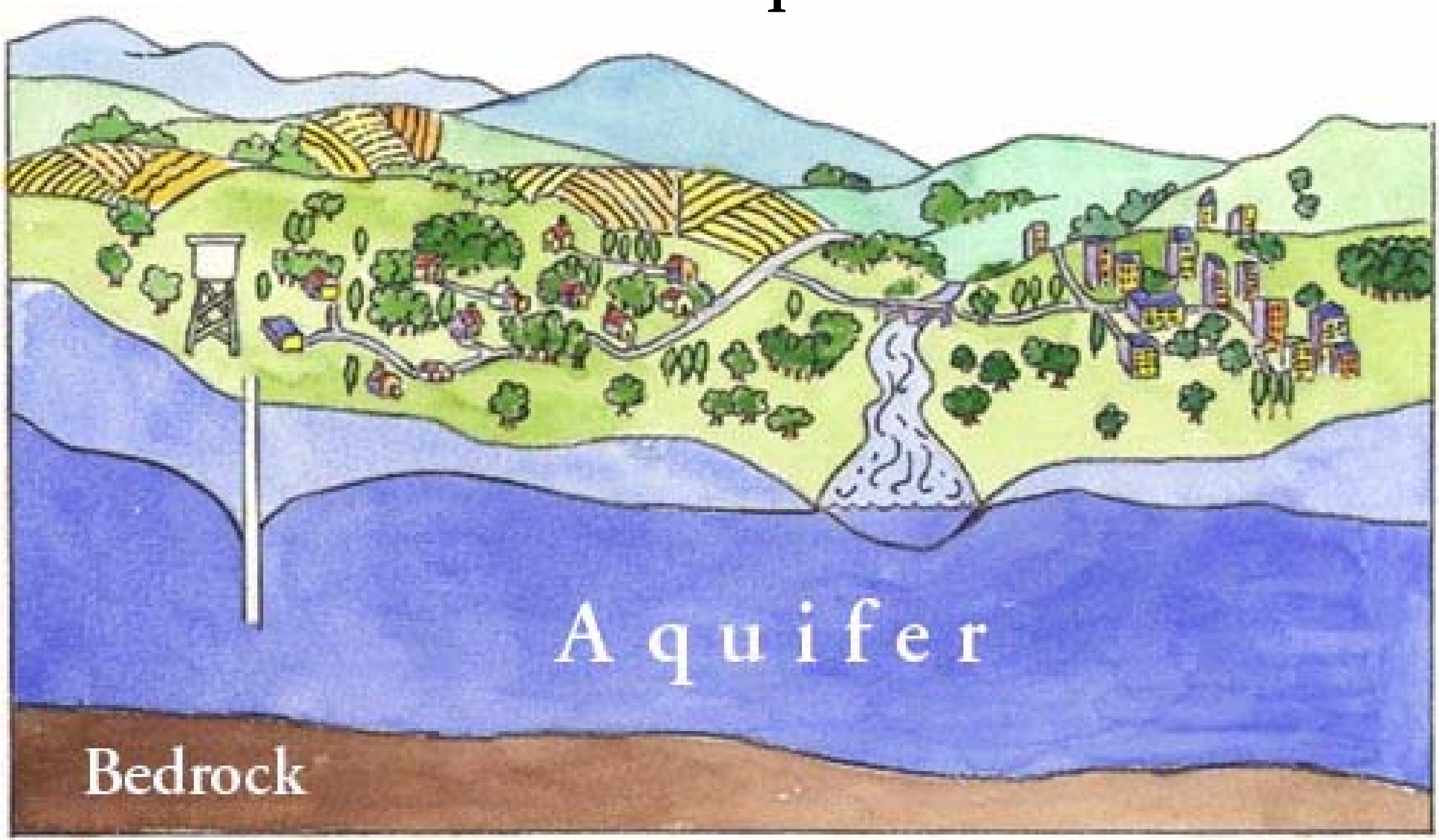
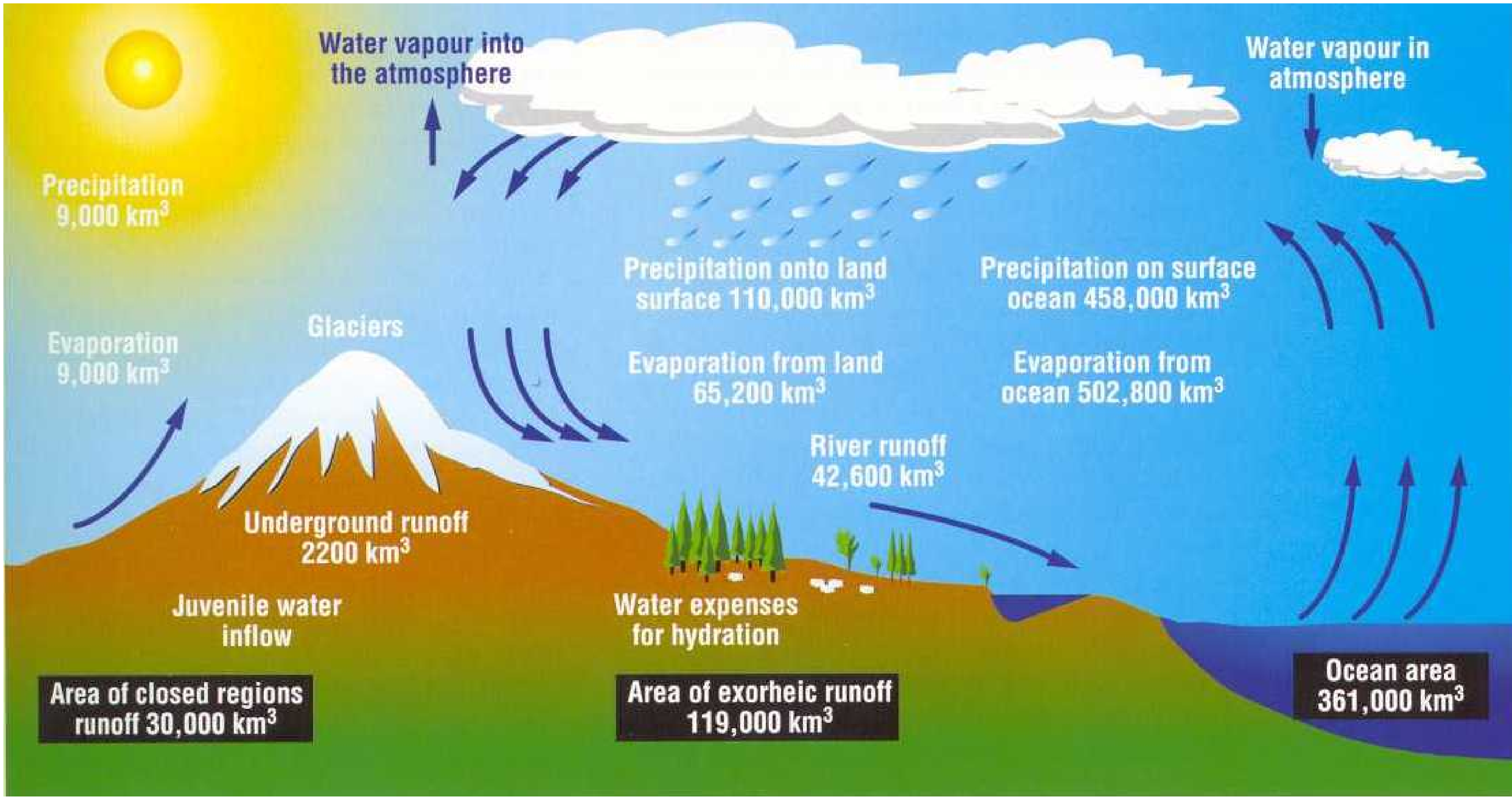
Water Part II
The Aquifer

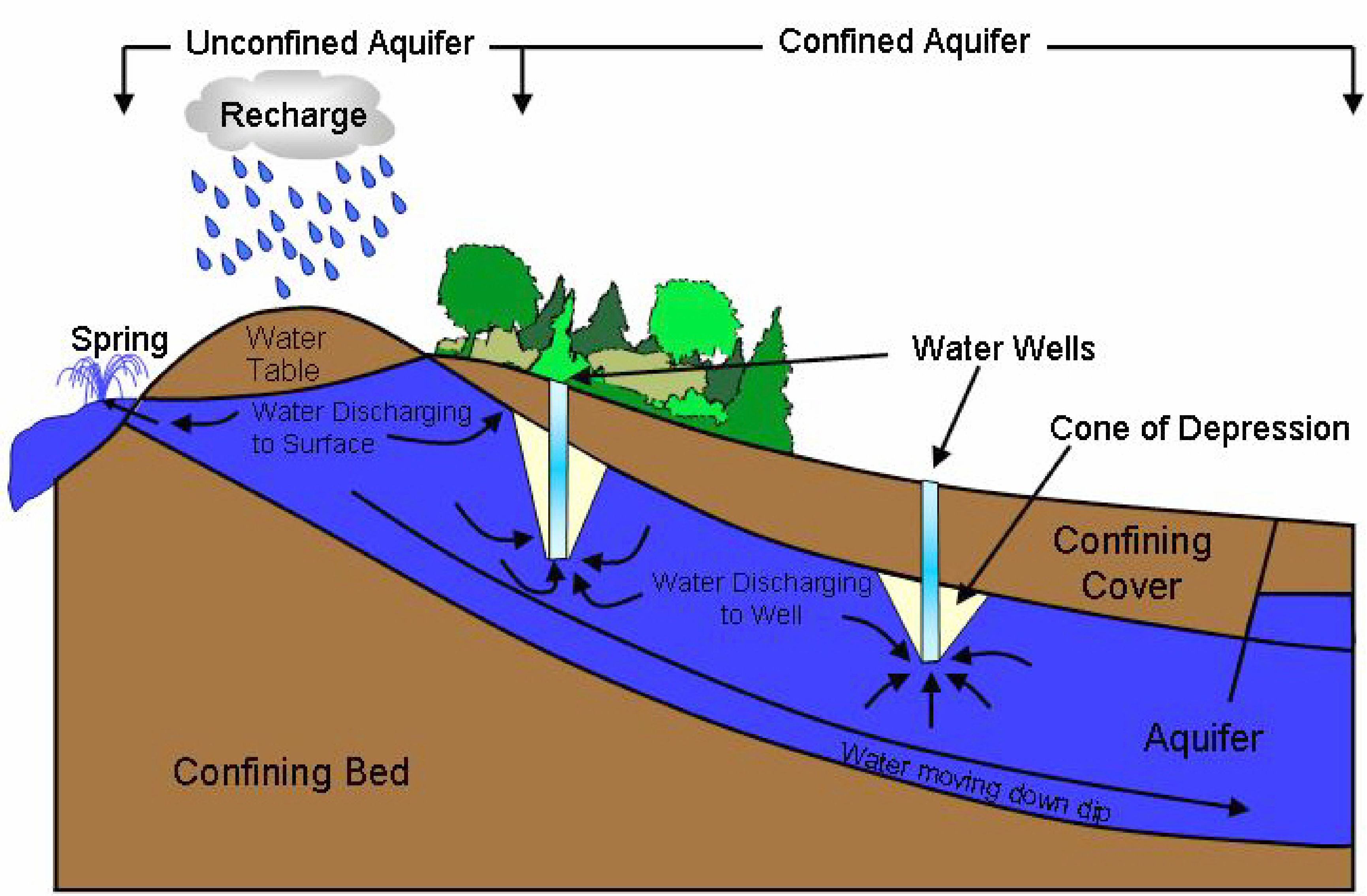


Hydrological Cycle



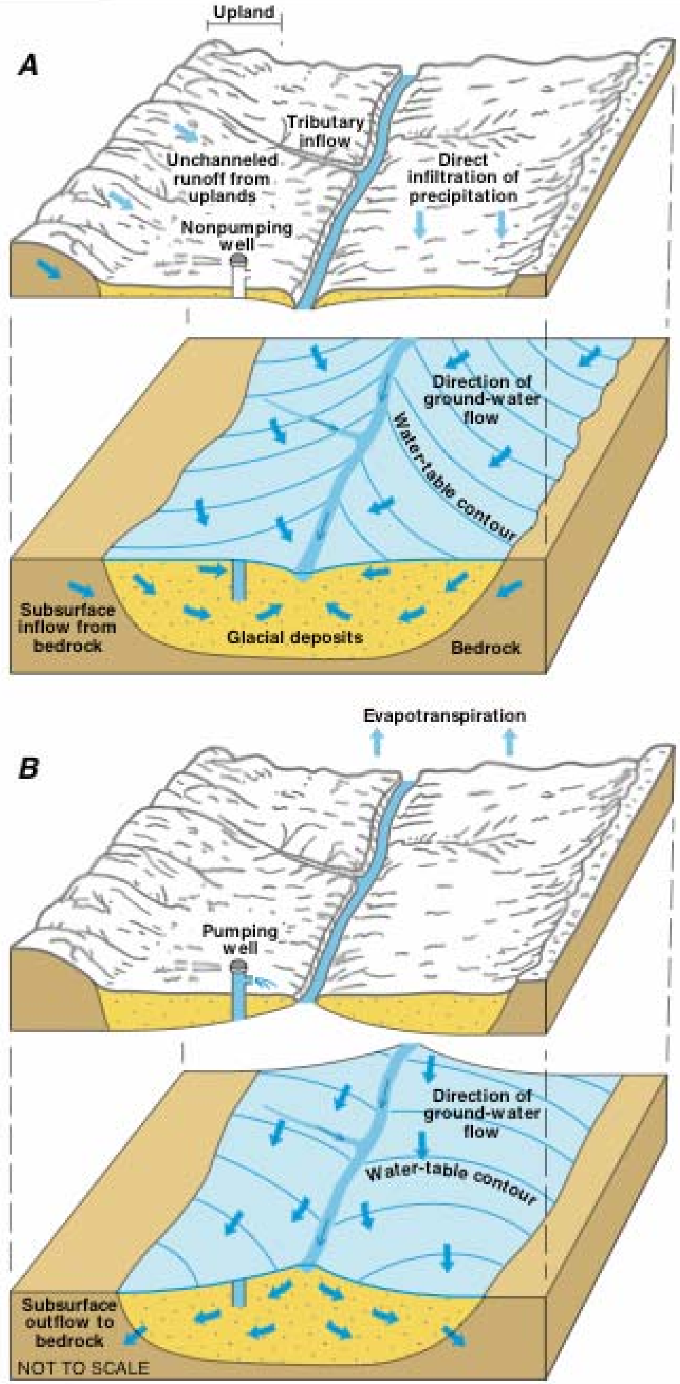
Courtesy: UNESCO

Aquifer Essentials

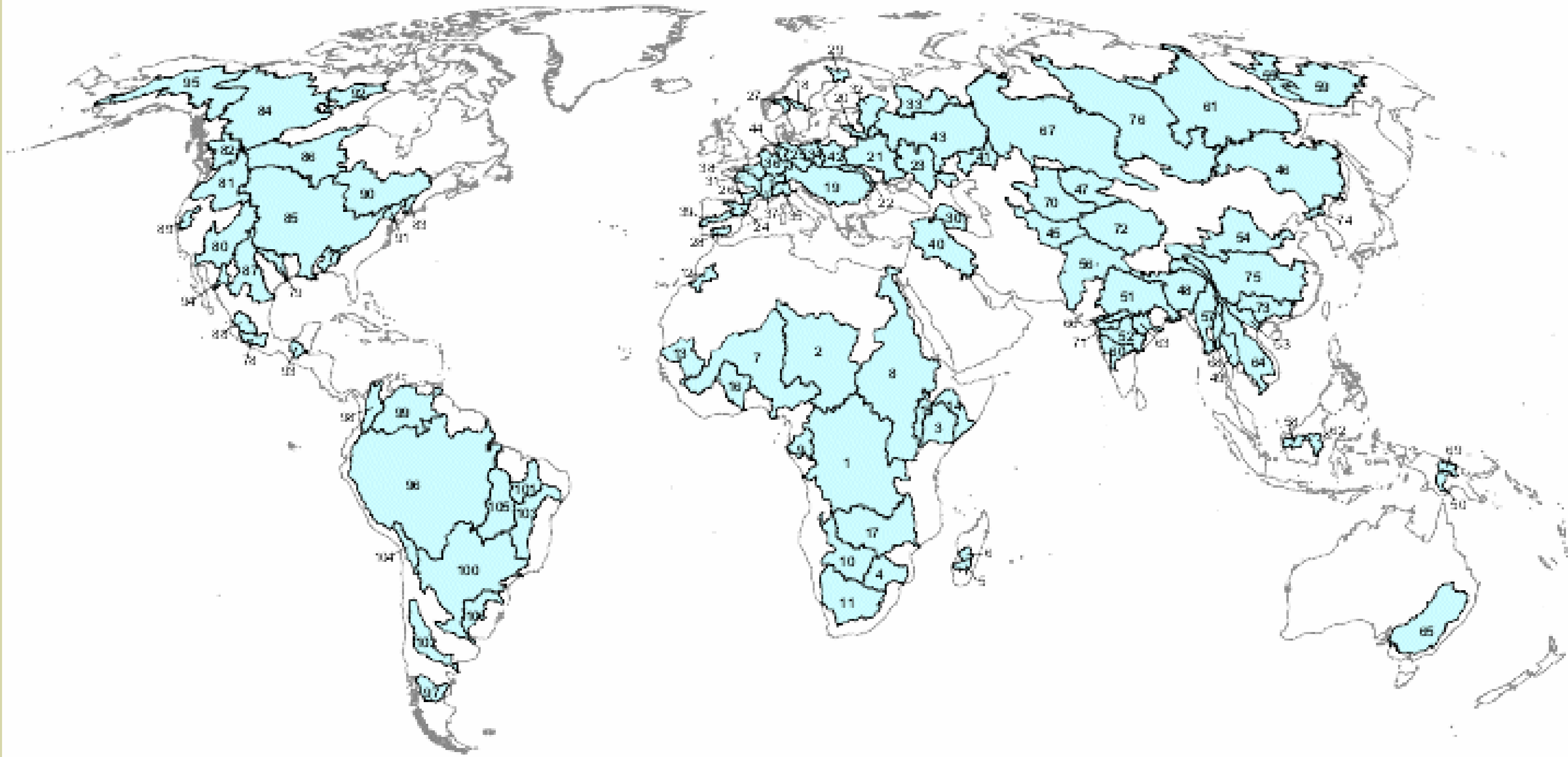


groundwater.orst.edu/ under/aquifer.html

Figure 15. Recharge to valley-fill aquifers is from multiple sources, and, during periods of normal precipitation, is adequate to maintain aquifer water levels above those of streams (A); water moves from the aquifer to the stream. During droughts, discharge by seepage to adjacent bedrock, evapotranspiration, and withdrawals from wells, coupled with a decrease in recharge, can lower aquifer water levels until flow is reversed and water moves from the stream to the aquifer (B).



Modified from Rosenshein, J.S., 1988, Region 18, Alluvial valleys, in Back, William, Rosenshein, J.S., and Seaber, P.R., eds., Hydrogeology: Geological Society of America, The Geology of North America, v. 0–2, p. 165–175.



Africa

1 Congo
2 Lake Chad
3 Jubba
4 Limpopo
5 Mangoky
6 Mania
7 Niger
8 Nile
9 Ogooue
10 Okavango Swamp
11 Orange
12 Oued Draa
13 Senegal
14 Shaballe
15 Turkana
16 Volta
17 Zambezi

Europe

18 Dalalven
19 Danube
20 Daugava
21 Dnieper
22 Dniester
23 Don
24 Ebro
25 Elbe
26 Garonne
27 Glama
28 Guadalquivir
29 Kemijoki
30 Kura-Araks
31 Loire
32 Neva
33 North Dvina
34 Oder
35 Po
36 Rhine & Meuse
37 Rhone
38 Seine
39 Tagus
40 Tigris & Euphrates
41 Ural
42 Vistula
43 Volga
44 Weser

Asia & Oceania

45 Amu Darya
46 Amur
47 Lake Balkhash
48 Brahmaputra
49 Chao Phrya
50 Fly
51 Ganges
52 Godavari
53 Hong (Red River)
54 Hwang He
55 Indigirka
56 Indus
57 Irrawaddy
58 Kapuas
59 Kolyma
60 Krishna
61 Lena
62 Mahakam
63 Mahanadi
64 Mekong
65 Murray-Darling
66 Narmada
67 Ob
68 Salween
69 Sepik
70 Syr Darya
71 Tapti
72 Tarim
73 Xi Jiang
74 Yalu Jiang
75 Yangtze
76 Yenisey

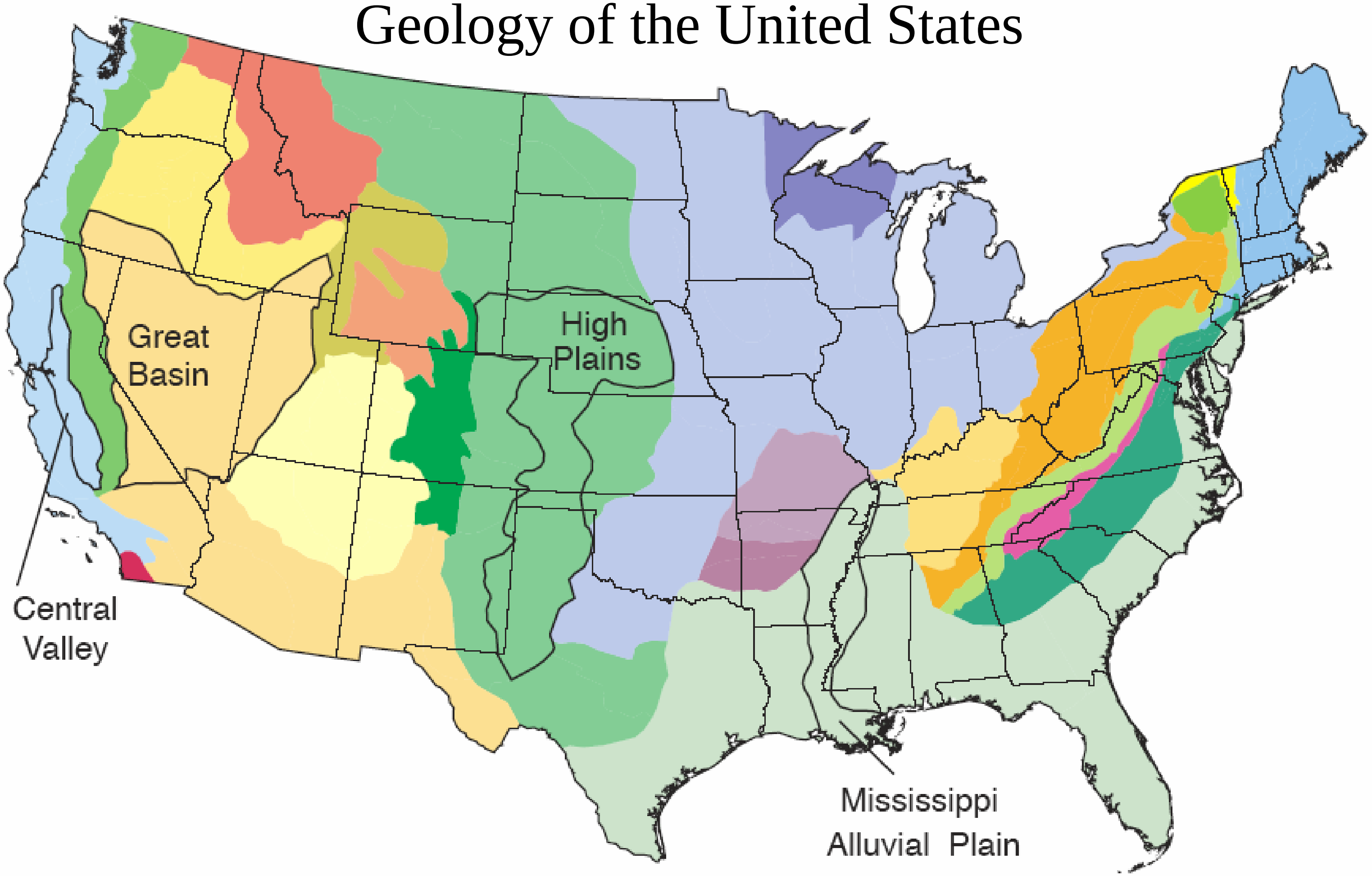
North & Central America

77 Alabama & Tombigbee
78 Balsas
79 Brazos
80 Colorado
81 Columbia
82 Fraser
83 Hudson
84 Mackenzie
85 Mississippi
86 Nelson
87 Rio Grande
88 Rio Grande de Santiago
89 Sacramento
90 St. Lawrence
91 Susquehanna
92 Thelon
93 Usumacinta
94 Yaqui
95 Yukon

South America

96 Amazon
97 Chubut
98 Magdalena
99 Orinoco
100 Paraná
101 Parnaiba
102 Rio Colorado
103 São Francisco
104 Lake Titicaca
105 Tocantins
106 Uruguay

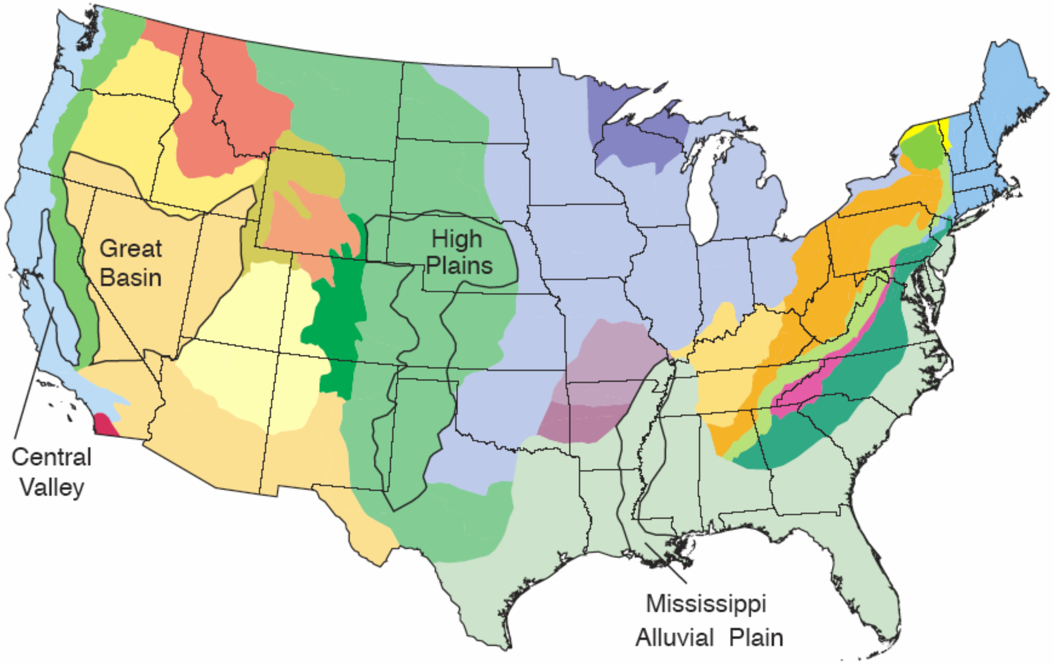
Geology of the United States



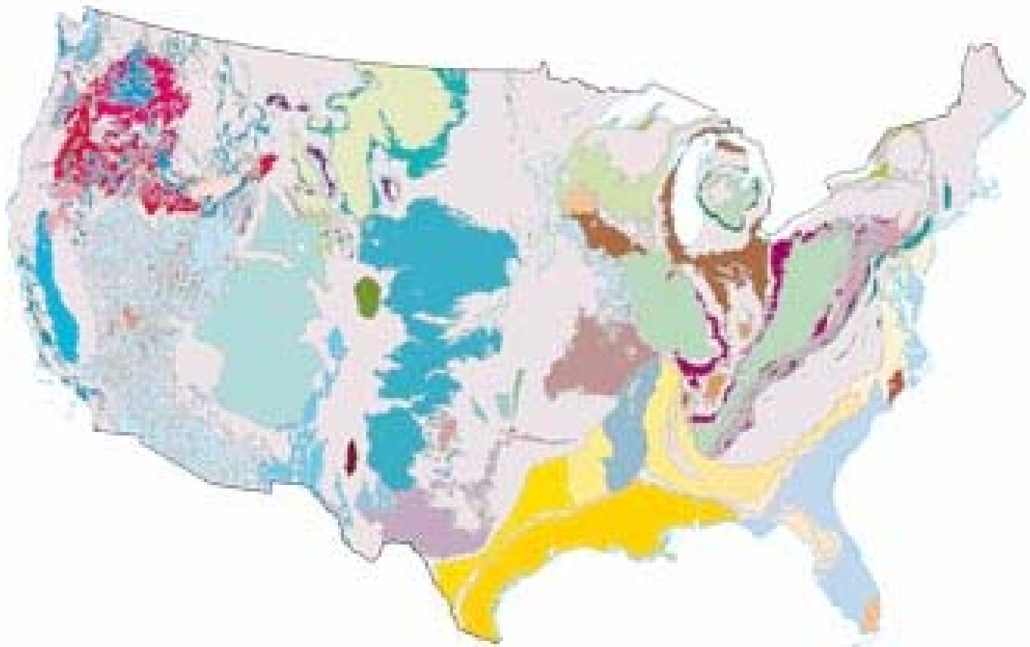
EXPLANATION
Physiographic divisions

- Superior Upland
- Coastal Plain
- Piedmont Province
- Blue Ridge Province
- Valley and Ridge Province
- St. Lawrence Valley
- Appalachian Plateaus
- New England
- Adirondack Province
- Interior Low Plateaus
- Central Lowland
- Great Plains Plateaus
- Ozark Plateaus
- Ouachita Province
- Southern Rocky Mountains
- Wyoming Basin
- Columbia Plateaus
- Northern Rocky Mountains
- Middle Rocky Mountains
- Colorado Plateaus
- Basin and Range Province
- Cascade and Sierra Mountains
- Pacific Border Province
- Lower California Province

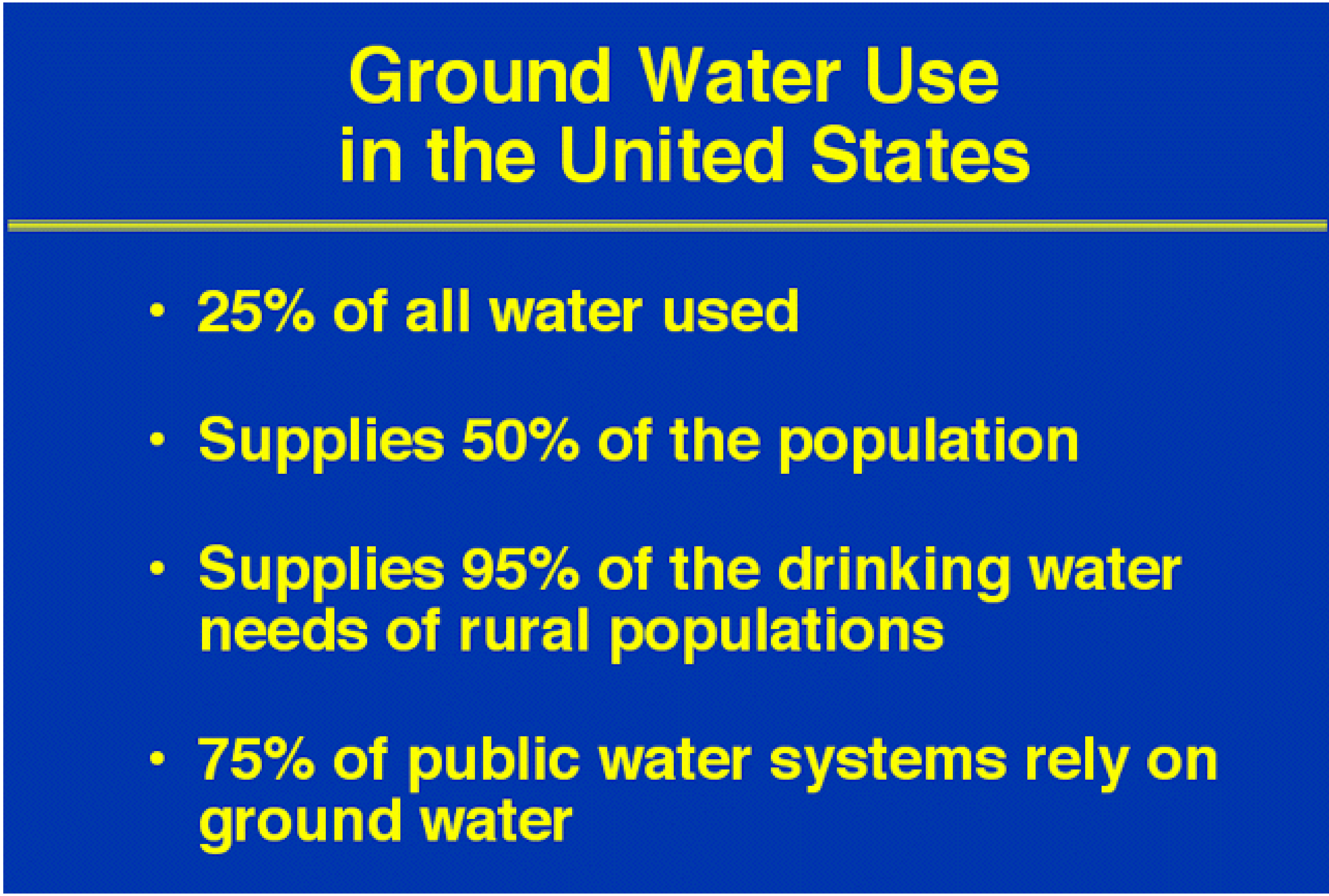
Aquifers of the Unites States



Geology

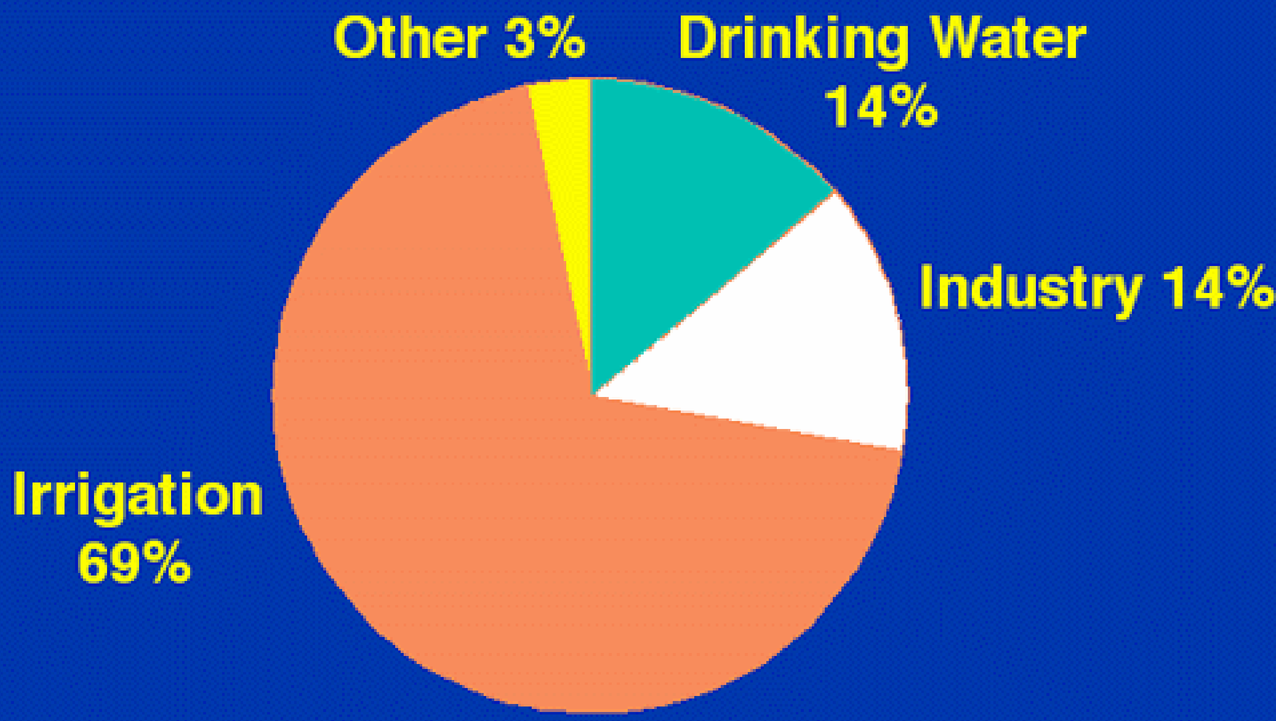


Aquifers



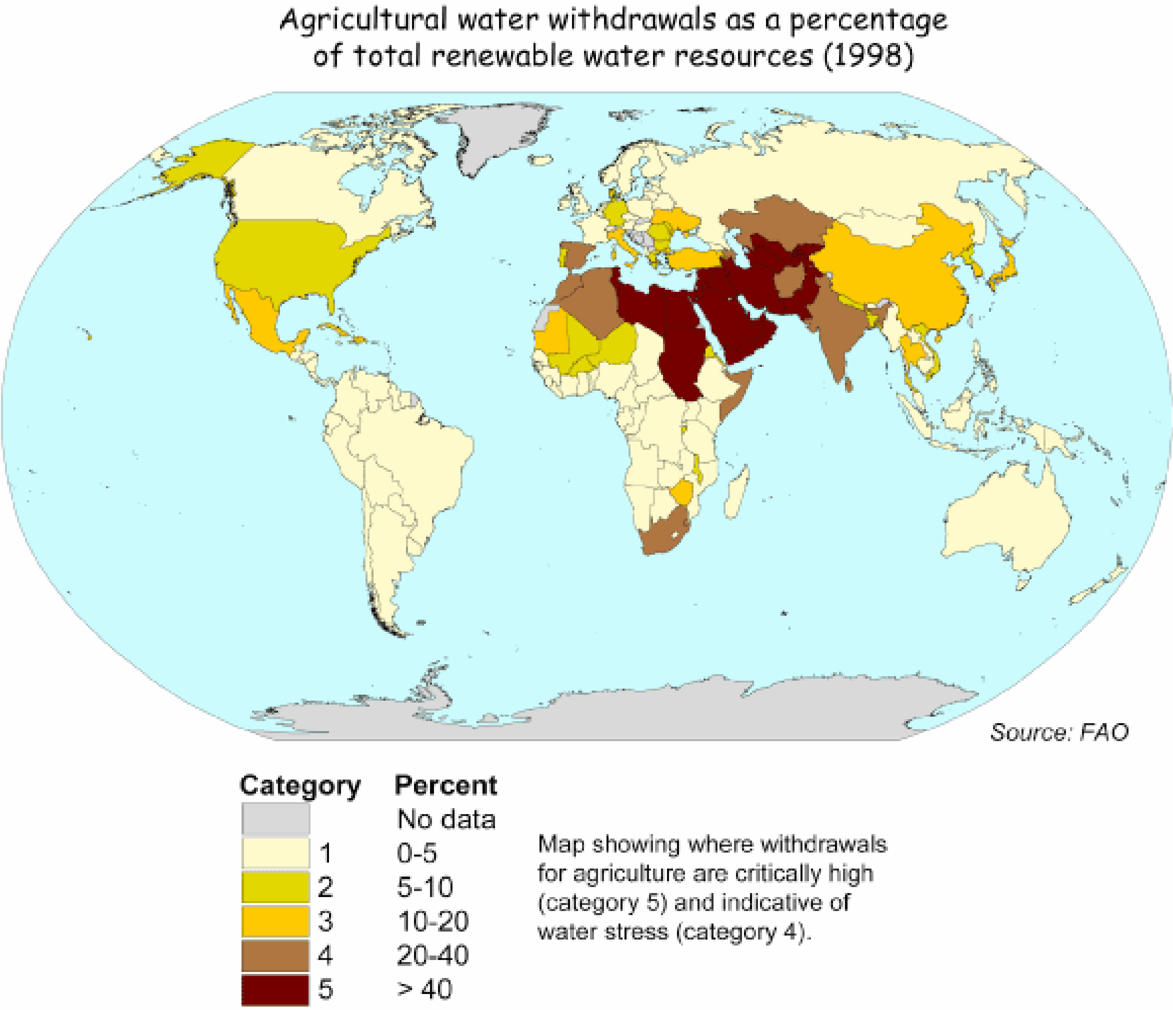
http://maven.gtri.gatech.edu/ward/slide12.html

Ground Water Use in the United States



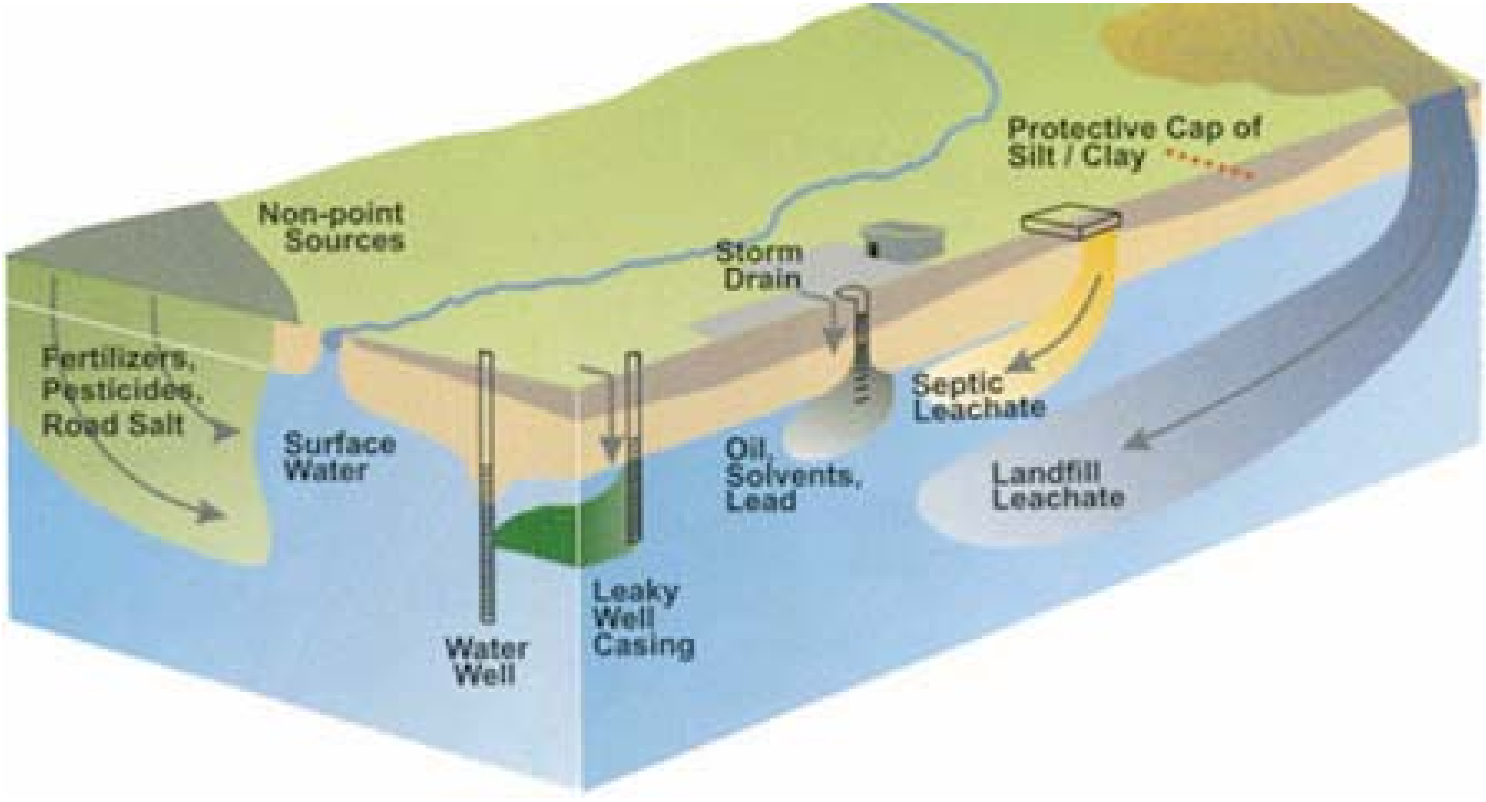
Aquifer Abuses

Contamination and Depletion



Contamination:

Point source and non-point source



Ground Water Contamination in the US
Magnitude / Cost of the Problem

Est. 33,000 to 400,000 total sites

1,400 Superfund sites

1,700 RCRA sites

TCE #1 and PCE #3 contaminants at NPL sites

Est. $0.5 to $1 Trillion cleanup cost

VOC Contamination of Ground Water

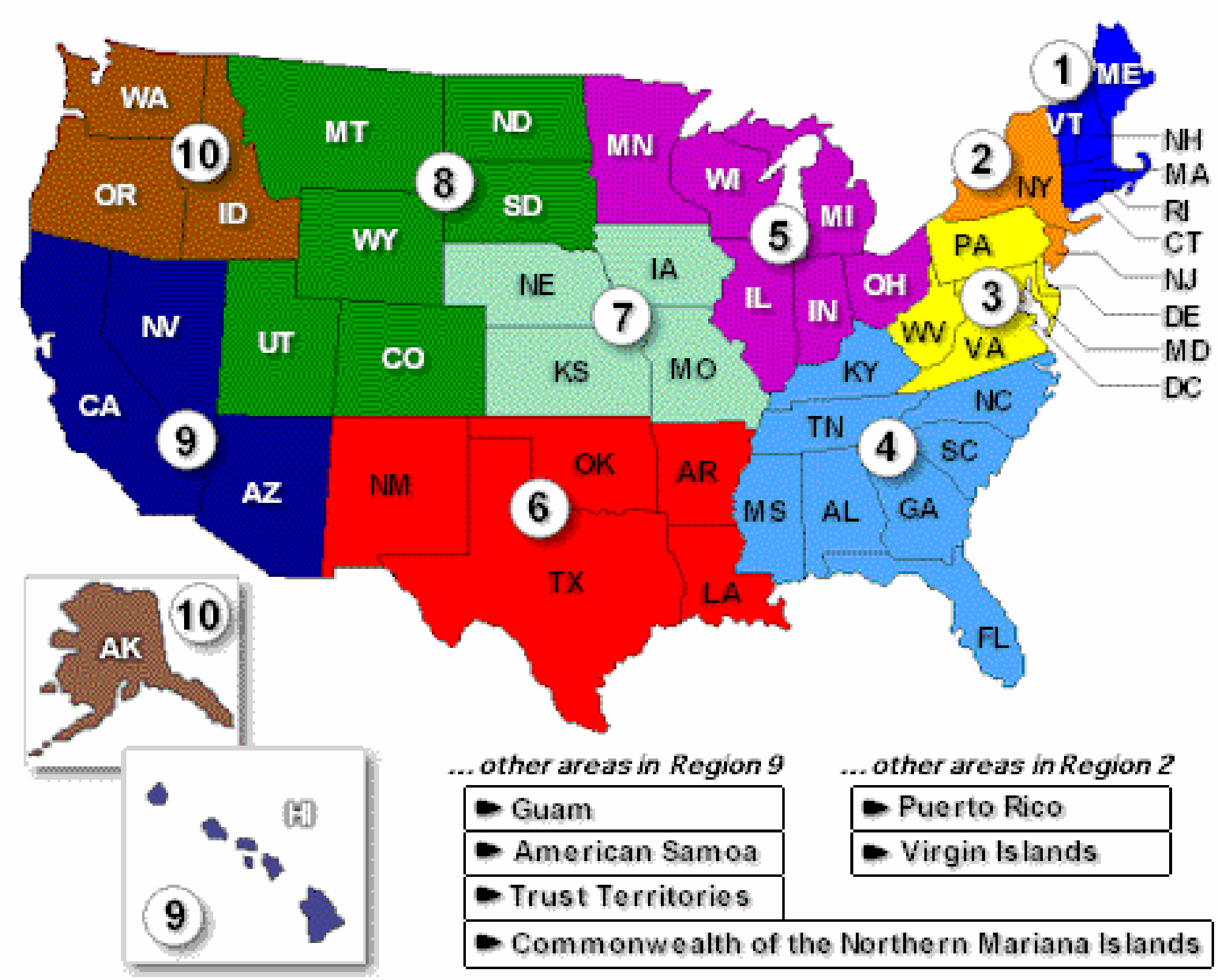
- Estimated 7% of U.S. ground water supplies contain more than 0.2 µg/L VOCs
- Drinking water for 35-50 million potentially affected
- Urban areas
  - 47% of wells had at least 1 VOC present
  - 29% had 2 or more VOCs present
- Most frequently detected VOCs
  - Trichloroethylene
  - Tetrachloroethylene
  - MTBE
  - Chloroform

Sites/Facilities to be Cleaned up in the United States

Program	Approximate Number
• Superfund	1,500 - 2,100
• RCRA Corrective Action	1,500 - 3,500
• Underground Storage Tanks	295,000
• Dept. of Defense (DOD)	7,300 (1,800 installations)
• Dept. of Energy (DOE)	4,000 (110 installations)
• Other Federal Agencies	350
• States	19,000*

*Sites needing some further investigation that might lead to cleanup

National Priorities List For Superfund Sites

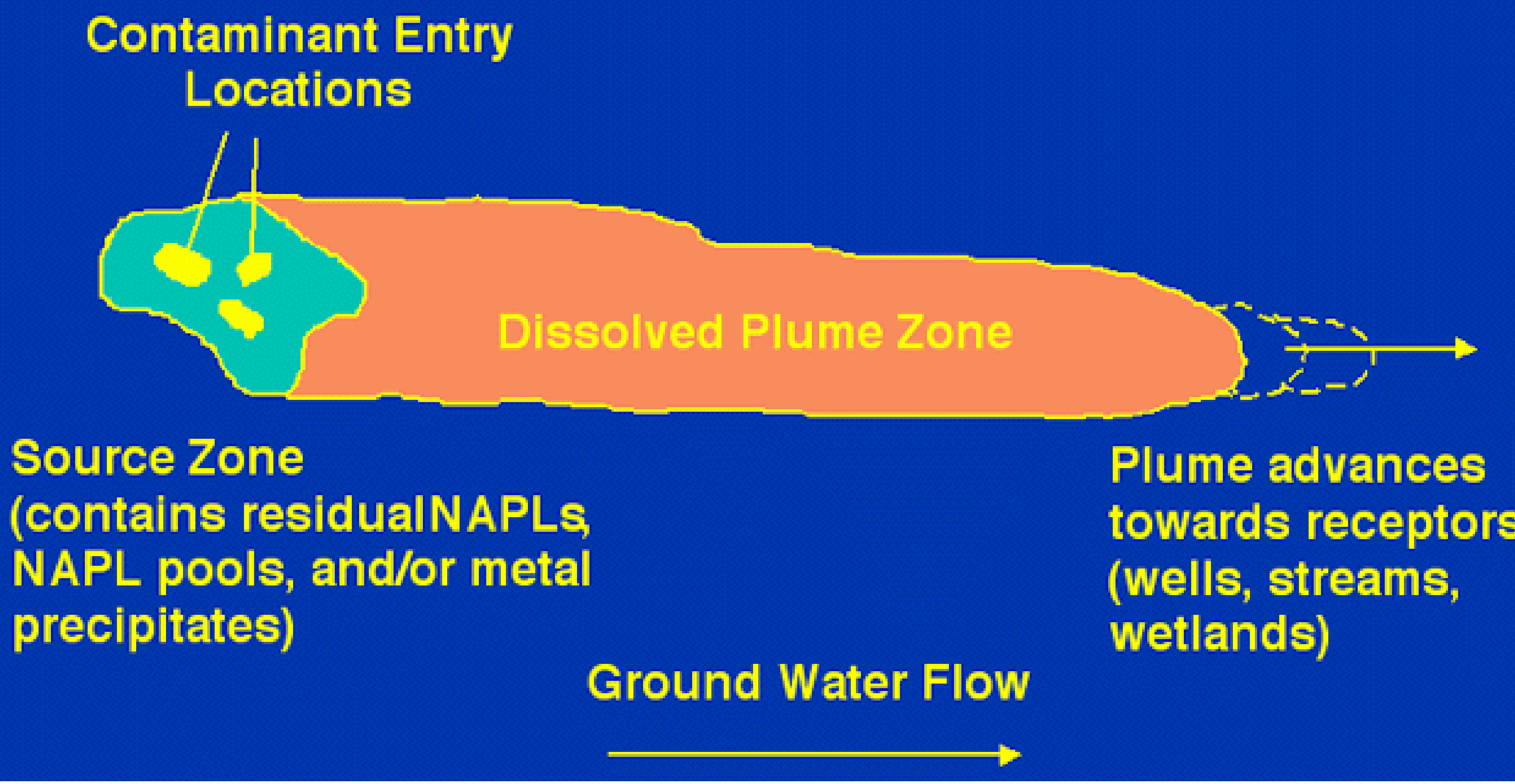


http://www.epa.gov/superfund/sites/npl/npl.htm

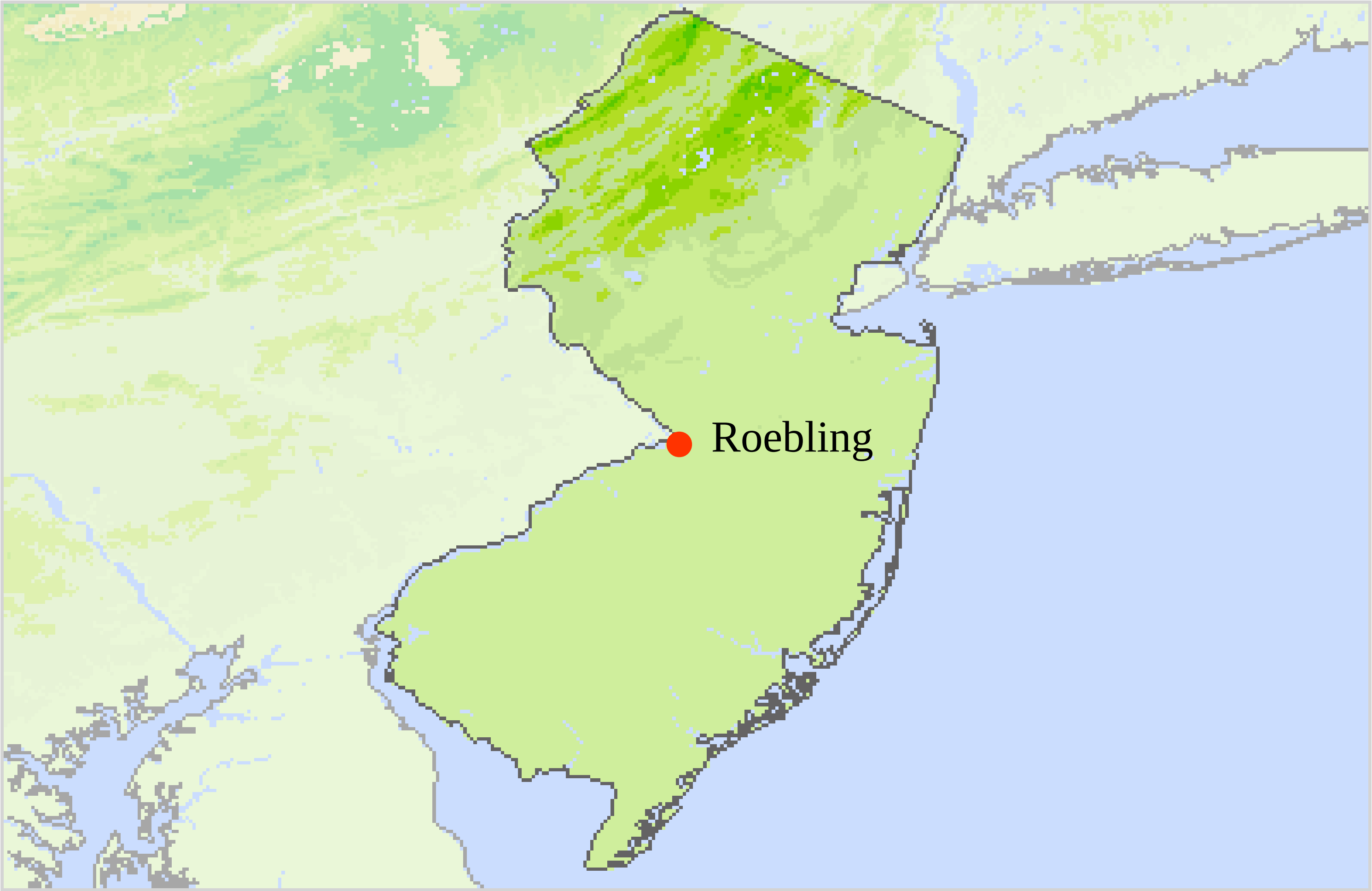
The 25 Most Frequently Detected Ground Water Contaminants at Hazardous Waste Sites

1. Trichloroethylene
2. Lead
3. Tetrachloroethylene
4. Benzene
5. Toluene
6. Chromium
7. Methylene chloride
8. Zinc
9. 1,1,1-Trichloroethane
10. Arsenic
11. Chloroform
12. 1,1-Dichloroethane
13. 1,2-Dichloroethene
14. Cadmium
15. Manganese
16. Copper
17. 1,1-Dichloroethene
18. Vinyl chloride
19. Barium
20. 1,2-Dichloroethane
21. Ethylbenzene
22. Nickel
23. Di(2-ethylhexyl)phthalate
24. Xylenes
25. Phenol

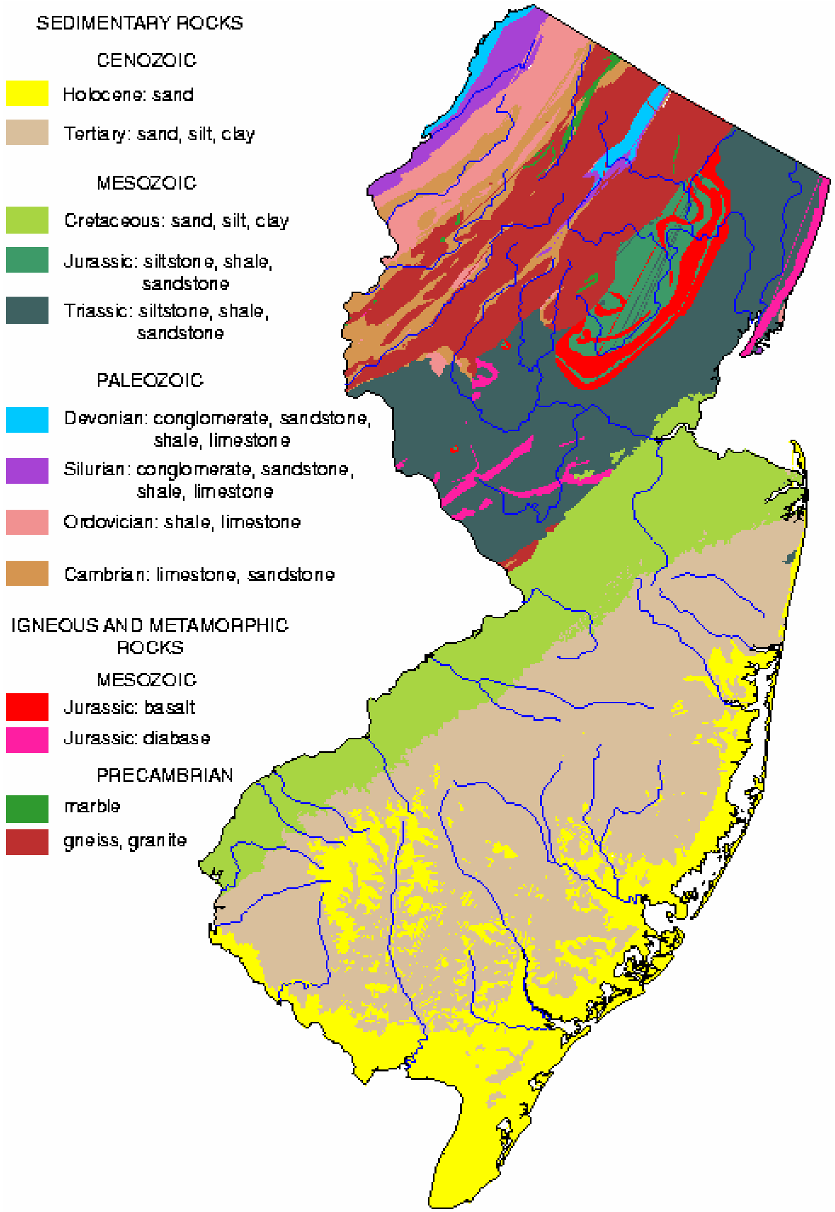
Source and Dissolved Plume



Welcome to New Jersey:
Home of the first EPA superfund site!



Geology of New Jersey



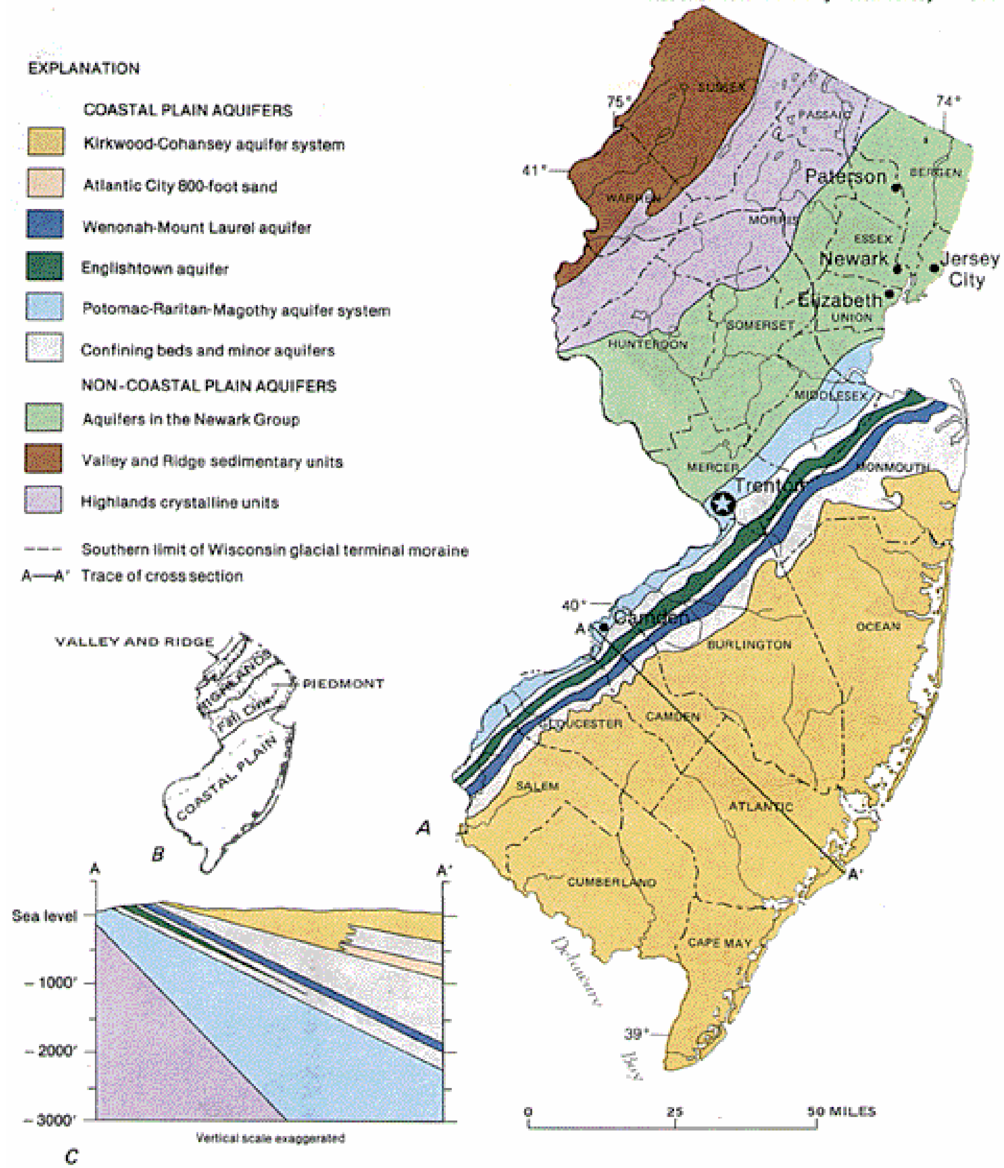
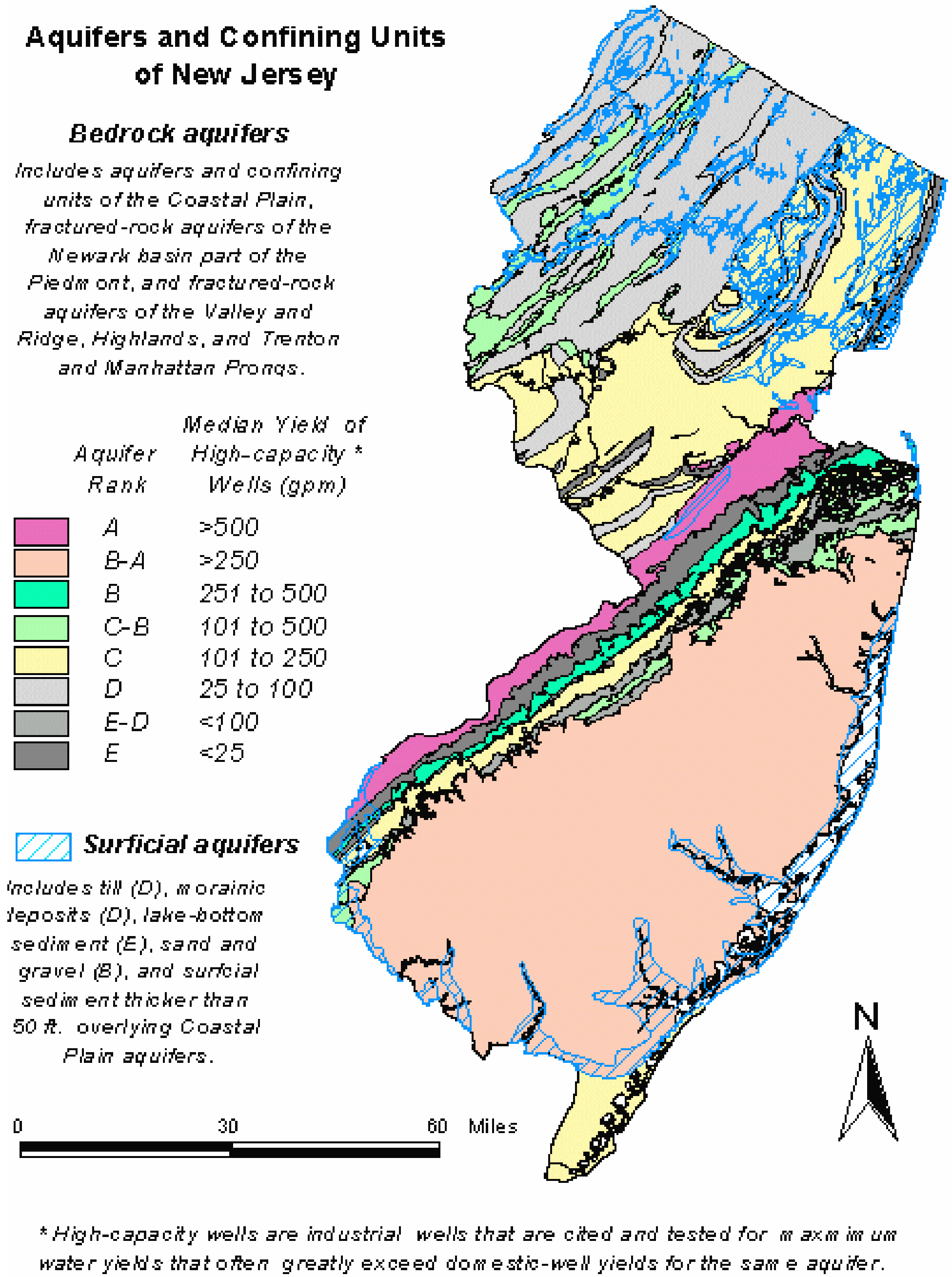
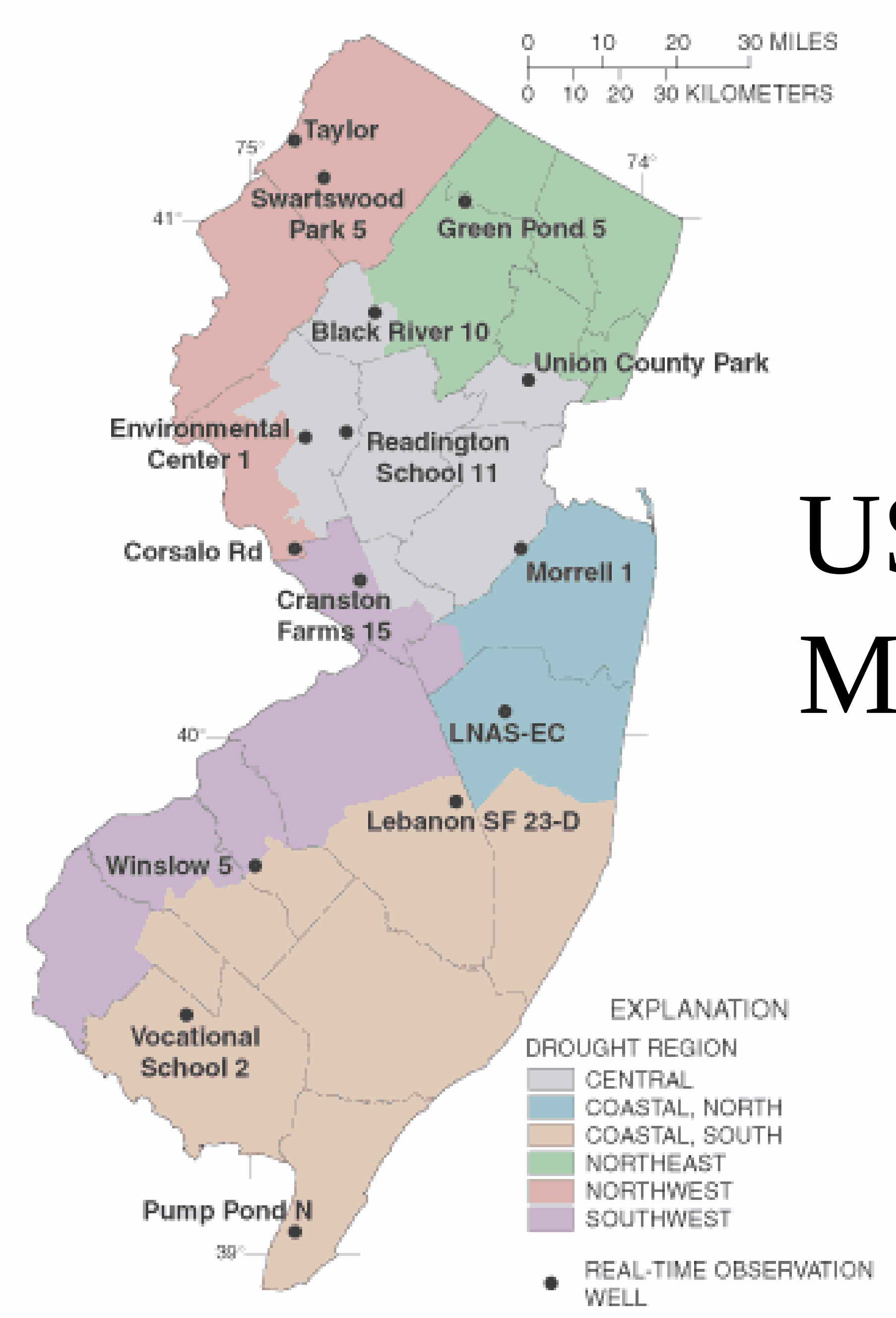
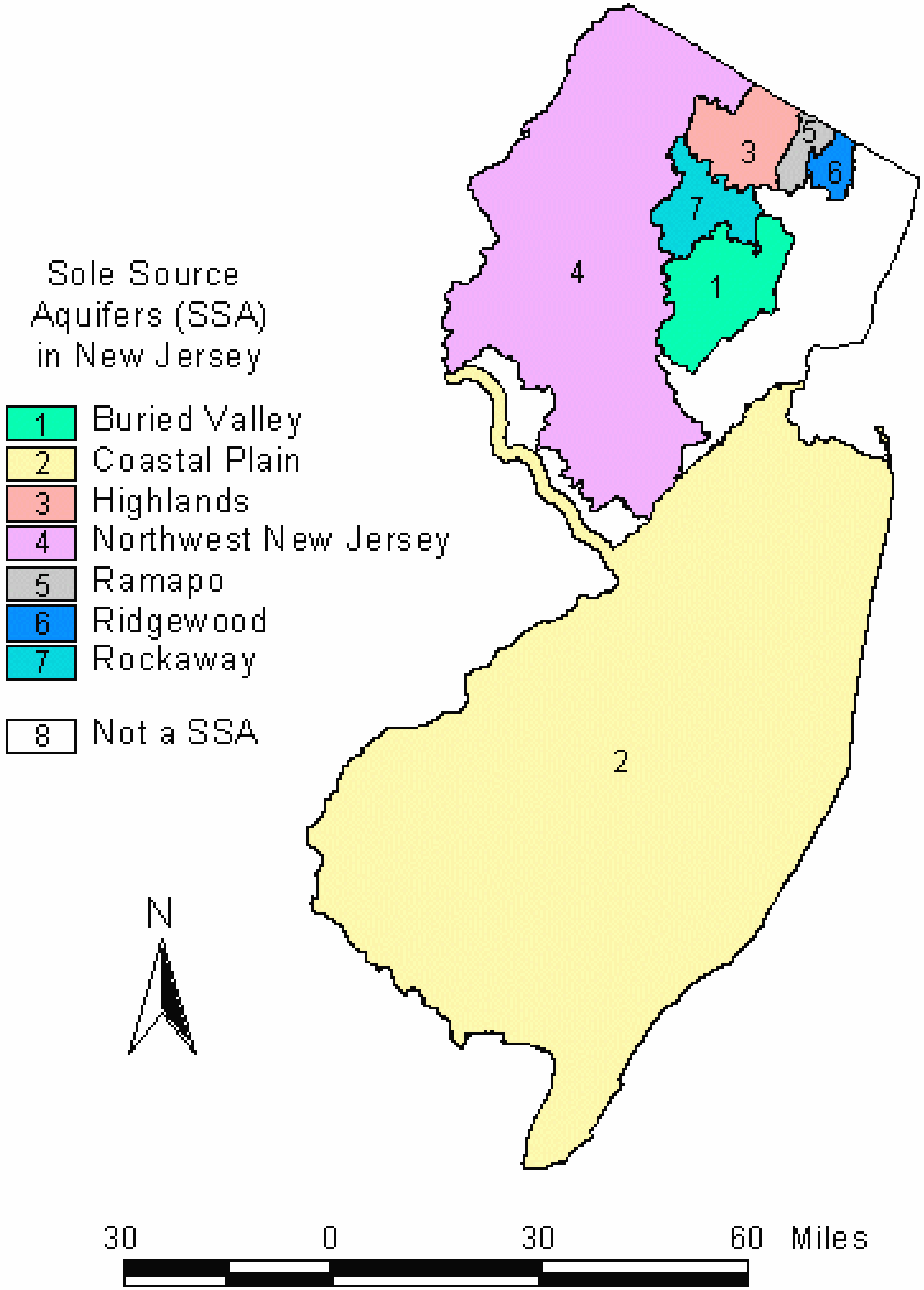


Figure 1. Principal aquifers in New Jersey. *A*, Geographic distribution. *B*, Physiographic diagram and divisions. *C*, Generalized cross section (A-A') of the Coastal Plain. (See table 2 for more detailed description of the aquifers. Sources: *A*, *C*, Compiled by O. S. Zapecza from U.S. Geological Survey files. *B*, Owens and Sohl, 1969; Raisz, 1954.)

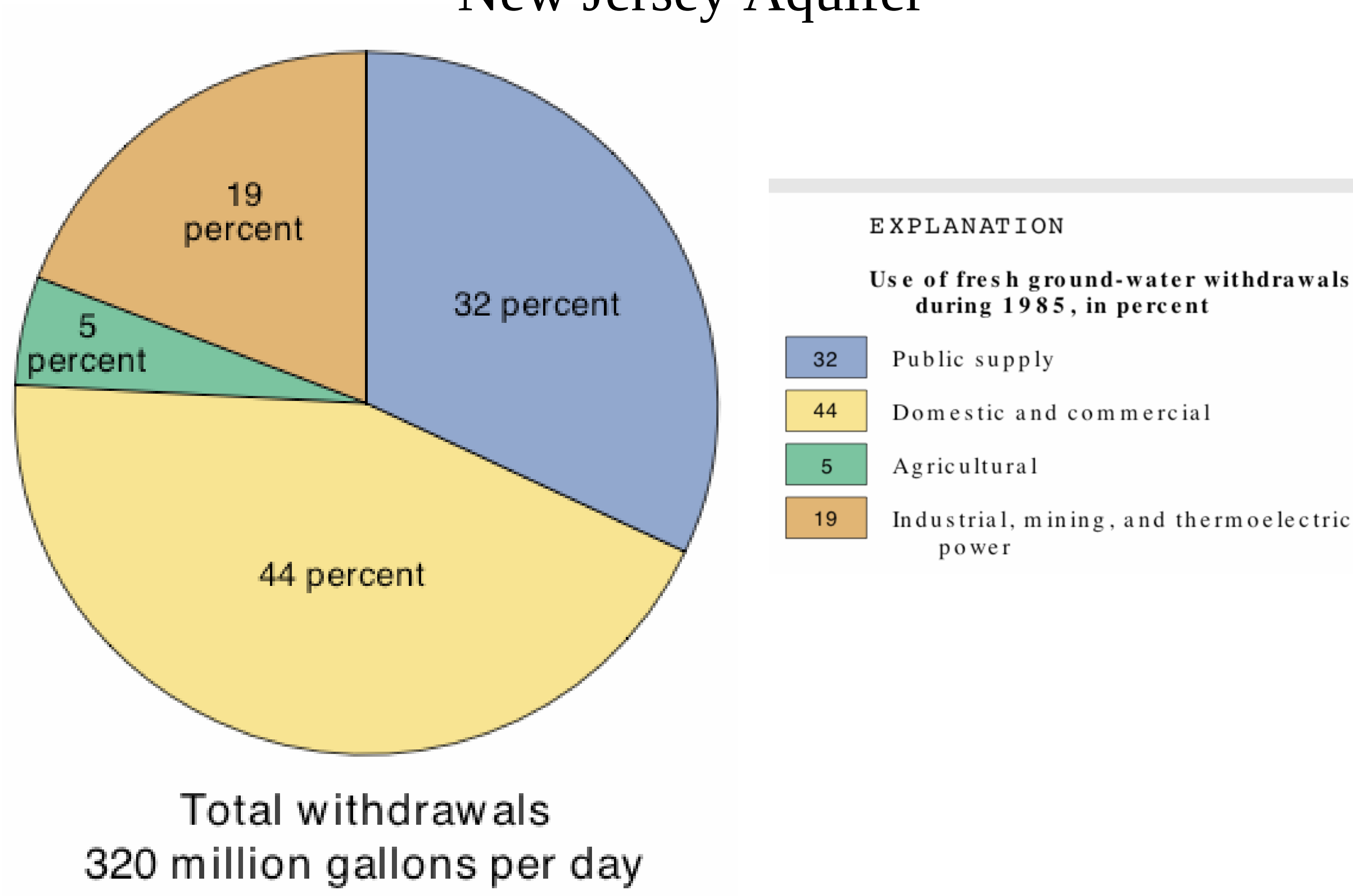

Aquifers and Confining Units of New Jersey
Bedrock aquifers
Includes aquifers and confining units of the Coastal Plain, fractured-rock aquifers of the Newark basin part of the Piedmont, and fractured-rock aquifers of the Valley and Ridge, Highlands, and Trenton and Manhattan Prongs.
Aquifer Rank
Median Yield of High-capacity * Wells (gpm)
A >500
B-A >250
B 251 to 500
C-B 101 to 500
C 101 to 250
D 25 to 100
E-D <100
E <25
Surficial aquifers
Includes till (D), morainic deposits (D), lake-bottom sediment (E), sand and gravel (B), and surficial sediment thicker than 50 ft. overlying Coastal Plain aquifers.
0 30 60 Miles
N
* High-capacity wells are industrial wells that are cited and tested for maximum water yields that often greatly exceed domestic-well yields for the same aquifer.



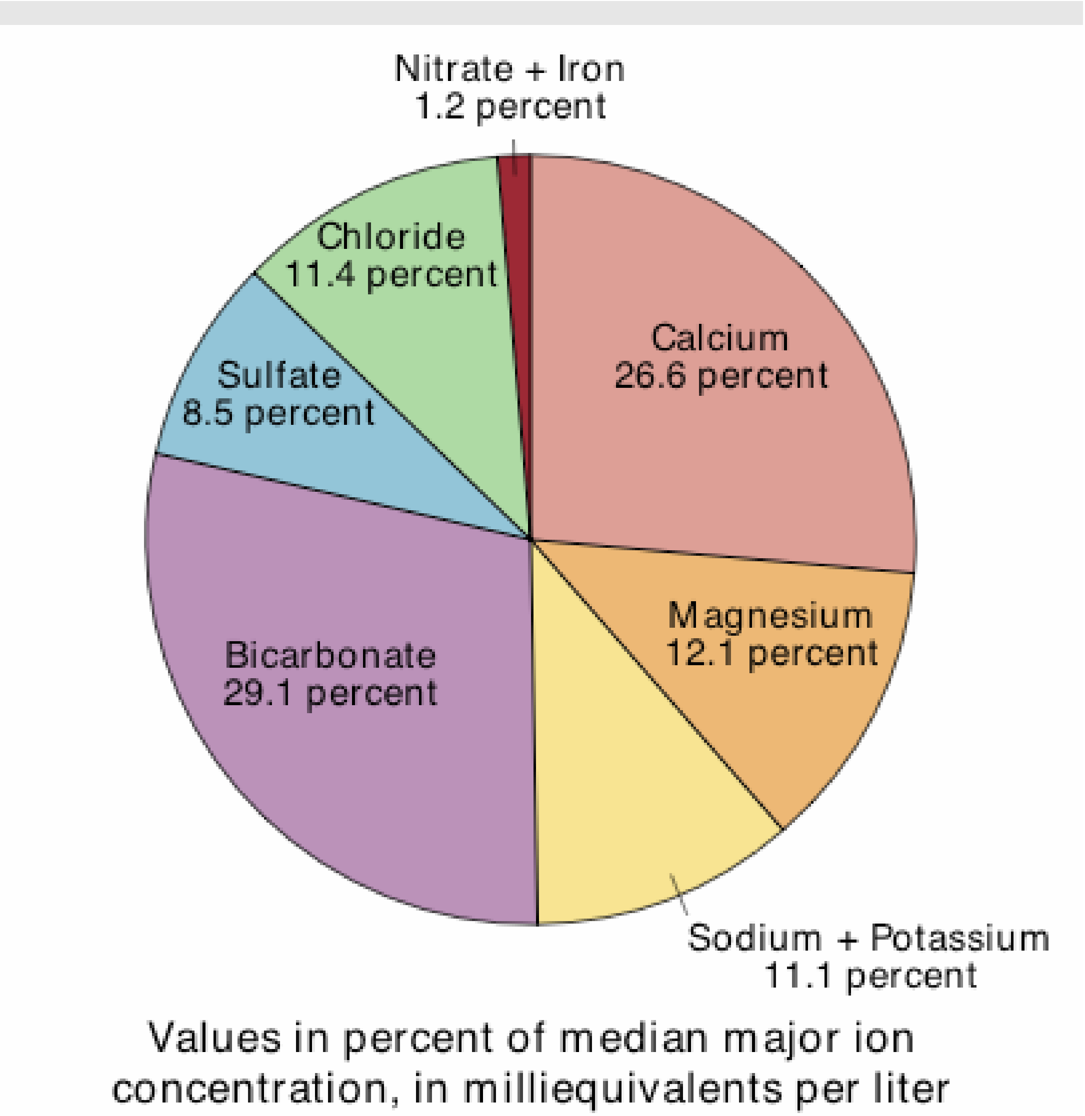
USGS Groundwater Monitoring Program


Sole Source
Aquifers (SSA)
in New Jersey
1 Buried Valley
2 Coastal Plain
3 Highlands
4 Northwest New Jersey
5 Ramapo
6 Ridgewood
7 Rockaway
8 Not a SSA
N
30 0 30 60 Miles
1
2
3
4
5
6
7

Ground Water Usage
New Jersey Aquifer

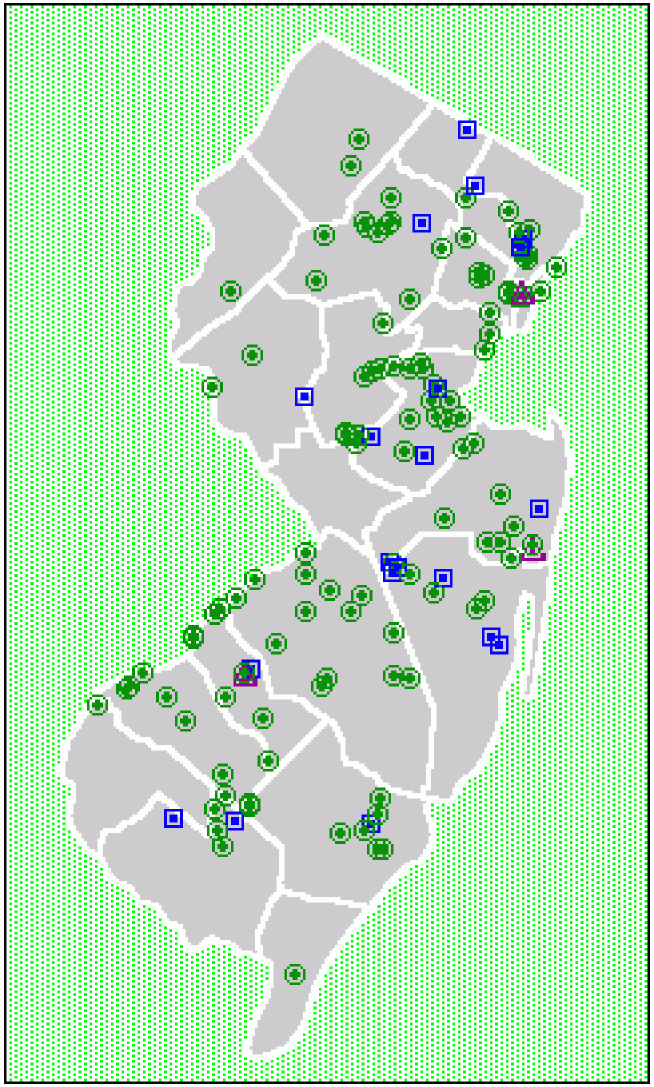


Water Quality New Jersey Aquifer

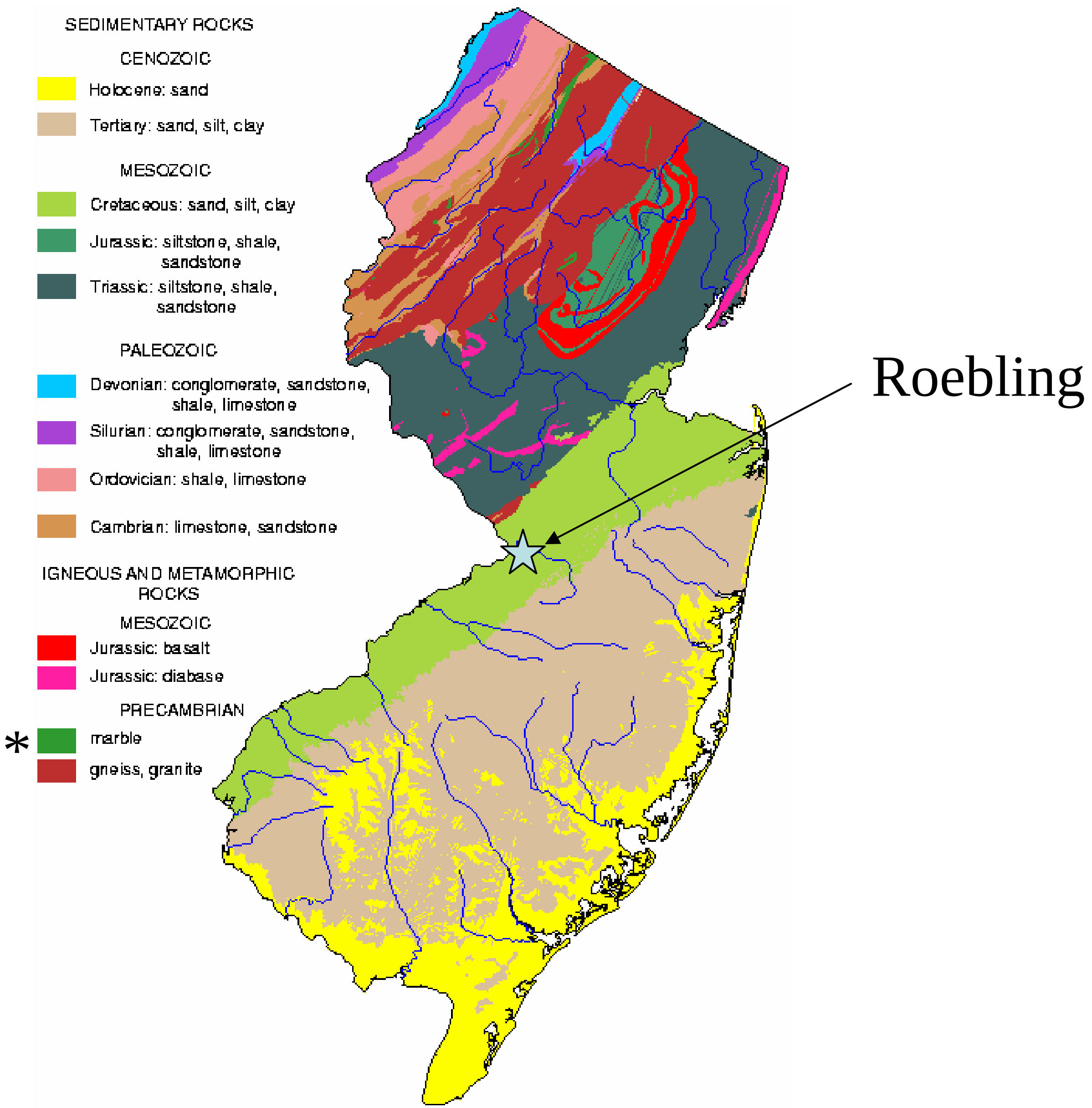


Bicarbonate-type water constituents

EPA Superfund Sites of New Jersey



Map Key: Proposed: 3 Final: 113 Deleted: 21



* marble is a form of limestone

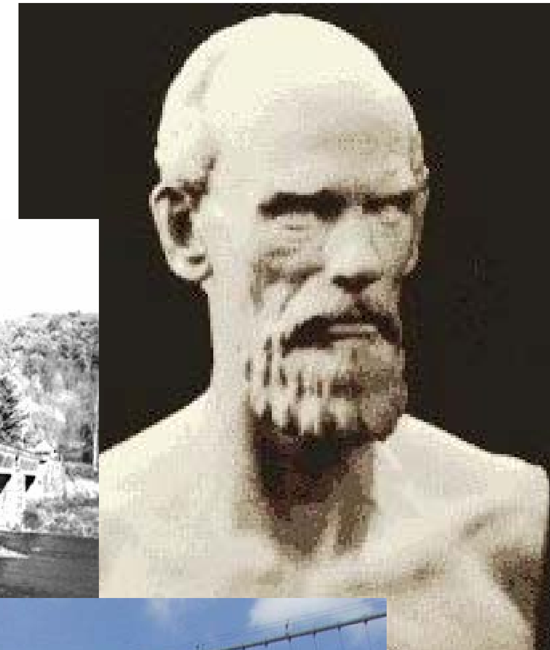
THE ORIGINAL ROEBLING WIRE MILL, 1848

John Roebling

1806-1869

Bridge Builder



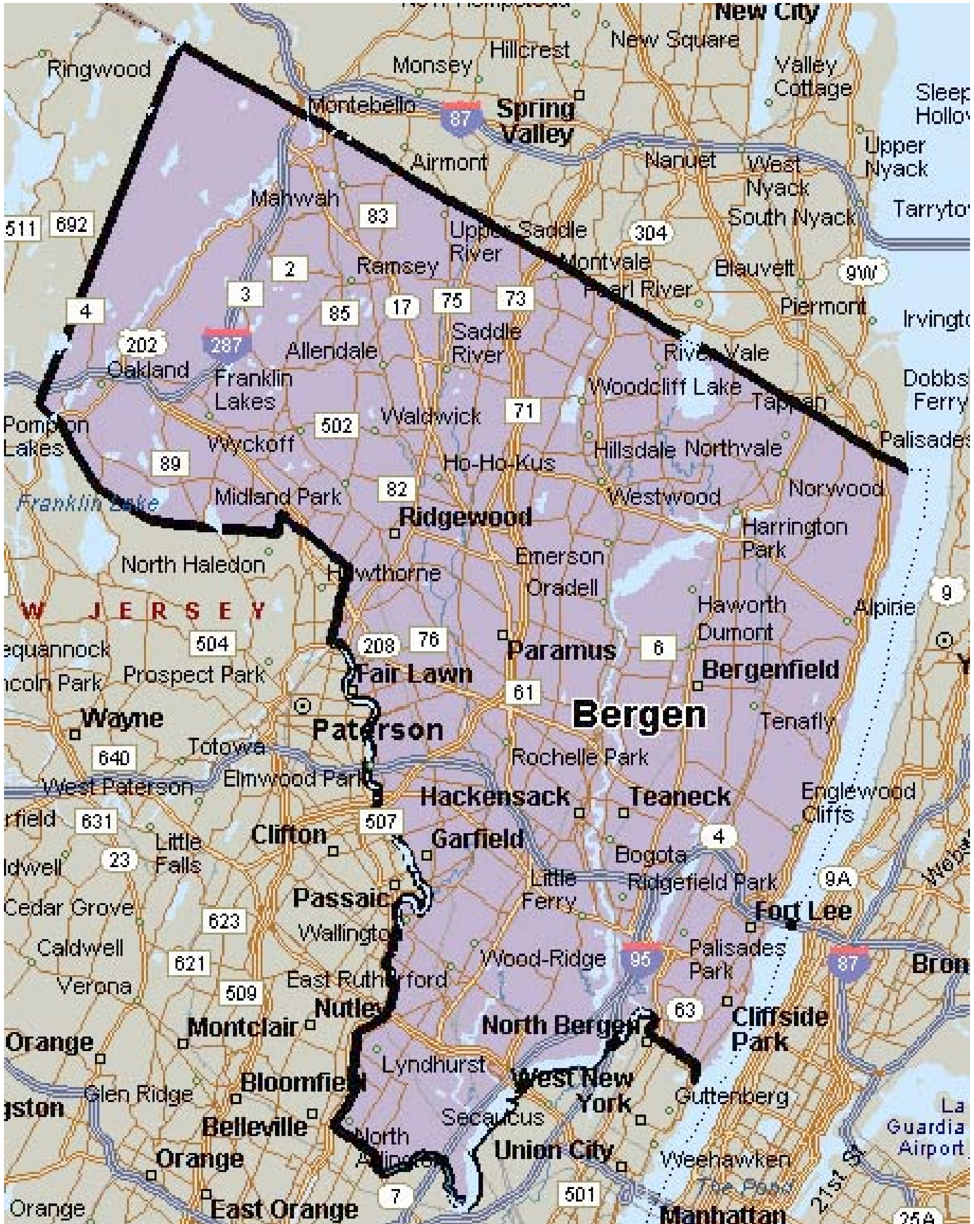



Home of The 1st Superfund Site

Roebling, New Jersey

New Jersey Officials Call on EPA to Resume Cleanup at Roebling Superfund Site

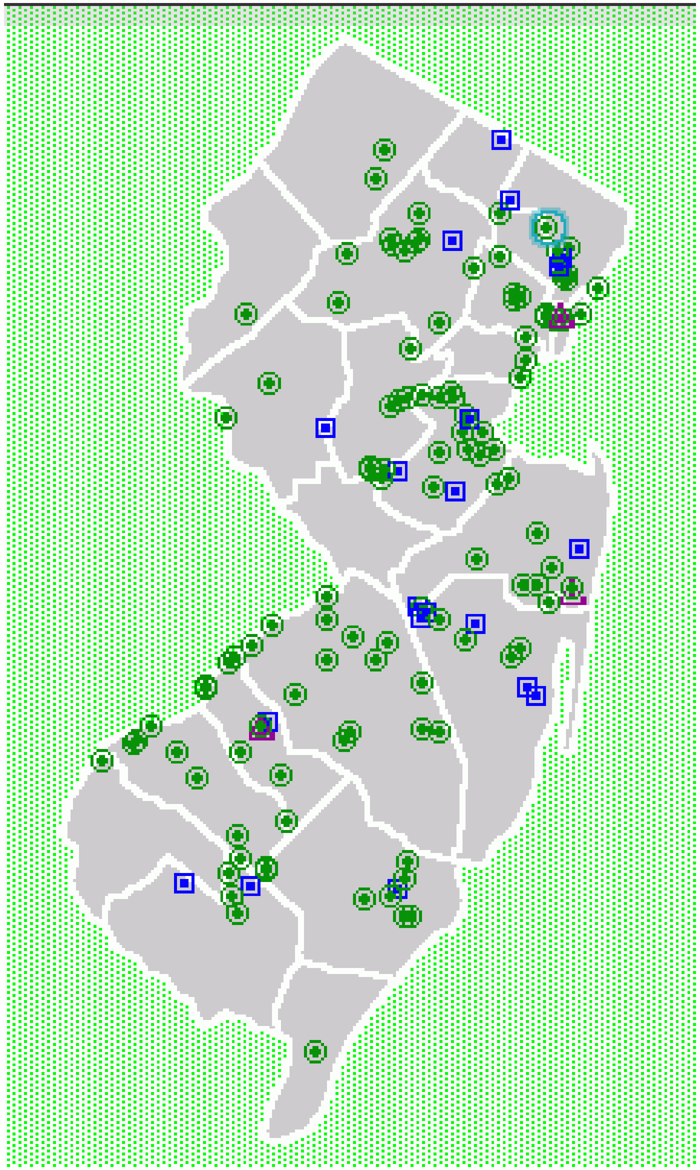
(03/111) Florence -- Department of Environmental Protection (DEP) Commissioner Bradley M. Campbell today joined Senator Jon S. Corzine, Florence Township Mayor Michael J. Muchowski and NJPIRG Campaign Director Doug O'Malley at the Roebling Superfund site to call for resumed federal cleanup funding of the former Burlington County steel plant where remedial work has stopped.



Bergen County, New Jersey

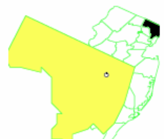
BERGEN COUNTY

Site Name CERCLIS ID	Proposed Listing	Final Listing	Construction Completion	Partial Deletion	Deletion
Curcio Scrap Metal, Inc. NJD011717584	1/22/87	7/22/87	9/30/97	N/A	N/A
Fair Lawn Well Field NJD980654107	12/30/82	9/08/83	N/A	N/A	N/A
Industrial Latex Corp. NJD981178411	6/24/88	3/31/89	9/27/01	N/A	4/21/03
Lodi Municipal Well NJD980769301	10/15/84	8/30/90	9/27/93	N/A	12/29/98
Maywood Chemical Co. NJD980529762	12/30/82	9/08/83	N/A	N/A	N/A
Quanta Resources NJD000606442	1/11/01	9/05/02	N/A	N/A	N/A
Scientific Chemical Processing NJD070565403	12/30/82	9/08/83	N/A	N/A	N/A
Universal Oil Products(Chemical Division NJD002005106	12/30/82	9/08/83	N/A	N/A	N/A
Ventron/Velsicol NJD980529879	9/08/83	9/21/84	N/A	N/A	N/A
Witco Chemical Corp.(Oakland Plt) NJD045653854	6/24/88	10/04/ 89	9/28/92	N/A	9/29/95



1 **CURCIO SCRAP METAL, INC.**
NEW JERSEY
EPA ID# NJD011717584

2 **MAYWOOD CHEMICAL COMPANY**
NEW JERSEY
EPA ID# NJD980529762



3 **LODI MUNICIPAL WELL**
NEW JERSEY
EPA ID# NJD980769301

4 **INDUSTRIAL LATEX CORP.**
NEW JERSEY
EPA ID# NJD981178411

5 **QUANTA RESOURCES CORP.**
NEW JERSEY
EPA ID# NJD000606442

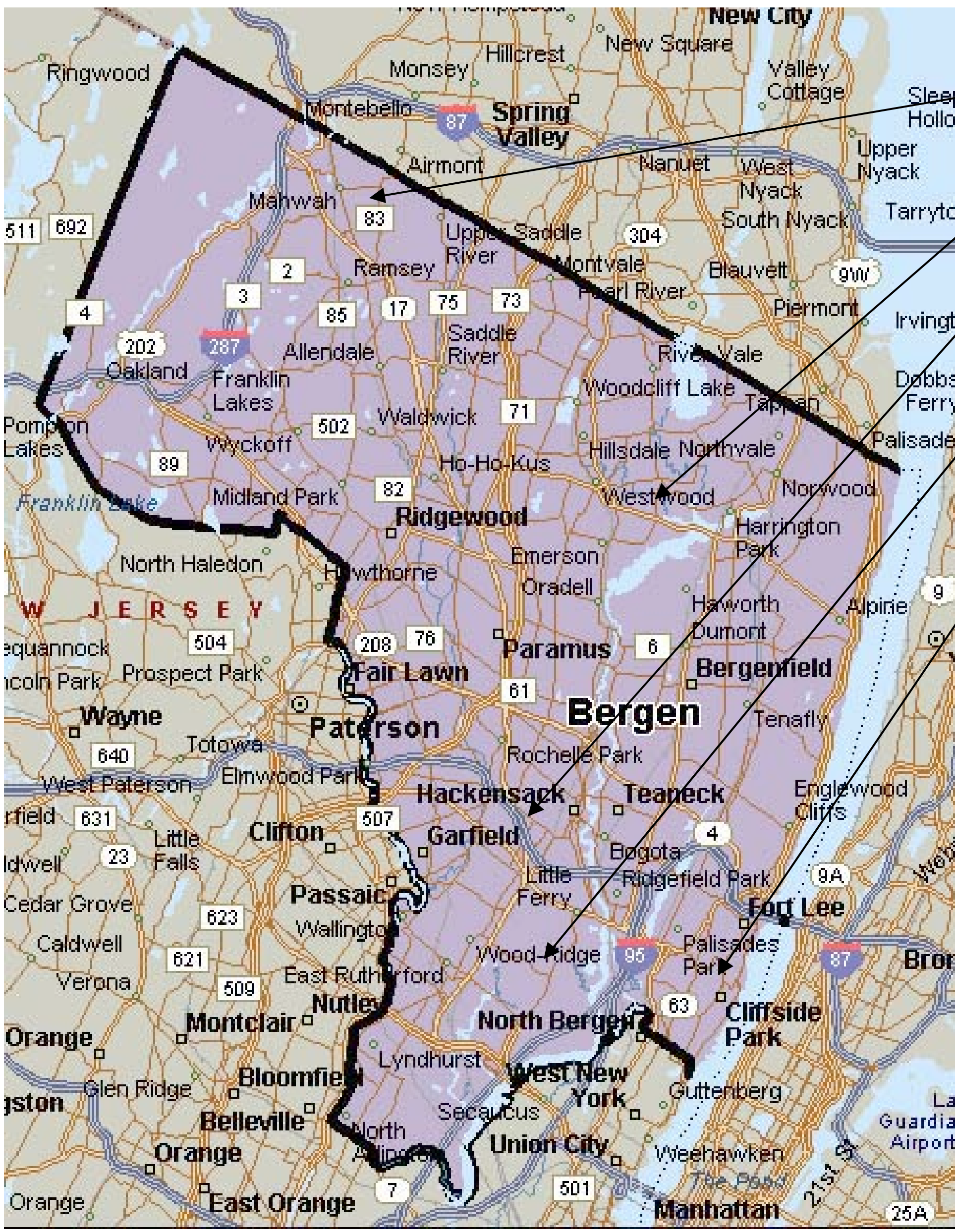
6 **UNIVERSAL OIL PRODUCTS**
NEW JERSEY
EPA ID# NJD002005106

7 **SCIENTIFIC CHEMICAL PROCESSING**
NEW JERSEY
EPA ID# NJD070565403

8 **VENTRON/ VELSICOL**
NEW JERSEY
EPA ID# NJD980529879

9 **WITCO CHEMICAL CORP.**
(OAKLAND PLANT)
NEW JERSEY
EPA ID# NJD045653854

10 **FAIR LAWN WELL FIELD**
NEW JERSEY
EPA ID# NJD980654107



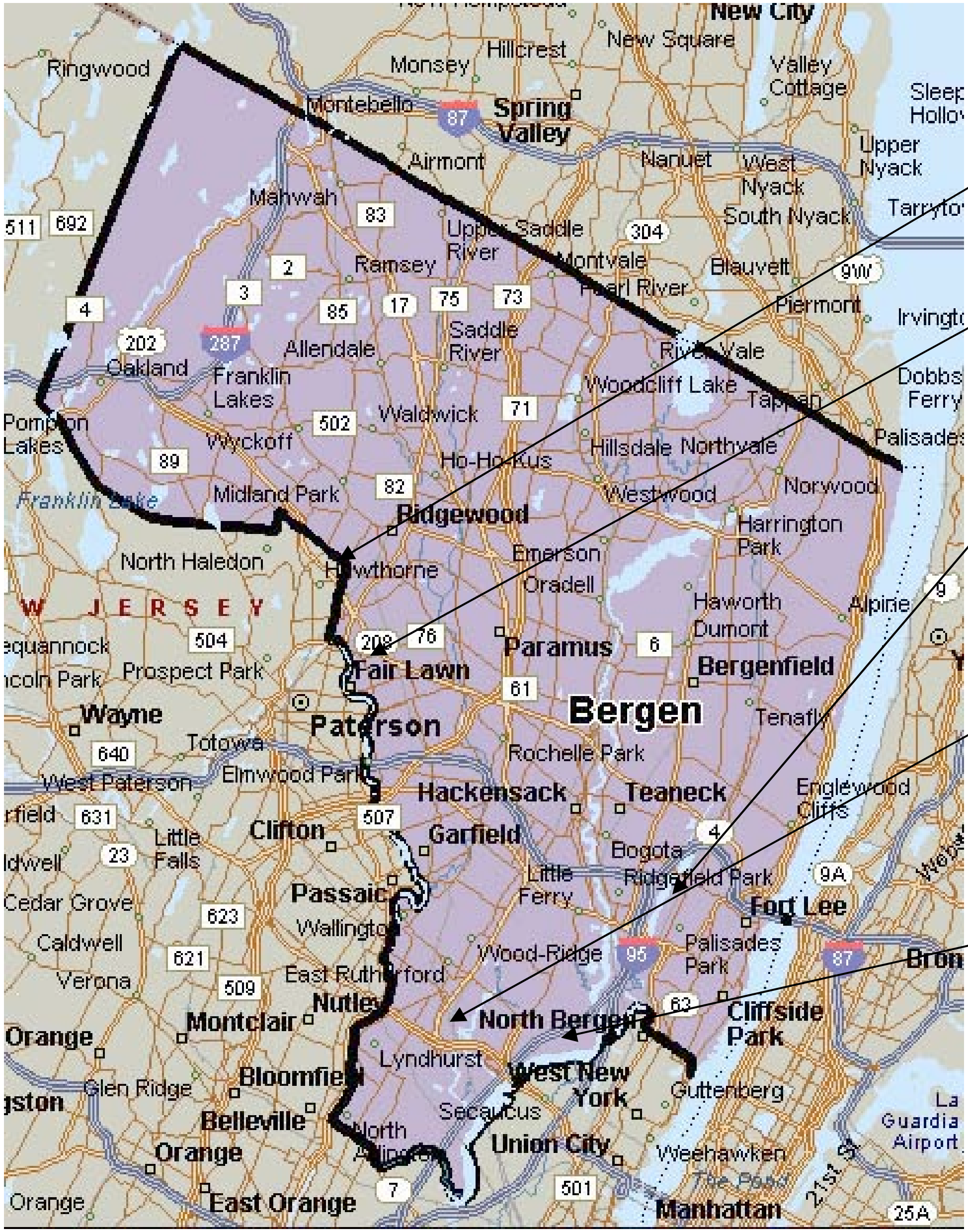
Curcio Scrap Metal #1

Maywood Chemical Co. #2

Lodi Municipal Well #3

Industrial Latex Corp. #4

Quanta Resources Corp. #5



Witco Chemical Corp #6

Fairlawn Well Field #7

Ventron/Velsicol #8

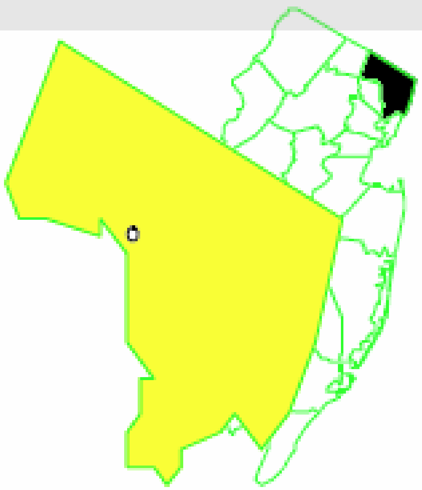
Scientific Chemical Processing #9

Universal Oil Products #10

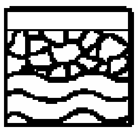
FAIR LAWN WELL FIELD

NEW JERSEY

EPA ID# NJD980654107



Threats and Contaminants



VOCs were detected in the groundwater from the three municipal wells. The threat due to exposure to the contaminated groundwater has been significantly reduced, since air strippers are currently treating contaminated groundwater from the municipal wells prior to distribution to the residents.

Cleanup Approach

This site is being addressed in two stages: immediate actions and a long-term remedial action. The immediate action of wellhead treatment has addressed the municipal well contamination, while the long-term action will focus on the entire groundwater cleanup and controlling potential sources of contamination.

Response Action Status

Immediate Actions: In 1984, the potentially responsible parties (PRPs), Fisher Scientific Company and Sandvik, Inc., removed contaminated soil from a portion of their property. In 1987, the Borough of Fair Lawn installed air strippers to treat the contaminated wells. The PRPs later reimbursed the Borough for the installation of the air strippers and provided funding for future operation and maintenance activities.

Cleanup Progress (Threats Mitigated by Cleanup Process)

The immediate actions described above have greatly reduced the potential for exposure to contaminated groundwater and soil at the Fair Lawn Well Field site while further investigations are taking place. The impacted public supply wells are currently being treated to remove contaminants and to ensure that the public is provided with a safe drinking water supply. The air stripper located at the Westmoreland Well Field is continuing to treat approximately 0.2 million gallons per day of contaminated groundwater.

NJ Drought Hotline: 1-800-4-ITS-DRY

Outside New Jersey Please Call: 1-609-633-0560

Drought Resources

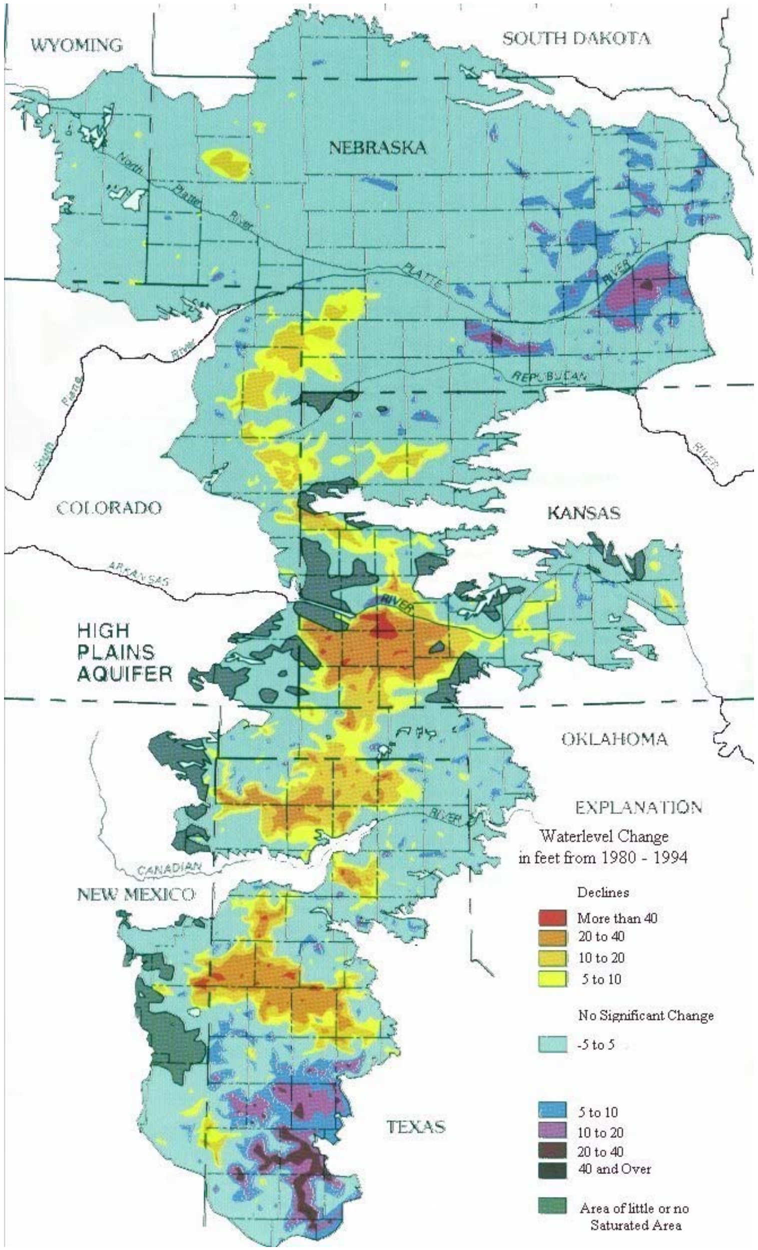
- frequently asked questions
- drought status & indicators (updated 2/4/04)
- drought regions in New Jersey
- ask NJDEP your drought question
- you can make a difference: ideas for saving water
- additional drought links
- hardship exemption form
- declared drought status in neighboring areas

Current Events

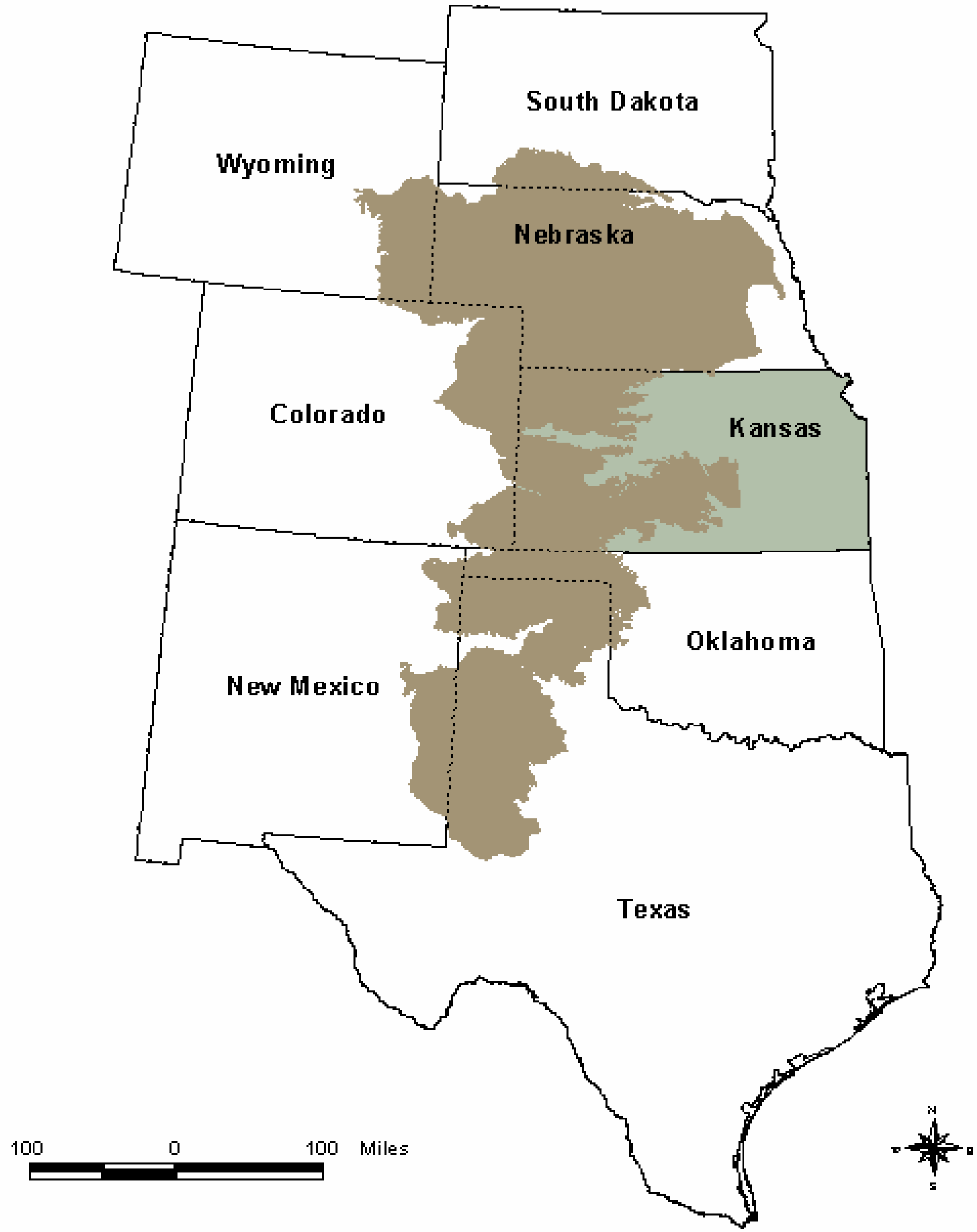
- public information sessions
- current drought restrictions
- current rainfall statistics
- current reservoir levels
- news releases
- administrative orders

Drought Regions

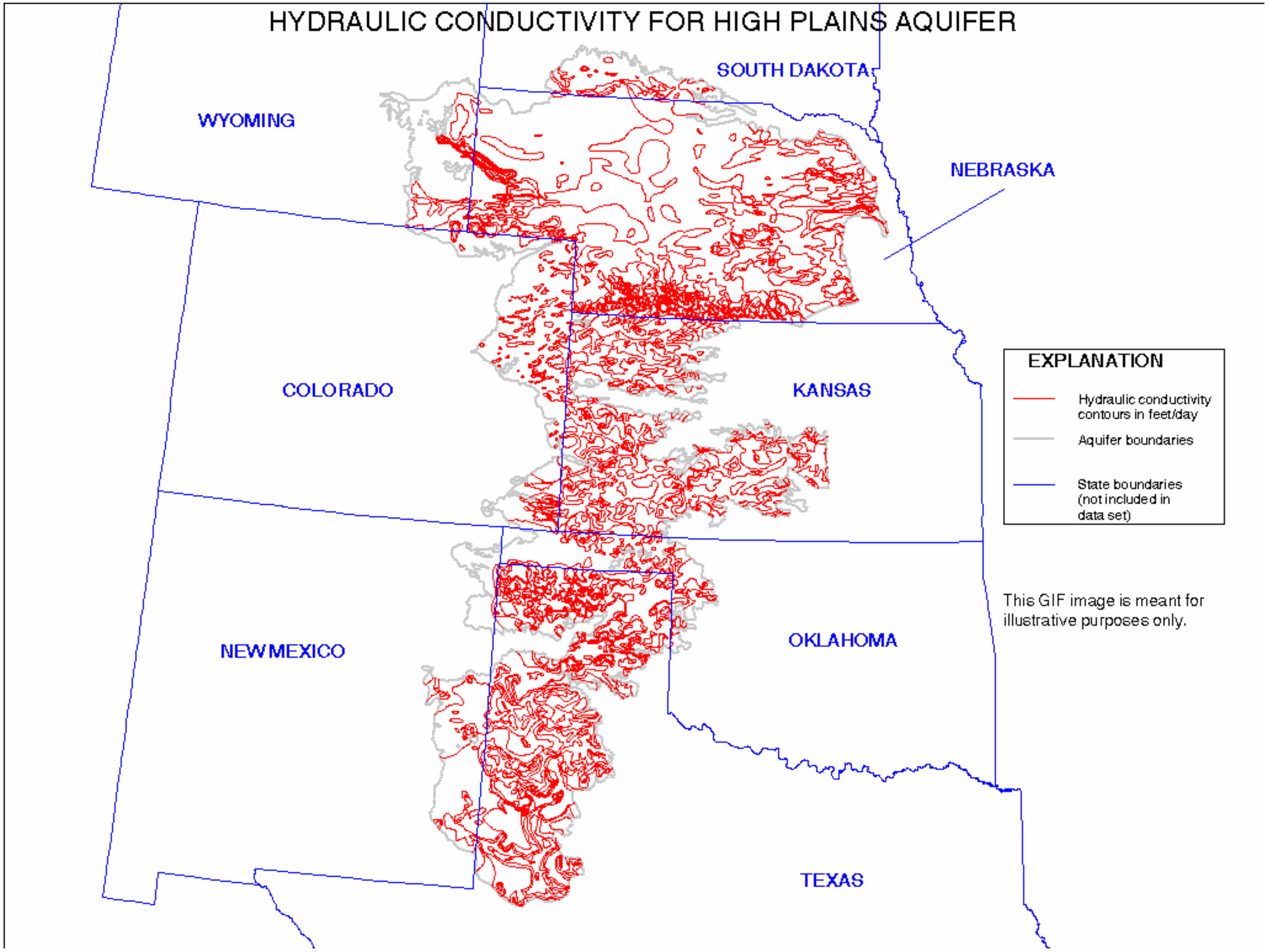
click an area for more status information

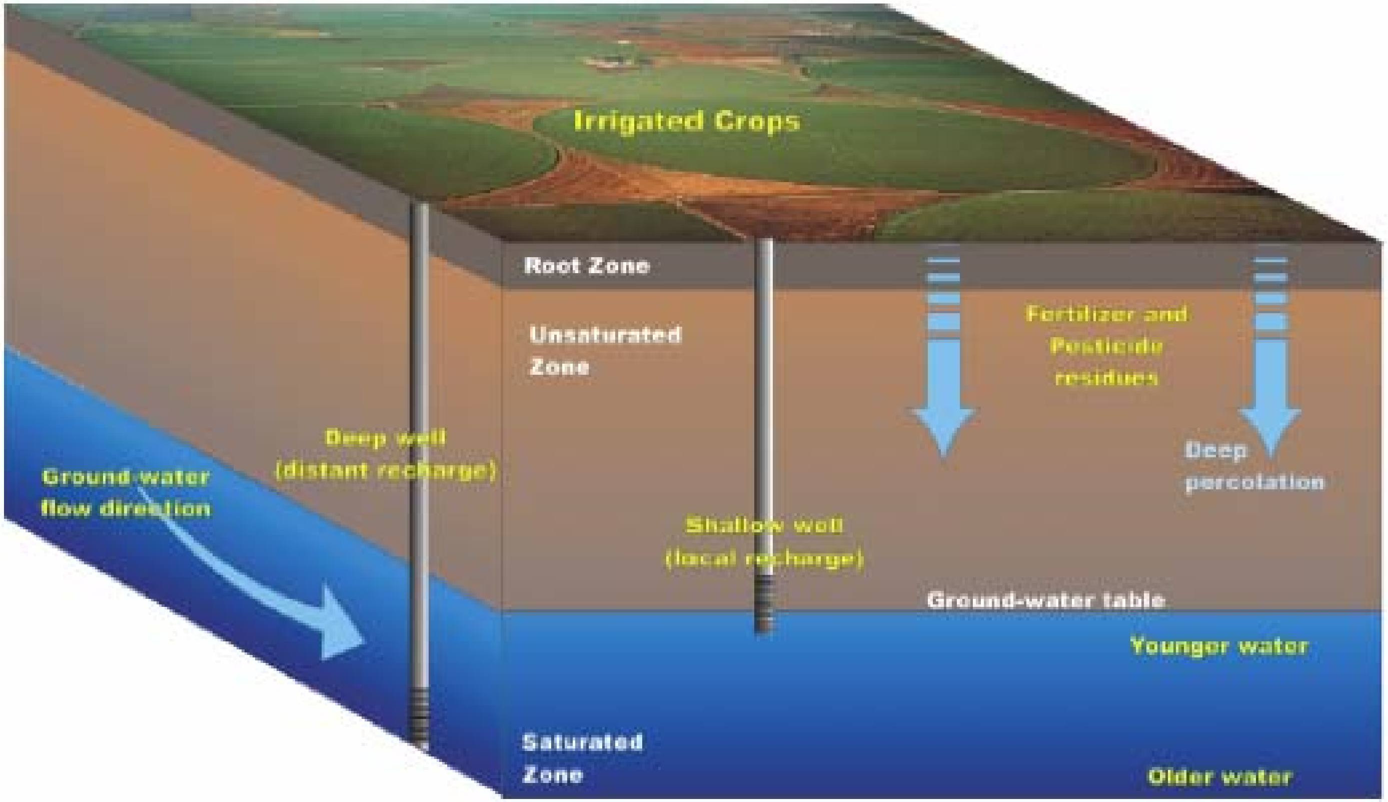


The Ogallala Aquifer



South Dakota
Wyoming
Nebraska
Colorado
Kansas
Oklahoma
New Mexico
Texas
100
0
100
Miles


HYDRAULIC CONDUCTIVITY FOR HIGH PLAINS AQUIFER
SOUTH DAKOTA
WYOMING
NEBRASKA
COLORADO
KANSAS
EXPLANATION
Hydraulic conductivity contours in feet/day
Aquifer boundaries
State boundaries (not included in data set)
This GIF image is meant for illustrative purposes only.
OKLAHOMA
NEW MEXICO
TEXAS


Irrigated Crops
Root Zone
Unsaturated Zone
Fertilizer and Pesticide residues
Deep well (distant recharge)
Deep percolation
Ground-water flow direction
Shallow well (local recharge)
Ground-water table
Younger water
Saturated Zone
Older water

"All parts of Kansas grow good corn but in wheat Kansas can beat the world." *Topeka Daily Capital*, 1888.

The Kansas climate is best suited to winter wheat (planted in the fall and harvested in the spring) because most moisture arrives in winter and early spring.

Kansas Wheat Farmers

Circa 1930


Colorado
Kansas
Dust
Bowl
Oklahoma
New Mexico
Texas
MEXICO

Kansas Wheat Farm Adventures

Ever wonder what life is like on a farm? These farm families kept diaries to help you find out what it's like to live and work on Kansas farms. Check out their daily entries and photos to learn more.

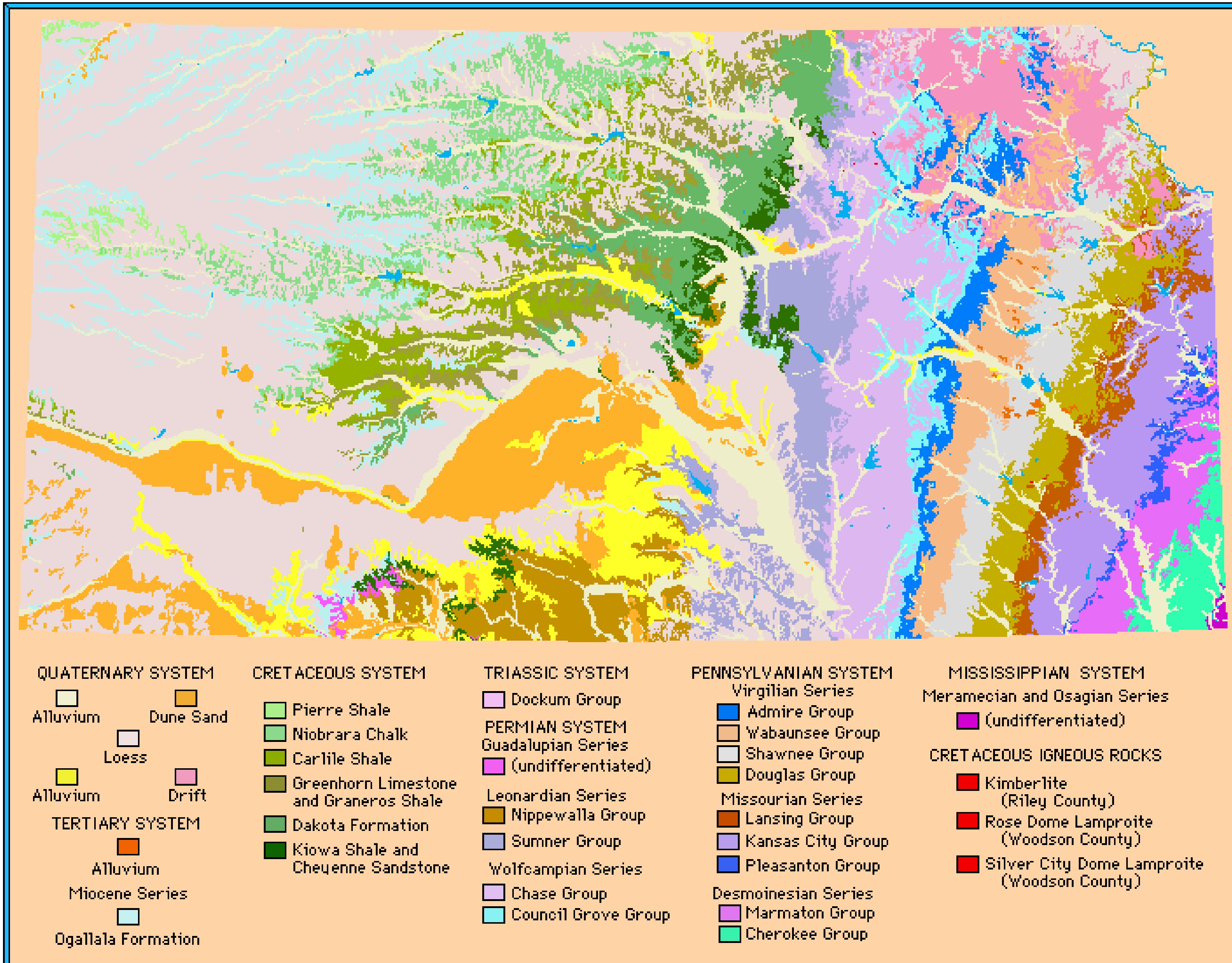
Stoskopf Family
Wheat Harvest & Summer Adventures – 1997
May 1998 Update

Ehmke Family
Fall Harvest & Activities – 1997
June 1998 Update
Harvest 2000!

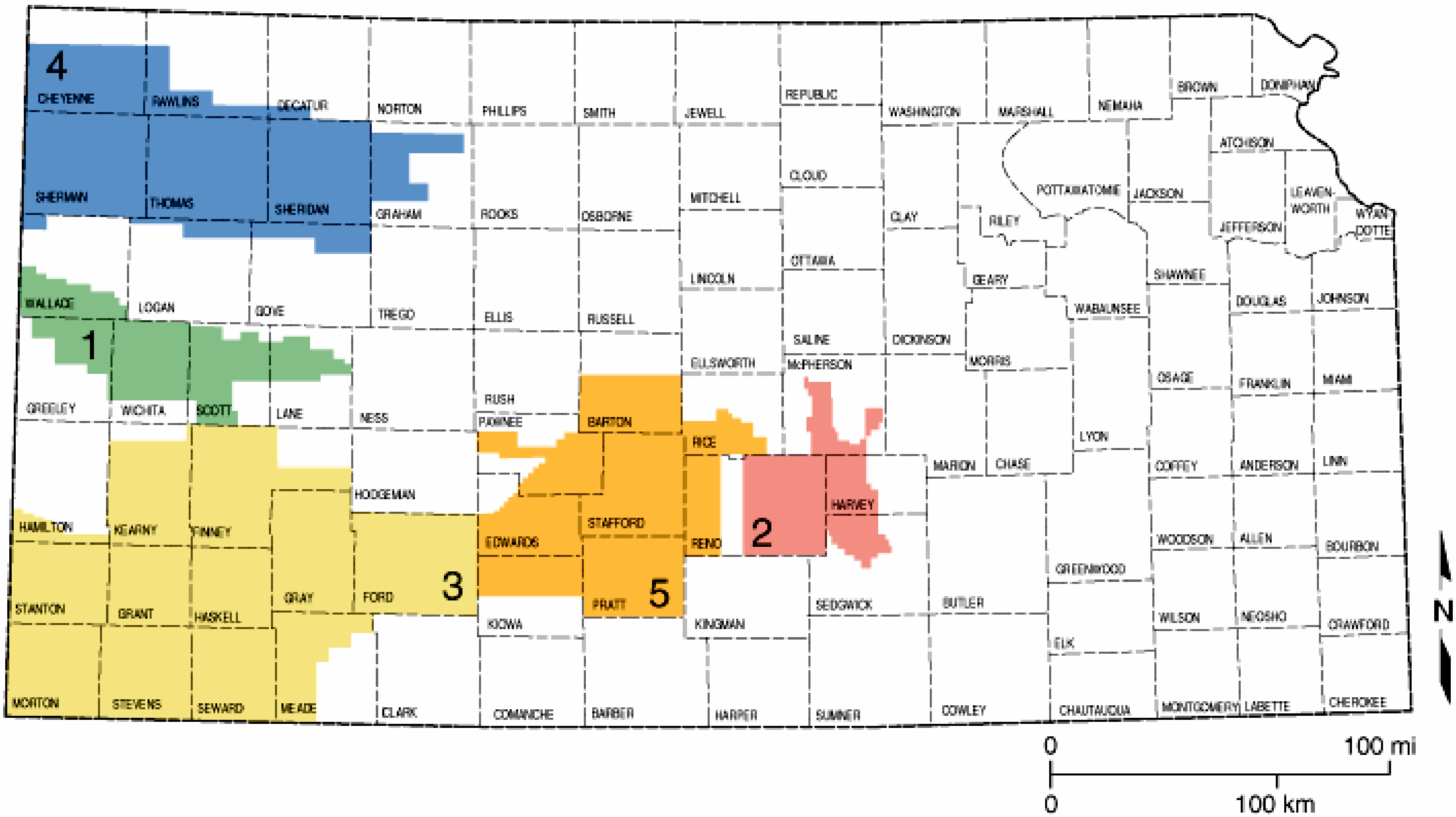
Hixon Family
Baby Calves & Winter Happenings

Clanton Family
Wheat Harvest & Fall Planting - 1998

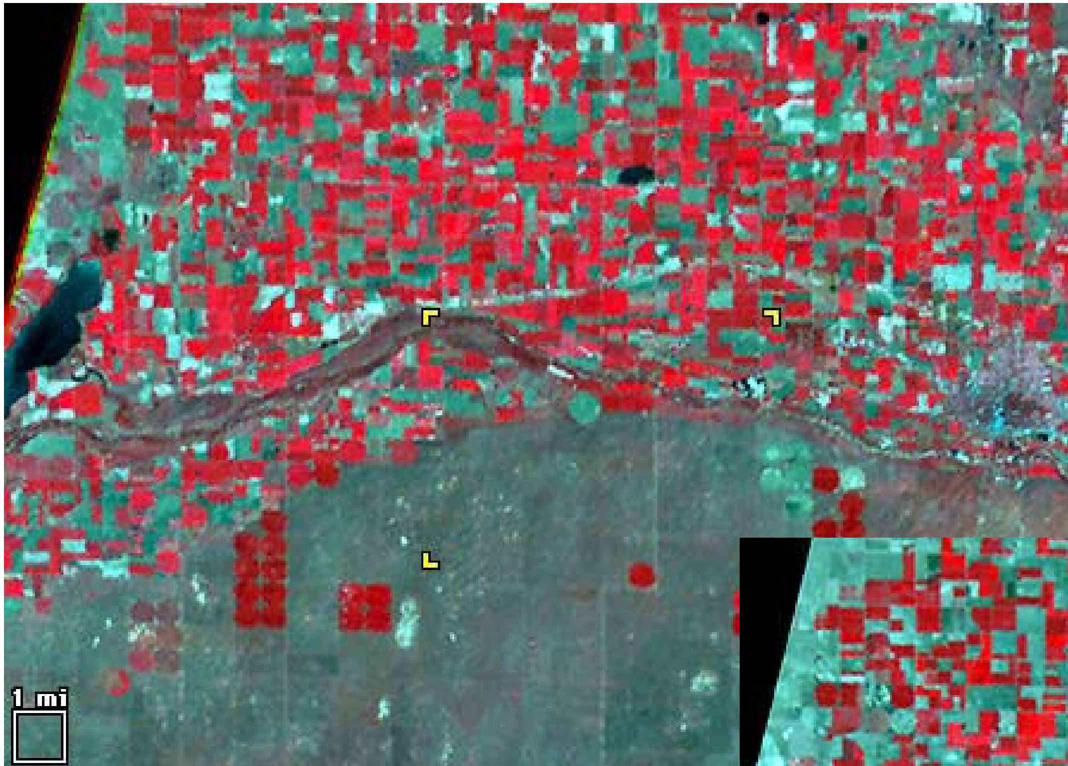
Contact any of the families at wackywheat@hoisington.com


QUATERNARY SYSTEM
Alluvium
Dune Sand
Loess
Alluvium
Drift
TERTIARY SYSTEM
Alluvium
Miocene Series
Ogallala Formation
CRETACEOUS SYSTEM
Pierre Shale
Niobrara Chalk
Carlile Shale
Greenhorn Limestone and Graneros Shale
Dakota Formation
Kiowa Shale and Cheyenne Sandstone
TRIASSIC SYSTEM
Dockum Group
PERMIAN SYSTEM
Guadalupian Series
(undifferentiated)
Leonardian Series
Nippewalla Group
Sumner Group
Wolfcampian Series
Chase Group
Council Grove Group
PENNSYLVANIAN SYSTEM
Virgilian Series
Admire Group
Wabaunsee Group
Shawnee Group
Douglas Group
Missourian Series
Lansing Group
Kansas City Group
Pleasanton Group
Desmoinesian Series
Marmaton Group
Cherokee Group
MISSISSIPPIAN SYSTEM
Meramecian and Osagian Series
(undifferentiated)
CRETACEOUS IGNEOUS ROCKS
Kimberlite (Riley County)
Rose Dome Lamproite (Woodson County)
Silver City Dome Lamproite (Woodson County)

Ground Water Management Districts



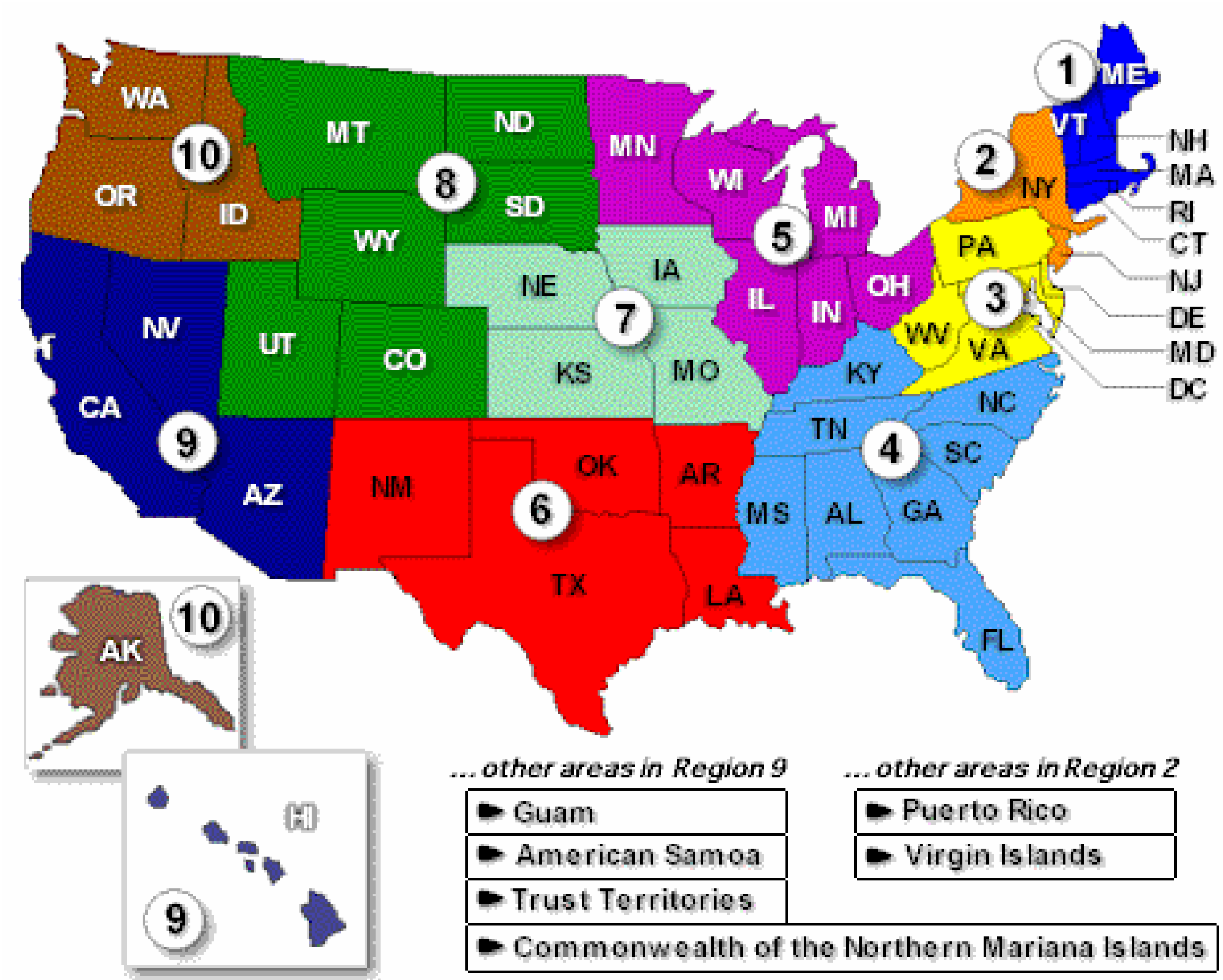
Land Use Change Western Kansas



1972

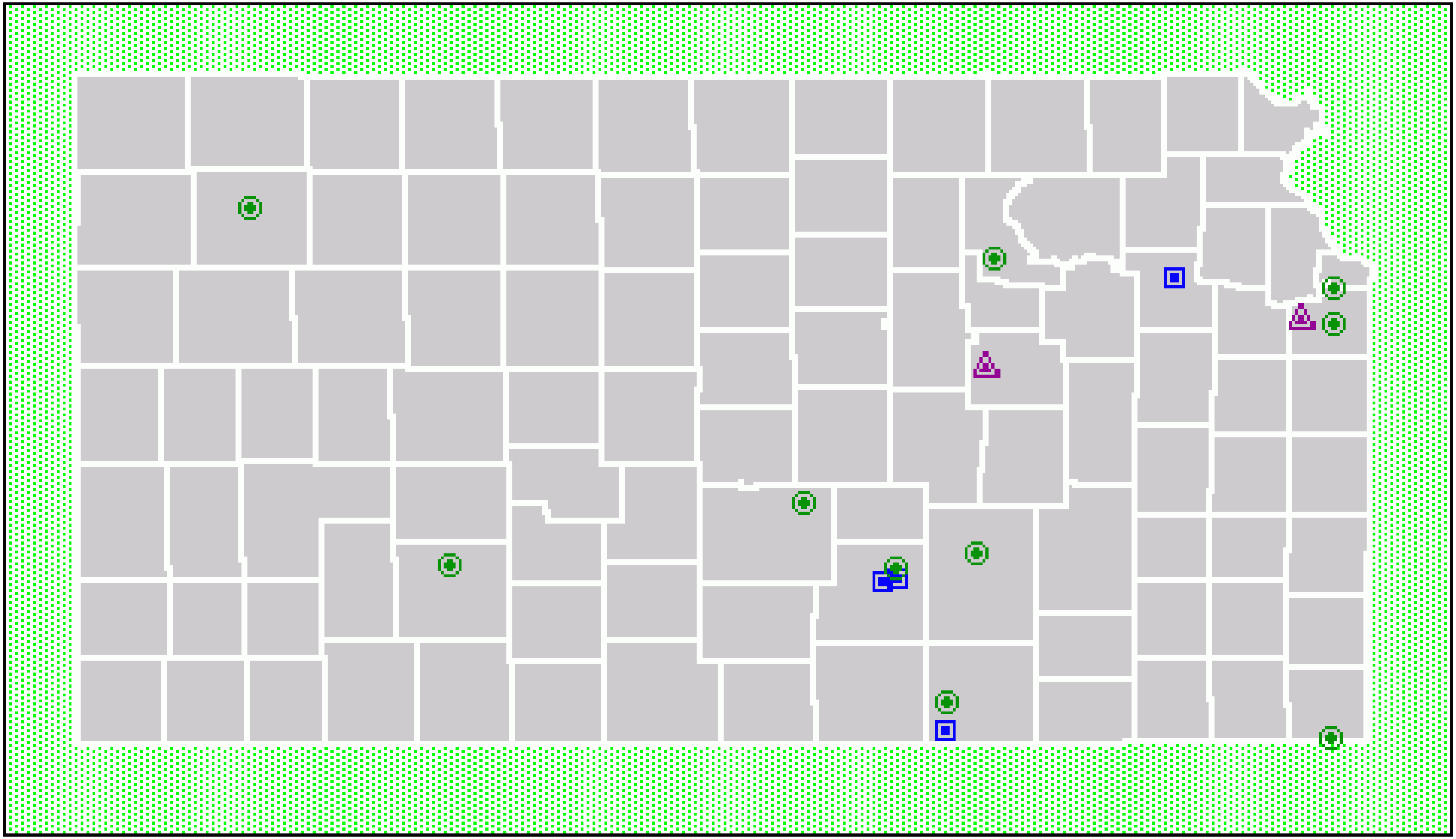
1988

National Priorities List For Superfund Sites



http://www.epa.gov/superfund/sites/npl/npl.htm

EPA Superfund Sites: Kansas



USGS
science for a changing world

HIGH PLAINS AQUIFER AND THE U.S. GEOLOGICAL SURVEY NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

By Larry M. Pope; U.S. geological Survey-Water Resources Division, Lawrence, KS

"Whiskey is for drinking and water is for fighting"

Water from 22 percent of the wells sampled in Kansas had dissolved solids concentrations greater than the U.S. Environmental Protection Agency (USEPA) Secondary Maximum Contaminant Level of 500 milligrams per liter for drinking water; dissolved solids in water from 2 of the 46 wells exceeded 1,000 milligrams per liter. Water from 9 percent of the wells had nitrate concentrations greater than the 10-milligrams-per-liter USEPA Maximum Contaminant Level (a primary drinking-water standard); 76 percent of the wells had nitrate concentrations greater than 2.0 milligrams per liter, which indicates potential enrichment from land-use activities. Concentrations of trace elements exceeded water-quality standards in water from only two wells. Concentrations of arsenic and manganese exceeded standards in one sample each from these two wells.

http://webserver.cr.usgs.gov/nawqa/hpgw/meetings/POPE2.html

ACE SERVICES

KANSAS

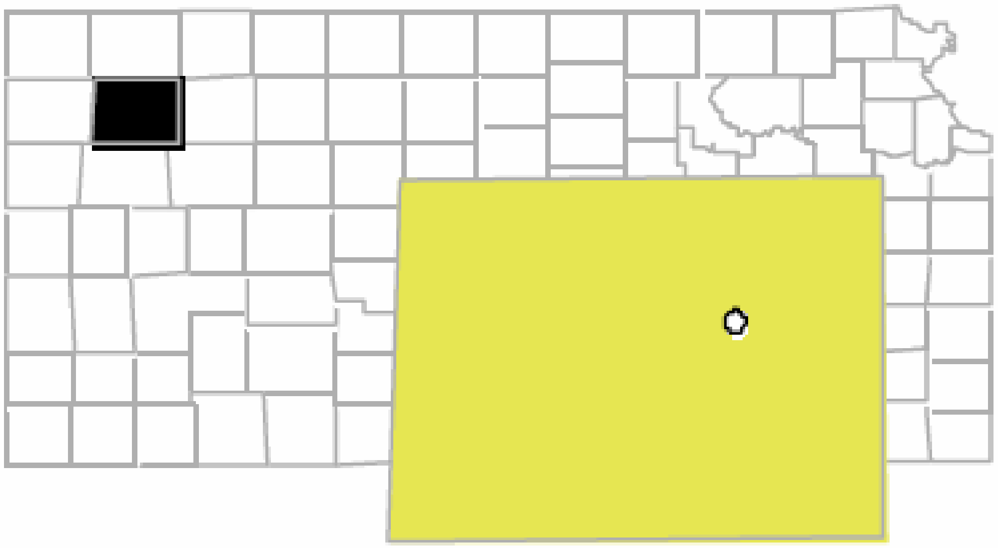
EPA ID# KSD046746731

EPA Region 7

City: Colby

County: Thomas County

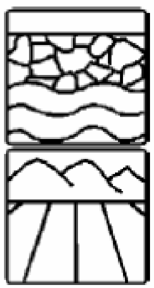
Other Names:



SITE DESCRIPTION

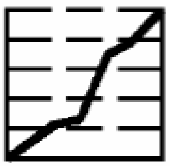
The 2 1/2-acre Ace Services site is a former chrome plating facility where chrome plating was applied to farm implement parts. The facility operated from 1969 to 1989, and was permanently closed in early 1990. From 1969 to 1975, chrome plating wastewater generated during operations at the Ace Services facility was discharged directly to the ground surface immediately west of the unnamed tributary to Prairie Dog Creek. A local citizen filed a complaint with the Kansas Department of Health and Environment (KDHE) in early 1971. KDHE and EPA collected wastewater samples in 1971 and 1972 that showed the presence of chromium. In 1974 and 1975, concrete retention vats were installed at the present at the site. Ground water from the Ogallala Aquifer is the sole source of municipal and private drinking water in and around Colby. The Colby public water supply well No. 8 is located one-fifth of a mile from the site. This well was closed by KDHE in 1980 due to chromium concentrations measuring above Federal drinking water standards. Approximately 6,180 people are currently served by seven

THREATS AND CONTAMINANTS



Soils and sludge in the lagoon area were contaminated with chromium prior to removal by Ace Services, KDHE and EPA. Surface wastewater was also contaminated with chromium prior to treatment and disposal by KDHE and EPA. The ground water in the Ogallala Aquifer is contaminated with chromium. Inhalation exposure to lead and chromium VI in indoor air within on-site buildings and ingesting contaminated ground water are the primary threats to the public.

ENVIRONMENTAL PROGRESS



Removing containers of hazardous waste and removing and stabilizing contaminated soils, sludges, dust, and buildings, and treating contaminated wastewater reduced threats at the Ace Service site while investigations into ground water contamination were conducted. Remedial design for the ground water remedy is currently completed and construction on the ground water treatment system has just begun.

WRIGHT GROUND WATER CONTAMINATION

KANSAS

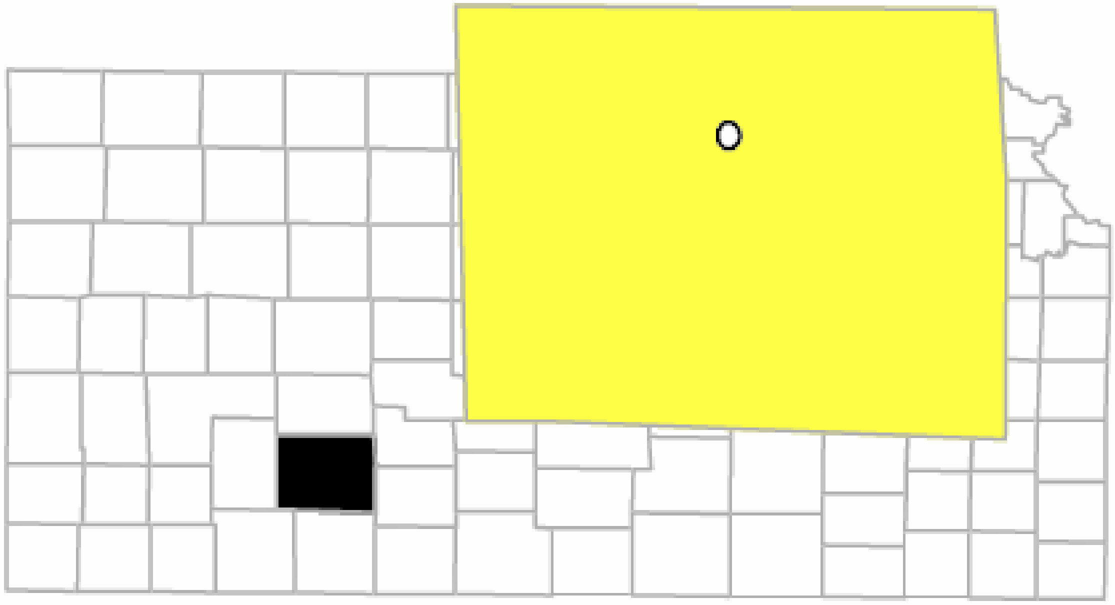
EPA ID# KSD984985929

EPA Region 7

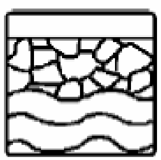
City: Wright

County: Ford County

Other Names:



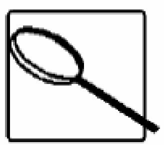
THREATS AND CONTAMINANTS



Groundwater is contaminated with pesticides, heavy metals, and VOCs including benzene, bromodichloromethane, and carbon tetrachloride. There are no bodies of water located within 2 miles of the site and it is unlikely that the hazardous substances in the groundwater would be released into the air or soil.

CLEANUP APPROACH

Response Action Status



Site Studies: Entire Site: A full-scale investigation into the nature and extent of groundwater contamination has been completed. A final cleanup remedy is being selected to address long-term cleanup goals.

Site Facts: A non-time critical removal, completed in 1997, provided a municipal water system for the residents of Wright.

ENVIRONMENTAL PROGRESS

The provision of bottle water and whole-house filter systems has reduced the risk of groundwater contamination to residents affected by the Wright Ground Water Contamination site while investigations are being planned.

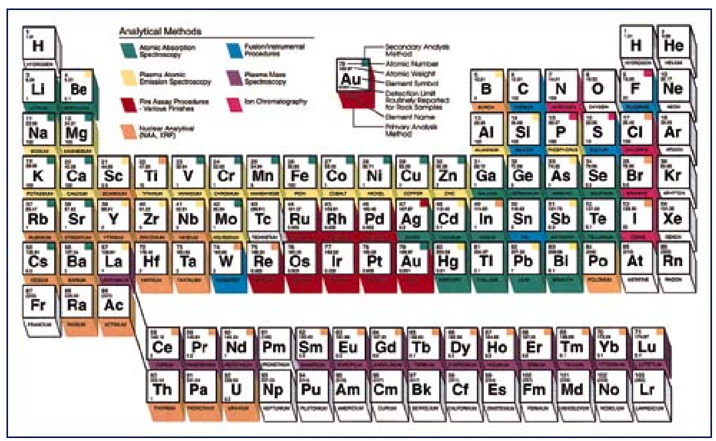
Agrochemicals

Pesticides

2,4,5-T
endrin
aldrin
paraquat
chlordane
lindane
DDT
campachlor
chlordimeform
ethylene dibromide
DBCP
dieldrin
ethyl parathion
pentachlorophenol

Herbicides

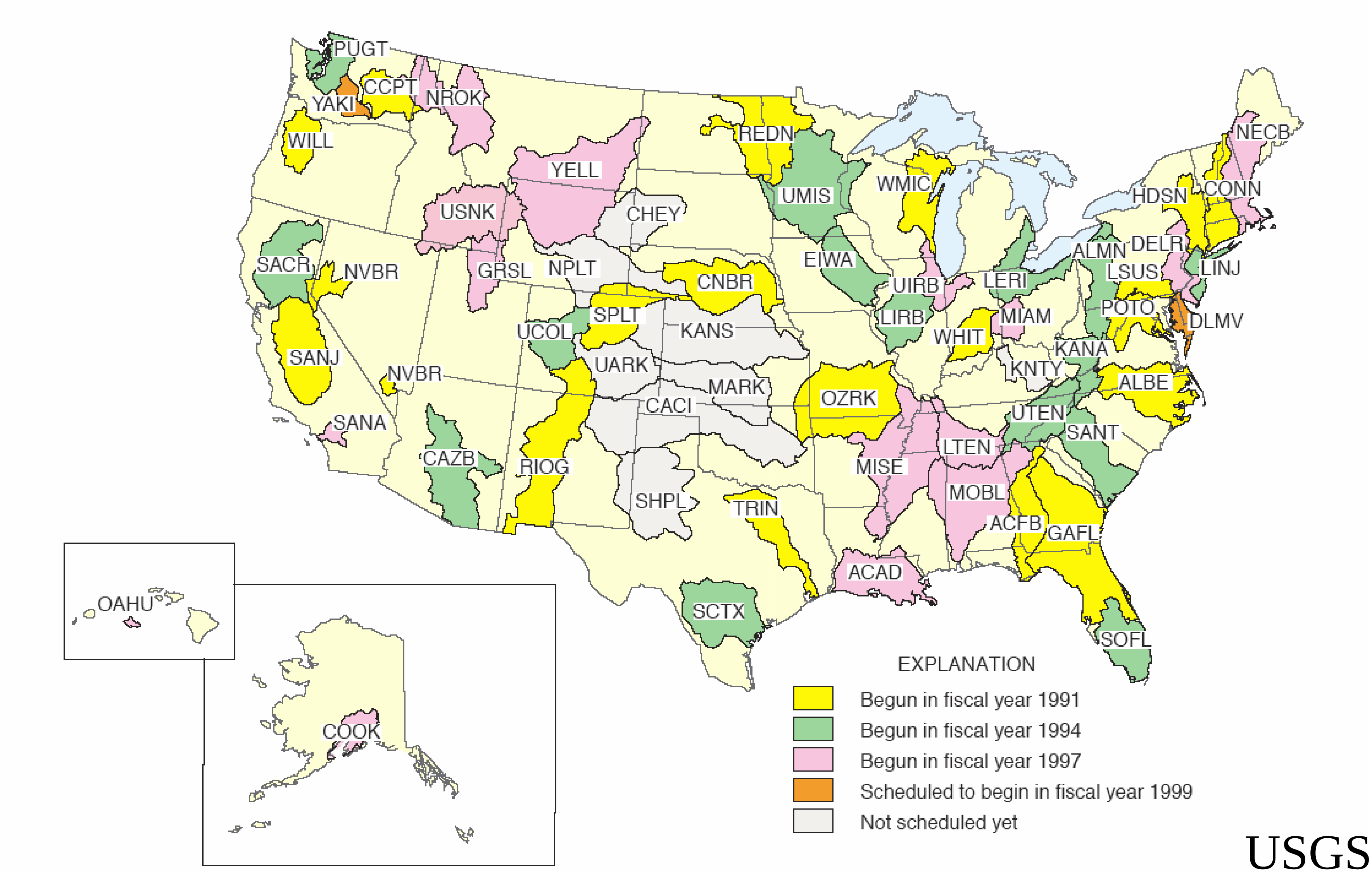
Atrazine
Cyanazine
Prometon
Simazine
Acetochlor
Alachlor
Metolachlor



Fertilizers

Ammonia
Ammonium Nitrate
Ammonium Phosphate (N)
Ammonium Phosphat (P2O5)
Ammonium Sulphate
Ammonium Sulphat Nitrate
Basic Slag
Calcium Ammonium Nitrate
Calcium Cyanamide
Calcium Nitrate
Complex Fertilizer (K2O)
Concent Superphosphate
CRUDE FERTILIZERS -271+
CRUDE FERTILIZERS -271>
Phosphate Fertilizers
Phosphoric Acid
Potash Fertilizers
Potassium Sulphate
Single Superphosphate
Sodium Nitrate

National Water Quality Assessment Study



USGS

Clean Water Act

Originally enacted under the administration of Gerald Ford in 1977 and amended under the administration of George W. Bush in 2002

Activities Exempt under the Clean Water Act, Section 404(f):

- Established (ongoing) farming, ranching, and forestry activities
- Plowing
- Seeding
- Cultivating
- Harvesting food, fiber, and forest products
- Minor drainage
- Upland soil and water conservation practices
- Maintenance (but not construction) of drainage ditches
- Construction and maintenance of irrigation ditches
- Construction and maintenance of farm or stock ponds
- Construction and maintenance of farm and forest roads, in accordance with best management practices
- Maintenance of structures, such as dams, dikes, and levees

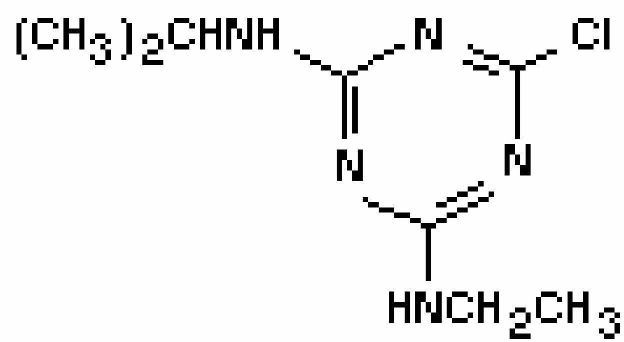
See: http://www.epa.gov/region5/water/cwa.htm

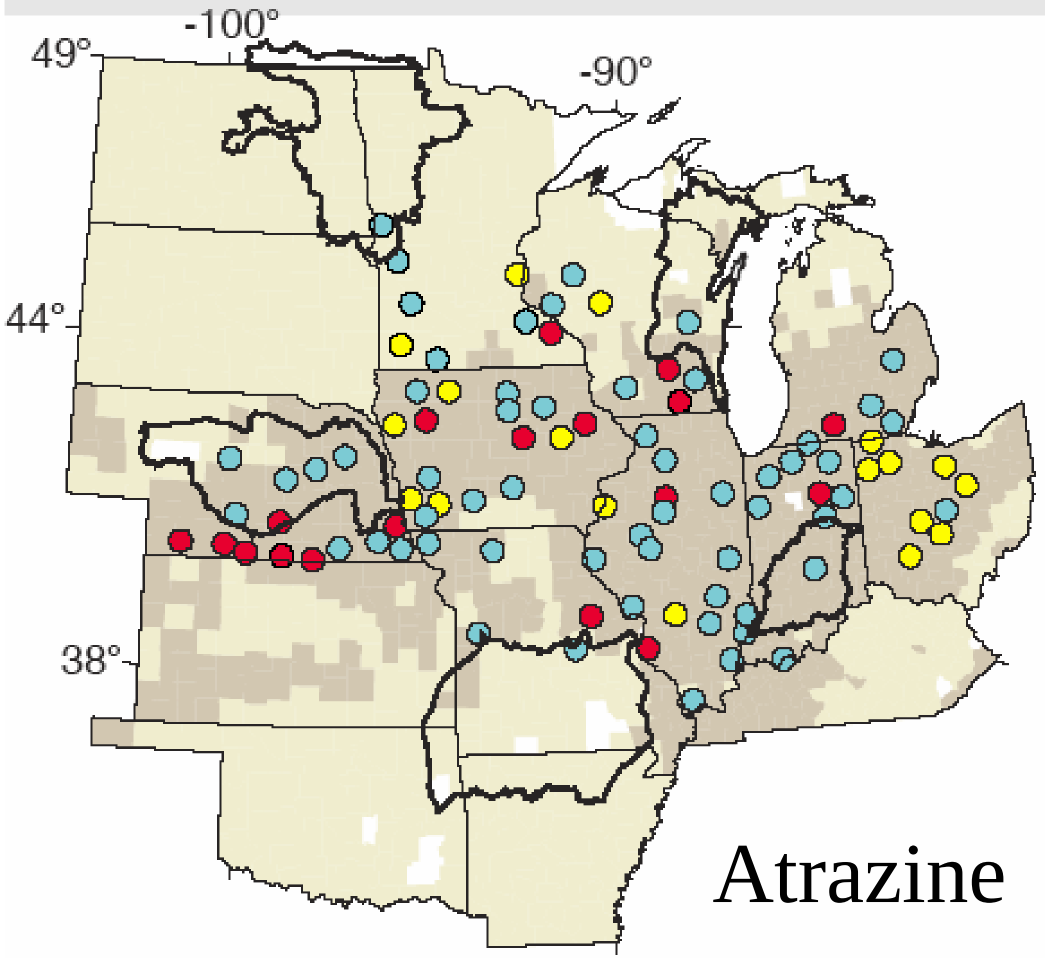
Herbicide:

Atrazine Usage: 2001

Atrazine Application on Corn Crops by State, 2001

State	Pounds of Atrazine
CO, GA, KY, NC, ND, NY, PA, SD, TX, WI	Between 166,000 and 1,915,000
MI, MO, MN	Between 1,915,000 and 3,664,000
KS, OH	Between 3,664,000 and 5,413,000
NE	Between 5,413,000 and 7,162,000
IA, IN	Between 7,162,000 and 8,911,000
IL	Between 12,409,000 and 14,158,000
No data or very little data: AL, AR, AZ, CA, CT, DC, DE,FL, ID, LA, MA, MD, ME, MS, MT, NH, NJ, NM, NV, OK, OR, RI, SC, TN, VA, VT, WA, WV, WY	





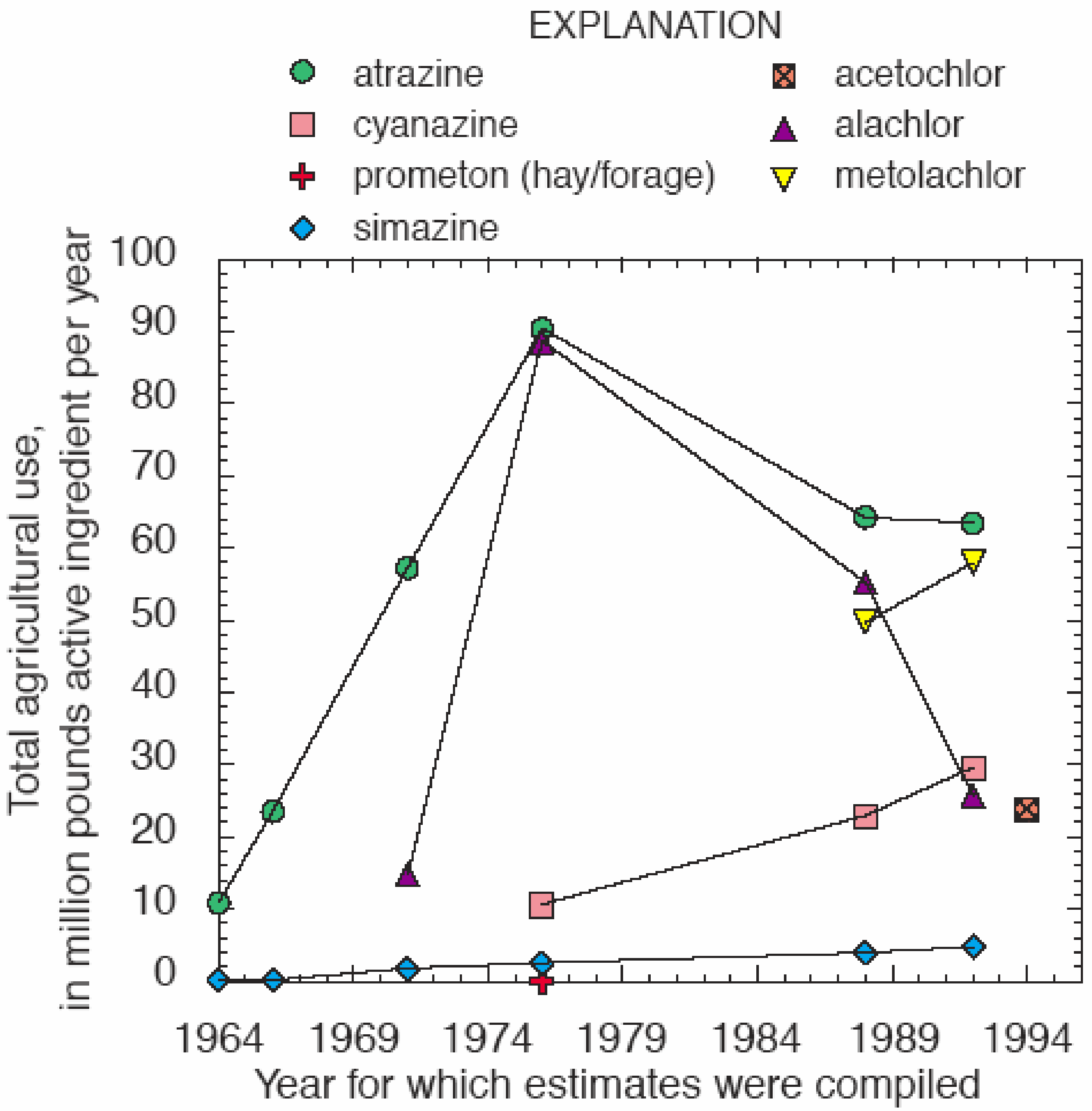
EXPLANATION

Concentration, in micrograms per liter

- Not detected
- 0.003 - 0.030
- 0.035 - 0.84

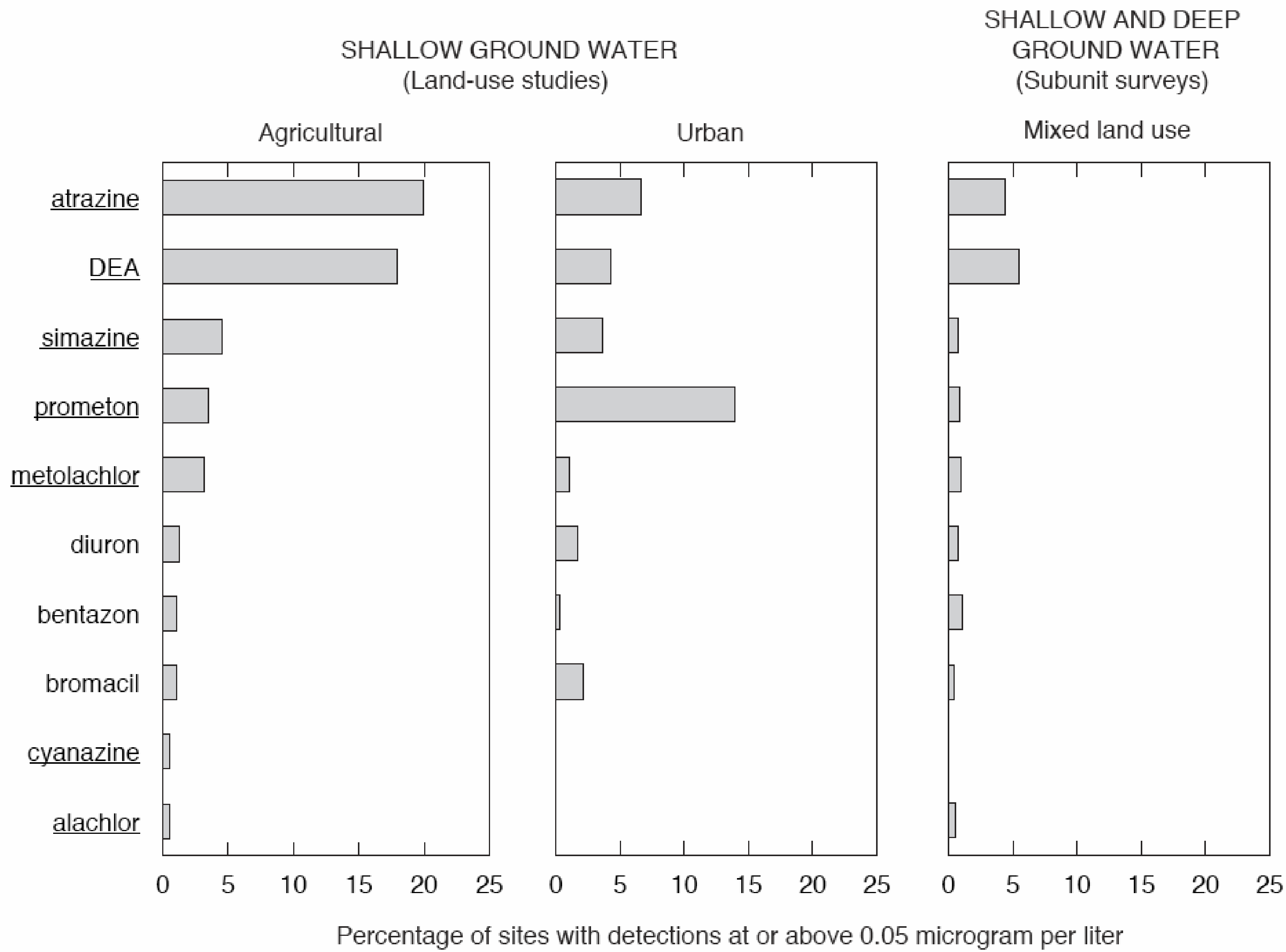
Use, in pounds active ingredient applied annually per acre of harvested cropland and pasture in county

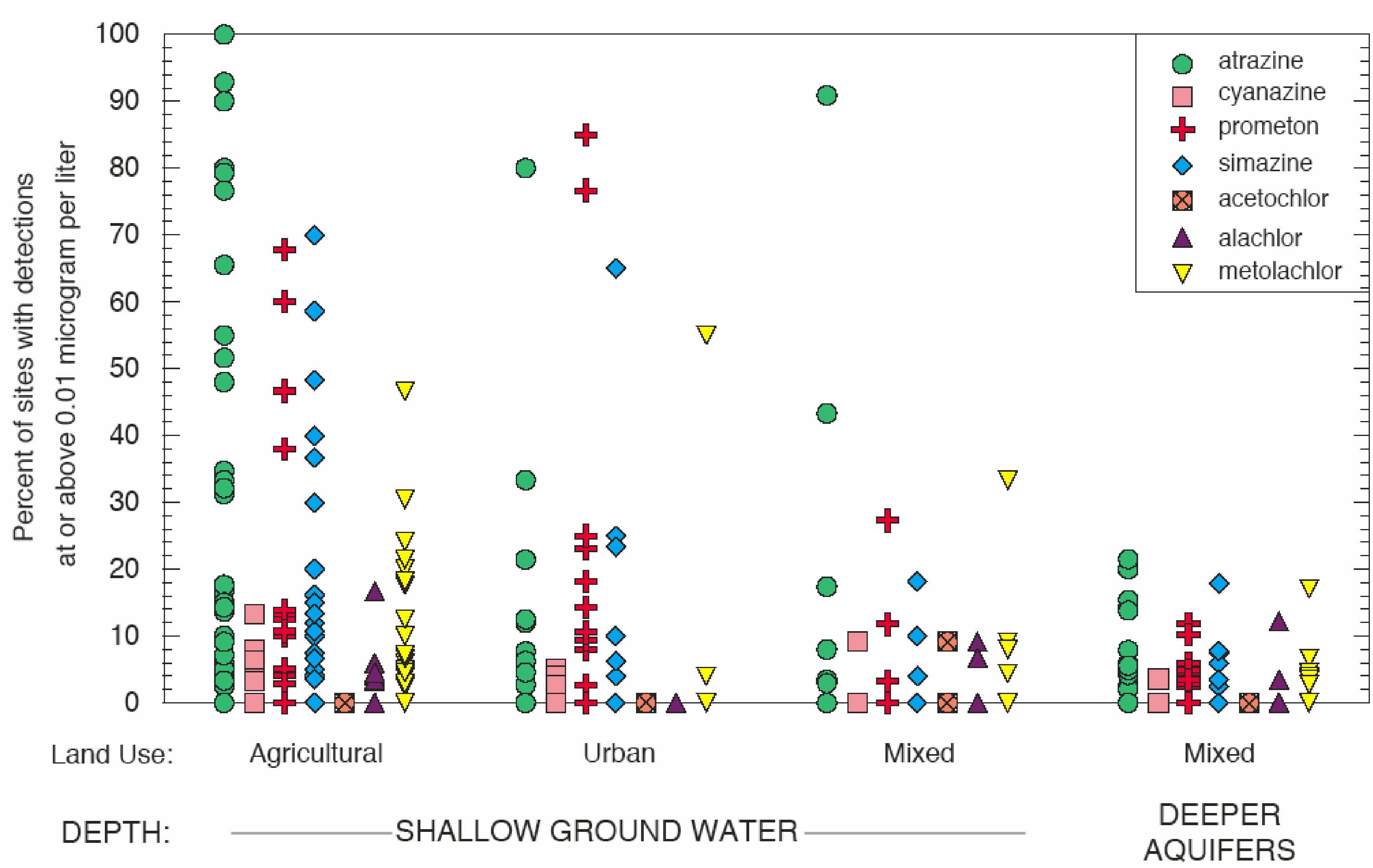
- No estimated use
- < 0.16
- ≥ 0.16
- NAWQA study-unit boundary

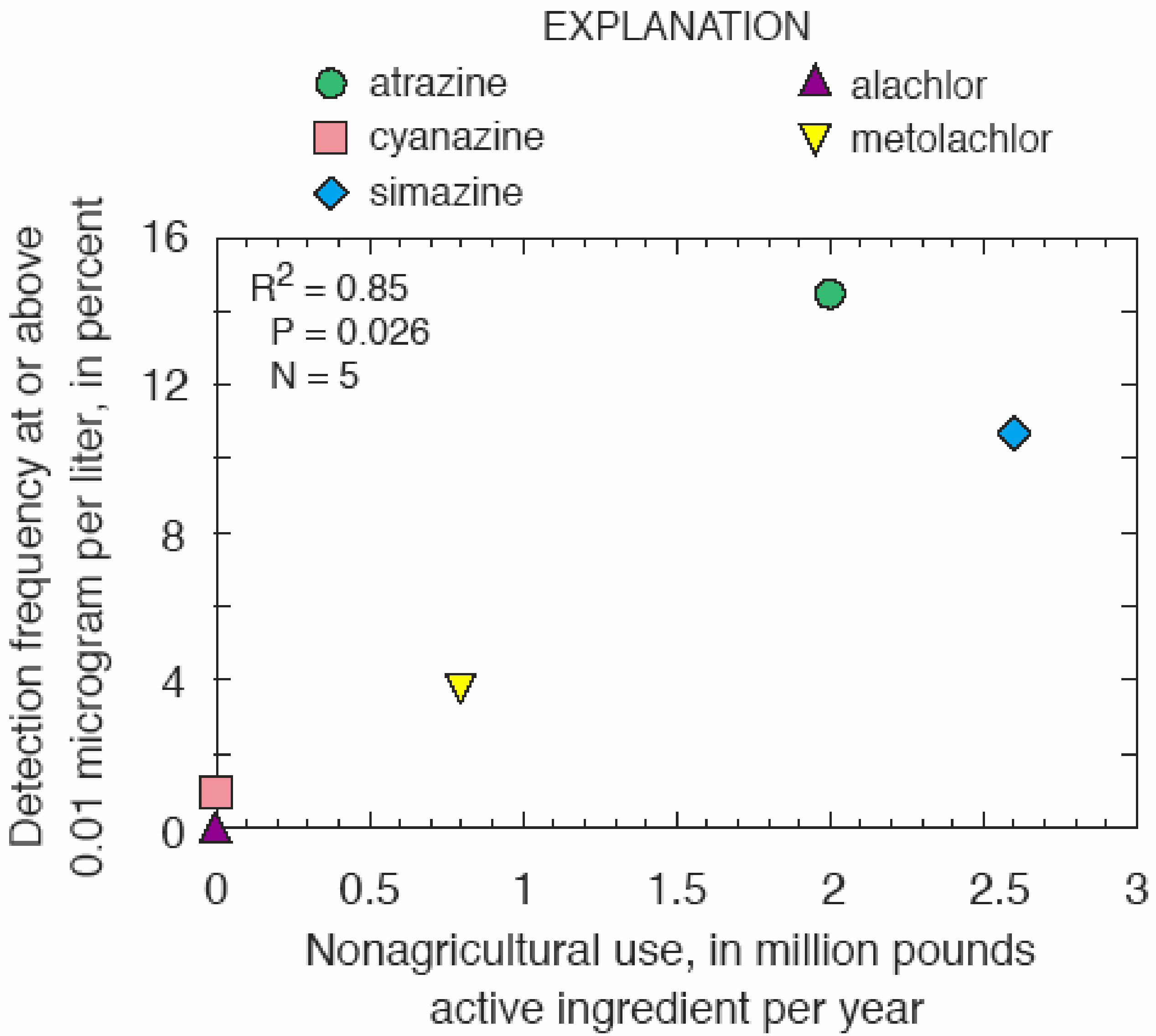

EXPLANATION
atrazine
cyanazine
prometon (hay/forage)
simazine
acetochlor
alachlor
metolachlor
Total agricultural use, in million pounds active ingredient per year
100
90
80
70
60
50
40
30
20
10
0
1964
1969
1974
1979
1984
1989
1994
Year for which estimates were compiled

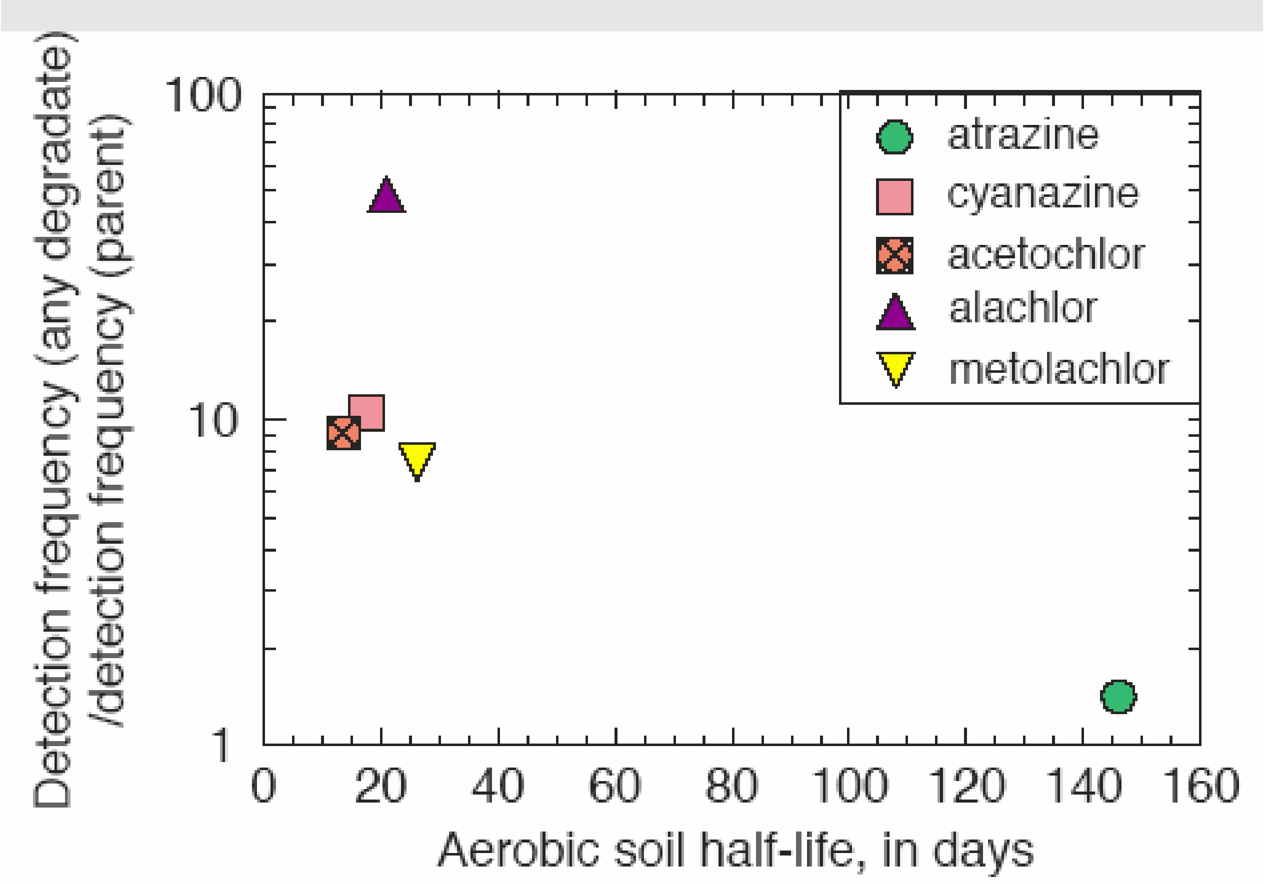
Average Annual Use Of Herbicides 1991-1995

Parameter	Atrazine	Cyanazine	Prometon	Simazine	Acetochlor	Alachlor	Metolachlor
Agricultural use (principal crops)							
	Field crops, pasture	Field crops	Rangeland, hay, forage	Field crops, orchards, vegetables	Field crops	Field crops	Field crops, vegetables
Millions of pounds a.i. applied per year	63.9	29.5	—	4.8	23.8	25.6	57.9
Millions of acres treated per year	57.0	15.8	—	3.4	11.8	14.5	31.3
Pounds a.i. applied per treated acre per year	1.1	1.9	—	1.4	2.0	1.8	1.9
Nonagricultural use (principal settings)							
	Turf, sod farms, roads, forests, plantations, rights-of-way	None	Asphalt, rights-of-way, fence rows	Rights-of-way, lawns, forests, plantations, sod farms, ponds and aquaria	—	None	Turf, hedgerows, fencerows, landscaping
Millions of pounds a.i. applied per year	1.6–2.4	0	—	1.9–3.3	—	0	0.8
Millions of acres treated per year	—	—	—	—	—	—	—

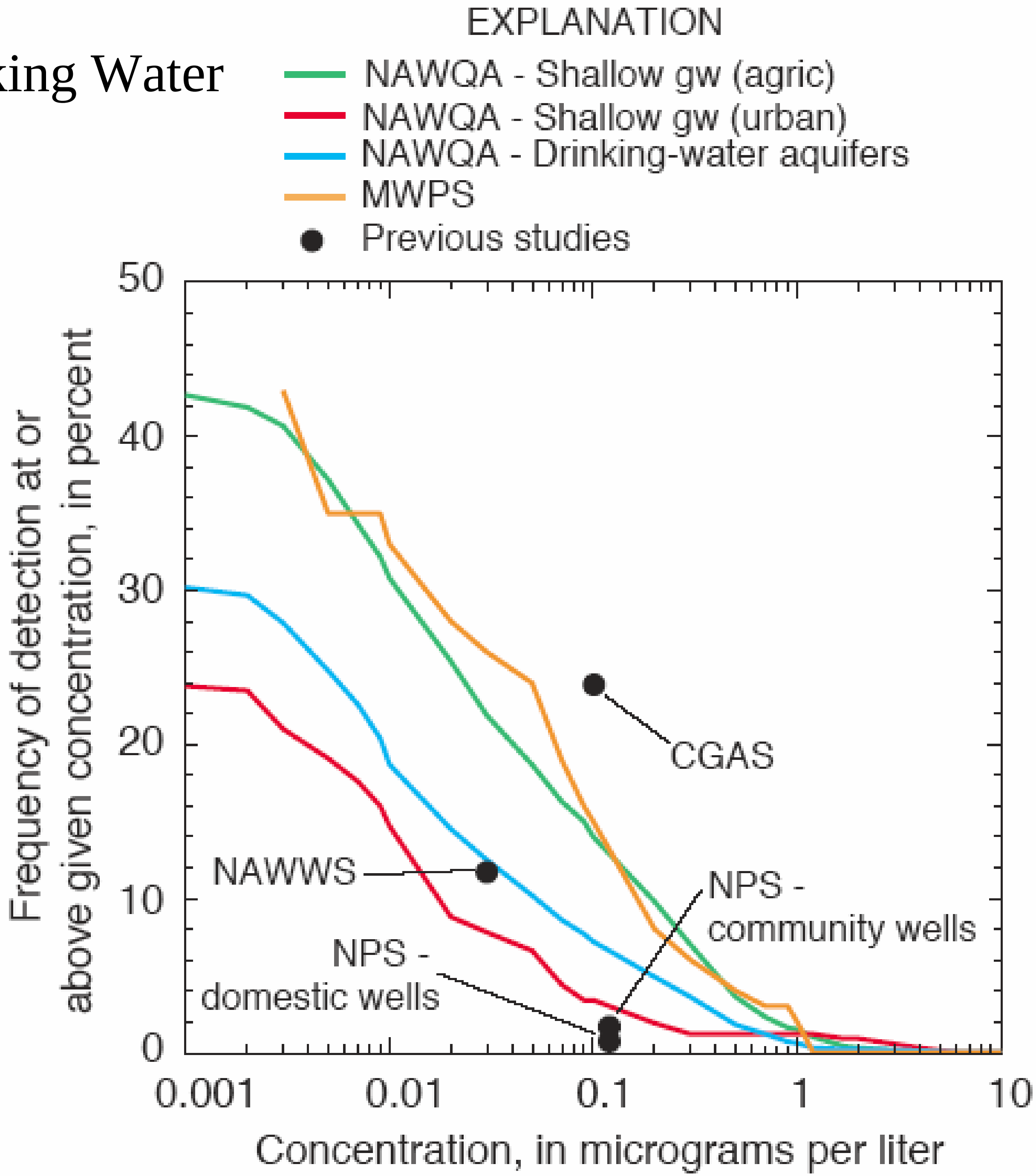

SHALLOW GROUND WATER
(Land-use studies)
SHALLOW AND DEEP
GROUND WATER
(Subunit surveys)
Agricultural
Urban
Mixed land use
atrazine
DEA
simazine
prometon
metolachlor
diuron
bentazon
bromacil
cyanazine
alachlor
0
5
10
15
20
25
Percentage of sites with detections at or above 0.05 microgram per liter


Percent of sites with detections at or above 0.01 microgram per liter
100
90
80
70
60
50
40
30
20
10
0
atrazine
cyanazine
prometon
simazine
acetochlor
alachlor
metolachlor
Land Use:
Agricultural
Urban
Mixed
Mixed
DEPTH:
SHALLOW GROUND WATER
DEEPER AQUIFERS


EXPLANATION
atrazine
cyanazine
simazine
alachlor
metolachlor
$R^2 = 0.85$
$P = 0.026$
$N = 5$
Detection frequency at or above 0.01 microgram per liter, in percent
0
4
8
12
16
0
0.5
1
1.5
2
2.5
3
Nonagricultural use, in million pounds active ingredient per year


Detection frequency (any degradate) /detection frequency (parent)
100
10
1
0
20
40
60
80
100
120
140
160
Aerobic soil half-life, in days
atrazine
cyanazine
acetochlor
alachlor
metolachlor

Atrazine in Drinking Water



Syngenta's Workers Sue

A number of workers at the St. Gabriel facility have sued Syngenta, alleging that working in an atrazine-laced environment caused them to develop prostate cancer. Their claims are remarkable. One worker says that he "worked 'eyeball' deep in the powder [atrazine]" and recalls instances of employees "eating meals . . . in areas covered with atrazine dust." Another worker recalls his supervisors telling him that "atrazine could be eaten without any adverse health effects."

http://www.nrdc.org/health/pesticides/natrazine.asp

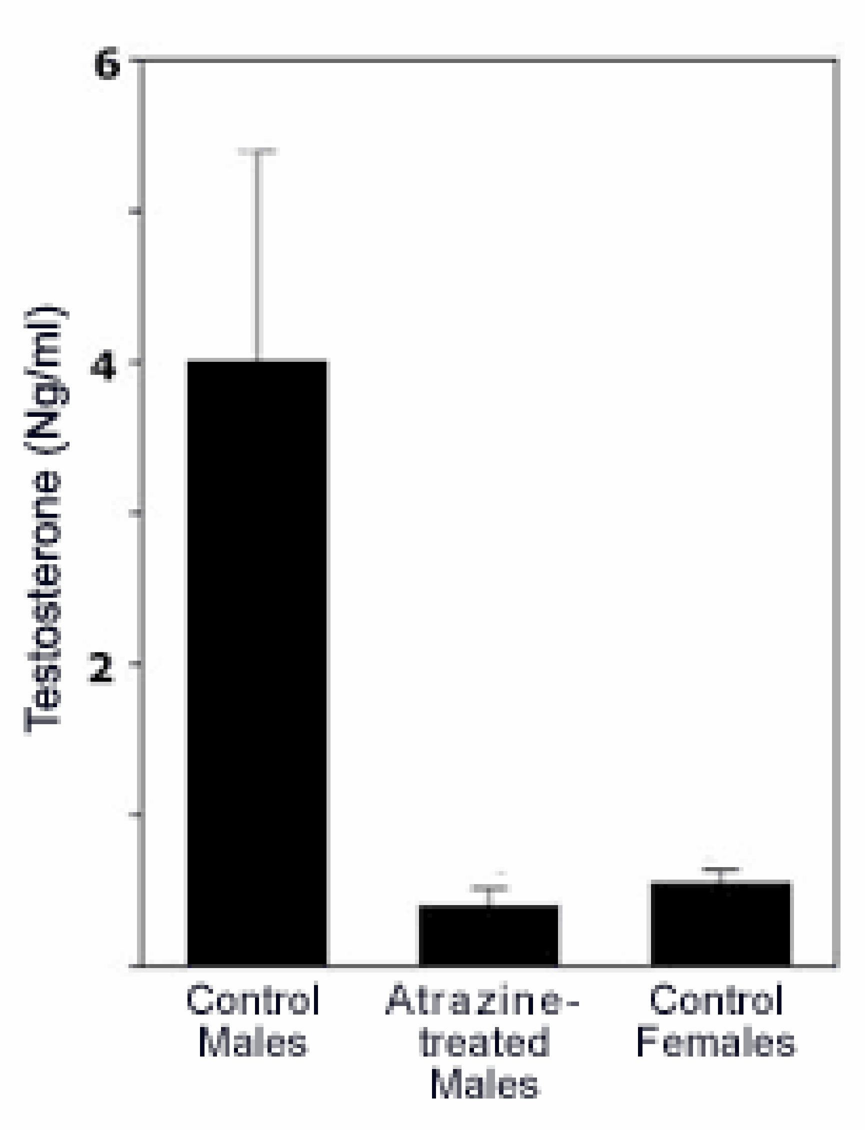
Arch. Environ. Contam. Toxicol. 33, 261-267 (1997)

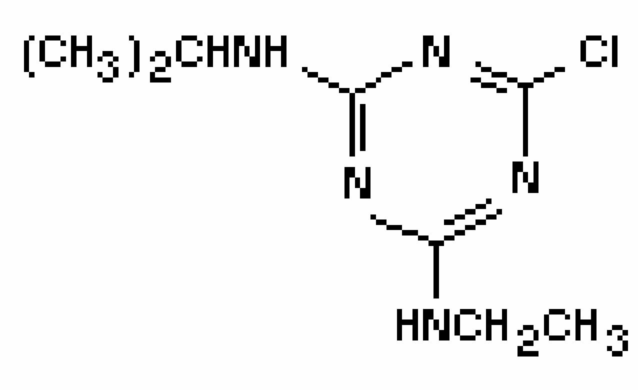
ARCHIVES OF
Environmental
Contamination
and Toxicology

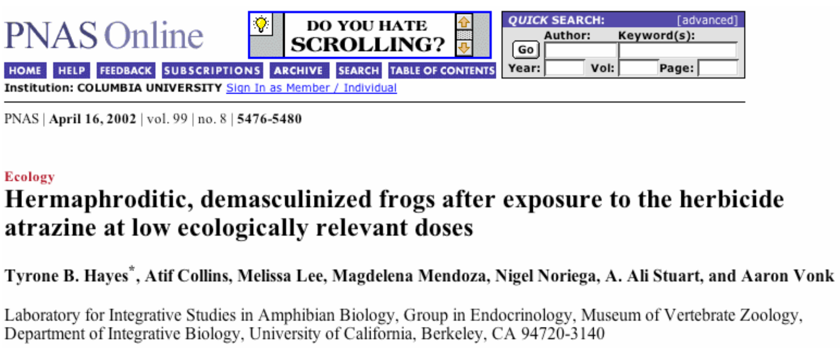
Chronic Toxicity of Atrazine to Sago Pondweed at a Range of Salinities: Implications for Criteria Development and Ecological Risk

L. W. Hall, Jr.,[1] R. D. Anderson,[1] M. S. Ailstock[2]

Effects of Atrazine* on Frog Development







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PNAS | **April 16, 2002** | vol. 99 | no. 8 | **5476-5480**

Ecology

Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses

Tyrone B. Hayes*, Atif Collins, Melissa Lee, Magdelena Mendoza, Nigel Noriega, A. Ali Stuart, and Aaron Vonk

Laboratory for Integrative Studies in Amphibian Biology, Group in Endocrinology, Museum of Vertebrate Zoology, Department of Integrative Biology, University of California, Berkeley, CA 94720-3140

*endocrine disrupter

NRDC
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NATURAL RESOURCES DEFENSE COUNCIL

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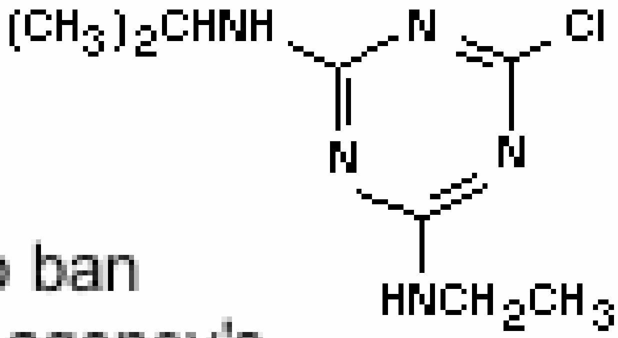
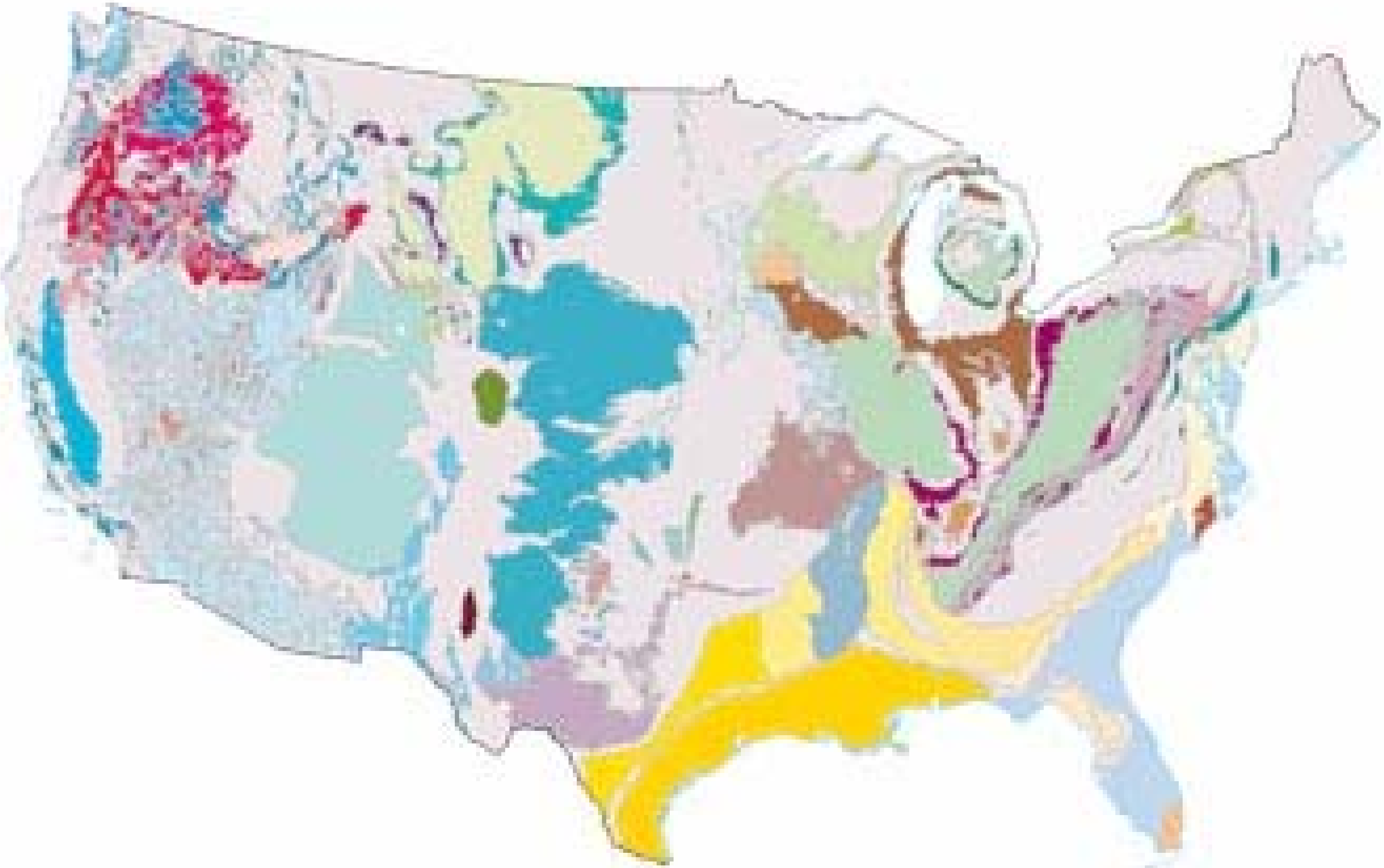
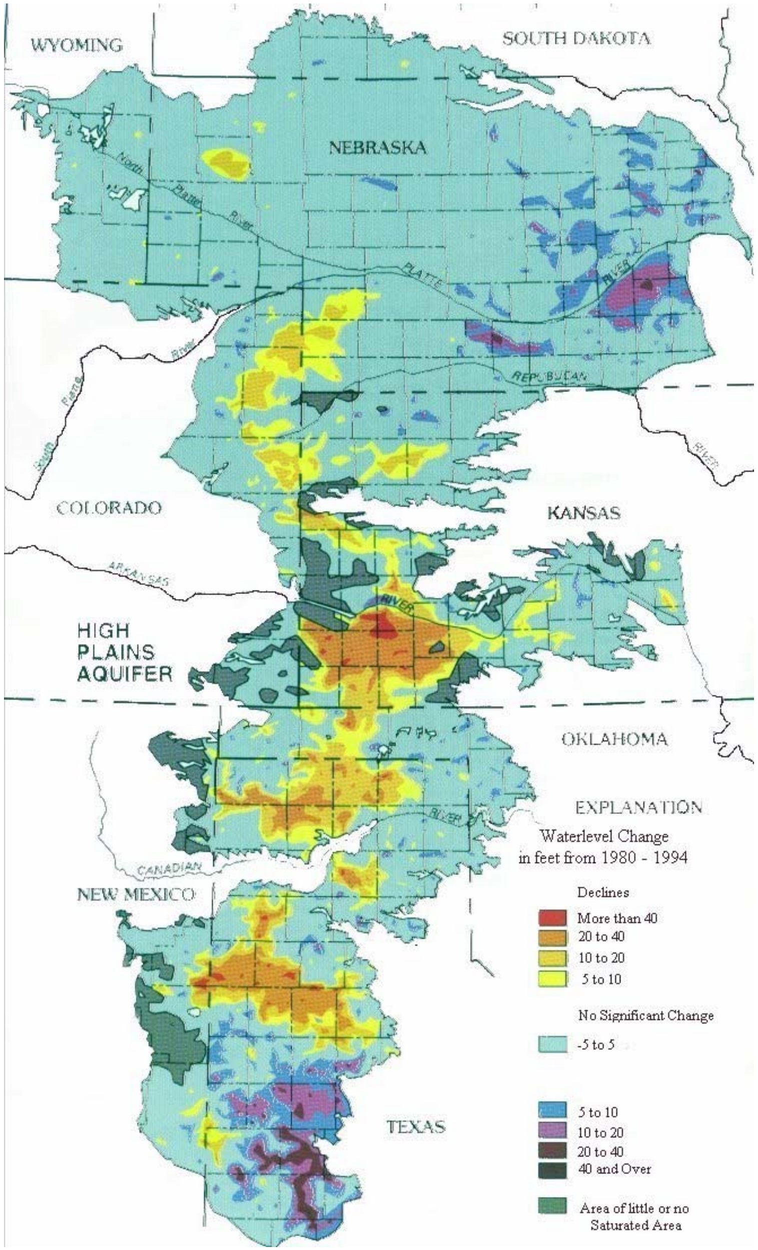


Time to Take Action

NRDC is calling on the EPA to ban atrazine from the market. The agency's current atrazine assessment is significantly flawed, understating risks from exposure. And the deal the agency appears to have cut with Syngenta will make matters worse, not better.

Drawdown

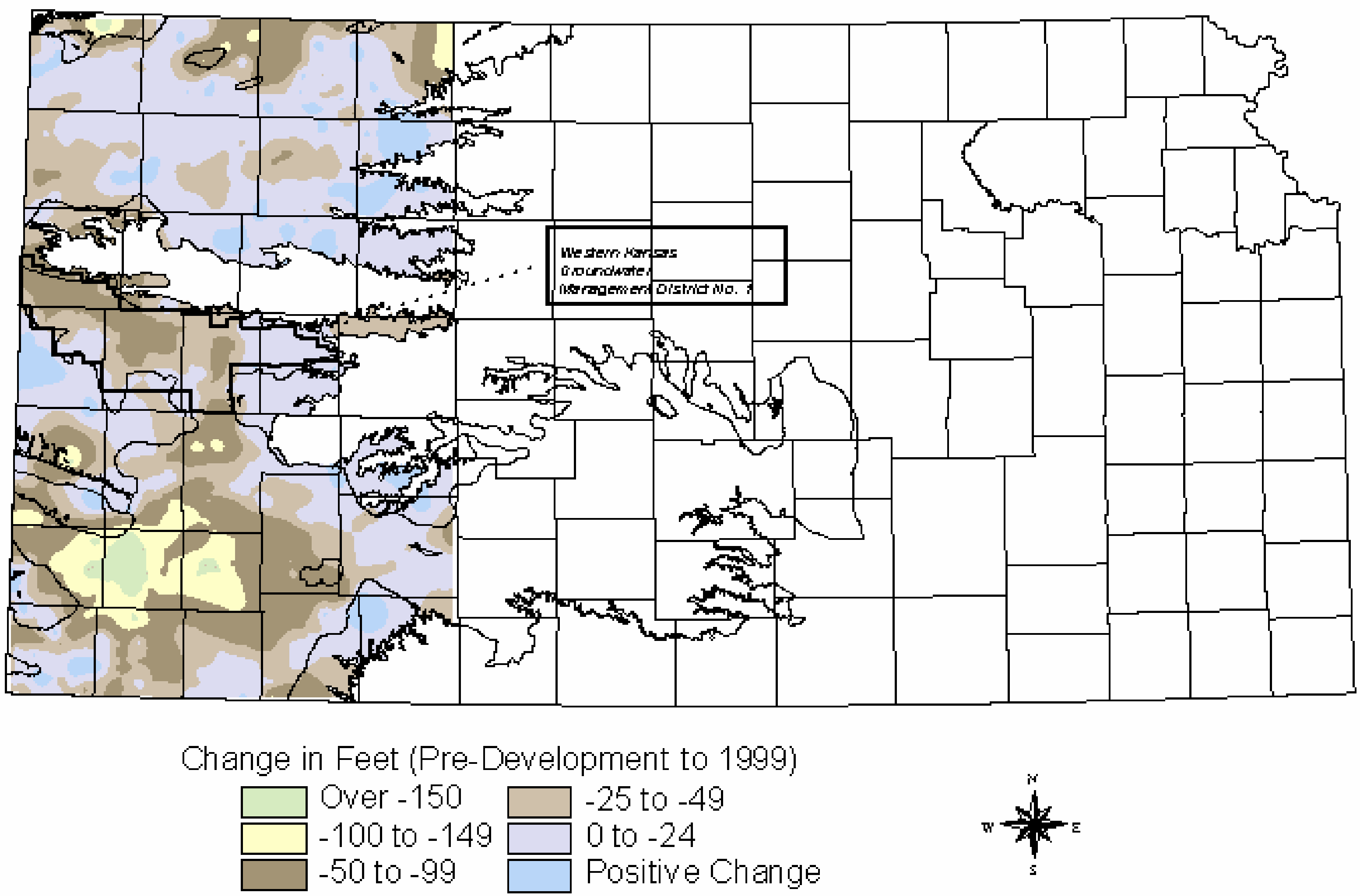


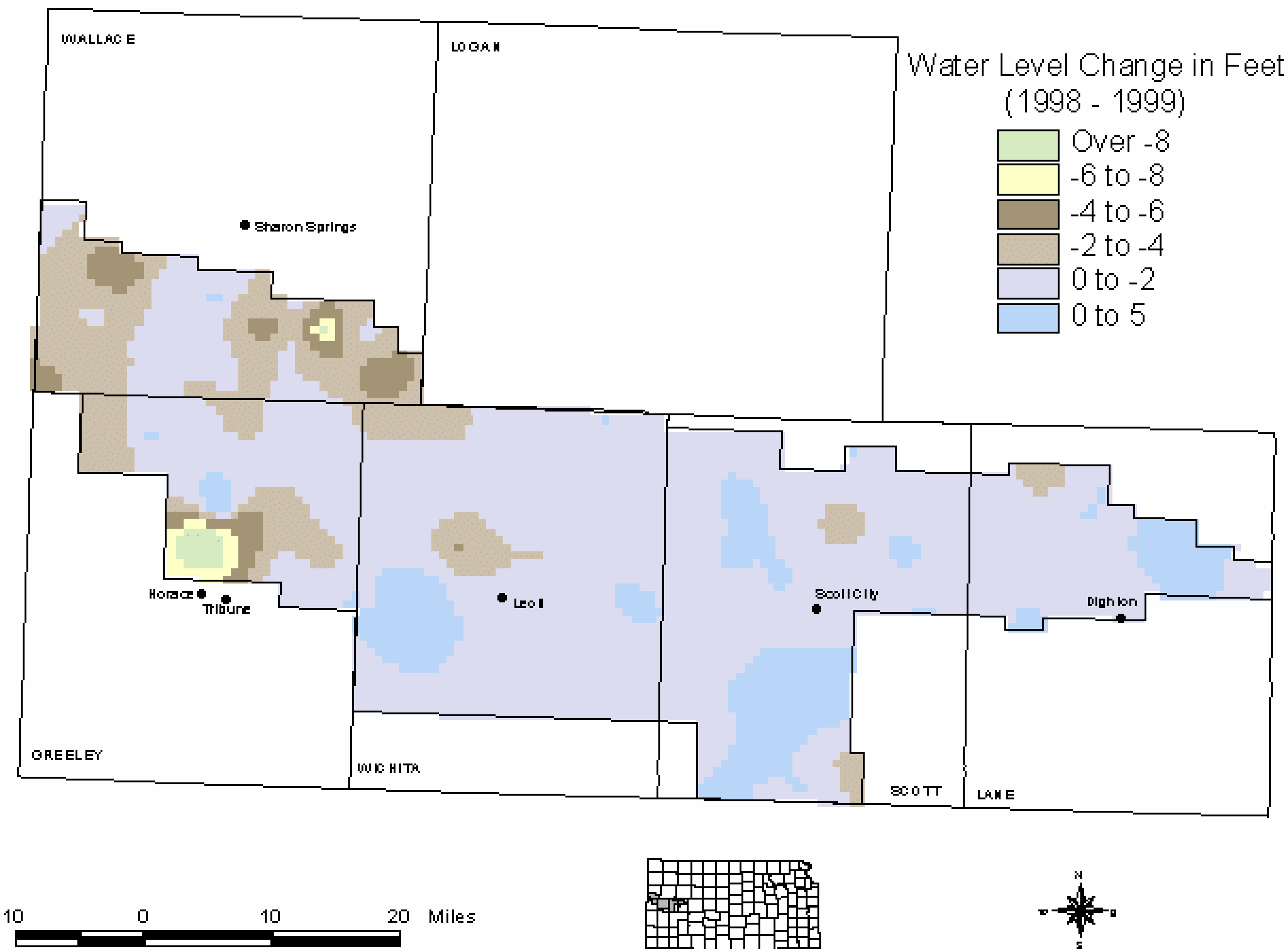


Depleting the
The Ogallala Aquifer:

Cause - Wheat farming

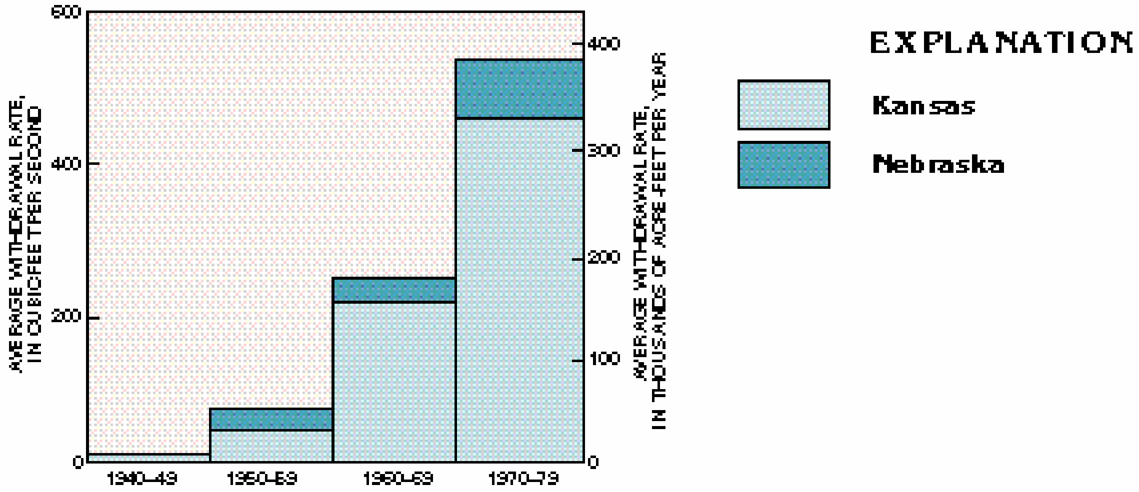
Effect - plumes of pollution migrate to sites of drawdown


Western Kansas
Groundwater
Management District No. 1
Change in Feet (Pre-Development to 1999)
Over -150
-100 to -149
-50 to -99
-25 to -49
0 to -24
Positive Change
N
W
E
S



Water Level Change in Feet
(1998 - 1999)
Over -8
-6 to -8
-4 to -6
-2 to -4
0 to -2
0 to 5
WALLACE
LOGAN
GREELEY
WICHITA
SCOTT
LANE
Sharon Springs
Horace
Tribune
Leoti
Scott City
Dighton
10 0 10 20 Miles

Drawdown of the Ogallala Aquifer



Modified from Helgesen, J.O., Leonard, R.B., and Wolf, R.J., 1993, Hydrology of the Great Plains aquifer system in Nebraska, Colorado, Kansas, and adjacent areas: U.S. Geological Survey Professional Paper 1414–E, 80 p.

Figure 86. Rates of withdrawal of freshwater from the aquifer system in Kansas and Nebraska increased greatly during the 1960's and the 1970's. Withdrawals in Kansas were much greater than those in Nebraska during these two decades.

Dwindling water supplies shape future of farming in western Kansas

October 2001

U.S. Water News Online

SHARON SPRINGS, Kan. -- At age 12, Bill Mai was old enough to help move irrigation pipe at the family farm near Sharon Springs. That was back in 1948, when his father took out the first water right in southeast Wallace County.

They drilled down nearly 105 feet to tap into the Ogallala Aquifer, the bottom of which reached 220 feet below the Kansas prairie.

Now 65, Mai owns that old water right. But the water table has dropped to 175 feet at the family homestead.

Last year alone, water levels fell another 2 to 3 feet -- even though Mai stopped irrigating two years ago and went to dryland crops and no-till farming. His neighbors still irrigate their fields.

``We shut down our wells because of the fact we know we can't keep pumping and have water left over for drinking, eventually," he said. ``We have done this in my lifetime."

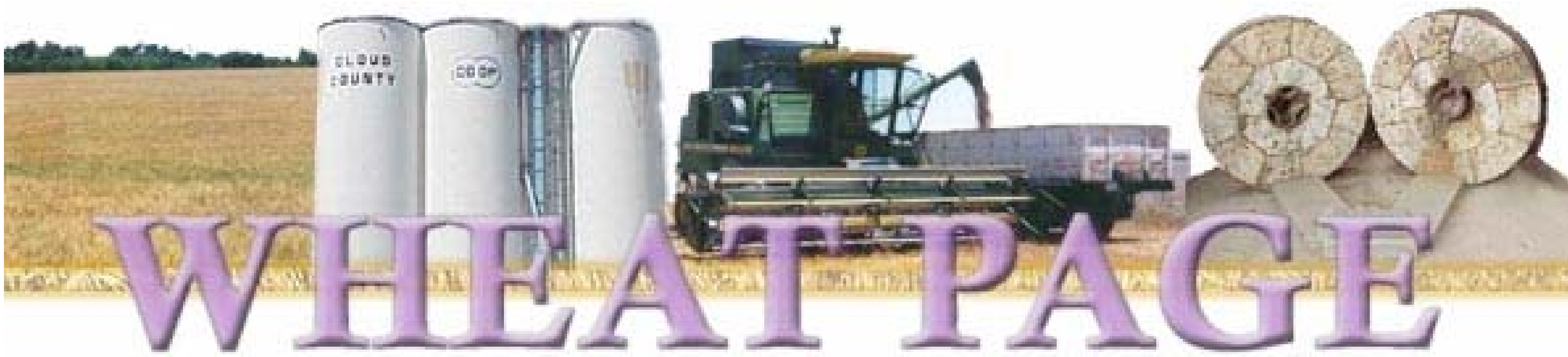
Crop Progress Reports

"Adopt a Wheat Field"

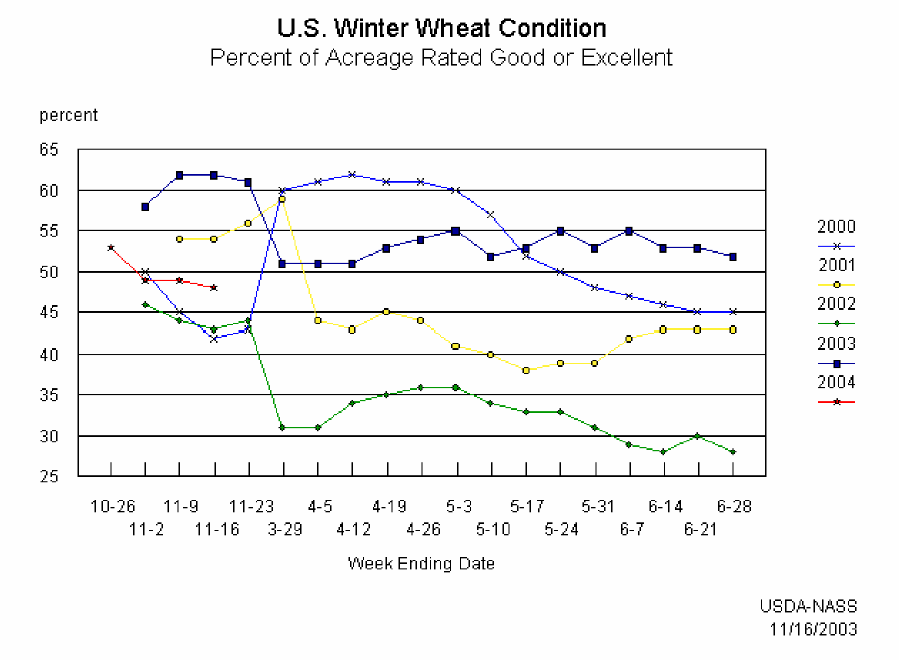
By Extension Crops Specialist Jim Shroyer

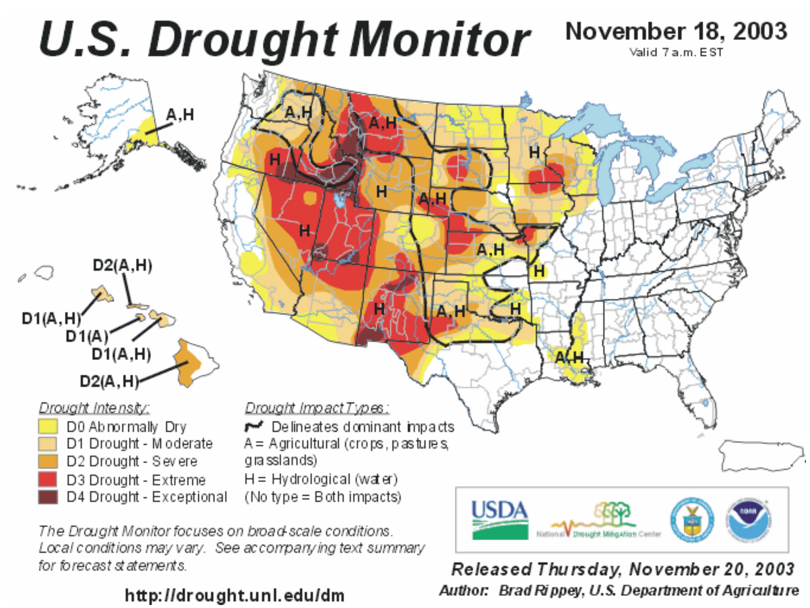
The Crop Progress Reports from Kansas Agricultural Statistics Will Only Be Issued Monthly During the Winter

Topsoil Moisture Still 55 percent Short to Very Short
Monday, February 2, 2004



Kansas Wheat Production





WheatOnline.com

The Home Page of the
Kansas Association of Wheat Growers

From The Western Kansas Wheat Field

By Vance Ehmke
A Wheat Producer Farming Near Healy, Kansas
And a KAWG Past President

Snow is Good News

February 5, 2004

It has been some time since I've written because I have gotten very tired of writing only bad news. So I vowed I wouldn't write again until we had some good news to report. Finally, we have some good news.

Over the past four to five days, we have gotten two snowstorms with 3 and 5 inches of snow. Hopefully this will keep us alive and in the game a little longer.

Read More About It

References:

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Other Sources of Ground-water Information

Scientific Organizations and Agencies

- US Environmental Protection Agency (EPA) || Office of Water
- American Geophysical Union (AGU)
- American Water Resources Association (AWRA)
- American Water Works Association(AWWA)
- Association of American State Geologists
- Geological Society of America (GSA)
- National Ground Water Association (NGWA)
- Other USGS links and other science organizations and agencies
- The Groundwater Foundation
- Conservation Technology Information Center (CTIC) || Know Your Watershed

http://water.usgs.gov/ogw/other.html

Appendix

Irrigation water use per country in the year 2000

	Total renewable water resources (cubic km)	*Irrigation water requirements (cubic km)*	*Water use efficiency in percentages*	*Water withdrawal for agriculture (cubic km)*	*Water withdrawal as percentage of renewable water resources*
Afghanistan	65	8.78	38%	22.84	35%
Algeria	14.32	1.45	37%	3.94	27%
Angola	184	0.04	20%	0.21	0%
Argentina	814	3.43	16%	21.52	3%
Bangladesh	1210.644	19.09	25%	76.35	6%
Benin	24.8	0.06	30%	0.19	1%
Bolivia	622.531	0.26	23%	1.16	0%
Botswana	14.4	0.02	30%	0.06	0%
Brazil	8233	6.21	17%	36.63	0%
Burkina Faso	12.5	0.21	30%	0.69	5%
Burundi	3.6	0.06	30%	0.19	5%
Cambodia	476.11	1.20	30%	4.00	1%
Cameroon	285.5	0.22	30%	0.73	0%
Chad	43	0.07	35%	0.19	0%
Chile	922	1.59	20%	7.97	1%
China	2829.569	153.90	36%	426.85	15%
Colombia	2132	1.23	25%	4.92	0%
Congo, Republic of	832	0.00	30%	0.00	0%
Congo, Dem Republic of	1283	0.03	30%	0.11	0%
Costa Rica	112.4	0.36	25%	1.43	1%
Côte d'Ivoire	81	0.17	28%	0.60	1%
Cuba	38.12	1.41	25%	5.64	15%
Dominican Republic	20.995	0.56	25%	2.24	11%

	Total renewable water resources (cubic km)	Irrigation water requirements (cubic km)	Water use efficiency in percentages	Water withdrawal for agriculture (cubic km)	Water withdrawal as percentage of renewable water resources
Ecuador	432	2.67	19%	13.96	3%
Egypt	58.3	28.43	53%	53.85	92%
El Salvador	25.23	0.19	25%	0.76	3%
Eritrea	6.3	0.09	32%	0.29	5%
Ethiopia	110	0.56	22%	2.47	2%
Gabon	164	0.02	30%	0.05	0%
Gambia	8	0.01	30%	0.02	0%
Ghana	53.2	0.06	26%	0.25	0%
Guatemala	111.27	0.40	25%	1.61	1%
Guinea	226	0.41	30%	1.36	1%
Guyana	241	0.45	28%	1.60	1%
Haiti	14.025	0.18	20%	0.93	7%
Honduras	95.929	0.17	25%	0.69	1%
India	1896.66	303.24	54%	558.39	29%
Indonesia	2838	21.49	28%	75.60	3%
Iran, Islamic Rep of	137.51	21.06	32%	66.23	48%
Iraq	75.42	11.20	28%	39.38	52%
Jamaica	9.404	0.01	25%	0.02	0%
Jordan	0.88	0.29	39%	0.76	86%
Kenya	30.2	0.30	30%	1.01	3%
Korea, Dem People's Rep	77.135	1.49	30%	4.96	6%
Korea, Republic of	69.7	2.67	30%	8.92	13%
Laos	333.55	0.81	30%	2.70	1%
Lebanon	4.407	0.37	40%	0.92	21%
Libyan Arab Jamahiriya	0.6	2.56	60%	4.27	712%

	Total renewable water resources (cubic km)	Irrigation water requirements (cubic km)	Water use efficiency in percentages	Water withdrawal for agriculture (cubic km)	Water withdrawal as percentage of renewable water resources
Madagascar	337	3.58	25%	14.31	4%
Malawi	17.28	0.20	25%	0.81	5%
Malaysia	580	1.68	30%	5.60	1%
Mali	100	2.06	30%	6.87	7%
Mauritania	11.4	0.44	29%	1.50	13%
Mexico	457.222	18.53	31%	60.34	13%
Morocco	29	4.28	37%	11.48	40%
Mozambique	216.11	0.22	39%	0.55	0%
Myanmar	1045.601	9.79	30%	32.64	3%
Namibia	17.94	0.07	40%	0.17	1%
Nepal	210.2	2.45	25%	9.82	5%
Nicaragua	196.69	0.30	27%	1.08	1%
Niger	33.65	0.62	30%	2.08	6%
Nigeria	286.2	1.65	30%	5.51	2%
Pakistan	222.67	72.14	44%	162.65	73%
Panama	147.98	0.05	20%	0.23	0%
Paraguay	336	0.08	23%	0.35	0%
Peru	1913	5.07	31%	16.42	1%
Philippines	479	6.33	30%	21.10	4%
Rwanda	5.2	0.01	30%	0.03	1%

	Total renewable water resources (cubic km)	Irrigation water requirements (cubic km)	Water use efficiency in percentages	Water withdrawal for agriculture (cubic km)	Water withdrawal as percentage of renewable water resources
Saudi Arabia	2.4	6.68	43%	15.42	643%
Senegal	39.4	0.43	30%	1.43	4%
Sierra Leone	160	0.12	33%	0.35	0%
Somalia	13.5	0.98	30%	3.28	24%
South Africa	50	2.34	21%	11.12	22%
Sri Lanka	50	2.92	24%	12.00	24%
Sudan	64.5	14.43	40%	36.07	56%
Suriname	122	0.18	30%	0.62	1%
Swaziland	4.51	0.12	16%	0.76	17%
Syrian Arab Republic	26.26	8.52	45%	18.93	72%
Tanzania, United Rep of	91	0.56	30%	1.85	2%
Thailand	409.944	24.83	30%	82.75	20%
Togo	14.7	0.02	30%	0.08	1%
Tunisia	4.56	1.21	54%	2.23	49%
Turkey	229.3	11.27	40%	27.86	12%
Uganda	66	0.03	30%	0.12	0%
Uruguay	139	0.66	22%	3.03	2%
Venezuela, Boliv Rep of	1233.17	1.24	31%	3.97	0%
Viet Nam	891.21	15.18	31%	48.62	5%
Yemen	4.1	2.53	40%	6.32	154%
Zambia	105.2	0.26	19%	1.32	1%
Zimbabwe	20	0.67	30%	2.24	11%