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STUDY GW17/GW17A: GROUNDWATER PROTECTION LIST MONITORING FOR IMIDACLOPRID

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ABSTRACT

Groundwater Protection Program (GWPP) staff from the California Department of Pesticide Regulation's (DPR) Environmental Monitoring Branch (EM) sampled 69 wells between June 2017 (GW17 Study) and November 2019 (GW17a Study) to determine if agricultural uses of imidacloprid resulted in contamination of groundwater. For this study, wells were sampled in moderate to high use sections of Fresno, Kern, Madera, Monterey, San Luis Obispo, Santa Barbara, and Tulare counties. Imidacloprid was detected above the reporting limit in five wells located in Fresno, Santa Barbara, and Tulare counties, with concentrations ranging from 0.054 to 0.124 parts per billion (ppb), while trace concentrations (between the reporting limit and method detection limit) were detected in nine wells located in Fresno, Monterey, Santa Barbara, and Tulare counties. Fifty-five of the wells were also analyzed for imidacloprid degradates, and since there were no detections, the degradates were not analyzed for in subsequent samples. Several other pesticides, mostly 6800(a)-listed pesticides or degradates, were also detected in the counties monitored. All pesticides detected in this study were below the established drinking water quality standards.

BACKGROUND

The Pesticide Contamination Prevention Act (PCPA) of 1985 (Food and Agricultural Code [FAC] sections 13149–13152) requires DPR to identify pesticides or degradates that have the potential to pollute groundwater based on their physical and chemical properties. These pesticides are placed on the Groundwater Protection List (GWPL) (Title 3 California Code of

Regulations [3CCR] section 6800) and DPR conducts monitoring to determine if they have migrated to groundwater due to agricultural use.

DPR's GWPP conducted imidacloprid monitoring studies in 2003 and 2009 and collected samples from 67 wells in seven counties (Fresno, Monterey, San Benito, San Luis Obispo, Santa Barbara, Tulare, and Ventura). Imidacloprid or imidacloprid degradates were not detected in any well (Weaver and Nordmark, 2004; Bergin and Nordmark, 2009).

The GWPP also samples numerous wells annually as part of the Well Network, a long-term groundwater monitoring study in Fresno and Tulare counties (1999–present) (Davalos, 2021). These wells are located in areas highly vulnerable to groundwater contamination from the agricultural use of pesticides. Recently, the GWPP began to analyze samples from wells monitored, regardless of the study purpose, for more pesticides, including imidacloprid, as part of the Multi-Analyte Screen. In the Well Network, imidacloprid was first detected above the reporting limit in a single well in 2014 and in a total of eight wells during 2014–2017 (Davalos, 2021). These detections prompted the GWPP to conduct additional well sampling in high-use areas throughout California to reassess current imidacloprid concentrations in groundwater.

Since 1990, DPR has required use reports for pesticides applied to agriculture. As such, the DPR Pesticide Use Report (PUR) database contains reported agricultural use of imidacloprid (in pounds active ingredient) at the section scale (i.e., 1 square mile, approximately 640 acres) since it was first registered for use in California in 1994 (CDPR, 2020). As of March 1, 2021, 242 active products containing imidacloprid were registered for all uses in California under a wide variety of trade names (CDPR, 2021). In California, over 4.1 million pounds of imidacloprid active ingredient have been used to treat crops on over 26 million acres from 1995 to 2018 (CDPR, 2020). Figure 1 shows the reported agricultural use of imidacloprid (pounds active ingredient) in California during this period. Agricultural imidacloprid use has been steadily increasing in California since 2000, with usage rising more than five times since 2000 (CDPR, 2020).

As of 2018, approximately 65% of statewide applications of reported agricultural use of imidacloprid occurred in Fresno, Kern, Madera, Monterey, San Luis Obispo, Santa Barbara, and Tulare counties with the highest use on wine grapes, grapes, processing tomatoes, head lettuce, and oranges (CDPR, 2020; Table 1; Figure 1; Figure 2). The GWPP primarily focused groundwater monitoring for imidacloprid on these highest use counties to determine if agricultural uses of imidacloprid have resulted in contamination of groundwater (Figures 3–9).

Table 1. Highest use of imidacloprid by crop 1995–2018 (CDPR, 2020).

Crop	Imidacloprid Use (lbs.)
Wine Grapes	717,664
Grapes	500,486
Processing/Canning Tomatoes	375,143
Head Lettuce (All or Unspecified)	285,330
Orange (All or Unspecified)	285,150

METHODS

Sampling Methods

GWPP sampling protocols for Studies GW17 and GW17a document the background and planning information for these imidacloprid studies (Aggarwal, 2017; 2019). GWPP staff collected samples in accordance with Standard Operating Procedure (SOP) FSWA001.03 (Kocis, 2020). Domestic wells were prioritized for sample collection because they are usually shallower than municipal and irrigation wells. During collection of groundwater samples, all efforts were taken to sample water directly from the aquifer as outlined in the SOP.

GWPP staff sampled 69 wells in Fresno, Kern, Madera, Monterey, San Luis Obispo, Santa Barbara, and Tulare counties between June 2017 and November 2019. GWPP staff chose most sampling locations based on reported imidacloprid use (1995–2015) in a one-square-mile section area (as reported in the PUR). For GW17, sampling locations were prioritized based on their similarity to the areas in Fresno County where imidacloprid had been detected in well samples: moderate to high reported imidacloprid use from 1995-2015, depth to groundwater of less than 60 feet, and previous detections of pesticides by DPR (Aggarwal, 2017). Most sections targeted for sampling in 2017 were located in Fresno and Tulare counties. Due to imidacloprid detections in GW17, the study was expanded in 2019 (GW17a) to prioritize sampling in sections with reported imidacloprid use from 1995-2015 of >2000 lbs and depths to groundwater of 130 feet or less anywhere in California (Aggarwal, 2019).

Due to variations in well location and well owner participation, acquiring samples within a given section was sometimes problematic. In these cases, GWPP staff attempted to collect samples in the neighboring sections, if possible. Each well was monitored for imidacloprid and more than 50 additional pesticides or degradation products using four analytical screens in 2017 and three analytical screens in 2019 (Table 2).

Analytical Methods

The California Department of Food and Agriculture's (CDFA) Center for Analytical Chemistry performed the chemical analysis. Only samples collected in 2017 were analyzed for

imidacloprid and imidacloprid degradates using the Imidacloprid Screen, EMON-SM-13.0 (CDFA, 2008). All samples were analyzed for imidacloprid and analytes using the Multi-Analyte Screen, EMON-SM-05-032 (CDFA, 2013) and the Triazine Screen, EMON-SM-62.9 (CDFA, 2009) (Table 2).

The current version of the PCPA no longer requires confirmation of pesticide detections in at least two discrete well samples or verification of a pesticide detection by a second analytical method or analytical laboratory. The PCPA allows a finding of an active ingredient or its degradates in groundwater by a single analytical laboratory using a single analytical method if the method is approved by DPR and provides unequivocal identification of those chemicals (FAC § 13149[d]). The analytical method for imidacloprid and imidacloprid degradates, EMON-SM-13.0, was determined by DPR to provide unequivocal identification of imidacloprid and imidacloprid degradates in groundwater (Fattah, 2008a). DPR also determined the other analytical methods used in this study to be unequivocal (Fattah, 2008b; Aggarwal, 2016). The updates to the PCPA and the unequivocal determinations supersede the information in SOP QAQC001.00 (Segawa, 1995) regarding verification requirements. The SOP was recently updated to reflect the changes in the PCPA verification requirements that were followed but were not documented in the SOP at the time of the study (SOP QAQC001.01 [Peoples, 2019]).

The reporting limit for all analytes was 0.05 ppb, except imidacloprid olefin, which had a reporting limit of 0.1 ppb. The reporting limit is the smallest detectable concentration when following an analytical method that is set at a level high enough to account for matrix effects (1 to 5 times the method detection limit). Whereas, trace concentrations are the concentrations between the method detection limit (0.01 ppb) and the reporting limit (0.05 ppb).

Table 2. Pesticides and degradates included in CDFA laboratory screens.

LCMS Multi-Analyte Screen		GCMS Multi-Analyte Screen	Triazine Screen	Imidacloprid** Screen
EMON-SM-05-032		EMON-SM-05-032	EMON-62.9	EMON-SM-13.0
Atrazine	Linuron	Clomazone	ACET[2]	Imidacloprid
Azinphos-methyl*	Mefenoxam/ Metalaxyl[1]	Dichloran	Atrazine	Imidacloprid olefin[6]
Azoxystrobin	Methiocarb	Dichlobenil	Bromacil	Imidacloprid urea[6]
Bensulide	Metolachlor	Disulfoton*	DACT[3]	Imidacloprid guanidine[6]
Bromacil	Metribuzin	Ethoprophos	DEA[4]	Imidacloprid guanidine olefin[6]
Carbaryl	Napropamide	Ethyl parathion*	Diuron	
Carbofuran*	Norflurazon	Fonofos*	DSMN[5]	
Diazinon	Oryzalin	Malathion	Hexazinone	
Dimethenamide	Prometon	Methyl parathion*	Norflurazon	
Dimethoate	Simazine	Phorate	Prometon	
Diuron	Tebuthiuron	Piperonyl butoxide*	Simazine	
Ethofumesate	Thiamethoxam	Prometryn		
Fenamiphos*	Thiobencarb	Propanil		
Fludioxonil	Uniconazole*	Triallate		
Imidacloprid				

* These pesticides were only analyzed for samples collected in 2019.

** Imidacloprid Screen was only used for samples collected in 2017.

1 Mefenoxam and metalaxyl are stereoisomers. The analytical method cannot differentiate the two analytes.

2 ACET: deisopropyl atrazine; degradate of atrazine and simazine.

3 DACT: diaminochlortriazine; degradate of simazine.

4 DEA: deethyl atrazine; degradate of atrazine.

5 DSMN: desmethyl norflurazon; degradate of norflurazon.

6 Degradate of imidacloprid.

Quality Assurance and Quality Control

The CDFA Center for Analytical Chemistry (CAC) analyzed continuing quality control samples with every set of samples to assess lab precision. Procedures for continuing quality control (QC) measures are specified in SOP QAQC001.01 (Peoples, 2019). During sample analysis for each extraction set (a group of samples extracted and processed as a batch), the laboratory simultaneously analyzed a lab matrix-blank and a continuing QC matrix-spike. The lab matrix-blank is a sample of analyte-free groundwater collected from a well in the Sierra foothills. The continuing QC matrix-spike consists of the same source of analyte-free groundwater fortified (spiked) with all analytes on each screen. The continuing QC matrix-spike results were evaluated by laboratory chemists, the CDFA CAC Quality Assurance Program, and the EM QA Officer to ensure analytical integrity. The evaluation includes comparing the continuing QC matrix-spike recoveries to control limits set at 3-times the standard deviation of the method validation data for each analyte fortified. Recoveries from the continuing QC were used to assess and monitor ongoing sample analysis and minor variation was expected. Additionally,

the EM QA Officer submitted blind spikes to the lab disguised as field samples (SOP QAQC008.00; Ganapathy, 2005); a blind spike consists of the analyte-free groundwater (matrix-blank sample) fortified with the chosen analytes.

RESULTS

Sample Analysis

Complete sample analysis results for the Imidacloprid and the LCMS Multi-Analyte Screens are shown in Appendix 1, Tables A1-1 and A1-2, respectively. Complete sample analysis results for the GCMS Multi-Analyte Screen and the Triazine Screens are shown in Appendix 1, Tables A1-3 and A1-4, respectively. A summary of the sample analysis results for detections above the reporting limit is shown in Table 3.

Out of the 69 wells sampled and analyzed for imidacloprid for this study, 55 wells sampled in 2017 were also analyzed for imidacloprid degradates. Imidacloprid degradates were not detected in any of the wells tested. There was an average of 6.35 relative percent difference between concentrations of imidacloprid detected above the reporting limit by the two methods used (EMON-SM-13.0 and EMON-SM-05-032) on replicate samples for the sampling conducted in 2017 (Table 4). Since imidacloprid degradates were not detected in any of the samples, the separate imidacloprid method was deemed redundant, and subsequent samples were not analyzed for imidacloprid degradates. The Multi-Analyte Screen, EMON-SM-05-032, was used from that time forward.

Table 3. Summary of pesticide or degradate detections above the reporting limit.

County	Number of Wells Sampled	Number of Wells with Detections	Pesticides or Degradates Detected
Fresno	15	14	Imidacloprid, ACET, Bromacil, DACT, Diuron, DSMN, Norflurazon, Simazine
Kern	3	0	None
Madera	3	3	ACET, DACT
Monterey	5	0	None
San Luis Obispo	5	0	None
Santa Barbara	15	1	Imidacloprid
Tulare	23	23	Imidacloprid, ACET, Bromacil, DACT, Diuron, DSMN, Mefenoxam/Metalaxyl, Norflurazon, Simazine

Table 4. Comparison of imidacloprid concentrations (ppb) from replicate samples using two analytical methods (EMON-SM-13.0 and EMON-SM-05-032).

County	COMTRS[a]	Imidacloprid Concentration (ppb)[b]	
		EMON-SM-13.0	EMON-SM-05-032
Detections Greater Than Limit of Quantitation (Above Reporting Limit)			
Fresno	10M15S22E06	0.067	0.072
Fresno	10M14S22E02	0.054	0.054
Santa Barbara	42S10N34W17	0.103	0.104
Tulare	54M16S24E12	0.124	0.105
Tulare	54M17S25E11	0.069	0.074
Detections Between Limit of Detection and Limit of Quantitation (Below Reporting Limit)			
Fresno	10M14S22E01	Trace[c]	Trace
Fresno	10M14S22E01	Trace	Trace
Fresno	10M14S22E18	Trace	ND[d]
Fresno	10M15S21E09	Trace	Trace
Fresno	10M15S23E03	Trace	ND
Tulare	54M18S26E24	Trace	ND

a. County, meridian, township, range, and section of the well(s). A section is approximately one square mile.
b. Imidacloprid was not detected in 44 other wells analyzed using both methods.
c. Trace concentrations = between the method detection limit (0.01 ppb) and the reporting limit (0.05 ppb).
d. ND = non-detect = below the method detection limit (0.01 ppb).

Detections above the Reporting Limit

The locations and concentrations of all pesticides detected above the reporting limit are shown in Table 5. Imidacloprid was detected above the reporting limit (0.05 ppb) in five wells: two wells in Fresno County, one well in Santa Barbara County, and two wells in Tulare County. Imidacloprid concentrations ranged from 0.054 to 0.124 ppb (Table 5). DPR has adopted regulations to identify areas vulnerable to groundwater contamination based either on detecting pesticides in groundwater or on soil characteristics and depth to groundwater. These vulnerable areas are identified as either leaching Ground Water Protection Areas (GWPAs) or runoff GWPAs, depending on the predicted pathway to groundwater. Imidacloprid was detected in both leaching GWPAs (Fresno County) and runoff GWPAs (Fresno and Tulare counties), providing further evidence that imidacloprid is mobile and persistent enough to move to groundwater from agricultural use. One well with a confirmed detection of imidacloprid was in a section that has not been designated as a GWPA (Santa Barbara County) (Table 5). No other pesticides were detected in the Santa Barbara County well where imidacloprid was detected above the reporting limit. The GWPP will evaluate these data further to determine if imidacloprid should enter the pesticide detection response process outlined in FAC § 13149-13151.

Besides imidacloprid, there were also detections of other pesticides in the wells monitored:

- Thirty-five detections of ACET (a degradate of atrazine and simazine, both 6800[a]-listed pesticides) in Fresno, Madera, and Tulare counties.
- Twenty-one detections of bromacil (a 6800[a]-listed pesticide) in Fresno and Tulare counties.
- Forty detections of DACT (a degradate of simazine, a 6800[a]-listed pesticide) in Fresno, Madera, and Tulare counties.
- Nine detections of diuron (a 6800[a]-listed pesticide) in Fresno and Tulare counties.
- Thirteen detections of DSMN (a degradate of norflurazon, a 6800[a]-listed pesticide) in Fresno and Tulare counties.
- Seven detections of norflurazon (a 6800[a]-listed pesticide) in Fresno and Tulare counties.
- Fifteen detections of simazine (a 6800[a]-listed pesticide) in Fresno and Tulare counties.

Each of these 6800(a)-listed pesticides had previously been detected in groundwater and underwent a rigorous formal review process that determined that, although they have the potential to pollute groundwater, their use can be mitigated. To protect groundwater from further contamination, they are listed in 3CCR section 6800(a) and are regulated as groundwater contaminants within GWPAs. DPR requires specific management practices outlined in 3CCR section 6487.

There was also one detection of mefenoxam/metalaxyl, a 6800[b]-listed pesticide, in Tulare County. This detection will be investigated further to determine if follow-up or future monitoring is warranted.

The locations and concentrations of all these detected pesticides are shown in Table 5. All of these detections were below the established drinking water quality standards, as outlined in Table 6. All of the detections above the reporting limit, except one imidacloprid detection in Santa Barbara County, occurred in existing GWPAs.

Trace Detections

Trace detections are detections below the reporting limit but above the method detection limit. Trace detections do not trigger any regulatory processes or response but can serve as an indicator of areas that may need follow-up or future groundwater monitoring. Table 5 also lists the locations of the wells with trace detections. There were nine wells with trace detections of

imidacloprid: five wells in Fresno County, one well each in Monterey and Tulare counties, and two wells in Santa Barbara County. All wells with trace detections in Fresno and Tulare counties are located in GWPAs, while wells with trace detections in Monterey and Santa Barbara counties are not located in GWPAs.

There were also trace detections of ACET (Fresno, Kern, and Madera counties), bromacil (Fresno, Kern, and Tulare counties), DACT (Kern County), DEA (Fresno and Tulare counties), diuron (Fresno, Madera, and Tulare counties), DSMN (Fresno and Tulare counties), ethoprophos (Fresno County), hexazinone (Madera County), norflurazon (Fresno and Tulare counties), simazine (Fresno and Tulare counties), and thiamethoxam (Fresno and Santa Barbara counties) (Table 5). These pesticides, except for ethoprophos and thiamethoxam, have previously been detected in California groundwater. All trace detections, except ACET, bromacil, and DACT in Kern County, and thiamethoxam in Santa Barbara County, are located in GWPAs. Trace detections do not meet the criteria to establish a GWPA. These detections will be investigated further to determine if follow-up or future monitoring is warranted.

Table 5. Locations, Ground Water Protection Area pathway, and concentrations of pesticides detected[a] in the study.

County	Location (Meridian-Township/Range-Section)[b]	Location Code	GWPA Pathway	Pesticide(s) or Degradate(s) (Concentration, ppb)
Fresno	14S22E02	10-01	Runoff	**Imidacloprid (0.054)**, ACET (0.259), Bromacil (1.05), DACT (1.13), DEA (T[c]), Diuron (0.056), DSMN (0.094), Ethoprophos (T), Norflurazon (T), Simazine (0.056)
Fresno	14S22E01	10-02	Runoff	**Imidacloprid (T)**, ACET (0.176), Bromacil (0.502), DACT (0.673), Diuron (T), DSMN (1.97), Norflurazon (0.283), Simazine (0.053)
Fresno	13S22E35	10-03	Runoff	ACET (0.093), Bromacil (0.344), DACT (0.293), Diuron (T), DSMN (0.059), Norflurazon (T), Simazine (T)
Fresno	14S22E01	10-04	Runoff	**Imidacloprid (T)**, ACET (0.201), Bromacil (0.710), DACT (0.480), Diuron (0.053), DSMN (0.390), Norflurazon (0.278), Simazine (0.077)
Fresno	13S22E36	10-05	Runoff	DACT (0.066)
Fresno	15S21E09	10-07	Leaching	**Imidacloprid (T)**, ACET (0.110), DACT (0.215), DSMN (T), Simazine (0.055), Thiamethoxam (T)

County	Location (Meridian-Township/Range-Section)[b]	Location Code	GWPA Pathway	Pesticide(s) or Degradate(s) (Concentration, ppb)
Fresno	14S22E18	10-11	Runoff	**Imidacloprid (T)**, ACET (0.144), DACT (0.380), Diuron (T), DSMN (T), Simazine (0.091)
Fresno	15S22E06	10-12	Leaching	**Imidacloprid (0.072)**, ACET (0.097), DACT (0.455), Diuron (T), DSMN (T), Simazine (T)
Fresno	14S21E33	10-13	Leaching	ACET (0.218), Bromacil (T), DACT (0.386), Diuron (0.204), Simazine (0.072)
Fresno	15S23E03	10-14	Runoff	**Imidacloprid (T)**, ACET (T), DACT (0.143), DSMN (T), Norflurazon (T), Simazine (T)
Fresno	15S24E25	10-15	Runoff	ACET (0.360), Bromacil (T), DACT (1.70), Diuron (T), Simazine (0.060)
Fresno	15S24E35	10-16	Runoff	DACT (0.093)
Fresno	15S24E25	10-21	Runoff	ACET (0.418), Bromacil (0.706), DACT (1.73), Diuron (T), DSMN (T), Simazine (0.051)
Fresno	15S24E23	10-22	Runoff	ACET (0.324), DACT (1.84), Diuron (T), DSMN (0.170), Norflurazon (T), Simazine (T)
Kern	25S26E09	15-03	Not designated[d]	ACET (T), Bromacil (T), DACT (T)
Madera	12S17E35	20-01	Leaching	ACET (0.095), DACT (0.394), Diuron (T)
Madera	12S17E34	20-02	Leaching	ACET (T), DACT (0.529)
Madera	13S16E07	20-03	Leaching	ACET (T), DACT (0.160), Diuron (T), Hexazinone (T)
Monterey	15S03E09	27-01	Not designated	**Imidacloprid (T)**
Santa Barbara	10N33W20	42-01	Not designated	**Imidacloprid (T),** Thiamethoxam (T)
Santa Barbara	08N33W25	42-12	Not designated	**Imidacloprid (T),** Thiamethoxam (T)
Santa Barbara	10N34W17	42-74	Not designated	**Imidacloprid (0.104)**
Tulare	17S25E23	54-01	Runoff	ACET (0.178), Bromacil (0.819), DACT (0.963), Diuron (T), Simazine (T)
Tulare	17S26E30	54-02	Runoff	ACET (0.281), Bromacil (0.486), DACT (1.90), Diuron (0.072)
Tulare	17S25E11	54-03	Runoff	**Imidacloprid (0.074)**, ACET (0.271), Bromacil (T), DACT (0.498), DSMN (0.061), Norflurazon (0.063), Simazine (T)

County	Location (Meridian-Township/Range-Section)[b]	Location Code	GWPA Pathway	Pesticide(s) or Degradate(s) (Concentration, ppb)
Tulare	17S26E18	54-04	Leaching	ACET (0.291), Bromacil (T), DACT (0.631), Diuron (0.052), DSMN (T), Norflurazon (0.052), Simazine (0.082)
Tulare	17S25E26	54-05	Runoff	ACET (0.187), Bromacil (0.504), DACT (0.803), Diuron (T), DSMN (T), Norflurazon (T), Simazine (T)
Tulare	17S25E23	54-06	Runoff	ACET (0.340), Bromacil (1.23), DACT (2.26), Diuron (0.055), Simazine (T)
Tulare	17S26E20	54-07	Runoff	ACET (0.382), Bromacil (0.787), DACT (2.45), DEA (T),Diuron (0.064), Simazine (T)
Tulare	17S26E20	54-08	Runoff	ACET (0.480), Bromacil (0.321), DACT (1.35), DEA (T),Diuron (T), DSMN (T), Simazine (T)
Tulare	17S26E29	54-09	Runoff	ACET (0.657), Bromacil (0.895), DACT (3.35), Diuron (T), Simazine (T)
Tulare	17S26E30	54-10	Runoff	ACET (0.400), Bromacil (0.492), DACT (2.26), Diuron (T), DSMN (T), Mefenoxam/Metalaxyl (0.147), Norflurazon (T), Simazine (T)
Tulare	18S26E24	54-11	Runoff	**Imidacloprid (T)**, ACET (0.243), DACT (1.22), Diuron (T), DSMN (0.185), Norflurazon (0.139), Simazine (0.059)
Tulare	18S27E18	54-12	Runoff	ACET (0.129), DACT (0.865), Diuron (T), DSMN (0.109), Norflurazon (T), Simazine (0.084)
Tulare	18S27E19	54-13	Runoff	ACET (0.464), Bromacil (0.797), DACT (3.73), Diuron (0.057), DSMN (0.056), Norflurazon (T), Simazine (T)
Tulare	18S27E17	54-14	Runoff	ACET (0.195), Bromacil (0.103), DACT (0.741), Diuron (T), DSMN (0.068), Norflurazon (T), Simazine (0.062)
Tulare	18S27E17	54-15	Runoff	ACET (0.437), DACT (3.45), Diuron (T), DSMN (T), Norflurazon (T), Simazine (T)
Tulare	18S27E17	54-16	Runoff	ACET (0.468), DACT (2.36), Diuron (T), DSMN (0.151), Norflurazon (T), Simazine (T)
Tulare	20S26E25	54-17	Runoff	ACET (0.560), Bromacil (1.27), DACT (2.69), Diuron (T), Simazine (0.078)
Tulare	20S27E30	54-18	Runoff	ACET (0.714), Bromacil (0.184), DACT (1.91), Simazine (0.099)

County	Location (Meridian-Township/Range-Section)[b]	Location Code	GWPA Pathway	Pesticide(s) or Degradate(s) (Concentration, ppb)
Tulare	20S27E31	54-19	Runoff	ACET (0.117), Bromacil (0.739), DACT (0.254), Diuron (T), DSMN (T), Norflurazon (T), Simazine (T)
Tulare	21S27E05	54-20	Runoff	ACET (0.122), Bromacil (1.10), DACT (0.355), Diuron (T), Simazine (T)
Tulare	16S24E12	54-21	Runoff	**Imidacloprid (0.124)**, ACET (0.104), DACT (0.473), Diuron (0.071), DSMN (0.306), Norflurazon (0.064), Simazine (T)
Tulare	16S24E01	54-22	Runoff	ACET (0.328), Bromacil (5.57), DACT (1.48), Diuron (T), DSMN (0.165), Norflurazon (0.073), Simazine (T)
Tulare	15S25E31	54-23	Runoff	ACET (0.395), Bromacil (0.440), DACT (1.59), Diuron (T), Simazine (0.063)

a. If a pesticide was analyzed by two different methods, then the higher reported value is shown, irrespective of the method used.

b. Meridian, township, range, and section of the well(s). A section is approximately one square mile.

c. T = Trace concentrations = between the method detection limit (0.01 ppb) and the reporting limit (0.05 ppb).

d. Not designated = Section is not a Ground Water Protection Area.

Table 6. Drinking water quality standards for detected pesticides or degradates.

Pesticide or Degradate	Primary Agricultural Use	Drinking Water Quality Standard (ppb)			
		MCL[a]	Chronic HHBP[b]	PHG[c]	DWEL HA[d]
Imidacloprid	Insecticide	*	360	*	*
ACET	Degradate of Atrazine and Simazine	*	*	*	*
Bromacil	Herbicide	*	*	*	3500
DACT	Degradate of Simazine	*	12	*	*
Diuron	Herbicide	*	*	*	100
DSMN	Degradate of Norflurazon	*	*	*	*
Mefenoxam/Metalaxyl	Fungicide	*	474	*	*
Norflurazon	Herbicide	*	96	*	*
Simazine	Herbicide	4	*	4	700

a. MCL: Maximum Contaminant Level: The highest level of a contaminant allowed in drinking water. This is an enforceable standard set by the California State Water Resources Control Board (SWRCB, 2020).

b. Chronic HHBP: Chronic Human Health Benchmarks for Pesticides: Levels of certain pesticides in water at or below which adverse health effects are not anticipated from lifetime exposure (non-cancer). These levels are set by the U.S. EPA (USEPA, 2020).

c. PHG: Public Health Goal: At this concentration, drinking water contaminants pose no significant health risk if consumed for a lifetime. These levels are set by the California Office of Environmental Health Hazard Assessment (OEHHA, 2020).

d. DWEL HA: A Drinking Water Equivalent Level (DWEL) is a lifetime exposure level, assuming 100% exposure from drinking water, at or below which adverse, non-carcinogenic health effects would not be expected to occur (USEPA, 2018).

* No level currently established.

Quality Assurance and Quality Control

For this study, the lab matrix-blank results were all non-detects. The continuing QC and blind spike results for the analysis of imidacloprid and the imidacloprid degradates are included in this section. QC data for all other analytes are also summarized in this section. QC data for all analytes are available upon request.

Imidacloprid Screen QC Samples

Nine matrix spikes were analyzed along with sets of samples using the Imidacloprid Screen. All analytes were spiked at 0.1 ppb except the last extraction set which was spiked at 0.05 ppb. The average recovery for imidacloprid QC was 93.1%. The recoveries of the four degradate analytes ranged from 86.9 to 93.9%. The standard deviation of all recoveries ranged from 8.0 to 15.9%. All the QC samples were within the control limits (Table 7-1).

Table 7-1. Continuing quality control data for the Imidacloprid Screen.

Analysis Date	Analyte	Spike Level (ppb)	% Recovery	Control Limit Exceeded?
6/9/2017	Imidacloprid	0.100	93.7%	No
	Imidacloprid olefin	0.100	89.5%	No
	Imidacloprid urea	0.100	92.4%	No
	Imidacloprid guanidine	0.100	93.6%	No
	Imidacloprid guanidine olefin	0.100	91.0%	No
6/13/2017	Imidacloprid	0.100	87.3%	No
	Imidacloprid olefin	0.100	86.9%	No
	Imidacloprid urea	0.100	88.1%	No
	Imidacloprid guanidine	0.100	85.4%	No
	Imidacloprid guanidine olefin	0.100	70.4%	No
6/30/2017	Imidacloprid	0.100	92.4%	No
	Imidacloprid olefin	0.100	88.7%	No
	Imidacloprid urea	0.100	85.6%	No
	Imidacloprid guanidine	0.100	87.2%	No
	Imidacloprid guanidine olefin	0.100	76.4%	No
7/6/2017	Imidacloprid	0.100	92.7%	No
	Imidacloprid olefin	0.100	89.1%	No
	Imidacloprid urea	0.100	85.3%	No
	Imidacloprid guanidine	0.100	94.6%	No
	Imidacloprid guanidine olefin	0.100	79.1%	No
8/24/2017	Imidacloprid	0.100	110%	No
	Imidacloprid olefin	0.100	81.3%	No
	Imidacloprid urea	0.100	114%	No
	Imidacloprid guanidine	0.100	102%	No
	Imidacloprid guanidine olefin	0.100	115%	No
8/31/2017	Imidacloprid	0.100	104%	No
	Imidacloprid olefin	0.100	88.8%	No
	Imidacloprid urea	0.100	102%	No
	Imidacloprid guanidine	0.100	90.6%	No
	Imidacloprid guanidine olefin	0.100	115%	No
12/11/2017	Imidacloprid	0.100	89.0%	No
	Imidacloprid olefin	0.100	88.0%	No
	Imidacloprid urea	0.100	80.0%	No
	Imidacloprid guanidine	0.100	109%	No
	Imidacloprid guanidine olefin	0.100	95.0%	No
12/12/2017	Imidacloprid	0.100	89.0%	No
	Imidacloprid olefin	0.100	100%	No
	Imidacloprid urea	0.100	80.0%	No
	Imidacloprid guanidine	0.100	103%	No
	Imidacloprid guanidine olefin	0.100	101%	No

Analysis Date	Analyte	Spike Level (ppb)	% Recovery	Control Limit Exceeded?
3/8/2018	Imidacloprid	0.050	80.0%	No
	Imidacloprid olefin	0. 050	70.0%	No
	Imidacloprid urea	0. 050	76.0%	No
	Imidacloprid guanidine	0. 050	80.0%	No
	Imidacloprid guanidine olefin	0. 050	90.0%	No
Mean (SD*)	Imidacloprid		93.1% (9.0%)	
	Imidacloprid olefin		86.9% (8.0%)	
	Imidacloprid urea		89.3% (12.1%)	
	Imidacloprid guanidine		93.9% (9.3%)	
	Imidacloprid guanidine olefin		92.5% (15.9%)	
Control Limits	Imidacloprid		71.2 – 137%	
	Imidacloprid olefin		65.2 – 133%	
	Imidacloprid urea		60.0 – 114%	
	Imidacloprid guanidine		52.4 – 147%	
	Imidacloprid guanidine olefin		47.1 – 119%	

* SD: Standard deviation (values in parenthesis).

Multi-Analyte Screen QC Samples including Imidacloprid Analysis

For the Multi-Analyte Screen, matrix spikes were extracted and split to be analyzed along with sets of samples for both the LCMS and GCMS instruments. Fourteen matrix spikes were analyzed along with sets of samples using LCMS for the Multi-Analyte Screen. The LCMS portion also included the analysis of imidacloprid. All analytes were spiked at 0.2 ppb. The average recovery for imidacloprid continuing QC was 93.9% (Table 7-2). Recovery for the other 28 analytes ranged from 75.4 to 97.9%. The standard deviation of all of the recoveries ranged from 4.5 to 18.7%. Eight of 29 analytes analyzed using the LCMS screen had one to seven recoveries beyond the control limits (30 analyte spikes beyond control limits out of the 406 total spiked analytes); however, all imidacloprid QC samples were within the control limits.

Twelve matrix spikes were analyzed along with sets of samples using GCMS for the Multi-Analyte Screen. All analytes were spiked at 0.2 ppb except the last three extraction sets which were spiked at 0.1 ppb. The average recoveries for the 14 analytes ranged from 77.9 to 96.5%. The standard deviation of the recoveries ranged from 9.1 to 21.1%. All 14 analytes were within the control limits.

Table 7-2. Continuing quality control data for imidacloprid on the Multi-Analyte Screen.

Analysis Date	Spike Level (ppb)	% Recovery	Control Limit Exceeded?
6/13/2017	0.200	96.5%	No
6/14/2017	0.200	88.5%	No
7/6/2017	0.200	99.0%	No
7/6/2017	0.200	93.5%	No
7/27/2017	0.200	92.5%	No
8/17/2017	0.200	94.5%	No
8/18/2017	0.200	91.0%	No
12/4/2017	0.200	93.0%	No
12/5/2017	0.200	95.1%	No
3/12/2018	0.200	97.5%	No
11/8/2019	0.200	98.5%	No
11/19/2019	0.200	79.0%	No
11/27/2019	0.200	101%	No
12/10/2019	0.200	95.0%	No
Mean (SD*)	93.9% (5.4%)		
Control Limits	70.7 – 118%		

* SD: Standard deviation (values in parenthesis).

Triazine Screen QC Samples

Sixteen matrix spikes (three were duplicate spikes) were analyzed along with 13 sets of samples with the Triazine Screen. All analytes were spiked at 0.2 ppb. The average recoveries for the 12 analytes ranged from 73.0 to 83.1%. The standard deviation of the recoveries ranged from 5.1 to 18.9%. Eight analytes were beyond the control limits one to nine times each (33 analyte spikes beyond control limits out of the 184 total spiked analytes). The propazine surrogate recovery was within the control limits in the continuing QC, as well as in every sample analyzed for this screen (Table A1-4).

Blind Spikes

A blind spike is a matrix-blank sample spiked by a chemist other than the chemist extracting and analyzing that screen. Blind spikes were described in the methods section earlier. Eight blind spikes containing two to five analytes were submitted throughout the study period. Of the 25 analytes spiked, recoveries of 23 analytes (92%) were within the control limits, while the recovery of one analyte was outside the control limit and one was spiked too low to quantify. All blind spike results are presented in Table 8.

Table 8. Blind spike levels and recoveries.

Sample #	Analysis Date	Analysis Screen	Analyte	Spike Level (ppb)	Result (ppb)	% Recovery	Control Limit Exceeded
228	6/14/2017	Multi-Analyte	Metolachlor	0.150	0.118	78.7%	No
			Ethoprophos	0.200	0.242	124%	No
			Propanil	0.100	0.102	102%	No
226	6/29/2017	Imidacloprid	Imidacloprid	0.150	0.146	97.3%	No
			Imidacloprid olefin	0.100	Trace[a]	0.00%	NA[b]
			Imidacloprid guanidine	0.100	0.106	106%	No
235	7/6/2017	Imidacloprid	Imidacloprid	0.100	0.103	103%	No
			Imidacloprid urea	0.100	0.088	88.0%	No
			Imidacloprid guanidine olefin	0.100	0.058	58.0%	No
237	7/7/2017	Multi-Analyte	Norflurazon	0.200	0.192	96.0%	No
			Prometon	0.150	0.178	119%	No
245	12/6/2017	Triazine	Diuron	0.200	0.138	69.0%	No
			Norflurazon	0.150	0.129	86.0%	No
			Simazine	0.100	0.098	98.0%	No
244[c]	3/22/2018	Imidacloprid	Imidacloprid	0.200	0.154	77.0%	No
			Imidacloprid olefin	0.200	0.159	79.5%	No
			Imidacloprid urea	0.200	0.145	72.5%	No
			Imidacloprid guanidine	0.200	0.222	111%	No
			Imidacloprid guanidine olefin	0.200	0.201	101	No
13	11/14/2019	Triazine	ACET	0.150	0.126	84.0%	No
			DACT	0.200	0.143	71.5%	No
			DEA	0.250	0.246	98.4%	No
68	11/22/2019	Multi-Analyte	Imidacloprid	0.20	0.192	96.0%	No
			Linuron	0.150	0.176	117%	Yes
			Dichlobenil	0.100	0.100	100%	No

a. Trace concentrations = between the method detection limit (0.01 ppb) and the reporting limit (0.05 ppb).

b. This blind spike was spiked at the reporting limit, which is too low to report at less than 100% recovery.

c. Recoveries for this blind spike were reported as trace except for imidacloprid olefin (113% recovery) in the first analysis. The lab was contacted and subsequently re-extracted and analyzed the remaining sample on 3/22/2018. The updated results are reported in the table.

CONCLUSIONS

The GWPP sampled 69 wells in sections of seven counties with moderate to high imidacloprid use and shallow groundwater. Imidacloprid was detected at quantifiable levels in five wells, and at trace levels in nine wells. Given the imidacloprid detections and the continued increase in imidacloprid use, the GWPP will continue to monitor for imidacloprid and will also determine if imidacloprid should enter the pesticide detection response process. Imidacloprid has been added to the Multi-Analyte Screen to facilitate continued statewide monitoring.

A detection of mefenoxam/metalaxyl above the reporting limit will be investigated further. ACET, bromacil, DACT, diuron, DSMN, norflurazon, and simazine were also detected above the

reporting limit in GWPAs. No additional action is required for these detections since these chemicals are already regulated in GWPAs via 3CCR sections 6800(a) and 6487.

Trace concentrations of ACET, bromacil, DACT, and thiamethoxam were detected in sections that have not been designated as a GWPAs, while hexazinone was detected in a single well located in a GWPA. These detections will be investigated further to determine if follow-up or future monitoring is warranted.

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FIGURES

Figure 1. Total reported agricultural imidacloprid use per year in California (CDPR, 2020).

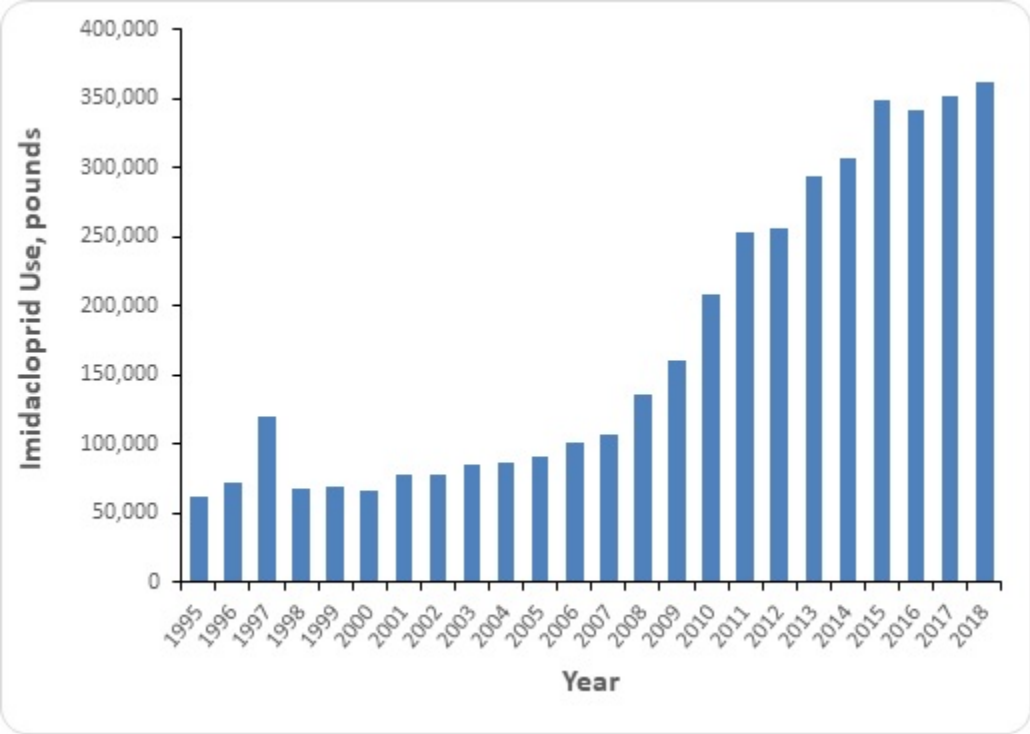


Figure 2. Total reported agricultural imidacloprid use per year by counties in study (CDPR, 2020).

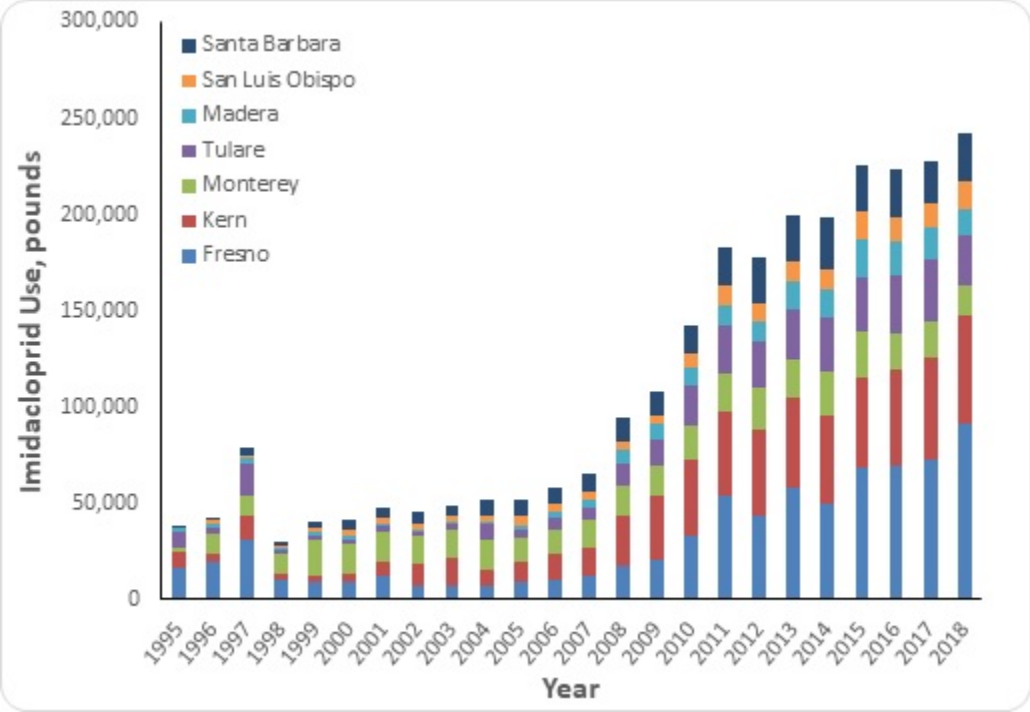


Figure 3. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in Fresno County (CDPR, 2020).

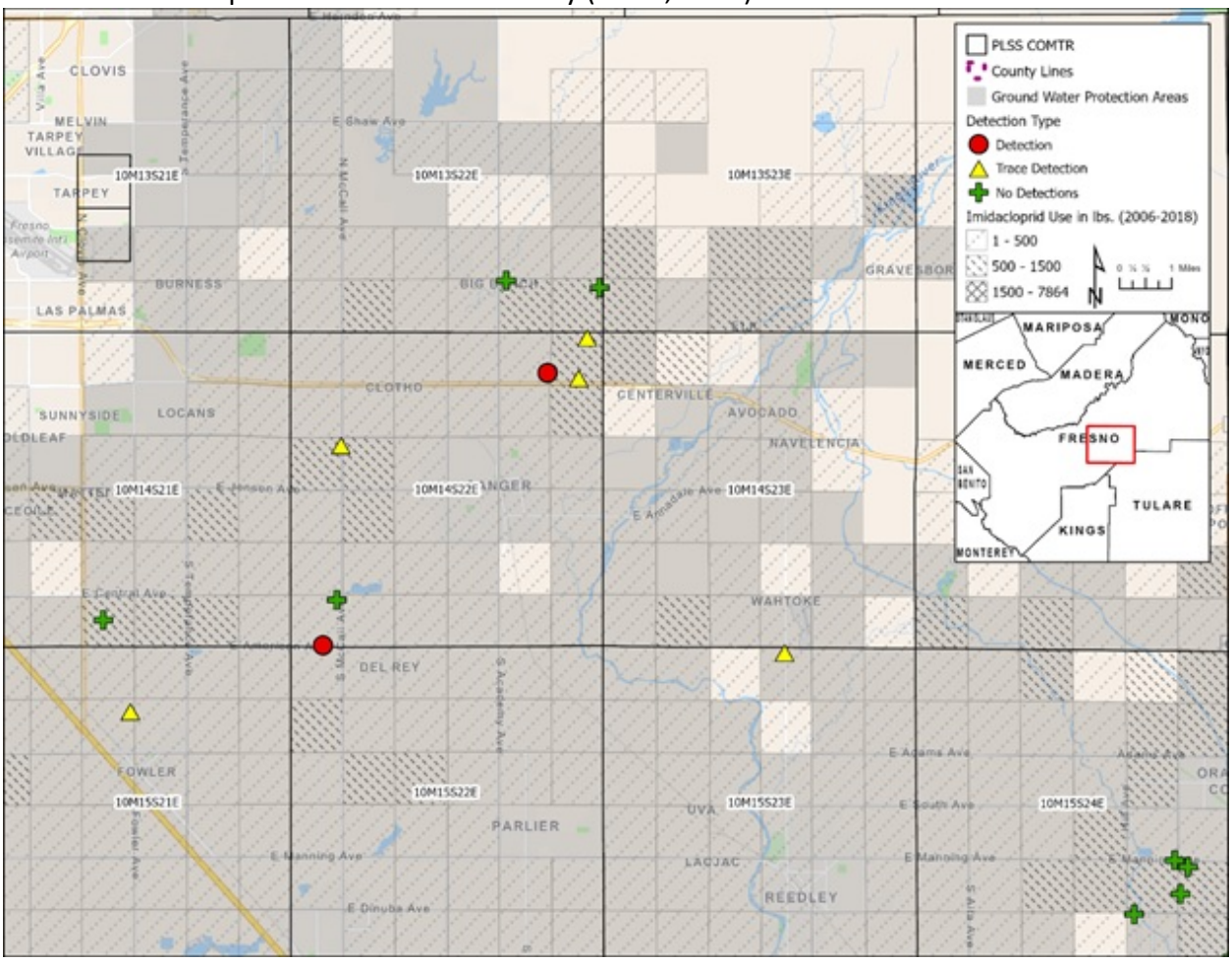


Figure 4. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in Santa Barbara County (CDPR, 2020).

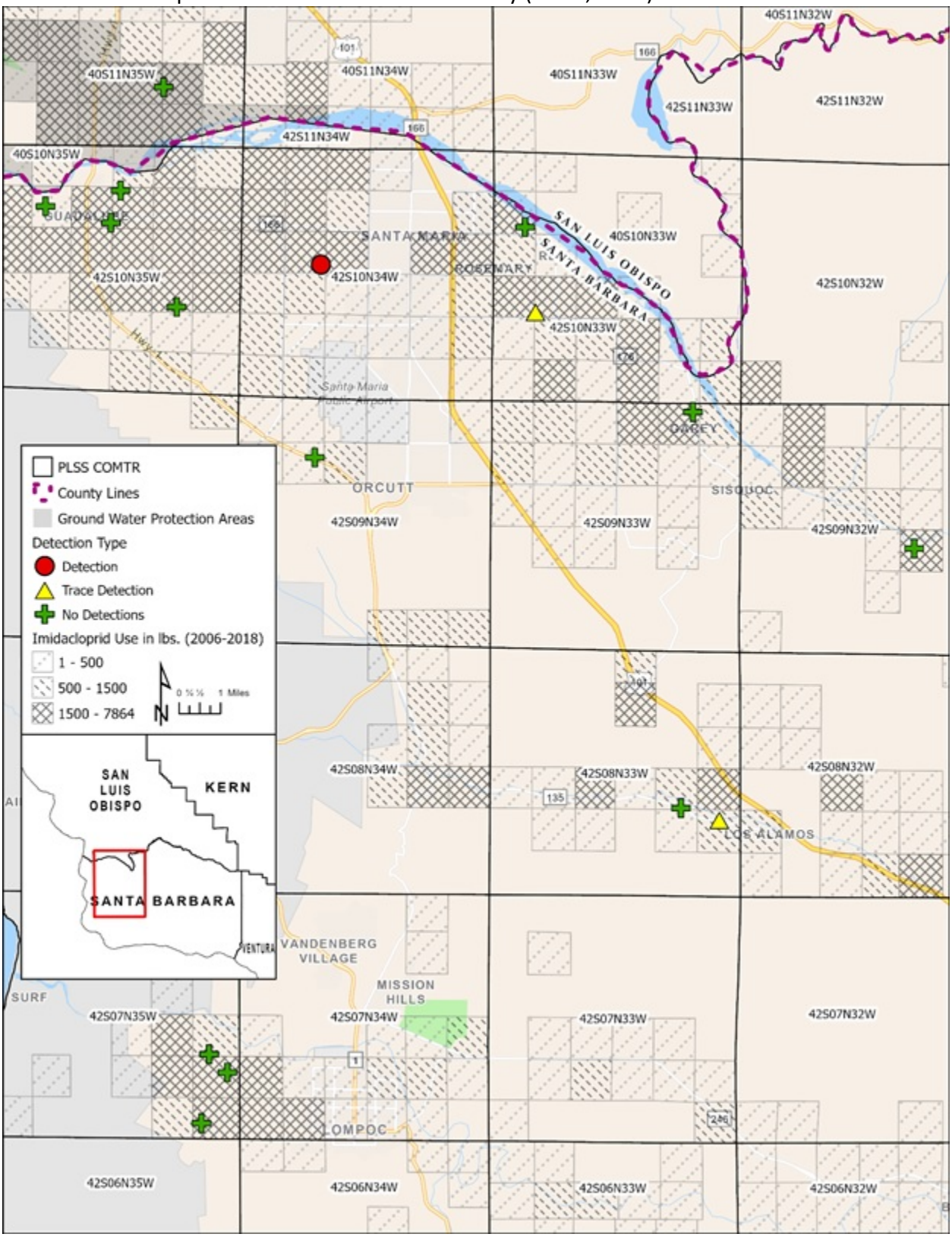


Figure 5. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in Tulare County (CDPR, 2020).

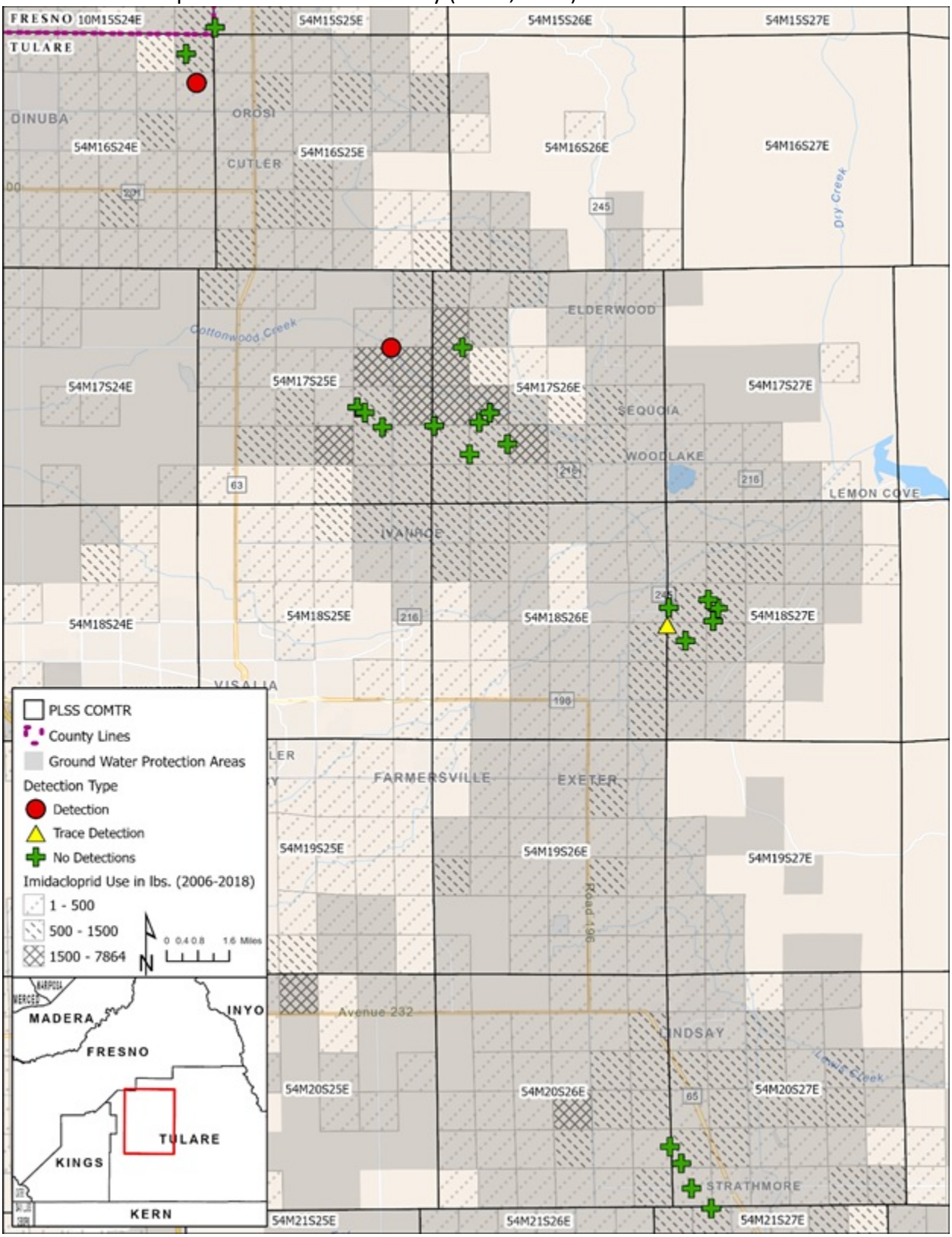


Figure 6. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in Monterey County (CDPR, 2020).

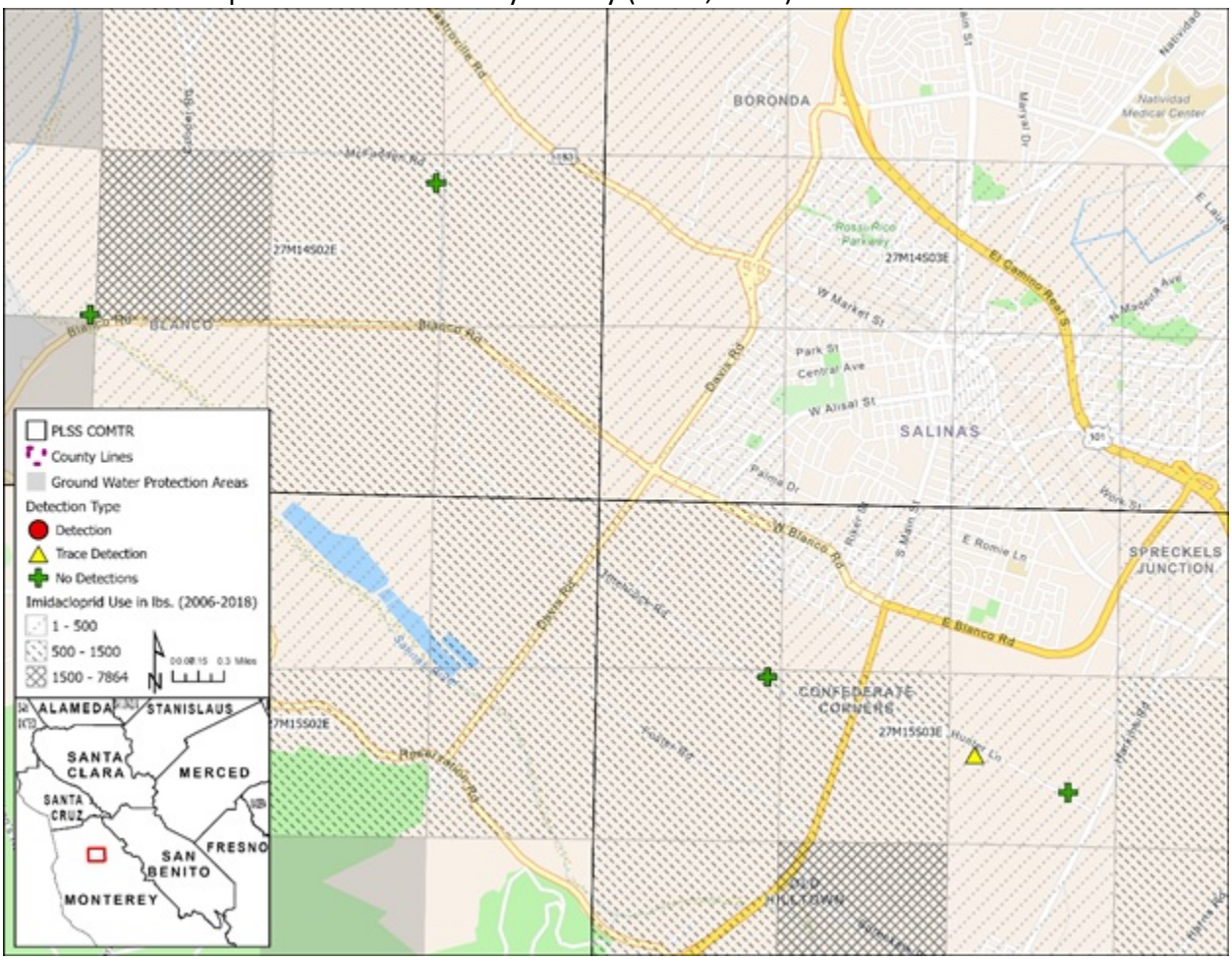


Figure 7. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in Kern County (CDPR, 2020).

Figure 8. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in Madera County (CDPR, 2020).

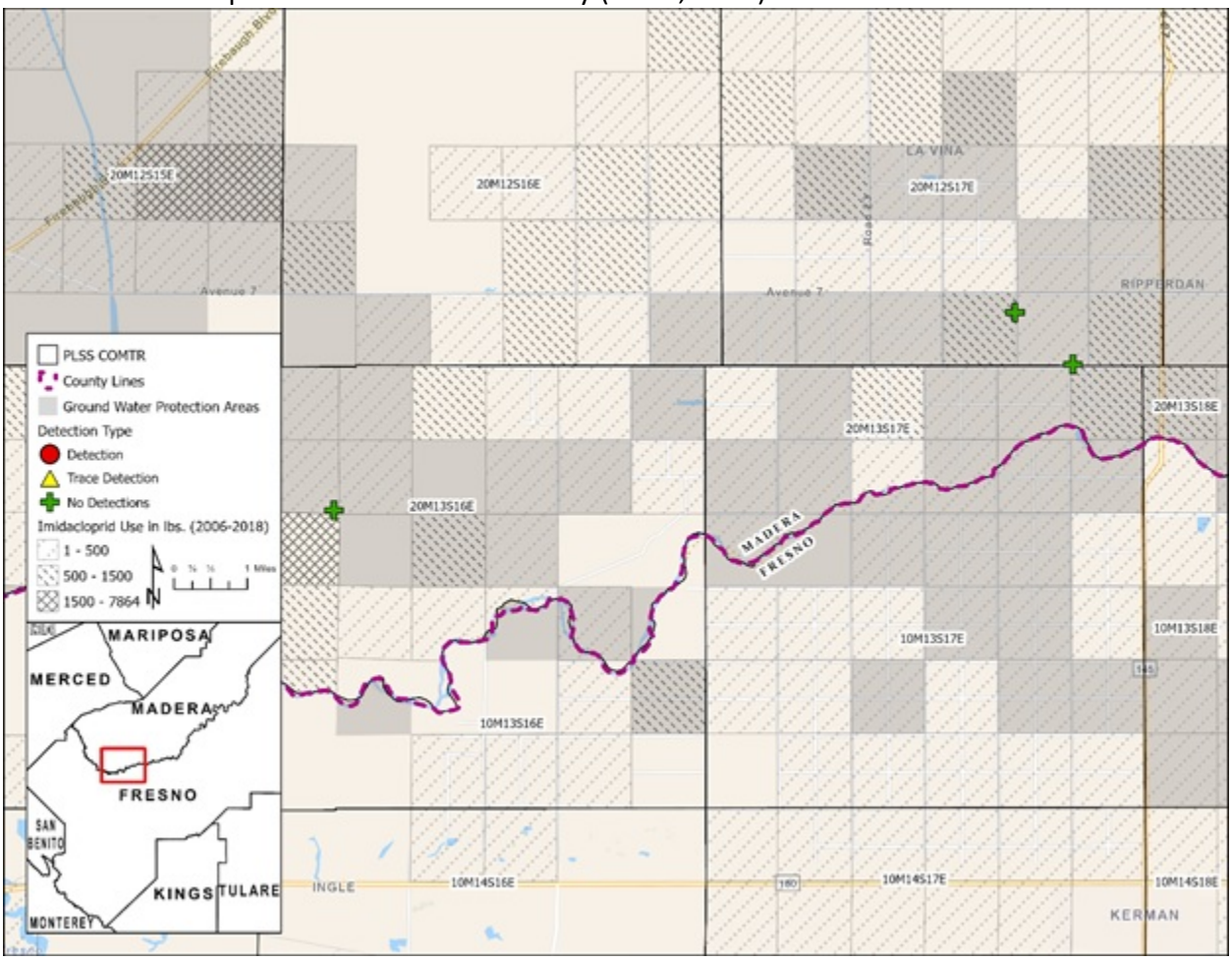
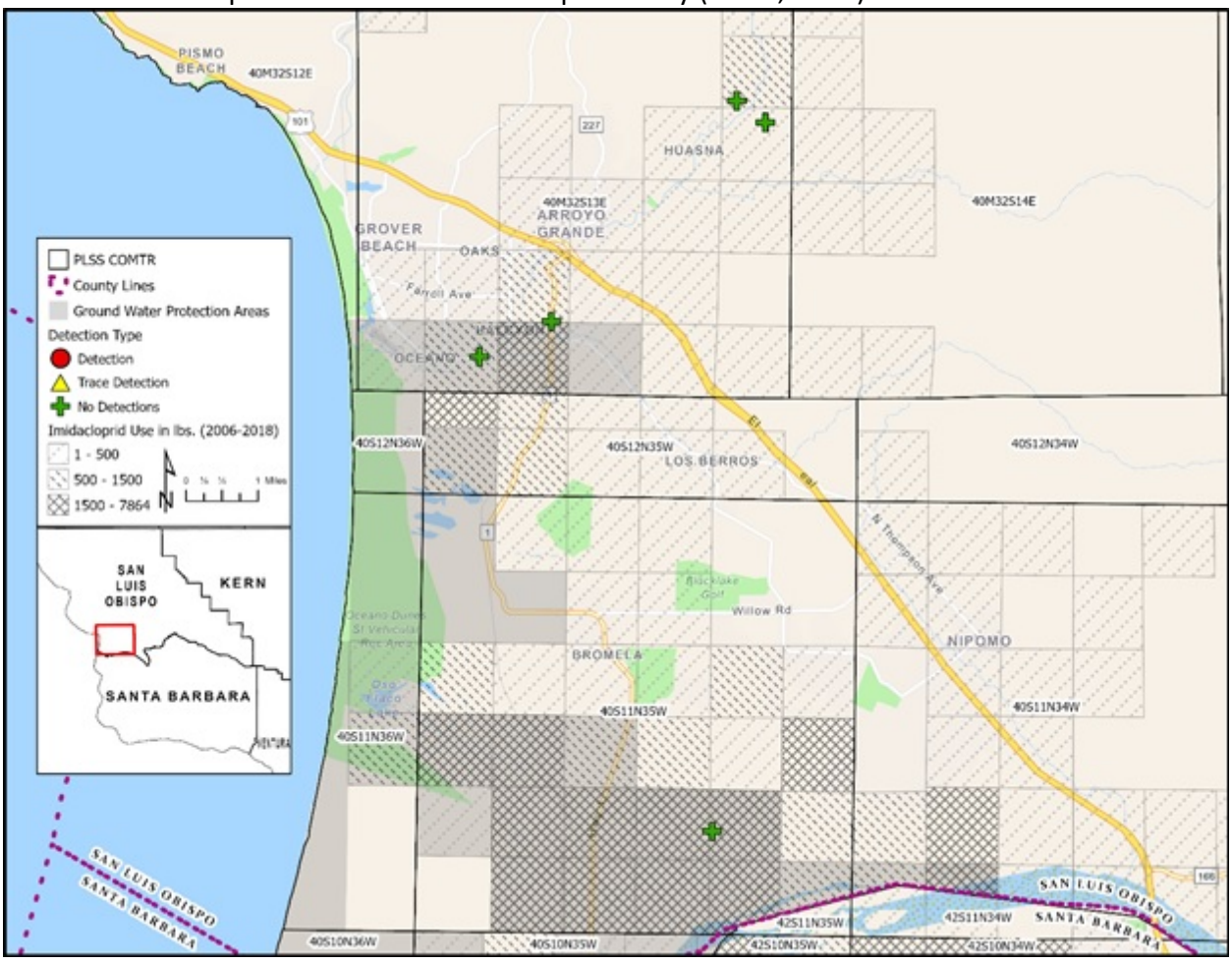


Figure 9. Total reported agricultural imidacloprid use (pounds per section) from 2006 to 2018 and sampled wells in San Luis Obispo County (CDPR, 2020).



APPENDIX 1: SAMPLE ANALYSIS RESULTS

Table A1-1. 2017 Imidacloprid Screen sample analysis results (ppb)*.

Sample Number	Sample Code**	County	Township/Range/Section	Location Code	Sample Date	Analysis Date	Imidacloprid***
109	P	Fresno	14S22E02	10-01	6/6/2017	6/29/2017	0.054
115	FB	Fresno	14S22E02	10-01	6/6/2017	9/7/2017	ND†
064	P	Fresno	14S22E01	10-02	6/6/2017	6/29/2017	Trace‡
070	FB	Fresno	14S22E01	10-02	6/6/2017	9/7/2017	ND
118	P	Fresno	13S22E35	10-03	6/6/2017	6/29/2017	ND
100	P	Fresno	14S22E01	10-04	6/7/2017	6/29/2017	Trace
106	FB	Fresno	14S22E01	10-04	6/7/2017	9/7/2017	ND
019	P	Fresno	13S22E36	10-05	6/7/2017	6/29/2017	ND
010	P	Fresno	14S22E31	10-06	6/7/2017	6/29/2017	ND
037	P	Fresno	15S21E09	10-07	6/7/2017	6/29/2017	Trace
043	FB	Fresno	15S21E09	10-07	6/7/2017	9/7/2017	ND
586	P	Fresno	14S22E18	10-11	6/26/2017	7/6/2017	Trace
592	FB	Fresno	14S22E18	10-11	6/26/2017	9/7/2017	ND
595	P	Fresno	15S22E06	10-12	6/27/2017	7/6/2017	0.067
601	FB	Fresno	15S22E06	10-12	6/27/2017	9/7/2017	ND
532	P	Fresno	14S21E33	10-13	6/27/2017	7/6/2017	ND
091	P	Fresno	15S23E03	10-14	6/27/2017	7/6/2017	Trace
097	FB	Fresno	15S23E03	10-14	6/27/2017	9/7/2017	ND
568	P	Fresno	15S24E25	10-15	6/27/2017	7/6/2017	ND
541	P	Fresno	15S24E35	10-16	6/27/2017	7/6/2017	ND
073	P	Fresno	15S24E25	10-21	6/28/2017	7/6/2017	ND
082	P	Fresno	15S24E23	10-22	6/28/2017	7/6/2017	ND
028	P	Madera	12S17E35	20-01	6/5/2017	6/29/2017	ND
145	P	Madera	12S17E34	20-02	6/5/2017	6/29/2017	ND
055	P	Madera	13S16E07	20-03	6/6/2017	6/29/2017	ND
793	P	San Luis Obispo	32S13E12	40-51	11/28/2017	12/13/2017	ND
352	P	San Luis Obispo	32S13E13	40-52	11/28/2017	12/12/2017	ND
676	P	San Luis Obispo	32S13E28	40-53	11/28/2017	12/13/2017	ND
658	P	San Luis Obispo	32S13E32	40-54	11/28/2017	12/13/2017	ND
703	P	San Luis Obispo	11N35W26	40-55	11/28/2017	12/13/2017	ND

Sample Number	Sample Code*	County	Township/Range/Section	Location Code	Sample Date	Analysis Date	Imidacloprid***
370	P	Santa Barbara	10N35W09	42-61	11/28/2017	12/12/2017	ND
397	P	Santa Barbara	10N35W23	42-62	11/28/2017	12/12/2017	ND
775	P	Santa Barbara	09N33W02	42-63	11/28/2017	12/12/2017	ND
667	P	Santa Barbara	07N35W25	42-64	11/29/2017	12/12/2017	ND
325	P	Santa Barbara	07N35W24	42-65	11/29/2017	12/12/2017	ND
694	P	Santa Barbara	09N34W08	42-71	11/29/2017	12/13/2017	ND
388	P	Santa Barbara	10N35W08	42-72	11/29/2017	12/12/2017	ND
640	P	Santa Barbara	10N35W10	42-73	11/29/2017	12/13/2017	ND
721	P	Santa Barbara	10N34W17	42-74	11/30/2017	12/13/2017	0.103
727	FB	Santa Barbara	10N34W17	42-74	11/30/2017	3/08/2018	ND
136	P	Tulare	17S25E23	54-01	6/5/2017	6/29/2017	ND
181	P	Tulare	17S26E30	54-02	6/6/2017	6/29/2017	ND
199	P	Tulare	17S25E11	54-03	6/6/2017	6/29/2017	0.069
205	FB	Tulare	17S25E11	54-03	6/6/2017	9/7/2017	ND
172	P	Tulare	17S26E18	54-04	6/6/2017	6/29/2017	ND
163	P	Tulare	17S25E26	54-05	6/6/2017	6/29/2017	ND
190	P	Tulare	17S25E23	54-06	6/6/2017	6/29/2017	ND
127	P	Tulare	17S26E20	54-07	6/7/2017	6/29/2017	ND
217	P	Tulare	17S26E20	54-08	6/7/2017	6/29/2017	ND
154	P	Tulare	17S26E29	54-09	6/7/2017	6/29/2017	ND
208	P	Tulare	17S26E30	54-10	6/7/2017	6/29/2017	ND
487	P	Tulare	18S26E24	54-11	6/26/2017	7/6/2017	Trace
493	FB	Tulare	18S26E24	54-11	6/26/2017	9/7/2017	ND
046	P	Tulare	18S27E18	54-12	6/26/2017	7/6/2017	ND
496	P	Tulare	18S27E19	54-13	6/27/2017	7/6/2017	ND
559	P	Tulare	18S27E17	54-14	6/27/2017	7/6/2017	ND
478	P	Tulare	18S27E17	54-15	6/27/2017	7/6/2017	ND
451	P	Tulare	18S27E17	54-16	6/27/2017	7/6/2017	ND
604	P	Tulare	20S26E25	54-17	6/28/2017	7/6/2017	ND
469	P	Tulare	20S27E30	54-18	6/28/2017	7/6/2017	ND

Sample Number	Sample Code*	County	Township/Range/Section	Location Code	Sample Date	Analysis Date	Imidacloprid***
550	P	Tulare	20S27E31	54-19	6/28/2017	7/6/2017	ND
577	P	Tulare	21S27E05	54-20	6/28/2017	7/6/2017	ND
460	P	Tulare	16S24E12	54-21	6/27/2017	7/6/2017	0.124
466	FB	Tulare	16S24E12	54-21	6/27/2017	9/7/2017	ND
001	P	Tulare	16S24E01	54-22	6/27/2017	7/6/2017	ND
613	P	Tulare	15S25E31	54-23	6/28/2017	7/6/2017	ND

* Samples collected in 2019 were analyzed for imidacloprid by Multi-Analyte Screen only, while samples collected in 2017 were analyzed by both methods, Imidacloprid Screen and Multi-Analyte Screen. Results from Multi-Analyte Screen are presented in Table A1-2.

** P = primary sample, FB = field blank sample.

*** Imidacloprid degradates were not detected in any of the samples.

† ND = non-detect = below the method detection limit of 0.01 ppb.

‡ Trace concentrations = between the method detection limit (0.01 ppb) and the reporting limit (0.05 ppb).

Table A1-2. LCMS Multi-Analyte Screen sample analysis results (ppb) for all wells. TR refers to a trace detection that is between the method detection limit and the reporting limit for each analyte. Analytes analyzed for in every sample that were not detected are listed at the bottom of the table.

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	Azinphos-Methyl	Bromacil	Carbofuran	Diuron	Fenamiphos	Imidacloprid	Mefenoxam/ Metalaxyl	Norflurazon	Simazine	Thiamethoxam	Uniconazole
111	P	Fresno	14S22E02	10-01	6/6/2017	6/13/2017	X	1.05	X	0.056	X	0.054	ND	TR	0.056	ND	X
117	FB	Fresno	14S22E02	10-01	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
066	P	Fresno	14S22E01	10-02	6/6/2017	6/13/2017	X	0.502	X	TR	X	TR	ND	0.283	0.053	ND	X
072	FB	Fresno	14S22E01	10-02	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
120	P	Fresno	13S22E35	10-03	6/6/2017	6/13/2017	X	0.231	X	TR	X	ND	ND	ND	TR	ND	X
126	FB	Fresno	13S22E35	10-03	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
102	P	Fresno	14S22E01	10-04	6/7/2017	6/13/2017	X	0.710	X	0.053	X	TR	ND	0.278	0.077	ND	X
108	FB	Fresno	14S22E01	10-04	6/7/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
021	P	Fresno	13S22E36	10-05	6/7/2017	6/13/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
012	P	Fresno	14S22E31	10-06	6/7/2017	6/13/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
039	P	Fresno	15S21E09	10-07	6/7/2017	6/13/2017	X	ND	X	ND	X	**TR**	ND	ND	0.055	TR	X
045	FB	Fresno	15S21E09	10-07	6/7/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
588	P	Fresno	14S22E18	10-11	6/26/2017	7/6/2017	X	ND	X	TR	X	ND	ND	ND	0.091	ND	X
594	FB	Fresno	14S22E18	10-11	6/26/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
597	P	Fresno	15S22E06	10-12	6/27/2017	7/6/2017	X	ND	X	TR	X	0.072	ND	ND	TR	ND	X
603	FB	Fresno	15S22E06	10-12	6/27/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
534	P	Fresno	14S21E33	10-13	6/27/2017	7/6/2017	X	TR	X	0.204	X	ND	ND	ND	0.072	ND	X
540	FB	Fresno	14S21E33	10-13	6/27/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
093	P	Fresno	15S23E03	10-14	6/27/2017	7/6/2017	X	ND	X	ND	X	ND	ND	ND	TR	ND	X
099	FB	Fresno	15S23E03	10-14	6/27/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
570	P	Fresno	15S24E25	10-15	6/27/2017	7/6/2017	X	TR	X	TR	X	ND	ND	ND	0.060	ND	X
576	FB	Fresno	15S24E25	10-15	6/27/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
543	P	Fresno	15S24E35	10-16	6/27/2017	7/6/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
075	P	Fresno	15S24E25	10-21	6/28/2017	7/6/2017	X	0.706	X	TR	X	ND	ND	0.073	0.051	ND	X
081	FB	Fresno	15S24E25	10-21	6/28/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
084	P	Fresno	15S24E23	10-22	6/28/2017	7/6/2017	X	ND	X	TR	X	ND	ND	TR	TR	ND	X
090	FB	Fresno	15S24E23	10-22	6/28/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	Azinphos-Methyl	Bromacil	Carbofuran	Diuron	Fenamiphos	Imidacloprid	Mefenoxam/ Metalaxyl	Norflurazon	Simazine	Thiamethoxam	Uniconazole
050	P	Kern	25S26E16	15-01	11/19/2019	11/27/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
302	P	Kern	25S26E17	15-02	11/19/2019	11/27/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
002	P	Kern	25S26E09	15-03	11/19/2019	11/27/2019	ND	TR	ND	ND	ND	ND	ND	ND	ND	ND	ND
006	FB	Kern	25S26E09	15-03	11/19/2019	12/10/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
030	P	Madera	12S17E35	20-01	6/5/2017	6/13/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
147	P	Madera	12S17E34	20-02	6/5/2017	6/13/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
057	P	Madera	13S16E07	20-03	6/6/2017	6/13/2017	X	ND	X	TR	X	ND	ND	ND	ND	ND	X
368	P	Monterey	15S03E09	27-01	11/5/2019	11/8/2019	ND	ND	ND	ND	ND	TR	ND	ND	ND	ND	ND
372	FB	Monterey	15S03E09	27-01	11/5/2019	12/10/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
272	P	Monterey	15S03E09	27-02	11/5/2019	11/8/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
152	P	Monterey	14S02E26	27-03	11/5/2019	11/8/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
320	P	Monterey	14S02E28	27-04	11/5/2019	11/8/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
038	P	Monterey	15S03E07	27-05	11/5/2019	11/8/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
795	P	San Luis Obispo	32S13E12	40-51	11/28/2017	12/5/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
354	P	San Luis Obispo	32S13E13	40-52	11/28/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
678	P	San Luis Obispo	32S13E28	40-53	11/28/2017	12/5/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
660	P	San Luis Obispo	32S13E32	40-54	11/28/2017	12/5/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
705	P	San Luis Obispo	11N35W26	40-55	11/28/2017	12/5/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
062	P	Santa Barbara	10N33W20	42-01	11/13/2019	11/22/2019	ND	ND	ND	ND	ND	TR	ND	ND	ND	TR	ND
066	FB	Santa Barbara	10N33W20	42-01	11/13/2019	12/10/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
314	P	Santa Barbara	10N33W07	42-02	11/13/2019	11/22/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
056	P	Santa Barbara	08N33W23	42-11	11/13/2019	11/22/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
362	P	Santa Barbara	08N33W25	42-12	11/14/2019	11/22/2019	ND	ND	ND	ND	ND	TR	ND	ND	ND	TR	ND
366	FB	Santa Barbara	08N33W25	42-12	11/14/2019	12/10/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
308	P	Santa Barbara	07N35W36	42-13	11/14/2019	11/22/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
290	P	Santa Barbara	09N32W23	42-14	11/15/2019	11/22/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
372	P	Santa Barbara	10N35W09	42-61	11/28/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
399	P	Santa Barbara	10N35W23	42-62	11/28/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
777	P	Santa Barbara	09N33W02	42-63	11/28/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
669	P	Santa Barbara	07N35W25	42-64	11/29/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	Azinphos-Methyl	Bromacil	Carbofuran	Diuron	Fenamiphos	Imidacloprid	Mefenoxam/ Metalaxyl	Norflurazon	Simazine	Thiamethoxam	Uniconazole
327	P	Santa Barbara	07N35W24	42-65	11/29/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
696	P	Santa Barbara	09N34W08	42-71	11/29/2017	12/5/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
390	P	Santa Barbara	10N35W08	42-72	11/29/2017	12/4/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
642	P	Santa Barbara	10N35W10	42-73	11/29/2017	12/5/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
723	P	Santa Barbara	10N34W17	42-74	11/30/2017	12/5/2017	X	ND	X	ND	X	0.104	ND	ND	ND	ND	X
729	FB	Santa Barbara	10N34W17	42-74	11/30/2017	3/12/2018	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
138	P	Tulare	17S25E23	54-01	6/5/2017	6/14/2017	X	0.612	X	TR	X	ND	ND	ND	TR	ND	X
144	FB	Tulare	17S25E23	54-01	6/5/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
183	P	Tulare	17S26E30	54-02	6/6/2017	6/14/2017	X	0.486	X	0.072	X	ND	ND	ND	ND	ND	X
189	FB	Tulare	17S26E30	54-02	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
201	P	Tulare	17S25E11	54-03	6/6/2017	6/14/2017	X	TR	X	ND	X	0.074	ND	0.063	TR	ND	X
207	FB	Tulare	17S25E11	54-03	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
174	P	Tulare	17S26E18	54-04	6/6/2017	6/14/2017	X	TR	X	0.052	X	ND	ND	0.052	0.082	ND	X
180	FB	Tulare	17S26E18	54-04	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
165	P	Tulare	17S25E26	54-05	6/6/2017	6/14/2017	X	0.504	X	TR	X	ND	ND	TR	TR	ND	X
171	FB	Tulare	17S25E26	54-05	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
192	P	Tulare	17S25E23	54-06	6/6/2017	6/14/2017	X	1.01	X	0.055	X	ND	ND	ND	TR	ND	X
198	FB	Tulare	17S25E23	54-06	6/6/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
129	P	Tulare	17S26E20	54-07	6/7/2017	6/13/2017	X	0.787	X	0.064	X	ND	ND	ND	TR	ND	X
135	FB	Tulare	17S26E20	54-07	6/7/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
219	P	Tulare	17S26E20	54-08	6/7/2017	6/14/2017	X	0.321	X	TR	X	ND	ND	ND	TR	ND	X
225	FB	Tulare	17S26E20	54-08	6/7/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
156	P	Tulare	17S26E29	54-09	6/7/2017	6/14/2017	X	0.760	X	TR	X	ND	ND	ND	TR	ND	X
162	FB	Tulare	17S26E29	54-09	6/7/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
210	P	Tulare	17S26E30	54-10	6/7/2017	6/14/2017	X	0.492	X	TR	X	ND	0.147	TR	TR	ND	X
216	FB	Tulare	17S26E30	54-10	6/7/2017	7/31/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
489	P	Tulare	18S26E24	54-11	6/26/2017	7/10/2017	X	ND	X	TR	X	ND	ND	0.139	0.059	ND	X
495	FB	Tulare	18S26E24	54-11	6/26/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
048	P	Tulare	18S27E18	54-12	6/26/2017	7/10/2017	X	ND	X	TR	X	ND	ND	TR	0.084	ND	X
054	FB	Tulare	18S27E18	54-12	6/26/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	Azinphos-Methyl	Bromacil	Carbofuran	Diuron	Fenamiphos	Imidacloprid	Mefenoxam/ Metalaxyl	Norflurazon	Simazine	Thiamethoxam	Uniconazole
498	P	Tulare	18S27E19	54-13	6/27/2017	7/10/2017	X	0.797	X	0.057	X	ND	ND	TR	TR	ND	X
504	FB	Tulare	18S27E19	54-13	6/27/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
561	P	Tulare	18S27E17	54-14	6/27/2017	7/10/2017	X	0.103	X	TR	X	ND	ND	TR	0.062	ND	X
567	FB	Tulare	18S27E17	54-14	6/27/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
480	P	Tulare	18S27E17	54-15	6/27/2017	7/10/2017	X	ND	X	TR	X	ND	ND	TR	TR	ND	X
486	FB	Tulare	18S27E17	54-15	6/27/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
453	P	Tulare	18S27E17	54-16	6/27/2017	7/10/2017	X	ND	X	TR	X	ND	ND	TR	TR	ND	X
459	FB	Tulare	18S27E17	54-16	6/27/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
606	P	Tulare	20S26E25	54-17	6/28/2017	7/10/2017	X	1.27	X	TR	X	ND	ND	ND	0.078	ND	X
612	FB	Tulare	20S26E25	54-17	6/28/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
471	P	Tulare	20S27E30	54-18	6/28/2017	7/10/2017	X	0.184	X	ND	X	ND	ND	ND	0.099	ND	X
477	FB	Tulare	20S27E30	54-18	6/28/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
552	P	Tulare	20S27E31	54-19	6/28/2017	7/10/2017	X	0.739	X	TR	X	ND	ND	TR	TR	ND	X
558	FB	Tulare	20S27E31	54-19	6/28/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
579	P	Tulare	21S27E05	54-20	6/28/2017	7/10/2017	X	1.10	X	TR	X	ND	ND	ND	TR	ND	X
585	FB	Tulare	21S27E05	54-20	6/28/2017	8/18/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
462	P	Tulare	16S24E12	54-21	6/27/2017	7/6/2017	X	ND	X	0.071	X	0.105	ND	0.064	TR	ND	X
468	FB	Tulare	16S24E12	54-21	6/27/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
003	P	Tulare	16S24E01	54-22	6/27/2017	7/6/2017	X	5.57	X	TR	X	ND	ND	0.073	TR	ND	X
009	FB	Tulare	16S24E01	54-22	6/27/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X
615	P	Tulare	15S25E31	54-23	6/28/2017	7/6/2017	X	0.441	X	TR	X	ND	ND	ND	0.063	ND	X
621	FB	Tulare	15S25E31	54-23	6/28/2017	8/17/2017	X	ND	X	ND	X	ND	ND	ND	ND	ND	X

* P = primary sample, FB = field blank sample.

† ND = non-detect = below the method detection limit.

X = Not analyzed in the screen initially. These analytes were added in 2018.

Atrazine, azoxystrobin, bensulide, carbaryl, diazinon, dimethenamide, dimethoate, ethofumesate, fludioxonil, linuron, methiocarb, metolachlor, metribuzin, napropamide, oryzalin, prometon, tebuthiuron, and thiobencarb were analyzed in every sample but were non-detects.

Table A1-3. GCMS Multi-Analyte Screen sample analysis results (ppb) for all wells. TR refers to a trace detection that is between the method detection limit and the reporting limit for each analyte. Analytes analyzed for every sample that were not detected are listed at the bottom of the table.

Sample Number	Sample Code*	County	Township/ Range/ Section	Location Code	Sample Date	Analysis Date	Disulfoton	Ethoprophos	Ethyl Parathion	Fonofos	Methyl Parathion	Piperonyl Butoxide
111	P	Fresno	14S22E02	10-01	6/6/2017	6/15/2017	X	TR	X	X	X	X
117	FB	Fresno	14S22E02	10-01	6/6/2017	7/31/2017	X	ND†	X	X	X	X
066	P	Fresno	14S22E01	10-02	6/6/2017	6/15/2017	X	ND	X	X	X	X
072	FB	Fresno	14S22E01	10-02	6/6/2017	7/31/2017	X	ND	X	X	X	X
120	P	Fresno	13S22E35	10-03	6/6/2017	6/15/2017	X	ND	X	X	X	X
126	FB	Fresno	13S22E35	10-03	6/6/2017	7/31/2017	X	ND	X	X	X	X
102	P	Fresno	14S22E01	10-04	6/7/2017	6/15/2017	X	ND	X	X	X	X
108	FB	Fresno	14S22E01	10-04	6/7/2017	7/31/2017	X	ND	X	X	X	X
021	P	Fresno	13S22E36	10-05	6/7/2017	6/15/2017	X	ND	X	X	X	X
012	P	Fresno	14S22E31	10-06	6/7/2017	6/15/2017	X	ND	X	X	X	X
039	P	Fresno	15S21E09	10-07	6/7/2017	6/15/2017	X	ND	X	X	X	X
045	FB	Fresno	15S21E09	10-07	6/7/2017	7/31/2017	X	ND	X	X	X	X
588	P	Fresno	14S22E18	10-11	6/26/2017	7/7/2017	X	ND	X	X	X	X
594	FB	Fresno	14S22E18	10-11	6/26/2017	8/21/2017	X	ND	X	X	X	X
597	P	Fresno	15S22E06	10-12	6/27/2017	7/7/2017	X	ND	X	X	X	X
603	FB	Fresno	15S22E06	10-12	6/27/2017	8/21/2017	X	ND	X	X	X	X
534	P	Fresno	14S21E33	10-13	6/27/2017	7/7/2017	X	ND	X	X	X	X
540	FB	Fresno	14S21E33	10-13	6/27/2017	8/21/2017	X	ND	X	X	X	X
093	P	Fresno	15S23E03	10-14	6/27/2017	7/7/2017	X	ND	X	X	X	X
099	FB	Fresno	15S23E03	10-14	6/27/2017	8/21/2017	X	ND	X	X	X	X
570	P	Fresno	15S24E25	10-15	6/27/2017	7/7/2017	X	ND	X	X	X	X
576	FB	Fresno	15S24E25	10-15	6/27/2017	8/21/2017	X	ND	X	X	X	X
543	P	Fresno	15S24E35	10-16	6/27/2017	7/7/2017	X	ND	X	X	X	X
075	P	Fresno	15S24E25	10-21	6/28/2017	7/7/2017	X	ND	X	X	X	X
081	FB	Fresno	15S24E25	10-21	6/28/2017	8/21/2017	X	ND	X	X	X	X
084	P	Fresno	15S24E23	10-22	6/28/2017	7/7/2017	X	ND	X	X	X	X
090	FB	Fresno	15S24E23	10-22	6/28/2017	8/21/2017	X	ND	X	X	X	X

Sample Number	Sample Code*	County	Township/ Range/ Section	Location Code	Sample Date	Analysis Date	Disulfoton	Ethoprophos	Ethyl Parathion	Fonofos	Methyl Parathion	Piperonyl Butoxide
050	P	Kern	25S26E16	15-01	11/19/2019	12/2/2019	ND	ND	ND	ND	ND	ND
302	P	Kern	25S26E17	15-02	11/19/2019	12/2/2019	ND	ND	ND	ND	ND	ND
002	P	Kern	25S26E09	15-03	11/19/2019	12/2/2019	ND	ND	ND	ND	ND	ND
030	P	Madera	12S17E35	20-01	6/5/2017	6/15/2017	X	ND	X	X	X	X
147	P	Madera	12S17E34	20-02	6/5/2017	6/15/2017	X	ND	X	X	X	X
057	P	Madera	13S16E07	20-03	6/6/2017	6/15/2017	X	ND	X	X	X	X
368	P	Monterey	15S03E09	27-01	11/5/2019	11/13/2019	ND	ND	ND	ND	ND	ND
272	P	Monterey	15S03E09	27-02	11/5/2019	11/13/2019	ND	ND	ND	ND	ND	ND
152	P	Monterey	14S02E26	27-03	11/5/2019	11/13/2019	ND	ND	ND	ND	ND	ND
320	P	Monterey	14S02E28	27-04	11/5/2019	11/13/2019	ND	ND	ND	ND	ND	ND
038	P	Monterey	15S03E07	27-05	11/5/2019	11/13/2019	ND	ND	ND	ND	ND	ND
795	P	San Luis Obispo	32S13E12	40-51	11/28/2017	12/6/2017	X	ND	X	X	X	X
354	P	San Luis Obispo	32S13E13	40-52	11/28/2017	12/5/2017	X	ND	X	X	X	X
678	P	San Luis Obispo	32S13E28	40-53	11/28/2017	12/6/2017	X	ND	X	X	X	X
660	P	San Luis Obispo	32S13E32	40-54	11/28/2017	12/6/2017	X	ND	X	X	X	X
705	P	San Luis Obispo	11N35W26	40-55	11/28/2017	12/6/2017	X	ND	X	X	X	X
062	P	Santa Barbara	10N33W20	42-01	11/13/2019	11/19/2019	ND	ND	ND	ND	ND	ND
314	P	Santa Barbara	10N33W07	42-02	11/13/2019	11/19/2019	ND	ND	ND	ND	ND	ND
056	P	Santa Barbara	08N33W23	42-11	11/13/2019	11/19/2019	ND	ND	ND	ND	ND	ND
362	P	Santa Barbara	08N33W25	42-12	11/14/2019	11/19/2019	ND	ND	ND	ND	ND	ND
308	P	Santa Barbara	07N35W36	42-13	11/14/2019	11/19/2019	ND	ND	ND	ND	ND	ND
290	P	Santa Barbara	09N32W23	42-14	11/15/2019	11/19/2019	ND	ND	ND	ND	ND	ND
372	P	Santa Barbara	10N35W09	42-61	11/28/2017	12/5/2017	X	ND	X	X	X	X
399	P	Santa Barbara	10N35W23	42-62	11/28/2017	12/5/2017	X	ND	X	X	X	X
777	P	Santa Barbara	09N33W02	42-63	11/28/2017	12/5/2017	X	ND	X	X	X	X
669	P	Santa Barbara	07N35W25	42-64	11/29/2017	12/5/2017	X	ND	X	X	X	X
327	P	Santa Barbara	07N35W24	42-65	11/29/2017	12/5/2017	X	ND	X	X	X	X
696	P	Santa Barbara	09N34W08	42-71	11/29/2017	12/6/2017	X	ND	X	X	X	X
390	P	Santa Barbara	10N35W08	42-72	11/29/2017	12/5/2017	X	ND	X	X	X	X
642	P	Santa Barbara	10N35W10	42-73	11/29/2017	12/6/2017	X	ND	X	X	X	X

Sample Number	Sample Code*	County	Township/ Range/ Section	Location Code	Sample Date	Analysis Date	Disulfoton	Ethoprophos	Ethyl Parathion	Fonofos	Methyl Parathion	Piperonyl Butoxide
723	P	Santa Barbara	10N34W17	42-74	11/30/2017	12/6/2017	X	ND	X	X	X	X
138	P	Tulare	17S25E23	54-01	6/5/2017	6/23/2017	X	ND	X	X	X	X
144	FB	Tulare	17S25E23	54-01	6/5/2017	7/31/2017	X	ND	X	X	X	X
183	P	Tulare	17S26E30	54-02	6/6/2017	6/23/2017	X	ND	X	X	X	X
189	FB	Tulare	17S26E30	54-02	6/6/2017	7/31/2017	X	ND	X	X	X	X
201	P	Tulare	17S25E11	54-03	6/6/2017	6/23/2017	X	ND	X	X	X	X
207	FB	Tulare	17S25E11	54-03	6/6/2017	7/31/2017	X	ND	X	X	X	X
174	P	Tulare	17S26E18	54-04	6/6/2017	6/23/2017	X	ND	X	X	X	X
180	FB	Tulare	17S26E18	54-04	6/6/2017	7/31/2017	X	ND	X	X	X	X
165	P	Tulare	17S25E26	54-05	6/6/2017	6/23/2017	X	ND	X	X	X	X
171	FB	Tulare	17S25E26	54-05	6/6/2017	7/31/2017	X	ND	X	X	X	X
192	P	Tulare	17S25E23	54-06	6/6/2017	6/23/2017	X	ND	X	X	X	X
198	FB	Tulare	17S25E23	54-06	6/6/2017	7/31/2017	X	ND	X	X	X	X
129	P	Tulare	17S26E20	54-07	6/7/2017	6/15/2017	X	ND	X	X	X	X
135	FB	Tulare	17S26E20	54-07	6/7/2017	7/31/2017	X	ND	X	X	X	X
219	P	Tulare	17S26E20	54-08	6/7/2017	6/23/2017	X	ND	X	X	X	X
225	FB	Tulare	17S26E20	54-08	6/7/2017	7/31/2017	X	ND	X	X	X	X
156	P	Tulare	17S26E29	54-09	6/7/2017	6/23/2017	X	ND	X	X	X	X
162	FB	Tulare	17S26E29	54-09	6/7/2017	7/31/2017	X	ND	X	X	X	X
210	P	Tulare	17S26E30	54-10	6/7/2017	6/23/2017	X	ND	X	X	X	X
216	FB	Tulare	17S26E30	54-10	6/7/2017	7/31/2017	X	ND	X	X	X	X
489	P	Tulare	18S26E24	54-11	6/26/2017	7/7/2017	X	ND	X	X	X	X
495	FB	Tulare	18S26E24	54-11	6/26/2017	8/23/2017	X	ND	X	X	X	X
048	P	Tulare	18S27E18	54-12	6/26/2017	7/7/2017	X	ND	X	X	X	X
054	FB	Tulare	18S27E18	54-12	6/26/2017	8/23/2017	X	ND	X	X	X	X
498	P	Tulare	18S27E19	54-13	6/27/2017	7/7/2017	X	ND	X	X	X	X
504	FB	Tulare	18S27E19	54-13	6/27/2017	8/23/2017	X	ND	X	X	X	X
561	P	Tulare	18S27E17	54-14	6/27/2017	7/7/2017	X	ND	X	X	X	X
567	FB	Tulare	18S27E17	54-14	6/27/2017	8/23/2017	X	ND	X	X	X	X
480	P	Tulare	18S27E17	54-15	6/27/2017	7/7/2017	X	ND	X	X	X	X

Sample Number	Sample Code*	County	Township/ Range/ Section	Location Code	Sample Date	Analysis Date	Disulfoton	Ethoprophos	Ethyl Parathion	Fonofos	Methyl Parathion	Piperonyl Butoxide
486	FB	Tulare	18S27E17	54-15	6/27/2017	8/23/2017	X	ND	X	X	X	X
453	P	Tulare	18S27E17	54-16	6/27/2017	7/7/2017	X	ND	X	X	X	X
459	FB	Tulare	18S27E17	54-16	6/27/2017	8/23/2017	X	ND	X	X	X	X
606	P	Tulare	20S26E25	54-17	6/28/2017	7/7/2017	X	ND	X	X	X	X
612	FB	Tulare	20S26E25	54-17	6/28/2017	8/23/2017	X	ND	X	X	X	X
471	P	Tulare	20S27E30	54-18	6/28/2017	7/7/2017	X	ND	X	X	X	X
477	FB	Tulare	20S27E30	54-18	6/28/2017	8/23/2017	X	ND	X	X	X	X
552	P	Tulare	20S27E31	54-19	6/28/2017	7/7/2017	X	ND	X	X	X	X
558	FB	Tulare	20S27E31	54-19	6/28/2017	8/23/2017	X	ND	X	X	X	X
579	P	Tulare	21S27E05	54-20	6/28/2017	7/7/2017	X	ND	X	X	X	X
585	FB	Tulare	21S27E05	54-20	6/28/2017	8/23/2017	X	ND	X	X	X	X
462	P	Tulare	16S24E12	54-21	6/27/2017	7/7/2017	X	ND	X	X	X	X
468	FB	Tulare	16S24E12	54-21	6/27/2017	8/21/2017	X	ND	X	X	X	X
003	P	Tulare	16S24E01	54-22	6/27/2017	7/7/2017	X	ND	X	X	X	X
009	FB	Tulare	16S24E01	54-22	6/27/2017	8/21/2017	X	ND	X	X	X	X
615	P	Tulare	15S25E31	54-23	6/28/2017	7/7/2017	X	ND	X	X	X	X
621	FB	Tulare	15S25E31	54-23	6/28/2017	8/21/2017	X	ND	X	X	X	X

* P = primary sample, FB = field blank sample.

X = Not analyzed in the screen initially. These analytes were added to the screen in 2018.

† ND = non-detect = below the method detection limit.

Clomazone, dichloran, dichlobenil, malathion, phorate, prometryn, propanil, and triallate were analyzed in every sample but were non-detects.

Table A1-4. Triazine Screen sample analysis results (ppb) for all wells. TR refers to a trace detection that is between the method detection limit and the reporting limit for each analyte. Analytes analyzed for every sample that were not detected are listed at the bottom of the table.

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	ACET	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Simazine	Propazine %
110	P	Fresno	14S22E02	10-01	6/6/2017	7/14/2017	0.259	0.442	1.13	TR	TR	0.094	ND†	TR	TR	68.0
116	FB	Fresno	14S22E02	10-01	6/6/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	88.0
065	P	Fresno	14S22E01	10-02	6/6/2017	7/14/2017	0.176	0.338	0.673	ND	TR	1.97	ND	0.264	TR	75.0
071	FB	Fresno	14S22E01	10-02	6/6/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	70.0
119	P	Fresno	13S22E35	10-03	6/6/2017	7/14/2017	0.093	0.344	0.293	ND	TR	0.059	ND	TR	TR	58.5
125	FB	Fresno	13S22E35	10-03	6/6/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	76.5
101	P	Fresno	14S22E01	10-04	6/7/2017	7/14/2017	0.201	0.468	0.480	ND	TR	0.390	ND	0.251	0.057	77.5
107	FB	Fresno	14S22E01	10-04	6/7/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	75.5
020	P	Fresno	13S22E36	10-05	6/7/2017	7/14/2017	ND	ND	0.066	ND	ND	ND	ND	ND	ND	72.0
026	FB	Fresno	13S22E36	10-05	6/7/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	73.0
011	P	Fresno	14S22E31	10-06	6/7/2017	7/14/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	70.0
038	P	Fresno	15S21E09	10-07	6/7/2017	7/14/2017	0.110	ND	0.215	ND	ND	TR	ND	ND	0.050	76.5
044	FB	Fresno	15S21E09	10-07	6/7/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.0
587	P	Fresno	14S22E18	10-11	6/26/2017	7/21/2017	0.144	ND	0.380	ND	TR	TR	ND	ND	0.052	68.5
593	FB	Fresno	14S22E18	10-11	6/26/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.5
596	P	Fresno	15S22E06	10-12	6/27/2017	7/21/2017	0.097	ND	0.455	ND	TR	TR	ND	ND	TR	58.0
602	FB	Fresno	15S22E06	10-12	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	90.0
533	P	Fresno	14S21E33	10-13	6/27/2017	7/21/2017	0.218	TR	0.386	ND	0.122	ND	ND	ND	TR	61.5
539	FB	Fresno	14S21E33	10-13	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	85.5
092	P	Fresno	15S23E03	10-14	6/27/2017	7/21/2017	TR	ND	0.143	ND	ND	TR	ND	TR	TR	67.0
098	FB	Fresno	15S23E03	10-14	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	79.0
569	P	Fresno	15S24E25	10-15	6/27/2017	7/21/2017	0.360	TR	1.70	ND	TR	ND	ND	ND	TR	66.0
575	FB	Fresno	15S24E25	10-15	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	71.5
542	P	Fresno	15S24E35	10-16	6/27/2017	7/21/2017	ND	ND	0.093	ND	ND	ND	ND	ND	ND	67.5
548	FB	Fresno	15S24E35	10-16	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	82.5
074	P	Fresno	15S24E25	10-21	6/28/2017	7/21/2017	0.418	0.337	1.73	ND	TR	TR	ND	ND	TR	57.0
080	FB	Fresno	15S24E25	10-21	6/28/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	80.0

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	ACET	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Simazine	Propazine %
083	P	Fresno	15S24E23	10-22	6/28/2017	7/21/2017	0.324	ND	1.84	ND	TR	0.170	ND	TR	TR	65.0
089	FB	Fresno	15S24E23	10-22	6/28/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	71.0
049	P	Kern	25S26E16	15-01	11/19/2019	12/2/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	81.0
301	P	Kern	25S26E17	15-02	11/19/2019	12/2/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	83.0
001	P	Kern	25S26E09	15-03	11/19/2019	12/2/2019	TR	TR	TR	ND	ND	ND	ND	ND	ND	80.5
029	P	Madera	12S17E35	20-01	6/5/2017	7/14/2017	0.095	ND	0.394	ND	TR	ND	ND	ND	ND	79.0
035	FB	Madera	12S17E35	20-01	6/5/2017	8/22/2017	ND	ND	ND	ND	ND	ND	TR	ND	ND	67.5
146	P	Madera	12S17E34	20-02	6/5/2017	7/14/2017	TR	ND	0.529	ND	ND	ND	ND	ND	ND	69.0
152	FB	Madera	12S17E34	20-02	6/5/2017	8/22/2017	ND	ND	ND	ND	ND	ND	TR	ND	ND	76.5
056	P	Madera	13S16E07	20-03	6/6/2017	7/14/2017	TR	ND	0.160	ND	TR	ND	TR	ND	ND	64.0
062	FB	Madera	13S16E07	20-03	6/6/2017	8/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	77.0
367	P	Monterey	15S03E09	27-01	11/5/2019	11/14/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	77.0
271	P	Monterey	15S03E09	27-02	11/5/2019	11/14/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	83.0
151	P	Monterey	14S02E26	27-03	11/5/2019	11/14/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	85.0
319	P	Monterey	14S02E28	27-04	11/5/2019	11/14/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	82.5
037	P	Monterey	15S03E07	27-05	11/5/2019	11/14/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	83.0
794	P	San Luis Obispo	32S13E12	40-51	11/28/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	54.0
353	P	San Luis Obispo	32S13E13	40-52	11/28/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	62.5
677	P	San Luis Obispo	32S13E28	40-53	11/28/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	59.0
659	P	San Luis Obispo	32S13E32	40-54	11/28/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	62.5
704	P	San Luis Obispo	11N35W26	40-55	11/28/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	62.5
061	P	Santa Barbara	10N33W20	42-01	11/13/2019	11/20/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	79.0
313	P	Santa Barbara	10N33W07	42-02	11/13/2019	11/20/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.5
055	P	Santa Barbara	08N33W23	42-11	11/13/2019	11/20/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.0
361	P	Santa Barbara	08N33W25	42-12	11/14/2019	11/20/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	71.5
307	P	Santa Barbara	07N35W36	42-13	11/14/2019	11/20/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	84.5
289	P	Santa Barbara	09N32W23	42-14	11/15/2019	11/20/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	74.0
371	P	Santa Barbara	10N35W09	42-61	11/28/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	70.5
398	P	Santa Barbara	10N35W23	42-62	11/28/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	59.5
776	P	Santa Barbara	09N33W02	42-63	11/28/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	71.0

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	ACET	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Simazine	Propazine %
668	P	Santa Barbara	07N35W25	42-64	11/29/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	60.0
326	P	Santa Barbara	07N35W24	42-65	11/29/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	54.0
695	P	Santa Barbara	09N34W08	42-71	11/29/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	55.5
389	P	Santa Barbara	10N35W08	42-72	11/29/2017	12/6/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	66.0
641	P	Santa Barbara	10N35W10	42-73	11/29/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	68.0
722	P	Santa Barbara	10N34W17	42-74	11/30/2017	12/8/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	61.5
137	P	Tulare	17S25E23	54-01	6/5/2017	7/14/2017	0.178	0.819	**0.963**	ND	**TR**	ND	ND	ND	**TR**	72.0
143	FB	Tulare	17S25E23	54-01	6/5/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.5
182	P	Tulare	17S26E30	54-02	6/6/2017	7/14/2017	0.281	0.297	1.90	ND	0.05	ND	ND	ND	ND	75.0
188	FB	Tulare	17S26E30	54-02	6/6/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	85.5
200	P	Tulare	17S25E11	54-03	6/6/2017	7/14/2017	0.271	TR	0.498	ND	ND	0.061	ND	0.058	**TR**	84.5
206	FB	Tulare	17S25E11	54-03	6/6/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	88.5
173	P	Tulare	17S26E18	54-04	6/6/2017	7/14/2017	0.291	TR	0.631	ND	TR	TR	ND	TR	0.058	75.0
179	FB	Tulare	17S26E18	54-04	6/6/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND**
164	P	Tulare	17S25E26	54-05	6/6/2017	7/14/2017	0.187	0.367	0.803	ND	TR	TR	ND	TR	TR	68.5
170	FB	Tulare	17S25E26	54-05	6/6/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	77.0
191	P	Tulare	17S25E23	54-06	6/6/2017	7/14/2017	0.340	1.23	2.26	ND	TR	ND	ND	ND	TR	72.5
197	FB	Tulare	17S25E23	54-06	6/6/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.0
128	P	Tulare	17S26E20	54-07	6/7/2017	7/14/2017	0.382	0.488	2.45	TR	TR	ND	ND	ND	TR	84.0
134	FB	Tulare	17S26E20	54-07	6/7/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	84.0
218	P	Tulare	17S26E20	54-08	6/7/2017	7/14/2017	0.480	0.257	1.35	TR	TR	TR	ND	ND	TR	91.0
224	FB	Tulare	17S26E20	54-08	6/7/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	71.5
155	P	Tulare	17S26E29	54-09	6/7/2017	7/14/2017	0.657	0.895	3.35	ND	TR	ND	ND	ND	TR	79.0
161	FB	Tulare	17S26E29	54-09	6/7/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	76.5
209	P	Tulare	17S26E30	54-10	6/7/2017	7/14/2017	0.400	0.419	2.26	ND	TR	TR	ND	TR	TR	69.0
215	FB	Tulare	17S26E30	54-10	6/7/2017	8/29/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	80.0
488	P	Tulare	18S26E24	54-11	6/26/2017	7/25/2017	0.243	ND	1.22	ND	ND	0.185	ND	0.125	TR	73.0
494	FB	Tulare	18S26E24	54-11	6/26/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	66.5
047	P	Tulare	18S27E18	54-12	6/26/2017	7/25/2017	0.129	ND	0.865	ND	TR	0.109	ND	TR	0.052	71.0
053	P	Tulare	18S27E18	54-12	6/26/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	77.0

Sample Number	Sample Code*	County	Township/ Range/Section	Location Code	Sample Date	Analysis Date	ACET	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Simazine	Propazine %
497	P	Tulare	18S27E19	54-13	6/27/2017	7/25/2017	0.464	0.518	3.73	ND	TR	0.056	ND	TR	TR	71.0
503	FB	Tulare	18S27E19	54-13	6/27/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	64.0
560	P	Tulare	18S27E17	54-14	6/27/2017	7/25/2017	0.195	0.075	0.741	ND	TR	0.068	ND	TR	TR	68.0
566	FB	Tulare	18S27E17	54-14	6/27/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	80.5
479	P	Tulare	18S27E17	54-15	6/27/2017	7/25/2017	0.437	ND	3.45	ND	TR	TR	ND	TR	TR	80.0
485	FB	Tulare	18S27E17	54-15	6/27/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	75.0
452	P	Tulare	18S27E17	54-16	6/27/2017	7/25/2017	0.468	ND	2.36	ND	ND	0.151	ND	TR	TR	77.0
458	FB	Tulare	18S27E17	54-16	6/27/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.5
605	P	Tulare	20S26E25	54-17	6/28/2017	7/25/2017	0.560	1.02	2.69	ND	TR	ND	ND	ND	0.055	70.0
611	FB	Tulare	20S26E25	54-17	6/28/2017	9/18/2017	ND	ND	ND	ND	ND	ND	TR	ND	ND	64.0
470	P	Tulare	20S27E30	54-18	6/28/2017	7/25/2017	0.714	0.159	1.91	ND	ND	ND	ND	ND	0.064	73.0
476	FB	Tulare	20S27E30	54-18	6/28/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	78.0
551	P	Tulare	20S27E31	54-19	6/28/2017	7/25/2017	0.117	0.309	0.254	ND	TR	TR	ND	TR	TR	76.0
557	FB	Tulare	20S27E31	54-19	6/28/2017	9/18/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	79.5
578	P	Tulare	21S27E05	54-20	6/28/2017	7/25/2017	0.122	0.714	0.355	ND	TR	ND	ND	ND	TR	75.0
584	FB	Tulare	21S27E05	54-20	6/28/2017	9/18/2017	ND	ND	ND	ND	ND	ND	TR	ND	ND	82.5
461	P	Tulare	16S24E12	54-21	6/27/2017	7/21/2017	0.104	ND	0.473	ND	TR	0.306	ND	TR	TR	61.5
467	FB	Tulare	16S24E12	54-21	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND**
002	P	Tulare	16S24E01	54-22	6/27/2017	7/21/2017	0.328	5.10	1.48	ND	TR	0.165	ND	0.056	TR	57.0
008	FB	Tulare	16S24E01	54-22	6/27/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	84.5
614	P	Tulare	15S25E31	54-23	6/28/2017	7/21/2017	0.395	0.258	1.59	ND	TR	ND	ND	ND	TR	75.0
620	FB	Tulare	15S25E31	54-23	6/28/2017	8/28/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	91.5

* P = primary sample, FB = field blank sample.

† ND = non-detect = below the method detection limit.

** = Lab extracted sample without adding propazine surrogate fortification.

Atrazine and prometon were analyzed in every sample but were non-detects.