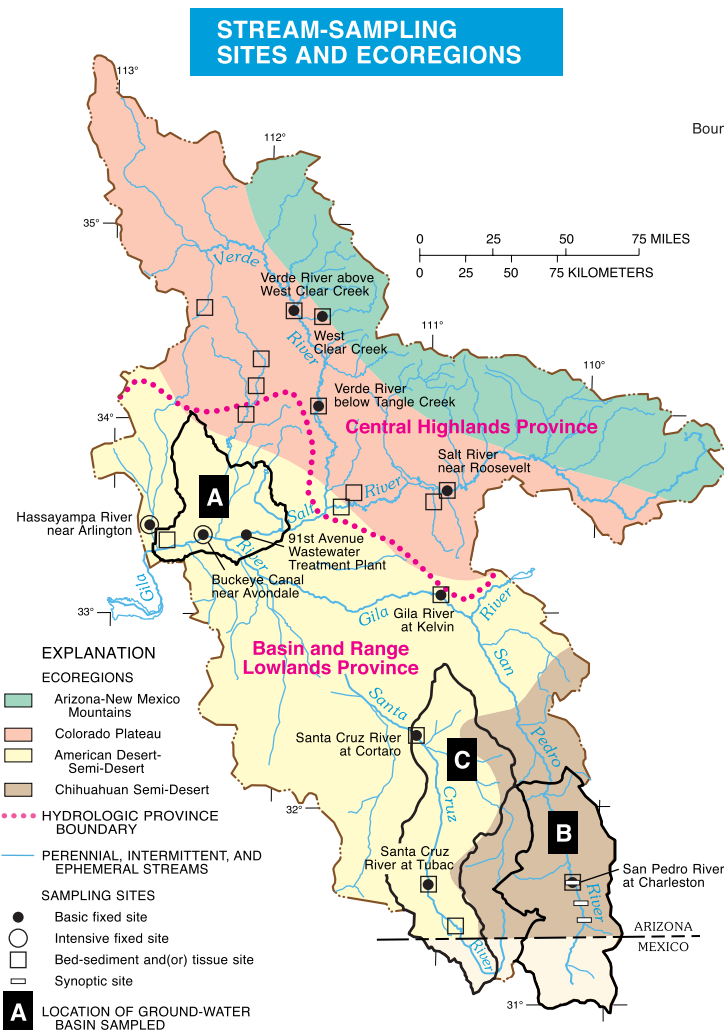


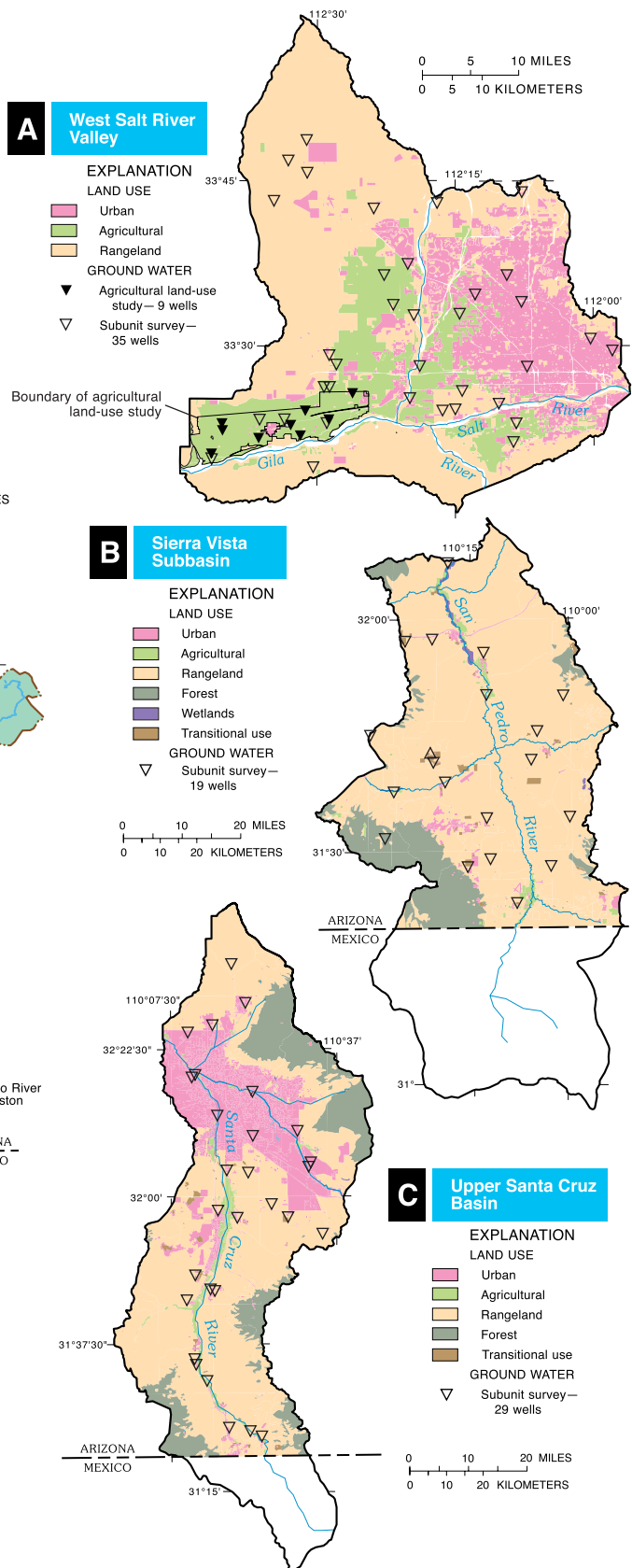
STUDY UNIT DESIGN

The Central Arizona Basins study was designed to provide nationally comparable water-quality data and address local and national questions about water quality. The primary goal of the study was to understand the human and natural factors that affect the chemistry of ground and surface water and communities of aquatic organisms.

Surface-water chemistry and biological-sampling sites were divided between the two main hydrologic



GROUND-WATER-QUALITY-SAMPLING SITES AND LAND USE



provinces in the study area: the Central Highlands and the Basin and Range Lowlands (see above). Ground-water samples were collected in three basins in the Basin and Range Lowlands. Human activities were least in the Sierra Vista subbasin, greatest in the West Salt River Valley, and intermediate in the Upper Santa Cruz Basin. Effects of agricultural activities on ground water were studied in the western part of the West Salt River Valley.

SUMMARY OF DATA COLLECTION IN THE CENTRAL ARIZONA BASINS, 1995–98

Study component	What data were collected and why	Types of sites sampled	Number of sites	Sampling frequency and period
Stream Chemistry				
Basic fixed sites, general water quality	Streamflow, dissolved oxygen, pH, alkalinity, specific conductance, temperature, nutrients, major ions, organic carbon, and suspended sediment were measured to determine occurrence and distribution.	Streams selected to represent urban, mixed agricultural/urban, and forest/rangeland land uses were distributed throughout the study area. Basins ranged from 0 miles (at point sources) to 18,011 square miles.	9	Monthly plus high flows Oct. 1995–Apr. 1998
Intensive fixed sites	Above constituents plus 87 pesticides and 85 volatile organic compounds.	Sites selected closer to urban and (or) agricultural areas so as to be more likely to reflect those land uses.	2	Monthly Jan. 1996–Dec. 1996, increased sampling frequency to approximately twice a month Dec. 1996–Feb. 1998
Fixed sites, dissolved organic carbon	Spectral characteristics of dissolved organic carbon from surface water were measured to determine sources.	Same sites as basic fixed sites and intensive fixed sites.	11	Monthly Jan. 1996–August 1997
Synoptic	Same as basic fixed sites, plus pesticides.	Three locations collocated with key sites for stream ecology synoptic.	3	Quarterly Jan. 97–Oct. 97
Contaminants in bed sediment	Trace elements and (or) organic compounds to determine occurrence and distribution in streambed sediments.	Depositional zones of most basic and intensive stream-chemistry sites plus additional sites.	17	Once May and June 1996
Contaminants in tissues of aquatic biota	Trace elements and (or) organic compounds to determine occurrence and distribution in tissues of fish, clams, and crayfish.	Same sites as sediment samples.	15	Once May and June 1996
Stream Ecology				
Basic sites	Communities of algae, invertebrates, and fish; and instream and riparian habitats surveyed to assess biological conditions of the study area.	Sites collocated with most basic and intensive stream-chemistry sites.	7	Once Oct. 1995–Jan. 1996
			2	Annually 1995–1997
Synoptic	Communities of algae, invertebrates, and fish; and instream and riparian habitats surveyed to evaluate spatial variability.	Nine reaches along one segment of a stream with minimal anthropogenic influences.	9	Once Oct.–Dec. 1996
Ground-Water Chemistry				
Study Unit West Salt River Valley - mixed land use	Nutrients, major ions, trace elements, volatile organic compounds, radon, dissolved organic carbon, and pesticides to assess water quality of the basin's aquifers.	Existing domestic, public-supply, irrigation, livestock, and industrial wells.	35	Once 1996–1997
Study Unit Upper Santa Cruz Basin - mixed land use	Nutrients, major ions, trace elements, volatile organic compounds, radon, dissolved organic carbon, and pesticides to assess water quality of the basin's aquifers.	Existing domestic, public-supply, irrigation, livestock, and industrial wells.	29	Once 1998
Study Unit Sierra Vista subbasin - mixed land use	Nutrients, major ions, trace elements, volatile organic compounds, radon, dissolved organic carbon, and pesticides to assess water quality of the basin's aquifers.	Existing domestic, public-supply, irrigation, and livestock wells.	19	Once 1996
Land use West Salt River Valley - agricultural	Nutrients, major ions, trace elements, volatile organic compounds, radon, dissolved organic carbon, and pesticides to determine effects of agricultural land use on shallow ground-water quality.	Shallow monitoring wells.	9	Twice Aug. 1997 Feb. 1998

GLOSSARY

- Anthropogenic**—A condition or occurrence that is the result of, or is influenced by, human activity.
- Aquatic-life criteria**—Water-quality guidelines for protection of aquatic life. Typically refers to U.S. Environmental Protection Agency water-quality criteria for protection of aquatic organisms.
- Aquifer**—A water-bearing layer of soil, sand, gravel, or rock that will yield usable quantities of water to a well.
- Background concentration**—A concentration of a substance in a particular environment that is indicative of minimal influence by human (anthropogenic) sources.
- Base flow**—Sustained, low flow in a stream; ground-water discharge is the source of base flow in most places.
- Basic fixed sites**—Sites on streams at which streamflow is measured and samples are collected for temperature, salinity, suspended sediment, major ions and metals, nutrients, and organic carbon to assess the broad-scale spatial and temporal character and transport of inorganic constituents of streamwater in relation to hydrologic conditions and environmental settings.
- Bed sediment**—The material that temporarily is stationary in the bottom of a stream or other watercourse.
- Bioaccumulation**—The biological sequestering of a substance at a higher concentration than that at which it occurs in the surrounding environment or medium. Also, the process whereby a substance enters organisms through the gills, epithelial tissues, or dietary or other sources.
- Biomass**—The amount of living matter, in the form of organisms, present in a particular habitat, usually expressed as weight per unit area.
- Breakdown product**—A compound derived by chemical, biological, or physical action upon a pesticide. The breakdown is a natural process that may result in a more toxic or a less toxic compound and a more persistent or less persistent compound.
- Concentration**—The amount or mass of a substance present in a given volume or mass of sample. Usually expressed as milligrams per liter or micrograms per liter (water sample) or micrograms per kilogram (sediment or tissue sample).
- Confining layer**—A layer of sediment or lithologic unit of low permeability that bounds an aquifer.
- Cubic foot per second (ft³/s or cfs)**—Rate of water discharge representing a volume of 1 cubic foot passing a given point during 1 second, equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute or 0.02832 cubic meter per second.
- Dissolved solids**—Amount of minerals, such as salt, that are dissolved in water; amount of dissolved solids is an indicator of salinity or hardness.
- Drainage basin**—The portion of the surface of the Earth that contributes water to a stream through overland runoff, including tributaries and impoundments.
- Drinking-water guideline**—Nonenforceable Federal guideline regarding cosmetic (tooth or skin discoloration) or aesthetic effects (such as taste, color, odor).
- Drinking-water standard**—A threshold concentration in a public drinking-water supply, designed to protect human health or as defined here, standards are U.S. Environmental Protection Agency regulations that specify the maximum contamination levels for public water systems required to protect the public welfare.
- Ecoregion**—An area of similar climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.
- Effluent**—Outflow from a particular source, such as a stream that flows from a lake or liquid waste that flows from a factory or sewage-treatment plant.
- Ephemeral stream**—A stream or part of a stream that flows only in direct response to precipitation or snowmelt. Its channel is above the water table at all times.
- Eutrophication**—The process by which water becomes enriched with plant nutrients, most commonly phosphorus and nitrogen.
- Evaporite minerals (deposits)**—Minerals or deposits of minerals formed by evaporation of water containing salts. These deposits are common in arid climates.
- Evapotranspiration**—A collective term that includes water lost through evaporation from the soil and surface-water bodies and by plant transpiration.
- Infiltration**—Movement of water, typically downward, into soil or porous rock.
- Intensive fixed sites**—Basic Fixed Sites with increased sampling frequency during selected seasonal periods and analysis of dissolved pesticides for 1 year. Most NAWQA Study Units have one to two integrator Intensive Fixed Sites and one to four indicator Intensive Fixed Sites.
- Intermittent stream**—A stream that flows only when it receives water from rainfall runoff or springs, or from some surface source such as melting snow.
- Invertebrate**—An animal having no backbone or spinal column.
- Irrigation return flow**—The part of irrigation applied to the surface that is not consumed by evapotranspiration or uptake by plants and that migrates to an aquifer or surface-water body.
- Land subsidence**—Compression of soft aquifer materials in a confined aquifer due to pumping of water from the aquifer.
- Leaching**—The removal of materials in solution from soil or rock to ground water; refers to movement of pesticides or nutrients from land surface to ground water.
- Load**—General term that refers to a material or constituent in solution, in suspension, or in transport; usually expressed in terms of mass or volume.

LOWESS smooth—LOcally WEighted Scatterplot

Smoothing is a statistical method of defining a smooth curve through the middle of a scatterplot to highlight trends or patterns in the data.

Maximum Contaminant Level (MCL)—Maximum permissible level of a contaminant in water that is delivered to any user of a public water system. MCLs are enforceable standards established by the U.S. Environmental Protection Agency.

Median—The middle or central value in a distribution of data ranked in order of magnitude. The median is also known as the 50th percentile.

Metabolite—A substance produced in or by biological processes.

Micrograms per liter ($\mu\text{g/L}$)—A unit expressing the concentration of constituents in solution as weight (micrograms) of solute per unit volume (liter) of water; equivalent to one part per billion in most stream water and ground water. One thousand micrograms per liter equals 1 mg/L.

Milligrams per liter (mg/L)—A unit expressing the concentration of chemical constituents in solution as mass (milligrams) of solute per unit volume (liter) of water; equivalent to one part per million in most stream water and ground water. One thousand micrograms per liter equals 1 mg/L.

Nutrient—Element or compound essential for animal and plant growth. Common nutrients in fertilizer include nitrogen, phosphorus, and potassium.

Organochlorine insecticide—A class of organic insecticides containing a high percentage of chlorine. Includes dichlorodiphenylethanes (such as DDT), chlorinated cyclodienes (such as chlordane), and chlorinated benzenes (such as lindane). Most organochlorine insecticides were banned because of their carcinogenicity, tendency to bioaccumulate, and toxicity to wildlife.

Perennial stream—A stream that normally has water in its channel at all times.

Pesticide—A chemical applied to crops, rights of way, lawns, or residences to control weeds, insects, fungi, nematodes, rodents or other "pests."

Picocurie (pCi)—One trillionth (10^{-12}) of the amount of radioactivity represented by a curie (Ci). A curie is the quantity of any radioactive nuclide in which the number of disintegrations is 3.7×10^{10} per second (dps). A picocurie yields 2.22 disintegrations per minute (dpm) or 0.037 dps.

Public-supply withdrawals—Water withdrawn by public and private water suppliers for use within a general community. Water is used for a variety of purposes such as domestic, commercial, industrial, and public water use.

Recharge—Water that infiltrates the ground and reaches the saturated zone.

Riparian—Areas adjacent to rivers and streams with a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

Runoff—Excess rainwater or snowmelt that is transported to streams by overland flow, tile drains, or ground water.

Secondary maximum contaminant level (SMCL)—The maximum contamination level in public water systems that, in the judgment of the U.S. Environmental Protection Agency (USEPA), is acceptable to protect the public welfare. SMCLs are secondary (nonenforceable) drinking water regulations established by the USEPA for contaminants that may adversely affect the odor or appearance of such water.

Specific conductance—A measure of the ability of a liquid to conduct an electrical current.

Tolerant species—Those species that are adaptable to (tolerant of) human alterations to the environment and often increase in number when human alterations occur.

Trace element—An element typically found in only minor amounts (concentrations less than 1.0 milligram per liter) in water; includes arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc.

Volatile organic compounds (VOCs)—Organic chemicals that have a high vapor pressure relative to their water solubility. VOCs include components of gasoline, fuel oils, and lubricants, as well as organic solvents, fumigants, some inert ingredients in pesticides, and some by-products of chlorine disinfection.

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APPENDIX—WATER-QUALITY DATA FROM THE CENTRAL ARIZONA BASINS IN A NATIONAL CONTEXT

For a complete view of Central Arizona Basins data and for additional information about specific benchmarks used, visit our Web site at <http://water.usgs.gov/nawqa/>. Also visit the NAWQA Data Warehouse for access to NAWQA data sets at <http://water.usgs.gov/nawqa/data>.

This appendix is a summary of chemical concentrations and biological indicators assessed in the Central Arizona Basins. Selected results for this Study Unit are graphically compared to results from as many as 36 NAWQA Study Units investigated from 1991 to 1998 and to national water-quality benchmarks for human health, aquatic life, or fish-eating wildlife. The chemical and biological indicators shown were selected on the basis of frequent detection, detection at concentrations above a national benchmark, or regulatory or scientific importance. The graphs illustrate how conditions associated with each land use sampled in the Central Arizona Basins compare to results from across the Nation, and how conditions compare among the several land uses. Graphs for chemicals show only detected concentrations and, thus, care must be taken to evaluate detection frequencies in addition to concentrations when comparing study-unit and national results. For example, trifluralin concentrations in Central Arizona Basins agricultural streams were similar to the national distribution, but the detection frequency was much higher (76 percent compared to 21 percent).

CHEMICALS IN WATER

Concentrations and detection frequencies, Central Arizona Basins, 1995–98—Detection sensitivity varies among chemicals and, thus, frequencies are not directly comparable among chemicals

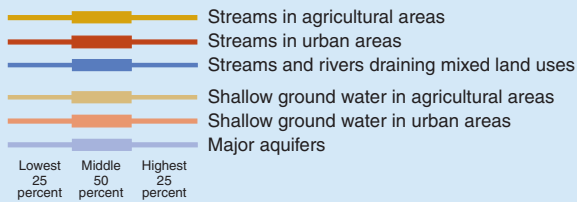
◆ Detected concentration in Study Unit

⁶⁶ ³⁸ Frequencies of detection, in percent. Detection frequencies were not censored at any common reporting limit. The left-hand column is the study-unit frequency and the right-hand column is the national frequency

-- Not measured or sample size less than two

¹² Study-unit sample size. For ground water, the number of samples is equal to the number of wells sampled

National ranges of detected concentrations, by land use, in 36 NAWQA Study Units, 1991–98—Ranges include only samples in which a chemical was detected

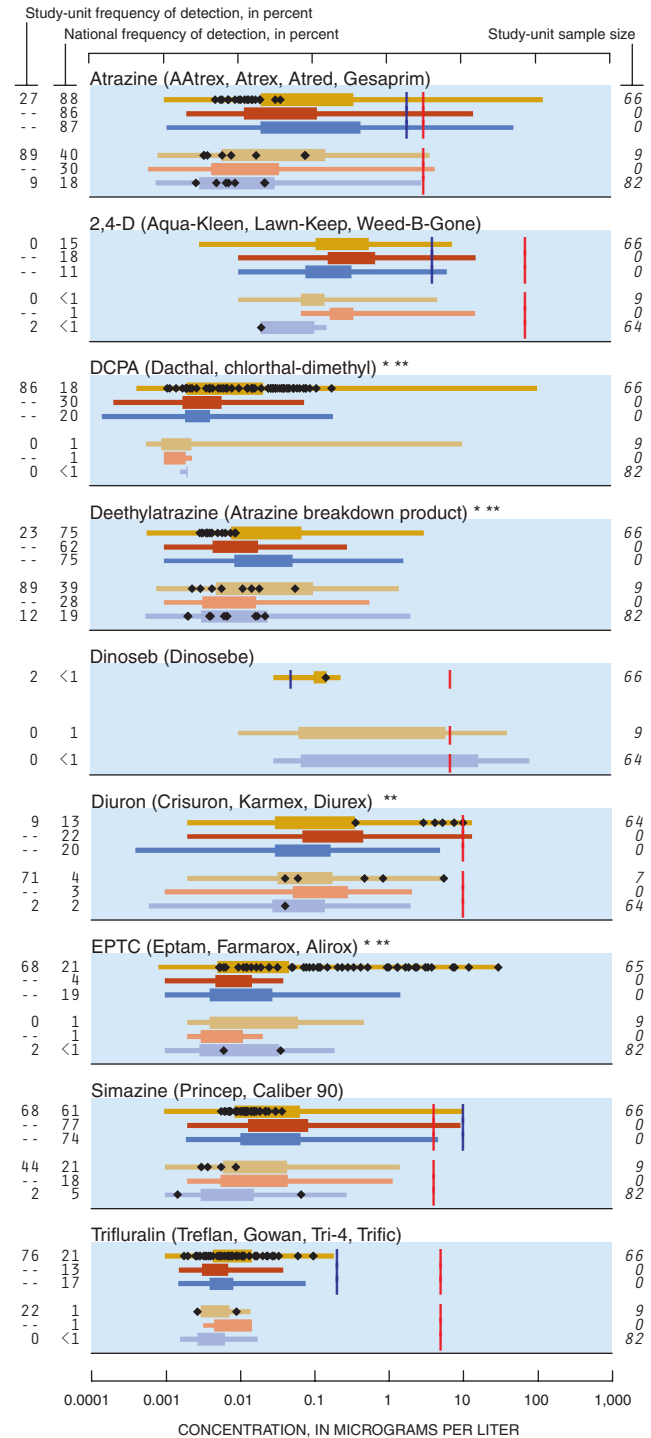


National water-quality benchmarks

National benchmarks include standards and guidelines related to drinking-water quality, criteria for protecting the health of aquatic life, and a goal for preventing stream eutrophication due to phosphorus. Sources include the U.S. Environmental Protection Agency and the Canadian Council of Ministers of the Environment

- | Drinking-water quality (applies to ground water and surface water)
- | Protection of aquatic life (applies to surface water only)
- | Prevention of eutrophication in streams not flowing directly into lakes or impoundments
- * No benchmark for drinking-water quality
- ** No benchmark for protection of aquatic life

Pesticides in water—Herbicides



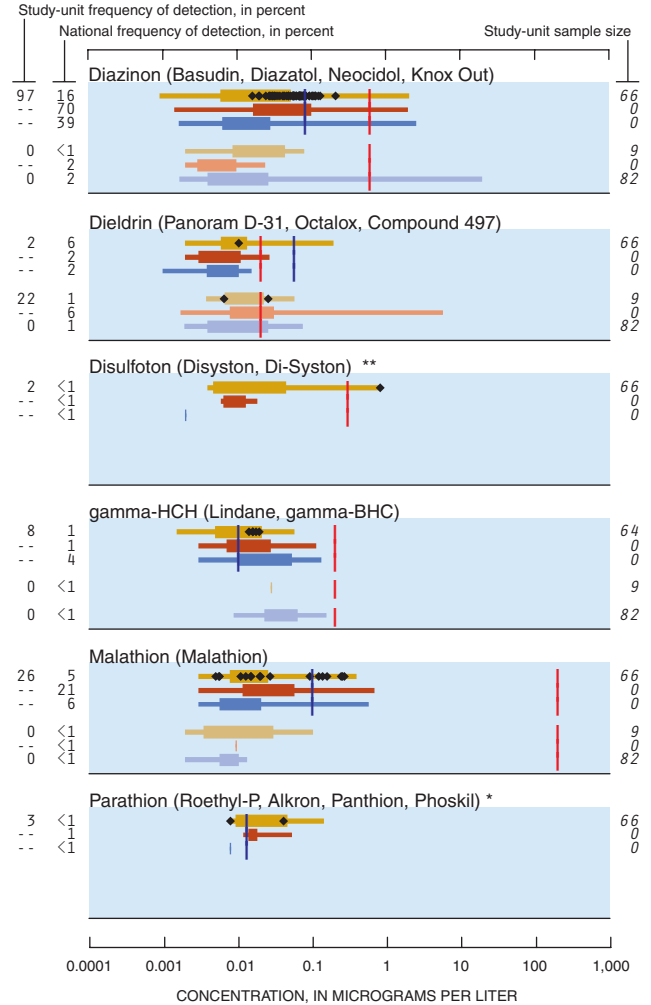
Other herbicides detected

- Acetochlor (Harness Plus, Surpass) ** *
- Benfluralin (Balan, Benefin, Bonalan) ** *
- Cyanazine (Bladex, Fortrol)
- Linuron (Lorox, Linex, Sarclex, Linurex, Afalon) *
- Metribuzin (Lexone, Sencor)

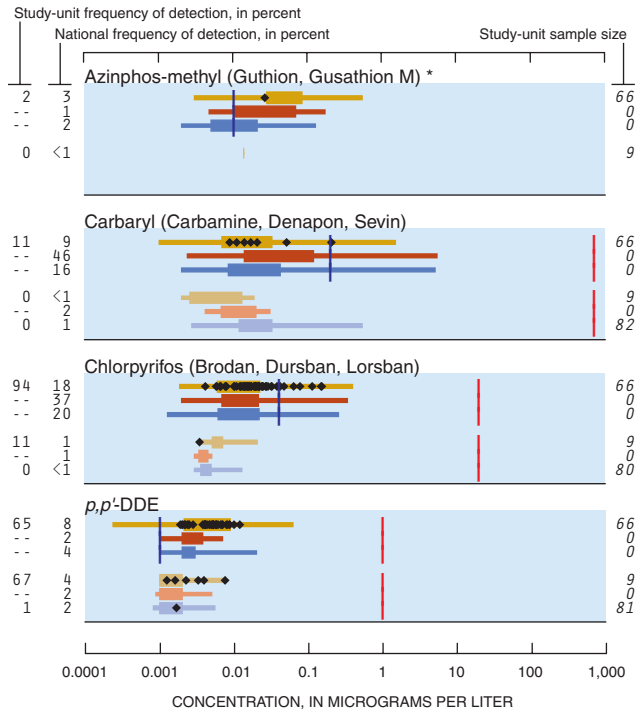
Molinate (Ordram) * **
 Pendimethalin (Pre-M, Prowl, Stomp) * **
 Prometon (Pramitol, Princep) **
 Pronamide (Kerb, Propyzamid) **
 Propachlor (Ramrod, Satecid) **
 Tebuthiuron (Spike, Tebusan)
 Triallate (Far-Go, Avadex BW, Tri-allate) *

Herbicides not detected

Acifluorfen (Blazer, Tackle 2S) **
 Alachlor (Lasso, Bronco, Lariat, Bullet) **
 Bentazon (Basagran, Bentazone) **
 Bromacil (Hyvar X, Urox B, Bromax)
 Bromoxynil (Buctril, Brominal) *
 Butylate (Sutan +, Genate Plus, Butilate) **
 Chloramben (Amiben, Amilon-WP, Vegiben) **
 Clopyralid (Stinger, Lontrel, Transline) * **
 2,4-DB (Butyrac, Butoxone, Embutox Plus, Embutone) * **
 Dacthal mono-acid (Dacthal breakdown product) * **
 Dicamba (Banvel, Dianat, Scotts Proturf)
 Dichlorprop (2,4-DP, Seritox 50, Lentemul) * **
 2,6-Diethylaniline (Alachlor breakdown product) * **
 Ethalfuralin (Sonalan, Curbit) * **
 Fenuron (Fenulon, Fenidim) * **
 Fluometuron (Flo-Met, Cotoran) **
 MCPA (Rhomene, Rhonox, Chiptox)
 MCPB (Thistrol) * **
 Metolachlor (Dual, Pennant)
 Napropamide (Devrinol) * **
 Neburon (Neburea, Neburyl, Noruben) * **
 Norflurazon (Evital, Predict, Solicam, Zorial) * **
 Oryzalin (Surflan, Dirimal) * **
 Pebulate (Tillam, PEBC) * **
 Picloram (Grazon, Tordon)
 Propanil (Stam, Stampede, Wham) * **
 Propham (Tuberite) **
 2,4,5-T **
 2,4,5-TP (Silvex, Fenoprop) **
 Terbacil (Sinbar) **
 Thiobencarb (Bolero, Saturn, Benthicarb) * **
 Triclopyr (Garlon, Grandstand, Redeem, Remedy) * **



Pesticides in water—Insecticides



Other insecticides detected

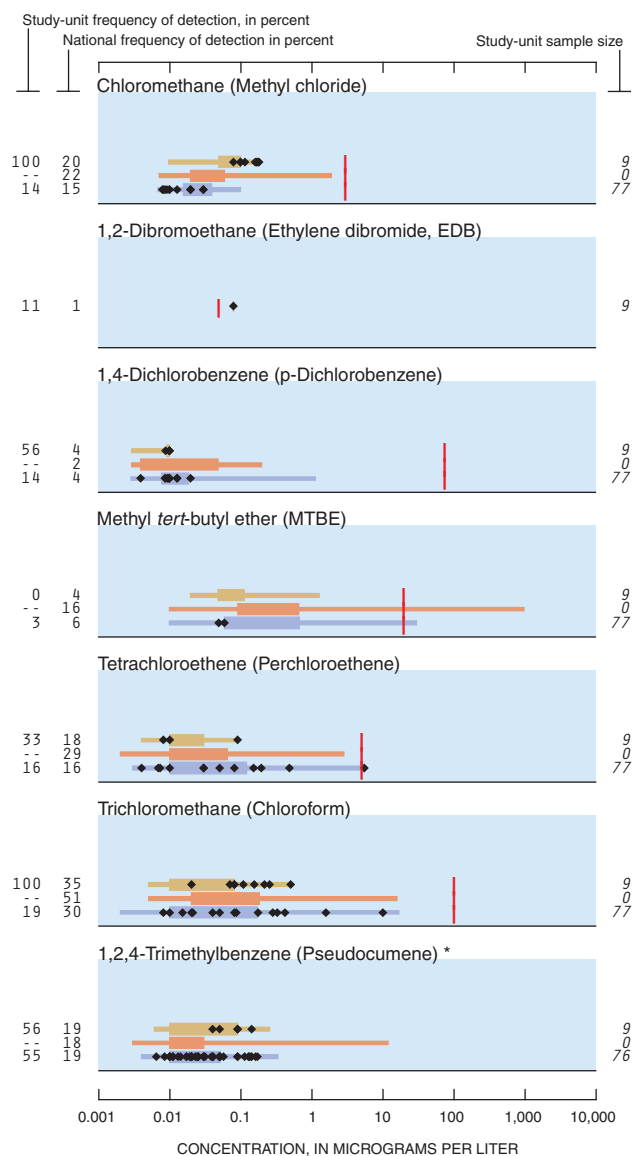
Carbofuran (Furadan, Curaterr, Yaltox)
 Methomyl (Lanox, Lannate, Acinate) **
 Methyl parathion (Penncap-M, Folidol-M) **
 Phorate (Thimet, Granutox, Geomet, Rampart) * **
 Propoxur (Baygon, Blattanex, Uden, Proprotol) * **

Insecticides not detected

Aldicarb (Temik, Ambush, Pounce)
 Aldicarb sulfone (Standak, aldoxycarb)
 Aldicarb sulfoxide (Aldicarb breakdown product)
 Ethoprop (Mocap, Ethoprophos) * **
 Fonofos (Dyfonate, Capfos, Cudgel, Tycap) **
 alpha-HCH (alpha-BHC, alpha-lindane) **
 3-Hydroxycarbofuran (Carbofuran breakdown product) * **
 Methiocarb (Slug-Geta, Grandslam, Mesuroil) * **
 Oxamyl (Vydate L, Pratt) **
 cis-Permethrin (Ambush, Astro, Pounce) * **
 Propargite (Comite, Omite, Ornamate) * **
 Terbufos (Contraven, Counter, Pilarfox) **

Volatile organic compounds (VOCs) in ground water

These graphs represent data from 16 Study Units, sampled from 1996 to 1998



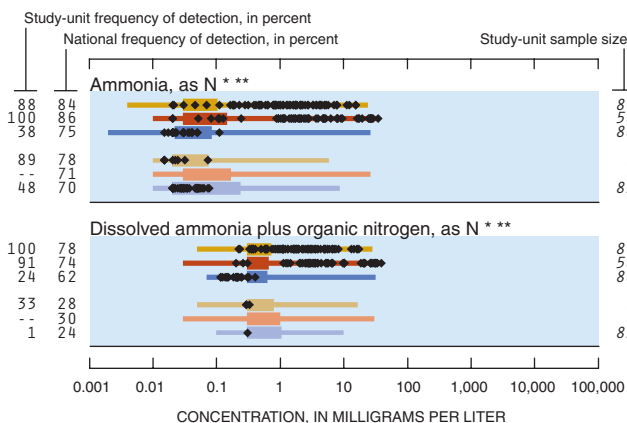
Other VOCs detected

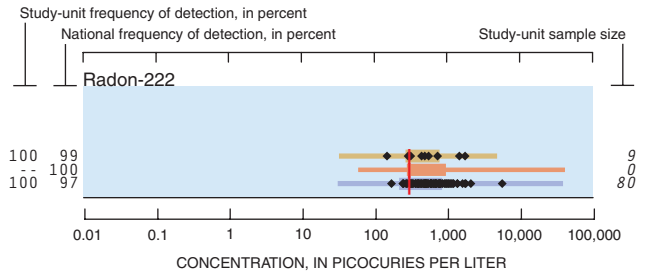
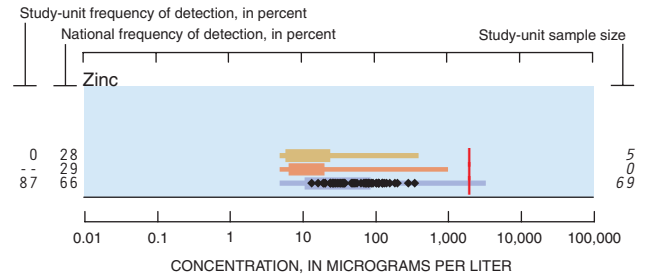
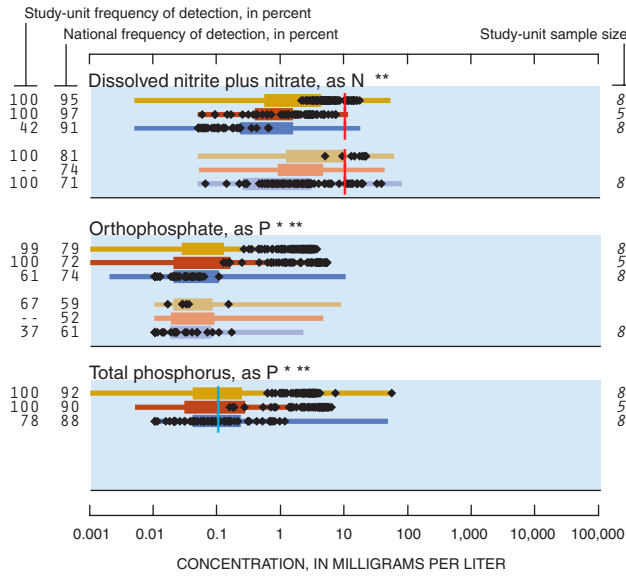
Benzene
 Bromodichloromethane (Dichlorobromomethane)
 Carbon disulfide *
 1-Chloro-2-methylbenzene (*o*-Chlorotoluene)
 Chlorobenzene (Monochlorobenzene)
 Dichlorodifluoromethane (CFC 12, Freon 12)
 1,1-Dichloroethane (Ethylidene dichloride) *
 1,1-Dichloroethene (Vinylidene chloride)
 Dichloromethane (Methylene chloride)
 1,2-Dimethylbenzene (*o*-Xylene)
 1,3 & 1,4-Dimethylbenzene (*m*-&*p*-Xylene)
 1-4-Epoxy butane (Tetrahydrofuran, Diethylene oxide) *
 Ethylbenzene (Phenylethane)
 Iodomethane (Methyl iodide) *
 Methylbenzene (Toluene)
 2-Propanone (Acetone) *
 Tribromomethane (Bromoform)
 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) *
 1,1,1-Trichloroethane (Methylchloroform)
 Trichloroethene (TCE)
 Trichlorofluoromethane (CFC 11, Freon 11)

VOCs not detected

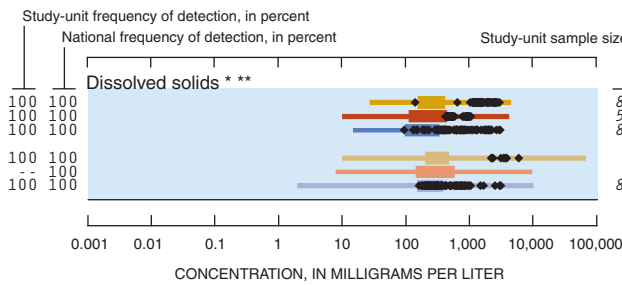
tert-Amylmethylether (*tert*-amyl methyl ether (TAME)) *
 Bromobenzene (Phenyl bromide) *
 Bromochloromethane (Methylene chlorobromide)
 Bromoethene (Vinyl bromide) *
 Bromomethane (Methyl bromide)
 2-Butanone (Methyl ethyl ketone (MEK)) *
n-Butylbenzene (1-Phenylbutane) *
sec-Butylbenzene *
tert-Butylbenzene *
 3-Chloro-1-propene (3-Chloropropene) *
 1-Chloro-4-methylbenzene (*p*-Chlorotoluene)
 Chlorodibromomethane (Dibromochloromethane)
 Chloroethane (Ethyl chloride) *
 Chloroethene (Vinyl chloride)
 1,2-Dibromo-3-chloropropane (DBCP, Nemagon)
 Dibromomethane (Methylene dibromide) *
trans-1,4-Dichloro-2-butene ((*Z*)-1,4-Dichloro-2-butene) *
 1,2-Dichlorobenzene (*o*-Dichlorobenzene)
 1,3-Dichlorobenzene (*m*-Dichlorobenzene)
 1,2-Dichloroethane (Ethylene dichloride)
trans-1,2-Dichloroethene ((*E*)-1,2-Dichloroethene)
cis-1,2-Dichloroethene ((*Z*)-1,2-Dichloroethene)
 1,2-Dichloropropane (Propylene dichloride)
 2,2-Dichloropropane *
 1,3-Dichloropropane (Trimethylene dichloride) *
trans-1,3-Dichloropropene ((*E*)-1,3-Dichloropropene)
cis-1,3-Dichloropropene ((*Z*)-1,3-Dichloropropene)
 1,1-Dichloropropene *
 Diethyl ether (Ethyl ether) *
 Diisopropyl ether (Diisopropylether (DIPE)) *
 Dimethylbenzenes (Xylenes (total))
 Ethenylbenzene (Styrene)
 Ethyl methacrylate *
 Ethyl *tert*-butyl ether (Ethyl-*t*-butyl ether (ETBE)) *
 1-Ethyl-2-methylbenzene (2-Ethyltoluene) *
 Hexachlorobutadiene
 1,1,1,2,2,2-Hexachloroethane (Hexachloroethane)
 2-Hexanone (Methyl butyl ketone (MBK)) *
 Isopropylbenzene (Cumene) *
p-Isopropyltoluene (*p*-Cymene) *
 Methyl acrylonitrile *
 Methyl-2-methacrylate (Methyl methacrylate) *
 4-Methyl-2-pentanone (Methyl isobutyl ketone (MIBK)) *
 Methyl-2-propenoate (Methyl acrylate) *
 Naphthalene
 2-Propenenitrile (Acrylonitrile)
n-Propylbenzene (Isocumene) *
 1,1,1,2,2-Tetrachloroethane *
 1,1,1,2-Tetrachloroethane
 Tetrachloromethane (Carbon tetrachloride)
 1,2,3,4-Tetramethylbenzene (Prehnitene) *
 1,2,3,5-Tetramethylbenzene (Isodurene) *
 1,2,4-Trichlorobenzene
 1,2,3-Trichlorobenzene *
 1,1,2-Trichloroethane (Vinyl trichloride)
 1,2,3-Trichloropropane (Allyl trichloride)
 1,2,3-Trimethylbenzene (Hemimellitene) *
 1,3,5-Trimethylbenzene (Mesitylene) *

Nutrients in water





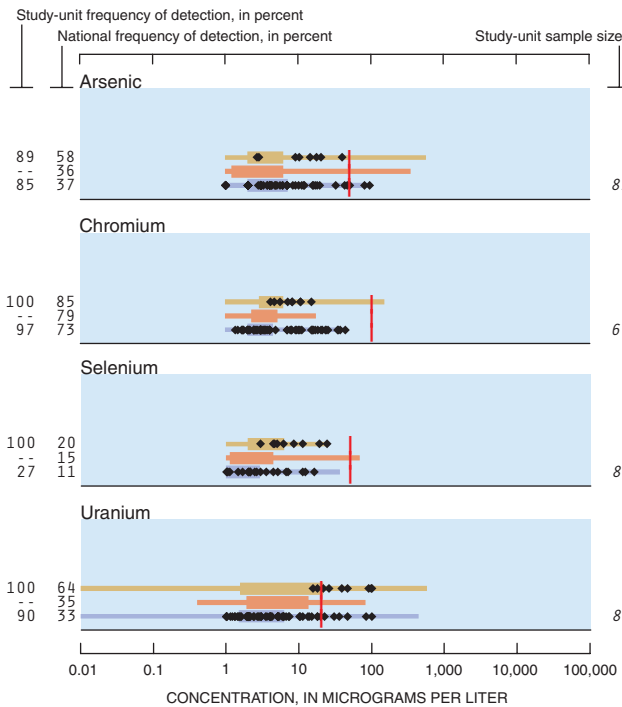
Dissolved solids in water



Other trace elements detected
Lead

Trace elements not detected
Cadmium

Trace elements in ground water



CHEMICALS IN FISH TISSUE AND BED SEDIMENT

Concentrations and detection frequencies, Central Arizona Basins, 1995–98—Detection sensitivity varies among chemicals and, thus, frequencies are not directly comparable among chemicals.

Study-unit frequencies of detection are based on small sample sizes; the applicable sample size is specified in each graph

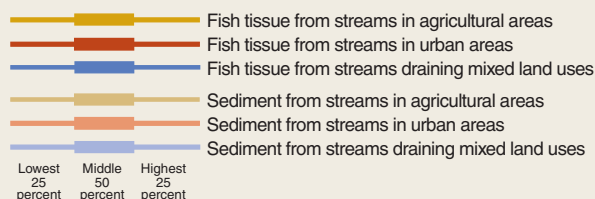
◆ Detected concentration in Study Unit

66 38 Frequencies of detection, in percent. Detection frequencies were not censored at any common reporting limit. The left-hand column is the study-unit frequency and the right-hand column is the national frequency

-- Not measured or sample size less than two

12 Study-unit sample size

National ranges of concentrations detected, by land use, in 36 NAWQA Study Units, 1991–98—Ranges include only samples in which a chemical was detected

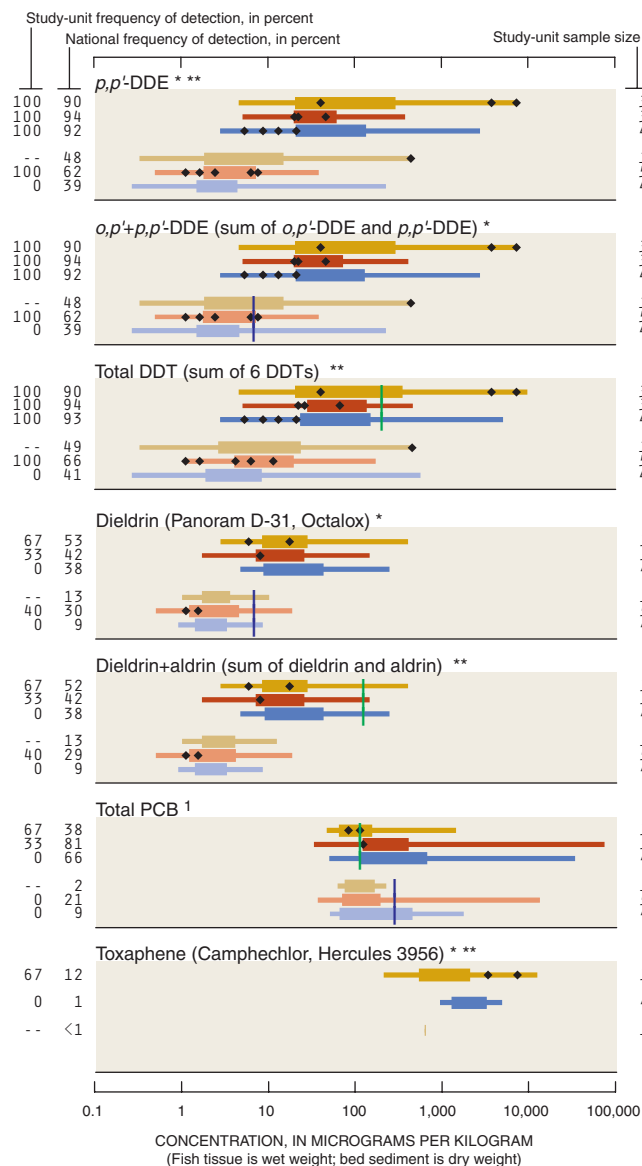
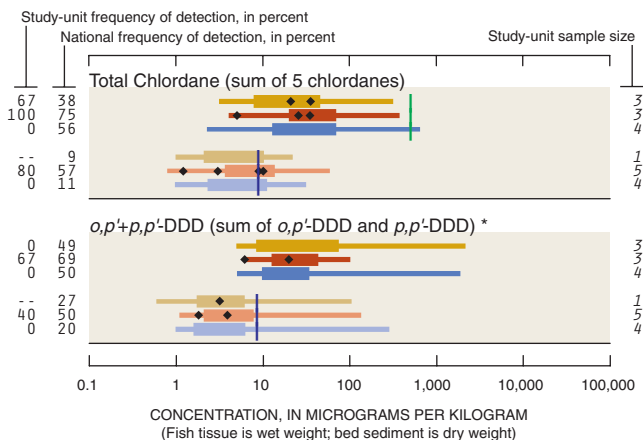


National benchmarks for fish tissue and bed sediment

National benchmarks include standards and guidelines related to criteria for protection of the health of fish-eating wildlife and aquatic organisms. Sources include the U.S. Environmental Protection Agency, other Federal and State agencies, and the Canadian Council of Ministers of the Environment

- | Protection of fish-eating wildlife (applies to fish tissue)
- | Protection of aquatic life (applies to bed sediment)
- * No benchmark for protection of fish-eating wildlife
- ** No benchmark for protection of aquatic life

Organochlorines in fish tissue (whole body) and bed sediment



¹ The national detection frequencies for total PCB in sediment are biased low because about 30 percent of samples nationally had elevated detection levels compared to this Study Unit. See <http://water.usgs.gov/nawqa/> for additional information.

Other organochlorines detected

Pentachloroanisole (PCA) ***
cis-Permethrin (Ambush, Astro, Pounce) ***
trans-Permethrin (Ambush, Astro, Pounce) ***

Organochlorines not detected

Chloroneb (Chloronebe, Demosan) ***
 DCPA (Dacthal, chlorthal-dimethyl) ***
 Endosulfan I (alpha-Endosulfan, Thiodan) ***
 Endrin (Endrine)
 gamma-HCH (Lindane, gamma-BHC, Gammexane) *
 Total-HCH (sum of alpha-HCH, beta-HCH, gamma-HCH, and delta-HCH) **
 Heptachlor epoxide (Heptachlor breakdown product) *
 Heptachlor+heptachlor epoxide (sum of heptachlor and heptachlor epoxide) **
 Hexachlorobenzene (HCB) **
 Isodrin (Isodrine, Compound 711) ***
 p,p'-Methoxychlor (Marlate, methoxychlor) ***
 o,p'-Methoxychlor * **
 Mirex (Dechlorane) **

BIOLOGICAL INDICATORS

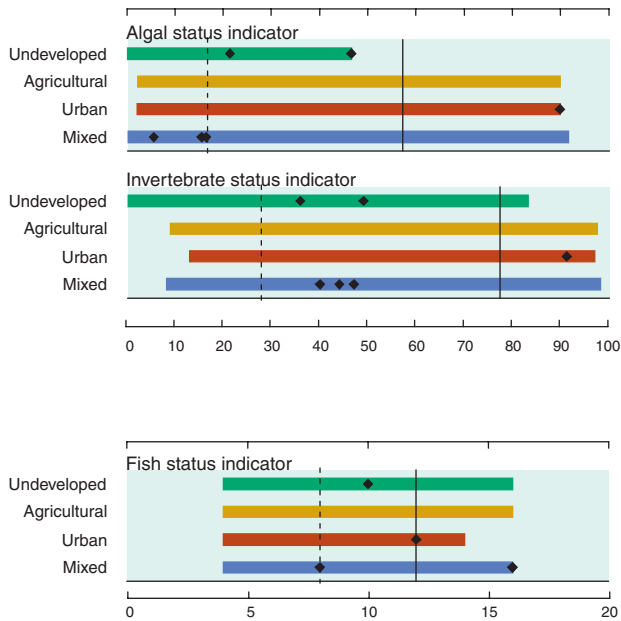
Higher national scores suggest habitat disturbance, water-quality degradation, or naturally harsh conditions. The status of algae, invertebrates (insects, worms, and clams), and fish provide a record of water-quality and stream conditions that water-chemistry indicators may not reveal. **Algal status** focuses on the changes in the percentage of certain algae in response to increasing siltation, and it often correlates with higher nutrient concentrations in some regions. **Invertebrate status** averages 11 metrics that summarize changes in richness, tolerance, trophic conditions, and dominance associated with water-quality degradation. **Fish status** sums the scores of four fish metrics (percent tolerant, omnivorous, non-native individuals, and percent individuals with external anomalies) that increase in association with water-quality degradation

Biological indicator value, Central Arizona Basins, by land use, 1995–98

- ◆ Biological status assessed at a site

National ranges of biological indicators, in 16 NAWQA Study Units, 1994–98

- Streams in undeveloped areas
- Streams in agricultural areas
- Streams in urban areas
- Streams in mixed-land-use areas
- 75th percentile
- - - 25th percentile



A COORDINATED EFFORT

Coordination with agencies and organizations in the Central Arizona Basins Study Unit was integral to the success of this water-quality assessment. We thank those who served as members of our liaison committee.

Federal Agencies

Bureau of Indian Affairs
Bureau of Reclamation
Centro de Investigación y Estudios Ambientales
Comisión Nacional del Agua
International Boundary and Water Commission
National Park Service
Natural Resources Conservation Service
Salt River-Pima Indian Community
Tohono O'odham Nation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service (USFWS)
U.S. Department of Agriculture, Forest Service
U.S. Department of Agriculture, Water Conservation Laboratory

State Agencies

Arizona Department of Environmental Quality (ADEQ)
Arizona Department of Water Resources (ADWR)
Arizona Game and Fish Department (AzGF)
Arizona Geological Survey

Local Agencies

City of Phoenix
City of Tucson
Maricopa County
Pima Association of Governments
Pima County
Southern Arizona Association of Governments

Universities

Arizona State University
University of Arizona

Other public and private organizations

Arizona Toxics Information
Friends of the Santa Cruz River
Salt River Project
Southern Arizona Water Resources Association
The Nature Conservancy

We thank the following individuals and organizations for contributing to this effort.

Laurie Wirt (USGS) designed and guided the surface-water-quality sampling program for the CAZB from 1994 to 1996.

Doug Towne and Maureen Freark (ADEQ) coordinated with CAZB to design cooperative ground-water studies in the Upper Santa Cruz Basin and the Sierra Vista subbasin.

Salt River Project, ADEQ, and ADWR provided valuable data for our study.

Buckeye Water Conservation and Drainage District, City of Phoenix, City of Peoria, Town of Buckeye, City of Goodyear, Roosevelt Irrigation District, and numerous individual landowners allowed us access to their wells and data.

Terry Short, Lisa H. Nowell, A.B. Richards, and Steve Goodbred provided invaluable assistance and guidance for the CAZB biological data collection and reports.

Patrice Spindler (ADEQ), Kirke King (USFW), Kirk Young (AzGF), W.L. Minckley, and Paul Marsh (ASU) provided information and expertise for the biological aspects of this project.

Karen Beaulieu, Dave Peyton, Joe Capesius, Christie O'Day, Ann Tillery, Melissa Butler, Todd Ingersol, Ray Davis, David Graham, Ken Galyean, Frank Oliver, Rodrigo Morales, Tasha Lewis, Dawn McDoniel, Herb Pierce, Cory Angeroth (USGS), Tom Rees (volunteer), and Brian Popadac (volunteer) assisted with data collection and compilation.

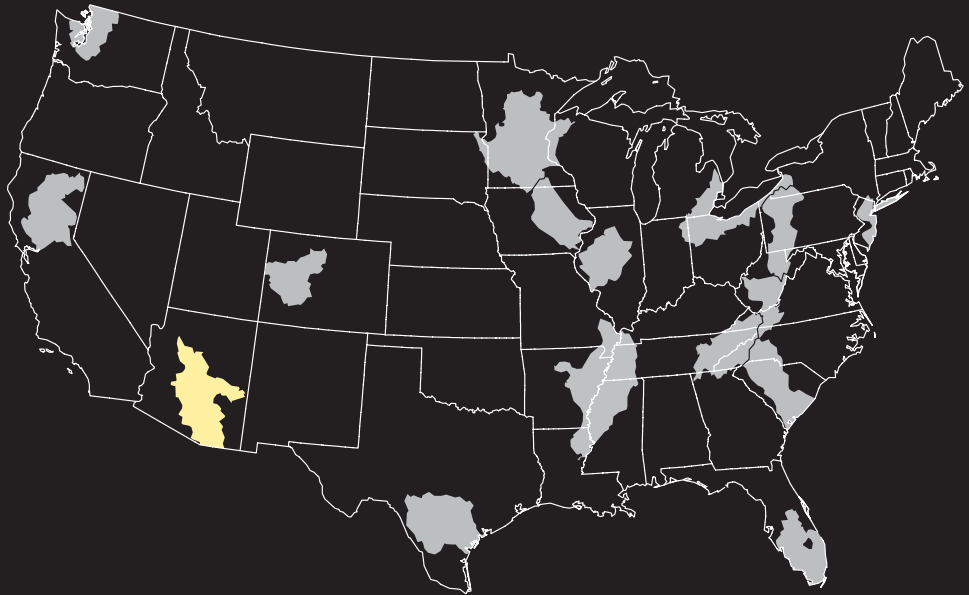
Sid Alwin, Pat Rigas, Doug Cummings, and John Callahan (USGS) contributed their talents to the preparation of this report.

Norm Spahr and Joe Domagalski (USGS), Marlene Baker (Concerned Citizens About Responsible Environment), Jeanmarie Haney (Tucson Regional Water Council), and many NAWQA Program staff provided valuable reviews of this report.

We extend special thanks and appreciation to our spouses, families, and friends, without whose support we could not have accomplished the work described herein.

NAWQA

National Water-Quality Assessment (NAWQA) Program Central Arizona Basins



Cordly and others—Water Quality in the Central Arizona Basins
U.S. Geological Survey Circular 1213

ISBN 0-607-95418-3



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