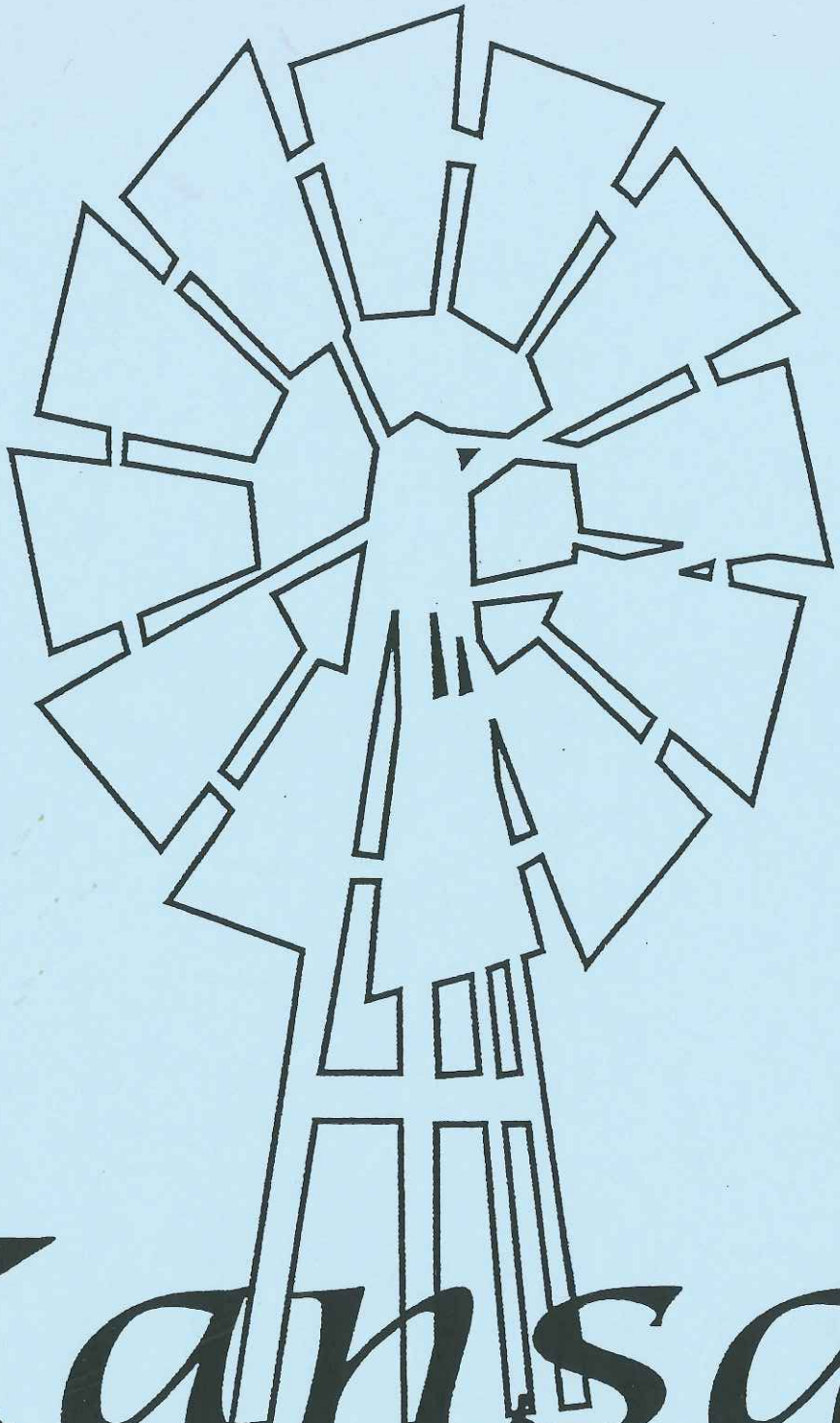

Kansas

1993-1994

Private water well survey

Kansas 1993-1994 Private Water Well Survey

Members of the
Flood Response Section
November, 1995

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INTRODUCTION

BACKGROUND:

The 1994 Private Water Well Survey was conducted from May through September of 1994 under the direction of the Flood Response Section, Bureau of Environmental Health Services, Kansas Department of Health and Environment. The Flood Response Section was organized as a result of environmental health impacts the "Flood of 93" had on the residents of 56 counties in Kansas. The section is completely funded by a cooperative agreement grant from the Centers for Disease Control and Prevention (CDC) to the Kansas Department of Health and Environment (KDHE).

In April of 1994, CDC requested that Kansas join eight other flood affected states (IA, IL, MO, MN, NB, ND, SD, and WI) in conducting a comprehensive and systematic study of private water wells at a specified point in time. It was estimated that within the nine aforementioned flood affected states approximately one million private water wells were affected by either flood waters or subsequent high water tables. A major environmental health concern was to what extent the flood waters may have microbiologically and/or chemically contaminated the ground water. The well survey was designed to test private water wells for the following contaminates: total coliform bacteria, *E. coli* bacteria, nitrate, atrazine (a common herbicide), and lead. In addition to the collection of water samples, the survey included a three page questionnaire to be completed by well owners or users. The questionnaire covered the following topics: well construction, depth, age, location in relation to possible sources of contamination and demographic data and health of well users.

Sanitarians from the Local Environmental Protection Programs (LEPP) conducted the majority of the well sampling. Flood Response personnel, local sanitarians, and county extension agents conducted the sampling in counties that did not participate in the LEPP program or did not have a local sanitarian. The Kansas Health and Environment Laboratory in Topeka, Kansas, performed the required tests utilizing the practices described in Standard Methods for the Examination of Water and Wastewater, 16th edition, published by the American Public Health Association, American Water Works Association, and Water Environment Federation.

Well test results with an explanation of the results were provided to the well owners by the individuals who conducted the surveys. Well owners received information from KDHE and Kansas State University Extension Service on maintaining a safe well or general recommendations on removing contamination sources.

GOALS OF THE SURVEY:

The survey was designed to provide a valid statewide estimate of possible contaminated wells in Kansas at a specified time. It was not designed to provide statistically valid data about contamination levels in individual townships or counties within the state. The survey sample was not stratified on conditions such as well depth, distance from river, soil type, or chlorine use because preliminary information about these factors were not available. The goals of the survey, as described in the CDC survey protocol, were:

The primary goal was to estimate the contamination fraction in Kansas with a minimum 90% statistical power within a specified % difference (± 10%) from a presumed contamination rate of 50%. A 50% rate was used because we have only anecdotal data on contamination and a 50% rate assumes an equal likelihood that a well was contaminated.

The second goal was to provide information on the within-state distribution of contamination. Statements of statistical significance of differences between counties cannot be made since the study design does not allow a direct comparison of the results of one county to the results of other counties.

The third goal was to obtain data on levels of background contamination by sampling areas not affected by the flooding.

The fourth goal was to obtain well construction and maintenance data for an objective assessment and development of cost-effective solutions to contamination.

TOTAL NUMBER OF SAMPLES PER STATE:

The CDC collection plan required that: 1) a minimum of 400 samples be collected and analyzed in each state and 2) a minimum of eight samples be collected in each county. A total of over 8,700 wells were identified to be tested within the nine states. Kansas had a goal to sample a total of 937 wells; 825 wells were sampled. CDC will release a report containing the results of the total wells surveyed by state.

SAMPLE COLLECTION WITHIN THE STATE:

CDC provided a ten-mile intersecting grid that was overlaid on a map of Kansas. Samples were to be collected at the intersecting points of the grid. This provided a uniform method for sampling wells in a systematic manner, by county and state. Additional samples were collected in some counties to insure that each county met the minimum requirement of eight samples. These additional locations were chosen at random by the collectors. If no well was found within a three-mile radius of a sample location, an additional sample was collected at the previous or following

sample location. To insure quality control by the collectors and KDHE laboratory procedures, 160 duplicate samples were taken. The duplicate samples were required for every 8th well sampled or at least 1 per county.

DEVIATIONS FROM SAMPLE LOCATIONS:

The sample location was the intersection of the vertical and horizontal sample lines. The sample point was the exact location of the well sampled, relative to its map location. Because wells did not fall exactly at sample locations, a protocol was necessary to select them systematically. This was done by drawing concentric circles (within a three-mile radius) outward from each sample location (intersection point) and sampling the well falling closest to the sample location, regardless of its direction from the location. That well became the sample point.

If no well was found within a three-mile radius from the sample location, "NO WELL AT LOCATION" was marked on page one of the form. If a well was found, but the owner refused to allow a sample to be collected and no other wells could be sampled within a three-mile radius because of multiple refusals, "REFUSED" was marked on the form . If a well was located within a three-mile radius, but residents were not available, "NO RESIDENT AVAILABLE" was marked on the form.

SPECIMEN COLLECTION:

Tap water was taken from a drinking water faucet within the home. The lead water sample was taken immediately from the first flow of water. Water was then run for 3-5 minutes prior to taking the bacteria, nitrate, and atrazine samples. Care was taken not to touch sample bottles against any object when Collecting specimens. The same standard method for collecting water specimens was used in Kansas and in the other eight states.

FLOOD RESPONSE TRAINING WORKSHOPS:

During the initial phase of the survey, Flood Response personnel conducted training workshops at district offices to: 1) explain the purpose and protocol of the survey, 2) provide sampling and transportation materials, and 3) provide assistance in resolving problems that might arise from any unusual situations.

UNIQUE SAMPLE IDENTIFICATION CODE:

Assigned sample identification codes were used to identify each sample location unique to a county. For example, NT-2657 indicated Norton county, well number 2657. Each sample that fell within an intersection location can be cross-referenced back to that location. If a sample was an additional one needed to meet the required eight sample county minimum, it did not have an intersection location and was

instead identified by a 12000 series number. Each sample ID code also can be referenced to its matching grid point.

DATA CONFIDENTIALITY:

Individual identifier data were not retained by CDC, but will reside with the county and state to facilitate appropriate follow-up. Data that are made available to the public only on an aggregate basis. Individual well owner/user names and results from wells will not be released outside local government agencies and public health organizations.

LABORATORY METHODS FOR WELL WATER ANALYSIS & QUALITY CONTROL:

Except for atrazine, all participating states used identical analytical laboratory methods for microbiologic testing and nitrate detection. Kansas used the following approved testing procedures: 1) a semi-quantitative bacteriologic test (Colilert) for testing total coliform and *E. coli* - 10 tube MPN (Most Probable Number) detecting one organism per 100 mL, 2) cadmium reduction methodology for testing nitrate - detecting levels greater than 0.01 mg/L, 3) immunoassay for testing atrazine - detecting levels greater than 0.1 μg/L, and 4) inductively coupled mass spectrometer or graphite furnace atomic absorption for testing lead - detecting levels greater than 0.001 mg/L. All samples were immediately refrigerated and analyzed within 30 hours of collection. The following units of measurement are used for reporting purposes: total coliform (MPN/100 mL), *E. coli* (MPN/100 mL), nitrate (mg/L), atrazine (μg/L), and lead (mg/L).

Two quality control procedures were implemented. The first QC was the weekly use of the Quanti-Cult or equivalent American Type Culture Collection (ATCC) strains to ensure a positive and negative control for microbiologic tests conducted. The second QC was the duplicate water well samples collected for laboratory testing to determine agreement on collection and laboratory procedures.

DATA COLLECTION AND TRANSMISSION:

A three page questionnaire (Appendix A) was completed at the time of sampling each well, including the exact sample collection time so that the 24-30 hour time interval between collection and measurement could be checked. A copy was forwarded to the Flood Response Section and KDHE Laboratory. Each sampling site had a KDHE laboratory ID, a CDC study ID (state code, county code, and well number), and a Kansas ID (county code and well number). These numbers identify each data sheet against each specimen and ensured sample integrity. The final laboratory results were annotated on the back page of the questionnaire. Kansas data were sent to CDC on September 23, 1994.

DATA ANALYSIS:

The questionnaire information and well test results were reviewed for accuracy by Flood Response and KDHE laboratory technicians prior to being entered into the KDHE Information Network IBM AS/400 Mainframe Computer. The data will be analyzed by various public and private organizations for current public health impacts and future policy decisions. Data from Kansas and the eight other states will be used by CDC in making an estimation of state contamination rates and statistical confidence limits. In the future, sample data will be mapped into a Geographic Information System (GIS) for display by county and latitude/longitude format. Surface water and aquifers will be overprinted on the GIS contamination map for additional studies as well.

SECTION I

TABLES AND GRAPHS

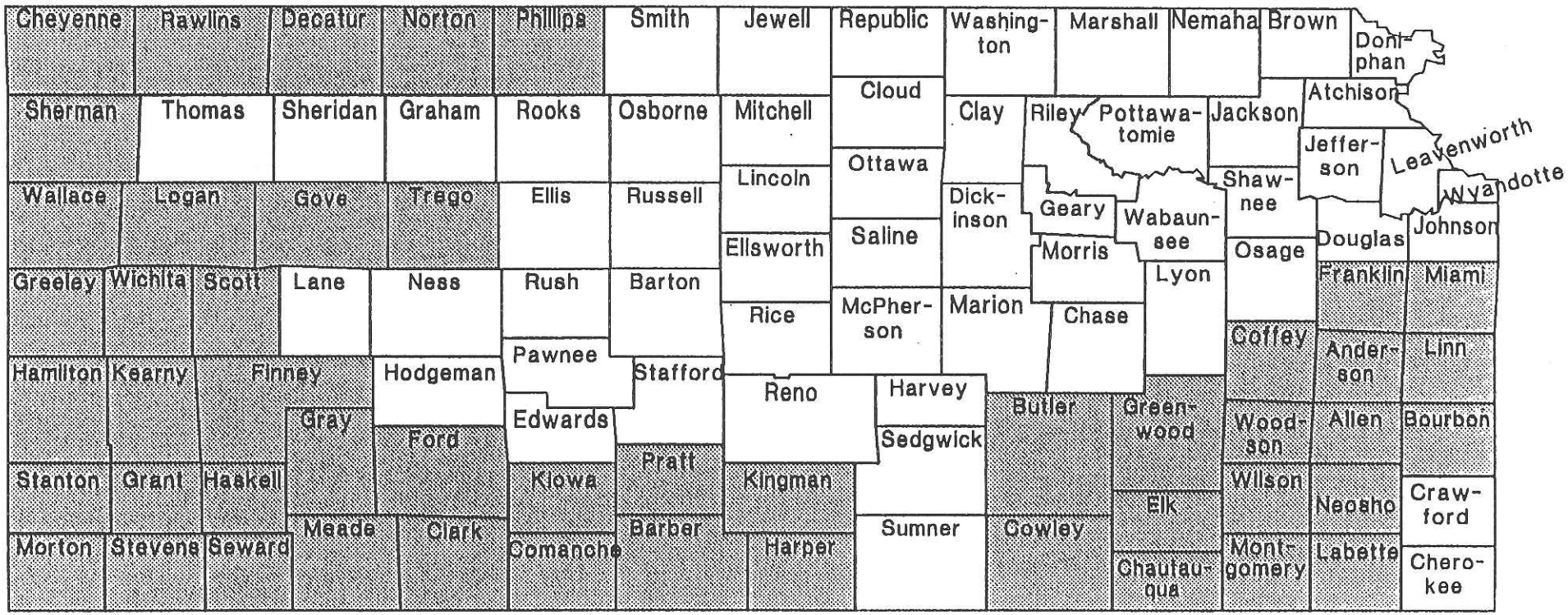
1994 KANSAS WATER WELL SURVEY SUMMARY

BY CATEGORY	1994 RESULTS	
Total Samples Required		
Wells (R,D,S,B,O)	75%	825/1097
Duplicate Samples	15%	160/1097
Wells not tested	10%	112/1097
Total Well Samples:		
Drilled Wells (R)	59%	648/1097
Dug Wells (D)	13%	146/1097
Sandpoint (S)	1%	10/1097
Buried Slab (B)	1%	1/1097
Other (O)	2%	20/1097
Duplicate Wells	15%	160/1097
Wells not tested	10%	112/1097
Total Coliform Positive:		
Total Wells Tested	51%	424/825
Drilled Wells (R)	43%	280/648
Dug Wells (D)	85%	124/146
Sandpoint (S)	20%	2/10
Buried Slab (B)	100%	1/1
Other (O)	85%	17/20

BY CATEGORY	1994 RESULTS	
E. Coli Positive:		
Total Wells Tested	18%	151/825
Drilled Wells (R)	8%	55/648
Dug Wells (D)	60%	87/146
Sandpoint (S)	0%	0/10
Buried Slab (B)	0%	0/1
Other (O)	45%	9/20
Nitrate >= 10 mg/L		
Total Wells Tested	24%	196/825
Drilled Wells (R)	21%	136/648
Dug Wells (D)	35%	51/146
Sandpoint (S)	20%	2/10
Buried Slab (B)	100%	1/1
Other (O)	30%	6/20
Atrazine >= 3 ppb		
Total Wells Tested	5%	4/825
Drilled Wells (R)	0%	0/648
Dug Wells (D)	3%	4/146
Sandpoint (S)	0%	0/10
Buried Slab (B)	0%	0/1
Other (O)	0%	0/20
Lead Positive >= 0.015 mg		
Total Wells Tested	6%	53/825
Drilled Wells (R)	6%	7/648
Dug Wells (D)	10%	14/146
Sandpoint (S)	10%	1/10
Buried Slab (B)	0%	0/1
Other (O)	5%	1/20

Flooded Counties & Non-Flooded Counties

KDHE - Flood Response



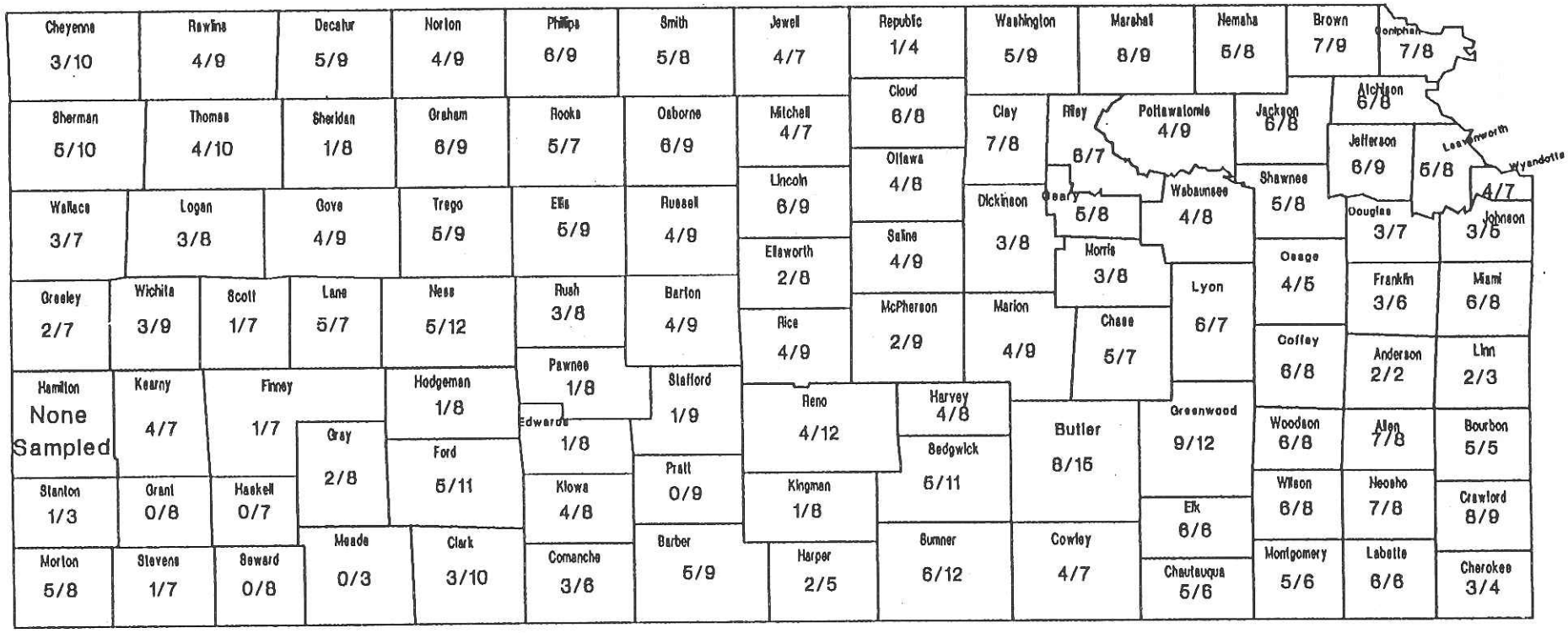
Flooded Counties

Non-Flooded Counties

Flooded Counties & Non-Flooded Counties Comparison

		Flooded Counties		Non-Flooded	
		# Wells	% Wells	# Wells	% Wells
Total Coliform					
	Presence	246	53.6%	177	48.4%
	Absence	213	46.4%	189	51.6%
		459	100.0%	366	100.0%
E. coli					
	Presence	91	19.8%	60	16.4%
	Absence	368	80.2%	306	83.6%
		459	100.0%	366	100.0%
Nitrate					
	≥ 20 mg/L	58	12.6%	24	6.6%
	≥ 10 mg/L	135	29.4%	63	17.2%
	< 10 mg/L	324	70.6%	303	82.8%
		459	100.0%	366	100.0%
Atrazine					
	≥ 3 ppb	1	0.2%	3	0.8%
	< 3 ppb	458	99.8%	363	99.2%
		459	100.0%	366	100.0%
Lead					
	≥ 15 ppb	36	7.8%	17	4.6%
	< 15 ppb	423	92.2%	349	95.4%
		459	100.0%	366	100.0%

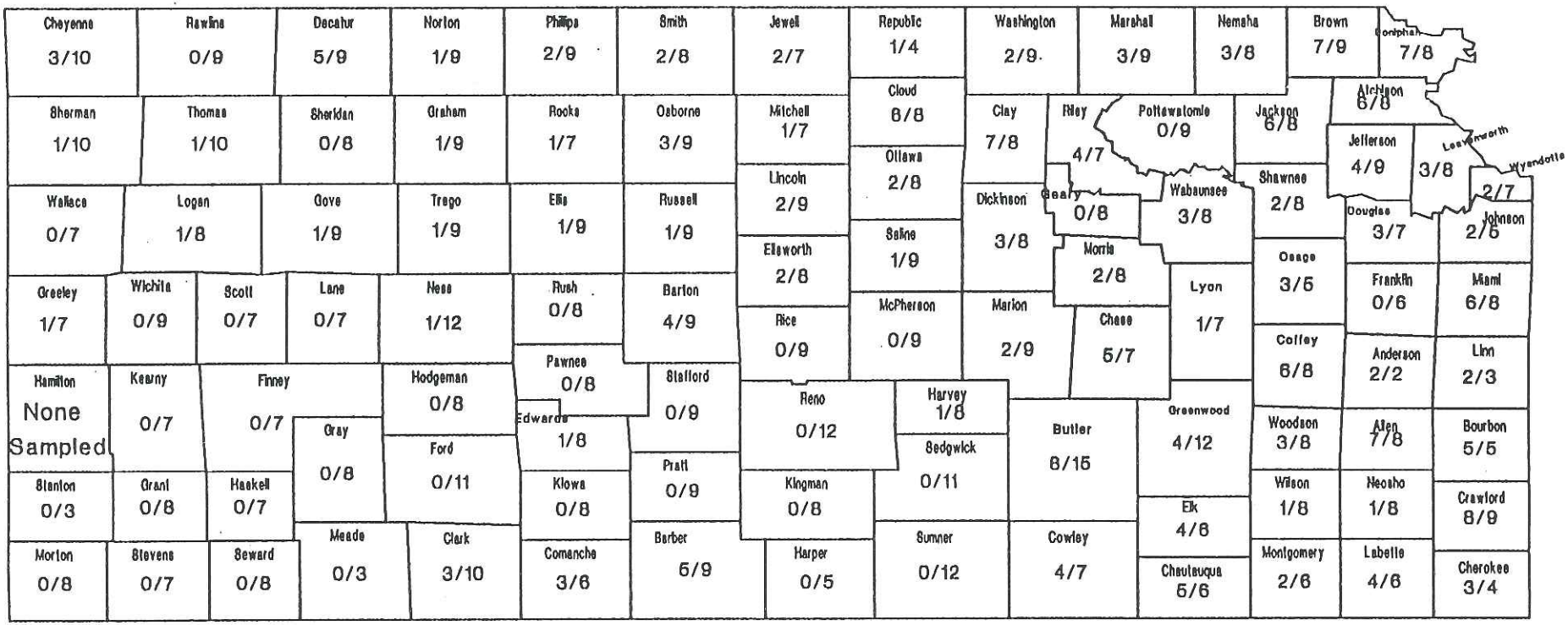
Total Coliform (>= 1 tube) in wells tested, by County



Number of wells positive/Total wells tested

NOTE: Results by county are presented for informational purposes only. The study design does not allow a direct comparison of the results of one county to the results of other counties.

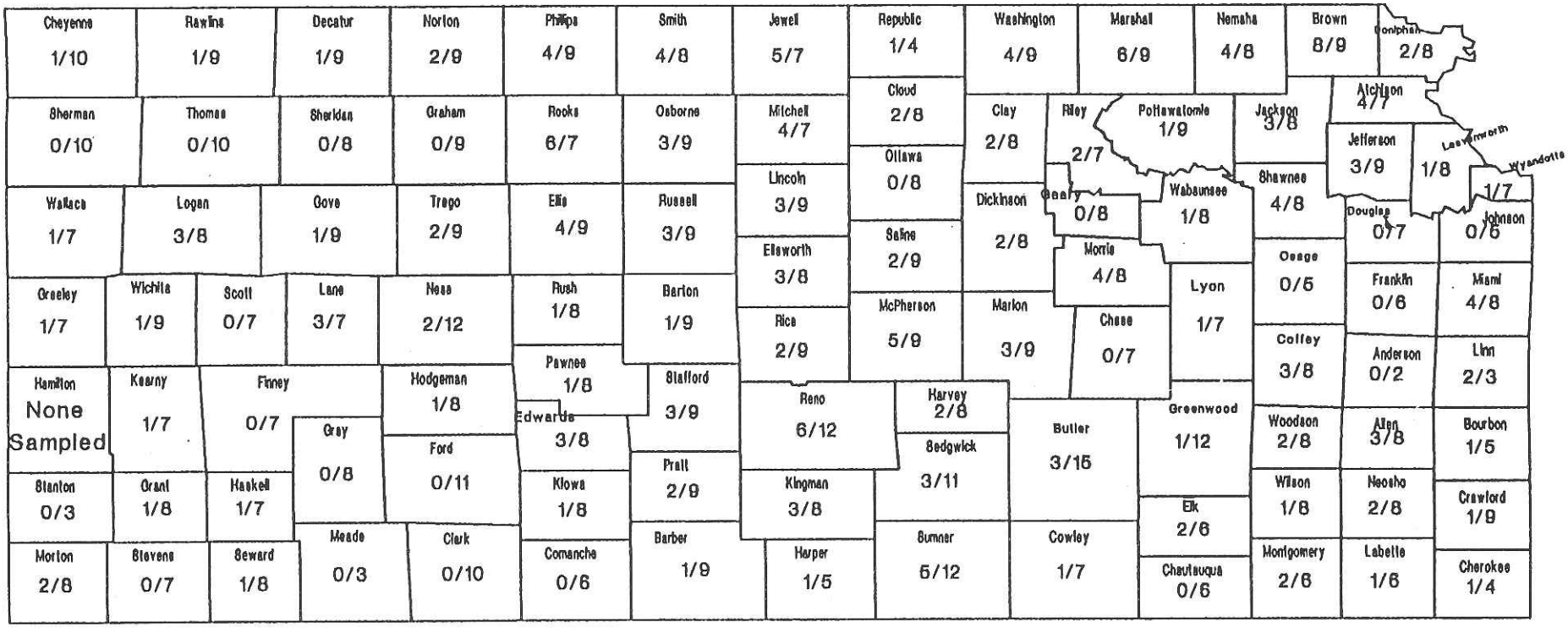
E. coli (>= 1 tube) in wells tested, by County



Number of wells positive/Total wells tested

NOTE: Results by county are presented for informational purposes only. The study design does not allow a direct comparison of the results of one county to the results of other counties.

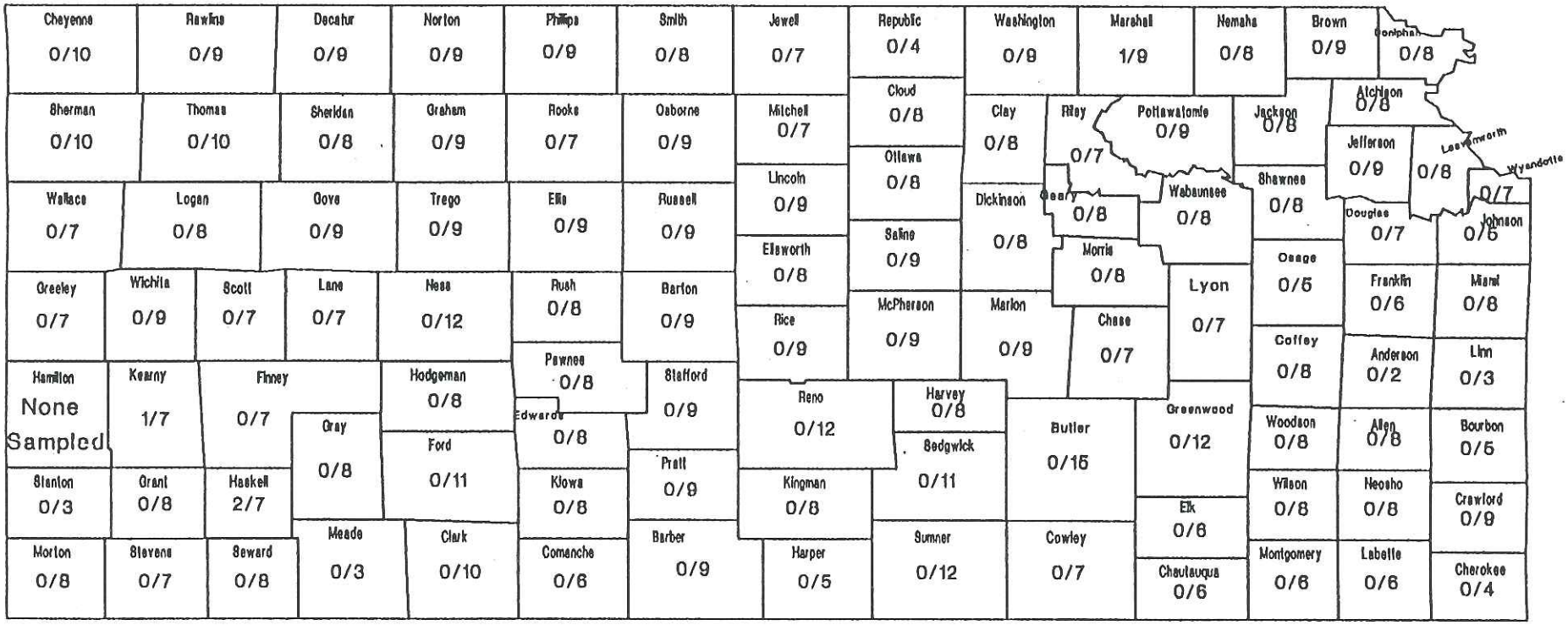
Nitrate (>= 10 mg/L) in wells tested, by County



Number of wells positive/Total wells tested

NOTE: Results by county are presented for informational purposes only. The study design does not allow a direct comparison of the results of one county to the results of other counties.

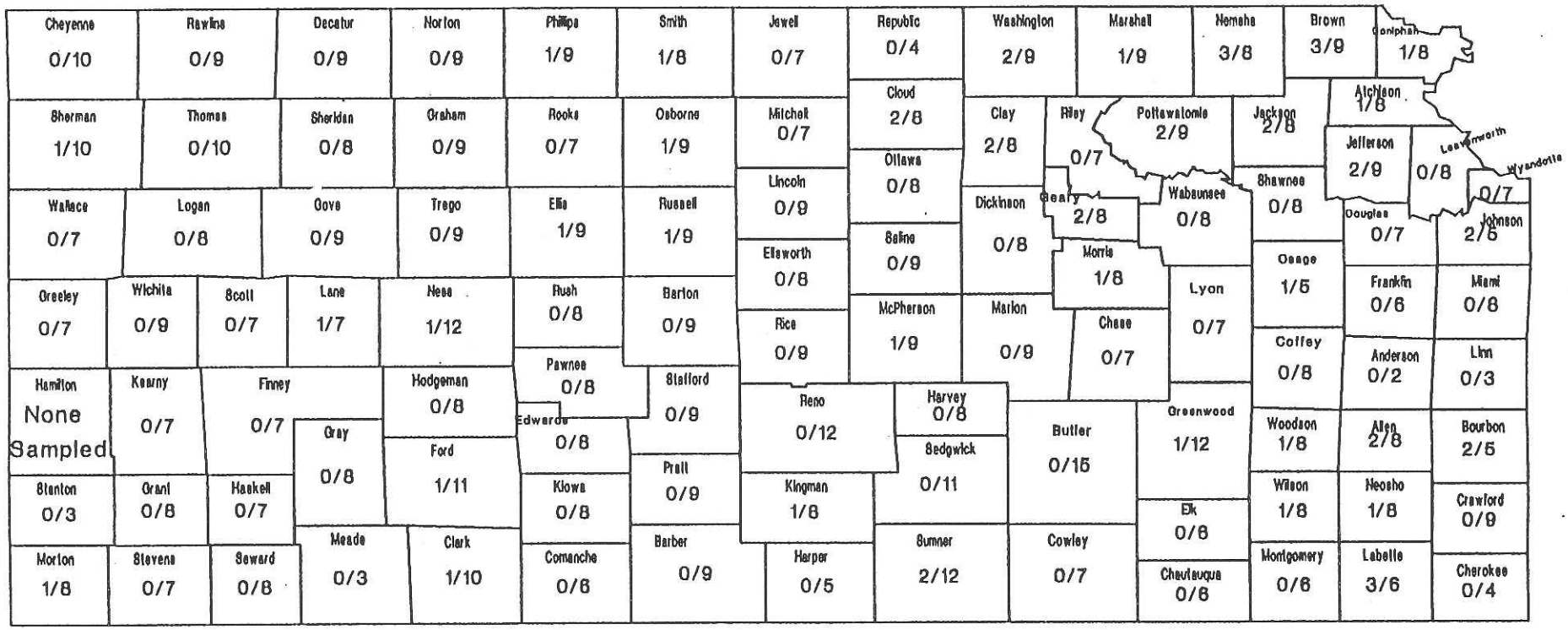
Atrazine (>= 3.0 ppb) in wells tested, by County



Number of wells positive/Total wells tested

NOTE: Results by county are presented for informational purposes only. The study design does not allow a direct comparison of the results of one county to the results of other counties.

Lead (>= 0.015 mg/L) in wells tested, by County



Number of wells positive/Total wells tested

NOTE: Results by county are presented for informational purposes only. The study design does not allow a direct comparison of the results of one county to the results of other counties.

COUNTY RESULTS

COUNTY RESULTS

COUNTY	# OF WELLS TESTED	# OF SAMPLE WELLS NOT TESTED	REASON FOR NOT TESTING	# OF WELLS BY TYPE:				
				DRILLED	DUG	SANDPOINT	BURIED SLAB	OTHER
ALLEN	8	0		4	4			
ANDERSON	2	6	No well at location	1	1			
ATCHISON	8	0		5	1	1		1
BARBER	9	0		8		1		
BARTON	9	0		7				2
BOURBON	5	3	No well at location		5			
BROWN	9	0		6	3			
BUTLER	15	0		15				
CHASE	7	1	No residents available	5	2			
CHAUTAUQUA	6	2	No well at location	5	1			
CHEROKEE	4	4	No well at location (1) No residents available (3)	3	1			
CHEYENNE	10	2	No residents available	10				
CLARK	10	2	No well at location	10				
CLAY	8	0		7	1			
CLOUD	8	0		6	1			1
COFFEY	8	1	No well at location		8			
COMANCHE	6	3	No well at location	6				
COWLEY	7	2	No residents available (1) No well at location (1)	7				
CRAWFORD	9	0		1	8			
DECATUR	9	0		9				
DICKINSON	8	0		7		1		
DONIPHAN	8	0		3	3	1		1
DOUGLAS	7	1	No well at location	5	1	1		
EDWARDS	8	0		6		1		1
ELK	6	2	Landowner refused	4	2			
ELLIS	9	0		9				
ELLSWORTH	8	0		8				
FINNEY	7	2	No residents available	7				
FORD	11	1	Landowner refused	10	1			
FRANKLIN	6	2	No well at location	6				
GEARY	8	0		7				1
GOVE	9	2	No well at location	8	1			
GRAHAM	9	0		9				
GRANT	8	0		8				
GRAY	8	0		8				
GREELEY	7	1	No well at location	7				
GREENWOOD	12	0		6	5			1
HAMILTON	0	10	No well at location (7) No residents available (3)					
HARPER	5	4	No well at location	5				
HARVEY	8	0		5	2			1
HASKELL	7	1	No residents available	7				
HODGEMAN	8	0		8				
JACKSON	8	0		3	5			
JEFFERSON	9	0		4	4			1
JEWELL	7	2	No well at location (1) Landowner refused (1)	5	2			
JOHNSON	5	3	No well at location	2	1			2
KEARNY	7	4	Landowner refused (3) No residents available (1)	7				
KINGMAN	8	0		8				
KIOWA	8	0		8				

CONTAMINANTS:					MEAN		MEAN		# OF SAMPLE	# OF SAMPLE
TOTAL COLIFORM PRESENCE	E. coli PRESENCE	NITRATE (>= 10 mg/l)	ATRAZINE (>= 3 ppb)	LEAD (>= .015 mg/L)	DEPTH OF WELLS	DEPTH RANGE	AGE OF WELLS	AGE RANGE	WELLS USED FOR DRINKING WATER	WELLS WITH DIARRHEA REPORTED
7 (88%)	4 (50%)	3 (38%)	0 (0%)	2 (25%)	49	20 - 175	37	5 - 80	6	0
2 (100%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	28	25 - 30	27	30	2	0
6 (75%)	3 (38%)	4 (50%)	0 (0%)	1 (13%)	75	20 - 150	27	4 - 99	7	0
5 (56%)	1 (11%)	1 (11%)	0 (0%)	0 (0%)	68	12 - 125	40	8 - 80	9	1
4 (44%)	1 (11%)	1 (11%)	0 (0%)	0 (0%)	119	50 - 200	16	6 - 38	9	0
5 (100%)	5 (100%)	1 (20%)	0 (0%)	2 (40%)	33	20 - 50	76	50 - 99	3	0
7 (78%)	3 (33%)	8 (89%)	0 (0%)	3 (33%)	47	10 - 100	44	25 - 60	8	1
8 (53%)	2 (13%)	3 (20%)	0 (0%)	0 (0%)	94	32 - 285	29	1 - 90	12	5
5 (71%)	3 (43%)	0 (0%)	0 (0%)	0 (0%)	48	25 - 70	38	12 - 95	7	1
5 (83%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	113	40 - 300	44	10 - 99	2	0
3 (75%)	1 (25%)	1 (25%)	0 (0%)	0 (0%)	207	32 - 400	39	2 - 99	4	0
3 (30%)	1 (10%)	1 (10%)	0 (0%)	0 (0%)	178	13 - 270	36	6 - 90	10	0
3 (30%)	3 (30%)	0 (0%)	0 (0%)	1 (10%)	198	85 - 330	26	6 - 55	6	0
7 (88%)	1 (13%)	2 (25%)	0 (0%)	2 (25%)	60	15 - 160	52	30 - 99	8	0
6 (75%)	0 (0%)	2 (25%)	0 (0%)	2 (25%)	95	32 - 128	44	10 - 99	7	0
6 (75%)	4 (50%)	3 (38%)	0 (0%)	0 (0%)	23	7 - 40	39	2 - 84	8	2
3 (50%)	1 (17%)	0 (0%)	0 (0%)	0 (0%)	76	40 - 90	33	1 - 60	6	0
4 (57%)	1 (14%)	1 (14%)	0 (0%)	0 (0%)	111	68 - 170	28	5 - 50	6	0
8 (89%)	7 (78%)	1 (11%)	0 (0%)	0 (0%)	34	20 - 80	65	40 - 99	8	1
5 (56%)	0 (0%)	1 (11%)	0 (0%)	0 (0%)	85	26 - 190	36	3 - 78	9	0
3 (38%)	0 (0%)	2 (25%)	0 (0%)	0 (0%)	64	40 - 80	36	2 - 92	8	1
7 (88%)	6 (75%)	2 (25%)	0 (0%)	1 (13%)	29	9 - 40	52	16 - 99	4	1
3 (100%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	92	20 - 170	23	2 - 90	5	0
1 (13%)	1 (13%)	3 (38%)	0 (0%)	0 (0%)	81	40 - 140	29	9 - 44	8	1
6 (100%)	4 (67%)	2 (33%)	0 (0%)	0 (0%)	64	21 - 160	37	4 - 90	6	0
5 (56%)	1 (11%)	4 (44%)	0 (0%)	1 (11%)	42	20 - 70	16	3 - 35	9	0
2 (25%)	0 (0%)	3 (38%)	0 (0%)	0 (0%)	107	40 - 210	35	2 - 70	8	0
1 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	206	150 - 300	13	8 - 20	7	2
5 (45%)	0 (0%)	0 (0%)	0 (0%)	1 (9%)	151	50 - 320	32	2 - 90	11	0
3 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	133	95 - 151	28	5 - 99	4	0
5 (63%)	0 (0%)	0 (0%)	0 (0%)	2 (25%)	59	30 - 100	36	7 - 99	8	2
4 (44%)	1 (11%)	1 (11%)	0 (0%)	0 (0%)	58	8 - 100	29	15 - 50	9	0
6 (67%)	1 (11%)	0 (0%)	0 (0%)	0 (0%)	71	20 - 120	21	2 - 46	9	0
0 (0%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	458	400 - 500	16	10 - 30	8	0
2 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	224	145 - 300	15	2 - 40	8	0
2 (29%)	1 (14%)	1 (14%)	0 (0%)	0 (0%)	179	125 - 240	20	4 - 30	7	1
9 (75%)	4 (33%)	1 (8%)	0 (0%)	1 (8%)	76	9 - 290	54	2 - 99	10	0
No samples collected	No samples collected	No samples collected	No samples collected	No samples collected	No info. available	No info. available	No info. available	No info. available	No info. available	No info. available
2 (40%)	0 (0%)	1 (20%)	0 (0%)	0 (0%)	60	35 - 126	36	25 - 60	5	0
4 (50%)	1 (13%)	2 (25%)	0 (0%)	0 (0%)	74	30 - 120	36	5 - 90	8	0
0 (0%)	0 (0%)	1 (14%)	2 (29%)	0 (0%)	377	300 - 450	27	2 - 84	7	0
1 (13%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	107	25 - 330	27	20 - 50	8	0
6 (75%)	6 (75%)	3 (38%)	0 (0%)	2 (25%)	37	21 - 60	52	12 - 99	5	0
6 (67%)	4 (44%)	3 (33%)	0 (0%)	2 (22%)	47	6 - 115	50	5 - 99	7	0
4 (57%)	2 (29%)	5 (71%)	0 (0%)	0 (0%)	40	18 - 66	36	10 - 60	7	0
3 (60%)	2 (40%)	0 (0%)	0 (0%)	2 (40%)	91	15 - 265	60	10 - 60	5	0
4 (57%)	0 (0%)	1 (14%)	1 (14%)	0 (0%)	299	260 - 350	22	15 - 30	7	0
1 (13%)	0 (0%)	3 (38%)	0 (0%)	1 (13%)	66	30 - 104	13	1 - 43	8	0
4 (50%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	84	30 - 120	28	20 - 35	8	0

COUNTY RESULTS (continued)

COUNTY	# OF WELLS TESTED	# OF SAMPLE WELLS NOT TESTED	REASON FOR NOT TESTING	# OF WELLS BY TYPE:				
				DRILLED	DUG	SANDPOINT	BURIED SLAB	OTHER
LABETTE	6	2	No residents available	3	3			
LANE	7	1	No residents available	7				
LEAVENWORTH	8	0		1	7			
LINCOLN	9	0		6	3			
LINN	3	6	No well at location	1	2			
LOGAN	8	3	No residents available	7				1
LYON	7	1	No residents available	4	3			
MARION	9	0		9				
MARSHALL	9	0		6	1			2
MCPHERSON	9	0		4	4	1		
MEADE	3	7	No residents available (5) Landowner refused (2)	3				
MIAMI	8	0		1	6			1
MITCHELL	7	1	No well at location	6	1			
MONTGOMERY	6	3	No well at location	4	2			
MORRIS	8	0		8				
MORTON	8	1	No well at location	8				
NEMAHA	8	0		5	3			
NEOSHO	8	0		8				
NESS	12	0		10	2			
NORTON	9	0		9				
OSAGE	5	4	No well at location	2	3			
OSBORNE	9	0		2	7			
OTTAWA	8	0		6	2			
PAWNEE	8	0		8				
PHILLIPS	9	0		6	3			
POTTAWATOMIE	9	0		8	1			
PRATT	9	0		9				
RAWLINS	9	0		9				
RENO	12	0		11		1		
REPUBLIC	4	4	No residents available (3) No well at location (1)	3	1			
RICE	9	0		9				
RILEY	7	1	No well at location	4	1		1	1
ROOKS	7	2	No well at location (1) No residents available (1)	4	3			
RUSH	8	0		8				
RUSSELL	9	0		6	3			
SALINE	9	0		9				
SCOTT	7	1	No residents available	7				
SEDGWICK	11	0		11				
SEWARD	8	0		8				
SHAWNEE	8	0		4	3	1		
SHERIDAN	8	1	No residents available	8				
SHERMAN	10	2	No residents available	10				
SMITH	8	1	No residents available	3	5			
STAFFORD	9	0		8		1		
STANTON	3	5	No residents available (2) Landowner refused (2) No well at location (1)	3				
STEVENS	7	1	No residents available	7				
SUMNER	12	0		12				
THOMAS	10	0		10				
TREGO	9	0		7	1		1	
WABAUNSEE	8	0		5	1			2
WALLACE	7	2	No residents available (1) Landowner refused (1)	7				
WASHINGTON	9	0		7	2			
WICHITA	9	1	No residents available	9				
WILSON	8	0		3	5			
WOODSON	8	0		4	4			
WYANDOTTE	7	1	No well at location	6	1			

CONTAMINANTS:					MEAN		MEAN		# OF SAMPLE	# OF SAMPLE
TOTAL COLIFORM PRESENCE	E. coli PRESENCE	NITRATE (>= 10 mg/l)	ATRAZINE (>= 3 ppb)	LEAD (>= .015 mg/L)	DEPTH OF WELLS	DEPTH RANGE	AGE OF WELLS	AGE RANGE	WELLS USED FOR DRINKING WATER	WELLS WITH DIARRHEA REPORTED
6 (100%)	4 (67%)	1 (17%)	0 (0%)	3 (50%)	43	12 - 100	43	10 - 99	2	0
5 (71%)	0 (0%)	3 (43%)	0 (0%)	1 (14%)	75	35 - 100	26	9 - 46	7	0
5 (63%)	3 (38%)	1 (13%)	0 (0%)	0 (0%)	32	15 - 69	62	24 - 99	7	0
6 (67%)	2 (22%)	3 (33%)	0 (0%)	0 (0%)	64	20 - 200	45	6 - 95	9	0
2 (67%)	2 (67%)	2 (67%)	0 (0%)	0 (0%)	31	30 - 31	82	80 - 86	3	0
3 (38%)	1 (13%)	3 (38%)	0 (0%)	0 (0%)	132	60 - 205	15	6 - 25	8	0
6 (86%)	1 (14%)	1 (14%)	0 (0%)	0 (0%)	54	16 - 102	38	20 - 50	7	0
4 (44%)	2 (22%)	3 (33%)	0 (0%)	0 (0%)	60	45 - 80	35	3 - 64	9	0
8 (89%)	3 (33%)	6 (67%)	1 (11%)	1 (11%)	47	35 - 64	23	7 - 50	9	1
2 (22%)	0 (0%)	5 (56%)	0 (0%)	1 (11%)	46	10 - 85	19	2 - 50	9	0
0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	200	200	10	10	3	0
6 (75%)	5 (63%)	4 (50%)	0 (0%)	0 (0%)	32	12 - 100	66	12 - 99	7	0
5 (71%)	1 (14%)	4 (57%)	0 (0%)	0 (0%)	112	40 - 180	112	40 - 180	7	0
5 (83%)	2 (33%)	2 (33%)	0 (0%)	0 (0%)	67	18 - 100	43	7 - 99	6	0
3 (38%)	2 (25%)	4 (50%)	0 (0%)	1 (13%)	99	40 - 125	43	8 - 256	8	1
5 (63%)	0 (0%)	2 (25%)	0 (0%)	1 (13%)	175	100 - 225	15	3 - 20	8	0
5 (63%)	3 (38%)	4 (50%)	0 (0%)	3 (38%)	72	20 - 175	29	5 - 60	4	0
7 (88%)	2 (25%)	2 (25%)	0 (0%)	1 (13%)	63	55 - 90	53	11 - 85	7	0
5 (42%)	1 (8%)	2 (17%)	0 (0%)	1 (8%)	118	35 - 510	28	4 - 94	12	0
4 (44%)	1 (11%)	2 (22%)	0 (0%)	0 (0%)	97	43 - 190	17	9 - 35	9	0
4 (80%)	3 (60%)	0 (0%)	0 (0%)	1 (20%)	77	17 - 180	67	4 - 99	5	2
6 (67%)	3 (33%)	3 (33%)	0 (0%)	1 (11%)	27	20 - 40	59	26 - 85	9	0
4 (50%)	2 (25%)	0 (0%)	0 (0%)	0 (0%)	79	22 - 196	31	1 - 99	8	0
1 (13%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	117	25 - 300	24	1 - 99	8	0
6 (67%)	2 (22%)	4 (44%)	0 (0%)	1 (11%)	49	27 - 60	37	7 - 60	9	1
4 (44%)	0 (0%)	1 (11%)	0 (0%)	2 (22%)	61	25 - 118	29	2 - 85	9	0
0 (0%)	0 (0%)	2 (22%)	0 (0%)	0 (0%)	73	30 - 110	23	2 - 43	9	0
4 (44%)	0 (0%)	1 (11%)	0 (0%)	0 (0%)	169	65 - 248	23	5 - 40	9	0
4 (33%)	0 (0%)	6 (50%)	0 (0%)	0 (0%)	64	24 - 103	24	1 - 84	12	0
1 (25%)	1 (25%)	1 (25%)	0 (0%)	0 (0%)	30	20 - 40	23	10 - 30	4	0
4 (44%)	0 (0%)	2 (22%)	0 (0%)	0 (0%)	74	35 - 160	29	3 - 50	9	0
6 (86%)	4 (57%)	2 (29%)	0 (0%)	0 (0%)	91	24 - 240	50	21 - 99	7	2
5 (71%)	1 (14%)	6 (86%)	0 (0%)	0 (0%)	38	30 - 60	30	20 - 40	7	0
3 (38%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	90	20 - 227	16	1 - 45	8	1
4 (44%)	1 (11%)	3 (33%)	0 (0%)	1 (11%)	82	20 - 300	50	17 - 80	9	0
4 (44%)	1 (11%)	2 (22%)	0 (0%)	0 (0%)	51	30 - 76	24	12 - 55	9	0
1 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	145	100 - 207	18	5 - 25	7	0
5 (45%)	0 (0%)	3 (27%)	0 (0%)	0 (0%)	68	28 - 150	13	1 - 25	8	0
0 (0%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	240	40 - 540	19	5 - 36	8	0
5 (63%)	2 (25%)	4 (50%)	0 (0%)	0 (0%)	29	15 - 55	45	5 - 99	5	0
1 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	141	35 - 230	22	12 - 40	8	2
5 (50%)	1 (10%)	0 (0%)	0 (0%)	1 (10%)	220	200 - 300	28	10 - 69	10	0
5 (63%)	2 (25%)	4 (50%)	0 (0%)	1 (13%)	35	30 - 45	35	15 - 40	8	0
1 (11%)	0 (0%)	3 (33%)	0 (0%)	0 (0%)	69	24 - 114	34	2 - 90	9	0
1 (33%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	300	250 - 350	17	15 - 20	3	0
1 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	281	230 - 350	28	15 - 47	7	0
6 (50%)	0 (0%)	5 (42%)	0 (0%)	2 (17%)	107	40 - 571	26	13 - 40	12	0
4 (40%)	1 (10%)	0 (0%)	0 (0%)	0 (0%)	172	75 - 210	18	5 - 40	10	0
5 (56%)	1 (11%)	2 (22%)	0 (0%)	0 (0%)	51	8 - 90	35	5 - 99	9	1
4 (50%)	3 (38%)	1 (13%)	0 (0%)	0 (0%)	48	2 - 100	35	15 - 99	8	1
3 (43%)	0 (0%)	1 (14%)	0 (0%)	0 (0%)	140	30 - 300	21	4 - 20	7	0
5 (56%)	2 (22%)	4 (44%)	0 (0%)	2 (22%)	59	30 - 120	8	1 - 14	9	1
3 (33%)	0 (0%)	1 (11%)	0 (0%)	0 (0%)	148	80 - 226	17	3 - 30	9	1
6 (75%)	1 (13%)	1 (13%)	0 (0%)	1 (13%)	81	20 - 300	62	25 - 99	8	0
6 (75%)	3 (38%)	2 (25%)	0 (0%)	1 (13%)	40	22 - 99	50	25 - 99	8	1
4 (57%)	2 (29%)	1 (14%)	0 (0%)	0 (0%)	107	30 - 215	40	23 - 60	7	0

SECTION II

APPENDICES

APPENDIX A

SAMPLE SURVEY FORM

Data Collection Form - Survey of Well Contamination
Midwestern States Affected by 1993 Flooding

Do NOT survey well if chlorinated within last 4 days!

Study Sample Code (1-2) (4-6) (8-12) _____ - _____ - _____ (State - County - Well Number)

State Sample # (14-24) _____

Well sampled: __Yes __No (26)

If not sampled, check most appropriate reason:

__Refusal(s) (R) __No well at location (W) __No resident(s) available (S) (28)

Person collecting sample: _____ (57-70)

Date & time of sample collection: (71-78) __/__/__ MM DD YY (80-83) __ __ hour min (24-hour time)

Contact person: (85-100) _____ Phone (AC) (__ __) - __ __ __ - __ __ __ __ (101-112)

Location of well (address/~~distance from permanent markers~~): (113-170)

_____

Well depth (feet) _____ (171-173)

Well currently used for drinking water __Yes __No (174)

Standing surface-water within 100' during/after flood __NA (A) __Yes __No (175)

Age of well in years _____ (176-7)

Date of last chlorination __ __/__ __/__ __ MM DD YY (179-186)

No. of chlorinations in last 6 months _____ (188)

Reason for chlorination _____ (190-220)

Important!

Water samples must be refrigerated immediately after collection.

Filtration treatment __Sand (U) __Softener (T) __Other (O) (221)

Well-water tested previously for contamination { __Yes __No (222) __/__/__ MM DD YY (date collected) (224-231); __Pos __Neg (223) (previous test result) }

Well-head location: (check one)

__ Pumphouse (U) __ Pit (T) __ Basement (B) __ Barn (R) __ Outdoors (O) __ Other (H) (232)

Well diameter in inches: ____ (235-236)

Type of casing: (check one)

__ Steel (S) __ Concrete or clay tile (C) __ Brick or rock (B) __ Plastic (P) __ Wood (W) __ Other (O) (237)

Type of well: (check one)

__ Sandpoint (S) __ Buried slab (B) __ Drilled (R) __ Dug (D) __ Other:_____ (240)

Data Collection Form - Survey of Well Contamination
Midwestern States Affected by 1993 Flooding

Study Sample Code _____ - _____ - _____ (State - County - Well Number)

State Sample # _____

Well capped: ___ Yes ___ No ___ ND (ND = Not Determined) (242)

[Key N for ND below]

Lid setting on top of casing: (check one)

___ Wood - solid sheet (S) ___ Wood - boards (B) ___ Concrete (C) ___ Metal (M) Other _____ (O) (252)

Cap secured to top of casing on the outside (standard cap)? ___ Yes ___ No ___ ND (253)

Cap secured to top of casing on the inside (sanitary seal)? ___ Yes ___ No ___ ND (254)

Is the well vented? ___ Yes ___ No (263) ___ ND If so, does the vent have a screen? ___ Yes ___ No (266)

Are there any openings between the lid and the casing? ___ Yes ___ No ___ ND (267)

Are there any holes or cracks in the casing? ___ Yes ___ No ___ ND (268)

Is there a tight seal with a grommet, caulking, or conduit (to the electric source) where electric line inlet goes through the cap? ___ Yes ___ No ___ ND (269)

Is there a standard pitless adaptor? ___ Yes ___ No ___ ND (270)

Type of pump: (check one)

___ Deep jet pump (D) ___ Shallow jet pump (H) ___ Pump jack/hand pump (P)

___ Submersible pump (U) ___ Centrifugal pump (C) ___ Turbine pump (T) Other _____ (O) (271)

Location of pump: (check one) ___ In the well (W) ___ In pumphouse (H) ___ In well pit (P) Other _____ (O) (272)

Is the well located down slope from any possible contamination sources within 100 feet? ___ Yes ___ No (273)

Are any back-flow prevention assemblies present? ___ Yes ___ No (274)

How far does the well casing extend above ground level: __ feet (275-276) __ inches (278-279)

Is the well located in a 100-year flood plain? ___ Yes ___ No (281)

Are any of the following found within 100 feet of well:

	(Check one)	Usage (check most applicable)
Sinkholes?	___ Yes ___ No ___ Don't Know (282)	
Ag-drainage wells?	___ Yes ___ No ___ Don't Know (284)	___ Abandoned ___ continuous ___ intermittent (285)
Abandoned wells?	___ Yes ___ No ___ Don't Know (286)	
Septic tank?	___ Yes ___ No ___ Don't Know (288)	___ Abandoned ___ continuous ___ intermittent (289)
Lateral field?	___ Yes ___ No ___ Don't Know (290)	___ Abandoned ___ continuous ___ intermittent (291)
Outhouse?	___ Yes ___ No ___ Don't Know (292)	___ Abandoned ___ continuous ___ intermittent (293)
Sewage lagoon?	___ Yes ___ No ___ Don't Know (294)	___ Abandoned ___ continuous ___ intermittent (295)
Manure storage?	___ Yes ___ No ___ Don't Know (296)	___ Abandoned ___ continuous ___ intermittent (297)
Below-ground brick or tile cistern?	___ Yes ___ No ___ Don't Know (298)	___ Abandoned ___ continuous ___ intermittent (299)
Trench/ground silage facilities?	___ Yes ___ No ___ Don't Know (300)	___ Abandoned ___ continuous ___ intermittent (301)

Data Collection Form - Survey of Well Contamination
Midwestern States Affected by 1993 Flooding

Study Sample Code _____ - _____ - _____
(State - County - Well Number)

State Sample # _____

Number of adults and children currently living in household - ___ adults (>17) (302-303) ___ Children (6-17) (305-306) ___ Children (<6) (308-309)

Of those living in household, how many adults and children are currently drinking water from the well (do not count if all drinking water is boiled). ___ adults (>17) (311-312) ___ Children (6-17) (314-315) ___ Children (<6) (317-318)

Of those drinking water from the well, how many have had diarrhea (3 or more loose or watery stools in one 24-hour period) in the last 2 weeks? ___ adults (>17) (320-321) ___ Children (6-17) (323-324) ___ Children (<6) (326-327)

Commercial fertilizers ever used ___Yes ___No (329)

Distance used/mixed from well _____ feet (331-335) Date last used _____ Month (337-338) 19___ Year (340-341)

Manure ever used ___Yes ___No (342)

Distance used/stored from well _____ feet (343-347) Date last used _____ Month (349-350) 19___ Year (352-353)

Pesticides ever used ___Yes ___No (354)

Distance used/mixed from well _____ feet (355-359) Date last used _____ Month (361-362) 19___ Year (363-364)

For Laboratory Use Only: date___/___/___ (MMDDYY) ___ ___ (24 hour time)

Bacti Test:	(Y if present)	Tubes (0-10)	No. CFU/100 ml
Total coliforms	_____	_____	_____
E. coli	_____	_____	_____

Nitrate: Results _____ mg/L

Atrazine: Results _____ ppb