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Technical Appendices

Transitions for the Delta Economy

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Appendix A: Estimates of Acreage and Land Use

This appendix provides estimates of acreage by county of zones within the legal Delta and the Delta IMPLAN area used to model the regional economy (Table A1) and detailed estimates of land use by zones within the legal Delta from the California Department of Water Resources field surveys from 1991 and 2007 (Table A2). The results of the 2007 survey are preliminary.

TABLE A1
Acreage by county of zones within the legal Delta and the Delta zip code region

Zone	Contra Costa	Sacramento	San Joaquin	Solano	Yolo	Total
Delta counties*	513,983	635,791	912,148	582,319	653,371	3,297,612
Delta zip code region	217,900	386,068	522,602	406,333	134,574	1,667,476
Legal Delta*	110,489	118,965	318,800	92,005	92,171	737,341
Land area	92,466	102,657	295,757	79,692	85,487	660,969
Secondary zone*	66,238	17,421	126,699	6,256	17,295	238,756
Land area	63,505	15,662	120,694	5,455	15,615	225,668
Primary zone*	44,251	101,544	192,102	85,750	74,876	498,585
Land area	28,962	86,995	175,064	74,238	69,872	435,184
Primary/outer	22,687	38,932	24,870	74,055	74,714	229,144
Land area	8,093	32,249	17,768	62,563	69,872	190,598
Primary/repair	4,801	43,036	114,478	11,788	0	174,104
Land area	4,621	42,211	111,731	11,675	0	170,237
Primary/no repair	16,763	12,584	46,580	0	0	75,927
Land area	16,247	12,535	45,565	0	0	74,348

SOURCE: Author estimates.

NOTES: The primary zone depicted here is roughly 8,000 acres larger than the legal primary zone because it includes parts of several islands that are split in the legal definition (Brannan-Andrus, Roberts, Canal Ranch) and Wright-Elmwood, a subsided island located entirely in the secondary zone. These islands are included in the repair and no repair zones, as described in the text. For a map of the zones within the legal Delta, see Figure 2. For a map of the Delta zip code region and Delta counties, see Figure 3.

*Total column includes 4,848 acres of land in the secondary zone and 62 acres in the outer primary zone that lie within Alameda County.

TABLE A2a
Land use estimates for zones within the legal Delta, 1991

Land use class	Legal Delta	Secondary zone	Primary zone	Primary/outer	Primary/repair	Primary/no repair
Perennial fruits and nuts						
Almond and pistachio	–	–	–	–	–	–
Other deciduous	21,943	13,048	8,895	5,280	3,339	276
Subtropical	83	–	83	32	20	32
Vine	10,060	1,933	8,127	5,617	1,979	531
Tomatoes and other truck farming			–			
Cucurbits	3,514	3,033	481	132	297	52
Tomato	42,536	14,703	27,832	16,269	10,483	1,081
Other truck	35,560	5,940	29,621	2,845	18,791	7,985
Field crops and pasture			–			
Alfalfa	75,635	34,185	41,450	17,293	23,563	594
Corn	57,869	14,688	43,181	4,370	25,505	13,306
Cotton	198	75	123	123	–	–
Dry beans	10,316	9,173	1,143	1,143	–	–
Grain	95,037	17,483	77,555	26,376	32,450	18,729
Irrigated pasture	32,959	11,228	21,731	14,736	2,588	4,407
Non-irrigated grain and pasture	–	–	–	–		
Other field crops	75,321	8,267	67,053	28,663	20,960	17,430
Rice	18	–	18	–		18
Safflower	7,825	1,626	6,199	2,672	3,526	
Sugar beet	27,685	4,451	23,234	7,862	13,534	1,838
*Fallowed (Drought Water Bank)**	*(83,657)*	*(8,960)*	*(74,697)*	*(30,156)*	*(24,155)*	*(20,386)*
Livestock	2,448	2,126	321	321	–	–
Fallowed (not Drought Water Bank)*	33,336	12,387	20,949	15,916	2,146	2,887
Semi-agricultural	4,480	1,623	2,857	1,316	1,209	332
Urban	62,002	58,234	3,768	1,715	1,829	224
Native (land and water)	135,140	30,762	104,377	90,394	8,256	5,727
Not surveyed or classified	3,326	2,235	1,092	714	372	5
TOTAL	737,292	247,202	490,090	243,789	170,847	75,453

SOURCE: California Department of Water Resources field survey.

NOTE: For a map of zones, see Figure 2 in main report.

*The acreage fallowed under the Drought Water Bank is included in crop acreages within the field crop category (see text of main report for a discussion). The acreage fallowed outside of the Drought Water Bank is not included in crop acreages.

TABLE A2b
Land use estimates for zones within the legal Delta, 2007

Land use class	Legal Delta	Secondary zone	Primary zone	Primary/outer	Primary/repair	Primary/no repair
Perennial fruits and nuts						
Almond and pistachio	3,157	3,090	67	4	63	
Other deciduous	13,480	4,622	8,859	4,848	3,597	413
Subtropical	800	57	743	86	657	
Vine	28,537	4,937	23,600	15,311	7,637	653
Tomatoes and other truck farming			–			
Cucurbits	–	–	–	–		
Tomato	31,298	11,008	20,289	6,797	11,554	1,938
Other truck	22,124	3,897	18,227	2,665	11,433	4,129
Field crops and pasture			–			
Alfalfa	82,126	22,419	59,707	23,014	32,575	4,117
Corn	109,468	19,058	90,410	7,101	49,541	33,768
Cotton	34	34	–	–		
Dry beans	–	–	–	–		
Grain	14,957	3,344	11,613	3,106	6,086	2,421
Irrigated pasture	48,779	8,705	40,074	28,668	7,371	4,035
Non-irrigated grain and pasture	43,568	10,000	33,568	23,675	7,254	2,640
Other field crops	19,855	9,190	10,665	6,871	3,365	429
Rice	5,035	2,266	2,769	(72)	1,743	1,098
Safflower	–	–	–	–		
Sugar beet	310	–	310	0	310	
Livestock	1,277	1,025	252	252		
Fallowed cropland	7,915	3,859	4,056	1,216	1,377	1,462
Semi-agricultural	32,163	9,089	23,074	9,756	11,117	2,201
Urban	90,859	82,977	7,882	4,530	2,647	705
Native (land and water)	181,352	47,665	133,687	105,248	12,996	15,443
Not surveyed or classified	238	–	238	238	–	–
TOTAL	737,332	247,242	490,090	243,314	171,322	75,453

SOURCE: California Department of Water Resources field survey.

NOTES: Results of the 2007 field survey are preliminary. For a map of zones, see Figure 2 of main report. "Semi-agricultural" lands include non-cultivated areas with structures, ditches, or otherwise non-productive farmland

Appendix B: Estimating Delta Employment Using the NETS

This appendix describes the National Establishment Time Series (NETS) database and the matching process used to locate establishments and employment within subzones of the Delta. It also provides detailed estimates of employment by industry for the five-county Delta region and the Delta sub-zones for 1992 and 2006 (Table B2).

An Overview of the NETS

The NETS database used in this study is a long-term project of Walls & Associates in conjunction with Dun and Bradstreet (D&B) (Neumark, Zhang and Kolko 2006; Kolko and Neumark, 2007). D&B strives to identify all business establishments, and to assemble information on them, through a massive data collection effort, including making over 100 million telephone calls from four calling centers each year, as well as obtaining information from legal and court filings, newspapers and electronic news services, public utilities, all U.S. Secretaries of State, government registries and licensing data, payment and collections information, company filings and news reports, and the U.S. Postal Service. Particular efforts are devoted to identifying the births and deaths of establishments. For every establishment identified, D&B assigns a DUNS number as a means of tracking the establishment. Beginning around 1990, the DUNS has increasingly become the standard way of tracking business and has been adopted by many government agencies in the United States and internationally.

Although the goal of D&B is not to collect and organize data for scholarly research, it does have an incentive to ensure the accuracy of its contemporaneous data files, because inaccuracies would hurt D&B's business and might even result in lawsuits. D&B has established a sophisticated quality control system and engages in extensive quality and consistency checks. Thus, the data in each cross-section should provide high quality "snapshots" of business establishments.

Walls & Associates entered into collaboration with D&B with a very different purpose in mind—namely, to provide a dynamic view of the U.S. economy using data from the D&B archives (Walls & Associates, 2003). Essentially, this requires linking the D&B cross-sections into a longitudinal file that tracks every establishment from its birth, through any physical moves it may make, capturing any changes of ownership, and recording the establishment's death if it occurs. This is a multistage process, the most important steps of which include merging the data files, imputing data when data are not reported, eliminating duplicate records, merging records on establishments for which the DUNS number changes yet which appear to cover the same establishment (which happens occasionally), and identifying establishment relocations.

Neumark, Zhang, and Kolko (2006) and Kolko and Neumark (2007) have shown that the NETS is a useful source of information for tracking employment over time, particularly over intervals of more than one year. The NETS often registers higher employment numbers than other sources, because it includes self-employment and it counts jobs, not individuals who work—thus someone with more than one job (or more than one self-employed business) will be counted more than once. The NETS may underreport employment in the most recent year because of a lag in observing births in establishments.

For this study, we use data from the five-county Delta region from 1992, the first year for which NETS data are considered sufficiently reliable for analysis (Kolko and Neumark, 2007), and 2006, the last year in the NETS subscription available to us. For 2006, we find a very close match (99%) between NETS and IMPLAN data on non-farm employment for the Delta zip code region used for the analysis of economic effects (consisting of the zip codes shown in Figure 3 in the main report), even though IMPLAN relies on a variety of other sources. For the five Delta counties (Contra Costa, Sacramento, San Joaquin, Solano, and Yolo), non-farm employment in the IMPLAN database was somewhat higher (15%) than in NETS. Also, the growth rates in employment in the five county region as registered by County Business Pattern (CBP) data from the U.S. Bureau of Labor Statistics (a source that does not include self-employment) were somewhat higher in several counties (Table B1).

TABLE B1
Growth in employment, CBP versus NETS, 1992 to 2006

County	CBP (%)	NETS (%)	Difference CBP – NETS (%)
Contra Costa	28	25	3
Sacramento	39	20	19
San Joaquin	46	15	32
Solano	36	8	29
Yolo	40	35	5
Total	37	20	17

SOURCE: Author calculations using CBP and NETS data.

Geocoding NETS Employment in the Delta

A particular value of the NETS database for understanding employment patterns and trends in the Delta is the availability of information on establishment location. We engaged in a three-step process to geocode the NETS data. First, we used geocoding software to match the majority of addresses.[1] Second, we conducted manual matches for establishments within the primary zone of the Delta whose street addresses were not matched automatically by the software, by correcting or supplying addresses wherever possible.[2] Finally, for the establishments that could not be matched (generally because of an erroneous or missing street address), we imputed location based on the Census place name (which includes incorporated cities and towns as well as unincorporated places) and the industry. We took the match rates for each industry-place unit and adjusted upward the employment and establishment count of each matched establishment in the city-industry by the inverse of the city-industry match rate. These adjusted values approximate the actual values that would exist at the zone level if we had a perfect geocoding match rate. For the legal Delta as a whole, 11 percent of all establishments were matched to specific subzones of the Delta in this way. Smaller and more rural establishments were more likely to require this adjustment. Table B2 summarizes employment in each zone by industry group for all establishments in the Delta.

[1] These establishments were geocoded in ArcView 9.1. The street addresses that the establishment addresses were matched to are from the streets.sdc file provided by ESRI as their StreetMap North America dataset. This file reflects streets as they existed in 2003 and was originally created by TeleAtlas, then enhanced by TeleAtlas and ESRI and packaged with ArcView by ESRI.
[2] If the parameters used in geocoding (street name and number, city name, zip code) change over time, or if an establishment provides a non-official city name, this can prevent an automatic match. For primary zone establishments, we also looked up company names to find missing addresses. In all, we manually matched 46 percent of primary zone establishments in 1992 and 29 percent in 2006.

Matching Marinas

To provide estimates of the size of the water-based recreational economy, it was necessary to have an accurate picture of the marina sector within the Delta. We therefore compared the Delta establishments listed as marinas in the NETS for 2006 (NAICS code 713930) with the 90 marinas listed in two other sources: Delta Boating (http://www.deltaboating.com/marinas.htm) and Yachtsman's 2009 Marina Guide. In all, we identified 97 marinas in the Delta in the NETS. There were direct matches for 77 marinas, although 20 of these establishments were listed under a different industry code in the NETS (restaurants, lodging facilities, recreational vehicle parks, etc.). By following up by phone on discrepancies, we also established that seven marinas listed in the NETS and not in either of other two sources were in fact marinas. For the remaining 13 marinas, there is a discrepancy between the NETS and the other two lists. The NETS includes as marinas 13 establishments that are boat storage facilities not located on the water. The other two lists included one marina that was no longer in operation and 12 that were in operation but not in the NETS, at least under their present name. For purposes of estimating the size of the marina sector in the Delta, we use the employment figures from the 97 identified establishments. It is possible that the sector is slightly larger (in light of the 12 missing observations in the NETS).

TABLE B2a
Employment by zone within the Delta's five-county region, 1992

	NAICS codes	Non-Delta	Secondary zone	Primary zone	Primary/outer	Primary/repair	Primary/no repair	Total
Agriculture, forestry, fishing								
Animal production	112	1,925	178	91	30	61		2,194
Crop production	111	7,085	1,146	1,529	1,008	493	28	9,760
Fishing, hunting, trapping	114	119		–				119
Forestry and logging	113	73	7	2	2			82
Agricultural support activities	115	4,293	287	311	140	170		4,891
Goods producing (non-farm)								
Construction	23	67,282	8,540	464	403	39	21	76,286
Manufacturing	31, 32, 33	96,402	15,496	228	186	32	10	112,127
Mining	21	4,357	131	59	56	3		4,547
Utilities	22	10,675	1,273	–	–			11,948
Goods trade								
Retail trade	44, 45	138,149	18,832	293	159	115	20	157,274
Transportation and warehousing	48, 49	29,542	5,254	169	128	19	22	34,965
Wholesale trade	42	52,745	7,391	132	90	12	30	60,269
Business services								
Administrative support	56	54,040	4,051	102	83	20	–	58,193
Finance and insurance	52	60,722	4,074	16	14	2		64,812
Information	51	36,035	2,352	299	277	22	–	38,686
Management of companies	55	250	5	–	–			255
Professional services	54	91,763	6,873	69	55	15		98,705
Real estate	53	32,515	3,659	165	102	60	2	36,339
Consumer services								
Lodging and food services	72	62,633	7,410	409	193	195	21	70,452
Arts and recreation (except marinas)	71	16,893	1,149	22	22	–	–	18,064
Education	61	69,999	9,126	221	144	56	21	79,347
Health care	62	110,879	13,548	53	42	7	5	124,480
Marinas*	713930	206	405	173	71	56	46	784
Other services	81	79,833	6,198	130	75	43	12	86,161
Public administration	92	144,394	5,458	39	39	–	–	149,891
Unclassified	99	163	12	100	100			275
TOTAL		1,172,974	122,854	5,078	3,418	1,421	239	1,300,906

SOURCE: Author estimates using the NETS database for 1992.

*Marinas within the Delta were adjusted to include establishments in other sectors that also function as marinas, as described in the text.

TABLE B2b
Employment by zone within the Delta's five-county region, 2006

	NAICS codes	Non-Delta	Secondary zone	Primary zone	Primary/outer	Primary/repair	Primary/no repair	Total
Agriculture, forestry, fishing								
Animal production	112	1,963	133	78	41	36		2,174
Crop production	111	9,273	1,072	1,495	670	444	380	11,840
Fishing, hunting, trapping	114	91		–				91
Forestry and logging	113	13	–	2	2			15
Agricultural support activities	115	5,317	592	167	146	21		6,076
Goods producing (non-farm)								
Construction	23	90,961	10,963	362	288	62	12	102,286
Manufacturing	31, 32, 33	92,844	14,939	177	85	92	–	107,960
Mining	21	4,041	199	144	135	9		4,384
Utilities	22	4,942	1,110	8	8			6,060
Goods trade								
Retail trade	44, 45	155,693	20,693	181	101	79	1	176,567
Transportation and warehousing	48, 49	40,173	8,406	570	108	447	15	49,149
Wholesale trade	42	50,496	8,098	255	108	38	108	58,849
Business services								
Administrative support	56	71,725	6,365	92	48	43	1	78,182
Finance and insurance	52	74,661	6,055	44	18	26		80,760
Information	51	43,660	2,311	286	273	11	2	46,257
Management of companies	55	1,789	50	2	2			1,841
Professional services	54	112,273	7,804	105	65	40		120,182
Real estate	53	41,180	5,884	170	111	58	1	47,234
Consumer services								
Lodging and food services	72	85,287	11,199	199	65	123	11	96,685
Arts and recreation (except marinas)	71	25,490	2,256	20	6	10	3	27,766
Education	61	91,874	13,411	237	131	76	30	105,523
Health care	62	164,586	16,586	43	40	1	2	181,215
Marinas*	713930	177	294	304	134	154	15	775
Other services	81	79,285	8,451	373	334	38	1	88,109
Public administration	92	151,260	9,252	89	29	54	6	160,601
Unclassified	99	1,012	134	–	–			1,146
TOTAL		1,400,066	156,257	5,403	2,951	1,863	590	1,561,727

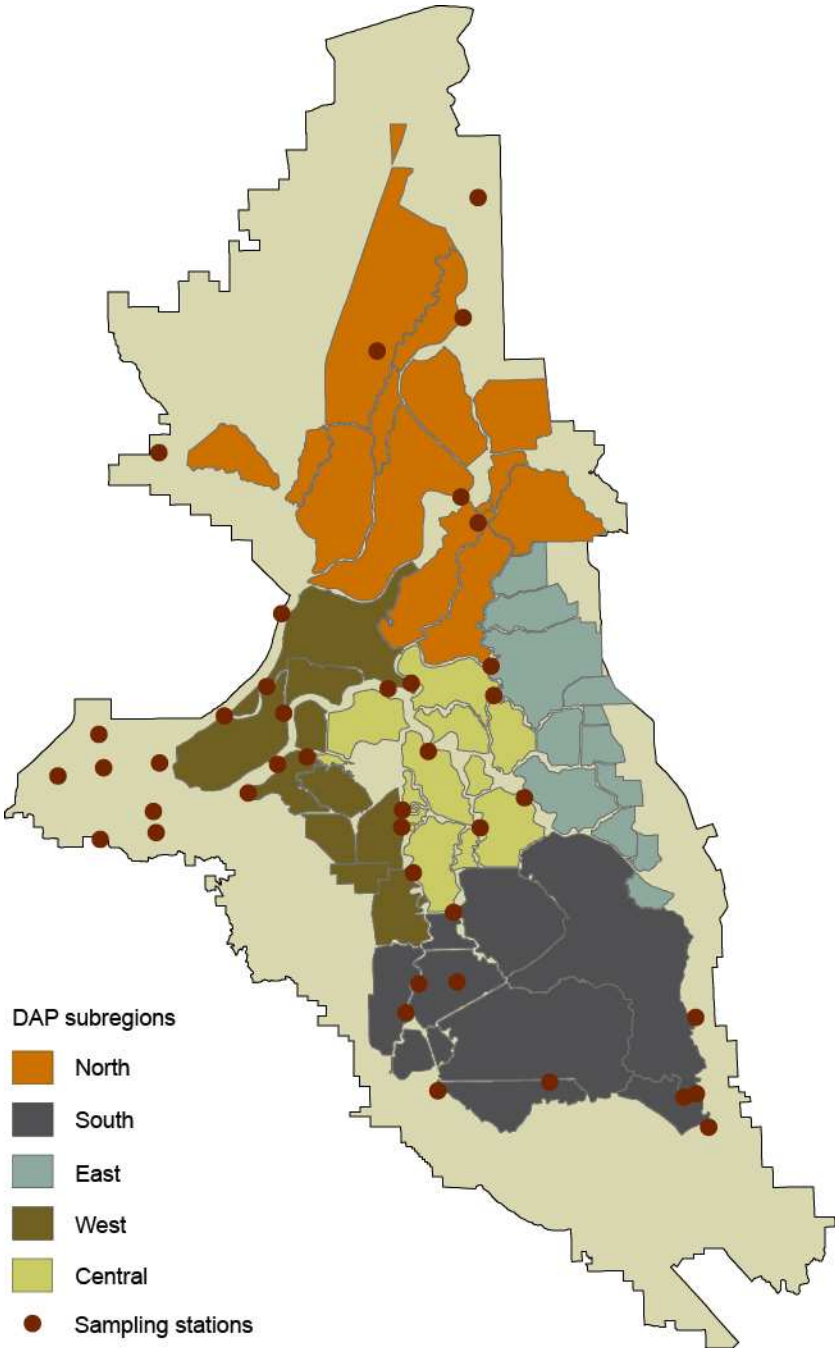
SOURCE: Author estimates using the NETS database for 1992.

*Marinas within the Delta were adjusted to include establishments in other sectors that also function as marinas, as described in the text.

Appendix C: Salinity Projections in the Delta

This appendix shows the locations of salinity measurement points within the Delta used to assign salinity levels to irrigation water in various parts of the Delta and the sub-regional island groups used to summarize effects in different parts of the Delta in Figures 9 and 10 of the report (Figure C1). It also provides detailed salinity estimates and projections used for each island in the estimation of cropping changes and costs (Tables C1 and C2).

FIGURE C1
Location of sampling stations for water salinity measurement



SOURCE: Resource Management Associates, Inc., as described in Fleenor et al., 2008.

NOTES: In the modeling results presented in the main report, the salinity level from the nearest station is applied to each island to determine crop production effects. When more than one station is adjacent to an island, the higher salinity level is applied. The zones shown in this map correspond to those reported in Figures 9 and 10 in the main report to describe salinity levels in different parts of the Delta. The map does not depict several additional sampling stations in the Suisun Bay area. A slightly smaller number of stations was used for the western island flooding runs.

TABLE C1
Salinity projections by island with current conditions, dual conveyance, and sea level rise (1981–2000 base period) (EC in mS/cm)

Zone	Island	Current conditions	Dual conveyance	1 foot SLR	1 foot SLR & dual conveyance	3 foot SLR	3 foot SLR & dual conveyance	Dry year current conditions	Dry year dual conveyance
Central	Bacon	0.38	0.40	0.54	0.49	0.96	0.85	0.58	0.56
Central	Bouldin	0.17	0.17	0.17	0.17	0.27	0.25	0.17	0.17
Central	Empire	0.29	0.32	0.32	0.33	0.48	0.45	0.32	0.35
Central	Little Franks	0.39	0.39	0.55	0.49	0.98	0.87	1.18	1.18
Central	Little Mandeville	0.39	0.39	0.55	0.49	0.98	0.87	0.59	0.58
Central	Little Tinsley	0.29	0.32	0.33	0.33	0.56	0.51	0.32	0.35
Central	Mandeville	0.26	0.30	0.34	0.33	0.63	0.56	0.29	0.31
Central	McDonald	0.29	0.32	0.33	0.33	0.56	0.51	0.32	0.35
Central	Medford	0.29	0.32	0.34	0.33	0.63	0.56	0.32	0.35
Central	Mildred Island	0.31	0.36	0.35	0.36	0.56	0.51	0.36	0.40
Central	Quimby	0.39	0.39	0.55	0.49	0.98	0.87	0.59	0.58
Central	Rhode	0.39	0.39	0.55	0.49	0.98	0.87	0.59	0.58
Central	Venice	0.25	0.26	0.34	0.31	0.63	0.56	0.29	0.29
Central	Webb	0.26	0.26	0.38	0.33	0.74	0.63	0.33	0.29
East	Bishop	0.29	0.32	0.32	0.33	0.48	0.45	0.32	0.35
East	Brack	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15
East	Canal Ranch	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15
East	King	0.29	0.32	0.32	0.33	0.48	0.45	0.32	0.35
East	Rindge	0.29	0.32	0.33	0.33	0.56	0.51	0.32	0.35
East	Rio Blanco	0.29	0.32	0.32	0.33	0.48	0.45	0.32	0.35
East	Rough and Ready	0.55	0.55	0.55	0.55	0.55	0.55	0.75	0.74
East	Sargent Barnhart	0.55	0.55	0.55	0.55	0.55	0.55	0.75	0.74
East	Shima	0.55	0.55	0.55	0.55	0.55	0.55	0.75	0.74
East	Shin Kee	0.29	0.32	0.32	0.33	0.48	0.45	0.32	0.35
East	Sycamore	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15
East	Terminous	0.19	0.20	0.22	0.22	0.37	0.35	0.18	0.19
East	Wright-Elmwood	0.55	0.55	0.55	0.55	0.55	0.55	0.75	0.74
North	Deadhorse Island	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	Glanville	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	Grand	0.24	0.66	0.44	0.64	0.94	1.31	0.37	0.99
North	Hastings	0.29	0.66	0.44	0.64	0.94	1.31	0.37	0.99
North	McCormack-Williamson	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	Merritt	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	Netherlands	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	New Hope	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	Pierson District	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
North	Prospect	0.24	0.66	0.44	0.64	0.94	1.31	0.37	0.99
North	Ryer	0.29	0.34	0.31	0.35	0.46	0.61	0.36	0.44
North	Staten	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15
North	Sutter	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

TABLE C1 *(continued)*

Zone	Island	Current conditions	Dual conveyance	1 foot SLR	1 foot SLR & dual conveyance	3 foot SLR	3 foot SLR & dual conveyance	Dry year current conditions	Dry year dual conveyance
North	Tyler	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
South	Byron	0.43	0.48	0.47	0.48	0.66	0.62	0.58	0.60
South	Clifton Court	0.43	0.48	0.47	0.48	0.66	0.62	0.58	0.60
South	Coney	0.43	0.48	0.47	0.48	0.66	0.62	0.58	0.60
South	Fabian	0.56	0.56	0.56	0.56	0.66	0.62	0.76	0.76
South	Jones	0.31	0.37	0.35	0.37	0.54	0.51	0.37	0.41
South	Roberts	0.55	0.55	0.55	0.55	0.55	0.55	0.75	0.74
South	Stewart	0.56	0.56	0.56	0.56	0.56	0.56	0.77	0.77
South	Union	0.56	0.56	0.56	0.56	0.66	0.62	0.76	0.76
South	Victoria	0.38	0.41	0.52	0.48	0.89	0.79	0.56	0.55
South	Woodward	0.38	0.41	0.52	0.48	0.89	0.79	0.56	0.55
West	Bethel	0.39	0.39	0.55	0.49	0.98	0.87	1.18	1.18
West	Bradford	0.76	1.23	0.95	1.03	1.48	1.47	1.49	2.33
West	Brannan-Andrus	0.26	0.66	0.44	0.64	0.94	1.31	0.37	0.99
West	Decker	2.56	3.15	3.32	3.40	4.91	5.03	4.72	5.68
West	Fay	0.38	0.40	0.54	0.49	0.96	0.85	0.58	0.56
West	Holland	0.39	0.39	0.55	0.49	0.98	0.87	0.59	0.58
West	Hotchkiss	0.99	0.81	1.46	1.20	2.36	2.13	1.73	1.50
West	Jersey	0.99	0.81	1.46	1.20	2.36	2.13	1.73	1.50
West	Orwood	0.38	0.40	0.54	0.49	0.96	0.85	0.58	0.56
West	Palm	0.38	0.40	0.54	0.49	0.96	0.85	0.58	0.56
West	Sherman	1.24	2.19	1.62	1.98	2.40	2.82	2.46	3.96
West	Twitchell	0.76	1.23	0.95	1.03	1.48	1.47	1.49	2.33
West	Veale	0.38	0.41	0.54	0.49	0.96	0.85	0.58	0.56
Far-west	Browns	6.35	7.59	6.94	7.02	8.00	8.11	10.69	12.42
Far-west	Chipps	5.19	6.25	5.80	5.89	6.90	7.02	9.01	10.58
Far-west	Kimball	6.35	7.59	6.94	7.02	8.00	8.11	10.69	12.42
Far-west	Neville	6.35	7.59	6.94	7.02	8.00	8.11	10.69	12.42
Far-west	Van Sickle	3.08	3.85	3.65	3.76	4.82	4.95	5.71	6.97
Far-west	Winter	6.35	7.59	6.94	7.02	8.00	8.11	10.69	12.42

SOURCE: Modeling results from Fleenor et al. (2008)

NOTES: The table reports average salinity levels during the irrigation season (April 1 through September 30). Data for dry years include the critically dry years 1987-1992 and 1994. Islands in the "Far-west" zone are not depicted in Figure C1 or included in Figure 9.

TABLE C2
Salinity projections by island with current conditions and the flooding of five western islands (April 12, 2002 to December 31, 2004 base period) (EC in mS/cm)

Zone	Island	Current conditions—Irrigation season	Flooded Islands—Irrigation season	Current conditions—Rest of year	Flooded Islands—Rest of year
Central	Bacon	0.34	0.39	0.45	0.73
Central	Bouldin	0.17	0.17	0.19	0.19
Central	Empire	0.34	0.35	0.35	0.44
Central	Little Franks	0.36	0.41	0.51	0.83
Central	Little Mandeville	0.36	0.41	0.51	0.83
Central	Little Tinsley	0.34	0.35	0.35	0.44
Central	Mandeville	0.26	0.30	0.29	0.47
Central	McDonald	0.34	0.35	0.35	0.44
Central	Medford	0.34	0.35	0.35	0.47
Central	Mildred Island	0.30	0.33	0.35	0.49
Central	Quimby	0.36	0.41	0.51	0.83
Central	Rhode	0.36	0.41	0.51	0.83
Central	Venice	0.24	0.29	0.26	0.47
Central	Webb	0.24	0.29	0.33	0.61
East	Bishop	0.34	0.35	0.35	0.44
East	Brack	0.17	0.17	0.19	0.19
East	Canal Ranch	0.17	0.17	0.19	0.19
East	King	0.34	0.35	0.35	0.44
East	Rindge	0.34	0.35	0.35	0.44
East	Rio Blanco	0.34	0.35	0.35	0.44
East	Rough and Ready	0.61	0.61	0.79	0.79
East	Sargent Barnhart	0.61	0.61	0.79	0.79
East	Shima	0.61	0.61	0.79	0.79
East	Shin Kee	0.34	0.35	0.35	0.44
East	Sycamore	0.17	0.17	0.19	0.19
East	Terminous	0.17	0.17	0.19	0.19
East	Wright-Elmwood	0.61	0.61	0.79	0.79
North	Deadhorse Island	0.16	0.15	0.19	0.19
North	Glanville	0.14	0.14	0.16	0.16
North	Grand	0.15	0.15	0.20	0.18
North	Hastings	0.15	0.15	0.20	0.18
North	McCormack-Williamson	0.16	0.15	0.19	0.19
North	Merritt	0.14	0.14	0.16	0.16
North	Netherlands	0.14	0.14	0.16	0.16
North	New Hope	0.16	0.15	0.19	0.19
North	Pierson District	0.14	0.14	0.16	0.16
North	Prospect	0.15	0.15	0.20	0.18
North	Ryer	0.14	0.14	0.16	0.16
North	Staten	0.17	0.17	0.19	0.19
North	Sutter	0.14	0.14	0.16	0.16
North	Tyler	0.16	0.15	0.19	0.19
South	Byron	0.35	0.39	0.51	0.67
South	Clifton Court	0.35	0.39	0.51	0.67
South	Coney	0.35	0.39	0.51	0.67
South	Fabian	0.62	0.62	0.79	0.79
South	Jones	0.30	0.33	0.35	0.49
South	Roberts	0.61	0.61	0.79	0.79
South	Stewart	0.61	0.61	0.79	0.79
South	Union	0.62	0.62	0.79	0.79
South	Victoria	0.34	0.37	0.43	0.63
South	Woodward	0.34	0.37	0.43	0.63
West	Bethel	0.36	0.41	0.51	0.83
West	Bradford	0.38	0.41	0.49	0.73
West	Brannan-Andrus	0.23	0.28	0.33	0.61

TABLE C2 *(continued)*

Zone	Island	Current conditions—Irrigation season	Flooded Islands—Irrigation season	Current conditions—Rest of year	Flooded Islands—Rest of year
West	Decker	0.16	0.15	0.29	0.29
West	Fay	0.34	0.39	0.45	0.73
West	Holland	0.36	0.41	0.51	0.83
West	Hotchkiss	0.34	0.39	0.45	0.73
West	Jersey	0.43	0.47	0.74	0.98
West	Orwood	0.34	0.39	0.45	0.73
West	Palm	0.34	0.39	0.45	0.73
West	Sherman	0.38	0.41	0.49	0.73
West	Twitchell	0.38	0.41	0.49	0.73
West	Veale	0.34	0.39	0.45	0.73
Far-west	Browns	3.37	3.15	7.26	6.84
Far-west	Chipps	3.37	3.15	7.26	6.84
Far-west	Kimball	3.37	3.15	7.26	6.84
Far-west	Neville	3.37	3.15	7.26	6.84
Far-west	Van Sickle	3.37	3.15	7.26	6.84
Far-west	Winter	3.37	3.15	7.26	6.84

SOURCE: RMA, Inc (as described in Fleenor et al., 2008).

NOTES: The table reports average salinity levels for the irrigation season (April 1 to September 30) and rest of the year. Islands in the "Far-west" zone are not depicted in Figure C1 or included in Figure 10.

Appendix D: Evaluating Economic Change in the Delta

This appendix describes the methods we used to investigate effects on the Delta economy of the changes in land availability and water quality. We begin with a brief description of the data and model used to characterize the Delta economy, and then describe several economic scenarios examined. Given the primary importance of agriculture in the inner Delta, where the changes are likely to be felt most strongly, we focus particularly on effects for this sector and look at two scenarios for 2030: 1) a continuation of 2007 land use (Status Quo); and 2) a response to increased market demand for higher-value crops (Value Intensification). We then describe the treatment of other sectors, including a focused look at potential increases in water-based recreation.

Modeling the Delta Economy

To gauge the effects of land area and water quality changes on key economic indicators, we use the IMPLAN model for the year 2006. IMPLAN (IMpact Analysis for PLANning) was developed by the Minnesota IMPLAN Group; it provides a snapshot of a local economy and facilitates the assessment of likely economic consequences of projects or actions within sectors of that economy.[3] To do this, IMPLAN estimates both the "direct" and "multiplier" effects of economic changes on yearly revenues, employment, and "value added"—the difference between revenues and the cost of non-labor business expenses. Value added, not revenue, is the primary measure of the value of economic activity in a region. It includes compensation for employees as well as income to business and landowners and other businesses. Federal, state, and local government receipts are generated from taxes on various components of value added.

Direct Effects and Multiplier Effects

"Direct" effects are the initial effects on revenues, employment, and value added on the sectors that are directly affected by a policy action or event. Multiplier effects are the additional effects of this change on the broader economy. Multiplier effects include both "indirect" effects on the businesses in related sectors and "induced" effects of changes in spending on the overall economy. As an illustration, consider the effects of permanently flooding a Delta island on which the only economic activity is farming. The direct effects are reduced agricultural production, revenues, and incomes of employees, managers, and landowners. The indirect effects include reduced demand for purchased farm inputs (seeds, fertilizer, pesticides, machinery, etc.) as well as reduced supply of agricultural outputs to processing plants and wholesale and retail trade establishments that trade in these goods. Such reductions cause revenue and job losses for the affected businesses. The induced effects are the reduced spending by employees and businesses affected by direct and indirect earnings losses, further reducing overall economic activity.

IMPLAN tends to provide upper bound estimates of the annual economic loss from reducing a particular economic activity, because it assumes that the economy is very inflexible, and that unemployed resources will not transition into other activities. Although farmland lost from island flooding probably cannot be replaced within the Delta, it is likely that at least some of the labor and other production inputs can find

[3] See http://www.implan.com, IMPLAN constructs Social Accounting Matrixes (Pyatt and Round, 1984) to describe the structure and function of the economy.

other uses, either in crop production elsewhere in the region or in other sectors. Such transitions and adjustments are increasingly likely over time.

An IMPLAN Model for the Delta

Because the Delta does not correspond to the standard geographic areas available for IMPLAN models (states, counties, or zip codes), it was necessary to construct an area roughly corresponding to the Delta from an amalgam of zip code areas. This area, shown in Figure 3 of the main report, covers most of the legal Delta; but it is roughly 2.3 times larger in size and roughly 3 times larger in employment and value added (Table 5 of the main report). Although the direct economic effects we measure with this model are all within the legal Delta, some of the multiplier effects would be experienced in this larger surrounding area. Some simulations also consider effects of changes in the Delta on the five Delta counties.

Estimates of the agricultural economy are a weak point in IMPLAN, particularly at smaller geographic scales, and users are encouraged to modify this data when they have access to more accurate sources.[4] Given the importance of agriculture in the investigations here, we modified the IMPLAN model's crop revenues using local data, as described next.

Two Scenarios for Delta Agriculture

We consider two potential futures for Delta agriculture in 2030, allowing land use and the size of the agricultural economy to vary in the following ways:

1. Status quo: a continuation of 2007 land use
2. Value intensification: a shift toward specialty crops (fruits and vegetables) in response to market demands

The first scenario assume constant prices and crop technology (same inputs, employees, and yields per acre), using average revenues per acre for the 2005-2008 period for region 9 of the Statewide Agricultural Production (SWAP) model, converted to $2008.[5] The value intensification scenario allows both prices and technology to adjust to projected conditions for 2030 (see Appendix E). Both scenarios may overstate the level of employment in crop production, because IMPLAN's ratios of jobs to revenues are somewhat higher than those measured by other sources.[6] Both are optimistic regarding the level of planted acreage, because they assume that the declining trend observed between 1991 and 2007 will not continue.

Scenario 1: Status Quo

This case assumes no further loss in agricultural area in the Delta, and a continuation of the same cropping patterns as in 2007, with constant revenues per acre (equivalent to assuming constant prices and yields).[7]

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[4] See p. 237 of the IMPLAN handbook (Minnesota IMPLAN Group, Inc., 2010).
[5] For crop revenues per acre, see Appendix Table E.1.
[6] In the model, we substituted our estimates of crop revenues for the IMPLAN defaults but maintained IMPLAN's ratios of revenues to jobs and value added. For the five Delta counties, IMPLAN estimates of agricultural employment are 50 percent higher than estimates from the California Employment Development Department. For the Delta zip code area, IMPLAN estimates are 30 percent higher than those obtained with the NETS database presented in Appendix B.
[7] We modified the IMPLAN default values using estimates of acreages obtained from DWR's detailed land use surveys and revenues per acre from the Statewide Agricultural Production Model. For the legal Delta, we used the 2007 land use survey and the SWAP 2005–08 revenues per acre for region 9. For the areas outside the legal Delta, we relied on DWR surveys from earlier years: Contra Costa (1995), Sacramento (2000), San Joaquin (1996), Solano (2003), and Yolo (1997), and used the same revenues per acre as for the legal Delta. (For habitat conversion in the Yolo

This case is optimistic relative to historical trends in land use, but pessimistic in assumptions regarding yields. Appendix Table A2 presents the crop mix for the legal Delta for this case, and Table 5 of the main report presents the agricultural employment, revenues, and value added.

Scenario 2: Value Intensification

In this case, Delta agriculture again breaks with past trends of decreasing crop acreages, and follows the rest of the Central Valley in responding to market demands for higher-value crops. Yields per acre also increase. To estimate land uses and revenues, we use the Delta Agricultural Production (DAP) model, which allows Delta farmers to choose their most profitable crop mix, taking into account prices and the level of salinity in their water supplies (for further description of DAP, see Appendix E). Because this case assumes no further declines in Delta cropland and a shift toward higher-value crops, it is the most optimistic case examined regarding the value of Delta agriculture in 2030.

We use Scenario 2 to assess all three types of physical changes to the Delta. For the flooding of islands that may not warrant repair based on the value of their economic activity and for habitat expansion, the DAP model assumes current levels of salinity. For the analysis of impacts of various changes in salinity, we use salinity levels from the hydrodynamic model runs described in the report and presented in Appendix C.

Relative to average revenue/acre in 2005-08, crop values in 2030 are projected to increase in real terms, led by vegetables and other truck farming (+51%), corn (+46%), processing tomatoes (+38%), and wine grapes (+18%) (see Appendix Table E1). Real agricultural revenues rise by 15 percent, real value added by 19 percent, and employment by 11 percent (assuming constant ratios of value added and employment to revenues).

Recreation and Other Sectors

In general, we consider other sectors unchanged, similar to the status quo scenario for agriculture. With island flooding, we do assume direct losses in non-farm jobs. (The salinity and habitat analyses assume only losses of agricultural land). We also consider how increases in water-based recreation could affect the overall Delta economy.

Non-Farm Losses with Flooded Islands

In the scenarios examining costs of flooded islands, we assume that all farm and non-farm jobs on the islands will disappear rather than relocate to other locations within the Delta. To calculate the non-farm losses, we subtract our 2006 estimates of non-farm employment in the primary/no repair zone from the IMPLAN model of the Delta economy.

Increases in Water-Based Recreation

We use the IMPLAN model to examine the potential role of water-based recreation (boating and fishing) to offset economic losses from habitat expansion and island flooding. We estimate the overall size of water-

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Bypass we used DWR's preliminary Yolo County survey for 2008.) This agricultural sector is somewhat larger than the IMPLAN default values, with 21 percent higher revenues, 18 percent higher value added, and 31 percent more jobs. It has a higher share of fruits and nuts in total crop revenues (57% versus 47%), a lower share of vegetables (16% versus 38%), and a higher share of grains (9% versus 3%) and other crops (19% versus 12%).

based recreation within the legal Delta using estimates of employment and revenues in marinas and related sectors (food and lodging and retail supplies).[8] In 2006, water-based recreation in the Delta directly accounted for 2,566 jobs, $177 million in revenues, and $106 million in value added.[9] Thus, the sector was about one-third as large as agriculture in terms of revenues and value added, and it accounted for slightly over half as many jobs (see Table 5 of main report).

Other Changes in the Delta Economy

The non-farm sector is likely to continue to grow both absolutely and as a share of total employment and value added in the overall Delta economy. Some other activities also could grow along with the changes examined here, such as additional nature-based recreation activities in new habitat areas. Therefore, our assumption that other sectors remain constant likely exaggerates the loss of economic activity from the physical changes examined here.

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[8] We use detailed estimates of employment in marinas in the legal Delta (NAICS sector 713390, adjusted to include marinas that were classified in other categories in the NETS) and obtained revenues for this sector using the average revenues/employee from IMPLAN. Related sector contributions are based on visitor expenditure estimates in Goldman et al. (1998). We assume that on average, for every one dollar spent on marinas, $1.34 was spent on lodging, $1.23 on food at restaurants and bars, and $1.54 on retail supplies in 2006.
[9] With multiplier effects, the totals come to 3,230 jobs, $261 million in revenues, and $156 million in value added.

Appendix E: Delta Agricultural Production Model Update

The Delta Agricultural Production (DAP) model has been employed in the past to estimate the economic effects of water salinity on agricultural production in the Delta (Lund et al., 2007, Appendix D). DAP estimates the crop mix that maximizes total net revenues on land areas within the Delta, taking into account production costs, crop prices, crop yields, water use, and water salinity. For this study, we have updated the DAP model with new land use, salinity cost, crop price, and crop yield information. We use these estimates to examine a "value intensification" scenario of agricultural production in the Delta in 2030 that incorporates changes in market conditions and yield improvements since the late 2000s (see main report and Appendix D). We then subject this 2030 baseline to a series of changes in Delta land and water conditions, including land losses from permanent island flooding and habitat conversions and salinity changes associated with sea level rise, the introduction of dual conveyance, and the permanent flooding of five islands in the western Delta. We use the estimates of revenue losses from these changes to estimate direct and total losses in employment, revenues, and value added using IMPLAN models for the Delta zip code region and Delta counties, as described in Appendix D.

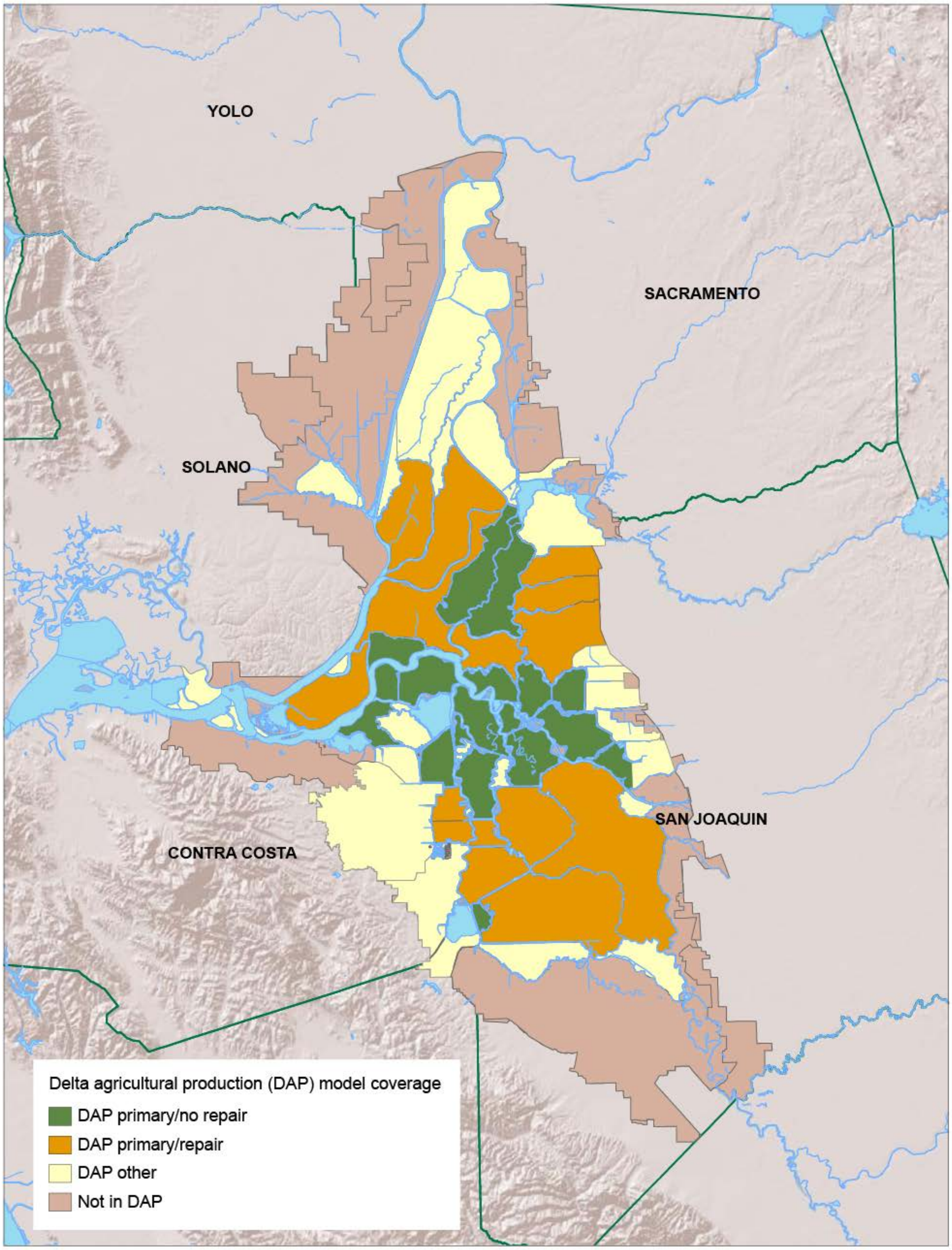
This appendix describes updates to the DAP model used in this study.

Land Use

This latest version of DAP employs preliminary land use estimates from the Department of Water Resources 2007 field survey of the Delta (See Appendix Table A2). Instead of clustering small agricultural production areas into larger ones as in Lund et al. (2007), this updated version of DAP treats each of 70 different Delta "islands" (including some upland areas such as the Yolo Bypass) as an individual farming unit. Figure E1 displays DAP coverage and highlights the zones used for the analysis of costs associated with lands lost to permanent island flooding (the "primary/no repair" zone —see discussion in the main report). In all, DAP covers 418,623 acres and 262,585 crop acres within the Delta, or 57 and 53 percent of all Delta lands, respectively.[10]

[10] For the areas not covered in DAP within the rest of the Delta zip code area and Delta counties used for the analysis using IMPLAN, the resulting percentage changes in revenues from each water quality scenario were applied to the base crop scenario by crop group (fruits and nuts, vegetables and other truck farming (including nursery), grains, and other crops.

FIGURE E1
DAP coverage within the Legal Delta



Crop Prices, Yields, and Production Costs

Crops recorded in DWR's 2007 Delta field survey were aggregated into 20 crop groups used in the Statewide Agricultural Production Model (SWAP). SWAP estimates the crop mix that maximizes total net revenues on land areas within California's main agricultural regions, taking into account production costs, crop prices, crop yields, and water use. For this application to the Delta, we used baseline water use, production costs, crop prices, and yield information for these crop groups for the CVPM region 9 in SWAP (http://swap.ucdavis.edu). As described below, DAP also considers the effects of salinity on production decisions.

SWAP crop production budgets are regularly updated using UC Davis cost studies (http://coststudies.ucdavis.edu/). The SWAP crop prices and yields and resulting revenues per acre for the baseline period (2005-2008 average) are from a recent analysis by CH2MHill, which used USDA-NASS County Agricultural Commissioners' reports, adjusted in some cases to ensure profitability (Table E1). (Thus, irrigated pasture, which has very low revenues per acre in the Commissioners' reports—around $125—is assigned a higher value here—nearly $600). Whereas land use and applied water in SWAP can be represented at a very fine scale, production costs for each of the 20 DWR crop groups are compiled at a regional scale. SWAP applications for California include water markets (Howitt et al., 2009b), soil salinity in the Central Valley (Howitt et al., 2009b; Medellín-Azuara et al., 2008), climate change (Medellín-Azuara et al., forthcoming), and regional economic impacts of water shortages in the Central Valley (Howitt et al., 2009a).

DAP projections for 2030 include yield increases and long-term shifts in crop prices relative to baseline conditions in 2005–08. Technology projections were obtained from Brunke et al. (2005) and crop price estimates from Medellin-Azuara et al. (forthcoming). It was assumed that California is likely to keep its market share of specialty crops (fruits, nuts, and vegetables) and that prices of commodities such as rice and corn will depend on world trends. Therefore, endogenous demand (and price) for California specialty crops by 2030 are influenced mostly by projections of population and income; whereas world agricultural commodities are influenced by expected world demand trends, for which California is a price taker.

Table E1 presents a comparison of baseline revenues per acre in 2005–08 and in 2030 in the Delta, taking into account farmers' responses to prices, yields, and baseline salinity conditions. As a result of yield and price changes, some crops maintain about the same irrigated land area (e.g., alfalfa and corn). Most vegetable and fruit crops (fruit orchards, tomatoes, other vegetables, sugar beet, and vine crops) experience a slight increase (1% to 7%) in irrigated area. Lastly, almonds and pistachios, some grains, some field crops, irrigated pasture, and rice and subtropical crop groups face reductions ranging from 2 to 10 percent.

TABLE E1
Revenues per acre in 2005–08 and 2030 with technological improvement and crop demand shifts ($2008)

Crop group	2005–08	2030	Increase (%)
Perennial fruits and nuts			
Almond and pistachio	5,054	5,533	9
Other deciduous	4,401	5,084	16
Subtropical	5,983	6,825	14
Vine	4,632	5,479	18
Vegetables and other truck farming			
Tomato*	1,940	2,668	38
Other truck	4,120	6,234	51
Field crops and pasture			
Alfalfa	1,004	1,207	20
Corn	853	1,242	46
Grain	464	470	1
Irrigated pasture	597	691	16
Non-irrigated grain and pasture	464	470	1
Other field crops	1,000	1,135	13
Rice	1,333	1,486	11
Sugar beet	1,891	2,043	8

SOURCE: Author estimates using SWAP (see text).

*According to the DWR field survey for 2007, almost all tomatoes in the Delta are processing tomatoes.

Crop Response to Salinity

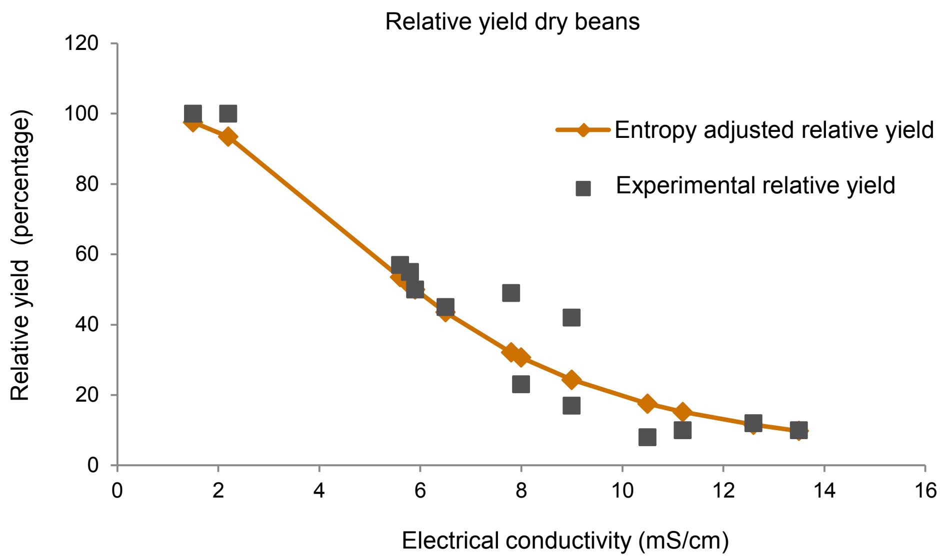
The salinity response module of DAP was updated for this study to incorporate recent salinity response estimates for crops in the southern Delta (Hoffman, 2010). As before (Lund et al., 2007), it was assumed that soil salinity in the root zone was the same as salinity of the water used for irrigation.

Salinity response in DAP is based on the Van Genuchten and Hoffman (1985) inverse sigmoid yield response function as described in Lund et al. (2007). The effect of salinity on agricultural production represented by the relative yield reduction $yred_{gj}$, for crop i in region g, is given by:

$$Yr_{gi} = \frac{1}{1 + (\frac{C_g}{C_{50i}})^{\rho}}$$

In this formulation, C_g is the root zone salinity in region g and C_{50i} is the root zone salinity at which the yield of crop i is reduced by half. Figure E2 shows the relative yield as a function of salt concentration in the root zone for different parameter values. The difference between groundwater and root zone salinity is modeled by the assumption that the yield effect of shallow saline water is half that of equivalent root zone levels.

FIGURE E2
Comparison of empirical data on relative yield response to electrical conductivity for dry beans and the entropy calibrated yield response model



SOURCE: Authors' calculations using experimental data compiled by Hoffman (2010).

In this version of DAP, we have recalibrated the value of the rho parameter using a compilation of studies by Hoffman (2010) for crops in the southern Delta. In this most recent work, Hoffman finds that southern Delta farmers should be able to adapt to salinity conditions. He observed that over time in the Delta, more salt-sensitive crops (see below) have displaced salt-tolerant crops such as sugar beets and some field crops. This suggests that responses to salinity are less severe than was earlier thought. As in Hoffman's study, we assume that irrigation efficiency in the Delta is 85 percent, with a 15 percent leaching fraction.

We applied a maximum entropy estimation to obtain a probability distribution and the expected value of the rho parameter in the non-linear response function shown in Lund et al. (2007). With respect to the entropy-estimated rho parameter, we grouped the Delta crops into moderately sensitive and sensitive to salinity in the root zone. The sensitive group includes dry beans, almonds and pistachios, some vegetables, and subtropical fruits. The moderately sensitive group includes alfalfa, cucurbits, pasture, tomatoes, and vine crops. For the rest of the DAP crop groups (grain, other field, potato, rice, safflower, sugar beet, and cotton) we employed parameter information for the relative yield equation above from Lund et al. (2007).

To assign irrigation water salinity for each island and water quality scenario we located the two closest sampling locations (Appendix Figure C1 shows the islands and sampling stations) and then selected the sampling station with the highest monthly average salinity during the irrigation season. We explored salinity conditions within a relatively long irrigation season (April to September), which likely overstates average salinity conditions most farmers face when irrigating their crops, because salinity tends to be highest in the late summer and fall, when most irrigation is finished except for pasture and hay crops.

Unlike the estimates in Lund et al. (2007), in which irrigation water salinity increases were set up as ten- and twenty-fold multiples of baseline salinity, we employed hydrodynamic modeling results reported in Fleenor et al. (2008) to estimate salinity changes from dual conveyance, sea level rise, and the permanent flooding of western islands serving as a salinity barrier. Appendix Tables C1 and C2 provide baseline salinity conditions and projected changes in salinity for each island, and Figures 9 and 10 in the main report display average salinity levels within each of five Delta sub-regions. These projected salinity increases are substantially lower than the increases used in Lund et al. (2007). In most scenarios and most locations within the Delta, salinity during the irrigation season is projected to increase by less than 20 percent. In the most extreme cases (three-feet sea level rise), salinity doubles in some parts of the Delta.

In general, higher salinity reduces the relative yield of crops in the Delta. However, a large enough change to cause significant yield losses throughout the Delta is unlikely even under the worst-case conditions modeled here (three feet of sea level rise). In most cases, relative yields remain at levels between 85 and 99 percent of baseline conditions. These results assume that there is no long-term salinity accumulation in Delta soils, because Delta farmers are able to drain their soils to avoid long-term salinity build-up. This is in contrast to closed basins such as the Tulare Basin, where imported salinity accumulates because it cannot be exported (Medellín-Azuara et al., 2008). Crop farming revenue losses might be higher if such accumulation occurs. Also, as discussed in the main report, additional hydrodynamic modeling is needed to examine the projected effects of different operational changes on Delta salinity and to further explore the effects of island flooding under different hydrologic conditions.

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