State/Regional Ground Water Monitoring Networks – Results of 2007 Survey

Joint Project of:

Association of American State Geologists

Ground Water Protection Council

Interstate Council on Water Policy

National Ground Water Association

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Joint Project Organizations

The **Association of American State Geologists (AASG)** represents the State Geologists of the 50 United States and Puerto Rico. Founded in 1908, AASG seeks to advance the science and practical application of geology and related earth sciences in the United States and its territories, commonwealths, and possessions

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The **Ground Water Protection Council (GWPC)** is a national association of state ground water and underground injection control agencies whose mission is to promote the protection and conservation of ground water resources for all beneficial uses, recognizing ground water as a critical component of the ecosystem.

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The **Interstate Council on Water Policy (ICWP)** is the national organization of state and regional water resource management agencies. It is the mission of the ICWP to enhance the stewardship of the nation's water resources

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The **National Ground Water Association (NGWA)** is a not-for-profit professional society and trade association for the ground water industry. Its 14,000 members include some of the country's leading public and private sector ground water scientists, engineers, water well contractors, manufacturers, and suppliers of ground water related products and services. The Association's vision is to be the leading community of ground water professionals that promotes the responsible development, use and management of ground water resources.

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Acknowledgements

The project sponsors thank the state and regional ground water monitoring staff who generously shared their time to respond to the surveys. Without their assistance, this information would not be available.

Introduction

Ground water is vital to public health, the environment, and the economy. Approximately 75% of community water systems rely on ground water.[1] Nearly all of rural America, as well as large metropolitan areas, use ground water supplied water systems. Ground water feeds streams and rivers, especially during periods of drought or low flow. The agricultural industry uses ground water for irrigation. The percentage of total irrigation withdrawals from ground water increased from 23 percent in 1950 to 42 percent in 2000.[2] According to a U.S. Government Accountability Office (GAO) report, 36 states anticipate water shortages statewide, regionally or locally in the next 10 years under normal conditions.[3] In the face of these expected shortages, the question is do states have programs that will monitor the ground water quantity and quality so they have information to take either proactive or reactive measures based on sound information? These surveys are intended, in part, to provide a broad overview of the current status of ground water monitoring being conducted by states and regional entities.

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[1] *U.S. Environmental Protection Agency, 2002. Community water system survey 2000, Volume I. Retrieved at http://www.epa.gov/OGWDW/consumer/cwss_2000_volume_i.pdf.*

[2] *Hutson, Susan S., Nancy L. Barber, Joan F. Kenny, Kristin S. Linsey, Deborah S. Lumia, and Molly A. Maupin. 2004. Estimated use of water in the United States in 2000. U.S. Geological Survey Circular 1268.*

[3] *U.S. Government Accountability Office. Freshwater Supply: State's Views of How Federal Agencies Could Help them Meet the Challenges of Expected Shortages (GAO-03-514), 2003.*

The Survey

Between August and October 2007, 174 emails went to state agencies in all 50 states targeting those agencies responsible for ground water quality and/or quantity regulations, and state geological surveys. The survey was sent simultaneously to different agencies in an effort to enlist a “shotgun” approach to ensure the highest number of respondents possible. The email requested that they complete an electronic survey on statewide or regional ground water monitoring programs in their states. Regional was defined for purposes of the survey as monitoring networks that cover large, (e.g., multi-county) areas within a state.

A separate survey was developed for ground water level monitoring programs and ground water quality monitoring programs. Forty-one states responded to the ground water level monitoring survey. Forty-nine states responded to the ground water quality monitoring survey. Although the surveys varied, the questions common to both surveys included:

- ✓ Program status
- ✓ Monitoring program objectives
- ✓ Who manages the program
- ✓ How is the program funded
- ✓ What types of wells are used in the network
- ✓ What are the numbers of wells sampled, the sampling frequency and the length of record
- ✓ Who collects the samples
- ✓ What metadata is collected
- ✓ Who developed the field practices standard operating procedures
- ✓ Who developed the data standards and data management standard operation procedures
- ✓ How are data stored

The survey results were also supplemented by contacts and information provided by the U.S. Geological Survey.

Summary of Findings

Table 1 identifies the status of statewide and regional ground water level monitoring networks. Map 1 identifies the status of statewide/regional ground water level monitoring programs by state.

Table 1 – Ground Water Level Networks

Number of States	Type Program
22	One or more statewide networks
15	One or more statewide and regional networks
5	One or more regional networks
8	No statewide or regional network
50	Total states

Map 1 – Ground Water Level Networks

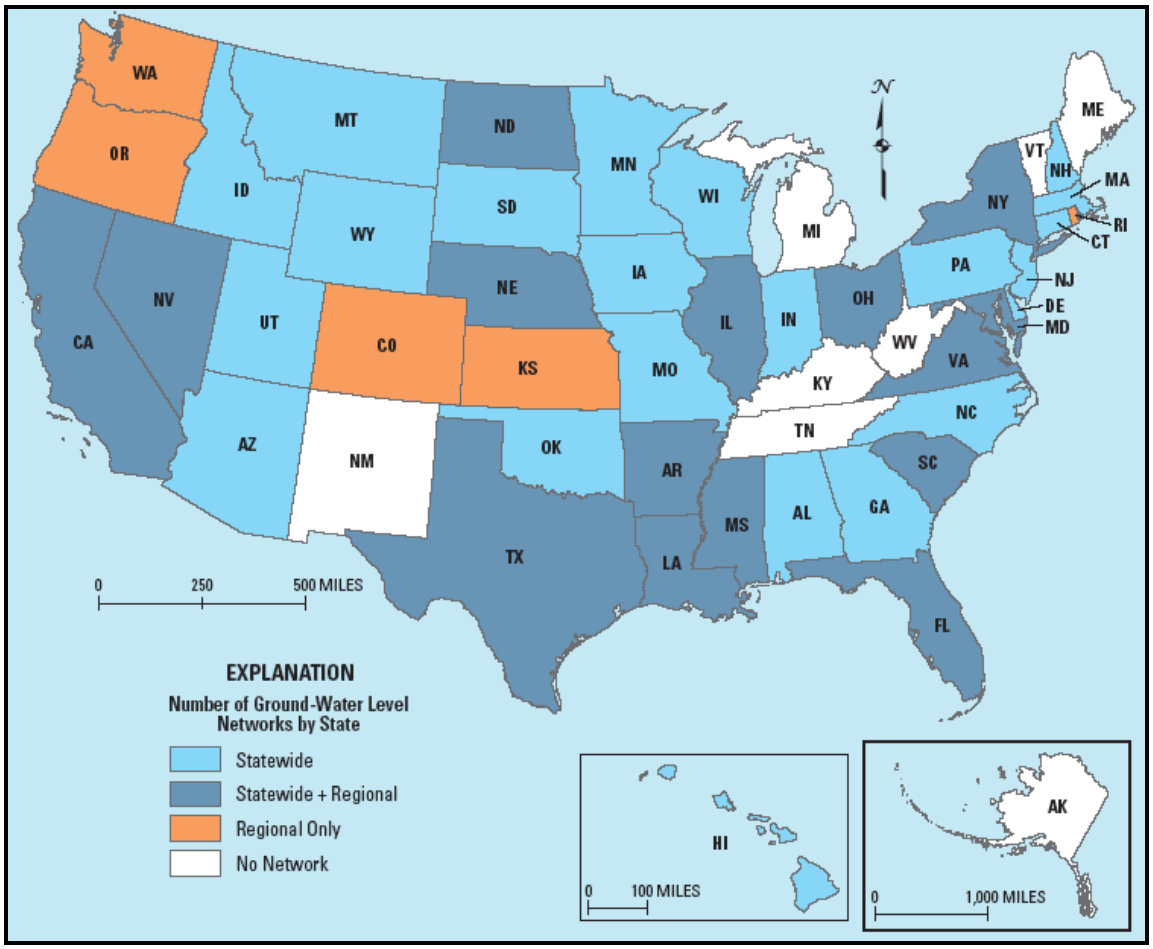
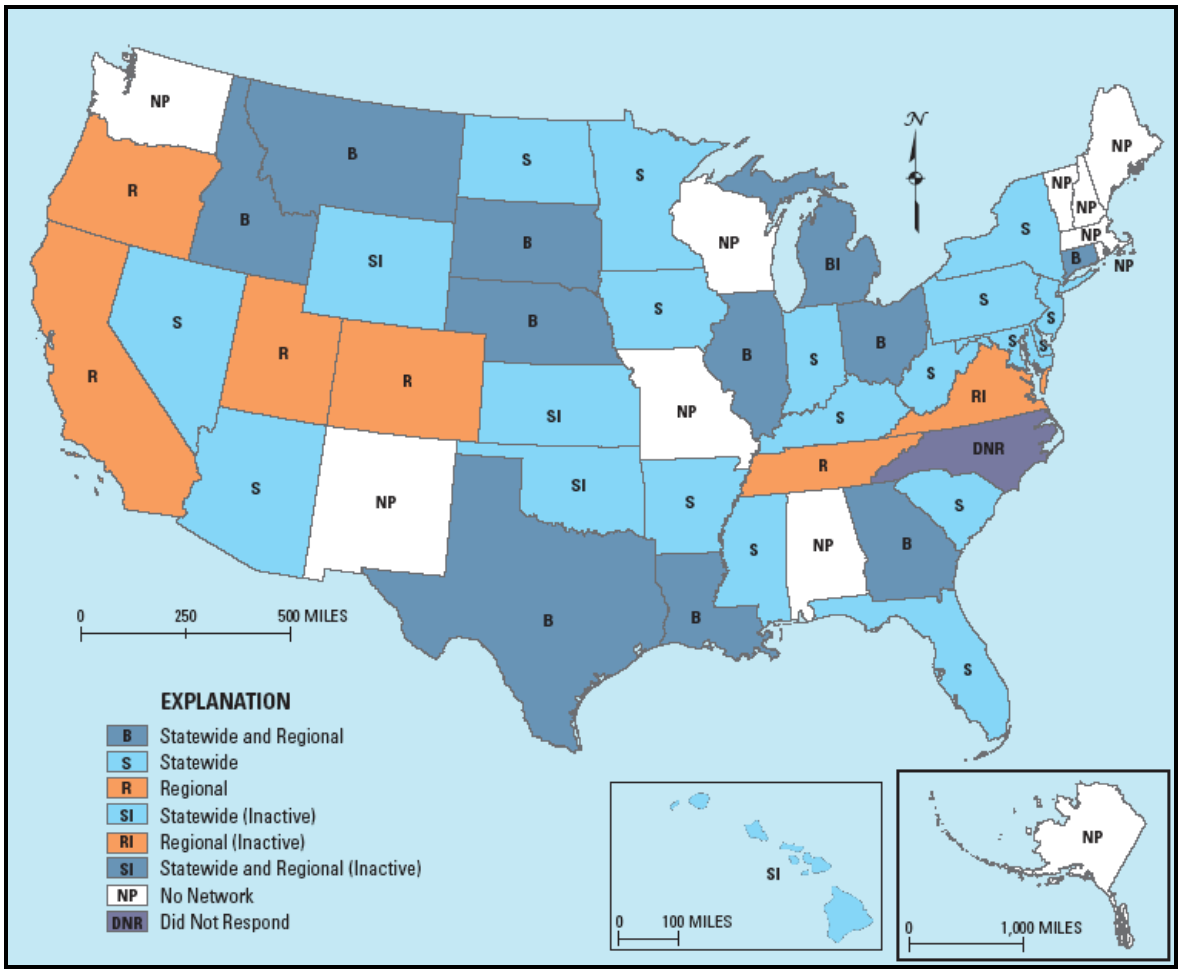


Table 2 identifies the status of statewide and regional ground water quality monitoring networks. Map 2 identifies the status of statewide/regional ground water quality monitoring programs by state.

Table 2 – Ground Water Quality Networks	
Number of States	**Type Program**
18	One or more statewide networks
10	One or more statewide and regional networks
5	One or more regional networks
11	No statewide or regional network
5	Inactive either statewide or regional
1	No response
50	Total states

Map 2 – Ground Water Quality Networks

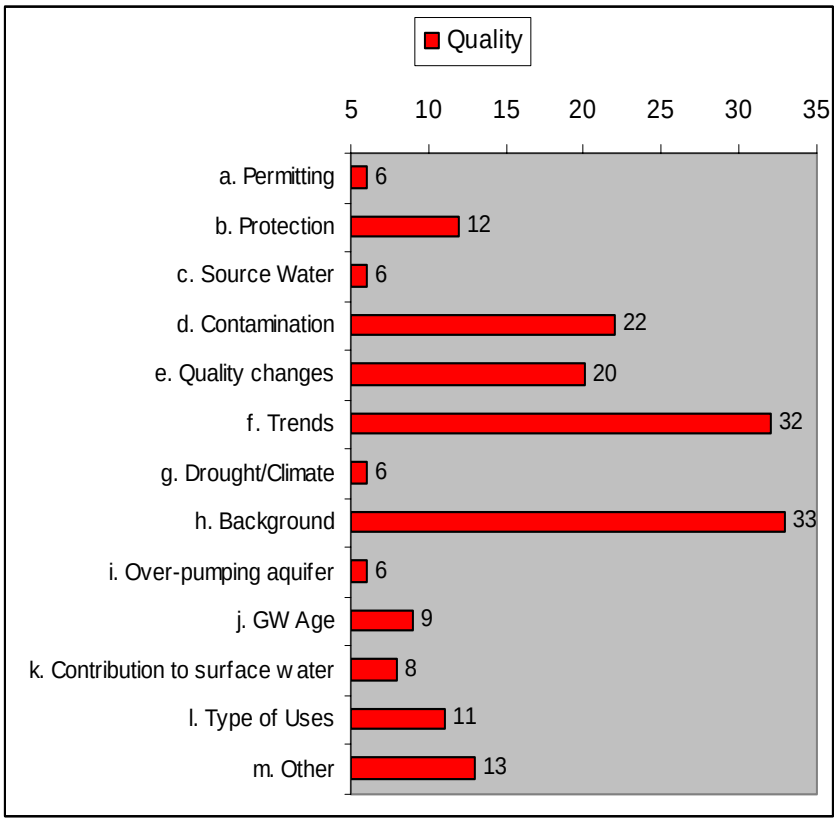


The following graphs represent a compilation of the *Ground Water Level Monitoring* survey and *Ground Water Quality Monitoring* survey responses. The responses are included on one graph for questions common to both surveys (including answer choices) and are indicated by different colored bars. For questions that differed between the surveys, an individual graph unique to that question is shown.

Question 4. Please indicate whether the existing state-wide/regional ground water quality monitoring network is intended to provide ground water level data to answer the following questions.

QUALITY

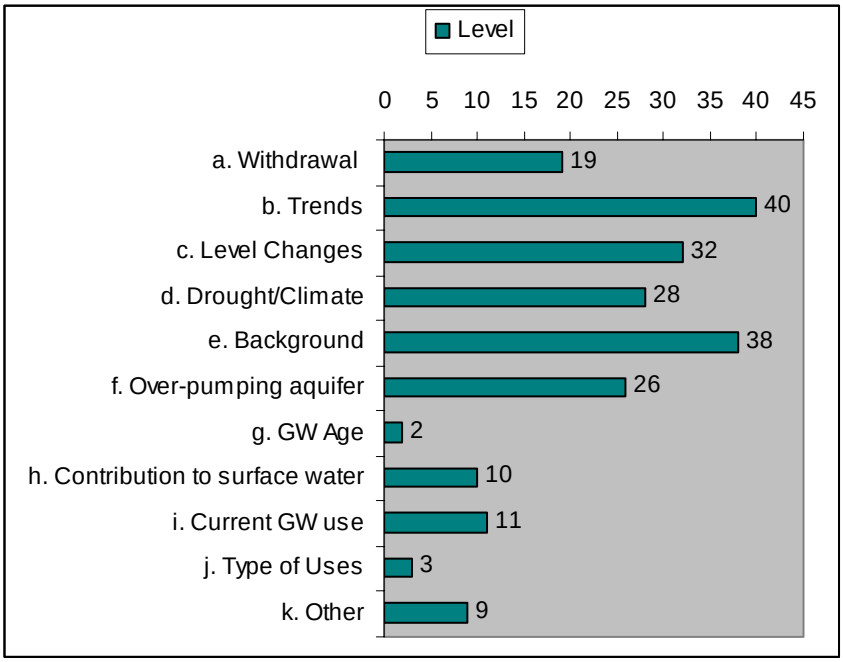
a. How effective are groundwater permitting programs in protecting water quality?
b. How effective are voluntary protection programs?
c. How effective are protection programs in source water protection areas?
d. What is the extent of ground water contamination?
e. How/why does a specific ground water quality parameter change over time?
f. What are the trends in ground water quality over time?
g. What are the effects of drought/climate change?
h. What is the current background (ambient) quality?
i. What are the impacts to ground water quality/level due to over-pumping of aquifers
j. What is the age of ground water within an aquifer?
k. What is the ground water quality/level contribution to surface water and vice versa?
l. What type(s) of uses (e.g. domestic, irrigation, livestock, industrial, etc) is ground water suitable for?
m. Other, please specify.



Question 4. Please indicate whether the existing state-wide/regional ground water level monitoring network is intended to provide ground water level data to answer the following questions.

LEVEL

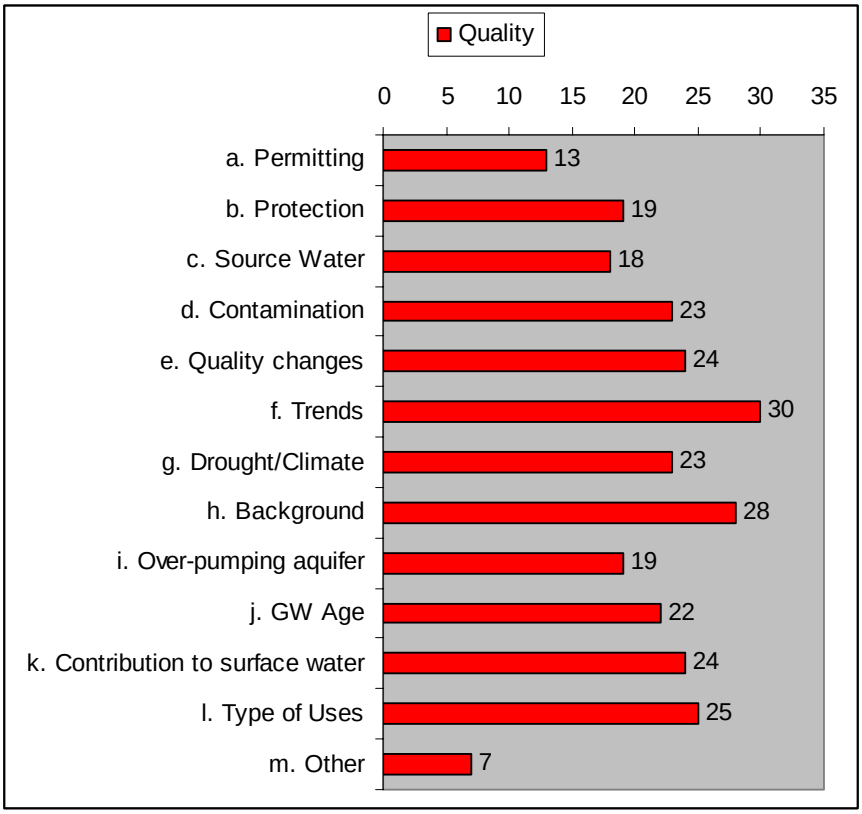
a. How effective are groundwater management programs in managing ground water withdrawals?
b. What are the trends in ground water quality/levels over time?
c. What are the effects of drought/climate change?
d. How/why do ground water levels change over time?
e. What is the current background (ambient) quality?
f. What are the impacts to ground water quality/level due to over-pumping of aquifers
g. What is the age of ground water within an aquifer?
h. What is the ground water level contribution to surface water and vice versa?
i. How much ground water is currently being used?
j. What type(s) of uses (e.g. domestic, irrigation, livestock, industrial, etc) is ground water suitable for?
k. Other, please specify.



Question 5. Please indicate whether the existing state-wide/regional monitoring network could be used to answer the following questions.

QUALITY

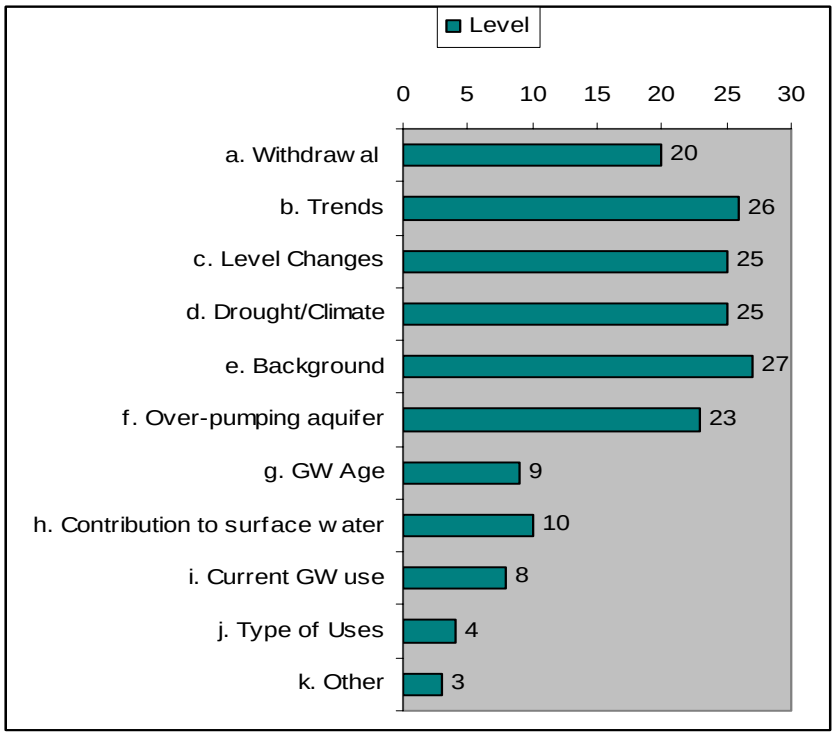
a. How effective are groundwater permitting programs in protecting water quality?
b. How effective are voluntary protection programs?
c. How effective are protection programs in source water protection areas?
d. What is the extent of ground water contamination?
e. How/why does a specific ground water quality parameter change over time?
f. What are the trends in ground water quality over time?
g. What are the effects of drought/climate change?
h. What is the current background (ambient) quality?
i. What are the impacts to ground water quality/level due to over-pumping of aquifers
j. What is the age of ground water within an aquifer?
k. What is the ground water quality/level contribution to surface water and vice versa?
l. What type(s) of uses (e.g. domestic, irrigation, livestock, industrial, etc) is ground water suitable for?
m. Other, please specify.



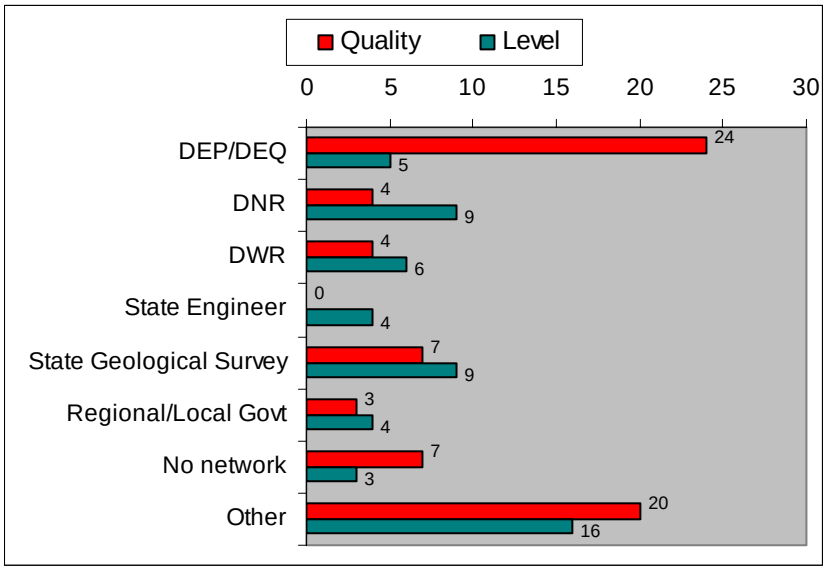
Question 5. Please indicate whether the existing state-wide/regional monitoring network could be used to answer the following questions.

LEVEL

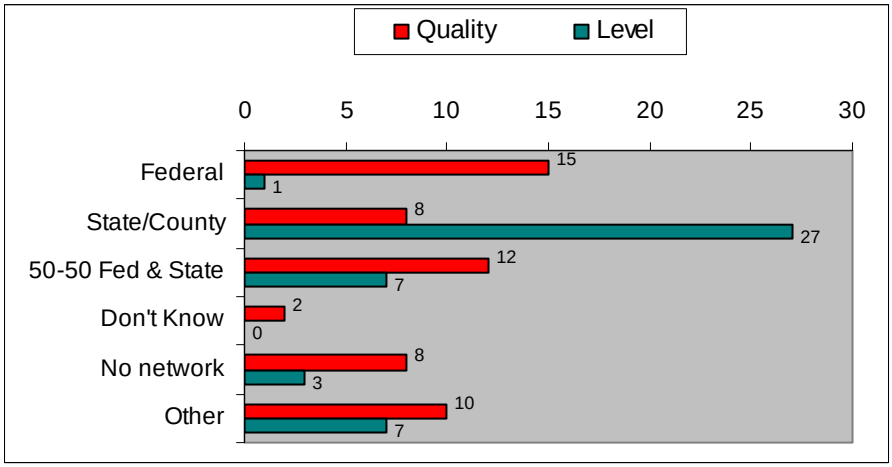
l. How effective are groundwater management programs in managing ground water withdrawals?
m. What are the trends in ground water quality/levels over time?
n. What are the effects of drought/climate change?
o. How/why do ground water levels change over time?
p. What is the current background (ambient) quality?
q. What are the impacts to ground water quality/level due to over-pumping of aquifers
r. What is the age of ground water within an aquifer?
s. What is the ground water level contribution to surface water and vice versa?
t. How much ground water is currently being used?
u. What type(s) of uses (e.g. domestic, irrigation, livestock, industrial, etc) is ground water suitable for?
v. Other, please specify.



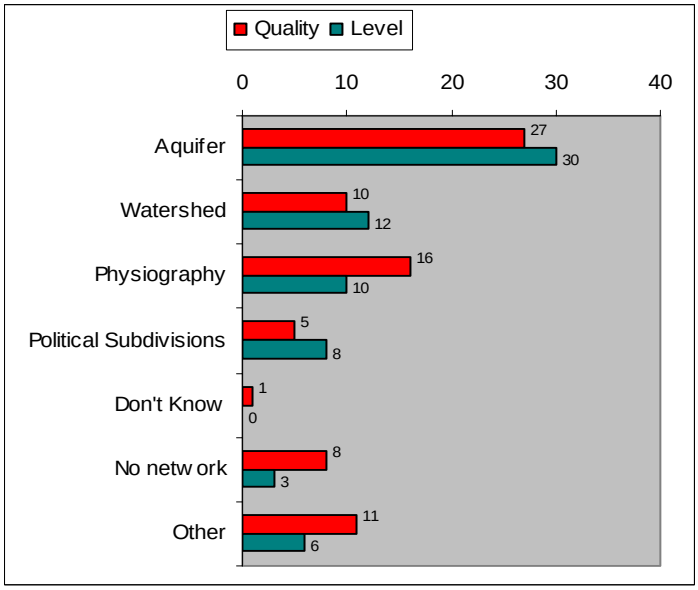
Question 6. Who manages the state-wide/regional ground water monitoring network?



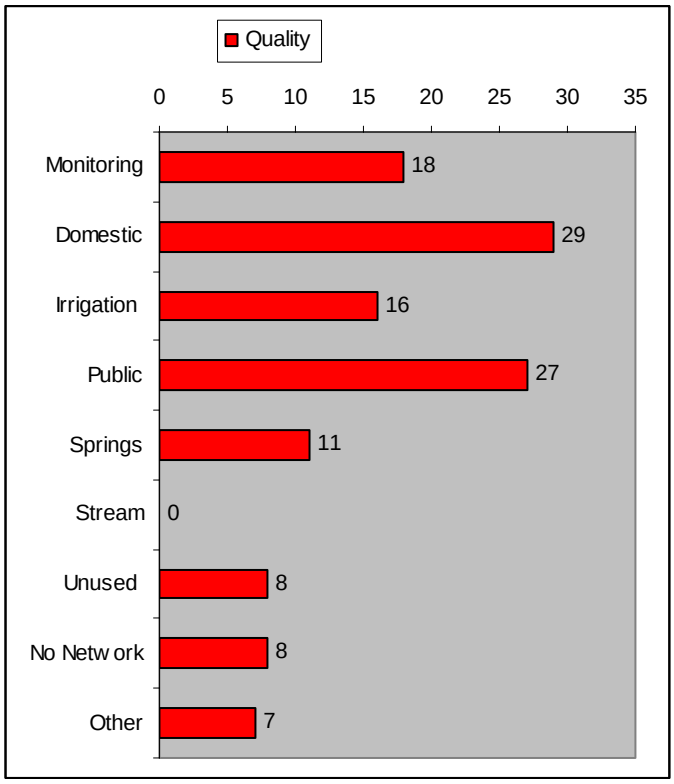
Question 7. How is the stated-wide/regional monitoring network funded?



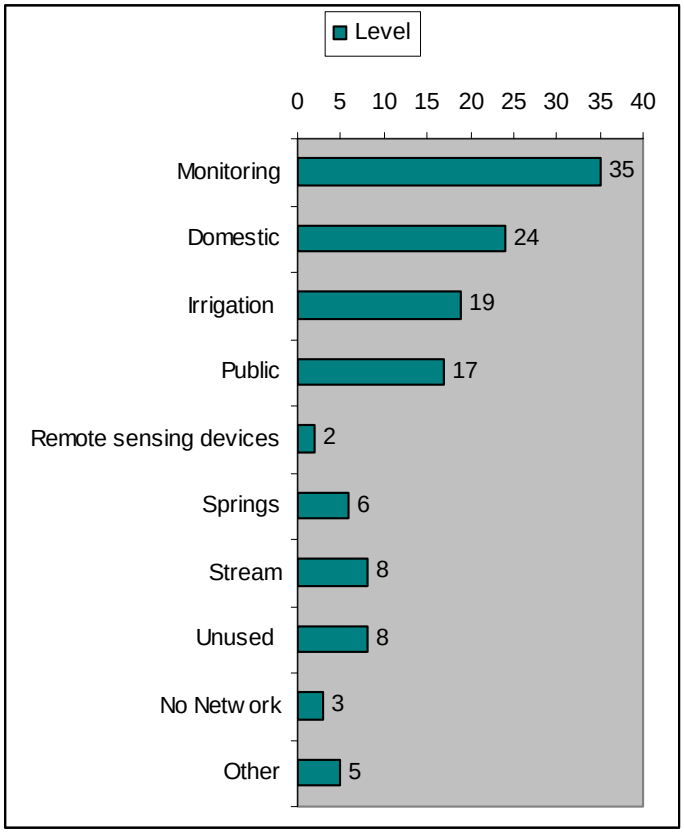
Question 8. Is the state-wide/regional ground water monitoring network designed based on:



Question 9. What wells or other observation points are used for statewide/regional ground water quality monitoring network?



Question 9. What wells or other observation points are used for statewide/regional ground water level monitoring network?



LEVEL	Question 10: Total Wells		Question 11: Wells Measured Once a Year		Question 12: Wells Measured Semi-Annually		Question 13: Wells Measured Quarterly	
State	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements
Alabama	450	430	450	430	19	19	19	19
Arizona	1500	1000	1200 - 1500	1000	90	40	90	40
Arkansas	1340	1250	1100	1000	400	350	50	50
California	42,916	8,245						
Colorado	1200	1200	1200	1200	105	105	0	0
Delaware	102	102	102	102	102	102	95	95
Delaware	85	70	85	70	85	70	85	70
Florida	1500	46	46	46	46	46	46	46
Florida	1337	953	1337	953	1337	953	1337	953
Georgia	180 continuous recorders; 150 annual	371 historical continuous recorders	about 150 annually	about 150 annually	60	60		
Hawaii	approximately 55	approximately 50					approx 55	approx 50
Illinois	500+	500+	~100	~100	~100	~100	~50	~50
Indiana	90	90	50	50	50	50	50	50
Kansas	1400	1400	1400	1400	~100	~100	~300	~300
Louisiana	280	180	280	180	280	180	275	175
Maine								
Maryland	149	140 (est.)	149	140 (est)	149	140 (est)	43	
Massachusetts	92	90	92	90	92	90	92	90
Minnesota	750	730	750	730	750	730	675	675
Mississippi			2202	1777	525	477	N/A	N/A
Missouri	101	70	101	70	101	70	101	70
Montana	909	878	0	0	0	0	784	758
Nebraska	5600	4800	5600	4800	105	105	12	12
Nevada	1608	1570	1397	1370	103	92	52	52
New Hampshire	27	26	27	26	27	26	27	26
New Jersey	217	210	217	210	166	159	166	159
New York	50	37	50	37	50	37	50	37
North Carolina	548 wells	~500	548	~500	548	~500	548	~500
North Dakota	3,800	3,600	495	495	65	65	693	693
Ohio	139	118			2	2		
Ohio	77	70	77	70	77	70	77	70
Oklahoma	503	503	503	503	0	0	0	0
Oregon	8	8	8	8	8	8	8	8
Rhode Island		29		29		29		29
South Carolina	135	69	135	69	135	69	135	69
South Dakota	1639	1639	1639	1639	1639	1639	1639	1639
Texas	about 8,000	85%	6000	85%	1500-2000	85%	1000	90%
Vermont	See USGS for info		See USGS for info		See usgs for info			
Virginia	404 active wells in the network	667 includes active and inactive wells	404	667	404	595	349	388
Washington	around 1000	around 700	around 750	around 700	around 500	around 500	around 250	around 200
Wisconsin	120	120	120	120	120	120		
Wyoming	approx. 250	approx 240	approx 200	approx 190	approx 200	approx 190	approx 200	approx 190

LEVEL	Question 14: Wells Measured Monthly		Question 15: Wells Measured Weekly		Question 16: Wells Measured Daily		Question 17: Wells Measured in Real Time	
State	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements
Alabama	18	18	18	18	18	18	0	0
Arizona	90	40	90	40	45	40	45	40
Arkansas	24	20	24	20	19	14	19	14
California					200	200	0	0
Colorado	0	0	0	0	0	0	0	0
Delaware	0	0	0	0	0	0	0	0
Delaware	45	45	18	14	18	14	1	1
Florida	0	0	0	0	0	0	0	0
Florida	1310	953	716	439	615	438	269	302
Georgia	180 continuous sites are measured every 2 months	180 continuous sites are measured every 2 months			180	180	25	20
Hawaii								
Illinois	~50	~50	maybe 6-12	0	maybe 6-12	0	0	
Indiana	40	40	38	38	38	38	5	5
Kansas	~20	~20	0	0	0	0	0	0
Louisiana	8	8	8	8	8	8	8	8
Maine								
Maryland	43		5 (recorders)		5 (recorders)		5	
Massachusetts	92	90	0	0	12	11	10	9
Minnesota	675	675	20	2	20	2	12	0
Mississippi	None	None	None	None	Only as needed for short-duration investigations.	No on-going studies.	None	None
Missouri	101	70	101	70	101	70	101	70
Montana	25	25	0	0	100	95	0	0
Nebraska	12	12	6	6	6	6	2	0
Nevada	38	38	9	9	9	9	9	9
New Hampshire	27	26	1		1		1	
New Jersey	163	156	163	156	163	156	20	14
New York	50	37	Get the info from http://groundwaterwatch.usgs.gov	Get the info from http://groundwaterwatch.usgs.gov	Get the info from http://groundwaterwatch.usgs.gov	Get the info from http://groundwaterwatch.usgs.gov	Get the info from http://groundwaterwatch.usgs.gov	Get the info from http://groundwaterwatch.usgs.gov
North Carolina	247	unsure	247	unsure	248	unsure	0	0
North Dakota	2547	2547	0	0	50	10	0	0
Ohio					137	116	10	7
Ohio	77	70	28	28	28	28	0	0
Oklahoma	0	0	0	0	0	0	0	0
Oregon	4	4	4	4	4	4	4	4
Rhode Island		29		None		None		None
South Carolina					40	40	0	0
South Dakota	1639	1639	60	60	60	60	0	0
Texas	500	92%	110	94%	same 110 as in no. 15	94%	91	95%
Vermont								
Virginia	80	46	80	46	80	46	60	2
Washington	a few hundred	not many	maybe 100	not many	maybe 100	not many	1	1
Wisconsin					20	20	3	3
Wyoming	approx 150	approx 140	approx 150	approx 140	approx 150	approx 140	3	3

QUALITY	Question 10: Total Wells		Quesiton 11: Wells Measured Once a Year		Quesiton 12: Wells Measured Semi-Annually		Question 13: Wells Measured Quarterly	
State	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements
Alaska	NA	NA	NA	NA	NA	NA	NA	NA
Arizona	129	136	129	136	na	na	na	na
Arkansas	200	120	0	0	0	0	0	0
California	898	594	0	0	0	0	0	0
Colorado	approx. 130	apprx 75, but most data is on pesticides & nitrate	approx 130	apprx 75, but most data is on pesticides & nitrat	0	0	0	0
Connecticut	36	36	0	0	0	0	0	0
Delaware	Approx 40	Approx. 40	Approx 40	Approx 40	Approx 40	Approx 40	0	0
Delaware	103	103	103	103	50	50	0	0
Florida	150-180 per year; approximately 870 every 5 years	46	46	46	46	46	46	46
Florida	58	53	58	53	58	53	58	53
Georgia	180	0	0	0	0	0	0	0
Hawaii								
Idaho	1200	1200	1200	1200	80	80	40	40
Idaho	150	0	50	0	0	0	0	0
Idaho	500	100	100	100	30	0	30	0
Idaho	About 2000	98 or 99	100	98 or 99	0	0	0	0
Illinois	350	350	350	350	0	0	0	0
Illinois	18	18	0	0	0	0	0	0
Illinois	144	144						
Indiana	300	0	300	0	0	0	0	0
Iowa	150 annually; 2000 wells with one obs.	45	45	45	0	0	0	0
Kansas	>500 (two-year rotation)	300+ (two-year rotation)						
Kentucky	1000 (see comment)	150	380	150	380	150	300	150
Louisiana	285	255	0	0	0	0	0	0
Louisiana	about 90	about 90	about 90	about 90	about 55	about 55	0	0
Maine								
Maryland	77	about 50	0		0		0	
Massachusetts								
Michigan								
Minnesota	675	675	675	675	675	675	0	0
Minnesota	Current 400, new randomly selected wells each year	0	Building to 450	0 (2007 is 4th sampling year of current network)	0	0	0	0
Mississippi	1341	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Missouri								
Montana	42 dedicated pmw +	35			42 + special project wells (~30)	35	none at this time	15
Montana	900+/-	300 wells have >=2 samples; period >= 5 yrs						
Nebraska	1438	700 (estimated)	1000 (estimated)	500 (estimated)	250 (estimated)	200 (estimated)	100 (estimated)	75 (estimated)
Nevada	67	52	44	52	44	52	0	0
New Hampshire								
New Jersey	150	150 with at least one sampling event						
New Mexico								
New York								
North Dakota	1027	0 - Wells are sampled on a 5-year rotation	0	0	0	0	0	0
Ohio	200 Active Wells - 150 Inactive Wells	190 Active Wells	160	155	85	82	0	0
Oklahoma	1200	0	0	0	0	0	0	0
Oregon	120 wells sampled 6/year	500	120	120	120	120	120	120
Pennsylvania	approx. 30 per year	3	3	3	2	3	2	3
Rhode Island								
South Carolina	128	0	0	0	0	0	0	0
South Dakota	145	145	145	145	28	28	28	28
Tennessee	0	0	0	0	0	0	0	0
Tennessee	14	14	14	14	14	14	14	14
Texas	~8000	85%	6000	85%	1500 - 2000	85%	1000	
Utah	300	300	100	300	0	300	0	300
Vermont	N/A	N/A						
Virginia								
Washington								
West Virginia	296	0	0	0	0	0	0	0
Wisconsin								
Wyoming	296	0	296	0	0	0	0	0

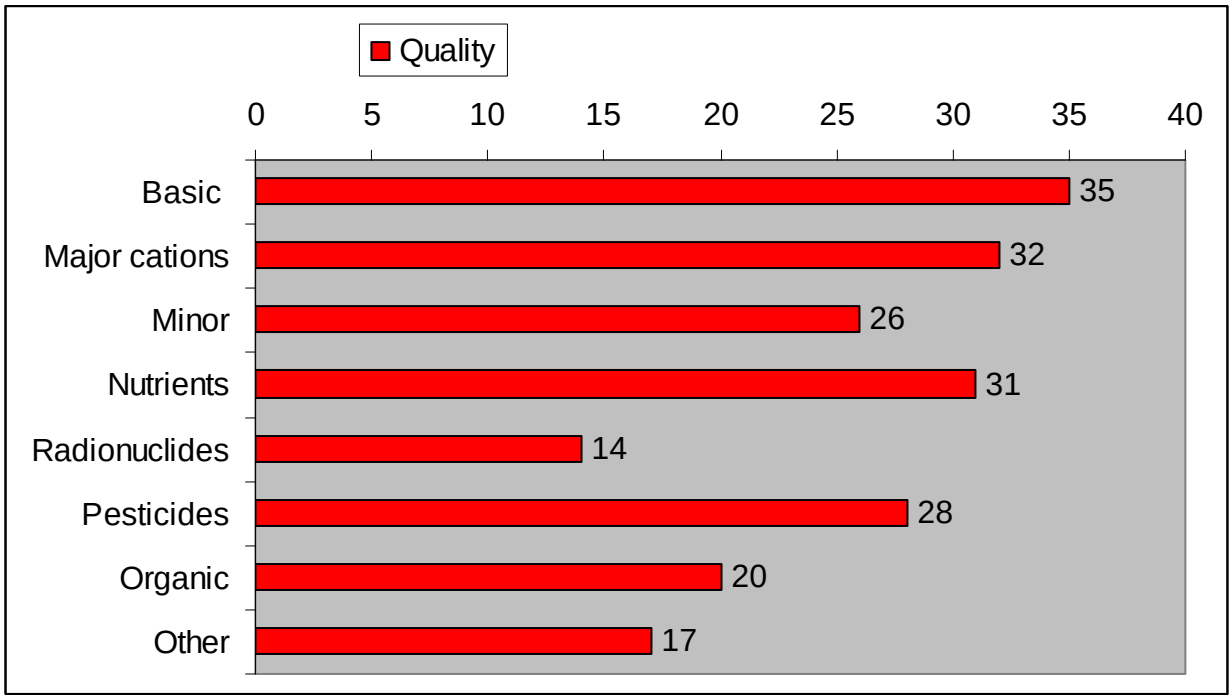
QUALITY	Question 14: Wells Measured Monthly		Question 15: Wells Measured Weekly		Question 16: Wells Measured Daily		Question 17; Wells Measured in Real Time	
State	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements	Total Measured	Total w/at least 5 yrs. Measurements
Alaska	NA	NA	NA	NA	NA	NA	NA	NA
Arizona							na	na
Arkansas			0	0	0	0	0	0
California	0	0	0	0	0	0	0	0
Colorado	0	0	0	0	0	0	0	0
Connecticut	0	0	0	0	0	0	0	0
Delaware	0	0	0	0	0	0	0	0
Delaware	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	0	0
Georgia	0	0	0	0	0	0	0	0
Hawaii								
Idaho	25	25	0	0	0	0	0	0
Idaho	0	0	0	0	0	0	0	0
Idaho	0	0	0	0	0	0	0	0
Idaho	0	0	0	0	0	0	0	0
Illinois	0	0	0	0	0	0	0	0
Illinois	0	0	0	0	0	0	0	0
Illinois								
Indiana	0	0	0	0	0	0	0	0
Iowa	0	0	0	0	0	0	0	0
Kansas								
Kentucky	0	0	0	0	0	0	0	0
Louisiana	0	0	0	0	0	0	0	0
Louisiana	0	0	0	0	0	0	0	0
Maine								
Maryland	0		0		0		0	
Massachusetts								
Michigan								
Minnesota	0	0	0	0	0	0	0	0
Minnesota	0	0	0	0	10	0	0	0
Mississippi	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Missouri								
Montana	0	0	0	0	0	0	0	0
Montana								
Nebraska	0	0	0	0	0	0	0	0
Nevada	0	0	0	0	0	0	0	0
New Hampshire								
New Jersey								
New Mexico								
New York								
North Dakota	0	0	0	0	0	0	0	0
Ohio	0	0	0	0	0	0	0	0
Oklahoma	0	0	0	0	0	0	0	0
Oregon	0	0	0	0	0	0	0	0
Pennsylvania	0	0	0	0	0	0	0	0
Rhode Island								
South Carolina	0	0	0	0	0	0	0	0
South Dakota	0	0	0	0	0	0	0	0
Tennessee	0	0	0	0	0	0	0	0
Tennessee	14	14	0	0	0	0	0	0
Texas	500	85%	100	95%	100	95%	100	95%
Utah	0	300	0	300	0	300	0	300
Vermont								
Virginia								
Washington								
West Virginia	0	0	0	0	0	0	0	0
Wisconsin								
Wyoming	0	0	0	0	0	0	0	0

Cell: B25

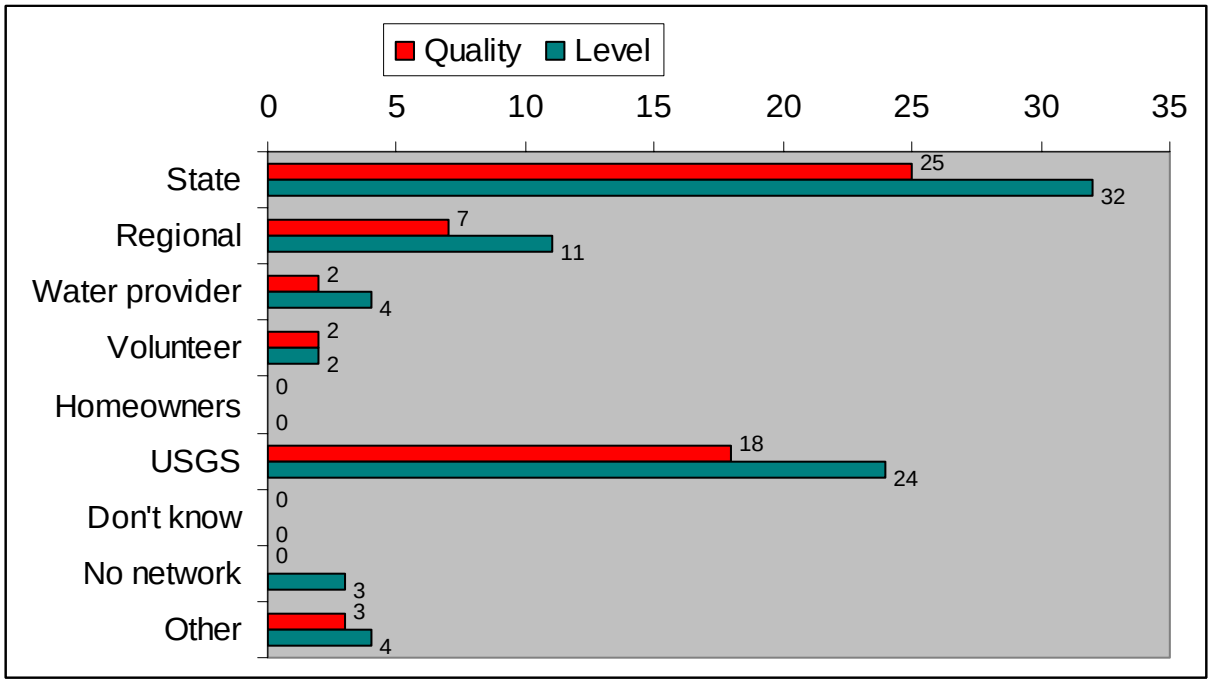
Comment: :

The Kentucky Statewide Ambient Groundwater Monitoring Network is an "umbrella" title for integrating the various groundwater monitoring projects that we conduct. The network was established in 1995 and along with sites we've monitored regularly since then, we've incorporated other projects into this system, including CWA Section 319 Nonpoint Source groundwater studies, monitoring conducted through an MOA with the Division of Pesticides, as well as monitoring/sampling conducted for complaints, assistance, and in response to environmental spills. Most, if not virtually all, of the data collected on these latter projects really represents ambient groundwater conditions. By design, Kentucky's groundwater monitoring is a dynamic and flexible system, rather than a static network of sites. Furthermore, and importantly, all groundwater monitoring activities conducted by various agencies throughout the state are coordinated, per legislation passed in 1998, by the Interagency Technical Advisory Committee on Groundwater. This group of groundwater professionals from about a dozen entities with varying interests has proven to be an invaluable tool in our monitoring efforts.

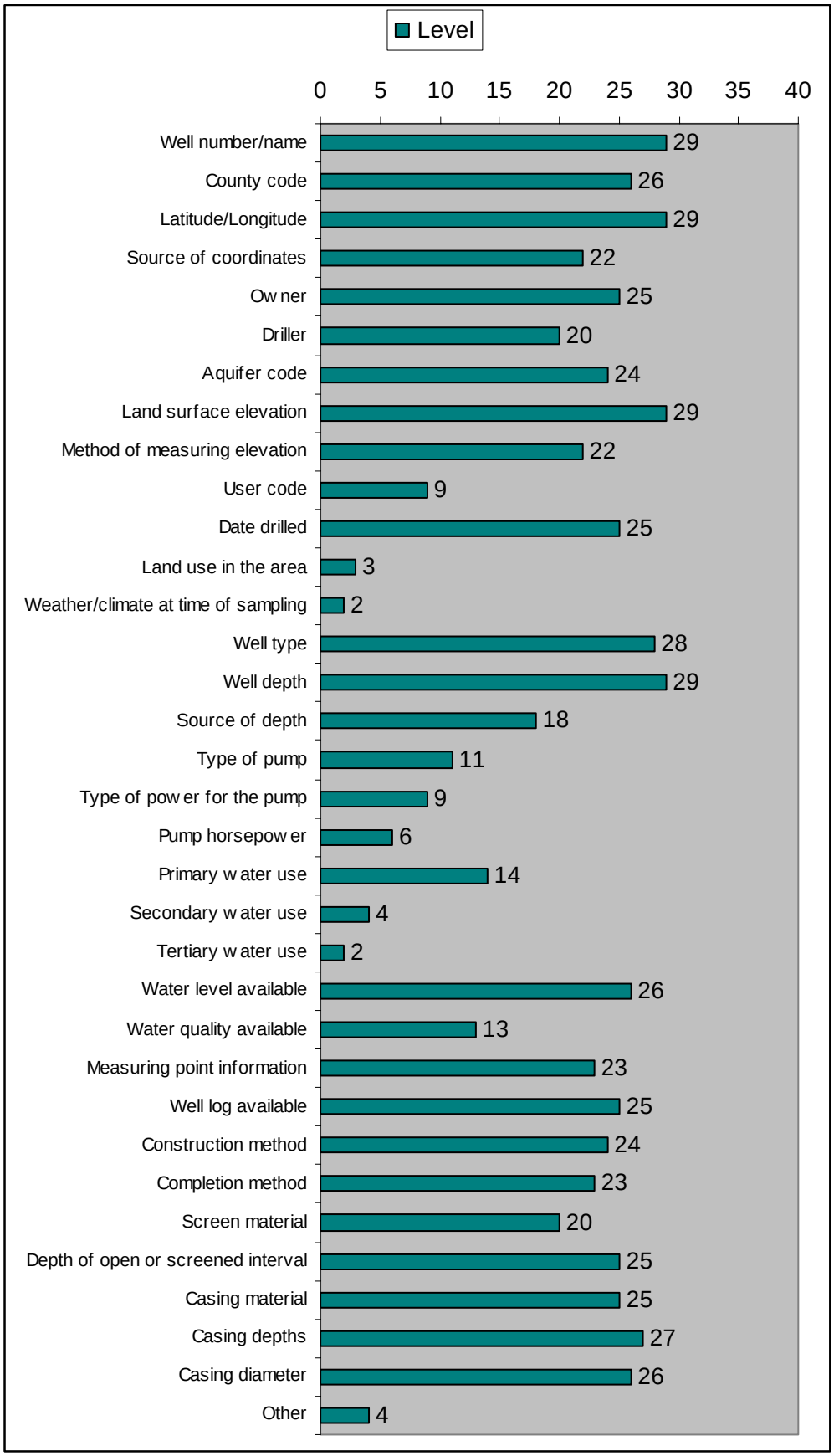
Question 18 - QUALITY. What analytes are included in the state-wide/regional ground water quality monitoring network?



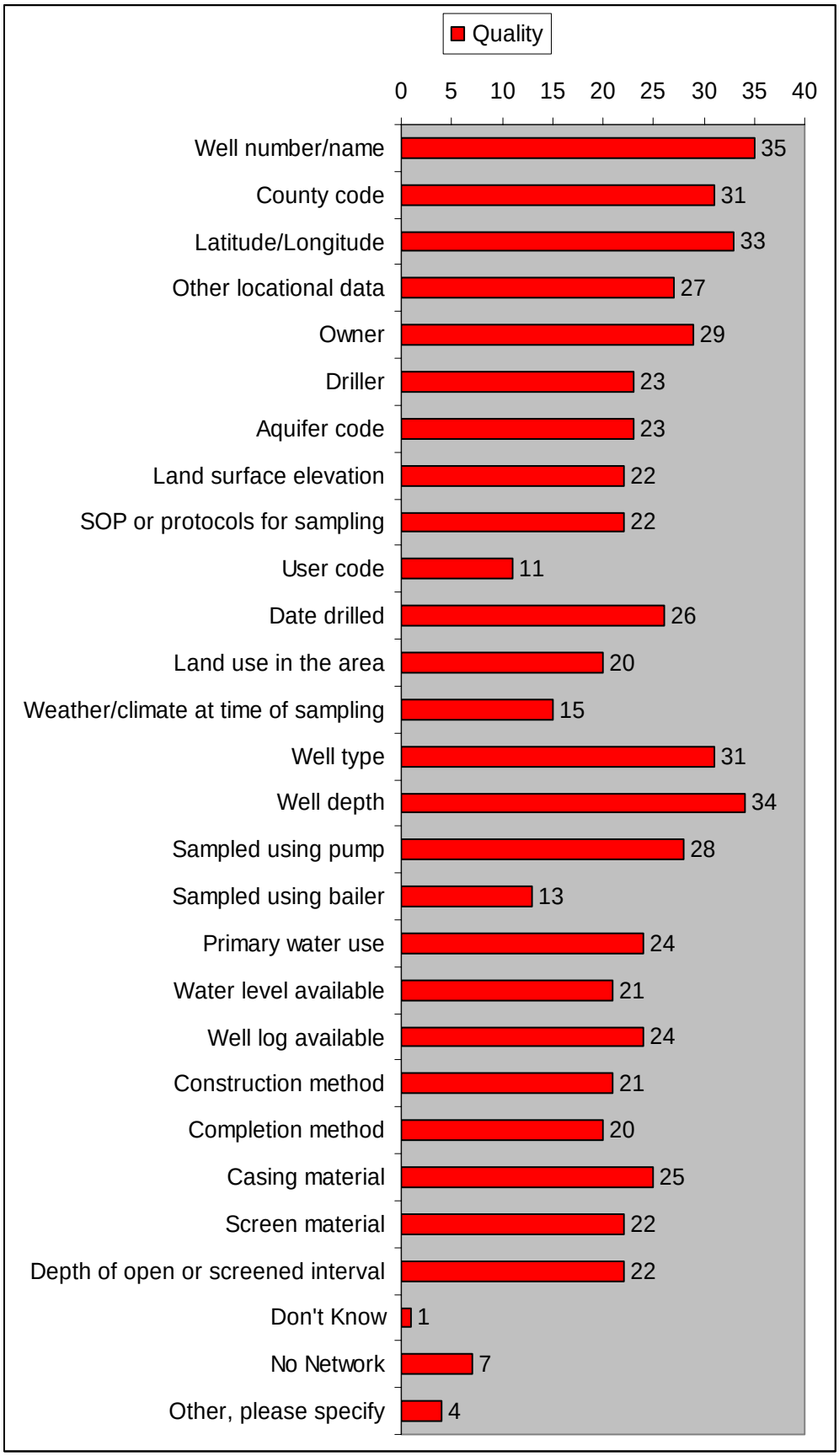
Question 18 – LEVEL/Question 19 – QUALITY. Who collects ground water data for the state-wide/regional ground water monitoring network?



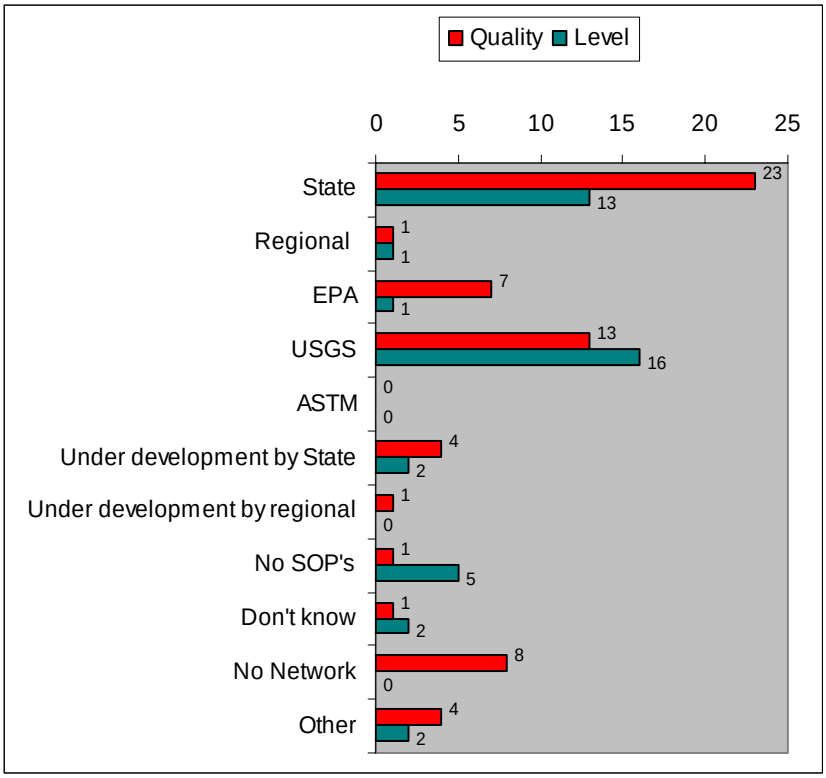
Question 19 - LEVEL. What information is typically available for wells or observation points in the state-wide/regional ground water level monitoring network?



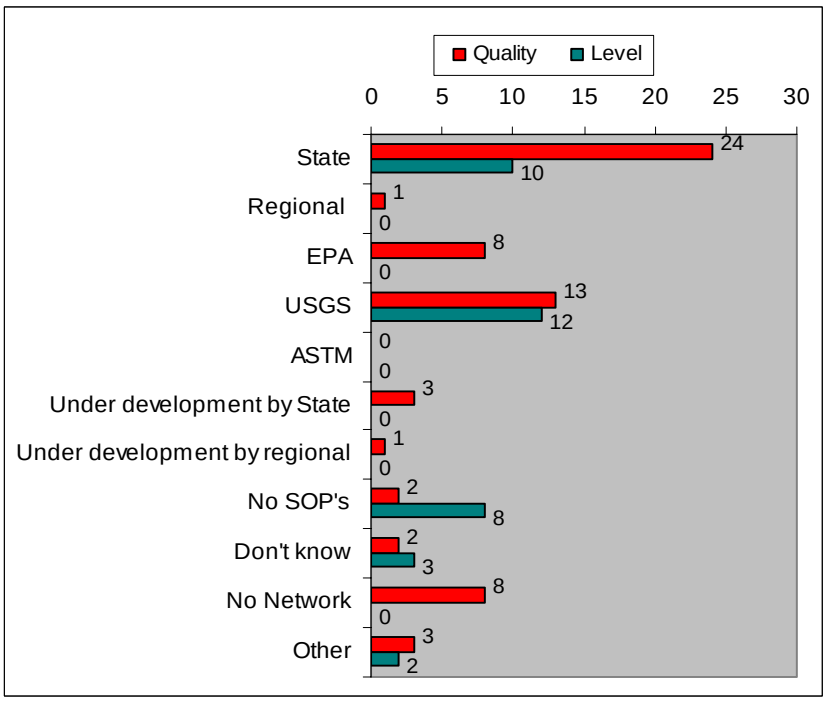
Question 20 – QUALITY. What information is typically available for wells or observation points in the state-wide/regional ground water quality monitoring network?



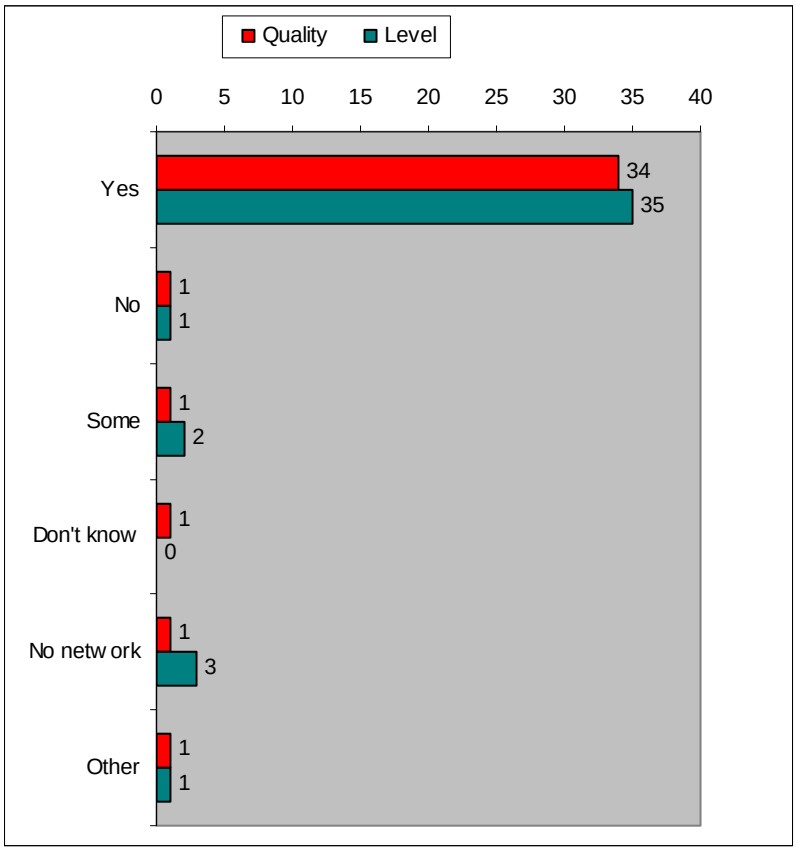
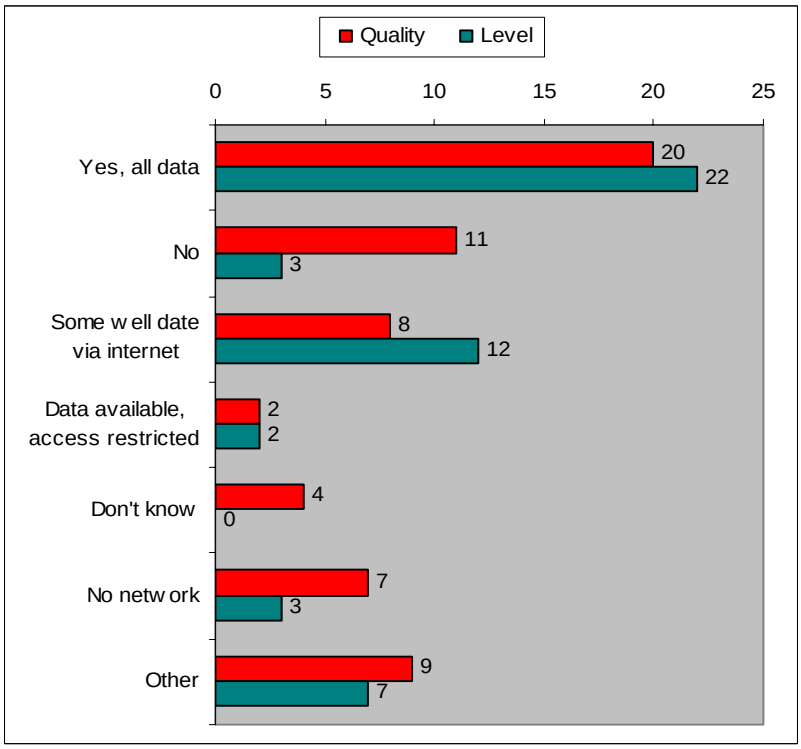
Question 20 –LEVEL/Question 21 – QUALITY. The written Standard Operating Procedures (SOP's) used for Field Data Collection for the state-wide/regional ground water monitoring network were developed by?



Question 21 – LEVEL/Question 22 – QUALITY. The written Standard Operating Procedures used for Data Management and Storage for the state-wide/regional ground water monitoring network were developed by?



Question 22 – LEVEL/Question 23 – QUALITY. Are the data collected for the state-wide/regional ground water monitoring network routinely entered/maintained in a computer data base?



Question 23 – LEVEL/Question 24 - QUALITY. Are the data available on a website accessible to the public?