Department of Pesticide Regulation

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M E M O R A N D U M

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DATE: March 11, 2013

SUBJECT: STUDY 182/228- SUMMARY OF WELL NETWORK SAMPLING RESULTS FROM 1999 THROUGH 2012

SCOPE OF THE MEMORANDUM

This memorandum summarizes results of a monitoring program that documents pesticide concentrations in domestic wells located in the San Joaquin Valley of California. The wells were sampled annually from 1999 through 2012. Included here are the results of each annual sampling with respect to number of wells sampled, the number of wells with detections of residues, and the mean concentration of detected residues. A subsequent report will present in depth statistical analysis and discussion of measured trends.

BACKGROUND

In 1982, the Department of Pesticide Regulation (DPR) reported the first incidence of simazine in groundwater in California (Weaver et al., 1983). In 1983, DPR found simazine in soil to a depth of 28 feet at concentrations of 2 to 55ug/L (ppb) (Zalkin et al., 1984). In 1985, California Assembly Bill AB2021, called the Pesticide Contamination Prevention Act, was passed in an attempt to prevent further contamination of California groundwater by pesticides (Food and Agriculture Code, section 13141-13152). DPR first developed regulations for use of pesticides detected in groundwater in the late 1980's. Use was regulated in areas denoted as Pesticide Management Zones (PMZs), which were sections of land where pesticide residues were detected in well water.

The groundwater regulations were revised in May of 2004. The revisions expanded the definition of a vulnerable area to include all the former existing and draft Pesticide Management Zones as well as sections of land with no reported detections but with soil types and depths-to-ground water that are characteristic of contaminated areas. The term Pesticide Management Zone was dropped and replaced by the term Groundwater Protection Area (GWPA). GWPAs are designated as either leaching or runoff based on the pathway of pesticide movement to ground water. Property operators are required to obtain a permit from the County

Agricultural Commissioner before they may use a regulated pesticide in a GWPA. The permit specifies the pesticide use modifications, tailored to the specific vulnerability of the intended treatment site.

To support the ground water regulatory program, DPR conducted a study in 1997 (Spurlock et al., 2000) using chlorofluorocarbon tracers in well water in Fresno and Tulare counties to estimate the amount of time it took for an herbicide to reach groundwater from the time it was applied to the soil. More than half of the detections in the study were determined to have been from applications that occurred seven to nine years previously. In 1999, anticipating the 2004 regulations, this monitoring well network was developed as a means to measure the impact of these and previous groundwater protection regulations. Based on the chlorofluorocarbon dating results, sampling will continue for many years, possibly decades, to ensure enough data to relate regulatory actions to observed trends in detection frequencies and concentrations.

MATERIALS AND METHODS

A protocol was written for this study in 1999 (Garretson, 1999) and wells were chosen that had been sampled previously by DPR and that were found to have positive detections for simazine, bromacil, or diuron (Troiano and Segawa, 1987). DPR's Ground Water Protection Program obtains samples primarily from domestic wells because they are more susceptible to contamination than municipal wells due to their location in agricultural areas and because they generally draw water from shallower aquifers. The wells in this study are located in Tulare and Fresno Counties in areas that have been identified as being susceptible to the movement of pesticides to groundwater based on soil type and average depth to ground water (Teso et al., 1988; Troiano et al., 1998). Sections of land determined to be the most susceptible are those containing coarse soils because pesticides may leach to groundwater, and those containing a hardpan layer because pesticides may move off site in runoff water to areas or structures that provide fast movement to groundwater. Permission to sample each well was obtained from 75 well owners: 33 in Fresno County coarse soil sections, 18 in Fresno County hardpan, 3 in Tulare County coarse soil sections, and 21 in Tulare County hardpan soil sections.

Sampling began in the fall of 1999 following procedures in DPR SOP FSWA001.00 (Nordmark and Herrig, 2011). A chain of custody record was completed and accompanied each sample. Collection and transport of samples followed DPR SOP QAQC004.01 (Jones, 1999). The California Department of Food and Agriculture, Center for Analytical Chemistry analyzed all samples according to analytical method EMON-SM-62.9 (CDFA, 2009), Determination of

Atrazine, Bromacil, Cyanazine, Diuron, Hexazinone, Metribuzin, Norflurazon, Prometon, Prometryn, Simazine, Deethyl Atrazine (DEA), Deisopropyl Atrazine (ACET), and Diamino Chlorotraizine (DACT) in Well Water and River Water By Liquid Chromatography-Atmospheric Pressure Chemical Ionization Mass Spectrometry. The reporting limit for each

analyte is 0.05ug/L. Over time, the method was streamlined to exclude chemicals that were not detected and that had little to no use in the sampled areas or to include new chemicals of concern. These changes are documented in the Results section. Quality control samples were collected in accordance with the well water study procedures described in DPR SOP QAQC001.00 with the following deviation (Segawa, 1995). The SOP requires study staff to collect one field blank sample per well and to have that sample analyzed for each positive well sample. As this is an ongoing study of wells that have been sampled and shown to be positive for one or more of the target analytes, field blank samples are analyzed for approximately 10% of the study wells at each sampling interval. No field blanks have had a positive result during the course of the study.

RESULTS

Table 1 presents a chart depicting which chemicals were analyzed in each sampling interval.

Yearly Summary of Number of Wells Sampled and Pesticide Residues Monitored:

1999

- Fall–75 wells were sampled in August and September.
  The samples were analyzed for: atrazine, simazine, diuron, bromacil, prometon, prometryn, hexazinone, cyanazine, metribuzin, norflurazon, deethyl atrazine (DEA) (a metabolite of atrazine), 2-amino-4-chlor-6-ethymaino-s-triazine (ACET), and diamino chlorotriazine (DACT) (metabolites of atrazine and simazine).

2000

- Spring–74 wells were sampled in March and April.

- Fall–70 wells were sampled in November and December.

2001

- Spring–71 wells were sampled in March, April and May.
  Nitrate was added at the request of the owners in Spring 2001 and was included in all future sampling.

- Fall–71 wells were sampled in August and September.
  Prometryn, cyanazine and metribuzin were not detected in the four previous samplings so they were excluded from the analysis as of Fall 2001.

2002

- Spring–70 wells were sampled in March, April and May.

Three degradation products of hexazinone (A1-G3453, B-A3928, IN-G3710) were added to the analysis when the laboratory had the capability to include them in the screen. The ratio of a degradation product to its parent compound may be one factor that can help to determine if positive results are due to new pesticide application. None of the hexazinone degradation products were found in the Spring 2002 sampling and they were not included in the analysis for any future sampling.

- Fall–69 wells were sampled in October.

2003

- Spring–72 wells were sampled in April and May.
  The Fall samplings were dropped from the schedule due to personnel and budget limitations. Sampling was initially scheduled for twice a year, once in the Spring and then again in the Fall for each well. The concern was that aquifer levels normally drop between the spring and fall due to pumping for crop irrigations. This drop in water level could have caused variation in concentrations. An analysis of the paired Spring and Fall data indicated that for wells where concentrations remained similar throughout the years, the Spring and Fall concentrations were also similar. For wells where trends were noted the fall concentrations followed the trend line. The conclusion was that a single spring sampling was adequate to track changes and that a long term commitment was the more important factor in measuring potential trends in concentration.

2004

- Spring–68 wells were sampled in May and June.
  Desmethyl norflurazon (DMN), a metabolite of norflurazon, was added to the analysis when the laboratory was able to add it to the screen. It was found in almost half of the wells and was included in all future sampling.

2005

- Spring–68 wells were sampled in May and June.

2006

- Spring–66 wells were sampled in May and June.

2007

- Spring–69 wells were sampled in April and May.

2008

- Spring–68 wells were sampled in March, April and May.

2009

- Spring–68 wells were sampled in March, April and May.
  Tebuthiuron was added to the analysis when the laboratory was able to add it to the screen. There were no detections of tebuthiuron.

2010

- Spring–68 wells were sampled in February, March, and April.
  Four degradation products of tebuthiuron (M-104, M-106, M-107, and M-108) were added to the analysis when the laboratory was able to add them to the screen. No tebuthiuron and none of its' degradates were detected. Oryzalin, an herbicide that has been identified by DPR as a potential groundwater contaminant, was analyzed in twenty-three of the study wells where its use in the sections around the wells was the highest (as determined by pesticide use reports). No oryzalin was detected in any of the samples. Tebuthiuron, its degradation products, and oryzalin were all excluded from future analysis.

2011

- Spring–68 wells were sampled in March and April.

2012

- Spring–68 wells were sampled in March and April.

Summary of Detection Frequencies and Residue Concentrations:

Appendix 1 presents raw sampling results for 2012 for each well. A summary of detection frequency is presented in Table 2 and Figure 1. Table 3 and Figure 2 present the average concentrations detected during each sampling interval. Figure 3 depicts the annual use of the pesticides in the study sections.

- Simazine was present in over 80% of wells at the beginning of the study. In the last several years the detection frequency has declined and in 2012 it was found in less than 60% of wells sampled. The mean concentration has remained around 0.1ug/L.

- Diuron was found in more than half of the wells initially, until the last few years when detection frequency started to decline. It is now found in just over a third of the wells sampled in 2012. Its concentration decreased from 0.35ug/L to 0.10ug/L in 2012.

- ACET and DACT have remained in over 80% of the wells for most of the study. Levels for DACT have varied from 0.7 to 1.1ug/L and from 0.4 to 0.6ug/L for ACET.

- Bromacil was present in almost 40% of the wells originally, and is now down to a quarter of wells sampled in 2012. The mean concentration has decreased from over 1ug/L at the beginning of the study to 0.65ug/L now.

- Norflurazon was present in less than 20% of the wells and is now found in 28% at concentrations of 0.09-0.28ug/L. Its breakdown product, DMN, was found in almost 50% of the wells at levels of 0.22-0.27ug/L.

- Atrazine, prometon and hexazinone were found at a lower frequency, in 5% of wells or less, during the course of the study at levels from 0.05 to 0.12ug/L.

Summary of Pesticide Use Patterns:

Atrazine, bromacil, diuron, hexazinone, norflurazon, prometon, and simazine are pre-emergence herbicides. ACET and DACT are degradation products of atrazine and/or simazine, DEA is a degradation product of atrazine, and DMN is a degradation product of norflurazon. Figure 3 shows that the annual use of simazine and diuron peaked in the study sections in the 1990's at 17,000lbs and 9,000lbs respectively. By 2010, the pounds used annually declined to 6,000 for simazine and 3,000 for diuron. Norflurazon annual use in the study area peaked at close to 4,000lbs between 1999 to 2002 and by 2010 dropped to near 500lbs. Use of bromacil in the study area has remained relatively stable, at between 500 to 1500lbs annually. Atrazine, hexazinone, and prometon are not included in the table since their use in these sections was negligible (50lbs or less in just 4 or fewer years).

CONCLUSIONS

- Based on frequency alone, detections for several of the regulated pesticide active ingredients, namely simazine, diuron, and bromacil, are decreasing in regulated areas. Average concentrations also show a decline over the 13-year period.

- The decrease in frequency and concentration of the pesticides coincides with enactment of the 1999 and 2004 regulations.

- There was a marked decline in the use of simazine and diuron from 1999 until the present.

Taken together these findings indicate that regulations may have prompted growers to switch to using nonregulated herbicides, or to continue using regulated herbicides while implementing mitigation measures, or both. The study will continue as more information is gathered in an effort to determine the potential contributions of either or both of these actions. In addition DPR

will be researching agricultural practices, including changes in pesticide use, in the areas of the study wells.

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Table 1. Chemicals Analyzed in Each Sampling Interval.

	Fall 1999	Spring 2000	Fall 2000	Spring 2001	Fall 2001	Spring 2002	Fall 2002	Spring 2003	Spring 2004	Spring 2005	Spring 2006	Spring 2007	Spring 2008	Spring 2009	Spring 2010	Spring 2011	Spring 2012
Atrazine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Simazine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Diuron	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Prometon	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bromacil	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hexazinone	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Norflurazon	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DEA[a]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ACET[b]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DACT[c]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Prometryn	x	x	x	x													
Cyanazine	x	x	x	x													
Metribuzin	x	x	x	x													
Hex A1(G3453)[d]						x											
Hex B(A3928)[d]						x											
Hex IN(G3710)[d]						x											
DMN[e]									x	x	x	x	x	x	x	x	x
Tebuthiuron														x	x		
Teb M-104[f]															x		
Teb M-106[f]															x		
Teb M-107[f]															x		
Teb M-108[f]															x		

[a] DEA (deethyl atrazine) a degradation product of atrazine
[b] ACET (2-amino-4-chlor-6-ethylamino-s-triazine) a degradation product of atrazine and/or simazine
[c] DACT (2-amino-4-chlor-6-isopropylamino-s-triazine) a degradation product of atrazine and/or simazine
[d] Degradation product of hexazinone
[e] DMN (desmethyl norflurazon) a degradation product of norflurazon
[f] Degradation product of tebuthiuron

Table 2. Percent of wells sampled annually that contained pesticides and/or pesticide degradation products.

	ACET	DACT	Simazine	Diuron	DMN	Bromacil	Norflurazon	DEA	Atrazine	Prometon	Hexazinone
Fall 1999	95	85	87	60		40	17	8	5	1	0
Spring 2000	89	89	82	50		38	18	4	4	1	1
Fall 2000	99	86	90	61		37	20	7	4	1	0
Spring 2001	94	86	86	59		39	23	8	4	1	1
Fall 2001	89	85	80	59		37	18	7	4	3	1
Spring 2002	94	89	93	64		39	16	13	4	1	0
Fall 2002	87	86	87	61		41	20	12	4	1	1
Spring 2003	89	86	86	61		40	21	10	4	1	0
Spring 2004	87	85	81	57	44	34	25	9	4	1	0
Spring 2005	88	75	71	54	46	34	24	6	4	1	0
Spring 2006	83	83	73	52	44	38	23	8	5	2	0
Spring 2007	86	86	77	46	45	32	29	6	3	1	0
Spring 2008	85	85	69	50	44	34	21	6	4	1	0
Spring 2009	88	85	60	46	47	31	21	4	3	1	0
Spring 2010	81	85	63	38	50	29	28	4	3	1	1
Spring 2011	76	79	56	32	53	31	28	6	4	0	1
Spring 2012	82	81	59	37	50	25	28	4	3	0	0
MEAN	88	84	76	52	47	35	22	7	4	1	0
SD	6	3	12	10	3	4	4	3	1	1	1

Table 3. Average annual concentration in ug/L(ppb) for wells sampled that contained pesticide residues.

	Bromacil	DACT	ACET	Diuron	DMN	Norflurazon	DEA	Simazine	Atrazine	Prometon	Hexazinone
Fall 1999	0.96	0.82	0.48	0.35		0.16	0.11	0.13	0.08	0.07	
Spring 2000	1.31	0.75	0.47	0.35		0.14	0.13	0.11	0.08	0.06	0.07
Fall 2000	1.16	0.91	0.47	0.28		0.09	0.15	0.10	0.10	0.09	
Spring 2001	1.12	0.97	0.50	0.33		0.11	0.13	0.12	0.10	0.10	0.05
Fall 2001	0.92	0.91	0.51	0.28		0.16	0.10	0.11	0.08	0.10	0.06
Spring 2002	0.85	1.08	0.58	0.31		0.28	0.09	0.13	0.08	0.09	
Fall 2002	0.75	0.90	0.51	0.30		0.20	0.12	0.12	0.11	0.09	0.06
Spring 2003	0.99	0.89	0.55	0.31		0.18	0.12	0.14	0.11	0.08	
Spring 2004	1.12	0.85	0.50	0.28	0.22	0.21	0.15	0.10	0.12	0.09	
Spring 2005	0.95	0.66	0.38	0.25	0.25	0.24	0.17	0.10	0.10	0.09	
Spring 2006	0.88	0.82	0.42	0.28	0.27	0.23	0.13	0.10	0.09	0.06	
Spring 2007	0.85	0.80	0.40	0.26	0.26	0.13	0.10	0.10	0.07	0.06	
Spring 2008	0.81	0.68	0.38	0.21	0.25	0.24	0.10	0.09	0.07	0.07	
Spring 2009	0.79	0.67	0.39	0.20	0.23	0.21	0.12	0.09	0.07	0.06	
Spring 2010	0.83	0.70	0.41	0.17	0.27	0.19	0.15	0.10	0.11	0.09	0.05
Spring 2011	0.82	0.71	0.40	0.12	0.23	0.19	0.15	0.09	0.09		0.07
Spring 2012	0.65	0.82	0.39	0.10	0.24	0.19	0.12	0.09	0.09		
MEAN	0.93	0.82	0.46	0.26	0.25	0.18	0.13	0.11	0.09	0.08	0.06
SD	0.17	0.12	0.06	0.07	0.02	0.05	0.02	0.02	0.02	0.01	0.01

Figure 1. Plot of the annual percentage of wells sampled that contained pesticide residues.

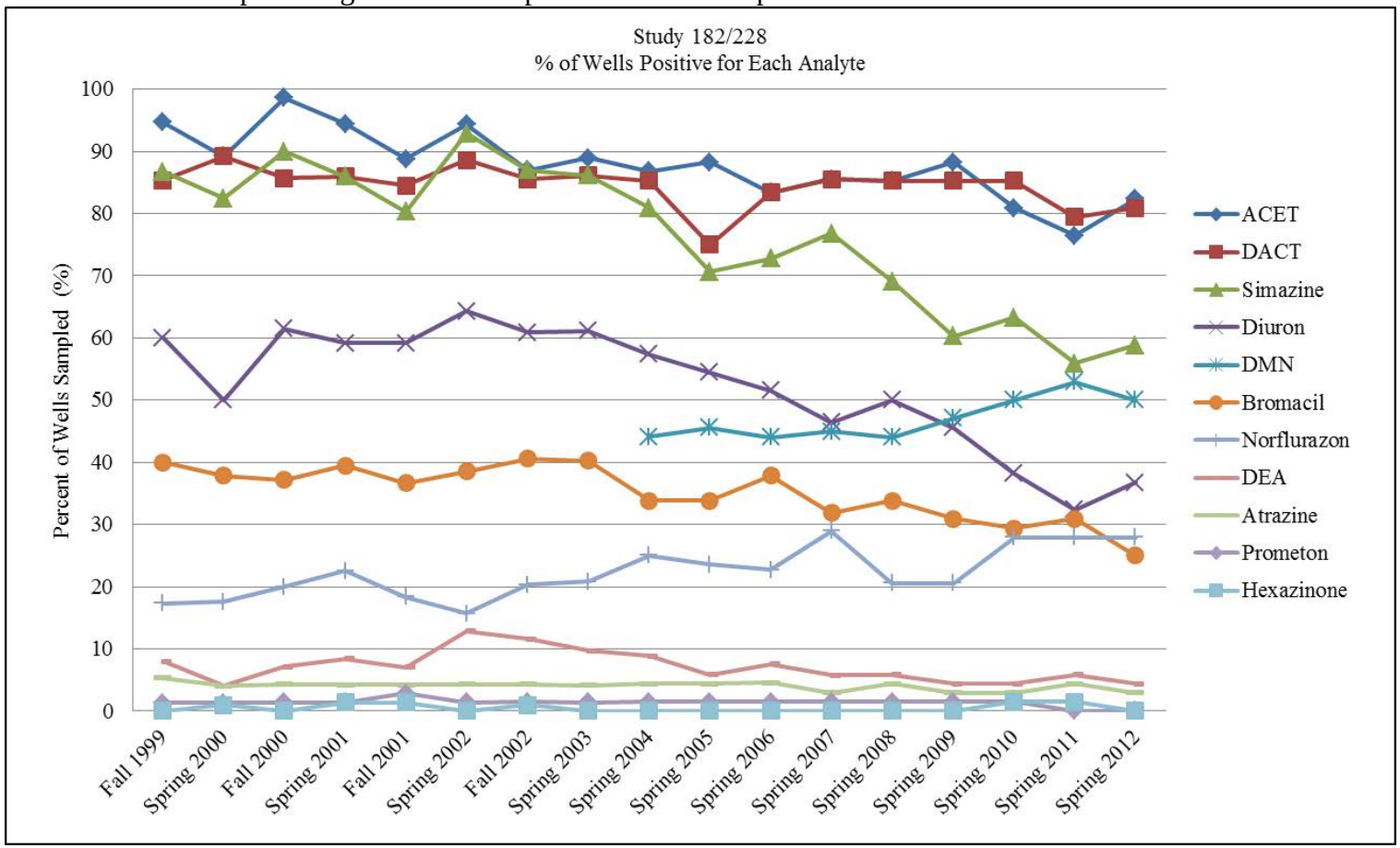


Figure 2. Plot of the annual mean concentration for each pesticide residue for wells with detections.

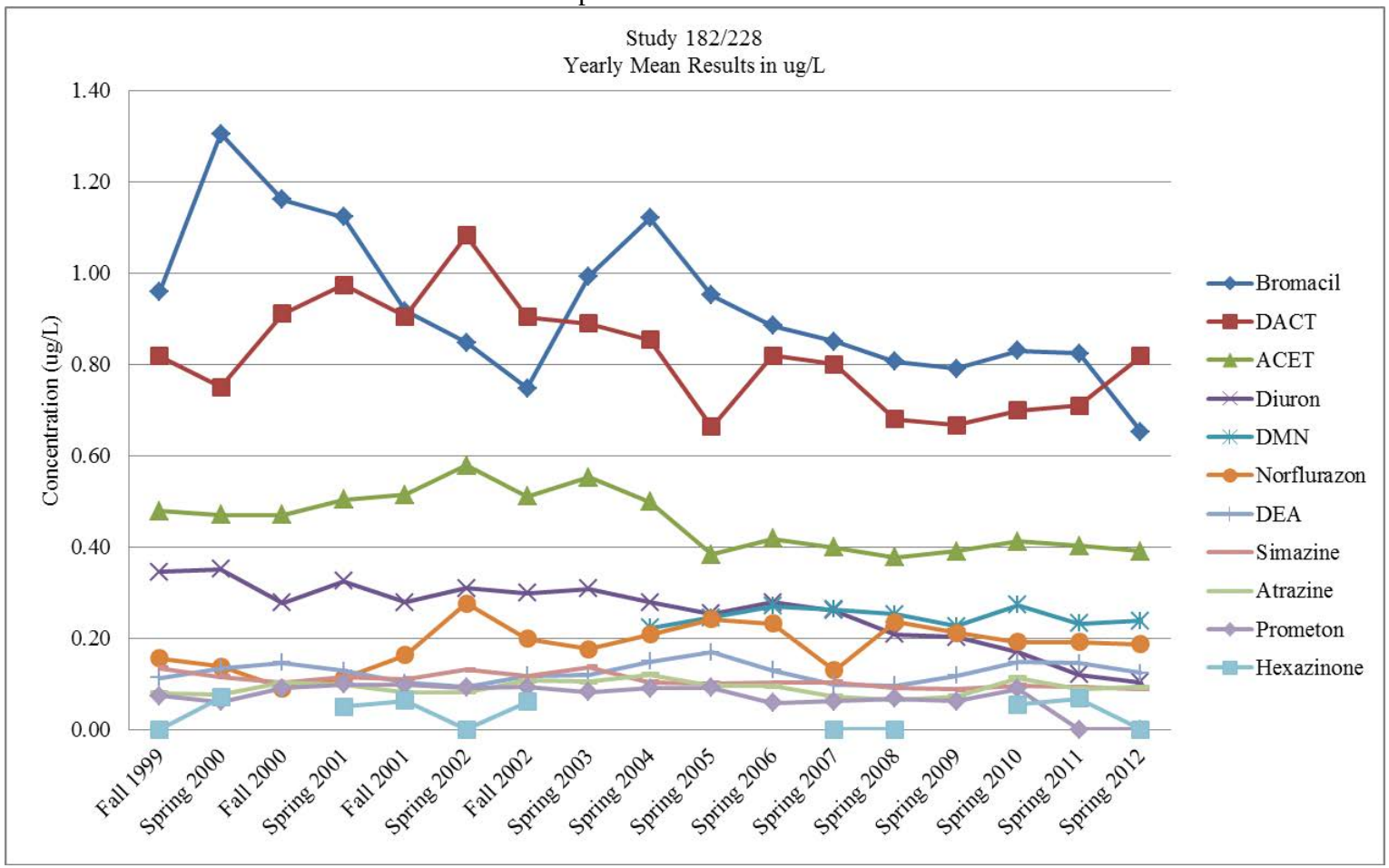
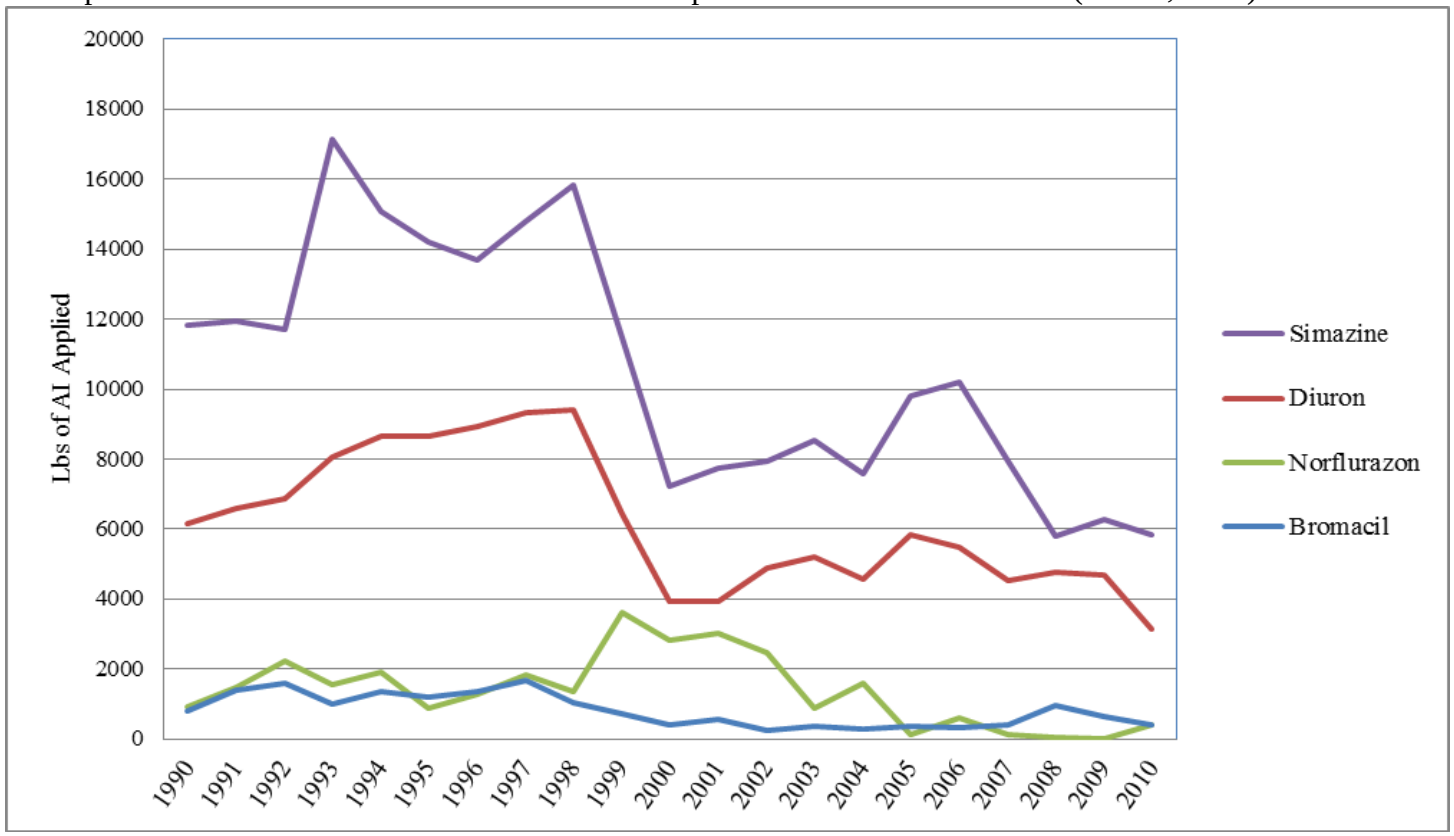


Figure 3. Use of pesticides in sections with wells that contained pesticide residues 1990-2010 (CDPR, 2010).



APPENDIX 1. Spring 2012 Sampling Results in ug/L(ppb).

Well Number	Date Sampled	Atrazine	Simazine	Diuron	Prometon	Bromacil	Hexazinone	Norflurazon	DEA	ACET	DACT	DMN	Reporting Limit
1	4/18/12	ND[1]	0.077	0.438	ND	ND	ND	ND	ND	0.721	0.514	ND	0.05
2	4/17/12	ND	0.078	0.069	ND	ND	ND	ND	ND	0.137	0.104	0.053	0.05
3	4/17/12	ND	0.093	ND	ND	ND	ND	ND	ND	0.141	0.136	0.194	0.05
4	4/17/12	ND	0.111	0.066	ND	2.860	ND	0.227	ND	0.646	1.580	0.231	0.05
5	4/18/12	ND	0.130	ND	ND	ND	ND	0.050	ND	0.613	1.010	0.476	0.05
6	4/18/12	ND	0.103	ND	ND	ND	ND	ND	ND	0.729	1.140	0.052	0.05
7	4/18/12	ND	0.054	ND	ND	ND	ND	ND	ND	0.163	0.379	ND	0.05
8	4/18/12	ND	0.096	0.089	ND	0.106	ND	ND	ND	0.261	0.320	ND	0.05
11	4/17/12	ND	0.068	0.057	ND	0.091	ND	ND	ND	0.312	0.599	0.143	0.05
12	4/17/12	ND	ND	ND	ND	0.325	ND	ND	ND	0.363	0.307	ND	0.05
13	4/17/12	ND	ND	0.104	ND	0.259	ND	0.165	ND	0.154	0.356	0.136	0.05
14	4/17/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
15	4/18/12	ND	0.095	0.079	ND	ND	ND	0.172	ND	0.133	0.180	0.272	0.05
16	4/17/12	ND	0.089	0.196	ND	0.056	ND	0.428	ND	0.278	0.712	0.790	0.05
18	3/28/12	ND	0.053	ND	ND	ND	ND	ND	ND	0.141	0.288	0.058	0.05
19	3/20/12	ND	0.066	ND	ND	ND	ND	ND	ND	0.249	0.294	0.217	0.05
20	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	0.130	0.101	ND	0.05
21	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	0.062	0.143	0.388	0.05
22	3/20/12	ND	ND	0.054	ND	0.092	ND	ND	ND	0.159	0.212	0.139	0.05
23	3/21/12	ND	0.105	ND	ND	ND	ND	ND	ND	0.234	0.415	ND	0.05
24	3/28/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.073	0.05
25	3/28/12	ND	ND	ND	ND	ND	ND	ND	ND	0.071	0.059	ND	0.05
26	3/26/12	ND	ND	ND	ND	ND	ND	ND	ND	0.167	0.175	0.126	0.05
27	3/26/12	ND	0.062	ND	ND	ND	ND	ND	ND	0.189	0.158	ND	0.05
28	3/26/12	ND	ND	ND	ND	ND	ND	ND	ND	0.051	0.154	ND	0.05
29	3/27/12	ND	ND	0.071	ND	ND	ND	0.164	ND	0.142	0.161	0.666	0.05
30	3/27/12	ND	0.090	ND	ND	ND	ND	0.076	ND	0.326	0.487	0.495	0.05
32	3/27/12	ND	0.076	ND	ND	ND	ND	0.248	ND	0.242	0.257	0.402	0.05
34	3/27/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.072	0.05
35	3/27/12	ND	0.087	0.077	ND	ND	ND	ND	ND	0.128	0.143	0.058	0.05
36	3/27/12	ND	0.058	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
37	3/27/12	ND	0.089	ND	ND	ND	ND	ND	ND	0.060	0.097	ND	0.05
43	3/20/12	ND	0.111	0.129	ND	ND	ND	0.131	ND	0.280	0.172	0.095	0.05

ND[1] = none detected (0.05ug/L)

APPENDIX 1. cont'd. Spring 2012 Sampling Results in ug/L(ppb).

Well Number	Date Sampled	Atrazine	Simazine	Diuron	Prometon	Bromacil	Hexazinone	Norflurazon	DEA	ACET	DACT	DMN	Reporting Limit
44	4/24/12	ND[1]	ND	0.082	ND	ND	ND	ND	ND	0.119	0.167	ND	0.05
45	3/20/12	ND	ND	0.062	ND	ND	ND	ND	ND	ND	ND	ND	0.05
47	3/19/12	ND	0.064	0.050	ND	ND	ND	ND	0.073	0.727	1.140	ND	0.05
48	3/19/12	ND	0.080	0.057	ND	0.674	ND	ND	ND	1.070	1.810	ND	0.05
49	3/19/12	ND	0.087	ND	ND	ND	ND	ND	ND	1.400	3.850	0.104	0.05
50	3/26/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
51	3/26/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
52	3/26/12	ND	0.117	ND	ND	ND	ND	ND	ND	0.174	0.217	0.090	0.05
53	3/26/12	ND	ND	ND	ND	ND	ND	ND	ND	0.056	0.135	ND	0.05
54	3/26/12	ND	0.073	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
56	3/21/12	ND	0.098	ND	ND	ND	ND	ND	ND	0.372	0.851	ND	0.05
57	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	0.150	0.345	ND	0.05
58	3/20/12	ND	0.054	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
59	3/19/12	0.097	ND	0.056	ND	ND	ND	0.105	0.114	0.364	0.325	0.443	0.05
61	3/19/12	ND	0.064	ND	ND	0.780	ND	ND	ND	0.372	1.060	ND	0.05
63	4/23/12	ND	0.050	ND	ND	ND	ND	ND	ND	0.133	0.206	ND	0.05
65	3/14/12	ND	ND	ND	ND	ND	ND	ND	ND	0.050	ND	ND	0.05
68	3/14/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
69	3/14/12	ND	ND	ND	ND	1.430	ND	ND	ND	0.877	2.540	ND	0.05
70	3/13/12	ND	0.123	ND	ND	ND	ND	0.228	ND	0.263	0.480	0.401	0.05
71	3/13/12	ND	0.054	0.053	ND	0.631	ND	0.395	ND	0.806	1.450	0.489	0.05
72	4/12/12	ND	0.111	ND	ND	ND	ND	ND	ND	0.687	1.300	ND	0.05
73	3/13/12	ND	ND	ND	ND	ND	ND	ND	ND	0.283	1.320	0.151	0.05
74	3/13/12	ND	0.107	0.053	ND	0.521	ND	0.113	ND	0.768	0.951	ND	0.05
75	3/13/12	ND	0.095	0.052	ND	0.487	ND	ND	ND	1.090	0.815	ND	0.05
79	3/12/12	ND	0.225	0.299	ND	ND	ND	0.055	ND	0.101	0.061	0.061	0.05
80	3/12/12	ND	ND	0.073	ND	1.490	ND	0.123	ND	0.946	4.120	0.137	0.05
84	3/12/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
85	3/12/12	ND	0.107	ND	ND	0.888	ND	0.670	ND	0.768	0.775	0.430	0.05
86	3/12/12	ND	0.096	ND	ND	ND	ND	0.055	ND	1.460	6.270	0.138	0.05
89	4/17/12	ND	ND	ND	ND	ND	ND	ND	ND	0.088	0.133	0.065	0.05
90	3/27/12	0.089	0.078	0.098	ND	0.095	ND	ND	0.183	0.184	0.203	ND	0.05
92	3/21/12	ND	ND	0.146	ND	ND	ND	0.074	ND	0.289	0.329	0.160	0.05
94	3/19/12	ND	0.065	0.082	ND	0.307	ND	0.071	ND	1.000	3.480	0.267	0.05
95	3/27/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05

ND[1] = none detected (0.05ug/L)