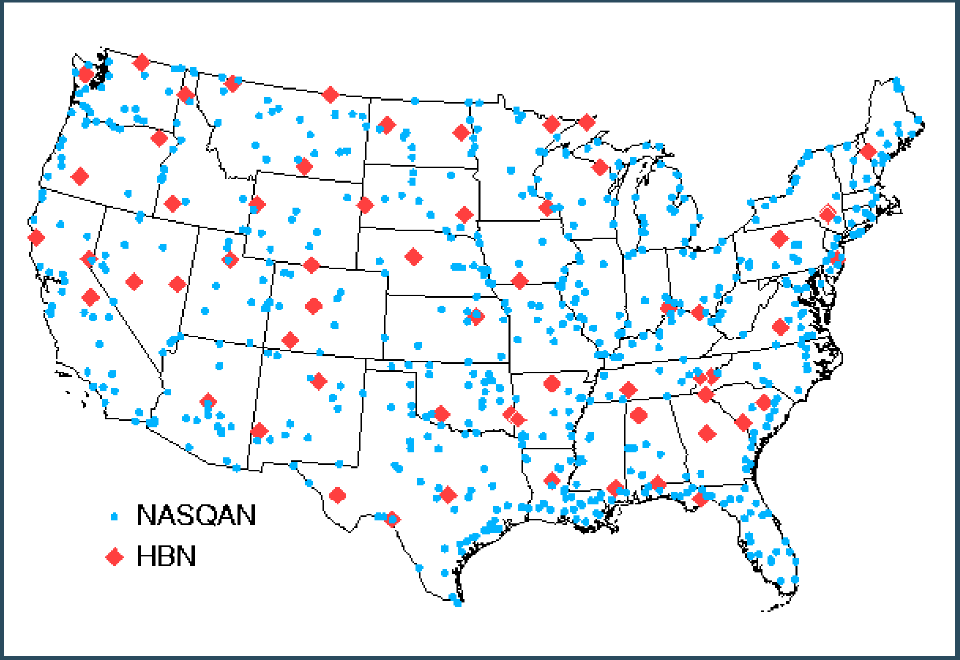
National Water-Quality Monitoring Programs of the U.S. Geological Survey



by

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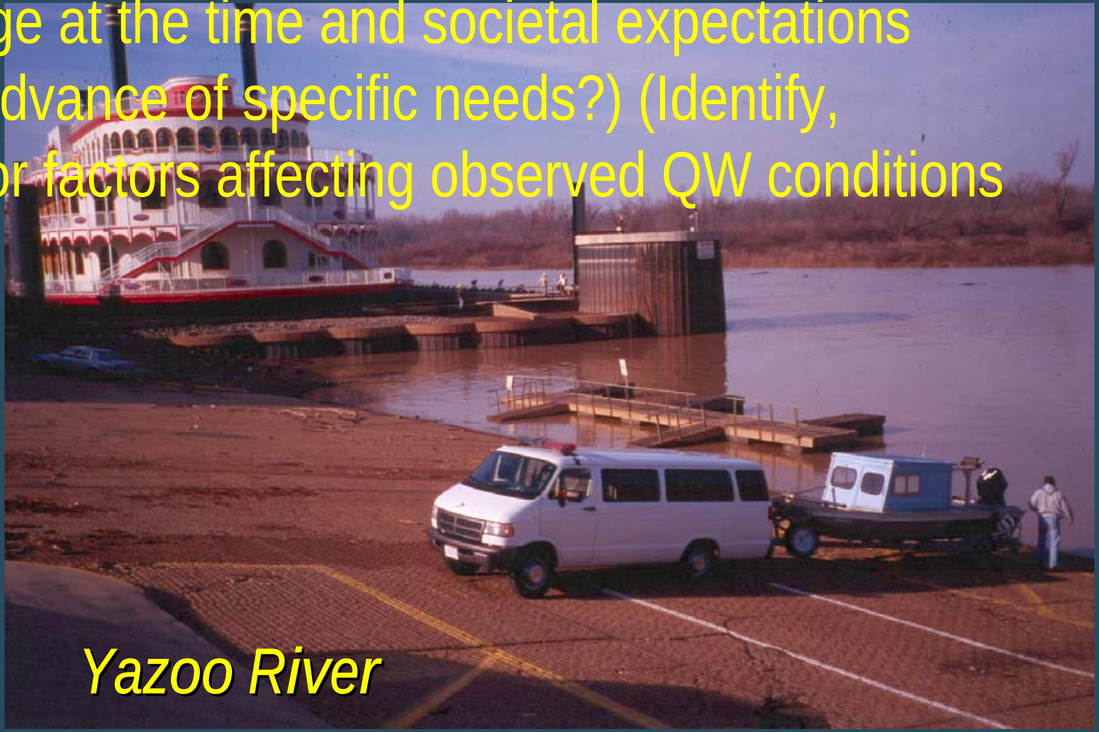
During its 125 year history the USGS has operated a number monitoring programs designed to answer questions about water-quality on a National Scale. The design (status and trends of the resource are generic to monitoring programs), implementation, and objectives of the monitoring programs were different and depended upon the state of knowledge at the time and societal expectations (can data be collected in advance of specific needs?) (Identify, describe, and explain major factors affecting observed QW conditions and trends).



Today I'm only going to talk about two of the Survey's monitoring programs; one of the earliest and one that has been in operation for more than 30 years, albeit with a number of modifications.

I’m going to talk a little about success and failures of these two programs, some lessons learned, and address the question, “Can data be collected in advance of a specific need”.

“Dole and Stabler, (1909)”

- The first monitoring program that I want to talk about occurred just after the turn of the 20th century. Strangely, the program doesn’t appear to have the requisite government acronym and the work is usually referred to as that of “Dole and Stabler, (1909)” their seminal work was entitled “Denudation”. This is a classic work, the first one to give an estimate of off continent flux of sediment from the United States. Interestingly though, one with less then 6 pages of text and only one long table. But, behind this short, important paper are thousands of water-quality analyses from hundreds of rivers across the US.
- R.B. Dole, from the USGS oversaw the collection and analyses of stream samples from streams in CA and east of the 100th meridian and H. Stabler from the Bureau of Reclamation oversaw the data collection and analyses from rivers and streams in the arid west. Samples were collected daily for one year and composted into 7 to 10 day increments and analyzed.
- There was much collaboration between the USGS and State Survey’s and Universities in the collect and analyses of these data.

"Dole and Stabler, (1909)" -continued

- The impetus and objectives of this monitoring reflected societies needs at that time– steam power. Mineral content of water – the wanted to know who had water that was suitable for use in boilers, laundries, and breweries.
- I cannot find any evidence that these data were used to further the stated objectives; however, these data have proven to be invaluable through the last 100 years.

Denudation

Drainage basin.	Physical and chemical data.				Estimated denudation.								
	Area (square miles).	Solids (parts per million).		Run-off (second-feet per square mile).	Tons of solids per square mile per year.		Thousand tons of solids per year.		Millionths of an inch per year.		Years required for 1 inch.		
		Dis-solved.	Sus-pended.		Dis-solved.	Sus-pended.	Dis-solved.	Sus-pended.	Dis-solved.	Sus-pended.	Dis-solved.	Sus-pended.	Total.
I. Northern Atlantic—Continued.													
18. Potomac—Continued.													
Cumberland, Md	620	130	29.0	1.70	217	49							
Millville, W. Va. (Shenandoah River)	3,000	140	39.0	1.07	147	41							
Point of Rocks, Md	9,650			1.07									
Great Falls, Md	11,400	115	85.0	1.12	127	94							
19. James	10,400			1.35	115	95	1,195	988	600	500	1,700	2,000	900
Cartersville, Va	6,230			1.33									
Richmond, Va	6,820	89	71.0	1.33	117	93							
20. Minor Chesapeake Bay	12,800			1.59	130	40	3,870	1,193	680	210	1,500	4,800	1,100
21. Minor North Atlantic	17,000			2.18									
II. Southern Atlantic	123,900				94	176	11,688	21,775	490	920	2,000	1,100	710
1. Chowan	5,000			1.40	85	80	425	400	440	420	2,300	2,400	1,200
2. Roanoke	9,750			1.25	101	256	984	2,490	530	1,300	1,900	750	540
South Boston, Va. (Dan River)	2,750	71	264.0	1.34	94	348							
Randolph, Va	3,080	79	127.0	1.39	108	174							
3. Tar	4,360			1.26	85	80	371	349	440	420	2,300	2,400	1,200
4. Neuse	5,550			1.32	86	80	477	444	450	420	2,200	2,400	1,200
Raleigh, N. C	1,000	73	68.0	1.19	86	80							
Selma, N. C	1,170			1.19									
5. Cape Fear	9,030			1.23	69	25	623	226	360	130	2,800	7,700	2,000
Wilmington, N. C	9,030	57	21.0	1.23	69	25							
6. Pedee (Yadkin)	10,600			1.60	113	154	1,198	1,630	590	800	1,700	1,200	720
Salisbury, N. C	3,400			1.69									
Pee Dee, N. C	6,100	69	94.0	1.66	113	154							
7. Santee	14,800			1.66	107	233	1,583	3,445	560	1,200	1,800	820	560
Camden, S. C. (Wateree River)	4,500	73	214.0	1.44	104	303							
Waterloo, S. C. (Saluda River)	1,060			1.85									
Columbia, S. C. (Saluda River)	2,350	62	54.0	1.85	113	98							
8. Savannah	11,100			1.58	98	232	1,088	2,575	510	1,200	2,000	830	580
Augusta, Ga	7,300	60	142.0	1.66	98	232							

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Fluvial-Sediment Discharge to the Oceans from the Conterminous United States

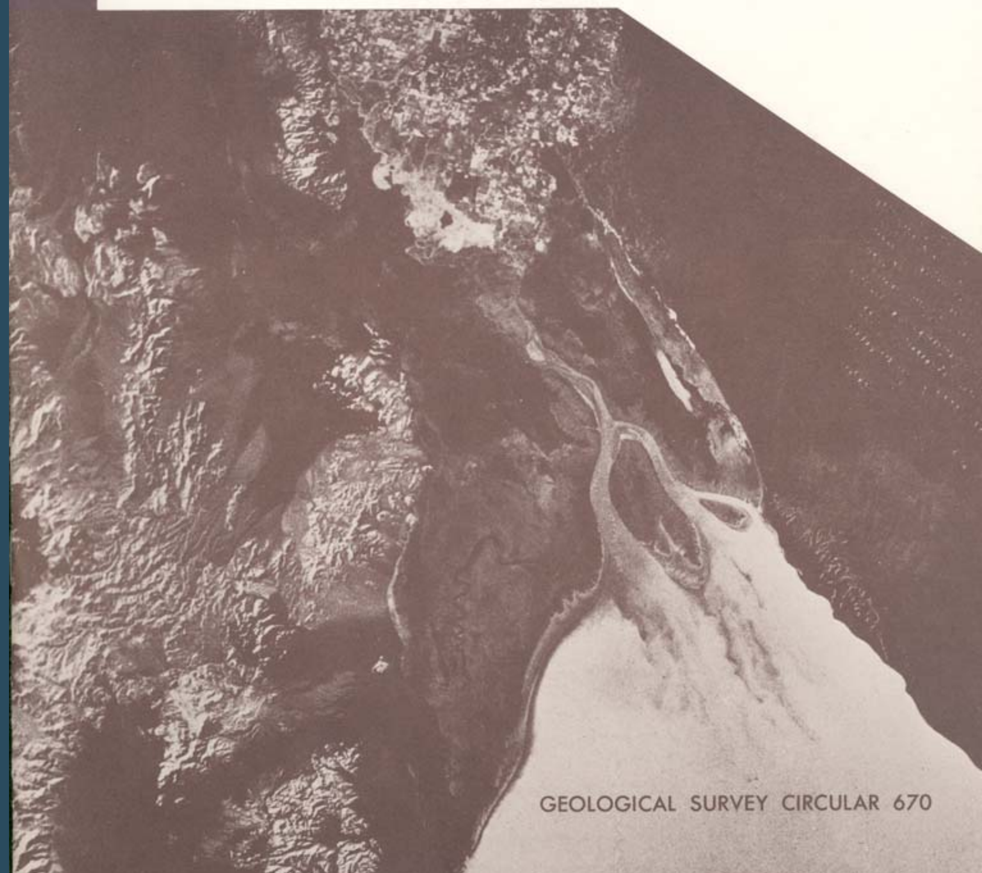

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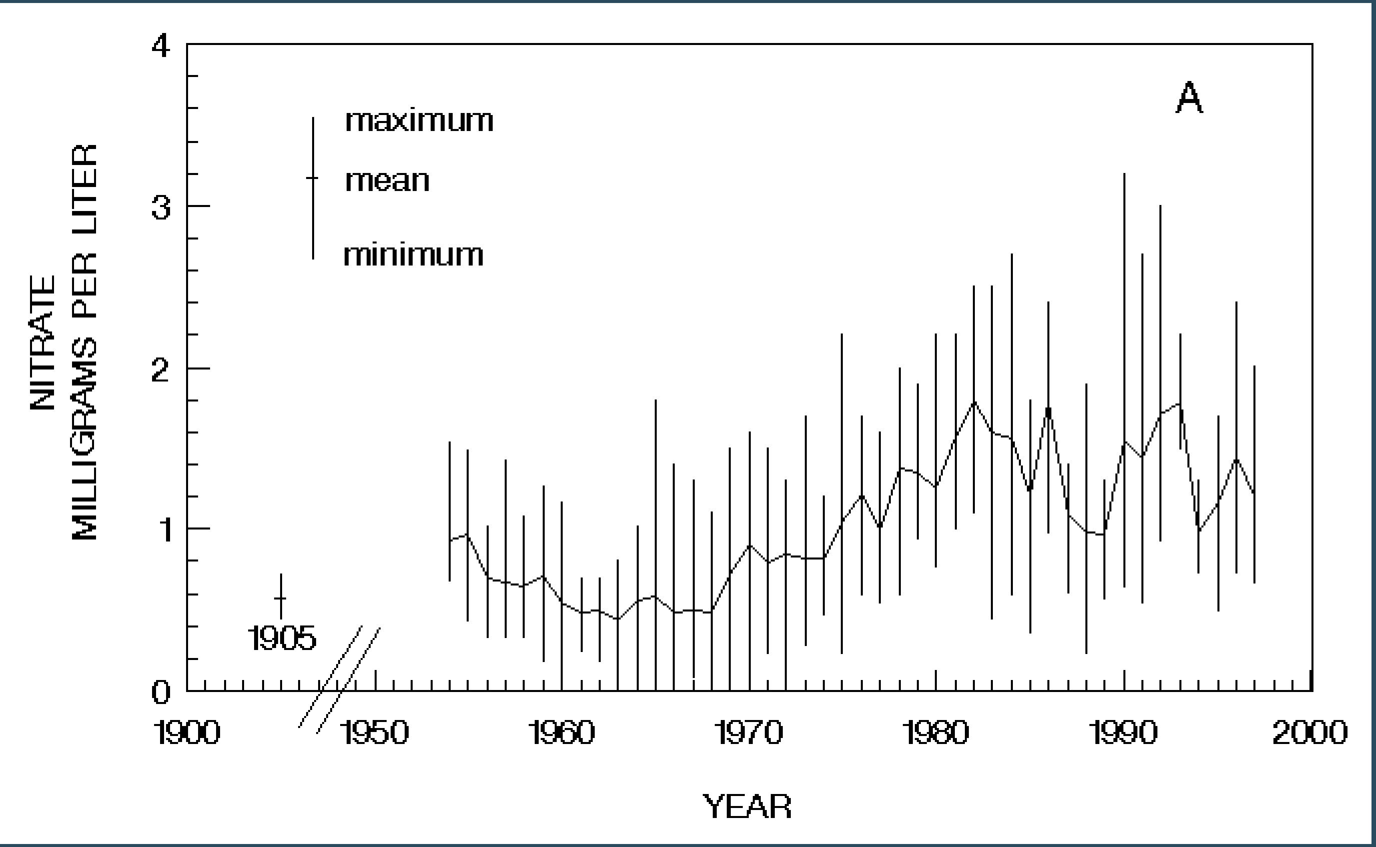
TABLE 2.—*Comparison between present and past estimates of sediment yields for selected rivers discharging to the oceans from the conterminous United States*

Area or river basin	Average annual suspended-sediment yield, in tons per square mile			Drainage area, in square miles	Average annual suspended-sediment discharge, in thousands of tons		
	This report	Judson and Ritter (1964)	Dole and Stabler (1909)		This report	Judson and Ritter (1964)	Dole and Stabler (1909)
Atlantic Ocean:	49.5	----	97.2	287,166	14,204	----	27,900
Delaware River	111	147	56	6,780	749	998	380
Susquehanna River	81.0	----	35	24,100	1,953	----	845
Potomac River	81.4	----	95	9,651	786	----	913
Pee Dee River	15.2	----	154	8,830	442	----	1,360
Ogeechee River	23.2	----	225	2,650	61.6	----	596
Gulf of Mexico:	217.4	----	220	1,739,200	378,179	----	382,600
Apalachicola River	10.1	----	159	17,200	173	----	2,740
Tombigbee River	128	120	104	19,200	2,454	2,300	2,000
Alabama River	115	97	178	22,000	2,528	2,140	3,920
Pearl River	133	----	58	6,630	881	----	385
Mississippi River	259	244	269	1,262,000	244,900	308,000	340,000
Pacific Ocean:	157	623	----	632,410	99,067	[1] 394,100	----
Colorado River	.04	1,190	387	245,000	10.6	292,000	94,800
San Francisco Bay	75.4	----	77	47,570	3,585	----	3,660
Sacramento River	116	94	86	23,530	2,719	2,215	2,020
Eel River	9,426	5,846	----	3,113	29,345	18,200	----
Mad River	5,549	3,711	----	485	2,691	1,800	----
Trinity River	1,919	1,141	----	2,865	5,497	3,270	----
Columbia River	60.5	125	----	258,200	15,620	32,300	----

[1] Sum of Colorado, Pacific Slopes, California, and Columbia Regions.

Historical Nitrate Concentrations in the lower Mississippi River



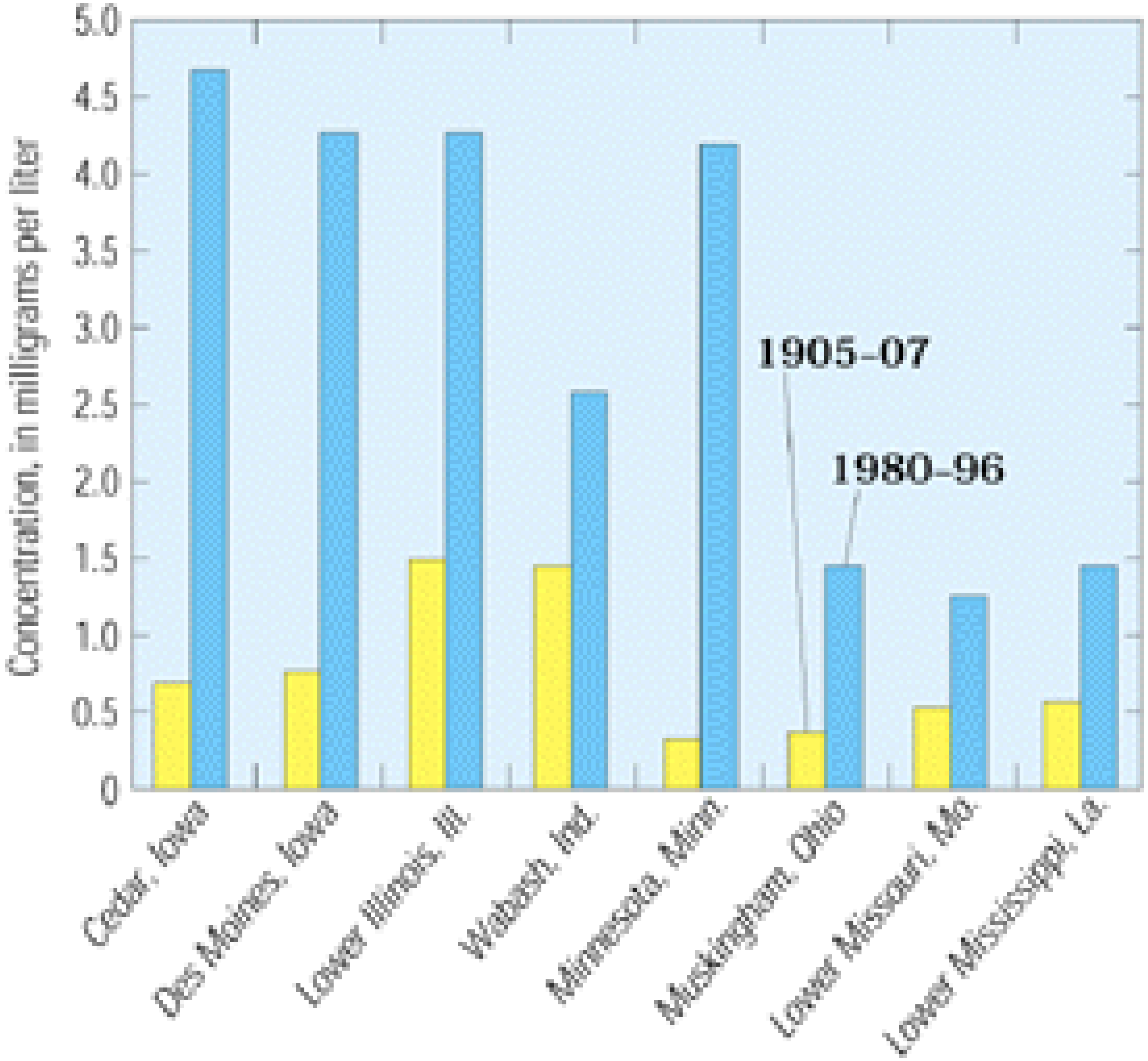


Figure 3. Average annual nitrate concentrations in selected rivers during 1905–07 and 1980–96.

Lessons

- Data from a well planned study can out last the initial reason for collection
- Collaboration is important
- Short lived – didn't suffer the vagaries of funding
- Documentation

NASQAN

The second USGS monitoring program that I want to talk about today is the NASQAN program, or National Stream Quality Accounting Network. The NASQAN program was begun in 1973 and, although greatly changed, is still in operation today.

NASQAN

The NASQAN program was designed to meet the Nation’s requirement to evaluate surface-water quality on a National basis. The primary objectives of the program were:

- To account for the quantity and quality of water moving within and from the US,
- to depict areal variability,
- to detect changes in stream quality, and
- to lay the groundwork for future assessments of changes in stream quality

NASQAN -- 1975

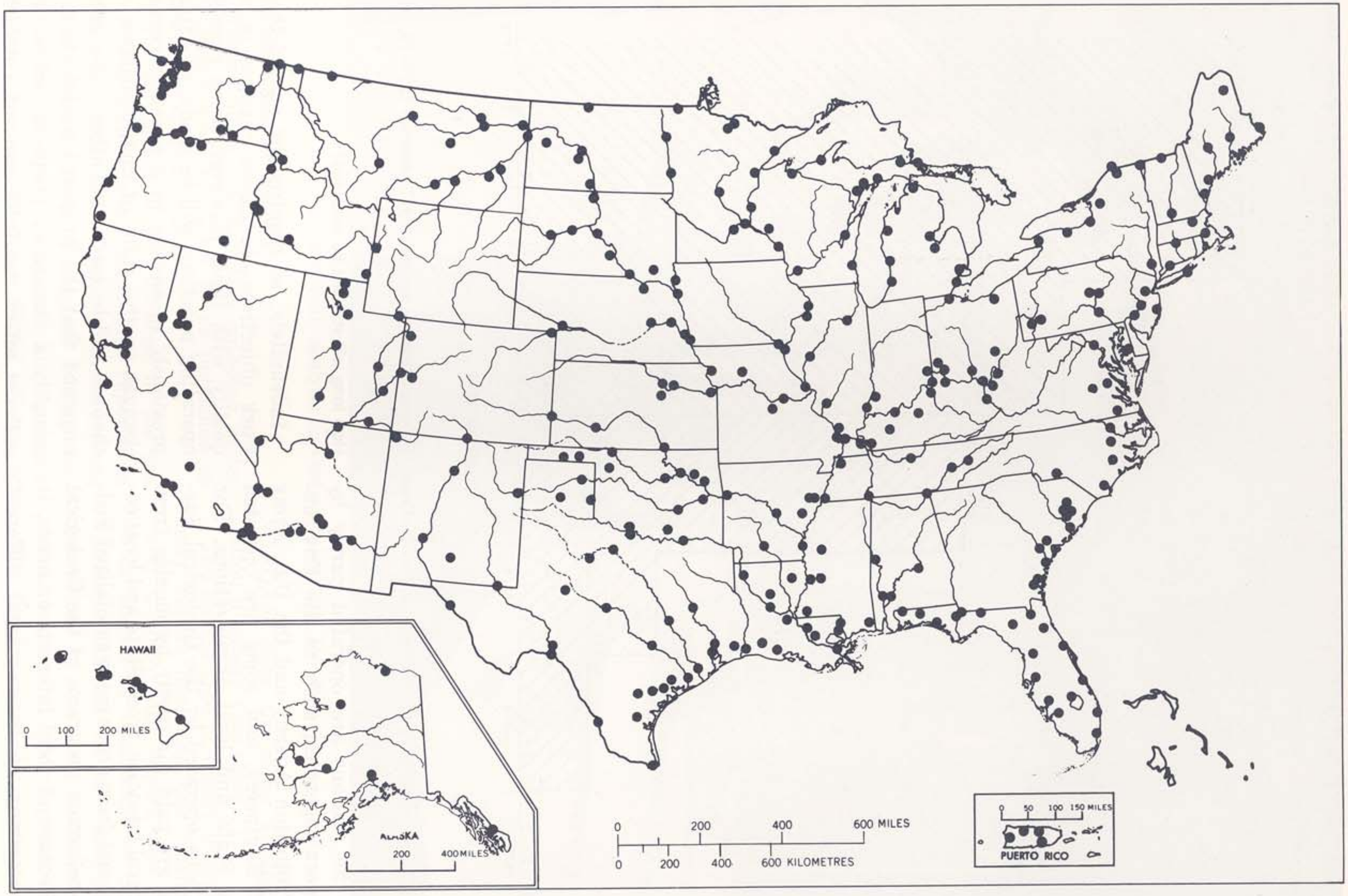


FIGURE 3.—Locations of stations in the National Stream Quality Accounting Network in operation as of January 1, 1975.

NASQAN – 1973--1995

- The NASQAN program was quite successful. Over the last 30 years considerable changes have occurred in terrestrial and atmospheric sources of water pollutants in the US brought about, in part, by regulatory actions.

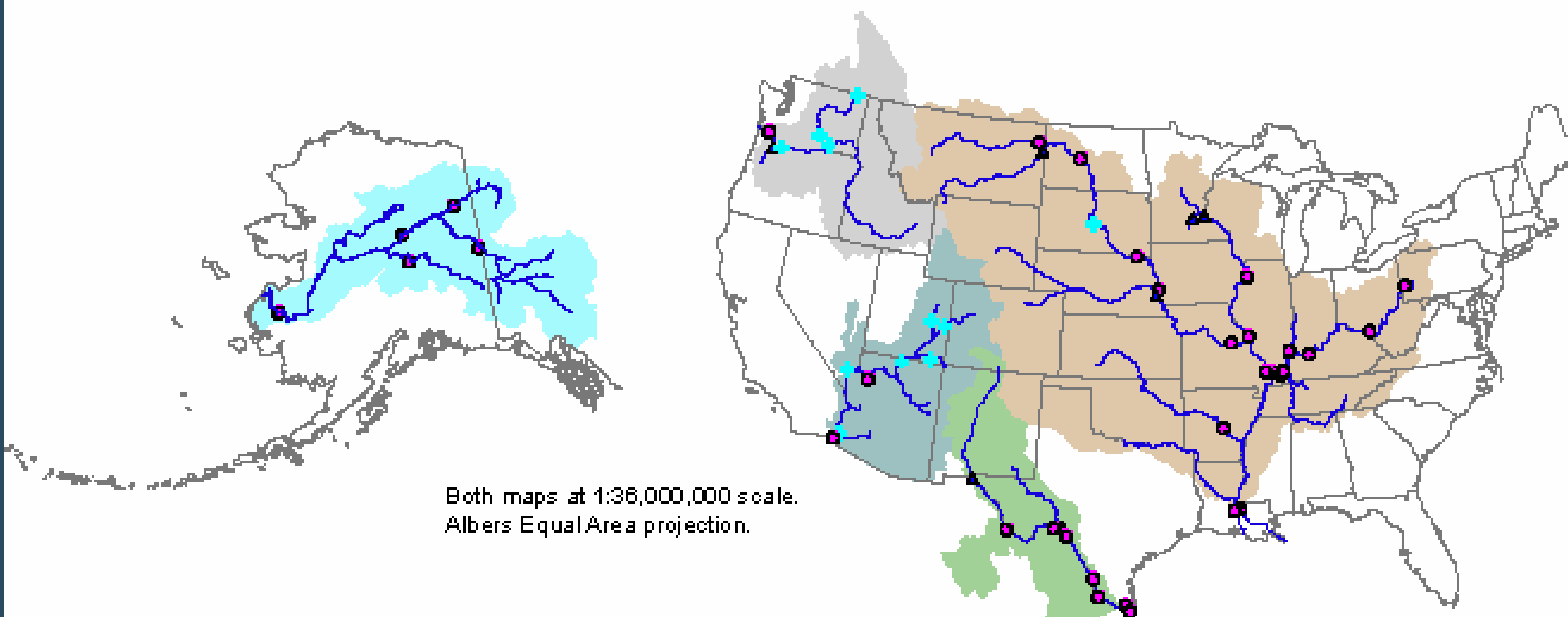
- This includes:
  changes in fertilizer use,
  atmospheric sources of sulfur and N and,
  waster water discharges from municipal sewage treatment plants.

  The NASQAN data has provided some of the best available data for investigating the influences of these sources on national and regional water quality. Additionally, NASQAN data has been used to quantify trends in stream water quality, estimate the rates of chemical flux from watersheds, and investigate relations between water quality and streamflow and between water quality and various physical characteristics of the watersheds.

NASQAN – 1973--1995

- Program objectives were not achievable with the current network configuration.
  a. Continued funding reductions and inflation creep reduced the number of stations and/or number of samples almost yearly
- Constituents measured did not include societally important chemicals (pesticides)
  a. advances in analytical chemistry had outpaced our ability to sample "cleanly"
  b. The flux of material from a basin became important and the fixed schedule sampling used by NASQAN was not optimal for calculating fluxes.
- Relation between new USGS programs and NASQAN were unclear (specifically the new NAWQA program was designed to achieve NASQAN objectives in small to medium sized basins).

NASQAN Stations, Fiscal Year 2002



NASQAN 1995--

- Describe and compare yields of non-point source contaminants among large regional basins.
- Describe long-term tends in the flux and concentration of constituents at key locations.
- Calculate loads to receiving waters, including off-continent flux.
- Test regional models of the influence of land use on water quality.

Sources Areas for Nutrients Discharged to the Gulf of Mexico

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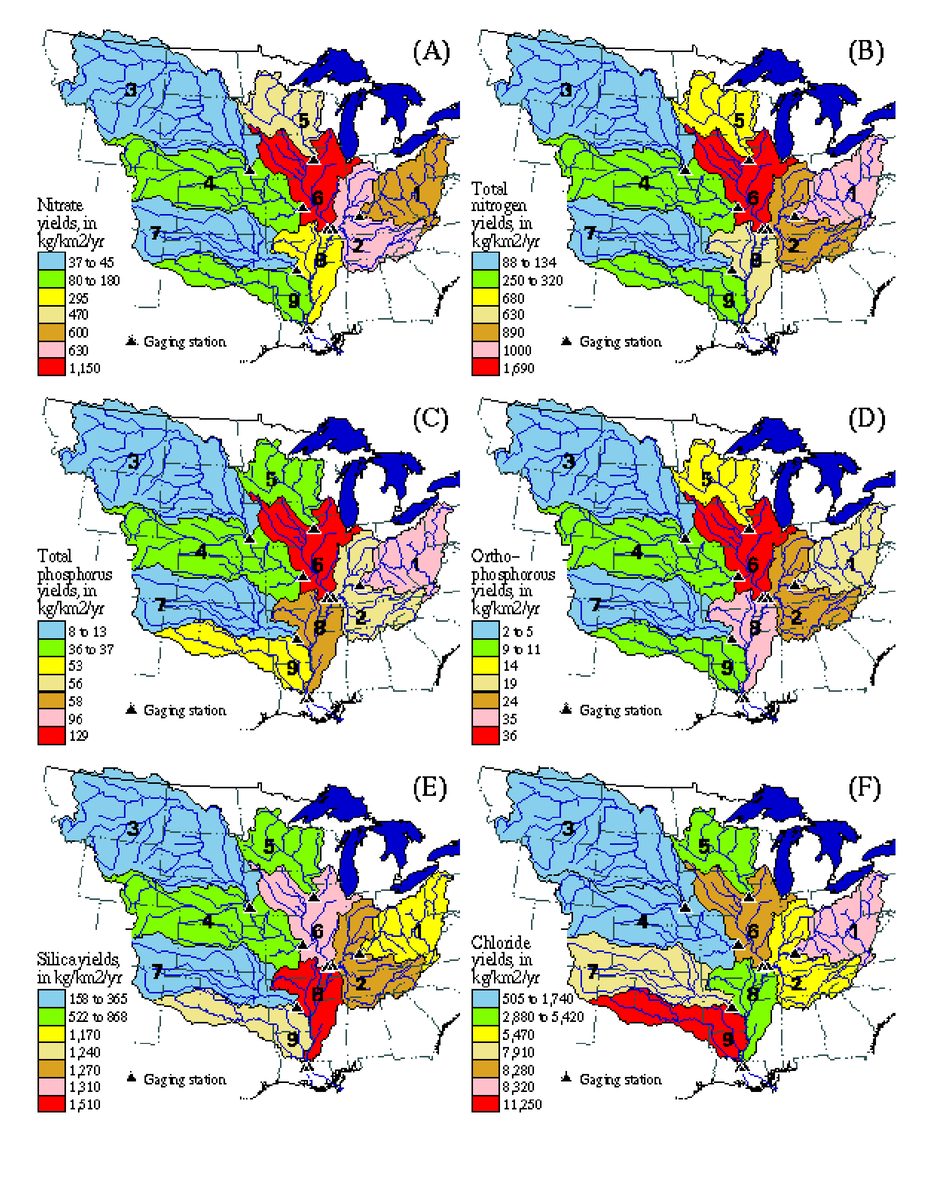
Data from the first 20 years of the NASQAN program continue to be of importance



Science, July 2003, v 301, p 88-91

Other researchers also continue to use NASQAN data – carbon sequestration

REPORTS

Increase in the Export of Alkalinity from North America's Largest River

Peter A. Raymond[1]* and Jonathan J. Cole[2]

Chemical weathering and the subsequent export of carbonate alkalinity (HCO_3^- + CO_3^{-2}) from soils to rivers account for significant amounts of terrestrially sequestered atmospheric CO_2. We show here that during the past half-century, the export of this alkalinity has increased dramatically from North America's largest river, the Mississippi. This increased export is in part the result of increased flow resulting from higher rainfall in the Mississippi basin. Subcatchment data from the Mississippi suggest that the increase in the export of alkalinity is also linked to amount and type of land cover. These observations have important implications for the potential management of carbon sequestration in the United States.

Lessons

- Monitoring data are extremely valuable and if it doesn't exist – there isn't any substitute for data—i.e. contentious issues.
- Monitoring programs need constant supervision and frequent evaluation
  i. QA/QC
  ii. Objectives
  iii. Personnel
- Monitoring programs need to be well Documented
- Serendipitous use of the data – or can data be collected in advance of a specific need.

Society's Expectations?

That scientifically defensible data will be available to answer important water supply and water quality issues

You can plan, discuss, and cogitate

But, without data …..

UP the creek without a paddle?

Or, in this case on the truck in the water without a life jacket