-5, I-80, and I-205) and is bordered by two others (I-580 and I-680). The 2007 Status and Trends of Delta-Suisun Services report identified evidence of Delta traffic growth disproportionate to population growth.[220] That trend continues to be evident in recent years. Table 40 reports an index of daily total vehicle trips (DTVT) on these transportation corridors between 1992 and 2009 as well as actual 2009 DTVTs. Accordingly, excluding some sections of SR 160, traffic volumes on highways and freeways increased between 23 percent and 65 percent during this period. In comparison, population in the five-

[217] P. Todorovich (ed.), *America 2050: An Infrastructure Vision for 21st Century America*. New York: America 2050, 2008. http://www.america2050.org/pdf/2050_Report_Infrastructure_2008.pdf
[218] S. Sassen, "Megaregions: Benefits beyond Sharing Trains and Parking Lots?" *The Economic Geography of Megaregions,* The Policy Research Institute for the Region, Woodrow Wilson School of Public and International Affairs, Princeton University, February 9, 2007. http://wws.princeton.edu/research/prior-publications/conference-books/megaregions.pdf
[219] DPC, *Final Draft Delta Protection Commission Economic Sustainability Plan Framework Study Volume II,* Delta Protection Commission. December 6, 2010.
[220] DWR, *Status and Trends of Delta-Suisun Services,* Public Review Draft, Department of Water Resources, March 2007.

county region increased by 20 percent, ranging between 12 percent (Solano County) and 26 percent (Yolo County and San Joaquin County) during the same period.[221]

Table 40 Daily Total Vehicle Trips (DTVT) on Key Transportation Routes 1992-2009

Route	Intersection	1992	1995	2000	2005	2006	2007	2008	2009	2009 DTVTs
CA-12	CA-84 (Rio Vista)	100	93	111	147	150	150	134	129	***39,000***
CA-12	I-5 (Lodi)	100	99	97	151	153	153	134	134	***31,000***
CA-160	CA-220 (Walnut Grove)	100	64	73	80	81	81	70	70	***4,700***
CA-160	Wilbur Ave (Antioch)	100	94	113	125	140	136	124	123	***25,000***
CA-160	Isleton Bridge (Isleton)	100	71	73	80	81	81	73	73	***6,150***
CA-4	Byron Highw ay (Byron)	100	108	125	131	123	125	112	117	***38,600***
CA-4	Roberts Road (Stockton)	100	115	N/A	N/A	165	153	139	135	***19,400***
CA-4	Port Chicago Freew ay (Concord)	100	105	140	184	177	179	171	165	***277,000***
I-205	Old Route 50 (Tracy)	100	115	139	169	170	170	180	160	***195,000***
I-5	I Street (Sacramento)	100	116	133	161	166	167	155	159	***364,000***
I-5	CA-12 (Lodi)	100	103	113	166	169	169	156	156	***130,000***
I-5	French Camp Overcross (French Camp)	100	105	108	174	176	176	159	159	***196,000***
I-80	I-5 (Sacramento)	100	82	114	124	127	134	128	126	***231,000***
I-80	CA 113 (Davis)	100	107	123	137	135	130	126	135	***246,000***

Source: Caltrans traffic volume data. Traffic Data Branch. Accessed June 30, 2011: http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm

Box 2 California State Route 12 Corridor: Challenges and Opportunities

Many of the challenges and opportunities of road transportation in the Delta occur along the California State Route 12 corridor, which bisects the Delta from the east at Interstate-5 near Lodi to the west at Rio Vista. The corridor provides important interregional linkages between the Bay Area and the San Joaquin Valley. It is also an important emergency access route into the Delta for first responders. In addition, the corridor is a principal access route for Delta recreators. As such, the corridor has an important role in both inter- and intra-regional growth. However, growing inward Bay Area commuting, expanding freight and goods transportation across the Delta, future development of Rio Vista, and enhanced use of Travis Air Force Base as a passenger/freight airport all pose significant challenges and opportunities for the corridor in general and the Delta in particular. These potential increases in demand on the corridor create opportunities to enhance access for existing in-Delta users, expand multi-modal access within and across the Delta, as well as increase the corridor's general safety and facilitate marketing of the Delta as a place. Nonetheless, the increased demand may also generate congestion, enhance negative environmental effects, degrade safety along the corridor, and inhibit access to other parts of the Delta. The presence of several drawbridges along the route adds further complexity to the associated challenges as increased recreational usage and shipping to the Port of West Sacramento may compound congestion along this important road transportation corridor. However, as discussed later in this chapter, development of the M-580 Marine Highway Corridor may relieve some congestion by decreasing the number of drayage trucks.
(Source: The information above is a compilation of issues drawn from the Moving Forward State Route 12 Corridor Study. For further information see: www.movingsr12forward.com)

The decline in vehicle traffic along SR 160 is notable. SR 160 has Scenic Roadway designation and as such it is an important driving-for-pleasure resource within the Delta. When examined, the largest decline in vehicle traffic occurred between 1992 and 1995, with some recovery followed by a period of flat to slightly declining traffic volumes along SR 160 in the northern Delta between 1995 and 2009, and with some growth in the southern portion of the route.[222]

[221] Population calculations based on Census Bureau midyear population estimates. Accessed from: http://www.census.gov/popest/counties/counties.html
[222] See Chapter 8, Recreation and Tourism for a discussion of trends in driving for pleasure in the Delta.

The trends in truck traffic are more diverse as indicated in Table 41. Truck traffic has decreased markedly in some areas, such as the 45 percent decline in truck traffic on I-80 near Davis. However, truck traffic has increased in other areas, particularly along the I-5 corridor: traffic increased by 112 percent near Lodi, 66 percent near Sacramento, and 59 percent near French Camp.

Table 41 Daily Total Truck Trips (DTTT) on Key Transportation Routes 1992-2009

Route	Intersection	1992	1995	2000	2005	2006	2007	2008	2009	2009 DTVTs
CA-12	CA-84 (Rio Vista)	100	90	87	136	137	137	120	120	3,871
CA-12	I-5 (Lodi)	100	78	76	90	92	92	83	83	4,519
CA-4	Byron Highway (Byron)	100	80	124	130	123	124	111	116	5,775
CA-4	Roberts Road (Stockton)	100	103	137	76	164	152	138	134	2,471
CA-4	Port Chicago Freeway (Concord)	100	97	109	139	134	135	129	124	14,779
I-205	Old Route 50 (Tracy)	100	114	138	103	104	104	110	94	12,240
I-5	I Street (Sacramento)	100	120	136	166	171	173	162	166	17,856
I-5	CA-12 (Lodi)	100	142	144	231	233	233	212	212	23,459
I-5	French Camp Overcross (French Camp)	100	124	138	151	153	174	159	159	49,480
I-80	I-5 (Sac)	100	111	156	131	134	140	135	132	16,428
I-80	CA 113 (Davis)	100	59	69	55	53	54	52	55	8,107

Source: Caltrans traffic volume data. Traffic Data Branch. Accessed June 30, 2011: http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm

The Delta's central location in the Northern California megaregion and the significant highway and freeway infrastructure through and around it make it an important road transportation hub. Proximity to the large urban populations in the Bay Area, with comparatively less expensive property, further facilitates road freight, logistics, and other supply-chain facilities in parts of the Delta's Secondary Zone as well as adjoining areas. This road freight transportation nexus is additionally supported by I-5 & CA-99 which provide north-south access from Mexico to Canada as well as I-80 which provides road freight transportation linkages to the eastern U.S. Given the trends in road-based freight transportation and continued population growth in the megaregion characterized by increased integration, the baseline trend for the Delta's road transportation infrastructure is further growth in demand. [223]

Table 42 Legal Delta Road Infrastructure in 100-year floodplain[224]

	Quantity	Asset Value (millions)
Highway Bridges (count)	182	353.4
Highway Roads (miles)	182	316.9
Non-Highway Bridges (count)	41	21.5
Minor Roads (miles)	1,453	1,534.5
Major Roads (miles)	157	274.1

Utilizing the Department of Water Resources (DWR) Delta Risk Management Strategy (DRMS) Phase 1 study of infrastructure in the Delta,[225] we are able to identify both road infrastructure in the Delta's current 100 year floodplain and that study's estimate of this road infrastructure's

[223] It is important to note that this analysis has not examined the likelihood of further provision of road infrastructure in the Delta.
[224] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.
[225] Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.

asset value.[226] As seen in Table 42, the Delta has nearly 1,800 miles of road and over 220 bridges in its 100-year floodplain.[227] In total, the asset value of this road infrastructure is estimated to be in excess of $2.5 billion. Besides the infrastructure identified in Table 42, it is worth noting that there are also five operational ferries in the Delta's 100-year floodplain; two of the five ferries are operated by Caltrans and the other three ferries are privately operated.[228] This road infrastructure is dependent upon the Delta's flood protection system to prevent damage during flooding events. While the baseline assumes PL 84-99 standards for all levees in the Delta, at this standard there is still significant risk of damage from flooding and earthquake events.[229]

9.3.2 Rail Infrastructure

The Delta's short-line railroad was historically an important transportation resource for the region's agricultural industry.[230] Currently, two of the largest railroads in North America, Burlington Northern Santa Fe (BNSF) railway and the Union Pacific railroad (UPRR),[231] posses an extensive rail network that passes through and encircles the Delta as it links the Bay Area with the Central Valley and beyond. These lines are further complemented by short-line and rail rapid transit systems within and adjoining the Delta to form an extensive regional rail transport infrastructure with multimodal linkages.

The Delta's rail freight infrastructure is a critical component of the regional transportation system. Rail access to the Port of West Sacramento and the Port of Stockton facilitates the ports' role as regional bulk and general cargo provision. Freight rail is particularly competitive with long-distance freight, which facilitates outward and inward shipment of goods from across California, the nation, and internationally. Railroads are also four times more fuel efficient than trucks on average, which reduces emissions.[232] Therefore, the rail freight system affords reduced congestion on the road infrastructure by relieving the need for long-haul trucking and by providing a greater carrying capacity. These efficiencies in rail freight offer an important means to facilitate economic expansion in the megaregion without excessively burdening the local environment.

In addition to freight transportation, there is an established passenger rail network that passes through the Delta and provides important interregional connections. The Amtrak San Joaquin route provides rail services from Bakersfield to Sacramento and Oakland. The San Joaquin thereby provides passenger rail services through a large portion of the Central Valley and the

[226] This 100-year floodplain is an imaginary boundary that defines the area around the Delta, an overview of this boundary is provided in Figure 13-1 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. Throughout estimates are derived by the authors as they were not identified in the DWR report as such.
[227] Figure D2 in Appendix D is a map which shows islands in the Delta 100-year floodplain that protect highways.
[228] Caltrans, *SR-12 Comprehensive Corridor Evaluation and Corridor Management Plan from SR-29 to I-5, 2011.*
[229] The DRMS study has conducted a road closure cost estimate with daily costs ranging between $100,000 and $24,060,000 per day. Table 24 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences,* Department of Water Resources, May 2008.
[230] DPC, Utilities and Infrastructure, Background Report, 1994.
[231] Together BNSF and UPRR accounted for 47 percent of all freight railroad revenue in the United States in 2009. Note: Author's calculation based on AAR (2011) and AAR (2010).
[232] AAR (2011) "An Overview of America's Freight Railroads," *American Association of Railroads, Background Paper*. April 2011.

Bay Area. It also provides access to other Amtrak routes including the Capitol Corridor, which travels just outside the Legal Delta but also provides an important interregional rail link between the Central Valley and the Bay Area.

Table 43 presents an index of Amtrak ridership, measured in terms of passengers boarding and detraining, at select stations along the San Joaquin route. While the individual stations' ridership varied considerably, they all have seen a steady growth ranging between 23 percent and 67 percent increases from 2004 to 2010. Across the entirety of the San Joaquin route there were 960,165 passenger trips in 2010.[233]

Table 43 Index of Amtrak Passengers Boarding & Detraining (PBDs) by Station, 2004-2010 and 2010 Value

Station	2004	2005	2006	2007	2008	2009	2010	2010 PBTs
Sacramento	100	108	107	113	133	129	128	***1,090,122***
Lodi	100	91	104	95	126	122	123	***7,443***
Stockton	100	97	109	109	128	126	135	***234,678***
Modesto	100	98	104	109	129	127	134	***95,532***
Antioch	100	102	110	118	141	140	167	***34,417***

Source: National Association of Railroad Passengers, Amtrak factsheets. Accessed June 30, 2011: http://www.narprail.org/cms/images/uploads/fels/index.htm

Box 3 Intermodal Transportation of Freight

Intermodal freight is an important component of transportation in and around the Delta. Szyliowicz (2000) describes intermodal transport: "*Intermodal freight transport involves the transportation of freight in an intermodal container or vehicle, using multiple modes of transportation (rail, ship, and truck), without any handling of the freight itself when changing modes. The method reduces cargo handling, and so improves security, reduces damages and losses, and allows freight to be transported faster.*" Central to intermodal transport is maximization of each mode's comparative advantage to simultaneously optimize existing resources while enhancing component productivity as well as the overall productivity of the entire transportation system. Intermodal freight transport has been the fastest growing segment of rail freight traffic over the past quarter century (AAR 2011: 2). As a result of its decreasing traffic congestion and transportation costs, intermodal freight in and around the Delta supports the inter- and intra-regional competitiveness of the Northern California megaregion. According to the AAR (2011) nearly 60 percent of intermodal rail consist of imports or exports, which also makes intermodal transport an important component of international trade. While there are no intermodal terminals in the Delta itself, there are six intermodal terminals operated by BNSF and UPRR in the five-county region. These facilities have and/or are developing ties with nearby logistics clusters, in-Delta and nearby -ports, and warehousing facilities. Furthermore, through rail linkages across the Central Valley and beyond, intermodal rail more generally facilitates California's foreign trade.

Sources: Szyliowicz, J.S. (2000) Intermodalism: The Challenge and the Promise. *NCIT Final Report.*
AAR (2011) "An Overview of America's Freight Railroads," *American Association of Railroads, Background Paper*. April 2011.

The Altamont Commuter Express (ACE Rail) is another important passenger rail network that passes through the Delta. ACE Rail is a commuter train operating between Stockton and San Jose. It thereby facilitates workers in the Silicon Valley accessing more affordable housing from the Central Valley. Table 44 presents an annual index of ridership across the entirety of the ACE Rail route between 2004 and 2010. While there were 676,444 passenger trips on ACE Rail in 2010, the economic recession appears to have significantly depressed ridership along the route beginning in 2009.

[233] NARPRAIL, *Amtrak Fact Sheet: San Joaquins Service.* Accessed June 30, 2011: http://www.narprail.org/cms/images/uploads/fels/trains/39.pdf

Table 44 Index of ACE Rail Ridership 2004-2010 and Actual Passengers in 2010[234]

	2004	2005	2006	2007	2008	2009	2010	2010 Passengers
Total Annual Ridership	100	96	105	117	134	106	105	***676,444***

Source: ACE Rail ridership information was provided by the San Joaquin Regional Rail Commission

These three passenger rail corridors each rank among the busiest in the United States.[235] Especially in the context of the projected growth that will occur in the megaregion over the next few decades, it is likely that this regional rail infrastructure, including those parts in the Delta, will experience significant growth in demand. [236]

Table 45 Legal Delta Rail Infrastructure in 100-year floodplain[237]

	Quantity	Asset Value (millions)
Rail Facilities (count)	9	23.2
Rail Bridges (count)	10	10.0
Railroads (miles)	74	111.7

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,[238] we are able to identify both rail infrastructure in the Delta's current 100-year floodplain and that study's estimate of this rail infrastructure's asset value. As seen in Table 45, the Delta has 74 miles of railroad and 10 bridges in its 100-year floodplain.[239] In total, the asset value of this rail infrastructure is estimated to be in excess of $145 million. It is important to note that the rail infrastructure reported in Table 45 includes some historic short-line railroads which are not currently operated. The rail infrastructure identified in the table is dependent upon the Delta's flood protection system to prevent damage during flooding events. While the baseline assumes PL 84-99 standards for all levees in the Delta at this standard there is still significant risk of damage from flooding and earthquake events.[240]

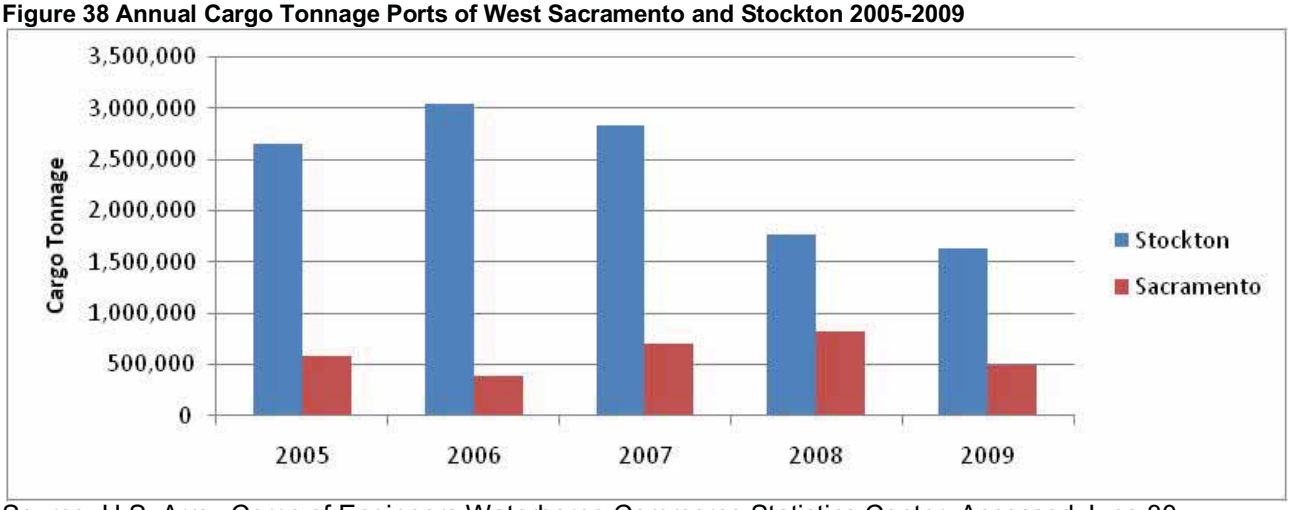
9.3.3 Ports and Maritime Infrastructure

The Delta hosts several ports, the most significant being the Port of Stockton and the Port of West Sacramento.[241] The Stockton Deep Water Ship Channel was constructed in 1927 and the

[234] ACE Rail ridership information was provided by the San Joaquin Regional Rail Commission and compiled by the ESP project team.
[235] Amtrak, "National Fact Sheet: FY2010," 2011. Accessed at: http://www.amtrak.com/
[236] It is important to note that this analysis has not examined the likelihood of further provision of rail infrastructure in the Delta or other areas.
[237] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.
[238] Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.
[239] Figure D3 in Appendix D is a map which shows islands in the Delta 100-year floodplain that protect the BNSF railway.
[240] The DRMS study has conducted a rail closure cost estimate with daily costs ranging between $202,625 and $804,000 per day. Tables 25 and 26 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences,* Department of Water Resources, May 2008.
[241] According to *World Port Source* the Delta hosts five ports with some cargo capacity. These are: Port of Pittsburg, Port of Stockton, Port of West Sacramento, Rio Vista Harbor, and San Joaquin Harbor. Accessed at: www.worldportsource.com

Sacramento Deep Water Ship Channel in 1963.[242] The Port of West Sacramento is located 79 nautical miles from the Golden Gate Bridge and consists of 150 acres of operating terminals that currently handle a variety of bulk, break-bulk (general cargo), and project cargos. The Port of Stockton is located 75 nautical miles from the Golden Gate Bridge; it operates a diversified transportation center that encompasses 2,000 acres of operating area.[243]

Figure 38 Annual Cargo Tonnage Ports of West Sacramento and Stockton 2005-2009



Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics Center. Accessed June 30, 2011: http://www.ndc.iwr.usace.army.mil//wcsc/webpub09/webpubpart-4.htm

Facilitated by their rail linkages to the BNSF and UPRR networks, both the Port of Stockton and the Port of West Sacramento have become increasingly important shipping centers for bulk and

Box 4 Delta Shipping and the M-580 Marine Highway Corridor

In 2010, it was announced that the ports of Oakland, Stockton, and West Sacramento would be part of the national Marine Highway Program through a short sea shipping network called the M-580 Marine Highway Corridor. This marine highway will reduce truck transportation of containers on the Bay Area's congested road infrastructure through regularly schedule barge service. When the marine highway is fully operational, these two Delta ports will further deepen the regions' freight transportation infrastructure and significantly deepen multi-modal linkages. Similar to the advantages of rail transportation in comparison to truck transportation, but over smaller distances, the short sea shipping system will alleviate traffic congestion on the region's road infrastructure, and reduce costs as well as enhance air quality because of greater fuel efficiency. The Port of Oakland moves more than 99 percent of the containerized goods moving through Northern California. In 2010, there were 2.3 million containers moved through the Port of Oakland and by 2020 its volume is expected to increase by another 65 percent. Given this expansion and constraints around the port, development of the M-580 will offer significant opportunities for additional linkages beyond transportation and warehousing. In this regard, the Port of Stockton's West Complex development should realize important synergies as it seeks to build out industrial, commercial and maritime use of the former military facility that since 2000 has formed part of the port.

Sources: Port of Oakland website. Accessed at : http://www.portofoakland.com/maritime/facts_cargo.asp
Marad (2010) "Marine Highway Corridor Descriptions," Department of Transportation Maritime Administration. Accessed at: http://www.marad.dot.gov/documents/Marine_Highway_Corridors13_Sep_10.pdf
Port of Stockton, "Port of Stockton West Complex Development Plan," Final EIR, 2004.

[242] DWR, *Status and Trends of Delta-Suisun Services,* Public Review Draft, Department of Water Resources, March 2007.
[243] Port of Stockton website. Accessed at: http://www.portofstockton.com/

general cargos as the Port of Oakland has seen its container operations grow in dominance and other ports in the Bay Area reach capacity constraints. Figure 38 illustrates the growing cargo tonnage at both ports before the economic recession decreased tonnage.

As inland ports, both Stockton and West Sacramento are dependent on dredged deep water shipping channels. The levees and islands adjoining these channels provide important flows that prevent the channels from excessively silting-up. Nonetheless, both deep water shipping channels need to be dredged on a regular basis to maintain draft on the river of sufficient depth for vessels to navigate. In the case of the Stockton deep water shipping channel, there have been some challenges maintaining the channel depth at its specified depth of 35 feet at mean lower, low water (MLLW).[244] The Port of West Sacramento's deep water shipping channel is specified to a depth of 30 feet MLLW. Currently, both channels are seeking to further deepen their respective depths as demand for channel depths grows amongst the world's cargo ships.[245]

As with the other key components of transportation infrastructure in the Delta, the baseline trend for the Delta's ports and maritime infrastructure is for sustained expansion. This growth will be concentrated in the Ports of Stockton and West Sacramento, but given their existing rail linkages, and regional trends, opportunities exist for the port facilities in the West Delta as well. This expansion also appears likely to be tied to local, statewide and national expansion of foreign trade.

Table 46 Legal Delta Port and Maritime Infrastructure in 100-year floodplain[246]

	Quantity	Asset Value (millions)
Maritime Docks & Channel Markers (count)	40	102.9

Again, utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,[247] we are able to identify both the quantity of infrastructure in the Delta and that study's estimate of this infrastructure's asset value. As seen in Table 46, the Delta has some 40 maritime docks and channel markers.[248] In total, the asset value of this infrastructure is estimated to be in excess of $102 million.

9.3.4 Air Transportation Infrastructure

There are 11 general aviation airports located within the Legal Delta. These facilities are listed in Table 47. Besides those facilities, there are also small landing strips for property owners' use and small agricultural air strips used by commercial crop-dusting services.[249] Sacramento International Airport, Stockton Metropolitan Airport, and Travis Air Force Base are all located near the Legal Delta.

[244] Interview with the Port of Stockton, August 18, 2011.
[245] The Port of Stockton provided an illustrative estimate that an extra foot of draft in the deep water shipping channel would provide another $180,000 in revenue per vessel. Source: Email to author on August 22, 2011.
[246] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.
[247] Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.
[248] Figure D5 in Appendix D is a map which shows islands in the Delta 100-year floodplain that border the deep water shipping channels.
[249] DPC, *Utilities and Infrastructure,* Background Report, 1994.

Table 47 Aviation Facilities in the Legal Delta

Name	County	City	Category
Byron Airport	Contra Costa	Byron	General Aviation
Las Serpientas Airport	Contra Costa	Brentwood	General Aviation
Funny Farm Airport	Contra Costa	Brentwood	General Aviation
Spezia Airport	Sacramento	Isleton	General Aviation
Tracy Municipal Airport	San Joaquin	Tracy	General Aviation
Kingdon Airport	San Joaquin	Lodi	General Aviation
Lost Isle Seaplane Base	San Joaquin	Stockton	General Aviation
New Jerusalem Airport	San Joaquin	Tracy	General Aviation
33 Strip Airport	San Joaquin	Tracy	General Aviation
Rio Vista Municipal Airport	Solano	Rio Vista	General Aviation
Borges-Clarksburg Airport	Yolo	Clarksburg	General Aviation

Source: http://www.airport-data.com - Accessed June 30, 2011.

While there are no major airports in the Delta itself, the growing megaregion's population will likely create increased demand for the aviation facilities around the Delta and could expand demand for aviation facilities in the Delta. However, given the linkages that Delta aviation facilities have with agricultural services and to a lesser degree with recreation, it is likely they will parallel those sectors' baselines of higher-value agricultural crops and growing recreational activities although somewhat less than the broader regional population growth.[250]

Table 48 Legal Delta Aviation Infrastructure in 100-year floodplain[251]

	Quantity	Asset Value (millions)
Airports (count)	2	86.2

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,[252] we are again able to identify both the quantity of aviation infrastructure in the Delta and that study's estimate of this infrastructure's asset value. As seen in Table 48, the Delta has two airports located within its 100-year floodplain.[253] In total, the asset value of this aviation infrastructure is estimated to be in excess of $86 million.

9.3.5 Impact of Policy Scenarios on Transportation Infrastructure

While the baseline scenarios for each of the transportation systems have been discussed in their respective subsections, it is worth emphasizing that the risks to infrastructure as a result of potential flooding events is not likely to be limited to the loss of infrastructure itself. In many cases there are alternative routes and/or modes available for much of the Delta's transportation infrastructure. Nonetheless, the capacity of those alternatives is constrained and those constraints may or may not change in the future.

[250] See Chapters 7 and 8 for information on the baseline trends in agriculture and tourism respectively.
[251] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.
[252] Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.
[253] Figure D5 in Appendix D is a map which shows islands in the Delta 100-year floodplain that border the deep water shipping channels.

Under the baseline assumption of a PL84-99 standard of levee protection,[254] some non-negligible risks remain for parts of the Delta's transportation infrastructure. It is important to recognize the systemic relationships between the Delta's transportation infrastructure and that of the larger megaregion and beyond. Dynamic changes in components outside of the Delta could drastically alter the importance of through-Delta transportation. The robustness of the existing Delta infrastructure could thereby take on very different levels of significance. Based upon discussions with key stakeholders of the various components in the transportation infrastructure system and a review of previous analyses, some of the likely impacts on the Delta's transportation from the policy scenarios presented in Chapter 6 include:

• **Habitat Conservation:** While details of the location of tidal habitat matter; one specific area of concern would be the potential for additional silting of the deep water shipping channel. If the tidal habitat were located next to or near either of the deep water shipping channels, additional silting could occur which would incur significant costs and potentially inhibit commerce with the ports.

• **Open Water Scenario:** In terms of transportation infrastructure, there are minimal assets in the six islands. The existing infrastructure identified through the DWR DRMS study is presented in Table 49.[255] The infrastructure on the islands is primarily local in nature and would not have significant impacts of the larger regional transportation system.

Table 49 Transportation Infrastructure in the Six Island Open Water Scenario

	Quantity	Asset Value (millions)
Non-Highway Bridges (count)	1	0.5
Minor Roads (miles)	31	33.0

However, presence of the open water would expose the Stockton deep water shipping channel to rougher seas and increase silting, which as discussed above would be problematic and costly to the shipping system.

• **Higher Standard Levees Scenario:** Additional levee protection under this scenario would place the transportation infrastructure well above the 100-year standard. This protection would reduce the risk of local damage to the transportation infrastructure systems and reduce the likelihood of interruptions to the broader regional transportation system with which the Delta's infrastructure is increasingly important.

• **Regulatory Scenario:** The increased regulation scenario would potentially impact maintenance of the transportation infrastructure by adding another layer of approval, with potential delays and costs. In addition, the potential for denial would add risk and uncertainty to transportation infrastructure investments in the Delta. These would increase the costs of infrastructure investments and thereby likely lead to less transportation infrastructure investment in the Delta. Conversely, the streamlining of regulations would reduce delays and associated costs of infrastructure maintenance and facilitate capital investments by making a favorable environment for considered infrastructure projects.

[254] See Chapter 5 (Flood Control and Public Safety) and Chapter 6 (Framework for Economic Analysis) for further information regarding this standard as the baseline level of protection.
[255] Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.

• **Delta Vision Scenarios:** The Delta Vision proposals for National Heritage recognition and land use policies would offer potentially useful means to ensure that transportation infrastructure is consistent with maintaining and evolving the Delta as a place. The enterprise zone designation proposal would support the transportation system and associated enterprise development along the value chain.[256] Expansion of the State Park and Recreation Area network could support and be supported by development of the Delta's transportation infrastructure. Lastly, the Delta Investment Fund would also be a useful measure to increase transportation infrastructure that supports the broader consistent sustainable economic growth of the Delta.

9.4 Energy

The largely rural and unpopulated nature of the Delta's Primary Zone makes it a valuable location for energy infrastructure; significant regional natural gas pipelines, underground natural gas storage, and electricity transmission lines are present in the region. This infrastructure provides critical linkages to nearby electrical generation facilities that are significant features of the State's power generation capacity.

9.4.1 Natural Gas

The Delta hosts major natural gas pipelines, production, and storage facilities. There is approximately 242 miles of natural gas pipeline with an estimated asset value in excess of $325 million that serve regional users and the local gas fields in the Delta's 100-year floodplain.[257] There are two major natural fields in the Delta: the Rio Vista Gas Field and the French Camp Gas Field. The Rio Vista Field, the larger of the two, is California's largest natural gas field. Combined, these two fields produced 43 percent of California's non-associated, independent-from-oil production, natural gas and 13 percent of the State's total natural gas production in 2009.[258] In the Delta's 100-year floodplain alone, there are an estimated 287 natural gas wells and 111 square miles of natural gas fields.[259] Pacific Gas and Electric's (PG&E) underground storage facility at McDonald Island is the largest natural gas storage facility in the state with approximately 82 Bcf of gas storage capacity, which provides up to one-third of PG&E's peak natural gas supply.[260] This natural gas infrastructure also has important linkages with the proximate electricity generation facilities. A large portion of the Delta's natural gas infrastructure is located within the Delta's 100-year floodplain and as such may be damaged and disrupted during flooding events even with the baseline PL 84-99 standard of protection.[261]

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[256] Currently, there is an enterprise zone in San Joaquin County that covers large parts of the Delta. In addition, conditional designation has been granted to enterprise zones in Pittsburg, West Sacramento, and Sacramento. (Source: California Association of Enterprise Zones, www.caez.org)

[257] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.

[258] DOGGR, *Report of the state oil & gas supervisor: 2009*. Department of Oil, Gas, and Geothermal Resources, California Department of Conservation, 2010.

[259] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.

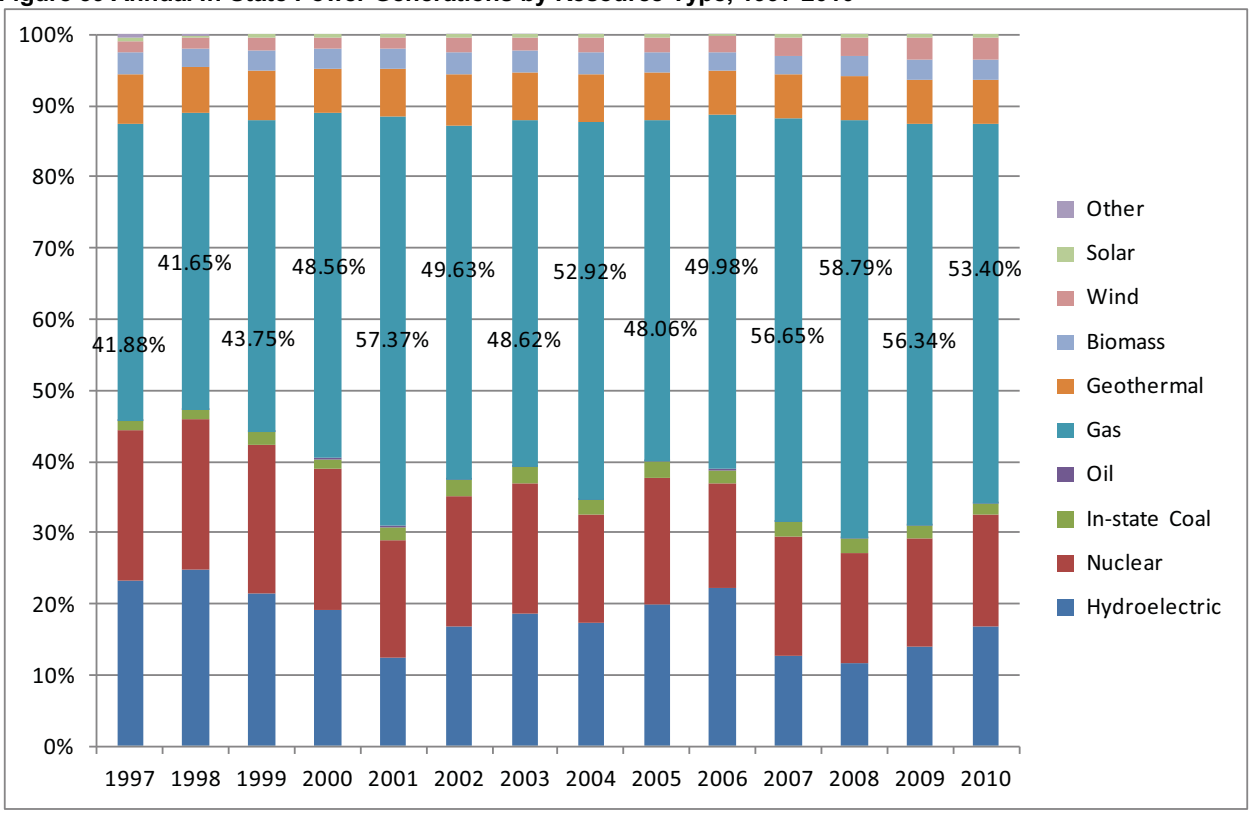
[260] California Public Utilities Commission, "California Natural Gas Infrastructure," January 2010.

[261] The DRMS study has estimated the monthly winter cost of a loss of the McDonald Island storage facility to be $114.4 million and the potential daily natural gas well production loss to equal $870,800. Table 24 and page 54 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences,* Department of Water Resources, May 2008. Figure D7 in Appendix D is a map which shows islands in the Delta 100-year floodplain with natural gas storage, fields, and pipelines.

9.4.2 Electricity Generation Systems

The Legal Delta and nearby power facilities are significant sources of energy for California's electrical grid. Natural gas has become an increasingly significant resource in California's electricity generation, rising in its contribution from 42 percent of the state's total electricity generation in 1997 to 53 percent in 2010.[262] This rise in natural gas use in electricity generation is highly relevant given the Delta's natural gas infrastructure. The Legal Delta hosts 23 power plants with generation from natural gas, petroleum coke, wind, biomass, and landfill gas.[263] The most significant was natural gas-based generation; in 2010, plants within the Legal Delta generated nearly 10 percent of the state's total natural gas-based electricity, and plants within the five-county Delta region generated nearly 20 percent of the state's total natural gas-based electricity.[264]

Figure 39 Annual In-State Power Generations by Resource Type, 1997-2010



Source: California Energy Almanac, July 8, 2011 update. Accessed at: http://energyalmanac.ca.gov/

The Delta's electricity generation capacity is largely located outside of the 100-year floodplain, but the single power plant located within the floodplain has an estimated asset value of $130 million. [265]

[262] California Energy Commission, *The California Energy Almanac*. Accessed June 30, 2011.
[263] For a list of the plants, their Mw capacity, primary fuel, and owner, see Appendix J.
[264] Power generation facilities in the Legal Delta generated nearly a third of the state's coal and coal-derived generation, but this only totaled 1,072 Gwh in 2010 and is a product of petroleum coke inputs supplied to these facilities from nearby oil refineries.
[265] Derived from Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.

9.4.3 Electricity Distribution Systems

According to the 2007 Department of Water Resources *Status and Trends of Delta-Suisun Services Report,* PG&E, the Sacramento Municipal Utility District, and Western Area Power Administration oversee most of the transmission lines and provide local electricity services within the Delta.[266] There are three major electric transmission lines that cross the Delta and interconnect California with loads and generation facilities across the Pacific Northwest. These transmission lines usually operate with combined loads near 4,000MW, but will run loads up to 4,800MW. In total the three lines carry roughly 10 percent of California's summer electricity load. Besides those three major transmission lines, there is a network of lower kilovolt lines in the Delta with combined loads of approximately 1,900MW. [267]

Table 50 Legal Delta Energy Transmission Infrastructure in 100-year floodplain[268]

	Quantity	Asset Value (millions)
Substations (Count)	32	$32.0
Transmission Lines (miles)	326	$448.4

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,[269] we are able to identify both energy transmission infrastructure in the Delta's current 100-year floodplain and that study's estimate of its asset value. As seen in Table 50, the Delta has 326 miles of transmission lines and 32 substations in its 100-year floodplain. In total, the asset value of this rail infrastructure is estimated to be in excess of $480 million.[270] While the baseline PL 84-99 standard for all levees in the Delta is assumed, flooding and earthquake events at this level of protection are not trivial and could place significant strain on the inter-state distribution system as well as entail significant local outages in and around the Delta.[271]

9.4.4 Other Energy Infrastructure

There are several pipelines of major regional significance that carry gasoline and aviation fuel across the Delta from Bay Area refineries to depots for distribution throughout Northern California and Nevada. This pipeline infrastructure extends from the Delta to Sacramento and Stockton onwards to Fresno and Bakersfield as well as to Chico and Reno. These pipelines supply roughly half of all transportation fuel used in the megaregion as well as being the principal source of fuel to several military bases across Northern California and Nevada.[272]

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[266] DWR, *Status and Trends of Delta-Suisun Services,* Public Review Draft, Department of Water Resources, March 2007.
[267] DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*, 2008.
[268] These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.
[269] Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.
[270] Figure D8 in Appendix D is a map which shows islands in the Delta 100-year floodplain that protect electric power transmission lines and substation.
[271] The DRMS study has conducted a power distribution cost estimate focused on two of the three major transmission lines with a two-month outage estimated costs equal to $42 million. Tables 19 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences,* Department of Water Resources, May 2008.
[272] DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft. Department of Water Resources. March 2007.

Table 51 Legal Delta Fuel Infrastructure in 100-year floodplain[273]

	Quantity	Asset Value (millions)
Petroleum Pipelines (miles)	70	$77.3
Oil Depot (count)	10	$30

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta, we identified approximately 70 miles of fuel pipeline and 10 oil depots in the Delta's current 100-year floodplain worth an estimated $107 million. While the baseline PL 84-99 standard for all levees in the Delta is assumed, the potential loss of this critical infrastructure would require massive mobilization of tanker trucks to minimize as far as possible associated fuel disruptions.[274]

Lastly, it is significant that the geologic structure of the Delta's associated sedimentary basin also appears to offer promising opportunities for potential CO_2 sequestration (capture and storage of carbon dioxide). This important potential development to reduce atmospheric man-made CO_2 emissions has identified the Delta's Sacramento Basin as one of the five most promising basins for CO_2 sequestration from an analysis of over 100 basins in California.[275]

9.4.5 Impact of Policy Scenarios on Energy Infrastructure

The baseline scenario for the various components of energy infrastructure in the Delta is assumed to be highly correlated with that of the Northern California megaregion. In general, the Delta's energy infrastructure should expand at a rate near to that of the megaregion. However, risks from flooding and earthquake events under the PL84-99 levee standard are assumed to have a greater downside probability, thereby decreasing the relative and absolute extent of the Delta's energy infrastructure. In addition, changes in power generation and transmission as well as fuel technologies or associated resources may increase or decrease the attractiveness of the Delta as an energy infrastructure node. With these caveats, some of the likely impacts on the Delta's energy infrastructure from the policy scenarios presented in Chapter 6 include:

• **Isolated Conveyance Scenario**: This is likely to have relatively minor direct impacts on the Delta's energy infrastructure. However, there are probable indirect impacts on at least some of the energy infrastructure as a result of increased energy requirements for pumping capacity in the isolated facility.

• **Habitat Conservation:** While this is also likely to be relatively minor, some conservation measures such as tidal habitat may restrict access to natural gas fields.

• **Open Water Scenario:** Based on our analysis of existing infrastructure identified through the DWR DRMS study, the only component of energy infrastructure in the six islands is a natural gas field on Webb Island. That infrastructure consists of an 83-acre natural gas field, one

[273] These figures were derived from Table 7-2a in DWR (2007) *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.
[274] The DRMS study has estimated costs on California consumers alone (excluding Northern California and military bases) from a loss of two of the systems to equal at least $25 million per day. Page 58 in DWR (2008) *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*. Department of Water Resources, May 2008.
[275] Downey and Clinkenbeard, 2005. *An Overview of Geologic Carbon Sequestration Potential in California*. California Geological Survey.

natural gas well, and a quarter mile of natural gas pipeline with an estimated asset value of $250,000.[276]

• **Higher-Standard Levees Scenario:** Assuming other factors are held constant, a higher level of levee protection would reduce the risks of energy infrastructure losses and likely lead to a greater probability for expansion of the Delta's energy infrastructure with associated investment above the baseline.

• **Delta Vision Scenarios:** As with Transportation infrastructure, the Delta Vision proposals for National Heritage recognition and land use policies would offer a potentially useful means to ensure that energy infrastructure is consistent with maintaining and evolving the Delta as a place.

9.5 Water Resources

9.5.1 Water Supply Infrastructure for Delta Communities and the Delta Region

Communities in and surrounding the Legal Delta rely on a variety of water supplies including groundwater, direct diversions from natural flows in the Delta, and diversion of surface water supplies that originate upstream from the Delta. For simplicity, this section focuses on municipal water supplies for Delta communities that divert water directly from the Delta. The largest municipal sources in this category are the Contra Costa Water District, which has several

Box 5 Salinity Impacts on Industrial Users of Delta Water

Beside agriculture, there are numerous industrial users of water from the Delta. These industries are primarily located in or near the western Delta and include power plants, steel mills, and oil refineries. Some of these industrial users maintain their own Delta intakes while others are provided industrial water by the local water districts. A large amount of water is used by these industries as boiler feedwater and for their cooling towers. Because of strict water quality requirements for optimal performance, degradation such as that from increased salinity reduces operating efficiencies or increases the cost of pre-treatment and creates adverse economic impacts. By way of illustrating these impacts on cooling tower systems, we examine an example of two refineries that are supplied industrial water by Contra Costa Water District. Increased salinity reduces thermal conductivity, decreasing cooling tower performance, and requires more water to cycle through to maintain performance. It was estimated that a 20 percent increase in salinity above average would require an additional 17 percent increase in industrial water purchases for the cooling towers' operation. Those increased water purchases would add approximately $985,000 in costs per year for the two refineries combined. The higher salinity would also accelerate corrosion of the cooling systems with associated increased costs for replacement, downtime, and reduced operating efficiency. There are numerous industrial customers in the Delta area whose operations would likely be significantly affected by increased salinity in the Delta. Therefore, the annual costs associated with increased salinity would be much greater than the illustrative estimate.

Note: This discussion draws on comments and estimates made regarding the August 9, 2011 Draft version of the ESP. Those comments were made by the Contra Costa Water District and are available at the Delta Protection Commission website: http://www.delta.ca.gov/ESP_Comments.htm.

intakes in the western and south Delta, and the new City of Stockton water supply project that is currently under construction. The City of Antioch also has an important water supply intake at the western edge of the Delta, and purchases water from the Contra Costa Water District when

[276] Table 7-2a from DWR (2007) *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.

the water quality at their intake deteriorates to poor levels.[277] The Solano County Water Agency has a major water intake in the northwest Delta that serves significant areas in a Delta county and nearby Napa, but does not directly serve customers in the Legal Delta. The City of Tracy receives a portion of its supply from the federal Central Valley Project that serves areas to the south, but has added other supplemental supplies in recent years to reduce its dependence on this source.

Box 6 Salinity Impacts on Residential Users of Delta Water[278]

There are a range of factors, including rising sea level and conveyance options that may increase the salinity of Delta water. Whatever the cause, saltier source water requires more water and energy to produce quality drinking water and also generates greenhouse gas. Owing to their intakes' proximity to the San Francisco Bay, the western Delta communities typically bear the initial impacts of increased Delta salinity. The City of Antioch, for instance, has been diverting fresh water from its intake since the 1860s, but when salinity levels are too high to utilize this water, Antioch purchases water from CCWD for an additional $750,000 per month or approximately $3 million per season on average. Therefore, as rising salinity levels reduce the operating horizon for their intake, the cost of providing water to their customers rises. CCWD has estimated the impacts associated with a 20 percent increase in fall salinity at their Rock Slough intake to equate to an additional operating cost of $94,000 per month due to increased releases from Vaqueros Reservoir and subsequent increased pumping to refill the reservoir. The additional energy requirements associated with increased use of Los Vaqueros Reservoir to dilute the saltier water would generate an additional estimated 190 metric tons of CO_2 emissions. Furthermore, CCWD is currently investigating a brackish water desalinization plant to be developed collaboratively with four other utilities. The estimated capital costs for this plant are between $150 million and $180 million, with annual operation and maintenance costs between $10 million and $13 million.

As for agriculture, water quality is a critical consideration for these users, although its impacts can be controlled to a greater extent than for agriculture by using modern water treatment procedures, which may be very expensive. Water quality impacts on agriculture are discussed in Chapter 7. There are numerous potential sources of significant changes to Delta water quality; several are discussed in the context of the scenarios below. However, the following two other factors may also significantly influence baseline Delta water quality.

1) It is the policy of the state to plan for 55 inches of sea-level rise by 2100, although there is a wide range of estimates available and little consensus among the scientific community. Regardless of the exact amount of sea level rise, rises in sea level approaching this number would have a significant effect on tidal action and salinity in the Delta. These effects could be partially mitigated by adaptive management and engineering, and by careful restoration of habitat designed to absorb tidal energy in the far western Delta and the Suisun Marsh. Maintenance and improvement of the levees on the eight western islands will become even more critical as sea level continues to rise.[279]

2) Changes in the water quality of the San Joaquin River are another significant factor affecting overall water quality of the Delta. Further degradation of the water quality in the San Joaquin

[277] The City of Antioch is partially reimbursed for these purchases according to the terms of a 1968 settlement agreement between the City of Antioch and the DWR.
[278] The impacts discussed in this box are derived from comments and consultations with both the City of Antioch and the Contra Costa Water District.
[279] Figure D1 in Appendix D is a map which shows the western islands and tracts in the Delta that have been identified as being critical to buffer against saltwater intrusion.

River is a long-standing problem with no easy solution. Actions directed towards updating specified flow criteria to improve water quality through salinity objectives may be realized through changes to the Bay-Delta Plan by the State Water Resources Control Board (SWRCD).[280]

In addition to the intake facilities themselves there are several associated pipelines conveying water from and through the Delta. Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta, we identified approximately 50 miles of aqueduct in the Delta's current 100-year floodplain worth an estimated $1.3 billion. [281] It is important to recognize that municipal water users have exhibited significant gains in efficiency and the continuation of these trends will likely reduce the relative demands on in-Delta water supplies despite future growth in the megaregion.

9.5.2 Wastewater Management Systems for Delta Communities

Many Delta communities discharge treated wastewater into the rivers and sloughs of the Delta. Such discharges are regulated by the State and Regional Water Boards through National Pollutant Discharge Elimination System (NPDES) permits to provide protection of all designated beneficial uses in the Delta. In recent years, the Central Valley Regional Water Quality Board has ordered virtually all Delta wastewater dischargers to significantly upgrade their plants to advanced treatment. Some wastewater utilities are in the process of constructing new facilities, whereas others, including the Sacramento Regional County Sanitation District facility, the largest wastewater treatment facility discharging to the Delta, are in the planning stages after recent regulatory decisions by the Central Valley Regional Water Board. Although the costs vary between utilities, the costs for upgrades to advanced treatment are significant compared to secondary treatment.[282] These treatment improvements may make some improvements to Delta water quality. This effort represents a significant investment from communities in and surrounding the Delta, and is an action item already in progress that supports the coequal goals.[283]

9.5.3 Impact of Policy Scenarios on Water Resources Infrastructure

- **Isolated Conveyance Scenario**:

The isolated conveyance scenario proposes construction of new intakes for exporting water from the Sacramento River to areas south of the Delta. Assuming that there is no separate action taken on San Joaquin River water quality, this would tend to reduce water quality in the entire Delta, which at present is sustained by the flow of relatively fresh Sacramento River water through the Delta. While it is reported that the current preferred conveyance alternative would include some through-Delta flow, the operating rules have not yet been fixed and there is no consensus on the BDCP effects analyses. Therefore, it is likely that isolated conveyance will

[280] Currently the SWRCB is targeting the summer of 2012 for adoption of these amendments to the flow and salinity objectives. For details see: http://www.waterboards.ca.gov/water_issues/programs/delta.shtml

[281] These figures were derived from Table 7-2a in DWR (2007) *Technical Memorandum: DRMS Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007.

[282] An example of the benefits derived from these investments in wastewater treatment facilities have been seen at the Port of Stockton where once the City of Stockton began operation of its nitrification facility a mile up river in 2006, aeration at the port was finally able to achieve their operating targets. (Source: DWR, *Final Report: Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project,* Department of Water Resources, 2010.)

[283] Utilizing the DWR DRMS Phase 1 study, 15 wastewater treatment facilities were identified in the Delta's current 100-year floodplain worth an estimated $2.2 billion. (Source: Table 7-2a in DWR, *Technical Memorandum: DRMS Phase 1 Topical Area: Impact to Infrastructure,* June 15, 2007. See Appendix J for further details.

increase salinity in the Delta even though the extent of these impacts is uncertain. As discussed above, increased salinity will tend to raise industrial and residential water costs, particularly in the western Delta. This will be problematic for the communities dependent on Delta water, especially if these additional costs are not mitigated.

• **Habitat Conservation:** The proposed conversion to tidal wetlands of lands around the periphery of the Delta, principally in the Cache Slough area and in the South Delta, would be beneficial for a range of fish species because of the steady introduction of organic carbon into the rivers and sloughs of the Delta. However, this same increase in organic carbon can have a significant impact on municipal water supplies because it can only be treated with advanced water treatment technology. A general idea of the estimated costs associated with this advanced water treatment is presented in Table 52.[284] While it is unlikely that all of the water providers in the Delta would need to implement advanced water treatment, it is illustrative of the potential impacts from the creation of environments for threatened and endangered species to thrive if they are located close to critical water supplies.

Table 52 Estimated advanced treatment costs

	MGD Capacity	Capital Costs (millions)	Annual O&M Costs (millions)
CCWD	125	$94	$7.2
NBA	121	$40-$90	$9-$29
Antioch*	38.0	$12-$28	$2.2-9.1
Stockton	30.0	$15	$3.5
*Estimated from other utilities			

A strategy for creating additional tidal marshes that could have fewer impacts to Delta water quality would be to restore the sunken islands in the far western Delta (and also perhaps Frank's Tract) as tidal marshes and to convert what are presently managed wetlands in the Suisun Marsh to tidal wetlands. This could have less impact on the introduction of organic carbon into municipal water supplies and could help mitigate salinity intrusion into the Delta.

A second kind of conservation measure, restoration of historic floodplains to temporarily store floodwater, could also increase organic carbon loading. This generally requires the removal of levees or the construction of new set-back levees. Re-activation of historic floodplains contributes to flood control by reducing the peak water-surface elevation as a flood crests and stretching out the flood hydrograph. It also directly restores one important element of the natural ecosystem, the burst of organic carbon introduced to the aquatic environment during flood crest. However, because this is only a temporary burst, rather than a sustained introduction of organic carbon, and it only occurs during periods of high flows, the consequences for municipal water treatment are not as severe. An excellent example of this approach to floodplain restoration is provided by the proposed Lower San Joaquin Bypass project which would widen Paradise Cut and reduce peak-water surface elevations in the San Joaquin River as it passes Lathrop and Stockton.[285]

[284] Treatment costs in Table 52 are estimates provided in consultation with the Contra Costa Water District (CCWD), the City of Stockton, and the Solano County Water Agency (North Bay Aqueduct (NBA), The range of costs for Antioch are scaled estimates based on the range of capital and O&M costs provided by the other agencies. It is important to note that the actual cost will depend on the type of technology required.

[285] Lower San Joaquin River Flood Bypass Proposal, South Delta Levee Protection and Channel Maintenance Authority, submitted to California Department of Water Resources, March, 2011.

• **Open Water Scenario:** The open water scenario would entail the removal of the City of Stockton's Delta Water Supply intake on Empire Tract. This $217 million project is currently under construction by the City of Stockton to replace surface water resources and protect groundwater supplies. Initially the intake will allow 30 million gallons per day (MGD) to be treated, with further expansion planned for capacity to treat up to 160 MGD.[286]

• **Higher-Standard Levees Scenario:** A failure of levees and the failure to restore flooded islands is yet another potential source of water quality degradation. As noted elsewhere, the ecological benefits of leaving islands flooded, or even deliberately breaching islands where the land surface is presently below sea level, are uncertain. What is clear, however, is that increasing open water in the Delta could have an adverse effect on adjacent islands as a result of increasing wave action and seepage forces, and could contribute to the conversion of the Delta from an estuarine ecosystem to that of a weedy lake. Water quality could be degraded as a result of increased salinity intrusion and as a result of more organic carbon and introduced organisms. These adverse effects would be mitigated by improving levees to a higher standard.

[286] Delta Water Supply Project website. Accessed at: http://www.deltawatersupplyproject.com/

Part Three: Integration and Recommendations

Chapter 10: Legacy Communities

The Legacy Communities of the Sacramento-San Joaquin Delta are integral to the cultural fabric of the Delta. These towns provide key services and support functions for surrounding residents and businesses, serve as important visitor waypoints, offer unique cultural activities, and lend great character to the Delta as a place. These communities have existed to support agriculture and recreation activities in the Delta, and until recently have been economically sustainable in their own right. However, demographic, economic, and land use trends have changed these communities considerably—some to the extent that visible signs of underutilization and decline are prevalent—and continued evolution of economics and public policy in the Delta will greatly affect their ability to thrive in the future.

The State of California has recognized the importance of cultural heritage in the Legacy Communities and has mandated that the Economic Sustainability Plan include recommendations concerning these communities.[287] This report indicates that there is great potential for revitalization of the Delta's Legacy Communities, and this chapter seeks to support this endeavor by documenting the historical framework and socio-economic conditions of these areas, analyzing ways in which these communities relate to larger contexts and may adapt in the future, creating the principles for future economic prosperity, and recommending strategies by which a sustainable vision can be implemented.

10.1 Overview and Key Findings

The Delta Reform Act of 2009 (SB X7 1) identifies the Delta's Legacy Communities as Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove. This chapter focuses primarily on the unincorporated Legacy Communities of the Sacramento River Corridor, including Clarksburg, Courtland, Hood, Isleton, Locke, Ryde, and Walnut Grove, providing a general overview of each.[288] In addition, Clarksburg, Walnut Grove, and Locke have been selected for more detailed study and focused economic sustainability planning.[289] This chapter discusses a potential "vision" of a sustainable future for each of these focal communities, the goal being to preserve their rich cultural histories while simultaneously providing for economic prosperity. The chapter also provides a high-level implementation strategy for the Legacy Communities. It is anticipated that facets of the strategy presented here may be applicable to other Legacy Communities in the Delta.

A primary aspect of sustainability planning for the Delta's Legacy Communities is the notion of enhancing legacy themes and creating better awareness of each of these distinctive communities. It is contemplated that promoting the uniqueness of these communities, in combination with strategic investments, will attract new residents, businesses, and visitors, thereby stimulating overall economic health and sustainability. To fully realize the economic potential of the Legacy Communities will require a comprehensive plan. Accordingly, the Economic Sustainability Plan provides a multi-faceted vision for Clarksburg, Walnut Grove, and Locke that touches on historic preservation, economic development, urban design, recreation, marketing, and other factors. In addition, the Economic Sustainability Plan considers the need for a coordinated effort to reinvest in the Legacy Communities.

[287] Delta Reform Act of 2009 (SB X7 1)
[288] While the Delta Reform Act of 2009 (SB X7 1) identifies additional "Legacy Communities," the ESP focuses on the communities of the Sacramento River Corridor. Findings and recommendations from the ESP may serve as a useful template for analysis of other Legacy Communities.
[289] Clarksburg, Walnut Grove, and Locke reflect a broad range of community typologies (character and land use mix) found in the Primary Zone.

The vision for each community and the overarching implementation strategy rely on extensive research of historical context, analysis of socioeconomic conditions, and public input. This chapter includes historical narratives, presents local demographic and economic data, and incorporates findings from community outreach. The chapter also reflects findings from field work, including assessments of community character and site-specific development opportunities. The following presents key opportunities and constraints for the Legacy Communities; the high-level vision for Clarksburg, Walnut Grove, and Locke; and an overview of the implementation strategy.

10.1.1 Opportunities and Strengths

Agriculture is the primary driver of economic activity in the Delta. As documented in detail throughout the Economic Sustainability Plan, the agriculture industry is the primary economic engine of the Delta. Along with the agriculture industry, the Legacy Communities have matured and evolved over time. The health of agricultural production around the Legacy Communities remains critical to the sustainability of the Legacy Communities.

Outdoor and cultural recreation is essential to long-term sustainability. Already a well-known and heavily visited recreation area, visitors are an important source of revenue for Delta businesses. It is crucial to maintain and enhance recreational offerings in the Delta and to add to or strengthen the region's visitor-serving amenities, ensuring that the Delta remains a top visitor destination for outdoor and cultural recreation in Northern California.

Improved lodging, entertainment, and retail options capture additional tourism dollars. Despite the significant number of recreation visitors to the Delta, there are relatively few hotel rooms, stores, and attractions to capture visitor spending. Overnight accommodations and entertainment options, in combination with supporting retail, could increase visitation, length of stay, and spending in the Delta, but will require substantial reduction of risk to attract investors given the other inherent risks of projects in this sector.

Transportation-related improvements are needed to enhance the visual landscape, attract visitors, and improve public safety. Roadway landscaping, signage, bike lanes, sidewalks, parking, transportation services, and other transportation-related improvements are needed in the Delta. Investments in transportation will improve quality of life for residents and increase tourism potential.

Restored historic buildings and contextual infill development improve community aesthetics and support economic growth. The Legacy Communities offer a unique sense of place and history that must be preserved. Historic preservation should be pursued in concert with new projects. Reinvestment and new investment in real estate is critical to economic sustainability. Development projects that are consistent with the existing community fabric will be an important factor in retention and recruitment of businesses. This will require increased regulatory flexibility to facilitate the use and adaptive reuse of vacant buildings. Meaningful progress in Locke should be among the highest priorities within the Primary Zone in this regard, as this unique community has the potential to catalyze tourism activity and related subsequent investments.

Agricultural tourism has growth potential. Agritourism and rural recreation is currently found throughout the Delta and is growing. Farms and other agricultural businesses (including wineries) are increasingly leisure destinations, with businesses seeking direct sales and brand awareness and visitors seeking fresh food and a physical connection to their food source.

However, substantial growth from current baseline conditions will require coordinated efforts to brand and market the region and its sub-districts, with the objective of breaking the Delta down to districts with distinct branding identities.

Festivals and community celebrations raise awareness and generate economic activity. There are numerous festivals and community events each year that boost tourism and business activity in Delta. Additional visitor programming, coordinated scheduling, marketing, and branding could increase the economic benefits of existing and future events in the Delta.

10.1.2 Constraints and Challenges

There is an over-arching need to reduce investment risk in order to spur economic activity in the Legacy Communities. Several factors work together to suppress business activity and economic growth, including incongruent and lengthy regulatory requirements between local, county, state, and federal entities, and significant flood risks.

A strict and multi-layered regulatory framework limits economic development. With numerous government agencies overseeing land use in the Legacy Communities, permitting new projects is frequently a costly and lengthy process. Furthermore, some projects are disallowed entirely. The Delta Plan's proposed "covered action" provision needs to be carefully reviewed to avoid further complicating and hindering economic development in the Primary Zone.

Risks associated with insufficient flood protection limit new investment. Adequate flood protection is essential to economic development in the Delta. Costly new and improved levees are necessary to encourage reinvestment and new investment in the Legacy Communities. Without levee investment, property owners are burdened by flood insurance requirements, as well as significant design, permitting, and financing hurdles for building improvements and new construction.

Housing options for Delta workers are limited. Only about one in ten employees working in the Primary Zone also lives there.[290] Without sufficient workforce housing, Delta employers must recruit non-local employees who must commute into the Delta to work, thereby compromising the environmental sustainability of the Legacy Communities. The need for workforce housing is an important policy concern for the Legacy Communities.

10.1.3 The Vision for Clarksburg, Walnut Grove, and Locke

Clarksburg – A Vibrant Agricultural Community. Clarksburg's primary competitive advantage is its agricultural abundance, with rural bucolic charm in close proximity to Sacramento. This area produces exceptional agricultural goods, most notably wine grapes, and attracts visitors who tour farm country and local wineries. The Economic Sustainability Plan proposes that the vision for Clarksburg build on momentum in the areas of agricultural tourism and value-added agricultural processing. Clarksburg should retain its historic character, grow as a food and wine destination, and attract new agriculture-related craft production businesses. In addition, some key local neighborhood services and amenities would work to make this community more attractive to visitors and local residents. Some increase in population growth, sensitively directed toward appropriate infill sites, would likely be necessary to achieve minimum market-based thresholds for retail or service sector business creation.

[290] Commute patterns are discussed in detail in Chapter 2.

Walnut Grove – The Heart of the Delta's Sacramento River Corridor. Walnut Grove is centrally located, with a cluster of businesses providing residents, workers, and visitors a variety of goods and services not found elsewhere in the Primary Zone. The Economic Sustainability Plan proposes that the vision for Walnut Grove build on its status as a hub of local businesses and services. Walnut Grove should preserve its community character; grow and diversify business activity; and continue to strengthen its physical connection to the Sacramento River.

Locke – A Historic Delta Community. Locke is known for its cultural heritage, historical significance, unique building stock, and points of interest. With great sensitivity to cultural, historical, and environmental values, the Economic Sustainability Plan proposes that Locke leverage its notable assets to increase tourism and spending in the community. Locke should preserve its historic character, offer improved hospitality and visitor services, and revitalize its "main street" business environment.

10.1.4 Implementation

Designate an agency to manage and implement economic sustainability efforts in the Delta. A designated entity responsible for economic development and community reinvestment should plan, coordinate, and participate in the implementation of the Economic Sustainability Plan. Future planning efforts would build on recommendations and findings from this Plan, refining the goals for the Legacy Communities and prioritizing potential strategic actions. The agency would ensure that strategic actions, such as marketing efforts and economic development, are implemented in a systematic, efficient, and consistent fashion throughout the Legacy Communities. Additionally, the agency might contribute to implementation directly, either carrying out actions independently or by coordinating partnerships between public- and private-sector actors. This topic is discussed in greater detail in Chapter 11 of this report.

Conduct additional study of potential community investment options. The Economic Sustainability Plan considers a number of strategic actions for the communities of Clarksburg, Walnut Grove, and Locke. In addition, opportunity sites are evaluated for higher and better land use potential. The proposed strategic actions and the review of opportunity sites presented in this chapter are intentionally high-level. As community-specific economic sustainability goals are refined over time, associated strategic actions will need to be updated and further detailed. Potential investments must be studied in detail to assess cost effectiveness and priority relative to a complete set of potential investments throughout all of the Legacy Communities.

Use the Delta Investment Fund to support economic development initiatives in Legacy Communities. Inadequate infrastructure is a major barrier to investment in the Legacy Communities. Funding for infrastructure (capital and maintenance) will be essential to promoting private sector investment in the future.

10.2 Existing Conditions and Trends

This section provides an overview of the Legacy Communities, including historical context, socioeconomic conditions, regulatory environment, and recent development projects.

10.2.1 Overview of the Legacy Communities

Although settlement and use patterns throughout the Delta occurred in tentative stages as early as the 1830s, it was not until the Congressional acts of 1850 and 1858 giving title of lands to the state and subsequently allowing the sale to individuals, that the Legacy Communities began to form. Concentrated agricultural use of the Sacramento Valley began with John Sutter's land grants of 1841. The emergence of New Helvetia as an important trading post subsequently led

to the establishment of a shipping wharf.[291] The confluence of three historical events—the California Gold Rush, the Second Industrial Revolution, which brought steam paddlewheel shipping and steam trains, and the end of the Mexican-American War—led to tremendous increases in population in San Francisco and the Bay area. As this population raced to extract the gold, the Delta became a valuable transportation, hunting, and fishing resource. Although the gold resources waned and miners rushed off to other finds, the agricultural and trading tradition of the area was already firmly established. As landowners looked for increased farming opportunities, the Delta became the focus of concentrated reclamation efforts.

The next 60 years saw the construction of levees and the draining of wetlands, which shaped much of the Delta that exists today. By 1920, reclamation of the Delta was complete and agriculture replaced gold as the regional economic driver. With dredging also complete, the Sacramento River became a predominant commerce route and recreation destination. Over the next several decades, the short-term mining practices and destruction of Delta ecosystems that took place during the gold rush subsided and were replaced by long-term management of the land and resources, including the building of permanent communities. Today, the Legacy Communities remain closely tied to the local agricultural economy and the Sacramento River.

The Legacy Communities of specific focus in the Economic Sustainability Plan are located in the Sacramento River Corridor and include Clarksburg, Courtland, Hood, Isleton, Locke, Ryde, and Walnut Grove. All Legacy Communities discussed in SB X7 1 are shown in Figure 40, and are briefly described below.

- **Bethel Island**, which is located just outside of the cities of Antioch and Oakley, is well-known as a recreation destination in the Delta. Relatively proximate to the San Francisco Bay area, Bethel Island offers residents and visitors retail and restaurants, a golf course, several marinas, and access to some the Delta's best waterways.

- **Clarksburg,** located in Yolo County on the west side of the Sacramento River, is well known for grape production and home to large-scale wine producer Bogle. The Old Sugar Mill, a redeveloped factory repurposed as wine tasting and production facility and event center, is a popular visitor attraction.

- **Courtland**, located in Sacramento County on the east side of the Sacramento River, is recognized for the significant pear production in the area. Each year, the Courtland Pear Fair celebrates the harvest.

- **Freeport** is the northernmost Legacy Community, located in Sacramento County, near the border of the City of Sacramento. Established as a port during after the California gold rush, Freeport has a distinct heritage in the history of goods movement in the Sacramento region.

- **Hood** is a small town located on the Sacramento River between Clarksburg and Courtland, about 12 miles south of Sacramento. In its heyday, Hood was an agricultural hub with two large packing houses, a rail spur to support goods movement, a hotel, and a movie theater.

- **Isleton**, an incorporated city located in southwestern Sacramento County near Rio Vista, contains a 19th century-era main street with numerous community- and visitor-serving businesses. The city is well known for its Crawdad Festival (Cajun Festival).

[291] http://www.sacdelta.com/hist.html and http://www.ppic.org/content/pubs/report/R_207JLChapter2R.pdf

- **Knightsen** is a small residential/farming community located near Oakley in Contra Costa County. Knightsen has become known for several horse ranching operations in its vicinity.

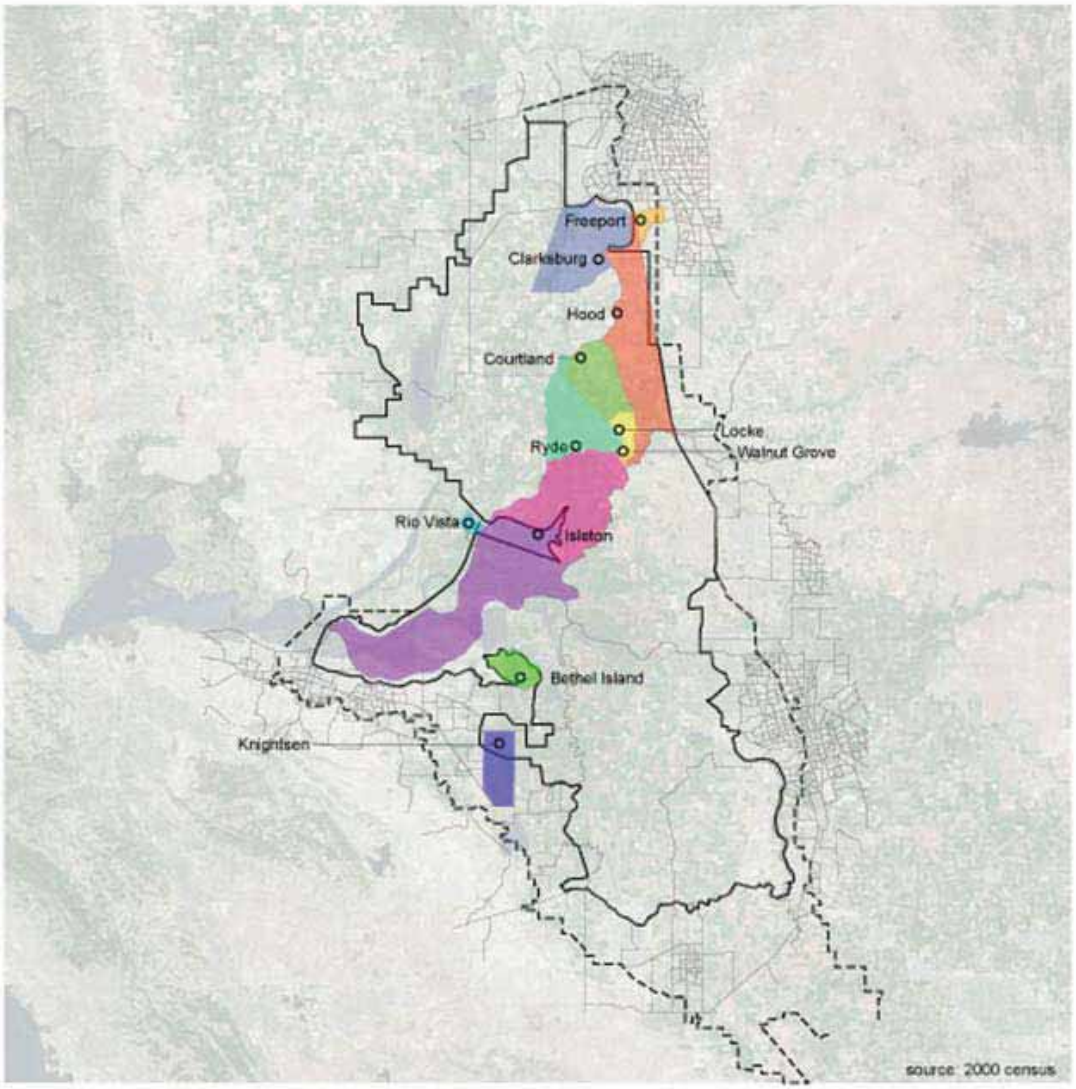
- **Locke**, located in Sacramento County on the east side of the Sacramento River, is nationally-significant example of a historic Chinese-American rural village. The town is a distinguished visitor destination in the Delta, with numerous points of interest, including the Locke Boarding House, Locke Chinese School, Locke Memorial Park, among others.

- **Rio Vista** is an incorporated city in Solano County. The most populated of all Legacy Communities, Rio Vista is home to many business and personal services which serve rural residents as well as visitors the Delta, and features an assortment of grocery stores, banks, restaurants, and other amenities.

- **Ryde**, located in Sacramento County on the west side of the Sacramento River, is well known for the historic Ryde Hotel and Event Center. Built in 1927, the recently refurbished Ryde Hotel is a Delta landmark and highly-regarded wedding and event venue.

- **Walnut Grove**, located in Sacramento County on the east and west sides of the Sacramento River, is a bustling small town with businesses, residences, a library, and a school. Walnut Grove is centrally located within the Sacramento River Corridor and offers many modern goods and services for businesses, residents, and visitors.

Figure 40Sacramento-San Joaquin Delta Legacy Communities[292]



Sacramento River Valley Legacy Communities
Area of Influence

LEGEND

- Legacy Communities
- Census Block Groups
- Primary Boundary
- Secondary Boundary

[292] For high resolution image see http://forecast.pacific.edu/desp-figs.html

10.2.2 Socioeconomics

Building on Chapter 2 (Overview of the People and Economy of the Delta), this section examines key demographic and economic conditions and trends in the Legacy Communities. The analysis focuses primarily on data-driven results and information from government data sources, including data from the U.S. Census Bureau. The Economic Sustainability Plan relies on Census block group-level data to evaluate the characteristics of population and jobs in the Legacy Communities.[293] Figure 40 shows the geographic boundaries of the block group data considered by this chapter. Appendix K provides detailed data tables supporting the findings discussed here.

10.2.2.1 Population Trends and Characteristics

According to Census 2010, there are approximately 6,600 residents in the Sacramento River Corridor Legacy Community block groups, an increase of almost 10 percent over year 2000 population. Most of the Legacy Community block groups experienced growth, with the greatest population growth (in percentage terms) observed in the block group that includes Hood, Freeport, and areas along Interstate 5. However, the block groups that include Isleton and Clarksburg grew at a much slower rate, with very little to slightly negative population growth since 2000.

The age distribution of residents in the Legacy Communities is generally similar to the Primary Zone overall, with few children and a high proportion of older residents, as compared to the population of the Legal Delta. In the Legacy Communities, the population under the age of 18 is only 18 percent of the population (compared to 29 percent in the Legal Delta) and the population age 55 and older is 36 percent of the population (compared to 20 percent in the Legal Delta). Census Bureau age data reveal more young residents in eastern Walnut Grove and Locke, with 25 percent of the population under the age of 18. In contrast, the Census Bureau indicates that population around Hood is notably older, with roughly 62 percent of residents over the age of 55.

The residents of the Legacy Communities are primarily White, although other racial groups and ethnicities are also well-represented. Eastern Walnut Grove and Locke are quite diverse, with Asians making up 38 percent of the population and Hispanics making up 40 percent of the population. Courtland also has a notable Hispanic population, with about 66 percent of the population reporting that ethnicity.

Across the Legacy Communities, the Census Bureau reports wide disparities in household income, with average household incomes ranging from less than $30,000 to over $90,000 per year. The highest average income is found around Ryde (including western Walnut Grove), where the Census Bureau reports an average household income of $92,200 (well above the average of $79,200 in the Legal Delta). However, directly across the Sacramento River in eastern Walnut Grove and Locke, the Census Bureau finds that average household income is significantly lower, at about $28,500.

The educational attainment of residents around the Legacy Communities is also varied, with notable correlation to the household income patterns. Around Ryde, almost 34 percent of residents hold a bachelor's degree, a significantly greater percentage than in the Primary Zone and Delta overall. In contrast, over 26 percent of eastern Walnut Grove and Locke residents are

[293] Although these geographic boundaries may differ from some other political or locally-accepted definitions of the Legacy Communities, U.S. Census Bureau data from the American Community Survey was the best information available at the time the analysis was conducted.

without a high school diploma or GED. The figure is even higher around Courtland, where about 34 percent of residents do not have a high school diploma or GED. However, Courtland also has a relatively high percentage of college graduates.

10.2.2.2 Labor Force and Economy

Similar to the Primary Zone overall, Census Bureau data concerning the Legacy Communities indicate that these residential areas serve as bedroom communities for nearby cities such as Sacramento and Stockton (i.e., most residents of these communities do not work in there). In fact, only about 12 percent of working residents in the Legacy Communities hold jobs close to home, in the Sacramento River Corridor.[294] Consistent with this finding, only about 15 percent of workers living in the Legacy Communities are employed in the agriculture, fishing, and forestry sector. However, agriculture sector workers make up a greater share of resident employment in eastern Walnut Grove and Locke (32 percent) and Clarksburg (25 percent). By comparison, only about one percent of workers living in Isleton are employed in the agriculture sector.

After agriculture, working residents of the Legacy Communities are commonly employed in the construction and education sectors, 11 percent and 10 percent respectively. In Isleton, almost one in five working residents has a construction industry job. In Courtland, nearly one quarter of working residents have a job in the education sector. In addition, closer to Sacramento, in the block group that includes Hood, nearly one quarter of working residents have a health care industry job. Residents are also commonly employed in manufacturing and administrative/waste services. Of employed residents in the Legacy Communities, approximately 64 percent are employed by for-profit enterprises, slightly lower than the roughly 68 percent observed in the Legal Delta.[295]

Jobs based in the Legacy Communities are most concentrated in agriculture- and recreation-related sectors. Census Bureau data indicate that employment in these industries makes up well over half of the jobs in the Legacy Communities. There are also notable employment concentrations in the construction, education and health, and trade, transportation, and utilities sectors.

10.2.3 Planning and Regulatory Overview

The complex, multi-jurisdictional regulatory environment that exists in the Legacy Communities today creates uncertainty and risk for investors considering a variety of economic development initiatives, including opening or expanding small businesses. Local municipal agencies (cities and counties) exert regulatory control for many items requiring land use approval (including building permits, subdivision maps, etc.). In addition, state and federal agencies also possess regulatory power over land use decisions, particularly in the Primary Zone. Despite efforts to coordinate land use planning and regulation in the Legacy Communities (see Chapter 4: Review of Key Policies and Planning Process), the current regulatory framework creates a significant burden for economic development projects. In fact, it is the opinion of many Legacy Community stakeholders that regulatory discord between the local and state entities is a key factor influencing disinvestment in the Legacy Communities. Additional discussion of regulatory constraints can be found in Section 8.3.2.2.

[294] LED-LEHD inflow/outflow data
[295] US Census Bureau, American Community Survey 2005-09.

10.2.4 Notable Real Estate Development Projects

Over the past several years, many real estate development projects have been proposed throughout the Delta, both in the outlying Secondary Zone as well within the heart of the Primary Zone and even within the Legacy Communities. These projects can shed light upon key issues that should be considered as part of an economic strategy for the Legacy Communities and are briefly discussed below.

10.2.4.1 Old Sugar Mill

The Old Sugar Mill project in Clarksburg is an important example of the challenges associated with real estate development in the Legacy Communities. While the project as it exists today (a winery and event venue) is a success story, project proponents originally conceived a mixed-use plan with a housing component that did not receive regulatory approval.

Originally constructed in the late 1930s to process sugar beets, the sugar mill became an aging and dilapidated structure after the processing facility was shut down in 1993. Redevelopment plans called for a mixed-use village that would incorporate 162 residential dwelling units and significant commercial and industrial space, including micro-wineries and an events venue. The residential component would have nearly doubled the population of Clarksburg. The housing component of the project generated local concern over potential impacts to Clarksburg's small-town character, which were evaluated and addressed throughout the project's environmental review process.

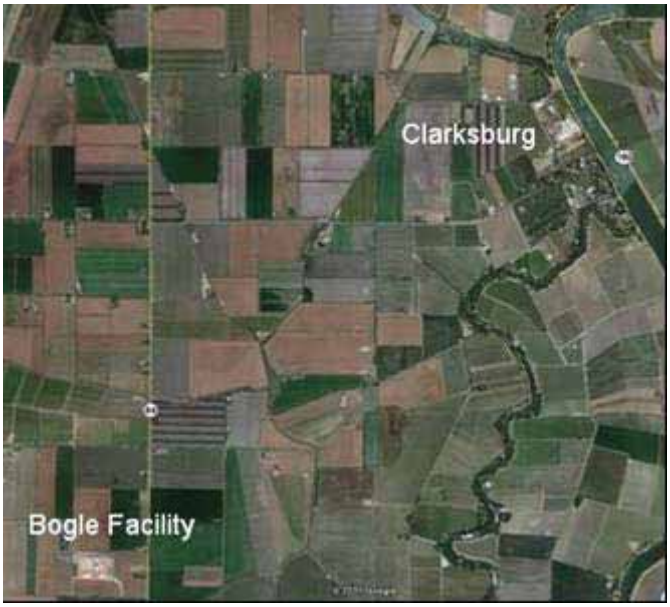
The project gained municipal approval from Yolo County in 2006. However, approval was also subject to the Delta Protection Commission's Land Use Management Plan. The Delta Protection Commission denied project approval in January 2007, citing flood control, residential/agricultural buffers, and residential density issues. According to local stakeholders, the ruling sent a strong signal to the development community and potential project investors concerning entitlement risk in the Primary Zone of the Delta.

Although the residential portion of the site was never constructed, project developers have moved forward with the rehabilitation and adaptive reuse of the Sugar Mill structure for commercial uses. The site is successfully operated today as a micro-winery and event facility. With programming such as the Delta Wine and Art Faire, the Old Sugar Mill has become a well-known visitor attraction and the primary venue for Clarksburg Appellation wine tasting.

10.2.4.2 Bogle Vineyards Delta Winery

Bogle Vineyards, a Clarksburg-based grape grower and wine maker, is expanding operations in Clarksburg. This development of a new winemaking facility is an important example of how public sector actors can facilitate development in the Legacy Communities. The new Bogle Vineyards Delta Winery facility in Clarksburg is located at the intersection of Jefferson Boulevard and Hamilton Road, outside of the developed town area, as shown in the map below.

Approved by Yolo County in 2010, construction is underway and the first phase is expected to be completed in 2011. Once fully completed, this winemaking facility will handle all aspects of wine production, from receiving and crushing grapes to packaging wine for shipment.



Yolo County streamlined the approval process for Bogle. Specifically, the latest Yolo County general plan designated 100 acres of Clarksburg for agricultural-industrial use. This designation simplified the project approval by negating the requirement for a General Plan amendment and associated environmental review under the California Environmental Quality Act (CEQA). In addition, the County is also considering reducing its development fees, subsidizing marketing efforts, relaxing regulatory standards, and using other methods to attract similar types of investment.[296]

The completion of the Bogle Vineyards Delta Winery will represent an important step in Clarksburg's continued evolution as a wine and food destination. For many years, processing facilities of this type were not easily developed in Clarksburg because of planning and zoning constraints. The facility contributes to the economic sustainability of the Delta by allowing Bogle to process grapes locally, retaining the added value of the final product within the Delta.

10.2.4.3 Isleton Residential Project

The recent failure of a significant residential project in Isleton demonstrates the potential scale and physical attributes of a sizable development project within the Legacy Communities, while it also reveals the market risk associated with residential development and small business in this area. In 2006, Del Valle Homes of Modesto broke ground on a 650-unit residential project in Isleton. The first phase of development covered forty acres, with plans for 250 single-family homes, which would have doubled the size of the town. The homes were proposed to be approximately 3,300 square feet over three stories, with garages on the ground floor, and situated on narrow lots. As construction of the project began, commercial property owners in Isleton started renovating their retail spaces and new businesses opened.

However, by 2007, the economy had turned and Isleton was hit hard. As a result, only 18 of the 250 homes were built and none of these homes were offered for sale. The development project

[296] Initial Study for Bogle Vineyards Delta Winery, Yolo County Planning and Public Works Department, November 2009.

has completely halted, the model homes currently sit empty, and there are no known plans to resume the project. In addition to losses incurred by the developer, the failure of this project has negatively impacted the community, as many of the newly opened stores have closed.[297] Although there were many challenges facing this project, its failure suggests that new home developments in the Legacy Communities should fit the scale, character, and market of the local area.

10.3 Economic Development Potential

As the Delta evolves as a place, there are likely to be numerous opportunities for the Legacy Communities to progress toward improved economic sustainability. However, these communities also face a variety of challenges and constraints that must be addressed. This section explores the potential prospects for economic prosperity in the Legacy Communities, with detailed consideration of the current limitations to growth and revitalization.

The Legacy Communities are largely a product of their environment, having developed over time along with the agriculture- and recreation-based economy in the Delta. Agriculture will likely remain the dominant economic sector in the Delta (see Chapter 7: Agriculture) and the Legacy Communities will continue to serve as economic hubs for agricultural workers and a variety of agriculture-related businesses. Looking forward, there will likely be opportunities for the Legacy Communities to continue to diversify their agriculture-related goods production and services. In addition, the recreation sector is a significant contributor to the economic development potential of the Legacy Communities in the future. Delta recreation will strengthen and diversify in the future, as urban populations in Northern California increase. Under a baseline scenario, the Economic Sustainability Plan recreation analysis indicates potential for a 35 percent increase in recreation visitation to the Delta by 2050. Building on this growth potential, the recreation analysis presents potential recreation development strategies to diversify recreational offerings in the Delta (see Chapter 8: Recreation).

The Legacy Communities must diversify business activities to satisfy the demands of visitors to the Delta. The Delta offers an array of scenic, historic, recreational, and agricultural attractions that if developed and marketed appropriately, could serve as an economic development driver in the Legacy Communities. For example, in areas where compelling recreation opportunities are proximate to Legacy Communities (e.g., Delta Meadows near eastern Walnut Grove and Locke), there are likely to be opportunities to develop visitor-targeted services and market a compelling tourism package. All of the Legacy Communities hold potential in this regard. Recognizing the tremendous potential for recreation to catalyze growth in the Legacy Communities, this section focuses on strategic economic opportunities related to Delta recreation as well as overarching improvement concepts for the Legacy Communities.

10.3.1 Economic Development Opportunities

This section considers potential economic development opportunities in the Legacy Communities, including lodging and visitor amenities, historic preservation, design and planning improvements, and event programming (e.g., festivals and heritage celebrations). While this section offers some specific recommendations that align with and build upon some of the recreation recommendations in Chapter 8, economic sustainability in the Legacy Communities requires that planning efforts consider changing agricultural activities, the emergence of enhanced recreational opportunities, improved flood protection, demographic changes, and shifting market preferences. The economic development strategy for the Legacy Communities must adapt and evolve over time.

[297] City of Isleton and local real estate brokers

Assuming that economic development opportunities in the Legacy Communities are generally limited to the current community footprints and logical extensions thereof, there are options for improving community gateways, connecting community anchors, rehabilitating and repurposing historic structures, and undertaking selective infill development projects to expand and diversify the local economy. These initiatives will involve the public and private sectors, with the public sector focused on securing infrastructure funding and ensuring workable land use policies, and the private sector deploying a combination of public and private sector financial resources with the intent of receiving returns commensurate with prevailing levels of risk.

10.3.1.1 Lodging and Visitor Amenities

There are very few lodging opportunities within all of the Legacy Communities. Although the Ryde Hotel is a historic landmark and local institution, it has reportedly struggled in recent years, despite strong revenue generation from weddings and other events. The only other formal lodging facilities within the Legacy Communities are in Isleton, and according to local sources, these motels are struggling as well. Altogether, the Legacy Communities offer fewer than 100 hotel rooms, none of which are modern or managed by major hospitality companies. While attracting more viable options for overnight lodging would help to bring additional people to the Delta, it would also present the opportunity to capture a much greater share of visitor spending.

The lack of new hotel rooms in the Legacy Communities reflects the risks associated with the development and operation of new lodging assets. While a major hotel or resort with modern amenities (e.g., personal services, retail offerings, etc.) would elevate the stature of the Delta, investment risks associated with uncertain market demand and project entitlement deter major hospitality groups from pursuing such projects. Further discouraging hospitality investments, the Delta has not been organized, branded, or marketed competitively within the region. Given current economic and policy conditions in the Delta, it is unlikely that major hotel or resort proposal will emerge within the next decade.

The seclusion of the Delta has become one of its main selling points, with restrictive permitting practices and challenging economic conditions creating a somewhat “sleepy” setting, which contributes to the Delta’s mystique. As a result, opportunities exist to leverage the authentic historic character of the Legacy Communities, which attract a consumer segment that values unique cultural assets over national brands. Bed and breakfast lodging and campsite business opportunities are therefore realistic alternatives to more risky and expensive hotel or resort projects, though longer-term opportunities for such investments still exist, depending on local sentiments about growth and land use, as well as required entitlement and flood protection improvements.

The introduction of additional restaurants and other visitor-serving uses, integrated within key activity nodes, would be a natural fit as the Legacy Communities grow and diversify, though local stakeholders have emphasized the need to protect existing businesses by avoiding head-on competition to the extent possible. While a number of small museums and interpretative centers are in operation, economic development efforts could promote additional visitor-oriented centers (e.g., Delta Discovery Center), possibly highlighting local food and agriculture, ecology and the environment, water infrastructure, or other local interest topics, making use of advanced-technology exhibits that capture the interest of families and a broad range of visitors.

Presenting (siting and designing) visitor amenities in a coordinated way throughout the Delta would go hand in hand with a concerted effort to increase the number of lodging rooms or other

overnight accommodations. Increasing the number of overnight stays would greatly improve average visitor expenditures throughout the Delta, enhancing economic performance and long-run sustainability for the Legacy Communities.

10.3.1.2 Historic Preservation

There are many opportunities throughout the Delta to retain its rich history and to leverage distinctive architectural assets to attract visitors and generate economic benefits. Significant historic structures should be preserved and restored so that these exceptional resources are not lost forever. In particular, there is a tremendous opportunity for businesses in Locke to capitalize on the town's unique history and cultural value. By systematically restoring existing historic structures and enhancing opportunities for visitors to learn about and experience the area's heritage, while also raising its profile through marketing and branding efforts, Locke can be elevated as a tourist destination. In addition, the establishment of a National Heritage Area (NHA) that encompasses the Legacy Communities would generate specific benefits for historic preservation (see Chapter 8: Recreation).

10.3.1.3 Event Programming

Community events such as festivals and heritage celebrations are good opportunities to instill civic pride in Legacy Community residents and to raise the profile of the area to visitors from outside of the area. Although community events do currently occur in the Legacy Communities, they mostly draw from a shallow market and rarely spur multi-day tourist visits. Enhancing, growing, and strategically marketing events in the Legacy Communities presents an opportunity to capture increased tourism and spending, generating more economic activity to support businesses in the Legacy Communities.

While the Delta Chambers and individual event promoters currently publicize events throughout the Delta region, events and other programs in the Legacy Communities should be coordinated with an overarching marketing and branding strategy. Coordinating Delta branding and marketing will be crucial to expanding the current market penetration of Delta events, ideally attracting more visitors from San Francisco, Oakland, San Jose, and other major northern California cities to the Delta for longer stays, including overnight visits. A good example of regional tourism promotion is found in Monterey County, where the Convention and Visitors Bureau does an excellent job promoting regional tourism to specific market segments though various media channels, including the internet, radio, and television.

10.3.2 Economic Development Constraints

The potential for private sector economic development activities to be undertaken in the Legacy Communities is directly tied to risk-reward tradeoffs, as compared with alternative investment options. The quantification of risk and ability to generate enough revenue to satisfy a minimum threshold rate of return (or discount rate[298]) associated with that risk is the primary determinant in an investor's decision to move forward with a project. Factors specific to Legacy Communities that affect the magnitude and certainty of investor return are discussed below in the context of catalyzing small-scale infill development that can bring additional

[298] The discount rate is the targeted internal rate of return on an initial investment that accounts for all inherent project risks.

housing, services, and amenities to existing communities and facilitating the recreational concepts contemplated by the Economic Sustainability Plan (see Chapter 8: Recreation), through the development of lodging, restaurants, and other visitor-related amenities. This section considers a variety of potential project risk factors in the Legacy Communities, including location, entitlement, market, financing, development, infrastructure, flood control, transportation, utilities, and communications characteristics.

10.3.2.1 Land and Location Characteristics.

Current land use management in and around the Legacy Communities ensures that greenfield land development potential will be very limited. Though there may be some unique exceptions, the regulatory limitations on land use force new development to infill development opportunities, primarily within the Legacy Communities. Infill development in this context brings a slew of specific development challenges, including:

- Irregularly-shaped parcels that complicate building design and construction
- Aged or insufficient infrastructure that requires upgrades
- Sub-surface issues (e.g., contamination) that may be poorly documented and costly
- Floodplain building requirements (e.g., elevated foundations) that complicate design[299]
- Challenges associated with renovating historic structures that increase project costs
- Financing for small-scale mixed use projects in untested markets that is very limited

Given these challenges and the generally high degree of complexity and uncertainty associated with infill development in the Legacy Communities, it will take a dedicated development team, and likely public sector partners, to successfully complete meaningful infill development projects that benefit the local economy.

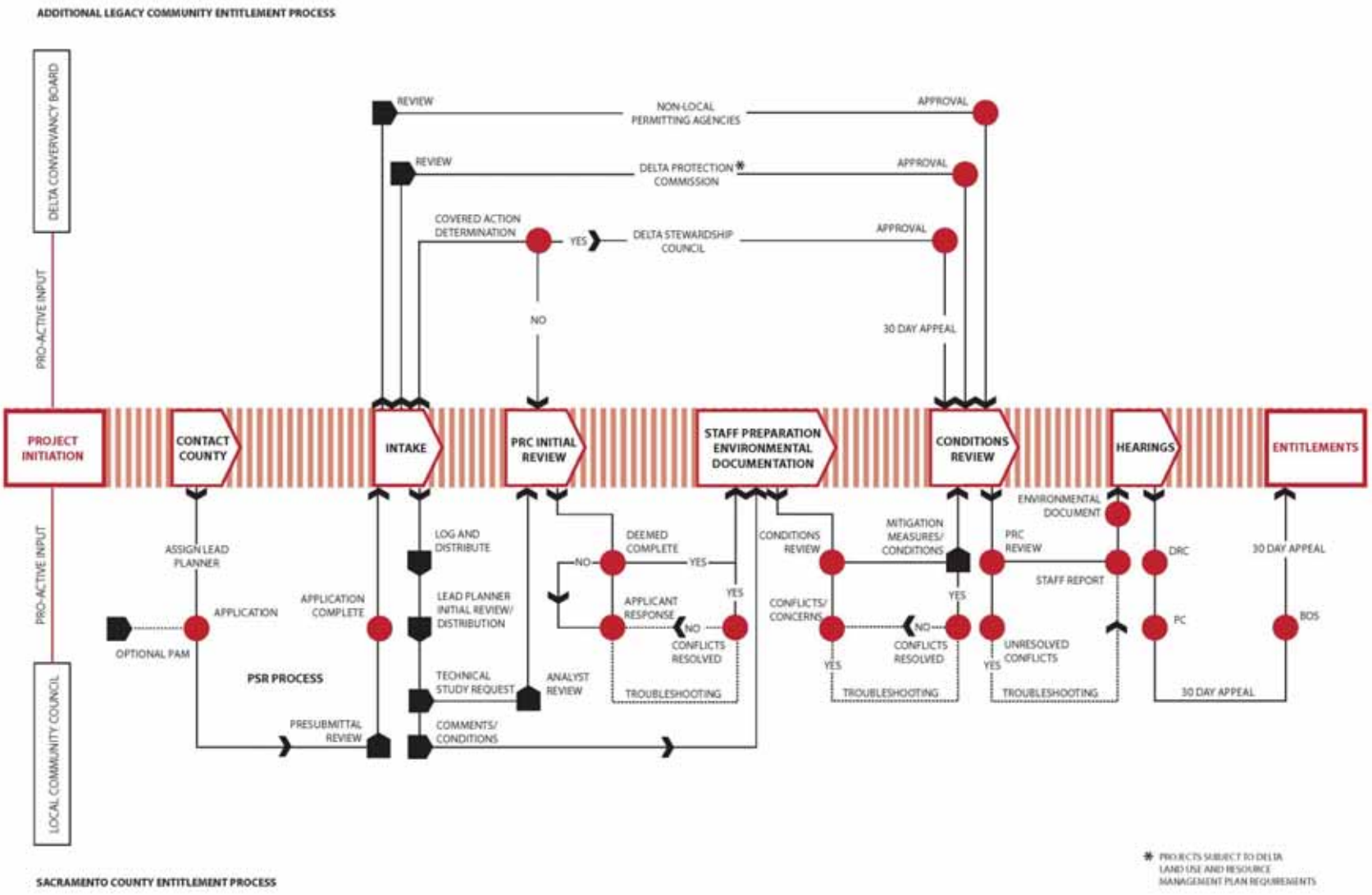
10.3.2.2 Entitlement Characteristics

The risk characteristics of project entitlement in the Legacy Communities indicate that this is among the most risky investment climates for a real estate developer in the U.S. This characterization is primarily a function of the arduous entitlement process in the Primary Zone, in combination with instances of community opposition to growth within the Legacy Communities. The entitlement process for a project in a Legacy Community is extremely complex and time consuming. In some cases, approvals extended by a County may be overruled by the Delta Protection Commission, and involvement with multiple regulating agencies (e.g., U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, state government, county government, etc.) is expected for larger projects. The risk of being “bounced” between multiple agencies during the entitlement process was showcased in the recent rejection of the residential portion of the Sugar Mill project in Clarksburg.

The diagram below (Figure 41) presents the typical project entitlement process in Sacramento County (bottom) and the additional process in the Primary Zone (top). As a project proponent develops conceptual plans, proactive input from both the Local Community Councils and the Delta Conservancy are recommended to align the project direction with Community Plans and the Conservancy’s legislative concerns. In addition, there may be input from community associations or historic preservation requirements as in the case of Locke.

[299] National Flood Insurance Program (FEMA)

Figure 41 Framework for Project Approval in Unincorporated Sacramento County/Primary Zone



Following the initial input, the project will undergo the county approval process. This multi-layered procedure includes input from multiple local, county, and state agencies and includes pre-submittal review, intake, initial review, applicant response, environmental documentation (CEQA), public hearings, appeal procedures, and determination. Approval is also subject to the requirements of the DPC's Land Use and Resource Management Plan.

As part of the Delta Plan, the Delta Stewardship Council (DSC) is proposing a new layer of project review and approval in the Delta. The Draft Delta Plan refers to "covered actions", projects which would receive additional scrutiny to determine their consistency with the state's coequal goals for the Delta. Determination of covered actions and DSC review are currently being developed and the ultimate requirements of the Delta Plan likely will have great impact on the length and financial risk associated with project proposals. For example, it is contemplated that the completion of CEQA documentation, a lengthy and costly process, may be necessary prior to DSC review and a subsequent 30-day appeal window, creating a major risk for potential investors. In addition, it may be that determination of a covered action requires a county board of supervisors calendar item, a condition that will greatly increase the burden of the process, as compared with determination at staff level. There is also the question of whether this determination will require a public hearing. While the number of non-local agencies involved with permitting is consistent with other natural, environmentally sensitive areas in California, it is far greater than in typical infill locations. Together, these entitlement processes create risks associated with increased permitting time, expense, and success probability.

Box 7 Improving the Entitlement Process: A Brief Case Study of Lake Tahoe

The entitlement dynamic in the Primary Zone of the Delta is a very powerful deterrent to investment. As has been demonstrated in the Lake Tahoe area, the approval uncertainty involving both county governments and the Tahoe Regional Planning Agency (TRPA) has effectively curtailed development of visitor accommodations and other investments along the North Shore of Lake Tahoe over decades, resulting in a motel room stock with an average age of 50 years, despite immediate proximity to a world-renowned natural resource attraction (according to Smith Travel Research and Economic & Planning Systems, Inc.). This uncertainty stems largely from two key factors that are comparable within the Delta. First, the TRPA and the counties' development regulations are developed from distinct mandates, and although they are intended to be coordinated, language in the codes that is subject to interpretation or is not clearly directive is interpreted by each agency under their own filter sets. Second, as each agency updates its regulatory policies, coordination within the two agencies continually lags as a result of update timelines, staffing, processing, and other factors.

In the case of Tahoe, steps are presently being taken to reform the development approval process to allow projects that use best management practices (BMPs) that minimize environmental impacts (e.g., storm water runoff), advanced infrastructure systems, and planning concepts that cluster development in a village format, protecting viewsheds and public access to the Lake.

As part of a pilot project program, projects that adhere to these key elements have an opportunity to receive coordinated development approvals and avoid the "whipsaw" effect resulting from inconsistent standards among disparate agencies. While this process is still being refined in Tahoe and is subject to an ongoing debate between various interests, it does indicate a potential direction for the DPC, counties, and other regulators in the Delta. Clear delineation and consistent interpretation and enforcement of entitlements will immensely improve prospects for attracting investment, even if these regulations remain appropriately stringent.

It is also notable that most of the local Community Plans were prepared in the 1980s and their CEQA documentation is in need of updating. As a result, coordination between the Community Plans, Conservancy concerns, DPC and DSC requirements, and other agencies is likely to be problematic for project proponents. While many project approvals require this type of inter-agency coordination, coordination with the DPC and potentially DSC is significantly beyond what would be required in areas outside the Delta, and thus presents additional potential stumbling blocks and risk.

Updated planning and associated CEQA documentation will help to improve coordination and reduce development risk in the Legacy Communities. A Programmatic Environmental Impact Report (EIR) for the Community Plans should be considered. A Programmatic EIR may be prepared on a series of actions that can be characterized as one large project (i.e., related by geography, actions, rules, regulations, plans, or other general criteria) or as individual activities under the same statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways.[300] Use of the Program EIR enables the Lead Agency to characterize the overall program as the project being approved at that time. When individual activities within the program are proposed, the lead agency is required to examine the individual activities to determine whether their effects were fully analyzed in the Program EIR. If so, these may be categorically exempt from further environmental review. If not, additional review may be necessary.

The ability to consolidate the concerns of multiple agencies and organizations within a comprehensive environmental document is a valuable tool used by numerous regulatory agencies to provide clarity and certainty in evaluating development proposals. A simplified, streamlined entitlement process is needed to encourage investment and economic development. However, changes to the entitlement process, as with other aspects of promoting growth and diversification in the Legacy Communities, should be vetted and refined through an extended community outreach processes, to ensure that local support for candidate projects is in place.

10.3.2.3 Project Planning and Market Concerns

Given the unique nature and small scale of potential infill development in the Legacy Communities, many of the typical market demand metrics used by developers and investors, such as regional economic projections and standard real estate market analysis techniques are of limited value. In the Legacy Communities, development opportunities are fine-grained and require dedicated “champions” to see through well-conceived and appropriate concepts. In many cases, success or failure relies on the quality of the project proponent to a greater degree than economic fundamentals (though the current economic environment is prohibitive).

Development that occurs in the Legacy Communities will likely occur “organically,” evolving in small increments over the mid- to long-term, with very few opportunities for large master-planned concepts.[301] With limited population densities around the Legacy Communities, many typical urban consumer services are not economically feasible (e.g., standard-format shopping centers with supermarkets and related in-line shops generally require at least 3,000 dwelling units). As such, the mainstream real estate development industry is likely to bypass the Delta, based on the inherent market risks, including constrained growth potential and seasonality concerns. Meaningful investment and economic diversification through infill development will most likely be brought about by local economic developers that are interested in improving the community in addition to turning a profit.

Development in this context often requires a public-private partnership, where strategic public investments are made in coordination with private-sector catalyst projects, with a shared vision of future community form and function. While there are numerous examples of successful

[300] CEQA Guidelines § 15168(a)(b)
[301] The 20-year evolution of 4th Street in Berkeley by developer Denny Abrams is a good example of “organic development” in which a local developer with a long-term vision and dedicated to a parcel-by-parcel approach often subsidizes specific users to achieve ideal land use/tenanting mix.

public-private real estate projects, a very small slice of the development community possesses the skills, dedication, and interest in engaging in this type of development. Further, public agencies presently lack the financial resources to expand redevelopment efforts or fund infrastructure and public services.[302] However, establishment of an investment fund for economic development could successfully attract developers to partnership projects. For this approach to work, public agencies would need to clarify the over-arching vision of the Delta, including the Legacy Communities. Currently, the lack of public sector coordination in the Delta undermines the public perception of the region, limits market potential, and hinders investor interest.

10.3.2.4 Development Financing

Construction and financing issues are closely related to the entitlement risks discussed earlier in this section. In particular, the requirements for new development in a floodplain are particularly burdensome. These costs include flood insurance and the cost (and likely infeasibility) of raising building structures above base flood elevations in established, urbanized areas.

Alternatively, the cost of levee improvements that reduce flood risks also are staggeringly high (see Chapter 5 for detailed discussion of Delta levees), as much as $5 million per mile,[303] to upgrade levees and protect Legacy Communities from the 100-year flood event, it is clear that local real estate development ventures and existing businesses and residents cannot carry the cost of such improvements solely through local reclamation districts.

The flood control issue demands further consideration and is described further in section 10.3.2.6 below. Development financing requires that flood risks be addressed. Without undesirable project modifications or further investment in levees or relief from excessive regulatory requirements, financial institutions cannot support development in the Legacy Communities.

10.3.2.5 Investment and Development

For a land development project entailing substantial complexity and risk, a required return on investment (also known as a “discount rate”)[304] will typically be in the range of 15 to 25 percent or more. The table below provides an example of a typical discount rate summary sheet that an investor might consider in attempting to quantify the potential return on investment.

Risks and uncertainties associated with infill development in the Legacy Communities are clearly at the high end of the spectrum, putting the required rate of return for development well outside the typical range of 15 to 25 percent. With a concerted effort to mitigate identified problems, however, Legacy Community projects could become more reasonable investments, attractive to patient and insightful developers interested in community development, particularly if strongly backed with public funding and coordination on infrastructure, flood control, and other key issues.

[302] In this regard, the concept of facilitating additional workforce housing must be tempered with the reality that adequate social and public safety services may be difficult to maintain in an unincorporated area.
[303] Personal communication with Bob Pyke, consulting engineer.
[304] Expressed as an internal rate of return (IRR).

Table 53 Discount Rate Requirements

Risk Type	Risk Premium Range	Pertinent Issues in Legacy Communities	Estimated Risk Premium [1]
Land and Location Characteristics	2-10%	Removed from urbanized areas, lack of infrastructure, environmental issues, etc.	8%
Entitlement Risks	0-10%	Extremely complex entitlement process	8%
Project Planning Risks	2-10%	Inflexible zoning; reduced ability to respond to market fluctuations	8%
Development/ Construction Risks	2-6%	Flood risks, environmental issues, etc.	5%
Financing Risks	1-6%	Case specific; conservatively assumes low-level financing risks	6%
Market Risks	1-10%	Lack of market area growth, poor performance of previous projects	8%
Cash Flow Projection Risks	(2)-5%	Case-specific; conservatively assumes low-level cash projection risks	2%
Base Discount Rate		T-Bond with 10 year maturity, (September, 2011)	2%
Total Estimated Risk Premium	**6-57%**		**47%**

[1] These values are provided as high-level illustrative estimates.
Source: Economic & Planning Systems, Inc.

10.3.2.6 Flood Control

Establishing adequate flood protection is a crucial issue which severely constrains development in the Delta. New development must be protected from 100-year flood risk or meet strict building requirements that limit potential damages from a flood event.

The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is administered primarily under the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 (FDPA). The FDPA made the purchase of flood insurance mandatory for the protection of property located in a Special Flood Hazard Area (SFHA) in participating communities. The Act of 1973 expanded the NFIP by increasing limits of coverage and the aggregate insurance authorized by establishing requirements for communities that wish to participate in the program. In 1979, the Federal Emergency Management Agency (FEMA) was established as an independent agency, absorbing the Federal Insurance Administration and the NFIP.

Today, nearly 20,000 communities across the United States participate in the NFIP. By adopting and enforcing floodplain management ordinances that reduce the potential for severe flood damage, communities qualify local homeowners, renters, and business owners for federally-backed flood insurance. For a community to enter the program, FEMA must conduct a Flood Insurance Study (FIS), which analyzes river flows, storm tides, hydrologic/hydraulic factors, and rainfall and topographic surveys. FEMA then uses these data to create the flood hazard maps that outline a community's flood risk areas. Once FEMA provides a community with the flood hazard information upon which floodplain management regulations are based, the community is

required to adopt a floodplain management ordinance that meets or exceeds the minimum NFIP requirements. The purpose of the floodplain management regulations is to ensure that participating communities take into account flood hazards, to the extent that they are known, in all official actions relating to land management and use.[305]

FEMA has determined that several areas within Sacramento County, including Walnut Grove, Freeport, Hood, Courtland, Locke, and Delta Islands will be affected by revised flood insurance maps. FEMA recently remapped Yolo County, de-accrediting the levees that protect Clarksburg. Currently, in Sacramento County, unless a developer with a pending or proposed project agrees to construct above the base flood elevation, as required by the County's Floodplain Management Ordinance, staff cannot approve the issuance of a Floodplain Management Permit for projects in decertification areas. Commercial and industrial projects may be considered below the flood hazard elevation on a case-by-case basis, if designed in a manner deemed to be flood-proofed. All new homes and substantial improvements or repairs must be elevated above the flood hazard.[306]

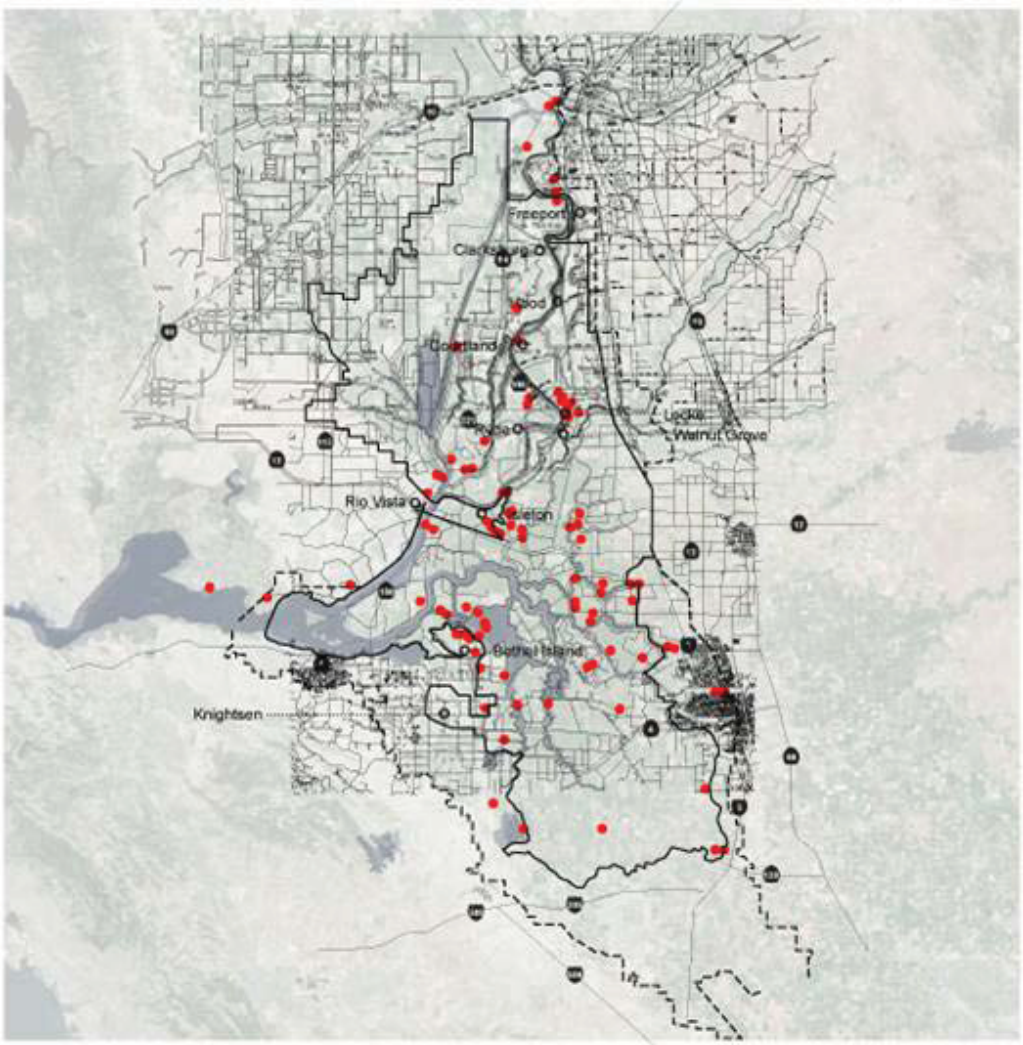
There are special considerations for levees that protect Legacy Communities in the Delta (see Appendix D). Detailed estimation of the likely cost of improving those levees awaits policy decisions that have not yet been made. However, if the levees on the relevant islands are upgraded to the proposed new Delta standard recommended by the ESP (see Chapter 5), the Legacy Communities, and also industrial/commercial facilities that serve Delta agriculture such as wineries and cold storage facilities, would automatically be afforded superior flood protection and special "ring levees" should not be required. In many cases superior flood protection is already provided to these communities and facilities by the existing project levees. For instance, the project levee that borders the Sacramento River in eastern Walnut Grove already has a wide crown, exceeding 50 feet at some locations, in order to accommodate a two-lane highway with parking on either side. While some additional improvements might be required elsewhere to protect Legacy Communities, the compliance issue is more attributable to non-compliance with vegetation, encroachment, and calculated seepage gradient requirements than real flood risk. FEMA compliance issues could likely be addressed much more cost effectively through variances from federal standards than construction, which has the potential to destroy the communities these plans are created to protect.

10.3.2.7 Transportation and Access

By land, access to the Legacy Communities is constrained. Local levy roads are narrow and dangerous. Generally, these roads cannot be widened without substantial costs. Access to the Legacy Communities is limited by water, as boat launch locations and short-term slips for visitor docking appear to be undersupplied. While transportation and access to the Legacy Communities does not seem to be a primary constraint for economic development today, it is important to recognize that limitations in this area do affect investment decisions and that future growth could require significant investments in transportation and access. In some instances, transportation and access improvements could spur investment, though additional study is required to identify such strategic transportation and access projects.[307]

[305] FEMA (http://www.fema.gov/about/programs/nfip/index.shtm)
[306] "Substantial improvement" (as defined by FEMA) refers to any reconstruction or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure. However, substantial improvement does not include either (1) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions or (2) any alteration of a "Historic Structure."
[307] Infrastructure in the Delta is addressed in detail in Chapter 9.

Figure 42 Sacramento River Valley Accessibility[308]



Sacramento River Valley Accessibility

This diagram is not intended to identify all specific Marinas and Roads but is intended to show patterns of water and ground access to the Legacy Communities.

LEGEND

- Marinas
- Focus Legacy Communities
- Federal Highway
- State Highway
- Primary Boundary
- Secondary Boundary

[308] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Box 8 Case Study Framework Examples: Sutter Creek and Winters

Other communities in the region have newly created (or in some cases longstanding) programs and policies that lend themselves to establishing a "brand" or strategic direction that contributes to economic sustainability, community vitality, and civic engagement on the part of residents and visitors alike. As a result, these communities are thriving, small-scale, functional towns that serve as local and regional hubs of activity.

Sutter Creek and Winters, discussed below, might serve as models for economic and cultural enhancement in the Legacy Communities. These distinctly different communities, in dissimilar physical settings, point to directions in which the Legacy Communities could possibly evolve and remain viable into the future.

Sutter Creek in Amador County, California (population 2,500) has established a co-brand with other nearby towns in the Gold Country as well as with California's "Golden Chain Highway 49." Sutter Creek has been able to capitalize on its historical roots, developing as a retail and service hub for residents and visitors. Some key elements of the town's success include the following:

- Well-preserved architecture
- New development that complements existing buildings in the historic core
- Clean public and private realms
- Amenities include post office, retail, and restaurants
- Walkable streets
- Active business association
- City-sponsored website and Facebook page
- Comprehensive marketing efforts promoting festivals, events, attractions, and destinations
- Brand focus on tourism, wine, and antiques
- Regularly occurring, year-round community programming

Main Street, Sutter Creek, CA

Winters, in western Yolo County, California (population 6,600) is cultivating a brand centered on wine, slow food, and agriculture. Regionally-acclaimed eating and entertainment establishments such as the Buckhorn Steakhouse restaurant and Palms Playhouse are popular with locals and visitors alike, and attract clientele from throughout the region. Some key elements of the town's success include the following:

- Quality historic preservation
- Redevelopment efforts including streetscape, park, pedestrian bridge
- Walkable streets
- City-sponsored website, Facebook page, and Twitter account
- Brand focus on food, agricultural heritage, and wineries
- Economic Advisory Committee
- Numerous local events (e.g., Tempfest, Plein Air Festival)

10.3.2.8 Water and Sewer

Many of the Legacy Communities suffer from inadequate water and sewer infrastructure facilities. For example, Clarksburg has no regional sewer or water infrastructure. Instead, each developed parcel in Clarksburg is served by its own well and septic system. This condition prevents sustainable development of the community in the long term, primarily in terms of potential effects on public health and water quality.

There are no plans to provide municipal services to the community. If any meaningful development is to be implemented in the future, the issue of sewer and water services must be solved, which is a significant barrier to growth. Water and sewer limitations were significant issues in the planning of the Old Sugar Mill and Bogle Delta Winery projects, although these issues were ultimately resolved through the engineering and design of expanded wells, self-contained wastewater treatment facilities, and other methods.

The western portion of Walnut Grove is served by California American Water and the eastern portion is served by Sacramento County Water Agency, as is the community of Hood. The entirety of Walnut Grove, Courtland, and Locke are served by the Sacramento County Sewer District for wastewater services. With water and sewer service in place, these Legacy Communities are somewhat better positioned for new development.[309]

10.3.2.9 Telecommunications

Currently, the cellular telephone coverage is inconsistent throughout the Delta, although service providers are reportedly working to enhance their service. In addition, internet access in most Delta communities is very limited, which prevents certain businesses and “telecommuters” from operating and working in some areas of the Delta. Where limitations exist, improved digital connectivity would be significant step in enhancing the economic competitiveness of the Legacy Communities.[310]

10.4 Overarching Implementation Strategies

There are a number of overarching economic development strategies that apply to all Legacy Communities which should be carried out in order to enhance the prospects for economic sustainability in the Delta.

Investment Fund. The “Delta Investment Fund” has been established to help achieve economic development goals in the Primary Zone, although funding sources have not been secured at this time. Moving forward, financial resources should be directed to key initiatives that will enhance economic activity. Priority uses of this funding might include infrastructure improvements, gap funding for catalytic development projects, economic development assistance, and marketing/branding efforts.

Strategic Levee Protection. Obtaining adequate flood protection is of the utmost importance to fostering economic sustainability in the Delta. Although costly, new and improved levees will encourage investment and reinvestment in some Legacy Community areas where flood protection is currently inadequate. Strategic levee enhancements to protect key assets should be carried out using any existing or new funding sources.

[309] Ibid.
[310] Ibid.

Streamlined Entitlement Process. As discussed throughout this chapter, the complex, multi-jurisdictional entitlement process limits the ability for new projects to be brought to market. A more transparent, understandable, and predictable entitlement process would greatly reduce the risk in new economic endeavors in the Primary Zone. Technical assistance and the creation of an "entitlement handbook" for prospective investors (to assist in evaluating potential projects) would facilitate project evaluation, planning, and development.

Historic Preservation. The Legacy Communities offer a unique sense of place and history that should be preserved for future generations. However, as structures age and communities decline, reinvestment and new investment in real estate assets is critical to economic sustainability. Development projects that are consistent with the existing community fabric should be encouraged, particularly as a strategy to retain and recruit businesses in the Legacy Communities.

Coordinated Economic Development. Although many economic development initiatives are already underway in the Delta, these efforts (along with new initiatives) should be well organized in a systematic way that will maximize the benefit to the area as a whole. A singular "facilitator organization" should be designated responsibility for planning, coordinating, and managing economic development efforts. One key component of this effort should be a coordinated, highly-visible branding campaign that is used to raise the profile of the Delta and its constituent communities for the purposes of tourism and agricultural enhancement. In addition, helping to secure tax incentives and other local and regional economic development tools should be part of this organization's charge.

10.5 Focused Evaluation of Clarksburg, Walnut Grove, and Locke

In this section, the Economic Sustainability Plan considers three Legacy Communities in detail, providing an overview of each community, a potential "vision" for the future, and specific economic development goals that are consistent with the vision. The assessment focuses on Clarksburg, Walnut Grove, and Locke, three distinct communities that generally reflect the broad range of community typologies found in the Primary Zone of the Delta.

10.5.1 Clarksburg Overview

This overview considers the history and socioeconomics within the Legacy Community of Clarksburg.

10.5.1.1 History

Like other towns on the Sacramento River in the Delta, Clarksburg grew to serve the early farmers who arrived shortly after gold was discovered in 1849. Historical accounts of Clarksburg indicate that it was settled in stages beginning as early as 1850. Farmers and hunters built homes on pilings or boats to survive the regular flooding of the area.

Immigrants flocked to California from the United States, Europe, and later from Asia. To get to the gold fields from San Francisco, early "49ers" traveled by boat up the Sacramento River, observing the vast rich areas of the Delta along the way. In Clarksburg, the first settlers included Josiah Green on the upper end of Merritt Island and a Portuguese settlement on the lower end of Lisbon Tract. Green purchased property from an agent in San Francisco and arrived to find the land flooded. Green subsequently built levees around his property, reportedly the first reclamation project in the Delta.[311]

[311] Background Report on Land Use and Development, Delta Protection Commission, 1994.

In 1916, the Holland Land Company refinanced the holdings of the failed Netherlands Farm Company, located their headquarters just outside Clarksburg, and built levees, canals, roads, bridges, power lines, and more than 90 buildings.[312] The property was subdivided and sold for farming. Sugar beets were the primary crop on the Holland Tract, and Clarksburg quickly became a commercial and social center in the area. The Sugar Mill refinery was constructed in 1934-35 and was the primary economic center of the community until it stopped operations in 1993.

During its sugar beet farming period, Clarksburg grew into a complete community, with schools, churches, a library, a fire district, retail businesses, as well as a wide array of civic organizations. The building stock in Clarksburg still reflects the community's history and growth patterns, with older homes and structures located adjacent to the levee and more recent development adjacent to the agricultural lands. At the heart of the community are the Delta Elementary Charter School, Clarksburg Middle School, and Delta High School. At each end of the community are industrial lands, with the Old Sugar Mill to the north and Ramos Oil to the South. The commercial district is concentrated on Clarksburg Road, between South River Road and Willow Avenue.

10.5.1.2 Socioeconomics

Today, the area that comprises the Clarksburg Census Block Groups contains approximately 1,275 people. Though it is a multi-generational community, Clarksburg's population is characterized by an older age profile, with over 30 percent of residents age 55 and up (as compared to approximately 20 percent in the Legal Delta). The residents of Clarksburg are generally White, with residents identifying themselves as "White alone" making up approximately 91 percent of the population (significantly higher than the 57 percent in the Legal Delta). Household income in Clarksburg is similar to that of the Legal Delta at about $81,000 per year.

Although 18 percent of Clarksburg residents work in Clarksburg, over four out of five working residents commute to work elsewhere. The labor force residing in Clarksburg commutes to various locations throughout Northern California, most notably, the City of Sacramento. Clarksburg-based jobs are filled by employees living throughout the region, particularly from Sacramento, Elk Grove, West Sacramento, and Rio Vista. However, 17 percent of Clarksburg jobs are held by residents of the community, which is relatively high proportion compared to the other Legacy Communities.

Following the collapse of the sugar beet processing in the region, Clarksburg's farmers were forced to adapt by growing new crops. Owing to its climate and fertile ground, wine grape production has become very successful in the area. Clarksburg is now a major producer of wine grapes for export and local wine production. With the opening of many local family and corporate wineries and the recent renovation of the Old Sugar Mill as an event center and wine co-op providing a venue for nearby wineries to directly market their products to tourists from throughout the region, Clarksburg is enjoying an agricultural renaissance.

Culturally, Clarksburg has been—and continues to be—home to families that share common community values, particularly related to good stewardship of the land. Volunteer organizations (e.g., fire department), local schools, and churches continue to be central to the community fabric. While many of residents must commute to jobs in Sacramento and other cities, and

[312] County of Yolo, Clarksburg General Plan Historical Perspective.

commercial businesses in town have dwindled over time, the residential community and its local farming traditions continue to thrive in Clarksburg.

10.5.2 Vision for Clarksburg: A Vibrant Agricultural Community

Clarksburg's primary competitive advantage as a community is its agricultural abundance. This region is known to produce exceptional agricultural products, most notably wine grapes and other wine products, and the culture of the town is very supportive of this agricultural heritage. Continued community sustainability in Clarksburg will depend upon several key factors:

- Because the community is predominantly built out within the Urban Limit Line, and the fact that there is no water or sewer infrastructure, maintaining and upgrading the existing building stock will be essential to maintaining its character and desirability. While many of the residential lots are zoned for multi-family, the density of these properties is low and most sites are already occupied by single family houses. FEMA's recent designation of Clarksburg as within the 100-year floodplain creates significant obstacles to residential remodeling and construction. In addition, regulatory hurdles adopted and proposed by the state will further increase costs or prohibit residential development altogether.

- The recent, successful appeal of the multi-use (i.e., commercial, industrial, and residential) plan proposed for the Sugar Mill site highlights the regulatory uncertainty confronting proposals that include increasing residential density within the Urban Limit Line of an existing primary zone community. The Sugar Mill occupies approximately 35 percent of the land within the Urban Limit Line. This site is well positioned for infill development, provided regulatory uncertainties are successfully addressed in the planning process. The community, the county and the state must resolve the vision and policies for this site if it is to be successfully integrated into the community and the Delta region as an agritourism destination.

- A community of this size does not support a local commercial/retail sector as is evidenced by the commercial vacancies and one small local market. In addition, Clarksburg is less than 6 miles from the retail/commercial services at Pocket Road and Meadowview Road in Sacramento. Clarksburg has already begun to establish a local agritourism center in the Sugar Mill that represents local, family-owned wineries. To enhance its regional draw, additional overnight accommodations, food and wine venues, and support services should be encouraged. However, unless the regulatory hurdles proposed by the state are successfully addressed, the risks associated with restoration and enhancement of structures will inhibit sustainability.

- Although it has a small private marina, Clarksburg does not have extensive waterfront development along the river. Public investment in enhancing this link has the potential to greatly increase access to the community for the significant numbers of water-based users.

- The 2030 General Plan currently designates the various school sites as Public/ Quasi-Public. If a future consolidation within the school district closes the middle and/or high schools, the community will need to assess the most appropriate use for the site, given the limitations of community infrastructure and services.

- The complete absence of water and sewer infrastructure within the community means that either a project will have to have enough density to create its own treatment facility (as the Old Sugar Mill Specific Plan proposed), or small enough to be served by an on-site septic

system. The provision of community-wide infrastructure within the Urban Limit Line would not only facilitate agritourism development, but would also protect the long-term health of residents.

An economically sustainable vision for Clarksburg should build upon the momentum of the agriculture sector in the region, while continuing to selectively add to the suite of local- and visitor-serving amenities in the community. Key tenets of the vision for Clarksburg include the following:

Preserved Historic Character: Clarksburg's established, attractive, and high-quality building stock should be maintained and/or enhanced. Planning should identify adaptive reuse opportunities and assess their potential benefits to the community.

Establishment as a Regional Food and Wine Destination: Over the last 25 years, the Clarksburg region has emerged as a premier Chardonnay-producing area, and the Clarksburg appellation is coming into its own as a high-quality wine grape-growing region. Clarksburg has the potential to become a regional destination by enhancing the current offerings and adding high-quality visitor attractions related to wine, vineyards, slow food, and the "loco-vore" movement.

Enhanced Resident and Visitor Amenities: Opportunities to add a variety of resident- and visitor-serving amenities should be carefully evaluated. Such uses could potentially include retail stores, restaurants, wine tasting rooms, and small-scale lodging (e.g., bed and breakfast establishments).

Increased Value-Added Agriculture Processing: In order to provide jobs and increase personal income created and retained within the community, select value-added processing facilities should be encouraged.

Figure 43 below shows a visionary plan for Clarksburg. Key information and aspects of this vision include the following:

- Clarksburg is primarily a single-family residential community with a strong relationship to agriculture and community institutions. This is supported by its physical layout and focus on organizations such as the charter school, library, churches, and civic groups. There are few vacant lots and there is limited opportunity for additional single-family residential development.

- The primary opportunity in Clarksburg continues to be the Old Sugar Mill property. Accounting for approximately 35 percent of the land area, redevelopment on this property has already created an agritourism destination within a 20-minute drive of Sacramento. This property provides additional opportunities to enhance agritourism with the potential for additional wineries, food services, entertainment, retail, and educational venues.

- Although the application for a multi-use specific plan on the site was blocked, an opportunity for visitor lodgings exists, dependent upon the will of the community and the availability of private investment. This type of use could potentially create a catalyst for additional commercial activity.

- The neighborhood commercial area at the entry to the community on Clarksburg Road is underutilized. There is the opportunity to reposition this area to serve both the residents and visitors to the area.

- While the commercial area serves as a buffer between the residential neighborhood and the Old Sugar Mill, an active, wide, linear pedestrian and food vendor connection between the site and the residents along the School Street right-of-way has the potential to provide local agriculture providers a place to sell their products and an active place-making link between the visitor focused uses and the residents.

- Boat access to the community and Sugar Mill could be greatly improved with a public boat dock with pedestrian links across South River Road.

- As with all of the Legacy Communities, its history and relationship to the river and agriculture are rich with character. The display and teaching of this history through interpretative Legacy Community markers is an opportunity for both residents and visitors.

- Clarksburg's three primary entry points from South River Road are Willow Point Road, Clarksburg Road, and Netherlands Road. There are opportunities to create "community identity nodes" at these intersections to create identification and way finding for out-of-town visitors to the area.

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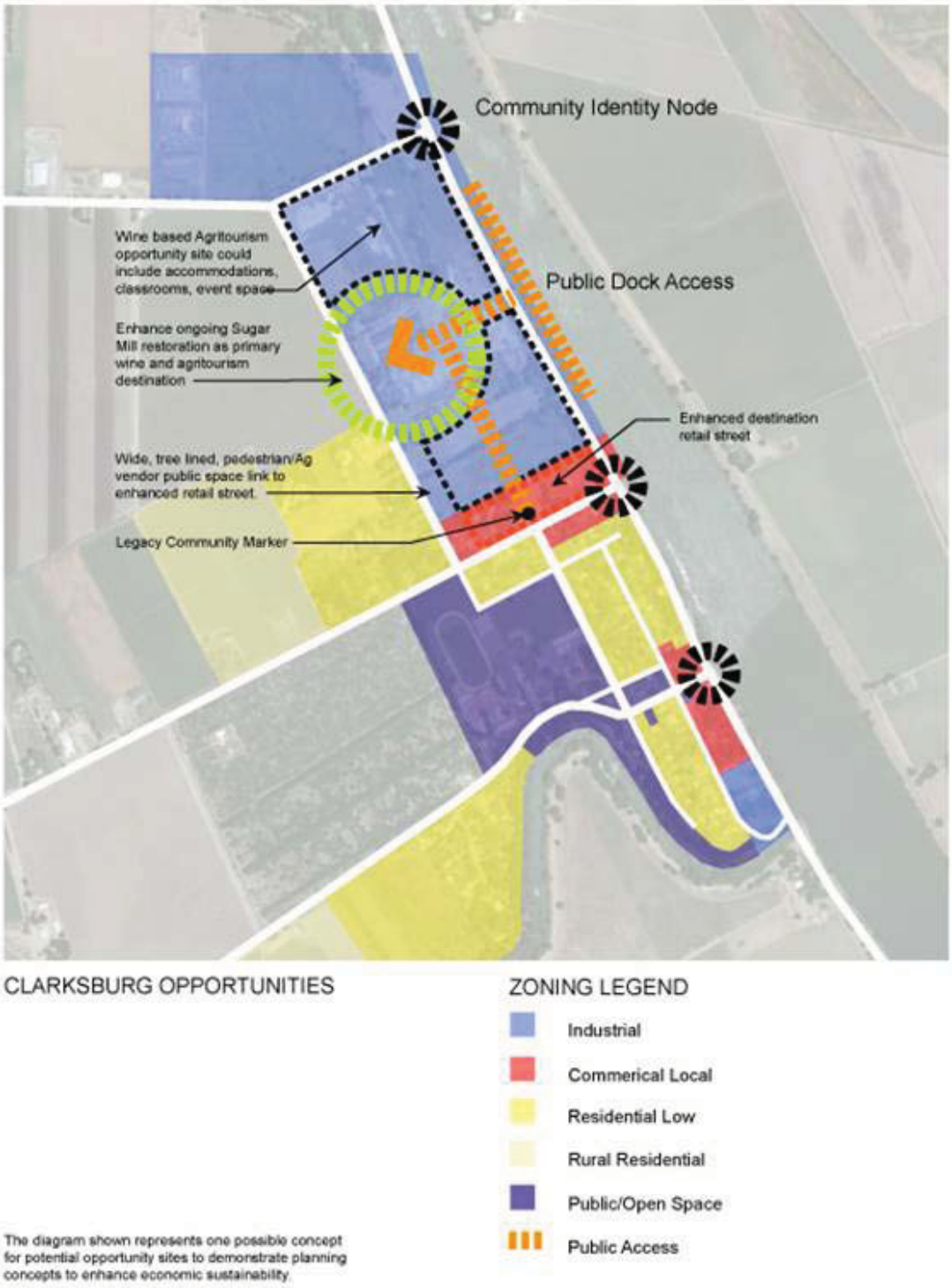
Figure 43 Clarksburg Vision and Opportunity Sites[313]



[313] For high resolution image see http://forecast.pacific.edu/desp-figs.html

10.5.2.1 Economic Development Goals for Clarksburg

Based on the planning concept and rationale presented above, the Economic Sustainability Plan recommends the following high-level goals for economic development in Clarksburg.

- Growth in the wine and viticulture industry, including local crushing, fermentation, bottling, and storage facilities
- New agriculture-related businesses, building on the success of the Old Sugar Mill
- Increased tourism, particularly agritourism activities (e.g., farm stays)
- New businesses offering locally-produced agricultural products
- Basic support services for tourists and visitors (e.g., boat-docking facility)
- Localized branding that is consistent with an overarching Delta brand
- Retention of existing local businesses

10.5.3 Walnut Grove and Locke Overview

This overview considers the history and socioeconomics within the Legacy Communities of Walnut Grove and Locke.

10.5.3.1 Walnut Grove History

Walnut Grove is one of the oldest towns in the Delta, founded in 1850-51 by John W. Sharp, who established a general store, brickyard, blacksmith shop, lumber mill, and one of the earliest post offices in the west. Sharp also opened the first hotel, school, and ferry operation (across the river). The town, which developed on both sides of the river, quickly prospered as an agricultural center and riverboat stop.[314] By 1865, Walnut Grove had become a major shipping port for agricultural products and fish. Walnut Grove played an important economic role in the region, providing goods, services, and workforce housing.

After Sharp's death in 1880, the town continued to flourish. The two sides of Walnut Grove evolved separately, with the east side of town emerging as the commercial and business center. In these early years, Chinese businessmen created a vibrant service and entertainment center serving Chinese agricultural workers. Just before the turn of the century, Japanese businessmen settled in Walnut Grove, opening numerous businesses to serve the community. By 1905, Japanese immigrants were farming nearly 80 percent of the land around Walnut Grove."[315] Following a fire in 1915, a Japanese commercial district emerged, comprised of nearly 70 businesses.

Since the 1882 Chinese Exclusion Act barred Chinese from becoming citizens and the 1913 Alien Land Act barred anyone who was not a citizen of the United States from purchasing land, local landowners leased land in the north end of the east side of Walnut Grove to the Chinese, and later to the Japanese, to construct housing and commercial structures. The east side of town included boarding houses for agricultural laborers, shops, restaurants, gaming halls, tong buildings, a Chinese school, and residences. By the 1930s, this area also included a Japanese Buddhist temple, a Japanese Methodist church, and a Japanese school. A segregated, public "Oriental School" operated in east Walnut Grove from 1921 until 1946.

[314] Compiled from Mary L. Manieri, "Walnut Grove Chinese-American Historic District," "Walnut Grove Japanese-American Historic District," and "Walnut Grove Commercial/Residential Historic District," (Sacramento County, California) National Register of Historic Places Registration Form, Washington, D.C.: U.S. Department of the Interior, National Park Service, 1990; and Tushio Sakai and Carol Branan, "Walnut Grove Gakuen Hall," (Sacramento County, California) National Register Registration Form, Washington, D.C.: U.S. Department of the Interior, National Park Service, 1980.
[315] Ibid.

In the early 1920s, Bob Clampett bought what is now Clampett Tract, on Grand Island (western Walnut Grove), from Robert Kercheval. Clampett drained the tract and subdivided the area into residential lots. In the 1930s, churches and businesses were added in Clampett Tract.

Despite the efforts of some local leaders to encourage more European Americans to settle in Walnut Grove, it remained predominantly Asian until the 1940s. As a segregated community, only Whites were allowed to live on the western side of the river. The Chinese population was aging and dwindling at that time, primarily because of the strict immigration laws, and the Japanese were removed to relocation camps at the beginning of World War II. With the loss of the Asian community, Walnut Grove's role as an Asian-oriented service and social center diminished, although it continued to serve as an important agricultural support center.

The Sacramento Housing and Redevelopment Agency (SHRA) began working in the Delta in the mid- to late-1970s. By the early 1980s, SHRA had established a Redevelopment Project Area in Walnut Grove. SHRA assisted the Homeowners and Merchants Association with property acquisitions (addressing land versus structure ownership issues) and began an aggressive revitalization program. In particular, SHRA constructed curbs, gutters, sidewalks, open space, a fire station, parking lots, sewer and water improvements, and a community boat dock. In addition, SHRA undertook a commercial revitalization program, which included commercial loans, grants, façade rebates, and technical assistance to the Walnut Grove Area Chamber of Commerce. The redevelopment project area expired in 2004 and SHRA has since suspended its involvement in the area.

10.5.3.2 Locke History

The history of Locke is closely tied to that of Walnut Grove. In 1915, when a fire destroyed the Chinese settlement in Walnut Grove, a group of Chinese residents leased land from the Locke family to build new homes and shops. Locke eventually grew into a bustling town. Between 1916 and 1920, restaurants, dry goods stores, hardware stores, grocery stores, brothels, and a merchant's association were established. Later, a drug store, soda fountain, post office, tobacco shop, shoe repair shop, bakery, theater, boarding houses, and opium rooms located in the town. At its peak, 600 residents and as many as 1,500 short-term and seasonal workers and visitors occupied Locke. However, Locke entered into decline as the Chinese population decreased due to strict immigration laws. In the latter half of the 20th century, Locke deteriorated to the point that the community was in danger of condemnation.[316]

Locke is the last remaining rural Chinatown in the United States and the entire community was placed on the National Register of Historic Places in 1970. In 2000, SHRA began a four-year process to address property ownership issues in Locke. In addition, SHRA assisted with building stabilization and facilitated construction of a new sewer system (assisted by a grant from the U.S. Department of Agriculture). In total, more than $3 million in federal Community Development Block Grant (CDBG) and Economic Development Initiative (EDI) funds were spent on these activities.[317]

In 2004, the SHRA turned over ownership of the subdivided land in Locke over to the building owners. As a condition of receiving the land from the SHRA, buyers accepted property conditions and limitations concerning the use of the buildings, historic architecture, sale

[316] www.locketown.com
[317] Sacramento Housing and Redevelopment Agency article: http://www.shra.org/SuccessStories/CommunityRevitalization.aspx#The_Transformation_of_Phoenix_Park

requirements (i.e., right of first refusal for descendants of the original settlers), and town management structure. In 2005, the California Department of State Parks purchased the Locke Boardinghouse, built in 1915, and have restored it in partnership with SHRA. Opened in 2008, the Locke Boarding House serves as a visitor center and interpretive center for visitors and residents.

10.5.3.3 Socioeconomics of Walnut Grove and Locke

While Walnut Grove and Locke are very distinct communities, the available socioeconomic data is limited and these communities must be analyzed together. Data from the U.S. Census Bureau's American Community Survey is available at the block group level, with eastern Walnut Grove and Locke located in the same block group (as shown in Figure 40). Western Walnut Grove and Ryde are also analyzed together due to the limitations of the available data.

Eastern Walnut Grove and Locke contain a very high concentration of Asian residents, with approximately 38 percent identifying themselves as "Asian alone," which is significantly higher than the reported 13 percent in the Legal Delta. On the other side of the Sacramento River in western Walnut Grove/Ryde, the racial composition is quite different. Only about 3 percent of residents in western Walnut Grove/Ryde identify themselves as "Asian alone," while 56 percent identify themselves as "White alone."

Household income differences between eastern Walnut Gove/Lock and western Walnut Grove/Ryde are notable as well. At roughly $29,000 per year, the average household income in eastern Walnut Grove/Locke is much lower than in the Legal Delta and the lowest of all Legacy Communities. More than 45 percent of households in eastern Walnut Grove/Locke report an income less than $15,000, compared to just 10 percent in the Legal Delta. By comparison, the residents of western Walnut Grove/Ryde are considerably more affluent. The average household income in western Walnut Grove/Ryde is $92,000, compared to roughly $80,000 in the Legal Delta. It is also noteworthy that more than 27 percent of western Walnut Grove/Ryde households earn more than $150,000 per year, compared to just over 11 percent in the Legal Delta.

The residents of eastern Walnut Grove/Locke frequently work outside of the area in which they live. Only 9 percent of these residents actually work within their local area. Many of these residents commute to the city of Sacramento, Stockton, West Sacramento, and San Jose. Commute patterns are similar in western Walnut Grove/Ryde, where about 15 percent of residents work in the local area. Residents frequently commute to Sacramento, Stockton, and Rio Vista. Jobs in eastern Walnut Grove/Locke are filled by workers from throughout the region, most notably from Sacramento, Elk Grove, Galt, Stockton, and Lodi. Only approximately 4 percent of eastern Walnut Grove/Locke workers live there too. Commute patterns in western Walnut Grove/Ryde are similar, although a higher proportion of workers (about 13 percent) also live there.

10.5.4 Vision for Walnut Grove: Heart of the Sacramento River Corridor

Walnut Grove is unique in that it is one of the few Delta communities that occupies both sides of the river, with the primary residential area on the West and the commercial area and historic Asian communities located on the East. The building stock in the residential community represents a range of typologies, from small pre-WW II homes to modern estate properties. In the commercial district, many historic structures and newer structures line the top of the levee. At the base of the levee, a mixed area of historic structures, post-war homes, community services, an elementary school and a community center are lined along both sides of the former

rail line. The community continues to be a service center for the agricultural businesses, as well as a destination for both water- and auto-based tourists.

There are multiple opportunity sites within Walnut Grove that could provide multi-family housing or tourist accommodations in close proximity to services. However, proposed regulatory policies could either prevent this infill development or create significant entitlement risk. The General Plan indicates the need for additional housing, and Walnut Grove has both the opportunity sites and infrastructure in place to provide for future housing needs.

- Walnut Grove has a valuable public dock with direct access to the core retail area. These retail uses currently cater to residents, daytime workers, and tourists. Because some businesses are highly visible at the top of the Sacramento River levee, they present opportunities to create a valuable pedestrian-oriented commercial node.

- Because Walnut Grove has commercial zones on both sides of the river, the Sacramento River bridge is an important linkage within the community. There is an opportunity to enhance the commercial area on the western side, particularly with a better pedestrian and bicycle crossing at the bridge.

- Consistent with the recommendations of the Recreation Chapter (see Chapter 8), the former rail line presents the opportunity to link the Delta Meadows River Park, the historic Locke community, and the historic Japanese and Chinese areas of Walnut Grove. Public improvements along the rail corridor have the potential to stimulate investment in Walnut Grove.

Walnut Grove is centrally located with the Sacramento River Corridor and contains many key services and amenities that are not available outside of nearby cities. Walnut Grove has the potential to build upon this role as a local commerce center.

Key tenets of a vision for Walnut Grove include the following:

Preserved Historic Character: Walnut Grove's established, attractive, and high-quality building stock should be maintained and/or enhanced. Planning should identify adaptive reuse opportunities and assess their potential benefits to the community.

Increased Resident, Visitor, and Business Services: Opportunities to add a variety commercial uses should be carefully evaluated. Additional retail stores, business service providers, and restaurant operations could be feasible, if undertaken as part of a broader strategy.

Improved Connection to the Sacramento River: The recent construction of water-side docking facilities in Walnut Grove have enhanced the ability for users to access the river and have created momentum which should be leveraged by efforts to enhance connections between the river and town.

Figure 44 below shows a planning concept for Walnut Grove and Locke (combined here for perspective). Figure 45 presents the Walnut Grove concept in detail. Key information for this vision includes the following.

- The east side of Walnut Grove includes a single-family residential area that has some infill opportunities. However, there are several properties along the levee that have higher-

density zoning and could be opportunity sites for additional workforce housing or visitor accommodations.

- At the levee edge, there are several commercial sites. There is the potential for this area to become a mixed-use area with housing, services, and amenities at elevations that provide views and access to the river.

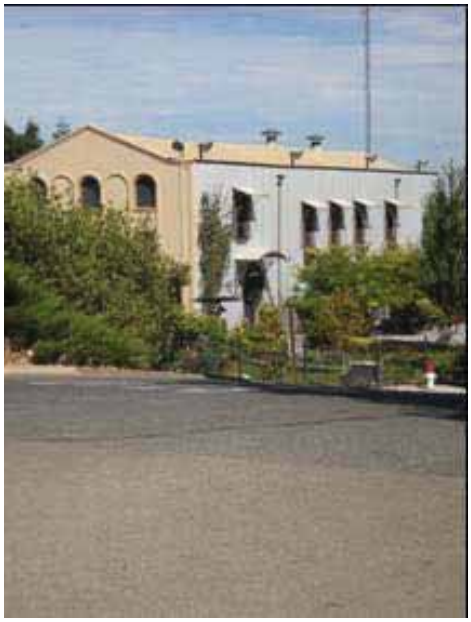
- East Walnut Grove is a complex community of historic districts and sites, single-family residences, industrial and institutional uses, and local commercial uses. There are several vacant or underutilized sites that represent opportunities for infill development including housing, commercial, industrial, and visitor accommodations.

- There is also the potential to create a strong pedestrian focus to River Road on both in both the East and West commercial areas as the levee is relatively wide. As the community evolves, linking these two commercial areas with enhanced connections across the bridge could provide a strong sense of place for Walnut Grove and create a significant visitor destination.

- There is at least one example of successful historic restoration and adaptive re-use in the historic movie theater as a metalwork sculpture studio and showroom. Encouraging this type of restoration in the area could serve to both preserve the history of the community and energize it with new activity.

- Two large opportunity sites, one residential and one industrial at the Southwest end of East Walnut Grove provide great opportunities to continue support of the agriculture industry and develop significant housing or visitor accommodations.

- The abandoned railroad right of way and Grove Street provide the opportunity to create a link between the Delta Meadows River Park trail to the North and potential recreation and interpretive venues to the South. This opportunity links potential development sites, historic areas, residential neighborhoods, and potential future recreation areas. Creating the link and activating it with commercial uses and visitor accommodations could work toward positioning Walnut Grove as a primary Delta destination.



- As with Clarksburg, Walnut Grove has multiple opportunities for Legacy Community markers and community identity nodes to increase interest and education, as well as to orient visitors.

Figure 44 Walnut Grove and Locke Vision and Opportunity Sites[318]

WALNUT GROVE/LOCKE LAND USE

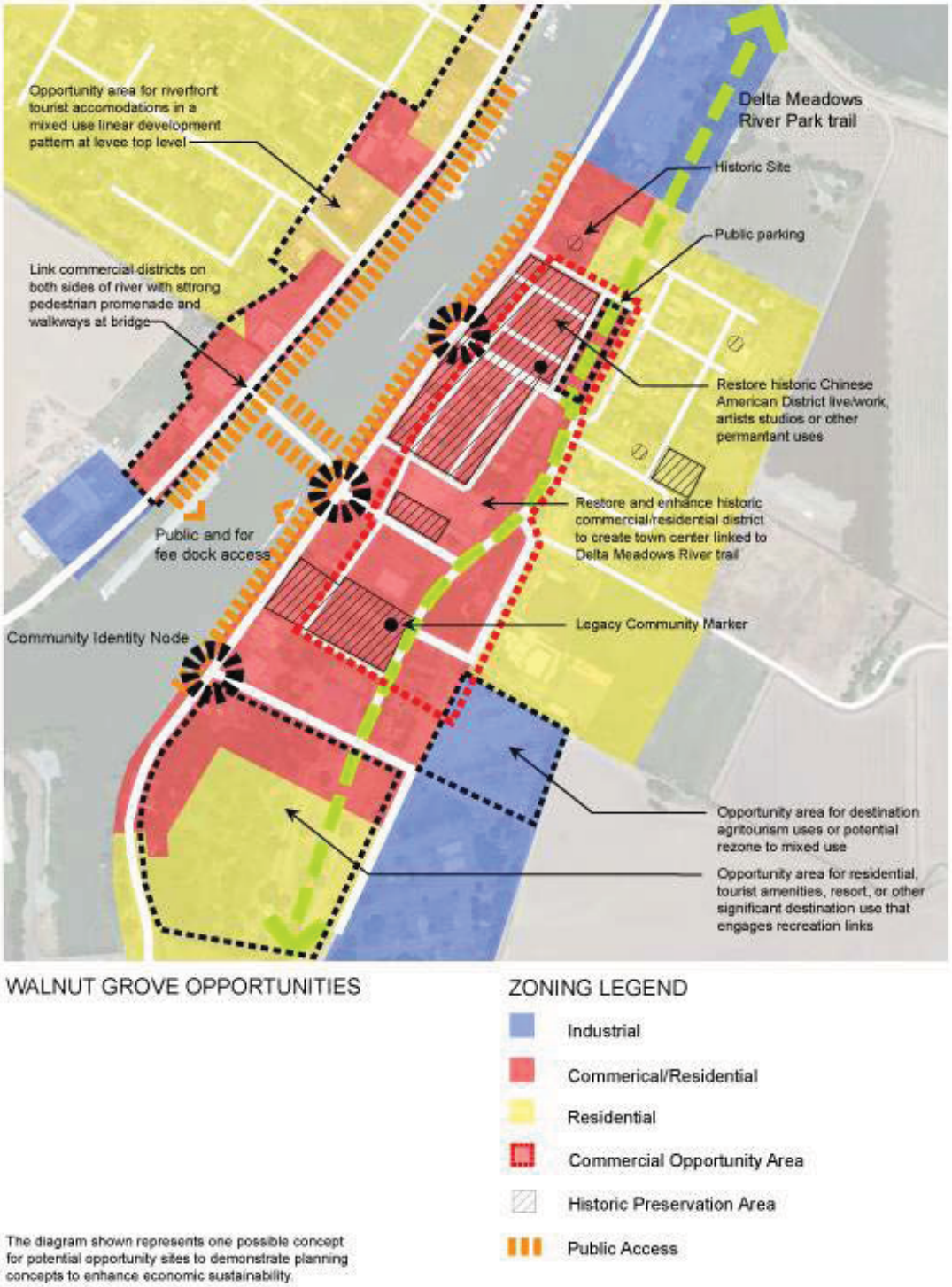
ZONING LEGEND

- Industrial
- Commerical/Residential
- Residential
- Commercial Boat
- Open Space
- Historic Preservation Area
- Special Plan Area

The diagram shown represents one possible concept for potential opportunity sites to demonstrate planning concepts to enhance economic sustainability.

[318] For high resolution image see http://forecast.pacific.edu/desp-figs.html

Figure 45 Walnut Grove Vision and Opportunity Sites[319]



[319] For high resolution image see http://forecast.pacific.edu/desp-figs.html

10.5.5 Vision for Locke: A Historic Delta Community

Locke is known for its cultural heritage, historical significance, unique building stock, and visitor attractions. These assets should be bolstered in a culturally, ecologically, and economically sustainable manner. Nearly all of the historic structures in Locke are in need of extensive restoration. According to Sacramento County planning officials there are multiple agency policy requirements, federal, state, and county, that would need to be addressed, and potentially waived, to permit this activity.

Locke is a Legacy Community that has struggled to survive both economically and physically. A majority of Locke's buildings are in great need of restoration and yet Locke holds tremendous historic and cultural significance as one of the only towns built by the Chinese immigrants for their community. In addition, the western adaptation of the Chinese Shop House typology makes Locke's architecture a national landmark. Restoration and adaptive reuse of these structures could provide Locke with the catalyst necessary for sustainability.

Key tenets of a vision for Locke include the following:

Preserved Historic Character: Locke's unique, historic building stock should be maintained and/or enhanced.

Improved Hospitality and Visitor Services: Opportunities to add a variety of visitor-serving uses should be evaluated. Uses might include retail stores, restaurants, and wine tasting rooms. Improved ground-level retail spaces would provide locations for businesses seeking to capitalize on the recreation enhancements around Locke, including Delta Meadows (see Chapter 8: Recreation).

Revitalized Main Street Business Environment: The scale and walkability of "main street" in Locke is conducive to visitor-oriented retail. Efforts to maintain and enhance storefronts should be undertaken with the objective of creating an improved destination for tourism.

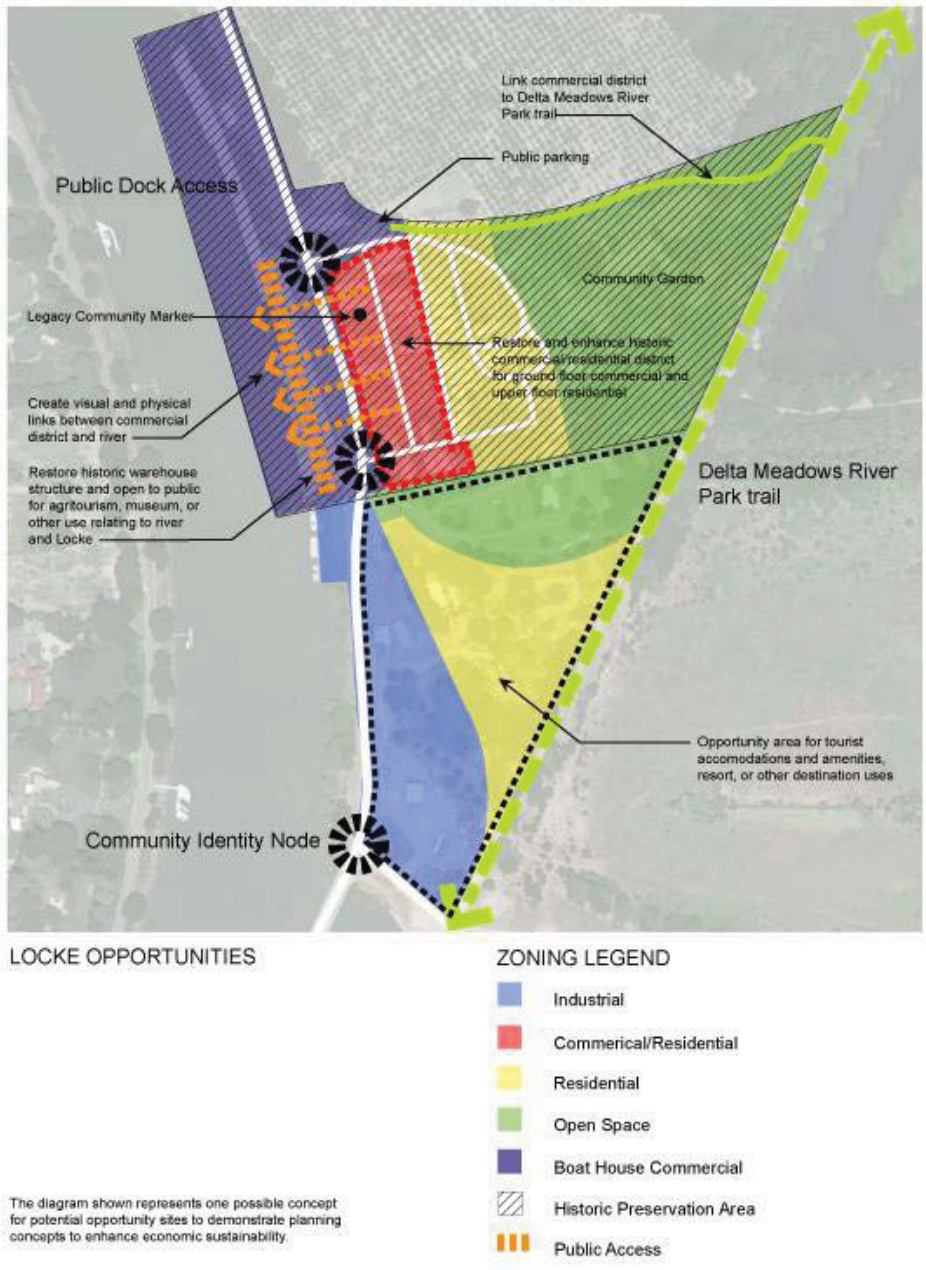
Figure 46 below shows a planning concept for Locke. Key information for this vision include the following.

- The historic wharf warehouse presents a unique opportunity to restore a significant historic structure as a catalyst to restoration of the entire community. Purchase of the structure and restoration for public uses such as agritourism vendors, historical interpretive exhibits, and even tourist accommodations could provide a destination for overnight visitors. It is currently under private ownership and would likely need a public-private partnership to ensure success.
- There is an opportunity site in the industrial zone along the river that is outside of the Historic Preservation Area and could be used as a recreation or agritourism venue. However, the risk associated with rezoning would need to be addressed before investment would occur.
- Locke has spent considerable energy in creating educational opportunities about its history, yet with so few visitor accommodations nearby, there are limited opportunities for overnight visits. The existing historic Shop Houses have the ability to accommodate live/work, artists' studios, bed and breakfast accommodations, and entertainment venues.
- At the southern end of Locke the open space, residential, and industrial properties provide an opportunity to create tourist accommodations, amenities, a resort, or other destination

uses. This site could leverage the expansive community garden, the surrounding agriculture, and the Delta Meadows River Park trail.

- The new public parking lot in Locke could provide or accommodate a trailhead link to the Delta Meadows River Park trail which is adjacent to the community garden.
- As with Clarksburg and Walnut Grove, Locke has opportunities for Legacy Community markers to augment the existing museums and parks, and community identity nodes.

Figure 46 Locke Vision and Opportunity Sites[320]



[320] For high resolution image see http://forecast.pacific.edu/desp-figs.html

10.5.6 Goals for Economic Development in Walnut Grove and Locke

Based on the planning concept and rationale presented above, the Economic Sustainability Plan recommends the following high-level goals for economic development in Walnut Grove and Locke.

- Quality building rehabilitation and adaptive reuse project
- Historical interpretation exhibits and publicly-accessible cultural and historic sites
- New businesses providing services related to agriculture and recreation
- New businesses offering locally-produced agricultural products
- Localized branding that is consistent with an overarching Delta brand
- Basic support services for tourists and visitors (e.g., restrooms, taxi/shuttle services)
- Retention of existing local businesses

Chapter 11: Integrated Issues for Delta Economic Sustainability

A number of issues and strategies cut across multiple chapters and topics that are analyzed in the Economic Sustainability Plan. In this chapter, we explain some of these cross-cutting recommendations in greater detail, and call out a few issues for additional clarification and emphasis. The first integrated issue discussed in this chapter is a more detailed and integrated discussion of the economic development facilitator organization recommended in the recreation and tourism and legacy community chapters. Other issues include the levees and infrastructure system, the future roles of recreation and agriculture in the Delta economy, and how the Economic Sustainability Plan is consistent with the coequal goals of the Delta Reform Act.

11.1 Integrated Issue 1: Facilitator Organization for Delta Economic Sustainability

11.1.1 Facilitator Roles and Responsibilities

As discussed in both the recreation and Legacy Community chapters of the Economic Sustainability Plan (ESP), a major challenge to achieving long-term sustainability in the Delta is action-oriented government and public/private coordination. While the Delta holds great potential for new recreational facilities and enhanced Legacy Communities in the future, the public sector must promote and manage sustainable growth in an integrated and holistic fashion. This section explores the concept of designating a “facilitator organization” in the Delta—the Delta Protection Commission or a joint powers authority of local agencies—to strategically coordinate and implement recreation-related projects and economic development.

Economic sustainability in the Delta requires that agricultural and recreational opportunities and the Legacy Communities evolve over time. Currently, the obstacles associated with planning, financing, development, and operation of a significant recreation area or Legacy Community development opportunity is difficult and time consuming. With its multiple cities, counties, special districts (both within and outside the Delta), state and federal agencies, along with numerous nonprofit and for-profit interests, the implementation process is a formidable challenge in the Delta. Complicating matters further, the Delta Stewardship Council, created in legislation to achieve the state mandated coequal goals for the Delta, has proposed additional regulatory policies that apply to certain proposed plans, programs, and projects by local and state agencies (i.e., “covered actions”).

In order to solve some of the complexities related to recreation, the ESP proposes a broad recreation vision concept that is compatible with State Parks Recreation Proposal, which in turn was structured and coordinated with other state agencies. The ESP’s recreation economic development recommendations follow on that planning, in coordination with the Legacy Communities. The Legacy Communities must evolve to better serve and attract visitors to the Delta, by anchoring and enhancing the experience in the Delta. Strategic planning of the Legacy Communities needs to occur in lock step with recreation planning to maximize economic benefits from investments in the Delta.

As presented in Chapter 8, recreation and tourism is an integral part of the Delta, complementing its multiple resources and contributing to the economic vitality of the region. Residents of nearby areas visit virtually every day, generating a total of roughly 12 million visitor days of use annually and a direct economic impact of more than a quarter of a billion dollars in spending. Private enterprise is both the existing and future driver of economic sustainability in the Delta, but its future success level can be shaped by the public facility contributions and

regulatory environment. The implementation of the ESP will be very complex. Overcoming the multiple steps, regulations, and planning processes by either agencies or individuals can be difficult for normal projects, but the multiplicity of agencies and interlocking safeguards and regulations in the Delta multiplies the difficulties. It is recommended that a facilitator organization be named to assist implementation efforts, to coordinate funding, and to stimulate funding for vital actions.

Box 9 National Heritage Area

The Delta Protection Commission, as mandated by SBX-7, is currently completing a feasibility study for a National Heritage Area (NHA) and determining what that designation might mean for the Delta (Senate Bill X7, 2009). Pursing the NHA designation has also been recommended by the Delta Plan and also in State Parks' recreation proposal for the Delta (State Parks 2011 p. 29-30). The management entity for an NHA may fill some of the needed roles of a facilitator organization.

A National Heritage Area is designated by Congress as "a place where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape." (http://www.delta.ca.gov/res/docs/InfoSheet_NHA.pdf). National stature would be achieved through NHA designation, enabling the Delta to gain visibility as a destination for persons as close as the Bay Area and Sacramento region, as well as on a national and international level. NHA designation can also be used as a marketing tool, to help brand the unique aspects of the Delta, such as its waterways and levees, long history of agricultural production, numerous recreational opportunities and diverse rural communities and cultural groups. Federal seed money is granted with NHA designation, which can be utilized to leverage other funds from public and private sources. NHA designation also has the capabilities to offer the following additional benefits.

- Provide sustainable economic development.
- Promote heritage tourism and recreation in the Delta that is aligned with existing land uses.
- Offer environmental and cultural interpretation and educational opportunities.
- Facilitate partnerships to undertake projects such as historic preservation with the consent and involvement of willing landowners.
- Develop necessary visitor amenities in the Delta such as waste receptacles, public restrooms and directional signage.
- Improve local quality of life and retain local control.

Senator Dianne Feinstein introduced S.29: Sacramento-San Joaquin Delta National Heritage Area Establishment Act on January 25, 2011, while Rep. John Garamendi introduced H.R. 486 on January 26, 2011. Both bills would establish the Sacramento-San Joaquin Delta National Heritage Area and designate the Delta Protection Commission as the management entity. Pursuing the National Heritage Area designation as previously also been recommended by State Parks, the Delta Stewardship Council, and the Delta Blue Ribbon Task Force.

As has been discussed elsewhere in the ESP, the Legacy Communities represent key focal points of Delta culture, and provide logical locations for supporting functions related to agriculture-, recreation-, and population-serving services. As with any community, the physical layout and condition of these communities requires adaptation and improvement over time by private sector investors in order to remain viable. However, this endeavor is not simple in the Delta, and the paucity of recent investment reflects a local land use policy regimen that is problematic in terms of predictability and economic viability. In short, these communities are not living up to their economic potential as catalysts or receivers of economic diversification and growth. Without considerable simplification and coordination of the local investment climate, it is unlikely that the proposed recreational facilities and Legacy Community enhancements

embodied within the ESP will be realized. It is vital that some organization take on the role of actively facilitating solutions and actions to the many impediments to sustained economic viability.

Currently, there are numerous organizations actively involved in implementing Delta-wide programs and services, including the Discover the Delta Foundation and the Delta Chamber of Commerce. These organizations do a lot with limited resources, but currently lack the capacity to implement ambitious recreation and economic development concepts. Coordinated efforts are needed between state and federal agencies, local governments, the private sector, and the local community. Going forward, substantial coordination needs to occur to meet economic sustainability goals in the following areas:

- **Recreation Enhancement.** Recreation facilities require ongoing reinvestment and new investment in order to meet the changing needs and desires of the recreationist or tourist. As previously described, the majority of recreation services are delivered in the Delta by private enterprises, predominantly marinas. Yet, more than 70 percent of the marinas in the Delta are over 40 years old and are in need of an estimated $127 million in upgrades, replacement, and repair.[321] Upgrading and enhancing these private facilities, as well as creating new catalyst public/private focal areas for recreation is essential to the continuing economic sustainability of the Delta region.

- **Strategic Levee Protection.** Obtaining adequate flood protection is of the utmost importance in order to foster additional meaningful economic activity in the recreation areas, Legacy Communities, and certain agricultural enterprises. Although levees are costly, improved flood protection is necessary to encourage new investment and reinvestment in the Legacy Communities, particularly in light of recent (and proposed) changes to FEMA maps.

- **Streamlined Entitlement Process.** The complex, multi-jurisdictional entitlement process in the Primary Zone severely limits the ability for new projects to be brought to market. A more transparent and predictable entitlement process would greatly reduce the risk to new economic endeavors in the Delta.

- **Historic Preservation.** The Legacy Communities offer a unique sense of place and history that should be preserved in the built environment for future generations to experience and enjoy. However, as structures age and decline, reinvestment and new investment in real estate is critical to economic sustainability. Therefore, development projects that are consistent with the existing community fabric should be encouraged and embraced. Retaining historical character is critical to the retention and recruitment of businesses in the Legacy Communities.

A well-funded facilitator organization is needed to provide planning consistency in the Delta, guide public and private projects through the regulatory process, contribute technical assistance, obtain supplemental funding (e.g., grants), and offer compelling marketing services. Specific tasks to be conducted by this organization might include the following:

- **Planning tasks** might include the development of approved master or specific plans, synchronized with public and private sector improvements throughout the Primary Zone. Efforts toward consistent planning are needed to achieve consensus concerning

[321] DBW 2002, p. 5-5 – 5-8

investment priorities. The planning process could also identify and recommend regulatory changes to facilitate realization of these plans.

- **Permit processing** requires clarity and transparency to encourage private sector investment. Permitting should be streamlined and supported by the facilitator organization through technical assistance to investors and developers. In addition, the facilitator would create and maintain a Delta "entitlement handbook" for prospective investors. Another role for this organization may be to recommend ways for agencies to streamline regulations in ways that would encourage appropriate development while continuing to protect the Delta resources.

- **Economic development tasks** could include coordination of economic development efforts with major prospective funding initiatives (e.g., regional tax sharing, broad-based levy assessments, etc.). Economic development efforts would facilitate specific catalyst projects by securing entitlements, assisting in land assembly, and providing "gap funding" (also addressed below). This could also include technical services such as training and professional development support for local businesses.

- **Financial responsibilities** could include prioritization of funding goals, pursuing available state and federal funding, working to create regional funding mechanisms for capital and maintenance, and finalizing annual capital improvement and service provision programs. This function could also include an informational clearing house services to ensure that prospective investors are aware of funding opportunities, tax incentives, and other programs.

- **Marketing responsibilities** are critical to future growth and diversification, and include promotion and coordination of festivals and special events, the formation and organization of wine tours, farm tours, and boat tours, use of web and social media technology linking potential visitors to activities, festivals, and facilities. Overall, serious consideration needs to be given to redefining the Delta through a major marketing and branding campaign, and these efforts need to be linked to specific economic development goals and objectives. By linking projects and events related to the major drivers of tourism (e.g., boaters, fishing organizations, wine purveyors, farm stands, tour operators, and overnight accommodations), visitors could more easily formulate weekend itineraries to take advantage of multiple Delta offerings. Coordinated branding and marketing of certain Delta agricultural products may also increase their recognition and value.

- **Operations and Management responsibilities** may help streamline development and implementation of signage, visitor centers, and/or kiosks at entry points or gateways to the Delta, marina dredging, as well as visitor amenities and sanitation. Implementation and operations of regional land and water trails could also be overseen by this organization. This organization may also assist in coordinating law enforcement and/or emergency response.

11.1.2 Facilitator Organization Recommendation

It is recommended that a formal and detailed organizational analysis be conducted to take the facilitator organization from concept to reality. There are many types of organizations which could potentially adopt a facilitator role, including nonprofit organizations, public agencies (state and local), public/private partnerships, and others. Existing organizations that currently are operating in the Delta may have existing alignment with this role (e.g., the Delta Protection

Commission, Delta Conservancy, local cities and counties, the Discover the Delta Foundation, State Parks, and others). For example, the Discover the Delta Foundation has built an attractive farmer's market/information center at the junction of state routes 160 and 12, and has plans for a visitor's center. They may be able to partner with others to expand this concept to other gateway areas. A Joint Powers Authority could be developed by Delta counties, cities, and state agencies which own or operate recreation areas in the Delta to provide one-stop visitor information services.

The following are key criteria to consider in either choosing an existing entity or creating a new consortium.

- Support of local communities/governments and state agencies
- Ability to take action and effectuate change
- Flexibility to coordinate between multiple agencies and affected stakeholders
- Funding support for internal operations
- Compatibility with existing mission and orientation
- Ability to coordinate and prioritize funding for competing projects

The facilitator organization will require adequate ongoing funding to plan, develop, market, and, potentially, operate improved facilities and activities. Long-term funding might come from mitigation from future Delta capital projects and potentially through the Delta Investment Fund. The matrix in Table 54 below presents a listing of existing organizations that could potentially adopt a facilitator role and the criteria that could be used to evaluate which organization could best move forward in this role.

Currently, the two best potential candidates to take on this Facilitator Organization role seem to include the DPC (or some sub-committee thereof), or a Joint Powers Authority (JPA) comprised of public and/or private entities with the Delta's economic well-being at heart. More discussion regarding each of these potential options follows below:

Option 1: Delta Protection Commission. The Delta Protection Commission is potentially suited to such a role. Its board is composed of both state and local agencies, it has respect from the community, and it has land use authority through the Land Use and Resource Management Plan. The DPC's role could be expanded to include economic development and marketing in the Delta. It would coordinate sustainability planning and development and could administer the Delta Investment Fund in the most effective way to prioritize catalyst projects. Through its potential designation as the management entity of a National Heritage Area (discussed in more detail above), it could undertake Delta-wide marketing and branding. The DPC could work in collaboration with the Delta Conservancy to provide grants and training to local agencies for local implementation of the Economic Sustainability Plan recommended strategies. It could also work with Joint Powers Authorities established between State Parks and local agencies to develop recreation areas or establish Gateways or Basecamps. Potential federal funds to the NHA could be matched through the Delta Investment Fund and the Delta Conservancy funds.

Option 2: County Joint Powers Authority (JPA). Local counties and their related redevelopment agencies have done an excellent job of protecting sensitive agricultural and resource areas and lobbying for improved public facilities (e.g., public moorage). As an alternative to DPC oversight, a Five County JPA could be formed. The strength of this option is related to the fact that individual counties have been excellent stewards of the Delta, have managed public safety and other services provision, and have conducted extensive redevelopment efforts (particularly in Sacramento County) in the past. Counties have been

strong advocates for local land use control, and have the inherent trust of the communities in this regard.

Table 54 Delta Recreation Facilitator Opportunities and Constraints Matrix

	Potential Facilitator						
	Existing Local Control/ No Central Authority	Existing Nonprofit Organi-zation (i.e. Discover the Delta Foundation)	State Parks	Delta Con-servancy	National Heritage Area with DPC as manage-ment entity	Public/ Private Partnership	Delta Economic Developm ent Joint Powers Authority (cities, counties)
Criteria							
Public/ Private	Both	Private	Public	Public	Public	Both	Public
Can take action and effectuate change	Limited	Limited	Limited	Limited	Yes	Yes	Yes
Funding Potential	As exists	Fundraising potential	Limited	Limited	Matching federal funds	Assessment District on local businesses	Funded by partner agencies - limited
Can coordinate between multiple agencies and stakeholders	No	Maybe	Maybe	Yes	Yes	Yes	Yes
Existing Mission	Yes	No	Partial	Partial	Partial	No	No
Allow for central marketing of Delta	No	Yes	No	Maybe	Yes	Yes	Yes
Produces stability/ encourages facility growth/ improvements	No	Yes	No	Maybe	Yes	Maybe	Maybe
Help alleviate use conflicts	No	Maybe	No	Maybe	Maybe	Maybe	Yes
Can promote/ produce additional festivals/ special events	Yes	Yes	With partners	With partners	With partners	Yes	Yes
Can identify and establish gateways	Yes	Yes	Maybe	Yes	Yes	Yes	Yes
Act as clearinghouse for information for private entrepreneurs	No	Yes	No	Yes	Yes	Yes	Yes
Ability to coordinate and prioritize funding	No	No	No	Yes	Yes	Yes	Yes
Support of local communities	Yes	Yes	Partial	Not Yet	DPC, yes, NHA not yet	Yes	Yes

.

11.2 Integrated Issue 2: Levees and Economic Sustainability

Since the early 20th century, the current-day Delta levee system provides flood control that allows productive agricultural and urban uses of land, channels water for urban and agricultural uses, protects critical infrastructure, and creates a desirable setting for boating and water-based recreation in an environment unique in California. The levee system is the foundation on which the entire Delta economy is built. Therefore, a sustainable Delta economy requires a sustainable levee system.

It has been the goal of the state and the federal government, working through the Department of Water Resources (DWR), the U.S. Army Corps of Engineers (USACE), and the local reclamation districts, to meet the PL 84-99 standard since 1982 when DWR and USACE produced a joint report on the Delta levees which recommended the basis for this standard. If effectively used, funds currently in the pipeline should bring the Delta levees close to achieving this goal. When these funds have been expended, more than $698 million will have been invested in improvements to the Delta levees since 1973. These improvements have created significantly improved Delta levees through modern engineering and construction, making obsolete the historic data that is still sometimes used for planning or predicting rates of levee failure.

Three approaches can help all jurisdictions and planners further reduce the risks resulting from the failure of the Delta levees. These approaches are: (1) build even more robust levees, (2) improve both regular maintenance and monitoring and flood-fighting and emergency response following earthquakes, and (3) improve preparedness for dealing with failures after they occur. With regard to the first approach, the big question is not whether they should be improved to the Delta-specific PL 84-99 standard. Instead, the key question is whether in order to support and enhance various in-Delta, regional, state, and federal interests they should be improved to a higher standard in order to address hazards posed by not only floods, but also earthquakes and sea-level rise. Our conclusion is that these improvements would be advantageous not only for flood control and protection against earthquakes and sea-level rise, but because they also would allow for planting vegetation on the water side of the levees—an essential component of Delta ecosystem repair. These further-improved levees would have wider crowns to provide for two-way traffic and could easily be further widened at selected locations to allow the construction of new tourist and recreational facilities out of the statutory floodplain.

Improvement of most Delta lowland levees and selected other levees to this higher standard would cost $1 to $2 billion in base construction costs over the cost of reaching the PL 84-99 standard. Including vegetation and habitat enhancement, total program costs might be in the order of $4 billion, similar to the cost projected by the PPIC (2007) in their “Fortress Delta” alternative. While the billions of dollars required to build levees to this higher standard is an enormous investment, it is a cost-effective joint solution that simultaneously reduces risk to all Delta infrastructure. While a $12 billion investment in isolated conveyance may allow for somewhat larger water exports, it doesn’t protect other critical infrastructure and billions in additional investments would still be required to protect highways, energy, and other water and transportation infrastructure. Just as a species by species approach is an inefficient and ineffective way to protect ecosystems, a system by system approach is an inefficient and ineffective way to protect the state’s infrastructure.

11.3 Integrated Issue 3: Relative Roles of Agriculture, Recreation and Tourism, and Economic Sustainability

Agriculture is the main economic driver in the Delta. As seen in Table 55 below, agriculture generates three to five times the regional economic impact of recreation and tourism. On average, a dollar of crop production in the Delta has more regional employment and income impact than a dollar of recreation and tourism spending in the Delta. This result is important for economic sustainability since many proposals to change the Delta would reduce agricultural production with hopes of increasing recreation and tourism. However, the growth of the recreation and agriculture economies is not necessarily in conflict. For example, flood control investments and improved water quality are critical to the future of both the recreation and agriculture economies. In addition, continuing growth in Delta wineries and agritourism will generate income for both sectors.

Table 55 Total Economic Impacts of Delta Agriculture and Recreation and Tourism[322]

Sector	Employment	Labor Income	Value Added	Output	Source Table
5-County Impacts					
Agriculture	13,179	$593,975,736	$1,059,453,520	$2,647,124,544	Table 13 p.125
Recreation & Tourism	3,064	$104,320,642	$175,862,370	$329,229,232	Table 36 p.174
California Impacts					
Agriculture	25,125	$1,252,216,824	$2,135,095,400	$5,372,014,752	Table 14 p.126
Recreation & Tourism	5,317	$208,104,490	$353,312,020	$654,415,364	Table 37 p.174

While recreation trips to the Delta are a significant contributor to the Delta economy and are expected to increase, increasing the economic impact of tourism spending requires increasing spending per trip to the Delta and the local economic impact of spending that does occur. The lower economic impact of recreation and tourism spending is because fuel and retail purchases dominate expenditures for the types of recreation and tourism that are currently available in the Delta. Although these are local expenditures, the goods are typically produced elsewhere have relatively low multiplier effects on the regional economy.

This requires diversification through new investment in high value-added, land-based tourist services that generate more local income and jobs than retail and fuel expenditures. A successful strategy would require significant new investment in hospitality enterprises within the Delta, and also stimulate investments needed to sustain and enhance the large existing economy associated with Delta boating. Increasing day trips for wildlife viewing and other ecologically-based activities is unlikely to generate significant increases to in-Delta economic activity, especially without new investment in services that encourage longer visits and overnight stays. This is a difficult challenge given the market and regulatory constraints of operating in the Delta. Chapters 8 and 10 provide some visions of more successful recreation and tourism focal points in the Delta that could occur if investment is encouraged and coordinated.

When it comes to agriculture, the prospects for Delta agriculture are good. If land and water resources are protected in the Delta, the plan projects about a 5 percent shift of land towards higher-value vineyards and truck crops, while the corn and alfalfa remaining steady at roughly

[322] For additional details on economic impacts see the listed source tables and associated discussions.

half of Delta agricultural land with prices remaining strong in the future. If urban encroachment is limited to existing sphere of influence of cities as we recommend, Delta agriculture will lose roughly 26,000 acres and $44 million in annual output to urbanization at current prices. The Delta could likely absorb a similar loss of agricultural land to habitat through 2050, and still meet the goal of maintaining and enhancing the value of Delta agriculture that will remain a solid, sustainable foundation for the Delta economy.

The Delta Stewardship Council and others are very interested in the potential for gains in the recreation economy to offset potential losses in agriculture. It is important to be realistic about this potential and understand current trends. Over the past twenty years, the trend for recreation in the Delta has been flat despite rapid population growth in the surrounding region. Delta agriculture has grown in value, and shares many of the same strong prospects as the nation's agriculture. This is in strong contrast to the 1980s when agriculture was a struggling industry and boating was growing fast. In the 1980s, one might have reasonably projected these trends would continue and recreation would supplant agriculture as the economic driver in the Delta. As discussed in the ESP, this transition did not occur over the past 20 years. Given the history of the past 20 years and current economic and demographic trends, a transition to a recreation economy should be viewed as far less likely today than it was 25 years ago. Thus, it would be irresponsible to develop Delta plans that count on a reversal of this pattern and dramatic growth in recreation and tourism.

Despite these cautions, it is important to note that this plan does show that there is significant potential to grow and enhance the Delta's recreation and tourism sectors. Improving recreation assets can not only provide economic benefits, but also enhance the quality of life in the Delta and people outside the Delta who could take advantage of these opportunities. However, growing recreation and tourism requires strategic investment and reinvestment in facilities, improved flood control, and scaling back some of the water supply and habitat proposals that conflicts with recreation and tourism.

11.4 Integrated Issue 4: The Coequal Goals and Economic Sustainability

The Delta Reform Act of 2009 states:

> Coequal goals means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. (Water Code section 85054)

The Delta Reform Act does not endorse any specific actions to achieve the coequal goals, and there are many options for both water supply reliability and protecting, restoring, and enhancing the Delta ecosystem. It does not precisely define terms such as water supply reliability. Reliability clearly means reducing the risk of catastrophic interruptions and uncertainty over supplies, but it is not clear whether it means an increasing supply of water deliveries. The BDCP alone is evaluating at least five water conveyance options, and it is not evaluating all options, including the investment in a seismically-resistant levee system as described in this plan. Similarly, the BDCP includes 18 non-conveyance habitat strategies and is also not exhaustive of all the options to improve the Delta ecosystem.

The presence of the second sentence acknowledges that the coequal goals could conflict with protecting and enhancing the Delta. While the coequal goals must be satisfied, it expresses a

clear preference for strategies that sustain and enhance the Delta over strategies that do not. Thus, one objective of the Economic Sustainability Plan has been to evaluate some of the leading proposals for the Delta to identify the strategies that do and do not "protect and enhance" the Delta. Because of the large number of options to achieve the coequal goals, the Economic Sustainability Plan can still be consistent with the coequal goals even as it recommends against a very small number of the available choices. The "evolving place" phrase recognizes that the Delta will and must change, and that status quo strategies are not acceptable.

The Economic Sustainability Plan recommends a set of actions that would dramatically change the Delta from its current state. The Economic Sustainability Plan would significantly improve water supply reliability by creating a seismically resistant levee system with enhanced emergency response that effectively addresses the risk of catastrophic, long-term interruption of water deliveries, the most important goal of water supply reliability. The Economic Sustainability Plan recommends many actions to improve the Delta ecosystem, including actions that support the Delta economy and even some actions that have significant costs for the Delta economy. The Economic Sustainability Plan presents a positive view of the Delta's economic future with strategies that are informed and realistic about the challenges it faces. Because of its lower cost and compatibility with Delta economic interests, the Economic Sustainability Plan is also a more feasible and realistic path to achieving the coequal goals than Delta plans that are built around large, isolated water conveyance facilities.

11.5 Integrated Issue 5: Cost-Benefit Analysis, the Co-equal Goals, and Economic Sustainability

The independent review panel for the ESP recommends that the Delta Stewardship Council "conduct a comprehensive and credible cost-benefit analysis to analyze alternatives for improving water supply reliability and enhancing ecosystem services." The panel also criticizes some of the ESP recommendations because they are not based on a complete cost-benefit analysis. Cost-benefit analysis is discussed and encouraged in chapter 1 of the ESP, because it is a well-established approach to analyzing these issues. A cost-benefit analysis would be the best available economic science,

However, there is a conflict between the co-equal goals and cost-benefit analysis. The co-equal goals elevate the importance of some areas of economic value above other types of economic values in a way that clearly violates the scientific and economic principles underpinning long-established principles of cost-benefit analysis. The co-equal goals are law, and therefore the conclusions of a cost-benefit analysis may not be consistent with the Delta Reform Act. Nevertheless, cost-benefit analysis would be very informative to weighing options, and should be supported by entities that are committed to the best available science.

Finally, it is important to note that there is a new cost-benefit analysis of Delta options, the recently released DRMS Phase 2. Some of the strengths and weaknesses of DRMS Phase 2 are discussed in chapter 5 of the ESP. Although released in 2011, the analysis is from 2007 and some of the scenarios and costs are out of date. For example, it doesn't consider a true improved levees scenario of the type described in the ESP and the costs of building an isolated conveyance are assumed to be under $5 billion. Despite these weaknesses, DRMS is far more comprehensive, reliable and consistent with cost-benefit analysis than other narrowly focused reports, most notably a series of Delta reports produced by the PPIC that ignore critical infrastructure issues. The consequences analysis in DRMS Phase 2 is very good and looks broadly at all potential impacts, and is compiled in a way that is consistent with the principles of

cost-benefit analysis. A peer-reviewed DRMS phase 2 that considers updated scenarios would satisfy the call for comprehensive and credible cost-benefit analysis.

The findings from DRMS phase 2 have tremendous implications for the Delta and the approach to the levee system and conveyance. Updating the scenarios and costs as we have described would most likely strengthen the case for levee investments and weaken the case for isolated conveyance in the Delta. Below are some key findings from the DRMS Phase 2[323]:

- Improving levees had the highest benefit-cost ratio of any Delta risk reduction strategy, including isolated water conveyance that was assumed to cost only $4.9 billion.
- Water exports account for only 20% of the economic costs from a large earthquake event that would flood between 10 and 30 Delta islands.
- Water exports account for less than 2% of the economic costs of more-common flood events due to high water and storms..
- Water exports account for 0% of the loss of life from any type of flood hazard event

While the DRMS Phase 2 report evaluated upgrading all Delta levees to the PL 84-99 standard, it did not evaluate further upgrading levees to a seismically resistant standard as recommended in the ESP. However, the August 20, 2007 preliminary draft of DRMS Phase 2 did consider an "Improved Levees" scenario that included seismic upgrades of 100 miles of south Delta levees. The results reported in the preliminary draft found that a scenario with seismic upgrades to levees had lower costs and 40% higher risk reduction benefits than the peripheral canal scenario. Consistent with the conclusions in the ESP, the preliminary draft of DRMS Phase 2 found seismic upgrades to levees improved water supply reliability. Despite seismic upgrades to only 100 miles of levees, the preliminary draft found the improved levee scenario reduced the water supply impact of the largest earthquake by two-thirds while simultaneously protecting other valuable infrastructure and Delta property.[324]

These findings have enormous implications for risk management in the Delta, and highlight some of the potential conflicts between cost-benefit analysis and the co-equal goals. Both the preliminary and final draft of DRMS Phase 2 found improving levees has the highest economic benefit per dollar invested and lowest total cost. Levee upgrades perform well in cost-benefit analysis of Delta options, because they reduce risk in all areas including water conveyance, other infrastructure, and in-Delta property. In contrast, isolated conveyance only protects water exports which DRMS clearly identifies as a minority of the economic risks.

[323] These findings are not what is highlighted by the Department of Water Resources in the Executive Summary of DRMS phase 2, but are easily found and calculated from the results tables in the analysis.
[324] A copy of the preliminary draft was requested in a December 15, 2011 to the Department of Water Resources (DWR). DWR responded quickly, and in a January 9, 2012 letter, emphasized that this was a 2007 preliminary draft, and stated regarding seismically improved levees, "It was also not part of the DRMS Phase 2 public draft, because it was not further considered for in-depth analysis in Phase 2." There was no explanation for why the highest ranking strategy in preliminary analysis was not considered for more in-depth analysis.

Chapter 12: Recommended Strategies and Actions for Economic Sustainability

The research and analysis for the Economic Sustainability Plan resulted in a number of findings and identified many important issues. The key findings are summarized at the beginning of each chapter, and the previous chapter further develops some important integrated issues that cut across the various topics. This final chapter presents the specific recommendations that support economic sustainability in the Delta.

Although the focus of this plan is the Delta, it is also a part of ongoing statewide planning initiatives related to the broader state's interests in the Delta's water resources and ecosystem. The plan recommends many specific actions where the state's coequal goals of water supply reliability and ecosystem restoration are consistent with the requirement to restore and enhance the Delta, and also identifies some proposed strategies that have conflicts with economic sustainability. Overall, the recommended strategies are consistent with the coequal goals of the 2009 Delta Reform Act.

12.1 Levees and Public Safety Recommendations

Levees are the fundamental infrastructure that supports the Delta and its economy. Chapter 5 contains a detailed analysis of the levee system and related emergency response and public safety issues. Levee investments are essential to economic sustainability in the Delta and are the most cost-effective strategy to achieve water supply reliability.

- **Improve and maintain all non-project levees to at least the Delta-specific PL 84-99 standard.** This engineering standard has been developed and supported by numerous studies and should remain the basic standard for non-project levees. These improvements are attainable and have economic benefits that exceed their cost, particularly when considered in the context of the systemic value of multiple infrastructure systems protected by the levee system. Achieving this goal will increase water supply reliability, and will leverage the substantial benefit of federal support through USACE in the event of future levee failures. Project levees should also be improved as necessary and maintained to a similar standard.

- **Improve most "lowland" levees and selected other levees to a higher Delta-specific standard that more fully addresses the risks due to earthquakes, extreme floods, and sea-level rise, allows for improved flood fighting and emergency response, provides improved protection for legacy communities, and allows for growth of vegetation on the water side of levees to improve habitat.** Improvement of most Delta lowland levees and selected other levees to this higher standard would cost $1 to $2 billion in base construction costs over the cost of reaching the PL 84-99 standard. Including vegetation and habitat enhancement, total program costs might be in the order of $4 billion, similar to the cost projected by the PPIC (2007) in their "Fortress Delta" alternative. While this is a longer-term program, planning should be initiated immediately.

- **The Delta Levee Subventions and Special Projects Program should continue to be supported.** These successful programs have significantly improved the performance of Delta levees in recent decades.

- **Transfer to a regional agency with fee assessment authority on levee beneficiaries responsibility for allocating funds for the longer-term improvement of Delta levees and the maintenance of regional emergency preparedness, response, and recovery**

systems developed jointly with the Delta counties and state and federal governments. The Delta Stewardship Council has proposed the creation of a new agency, the Delta Flood Risk Management Assessment District, with fee assessment authority on levee beneficiaries including some beneficiaries that are not currently assessed for levee maintenance and improvement. In accordance with California Constitution Article XIII D sections 3 and 4, specific benefit assessment authority and approval must be in place before funding can be assured. Whatever agency is given these powers by the legislature should also be the vehicle for distributing any additional funds that are provided by the state and federal governments for levee investments. Formation of a new agency such as a JPA consisting of the five Delta counties, or adoption of these responsibilities by an existing regional agency should have no impact on any existing liabilities associated with levee failures. This regional agency should place much more emphasis on preventative maintenance and inspections and the maintenance of flood fighting and emergency response systems developed by district, county, state, and federal emergency officials. Such flood fighting and emergency response systems should aim, first, at preventing breaches and, second, at minimizing flooding impact on people, property, and critical infrastructure in the event of a breach. This agency would necessarily work in close cooperation with the special districts, county, state, and federal officials responsible for emergency response in the Delta to develop the emergency response systems. The agency would then help maintain these systems on behalf of, and in cooperation with, those jurisdictions. This agency may have an actual response function in a flood emergency as agreed upon jointly by county, state, and federal officials. This agency, in accordance with regional response plans would closely coordinate with the Department of Water Resources and the Bureau of Reclamation following single or multiple levee breaches as these organizations would continue to control water conveyance and upstream reservoir operations.

- **In addition to providing funding for longer-term levee improvements, provide ongoing funding for regular levee maintenance and expanded emergency preparedness, response, and recovery**. This sum should cover nonproject and project levees as defined in Water Code sections 12980(e) and (f). The division of this funding between regular physical maintenance of the levee system and emergency preparedness, response, and recovery should be determined by the regional agency that assumes responsibility for both these activities. A portion of these funds should be set aside each year for dealing with emergencies when they occur. Such annual funding should be in addition to an initial emergency fund contribution.

- **Reduce or eliminate regulatory impediments to action by the creation of a one-stop permitting system for selected activities within the Delta including dredging, levee construction, and ecosystem restoration.** Regulatory impediments add significant cost to these activities and reduction or elimination of these impediments will allow more efficient improvements and thus improve economic sustainability.

- **Fully and expeditiously implement the recommendations contained in the SB27 Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force report.** This report was prepared by emergency managers of the five Delta counties, the Department of Water Resources, the California Emergency Management Agency, and the Delta Protection Commission and is due to be forwarded to the Governor and legislature in early 2012. The report is complemented by an earlier white paper prepared jointly in 2008 by the emergency managers of the five Delta counties entitled, “Basis for Regional Flood Response Planning”. These reports provide specific, and in many cases proven, actions that would improve emergency response efficiency and effectiveness in the Delta.

- **Formally identify the legal Delta as the geographic basis for integrated response, mutual aid, decision making, and information sharing processes during major floods**. Floods occur within hydrological basins and it is the jurisdictions within a common hydrological basin that are interdependent and must work together to reduce the overall impact. The current SEMS structure overlaid on the Delta hydrological basin divides it into five operational areas (counties and their independent cities and reclamation districts), two different mutual aid regions, and other legal and administrative "boundaries". Given the critical nature of the Delta to the state, this region should be designated as a distinct region for integrated emergency operations during floods in order to improve local response effectiveness and facilitate the creation of regional response systems.

12.2 General Recommendations for Economic Sustainability

This section details several general economic development recommendations that span individual sectors.

- **Designate a regional agency to implement and facilitate economic development efforts.** Several of the analysis chapters, particularly the recreation and tourism analysis and legacy community chapter, identified a cross-cutting need for a regional organization to strategically organize and facilitate economic development activities. The task to facilitate economic development strategies should be placed within the Delta Protection Commission or joint powers authority (JPA) led by local governments. The main tasks of this entity are: marketing and branding, permitting and regulatory assistance, planning and coordination with counties and cities, and strategically managing the Delta Investment Fund. Section 11.1 of Chapter 11 provides more details on the needed duties of the organization and evaluates the pros and cons of several candidate entities to take on the role.

- **Economic impacts of habitat creation and development of facilities for export water supply should be fully mitigated.** Local governments already face challenges delivering adequate public services to the rural Delta, and habitat development and other strategies could increase demand on local services while reducing the local tax base. Compensation for property taxes, assessments, and payments to property owners are essential parts of mitigation, but do not mitigate socio-economic impacts including lost income and sales in related industries and their associated tax revenues. Measuring and effectively compensating communities for dispersed and indirect net economic impacts should be further explored.

- **Land use planning and regulation must be clear and consistent across agencies.** The "covered action" component of the Delta Plan introduces a new element to land use planning that reduces local control and could increase uncertainty and risk to prospective investors. Increasing complexity of the Delta regulatory environment puts the Delta economy at a competitive disadvantage for new investment and will limit the ability of the Delta economy to evolve and be sustainable in a changing environment. It is vitally important that permitting, planning and regulation be streamlined, consistent, and coordinated across agencies. Local governments should be funded to develop base flood elevations.

12.3 Recommendations for the Economic Sustainability of Agriculture

Agriculture is the largest and most vital industry in the Delta. This section identifies the performance goal for Delta agriculture and several strategies to achieve it.

- **Maintain and enhance the value of Delta agriculture.** This goal is aligned with the performance measure in the Delta Stewardship Council's Fifth Draft of the Delta Plan, and can be attained in a way that is consistent with the state's coequal goals. The potential of other industries to replace any loss in economic output from Delta agriculture is limited.

- **Limit the loss of productive farmland to urbanization, habitat, and flooding to the greatest practical extent.** Some loss of farm land to these factors is inevitable, but continuing shifts of Delta agriculture to higher-valued crops and more value-added activities will compensate if land loss is not too great. To facilitate this goal, future residential development must be limited to the extent of city limits, city spheres of influence, and unincorporated areas that are consistent with city and county general plans.In addition, habitat measures must target existing public lands, lower-value agricultural lands, and consider adjusting acreage goals as discussed in the habitat recommendations.

- **Protect Delta water quality and water supplies for agriculture.** Increasing salinity levels and interference with water supply and flow—whether through changes to standards, operations of water export facilities, or habitat development—will harm Delta agriculture production.

- **Support growth in agritourism.** Agritourism is currently a very small contributor to the Delta's agricultural value, but is fast growing. Most agritourism is currently in the Secondary Zone close to urban areas, but could also be further developed in and around Legacy Communities and focal point recreation areas. Local area plans should support agritourism where appropriate.

- **Support local value-added processing of Delta crops**. Yolo County's agricultural and industrial zone that facilitated local expansion of the successful Bogle Winery is an example of a successful strategy. In addition to local governments, regulations from state and federal agencies such as FEMA that inhibit investment in value-added processing should be examined and streamlined where possible. This could be a role for the regional economic development entity described in Section 12.2. Besides the growth in wineries, this strategy can be applied to other emerging sectors such as olive pressing.

12.4 Recommendations for Economic Sustainability of Recreation and Tourism

Although recreation and tourism make a smaller contribution to the Delta economy than agriculture, it is a vital sector with growth potential that enhances quality of life for both residents and visitors. However, current trends in Delta recreation reveal signs of stagnation, and significant actions are required in order to capture the potential growth. Chapter 8 contains a detailed recreation and tourism enhancement strategy that contains 18 guiding principles developed to minimize constraints and take advantage of current and future influences and opportunities, resulting in five place-based strategies.

- **Protect and enhance private enterprise-based recreation with support from state and local public agencies.** Most of the economic activity related to recreation is generated by private enterprise. Public agencies can provide catalyst settings, recreation facilities, streamline permitting, and infrastructure to improve access, enhance and create settings for private development, and services.

- **Focus recreation development in five location-based concepts:**

  1) Enhance Delta Waterways
  2) Develop Dispersed Points of Interest and Activity Areas
  3) Create Focal Point Destination Complexes with natural areas, parks, Legacy Communities, marinas, historic features, and trails
  4) Expand public access to Natural Habitat Areas
  5) Create recreation-oriented buffers at Delta urban edges

- **Implement Economic Sustainability Plan through specific strategies**. Recommended strategies include consistency planning and regulation refinement, coordination among state and local agencies, obtaining strategic levee protection for legacy communities and key recreation areas, designating a marketing and economic development facilitator, and providing key funding for catalyst projects and agencies.

12.5 Recommendations for Infrastructure

The Delta's natural resources and its central location in the Northern California megaregion support its role as an infrastructure hub of local, state, and national importance. Chapter 9 analyzes key components of the Delta's infrastructure services, and identifies several means to ensure these goals are achieved.

- **Planning of levee investments must fully consider the economic value of infrastructure services along with all other benefits.** Comparisons of levee costs to farmland values substantially understate the value and importance of the levee system.. Increased levee investment is needed to sustain critical energy, transportation, and water supply infrastructure.

- **All owners and operators of infrastructure that depend on Delta levees must contribute to levee system investment and maintenance.** Some infrastructure systems make little or no financial contribution to sustaining Delta levees. All infrastructure services, including transportation, energy, and through-Delta conveyance of water must support levee investment.

- **Protect and improve Delta water quality and supply for agricultural, municipal and industrial uses.** Both salts and organic carbon significantly increase costs for farms, households, business and industry, in and outside the Delta.

- **Ensure that future development of infrastructure in the Delta is aligned with economic sustainability strategies**. Infrastructure demands within and around the Delta will require significant future investment. For example, investment in Delta roads and highways should be integrated with strategies to enhance agriculture, recreation, Legacy Communities, and emergency preparedness in the Delta, as well as minimize conflicts between uses. This could be a role for the Regional Economic Development Entity.

- **Support expansion and development of the ports.** The Marine Highway Corridor initiative offers significant environmental and infrastructure benefits for the greater Northern California Region, and is catalyzing economic development around Stockton, West Sacramento, and the state. More generally, development of these ports and marine facilities in the Pittsburg, Antioch, and Collinsville areas will support greater inter-regional integration, competitiveness, and economic development in the state.

12.6 Recommendations for Habitat and Ecosystem Improvements

Improving the Delta ecosystem is important to Delta communities, required by the coequal goals, and in some cases can benefit the Delta economy. However, there are some ecosystem proposals that can negatively impact the Delta economy and quality of life while having very uncertain benefits for the ecosystem. For example, the Economic Sustainability Plan finds that BDCP habitat proposals (not including conveyance) would reduce annual Delta agriculture revenues between $33 million and $137 million per year depending on how they are implemented. An evolving Delta economy could adapt to a $33 million decrease in agricultural revenue from habitat development, but a $137 million annual loss would create significant dislocation that could not be made up in other sectors. The wide variation shows the critical importance of considering Delta economic impacts when planning habitat projects.

- **Emphasize strategies with little or no conflict with the Delta economy.** Examples include increased fresh water flows, growth of vegetation on enlarged levees, restoration of mid-channel berms, and reactivation of upstream floodplains.

- **Expanded and enhanced flood bypasses can be consistent with economic sustainability if agencies work with local stakeholders to minimize and mitigate economic impacts.** Enhancing flood bypasses benefits fish and flood control, but can significantly impact agricultural production. The proposal to expand and enhance the Paradise Cut bypass in the South Delta is an example of an effective compromise between environmental groups and local landowners, and should be implemented.

- **Tidal marsh habitat plans should be significantly reduced.** Conversion of agricultural land to tidal marsh habitat creates significant economic, health, and water supply concerns with uncertain benefits for fish species. Tidal marsh would take high-value agricultural land out of production, negatively impact water quality for in-Delta and out-of-Delta users, increase seepage risks for nearby levees and lands, potentially increase water use, and create mosquito and vector control problems. Any tidal marsh habitat plans should be developed in cooperation with local stakeholders.

- **Increased open-water habitat in the Delta is not recommended.** Flooded islands in the Delta would create similar problems to tidal marsh, increase wave and seepage forces on adjacent islands and levees, and could have other significant negative effects on recreational boating and existing marinas and recreational facilities. The ecosystem benefits of open water are uncertain.

- **Include recreation facility development in habitat enhancement plans when possible.** Habitat restoration plans should be aware of the recreation and tourism enhancement strategy and look for co-development opportunities.

- **Habitat restoration should start on state-owned land and only occur on private lands with willing sellers consistent with local land use plans.** While willing sellers of habitat and easements are essential, it is important to note that compensating owners of land does not mitigate the socio-economic impacts of taking farm land out of production for habitat. In most cases, the loss in employee, supplier, and processor income in addition to other community spillover effects significantly exceeds the loss in farm income that is compensated through a voluntary sale.

12.7 Recommendations for Water Supply Reliability

Water supply reliability is required by the Delta Reform Act, but not defined. Reducing the risk of interruptions in water supply from earthquakes or floods is clearly one aspect of reliability, but there is debate about whether increasing reliability means increasing the quantity of water exported from the Delta or allows for decreasing it. The state policy to reduce reliance on the Delta suggests that lower exports from the Delta can be consistent with reliability as long as export supplies are more stable and secure. Regardless of the definition of reliability, sustaining and enhancing the Delta as a place requires consideration of the potential impacts of measures to improve water supply reliability on the Delta economy and quality of life. There are four primary areas of in-Delta impacts: 1) water quality; 2) land consumption by water supply infrastructure; 3) visual, noise, and other operational impacts of supply intakes; and 4) the risk of reduced water quality and/or the risk of reduced levee investments in the future.

- **Continuing the through-Delta conveyance is important to economic sustainability in the Delta and can be consistent with water supply reliability within and outside the Delta.** The substantial levee investments recommended in the ESP will substantially increase the reliability of through-Delta conveyance at a much lower cost than isolated conveyance.

- **A dual conveyance plan with a large, 15,000 cfs isolated conveyance facility has large conflicts with Delta economic sustainability and has high risk for Delta stakeholders**. Even if water quality standards were maintained, a large facility would have significant agricultural impacts, as well as negative quality of life and tourism impacts. The biggest long-term problem with isolated conveyance is the risk of lower water quality to maximize the value of the large facility to the exporters paying for the facility, and a reduced commitment to levee investment and maintenance by the state and water exporters that puts the Delta economy and other regional infrastructure at greater risk.

- **Options to large isolated conveyance must be fully and consistently evaluated**. In addition to through-Delta conveyance with the large levee upgrades, maintenance, and emergency measures recommended in this plan, these options include, but are not limited to a smaller-capacity isolated conveyance, the Delta Corridors plan, and proposals to move export intakes to the Western Delta in conjunction with additional south of Delta storage.

12.8 Recommendations for Research and Monitoring

The research for the Economic Sustainability Plan exposed some significant data and research gaps regarding the Delta economy and infrastructure systems. New data and research can help clear up points of disagreement and facilitate progress towards Delta solutions.

- **Conduct a comprehensive and credible cost-benefit analysis to analyze Delta alternatives.** This mirrors a recommendation the independent review panel for the ESP made to the Stewardship Council. Supporting such an analysis would be consistent with supporting the best available science to guide Delta decision making.

- **New recreation data is needed and should be updated regularly.** A key first step is to improve data on recreation and tourism use with an updated visitor survey and additional primary data collection that is repeated on five-year intervals. This data is crucial for future recreation planning and marketing, and could inform ecosystem restoration plans.

- **Maintain an Economic Sustainability Scoreboard to track progress.** Agricultural data is more available than recreation but should be consistently collected and compiled over time.

Indicators for infrastructure, other economic sectors, and socio-economic status should also be developed and tracked to inform implementation of the plan.

- **The Delta Science Program should sponsor more engineering and economic studies in addition to ecological research.** Information gaps surrounding Delta levees, local economic impacts, and valuation of benefits, and costs of ecosystem restoration hinder Delta decision making and should be a higher priority for scientific research funding.

- **Increase alignment among the various research and planning initiatives.** Updates of the Delta Plan should consider periodic updates of the Economic Sustainability Plan.

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