SUPPORTING INFORMATION

Assessing pesticide application contributions of per- and polyfluoroalkyl substances (PFAS) in agricultural streams

Emily E. Woodward[1,*]

Michelle L. Hladik[2]

James L. Orlando[2]

Matthew Uychutin[2]

James L. Gray[3]

Dana W. Kolpin[4]

[1] U.S. Geological Survey, 1025 Washington Pike, Bridgeville, Pennsylvania 15017

[2] U.S. Geological Survey, 6000 J. Street, Placer Hall, Sacramento, California 95819

[3] U.S. Geological Survey, Denver Federal Center, Lakewood, Colorado 80225

[4] U.S. Geological Survey, 400 S. Clinton St., Iowa City, Iowa, 52240

[*] Corresponding author. Email address: ewoodward@usgs.gov

*Corresponding author email: ewoodward@usgs.gov

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Quality assurance and quality control

All quality assurance and quality control samples (field blanks, replicates, and matrix spikes) are included in Tables S3-S4.

Pesticides

One field blank was collected, and there were no pesticide compounds detected in the field blank. One field replicate was collected, and relative percent differences (RPD) between the regular and replicate samples were calculated, when possible, for each compound. There were 30 environmental and replicate pairs with detections, and RPDs ranged from 0 to 18%. One environmental replicate pair had an environmental concentration of non-detect (ND; associated method detection level of 1.5 ng/L) and a replicate concentration of 1.5 ng/L. All the remaining environmental and replicate sample pairs had ND values. One matrix spike and matrix spike replicate were also done in the laboratory. The mean recovery for all spike compounds was 96% (ranged from 72 to 127%) with a standard deviation of 11%. The RPDs between the matrix spike and the matrix spike replicate ranged from 0.12 to 12%. Recovery of surrogate compounds ranged from 71 to 108%, the mean recovery was 93%. Data were not recovery corrected.

PFAS

Field blanks were collected (n=2), and there were no PFAS detections in any of the field blanks. Field replicates were collected (n=2). All but two of the environmental and replicate sample pairs had ND values. One had an environmental concentration of ND for PFOA (associated method reporting level 0.2 ng/L) and a replicate concentration of 0.6 ng/L, and another pair had an environmental concentration of 1.1 ng/L for 6:2 FTS and a replicate concentration of ND (associated method reporting level 1 ng/L).

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Matrix spikes were also done in the laboratory (n=3; no matrix spike associated with July 18 sample set). The mean recovery for all spike compounds was 101% (ranged from 51 to 147%) with a standard deviation of 15%. Only 7 individual matrix spike recoveries were outside of the 70-130% range, and all but one (PFBA July 17th; 51%) were for compounds not detected in this study. The two detections for PFBA in May were associated with a PFBA matrix spike recovery of 104%, indicating that there were no issues with PFBA method performance in May, but the 51% matrix spike recovery in July suggests that method performance can vary (Table S3).

Analytical method details

Pesticides

Pesticide samples were transferred on ice to the U.S. Geological Survey (USGS) Organic Chemistry Research Laboratory in Sacramento, California. Concentrations of 183 pesticides and pesticide transformation products (Table S4) were determined in water samples using a solid phase extraction procedure followed by LC-MS/MS and GC-MS/MS. Samples were filtered through 0.7-µm glass-fiber filters and then spiked with surrogate solution containing atrazine-$^{13}C_3$, fipronil-$^{13}C_4$, $^{15}N_2$, imidacloprid-d_4, metolachlor-$^{13}C_6$, *cis*-permethrin-$^{13}C_6$, *p,p′*-DDE-$^{13}C_{12}$, tebuconazole-$^{13}C_3$, and trifluralin-d_{14}. Water was extracted using a pre-conditioned Oasis HLB (Waters, Milford, Mass.; 6 milliliters [mL], 500 milligrams [mg]) cartridge. Eluents were exchanged into acetonitrile, spiked with internal standards (acenaphthene-d_{10}, bifenthrin-d_5, clothianidin-d_3, myclobutanil-d_4, and oxyfluorfen-d_5), and analyzed by LC-MS/MS (Agilent Technologies (Santa Clara, Calif.) 1260 infinity bio-inert high-performance liquid chromatograph coupled to a 6430 triple quadrupole mass spectrometer) and GC-MS/MS (Trace 1310 gas chromatograph coupled to a TSQ 9000 triple quadrupole mass spectrometer (Thermo Scientific, Waltham, Mass.). Refer to Gross et al.[1] for more specific details.

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

PFAS

PFAS samples were frozen and shipped on ice to the USGS National Water Quality Laboratory in Denver, CO. Concentrations of 57 individual PFAS analytes (Table S3) were measured in water samples. Methanol (approximately 50 percent) was added to the samples followed by centrifugation to remove particles. An initial preconcentration using online solid phase extraction was followed by LC-MS/MS with quantification by isotope-dilution. Samples were loaded directly onto an Oasis WAX cartridge (3.9 x 20 mm column, 3.9 μm particle diameter) with organic free water (Fisher Optima HPLC grade) at 0.5 mL/min for 6 minutes. Following the preconcentration step, the sample was eluted onto a reversed-phase, porous shell LC column with a water/1 % ammonium hydroxide and methanol/0.4% ammonium hydroxide gradient. Data were acquired in dynamic multiple reaction monitoring (dMRM) mode with two transitions per analyte for confirmation (except for PFBA and PFPeA that only had one confirming ion). Reporting limits ranged from 0.1-18 ng/L for all analytes. Refer to Gray et al.[2] and Faber et al.[3] for more specific details.

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



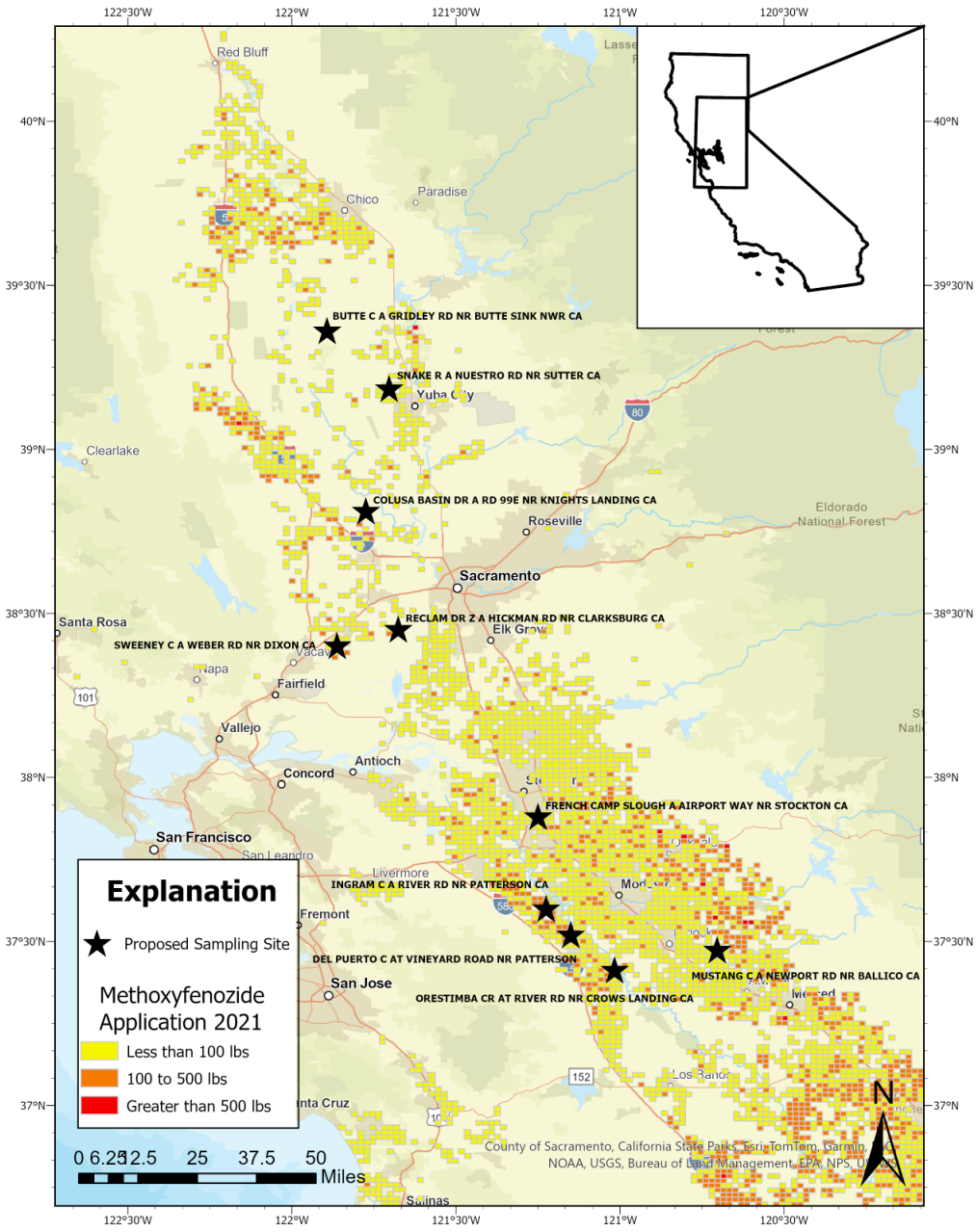
Figure S1. Photographic representations of sites[4] in the San Joaquin Valley: (a) Mustang Creek (USGS-372829120420801), (b) Orestimba Creek (USGS-11274538), (c) Del Puerto Creek (USGS-11274653), (d) Ingram Creek (USGS-373747121125200), and (e) French Camp Slough (USGS-375252121145401). Refer to Table S2 for additional site information. Photographs courtesy of U.S. Geological Survey (USGS).

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



Figure S2. Photographic representations of sites[4] in the Sacramento Valley: (a) Reclamation Drain (USGS-11455125), (b) Sweeney Creek (USGS-11455255), (c) Colusa Basin Drainage Canal (USGS-11390890), (d) Snake River (USGS-391107121421201), and (e) Butte Creek (USGS-392143121532901). Refer to Table S2 for additional site information. Photographs courtesy of U.S. Geological Survey (USGS).

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



133

134 **Figure S3.** Site distribution and methoxyfenozide application (lbs) throughout the San Joaquin

135 and Sacramento Valleys. Refer to Table S2 for additional site information. California

136 Department of Pesticide Regulation (CADPR) tracks pesticide usage throughout the state; at the

137 time of study design, 2021 was the most recent year of available data[5]. [lbs, pound]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

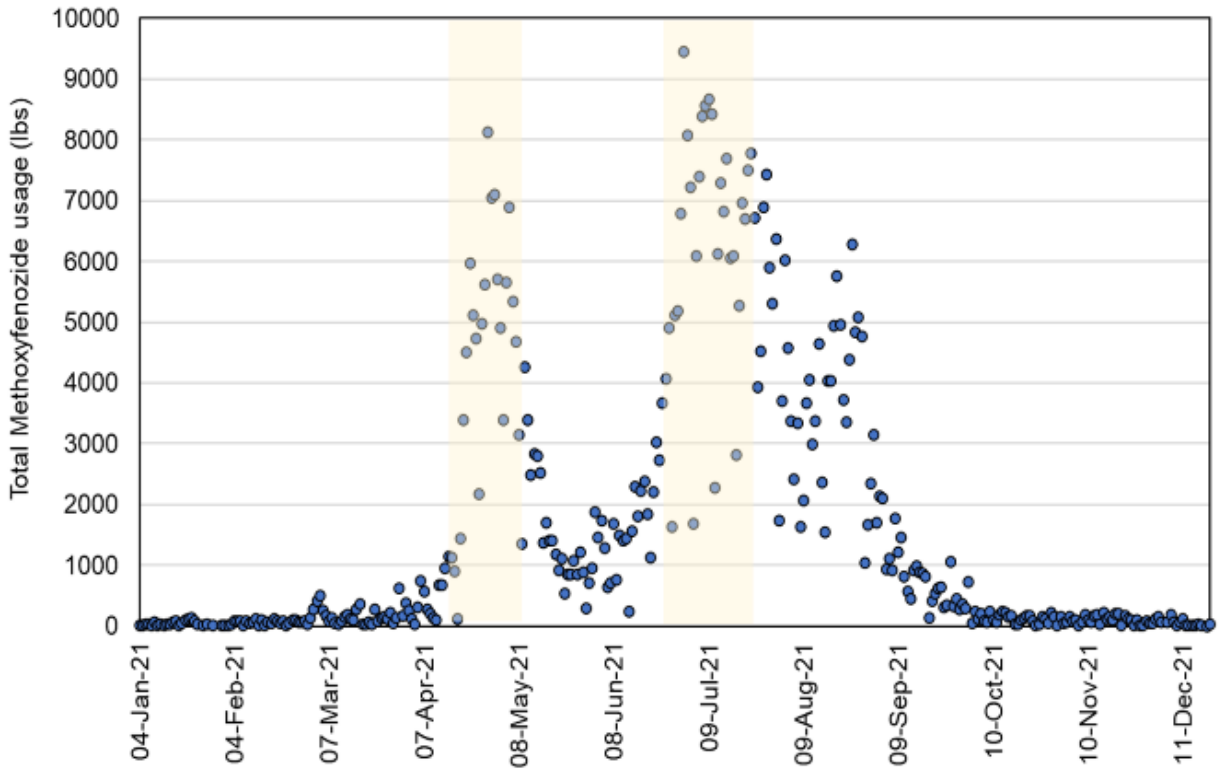
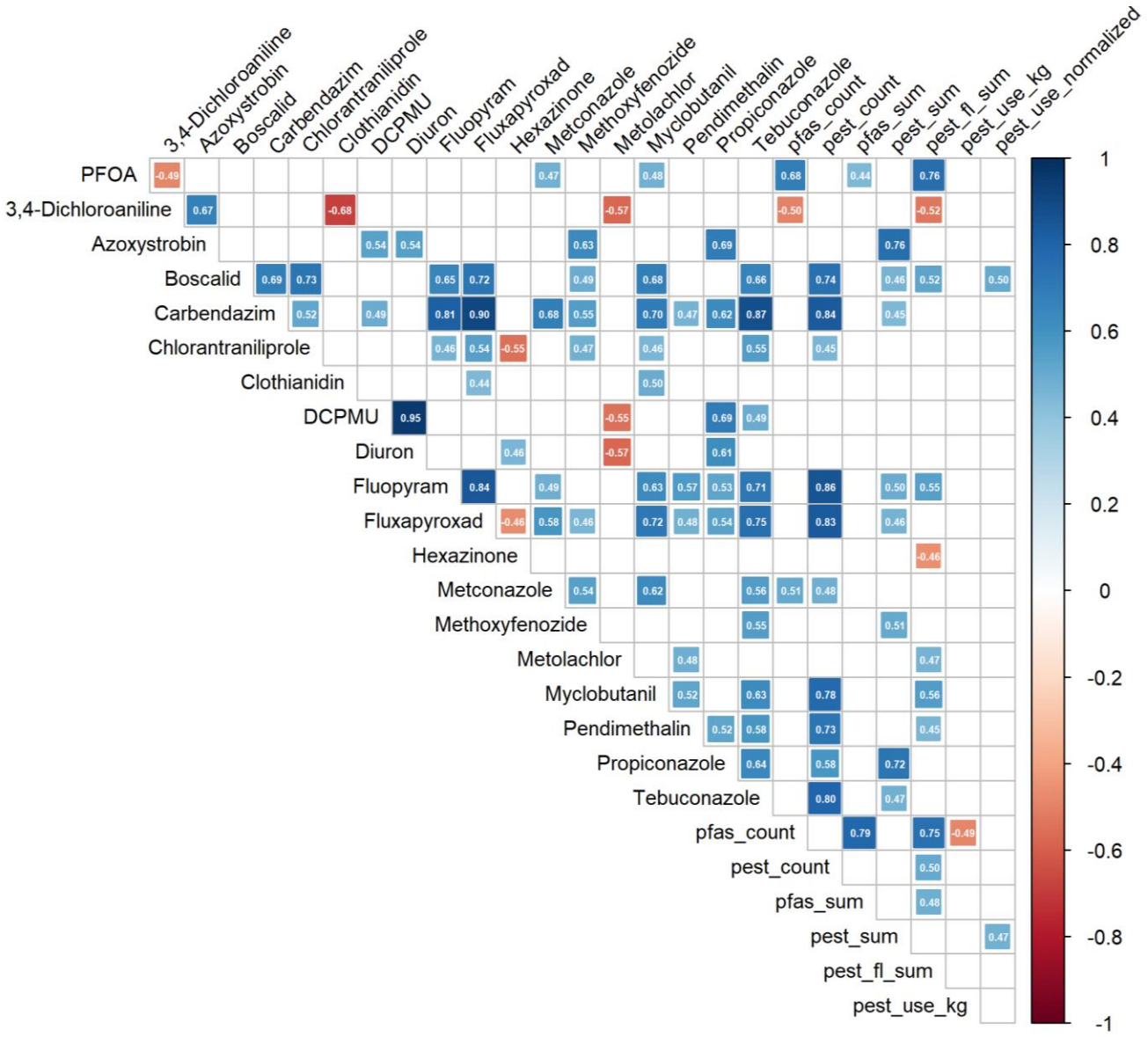


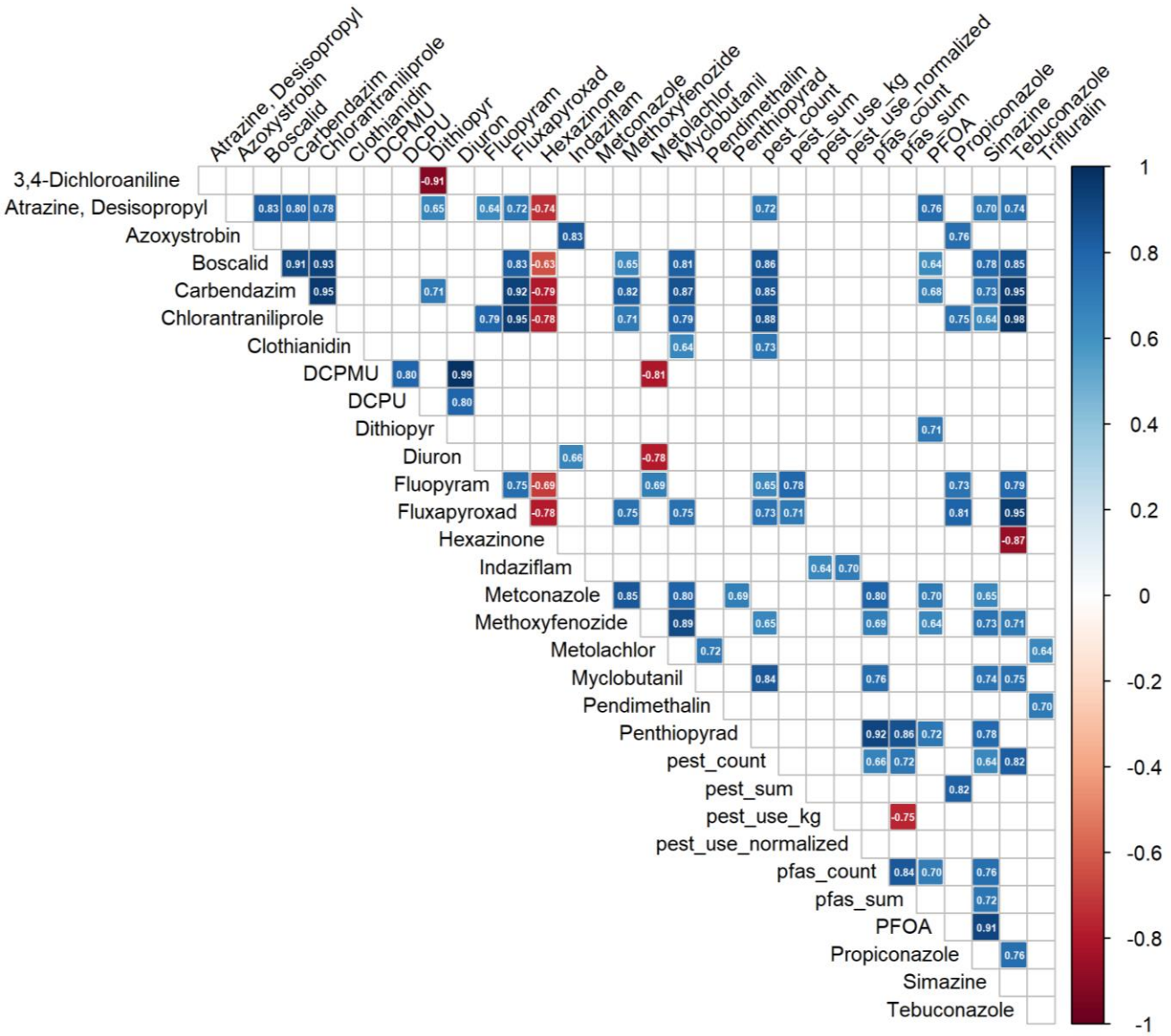
Figure S4. Annual, statewide (California) application of methoxyfenozide (lbs). The tan shaded areas represent peak windows of application. Samples were collected in May (6-8) and July (17-18), 2024. California Department of Pesticide Regulation (CADPR) tracks pesticide usage throughout the state; at the time of study design, 2021 was the most recent year of available data[5]. [lbs, pound]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



Figures S5. Spearman correlation coefficient across all 20 samples for individual compounds (DF > 50%), pesticide and PFAS count and sum (total concentration in ng/L) metrics, pesticide use by watershed (kg) and pesticide use by watershed normalized by area (kg per km^2). Blank cells represent non-statistically significant relationships. Statistical significance was evaluated at $\alpha = 0.05$. [DF, detection frequency; ng/L, nanograms per liter; kg, kilogram; km^2, square kilometer]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



159

160 **Figures S6.** Spearman correlation coefficients across the 10 samples collected in May only for

161 individual compounds (DF > 50%), pesticide and PFAS count and sum (total concentration in

162 ng/L) metrics, pesticide use by watershed (kg) and pesticide use by watershed normalized by

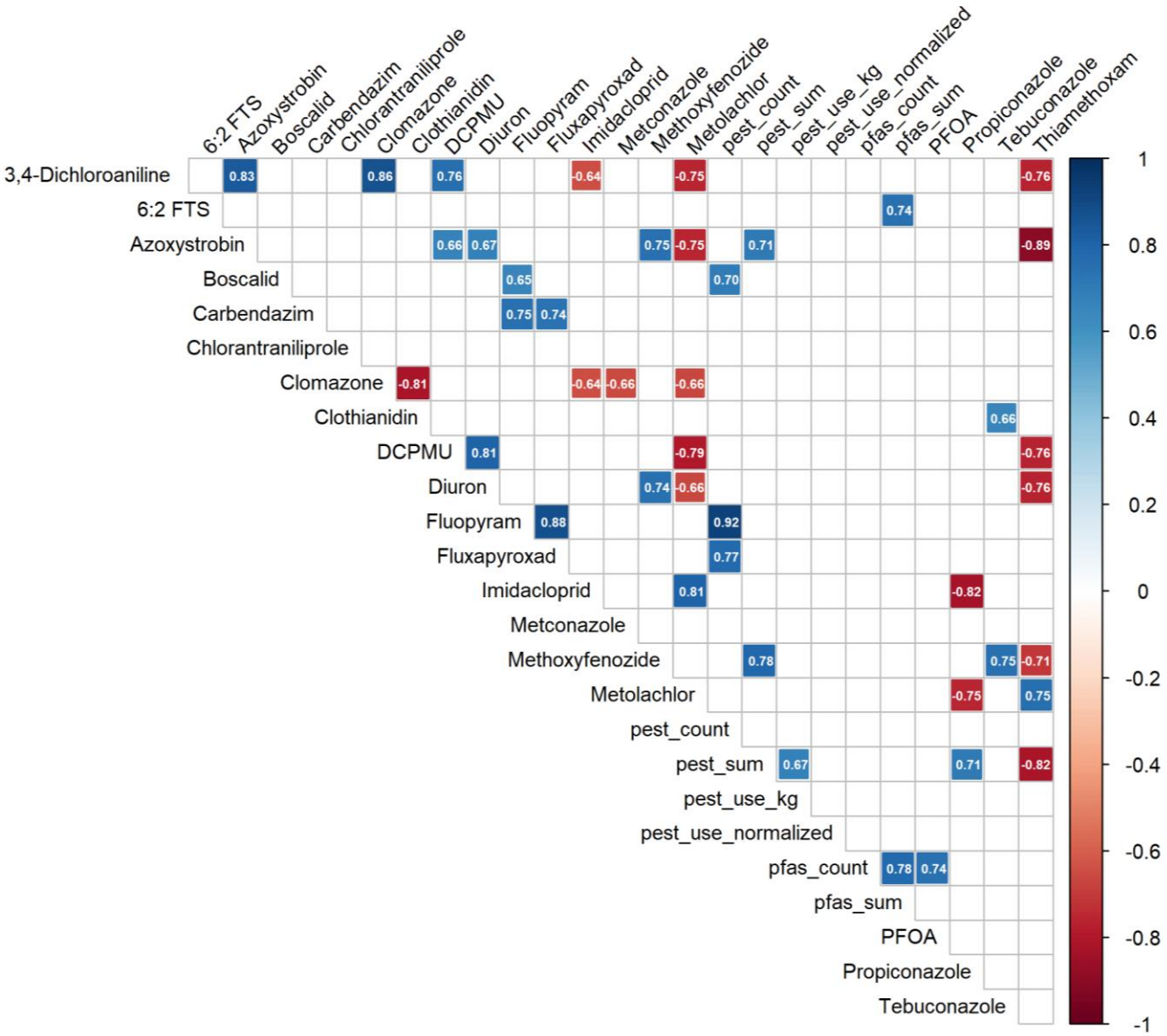
163 area (kg per km^2). Blank cells represent non-statistically significant relationships. Statistical

164 significance was evaluated at $\alpha = 0.05$. [DF, detection frequency; ng/L, nanograms per liter; kg,

165 kilogram; km^2, square kilometer]

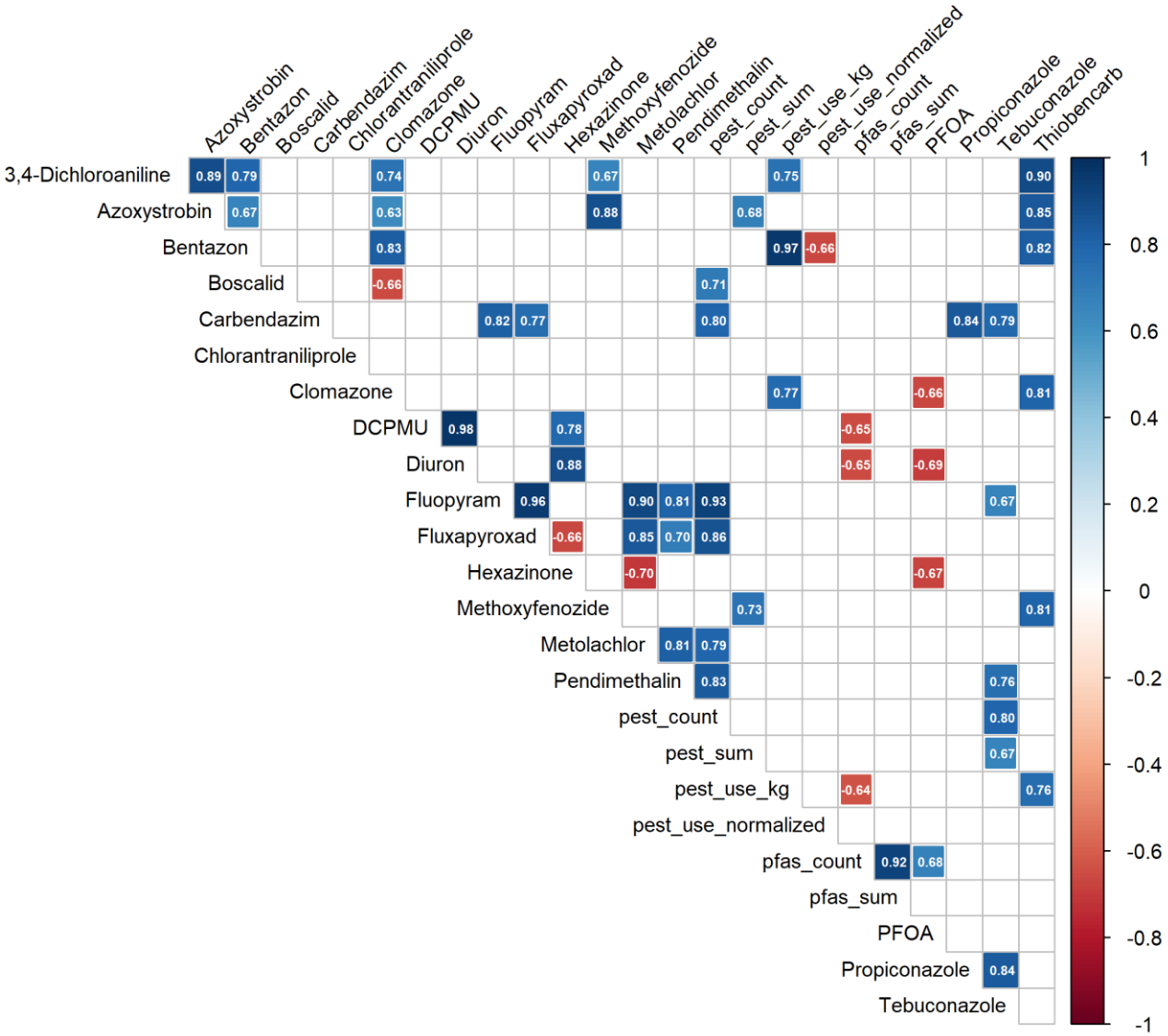
166

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



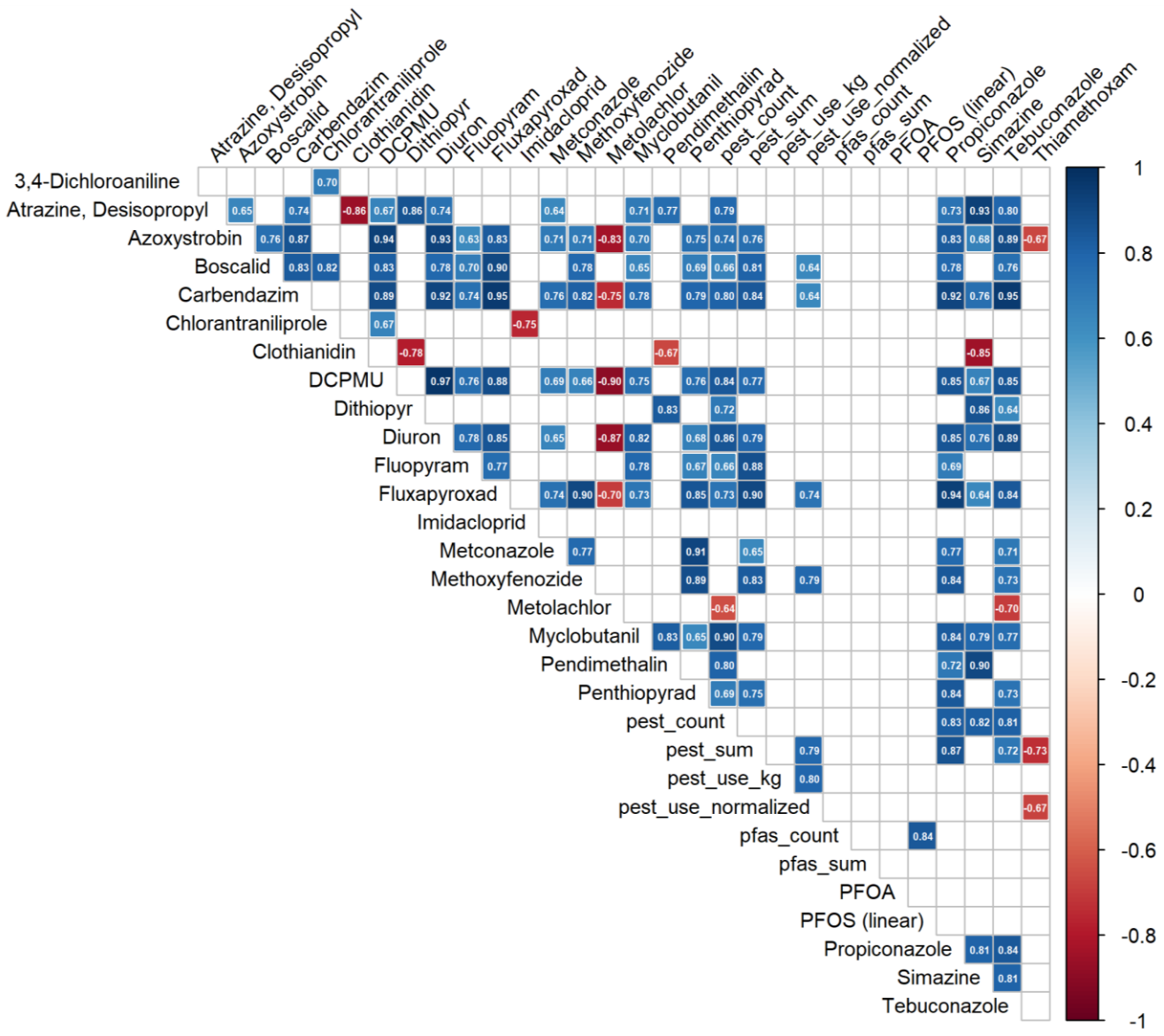
Figures S7. Spearman correlation coefficients across the 10 samples collected in July only for individual compounds (DF > 50%), pesticide and PFAS count and sum (total concentration in ng/L) metrics, pesticide use by watershed (kg) and pesticide use by watershed normalized by area (kg per km^2). Blank cells represent non-statistically significant relationships. Statistical significance was evaluated at $\alpha = 0.05$. [DF, detection frequency; ng/L, nanograms per liter; kg, kilogram; km^2, square kilometer]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



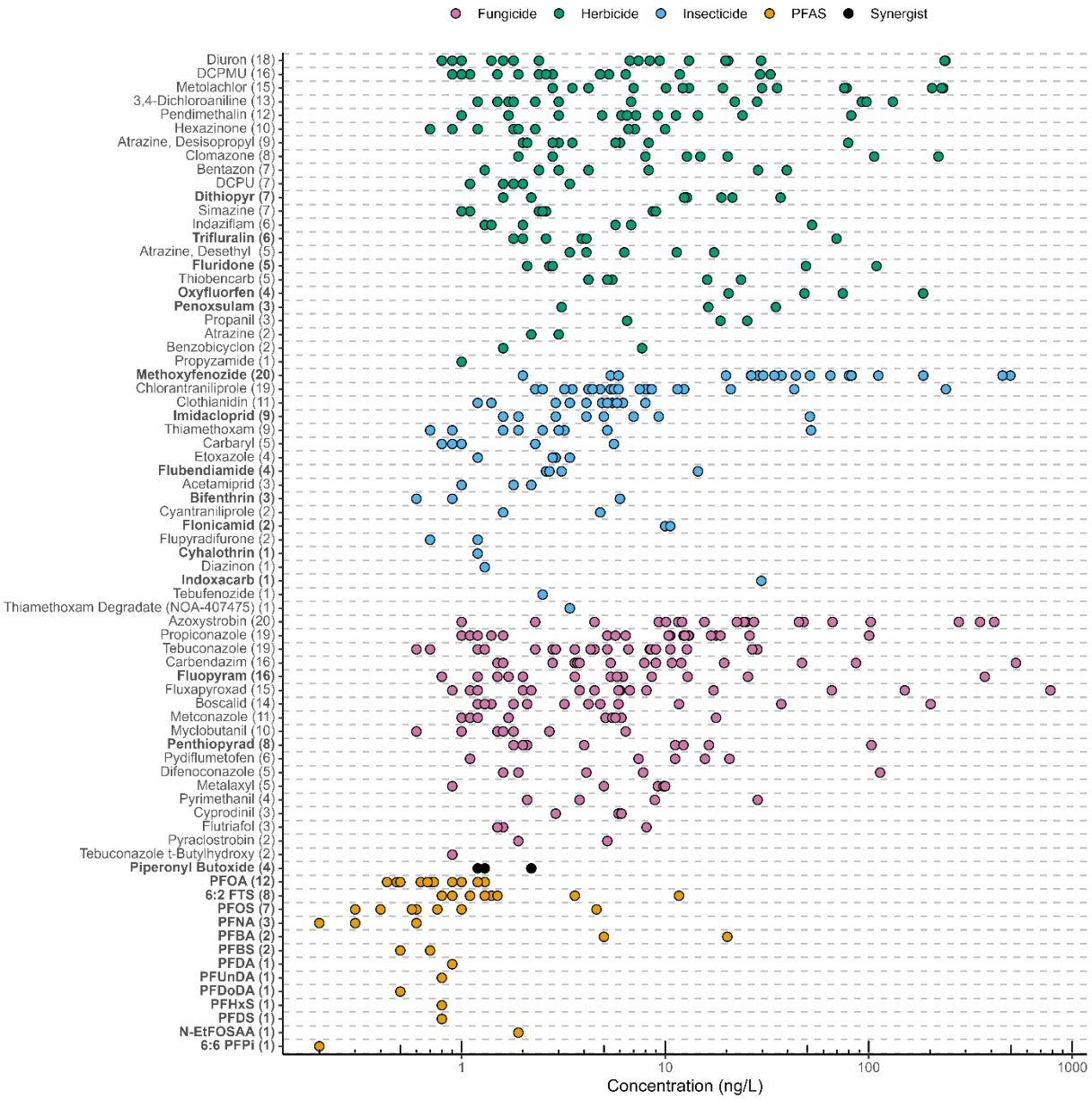
Figures S8. Spearman correlation coefficients across the 10 samples collected at the northern sites (Sacramento Valley) only for individual compounds (DF > 50%), pesticide and PFAS count and sum (total concentration in ng/L) metrics, pesticide use by watershed (kg) and pesticide use by watershed normalized by area (kg per km^2). Blank cells represent non-statistically significant relationships. Statistical significance was evaluated at $\alpha = 0.05$. [DF, detection frequency; ng/L, nanograms per liter; kg, kilogram; km^2, square kilometer]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



Figures S9. Spearman correlation coefficients across the 10 samples collected at the southern sites (San Joaquin Valley) only for individual compounds (DF > 50%), pesticide and PFAS count and sum (total concentration in ng/L) metrics, pesticide use by watershed (kg) and pesticide use by watershed normalized by area (kg per km^2). Blank cells represent non-statistically significant relationships. Statistical significance was evaluated at $\alpha = 0.05$. [DF, detection frequency; ng/L, nanograms per liter; kg, kilogram; km^2, square kilometer]

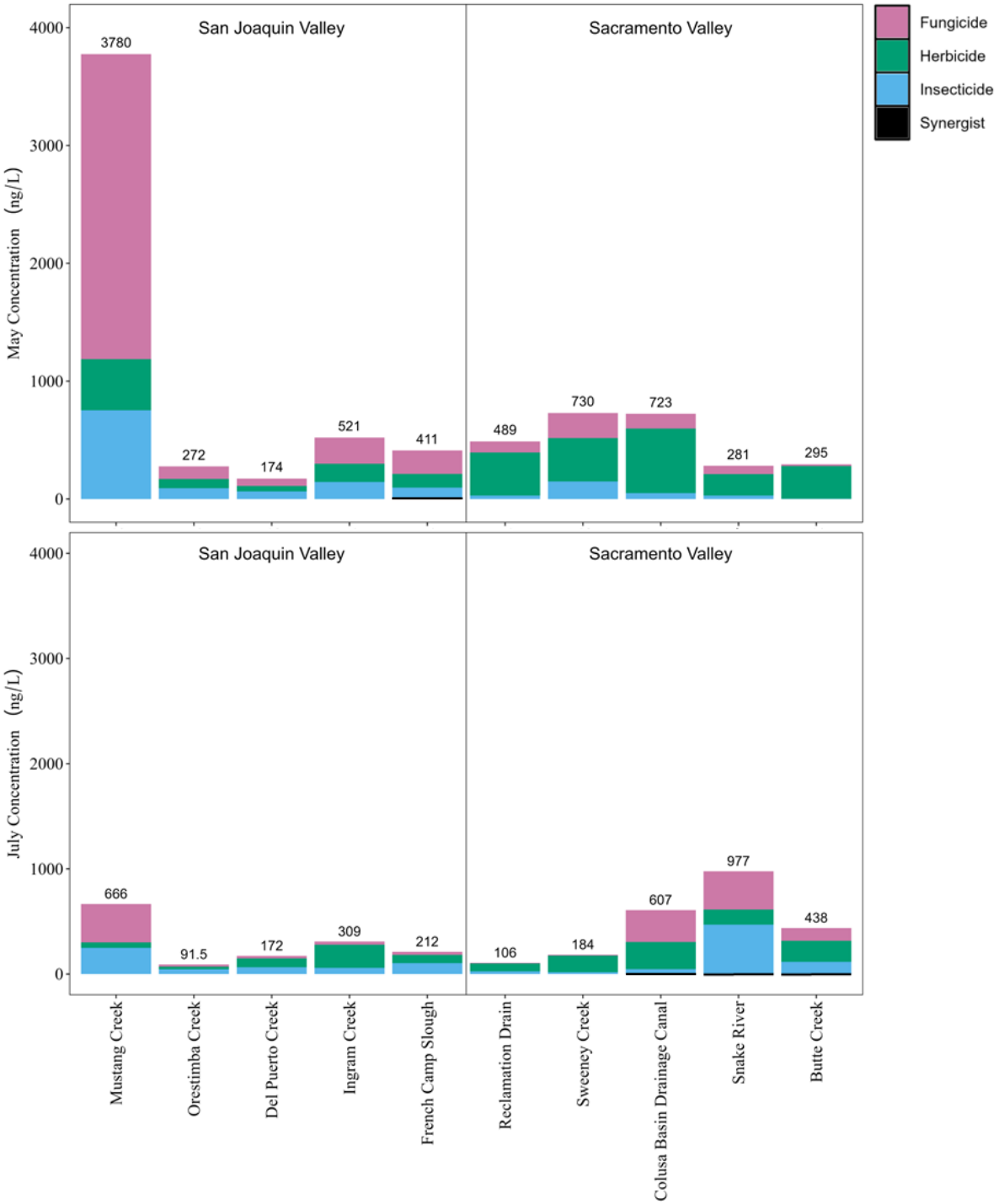
Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



192

193 **Figure S10.** Concentrations (ng/L) of pesticides and PFAS detected across all sites (n=20). The
194 number in parentheses next to each compound indicates the number of detections, and
195 concentrations of linear and branched PFAS reported in Table S3 were combined. Compounds in
196 bold are either OECD fluorinated pesticides, pesticide active ingredients that have been linked to
197 PFAS, or PFAS and are highlighted in more detail in the main text (Figure 2). [PFAS, per- and
198 polyfluoroalkyl substances; OECD, Organisation for Economic Cooperation and Development]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



199

200 **Figure S11.** Concentrations (ng/L) of all pesticides detected at each site during (a) May 2024

201 sampling and (b) July 2024 sampling. The number above each bar represents the total pesticide

202 concentration (ng/L) for detected compounds only.

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Table S1. Pesticide products linked to per- and polyfluoroalkyl substances (PFAS) in the literature[6-8]. Bold and italic compounds were included in this study's pesticide analysis, and compounds with an asterisk (*) were detected.

Product Name	PFAS detected	Product Active Ingredient (s)
Anvil 10-10	PFOA, HFPO-DA, PFBA, PFPeA, PFHxA, PFHpA, PFHxS, 6:2 FTS, PFOS, PFHpS	***Sumithrin (d-Phenothrin)***, ***Piperonyl Butoxide****
Permanone 30-30	PFOA, HFPO-DA	***Permethrin***, ***Piperonyl butoxide****
Frontline Plus for dogs	PFHxA, PFHpA, PFHpS, HFPO-DA	***Fipronil***, ***(s) methoprene***
Seresto Collar	PFDoDS	Flumethrin, ***Imidacloprid****
Malathion 5EC	PFOA, PFHpS, PFOS	***Malathion***
Oberon 2SC	PFBA, PFOS	Spiromesifen
Intrepid 2F	PFBS	***Methoxyfenozide****
Avid 1.5 EC	PFOS	Abamectin
Pedestal	PFOS	***Novaluron***
Marathon 1%	PFOS	***Imidacloprid****
Ultra-Pure Oil	PFOS	Mineral oil

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Table S2. Ten U.S. Geological Survey sites[4] sampled across the San Joaquin (SJV) and Sacramento (SV) Valleys. Each site was sampled twice, and samples were analyzed for pesticides and per- and polyfluoroalkyl substances (PFAS). Flow data from upstream gages were available for three sampling sites and are reported for each sampling date. [ft, feet; s, second; -, flow not available]

USGS site number	USGS Site name	Site short name	Sampling dates (flow in ft^3/s where available)	County (Valley)
11274653	Del Puerto C at Vineyard Road NR Patterson	Del Puerto Creek	5/6/2024 (11.5) 7/17/2024 (0.04)	Stanislaus (SJV)
375252121145401	French Camp Slough a Airport Way NR Stockton CA	French Camp Slough	5/6/2024 (-) 7/17/2024 (-)	San Joaquin (SJV)
373747121125200	Ingram C a River RD NR Patterson CA	Ingram Creek	5/6/2024 (-) 7/17/2024 (-)	Stanislaus (SJV)
372829120420801	Mustang C a Newport RD NR Ballico CA	Mustang Creek	5/6/2024 (-) 7/17/2024 (-)	Merced (SJV)
11274538	Orestimba CR at River RD NR Crows Landing CA	Orestimba Creek	5/6/2024 (18.60) 7/17/2024 (0)	Stanislaus (SJV)
392143121532901	Butte C a Gridley RD NR Butte Sink Nwr Ca	Butte Creek	5/8/2024 (774) 7/18/2024 (167)	Butte (SV)
11390890	Colusa Basin DR a RD 99E NR Knights Landing CA	Colusa Basin Drainage Canal	5/8/2024 (-) 7/18/2024 (-)	Yolo (SV)
11455125	Reclam DR Z a Hickman RD NR Clarksburg CA	Reclamation Drain	5/8/2024 (-) 7/18/2024 (-)	Solano (SV)
391107121421201	Snake R a Nuestro RD NR Sutter CA	Snake River	5/8/2024 (-) 7/18/2024 (-)	Sutter (SV)
11455255	Sweeney C a Weber RD NR Dixon CA	Sweeney Creek	5/8/2024 (-) 7/18/2024 (-)	Solano (SV)

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdfez6c00132_si_001/ by guest on 01 September 2026

Table S3 (refer to spreadsheet). Field concentrations of per- and polyfluoroalkyl substances, including associated quality control and quality assurance data: field blank, replicate, and spike recoveries. The MRL is in ng/L units. A second compound name in brackets [ ] indicates alternative nomenclature. Italicized CAS numbers represent compounds for which a CAS number for the anion form could be found in the EPA CompTox Chemicals Dashboard (refer to Williams et al.[9]). Instead the CAS number for the acid form is reported. Additional site information available at U.S. Geological Survey[4]. [L, Liter; ND, non-detect; ng/L, nanograms per liter; %, percent; -, no data; MRL, method reporting limit; E, estimated (refer to Gray et al.[2] and Childress et al.[10]); CAS, chemical abstract service]

Table S4 (refer to spreadsheet). Field concentrations of pesticides, including associated quality control and quality assurance data: field blank and replicate results and surrogate and spike recoveries. Result values in parentheses are concentrations reported between the MDL and the RL, which are both in ng/L units. Compounds in italics are pesticide transformation products. Additional site information available at U.S. Geological Survey[4]. [L, Liter; ND, non-detect; ng/L, nanograms per liter; %, percent; -, no data; MDL, method detection limit; RL, reporting limit; CAS, chemical abstract service]

Table S5 (refer to spreadsheet). Pesticide chemicals applied within each watershed for the year 2022, most recent year of data availability. Data from California Department of Pesticide Regulation (CADPR)[11]. CAS numbers are from CADPR metadata, and for some compounds, multiple CAS numbers were provided. [lbs, pound; kg, kilogram; km2, square kilometer; CAS, chemical abstaract service; " ", no data]

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Table S6 (refer to spreadsheet). Landcover and crop types and associated percentages within each sampling watershed. Yellow cells indicate non-cropped landcovers. Crop data are from United States Department of Agriculture[12]. [%, percent; km2, square kilometer; NA, not in watershed]

Table S7. Crops grown near each sampling location[4,12].

USGS site number	Site short name	2024 Crop(s)
11274653	Del Puerto Creek	Almonds, tomatoes, peaches, grapes, walnuts, pasture
375252121145401	French Camp Slough	Barley, alfalfa, winter wheat, dry beans, corn, cotton
373747121125200	Ingram Creek	Almonds
372829120420801	Mustang Creek	Almonds, tomatoes, sweet potatoes
11274538	Orestimba Creek	Almonds, walnuts
392143121532901	Butte Creek	Rice, almonds
11390890	Colusa Basin Drainage Canal	Rice
11455125	Reclamation Drain	Pasture, clover/wildflowers, almonds
391107121421201	Snake River	Rice, almonds, prunes
11455255	Sweeney Creek	Almonds, pasture

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Table S8. Average precipitation across each county associated with a sampling site. Average precipitation was calculated for the day before sampling using data from the Community Collaborative Rain, Hail and Snow, Network[13]. [in., inches; -, no stations in county]

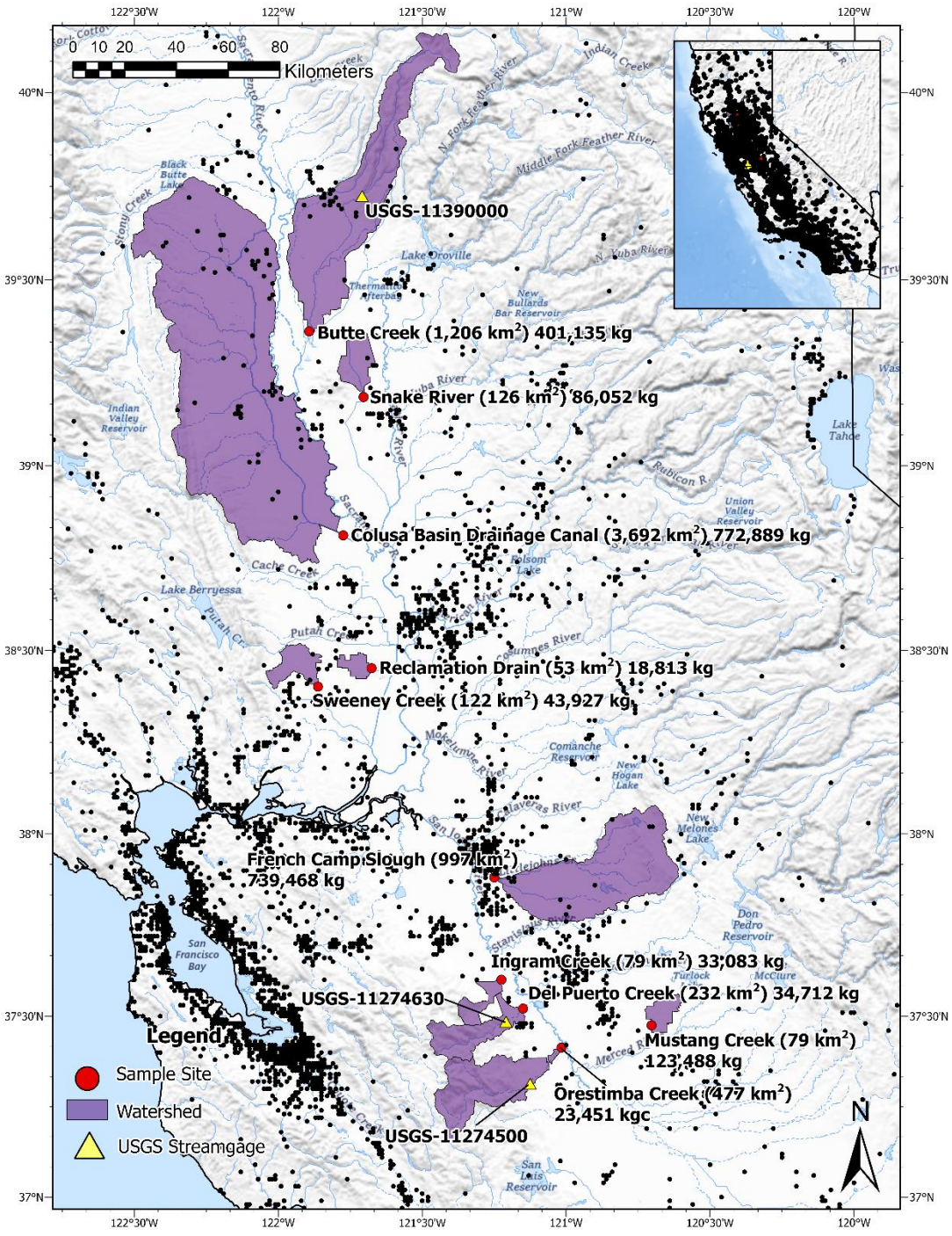
Site short name	Sampling date	County	Average precipitation (in.) the day before sampling (number of precipitation stations in county)
Del Puerto Creek	5/6/2024	Stanislaus	0.85 ± 0.15 (5)
French Camp Slough	5/6/2024	San Joaquin	0.61 ± 0.24 (7)
Ingram Creek	5/6/2024	Stanislaus	0.85 ± 0.15 (5)
Mustang Creek	5/6/2024	Merced	0.57 (1)
Orestimba Creek	5/6/2024	Stanislaus	0.85 ± 0.15 (5)
Butte Creek	5/8/2024	Butte	0 (7)
Colusa Basin Drainage Canal	5/8/2024	Yolo	0 (9)
Reclamation Drain	5/8/2024	Solano	0 (2)
Snake River	5/8/2024	Sutter	-
Sweeney Creek	5/8/2024	Solano	0 (2)
Del Puerto Creek	7/17/2024	Stanislaus	0
French Camp Slough	7/17/2024	San Joaquin	0
Ingram Creek	7/17/2024	Stanislaus	0
Mustang Creek	7/17/2024	Merced	0
Orestimba Creek	7/17/2024	Stanislaus	0
Butte Creek	7/18/2024	Butte	0
Colusa Basin Drainage Canal	7/18/2024	Yolo	0
Reclamation Drain	7/18/2024	Solano	0
Snake River	7/18/2024	Sutter	-
Sweeney Creek	7/18/2024	Solano	0

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Additional PFAS sources in the study watersheds

The goal of this study was to select sites that were predominantly represented by agricultural activity. To support this assumption and aid in interpretation, the U.S. Environmental Protection Agency PFAS Analytics Tool was used to explore PFAS sources in the study watersheds. Sources are defined as facilities that operate in sectors that may handle, use, or release PFAS chemicals[14]. The following source layers were downloaded and counted within each watershed: aqueous film forming foam spills, discharge monitoring National Pollutant Discharge Elimination System (NPDES) for PFAS, federal facilities linked to PFAS, superfund sites, PFAS manufacturing and importing, toxic releases, and industry sectors (e.g., chemical and metal manufacturing, waste management, textiles, oil and gas).

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026



284

285 **Figure S12.** Potential PFAS sources in the study area upstream and in the vicinity of the ten

286 sampling locations[4,14].

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Table S9. Description and number of PFAS sources within each study watershed. Sources were downloaded from the PFAS Analytics Tool[14]. [mfg, manufacturing; PFAS, per- and polyfluoroalkyl substances]

Site name	Total number of sources	Source types (count)
Colusa Basin Drainage Canal	50	Oil and gas (17), airports (12), waste management (9), petroleum (6), electronics (1), fire protection (1), metal machinery mfg (1), metal coating (1), plastics and resins (1), textiles and leather (1)
Butte Creek	19	Waste management (4), paints and coatings (4), airports (3), fire protection (3), chemical mfg (2), furniture and carpet (2), electronics (1)
Sweeney Creek	2	Waste management
Snake River	1	Airports
Reclamation Drain	0	-
French Camp Slough	11	Waste management (8), chemical mfg (1), metal machinery mfg (1), mining and refining (1)
Del Puerto Creek	1	Waste management
Ingram Creek	0	-
Mustang Creek	0	-
Orestimba Creek	0	-

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

References

(1) Gross, M.S., Sanders, C.J., De Parsia, M.D., and Hladik, M.L., 2024, Methods of analysis—Determination of pesticides in filtered water and suspended sediment using liquid chromatography- and gas chromatography-tandem mass spectrometry: U.S. Geological Survey Techniques and Methods, book 5, chap. A12, 33 p., https://doi.org/10.3133/tm5A12

(2) Gray, J. L.; Kanagy, L. K.; Kanagy, C. J.; Anderson, C. A. 2025, Determination of Per- and Polyfluoroalkyl Substances in Water by Direct Injection of Matrix-Modified Centrifuge Supernatant and Liquid Chromatography-Tandem Mass Spectrometry with Isotope Dilution; U.S. Geological Survey Techniques and Methods, book 5, chap. B13, 127 p. https://doi.org/10.3133/tm5B13.

(3) Faber, K.A.; Pomerantz, W.C.K.; Gray, J.L.; Hubbard, L.E.; Kolpin, D.W.; Arnold, W.A. Revealing organofluorine contamination in effluents and surface waters with complimentary approaches: Fluorine-19 nuclear magnetic spectroscopy (19F-NMR) and liquid chromatography-tandem mass spectrometry (LC-MS/MS). *Environ. Sci. Technol.* 2025, 59, 28, 14695-14706. DOI: 10.1021/acs.est.5c05079

(4) U.S. Geological Survey. (2024). USGS water data for the Nation: U.S. Geological Survey National Water Information System database, accessed [May 28, 2025], at http://doi.org/10.5066/F7P55KJN

(5) California Department of Pesticide Regulation, 2021, Pesticide use data for 2021: Sacramento, California Department of Pesticide Regulation, accessed March 24, 2024, at http://www.cdpr.ca.gov/docs/pur/purmain.htm

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

(6) Donley, N.; Cox, C.; Bennett, K.; Temkin A.M.; Andrews, D.Q.; Naidenko, O.V. Forever pesticides: a growing source of PFAS contamination in the environment. *Eniron. Health. Perspect*. 2024, 132, 7. DOI:10.1289/EHP13954

(7) Lasee, S.; McDermett, K.; Kumar, N.; Guelfo, J.; Payton, P.; Yang, Z.; Anderson, T.A. Targeted analysis and total oxidizable precursor assay of several insecticides for PFAS. *J. Health. Hazard. Mater.* 2022, 3, 100067. DOI:10.1016/j.hazl.2022.100067

(8) Libenson, A.; Karasaki, S.; Cushing, L.J.; Tran, T.; Rempel, J.L.; Morello-Frosch, R.; Pace, C.E. PFAS-contaminated pesticides applied near public supply wells disproportionately impact communities of color in California. *ACS ES&T Water.* 2024, 4, 6, 2495-2503. DOI:10.1021/acsestwater.3c00845

(9) Williams, A.J.; Grulke, C.M.; Edwards, J.; McEachran, A.D.; Mansouri, K.; Baker, N.C.; Patlewicz, G.; Shah, I.; Wambaugh, J.F.; Judson, R.S.; Richard, A.M. The CompTox Chemistry Dashboard: a community data resource for environmental chemistry. *J Chemoinform.* 2017, 9, 61. DOI: 10.1186/s13321-017-0247-6

(10) Childress, C.J.O., Foreman, W.T., Connor, B.F., and Maloney, T.J., 1999, New reporting procedures based on long-term method detection levels and some considerations for interpretations of water-quality data provided by the U.S. Geological Survey National Water Quality Laboratory: U.S. Geological Survey Open-File Report 99–193, 19 p.

(11) California Department of Pesticide Regulation, 2022, Pesticide use data for 2022: Sacramento, California Department of Pesticide Regulation, accessed April 1, 2025, at http://www.cdpr.ca.gov/docs/pur/purmain.htm

(12) United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS), 2024, Cropland Data Layer: USDA NASS, USDA NASS Marketing and

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026

Information Services Office, Washington, D.C. accessed April, 2024 at https://croplandcros.scinet.usda.gov/

(13) Community Collaborative Rain, Hail and Snow Network (COCORAHS) 2024 Precipitation for May 5, May 7, July 16, and July 17, 2024 for California (county specific), accessed May, 2025 at https://www.cocorahs.org/ViewData/

(14) U.S. Environmental Protection Agency. PFAS analytic tools, 2023, accessed March, 2024 at https://echo.epa.gov/trends/pfas-tools

Downloaded from pubs.acs.org/estlcu/article-supplement/5146640/pdf/ez6c00132_si_001/ by guest on 01 September 2026