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Design and Methods of the California Stream Quality Assessment (CSQA), 2017

Open-File Report 2020–1023

U.S. Department of the Interior
U.S. Geological Survey

Front cover: Nacimiento River, California.
Inset: eDNA sampling by U.S. Geological Survey personnel in Alisal Creek, California. Photographs by Alan Cressler, U.S. Geological Survey.

Back Cover: *Top left*: Map of Central California Coastal study area and sampling sites.
Top right: Arroyo Seco at Elm Avenue Bridge, California. Photograph by Alan Cressler, U.S. Geological Survey.
Bottom left: Sediment sampling in Reclamation Ditch, California. Photograph by Alan Cressler, U.S. Geological Survey.
Bottom middle: Ceramic tile deployed to collect biofilms for pesticide analysis. Photograph by Barbara Mahler, U.S. Geological Survey.
Bottom right: Algae and invertebrate sampling in Alisal Creek, California. Photograph by Alan Cressler, U.S. Geological Survey.

Design and Methods of the California Stream Quality Assessment (CSQA), 2017

By Jason T. May, Lisa H. Nowell, James F. Coles, Daniel T. Button,
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DAVID BERNHARDT, Secretary

U.S. Geological Survey
James F. Reilly II, Director

U.S. Geological Survey, Reston, Virginia: 2020

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Acknowledgment pages: *Left page*: Salinas River, California. Photograph by Alan Cressler, U.S. Geological Survey.
Right page: Jason May and Daniel Calhoun sampling for fish in Nanticoke Creek, NY, as part of the Northeast Stream Quality Assessment study. Photograph by Alan Cressler, U.S. Geological Survey.

Acknowledgments

It is with deep appreciation and affection that we acknowledge the contributions of Jason Todd May to the planning and success of the California Stream Quality Assessment study. Sadly, Jason passed away on August 22, 2019, after a year-long illness. His efforts in study-site selection, organization of sampling crews, and data collection were invaluable in making the study a success. Jason's efforts on this study are a reflection of his dedication as a scientist at the California Water Science Center, where his broad experience was highly valued and resulted in his co-authoring more than 45 journal articles and U.S. Geological Survey reports. Jason was always willing to share his expertise with others inside and outside of the U.S. Geological Survey. His participation in the California Stream Quality Assessment and his dedication to quality science at the California Water Science Center will be missed.

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
micrometer (µm)	3.937×10^{-5}	inch (in.)
nanometer (nm)	3.937×10^{-8}	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
	Area	
square meter (m^2)	0.0002471	acre
square meter (m^2)	10.76	square foot (ft^2)
square centimeter (cm^2)	0.1550	square inch (ft^2)
square kilometer (km^2)	0.3861	square mile (mi^2)
	Volume	
milliliter (mL)	0.0002642	gallon (gal)
liter (L)	0.2642	gallon (gal)
liter (L)	61.02	cubic inch (in^3)
	Flow rate	
meter per second (m/s)	3.281	foot per second (ft/s)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
nanogram (ng)	3.527×10^{-11}	ounce, avoirdupois (oz)
gram per square meter (g/m^2)	0.0002048	pound per square foot (lb/ft^2)
milligram per square meter (mg/m^2)	0.000003277	ounce, avoirdupois, per square foot (oz/ft^2)
	Pressure	
kilopascal (kPa)	0.1450	pound-force per inch (lbf/in [or psi])

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32.$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C = (°F - 32) / 1.8.$$

Datum

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Supplemental Information

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L), micrograms per liter (µg/L), or nanograms per liter (ng/L). Concentrations of chemical constituents in bed sediment are given in micrograms per kilogram (µg/kg).

Abbreviations

ASE	accelerated solvent extraction
ASR	analytical service request
CERC	Columbia Environmental Research Center
CSQA	California Stream Quality Assessment
DAI	direct aqueous injection
DOC	dissolved organic carbon
eDNA	environmental DNA
ELISA	enzyme-linked immunosorbent assay
EPA	U.S. Environmental Protection Agency
ESI	electrospray ionization
GC/MS	gas chromatography mass spectrometry
GC-MS/MS	gas chromatography-tandem mass spectrometry
GIS	geographic information system
INSTAAR	Institute of Arctic and Alpine Research
LC-MS/MS	liquid chromatography tandem mass spectrometry

NAWQA	National Water-Quality Assessment
NHDPlus	National Hydrography Dataset Plus
NIST	National Institute of Standards and Technology
NLCD	National Land Cover Database
NWALT	National Water-Quality Assessment Wall-to-Wall Anthropogenic Land Use Trends
NWQL	National Water Quality Laboratory
NWIS	National Water Information System
OPP	Office of Pesticide Programs
OCRL	Organic Chemistry Research Laboratory
OGRL	Organic Geochemistry Research Laboratory
OTU	operational taxonomic unit
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCFF	Personal Computer Field Form
POCIS	polar organic chemical integrative sampler
QA	quality assurance
QC	quality control
QW	quality of water
RP	reference point
RSQA	Regional Stream Quality Assessment
RWB	Reach-wide benthos
USGS	U.S. Geological Survey
UVA	ultraviolet absorbance
WQ	water quality
WSC	Water Science Center

Design and Methods of the California Stream Quality Assessment (CSQA), 2017

By Jason T. May†, Lisa H. Nowell, James F. Coles, Daniel T. Button, Amanda H. Bell, Sharon L. Qi, and Peter C. Van Metre

Abstract

During 2017, as part of the National Water-Quality Assessment Project, the U.S. Geological Survey conducted the California Stream Quality Assessment to investigate the quality of streams in the Central California Foothills and Coastal Mountains ecoregion, United States. The goal of the California Stream Quality Assessment study was to assess the health of wadeable streams in the region by characterizing multiple water-quality factors that are stressors to aquatic biota and by evaluating the relation between these stressors and biological indicators of stream health. Urbanization, agriculture, and modifications to streamflow are anthropogenic changes that affect water quality in the region; consequently, the study design primarily targeted sites and specific stressors associated with these activities. For the study, 85 stream sites were selected to represent the types and intensity of land use in the watershed; categories of site types were undeveloped, urban (low, medium, high), agriculture (low, high), and mixed (urban and agriculture). Most sites (about 70 percent) represent a gradient of urbanization from undeveloped to 99-percent urbanized. At most of the sites, streamgages or pressure transducers were used to monitor stream discharge and stage, as well as temperature. Water-quality samples were collected routinely at all sites and were analyzed for major ions, organic contaminants, nutrients, and suspended sediment. Sampling frequency varied on the basis of site type and location. Discrete water samples were collected weekly and generally 6 times per site, except for 11 undeveloped sites that were sampled only 4 times (during the last 4 weeks). Water sampling began at sites in the southern part of the study on March 13, 2017, and at sites in the northern part of the study on April 3, 2017. Passive samplers were deployed at most sites for measurement of polar organic contaminants (pesticides and pharmaceuticals). In May 2017, coincident with completion of water-quality sampling, an ecological survey was conducted at each site to assess benthic algal and macroinvertebrate communities and instream habitat. During the ecological surveys, a single composite streambed-sediment sample was collected for chemical analysis and toxicity testing. In addition, a few focused studies were done at subsets of sites, namely, measuring pesticides using small-volume automated samplers, measuring pesticides in biofilms, and sampling suspended sediments using passive samplers. This report describes the various study components and methods of the California Stream Quality Assessment, including measurements of water quality, sediment chemistry, habitat assessments, and ecological surveys, as well as procedures for sample analysis, quality assurance and quality control, and data management.

Introduction

Many natural and anthropogenic stressors can affect stream ecosystems, and often the stressors that degrade streams are associated with land use in the watershed (U.S. Environmental Protection Agency, 2013, 2019). Variations in streamflow, habitat, temperature, and levels of sediment and nutrients are essential characteristics of natural stream ecosystems, but deviation from the natural patterns of streams can substantially alter their biological condition and ecological function (Lenat and Crawford, 1994; Gregory and Calhoun, 2007; Nagy and others, 2011). Organic contaminants differ from other stressors in that many are derived from human activities and, through various modes of action and toxicity, are potentially detrimental to aquatic life as well as to humans who use water resources. To efficiently manage water resources, it is important to understand the conditions under which stressors—individually or in combinations—adversely affect the biological condition of streams and the water resources valued by people.

†Deceased August 22, 2019.

Multistressor effects are often assessed in the laboratory, under controlled conditions, or in the field at small-catchment scales (Townsend and others, 2008; Culp and others, 2017). At these small scales, biogeochemical processes and complex environmental interactions can be manipulated and monitored; however, results of such studies are not readily extended over larger spatial scales. Alternatively, by characterizing the conditions of multiple streams over a large area, specific stressors and biological conditions can be evaluated on regional and national scales (U.S. Environmental Protection Agency, 2006; Herlihy and others, 2008); from such studies, empirical models have been developed to predict environmental stressors or the biological condition across national-scale disturbance gradients (Waite and others, 2000; Klemm and others, 2003; Herlihy and others, 2006; Coles and others, 2012). To date (2020), most regional- and national-scale studies have not included organic contaminants among the studied stressors (such as U.S. Environmental Protection Agency, 2016) or have generally limited their evaluations to relations between land use and biological condition (such as Gregory and Calhoun, 2007; Cuffney and others, 2011; Brown and others, 2012).

The U.S. Geological Survey (USGS), through the National Water-Quality Assessment (NAWQA) Project, is performing studies to bridge the gap in stressor coverage at large spatial scales, by extensively characterizing stressors (including contaminants) at the regional scale, with enough sampling sites to promote development of empirical models. As such, the studies are intended to provide the public and policymakers with information about the human and environmental factors that have the greatest effects on stream quality by addressing the following objectives in five regions of the United States:

1. Determine the status of stream quality across the region on the basis of contaminants, nutrients, sediments, toxicity of the bed sediments, streamflow, habitat, and biological communities;

2. Evaluate the relative influence of contaminants, nutrients, sediment, streamflow, and habitat on biological communities in the streams;

3. Identify how the natural and anthropogenic characteristics of the watersheds are related to stressors measured at the stream-reach scale and how the condition of biological communities can be explained by these stressors.

4. Develop statistical models and management tools to predict the ecological health of wadeable streams throughout the region and how ecological health is associated with concentrations of contaminants, nutrients, and sediment.

Background

The USGS launched Cycle III of the NAWQA Project in 2013, which marked the beginning of NAWQA's third decade of water-quality assessments for the Nation. In 1992, NAWQA began its Cycle I investigations, which aimed to characterize baseline water-quality conditions in the Nation's streams and aquifers (Leahy and others, 1990). A decade later, NAWQA transitioned to Cycle II, which emphasized trends and modeling and included five "topical" studies designed to improve our understanding of environmental processes affecting water quality. The topical studies addressed (1) the fate and transport of agricultural chemicals, (2) effects of urbanization on stream ecosystems, (3) effects of nutrient enrichment on stream ecosystems, (4) transport of contaminants to public-supply wells, and (5) bioaccumulation of mercury in stream ecosystems. Cycle III is built on 20 years of studies that describe contaminant sources and their transport to receiving waters, and the effects of land use on stream quality and ecological condition.

One of the major objectives in Cycle III is to assess the occurrence and effects of multiple instream stressors on stream ecological condition. Designated as Regional Stream Quality Assessment (RSQA) studies, these studies characterize watershed and stream water-quality stressors and aquatic biological conditions to improve understanding of stressor effects at regional scales (https://webapps.usgs.gov/RSQA/). Each RSQA study is a short-term assessment of wadeable streams in a targeted region, generally delineated by the U.S. Environmental Protection Agency (EPA) ecoregions (Omernik and Griffith, 2014). Between 75 and 100 streams are sampled in each RSQA study to investigate stream ecology and the effects of stressors that are primarily associated with urban development and agricultural land use. Wadeable streams are selected across gradients in urban or agricultural land use, depending on the dominant land use(s) in the region. Weekly water sampling typically is done for 4–12 weeks (depending on region and site characteristics) for a wide range of chemical constituents, and continuous monitoring of flow or stage and temperature is done at all stream sites. The timing of this water-quality (WQ) index period—defined as the 4- to 12-week period during which weekly discrete water samples were collected and analyzed for water-quality constituents—is designed to capture the spring and(or) early summer growing season, when pesticide and fertilizer applications are highest. Data from the WQ index period characterizes water-quality conditions antecedent to the ecological surveys, during which streambed sediment is collected for chemical analyses and toxicity testing, and stream habitat and biological communities are assessed.

A RSQA study was conducted in the Central California Foothills and Coastal Mountains ecoregion (Omernik and Griffith, 2014) in 2017. Designated as the California Stream Quality Assessment (CSQA), this study included a network of 85 streams and associated watersheds, and was the last of five NAWQA Cycle III regional stream-quality assessment studies (fig. 1); other studies were the Midwest Stream Quality Assessment in 2013 (Garrett and others, 2017), the Southeast Stream Quality Assessment in 2014 (Journey and others, 2015), the Pacific Northwest Stream Quality Assessment in 2015 (Sheibley and others, 2017), and the Northeast Stream Quality Assessment in 2016 (Coles and others, 2019). Like the three most recent RSQA studies, the 2017 CSQA study was done to investigate stressors along an urban gradient because urbanization is particularly intense from San Francisco and Oakland to San Jose. Additional sites were selected to represent agriculture in the region, which includes vineyards, orchards, and various row crops, as well as mixed land uses.

Purpose and Scope

This report describes the design and methods of the CSQA study (Van Metre and others, 2017b). The methods described include the collection and processing of water- and sediment- quality samples, and surveys of stream habitat and algal and macroinvertebrate communities, at 85 stream sites. Methods also are described for several focused studies done at subsets of sites, and for the procedures of laboratory analysis, quality assurance (QA) and quality control (QC), and data management.

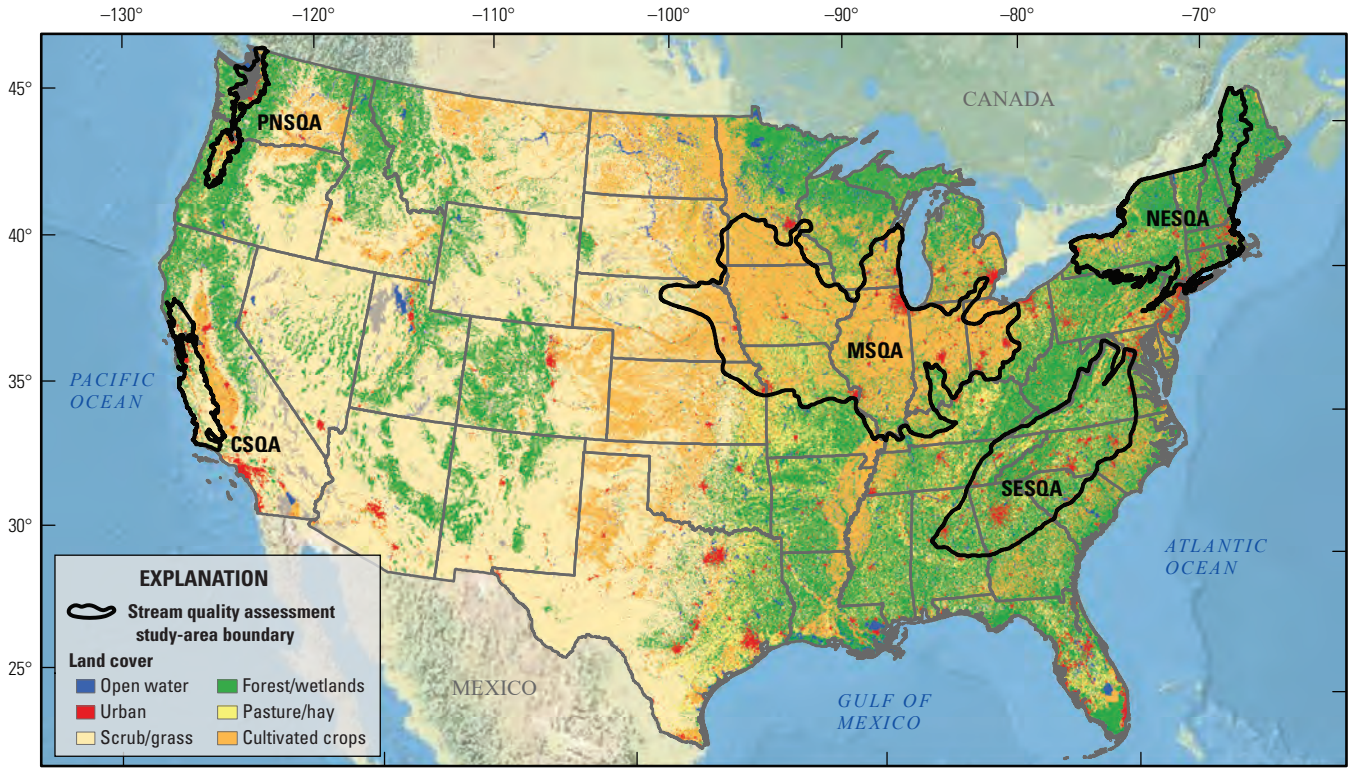

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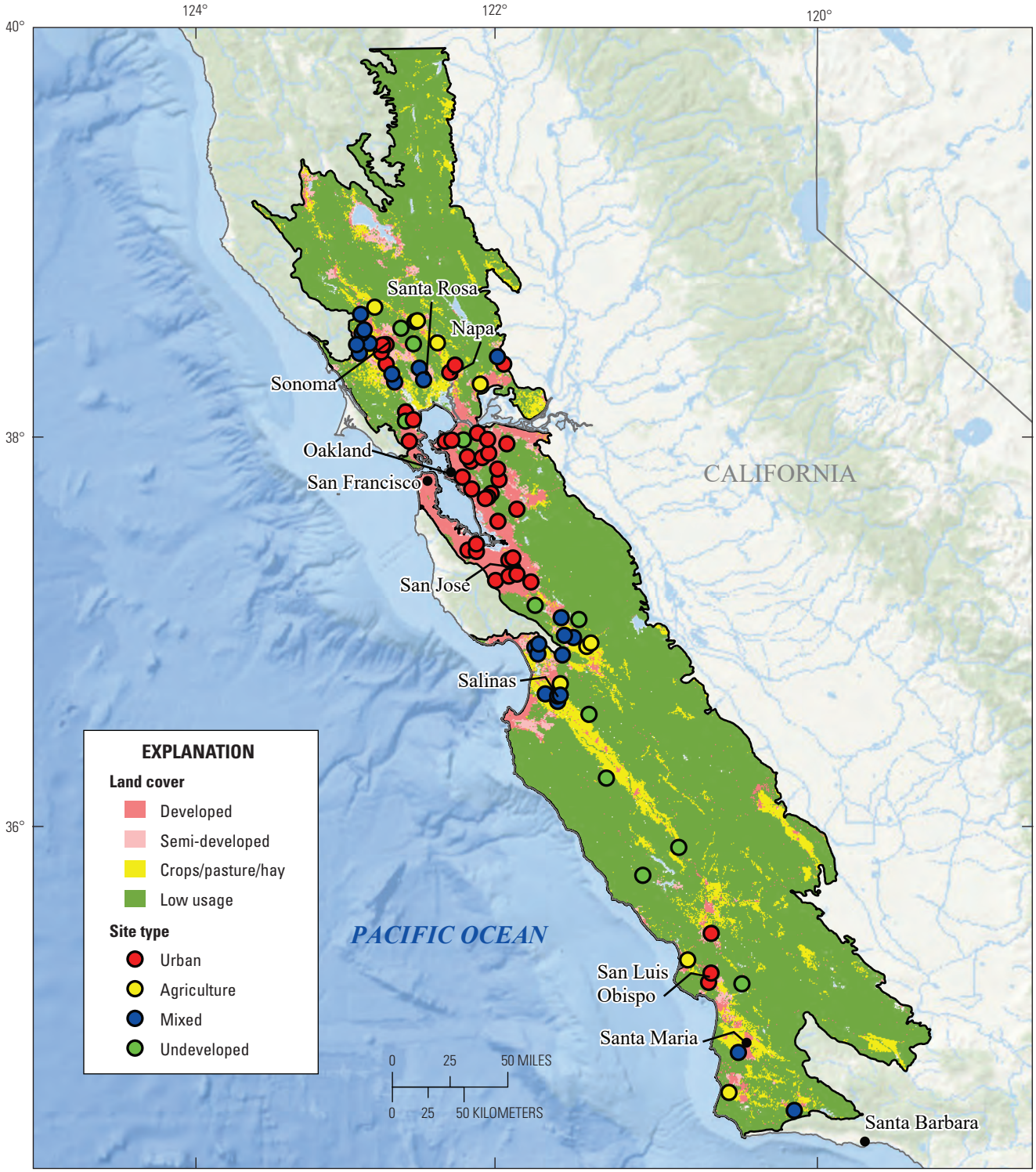
Figure 1. Locations of the Regional Stream Quality Assessment studies across the United States. (CSQA, California Stream Quality Assessment; MSQA, Midwest Stream Quality Assessment; NESQA, Northeast Stream Quality Assessment; PNSQA, Pacific Northwest Stream Quality Assessment; SESQA, Southeast Stream Quality Assessment).

Study-Area Description

The 85 CSQA streams are distributed over much of the Central California Foothills and Coastal Mountains ecoregion, an EPA Level III ecoregion, where urbanization and agriculture in the larger valleys are associated with degradation of stream health (Ode and others, 2011). The following information describing the Central California Foothills and Coastal Mountains ecoregion (hereafter coastal California, modified from Griffith and others, 2016) is summarized from Wiken and others (2011) and Omernik and Griffith (2014).

A primary distinguishing characteristic of the coastal California ecoregion is its Mediterranean climate of hot dry summers and cool moist winters. The mean annual temperature ranges from approximately 14 degrees Celsius (°C) to 18 °C, and the frost-free period ranges from 180 to 365 days. The mean annual precipitation is 548 millimeters (mm) and ranges from 200 to more than 1,400 mm on higher peaks in the northern portion of the ecoregion. Coastal fogs provide some moisture in the dry season. Vegetative cover is composed mainly of chaparral and oak woodlands, with grasslands occurring in some lower elevations and patches of pine at higher elevations. This ecoregion surrounds the lower and flatter Central California Valley ecoregion (although the CSQA sampled only on the western side of the Central Valley; fig. 2), and mostly consists of coastal terraces, some open low mountains or foothills, parallel ranges and valleys, and areas of irregular plains in the south and near the border of the Central California Valley ecoregion.

The geology of the coastal California ecoregion consists of Cenozoic marine and non-marine sedimentary rocks and Mesozoic granitic rocks; coarse sediments are found on colluvial slopes. Dominant soil orders include Alfisols, Entisols, and Mollisols, with a thermic soil temperature regime and xeric soil moisture regime. Streamflow in the region is mostly ephemeral and intermittent, with a few perennial streams entering from adjacent highland ecoregions. The region generally lacks lakes, but a few ponds and reservoirs occur. Large areas are in ranch lands grazed by domestic livestock, and some valleys are major agricultural centers, such as the Salinas Valley and the vineyards of Napa and Sonoma, but in general, little land has been cultivated. The highest levels of urban development are in the San Francisco Bay Area.



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Land-cover data modified from the National Water Quality Assessment wall-to-wall anthropogenic land use trends (NWALT) dataset (Falcone, 2015).

Figure 2. California Stream Quality Assessment study area, including sampling locations and generalized land cover. Site type indicates the dominant land use in the lower basin of the watershed. Land cover integrates land use from the National Water Quality Assessment wall-to-wall anthropogenic land use trends database (Falcone, 2015) and cropland from the Statewide Cropping Layer 2014 (Land IQ, LLC, 2017; California Department of Water Resources, 2019).

Study Design

The CSQA study was designed to assess differences in stream quality associated with urban and agricultural development in the region and to identify and measure specific stressors potentially causing ecological impairment. To the extent possible, sites were selected to represent a full urban gradient (ranging from undeveloped to a high percentage of urban land use) as well as agricultural indicator basins (representing crops characteristic of the region and with minimal urban land). However, watersheds with mixtures of urban and agricultural uses are very common in coastal California, and the selection of some mixed land-use basins could not be avoided. The CSQA sites are located within a single Level III ecoregion to minimize natural variability in biological communities and allow for a better understanding of how anthropogenic factors might affect water quality and ecological condition.

The CSQA study followed the general study design for a RSQA study: sampling water- and sediment-quality at 75–100 wadeable streams across a region during a 4- to 12-week WQ index period (4–6 weeks in CSQA). Meanwhile, continuous streamflow (or stage) and water temperature data were collected, and the CSQA study culminated in an ecological survey of the sampling reach of the stream at the end of the WQ index period.

The three elements of the RSQA studies can be characterized as comprehensive stressor assessments, focused studies, and ecological surveys. Comprehensive stressor assessments were designed to be conducted at all sites, including assessment of basic water quality (such as major ions, nutrients, pesticides) in all discrete water samples, additional water-quality constituents (such as mercury, organic wastewater indicators, algal toxins) in discrete water samples at least once during the WQ index period, selected WQ constituents (pesticides and pharmaceuticals) that were accumulated (integrated) by passive samplers deployed during the WQ index period, and streamflow or stage and temperature data collected continuously throughout the WQ index period. Focused studies were conducted at a subset of sites to assess selected stressors in more detail; these consisted of pesticides in daily and weekly composite samples collected by autosamplers, pesticides in biofilms, and radionuclides and other constituents in suspended sediment collected by passive samplers. At the end of the WQ index period, the ecological surveys assessed physical habitat, surveyed aquatic biota communities, and sampled bed sediment for chemical analysis and toxicity testing. In the CSQA study, algal and macroinvertebrate communities were sampled during the ecological surveys. Unlike other RSQA studies, fish were not surveyed in CSQA because of concerns that electro-fishing in the CSQA streams might adversely affect sensitive species. Dates of sample collection for all elements of CSQA are shown by site in appendix table 1.1.

The CSQA presented some challenges that were unique relative to the previous RSQA studies: a longer pesticide application season, combined with variation in the timing of pesticide applications from south to north, and the potential for streams to go dry during late spring and early summer, especially in the south. Timing of the sampling activities to coincide with peak pesticide applications, especially for the more toxic insecticides and fungicides, was desirable to capture the highest potential exposure. Pesticide applications in coastal California generally occur earlier in the south than in the north, and the CSQA sampling regime was designed to accommodate this difference. Sampling from March through June over the entire study area would have been desirable from the perspective of pesticide exposure, but some small- to medium-sized streams in coastal California are intermittent, generally only flowing for a few months in late winter and spring. To improve the likelihood that continuous flow conditions would persist throughout the sampling period, an early sampling period was chosen, and the sites were divided into a “Southern” group (n=36; table 1) and a “Northern” group (n=49). The water sampling period was offset by 3 weeks between the Southern sites (March 13 to April 21, 2017; table 1) and the Northern sites (April 3 to May 12, 2017).

Site Selection Process

Candidate sites for the CSQA study were identified from active and historical (inactive) USGS streamgages (n=125) and from sites monitored by the California Department of Fish and Wildlife (n=435). A few candidate sites had streamgages nearby that were operated by the county (such as Contra Costa, Napa, San Luis Obispo, Solano) or city (Vacaville, Petaluma). Additional State and local agencies and institutions were consulted for information about candidate sites, including the California State Water Resources Control Board, North Coast Regional Water Quality Control Board, San Francisco Regional Water Quality Control Board, Central Coast Regional Water Quality Control Board, San Francisco Estuary Institute, California Department of Pesticide Regulation, and researchers from University of California at Davis and University of California at Berkeley. Several sites that had not been previously sampled were identified to fill gaps in the distribution of land-use settings relative to design objectives. A geospatial database was created that included land-cover characteristics for the watersheds of candidate sites (Qi and Nakagaki, 2020).

Table 1. Characteristics of stream watersheds in the Central California Foothills and Coastal Mountains ecoregion of the United States that were assessed as part of the U.S. Geological Survey National Water-Quality Assessment Project, California Stream Quality Assessment, in 2017.

[Latitude and longitude of water quality sample location based on the North American Datum of 1983 and shown in decimal degrees. The column heading "Northern or Southern group" indicates relative location of sites in the San Francisco Bay area; sampling began the week of March 13, 2017, for the Southern group and April 3, 2017, for the Northern group. Sampling frequency is the number of discrete water samples collected at that site. **Abbreviations**: ID, identification; km², square kilometer; NWIS, U.S. Geological Survey National Water Information System database; N, northern; S, southern]

Map ID number[1]	NWIS station number	NWIS station name	Field identifier	Latitude (NWIS)	Longitude (NWIS)	Northern or Southern group	Basin area (km²)	Whole basin land use	Lower basin land use[2]	Site type (lower basin)[3]	Sampling frequency
48	11179100	ALAMEDA C NR FREMONT CA	CA_Alameda	37.566602	–122.001628	N	1,654.4	Urban_low	Urban_med	Urban	6
18	382035121575501	ALAMO C A TULARE RD BR NR VACAVILLE CA	CA_Alamo	38.343083	–121.96535	N	55.9	Urban_low	Urban_med	Urban	6
73	364003121373501	ALISAL C A FAIRVIEW AVE NR SALINAS CA	CA_Alisal	36.66725	–121.626999	S	105.2	Ag_high	Mixed	Mixed	6
47	11176900	ARROYO DE LA LAGUNA A VERONA CA	CA_Arroyo-DeLaLa	37.626599	–121.883013	S	1,045.6	Urban_low	Urban_med	Urban	6
27	380410122315501	ARROYO SAN JOSE A DIGITAL DR NR NOVATO CA	CA_ArroyoDig	38.069497	–122.531997	N	14.1	Urban_med	Urban_med	Urban	6
29	11182400	ARROYO DEL HAMBRE A MARTINEZ CA	CA_ArroyoMart	38.003255	–122.129965	N	38.0	Urban_low	Urban_low	Urban	6
28	380345122345201	ARROYO SAN JOSE A FAIRWAY DR NR NOVATO CA	CA_ArroyoNov	38.062272	–122.581152	N	2.3	Undeveloped	Undeveloped	Undeveloped	4
75	11152000	ARROYO SECO NR SOLEDAD CA	CA_ArroyoSeco	36.280521	–121.322706	S	625.4	Undeveloped	Undeveloped	Undeveloped	4
78	352934120395501	ATASCADERO C A W MALL BR A ATASCADERO CA	CA_Atascadero	35.492883	–120.665164	S	50.2	Urban_low	Urban_med	Urban	6
46	11181008	CASTRO VALLEY C A HAYWARD CA	CA_Castro	37.679931	–122.080519	N	14.4	Urban_high	Urban_high	Urban	6
79	352127120484501	CHORRO C A CHORRO C RD NR MORRO BAY CA	CA_Chorro	35.357508	–120.812464	S	105.0	Urban_low	Ag_low	Agriculture	6
74	363608121255201	CHUALAR C A CHUALAR CANYON RD NR CHUALAR CA	CA_ChuChuChu	36.6022	–121.430997	S	58.6	Undeveloped	Undeveloped	Undeveloped	4
14	11465690	COLGAN C NR SANTA ROSA CA	CA_Colgan	38.402135	–122.733043	N	9.0	Urban_high	Urban_high	Urban	6
8	11456500	CONN C NR OAKVILLE CA	CA_ConnOak	38.447278	–122.380556	N	146.1	Ag_low	Ag_high	Agriculture	6
17	11465660	COPELAND C A ROHNERT PARK CA	CA_Copeland	38.343248	–122.701932	N	14.9	Urban_med	Urban_high	Urban	6
66	11159200	CORRALITOS C A FREEDOM CA	CA_Corralitos	36.939397	–121.770506	S	70.8	Mixed	Mixed	Mixed	6
33	11460000	CORTE MADERA C A ROSS CA	CA_Corte	37.962979	–122.556922	N	46.7	Urban_med	Urban_med	Urban	6

Table 1. Characteristics of stream watersheds in the Central California Foothills and Coastal Mountains ecoregion of the United States that were assessed as part of the U.S. Geological Survey National Water-Quality Assessment Project, California Stream Quality Assessment, in 2017.—Continued

[Latitude and longitude of water quality sample location based on the North American Datum of 1983 and shown in decimal degrees. The column heading "Northern or Southern group" indicates relative location of sites in the San Francisco Bay area; sampling began the week of March 13, 2017, for the Southern group and April 3, 2017, for the Northern group. Sampling frequency is the number of discrete water samples collected at that site. **Abbreviations**: ID, identification; km², square kilometer; NWIS, U.S. Geological Survey National Water Information System database; N, northern; S, southern]

Map identification number[1]	NWIS station number	NWIS station name	Field identifier	Latitude (NWIS)	Longitude (NWIS)	Northern or Southern group	Basin area (km²)	Whole basin land use	Lower basin land use[2]	Site type (lower basin)[3]	Sampling frequency
52	372303121542901	COYOTE C BL CHARCOT AVE NR SAN JOSE CA	CA_CoyoteChar	37.384453	–121.907849	N	809.7	Urban_low	Urban_high	Urban	6
57	371554121474101	COYOTE C A COYOTE RD NR SAN JOSE CA	CA_CoyoteCoyote	37.264939	–121.794658	S	594.4	Urban_low	Urban_med	Urban	6
60	11169800	COYOTE C NR GILROY CA	CA_CoyoteGil	37.077723	–121.494383	S	282.5	Undeveloped	Undeveloped	Undeveloped	4
44	11180900	CROW C NR HAYWARD CA	CA_Crow	37.70493	–122.043851	N	27.3	Urban_low	Urban_low	Urban	6
2	11465350	DRY C NR MOUTH NR HEALDSBURG CA	CA_DryMouth	38.58741	–122.862216	N	565.0	Ag_low	Mixed	Mixed	6
72	364138121373701	GABILAN C AB E LAUREL DR NR SALINAS CA	CA_GabilanEastL	36.693963	–121.627252	S	107.7	Ag_low	Mixed	Mixed	6
69	11152600	GABILAN C NR SALINAS CA	CA_GabilanSal	36.755792	–121.610501	S	95.1	Undeveloped	Ag_low	Agriculture	6
30	375819122035801	GRAYSON C A GOLF CLUB RD NR PLEASANT HILL CA	CA_Grayson	37.972091	–122.066128	N	36.5	Urban_high	Urban_high	Urban	6
12	382619122531401	GREEN VALLEY C A GRATON CA	CA_Green	38.438729	–122.887208	N	25.7	Mixed	Mixed	Mixed	6
53	11169025	GUADALUPE R ABV HWY 101 A SAN JOSE CA	CA_GuadalupeA	37.37383	–121.933013	S	406.4	Urban_med	Urban_high	Urban	6
54	371814121525601	GUADALUPE R A WILLOW GLEN WAY NR SAN JOSE CA	CA_GuadalupeB	37.303947	–121.88225	S	219.0	Urban_med	Urban_high	Urban	6
38	375257122050001	LAS TRAMPAS C A LAFAYETTE CA	CA_LasTrampas	37.882397	–122.099997	N	20.4	Urban_low	Urban_med	Urban	6
22	381740122395901	LICHAU C A PENNGROVE CA	CA_Lichau	38.294481	–122.666361	N	20.0	Mixed	Mixed	Mixed	6
62	11153650	LLAGAS C NR GILROY	CA_LlagasGilroy	36.987449	–121.527162	S	218.9	Mixed	Mixed	Mixed	6
59	370512121361901	LLAGAS C A SAN MARTIN AVE A SAN MARTIN CA	CA_LlagasMartin	37.086742	–121.605206	S	73.0	Urban_low	Mixed	Mixed	6
58	11153470	LLAGAS C AB CHESBRO RES NR MORGAN HILL CA	CA_LlagasMorgan	37.148333	–121.768333	S	24.9	Undeveloped	Undeveloped	Undeveloped	4
82	11141280	LOPEZ C NR ARROYO GRANDE CA	CA_Lopez	35.23553	–120.472386	S	54.1	Undeveloped	Undeveloped	Undeveloped	4
55	371738121555901	LOS GATOS C A E HAMILTON AVE NR CAMPBELL CA	CA_LosGatos	37.2939	–121.933	S	119.1	Urban_low	Urban_high	Urban	6

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Map identification number[1]	NWIS station number	NWIS station name	Field identifier	Latitude (NWIS)	Longitude (NWIS)	Northern or Southern group	Basin area (km²)	Whole basin land use	Lower basin land use[2]	Site type (lower basin)[3]	Sampling frequency
1	383719122462501	MAACAMA C A CHALK HILL RD BR NR HEALDSBURG CA	CA_Maacama	38.621958	–122.773689	N	118.0	Ag_low	Ag_low	Agriculture	6
7	11466800	MARK WEST C NR MIRABEL HEIGHTS CA	CA_MarkWMir	38.494078	–122.853326	N	652.0	Mixed	Mixed	Mixed	6
5	383109122363301	MARK WEST C A TARWATER RD NR CALISTOGA CA	CA_MarkWTar	38.519047	–122.609222	N	10.5	Undeveloped	Undeveloped	Undeveloped	4
51	372500122081201	MATADERO C A JOSINA AVE A PALO ALTO CA	CA_Matadero	37.4168	–122.136592	S	16.1	Urban_med	Urban_high	Urban	6
11	11466170	MATANZAS C A SANTA ROSA CA	CA_Matanzas	38.438801	–122.702487	N	57.0	Mixed	Urban_med	Urban	6
19	382017122161101	MILLIKEN C BL HEDGESIDE AVE NR NAPA CA	CA_Milliken	38.338155	–122.269874	N	45.0	Urban_low	Urban_low	Urban	6
35	375701121564401	MT DIABLO C A CLAYTON CA	CA_MtDiablo	37.950364	–121.945647	N	42.7	Urban_low	Urban_med	Urban	6
77	11148900	NACIMIENTO R BL SAPAQUE C NR BRYSON CA	CA_NaciBryson	35.788579	–121.093805	S	403.3	Undeveloped	Undeveloped	Undeveloped	4
3	383321122302101	NAPA R A BALE LN NR DEER PARK CA	CA_NapaBale	38.555946	–122.505915	N	116.5	Ag_low	Ag_low	Agriculture	6
21	11458300	NAPA C A NAPA	CA_NapaNapa	38.301859	–122.303863	N	38.9	Urban_low	Urban_med	Urban	6
71	364155121363901	NATIVIDAD C NR SALINAS CA	CA_Natividad	36.6987	–121.610722	S	25.9	Ag_low	Mixed	Mixed	6
15	382346122521201	UNNAMED TRIB A MONTGOMERY RD NR SEBASTOPOL CA	CA_NoNameMon-ty	38.396125	–122.870039	N	14.9	Mixed	Mixed	Mixed	6
64	365718121444301	UNNAMED TRIB A PAULSEN RD NR FREEDOM CA	CA_NoNamePaul	36.955181	–121.745631	S	42.8	Mixed	Mixed	Mixed	6
26	11459500	NOVATO C A NOVATO CA	CA_Novato	38.107698	–122.579981	N	46.5	Urban_low	Urban_med	Urban	6
83	11141050	ORCUTT C NR ORCUTT CA	CA_Orcutt	34.88359	–120.494888	S	49.3	Urban_low	Mixed	Mixed	6
63	365736121250801	PACHECO C A SAN FELIPE RD NR DUNNEVILLE CA	CA_Pacheco	36.959818	–121.418968	S	395.3	Undeveloped	Ag_high	Agriculture	6
68	11159000	PAJARO R A CHITTENDEN CA	CA_PajaroChit	36.900231	–121.597721	S	3,071.5	Ag_low	Mixed	Mixed	6
67	11159500	PAJARO R A WATSONVILLE CA	CA_PajaroWat	36.905297	–121.7514	S	3,284.6	Ag_low	Mixed	Mixed	6

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Map identification number[1]	NWIS station number	NWIS station name	Field identifier	Latitude (NWIS)	Longitude (NWIS)	Northern or Southern group	Basin area (km²)	Whole basin land use	Lower basin land use[2]	Site type (lower basin)[3]	Sampling frequency
24	381519122385601	PETALUMA R NR PETALUMA CA	CA_Petaluma	38.255189	–122.648971	N	87.1	Mixed	Mixed	Mixed	6
31	375807122124001	PINOLE C BL ALHAMBRA VALLEY RD NR PINOLE CA	CA_Pinole	37.968652	–122.210997	N	13.4	Undeveloped	Undeveloped	Undeveloped	4
70	11152650	RECLAMATION DITCH NR SALINAS CA	CA_Reclamation	36.704959	–121.704948	S	274.6	Mixed	Mixed	Mixed	6
4	383305122311901	RITCHEY C NR DEER PARK CA	CA_Ritchey	38.551424	–122.521015	N	6.4	Undeveloped	Undeveloped	Undeveloped	4
76	11150500	SALINAS R NR BRADLEY CA	CA_Salinas	35.930243	–120.868791	S	6,570.4	Undeveloped	Undeveloped	Undeveloped	6
49	372716122080801	SAN FRANCISQUITO C DS OF NEWELL RD BR A PALO ALTO	CA_SanFranPalo	37.454383	–122.136631	N	99.9	Urban_med	Urban_high	Urban	6
50	11164500	SAN FRANCISQUITO C A STANFORD UNIVERSITY CA	CA_SanFranStan	37.423273	–122.18941	S	97.4	Urban_med	Urban_med	Urban	6
43	374336122095801	SAN LEANDRO C A ALVARADO ST A SAN LEANDRO CA	CA_SanLeandro	37.726608	–122.166178	N	114.8	Urban_low	Urban_high	Urban	6
81	351436120405201	SAN LUIS OBISPO C A LOS OSOS VLY RD NR SAN LUIS OB	CA_SanLObispo	35.243333	–120.681111	S	107.2	Urban_low	Urban_med	Urban	6
45	11181000	SAN LORENZO C A HAYWARD CA	CA_SanLorenzo	37.685486	–122.064407	N	97.8	Urban_low	Urban_med	Urban	6
39	375220122104201	SAN PABLO C A MORAGA WAY A ORINDA CA	CA_SanPabloMor	37.864508	–122.172306	N	4.4	Urban_med	Urban_med	Urban	6
37	375312122113501	SAN PABLO C A ORINDA CA	CA_SanPabloOr	37.886553	–122.193119	N	20.9	Urban_med	Urban_med	Urban	6
34	375746122195501	SAN PABLO C A EL PORTAL DR A SAN PABLO CA	CA_SanPabloPort	37.9628	–122.331997	N	104.0	Urban_med	Urban_med	Urban	6
40	374933122001301	SAN RAMON C A LA GONDA WAY A DANVILLE CA	CA_SanRamon-Dan	37.825711	–122.003539	N	87.5	Urban_med	Urban_med	Urban	6
42	11182500	SAN RAMON C A SAN RAMON CA	CA_SanRamon-San	37.772983	–121.994682	N	15.6	Urban_low	Urban_low	Urban	6
13	11466200	SANTA ROSA C A SANTA ROSA CA	CA_SantaSanta	38.436579	–122.72471	N	144.6	Urban_low	Urban_high	Urban	6

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Map identification number[1]	NWIS station number	NWIS station name	Field identifier	Latitude (NWIS)	Longitude (NWIS)	Northern or Southern group	Basin area (km²)	Whole basin land use	Lower basin land use[2]	Site type (lower basin)[3]	Sampling frequency
9	11466320	SANTA ROSA C A WILLOWSIDE RD NR SANTA ROSA CA	CA_SantaWillow	38.44519	–122.807213	N	197.5	Urban_med	Mixed	Mixed	6
84	11135250	SANTA YNEZ R A 13TH ST BRIDGE A VAFB NR LOMPOC CA	CA_SantaYnez-Lom	34.676617	–120.553389	S	2,283.2	Undeveloped	Ag_high	Agriculture	6
85	11128500	SANTA YNEZ R A SOLVANG CA	CA_SantaYnezSol	34.584987	–120.144593	S	1,498.9	Undeveloped	Mixed	Mixed	6
56	371620122005801	SARATOGA C A BRAEMAR DR A SARATOGA CA	CA_Saratoga	37.272252	–122.016288	S	26.2	Urban_low	Urban_med	Urban	6
41	374708122132801	SAUSAL C A OAKLAND CA	CA_Sausal	37.785681	–122.224339	N	10.2	Urban_med	Urban_high	Urban	6
10	382634122315201	SONOMA C A ADOBE CYN RD NR KENWOOD CA	CA_SonomaAdo-be	38.4427	–122.531	N	10.3	Undeveloped	Undeveloped	Undeveloped	4
20	11458500	SONOMA C A AGUA CALIENTE CA	CA_SonomaAgua	38.323247	–122.494426	N	150.5	Mixed	Mixed	Mixed	6
23	381556122280201	SONOMA C A WATMAUGH RD BR NR SONOMA CA	CA_SonomaWat	38.265797	–122.467397	N	188.0	Mixed	Mixed	Mixed	6
80	351725120395901	STENNER C A MURRAY AVE A SAN LUIS OBISPO CA	CA_Stenner	35.2904	–120.666319	S	23.2	Urban_low	Urban_low	Urban	6
25	381441122064301	SUISUN C A ROCKVILLE CA	CA_Suisan	38.244797	–122.111997	N	125.5	Ag_low	Ag_high	Agriculture	6
65	365634121264001	TEQUISQUITA SLOUGH A SHORE RD NR DUNNEVILLE CA	CA_Tequisquita	36.9427	–121.4445	S	301.6	Ag_low	Ag_high	Agriculture	6
16	382245122001601	ULATIS C A FARRELL RD NR VACAVILLE CA	CA_Ulatis	38.379169	–122.004319	N	27.9	Ag_low	Mixed	Mixed	6
61	365955121350601	UVAS C A MILLER AVE A GILROY CA	CA_UvasMiller	36.998533	–121.584958	S	178.7	Undeveloped	Mixed	Mixed	6
36	375413122033301	WALNUT C A CIVIC DR A WALNUT CREEK CA	CA_Walnut	37.903669	–122.059217	N	204.4	Urban_med	Urban_high	Urban	6
32	375808122172601	WILKIE C A SANTA RITA RD NR RICHMOND CA	CA_Wilkie	37.968842	–122.290553	N	3.2	Urban_high	Urban_high	Urban	6

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Map identification number[1]	NWIS station number	NWIS station name	Field identifier	Latitude (NWIS)	Longitude (NWIS)	Northern or Southern group	Basin area (km^2)	Whole basin land use	Lower basin land use[2]	Site type (lower basin)[3]	Sampling frequency
6	383039122502401	WINDSOR C A MARK WEST STATION RD NR WINDSOR CA	CA_Windsor	38.510957	–122.839956	N	65.1	Mixed	Mixed	Mixed	6

[1]Map identification number refers to site numbers in figure 3.

[2]Lower basin land use indicates the dominant land use in the lower part of the watershed extending 5 kilometers from the sampling location. Land-use subcategories are defined in table 3.

[3]Major site type, based on dominant land use in lower basin. Site types are shown in figure 2.

Watershed delineations and characteristics were available for streams with active USGS streamgages. For other candidate sites, catchment boundaries from the National Hydrography Dataset Plus (NHDPlus Version 2; U.S. Environmental Protection Agency and U.S. Geological Survey, 2012) were used as the watershed boundaries by selecting all upstream catchments from the segment on which the candidate site was located. Nationally available, digital geographic information systems (GIS) data layers (for example, the National Land Cover Database [NLCD], Homer and others, 2015) were overlain on the catchment-derived watersheds, and characteristics of the watersheds were assessed and summarized from these data layers for use during site selection.

After initial screening, based on GIS characteristics and prioritization of gaged and historically monitored sites, the remaining sites were evaluated with the use of satellite imagery (Google Earth®, https://www.google.com/earth/) for general watershed characteristics, potential stressor sources (for example, water treatment plants, industrial complexes, golf courses), and accessible sampling reach locations. An objective during this step of site selection was to distribute sites widely across the region and to represent the full range of undeveloped, agricultural, and urban land uses present. This "desk-top reconnaissance" was applied to about 330 sites, of which 129 were selected for field reconnaissance. A field reconnaissance of these sites was conducted by USGS staff during winter and spring 2017. Field observations for each site included evaluating the site for access and safety, assessing general stream characteristics to determine locations for water-quality sampling, and identifying a 150-meter (m) stream reach with riffle habitat suitable for conducting ecological surveys. Field notes and photography were recorded onsite by using field-reconnaissance forms on an electronic tablet; afterwards, information from these forms was compiled into spreadsheets for use in site review and final selection.

Final site selection was based on the field reconnaissance and on the distribution of land use in the candidate watersheds, again with the objective of representing the range of urban and agricultural development in the region. The distribution of the final 85 sites by land-use type was evaluated at two scales using the NAWQA Wall-to-Wall Anthropogenic Land Use Trends (NWALT) data layers (Falcone, 2015) for whole drainage basins (WB) and for the lower drainage basin only (LB; table 1). The LB boundaries were created by intersecting a 5-kilometer (km) buffer around the sampling site within the drainage basin boundary, consistent with the 5-km scale used by the State of California to assess ecological condition and contamination in streams (Ode and others, 2011). The purpose of using the LB approach was to capture the influence on water quality of land use upstream and close to the sampling location. Some headwater streams flow from relatively undeveloped hills of the California Coast Ranges into an intensely developed valley. In such cases, the WB characteristics might indicate a relatively undeveloped basin, even though the site might be strongly affected by proximal development.

The NWALT data provided a more detailed delineation of urban land uses than is available in NLCD (U.S. Geological Survey, 2014). A two-step process was applied, starting with the NWALT data, to assign a land-use category to each site. NWALT land-use "classes" (as described in Falcone, 2015, such as high density residential developed and cultivated crops) were combined into summed land-use "types" (such as Total Urban or Total Agriculture) to represent the types and degree of urban development and agriculture in the watersheds of sites (table 2). Each site was then assigned to a land-use category (Urban, Agriculture, Mixed, or Undeveloped) and a "land-use subcategory" (such as Urban_high, Ag_high, Undeveloped) on the basis of combinations and threshold levels of the various land-use types in the watershed (table 3). On the basis of visual inspections of the basins in satellite imagery (Google Earth®), NWALT data occasionally appeared to misrepresent some types of agricultural land in California; specifically, nurseries, greenhouses, orchards, and vineyards were classified in some cases as urban or semi-developed land. Such apparent errors were confirmed by consulting the Statewide Crop Mapping 2014 dataset (Land IQ, LLC, 2017), which is the official dataset of the California Department of Water Resources (CDWR) for determining agricultural land use and irrigated acres (California Department of Water Resources, 2019) and which indicated that the percentage of agricultural land was underestimated in some basins. In these cases, the assigned land-use category was adjusted to reflect the visual characteristics (such crop fields, greenhouses, orchards) and cropping patterns from the CDWR dataset.

The final 85 sites are widely distributed across the region (fig. 2). Individual site locations are shown in fig. 3, numbered in relation to site names in table 1. There were more mixed sites and fewer undeveloped sites for watershed delineations at the LB scale than at the WB scale (table 4), possibly because there was generally more undeveloped land in the upper basin. This intensification of development in the vicinity of the sampling site is seen by comparing plots of the WB and LB of site distributions in relation to two primary land-use types: total urban and cropland (fig. 4). In each of the WB and LB delineations, a large subset of sites represented a full urban gradient reasonably well, without the complicating factor of high levels of agricultural land use also within the watersheds. More mixed land-use sites were apparent at the LB scale (fig. 4; table 4). Of the 85 sites, 39 were classified as having some degree of urban land use at both the LB and WB scales; however, only 5 sites were classified as Agricultural sites at both the LB and WB scales. Although there is extensive agriculture in some watersheds in the region, most of it is mixed with urban development.

Table 2. Land-use classes from the National Water Quality Assessment wall-to-wall anthropogenic land use trends database were summed to create land-use types.

[The parenthetical numbers are the assigned numeric class designations from the National Water Quality Assessment wall-to-wall anthropogenic land use trends (NWALT) dataset (Falcone, 2015). Thresholds were applied to these land-use types to assign each site to a land-use category (as in table 3). **Abbreviation**: —, not applicable]

NWALT land-use classes[1]	Land-use types						
	Dense urban	Total urban	Extended urban	Cropland	Total agriculture	Total developed	Low usage
Water (11)	—	—	—	—	—	—	X
Wetlands (12)	—	—	—	—	—	—	X
Dev_MajorTransp (21)	X	X	X	—	—	X	—
Dev_CommServices (22)	X	X	X	—	—	X	—
Dev_IndusMilitary (23)	X	X	X	—	—	X	—
Dev_Recreation (24)	—	X	X	—	—	X	—
Dev_ResidHigh (25)	—	X	X	—	—	X	—
Dev_ResidLowMed (26)	—	X	X	—	—	X	—
Dev_Other (27)	—	X	X	—	—	X	—
SemiDev_UrbHigh (31)	—	([2])	X	—	—	X	—
SemiDev_UrbLowMed (32)	—	—	X	—	—	X	—
SemiDev_AnthroOth (33)	—	—	X	—	—	X	—
Prod_Mining (41)	—	—	—	—	—	X	—
Prod_Crops (43)	—	—	—	X	X	X	—
Prod_PastureHay (44)	—	—	—	—	X	X	—
Prod_GrazingPot (45)	—	—	—	—	X	X	—
LowUse (50)	—	—	—	—	—	—	X
VeryLowUse_Conserv (60)	—	—	—	—	—	—	X

[1]Dev_CommServices, developed, commercial/services, class 22; Dev_IndusMilitary, developed, industrial/military, class 23; Dev_MajorTransp, developed, major transportation, class 21; Dev_Other, developed, other, class 27; Dev_Recreation, developed, recreation, class 24; Dev_ResidHigh, developed, residential high density, class 25; Dev_ResidLowMed, developed, residential low-medium density, class 26; SemiDev_AnthroOth, semi-developed, anthropogenic other, class 33; SemiDev_UrbHigh, semideveloped, urban interface high, class 31; SemiDev_UrbLowMed, semi-developed, urban interface low-medium, class 32; Prod_Crops, production, crops, class 43; Prod_GrazingPot, production, grazing potential, class 45; Prod_Mining, production, mining/extraction, class 41; Prod_PastureHay, production, pasture/hay, class 44; LowUse, no other land use, class 50; VeryLowUse_Conserv, no other land use and in a protected area, conservation, class 60; Water, water, class 11; Wetlands, wetlands, class 12.

[2]For the California Stream Quality Assessment study, total urban excluded the SemiDev_UrbHigh class because in California, this NWALT class sometimes mischaracterized agricultural land containing scattered buildings (such as vineyards, nurseries) as semi-developed urban high. In other Regional Stream Quality Assessment studies, however, total urban included the SemiDev_UrbHigh class.

Table 3. Thresholds and combinations of land-use types used to assign sites to unique land-use categories.

[Land-use types used in the conditions below are defined in table 2, and are based on land-use data from the National Water Quality Assessment wall-to-wall anthropogenic land use trends (NWALT) dataset (Falcone, 2015). **Abbreviations**: >, greater than; %, percent; <, less than; —, not applicable]

Land use subcategory	Conditions (all must be met, except as indicated in OR statements)		
	Urban AND	Agriculture AND	Other
Major land use category: Urban			
Urban_high	>20% Dense urban OR >75% Total urban	<10% Cropland AND <25% Total agriculture	—
Urban_med	25–75% Total urban	<10% Cropland AND <25% Total agriculture	—
Urban_low	5–25% Total urban OR >25% Extended urban	<10% Cropland AND <25% Total agriculture	Total urban > Cropland
Major land use category: Agriculture			
Ag_high	<10% Total urban AND <25% Extended urban	>25% Cropland	—
Ag_low	<10% Total urban AND <25% Extended urban	5–25% Cropland OR >25% Total agriculture	Crops > Total urban
Major land use category: Mixed			
Mixed	>10% Total urban OR >25% Extended urban	>10% Cropland OR >25% Total agriculture	—
Major land use category: Undeveloped			
Undeveloped	<5% Total urban AND <25% Extended urban	<5% Cropland AND <25% Total agriculture	—

Table 4. Distribution of 85 California Stream Quality Assessment sites by land-use category for the whole basin and lower basin watershed delineations.

[Land-use categories are defined in table 3.]

Land-use category	Whole basin	Lower basin
Urban_high	4	15
Urban_med	15	20
Urban_low	24	5
Ag_high	1	5
Ag_low	11	4
Mixed	13	24
Undeveloped	17	12

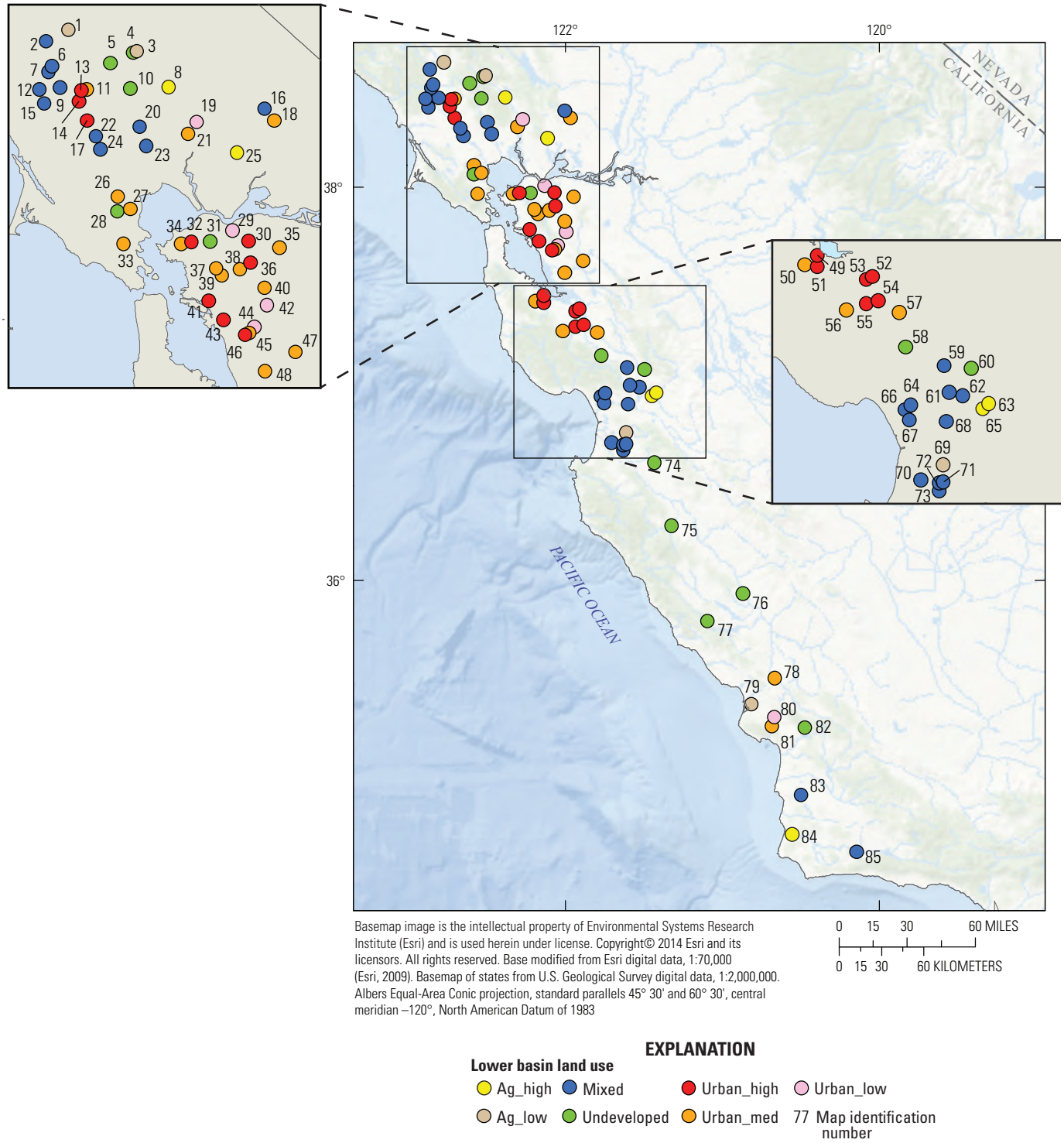

Figure 3. Locations of the 85 sites sampled for the California Stream Quality Assessment study, 2017. Sites are color-coded by lower basin land-use subcategory (as defined in table 3). Site names are listed by map identification number in table 1.

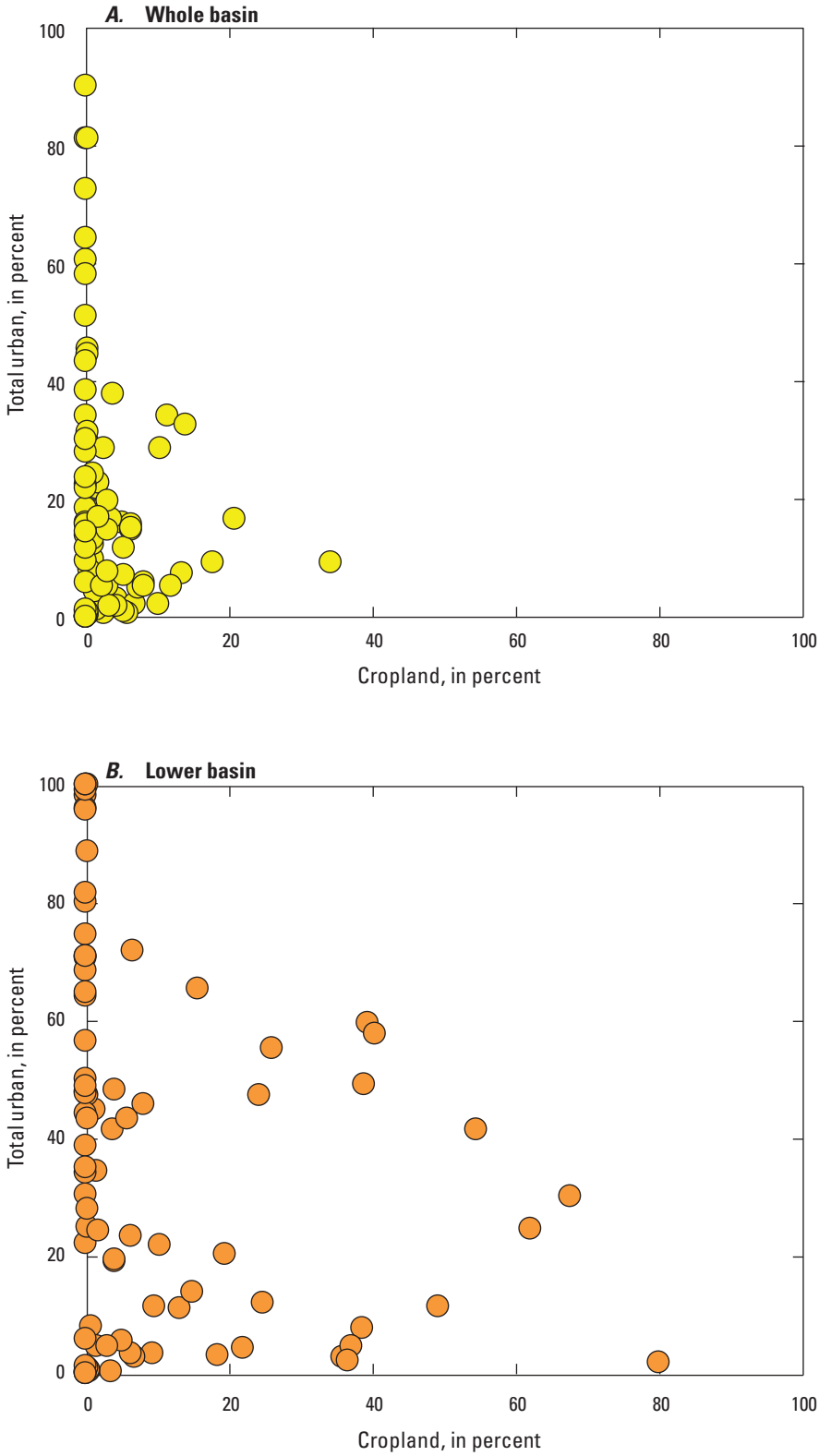

Figure 4. Distribution of 85 California Stream Quality Assessment sites in relation to percent of cropland and percent of total urban (as defined in table 2) for *A*, the whole basin; and *B*, lower basin watershed delineation approaches. Data are from Qi and Nakagaki (2020).

Sample Collection and Processing

The types of data and the intervals at which samples were collected varied among the sites according to land-cover type and associated potential stressors. Data collection and sampling routines were categorized nominally by three study-design components (table 5). The comprehensive stressor assessments identify the various water-quality constituents that were collected at all sites. Although the study design called for measuring streamflow or stage and continuous temperature at all sites, some sites are missing stage or temperature data because pressure or temperature sensors were either not deployed or were lost in the field owing to high flow conditions. The focused studies component was composed of limited investigations at subsets of streams that focused on the occurrence and timing of specific stressors potentially affecting the condition of those streams. The ecological surveys component identified sampling activities associated with the ecological surveys done at the end of the index period at all sites.

The various constituents in each study design component are characterized in table 5 by the time interval at which they were collected: discrete, integrated, or continuous. Discrete samples characterized stream conditions at a specific point in time and could be collected at multiple times during the study (for example, "Basic quality of water (QW)" constituents, table 5) or collected only once during the study (for example, "N and O isotopes," table 5). Integrated data were collected by passive sampling devices that were deployed during the study to represent an average or cumulative condition of the stream (for example, polar organic chemical integrative sampler; POCIS, table 5). Continuous data (such as streamflow, stage, temperature; table 5) were recorded at 15-minute intervals. All constituents included in Ecological Surveys (table 5) were measured once to represent conditions at a point in time and, therefore, the data are discrete; however, because these constituents generally acclimate to environmental variations over time, they typically reflect integrated conditions.

USGS staff who participated in the CSQA study received training before data collection activities, including instructions specific to water-quality sampling, focused studies, and ecological surveys. For example, the use of low-level analytical methods necessitated that water samples be collected according to "parts-per-billion" protocols (U.S. Geological Survey, 2006). During weeks when water-quality data were collected at all 85 sites, nine 2-person teams of USGS staff were deployed. To ensure consistency among the water-quality teams, training for the collection and processing of water-quality samples occurred in February 2017 for all personnel involved with sample collection. Classroom water-quality training was followed by field-training exercises to work through all sampling and processing procedures in the field before the start of sampling. The sample collection timelines, sample types collected at sites, and sample collection, processing, and handling procedures are summarized in appendix 1 and described briefly here.

Ecological survey teams were trained in consistent sampling protocols, including State of California protocols for the collection of algae and aquatic macroinvertebrates (Ode and others, 2016), and USGS protocols for habitat surveys (Fitzpatrick and others, 1998) and bed-sediment collection (Shelton and Capel, 1994; Radtke, 2005). Before beginning the sampling trip, participants gathered at a local stream and instructors demonstrated the various protocols for collecting each sample type. The participants completed a full ecological collection at the training location. The ecological sampling coordinator visited each 5-person team during the sampling trip to verify techniques and clarify any questions.

Comprehensive Stressor Assessments

To allocate resources effectively among the 85 sites, various water-quality constituents were sampled at different frequencies during the study; the differences in sampling among sites generally were based on intensities of watershed development. The WQ index period, described in the "Background" section, was 6 weeks for 74 of the 85 sites and 4 weeks for the other 11 sites (all of which were classified as "Undeveloped" at both the WB and LB scales). These undeveloped sites were sampled during the last 4 weeks of the 6-week study period.

The 6-week WQ index period was March 13 to April 21, 2017, for the Southern sites, and April 3 to May 12 for the Northern sites. Details of the sampling schedule indicating the weeks that constituents were sampled at individual sites are provided in appendix 1, table 1.1.

Table 5. Summary of data collected at the California Stream Quality Assessment sites in 2017.

[Constituents are categorized by the study-design components: Comprehensive Stressor Assessments, Focused Studies, and Ecological Surveys. Notes and abbreviations: See footnote 1 and text for Basic quality of water (QW) constituents. **Abbreviations**: C, continuous sample; D, discrete samples; I, integrative sample. Numerical value in cell indicates number of **discrete samples collected**: x, data or sample collected; —, not sampled. **Streamflow or stage**: Egage, gaging station for an external agency other than U.S. Geological Survey (USGS); Gage, USGS gaging station; PT, pressure transducer installed to record stream stage. **Ecological Surveys** were conducted once at sites near the end of the water-quality index period: Aquatic Biota, invertebrate and algal samples collected; ***Streambed Sediment***: Tx, two temporal samples were collected prior to collecting sediment during ecological survey; ***Sediment Toxicity Test***, sediment tested on survival of invertebrates: Ch, Chironomus larvae; Hy, Hyalella. **Other abbreviations**: N, nitrogen; NWIS; U.S. Geological Survey National Water Information System database; O, oxygen; POCIS, polar organic chemical integrative sampler; SS, suspended sediment]

Site information		Comprehensive stressor assessments										Focused studies			Ecological surveys			
NWIS station number	Field identifier	Basic QW[1] (D)	Mercury (D)	Organic waste indicators (D)	Pharmaceuticals (D)	Glyphosate analysis (D)	N and O isotopes (D)	Algal toxins (D)	POCIS (I)[2]	Streamflow or stage (C)[3]	Temperature (C)[3]	Pesticide autosampler (I)	Biofilm pesticides (I)	SS passive sampler (I)	Aquatic biota (D)	Physical habitat (D)	Streambed sediment (D)	Sediment toxicity test (D)
11179100	CA_Alameda	6	3	3	3	2	1	1	—	Gage	—	—	—	—	x	x	x	HyCh
382035121575501	CA_Alamo	6	3	3	3	2	1	1	—	Egage	—	—	x	—	x	x	x	HyCh
364003121373501	CA_Alisal	6	3	3	3	2	1	1	—	—	x	—	—	—	x	x	x	Hy
11176900	CA_ArroyoDeLaLa	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	x	HyCh
380410122315501	CA_ArroyoDig	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	HyCh
11182400	CA_ArroyoMart	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
380345122345201	CA_ArroyoNov	4	2	1	1	—	1	1	x	—	—	—	x	—	x	x	x	HyCh
11152000	CA_ArroyoSeco	4	2	1	1	—	1	1	—	Gage	x	—	x	—	x	x	x	Hy
352934120395501	CA_Atascadero	6	3	3	3	2	1	1	x	—	x	—	x	—	x	x	x	Hy
11181008	CA_Castro	6	3	3	3	2	1	1	x	Gage	—	L	—	x	x	x	x	HyCh
352127120484501	CA_Chorro	6	3	3	3	2	1	1	x	PT	x	—	—	—	x	x	x	Hy
363608121255201	CA_ChuChuChu	4	2	1	1	—	1	1	x	—	—	—	x	—	x	x	x	Hy
11465690	CA_Colgan	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	Tx	HyCh
11456500	CA_ConnOak	6	3	3	3	2	1	1	x	Gage	—	x	x	—	x	x	x	HyCh
11465660	CA_Copeland	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	Tx	Hy
11159200	CA_Corralitos	6	3	3	3	2	1	3	—	Gage	x	—	x	—	x	x	x	Hy
11460000	CA_Corte	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	x	HyCh
372303121542901	CA_CoyoteChar	6	3	3	3	2	1	1	—	—	—	x	—	—	x	x	Tx	HyCh
371554121474101	CA_CoyoteCoyote	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	Hy
11169800	CA_CoyoteGil	4	2	1	1	—	1	1	x	Gage	x	—	—	—	x	x	x	Hy
11180900	CA_Crow	6	3	3	3	2	1	1	x	Gage	—	—	—	x	x	x	x	HyCh
11465350	CA_DryMouth	6	3	3	3	2	1	1	x	Gage	—	—	—	—	—	—	—	—
364138121373701	CA_GabilanEastL	6	3	3	3	2	1	1	x	—	x	—	x	—	x	x	x	Hy
11152600	CA_GabilanSal	6	3	3	3	2	1	1	x	—	x	—	—	—	x	x	x	Hy
375819122035801	CA_Grayson	6	3	3	3	2	1	1	x	—	—	—	—	—	x	x	Tx	HyCh
382619122531401	CA_Green	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	Hy
11169025	CA_GuadalupeA	6	3	3	3	2	1	1	x	Gage	—	—	—	—	x	x	x	HyCh
371814121525601	CA_GuadalupeB	6	3	3	3	2	1	1	—	—	—	—	—	—	x	x	x	HyCh
375257122050001	CA_LasTrampas	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
381740122395901	CA_Lichau	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	Hy
11153650	CA_LlagasGilroy	6	3	3	3	2	1	3	x	Gage	—	—	x	—	x	x	Tx	Hy
370512121361901	CA_LlagasMartin	6	3	3	3	2	1	3	x	PT	x	—	—	—	x	x	x	Hy
11153470	CA_LlagasMorgan	4	2	1	1	—	1	1	x	—	—	—	—	—	x	x	x	Hy
11141280	CA_Lopez	4	2	1	1	—	1	1	x	Gage	x	—	x	—	x	x	x	Hy
371738121555901	CA_LosGatos	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
383719122462501	CA_Maacama	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	Hy

Table 5. Summary of data collected at the California Stream Quality Assessment sites in 2017.—Continued

[Constituents are categorized by the study-design components: Comprehensive Stressor Assessments, Focused Studies, and Ecological Surveys. Notes and abbreviations: See footnote 1 and text for Basic quality of water (QW) constituents. **Abbreviations**: C, continuous sample; D, discrete samples; I, integrative sample. Numerical value in cell indicates number of **discrete samples collected**: x, data or sample collected; —, not sampled. **Streamflow or stage**: Egage, gaging station for an external agency other than U.S. Geological Survey (USGS); Gage, USGS gaging station; PT, pressure transducer installed to record stream stage. **Ecological Surveys** were conducted once at sites near the end of the water-quality index period: Aquatic Biota, invertebrate and algal samples collected; ***Streambed Sediment***: Tx, two temporal samples were collected prior to collecting sediment during ecological survey; ***Sediment Toxicity Test***, sediment tested on survival of invertebrates: Ch, Chironomus larvae; Hy, Hyalella. **Other abbreviations**: N, nitrogen; NWIS; U.S. Geological Survey National Water Information System database; O, oxygen; POCIS, polar organic chemical integrative sampler; SS, suspended sediment]

Site information		Comprehensive stressor assessments										Focused studies			Ecological surveys			
NWIS station number	Field identifier	Basic QW[1] (D)	Mercury (D)	Organic waste indicators (D)	Pharmaceuticals (D)	Glyphosate analysis (D)	N and O isotopes (D)	Algal toxins (D)	POCIS (I)[2]	Streamflow or stage (C)[3]	Temperature (C)[3]	Pesticide autosampler (I)	Biofilm pesticides (I)	SS passive sampler (I)	Aquatic biota (D)	Physical habitat (D)	Streambed sediment (D)	Sediment toxicity test (D)
11466800	CA_MarkWMir	6	3	3	3	2	1	1	x	Gage	x	—	—	—	—	—	—	—
383109122363301	CA_MarkWTar	4	2	1	1	—	1	1	x	—	—	—	x	—	x	x	x	HyCh
372500122081201	CA_Matadero	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	x	HyCh
11466170	CA_Matanzas	6	3	3	3	2	1	1	x	Gage	x	x	x	—	x	x	x	HyCh
382017122161101	CA_Milliken	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	Hy
375701121564401	CA_MtDiablo	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
11148900	CA_NaciBryson	4	2	1	1	—	1	1	x	Gage	—	—	x	—	x	x	x	Hy
383321122302101	CA_NapaBale	6	3	3	3	2	1	1	x	PT	x	x	x	—	x	x	x	HyCh
11458300	CA_NapaNapa	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	HyCh
364155121363901	CA_Natividad	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	Hy
382346122521201	CA_NoNameMonty	6	3	3	3	2	1	1	x	PT	x	—	x	—	x	x	x	Hy
365718121444301	CA_NoNamePaul	6	3	3	3	2	1	3	—	PT	x	—	—	—	x	x	x	Hy
11459500	CA_Novato	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	x	HyCh
11141050	CA_Orcutt	6	3	3	3	2	1	1	—	Gage	x	—	—	—	x	x	x	Hy
365736121250801	CA_Pacheco	6	3	3	3	2	1	3	—	PT	x	—	x	—	x	x	x	Hy
11159000	CA_PajaroChit	6	3	3	3	2	1	3	—	Gage	x	—	—	—	x	x	x	Hy
11159500	CA_PajaroWat	6	3	3	3	2	1	3	x	—	—	—	—	—	x	x	x	Hy
381519122385601	CA_Petaluma	6	3	3	3	2	1	1	x	PT	x	—	—	—	—	—	—	—
375807122124001	CA_Pinole	4	2	1	1	—	1	1	—	—	—	—	—	—	x	x	x	HyCh
11152650	CA_Reclamation	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	Tx	Hy
383305122311901	CA_Ritchey	4	2	1	1	—	1	1	x	PT	x	—	x	—	x	x	x	Hy
11150500	CA_Salinas	6	3	3	3	2	1	1	—	Gage	x	—	—	—	x	x	x	Hy
372716122080801	CA_SanFranPalo	6	3	3	3	2	1	1	—	—	—	—	—	—	x	x	x	HyCh
11164500	CA_SanFranStan	6	3	3	3	2	1	1	x	Gage	x	—	—	—	x	x	x	HyCh
374336122095801	CA_SanLeandro	6	3	3	3	2	1	1	x	—	—	—	—	—	x	x	x	HyCh
351436120405201	CA_SanLObispo	6	3	3	3	2	1	1	—	PT	x	—	x	—	x	x	x	Hy
11181000	CA_SanLorenzo	6	3	3	3	2	1	1	—	Gage	—	—	—	—	x	x	x	HyCh
375220122104201	CA_SanPabloMor	6	3	3	3	2	1	1	—	—	—	—	x	—	x	x	x	HyCh
375312122113501	CA_SanPabloOr	6	3	3	3	2	1	1	—	—	—	—	x	x	x	x	x	HyCh
375746122195501	CA_SanPabloPort	6	3	3	3	2	1	1	x	—	—	—	—	—	x	x	x	HyCh
374933122001301	CA_SanRamonDan	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
11182500	CA_SanRamonSan	6	3	3	3	2	1	1	x	Gage	—	—	x	—	x	x	x	HyCh
11466200	CA_SantaSanta	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	x	HyCh
11466320	CA_SantaWillow	6	3	3	3	2	1	1	x	Gage	x	—	x	—	x	x	Tx	HyCh

Table 5. Summary of data collected at the California Stream Quality Assessment sites in 2017.—Continued

[Constituents are categorized by the study-design components: Comprehensive Stressor Assessments, Focused Studies, and Ecological Surveys. Notes and abbreviations: See footnote 1 and text for Basic quality of water (QW) constituents. **Abbreviations**: C, continuous sample; D, discrete samples; I, integrative sample. Numerical value in cell indicates number of **discrete samples collected**: x, data or sample collected; —, not sampled. **Streamflow or stage**: Egage, gaging station for an external agency other than U.S. Geological Survey (USGS); Gage, USGS gaging station; PT, pressure transducer installed to record stream stage. **Ecological Surveys** were conducted once at sites near the end of the water-quality index period: Aquatic Biota, invertebrate and algal samples collected; ***Streambed Sediment***: Tx, two temporal samples were collected prior to collecting sediment during ecological survey; ***Sediment Toxicity Test***, sediment tested on survival of invertebrates: Ch, Chironomus larvae; Hy, Hyalella. **Other abbreviations**: N, nitrogen; NWIS; U.S. Geological Survey National Water Information System database; O, oxygen; POCIS, polar organic chemical integrative sampler; SS, suspended sediment]

Site information		Comprehensive stressor assessments										Focused studies			Ecological surveys			
NWIS station number	Field identifier	Basic QW[1] (D)	Mercury (D)	Organic waste indicators (D)	Pharmaceuticals (D)	Glyphosate analysis (D)	N and O isotopes (D)	Algal toxins (D)	POCIS (I)[2]	Streamflow or stage (C)[3]	Temperature (C)[3]	Pesticide autosampler (I)	Biofilm pesticides (I)	SS passive sampler (I)	Aquatic biota (D)	Physical habitat (D)	Streambed sediment (D)	Sediment toxicity test (D)
11135250	CA_SantaYnezLom	6	3	3	3	2	1	1	x	—	x	—	x	—	x	x	x	Hy
11128500	CA_SantaYnezSol	6	3	3	3	2	1	1	x	Gage	x	—	—	—	x	x	x	Hy
371620122005801	CA_Saratoga	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	Hy
374708122132801	CA_Sausal	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
382634122315201	CA_SonomaAdobe	4	2	1	1	—	1	1	x	—	—	—	x	—	x	x	x	HyCh
11458500	CA_SonomaAgua	6	3	3	3	2	1	1	x	Gage	x	—	—	—	x	x	x	Hy
381556122280201	CA_SonomaWat	6	3	3	3	2	1	1	x	PT	x	—	—	—	x	x	x	Hy
351725120395901	CA_Stenner	6	3	3	3	2	1	1	x	PT	x	—	—	—	x	x	x	Hy
381441122064301	CA_Suisan	6	3	3	3	2	1	1	x	Egage	—	—	x	x	x	x	x	Hy
365634121264001	CA_Tequisquita	6	3	3	3	2	1	3	x	PT	x	—	x	—	x	x	x	Hy
382245122001601	CA_Ulatis	6	3	3	3	2	1	1	x	Egage	—	—	x	x	x	x	x	Hy
365955121350601	CA_UvasMiller	6	3	3	3	2	1	1	—	—	x	—	x	—	x	x	x	Hy
375413122033301	CA_Walnut	6	3	3	3	2	1	1	—	Egage	—	—	x	—	x	x	x	HyCh
375808122172601	CA_Wilkie	6	3	3	3	2	1	1	x	—	—	—	x	—	x	x	x	HyCh
383039122502401	CA_Windsor	6	3	3	3	2	1	1	—	PT	x	—	x	—	x	x	x	HyCh

[1]Basic QW constituents: suspended sediment, major ions, nutrients, pesticides, supplemental pesticides, glyphosate immunoassay, and dissolved organic carbon.

[2]Data at some sites were missing because sample or instrument was lost.

[3]Continuous stage or temperature data were missing at some sites because pressure or temperature sensors were either not deployed or lost in the field owing to high flow conditions.

Discrete Water-Quality Samples

During the WQ index period of each site, Basic QW samples were collected weekly for analysis of nutrients, major ions, dissolved organic carbon, pesticides (using an expanded target analyte list relative to prior RSQA studies), glyphosate by immunoassay, and suspended-sediment concentration (table 5; appendix 1, table 1.1). Additional water samples were collected or parameters were measured during selected weeks during the WQ index period at all 85 stream sites, unless specified otherwise, for the following: mercury (2–3 times during the study), organic waste indicators (1–3 times), pharmaceuticals (1–3 times), glyphosate by chemical analysis (2 times at 83 sites), stable isotopes ^{15}N and ^{18}O (1 time), and algal toxins (1 time at 77 sites, 3 times at 8 sites, plus 2 times at 1 nearby lake site). The weeks of the WQ index period during which these additional samples were collected or parameters were measured are specified in appendix 1, table 1.1. For algal toxins, one water sample was collected during the last week of the study period at all stream sites. In addition, two water samples were collected on July 11 and 25, 2017, at eight stream sites in the Pajaro River Basin and at one site in Pinto Lake (into which the Pajaro River flows), because of a history of microcystin contamination there (California Water Boards, 2014; Gibble and Kudela, 2014).

Water-quality samples were collected and processed following standard USGS protocols described in the National Field Manual (Wilde and others, 2009). Before collecting samples from the field, all field equipment was cleaned according to USGS protocols and then rinsed with native water immediately before samples were collected. In general, discrete water samples were collected for most analytes by an isokinetic, equal-width increment method (U.S. Geological Survey, 2006; fig. 5) where subsamples were collected at 10 increments across the stream with either a DH-81 or DH-95 sampler (Davis, 2005). The sampler has a precleaned Teflon cap and nozzle assembly that fitted a 1-liter (L) Teflon bottle (U.S. Geological Survey, 2006). Each incremental sample was placed immediately into a precleaned, acid- and methanol-rinsed Teflon churn for compositing before processing.

Water from the Teflon churn was not used for mercury analysis because ultra-trace concentration clean-sampling procedures and equipment were necessary to collect and process the samples for low-concentration total mercury and methylmercury analysis (U.S. Environmental Protection Agency, 1996; Lewis and Brigham, 2004). Water for mercury samples was collected separately as grab samples from the centroid of flow at about 0.3 m below the water surface in a 1-L Nalgene bottle. These samples were collected three times at the 6-week sites and two times at the 4-week sites (table 5, appendix 1, table 1.1). In addition, the dissolved organic carbon (DOC) samples were collected as grab samples from the centroid of flow; because mercury bioavailability is related to DOC levels in the aquatic environment, collecting mercury and DOC samples using the same method was deemed important to establish a relation between the two constituents. Filtering of samples utilized low-level mercury sampling techniques as described in the USGS Field Manual (Wilde and others, 2009, Section 5.6.4.B). After filtering, samples were preserved using ultrapure hydrochloric acid (Hydrochloric Acid 34–37 percent OmniTrace®), and filters were frozen (Wilde and others, 2009). Samples were processed at either a USGS California Laboratory or at the USGS Mercury Research Laboratory in Middleton, Wisconsin. Samples processed in California were shipped to the USGS Mercury Research Laboratory for mercury analysis.

A separate water sample was collected at all sites to determine concentrations of the algal toxin microcystin in streams (table 5; appendix 1, table 1.1) and at one lake site. These water samples were frozen (–20 °C) and shipped overnight to the USGS Organic Geochemistry Research Laboratory (OGRL) in Lawrence, Kansas, for processing and analysis.

When stream conditions did not meet the requirements for collecting equal-width increment subsamples with the Teflon churn (which required a velocity greater than 1.5 feet per second [ft/s]), samples were collected either by a multivertical grab (for velocity less than 1.5 ft/s, width greater than 10 feet [ft]), or by a grab from the centroid of flow (for velocity less than 1.5 ft/s, width less than 10 feet, depth less than 1 foot). When flow conditions were too high to safely collect equal-width increment subsamples, a single-point grab sample was collected from the bank or by wading as far as possible into the stream. For grab samples, water was collected directly into sample bottles for unfiltered constituents and into a precleaned 1-L Teflon sample bottle for filtered constituents; samples were subsequently filtered from that bottle into sample bottles (appendix 1, table 1.3).

California had a relatively wet year in 2017, particularly during the month of February, which preceded the study period. Overall, monthly runoff in California was higher during the March 3–May 13, 2017, study period than the average value over the previous 30 water years (a water year is the period beginning October 1st of one year and ending September 30th of the next year; https://ca.water.usgs.gov/california-drought/california-drought-runoff.html). High flow conditions occurred in some streams, in which case grab samples had to be collected (as described earlier in the text). At three Northern sites, high flow conditions at the end of the study period prevented collection of ecological samples, so ecological survey data were available for only 82 sites (appendix 1, table 1.1).

Field properties of specific conductance, pH, dissolved oxygen, and water temperature were measured at the time of each weekly water-quality sampling with a field-calibrated multiparameter sonde, as described in the USGS National Field Manual (Wilde, 2008). The measurements were made at five locations within the water-quality sampling transect and averaged. When the stream width was less than 10 ft (3 m), field parameters were measured from the centroid of flow.

Figure 5. A hydrologist moves an isokinetic sampler into position. Photograph by Stephanie Kula, U.S. Geological Survey.

Polar Organic Compound Integrative Samplers (POCIS)

Two POCIS housed within a single canister were deployed for between 33 and 38 days (about 5 weeks) at each of the 85 sites during the WQ index period; one POCIS from each canister was analyzed for pesticides and one for pharmaceuticals. Canisters were lost or compromised (such as by burial in sediment or exposure to air) at 21 sites, leaving 64 sites with valid POCIS samples (table 5; appendix 1, table 1.1). The POCIS are integrative samplers that contain the sorbent Oasis HLB (Waters, Milford, Mass.) and are designed to accumulate moderately water-soluble (polar or hydrophilic) organic compounds from surface water (Alvarez, 2010). Oasis HLB is considered a universal sorbent in environmental analyses and has been used to extract a wide assortment of chemical classes from water. The use of Oasis HLB in the POCIS allows for estimation of time-weighted average concentrations of target chemicals (pesticides and pharmaceuticals) over the deployment period, if a chemical-specific water "sampling rate" has been determined. Extracts of POCIS samples were analyzed for contaminants by using modified versions of the water methods for these chemical groups (Van Metre and others, 2017a).

Field deployment followed the guidelines provided in Alvarez (2010). A stream location was required to have enough depth (about 0.5 ft, or 15 centimeters [cm]) for the POCIS to remain submerged during the deployment period and be protected from excessive sediment accumulation, flood debris, and vandalism. Effective anchoring systems were adopted on the basis of site-specific characteristics (for example, sandy versus rocky substrate, streamflow variability, and so forth). The POCIS canister was attached to the same structure as the temperature data logger at many sites (see section "Continuous Streamflow, Stage, and Water Temperature"), either on the rebar or on the streamgage orifice pipe. Others were deployed in the centroid of flow and attached to a cinder block (fig. 6). Field records were maintained that included the site name; date and time of deployment and retrieval; and observations of streambed substrate, streamflow conditions, and water clarity.

Quality control (QC) POCIS samples collected in the field included replicates and blanks and are described in the "Quality Assurance and Quality Control" section. All environmental POCIS and QC canisters were stored on ice during transport to and from the field location. After the deployment period, the POCIS were retrieved from the sites and immediately sealed in their respective canisters; all environmental POCIS, QC canisters, and log sheets were shipped to the USGS Columbia Environmental Research Center (CERC), Columbia, Missouri, in coolers with wet ice.

Continuous Streamflow, Stage, and Water Temperature

The sampling design called for measurement of streamflow or stage at all sites, as well as continuous temperature. However, stage or temperature data were missing at some sites because pressure or temperature sensors were either not deployed or lost in the field due to high flow conditions. Overall, streamflow or stage was obtained at 54 sites and continuous temperature at 46 sites; details are provided in table 5.

Figure 6. Deployed polar organic compound integrated sampler on cinder-block-and-cable infrastructure. Photograph by Celeste Journey, U.S. Geological Survey.

U.S. Geological Survey streamgages were active at 28 sites and provided stream stage and streamflow discharge at 15-minute intervals (table 5). Four sites had continuous stage data from streamgages operated by county or city agencies. Pairs of pressure transducers (one in the water column and one in the air, as described farther on in the text) were successfully deployed at 19 sites, and these units were programmed to record stream stage at 15-minute intervals. Neither flow nor stage was monitored at the remaining 34 sites. The pressure transducers were the HOBO U20-001-04 digital loggers (specifications are in appendix 1, table 1.2). The units were deployed during February 2017, before the start of the WQ index periods, and were retrieved in the fall of 2017. Guidance from the manufacturer and the USGS was followed for deployment, calibration, and maintenance of the units (Sauer and Turnipseed, 2010; Onset Computer Corporation, 2014).

Full deployment of pressure transducers at a site included the installation of two units per site: one unit mounted in the water column to measure changes in water pressure as the water level changed, and one unit mounted in the air to measure barometric pressure to provide a correction factor for calculating stream stage with the water-pressure transducer data. The units were placed inside a vertical 2-inch polyvinyl chloride pipe mounted to a bridge support or directly to a metal post driven into the streambed. The water-pressure units were mounted at a depth where they would remain continually submerged, and the barometric-pressure units were typically mounted to a tree, bridge structure, pipe, or post. Both units were programmed to record on 15-minute intervals for the duration of the study.

Establishing a baseline water-level was necessary immediately after deployment of the pressure transducer in the water so that measurements of water pressure could be converted to actual water level. A reference point (RP), on which changes in water level were based, was established upstream from the pool that held the submerged unit. Typically, the RP was a mark scribed on a permanently fixed structure near the attached unit, such as a bridge support or wing wall; a measurement from the RP to the water surface was the “tape down” distance. An arbitrary datum was then established that was greater than the distance between the RP and the channel bottom, and this datum would cover all low stages and ensure no negative stage values; typically, 10 feet was used as the water level at the streamgage datum. The distance from the RP to the surface of the water at time of deployment was used to establish the initial stream stage. In addition, measurements from the RP to water surface were made during every site visit by the water-quality sampling crew, so that these values could be used to check data for consistency and quality.

Water temperature was continuously monitored at 2 sites with streamgages, 23 sites with instream pressure transducers, and 21 sites with digital temperature data loggers; continuous temperature was not recorded at the remaining 39 sites. The pressure transducers included temperature sensors that were used to record water temperature at 15-minute intervals. Deployment of a single pressure transducer mounted in the water column was sufficient to measure continuous temperature. Although pressure transducers were successfully deployed to measure stage at only 19 sites, instream pressure transducers recorded temperature at an additional 4 sites. At some stream sites that did not have a streamgage or pressure transducer recording temperature, digital data loggers recorded temperature at 15-minute intervals. These devices were deployed from early winter 2017 through the end of the study in order to provide a water-temperature dataset inclusive of all sampling activities. Where possible, loggers were deployed approximately 0.3 ft (10 cm) above the streambed, out of direct sunlight, and attached to rebar anchored into the streambed or to stable parts of streamgage infrastructure (for example, orifice pipe). In most cases, the HOBO Water Temp Pro v2 U22 loggers were deployed (device specifications are in appendix 1, table 1.2). Guidance from the manufacturer and the U.S. Forest Service concerning deployment, calibration, and maintenance generally was followed (Dunham and others, 2005; Onset Computer Corporation, 2012).

Focused Studies

Three types of focused studies were conducted at selected sites (table 5). Small-volume autonomous water samplers were deployed at five sites to collect daily composited water samples for pesticide analysis. Ceramic tiles were deployed at 54 sites to provide a substrate for the growth of biofilms that were collected and analyzed for selected pesticides. Passive suspended-sediment samplers were deployed at five sites to collect time-integrated samples of suspended sediment.

Sampling Pesticides with Small-Volume Pesticide Automated Samplers

A small-volume autonomous water autosampler (hereafter, “pesticide autosampler”) was designed and built at Portland State University, Oregon, to collect fixed-point, small-volume samples (McWhirter, 2020) for analysis of pesticides in water. In a collaborative study with EPA, the autosamplers were used at a subset of five CSQA sites to determine whether increasing sampling frequency would improve the accuracy of characterizations of instream pesticide stressor conditions to which biota were subjected. Although weekly discrete samples of pesticides were collected at all sites during the WQ index periods, discrete samples can miss short-term “spikes” in high concentrations that are potentially acutely toxic. The pesticide autosamplers were deployed at five Northern stream sites to collect daily and weekly composite samples over an approximately 6-week WQ index period: two high urban sites, one medium urban site, one high agriculture site, and one low agriculture site, as classified by lower-basin scale land use (tables 1 and 5, cross referenced). The autosampler was discontinued at one high urban site owing to repeated flooding. As part of this collaborative study with EPA, autosamplers also were deployed at two agricultural sites in the Central Valley (outside the CSQA study area), Cache Creek and Putah Creek.

The pesticide autosamplers (fig. 7) were programmed to collect multiple aliquots to form daily and weekly composite samples of stream water during successive 1-week periods. An aliquot of stream water was collected every 6 hours into daily composite vials (four aliquots per vial, with the “day” typically starting around noon) and every 12 hours into the weekly composite vial. Thus, eight vials were filled per week for 7 daily samples and 1 weekly sample. In addition, a ninth vial containing a known pesticide spike mixture in native stream water was placed in the autosampler at the start of the week; this QC sample was used to assess the potential for compound degradation during the weekly collection period. A 6-milliliter (mL) aliquot of a 1:1 methanol-water mixture was added, as a preservative, to each of the nine vials before deployment.

Over the 6 weeks of operation, the pesticide autosamplers were serviced each week on either Monday or Tuesday. Two units were available for each site, so that one unit could be serviced in the laboratory and exchanged in the field for the deployed unit. This arrangement minimized interruption by allowing ample time to remove and replace sample vials, charge batteries, clean tubing, and replace consumable components such as filters. Before deployment, each vial was labeled with the station identification number, vial number, date, and initial weight. Daily composite samples (vials 1 through 7) were analyzed for pesticide concentrations by the EPA Office of Pesticide Programs (OPP) Analytical Chemistry Laboratory in Fort Meade, Maryland. Sample splits of the weekly composite sample (vial 9) and the spike sample (vial 8) were analyzed for pesticides by both the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado, and the OPP laboratory. Analytical service request (ASR) forms (USGS) and cooler inventory forms (USGS and EPA) were included with sample shipments, and barcodes were affixed to each vial as an auxiliary data identifier and tracking method.

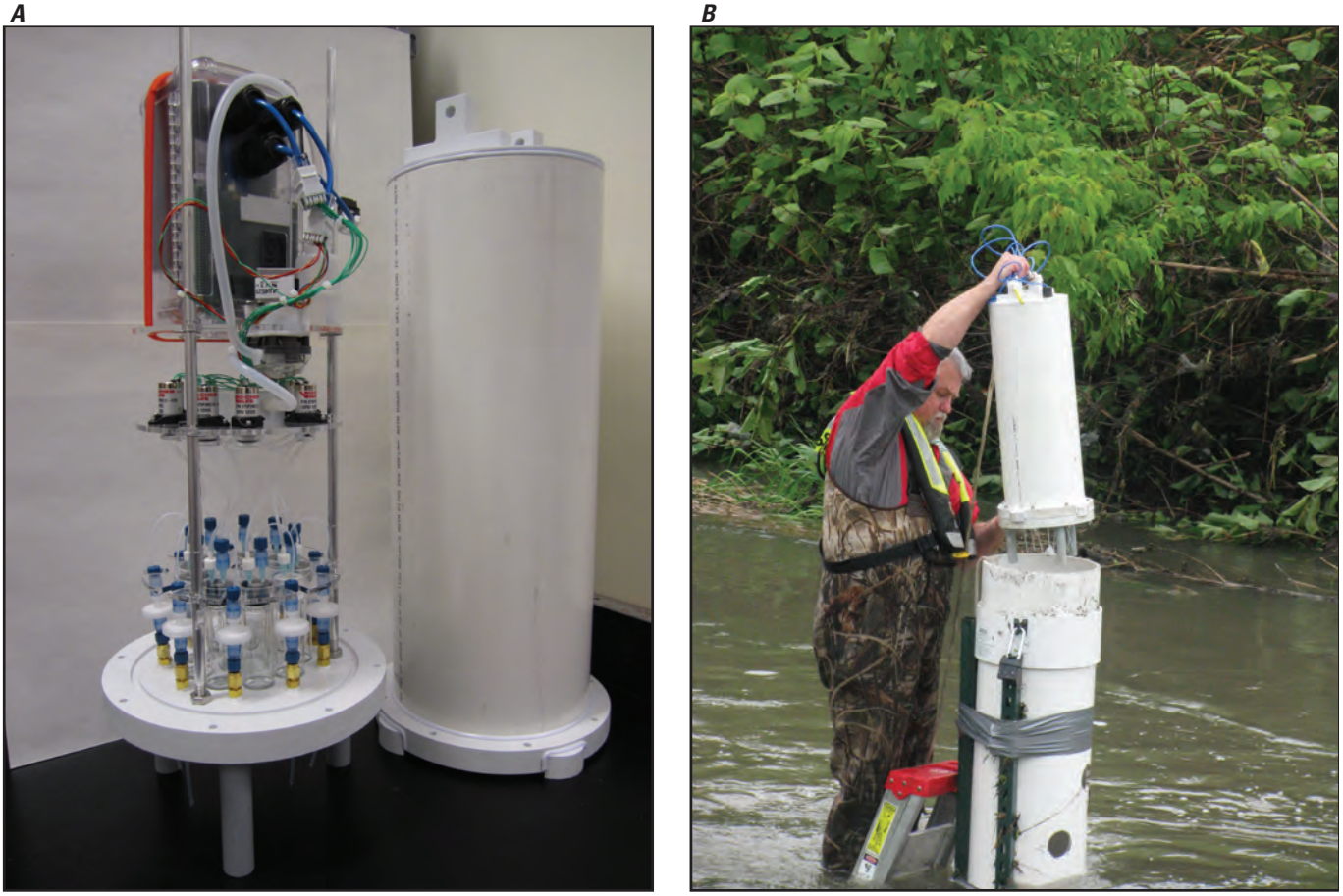

Figure 7. The small-volume pesticide autosampler used to collect filtered water at sub-daily intervals for pesticide analysis at selected sites: *A,* autosampler internals and the polyvinyl chloride housing (from McWhirter, 2020; photograph by Kevin McWhirter, Portland State University); and *B*, a hydrologic technician retrieving samples from the autosampler during deployment in the stream. Photograph by Peter Van Metre, U.S. Geological Survey. The samplers were designed and built at Portland State University (McWhirter, 2020).

Sampling Pesticides in Biofilms

A focused study was conducted in CSQA to determine whether pesticides bioaccumulate in biofilms (Barbara Mahler, written commun., 2020), which consist of fungi, bacteria, algae, and microfauna enclosed in a mucopolysaccharide matrix attached to a surface exposed to streamflow. This complex organic microlayer can retain organic contaminants, much like DOC (Sabater and others, 2007). Unglazed ceramic tiles were deployed at 54 sites that represented all land-use categories across the study area (tables 1 and 5, cross referenced) in February or March 2017. Tiles were secured to a concrete block about 30 cm thick using water-resistant cement, and three replicate tiles were distributed along the reach for a deployment period of at least 60 days (appendix 1, table 1.6). At each site, the biofilm that had grown on the tiles was removed by scraping and composited into a clean glass jar, placed in a cooler with ice, and delivered to the USGS Organic Chemistry Research Laboratory, Sacramento, Calif. Samples were kept frozen at the laboratory until extraction and analysis were done for insecticides. Quality control samples consisted of one field replicate sample, four laboratory blank samples, and three laboratory matrix spikes.

Sampling Suspended Sediment with Passive Samplers

Suspended-sediment samples were collected from five Northern sites by using time-integrating suspended-sediment passive samplers (Phillips and others, 2000). The fine sediments (less than 63 micrometers [µm]) were analyzed for major and trace elements, particle size, and radionuclides to assess sources and ages of sediment in the stream. These suspended-sediment passive samplers were deployed at three urban sites (one high, one medium, and one low urban), one agricultural site, and one mixed site, as characterized by lower-basin land use (tables 1 and 5, cross referenced).

The suspended-sediment passive samplers were attached to metal posts that were driven into the streambed and were oriented so that the conical end (fig. 8) faced into the flow. Typically, four samplers were installed in the channel in two pairs; each pair consisted of a lower sampler placed below the water level at base flow and the paired sampler placed above the lower sampler. If base flows were especially low at the time of deployment, the top sampler was allowed to be out of the water; in such cases, the top samplers would collect sediment only at flows higher than base flow.

The suspended-sediment passive samplers were deployed on January 24 or 25, 2017, and remained deployed for approximately 16 weeks, through early May, inclusive of the WQ index period. Sediment was retrieved every 2–3 weeks or following a large flow event, allowing enough time for sufficient sediment to accumulate for analyses of major and trace elements and radionuclides. To collect the sediment samples, the tubes were removed from their posts, the end caps were opened, and all the water and sediment were poured into a single 5-gallon plastic bucket. A spray bottle filled with deionized water was used to rinse any remaining sediment from the tubes. After collecting the samples, the tubes were cleaned with a brush and deionized water, then rinsed with native water. The water-sediment mixture was stored at room temperature in the 5-gallon bucket until the sediment settled to the bottom (usually 3–7 days), then the clear water was siphoned off and discarded. The remaining composite sediment sample was shipped on wet ice to the USGS Baltimore Sediment Laboratory, Md., where it was wet sieved with deionized water using a 63-µm polyester sieve. The sieved slurry was collected in glass bowls and dried at 65 °C for 2 or more days. The dried sediment was removed with a plastic utensil, and aliquots of the fine sediment (less than 63 µm) were shipped to multiple laboratories (see "Sample Analyses" section) for inorganic chemical analyses. For about 10 percent of samples, if sufficient sediment mass was available, duplicate aliquots (QC split samples) were analyzed for major and trace elements, and particle size.

Figure 8. Installation of time-integrating suspended-sediment passive samplers by U.S. Geological Survey personnel. Photograph by Celeste Journey, U.S. Geological Survey.

Ecological Surveys

Data collected during the ecological surveys characterize aquatic biota, physical habitat, and sediment contaminants along a 150-m sampling reach for each site (table 5). Five teams, each consisting of six USGS employees, were deployed across the region to conduct the surveys at all sites during May 2017, after the end of the WQ index period. The median number of days between the end of water-quality sampling and the ecological survey was 3 days for the Northern sites and 18 days for the Southern sites. As noted previously, no surveys were conducted at three sites (table 5; appendix table 1.1) where high water prohibited safe sampling during the targeted time of the ecological survey. Although the data collected during the ecological surveys were based on discrete samples, biological and habitat data generally represent integrative conditions over a longer, undefined time period. For example, sediment chemistry is affected by erosional processes and contaminant persistence, the species structure of aquatic biological communities depends on water-quality conditions that occur over the life cycles of the organisms, and the physical habitat of a stream reach typically is strongly affected by many years of hydrologic events and human actions.

The 150-m sampling reach was segmented with 11 equally spaced cross-sectional transects (primary transects) that were set 15 m apart along the reach, and 10 secondary transects, each set approximately midway between a pair of primary transects. All field data were recorded on electronic forms by using hand-held tablet computers. Field data collected from the habitat surveys, and field records for the algal and macroinvertebrate samples destined for laboratory analyses, were loaded into the USGS BioData database, the USGS repository for aquatic bioassessment data (U.S. Geological Survey, 2016).

Aquatic Biota

Benthic macroinvertebrate and algal communities were sampled by the reach-wide benthos (RWB) method using standard protocols from the Surface Water Ambient Monitoring Program (SWAMP) of the State of the California State Water Resources Control Board (Ode and others, 2016). The RWB method entails sampling throughout the reach at measurement points systematically placed in relation to the 11 primary transects established within the reach. Quantitative subsamples from the 11 transects were then combined into a single composite sample for each of benthic macroinvertebrates and algae. The goal of the RWB method is to represent the ecological condition throughout the reach. The RWB method was used for consistency with other bioassessment data in California and to enable calculation of the California Stream Condition Index (Rehn and others, 2015).

Benthic macroinvertebrate samples were collected before algal samples at a point 1 m downstream from each primary transect using a D-frame net with 500-µm mesh openings (fig. 9). Samples were collected starting with the downstream transect; a 0.09-square-meter (1-square-foot) sampling station was sited along the transect at a distance 25 percent of wetted width from the left bank (with left and right determined when facing downstream). Moving upstream, the sampling positions within successive transects were alternated between the center, right, and left positions along the transect (50, 75, and 25 percent of wetted width, respectively), cycling through this order repeatedly. If the targeted section of the stream was too deep to wade, the collection occurred as close to the targeted location as possible. Organisms were separated from the substrate; heavy organisms were removed by hand, larger rocks were scrubbed, and then the streambed was vigorously kicked for 30 seconds while capturing the material in the net.

Material was transferred from the net to a sieve bucket, where transect samples were composited, then emptied onto a double sieve with 0.635-cm (0.25-inch) mesh atop a 500-µm mesh. Gravel and detritus were removed from the upper sieve and larger predaceous macroinvertebrates caught on the top sieve were preserved immediately in 95-percent ethanol to reduce the chances of other specimens being consumed or damaged. Large or rare macroinvertebrates, such as crayfish and large mollusks, were photographed and released in accordance with collection permit procedures. The sample remaining on the lower sieve was transferred into one or more 1-L polystyrene wide-mouth bottles filled to no more than 50 percent with the sample material and preserved with 95-percent ethanol. Identification and enumeration of macroinvertebrate taxa (generally to either genus or species taxonomic levels) were completed by the NWQL.

Benthic algal samples were collected at each transect after the benthic macroinvertebrate samples were collected, and at a location approximately 0.25 m upstream from where the macroinvertebrates were collected. At each sampling location, the dominant substrate type was identified, and a pipe sampler, which was 40 mm long with an opening of approximately 12 square centimeters, was placed against the substrate. Hard substrates, such as cobble or wood, were lifted from the water, scrubbed with a stifle-bristled brush, and rinsed into the 500-mL wide-mouth polystyrene bottle. In soft substrates, such as sand or detritus, the pipe sampler was pressed into the substrate to a depth of approximately 0.5 cm, and a spatula was slid under the sampler to collect a thin sediment core, which was then rinsed into the sample bottle. For immobile hard substrates, such as boulders, bedrock, or concrete, the tip of a syringe was used to dislodge and suction algae from the area delimited by the pipe sampler, and the material then was emptied into the sample bottle.

Figure 9. Invertebrate sampling with a D-frame dip net by U.S. Geological Survey personnel. Photograph by Alan Cressler, U.S. Geological Survey.

Five aliquots were removed from the composite sample for various analyses. Four aliquots were filtered onto glass-fiber filters with 0.47-µm pore size. Two of these aliquots were placed on dry ice and shipped to the NWQL for analysis of chlorophyll *a* and pheophytin *a* (in one sample), and biomass, as ash-free dry mass (in a second sample). The two remaining 0.47-µm filtered aliquots were retained frozen as backups in the event of sample loss or damage, or in case additional material was needed for analysis. A fifth aliquot was put into a 2-mL vial and shipped to the Institute of Arctic and Alpine Research (INSTAAR) Diatom Laboratory at the University of Colorado, Boulder, for environmental DNA (eDNA) analysis. The remainder of the composite sample was preserved with buffered formalin at a concentration of approximately 5 percent and sent to the INSTAAR Laboratory for taxonomic identification and enumeration of diatoms.

Physical Habitat

Following collection of biological samples, the physical habitat of the reach was characterized using USGS protocols (Fitzpatrick and others, 1998). Descriptive and quantitative measurements were made across each primary transect and included geomorphic channel unit type (pool, riffle, or run), stream depth, substrate size at five locations (right and left edges of water, the center of the channel, and midway between channel edges and channel midpoint), stream wetted width, bank height, canopy cover at mid-transect, macrophyte coverage, and the presence of bars, islands, and potential fish habitat features. Substrate size also was measured across the secondary transects, at the same five locations described previously in the text. The surface-water gradient was measured over the entire 150-m reach, and the average slope from the top to the bottom of the reach was determined.

Streambed and Bank Sediment

During the ecological surveys, one composite sediment sample was collected from the wetted streambed and another composite sample was collected from the stream banks (table 5). At seven sites, wetted streambed samples were collected twice prior to the ecological surveys, during the first and fourth weeks of sampling at these sites (appendix 1, table 1.1). These additional samples were identified as “temporal sediment samples” and, in combination with results from samples collected during the ecological survey, will be used to evaluate how sediment chemistry varied over the sampling period. The sites where temporal sediments were collected are identified with “T” in the column labeled “Streambed Sediment,” under “Ecological Surveys,” in table 5.

The composite streambed-sediment sample was collected by following established USGS protocols (Shelton and Capel, 1994; Radtke, 2005), with some modifications, described as follows. Four-inch (about 10-cm) stainless-steel cylinders and stainless-steel spatulas were used to collect the sediment. Multiple collections of sediment were made from depositional areas along the 150-m sampling reach, targeting locations where fine-grained sediments accumulated (fig. 10). Depositional zones across the reach were sampled in approximate proportion to their bottom surface area. The collection method required pushing the stainless-steel cylinder into the streambed to a depth of 2 cm, then sliding the spatula under the cylinder to support the enclosed streambed core. Each streambed core was lifted gently out of the water to minimize the loss of fine material, and all cores were composited in a large plastic bucket. Approximately 6–10 L of streambed material was collected for the sample. Samples were sieved in the field by using a 2-mm stainless-steel sieve that rested on top of the bucket.

The bulk bed-sediment sample was placed on ice in the field and transported to a USGS research facility in Menlo Park, Calif., where samples were homogenized and split into aliquots for various analyses. Each sample was homogenized by using a kitchen mixer with a stainless-steel bowl and a bread-dough-style paddle operated at low speed. Before the CSQA study, RSQA staff had tested several streambed-sediment samples to determine the mixing time necessary to achieve a reasonably homogeneous sample; about 30 seconds was used for initial mixing, then about 15 seconds for additional mixing between removal of aliquots.

Sample aliquots (2-mm sieve) were shipped chilled to various laboratories for toxicity testing and analyses of organic constituents. Subsamples of streambed sediment were shipped to the USGS Maryland-Delaware-D.C. Water Science Center (WSC) in Baltimore, Md., where they were wet sieved with deionized water using a 63-µm polyester sieve. The sieved slurry was collected in glass bowls and dried at 650 °C for 2 or more days. The dried sediment was removed with a plastic utensil, and aliquots of the fine sediment (sieved at less than 63 µm) were shipped to multiple laboratories for analysis of inorganic chemicals and carbon. Altogether, sediment samples were collected from 82 sites, and aliquots were analyzed for the following constituents at all sites: current-use pesticides, polycyclic aromatic hydrocarbons (PAH) and other semivolatile compounds, organic wastewater indicators, hormones, halogenated organics (all sieved at 2 mm), trace and major elements, organic carbon, radionuclides (all sieved at 63 µm), and grain size. Temporal sediment samples collected at the nine sites (table 5) were analyzed for PAHs, organic wastewater indicators, hormones, radionuclides, trace and major elements, organic carbon, and microcystins.

Bed sediment was used to conduct standardized ambient whole-sediment toxicity tests at the USGS CERC, in accordance with American Society for Testing and Materials International (2016) and U.S. Environmental Protection Agency (2000) methods. Tests were performed with the amphipod *Hyalella azteca* (28-day exposures) at all sites and with the midge larvae *Chironomus dilutus* (10-day exposures) at 41 sites (table 5) to measure potential effects of contaminants on survival and growth.

Figure 10. Collection of composite bed-sediment samples from a depositional area along a reach. Photograph by Alan Cressler, U.S. Geological Survey.

The bank sediment sample was collected at 5–10 locations along the sampling reach where an exposed or eroding bank was observed on either side of the stream. At each location, sediment was collected by using a precleaned plastic trowel to scrape a vertical furrow from above the water line to the top of the exposed bank (about 1-cm depth into the bank). The bank scrapes were composited as a single sample in a 1-L plastic jar. Bank material was stored on wet ice and shipped to the USGS Maryland-Delaware-D.C. WSC in Baltimore, Md., where it was wet-sieved (2-mm) and dried; aliquots were sent to AGAT Laboratories, Mississauga, Ontario, Canada (https://www.agatlabs.com/index.cfm), for analyses of trace and major elements, and organic carbon.

Sample Analyses

This section describes chemical analyses of constituents in water and sediment samples, taxonomic analyses of biological samples, and processing of real-time data recorded by data-logging instruments in the field. Most of the chemical analyses of water and sediment samples were conducted by the NWQL or laboratories contracted by the NWQL, using either NWQL or EPA methods and schedules (appendix 2, tables 2.1 to 2.12), which are briefly described in this section; exceptions where other methods were used are noted. Analytical results for constituents in water and sediment from the NWQL were uploaded to the Water-Quality System database (QWDATA) in the National Water Information System (NWIS) of the USGS for storage and archiving. Results for each sample in QWDATA were uniquely identified by station identification number, date, time, and medium code. Additionally, each CSQA sample was labeled with a unique barcode as a backup sample-tracking identifier. Algal and macroinvertebrate samples were analyzed at the NWQL University of Colorado, Boulder, Colo., as described farther onin the text. Continuous data recorded by data-logging instruments, such as streamflow (or stage) and temperature, did not require laboratory analyses so they were processed at the USGS WSC in Sacramento, Calif. (the local WSC).

Comprehensive Stressor Assessments

Discrete Water-Quality Samples

Discrete water samples were collected weekly during the WQ index periods (table 5; appendix 1, table 1.1) and analyzed for nutrients, major ions, DOC, ultraviolet absorbance (UVA), and pesticides by the NWQL. Samples for major ions and nutrients were analyzed by the NWQL using various methods (appendix 2, tables 2.1 and 2.2). Specifically, total phosphorus concentrations were determined by colorimetry according to EPA method 365.1 (O'Dell, 1993). Dissolved ammonia, nitrite, and orthophosphate colorimetric analyses are described by Fishman (1993). Dissolved nitrate-plus-nitrite concentrations were determined by low-level enzyme reduction colorimetry with an automated discrete analyzer, as described by Patton and Kryskalla (2011). Concentrations of dissolved cations were determined by inductively coupled plasma-atomic emission spectroscopy (Fishman, 1993), and concentrations of dissolved anions were determined by ion chromatography, as described by Fishman and Friedman (1989).

For analysis of pesticides, discrete water samples were syringe filtered (0.7-µm pore size glass-fiber) into 20-mL vials. Two pesticide schedules were run on the filtered samples: a broad-spectrum method to determine 225 pesticides and degradates (LCM60, the same pesticide method used in prior RSQA studies; appendix 2, table 2.3.1) and a supplemental schedule of 30 pesticides and degradates (LCM75; appendix 2, table 2.3.2). For both schedules, pesticides were analyzed by direct aqueous injection (DAI) liquid chromatography tandem mass spectrometry (LC-MS/MS; Sandstrom and others, 2016). The original 225 pesticides and pesticide degradates represent a broad range of chemical classes and were selected on the basis of criteria such as the amount of current use, probability of occurrence in streams and groundwater, toxicity to humans or aquatic organisms, and precision of analytical methods (Norman and others, 2012). The supplemental schedule contains additional high-priority pesticides, including neonicotinoid and diamide insecticides and fungicides, and was run on an Agilent model 6495 LC-MS/MS instrument, which is more sensitive than the Agilent 6460 models used for the original method (Sandstrom and others, 2016). For the original LCM60 method, recoveries for most of the 225 analytes ranged from 80 to 120 percent in the water types tested, with relative standard deviations of less than 30 percent. The method detection limits (MDL) ranged from 1 to 106 nanograms per liter (ng/L) for most of the 225 analytes, with current reporting levels (RLDQC) ranging from 2 to 360 ng/L for these analytes (appendix 2, table 2.3.1). For the supplemental pesticide method LCM75, recoveries were in the 80- to 120-percent range for all but one of the 30 pesticide analytes. All 30 analytes had MDLs ranging from 1 to 28 ng/L and RLDQCs from 2 to 56 ng/L (appendix 2, table 2.3.2).

Weekly discrete whole-water samples were analyzed for suspended-sediment concentrations at the USGS California Sediment Laboratory in Menlo Park, Calif. Methods for processing suspended-sediment concentrations included use of wet-sieving filtration and are described in Guy (1969) and Knott and others (1993).

Filtered and particulate methylmercury were analyzed in grab water samples (see "Sample Collection and Processing" section) at the USGS Mercury Research Laboratory in Middleton, Wis., by gas chromatographic separation with cold vapor atomic fluorescence spectrometry (DeWild and others, 2002, 2004). Filtered and particulate total mercury were analyzed by oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry (method 1631, revision E; U.S. Environmental Protection Agency, 2002).

The USGS Mercury Research Laboratory also analyzed DOC in grab samples collected weekly, as well as ultraviolet absorbance at 254 nanometers (UVA254) in grab samples collected concurrently with the mercury samples.

Human-use pharmaceuticals and organic wastewater indicator compounds were analyzed three times for the 6-week sites and once for the 4-week sites (table 5; appendix 1, table 1.1). Pharmaceutical samples were syringe filtered (0.7-µm pore size glass-fiber) into 20-mL vials and analyzed at the NWQL for 113 compounds by DAI LC-MS/MS (appendix 2, table 2.4; Furlong and others, 2008, 2014). Organic wastewater indicator samples were collected as whole water samples into 1-L baked amber glass bottles and analyzed at the NWQL for 69 compounds by gas chromatography mass spectrometry (GC/MS; appendix 2, table 2.5; Zaugg and others, 2006).

Weekly filtered water samples were analyzed for glyphosate by using an enzyme-linked immunosorbent assay (ELISA) at the USGS Texas Water Science Center (Mahler and others, 2017). For all but 11 sites, glyphosate also was analyzed twice during the study period (table 5; appendix 1, table 1.1) at the Kansas OGRL by using solid-phase extraction and LC-MS/MS (Meyer and others, 2009). These data were used to evaluate quality control of the data analyzed by using the ELISA method.

Stable nitrogen (^{15}N) and oxygen (^{18}O) isotopes of nitrate were measured once at all sites (table 5; appendix 1, table 1.1). Samples were filtered into bottles and frozen until nitrate concentration data were received and then shipped to the USGS Reston Stable Isotope Laboratory in Reston, Virginia. Isotopic analyses were done by following the method of Coplen and others (2012). Dissolved nitrate in water is converted to nitrous oxide (N_2O) by denitrifying bacteria, and the nitrous oxide is analyzed for nitrogen and oxygen isotopic abundance by continuous-flow isotope-ratio mass spectrometry.

For analysis of the microcystins class of algal toxins, water samples were processed and analyzed by the OGRL following methods outlined in Loftin and others (2016). Unfiltered samples were lysed by three sequential freeze-thaw cycles at −20 °C and 25 °C and then syringe filtered through 0.7-µm glass fiber filters and frozen until analysis. Algal toxins were quantified by using the microcystin ELISA method with a minimum reporting level of 0.10 micrograms per liter.

Polar Organic Compound Integrative Samplers

The POCIS were processed for analysis of pesticides and pharmaceuticals by using the methods described in Alvarez (2010) and Van Metre and others (2017a). At CERC, the sample from each POCIS was individually extracted with methanol, and extracts were concentrated to 1 milliliter (mL). Concentrated extracts were sealed in 1-mL amber glass ampules and shipped to the NWQL in Denver, Colo., for analysis. At the NWQL, the extracts were transferred to analytical vials and diluted 1:100, which was required so as not to overwhelm the instrument with the high concentrations of some compounds and to prevent ionization suppression or enhancement of internal standards by the POCIS extracts during LC-MS/MS analysis. Laboratory blank and laboratory-fortified spike samples were prepared by using comparable volumes of methanol and then were processed along with the POCIS extracts. The extracts were analyzed for concentrations of the original 225 pesticides and degradates (LCM60; appendix 2, table 2.3.1), and pharmaceuticals (appendix 2, table 2.4), by using the LC-MS/MS methods described previously for the discrete water samples.

Continuous Streamflow, Stage, and Water Temperature

Discharge data collected at active USGS streamgages (28 sites) were continuously telemetered to the public in real time via the USGS NWIS database. Four additional sites had streamgages operated by outside agencies, and 19 sites had pressure transducers installed to continuously measure stream stage. At these 19 sites, the raw stage data were processed with the HOBOware graphing and analysis software (Onset Computer Corporation, 2014). This process included applying corrections to the stage values with barometric pressure readings and comparing tape-down measurements from the reference point to the water surface to ensure that the instruments functioned consistently and reliably while they were in service.

The water temperature data were also processed with the HOBOware software (Onset Computer Corporation, 2012); values were checked for outliers that could indicate that the data logger was out of the water, such as with very low flow conditions. The general procedure used to assess the validity of temperature readings that appeared inordinately high was to first review streamflows at the site to determine whether the high temperature values corresponded in time to minimal stage values, then compare these temperature values with those of nearby sites to assess whether the data logger was recording air rather than water temperature. Erroneous water temperature data were subsequently deleted from the data file.

Focused Studies

Pesticides from the Small-Volume Pesticide Automated Samplers

Daily composite samples from the pesticide autosamplers (vials 1 through 7) were analyzed for pesticide concentrations by the EPA OPP Analytical Chemistry Laboratory. Sample splits of the weekly composite sample (vial 9) and the spike sample (vial 8) were analyzed for pesticide concentrations by the NWQL in Denver, Colo., as well as the OPP laboratory. The NWQL analyzed one split sample for 225 current-use pesticides (appendix 2, table 2.3.1) following the methods described earlier in the text (Sandstrom and others, 2016). The OPP laboratory used the same direct aqueous-injection LC-MS/MS method and instrument model (Agilent Model 6460) used by the NWQL (Sandstrom and others, 2016), with similar detection levels, to analyze for 222 pesticides and degradates (appendix 2, table 2.12).

Pesticide Analysis in Biofilms

Biofilms were analyzed for 94 current-use pesticides (appendix table 2.11) at the USGS Organic Chemistry Research Laboratory (OCRL) in Sacramento, Calif., by using pressurized solvent extraction, cleanup with carbon/alumina (adapted from Hladik and McWayne, 2012), followed by GC-MS/MS analysis (instrument methods from Hladik and others, 2016).

Suspended-Sediment Passive Samplers

Aliquots of fine fractions (less than 63 µm) of suspended sediment collected from passive samplers and of streambed sediment were analyzed for major and trace elements by AGAT Laboratories, Mississauga, Ontario, Canada, using inductively coupled plasma-optical emission spectroscopy and inductively coupled plasma-mass spectrometry, following dissolution in a mixture of hydrochloric, nitric, perchloric, and hydrofluoric acids (similar to the method documented in Smith and others, 2013). Particle size was measured at the USGS Maryland-Delaware-D.C. WSC in Baltimore, Md., using a laser in situ scattering transmissometer (LISST-100X; Gellis and others, 2018). Additional aliquots of suspended sediment and streambed sediment (63-µm sieved) were analyzed for radionuclides (lead-210, radium-226, cesium-137, and beryllium-7) at the USGS Sediment Radioisotope Laboratory in Menlo Park, Calif. Radionuclides were analyzed by using a high-resolution gamma spectrometer with an intrinsic germanium detector, following methods described in Van Metre and others (2004).

Ecological Surveys

Aquatic Biota

Benthic macroinvertebrate samples were processed by the Biological Unit of the NWQL using a methodology similar to that used in the State of California's Surface Water Ambient Monitoring Program (SWAMP; Woodard and others, 2012). Briefly, the sample was sorted to attain a minimum of 600 organisms, which then were identified to the lowest possible taxonomic level (generally the species or genus level). Quality assurance was verified in both the sorting step and the taxonomic step by a second taxonomist, following the QA/QC procedures in Moulton and others (2000). Taxonomic and enumeration results were uploaded to BioData (U.S. Geological Survey, 2016).

Benthic algal samples were processed in the field by filtering onto 0.47-µm glass-fiber filters. The filters were analyzed at the NWQL for chlorophyll *a* and pheophytin *a* by using EPA method 445.0 and for algal ash-free dry mass by using USGS method B-3520-85 (appendix 2, table 2.10; Britton and Greeson, 1989; Arar and Collins, 1997).

Algal samples preserved with formalin were analyzed for diatom community composition and abundance at the INSTAAR laboratory at the University of Colorado, Boulder, following NAWQA protocols (Charles and others, 2002) with the following modification. Four replicate slides of the diatoms were made by using Battarbee chambers to obtain random distribution of cells on cover slips (Battarbee, 1973). A pre-count collection of voucher flora was created, based on examination of 80 percent of the algal slides. The voucher flora included images of all taxa encountered, with a greater number of images for rare and previously unknown taxa. The images were sorted into operational taxonomic units (OTUs) and assigned OTU codes. Samples and their order of analysis were randomly assigned to two analysts. Ten percent of samples were reanalyzed by each analyst, and 10 percent of samples were analyzed in cross comparison. Finally, OTU codes were translated into formal scientific names following the taxonomy in the USGS BioData program and Diatoms of the United States (Spaulding and others, 2010). Voucher slides, digested material, and the voucher flora were archived at INSTAAR. The soft algae fractions of the samples were stored at INSTAAR for possible analysis at a later time.

Physical Habitat

Data collected from habitat surveys were recorded on electronic field forms and reviewed later in the office by USGS staff. Any values on the field forms that were suspect (such as typographical errors) were resolved, and the data were archived for a future data release.

Streambed and Bank Sediment

Aliquots of bulk (homogenized, 2-mm sieved) streambed sediment were analyzed for grain size at the USGS Missouri Sediment Laboratory in Rolla, Mo. Major and trace elements and organic carbon were analyzed in aliquots of streambed sediment (less than 63 µm) by AGAT Laboratories using the same methods described earlier in the text for the suspended-sediment passive samples. Aliquots of the streambed samples (less than 63 µm) were analyzed for radionuclides at the USGS Sediment Radioisotope Laboratory in Menlo Park, Calif., using the same methods described earlier in the text for the suspended-sediment passive samples.

Aliquots of streambed sediment (less than 2 mm) were sent to the USGS NWQL for analysis of three organic contaminant schedules. One aliquot was analyzed for organic wastewater indicator compounds by using accelerated solvent extraction (ASE), solid-phase extraction cleanup, and GC/MS (appendix 2, table 2.6; Burkhardt and others, 2006). A custom method was used for selected organohalogens in sediment (chlorinated and brominated compounds including insecticides, polychlorinated biphenyls [PCBs], and polybrominated diphenyl ethers [PBDEs]), in which the sample was extracted by ASE, followed by solid-phase extraction cleanup and analysis by electron-capture negative ionization mode GC/MS with selected ion monitoring (appendix 2, table 2.8; reported in Mahler and others, 2009; Wagner and others, 2014). Hormone compounds in bed sediment were analyzed using a custom method (appendix 2, table 2.9) consisting of pressurized solvent extraction, then two solid-phase extraction steps to isolate the compounds and further clean the extract (Fischer and others, 2015), followed by compound derivatization and analysis by gas chromatography with tandem mass spectrometry (GC-MS/MS) using procedures similar to Foreman and others (2012). An additional aliquot of streambed sediment (less than 2 mm) was sent to RTI Laboratories, Livonia, Michigan (https://rtilab.com/), for analysis of 17 PAHs using EPA method 8270D (U.S. Environmental Protection Agency, 2014), with extraction by ASE and analysis by GC/MS with selected ion monitoring (appendix 2, table 2.7). Another aliquot of streambed sediment (less than 2 mm) was analyzed for 118 pesticides (most of which are in current use) at the USGS OCRL in Sacramento, Calif., by using pressurized solvent extraction, followed by a series of cleanup procedures (gel permeation chromatography and SPE with either carbon/alumina or Florisil), followed by GC/MS analysis (Hladik and McWayne, 2012).

Bank material (less than 2 mm) was analyzed for grain size at the USGS Maryland-Delaware-D.C. WSC, Baltimore, Md. Major and trace elements and organic carbon were analyzed by AGAT Laboratories, Mississauga, Ontario, Canada.

Sediment Toxicity Testing

Whole sediment toxicity tests were conducted with the amphipod *Hyalella azteca* (28-day exposures) and with the midge *Chironomus dilutus* (10-day exposures), following methods in U.S. Environmental Protection Agency (2000) and American Society for Testing and Materials International (2016), with detailed test conditions noted in Moran and others (2017). As much as 1.8 L (assuming a 50/50 split of solids and liquids) of the composited streambed sediment was used for toxicity testing. Testing for each species included endpoints of survival, weight, and biomass of test organisms. Exposures were conducted at 23 °C in 300-mL beakers containing 100 mL of sediment with two volume additions per day of overlying water. Ten organisms were exposed in each beaker with four replicate beakers per site. Endpoints were survival, growth (dry weight for amphipods and ash-free dry weight for midge), and biomass for each test species. Response of each endpoint for each species was compared to a standard control sediment from Spring River, Mo. (Besser and others, 2015). Comparisons also were made using a reference envelope approach, which addresses the variability observed from reference sediments that were primarily from undeveloped watersheds, had minimal levels of contamination, and showed acceptable biological performance, as defined in Kemble and others (2013).

Quality Assurance and Quality Control

This section describes the QA/QC procedures for stressor assessments (specifically, constituents in discrete water samples, POCIS samples, and streambed-sediment samples), as well as for overall project-specific training and management. QA/QC procedures for the focused studies were described in the "Sample Collection and Processing" section. For the ecological surveys, QA/QC procedures are built into the taxonomic identification process and are described in the "Sample Analyses" section.

Quality assurance/quality control for project data is an iterative process that begins when samples are collected, continues through the establishment of sample records in NWIS, and ends with the final acceptance of data as reviewed and approved or, in rare cases, rejected. This process allows for a continuous review of records by field personnel, laboratory analysts, RSQA team data managers, QW specialists, and other team members. Specific database scripts were developed to check sample coding logic and to generate data tables in multiple formats for data review and confirmation.

Quality assurance/quality control procedures maintain the integrity, accuracy, and legal defensibility of results from data collection and assessment. Documented USGS QA/QC policies and procedures for environmental sampling were implemented in the study to ensure that the data can be interpreted properly and are scientifically defensible (Mueller and others, 1997; U.S. Geological Survey, 2006). Quality control samples were collected to identify, quantify, and document bias and variability in data that result from the sampling procedure (through field QC sampling) and laboratory procedures (through laboratory QC sampling). Field QC sampling is used to estimate bias and variability from sample collection, processing, shipping, and handling of samples. Laboratory QC sampling documents the variability of analytical methods and sample preparation in the laboratory.

To ensure that all field crews followed consistent sample collection and processing procedures, classroom training was held for field personnel before the sampling period. In addition, all personnel worked through a full suite of sample collection and sample processing procedures in the field just before the start of the CSQA sampling period. To maximize efficiency in the field, all sampling scheduling and preparation of weekly sampling supplies were handled centrally by USGS personnel who had provided similar support to previous RSQA studies. Sample bottle packs were assembled at the USGS Sacramento Field Office by USGS staff at least 1 week before sampling. The bottle packs consisted of the necessary bottles, filters, preservatives, labels, and ASRs for each stream site. Centralizing the assembly and distribution of sample bottle packs helped ensure that correct sample coding, sample schedules, and timing of QC samples matched the sampling plan and reduced errors in the sample login process at the analytical laboratories.

The QC samples for constituents measured in water included field blanks, field matrix spikes, and replicates (table 6; appendix 1, table 1.1). The QA/QC plan was designed to have 5 percent or more QC samples for inorganics and 10 percent for organics, to ensure that QC samples were distributed across the region (spatially) and study period (temporally), and to assign collection of QC samples to every field crew. Field blanks were used to test whether field cleaning procedures would adequately remove any equipment contamination introduced by sampling at previous sites and to ensure that sample collection, processing, handling, and shipping did not result in contamination (Mueller and others, 1997; U.S. Geological Survey, 2006). Field replicates provided a measure of the variability introduced during sample processing and analysis (Mueller and others, 1997; U.S. Geological Survey, 2006). When water samples were collected from the churn, two aliquots of water were split from the churn into separate containers and analyzed as field replicates (split replicates). When grab samples were collected, replicates were collected sequentially directly from the stream. Field and laboratory matrix spikes were used to assess the potential bias for analytes in a particular sample matrix. Bias is estimated from spiked samples by calculating the percentage of the added analyte (spike material) that is measured (recovered) in the sample at the laboratory (Mueller and others, 1997; U.S. Geological Survey, 2006). Recovery can be either greater than or less than 100 percent, so the bias can be either positive or negative. However, matrix interference and analyte degradation generally result in a negative bias.

Field blanks were collected once from 16 to 18 sites for each of the basic laboratory schedules (major ions, nutrients, dissolved organic carbon, pesticides, and glyphosate by immunoassay; table 6) that were part of the comprehensive stressor assessments. The targeted number of total QC samples per analytical schedule was 10 percent for organic contaminants and 5 percent for inorganic constituents, with QC samples distributed throughout the study area, the study period (appendix table 1.1), and among the nine field crews. CSQA field QC samples represented 5–8 percent of environmental samples for major ions, nutrients, and DOC; 11 percent for mercury; and 16–18 percent for the broad-spectrum pesticide methods, glyphosate by LC-MS/MS, pharmaceuticals, and organic wastewater indicators, all of which met the frequency recommendations (table 6).

For pesticides, pharmaceuticals, and organic wastewater indicators, field blanks and field replicates each represented about 3–5 percent of the environmental samples (table 6). Field matrix spikes were created for analyses of all organic contaminants, with the exception of glyphosate analysis by immunoassay. The frequency of the field matrix spikes ranged from 5 to 10 percent for organic contaminants, depending on the laboratory schedule (table 6). For glyphosate by immunoassay, laboratory matrix spikes (not shown in table 6) were analyzed, which represented an additional 2 percent of environmental samples.

Table 6. Summary counts of environmental, field blank, replicate, and spike samples of stream water from the 85 stream sites sampled in the California Stream Quality Assessment study of the U.S. Geological Survey National Water-Quality Assessment Project in 2017.

[OGRL, U.S. Geological Survey Organic Geochemistry Research Laboratory in Lawrence, Kansas; QC, quality control; —, not applicable]

Type of sample	Sample counts	Ratio of QC to environmental samples (percent)	
		Actual	Recommended[1]
Laboratory schedule: Major ions			
Environmental	488	7.6	5
Blank	16	3.3	—
Replicate	21	4.3	—
Spike	0	0	—
Laboratory schedule: Nutrients			
Environmental	488	7.6	5
Blank	16	3.3	—
Replicate	21	4.3	—
Spike	0	0	—
Laboratory schedule: Dissolved organic carbon			
Environmental	485	5.0	5
Blank	17	3.5	—
Replicate	20	4.1	—
Spike	0	0	—
Laboratory schedule: Pesticides			
Environmental	488	17.4	10
Blank	18	3.7	—
Replicate	22	4.5	—
Spike	45	9.2	—
Laboratory schedule: Supplemental pesticides			
Environmental	488	17.6	10
Blank	18	3.7	—
Replicate	21	4.3	—
Spike	47	9.6	—
Laboratory schedule: Glyphosate (immunoassay)			
Environmental	487	7.6	10
Blank	16	3.3	—
Replicate	21	4.3	—
Spike	20	20	—
Laboratory schedule: Pharmaceuticals			
Environmental	233	16.3	10
Blank	11	4.7	—
Replicate	13	5.6	—
Spike	14	6.0	—
Laboratory schedule: Organic wastewater indicators			
Environmental	233	15.9	10
Blank	12	5.2	—
Replicate	12	5.2	—
Spike	13	5.6	—
Laboratory schedule: Glyphosate (OGRL)			
Environmental	147	15.0	10
Blank	9	6.1	—
Replicate	13	8.8	—
Laboratory schedule: Mercury			
Environmental	244	11.1	5
Blank	14	5.7	—
Replicate	13	5.3	—
Spike	0	0	—
Laboratory schedule: Algal toxins			
Environmental	84	12	10
Blank	5	6	—
Replicate	5	6	—
Spike	0	0	—
Laboratory schedule: Isotopes			
Environmental	84	10.7	5
Blank	0	0	—
Replicate	9	10.7	—
Spike	0	0	—

[1]Recommendations for total QC samples are 10 percent of environmental samples for organic constituents and 5 percent for inorganic constituents.

[2]Although no field matrix spike samples were analyzed, laboratory matrix spike samples (not shown in this table) represented an additional 4 percent of environmental samples.

Quality assurance/quality control procedures generally were simpler for sediment samples than for water samples and included the use of field replicates (splits of composite bed-sediment samples) as well as (for pesticides) laboratory blanks and laboratory matrix spikes. In addition, two additional streambed samples (for a total of three samples per site) were collected at a subset of seven sites to assess temporal variability in bed-sediment contaminants. Counts of environmental and QC samples for constituents in bed sediment are shown in table 7. Field replicates represented 11 percent of environmental samples for pesticides, PAHs, organic wastewater indicators, hormones, halogenated organic compounds, trace elements, radionuclides, and grain size. For pesticides in sediment, the laboratory blanks and laboratory matrix spikes analyzed each represented about 7 percent of environmental samples (table 7).

Quality assurance included maintaining standardized sample collection and handling protocols among all field personnel as described in the National Field Manual (U.S. Geological Survey, variously dated) for water and sediment sampling and in Moulton and others (2002) for ecological sampling. All sampling and handling protocols were reviewed by field personnel involved in the CSQA study during training courses, before field work began. Additionally, several programs exist in the USGS Quality Systems Branch to help document the quality of project results. For laboratory analyses conducted by the NWQL, documented QC included double-blind analyses of blanks for organic and inorganic constituents in water and provision of graphical and tabular control data for the analytical lines. Field personnel involved in the CSQA study are tested annually to verify their proficiency in collecting field data, including temperature, pH, dissolved oxygen, alkalinity, and specific conductance.

For POCIS samples, field QC samples included replicates and blanks, and their total number represented 20 percent of the environmental POCIS samples (appendix 1, table 1.5). Field replicate samples were obtained by deploying a second canister containing 2 POCIS, one for each of the pesticide and pharmaceutical schedules, at seven sites (11 percent). At six sites (9 percent), the environmental POCIS sample was accompanied by a field blank that was used to assess any accumulation of target and nontarget compounds from the air during shipment and deployment. All POCIS and blank canisters were stored on ice during transport to and from the field location. The blank canisters were open to the air at the same time and place as the environmental POCIS were exposed to air during deployment and retrieval. Between deployment and retrieval of the environmental POCIS samples, the POCIS blank canisters were kept sealed and stored between –20 and 0 °C.

Water-quality data from each sampling event were reviewed for completeness, precision, bias, and transcription errors when received from the laboratory as part of the QA/QC procedures. Water-quality and sediment-quality data were stored in the NWIS database; the data are available for retrieval at https://nwis.waterdata.usgs.gov/nwis/sw and through the data retrieval application at the RSQA project website (https://webapps.usgs.gov/RSQA/). The NWQL provides all QA/QC documentation for analytical services at https://nwql.usgs.gov/Public/quality.shtml. Data also will be published in ScienceBase.

Temperature calibration checks were completed on the HOBO U20 and U22 units before deployment and after retrieval according to the USGS National Field Manual (Wilde, 2008). The USGS WSC in Columbus, Ohio, maintains a commercially refrigerated water bath specifically for the purposes of thermometer and temperature sensor calibration. The bath is calibrated to a National Institute of Standards and Technology (NIST)-certified thermometer, and calibration checks on temperature sensors are conducted at 3.00, 10.05, 15.03, 25.05, 30.04, and 40.03 °C. Units found to be within their performance range are certified for deployment. Pressure transducer units also were checked that their barometric pressure reading was within 1 percent of a NIST-certified barometer before deployment and after retrieval. This was done at the atmospheric pressure for the USGS WSC in Columbus, Ohio. Air pressure transducer readings from sensors were not checked against NIST-certified barometers in the field. However, continuous readings were verified during the correction process against water-quality sonde readings measured during discrete sampling.

Continuous temperature and pressure data processing was done by a single person to maintain consistency within the CSQA study and included the following steps. Data were evaluated for erroneous readings at the start of deployment and the end of retrieval for situations where the device was actively logging data while in route to the site or stream. These data were removed. The data were then plotted to identify significant spikes or dips in the record, including possible loss of record. Spikes in the data that were inconsistent with

observed changes in air temperature, weather events, or flow, or that were not corroborated with other nearby records, were removed from the record.

Table 7. Summary counts of environmental, field replicate, field spike, and temporal samples of bed sediment collected from 82 stream sites in the California Stream Quality Assessment study of the U.S. Geological Survey National Water-Quality Assessment Project in 2017.

[Temporal bed sediment samples, which were collected at 7 sites (table 5), are not included in environmental sample counts and percentages of QC samples. **Abbreviations**: NAV, not available; QC, quality control; —, not applicable]

Type of sample	Sample counts	Ratio of QC to environmental samples (percent)	
		Actual	Recommended[1]
Laboratory schedule: Pesticides			
Environmental	82	26	10
Replicate	9	11	—
Blank[2]	6	7.3	—
Spike[2]	6	7.3	—
Temporal	NAV	NAV	—
Laboratory schedule: Polycyclic aromatic hydrocarbons			
Environmental	82	11	10
Replicate	9	11	—
Temporal	14	0	—
Laboratory schedule: Organic wastewater indicators			
Environmental	82	11	10
Replicate	9	11	—
Temporal	12	0	—
Laboratory schedule: Hormones			
Environmental	82	11	10
Replicate	9	11	—
Temporal	13	0	—
Laboratory schedule: Halogenated organics			
Environmental	82	11	10
Replicate	9	11	—
Temporal	12	0	—
Laboratory schedule: Trace elements			
Environmental	81	11	5
Replicate	9	11	—
Temporal	14	0	—
Laboratory schedule: Grain size			
Environmental	82	11	5
Replicate	9	11	—
Temporal	0	0	—
Laboratory schedule: Radionuclides			
Environmental	82	11	5
Replicate	9	11	—
Temporal	14	0	—

[1]Recommendations for total QC samples are 10 percent of environmental samples for organic constituents and 5 percent for inorganic constituents.

[2]Laboratory blanks and laboratory matrix spikes were analyzed for pesticides in bed sediment.

Data-Management Procedures

An important goal of data management for the CSQA study is to have the data reviewed, approved, and stored in a USGS approved database that is appropriate for the specific type of data (for example, water quality, streamflow or stage, and biological). Because CSQA sampling sites were only in California, data entry and retrieval for sites were managed by the local WSC. The NWIS station number that is used to identify a site (table 1) is the master indexing and retrieval element for accessing data specific to the site. The NWIS database is the repository for most of the water-quality and streamflow data, which constitute most of the CSQA data. Additionally, a data-management team composed of national RSQA staff and local CSQA staff was created to facilitate the data-management process. Centralization of the data-management process was adopted to ensure consistency among all RSQA study areas and the respective WSCs. Nine main steps were implemented in the data-management process:

1. Sampling matrix and sample coding design;
2. Electronic field form use, including barcoding;
3. Sample status checks at all laboratories;
4. NWIS sample record checks;
5. Data transfer from laboratory to NWIS;
6. Establishment of project networks;
7. Sample coding and field parameter checks;
8. Data quality checks;
9. Approval of data in NWIS and other databases, as appropriate.

Sites for the CSQA study were assigned the appropriate network designations in NWIS ProjectNetworks (Dupré and others, 2013), which allows integration with similar sites across many regions and designation of the network type in NWIS. These network designations were obtained from the project planning documents and, where possible, kept consistent with other network designations used in previous regional studies. ProjectNetworks documentation enabled local CSQA personnel to establish their sites in NWIS ProjectNetworks.

Before the start of sampling, the manager of the data-management team (henceforth, data manager) prepared a matrix that would be the sampling design and coding plan for all aspects of the field activities. The sampling matrix distributed QC samples approximately equally across sites, sample teams, and time periods for optimum coverage. The matrix also served as a summary for the type, frequency, and location of environmental and QC samples to be collected (appendix 1, table 1.1). A sample coding scheme was developed by the data manager that was used by the CSQA sampling teams to ensure a well-structured and manageable dataset. Additionally, training and written guidelines for sampling coding were made available to sampling teams before the start of sampling.

Most of the CSQA sampling teams used the Personal Computer Field Form (PCFF) version 7.2 software created by the USGS, which provides electronic field forms for data collection at sampling sites. Some field teams did not use the PCFF; in these cases, field data were recorded on paper field forms and then transferred to electronic digital forms in the office. In any case, the use of PCFF did not preclude the use of paper field forms when sampling; a two-page standardized form for CSQA water-quality field notes was routinely used at all sites to record basic site conditions when samples were collected and to affix bar codes that identified the samples. The bar codes are unique identifiers used to associate specific sample types with a site and the sampling event. The PCFF software streamlines the process of uploading (logging in) field data and sampling codes to NWIS by automatically generating the batch load files required by NWIS (qwsample and qwresult) and thereby improves the efficiency of data flow from field and laboratory to database. The information uploaded to NWIS for each sample is stored under a unique number associated with that sample, as are all results received later from the laboratory. In addition, the automation of data upload to NWIS limits the incidence of transcription errors that can occur during the manual entry of data into NWIS. The field-supply manager provided ASRs to the sampling teams each week along with the corresponding bottle sets.

Sample shipment schedules were established before the start of sampling for CSQA, and generally shipments were made twice per week (appendix 1, table 1.4). Sampling teams and other local WSC personnel were responsible for the shipment process. The data manager tracked the shipments to verify that the shipped samples were received at each laboratory (1) within the correct holding times, (2) in the proper condition (for example, chilled samples received at the appropriate temperature of 4 °C or less), and (3) with proper documentation. The data manager worked with the laboratories to correct problems with mislabeled samples or ASRs in a timely manner and to communicate problem-resolution approaches to local WSC personnel. During this process, the data manager also established the

connection between the USGS Laboratory Information Management System used to transfer sample results and the NWIS database used to store and receive sample results.

During sampling and the corresponding establishment of sample records in NWIS, the data manager inspected sample coding and procedures to ensure that sample records were established properly and in a consistent manner. Sample coding or the procedures of coding were modified if found to be inaccurate or inconsistent. These modifications involved changes or corrections to sample time offsets, sample type coding, or other documentation at the NWQL or in NWIS. Modifications in sample coding or procedures related to data management or sample submittal were communicated immediately to sampling teams to ensure that appropriate adjustments were made before the next sampling.

Most of the laboratories used for CSQA sample analysis transmitted sample results through the Water Quality Data Exchange (QWDX) for automatic upload into the NWIS database. For those laboratories without the ability to use QWDX, sample results were loaded into NWIS by using manually created batch files. Batch files were created by the data manager upon receipt of electronic data from the laboratory and were loaded into NWIS by the data manager or the database administrator for the local WSC. The data manager verified that the batch files of data were properly loaded into NWIS.

Similarly, the Ecology Sampling Coordinator verified that algal, macroinvertebrate, and habitat data were properly loaded into BioData and into the ScienceBase digital data repository supported by the USGS (https://www.sciencebase.gov/catalog/item/5e15f326e4b0ecf25c55c034). Data files provided through email by laboratories and data not applicable to NWIS (for example, CERC toxicity data) were stored electronically in the RSQA team database rather than in NWIS. These data, and data such as QC sample results not publicly available through NWIS, will be released separately through USGS ScienceBase.

After sampling was completed, the data manager inspected the NWIS sample records for completeness regarding field data collection, including stream measurements (streamflow, stage, sampling points, stream width, and so forth), field parameters (pH, air and water temperature, specific conductance, dissolved oxygen), and sample coding (sample purpose, purpose of site visit, sampling method, sampler type, and multiple QC-related sample codes). Manual checks were made for each sample, and any needed corrections were communicated to WSC personnel.

National RSQA staff scientists reviewed the water-quality and sediment-quality results received from the laboratories. The water-quality data reviews included identification and review of extremes in the data (outliers), inconsistencies or unexpected results, major differences between environmental samples and replicates, detected values in blanks, surrogate recoveries, and analyte recoveries in spike samples, as well as review of sample coding. The RSQA staff scientists communicated requests for reruns, reloads, and verification of results to the laboratory; they worked closely with the data manager to verify completeness and accuracy of sample results. After completion of data review by RSQA staff, the database administrator at the USGS California WSC in Sacramento, Calif., changed the data quality indicator (DQI), depending on the results of the review, for groups of parameter types to “reviewed and accepted” (R) or, in a few rare cases, “reviewed and rejected” (Q).

Water-quality, sediment, and ecological survey data will be available to the public in NWIS and ScienceBase, as well as at the RSQA mapping and data application website, which allows mapping, querying, and data downloads (https://webapps.usgs.gov/RSQA/#!/download).

Continuous stage and temperature data measured by the HOBO U20-001-04 digital loggers were reviewed and corrected as described in the "Quality Assurance and Quality Control" section and will be published in ScienceBase.

Summary

This report describes the design and methods used during an intensive regional study, designated by the California Stream Quality Assessment (CSQA), to assess stream quality in the central coastal region of California, United States, where the larger valleys contain intense urbanization or agriculture, or both. This is the last of five regional stream-quality assessment (RSQA) studies conducted by the U.S. Geological Survey (USGS). The overall goal of the RSQA studies is to improve the understanding of multiple water-quality stressors that affect wadeable streams throughout the region by evaluating relations between these stressors and biological indicators of stream health. The RSQA study design has three elements: comprehensive stressor assessments, focused studies, and ecological surveys. In CSQA, 85 wadeable stream sites were selected throughout the Central California Foothills and Coastal Mountains (an EPA Level III ecoregion) to determine the occurrence and levels of multiple stressors, and to assess stream habitat and the condition of aquatic algal and macroinvertebrate communities during spring 2017. A wide variety of potential stressors was assessed in the CSQA study, including nutrients, trace elements and major ions in water, several classes of organic contaminants in water and sediment, suspended sediment, and flow alteration. Data on water and sediment-quality constituents came from discrete, continuous, and integrative samples collected at all sites, supplemented by in-depth characterizations of selected stressors from focused studies conducted at subsets of sites.

The 85 sites were divided into a Southern group (36 sites) and a Northern group (49 sites). Water quality was measured at all sites during either a 4- or 6-week period from mid-March to mid-May 2017, with sampling at the Southern sites starting 3 weeks earlier than at the Northern sites. After the water-quality sampling period, an ecological survey was conducted at each site in May 2017 to assess algal and macroinvertebrate communities, the presence of harmful algal toxins, contaminants in sediment, sediment toxicity to amphipods and midge larvae, and the physical habitat of the stream. This report describes procedures used for sample collection and processing, sample analyses, quality assurance and quality control, and data management.

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Appendix 1. Description of the Sampling Timelines, Matrix, Collection, and Processing for Water, Sediment, and Ecological Samples

Table 1.1. Sampling matrix for the 85 sites sampled as part of the U.S. Geological Survey California Stream Quality Assessment in 2017 is provided as a downloadable Excel file available at https://doi.org/10.3133/sir20201023.

Table 1.2. Onset Computer Corporation specifications for the HOBO Water Temp Pro v2 U22 and U20 water-level loggers used to monitor continuous water temperature and water level, respectively, at selected stream sites as part of the California Stream Quality Assessment study of the U.S. Geological Survey National Water-Quality Assessment Project in 2017.

[°C, degree Celsius; °F, degree Fahrenheit; ±, plus or minus; m/s, meter per second; kPa, kilopascal; psi, pound per square inch; m, meter; ft. foot; FS, full scale pressure; cm, centimeter; <, less than]

Specifications	Range
HOBO® Water Temp Pro v2 U22 Logger	
Operation range	–40 to 70 °C (–40 to 158 °F) in air; maximum sustained temperature of 50 °C (122 °F) in water
Accuracy	±0.21 °C from 0 to 50 °C (±0.38 °F from 32 to 122 °F)
Resolution	0.02 °C at 25 °C (0.04 °F at 77 °F)
Response time (90 percent)	5 minutes in water; 12 minutes in air moving 2 m/s (typical)
Stability (drift)	0.1 °C (0.18 °F) per year
HOBO® U20-001-04 Water Level Logger	
Operation range	0 to 145 kPa (0 to 21 psi); approximately 0 to 4 m (0 to 13 ft) of water depth at sea level
Accuracy	±0.75 percent FS, 0.3 cm (0.01 ft) water
Resolution	<0.014 kPa (0.063 psi); 0.14 cm (0.005 ft) water
Pressure response time (90 percent)	<1 second

Table 1.3. Description of the data collection and processing steps for water samples collected during the U.S. Geological Survey California Stream Quality Assessment study in 2017.

[4.5 N H2SO4, 4.5 normal sulfuric acid; 7.5N HNO3, 7.5 normal nitric acid; AR, acid-rinsed; DH-81 and DH-95, sampling devices; DOC, dissolved organic carbon; EWI, equal-width increment sampling protocol; ft, foot; ft/s, foot per second; HCl, hydrochloric acid; Hg, mercury; L, liter; LS, Kansas; m, meter; mL, milliter; poly, polyethylene bottle; TX, Texas; UVA, ultraviolet absorbance; —, not applicable; < less than; >, greater than. **Sample type** labels are designated by the National Water Quality Laboratory: BGC, baked, amber glass wide-mouth jar, chilled; FA, filtered, acidified cations; FCC, filtered, chilled nutrients; FU, filtered, unpreserved anions; GCC, baked, amber glass bottle, chilled; GLY2, glyphosate by U.S. Geological Survey Kansas Water Science Center; IMMGLY, glyphosate by immunoassay; OWI, organic wastewater indicators; PEST, pesticide; PHARM, pharmaceutical; RU, raw, unpreserved physical properties; SSC, suspended sediment concentration; WCA, whole, chilled, acidified nutrients]

Steps	Method		
	EWI, >1.5 ft/s and depth >1 ft	**Multivertical grab, <1.5 ft/s and width >10 ft (3 m)**	**Grab in centroid of flow, <1.5 ft/s, width <10 ft (3 m) and depth <1 ft**
	Data collection based on stream width, depth, and velocity		
1	Set up tagline and determine width of 10 increments in transect.	Set up tagline and determine width of 5–10 increments in transect.	Field rinse sample bottles in centroid of flow; then collect directly from stream.
2	Determine transit rate using DH-81 (wading) or DH-95 (from bridge) and field rinse sample bottles/churn.	Field rinse 1-L sample bottle and churn.	1-L poly jar (SSC).
3	Collect water samples at 10 increments using same transit rate; composite in churn.	Use DH-81/no nozzle or dip 1-L sample bottle with hand (wading) or weighted bottle sampler (bridge) at each increment; composite in churn.	1-L GCC (sample label OWI).
4	—	—	[1]125 mL clear poly bottle (sample label WCA).
5	—	—	250 mL clear poly bottle (sample label RU).
6	—	—	500 mL BGC.
7	—	—	Collect 1-L sample using sample bottles in centroid of flow.
8	Collect field parameters at five locations.		
9	Collect grab samples for DOC/UVA and Hg in centroid of flow.		
	Process samples in field vehicle or station		
10	Fill raw-sample bottles from churn. 1-L poly jar (SSC). 1-L GCC (OWI). 125 mL clear poly [1](WCA). 250 mL clear poly (RU). fill 500 mL BGC amber glass jar for organics from churn, filtered in step 17.	Fill raw-sample bottles from churn. 1-L poly jar (SSC). 1-L GCC (OWI). 125 mL clear poly [1](WCA). 250 mL clear poly (RU). fill 500 mL BGC amber glass jar for organics from churn, filtered in step 17.	No churn required—bottles filled directly from stream (see steps 1–7).
11	Acidify WCA with 4.5N H2SO4 (1 vial).	Acidify WCA with 4.5N H2SO4 (1 vial).	Acidify WCA with 4.5N H2SO4 (1 vial).
12	Filter with capsule filter from churn. 250 mL clear AR poly [1](FA). 125 mL brown poly (FCC). 250 mL clear poly (FU). 125 mL brown poly (Isotopes).	Filter with capsule filter from churn. 250 mL clear AR poly [1](FA). 125 mL brown poly (FCC). 250 mL clear poly (FU). 125 mL brown poly (Isotopes).	Filter with capsule filter from 1-L. 250 mL clear AR poly (FA). 125 mL brown poly (FCC). 250 mL clear poly (FU). 125 mL brown poly (Isotopes).
13	Acidfy FA with 7.5N HNO3.	Acidfy FA with 7.5N HNO3.	Acidfy FA with 7.5N HNO3.

Table 1.3. Description of the data collection and processing steps for water samples collected during the U.S. Geological Survey California Stream Quality Assessment study in 2017.—Continued

[4.5 N H2SO4, 4.5 normal sulfuric acid; 7.5N HNO3, 7.5 normal nitric acid; AR, acid-rinsed; DH-81 and DH-95, sampling devices; DOC, dissolved organic carbon; EWI, equal-width increment sampling protocol; ft, foot; ft/s, foot per second; HCl, hydrochloric acid; Hg, mercury; L, liter; LS, Kansas; m, meter; mL, milliter; poly, polyethylene bottle; TX, Texas; UVA, ultraviolet absorbance; —, not applicable; < less than; >, greater than. **Sample type** labels are designated by the National Water Quality Laboratory: BGC, baked, amber glass wide-mouth jar, chilled; FA, filtered, acidified cations; FCC, filtered, chilled nutrients; FU, filtered, unpreserved anions; GCC, baked, amber glass bottle, chilled; GLY2, glyphosate by U.S. Geological Survey Kansas Water Science Center; IMMGLY, glyphosate by immunoassay; OWI, organic wastewater indicators; PEST, pesticide; PHARM, pharmaceutical; RU, raw, unpreserved physical properties; SSC, suspended sediment concentration; WCA, whole, chilled, acidified nutrients]

Steps	Method		
	EWI, >1.5 ft/s and depth >1 ft	**Multivertical grab, <1.5 ft/s and width >10 ft (3 m)**	**Grab in centroid of flow, <1.5 ft/s, width <10 ft (3 m) and depth <1 ft**
14	Filter with syringe filter from churn or BGC.	Filter with syringe filter from churn or BGC.	Filter with syringe filter from churn or BGC.
	Syringe filtration: Prep syringe and filter by (1) pull 10 mL through the needle, invert, plunge to 30 mL, shake and dispose of water, (2) pull 5 mL through the needle, removing the needle and adding filter, and squirting the water through filter..		
	Add 10 mL to 20 mL PEST. Fill 40 mL half full TX immunoassay (bottle label IMMGLY). Add 10 mL to 20-mL vial (bottle label PHARM). Fill two 40-mL vials 24 mL each, KS Glyphosate (bottle label GLY2).	Add 10 mL to 20 mL PEST. Fill 40 mL half full TX immunoassay (bottle label IMMGLY). Add 10 mL to 20-mL vial (bottle label PHARM). Fill two 40-mL vials 24 mL each, KS Glyphosate (bottle label GLY2).	Add 10 mL to 20 mL PEST. Fill 40 mL half full TX immunoassay (bottle label IMMGLY). Add 10 mL to 20-mL vial (bottle label PHARM). Fill two 40-mL vials 24 mL each, KS Glyphosate (bottle label GLY2).
15	Filter DOC with Aquaprep capsule filter. Condition aquaprep with organic blank water. Let the first 10 mL to waste then fill two 40-mL vials to neck.	Filter DOC with Aquaprep capsule filter. Condition aquaprep with organic blank water. Let the first 10 mL to waste then fill two 40-mL vials to neck.	Filter DOC with Aquaprep capsule filter. Condition aquaprep with organic blank water. Let the first 10 mL to waste then fill two 40-mL vials to neck.
16	Acidify mercury sample (10 mL of ultraclean HCl).	Acidify mercury sample (10 mL of ultraclean HCl).	Acidify mercury sample (10 mL of ultraclean HCl).
	Other data collection and clean up		
17	Take a reference point measurement for stage, double-check field sheets for completeness.	Take a reference point measurement for stage, double-check field sheets for completeness.	Take a reference point measurement for stage, double-check field sheets for completeness.
18	Field clean tubing, churn, and 1-L sample bottle and cap, if re-using.	Field clean tubing, churn, and 1-L sample bottle and cap, if re-using.	Field clean tubing, churn, and 1-L sample bottle and cap, if re-using.
19	Field clean tubing for DOC, if re-using.	Field clean tubing for DOC, if re-using.	Field clean tubing for DOC, if re-using.

[1] Acid preservation required.

Table 1.4. Description of the bottle types, laboratory schedules, and preservation protocols by parameter group for samples collected by the U.S. Geological Survey California Stream Quality Assessment study in 2017.

[**Laboratories**: CA OCRL, U.S. Geological Survey (USGS) California Organic Chemistry Research Laboratory, Sacramento, Calif.; CERC, USGS Columbia Environmental Research Center, Columbia, Mo.; CSL, USGS California Water Science Center Sediment Laboratory, Santa Cruz, Calif.; GD Lab, USGS Geologic Division Laboratory, Denver, Colo.; MRL, USGS Mercury Research Laboratory, Middleton, Wisc.; NWQL, USGS National Water Quality Laboratory, Denver, Colo.; OGRL, USGS Kansas Organic Geochemistry Research Laboratory, Lawrence, Kans.; RSIL, USGS Reston Stable Isotope Laboratory, Reston, Va.; TX WSC, USGS Texas Water Science Center, Austin, Tex. **Abbreviations**: BEDSED, halogenated compounds, organic wastewater indicators, hormones, PAHs, pesticides, major and trace elements; GLY2, glyphosate by liquid chromatography tandem mass spectrometry; L, liter; MERC, total mercury and total methylmercury; mL, milliliter; N, normal; PAHs, current use pesticides, major and trace elements, radionuclides; POCIS, polar organic chemical integrative sampler; poly, polyetheylene; RTH, richest targeted habitat; >, greater than. **Container label** assigned by the National Water Quality Laboratory: FA, filtered, acidified cations; FCC, filtered, chilled nutrients; FU, filtered, unpreserved anions; OWI, organic wastewater indicators; PEST, pesticide; PHARM, pharmaceutical; RU, raw, unpreserved physical properties; WCA, whole, chilled, acidified nutrients]

Parameter group	Laboratory or schedule	Container (label)	Source	Preservation
Water samples				
BASIC				
Major ions	NWQL 2590	250-mL acid-rinsed poly bottle (FA)	Churn, capsule filter	7.5N nitric acid
		250-mL clear poly bottle (FU)	Churn, capsule filter	
			Churn, raw	
		250-mL clear poly bottle (RU)	Churn, raw	
Nutrients	NWQL 2711	125-mL white poly bottle (WCA)	Churn, raw	4.5N sulfuric acid
		125-mL brown poly bottle (FCC)	Churn, capsule filter	
Pesticides	NWQL 2437	20-mL amber glass septum vial (PEST)	Churn, syringe filter	
Supplemental pesticides	NWQL LC9045	20-mL amber glass septum vial (9045)	Churn, syringe filter	
Dissolved organic carbon and ultraviolet absorbance at 254 nanometers	MRL	(2) 40-mL amber glass septum vials	Grab, 250-mL amber glass, disc filter	
Suspended sediment (concentration only)	CSL	1-L poly wide-mouth bottle	Churn, raw	
Immunoassay (glyphosate)	TX WSC	40-mL amber glass septum vial	Churn, syringe filter	Freeze if held > week
OWI				
Organic wastewater indicators (OWI)	NWQL 4433	1-L, baked amber glass bottle (OWI)	Churn, raw	
PHARM				
Pharmaceuticals	NWQL 2440	20-mL amber glass septum vial (PHARM)	Churn, syringe filter	
GLY2				
Glyphosate	OGRL	40-mL amber glass septum vial (PEST)	Churn, syringe filter	
MERC				
Total and methylmercury, filtered water and particulate	MRL	1-L Nalgene bottle	Grab	Ultrapure hydrochloric acid
ISOTOPES				
Nitrogen and oxygen isotopes	RSIL	125-mL clear poly bottle	Churn, capsule filter	
Sediment samples				

Table 1.4. Description of the bottle types, laboratory schedules, and preservation protocols by parameter group for samples collected by the U.S. Geological Survey California Stream Quality Assessment study in 2017.—Continued

[**Laboratories**: CA OCRL, U.S. Geological Survey (USGS) California Organic Chemistry Research Laboratory, Sacramento, Calif.; CERC, USGS Columbia Environmental Research Center, Columbia, Mo.; CSL, USGS California Water Science Center Sediment Laboratory, Santa Cruz, Calif.; GD Lab, USGS Geologic Division Laboratory, Denver, Colo.; MRL, USGS Mercury Research Laboratory, Middleton, Wisc.; NWQL, USGS National Water Quality Laboratory, Denver, Colo.; OGRL, USGS Kansas Organic Geochemistry Research Laboratory, Lawrence, Kans.; RSIL, USGS Reston Stable Isotope Laboratory, Reston, Va.; TX WSC, USGS Texas Water Science Center, Austin, Tex. **Abbreviations**: BEDSED, halogenated compounds, organic wastewater indicators, hormones, PAHs, pesticides, major and trace elements; GLY2, glyphosate by liquid chromatography tandem mass spectrometry; L, liter; MERC, total mercury and total methylmercury; mL, milliliter; N, normal; PAHs, current use pesticides, major and trace elements, radionuclides; POCIS, polar organic chemical integrative sampler; poly, polyetheylene; RTH, richest targeted habitat; >, greater than. **Container label** assigned by the National Water Quality Laboratory: FA, filtered, acidified cations; FCC, filtered, chilled nutrients; FU, filtered, unpreserved anions; OWI, organic wastewater indicators; PEST, pesticide; PHARM, pharmaceutical; RU, raw, unpreserved physical properties; WCA, whole, chilled, acidified nutrients]

Parameter group	Laboratory or schedule	Container (label)	Source	Preservation
		BEDSED		
Halogenated compounds	NWQL 8093	125-mL baked amber glass wide-mouth jar	Composite sediment	
Polycyclic aromatic hydrocarbons and other semivolatile organic compounds	NWQL 5506	125-mL baked amber glass wide-mouth jar	Composite sediment	
Organic wastewater indicators (OWI)	NWQL 5433	125-mL baked amber glass wide-mouth jar	Composite sediment	
Current use pesticides	CA OCRL	125-mL baked amber glass wide-mouth jar	Composite sediment	
Major and trace elements	GD Lab	125-mL poly wide-mouth jar	Composite sediment	
Hormones	NWQL 4434	125-mL baked amber glass wide-mouth jar	Composite sediment	
Radionuclides	Gellis and others, 2017	125-mL poly wide-mouth jar	Composite sediment	
		Algae samples		
		CHL		
Periphyton biomass, chlorophyll-a	NWQL 1632	(2) glass-fiber filters (GFF)	RTH, GFF filter	Freeze
		POCIS samplers		
		POCIS		
Current use pesticides	CERC		POCIS	
Organic wastewater indicators (OWI)	CERC		POCIS	
Pharmaceuticals	CERC		POCIS	

Table 1.5. Deployment dates for Polar Organic Chemical Integrative Samplers deployed by the U.S. Geological Survey California Stream Quality Assessment in 2017.

[Begin date, date that POCIS (polar organic chemical integrative samplers) were deployed in the stream; End date, date that POCIS were retrieved from the stream; g, gram; mm/dd/yyyy, month/day/year; N/A, not applicable; No., number; NWIS, U.S. Geological Survey National Water Information System database; wt, weight]

NWIS station number	Field identifier	No. of POCIS	Sorbent wt per POCIS (g)	Begin date (mm/dd/yyyy)	End date (mm/dd/yyyy)	No. days	Sample type
383719122462501	CA_Maacama	2	0.2	04/03/2017	05/08/2017	35	Environmental
11465350	CA_DryMouth	2	0.2	04/03/2017	05/08/2017	35	Environmental
11465350	CA_DryMouth	2	0.2	04/03/2017	05/08/2017	35	Replicate
11465350	CA_DryMouth	2	0.2	04/03/2017	05/08/2017	35	Field blank
11466800	CA_MarkWMir	2	0.2	04/04/2017	05/09/2017	35	Environmental
11466320	CA_SantaWillow	2	0.2	04/05/2017	05/10/2017	35	Environmental
382619122531401	CA_Green	2	0.2	04/05/2017	05/10/2017	35	Environmental
11466170	CA_Matanzas	2	0.2	04/04/2017	05/09/2017	35	Environmental
11466200	CA_SantaSanta	2	0.2	04/06/2017	05/11/2017	35	Environmental
11465690	CA_Colgan	2	0.2	04/06/2017	05/11/2017	35	Environmental
382346122521201	CA_NoNameMonty	2	0.2	04/05/2017	05/10/2017	35	Environmental
11465660	CA_Copeland	2	0.2	04/04/2017	05/09/2017	35	Environmental
11458500	CA_SonomaAgua	2	0.2	04/03/2017	05/08/2017	35	Environmental
381740122395901	CA_Lichau	2	0.2	04/04/2017	05/09/2017	35	Environmental
381556122280201	CA_SonomaWat	2	0.2	04/03/2017	05/08/2017	35	Environmental
381519122385601	CA_Petaluma	2	0.2	04/04/2017	05/09/2017	35	Environmental
11459500	CA_Novato	2	0.2	04/05/2017	05/10/2017	35	Environmental
11459500	CA_Novato	2	0.2	04/05/2017	05/10/2017	35	Replicate
11459500	CA_Novato	2	0.2	04/05/2017	05/10/2017	35	Field blank
380410122315501	CA_ArroyoDig	2	0.2	04/05/2017	05/10/2017	35	Environmental
380345122345201	CA_ArroyoNov	2	0.2	04/03/2017	05/08/2017	35	Environmental
11460000	CA_Corte	2	0.2	04/06/2017	05/11/2017	35	Environmental
383321122302101	CA_NapaBale	2	0.2	04/04/2017	05/09/2017	35	Environmental
383305122311901	CA_Ritchey	2	0.2	04/03/2017	05/08/2017	35	Environmental
383109122363301	CA_MarkWTar	2	0.2	04/03/2017	05/08/2017	35	Environmental
382634122315201	CA_SonomaAdobe	2	0.2	04/03/2017	05/08/2017	35	Environmental
382245122001601	CA_Ulatis	2	0.2	04/03/2017	05/08/2017	35	Environmental
11456500	CA_ConnOak	2	0.2	04/04/2017	05/09/2017	35	Environmental
382017122161101	CA_Milliken	2	0.2	04/06/2017	05/11/2017	35	Environmental
11458300	CA_NapaNapa	2	0.2	04/05/2017	05/10/2017	35	Environmental
11458300	CA_NapaNapa	2	0.2	04/05/2017	05/10/2017	35	Replicate
11458300	CA_NapaNapa	2	0.2	04/05/2017	05/10/2017	35	Field blank
381441122064301	CA_Suisan	2	0.2	04/06/2017	05/11/2017	35	Environmental
11182400	CA_ArroyoMart	2	0.2	04/05/2017	05/10/2017	35	Environmental
375819122035801	CA_Grayson	2	0.2	04/06/2017	05/11/2017	35	Environmental
375819122035801	CA_Grayson	2	0.2	04/06/2017	05/11/2017	35	Replicate
375819122035801	CA_Grayson	2	0.2	04/06/2017	05/11/2017	35	Field blank
375808122172601	CA_Wilkie	2	0.2	04/03/2017	05/08/2017	35	Environmental
375746122195501	CA_SanPabloPort	2	0.2	04/03/2017	05/08/2017	35	Environmental
375701121564401	CA_MtDiablo	2	0.2	04/06/2017	05/11/2017	35	Environmental

Table 1.5. Deployment dates for Polar Organic Chemical Integrative Samplers deployed by the U.S. Geological Survey California Stream Quality Assessment in 2017.—Continued

[Begin date, date that POCIS (polar organic chemical integrative samplers) were deployed in the stream; End date, date that POCIS were retrieved from the stream; g, gram; mm/dd/yyyy, month/day/year; N/A, not applicable; No., number; NWIS, U.S. Geological Survey National Water Information System database; wt, weight]

NWIS station number	Field identifier	No. of POCIS	Sorbent wt per POCIS (g)	Begin date (mm/dd/yyyy)	End date (mm/dd/yyyy)	No. days	Sample type
375257122050001	CA_LasTrampas	2	0.2	04/04/2017	05/10/2017	36	Environmental
374933122001301	CA_SanRamonDan	2	0.2	04/05/2017	05/10/2017	35	Environmental
11182500	Ca_SanRamonSan	2	0.2	04/05/2017	05/10/2017	35	Environmental
374708122132801	CA_Sausal	2	0.2	04/06/2017	05/11/2017	35	Environmental
374336122095801	CA_SanLeandro	2	0.2	04/06/2017	05/11/2017	35	Environmental
11180900	CA_Crow	2	0.2	04/05/2017	05/10/2017	35	Environmental
11181008	CA_Castro	2	0.2	04/03/2017	05/08/2017	35	Environmental
11164500	CA_SanFranStan	2	0.2	03/16/2017	04/20/2017	35	Environmental
372500122081201	CA_Matadero	2	0.2	03/16/2017	04/20/2017	35	Environmental
11176900	CA_ArroyoDeLaLa	2	0.2	03/14/2017	04/17/2017	34	Environmental
11176900	CA_ArroyoDeLaLa	2	0.2	03/14/2017	04/17/2017	34	Replicate
11169025	CA_GuadalupeA	2	0.2	03/13/2017	04/17/2017	35	Environmental
11169025	CA_GuadalupeA	2	0.2	03/13/2017	04/17/2017	35	Replicate
11169025	CA_GuadalupeA	2	0.2	03/13/2017	04/17/2017	35	Field blank
371738121555901	CA_LosGatos	2	0.2	03/15/2017	04/19/2017	35	Environmental
371554121474101	CA_CoyoteCoyote	2	0.2	03/14/2017	04/18/2017	35	Environmental
371554121474101	CA_CoyoteCoyote	2	0.2	03/14/2017	04/18/2017	35	Replicate
371620122005801	CA_Saratoga	2	0.2	03/15/2017	04/19/2017	35	Environmental
370512121361901	CA_LlagasMartin	2	0.2	03/13/2017	04/17/2017	35	Environmental
11169800	CA_CoyoteGil	2	0.2	03/13/2017	04/18/2017	36	Environmental
11153470	CA_LlagasMorgan	2	0.2	03/13/2017	04/17/2017	35	Environmental
11153650	CA_LlagasGilroy	2	0.2	03/14/2017	04/18/2017	35	Environmental
11159500	CA_PajaroWat	2	0.2	03/15/2017	04/19/2017	35	Environmental
11152600	CA_GabilanSal	2	0.2	03/15/2017	04/19/2017	35	Environmental
365634121264001	CA_Tequisquita	2	0.2	03/16/2017	04/20/2017	35	Environmental
365634121264001	CA_Tequisquita	2	0.2	03/16/2017	04/20/2017	35	Field blank
11152650	CA_Reclamation	2	0.2	03/13/2017	04/17/2017	35	Environmental
364155121363901	CA_Natividad	2	0.2	03/15/2017	04/19/2017	35	Environmental
364138121373701	CA_GabilanEastL	1	0.2	03/15/2017	04/19/2017	35	Environmental
363608121255201	CA_ChuChuChu	2	0.2	03/13/2017	04/18/2017	36	Environmental
11148900	CA_NaciBryson	2	0.2	03/13/2017	04/20/2017	38	Environmental
352934120395501	CA_Atascadero	2	0.2	03/16/2017	04/20/2017	35	Environmental
352127120484501	CA_Chorro	2	0.2	03/15/2017	04/19/2017	35	Environmental
351725120395901	CA_Stenner	2	0.2	03/15/2017	04/17/2017	33	Environmental
11141280	CA_Lopez	2	0.2	03/13/2017	04/18/2017	36	Environmental
11135250	CA_SantaYnezLom	2	0.2	03/14/2017	04/18/2017	35	Environmental
11128500	CA_SntaYnezSol	2	0.2	03/13/2017	04/17/2017	35	Environmental
3854430921636	POCIS Spike 1	2	0.2	N/A	N/A	N/A	Spike
3854430921636	POCIS Spike 2	2	0.2	N/A	N/A	N/A	Spike
3854430921636	POCIS Spike 3	2	0.2	N/A	N/A	N/A	Spike

Table 1.6. Deployment dates for ceramic tiles used to collect biofilms for pesticide analysis as part of the U.S. Geological Survey California Stream Quality Assessment study in 2017.

[Begin date, date that tiles were deployed in the stream; End date, date that tiles were retrieved from the stream; mm/dd/yyyy, month/day/year; No., number; NWIS, U.S. Geological Survey National Water Information System database]

NWIS station number	Field identifier	Begin date (mm/dd/yyyy)	End date (mm/dd/yyyy)	No. of days deployed
382035121575501	CA_Alamo	03/08/2017	05/11/2017	64
11176900	CA_ArroyoDeLaLa	03/07/2017	05/17/2017	71
380410122315501	CA_ArroyoDig	03/08/2017	05/11/2017	64
11182400	CA_ArroyoMart	03/07/2017	05/15/2017	69
380345122345201	CA_ArroyoNov	03/08/2017	05/10/2017	63
11152000	CA_ArroyoSeco	03/04/2017	05/06/2017	63
352934120395501	CA_Atascadero	02/11/2017	05/07/2017	85
363608121255201	CA_ChuChuChu	02/12/2017	05/05/2017	82
11465690	CA_Colgan	03/09/2017	05/12/2017	64
11456500	CA_ConnOak	03/09/2017	05/14/2017	66
11465660	CA_Copeland	03/09/2017	05/12/2017	64
11159200	CA_Corralitos	03/03/2017	05/06/2017	64
11460000	CA_Corte	03/08/2017	05/11/2017	64
371554121474101	CA_CoyoteCoyote	02/14/2017	05/10/2017	85
364138121373701	CA_GabilanEastL	02/12/2017	05/03/2017	80
382619122531401	CA_Green	03/09/2017	05/13/2017	65
375257122050001	CA_LasTrampas	03/07/2017	05/16/2017	70
381740122395901	CA_Lichau	03/08/2017	05/09/2017	62
11153650	CA_LlagasGilroy	03/06/2017	05/07/2017	62
11141280	CA_Lopez	02/11/2017	05/10/2017	88
371738121555901	CA_LosGatos	02/14/2017	05/04/2017	79
383719122462501	CA_Maacama	03/09/2017	05/10/2017	62
383109122363301	CA_MarkWTar	03/09/2017	05/10/2017	62
372500122081201	CA_Matadero	02/14/2017	05/02/2017	77
11466170	CA_Matanzas	03/10/2017	05/16/2017	67
382017122161101	CA_Milliken	03/08/2017	05/12/2017	65
375701121564401	CA_MtDiablo	03/07/2017	05/15/2017	69
11148900	CA_NaciBryson	03/04/2017	05/08/2017	65
383321122302101	CA_NapaBale	03/09/2017	05/15/2017	67
11458300	CA_NapaNapa	03/08/2017	05/12/2017	65
364155121363901	CA_Natividad	02/12/2017	05/03/2017	80
382346122521201	CA_NoNameMonty	03/09/2017	05/13/2017	65
11459500	CA_Novato	03/08/2017	05/10/2017	63
365736121250801	CA_Pacheco	02/13/2017	05/05/2017	81
11152650	CA_Reclamation	03/05/2017	05/04/2017	60
383305122311901	CA_Ritchey	03/09/2017	05/15/2017	67
351436120405201	CA_SanLObispo	02/10/2017	05/09/2017	88
375220122104201	CA_SanPabloCam	03/07/2017	05/17/2017	71
375312122113501	CA_SanPabloOr	03/07/2017	05/14/2017	68
374933122001301	CA_SanRamonDan	03/07/2017	05/13/2017	67
11182500	CA_SanRamonSan	03/07/2017	05/13/2017	67

Table 1.6. Deployment dates for ceramic tiles used to collect biofilms for pesticide analysis as part of the U.S. Geological Survey California Stream Quality Assessment study in 2017.—Continued

[Begin date, date that tiles were deployed in the stream; End date, date that tiles were retrieved from the stream; mm/dd/yyyy, month/day/year; No., number; NWIS, U.S. Geological Survey National Water Information System database]

NWIS station number	Field identifier	Begin date (mm/dd/yyyy)	End date (mm/dd/yyyy)	No. of days deployed
11466200	CA_SantaSanta	03/10/2017	05/16/2017	67
11466320	CA_SantaWillow	03/10/2017	05/11/2017	62
11135250	CA_SantaYnezLom	02/10/2017	05/11/2017	90
371620122005801	CA_Saratoga	02/14/2017	05/03/2017	78
374708122132801	CA_Sausal	03/08/2017	05/12/2017	65
382634122315201	CA_SonomaAdobe	03/09/2017	05/17/2017	69
381441122064301	CA_Suisan	03/08/2017	05/12/2017	65
365634121264001	CA_Tequisquita	02/13/2017	05/05/2017	81
382245122001601	CA_Ulatis	03/08/2017	05/11/2017	64
365955121350601	CA_UvasMiller	02/13/2017	05/07/2017	83
375413122033301	CA_Walnut	03/07/2017	05/16/2017	70
375808122172601	CA_Wilkie	03/07/2017	05/13/2017	67
383039122502401	CA_Windsor	03/10/2017	05/11/2017	62

Appendix 2 Description of the U.S. Geological Survey National Water Quality Laboratory Schedules Used for Water, Bed Sediment, and Biofilms

Table 2.1. U.S. Geological Survey National Water Quality Laboratory Schedule 2590 for major ions in water.

[CAS, Chemical Abstracts Service[1]; IC, ion chromatography; ICP/AES, inductively coupled plasma/atomic emission spectroscopy; ltmdl, long-term method detection limit; mg/L, milligram per liter; mrl, minimum reporting level; NWIS, USGS National Water Information System; NWQL, U.S. Geological Survey (USGS) National Water Quality Laboratory; —, no data; µS/cm, microsiemens per centimeter at 25 degrees Celsius]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type	Method citation	Method
Calcium	659	00915	PLA11	7440-70-2	0.022	mg/L	ltmdl	Fishman (1993)	ICP/AES
Chloride	1571	00940	IC022	16887-00-6	0.02	mg/L	ltmdl	Fishman and Friedman (1989)	IC
Magnesium	663	00925	PLA11	7439-95-4	0.011	mg/L	ltmdl	Fishman (1993)	ICP/AES
Potassium	2773	00935	PLO03	7440-09-7	0.03	mg/L	ltmdl	Fishman (1993)	ICP/AES
Sodium	675	00930	PLA11	7440-23-5	0.06	mg/L	ltmdl	Fishman (1993)	ICP/AES
Specific conductance, laboratory	69	90095	WHT03	—	5	µS/cm	mrl	Fishman and Friedman (1989)	Wheatstone Bridge
Sulfate	1572	00945	IC022	14808-79-8	0.02	mg/L	ltmdl	Fishman and Friedman (1989)	IC

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.2. U.S. Geological Survey National Water Quality Laboratory Schedule 2711 for nutrients in water.

[CAS, Chemical Abstracts Service[1]; EPA, U.S. Environmental Protection Agency; ltmdl, long-term method detection limit; mdl, method detection limit; mg/L, milligram per liter; N, nitrogen; NWIS, USGS National Water Information System; NWQL, U.S. Geological Survey (USGS) National Water Quality Laboratory; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type	Method citation	Method
Nitrogen, ammonia as N	3116	00608	00048	7664-41-7	0.01	mg/L	ltmdl	Fishman (1993)	Colorimetry
Nitrogen, nitrite	3117	00613	00049	14797-65-0	0.001	mg/L	mdl	Fishman (1993)	Colorimetry
Nitrogen, nitrite + nitrate	3156	00631	RED01	—	0.04	mg/L	mdl	Patton and Kryskalla (2003, 2011)	Colorimetry, enzyme reduction, low level
Phosphorus	2333	00665	CL021	7723-14-0	0.004	mg/L	ltmdl	O'Dell (1993)	EPA 365.1
Phosphorus, phosphate, ortho	3118	00671	00048	14265-44-2	0.004	mg/L	ltmdl	Fishman (1993)	Colorimetry
Total nitrogen (ammonia+nitrite+nitrate+organic), unfiltered	2756	62855	AKP01	17778-88-0	0.05	mg/L	ltmdl	Patton and Kryskalla (2003, 2011)	Colorimetry

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
1H-1,2,4-Triazole	68498	LCM60	288-88-0	22	ng/L	RLDQC
2,3,3-Trichloro-2-propene-1-sulfonic acid (TCPSA)	68691	LCM60	65600-62-6	55	ng/L	RLDQC
2,4-D	68500	LCM60	94-75-7	62	ng/L	RLDQC
2,4-D-d3, surrogate, water,filtered, percent recovery (surrogate)	91986	LCM60	202480-67-9	N/A	pct	N/A
2-(1-Hydroxyethyl)-6-methylaniline	68611	LCM60	196611-19-5	54	ng/L	RLDQC
2-[(2-Ethyl-6-methylphenyl)amino]-1-propanol	68595	LCM60	61520-53-4	5	ng/L	RLDQC
2-Amino-N-isopropylbenzamide	68503	LCM60	30391-89-0	4	ng/L	RLDQC
2-Aminobenzimidazole	68502	LCM60	934-32-7	9	ng/L	RLDQC
2-Chloro-2’,6’-diethylacetanilide	68525	LCM60	6967-29-9	5	ng/L	RLDQC
2-Chloro-4,6-diamino-s-triazine {CAAT} (Didealkylatrazine)	68547	LCM60	3397-62-4	24	ng/L	RLDQC
2-Chloro-4-isopropylamino-6-amino-s-triazine	68552	LCM60	6190-65-4	11	ng/L	RLDQC
2-Chloro-6-ethylamino-4-amino-s-triazine {CEAT}	68550	LCM60	1007-28-9	20	ng/L	RLDQC
2-Chloro-N-(2-ethyl-6-methylphenyl)acetamide	68521	LCM60	32428-71-0	5	ng/L	RLDQC
2-Hydroxy-4-isopropylamino-6-amino-s-triazine	68659	LCM60	19988-24-0	4	ng/L	RLDQC
2-Hydroxy-4-isopropylamino-6-ethylamino-s-triazine {OIET}	68660	LCM60	2163-68-0	8	ng/L	RLDQC
2-Hydroxy-6-ethylamino-4-amino-s-triazine	68656	LCM60	7313-54-4	100	ng/L	RLDQC
2-Isopropyl-6-methyl-4-pyrimidinol	68505	LCM60	2814-20-2	8	ng/L	RLDQC
3,4-Dichlorophenylurea	68226	LCM60	2327-02-8	108	ng/L	RLDQC
3-Hydroxycarbofuran	68508	LCM60	16655-82-6	16	ng/L	RLDQC
3-Phenoxybenzoic acid	68873	LCM60	3739-38-6	61	ng/L	RLDQC
3-Phenoxybenzoic acid-13C6 (surrogate)	90516	LCM60	—	N/A	pct	N/A
4-(Hydroxymethyl)pendimethalin	68511	LCM60	56750-76-6	114	ng/L	RLDQC
4-Chlorobenzylmethyl sulfoxide	68514	LCM60	24176-68-9	3.2	ng/L	RLDQC
4-Hydroxy molinate	68515	LCM60	66747-12-4	7	ng/L	RLDQC
4-Hydroxychlorothalonil	68336	LCM60	28343-61-5	98	ng/L	RLDQC
4-Hydroxyhexazinone A	68517	LCM60	72576-13-7	3	ng/L	RLDQC
Acephate	68519	LCM60	30560-19-1	10	ng/L	RLDQC
Acetochlor	68520	LCM60	34256-82-1	10	ng/L	RLDQC
Acetochlor oxanilic acid	68522	LCM60	194992-44-4	65	ng/L	RLDQC
Acetochlor sulfonic acid	68523	LCM60	187022-11-3	320	ng/L	RLDQC
Acetochlor sulfynilacetic acid	68524	LCM60	618113-86-3	176	ng/L	RLDQC
Acetochlor-d11 (surrogate)	90517	LCM60	1189897-44-6	N/A	pct	N/A
Alachlor	65064	LCM60	15972-60-8	27	ng/L	RLDQC
Alachlor oxanilic acid	68526	LCM60	171262-17-2	60	ng/L	RLDQC
Alachlor sulfonic acid	68871	LCM60	142363-53-9	360	ng/L	RLDQC
Alachlor sulfynilacetic acid	68527	LCM60	494847-39-1	128	ng/L	RLDQC
Alachlor-d13 (surrogate)	90518	LCM60	1015856-63-9	N/A	pct	N/A
Aldicarb	68528	LCM60	116-06-3	8	ng/L	RLDQC
Aldicarb sulfone	68529	LCM60	1646-88-4	20	ng/L	RLDQC

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.—Continued

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Aldicarb sulfoxide	68530	LCM60	1646-87-3	2.2	ng/L	RLDQC
Ametryn	68533	LCM60	834-12-8	2.6	ng/L	RLDQC
Asulam	68536	LCM60	3337-71-1	50	ng/L	RLDQC
Atrazine	65065	LCM60	1912-24-9	6.8	ng/L	RLDQC
Azinphos-methyl	65066	LCM60	86-50-0	8	ng/L	RLDQC
Azinphos-methyl oxon	68211	LCM60	961-22-8	15	ng/L	RLDQC
Azoxystrobin	66589	LCM60	131860-33-8	3	ng/L	RLDQC
Bentazon	68538	LCM60	25057-89-0	9	ng/L	RLDQC
Bifenthrin	65067	LCM60	82657-04-3	19	ng/L	RLDQC
Bromacil	68542	LCM60	314-40-9	5.6	ng/L	RLDQC
Bromoxynil	68543	LCM60	1689-84-5	60	ng/L	RLDQC
Butachlor sulfonic acid (surrogate)	90624	LCM60	187022-12-4	N/A	pct	N/A
Butralin	68545	LCM60	33629-47-9	5	ng/L	RLDQC
Butylate	65068	LCM60	2008-41-5	10	ng/L	RLDQC
Carbaryl	65069	LCM60	63-25-2	5.6	ng/L	RLDQC
Carbaryl-d7 (surrogate)	90519	LCM60	362049-56-7	N/A	pct	N/A
Carbendazim	68548	LCM60	10605-21-7	10	ng/L	RLDQC
Carbendazim-d4 (surrogate)	90520	LCM60	291765-95-2	N/A	pct	N/A
Carbofuran	65070	LCM60	1563-66-2	5	ng/L	RLDQC
Carbofuran-d3 (surrogate)	90521	LCM60	1007459-98-4	N/A	pct	N/A
Carboxy molinate	68549	LCM60	66747-13-5	54	ng/L	RLDQC
Chlorimuron-ethyl	68872	LCM60	90982-32-4	8.8	ng/L	RLDQC
Chlorosulfonamide acid	68551	LCM60	—	60	ng/L	RLDQC
Chlorpyrifos	65072	LCM60	2921-88-2	3	ng/L	RLDQC
Chlorpyrifos oxon	68216	LCM60	—	4.4	ng/L	RLDQC
Chlorsulfuron	61678	LCM60	64902-72-3	50	ng/L	RLDQC
cis-Bifenthrin acid/cis-Cyhalothrin acid/cis-Tefluthrin acid	68553	LCM60	68127-59-3	105	ng/L	RLDQC
cis-Permethrin	68769	LCM60	61949-76-6	4.2	ng/L	RLDQC
cis-Permethrin-13C6 (surrogate)	90558	LCM60	—	N/A	pct	N/A
Cyanazine	66592	LCM60	21725-46-2	50	ng/L	RLDQC
Dacthal monoacid	68560	LCM60	887-54-7	2700	ng/L	RLDQC
Dechlorofipronil	68561	LCM60	—	3.8	ng/L	RLDQC
Dechlorometolachlor	68562	LCM60	126605-22-9	2	ng/L	RLDQC
Deethylatrazine-d6 (surrogate)	90522	LCM60	—	N/A	pct	N/A
Deiodo flubendiamide	68563	LCM60	1016160-78-3	10	ng/L	RLDQC
Deisopropyl prometryn	68564	LCM60	4147-57-3	2.8	ng/L	RLDQC
Demethyl fluometuron	68591	LCM60	3032-40-4	3.6	ng/L	RLDQC
Demethyl hexazinone B	68566	LCM60	56611-54-2	3	ng/L	RLDQC
Demethyl norflurazon	68567	LCM60	23576-24-1	4	ng/L	RLDQC

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.—Continued

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Desamino metribuzin	68568	LCM60	35045-02-4	9	ng/L	RLDQC
Desamino-diketo metribuzin	68569	LCM60	52236-30-3	200	ng/L	RLDQC
Desulfinylfipronil	66607	LCM60	205650-65-3	3.8	ng/L	RLDQC
Desulfinylfipronil amide	68570	LCM60	1115248-09-3	10	ng/L	RLDQC
Diazinon	65078	LCM60	333-41-5	2.8	ng/L	RLDQC
Diazinon oxon	68236	LCM60	—	4	ng/L	RLDQC
Diazinon-d10 (surrogate)	90523	LCM60	100155-47-3	N/A	pct	N/A
Dicamba	68571	LCM60	1918-00-9	800	ng/L	RLDQC
Dichlorvos	68572	LCM60	—	52	ng/L	RLDQC
Dicrotophos	68573	LCM60	141-66-2	4	ng/L	RLDQC
Didemethyl hexazinone F	68574	LCM60	56611-54-2	10	ng/L	RLDQC
Diflubenzuron	68576	LCM60	35367-38-5	6	ng/L	RLDQC
Diflubenzuron-d4 (surrogate)	90524	LCM60	1219795-45-5	N/A	pct	N/A
Diflufenzopyr	68577	LCM60	109293-97-2	72	ng/L	RLDQC
Diketonitrile-isoxaflutole	68578	LCM60	143701-75-1	24	ng/L	RLDQC
Dimethachlor sulfonic acid (surrogate)	90625	LCM60	—	N/A	pct	N/A
Dimethenamid	68580	LCM60	87674-68-8	3	ng/L	RLDQC
Dimethenamid oxanilic acid	68581	LCM60	380412-59-9	85	ng/L	RLDQC
Dimethenamid SAA	68583	LCM60	—	189	ng/L	RLDQC
Dimethenamid sulfonic acid	68582	LCM60	205939-58-8	79	ng/L	RLDQC
Dimethoate	66596	LCM60	60-51-5	4.6	ng/L	RLDQC
Disulfoton	67595	LCM60	298-04-4	11	ng/L	RLDQC
Disulfoton oxon	68586	LCM60	126-75-0	2	ng/L	RLDQC
Disulfoton oxon sulfone	68588	LCM60	2496-91-5	6	ng/L	RLDQC
Disulfoton oxon sulfoxide	68587	LCM60	2496-92-6	6	ng/L	RLDQC
Disulfoton sulfone	68589	LCM60	2497-06-5	9	ng/L	RLDQC
Disulfoton sulfoxide	68590	LCM60	2497-07-6	4	ng/L	RLDQC
Diuron	66598	LCM60	330-54-1	5	ng/L	RLDQC
Diuron-d6 (surrogate)	90808	LCM60	—	N/A	pct	N/A
Diuron-d6 (surrogate)	N/A		—	N/A	pct	N/A
EPTC	65080	LCM60	759-94-4	206	ng/L	RLDQC
EPTC degradate R248722	68594	LCM60	65109-69-5	4	ng/L	RLDQC
Ethoprophos	68596	LCM60	13194-48-4	5	ng/L	RLDQC
Etoxazole	68598	LCM60	153233-91-1	4.2	ng/L	RLDQC
Fenamiphos	68599	LCM60	22224-92-6	4.6	ng/L	RLDQC
Fenamiphos sulfone	68600	LCM60	31972-44-8	5	ng/L	RLDQC
Fenamiphos sulfoxide	68601	LCM60	31972-43-7	5	ng/L	RLDQC
Fenbutatin oxide	68602	LCM60	13356-08-6	120	ng/L	MRL
Fentin	68603	LCM60	668-34-8	30	ng/L	RLDQC

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.—Continued

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Fipronil	66604	LCM60	120068-37-3	4	ng/L	RLDQC
Fipronil amide	68604	LCM60	205650-69-7	9.2	ng/L	RLDQC
Fipronil sulfide	66610	LCM60	120067-83-6	4.2	ng/L	RLDQC
Fipronil sulfonate	68605	LCM60	209248-72-6	96	ng/L	RLDQC
Fipronil sulfone	66613	LCM60	120068-36-2	5.6	ng/L	RLDQC
Flubendiamide	68606	LCM60	272451-65-7	4.4	ng/L	RLDQC
Flumetsulam	61679	LCM60	98967-40-9	17	ng/L	RLDQC
Fluometuron	68608	LCM60	2164-17-2	10	ng/L	RLDQC
Fonofos	65084	LCM60	944-22-9	11	ng/L	RLDQC
Halosulfuron-methyl	61680	LCM60	100784-20-1	12	ng/L	RLDQC
Hexazinone	65085	LCM60	51235-04-2	3.6	ng/L	RLDQC
Hexazinone Transformation Product C	68612	LCM60	72585-88-7	2	ng/L	RLDQC
Hexazinone Transformation Product D	68613	LCM60	30243-77-7	294	ng/L	RLDQC
Hexazinone Transformation Product E	68614	LCM60	72576-14-8	76	ng/L	RLDQC
Hexazinone Transformation Product G	68713	LCM60	—	22	ng/L	RLDQC
Hexazinone-d6 (surrogate)	90527	LCM60	1219804-22-4	N/A	pct	N/A
Hydroxy didemethyl fluometuron	68619	LCM60	—	50	ng/L	RLDQC
Hydroxy monodemethyl fluometuron	68617	LCM60	—	12	ng/L	RLDQC
Hydroxyacetochlor	68615	LCM60	60090-47-3	20	ng/L	RLDQC
Hydroxyalachlor	68616	LCM60	56681-55-1	6	ng/L	RLDQC
Hydroxydiazinon	68618	LCM60	29820-16-4	11	ng/L	RLDQC
Hydroxyfluometuron	68620	LCM60	—	56	ng/L	RLDQC
Hydroxymetolachlor	68622	LCM60	131068-72-9	2.4	ng/L	RLDQC
Hydroxyphthalazinone	68623	LCM60	—	28	ng/L	RLDQC
Hydroxysimazine	68624	LCM60	2599-11-3	120	ng/L	RLDQC
Imazamox	68625	LCM60	114311-32-9	30	ng/L	RLDQC
Imazaquin	61682	LCM60	81335-37-7	18	ng/L	RLDQC
Imazethapyr	61683	LCM60	81335-77-5	8	ng/L	RLDQC
Imidacloprid	68426	LCM60	138261-41-3	16	ng/L	RLDQC
Indoxacarb	68627	LCM60	173584-44-6	5.2	ng/L	RLDQC
Isoxaflutole	68632	LCM60	141112-29-0	18	ng/L	RLDQC
Isoxaflutole acid metabolite RPA 203328	68633	LCM60	142994-06-7	9.2	ng/L	RLDQC
Kresoxim-methyl	67670	LCM60	143390-89-0	5	ng/L	RLDQC
Lactofen	68638	LCM60	77501-63-4	10	ng/L	RLDQC
Linuron	68639	LCM60	330-55-2	5.6	ng/L	RLDQC
Linuron-d6 (dimethyl-d6) (surrogate)	90529	LCM60	1219804-76-8	N/A	pct	N/A
Linuron-d6 (dimethyl-d6) (surrogate)	N/A		1219804-76-8	N/A	pct	N/A
Malaoxon	68240	LCM60	1634-78-2	2.4	ng/L	RLDQC
Malathion	65087	LCM60	121-75-5	5.4	ng/L	RLDQC

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.—Continued

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Malathion-d10 (diethyl-d10) (surrogate)	90552	LCM60	347841-48-9	N/A	pct	N/A
MCPA	68641	LCM60	94-74-6	95	ng/L	RLDQC
Metalaxyl	68437	LCM60	57837-19-1	6	ng/L	RLDQC
Metconazole	66620	LCM60	125116-23-6	5	ng/L	RLDQC
Methamidophos	68644	LCM60	10265-92-6	10	ng/L	RLDQC
Methidathion	65088	LCM60	950-37-8	8.4	ng/L	RLDQC
Methomyl	68645	LCM60	16752-77-5	3	ng/L	RLDQC
Methomyl oxime	68646	LCM60	13749-94-5	8,000	ng/L	RLDQC
Methoxyfenozide	68647	LCM60	161050-58-4	2.2	ng/L	RLDQC
Methyl paraoxon	68648	LCM60	950-35-6	19	ng/L	RLDQC
Metolachlor	65090	LCM60	51218-45-2	3.2	ng/L	RLDQC
Metolachlor hydroxy morpholinone	68649	LCM60	61520-54-5	10	ng/L	RLDQC
Metolachlor oxanilic acid	68650	LCM60	152019-73-3	149	ng/L	RLDQC
Metolachlor sulfonic acid	68651	LCM60	171118-09-5	68	ng/L	RLDQC
Metolachlor-d6 (propyl-d6) (surrogate)	90553	LCM60	1219803-97-0	N/A	pct	N/A
Metribuzin	68652	LCM60	21087-64-9	20	ng/L	RLDQC
Metribuzin DK	68653	LCM60	56507-37-0	236	ng/L	RLDQC
Molinate	65091	LCM60	2212-67-1	28	ng/L	RLDQC
Myclobutanil	66632	LCM60	88671-89-0	7	ng/L	RLDQC
N-(3,4-Dichlorophenyl)-N’-methylurea	68231	LCM60	3567-62-2	5	ng/L	RLDQC
Naled	68654	LCM60	300-76-5	56	ng/L	RLDQC
Nicosulfuron	61685	LCM60	111991-09-4	12	ng/L	RLDQC
Nicosulfuron-d6 (surrogate)	90554	LCM60	1189419-41-7	N/A	pct	N/A
Norflurazon	67685	LCM60	27314-13-2	3.4	ng/L	RLDQC
Novaluron	68655	LCM60	116714-46-6	50	ng/L	RLDQC
O-Ethyl-O-methyl-S-propylphosphorothioate	68597	LCM60	76960-87-7	5	ng/L	RLDQC
O-Ethyl-S-methyl S-propyl phosphorodithioate	68657	LCM60	76936-72-6	3	ng/L	RLDQC
O-Ethyl-S-propyl phosphorothioate	68658	LCM60	31110-62-0	64	ng/L	RLDQC
Omethoate (Dimethoate oxon)	68661	LCM60	1113-02-6	2	ng/L	RLDQC
Orthosulfamuron	68662	LCM60	213464-77-8	6	ng/L	RLDQC
Oryzalin	68663	LCM60	19044-88-3	12	ng/L	RLDQC
Oxamyl	68664	LCM60	23135-22-0	2	ng/L	RLDQC
Oxamyl oxime	68665	LCM60	30558-43-1	5	ng/L	RLDQC
Oxyfluorfen	65093	LCM60	42874-03-3	500	ng/L	RLDQC
Paraoxon	68666	LCM60	311-45-5	3.4	ng/L	RLDQC
Pendimethalin	65098	LCM60	40487-42-1	10	ng/L	RLDQC
Phorate	68668	LCM60	298-02-2	11	ng/L	RLDQC
Phorate oxon	68669	LCM60	2600-69-3	55	ng/L	RLDQC
Phorate oxon sulfone	68670	LCM60	2588-06-9	20	ng/L	RLDQC

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.—Continued

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Phorate oxon sulfoxide	68671	LCM60	2588-05-8	7	ng/L	RLDQC
Phorate sulfone	68672	LCM60	2588-04-7	36	ng/L	RLDQC
Phorate sulfoxide	68673	LCM60	2588-03-6	4.6	ng/L	RLDQC
Phthalazinone	68675	LCM60	90004-07-2	15	ng/L	RLDQC
Piperonyl butoxide	65102	LCM60	51-03-6	60	ng/L	RLDQC
Profenofos	68676	LCM60	41198-08-7	3	ng/L	RLDQC
Prometon	67702	LCM60	1610-18-0	4	ng/L	RLDQC
Prometryn	65103	LCM60	7287-19-6	4.2	ng/L	RLDQC
Propanil	66641	LCM60	709-98-8	12	ng/L	RLDQC
Propargite	68677	LCM60	2312-35-8	2	ng/L	RLDQC
Propazine	68678	LCM60	139-40-2	3.2	ng/L	RLDQC
Propiconazole	66643	LCM60	60207-90-1	6	ng/L	RLDQC
Propoxur	68679	LCM60	114-26-1	3.2	ng/L	RLDQC
Propyzamide	67706	LCM60	23950-58-5	2.4	ng/L	RLDQC
Prosulfuron	61687	LCM60	94125-34-5	10	ng/L	RLDQC
Pyraclostrobin	66646	LCM60	175013-18-0	2.4	ng/L	RLDQC
Pyridaben	68682	LCM60	96489-71-3	2.4	ng/L	RLDQC
Pyriproxyfen	68683	LCM60	95737-68-1	3	ng/L	RLDQC
sec-Acetochlor oxanilic acid	68684	LCM60	152019-74-4	55	ng/L	RLDQC
sec-Alachlor oxanilic acid	68685	LCM60	628324-79-8	110	ng/L	RLDQC
Siduron	68686	LCM60	1982-49-6	5	ng/L	RLDQC
Simazine	65105	LCM60	122-34-9	7.2	ng/L	RLDQC
Sulfentrazone	68687	LCM60	122836-35-5	18	ng/L	RLDQC
Sulfometuron-methyl	68688	LCM60	74222-97-2	4	ng/L	RLDQC
Sulfosulfuron	68689	LCM60	141776-32-1	11	ng/L	RLDQC
Sulfosulfuron ethyl sulfone	68690	LCM60	—	2.8	ng/L	RLDQC
Tebuconazole	66649	LCM60	107534-96-3	15	ng/L	RLDQC
Tebuconazole-d6 (surrogate)	90555	LCM60	—	N/A	pct	N/A
Tebufenozide	68692	LCM60	112410-23-8	2	ng/L	RLDQC
Tebupirimfos oxon	68694	LCM60	—	2	ng/L	RLDQC
Tebupirimphos	68693	LCM60	96182-53-5	2	ng/L	RLDQC
Tebuthiuron	68695	LCM60	34014-18-1	3	ng/L	RLDQC
Tebuthiuron TP 104	68575	LCM60	59962-53-7	5.6	ng/L	RLDQC
Tebuthiuron TP 109	68621	LCM60	59962-54-8	11	ng/L	RLDQC
Tebuthiuron TP 109 (OH)	68697	LCM60	139888-73-6	38	ng/L	RLDQC
Tebuthiuron TP el108	68696	LCM60	39222-73-6	10	ng/L	RLDQC
Tebuthiuron Transformation Product 106	68714	LCM60	16279-27-9	32	ng/L	RLDQC
Terbacil	68698	LCM60	5902-51-2	21	ng/L	RLDQC
Terbufos	68699	LCM60	13071-79-9	6.8	ng/L	RLDQC

Table 2.3.1. U.S. Geological National Water Quality Laboratory Schedule 2437 for current-use pesticides in filtered water.—Continued

[Methods are described in Sandstrom and others (2016). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RLDQC, reporting level based on DQCALC software and procedure, as described in NWQL Technical Memorandum 15.02; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Terbufos oxon	68700	LCM60	56070-14-5	4	ng/L	RLDQC
Terbufos oxon sulfone	68701	LCM60	56070-15-6	11	ng/L	RLDQC
Terbufos oxon sulfoxide	68702	LCM60	56165-57-2	4	ng/L	RLDQC
Terbufos sulfone	68703	LCM60	56070-16-7	11	ng/L	RLDQC
Terbufos sulfoxide	68704	LCM60	10548-10-4	3	ng/L	RLDQC
Terbuthylazine	66651	LCM60	5915-41-3	3.6	ng/L	RLDQC
Tetraconazole	66654	LCM60	112281-77-3	7	ng/L	RLDQC
Thiobencarb	65107	LCM60	28249-77-6	4.2	ng/L	RLDQC
Thiobencarb-d10 (surrogate)	90556	LCM60	1219804-12-2	N/A	pct	N/A
trans-Permethrin	68708	LCM60	61949-77-7	3.8	ng/L	RLDQC
Triallate	68710	LCM60	—	12	ng/L	RLDQC
Tribufos	68711	LCM60	78-48-8	2	ng/L	RLDQC
Triclopyr	68712	LCM60	55335-06-3	88	ng/L	RLDQC
Trifloxystrobin	66660	LCM60	141517-21-7	2.8	ng/L	RLDQC

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.3.2. U.S. Geological National Water Quality Laboratory custom method LCM75 for supplemental pesticides and degradates in filtered water.

[Method is equivalent to that in Sandstrom and others (2016), except that the instrument used is an Agilent model 6495 LC-MS/MS. Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbrteviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; RSD, relative standard deviation; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type	Mean recovery (percent)	RSD (percent)
2,6-Dichlorobenzamide	9045	52656	LCM75	2008-58-4	3.3	ng/L	irl	106.4	13.2
Acetamiprid	9045	68302	LCM75	135410-20-7	11	ng/L	irl	105.5	10.2
Acetamiprid-13C6 (surrogate)	9045	90453	LCM75	—	N/A	pct	irl	—	—
Aminocyclopyrachlor	9045	52651	LCM75	858956-08-8	2.2	ng/L	irl	113.2	16.3
Benzovindiflupyr	9045	52652	LCM75	1072957-71-1	2.2	ng/L	irl	103.2	10.3
Bicyclopyrone	9045	52653	LCM75	352010-68-5	5.2	ng/L	irl	106.6	10.6
Boscalid	9045	67550	LCM75	188425-85-6	3.9	ng/L	irl	108.2	10.5
Chlorantraniliprole	9045	51856	LCM75	500008-45-7	3	ng/L	irl	107.0	12.2
Clothianidin	9045	68221	LCM75	210880-92-5	6	ng/L	irl	105.5	11.0
N-(2-Chlorothiazol-5-ylmethy1)-N’-methylguanidine (TMG)	9045	52661	LCM75	635283-91-9	3.9	ng/L	irl	118.1	11.1
N-(2-Chloro-5-thiazolyl methyl)-N’-nitroguanidine (TZNG)	9045	52660	LCM75	135018-15-4	19	ng/L	irl	102.0	11.3
Clothianidin-d3 (surrogate)	9045	90452	LCM75	1262776-24-8	N/A	pct	irl	—	—
Cyantraniliprole	9045	51862	LCM75	736994-63-1	4.6	ng/L	irl	83.7	14.8
Cyantraniliprole degradate IN-JSE76	9045	52662	LCM75	—	7	ng/L	irl	101.7	15.0
Cyantraniliprole degradate IN-K5A79	9045	52663	LCM75	—	13	ng/L	irl	86.7	18.9
Cyantraniliprole degradate IN-RNU71	9045	52664	LCM75	—	14	ng/L	irl	104.5	13.7
Cyprodinil	9045	67574	LCM75	121552-61-2	7.6	ng/L	irl	105.0	10.3
Dimethomorph	9045	68373	LCM75	110488-70-5	2.9	ng/L	irl	104.4	10.1
Dinotefuran	9045	68379	LCM75	165252-70-0	2.8	ng/L	irl	106.4	11.3
Fluopicolide	9045	51852	LCM75	239110-15-7	3	ng/L	irl	106.0	9.6
Flutriafol	9045	67653	LCM75	76674-21-0	2.2	ng/L	irl	103.8	18.9
Fomesafen	9045	52654	LCM75	72178-02-0	7.5	ng/L	irl	104.3	12.0
Imazosulfuron	9045	52655	LCM75	122548-33-8	4.1	ng/L	irl	105.4	11.4
Imidacloprid	9045	68426	LCM75	138261-41-3	14	ng/L	irl	107.7	13.3
Imidacloprid-d4 (surrogate)	9045	90537	LCM75	1015855-75-0	N/A	pct	irl	—	—
Imidacloprid-olefin	9045	52782	LCM75	115086-54-9	8.9	ng/L	irl	115.4	9.5
Myclobutanil	9045	66632	LCM75	88671-89-0	2.7	ng/L	irl	106.8	10.4
Pyrimethanil	9045	67717	LCM75	53112-28-0	9	ng/L	irl	107.0	12.9
Sulfoxaflor	9045	52657	LCM75	946578-00-3	3.1	ng/L	irl	109.6	9.8
Tebuconazole-d6 (surrogate)	9045	90555	LCM75	—	N/A	pct	irl	—	—
Thiacloprid	9045	68485	LCM75	111988-49-9	3.3	ng/L	irl	106.4	10.4
Thiamethoxam	9045	68245	LCM75	153719-23-4	2.8	ng/L	irl	109.0	13.1
Thiamethoxam-d3 (surrogate)	9045	90451	LCM75	1294048-82-0		pct	irl	—	—
Tribenuron-methyl	9045	52650	LCM75	101200-48-0	56	ng/L	irl	34.3	73.1
Zoxamide	9045	67768	LCM75	156052-68-5	2.3	ng/L	irl	102.8	9.4

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.4. U.S. Geological Survey National Water Quality Laboratory Schedule 2440 for pharmaceutical compounds in water.

[Methods are described in Furlong and others (2014). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; mrl, minimum reporting level; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
1,7-Dimethylxanthine (p-Xanthine)	67446	LCM56	611-59-6	87	ng/L	irl
10-Hydroxy-amitriptyline	67995	LCM56	64520-05-4	8.3	ng/L	irl
Abacavir	68022	LCM56	136470-78-5	8.2	ng/L	irl
Acetaminophen	67436	LCM56	103-90-2	7.1	ng/L	irl
Acetaminophen-d3 (surrogate)	91775	LCM56	—	N/A	pct	mrl
Acyclovir	67484	LCM56	59277-89-3	22	ng/L	irl
Albuterol	67437	LCM56	18559-94-9	6.7	ng/L	irl
Albuterol-d9 (surrogate)	91772	LCM56	—	N/A	pct	mrl
Alprazolam	68250	LCM56	28981-97-7	21	ng/L	irl
Amitriptyline	67522	LCM56	50-48-6	37	ng/L	irl
Amphetamine	67461	LCM56	300-62-9	8.1	ng/L	irl
Amphetamine-d6 (surrogate)	91784	LCM56	—	N/A	pct	mrl
Antipyrine	67477	LCM56	60-80-0	116	ng/L	irl
Atenolol	67502	LCM56	29122-68-7	13	ng/L	irl
Atrazine	65065	LCM56	1912-24-9	19	ng/L	irl
Benztropine	67997	LCM56	86-13-5	24	ng/L	irl
Betamethasone	67485	LCM56	378-44-9	114	ng/L	irl
Bupropion	67439	LCM56	34911-55-2	17	ng/L	irl
Caffeine	67440	LCM56	58-08-2	90	ng/L	irl
Caffeine (trimethyl-13C3) (surrogate)	91781	LCM56	—	N/A	pct	mrl
Carbamazepine	67441	LCM56	298-46-4	11	ng/L	irl
Carisoprodol	67498	LCM56	78-44-4	12	ng/L	irl
Chlorpheniramine	67497	LCM56	132-22-9	4.6	ng/L	irl
Cimetidine	67442	LCM56	51481-61-9	27	ng/L	irl
Citalopram	67505	LCM56	59729-33-8	6.5	ng/L	irl
Clonidine	67518	LCM56	4205-90-7	60	ng/L	irl
Codeine	67443	LCM56	76-57-3	88	ng/L	irl
Codeine-d6 (surrogate)	91786	LCM56	371151-94-9	N/A	pct	mrl
Cotinine	67444	LCM56	486-56-6	6.3	ng/L	irl
Cotinine-d3 (surrogate)	91783	LCM56	—	N/A	pct	mrl
Dehydronifedipine	67445	LCM56	67035-22-7	24	ng/L	irl
Desmethyldiltiazem	67999	LCM56	—	12	ng/L	irl
Desvenlafaxine	68251	LCM56	93413-62-8	7.4	ng/L	irl
Dextromethorphan	67468	LCM56	125-71-3	8.2	ng/L	irl
Diazepam (valium)	67499	LCM56	439-14-5	2.2	ng/L	irl
Diazepam-d5 surrogate (surrogate)	91790	LCM56	65854-76-4	N/A	pct	mrl
Diltiazem	67519	LCM56	42399-41-7	10	ng/L	irl
Diltiazem-d3 (surrogate)	91773	LCM56	—	N/A	pct	mrl
Diphenhydramine	67447	LCM56	147-24-0	5.7	ng/L	irl
Diphenhydramine-d3 (surrogate)	91788	LCM56	—	N/A	pct	mrl

Table 2.4. U.S. Geological Survey National Water Quality Laboratory Schedule 2440 for pharmaceutical compounds in water.—Continued

[Methods are described in Furlong and others (2014). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; mrl, minimum reporting level; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Duloxetine	67448	LCM56	116539-59-4	36	ng/L	irl
Erythromycin	67449	LCM56	114-07-8	53	ng/L	irl
Ezetimibe	67487	LCM56	163222-33-1	63	ng/L	irl
Fadrozole	68012	LCM56	102676-47-1	7.3	ng/L	irl
Famotidine	68000	LCM56	76824-35-6	10	ng/L	irl
Fenofibrate	67489	LCM56	49562-28-9	6.2	ng/L	irl
Fexofenadine	67510	LCM56	83799-24-0	19	ng/L	irl
Fluconazole	67478	LCM56	86386-73-4	71	ng/L	irl
Fluoxetine	67450	LCM56	54910-89-3	26	ng/L	irl
Fluoxetine-d6 (surrogate)	91789	LCM56	—	N/A	pct	mrl
Fluticasone	67529	LCM56	90566-53-3	4.6	ng/L	irl
Fluvoxamine	67521	LCM56	54739-18-3	53	ng/L	irl
Gabapentin	52817	LCM56	60142-96-3	400	ng/L	RLDQC
Glipizide	68001	LCM56	29094-61-9	148	ng/L	mrl
Glyburide	68002	LCM56	10238-21-8	3.9	ng/L	irl
Guanylurea	52816	LCM56	141-83-3	400	ng/L	RLDQC
Hexamethylenetetramine	52815	LCM56	100-97-0	110	ng/L	RLDQC
Hydrocodone	67506	LCM56	125-29-1	10	ng/L	irl
Hydrocodone-d3 (surrogate)	91779	LCM56	—	N/A	pct	mrl
Hydrocortisone	67459	LCM56	50-23-7	147	ng/L	irl
Hydroxyzine	68005	LCM56	68-88-2	7.4	ng/L	irl
Iminostilbene	67481	LCM56	256-96-2	145	ng/L	irl
Ketoconazole	68014	LCM56	65277-42-1	113	ng/L	irl
Lamivudine	68018	LCM56	134678-17-4	16	ng/L	irl
Lidocaine	67462	LCM56	137-58-6	15	ng/L	irl
Loperamide	67515	LCM56	53179-11-6	11	ng/L	irl
Loratadine	67488	LCM56	79794-75-5	6.9	ng/L	irl
Lorazepam	67470	LCM56	846-49-1	116	ng/L	irl
Meprobamate	67464	LCM56	57-53-4	86	ng/L	irl
Metaxalone	67504	LCM56	1665-48-1	15	ng/L	irl
Metformin	67492	LCM56	657-24-9	13	ng/L	irl
Methadone	67500	LCM56	76-99-3	7.6	ng/L	irl
Methadone-d9 (surrogate)	91777	LCM56	—	N/A	pct	mrl
Methocarbamol	67501	LCM56	532-03-6	8.7	ng/L	irl
Methotrexate	67525	LCM56	59-05-2	52	ng/L	irl
Methyl-1H-benzotriazole	67514	LCM56	29385-43-1	141	ng/L	irl
Metoprolol	67523	LCM56	51384-51-1	27	ng/L	irl
Morphine	67458	LCM56	57-27-2	14	ng/L	irl
Nadalol	68006	LCM56	42200-33-9	80	ng/L	irl

Table 2.4. U.S. Geological Survey National Water Quality Laboratory Schedule 2440 for pharmaceutical compounds in water.—Continued

[Methods are described in Furlong and others (2014). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; mrl, minimum reporting level; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Nevirapine	68017	LCM56	129618-40-2	15	ng/L	irl
Nicotine	67493	LCM56	54-11-5	57	ng/L	irl
Nizatidine	67479	LCM56	76963-41-2	19	ng/L	irl
Nordiazepam	68252	LCM56	1088-11-5	41	ng/L	irl
Norethindrone	67434	LCM56	68-22-4	10	ng/L	irl
Norfluoxetine	67451	LCM56	56161-73-0	199	ng/L	irl
Norfluoxetine-d6 (surrogate)	91776	LCM56	—	N/A	pct	mrl
Norsertraline	67532	LCM56	87857-41-8	192	ng/L	irl
Norverapamil	68007	LCM56	67018-85-3	8.5	ng/L	irl
Omeprazole	67512	LCM56	73590-58-6	5.6	ng/L	irl
Oseltamivir	67511	LCM56	196618-13-0	14	ng/L	irl
Oxazepam	67469	LCM56	604-75-1	140	ng/L	irl
Oxycodone	67495	LCM56	76-42-6	24	ng/L	irl
Oxycodone-d3 (surrogate)	91778	LCM56	—	N/A	pct	mrl
Paroxetine	67527	LCM56	61869-08-7	20	ng/L	irl
Penciclovir	68021	LCM56	39809-25-1	40	ng/L	irl
Pentoxifylline	67480	LCM56	6493-05-6	9.3	ng/L	irl
Phenazopyridine	68008	LCM56	94-78-0	13	ng/L	irl
Phendimetrazine	67496	LCM56	634-03-7	31	ng/L	irl
Phenytoin	67466	LCM56	57-41-0	188	ng/L	irl
Piperonyl butoxide	67435	LCM56	51-03-6	3	ng/L	irl
Prednisolone	67483	LCM56	50-24-8	150	ng/L	irl
Prednisone	67467	LCM56	53-03-2	168	ng/L	irl
Promethazine	67524	LCM56	60-87-7	50	ng/L	irl
Propoxyphene	68009	LCM56	469-62-5	17	ng/L	irl
Propranolol	67516	LCM56	525-66-6	26	ng/L	irl
Pseudoephedrine	67460	LCM56	—	11	ng/L	irl
Pseudoephedrine-d3 surrogate (surrogate)	91787	LCM56	—	N/A	pct	mrl
Quinine	68011	LCM56	130-95-0	79	ng/L	irl
Ractopamine	52814	LCM56	97825-25-7	20	ng/L	RLDQC
Raloxifene	67530	LCM56	84449-90-1	9.7	ng/L	irl
Ranitidine	67452	LCM56	66357-35-5	192	ng/L	irl
Sertraline	67528	LCM56	79617-96-2	16	ng/L	irl
Sitagliptin	67531	LCM56	790712-60-6	97	ng/L	irl
Sulfadimethoxine	67503	LCM56	122-11-2	65	ng/L	irl
Sulfamethizole	67476	LCM56	144-82-1	104	ng/L	irl
Sulfamethoxazole	67454	LCM56	723-46-6	26	ng/L	irl
Sulfamethoxazole-(phenyl-13C6) (surrogate)	91782	LCM56	—	N/A	pct	mrl
Tamoxifen	68015	LCM56	10540-29-1	80	ng/L	mrl

Table 2.4. U.S. Geological Survey National Water Quality Laboratory Schedule 2440 for pharmaceutical compounds in water.—Continued

[Methods are described in Furlong and others (2014). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; mrl, minimum reporting level; N/A, not applicable; ng/L, nanogram per liter; NWQL, USGS National Water Quality Laboratory; pct, percent; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Temazepam	67471	LCM56	846-50-4	18	ng/L	irl
Temazepam-d5 (surrogate)	91780	LCM56	—	N/A	pct	mrl
Theophylline	67494	LCM56	58-55-9	41	ng/L	irl
Thiabendazole	67455	LCM56	148-79-8	4.1	ng/L	irl
Thiabendazole-d4 (surrogate)	91769	LCM56	—	N/A	pct	mrl
Tiotropium	67508	LCM56	186691-13-4	43	ng/L	irl
Tramadol	67517	LCM56	27203-92-5	15	ng/L	irl
Triamterene	67475	LCM56	396-01-0	5.2	ng/L	irl
Trimethoprim	67456	LCM56	738-70-5	19	ng/L	irl
Trimethoprim-d9 (surrogate)	91774	LCM56	—	N/A	pct	mrl
Valacyclovir	67507	LCM56	124832-26-4	163	ng/L	irl
Venlafaxine	67534	LCM56	93413-69-5	4.4	ng/L	irl
Verapamil	67472	LCM56	52-53-9	15	ng/L	irl
Warfarin	67457	LCM56	81-81-2	6	ng/L	Irl

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.5. U.S. Geological Survey National Water Quality Laboratory Schedule 4433 for organic wastewater indicator compounds in water.

[Methods are described in Zaugg and others (2006). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; mL, milliliter; mrl, minimum reporting level; N/A, not applicable; NWQL, USGS National Water Quality Laboratory; pct, percent; —, no data; µg/L, microgram per liter]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
1,4-Dichlorobenzene	34571	GCM99	106-46-7	0.08	µg/L	irl
1-Methylnaphthalene	81696	GCM99	90-12-0	0.04	µg/L	irl
2,2’,4,4’-Tetrabromodiphenylether (PBDE 47)	63147	GCM99	5436-43-1	0.04	µg/L	irl
2,6-Dimethylnaphthalene	62805	GCM99	581-42-0	0.04	µg/L	irl
2-Methylnaphthalene	30194	GCM99	91-57-6	0.04	µg/L	irl
3,4-Dichlorophenyl isocyanate	63145	GCM99	102-36-3	0.32	µg/L	irl
3-beta-Coprostanol	62806	GCM99	360-68-9	1.6	µg/L	irl
3-Methyl-1(H)-indole (Skatole)	62807	GCM99	83-34-1	0.04	µg/L	irl
3-tert-Butyl-4-hydroxy anisole (BHA)	61702	GCM99	121-00-6	0.16	µg/L	irl
4-Cumylphenol	62808	GCM99	599-64-4	0.04	µg/L	irl
4-n-Octylphenol	62809	GCM99	1806-26-4	0.02	µg/L	irl
4-Nonylphenol diethoxylate (NP2EO), all isomers	61703	GCM99	—	1.6	µg/L	irl
4-Nonylphenol monoethoxylate (NP1EO), all isomers	61704	GCM99	104-35-8	1.6	µg/L	irl
4-tert-Octylphenol	62810	GCM99	140-66-9	0.4	µg/L	irl
4-tert-Octylphenol diethoxylate, aka OP2EO	62486	GCM99	2315-61-9	0.2	µg/L	irl
4-tert-Octylphenol monoethoxylate, aka OP1EO	62485	GCM99	2315-67-5	0.6	µg/L	irl
5-Methyl-1H-benzotriazole	61944	GCM99	136-85-6	0.32	µg/L	irl
Acetophenone	62811	GCM99	98-86-2	0.4	µg/L	irl
Acetyl hexamethyl tetrahydronaphthalene (AHTN)	62812	GCM99	21145-77-7	0.04	µg/L	irl
Anthracene	34220	GCM99	120-12-7	0.02	µg/L	irl
Anthraquinone	62813	GCM99	84-65-1	0.04	µg/L	irl
Atrazine	39630	GCM99	1912-24-9	0.16	µg/L	irl
Benzo[a]pyrene	34247	GCM99	50-32-8	0.02	µg/L	irl
Benzophenone	62814	GCM99	119-61-9	0.08	µg/L	irl
beta-Sitosterol	62815	GCM99	83-46-5	4.8	µg/L	irl
beta-Stigmastanol	61948	GCM99	19466-47-8	3.4	µg/L	irl
Bis(2-ethylhexyl) phthalate	39100	GCM99	117-81-7	2	µg/L	irl
Bisphenol A	62816	GCM99	80-05-7	0.04	µg/L	irl
Bisphenol A-d3 (surrogate)	62839	GCM99	—	N/A	pct	mrl
Bromacil	30234	GCM99	314-40-9	0.16	µg/L	irl
Bromoform	32104	GCM99	75-25-2	0.16	µg/L	irl
Caffeine	81436	GCM99	58-08-2	0.08	µg/L	irl
Caffeine-C13 (surrogate)	62840	GCM99	—	N/A	pct	mrl
Camphor	62817	GCM99	76-22-2	0.08	µg/L	irl
Carbaryl	39750	GCM99	63-25-2	0.06	µg/L	irl
Carbazole	77571	GCM99	86-74-8	0.02	µg/L	irl
Chlorpyrifos	38932	GCM99	2921-88-2	0.12	µg/L	irl
Cholesterol	62818	GCM99	57-88-5	1.6	µg/L	irl
Cotinine	61945	GCM99	486-56-6	0.08	µg/L	irl

Table 2.5. U.S. Geological Survey National Water Quality Laboratory Schedule 4433 for organic wastewater indicator compounds in water.—Continued

[Methods are described in Zaugg and others (2006). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; irl, interim reporting level; mL, milliliter; mrl, minimum reporting level; N/A, not applicable; NWQL, USGS National Water Quality Laboratory; pct, percent; —, no data; µg/L, microgram per liter]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
d-Limonene	62819	GCM99	5989-27-5	0.16	µg/L	irl
Decafluorobiphenyl (surrogate)	62841	GCM99	434-90-2	N/A	pct	mrl
Diazinon	39570	GCM99	333-41-5	0.32	µg/L	irl
Dichlorvos	30218	GCM99	62-73-7	0.08	µg/L	irl
Diethyl phthalate	34336	GCM99	84-66-2	0.4	µg/L	irl
Fluoranthene	34376	GCM99	206-44-0	0.02	µg/L	irl
Fluoranthene-d10 (surrogate)	62842	GCM99	93951-69-0	N/A	pct	mrl
Hexahydrohexamethylcyclopentabenzopyran (HHCB)	62823	GCM99	1222-05-5	0.04	µg/L	irl
Indole	62824	GCM99	120-72-9	0.04	µg/L	irl
Isoborneol	62825	GCM99	124-76-5	0.09	µg/L	irl
Isophorone	34408	GCM99	78-59-1	0.05	µg/L	irl
Isopropylbenzene	77223	GCM99	98-82-8	0.04	µg/L	irl
Isoquinoline	62826	GCM99	119-65-3	0.8	µg/L	irl
Menthol	62827	GCM99	89-78-1	0.32	µg/L	irl
Metalaxyl	04254	GCM99	57837-19-1	0.16	µg/L	irl
Methyl salicylate	62828	GCM99	119-36-8	0.08	µg/L	irl
Metolachlor	82612	GCM99	51218-45-2	0.04	µg/L	irl
N,N-Diethyl-meta-toluamide (DEET)	61947	GCM99	134-62-3	0.04	µg/L	irl
Naphthalene	34696	GCM99	91-20-3	0.02	µg/L	irl
p-Cresol	77146	GCM99	106-44-5	0.08	µg/L	irl
para-Nonylphenol (total) (branched)	62829	GCM99	84852-15-3	1.6	µg/L	irl
Pentachlorophenol	39032	GCM99	87-86-5	1.6	µg/L	irl
Phenanthrene	34461	GCM99	85-01-8	0.02	µg/L	irl
Phenol	34694	GCM99	108-95-2	0.16	µg/L	irl
Prometon	39056	GCM99	1610-18-0	0.16	µg/L	irl
Pyrene	34469	GCM99	129-00-0	0.02	µg/L	irl
Sample volume	99963	GCM99	—	N/A	mL	irl
Tetrachloroethylene	34475	GCM99	127-18-4	0.16	µg/L	irl
Tributyl phosphate	62832	GCM99	126-73-8	0.064	µg/L	irl
Triclosan	61708	GCM99	3380-34-5	0.32	µg/L	irl
Triethyl citrate (ethyl citrate)	62833	GCM99	77-93-0	0.04	µg/L	irl
Triphenyl phosphate	62834	GCM99	115-86-6	0.08	µg/L	irl
Tris(2-butoxyethyl)phosphate	62830	GCM99	78-51-3	0.64	µg/L	irl
Tris(2-chloroethyl)phosphate	62831	GCM99	115-96-8	0.16	µg/L	irl
Tris(dichloroisopropyl)phosphate	61707	GCM99	13674-87-8	0.32	µg/L	Irl

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Table 2.6. U.S. Geological Survey National Water Quality Laboratory Schedule 5433 for organic wastewater indicator compounds in bed sediment.

[Methods are decribed in Burkhardt and others (2006). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: NWQL, USGS National Water Quality Laboratory; CAS, Chemical Abstracts Service[1]; N/A, not applicable; µg/kg, microgram per kilogram; pct, percent; g, gram; irl, interim reporting level; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
1,4-Dichlorobenzene	80256	63163	GM008	106-46-7	100	µg/kg	irl
1-Methylnaphthalene	80257	63165	GM008	90-12-0	100	µg/kg	irl
2,2’,4,4’-Tetrabromodiphenylether (PBDE 47)	80313	63166	GM008	5436-43-1	100	µg/kg	irl
2,6-Dimethylnaphthalene	80258	63167	GM008	581-42-0	100	µg/kg	irl
2-Methylnaphthalene	80259	63168	GM008	91-57-6	100	µg/kg	irl
3-beta-Coprostanol	80261	63170	GM008	360-68-9	1,000	µg/kg	irl
3-Methyl-1(H)-indole (Skatole)	80262	63171	GM008	83-34-1	100	µg/kg	irl
3-tert-Butyl-4-hydroxy anisole (BHA)	80263	63172	GM008	121-00-6	300	µg/kg	irl
4-Cumylphenol	80264	63173	GM008	599-64-4	100	µg/kg	irl
4-n-Octylphenol	80265	63174	GM008	1806-26-4	100	µg/kg	irl
4-Nonylphenol (sum of all isomers)	80307	63175	GM008	104-40-5	1,500	µg/kg	irl
4-Nonylphenol diethoxylate (NP2EO), all isomers	80302	63200	GM008	—	2,000	µg/kg	irl
4-Nonylphenol monoethoxylate (NP1EO), all isomers	80303	63221	GM008	104-35-8	1,000	µg/kg	irl
4-tert-Octylphenol	80266	63176	GM008	140-66-9	100	µg/kg	irl
4-tert-Octylphenol diethoxylate, aka OP2EO	80304	63201	GM008	2315-61-9	100	µg/kg	irl
4-tert-Octylphenol monoethoxylate, aka OP1EO	80305	63206	GM008	2315-67-5	500	µg/kg	irl
Acetophenone	80267	63178	GM008	98-86-2	300	µg/kg	irl
Acetyl hexamethyl tetrahydronaphthalene (AHTN)	80268	63179	GM008	21145-77-7	100	µg/kg	irl
Anthracene	80269	63180	GM008	120-12-7	100	µg/kg	irl
Anthraquinone	80270	63181	GM008	84-65-1	100	µg/kg	irl
Atrazine	80271	63182	GM008	1912-24-9	200	µg/kg	irl
Benzo[a]pyrene	80272	63183	GM008	50-32-8	100	µg/kg	irl
Benzophenone	80273	63184	GM008	119-61-9	100	µg/kg	irl
beta-Sitosterol	80274	63185	GM008	83-46-5	1,000	µg/kg	irl
beta-Stigmastanol	80275	63186	GM008	19466-47-8	1,000	µg/kg	irl
Bis(2-ethylhexyl) phthalate	80286	63187	GM008	117-81-7	500	µg/kg	irl
Bisphenol A	80276	63188	GM008	80-05-7	100	µg/kg	irl
Bisphenol A-d3 (surrogate)	80277	90735	GM008	—	N/A	pct	irl
Bromacil	80278	63189	GM008	314-40-9	1,000	µg/kg	irl
Camphor	80279	63192	GM008	76-22-2	100	µg/kg	irl
Carbazole	80280	63194	GM008	86-74-8	100	µg/kg	irl
Chlorpyrifos	80281	63195	GM008	2921-88-2	100	µg/kg	irl
Cholesterol	80282	63196	GM008	57-88-5	500	µg/kg	irl
d-Limonene	80287	63203	GM008	5989-27-5	100	µg/kg	irl
Decafluorobiphenyl (surrogate)	80283	90737	GM008	434-90-2	N/A	pct	irl
Diazinon	80284	63198	GM008	333-41-5	100	µg/kg	irl
Diethyl phthalate	80285	63202	GM008	84-66-2	200	µg/kg	irl
Fluoranthene	80288	63208	GM008	206-44-0	100	µg/kg	irl
Fluoranthene-d10 (surrogate)	80289	90738	GM008	93951-69-0	N/A	pct	irl

Table 2.6. U.S. Geological Survey National Water Quality Laboratory Schedule 5433 for organic wastewater indicator compounds in bed sediment.—Continued

[Methods are decribed in Burkhardt and others (2006). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: NWQL, USGS National Water Quality Laboratory; CAS, Chemical Abstracts Service[1]; N/A, not applicable; µg/kg, microgram per kilogram; pct, percent; g, gram; irl, interim reporting level; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
Hexahydrohexamethylcyclopentabenzopyran (HHCB)	80290	63209	GM008	1222-05-5	100	µg/kg	irl
Indole	80291	63210	GM008	120-72-9	200	µg/kg	irl
Isoborneol	80292	63211	GM008	124-76-5	100	µg/kg	irl
Isophorone	80293	63212	GM008	78-59-1	100	µg/kg	irl
Isopropylbenzene	80294	63213	GM008	98-82-8	200	µg/kg	irl
Isoquinoline	80295	63214	GM008	119-65-3	200	µg/kg	irl
Menthol	80296	63215	GM008	89-78-1	100	µg/kg	irl
Metolachlor	80299	63218	GM008	51218-45-2	100	µg/kg	irl
N,N-Diethyl-meta-toluamide (DEET)	80300	63219	GM008	134-62-3	200	µg/kg	irl
Naphthalene	80301	63220	GM008	91-20-3	100	µg/kg	irl
p-Cresol	80306	63222	GM008	106-44-5	500	µg/kg	irl
Phenanthrene	80309	63224	GM008	85-01-8	100	µg/kg	irl
Phenol	80310	63225	GM008	108-95-2	100	µg/kg	irl
Prometon	80311	63226	GM008	1610-18-0	100	µg/kg	irl
Pyrene	80312	63227	GM008	129-00-0	100	µg/kg	irl
Sample weight, grams	80320	91100	GM008	—	N/A	g	irl
Tributyl phosphate	80317	63231	GM008	126-73-8	100	µg/kg	irl
Triclosan	80318	63232	GM008	3380-34-5	100	µg/kg	irl
Triphenyl phosphate	80319	63234	GM008	115-86-6	100	µg/kg	irl
Tris(2-butoxyethyl)phosphate	80314	63229	GM008	78-51-3	300	µg/kg	irl
Tris(2-chloroethyl)phosphate	80315	63230	GM008	115-96-8	200	µg/kg	irl
Tris(dichloroisopropyl)phosphate	80316	63235	GM008	13674-87-8	200	µg/kg	Irl

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Table 2.7. U.S. Environmental Protection Agency Laboratory Schedule for polycyclic aromatic hydrocarbons in bed sediment, using U.S. Environmental Protection Agency method 8270D.

[Methods are described in U.S. Environmental Protection Agency (2014). **Abbreviations**: µg/kg, microgram per kilogram; pct, percent; N/A, not applicable]

Parameter name	Reporting level	Unit
Acenaphthylene, bed sediment, recoverable, dry weight	25	µg/kg
Acenaphthene, bed sediment, recoverable, dry weight	25	µg/kg
Anthracene, bed sediment, recoverable, dry weight	25	µg/kg
Benzo[b]fluoranthene, bed sediment, recoverable	25	µg/kg
Benzo[k]fluoranthene, bed sediment, recoverable	25	µg/kg
Benzo[a]pyrene, bed sediment, recoverable, dry weight	25	µg/kg
Chrysene, bed sediment, recoverable, dry weight	25	µg/kg
Fluoranthene, bed sediment, recoverable, dry weight	25	µg/kg
9H-Fluorene, bed sediment, recoverable, dry weight	25	µg/kg
Indeno[1,2,3-cd]pyrene, bed sediment, recoverable, dry weight	25	µg/kg
Naphthalene, bed sediment, recoverable, dry weight	25	µg/kg
Phenanthrene, bed sediment, recoverable, dry weight	25	µg/kg
Pyrene, bed sediment, recoverable, dry weight	25	µg/kg
Benzo[ghi]perylene, bed sediment, recoverable, dry weight	25	µg/kg
Benzo[a]anthracene, bed sediment, recoverable, dry weight	25	µg/kg
Dibenzo[a,h]anthracene, bed sediment, recoverable, dry weight	25	µg/kg
2-Methylnaphthalene, bed sediment, recoverable, dry weight	25	µg/kg
Moisture content, bed sediment, dry weight	N/A	pct

Table 2.8. U.S. Geological Survey National Water Quality Laboratory custom method 8093 for halogenated organic compounds in bed sediment.

[Methods are described in Mahler and others (2009), and Wagner and others (2014). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: NWQL, USGS National Water Quality Laboratory; CAS, Chemical Abstracts Service[1]; N/A, not applicable; µg/kg, microgram per kilogram; pct, percent; g, gram; irl, interim reporting level; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
2,2’,4,4’-Tetrabromodiphenylether (PBDE 47)	81563	63166	GM014	5436-43-1	0.2	µg/kg	irl
Triclosan	81541	63232	GM014	3380-34-5	4	µg/kg	irl
alpha-Endosulfan	81542	63259	GM014	959-98-8	0.2	µg/kg	irl
beta-Endosulfan	82198	63260	GCM14	33213-65-9	0.2	µg/kg	irl
Benfluralin	81521	63265	GM014	1861-40-1	0.2	µg/kg	irl
cis-Chlordane	81540	63271	GM014	5103-71-9	0.2	µg/kg	irl
trans-Chlordane	81537	63272	GM014	5103-74-2	0.2	µg/kg	irl
Chlorpyrifos	81530	63273	GM014	2921-88-2	0.2	µg/kg	irl
Cyfluthrin	81571	63279	GM014	68359-37-5	0.2	µg/kg	irl
lambda-Cyhalothrin	81565	63280	GM014	91465-08-6	0.2	µg/kg	irl
Dacthal	81529	63282	GM014	1861-32-1	0.2	µg/kg	irl
Dieldrin	81545	63289	GM014	60-57-1	0.1	µg/kg	irl
Endosulfan sulfate	82195	63298	GCM14	1031-07-8	0.4	µg/kg	irl
Fipronil	81534	63313	GM014	120068-37-3	0.1	µg/kg	irl
Fipronil sulfide	81532	63314	GM014	120067-83-6	0.1	µg/kg	irl
Desulfinylfipronil	81526	63316	GM014	—	0.1	µg/kg	irl
cis-Nonachlor	81552	63338	GM014	5103-73-1	0.1	µg/kg	irl
trans-Nonachlor	81538	63339	GM014	39765-80-5	0.1	µg/kg	irl
Oxyfluorfen	81546	63341	GM014	42874-03-3	4	µg/kg	irl
p,p’-DDT	81556	63345	GM014	50-29-3	4	µg/kg	irl
p,p’-DDD	81553	63346	GM014	72-54-8	2	µg/kg	irl
p,p’-DDE	81544	63347	GM014	72-55-9	1	µg/kg	irl
Pendimethalin	81535	63353	GM014	40487-42-1	1	µg/kg	irl
Tefluthrin	81522	63377	GM014	79538-32-2	0.5	µg/kg	irl
Trifluralin	81520	63390	GM014	1582-09-8	0.2	µg/kg	irl
Hexachlorobenzene	81523	63631	GM014	118-74-1	0.1	µg/kg	irl
Methyl triclosan	81543	63639	GM014	4640-01-1	6	µg/kg	irl
Pentachloronitrobenzene	81525	63650	GM014	82-68-8	0.1	µg/kg	irl
Tetradifon	81566	63665	GM014	116-29-0	0.2	µg/kg	irl
Pentachloroanisole	81524	64119	GM014	1825-21-4	0.1	µg/kg	irl
PCB, congener, iupac #49	81528	64725	GM014	41464-40-8	2	µg/kg	irl
PCB, congener, iupac #52	81527	64726	GM014	35693-99-3	1	µg/kg	irl
PCB, congener, iupac #70	81536	64727	GM014	32598-11-1	2	µg/kg	irl
PCB, congener, iupac #101	81539	64729	GM014	37680-73-2	1	µg/kg	irl
PCB, congener, iupac #110	81547	64730	GM014	38380-03-9	1	µg/kg	irl
PCB, congener, iupac #118	81550	64731	GM014	31508-00-6	0.1	µg/kg	irl
PCB, congener, iupac #138	81555	64732	GM014	35065-28-2	0.1	µg/kg	irl
PCB, congener, iupac #146	81551	64733	GM014	51908-16-8	0.1	µg/kg	irl

Table 2.8. U.S. Geological Survey National Water Quality Laboratory custom method 8093 for halogenated organic compounds in bed sediment.—Continued

[Methods are described in Mahler and others (2009), and Wagner and others (2014). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: NWQL, USGS National Water Quality Laboratory; CAS, Chemical Abstracts Service[1]; N/A, not applicable; µg/kg, microgram per kilogram; pct, percent; g, gram; irl, interim reporting level; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
PCB, congener, iupac #149	81549	64734	GM014	38380-04-0	1	µg/kg	irl
PCB, congener, iupac #151	81548	64735	GM014	52663-63-5	0.1	µg/kg	irl
PCB, congener, iupac #170	81564	64736	GM014	35065-30-6	0.1	µg/kg	irl
PCB, congener, iupac #174	81559	64737	GM014	38411-25-5	0.1	µg/kg	irl
PCB, congener, iupac #177	81560	64738	GM014	52663-70-4	0.1	µg/kg	irl
PCB, congener, iupac #180	81561	64739	GM014	35065-29-3	0.1	µg/kg	irl
PCB, congener, iupac #183	81558	64740	GM014	52663-69-1	0.1	µg/kg	irl
PCB, congener, iupac #187	81557	64741	GM014	52663-68-0	0.1	µg/kg	irl
PCB, congener, iupac #194	81568	64742	GM014	35694-08-7	0.1	µg/kg	irl
PCB, congener, iupac #206	81570	64743	GM014	40186-72-9	0.1	µg/kg	irl
2,3’,4,4’-Tetrabromodiphenyl ether (PBDE 66)	81567	64852	GM014	189084-61-5	0.1	µg/kg	irl
2,3’,4’,6-Tetrabromodiphenyl ether (PBDE 71)	81562	64853	GM014	189084-62-6	0.1	µg/kg	irl
2,2’,3,4,4’-Pentabromodiphenyl ether (PBDE 85)	81573	64854	GM014	182346-21-0	0.1	µg/kg	irl
2,2’,4,4’,5-Pentabromodiphenyl ether (PBDE 99)	81572	64855	GM014	60348-60-9	0.2	µg/kg	irl
2,2’,4,4’,6-Pentabromodiphenyl ether (PBDE 100)	81569	64856	GM014	189084-64-8	0.1	µg/kg	irl
2,2’,3,4,4’,5’-Hexabromodiphenyl ether (PBDE138)	81576	64857	GM014	182677-30-1	0.1	µg/kg	irl
2,2’,4,4’,5,5’-Hexabromodiphenylether (PBDE 153)	81575	64858	GM014	68631-49-2	0.1	µg/kg	irl
2,2’,4,4’,5,6’-Hexabromodiphenyl ether (PBDE 154)	81574	64859	GM014	207122-15-4	0.1	µg/kg	irl
2,2’,3,4,4’,5’,6-Heptabromodiphenyl ether (PBDE 183)	81577	64860	GM014	207122-16-5	0.1	µg/kg	irl
Oxychlordane	81533	64866	GM014	27304-13-8	1	µg/kg	irl
Pentabromotoluene	81554	64867	GM014	87-83-2	1	µg/kg	irl
1,2-Bis(2,4,6-tribromophenoxy)ethane	81578	64868	GM014	37853-59-1	0.1	µg/kg	irl
Octachlorostyrene	81531	65217	GM014	29082-74-4	1	µg/kg	irl
bis(Hexachlorocyclopentadieno) cyclooctane [Dechlorane Plus]	81583	65220	GM014	13560-89-9	1	µg/kg	irl
PCB congener 202-13C12 (surrogate)	81581	90802	GM014	105600-26-8	N/A	pct	N/A
Sample weight, grams	81582	91137	GM014	—	N/A	g	N/A
4,4’-Dibromooctafluorobiphenyl (surrogate)	81579	91785	GM014	10386-84-2	N/A	pct	N/A
p,p’-DDT-d8 (surrogate)	81580	91828	GM014	—	N/A	pct	N/A

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Table 2.9. U.S. Geological Survey National Water Quality Laboratory Schedule 6434 for hormone compounds in bed sediment.

[Custom method derived from Foreman and others (2012). Parameter names are as shown in the U.S. Geological Survey (USGS) National Water Information System (NWIS) database and do not include special characters or formatting. **Abbreviations**: CAS, Chemical Abstracts Service[1]; g, gram; N/A, not applicable; irl, interim reporting level; MRL, minimum reporting level; pct, percent; µg/kg, microgram per kilogram; —, no data]

Parameter name	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type
11-Ketotestosterone	64467	GM006	564-35-2	0.52	µg/kg	MRL
16-Epiestriol-2,4-d2 (surrogate)	91684	GM006	366495-94-5	N/A	pct	
17-alpha-Estradiol	64468	GM006	57-91-0	0.2	µg/kg	irl
17-alpha-Ethynylestradiol	63207	GM006	57-63-6	0.2	µg/kg	irl
17-alpha-Ethynylestradiol-2,4,16,16-d4 (surrogate)	91805	GM006	350820-06-3	N/A	pct	
17-beta-Estradiol	63164	GM006	50-28-2	0.4	µg/kg	irl
17-beta-Estradiol-13,14,15,16,17,18-13C6 (surrogate)	91757	GM006	—	N/A	pct	
3-beta-Coprostanol	63170	GM006	360-68-9	50	µg/kg	MRL
4-Androstene-3,17-dione	64473	GM006	63-05-8	0.5	µg/kg	irl
Bisphenol A	63188	GM006	80-05-7	20	µg/kg	MRL
Bisphenol-A-d16 (surrogate)	67310	GM006	96210-87-6	N/A	pct	
Cholesterol	63196	GM006	57-88-5	120	µg/kg	MRL
Cholesterol-d7 (surrogate)	90772	GM006	83199-47-7	N/A	pct	
cis-Androsterone	63607	GM006	53-41-8	0.5	µg/kg	irl
cis-Androsterone-2,2,3,4,4-d5 (surrogate)	91808	GM006	89685-22-3	N/A	pct	
Dihydrotestosterone	64484	GM006	521-18-6	1	µg/kg	irl
Epitestosterone	64477	GM006	481-30-1	1	µg/kg	irl
Equilenin	63204	GM006	517-09-9	0.52	µg/kg	irl
Equilin	64479	GM006	474-86-2	4	µg/kg	irl
Estriol	64480	GM006	50-27-1	0.52	µg/kg	irl
Estriol-2,4,16,17-d4 (surrogate)	91617	GM006	—	N/A	pct	
Estrone	63205	GM006	53-16-7	0.5	µg/kg	irl
Estrone-13,14,15,16,17,18-13C6 (surrogate)	91758	GM006	—	N/A	pct	
Medroxyprogesterone-d3 (surrogate)	91686	GM006	162462-69-3	N/A	pct	
Mestranol	63638	GM006	72-33-3	0.4	µg/kg	irl
Mestranol-2,4,16,16-d4 (surrogate)	91813	GM006	—	N/A	pct	
Nandrolone-16,16,17-d3 (surrogate)	91687	GM006	120813-22-1	N/A	pct	
Norethindrone	63644	GM006	68-22-4	0.4	µg/kg	irl
Progesterone	63657	GM006	57-83-0	3	µg/kg	irl
Progesterone-2,3,4-13C3 (surrogate)	90512	GM006	327048-87-3	N/A	pct	
Sample weight, grams	91116	GM006	—	N/A	g	
Testosterone	64485	GM006	58-22-0	0.4	µg/kg	irl
trans-Diethyl-1,1,1’,1’-d4-stilbesterol-3,3’,5,5’-d4 (surrogate)	91809	GM006	91318-10-4	N/A	pct	
trans-Diethylstilbestrol	63620	GM006	56-53-1	0.33	µg/kg	MRL

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.10. U.S. Geological Survey National Water Quality Laboratory Schedule 1632 for chlorophyll *a*, pheophytin *a*, and ash-free dry mass in periphyton.

[NWQL, U.S. Geological Survey (USGS) National Water Quality Laboratory; NWIS, USGS National Water Information System; CAS, Chemical Abstracts Service[1]; g/m^2, gram per square meter; mg/m^2, milligram per square meter; mrl, minimum reporting level; lrl, laboratory reporting level; EPA, U.S. Environmental Protection Agency; —, no data]

Parameter name	NWQL lab code	NWIS parameter code	NWIS method code	CAS number	Reporting level	Unit	Reporting level type	Method citation	Method
Biomass, periphyton, ash free dry weight	2751	49954	GRV15	—	0.1	g/m^2	mrl	Britton and Greeson, 1987	USGS Method B-3520-85
Chlorophyll *a*	3153	70957	00050	479-61-8	0.1	mg/m^2	lrl	Arar and Collins, 1997	EPA 445.0
Periphyton, biomass, ash weight	611	00572	GRV15	—	0.1	g/m^2	mrl	Britton and Greeson, 1987	USGS Method B-3520-85
Periphyton, biomass, dry weight	603	00573	GRV15	—	0.1	g/m^2	mrl	Britton and Greeson, 1987	USGS Method B-3520-85
Pheophytin *a*, periphyton	80253	62359	00050	603-17-8	0.1	mg/m^2	lrl	Arar and Collins, 1997	EPA 445.0

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.11. U.S. Geological Survey Organic Chemistry Research Laboratory Schedule for pesticides in sediment and biofilms.

[Method is described in Hladik and McWayne (2012). **Abbreviations**: NWIS, USGS National Water Information System; CAS, Chemical Abstracts Service[1]; g, gram; MDL, method detection level; µg/kg, microgram per kilogram; —, no data; na, not applicable]

Compound	CAS number	NWIS parameter code for bed sediment	MDL in sediment (µg/kg)	MDL in biofilms (µg/kg) for 5 g sample
2-Chloro-2,6-Diethylacetanilide (CDEPA)	6967-29-9	68876	1.3	1.3
3,4-Dichloroaniline	95-76-1	66585	1.3	1.3
3,5-Dichloroaniline	626-43-7	67538	1.5	1.5
Alachlor	15972-60-8	04006	0.6	0.6
Allethrin	584-79-2	66588	1.7	1.7
Atrazine	1912-24-9	39631	1.5	1.5
Azinphos-methyl	86-50-0	64150	1.7	1.7
Azoxystrobin	131860-33-8	66591	0.9	0.9
Benfluralin (Benefin)	1861-40-1	68878	1.7	1.7
Bifenthrin	82657-04-3	64151	0.6	0.6
Boscalid	188425-85-6	67552	1.2	1.2
Butralin	33629-47-9	68880	1.6	1.6
Butylate	2008-41-5	64152	1.3	1.3
Captan	133-06-2	68324	3.1	na
Carbaryl	63-25-2	64153	1.2	1.2
Carbofuran	1563-66-2	64154	1.2	1.2
Chlorothalonil	1897-45-6	62904	1.1	na
Chlorpyrifos	2921-88-2	81404	0.9	0.9
Clomazone	81777-89-1	67564	2.0	2.0
Coumaphos	56-72-4	68882	1.2	1.2
Cycloate	1134-23-2	64155	0.8	0.8
Cyfluthrin	68359-37-5	65109	1.3	1.3
Cyhalofop-butyl	122008-85-9	68884	0.8	0.8
Cyhalothrin	68085-85-8	68356	0.7	0.7
Cypermethrin	52315-07-8	64156	1.2	1.2
Cyproconazole	94361-06-5	66595	1.0	na
Cyprodinil	121522-61-2	67576	1.7	na
DCPA (Dacthal)	1861-32-1	62905	1.7	1.7
Deltamethrin	52918-63-5	65110	1.3	1.3
Diazinon	333-41-5	39571	1.6	1.6
Difenoconazole	119446-68-3	67584	1.0	na
Dimethomorph	110488-70-5	68375	1.5	na
Dithiopyr	97886-45-8	68886	1.3	1.3
EPTC	759-94-4	64158	0.8	0.8
Esfenvalerate	66230-04-4	64159	1.0	1.0
Ethalfluralin	55283-68-6	64160	1.2	1.2
Etofenprox	80844-07-1	67606	1.0	1.0
Famoxadone	131807-57-3	67611	1.7	na
Fenarimol	60168-88-9	67615	1.4	na
Fenbuconazole	114369-43-6	67620	1.8	na
Fenhexamide	126833-17-8	67624	2.5	na
Fenpropathrin	39515-41-8	65111	1.0	1.0

Table 2.11. U.S. Geological Survey Organic Chemistry Research Laboratory Schedule for pesticides in sediment and biofilms.—Continued

[Method is described in Hladik and McWayne (2012). **Abbreviations**: NWIS, USGS National Water Information System; CAS, Chemical Abstracts Service[1]; g, gram; MDL, method detection level; µg/kg, microgram per kilogram; —, no data; na, not applicable]

Compound	CAS number	NWIS parameter code for bed sediment	MDL in sediment (µg/kg)	MDL in biofilms (µg/kg) for 5 g sample
Fenpyroximate	134098-61-6	68888	1.9	1.9
Fenthion	55-38-9	62046	2.0	2.0
Fipronil	120068-37-3	66606	1.6	1.6
Fipronil desulfinyl	—	66609	1.8	1.8
Fipronil desulfinyl amide	—	68891	2.0	2.0
Fipronil sulfide	120067-83-6	66612	1.5	1.5
Fipronil sulfone	120068-36-2	66615	1.0	1.0
Fluazinam	79622-59-6	67638	2.1	na
Fludioxinil	131341-86-1	67642	2.5	2.5
Flufenacet	142459-58-3	68893	1.0	1.0
Flumetralin	62924-70-3	68895	1.2	1.2
Fluoxastrobin	361377-29-9	67647	1.2	na
Flusilazole	85509-19-9	67651	2.2	na
Flutolanil	66332-96-5	68897	2.1	2.1
Flutriafol	76674-21-0	67655	1.1	na
Hexazinone	51235-04-2	64161	0.9	0.9
Imazalil	35554-44-0	67664	1.8	na
Indoxacarb	173584-44-6	68899	2.4	na
Iprodione	36734-19-7	66618	0.9	0.9
Kresoxim-methyl	143390-89-0	67672	0.5	0.5
Malathion	121-75-5	35931	1.0	1.0
Metalaxyl	57837-19-1	68439	1.9	na
Metconazole	125116-23-6	66622	1.2	1.2
Methidathion	950-37-8	62047	1.8	1.8
Methoprene	40596-69-8	66625	1.6	1.6
Methyl parathion	298-00-0	39601	1.1	1.1
Metolachlor	51218-45-2	04005	0.7	0.7
Molinate	2212-67-1	64163	1.0	1.0
Myclobutanil	88671-89-0	66634	1.7	1.7
Napropamide	15299-99-7	64164	0.9	0.9
Novaluron	116714-46-6	68901	1.1	1.1
Oxadiazon	19666-30-9	68903	1.4	1.4
Oxyfluorfen	42874-03-3	64165	1.9	1.9
p,p’-DDD	72-54-8	39311	1.0	1.0
p,p’-DDE	72-55-9	39321	1.0	1.0
p,p’-DDT	50-29-3	39301	0.8	0.8
Pebulate	1114-71-2	64166	0.9	na
Pendimethalin	40487-42-1	64167	0.8	na
Pentachloroanisole	1825-21-4	49460	1.1	1.1
Pentachloronitrobenzene	82-68-8	49446	1.1	1.1
Pebulate	1114-71-2	—	na	0.9
Pendimethalin	40487-42-1	—	na	0.8

Table 2.11. U.S. Geological Survey Organic Chemistry Research Laboratory Schedule for pesticides in sediment and biofilms.—Continued

[Method is described in Hladik and McWayne (2012). **Abbreviations**: NWIS, USGS National Water Information System; CAS, Chemical Abstracts Service[1]; g, gram; MDL, method detection level; µg/kg, microgram per kilogram; —, no data; na, not applicable]

Compound	CAS number	NWIS parameter code for bed sediment	MDL in sediment (µg/kg)	MDL in biofilms (µg/kg) for 5 g sample
Permethrin	52645-53-1	64168	0.9	0.9
Phenothrin	26002-80-2	65112	0.9	0.9
Phosmet	732-11-6	64169	0.9	0.9
Piperonyl butoxide	51-03-6	64170	1.2	1.2
Prodiamine	29091-21-2	68905	1.4	1.4
Prometon	1610-18-0	82402	2.7	2.7
Prometryn	7287-19-6	78688	1.3	1.3
Propanil	709-98-8	66642	2.2	2.2
Propargite	2312-35-8	68907	2.2	2.2
Propiconazole	60207-90-1	66645	1.1	1.1
Propyzamide (Pronamide)	23950-58-5	67708	1.5	1.5
Pyraclostrobin	175013-18-0	66648	1.1	na
Pyridaben	96489-71-3	68909	1.2	1.2
Pyrimethanil	53112-28-0	67719	1.1	na
Resmethrin	10453-86-8	65113	1.3	1.3
Simazine	122-34-9	39046	1.3	1.3
tau-fluvalinate	69409-94-5	65114	1.2	1.2
Tebuconazole	107534-96-3	66650	1.2	na
Tebupirimfos	—	68911	1.5	1.5
Tebupirimfos oxon	96182-53-5	68913	2.0	na
Tefluthrin	79538-32-2	67733	0.7	0.7
Tetraconazole	112281-77-3	66656	1.1	1.1
Tetradifon	116-29-0	68915	2.0	2.0
Tetramethrin	7696-12-0	66659	0.9	0.9
Thiazopyr	117718-60-2	68917	1.9	1.9
Thiobencarb	28249-77-6	64171	0.6	0.6
Triadimefon	43121-43-3	67743	1.5	1.5
Triadimenol	55219-65-3	67748	1.5	na
Triallate	2303-17-5	68919	1.4	1.4
Tribuphos	78-48-8	39050	2.2	2.2
Trifloxystrobin	141517-21-7	66662	1.0	1.0
Triflumizole	68694-11-1	67755	1.1	na
Trifluralin	1582-09-8	62902	0.9	0.9
Triticonazole	131983-72-7	67760	1.8	na
Vinclozolin	50471-44-8	67765	1.2	1.2
Zoxamide	156052-68-5	67770	1.1	1.1

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

Table 2.12. U.S. Environmental Protection Agency Laboratory Schedule for pesticides in filtered water from small-volume pesticide autosamplers.

[EPA, U.S. Environmental Protection Agency; CAS, Chemical Abstracts Service[1]; ESI+, positive electrospray ionization mode; ESI–, negative electrospray ionization mode; MDL, method detection level; ng/L, nanograms per liter; —, no data]

EPA parameter name	Method	MDL (ng/L)	CAS number
1H-1,2,4-Triazole	ESI+	11	288-88-0
2-(1-Hydroxyethyl)-6-methylaniline (HEMA)	ESI+	47	196611-19-5
2-(2-Ethyl-6-methyl-phenyl)aminopropan-1-ol	ESI+	2	61520-53-4
2,4-D	ESI–	31	94-75-7
2-Aminobenzimidazole	ESI+	4	934-32-7
2-Amino-N-isopropylbenzamide	ESI+	2	30391-89-0
2-Chloro-N-(2-ethyl-6-methylphenyl)acetamide	ESI+	2	32428-71-0
2-Hydroxy-4-isopropylamino-6-amino-s-triazine	ESI+	2	19988-24-0
2-Hydroxy-6-ethylamino-4-amino-s-triazine	ESI+	3	7313-54-4
2-Hydroxyatrazine	ESI+	4	2163-68-0
3,4-Dichlorophenylurea	ESI+	72	2327-02-8
3-Hydroxycarbofuran	ESI+	8	16655-82-6
3-Phenoxybenzoic acid	ESI–	30	3739-38-6
4-(Hydroxymethyl)pendimethalin	ESI–	106	56750-76-6
4-Chlorobenzylmethyl sulfoxide	ESI+	2	24176-68-9
4-Hydroxy molinate	ESI+	3	66747-12-4
4-Hydroxychlorothalonil	ESI–	49	28343-61-5
4-Hydroxyhexazinone A	ESI+	1	72576-13-7
4-Hydroxy-tert-fluometuron	ESI+	10	—
Acephate	ESI+	5	30560-19-1
Acetochlor	ESI+	5	34256-82-1
Acetochlor OA	ESI–	45	194992-44-4
Acetochlor SA	ESI–	50	187022-11-3
Acetochlor SAA	ESI–	88	618113-86-3
Alachlor	ESI+	6	15972-60-8
Alachlor OA	ESI–	42	171262-17-2
Alachlor SA	ESI–	140	142363-53-9
Alachlor SAA	ESI–	84	494847-39-1
Aldicarb	ESI+	4	116-06-3
Aldicarb sulfone	ESI+	10	1646-88-4
Aldicarb sulfoxide	ESI+	1	1646-87-3
Ametryn	ESI+	1	834-12-8
Asulam	ESI+	59	3337-71-1
Atrazine	ESI+	2	1912-24-9
Azinphos-methyl	ESI+	4	86-50-0
Azinphos-methyl oxon	ESI+	7	961-22-8
Azoxystrobin	ESI+	1	131860-33-8
Bentazone	ESI–	11	25057-89-0
Bifenthrin	ESI+	250	82657-04-3
Bromacil	ESI+	3	314-40-9
Bromoxynil	ESI–	39	1689-84-5

Table 2.12. U.S. Environmental Protection Agency Laboratory Schedule for pesticides in filtered water from small-volume pesticide autosamplers.—Continued

[EPA, U.S. Environmental Protection Agency; CAS, Chemical Abstracts Service[1]; ESI+, positive electrospray ionization mode; ESI–, negative electrospray ionization mode; MDL, method detection level; ng/L, nanograms per liter; —, no data]

EPA parameter name	Method	MDL (ng/L)	CAS number
Butralin	ESI+	4	33629-47-9
Butylate	ESI+	3	2008-41-5
Carbaryl	ESI+	3	63-25-2
Carbendazim	ESI+	1	10605-21-7
Carbofuran	ESI+	2	1563-66-2
Carboxy molinate	ESI+	11	66747-13-5
Chlorimuron-ethyl	ESI+	4	90982-32-4
Chlorosulfonamide acid	ESI–	37	130-45-0
Chlorpyrifos	ESI+	25	2921-88-2
Chlorpyrifos oxon	ESI+	2	5598-15-2
Chlorsulfuron	ESI+	25	64902-72-3
cis-Permethrin	ESI+	100	61949-76-6
Cyanazine	ESI+	25	21725-46-2
Dacthal monoacid	ESI–	250	887-54-7
Dechlorofipronil	ESI–	3	—
Dechlorometolachlor	ESI+	10,000	126605-22-9
Deethylatrazine	ESI+	5	6190-65-4
Deiodo flubendiamide	ESI+	4	1016160-78-3
Deisopropyl prometryn	ESI+	1	4147-57-3
Deisopropylatrazine	ESI+	10	1007-28-9
Demethyl hexazinone B	ESI+	1	56611-54-2
Demethyl norflurazon	ESI+	2	23576-24-1
Desulfinylfipronil	ESI–	7	205650-65-3
Desulfinylfipronil Amide	ESI–	8	1115248-09-3
Diazinon	ESI+	2	333-41-5
Diazinon oxon	ESI+	1	962-58-3
Dicamba	ESI–	250	1918-00-9
Dichlorvos	ESI+	26	62-73-7
Dicrotophos	ESI+	2	141-66-2
Didealkylatrazine	ESI+	25	3397-62-4
Diflubenzuron	ESI+	5	35367-38-5
Diflufenzopyr	ESI–	44	109293-97-2
Diketonitrile isoxaflutole	ESI–	31	143701-75-1
Dimethachlor SA	ESI–	10	
Dimethenamid	ESI+	1	87674-68-8
Dimethenamid OA	ESI–	42	380412-59-9
Dimethenamid SA	ESI–	39	205939-58-8
Dimethenamid SAA	ESI–	94	—
Dimethoate	ESI+	1	60-51-5
Dimethoate oxon	ESI+	1	1113-02-6
Disulfoton	ESI+	12	298-04-4

Table 2.12. U.S. Environmental Protection Agency Laboratory Schedule for pesticides in filtered water from small-volume pesticide autosamplers.—Continued

[EPA, U.S. Environmental Protection Agency; CAS, Chemical Abstracts Service[1]; ESI+, positive electrospray ionization mode; ESI–, negative electrospray ionization mode; MDL, method detection level; ng/L, nanograms per liter; —, no data]

EPA parameter name	Method	MDL (ng/L)	CAS number
Disulfoton oxon	ESI+	1	126-75-0
Disulfoton oxon sulfone	ESI+	3	2496-91-5
Disulfoton oxon sulfoxide	ESI+	100	2496-92-6
Disulfoton sulfone	ESI+	4	2497-06-5
Disulfoton sulfoxide	ESI+	2	2497-07-6
Diuron	ESI+	2	330-54-1
EPTC	ESI+	103	759-94-4
EPTC R248722	ESI+	2	65109-69-5
Ethoprop	ESI+	2	13194-48-4
Etoxazole	ESI+	3	153233-91-1
Famoxadone	ESI+	150	131807-57-3
Fenamiphos	ESI+	1	22224-92-6
Fenamiphos sulfone	ESI+	2	31972-44-8
Fenamiphos sulfoxide	ESI+	2	31972-43-7
Fenbutatin oxide	ESI+	100	13356-08-6
Fentin	ESI+	8	668-34-8
Fipronil	ESI–	8	120068-37-3
Fipronil amide	ESI–	8	205650-69-7
Fipronil sulfide	ESI–	9	120067-83-6
Fipronil sulfonate	ESI–	48	209248-72-6
Fipronil sulfone	ESI–	8	120068-36-2
Flubendiamide	ESI–	8	272451-65-7
Flumetsulam	ESI+	8	98967-40-9
Fluometuron	ESI+	1	2164-17-2
Fonofos	ESI+	5	944-22-9
Halosulfuron-methyl	ESI+	11	100784-20-1
Hexazinone	ESI+	1	51235-04-2
Hexazinone TP C	ESI+	1	72585-88-7
Hexazinone TP D	ESI–	100	30243-77-7
Hexazinone TP E	ESI–	38	72576-14-8
Hexazinone TP F	ESI+	38	56611-55-3
Hexazinone TP G	ESI+	11	—
Hydroxy mono demethyl fluometuron	ESI+	5	—
Hydroxyalachlor	ESI+	6	56681-55-1
Hydroxydiazinon	ESI+	5	29820-16-4
Hydroxyfluometuron	ESI+	4	—
Hydroxyphthalazinone	ESI+	40	—
Hydroxysimazine	ESI+	3	2599-11-3
Hydroxytebuthiurion	ESI+	25	59962-54-8
Imazamox	ESI+	14	114311-32-9
Imazaquin	ESI+	9	81335-37-7

Table 2.12. U.S. Environmental Protection Agency Laboratory Schedule for pesticides in filtered water from small-volume pesticide autosamplers.—Continued

[EPA, U.S. Environmental Protection Agency; CAS, Chemical Abstracts Service[1]; ESI+, positive electrospray ionization mode; ESI–, negative electrospray ionization mode; MDL, method detection level; ng/L, nanograms per liter; —, no data]

EPA parameter name	Method	MDL (ng/L)	CAS number
Imazethapyr	ESI+	10	81335-77-5
Imidacloprid	ESI+	5	138261-41-3
Indoxacarb	ESI+	12	173584-44-6
Isoxaflutole	ESI+	15	141112-29-0
Isoxaflutole acid RPA 203328	ESI–	6	142994-06-7
Kresoxim-methyl	ESI+	4	143390-89-0
Lactofen	ESI+	10	77501-63-4
Linuron	ESI+	3	330-55-2
Malaoxon	ESI+	1	1634-78-2
Malathion	ESI+	2	121-75-5
MCPA	ESI–	48	94-74-6
Metalaxyl	ESI+	3	57837-19-1
Metconazole	ESI+	2	125116-23-6
Methamidophos	ESI+	3	10265-92-6
Methidathion	ESI+	5	950-37-8
Methomyl	ESI+	2	16752-77-5
Methomyl oxime	ESI+	250	13749-94-5
Methoxyfenozide	ESI+	1	161050-58-4
Metolachlor	ESI+	4	51218-45-2
Metolachlor hydroxy morpholinone	ESI+	14	61520-54-5
Metolachlor OA	ESI–	74	152019-73-3
Metolachlor SA	ESI–	40	171118-09-5
Metribuzin	ESI+	10	21087-64-9
Metribuzin DA	ESI+	4	35045-02-4
Metribuzin DADK	ESI–	100	52236-30-3
Metribuzin DK	ESI–	140	56507-37-0
Molinate	ESI+	9	2212-67-1
Myclobutanil	ESI+	5	88671-89-0
N-(3,4-Dichlorophenyl)-N-methylurea	ESI+	5	3567-62-2
Naled	ESI+	15	300-76-5
Nicosulfuron	ESI+	7	111991-09-4
Norflurazon	ESI+	3	27314-13-2
Novaluron	ESI+	50	116714-46-6
O-Ethyl-O-methyl-S-propyl phosphorothioate	ESI+	2	76960-87-7
Orthosulfamuron	ESI+	3	213464-77-8
Oryzalin	ESI–	5	19044-88-3
Oxamyl	ESI+	1	23135-22-0
Oxamyl oxime	ESI+	3	30558-43-1
Oxyfluorfen	ESI+	500	42874-03-3
Paraoxon	ESI+	2	311-45-5
Paraoxon-methyl	ESI+	12	950-35-6

Table 2.12. U.S. Environmental Protection Agency Laboratory Schedule for pesticides in filtered water from small-volume pesticide autosamplers.—Continued

[EPA, U.S. Environmental Protection Agency; CAS, Chemical Abstracts Service[1]; ESI+, positive electrospray ionization mode; ESI–, negative electrospray ionization mode; MDL, method detection level; ng/L, nanograms per liter; —, no data]

EPA parameter name	Method	MDL (ng/L)	CAS number
Parathion-methyl	ESI+	250	298-00-0
Pendimethalin	ESI+	3	40487-42-1
Phorate	ESI+	3	298-02-2
Phorate oxon	ESI+	2	2600-69-3
Phorate oxon sulfone	ESI+	10	2588-06-9
Phorate oxon sulfoxide	ESI+	3	2588-05-8
Phorate sulfone	ESI+	4	2588-04-7
Phorate sulfoxide	ESI+	2	2588-03-6
Phosmet	ESI+	10,000	732-11-6
Phthalazinone	ESI+	6	90004-07-2
Piperonyl butoxide	ESI+	2	51-03-6
Profenofos	ESI+	1	41198-08-7
Prometon	ESI+	2	1610-18-0
Prometryn	ESI+	1	7287-19-6
Pronamide	ESI+	2	23950-58-5
Propanil	ESI+	5	709-98-8
Propargite	ESI+	2	2312-35-8
Propazine	ESI+	2	139-40-2
Propiconazole	ESI+	3	60207-90-1
Propoxur	ESI+	2	114-26-1
Prosulfuron	ESI+	5	94125-34-5
Pymetrozine	ESI+	1	123312-89-0
Pyraclostrobin	ESI+	1	175013-18-0
Pyridaben	ESI+	2	96489-71-3
Pyrimidinol	ESI+	10,000	2814-20-2
Pyriproxyfen	ESI+	2	95737-68-1
sec-Alachlor-OA	ESI–	68	628324-79-8
Siduron	ESI+	2	1982-49-6
Simazine	ESI+	5	122-34-9
Sulfentrazone	ESI–	25	122836-35-5
Sulfometuron-methyl	ESI+	2	74222-97-2
Sulfosulfuron	ESI+	25	141776-32-1
Sulfosulfuron ethyl sulfone	ESI+	1	—
Tebuconazole	ESI+	2	107534-96-3
Tebufenozide	ESI+	1	112410-23-8
Tebupirimfos	ESI+	1	96182-53-5
Tebupirimfos oxon	ESI+	1	—
Tebuthiuron	ESI+	1	34014-18-1
Tebuthiuron TP 104	ESI+	3	59962-53-7
Tebuthiuron TP 106	ESI+	40	16279-27-9
Tebuthiuron TP 108	ESI+	5	39222-73-6

Table 2.12. U.S. Environmental Protection Agency Laboratory Schedule for pesticides in filtered water from small-volume pesticide autosamplers.—Continued

[EPA, U.S. Environmental Protection Agency; CAS, Chemical Abstracts Service[1]; ESI+, positive electrospray ionization mode; ESI–, negative electrospray ionization mode; MDL, method detection level; ng/L, nanograms per liter; —, no data]

EPA parameter name	Method	MDL (ng/L)	CAS number
Tebuthiuron TP 109 (OH)	ESI+	13	139888-73-6
Terbacil	ESI+	15	5902-51-2
Terbufos	ESI+	4	13071-79-9
Terbufos oxon	ESI+	2	56070-14-5
Terbufos oxon sulfone	ESI+	5	56070-15-6
Terbufos oxon sulfoxide	ESI+	2	56165-57-2
Terbufos sulfone	ESI+	5	56070-16-7
Terbufos sulfoxide	ESI+	1	10548-10-4
Terbuthylazine	ESI+	1	5915-41-3
Tetraconazole	ESI+	5	112281-77-3
Thiobencarb	ESI+	2	28249-77-6
trans-Permethrin	ESI+	100	61949-77-7
Triallate	ESI+	10	2303-17-5
Triallate SA	ESI–	27	65600-62-6
Tribuphos	ESI+	5	78-48-8
Triclopyr	ESI–	44	55335-06-3
Trifloxystrobin	ESI+	1	141517-21-7

[1]This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CAS Registry Numbers through CAS Client Services℠.

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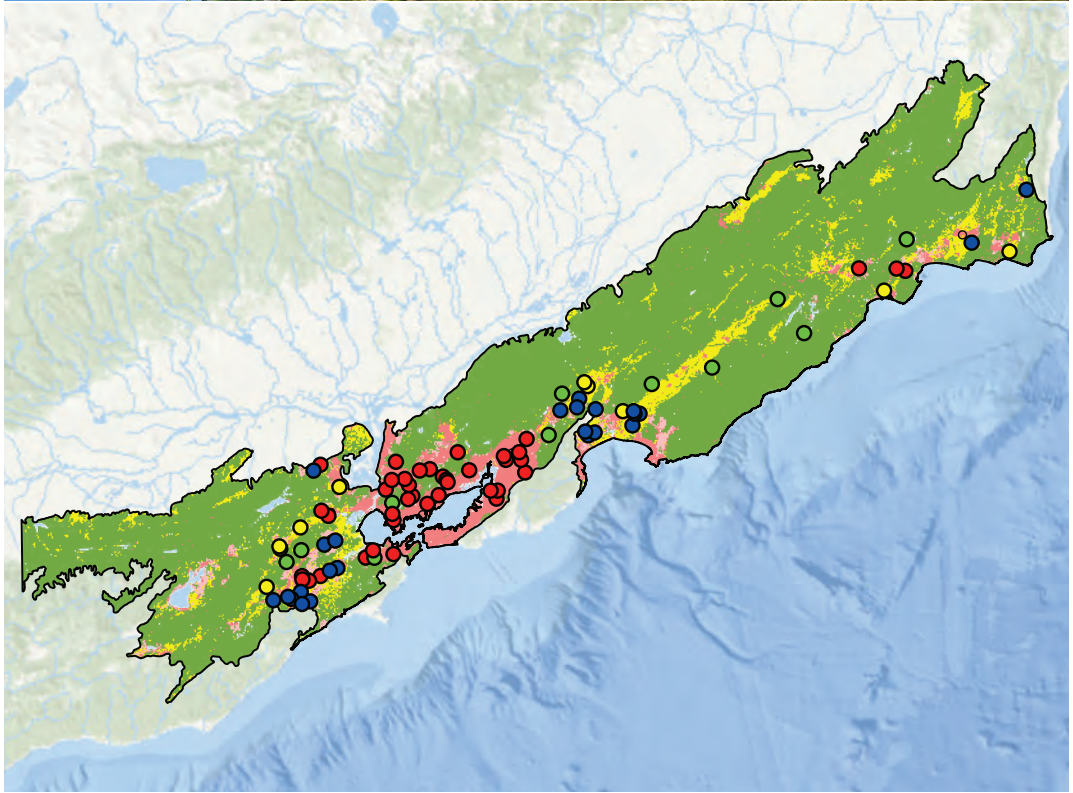

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