

Appendix 1. Summary of selected studies on domestic well water quality in the United States

Table

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[**Geographic scale:** Number in parentheses is number of states or counties in study area. U.S., United States. **Targeted contaminants:** Bact, fecal indicator bacteria; compounds. **Study findings: Percentage of wells with concentrations greater than USEPA MCLs:** Value for total coliform bacteria is any detection, MCL for maximum contaminant level; mg/L, milligram per liter; µg/L, microgram per liter; CDC, U.S. Centers for Disease Control and Prevention; USGS, U.S. Geological

State	Geographic scale	Targeted contaminants	Sampling design	Target population or area(s)
Multiple states	National	Bact, NO ₃ , Majors, TE, Rad, Pest	Random stratified	Rural households
	National	NO ₃ , Pest	Random and random stratified	Rural households
	Multiple states	Pest	Random stratified	Counties where alachlor was sold
	Multiple states (12) in the midwestern U.S.	NO ₃ , Pest	Non-random	Agricultural areas and shallow aquifers
	Multiple states (6)	All available data	Compilation of existing data	--
	Multiple states (5) in the midwestern U.S.	NO ₃ , Pest	Voluntary testing	--
	Multiple states (9) in the midwestern U.S.	Bact, NO ₃ , Pest	Random and random stratified	--
	Multiple states (4) in the southeastern U.S.	As	Voluntary testing	--
Alabama	National	NO ₃ , Majors, TE, Pest, VOCs, Rn, Rad	Non-random	--
	Statewide	NO ₃	Voluntary testing	--
California	County	Bact	Non-random	--
	County	Bact, NO ₃ , TE, VOCs, Rad	Voluntary testing	Specific focus areas
Georgia	Multiple counties (61)	NO ₃ , Majors	Non-random	Counties with intensive agriculture
	Statewide	Bact, NO ₃	Voluntary testing	--
Idaho	Statewide	NO ₃	Unknown	--
	Statewide	As	Stratified random	--
	Statewide	NO ₃	Stratified random	--
Illinois	Multiple counties (5)	NO ₃ , Pest	Stratified random	Agricultural areas with various aquifer depths
	Multiple counties (74)	NO ₃ , Pest	Random	--
	Statewide	F	Voluntary testing	--
Iowa	Statewide	Bact, NO ₃ , Majors, Pest	Stratified random	Rural households
	Statewide	Rn	Random	--
	Statewide	Bact, NO ₃ , Pest, As	Random	Wells serving multiple households
Kansas	Statewide	NO ₃ , Majors, Rad	Non-random	--
	Multiple counties (49)	NO ₃ , Majors, TE, Pest, VOCs	Non-random	Farm households
	Multiple counties (33)	NO ₃ , Pest	Non-random	Agricultural areas with shallow water table and permeable sediments
Kentucky	Statewide	NO ₃ , Pest	Voluntary testing	--
Louisiana	Statewide	NO ₃ , Majors, TE, Pest, VOCs, others	Non-random stratified	--

NO₃, nitrate; Majors, major ions; TE, trace elements; Rn, radon; Rad, radioactivity or radionuclides other than radon; Pest, pesticides; VOCs, volatile organic nitrate is 10 mg/L as N, and MCL for arsenic is 10 µg/L; numbers have been rounded to two significant digits. USEPA, U.S. Environmental Protection Agency; MCL, Survey; Coop. Ext., University Cooperative Extension Program; --, not available or not applicable; ~, approximately]

Number of wells	Agency or agency type	Study findings: Percentage of wells with concentrations greater than USEPA MCLs			Reference
		Total coliform bacteria	Nitrate	Arsenic	
1,057	USEPA	42	4.1	--	U.S. Environmental Protection Agency (1984)
734	USEPA	--	2.4	--	U.S. Environmental Protection Agency (1990a, 1990b, 1992)
1,430	Industry	--	4.9	--	Holden and others (1992)
303	USGS	--	6.0	--	Kolpin and others (1994)
--	U.S. General Accounting Office	14–46	3.2–28.2	--	U.S. General Accounting Office (1997)
34,759	University	--	3.4	--	Richards and others (1996)
5,520	CDC	41	13	--	U.S. Centers for Disease Control and Prevention (1998)
¹ 179	University	--	--	6.0	Shiber (2005)
~2,000–15,000	USGS	--	8.4	11	Focazio and others (2006)
1,021	Coop. Ext.	--	1.0–2.0	--	Liu and others (2005)
50	University	78	8.0	--	Conine and others (1989)
398	State	28	1.8	3.8	State Water Resources Control Board (2005)
2,588	State and University	--	1.7	--	Stuart and others (1995)
² 1,413	Coop. Ext.	41	3.6	--	Sonan and others (2005)
2,524	University and other	--	6.0	--	Mahler and Loeffelman (1999)
³ ~1,900	State and USGS	--	5.0	~15	Hagan (2004)
⁴ 1,868	State and USGS	--	5.0	--	Neely (2005)
240	State	--	18	--	Schock and others (1992); Mehnert and others (1995)
337	State	--	11	--	Goetsch and others (1992) in Ray and Schock (1996)
8,519	State	--	--	--	Mallatt and others (2003)
686	State and University	45	18	--	Hallberg and others (1992)
352	University	--	--	--	Field and Kross (1998) and Field (1996)
103	University and USGS	30	23	2.9	Iowa Department of Natural Resources (2004)
⁵ 766	USGS and State	--	14	--	Spruill (1983)
103	University	--	28	--	Steichen and others (1988)
78	State	--	32	--	Townsend and others (1998)
4,859	Coop. Ext., State, and other	--	4.6	--	Carey and others (1993)
⁶ 194	State	--	0	1.0	Louisiana Department of Environmental Quality (2003)

Table 1–1. Summary of selected studies on domestic well water quality in the United States.—Continued

[**Geographic scale:** Number in parentheses is number of states or counties in study area. U.S., United States. **Targeted contaminants:** Bact, fecal indicator bacteria; compounds. **Study findings: Percentage of wells with concentrations greater than USEPA MCLs:** Value for total coliform bacteria is any detection, MCL for maximum contaminant level; mg/L, milligram per liter; µg/L, microgram per liter; CDC, U.S. Centers for Disease Control and Prevention; USGS, U.S. Geological

State	Geographic scale	Targeted contaminants	Sampling design	Target population or area(s)
Maine	Statewide	VOCs	Random	--
Maryland	County	Bact, NO ₃	Required testing	--
Minnesota	Statewide	NO ₃ , Pest	Non-random	Agricultural areas with shallow water table and susceptible aquifers
Missouri	Multiple counties (~17)	NO ₃	Non-random stratified	Agricultural areas with various soil and aquifer types
Montana	Multiple counties (38)	Bact, NO ₃	Voluntary testing	--
Nebraska	Statewide	VOCs	Non-random	Wells near waste-disposal sites
	Statewide	Bact, NO ₃ , F, Pest	Stratified random	--
New Hampshire	Statewide	As	Random	--
	Multiple counties (3)	As	Stratified random	Bedrock wells
New Jersey	Statewide	Bact, NO ₃ , TE, VOCs	Required testing	--
New Mexico	Multiple counties (4)	Bact, NO ₃ , F, As, others	Non-random	Wells near potential sources, high population areas, and in vulnerable aquifers
New York	Multiple counties (2)	Pest	Non-random	Wells near potential sources and other wells
North Carolina	Multiple counties (12)	NO ₃ , Pest	Non-random	Wells near row-crop farming
	Statewide	NO ₃	Voluntary testing	Wells near intensive livestock operations
Ohio	Statewide	NO ₃ , Pest	Voluntary testing	--
Oregon	Multiple counties (2)	NO ₃	Non-random	Intensive agricultural areas
Pennsylvania	County	Rn	Non-random	--
	Statewide	NO ₃ , Rn, Pb	Unknown	--
South Carolina	Multiple counties (21)	NO ₃ , VOCs	Non-random	Wells near toxic release sites
Tennessee	Statewide	Bact, NO ₃ , others	Non-random	Farm households
Utah	Statewide	Bact, NO ₃ , Pest	Voluntary testing	--
Virginia	Multiple counties (65)	Bact, NO ₃	Voluntary testing	--
West Virginia	County	Bact	Random	Rural households
Wisconsin	Statewide	NO ₃ , Pest	Stratified random	Dairy farm households
	Statewide	NO ₃ , Pest	Stratified random	--
	Statewide	Bact, NO ₃ , others	Non-random	Wells near areas of septage disposal or densely located septic tanks
Wyoming	Statewide	Pest	Unknown	--

¹ Number is for bacteria samples only.

² 88 percent from domestic wells.

³ 67 percent from domestic wells.

⁴ About 2/3 from domestic wells.

⁵ Percent of samples from domestic wells unspecified.

⁶ 22 percent from domestic wells.

⁷ Number of samples was 3,342.

⁸ Not all wells were sampled for arsenic.

⁹ At least 30 percent from domestic wells.

NO₃, nitrate; Majors, major ions; TE, trace elements; Rn, radon; Rad, radioactivity or radionuclides other than radon; Pest, pesticides; VOCs, volatile organic nitrate is 10 mg/L as N, and MCL for arsenic is 10 µg/L; numbers have been rounded to two significant digits. USEPA, U.S. Environmental Protection Agency; MCL, Survey; Coop. Ext., University Cooperative Extension Program; --, not available or not applicable; ~, approximately]

Number of wells	Agency or agency type	Study findings: Percentage of wells with concentrations greater than USEPA MCLs			Reference
		Total coliform bacteria	Nitrate	Arsenic	
946	State	--	--	--	Maine Department of Human Services (1998)
832	County	36	--	--	Tuthill and others (1998)
100	State	--	23	--	Klaseus and others (1988)
226	Coop. Ext.	--	19	--	Sievers and Fulhage (1992)
1,300	Coop. Ext.	40	75.3	--	Bauder and others (1991) and Bauder (1993)
63	State	--	--	--	Goodenkauf and Atkinson (1986)
1,808	University and State	13	19	--	Gosselin and others (1996, 1997, 1999)
992	University	--	--	13	Peters and others (1999)
353	USGS, USEPA and State	--	--	19	Montgomery and others (2003)
51,028	State	--	2.7	82.8	New Jersey Department of Environmental Protection (2008)
99	Regional	19	19	1	New Mexico Department of Health (1998)
1,111	County	--	--	--	Suffolk County Department of Health Services (1998)
171	University	--	5.8	--	Maas and others (1995)
1,595	State	--	10	--	North Carolina Department of Health and Human Services (2003)
14,478	University	--	2.7	--	Baker and others (1989)
89	University and State	--	25	--	Mitchell and Harding (1996)
534	USGS and State	--	--	--	Sloto and Senior (1998)
~1,600	Coop. Ext.	--	9.0	--	Swistock and others (1993)
70	University	--	0.0	--	Aelion and Conte (2004)
150	USGS and State	--	2.0	--	Carmichael and Bennett (1993)
445	State	33	--	--	Riding and Quilter (2004) and others
9,697	Coop. Ext.	40	1.9	--	Boune (2001); Poff and Ross (2000)
9155	University	68	--	--	Sworobuk and others (1987)
534	State	--	10	--	LeMasters and Doyle (1989)
336	State	--	14	--	Brook and others (2002)
50	University	28	8.0	--	Borchardt and others (2003)
286	USGS and State	--	--	--	U.S. Geological Survey (2006a)

References Cited

- Aeolion, C.M., and Conte, B.C., 2004, Susceptibility of residential wells to VOC and nitrate contamination: *Environmental Science & Technology*, v. 38, no. 6, p. 1648–1653.
- Baker, D.B., Wallrabenstein, L.K., Richards, R.P., and Creamer, N.L., 1989, Nitrate and pesticides in private wells of Ohio—A state atlas: Tiffin, Ohio, Heidelberg College, The Water Quality Laboratory, June 1989, 304 p.
- Bauder, J.W., Sinclair, K.N., and Lund, R.E., 1993, Physiographic and land use characteristics associated with nitrate-nitrogen in Montana groundwater: *Journal of Environmental Quality*, v. 22, no. 2, p. 255–262.
- Bauder, J.W., White, B.A., and Inskeep, W.P., 1991, Montana extension initiative focuses on private well quality: *Journal of Soil and Water Conservation*, v. 46, no. 1, p. 69–74.
- Borchardt, M.A., Bertz, P.D., Spencer, S.K., and Battigelli, D.A., 2003, Incidence of enteric viruses in groundwater from household wells in Wisconsin: *Applied and Environmental Microbiology*, v. 69, no. 2, p. 1172–1180.
- Bourne, A.C., 2001, Assessing the contamination risk of private well water supplies in Virginia: Blacksburg, Va., Virginia Polytechnic Institute and State University, M.S. Thesis, 141 p.
- Brook, J.V., Rheineck, Bruce, Postle, Jeff, Allen, Paula, Zogbaum, Randy, Funk, Justin, Strohl, Derek, and Baldock, Jon, 2002, Agricultural chemicals in Wisconsin groundwater: Madison, Wis., Wisconsin Department of Agriculture, Trade, and Consumer Protection, Water Quality Section, 18 p.
- Carey, D.I., Dinger, J.S., Davidson, O.B., Sergeant, R.E., Taraba, J.L., Ilvento, T.W., Coleman, Steve, Boone, Rayetta, and Knoth, L.M., 1993, Quality of private groundwater supplies in Kentucky: Lexington, Ky., Kentucky Geological Survey Information Circular 44, 155 p.
- Carmichael, J.K., and Bennett, M.W., 1993, Reconnaissance of quality of water from farmstead wells in Tennessee, 1989–90: U.S. Geological Survey Water-Resources Investigations Report 92–4186, 43 p.
- Conine, S., Cox, D., Mitchell, K., Kuyper, C., and Bragg, J., 1989, Bacteriological quality of private water wells in Clark County, Arkansas: 1989, Proceedings of the Arkansas Academy of Science, v. 43, p. 19–20.
- Field, R.W., and Kross, B.C., 1996, Intercomparison of waterborne radon-222 collection methods—Professional vs. homeowner collection: *Ground Water Monitoring and Remediation*, v. 16, p. 106–112.
- Field, R.W., and Kross, B.C., 1998, Iowa survey of waterborne ²²²Rn concentrations in private wells: *Health Physics*, v. 74, no. 2, p. 249–252.
- Focazio, M.J., Tipton, Deborah, Shapiro, S.D., and Geiger, L.H., 2006, The chemical quality of self-supplied domestic well water in the United States: *Ground Water Monitoring & Remediation*, v. 26, no. 3, p. 1–13.
- Goetsch, W.D., McKenna, D.P., and Bicki, T.J., 1992, Statewide survey for agricultural chemicals in rural, private water-supply wells in Illinois: Springfield, Ill., Illinois Department of Agriculture.
- Goodenkauf, Owen, and Atkinson, J.C., 1986, Occurrence of volatile organic chemicals in Nebraska ground water: *Ground Water*, v. 24, no. 2, p. 231–233.
- Gosselin, D.C., Headrick, Jacqueline, Chen, X.H., Summerside, Scott, Tremblay, Rod, and Bottger, Kurt, 1996, Domestic well-water quality in rural Nebraska: Lincoln, Nebr., University of Nebraska, Institute of Agriculture and Natural Resources, Conservation and Survey Division, and Nebraska Department of Health, April 1996, variously paginated.
- Gosselin, D.C., Headrick, Jacqueline, Haravey, F.E., Tremblay, Rod, and McFarland, Kimberly, 1999, Fluoride in Nebraska's ground water: *Ground Water Monitoring & Remediation*, v. 19, p. 87–95.
- Gosselin, D.C., Headrick, Jacqueline, Tremblay, Rod, Chen, X.H., and Summerside, Scott, 1997, Domestic well water quality in rural Nebraska: Focus on nitrate-nitrogen, pesticides, and coliform bacteria: *Ground Water Monitoring & Remediation*, v. 17, p. 77–87.
- Hagan, E.F., 2004, State ambient ground water quality monitoring program, Arsenic speciation results (2002 & 2003): Idaho Department of Water Resources, Ground water quality technical brief, September 2004, 13 p., accessed September 14, 2006, at http://www.idwr.state.id.us/hydrologic/info/pubs/gwq/Arsenic_Technical_Brief_final.pdf.
- Hallberg, G.R., Woida, K., Libra, R.D., Rex, K.D., Sesker, K.D., Kross, B.C., Seigley, L.S., Nations, B.K., Quade, D.J., Bruner, D.R., Nicholson, H.F., Johnson, J.K., and Cherryholmes, K.L., 1992, The Iowa statewide rural well-water survey—Site and well characteristics and water quality: Iowa City, Iowa, Iowa Department of Water Resources, Technical Information Series 23, 43 p., accessed August 24, 2006, at <http://www.igsb.uiowa.edu/gspubs/pdf/TIS-23.pdf>.
- Holden, L.R., Graham, J.A., Whitmore, R.W., Alexander, W.J., Pratt, R.W., Liddle, S.K., and Piper, L.L., 1992, Results of a national alachlor well water survey: *Environmental Science & Technology*, v. 26, p. 935–943.

- Iowa Department of Natural Resources, 2004, Iowa community private well study: Iowa City, Iowa, Iowa Department of Natural Resources, Geological Survey, Water Fact Sheet 2004–4, accessed October 4, 2006, at http://www.cheec.uiowa.edu/private_well/priv_well.pdf.
- Klaseus, T.G., Buzicky, G.C., and Schneider, E.C., 1988, Pesticides and groundwater—Surveys of selected Minnesota wells: Minneapolis, Minn., Minnesota Department of Health and Minnesota Department of Agriculture, 95 p., accessed September 25, 2006, at <http://www.co.stearns.mn.us/documents/ground21.pdf>.
- Kolpin, D.W., Burkart, M.R., and Thurman, E.M., 1994, Herbicides and nitrate in near-surface aquifers in the midcontinental United States, 1991: U.S. Geological Survey Water-Supply Paper 2413, 34 p.
- LeMasters, Gary, and Doyle, D.J., 1989, Grade A dairy farm well water quality survey: Madison, Wis., Wisconsin Department of Agriculture, Trade, and Consumer Protection and Wisconsin Agricultural Statistics Service, April 1989, 36 p.
- Liu, Aiguo, Ming, Jinghua, and Ankumah, R.O., 2005, Nitrate contamination in private wells in rural Alabama, United States: *Science of the Total Environment*, v. 346, p. 112–120.
- Louisiana Department of Environmental Quality, 2003, Baseline monitoring program, Fiscal years 2001–2003 (July 2000 through June 2003): Environmental Technology Division of the Louisiana Department of Environmental Quality, Triennial summary report, 2003, 29 p.
- Maas, R.P., Kucken, D.J., Patch, S.C., Peek, B.T., and Van Engelen, D.L., 1995, Pesticides in eastern North Carolina rural supply wells—Land use factors and persistence: *Journal of Environmental Quality*, v. 24, no. 3, p. 426–431.
- Mahler, R.L., and Loeffelman, K.A., 1999, Idaho wellhead sampling program, Nitrate sampling, Cumulative results, 1990–99: Moscow, Idaho, University of Idaho, Soil Science Divisions, WQ-39, accessed August 24, 2006, at <http://www.uidaho.edu/wq/wqbr/wqbr39.html>.
- Maine Department of Human Services, 1998, The presence of MTBE and other gasoline compounds in Maine’s drinking water—A preliminary report: Augusta, Maine, Maine Department of Human Services, Bureau of Health, October 13, 1998, 24 p.
- Mallatt, M., Moore, E., Lutz, E., Yoder, K., and Oldham, J.M., 2003, Natural fluoride concentrations of private wells in Indiana: Proceedings, 32nd Annual Meeting and Exhibition of the American Association for Dental Research, San Antonio, Tex., March 12–15, 2003, accessed September 12, 2006, at http://iadr.confex.com/iadr/2003/SanAnton/techprogram/abstract_27977.htm.
- Mehnert, Edward, Schock, S.C., Barnhardt, M.L., Caughey, M.E., Chou, S.F.J., Dey, W.S., Dreher, G.B., and Ray, Chittaranjan, 1995, The occurrence of agricultural chemicals in Illinois’ rural, private wells—Results from the pilot study: *Ground Water Monitoring & Remediation*, v. 15, p. 142–149.
- Mitchell, T.J., and Harding, A.K., 1996, Who is drinking nitrate in their well water?: A study conducted in rural northeastern Oregon: *Journal of Environmental Health*, v. 58, p. 14–19.
- Montgomery, D.L., Ayotte, J.D., Carroll, P.R., and Hamlin, Patricia, 2003, Arsenic concentrations in private bedrock wells in southeastern New Hampshire: U.S. Geological Survey Fact Sheet FS–051–03, 4 p.
- Neely, K.W., 2005, Nitrate overview for the statewide ambient ground water quality monitoring program, 1990–2003: Idaho Department of Water Resources, Ground water quality technical brief, January 7, 2005, 12 p., accessed August 24, 2006, at http://www.idwr.state.id.us/hydrologic/info/pubs/gwq/Nitrate_Report_2005.pdf
- New Jersey Department of Environmental Protection, 2008, New Jersey Private Well Testing Act Program—Well test results for September 2002–April 2007: Trenton, N.J., New Jersey Department of Environmental Protection, 64 p., accessed September 18, 2008, at <http://www.nj.gov/dep/pwta>.
- New Mexico Department of Health, 1998, Executive summary—Well-water quality assessment for southern New Mexico: Las Cruces, N.M., New Mexico Department of Health, Border Health Council, accessed October 4, 2006, at <http://www.mnsu.edu/~bho/bhc/h20-nm.html>.
- North Carolina Department of Health and Human Services, 2003, Contamination of private drinking well water by nitrates: North Carolina Department of Health and Human Services, Public Health, accessed August 31, 2006, at <http://www.epi.state.nc.us/epi/meri/ilocontamination.html>.
- Peters, S.C., Blum, J.D., Klaue, Bjoern, and Karagas, M.R., 1999, Arsenic in New Hampshire drinking water: *Environmental Science & Technology*, v. 33, no. 9, p. 1328–1333.
- Poff, J.A., and Ross, B.B., A confidence report for Virginia’s groundwater: Blacksburg, Va., Virginia Water Resources Research Center Special Report, 65 p.

- Ray, Chittaranjan, and Schock, S.C., 1996, Comparability of large-scale studies of agricultural contamination of rural private wells: *Ground Water Monitoring & Remediation*, v. 16, p. 92–102.
- Richards, R.P., Baker, D.B., Creamer, N.L., Kramer, J.W., Ewing, D.E., Merryfield, B.J., and Wallrabenstein, L.K., 1996, Well water quality, well vulnerability, and agricultural contamination in the Midwestern United States: *Journal of Environmental Quality*, v. 25, p. 389–402.
- Riding, Rich, and Quilter, M.C., 2004, 2004 State of Utah ground-water program: Utah Department of Food and Agriculture, 15 p., accessed September 7, 2006, at http://www.ag.state.ut.us/conservation/gw_report.pdf.
- Schock, S.C., Mehnert, Edward, Caughey, M.E., Dreher, G.B., Dey, W.S., Wilson, Steven, Ray, Chittaranjan, Chou, S.F.J., Valkenburg, John, Gosar, J.M., Karny, J.R., Barnhardt, M.L., Black, W.F., Brown, M.R., and Garcia, V.J., 1992, Pilot study—Agricultural chemicals in rural, private wells in Illinois: Illinois State Geological Survey and Illinois State Water Survey Cooperative Report 14, 80 p., accessed September 12, 2006, at http://www.sus.uiuc.edu/pubdoc/coop/SWSCoop_14.pdf.
- Shiber, J.G., 2005, Arsenic in domestic well water and health in central Appalachia, U.S.A.: *Water, Air, and Soil Pollution*, v. 160, p. 327–341.
- Sievers, D.M., and Fulhage, C.D., 1992, Nitrate in rural wells of Missouri: *Transactions of the American Society of Agricultural Engineers*, v. 35, no. 5, p. 1633–1637.
- Sloto, R.A., and Senior, L.A., 1998, Radon in the ground water of Chester County, Pennsylvania: U.S. Geological Survey Fact Sheet 120–98, 4 p.
- Sonan, Leticia, Vendrell, Paul, and Hitchcock, Rick, 2005, Water quality in Georgia's private drinking water wells: Proceedings, Georgia Water Resources Conference, accessed August 24, 2006, at <http://gwri.ce.gatech.edu/GAConf/News/GAConfNews.php>.
- Spruill, T.B., 1983, Statistical summaries of selected chemical constituents in Kansas ground-water supplies, 1976–1981: U.S. Geological Survey Open-File Report 83–263, 29 p.
- State Water Resources Control Board, 2005, Volunteer domestic well assessment project, El Dorado County Data Summary Report: Sacramento, Calif., California Environmental Protection Agency, State Water Resources Control Board, 23 p.
- Steichen, James, Koelliker, James, Grosh, Doris, Heiman, Alan, Yearout, Robert, and Robins, Victor, 1988, Contamination of farmstead wells by pesticides, volatile organics, and inorganic chemicals in Kansas: *Ground Water Monitoring & Remediation*, v. 8, no. 3, p. 153–160.
- Stuart, M.A., Rich, F.J., and Bishop, G.A., 1995, Survey of nitrate contamination in shallow domestic drinking water wells of the Inner Coastal Plain of Georgia: *Ground Water*, v. 33, no. 2, p. 284–290.
- Suffolk County Department of Health Services, 1998, Water quality monitoring program to detect pesticide contamination in groundwaters of Nassau and Suffolk Counties, N.Y., 1997 PRL Annual Report—Appendix J: Suffolk County Department of Health Services, Division of Environmental Quality, Bureau of Groundwater Resources, Interim Report, June 1998, accessed September 5, 2006, at <http://www.dec.state.ny.us/website/dshh/prl/scdoh.htm>.
- Swistock, B.R., Sharpe, W.E., and Robillard, P.D., 1993, A survey of lead, nitrate, and radon contamination of private individual water systems in Pennsylvania: *Journal of Environmental Health*, v. 55, no. 5, p. 6–12.
- Sworobuk, J.E., Law, C.B., and Bissonnette, G.K., 1987, Assessment of the bacteriological quality of rural groundwater supplies in Northern West Virginia: *Water, Air, and Soil Pollution*, v. 36, no. 1–2, p. 163–170.
- Townsend, M.A., Young, D.P., and Healy, J., 1998, Results of agrichemical survey of ground water in Kansas, 1993–1994: Lawrence, Kans., Kansas Geological Survey Open-File Report 98–22, 46 p.
- Tuthill, Anna, Meikle, D.B., and Alavanja, M.C.R., 1998, Coliform bacteria and nitrate contamination of wells in major soils of Frederick, Maryland: *Journal of Environmental Health*, v. 60, p. 16–20.
- U.S. Centers for Disease Control and Prevention, 1998, A survey of the quality of water drawn from domestic wells in nine midwest states: U.S. Centers for Disease Control and Prevention, National Center for Environmental Health, accessed October 6, 1999, at <http://www.cdc.gov/nceh/programs/emergenc/WellWater/MidwestWell.htm>.
- U.S. Environmental Protection Agency, 1984, National statistical assessment of rural water conditions—Technical summary: Washington, D.C., U.S. Environmental Protection Agency, Office of Drinking Water, EPA570/9-84-004, 111 p.
- U.S. Environmental Protection Agency, 1990a, National Pesticide Survey—Summary results of EPA's national survey of pesticides in drinking water wells: Washington, D.C., U.S. Environmental Protection Agency, Office of Water and Office of Pesticides and Toxic Substances, EPA 570/9-90-NPS5, 17 p., accessed October 3, 2006, at <http://nepis.epa.gov/pubtitleOSWER.htm>.

- U.S. Environmental Protection Agency, 1990b, National Pesticide Survey—Project summary: Washington, D.C., U.S. Environmental Protection Agency, Office of Water and Office of Pesticides and Toxic Substances, EPA 570/9-90-NPS6, 11 p., accessed October 3, 2006, at <http://nepis.epa.gov/pubtitleOSWER.htm>.
- U.S. Environmental Protection Agency, 1992, National Pesticide Survey—Update and summary of Phase II results: Washington, D.C., U.S. Environmental Protection Agency, Office of Water and Office of Pesticides and Toxic Substances, EPA 570/9-91-021, 6 p., accessed October 3, 2006, at <http://nepis.epa.gov/pubtitleOSWER.htm>.
- U.S. General Accounting Office, 1997, Drinking water information on the quality of water found at community water systems and private wells: Washington, D.C., U.S. General Accounting Office, Resources, Community, and Economic Development Division, GAO/RCED-97-123, 47 p.
- U.S. Geological Survey, 2006a, Ground-water monitoring for pesticides in Wyoming: U.S. Geological Survey, Wyoming Water Science Center, accessed September 7, 2006, at <http://wy.water.usgs.gov/projects/pesticide>.

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