

Appendix C. Details of Generating Mass Loading Inputs for Areas Without Pre-Existing WARMF Model Runs.

In the workplan, it was determined that for areas beyond the range of those represented by existing WARMF model runs, salt and nitrate loading inputs to the mixing model would be developed based on results for selected groups of catchments within WARMF domains. The purpose of this appendix is to present some of the detailed information underlying this data development step.

The process of loading data development for non-WARMF areas is illustrated in Figure 1. Land cover acreage distribution (as characterized by DWR for overlapping detailed analysis units [DAUs] for the 1998-2001 period; see Appendix A for land cover class correspondences) was compared to select analogous WARMF model catchments for each non-WARMF area. Once an analogous group of catchments were selected, each catchment was weighted by the percentage falling into the selected set of DAUs. The acreage for each land cover class, loads of each constituent by land cover class, and loads of each constituent by WARMF model time step were provided for each WARMF catchment.

The land cover comparisons based on DWR data for DAUs are shown in Figures 2 through 5. These land cover data were particularly suited to this task because they are relatively simple to analyze, contain many of the major irrigated land cover classes, and pertain to DAUs which, while smaller than IAZs, collect groups of WARMF catchments. The DAU data do not, however, capture non-irrigated land cover, dairies, dairy land application, or other CAFOs. Therefore, land cover data furnished by the RWQCB for the Dairy General Order were employed to characterize and quantify the extent of dairy land application fields in each DAU.

Comparable groups of catchments were initially identified based on land cover patterns. In some cases (IAZ's 15 through 17, 20, and 21), areas of the San Joaquin Model were initially identified, but later replaced with the Tule River Model results because they appeared to better represent these areas. In all cases, the same DAU and dairy land cover class proportions were used.

For each catchment, land cover acreage distribution (as characterized in WARMF) was provided, along with constituent loading by land cover class, and by time-step. Land cover class acreages and constituent loading outputs for the set of DAUs were summed after weighting with the factors based on the comparisons of DAU data. These sums were then adjusted to account for differences in loading of solid materials (related to differences in land cover class acreages). Further corrections were made to account for estimated differences in loads from applied water and relatively large, permitted land application systems. The algebraic steps for these adjustments were as follows:

L = Load (kg/day)

A = Area (acres)

B = Basis DAUs (in WARMF domain)

P = Preliminary, before normalization to IAZ area

I = After normalization to IAZ area

n = a particular crop class

$LB_n/AB_n = LP_n/AP_n = L_n/I_n$

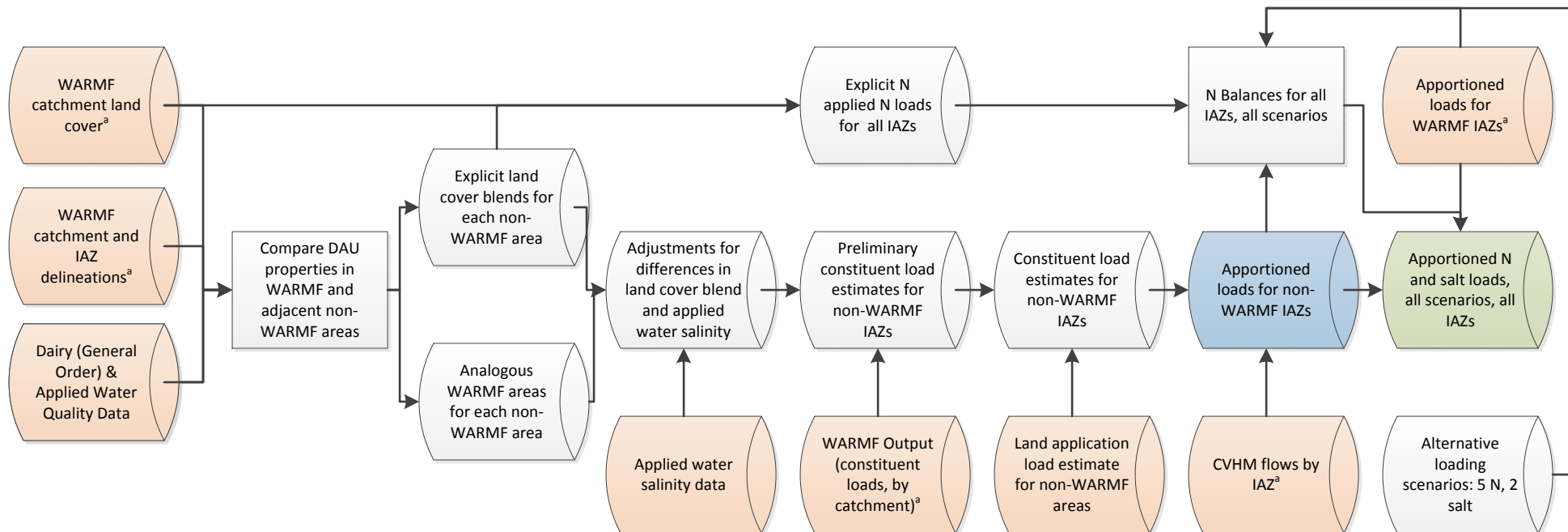
1. A factor (AP_n/AB_n) and ratio derived from study of land cover in DAU's
2. Acres (AB_n), areas in the basis catchments for each land cover class. From WARMF.
3. Acres*Factor * $AP_n = AB_n * AP_n/AB_n = AP_n$, preliminary acreage by land cover class, before normalization to IAZ acreage total
4. $Sum(AI)/sum(AP) = AI_n/AP_n$; $AI_n = sum(AI)/sum(AP) * AP_n$, the acreage of each land cover class in the IAZ
5. Load coming from each land cover class in the basis group of catchments (LB_n). From WARMF.
6. Preliminary load coming from each land cover class in the IAZ ($LP_n = LB_n/AB_n * AP_n$)

7. Load coming from each land cover class in the IAZ ($L_{in} = LP_n/AP_n * A_{in}$); For salt & chloride only: $L_{in} * AW$ quality factor (see [8]) = adjusted L_{in} (final for these land cover classes).
8. Applied water quality adjustment (factor * L_{in} = adjusted L_{in}). Based on the ratio of applied water concentration according to available data, which is 1 if no data are available.

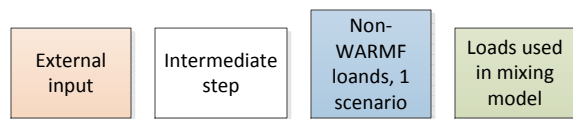
Loads were partitioned among subsurface and surface return flows based on flow partitioning in CVHM.

Land application loads are presented in Table 1. These were added to quarterly loads calculated by the previous method for each non-WARMF IAZ. The first page of the table shows loads derived from permits held for land application systems in the IAZs. The second page shows demographic data for Fresno (the largest system, and used to scale all loads over the model time period), along with the scaling factors, by time step. The loads were thus slightly lower than on the first page of Table 1 during the first half of the modeled period, and increased gradually and slightly beyond that date. The total load is equivalent to what would have occurred under a constant loading scenario. The third page of Table 1 shows how the same data were employed to derive loads to the specific areas of land application ponds in the Kings River Subregion for Task 7 (spatially detailed) loading analysis.

In non-WARMF areas, a piece of the water quality info that would help to reduce uncertainty regarding salt loading is applied water quality. Agricultural land users use surface water and/or groundwater to irrigate their crops. Irrigation districts in the Central Valley are relatively knowledgeable regarding applied surface and groundwater proportions and quality data for water applied to fields within their district boundaries. This information would be especially helpful for areas not covered by WARMF. A request was made to CV-SALTS agricultural stakeholders and coalitions to attain this information for inclusion in the GIS Task 5 data compilation, but the data were not available upon completion of that task. If the data are obtained in the future, they would help to reduce salt balance modeling uncertainty.



^aThese data came from pre-existing model runs, but were obtained from ICM Team members focusing on these models. In the case of WARMF runs, pre-existing runs were modified slightly when the models were re-run with updated fertilization rates derived from recent literature.



Element color key:

Figure 1. Schematic of process employed to develop ICM mixing model loading inputs.

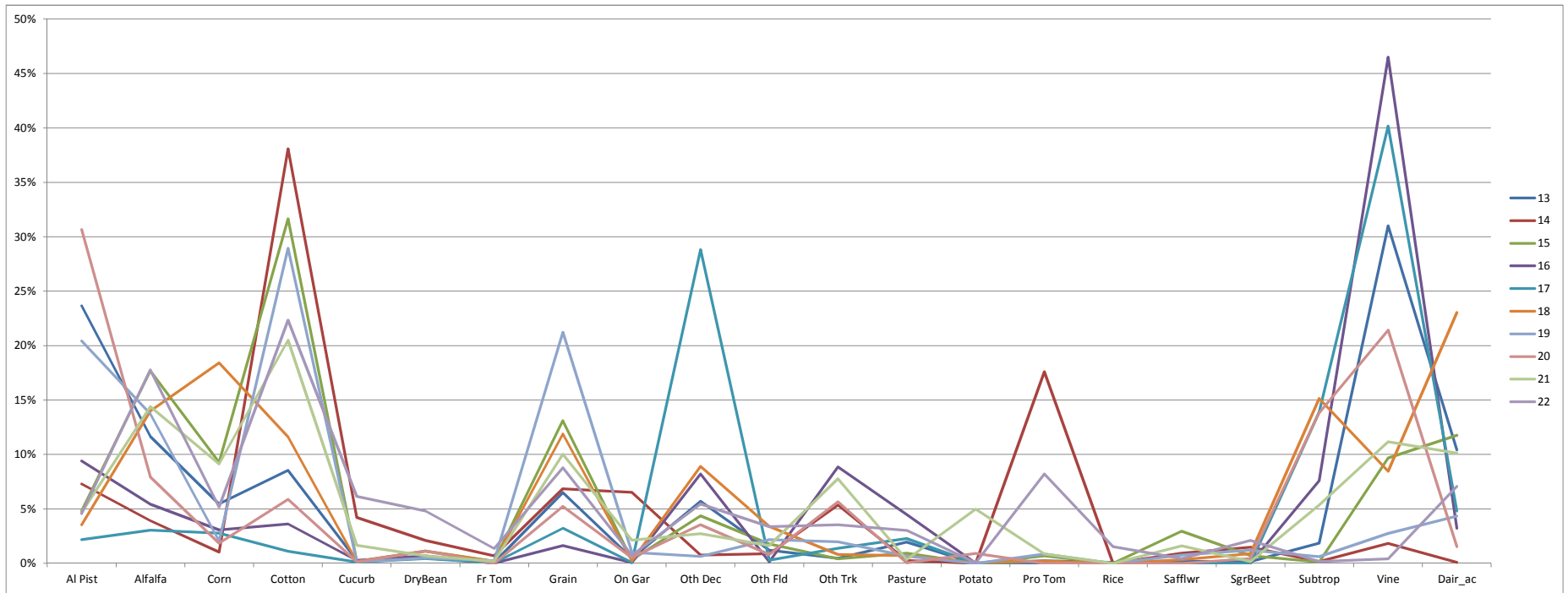


Figure 2. DAU and dairy land cover for IAZs.

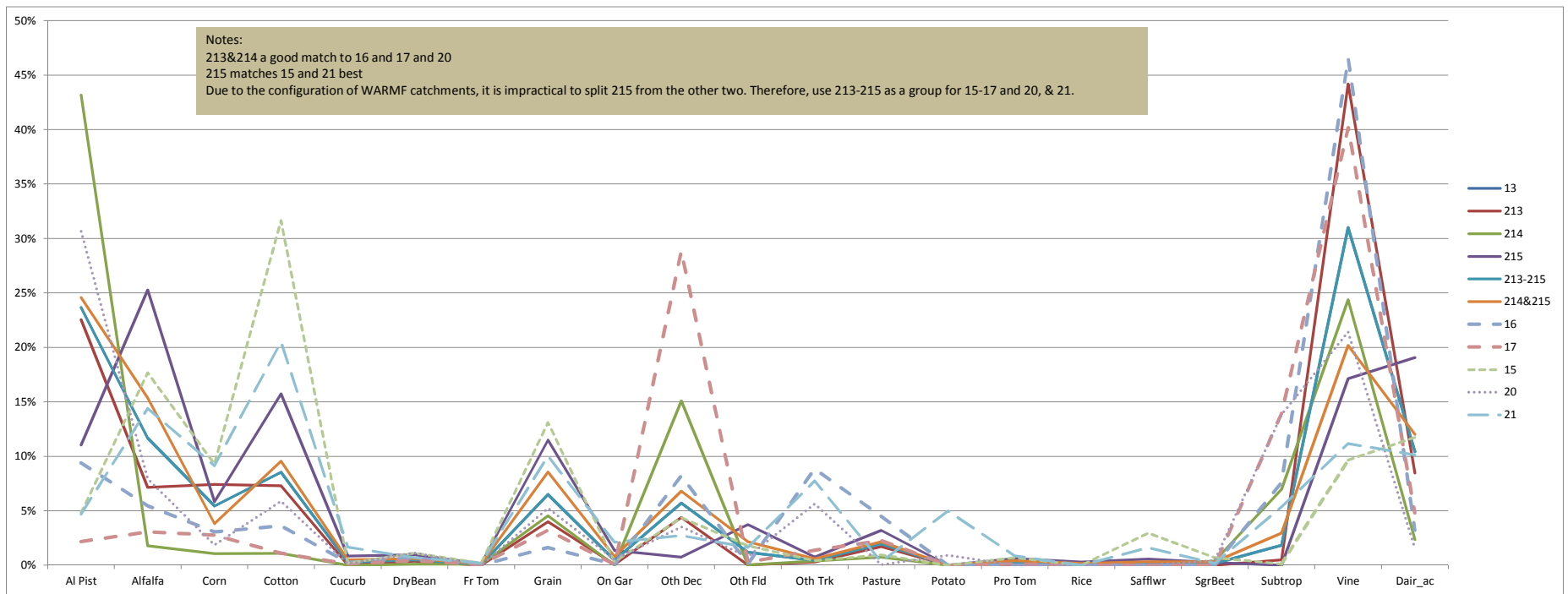


Figure 3. DAU and dairy land cover for IAZs and selected DAUs.

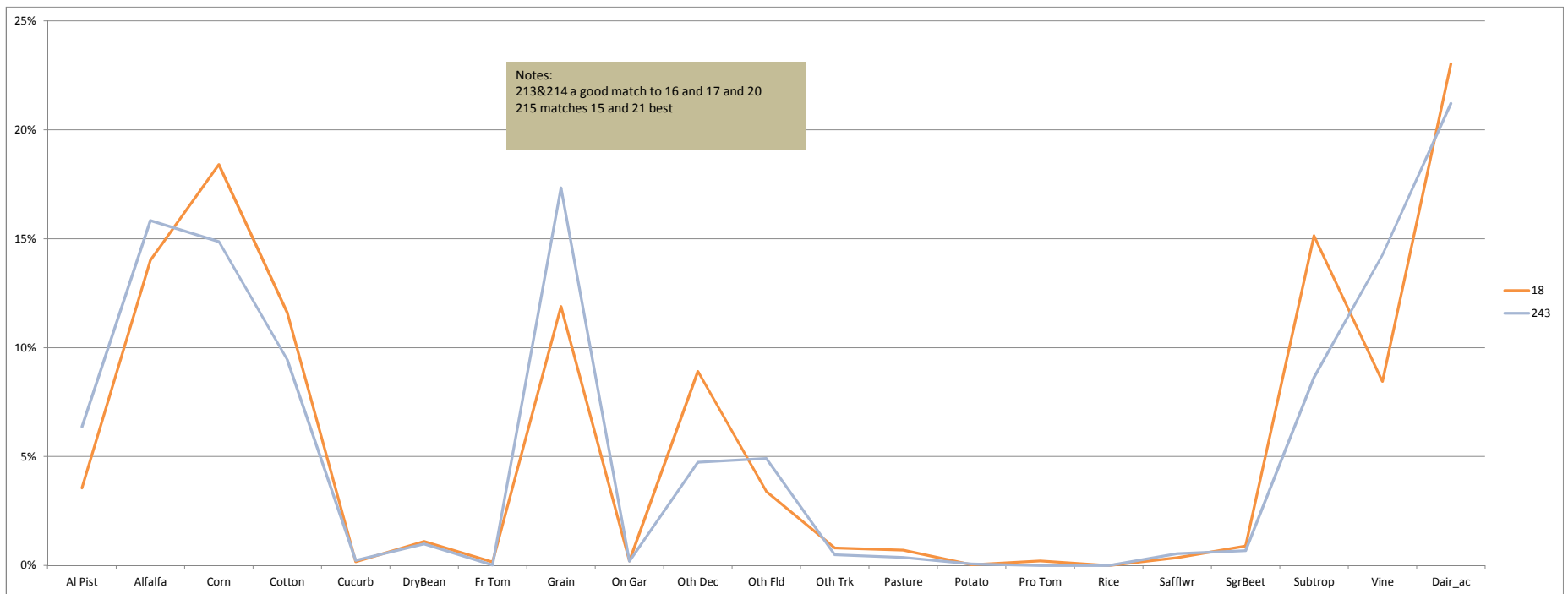


Figure 4. DAU and dairy land cover for IAZ 18 and DAU 243.

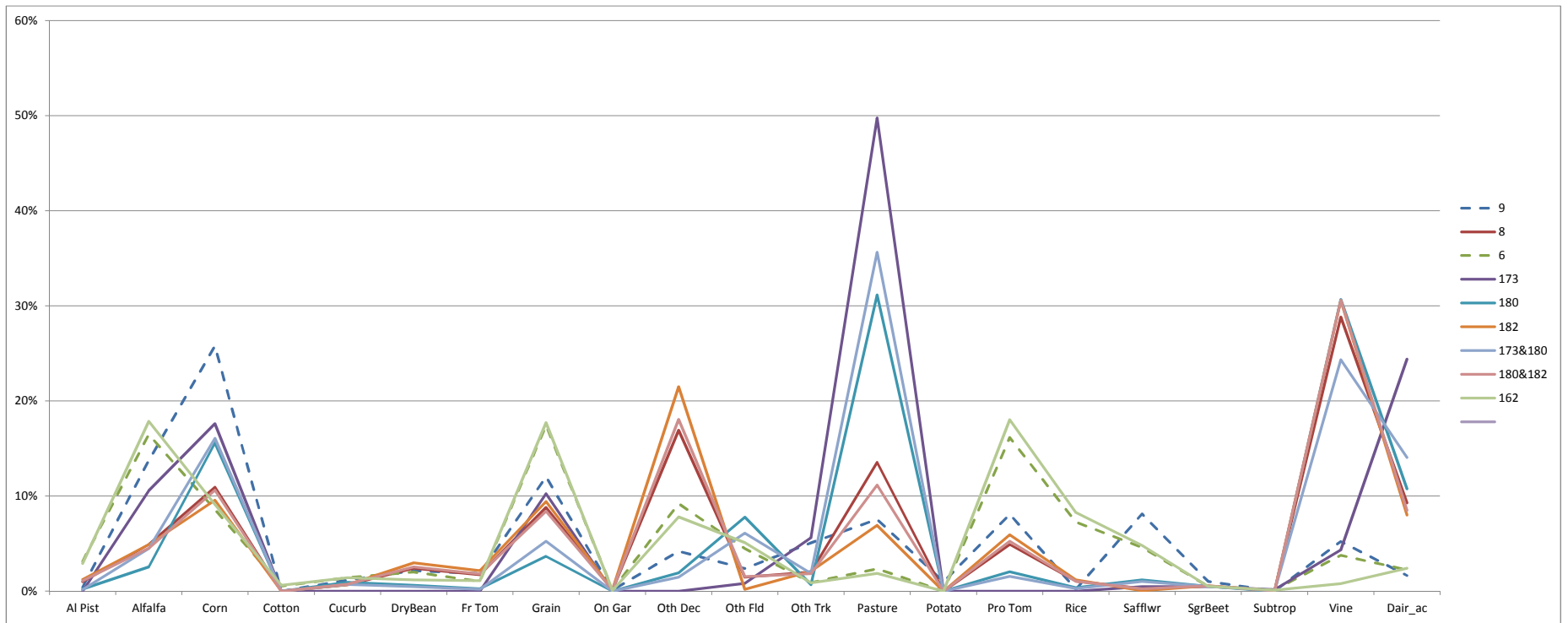


Figure 5. DAU and dairy land cover for Sacramento Valley IAZs and selected DAUs.

Table 1. Land application load calculation for non-WARMF areas.

Quarters:	80	Demographic data								
Quarter	Date	Proportion of mean load	Rate of growth	Year	Fresno Population	Multiplier	Result Pop	Difference	Daily Rate of growth	
1	10/1/1983	0.748		6/1/1980	515,000	1.00	515,000			
2	1/1/1984	0.753	0.007%	6/1/1990	667,000	1.30	667,000	0	0.007%	
3	4/1/1984	0.758	0.007%	6/1/2000	922,516	1.79	922,516	0	0.009%	
4	7/1/1984	0.762	0.007%							
5	10/1/1984	0.767	0.007%							
6	1/1/1985	0.773	0.007%							
7	4/1/1985	0.777	0.007%							
8	7/1/1985	0.782	0.007%							
9	10/1/1985	0.788	0.007%							
10	1/1/1986	0.793	0.007%							
11	4/1/1986	0.798	0.007%							
12	7/1/1986	0.803	0.007%							
13	10/1/1986	0.808	0.007%							
14	1/1/1987	0.813	0.007%							
15	4/1/1987	0.819	0.007%							
16	7/1/1987	0.824	0.007%							
17	10/1/1987	0.829	0.007%							
18	1/1/1988	0.835	0.007%							
19	4/1/1988	0.840	0.007%							
20	7/1/1988	0.846	0.007%							
21	10/1/1988	0.851	0.007%							
22	1/1/1989	0.857	0.007%							
23	4/1/1989	0.862	0.007%							
24	7/1/1989	0.868	0.007%							
25	10/1/1989	0.873	0.007%							
26	1/1/1990	0.879	0.007%							
27	4/1/1990	0.885	0.007%							
28	7/1/1990	0.890	0.007%							
29	10/1/1990	0.896	0.007%							
30	1/1/1991	0.902	0.007%							
31	4/1/1991	0.908	0.007%							
32	7/1/1991	0.914	0.007%							
33	10/1/1991	0.920	0.007%							
34	1/1/1992	0.926	0.007%							
35	4/1/1992	0.932	0.007%							
36	7/1/1992	0.938	0.007%							
37	10/1/1992	0.945	0.009%							
38	1/1/1993	0.953	0.009%							
39	4/1/1993	0.961	0.009%							
40	7/1/1993	0.969	0.009%							
41	10/1/1993	0.977	0.009%							
42	1/1/1994	0.985	0.009%							
43	4/1/1994	0.993	0.009%							
44	7/1/1994	1.001	0.009%							
45	10/1/1994	1.009	0.009%							
46	1/1/1995	1.017	0.009%							
47	4/1/1995	1.025	0.009%							
48	7/1/1995	1.034	0.009%							
49	10/1/1995	1.042	0.009%							
50	1/1/1996	1.051	0.009%							
51	4/1/1996	1.059	0.009%							
52	7/1/1996	1.068	0.009%							
53	10/1/1996	1.076	0.009%							
54	1/1/1997	1.085	0.009%							
55	4/1/1997	1.094	0.009%							
56	7/1/1997	1.103	0.009%							
57	10/1/1997	1.112	0.009%							
58	1/1/1998	1.121	0.009%							
59	4/1/1998	1.130	0.009%							
60	7/1/1998	1.139	0.009%							
61	10/1/1998	1.149	0.009%							
62	1/1/1999	1.158	0.009%							
63	4/1/1999	1.167	0.009%							
64	7/1/1999	1.177	0.009%							
65	10/1/1999	1.186	0.009%							
66	1/1/2000	1.196	0.009%							
67	4/1/2000	1.206	0.009%							
68	7/1/2000	1.216	0.009%							
69	10/1/2000	1.226	0.009%							
70	1/1/2001	1.236	0.009%							
71	4/1/2001	1.245	0.009%							
72	7/1/2001	1.256	0.009%							
73	10/1/2001	1.266	0.009%							
74	1/1/2002	1.276	0.009%							
75	4/1/2002	1.286	0.009%							
76	7/1/2002	1.297	0.009%							
77	10/1/2002	1.308	0.009%							
78	1/1/2003	1.318	0.009%							
79	4/1/2003	1.329	0.009%							
80	7/1/2003	1.340	0.009%							

Table 1. Land application load calculation for non-WARMF areas.				
Date	16 Total area:		2167 (Fresno only, for Task 7)	
	kg	TDS	kg/a	TDS
10/1/1983	191,928	8,206,575	89	3787
1/1/1984	193,182	8,260,216	89	3812
4/1/1984	194,431	8,313,620	90	3836
7/1/1984	195,688	8,367,369	90	3861
10/1/1984	196,968	8,422,061	91	3887
1/1/1985	198,255	8,477,111	91	3912
4/1/1985	199,523	8,531,313	92	3937
7/1/1985	200,813	8,586,469	93	3962
10/1/1985	202,125	8,642,594	93	3988
1/1/1986	203,446	8,699,086	94	4014
4/1/1986	204,747	8,754,706	94	4040
7/1/1986	206,071	8,811,307	95	4066
10/1/1986	207,418	8,868,901	96	4093
1/1/1987	208,774	8,926,872	96	4119
4/1/1987	210,108	8,983,949	97	4146
7/1/1987	211,467	9,042,032	98	4173
10/1/1987	212,849	9,101,134	98	4200
1/1/1988	214,240	9,160,623	99	4227
4/1/1988	215,625	9,219,848	100	4255
7/1/1988	217,020	9,279,456	100	4282
10/1/1988	218,438	9,340,110	101	4310
1/1/1989	219,866	9,401,161	101	4338
4/1/1989	221,272	9,461,271	102	4366
7/1/1989	222,702	9,522,439	103	4394
10/1/1989	224,158	9,584,682	103	4423
1/1/1990	225,623	9,647,331	104	4452
4/1/1990	227,066	9,709,015	105	4480
7/1/1990	228,534	9,771,785	105	4509
10/1/1990	230,027	9,835,658	106	4539
1/1/1991	231,531	9,899,948	107	4569
4/1/1991	233,011	9,963,247	108	4598
7/1/1991	234,518	10,027,661	108	4627
10/1/1991	236,051	10,093,206	109	4658
1/1/1992	237,594	10,159,179	110	4688
4/1/1992	239,130	10,224,860	110	4718
7/1/1992	240,676	10,290,965	111	4749
10/1/1992	242,650	10,375,363	112	4788
1/1/1993	244,640	10,460,454	113	4827
4/1/1993	246,602	10,544,371	114	4866
7/1/1993	248,603	10,629,904	115	4905
10/1/1993	250,641	10,717,082	116	4946
1/1/1994	252,697	10,804,975	117	4986
4/1/1994	254,724	10,891,656	118	5026
7/1/1994	256,790	10,980,006	119	5067
10/1/1994	258,896	11,070,055	119	5108
1/1/1995	261,020	11,160,844	120	5150
4/1/1995	263,114	11,250,379	121	5192
7/1/1995	265,248	11,341,639	122	5234
10/1/1995	267,423	11,434,654	123	5277
1/1/1996	269,617	11,528,433	124	5320
4/1/1996	271,804	11,621,948	125	5363
7/1/1996	274,008	11,716,222	126	5407
10/1/1996	276,256	11,812,310	127	5451
1/1/1997	278,521	11,909,186	129	5496
4/1/1997	280,756	12,004,724	130	5540
7/1/1997	283,033	12,102,103	131	5585
10/1/1997	285,354	12,201,355	132	5631
1/1/1998	287,695	12,301,422	133	5677
4/1/1998	290,002	12,400,107	134	5722
7/1/1998	292,355	12,500,693	135	5769
10/1/1998	294,753	12,603,214	136	5816
1/1/1999	297,170	12,706,576	137	5864
4/1/1999	299,554	12,808,511	138	5911
7/1/1999	301,984	12,912,411	139	5959
10/1/1999	304,460	13,018,308	140	6008
1/1/2000	306,957	13,125,075	142	6057
4/1/2000	309,447	13,231,542	143	6106
7/1/2000	311,958	13,338,873	144	6155
10/1/2000	314,516	13,448,268	145	6206
1/1/2001	317,095	13,558,560	146	6257
4/1/2001	319,639	13,667,330	148	6307
7/1/2001	322,232	13,778,196	149	6358
10/1/2001	324,875	13,891,195	150	6410
1/1/2002	327,539	14,005,120	151	6463
4/1/2002	330,167	14,117,472	152	6515
7/1/2002	332,845	14,231,989	154	6568
10/1/2002	335,575	14,348,709	155	6621
1/1/2003	338,327	14,466,386	156	6676
4/1/2003	341,041	14,582,439	157	6729
7/1/2003	343,807	14,700,728	159	6784