Water Part II
The Aquifer
Hydrological Cycle

Water vapour into the atmosphere

Precipitation
9,000 km³

Evaporation
9,000 km³

Precipitation onto land surface
110,000 km³

Evaporation from land
65,200 km³

Glaciers

Precipitation on surface ocean
458,000 km³

Evaporation from ocean
502,800 km³

Underground runoff
2200 km³

River runoff
42,600 km³

Juvenile water inflow

Water expenses for hydration

Area of closed regions runoff
30,000 km³

Area of exorheic runoff
119,000 km³

Ocean area
361,000 km³

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).

Aquifers of the United States
Geology

Aquifers
Ground Water Use in the United States

- 25% of all water used
- Supplies 50% of the population
- Supplies 95% of the drinking water needs of rural populations
- 75% of public water systems rely on ground water

http://maven.gtri.gatech.edu/ward/slide12.html
Ground Water Use in the United States

- Irrigation: 69%
- Industry: 14%
- Drinking Water: 14%
- Other: 3%

Aquifer Abuses
Contamination and Depletion

Agricultural water withdrawals as a percentage of total renewable water resources (1998)

Source: FAO

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No data</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0-5</td>
</tr>
<tr>
<td>2</td>
<td>5-10</td>
</tr>
<tr>
<td>3</td>
<td>10-20</td>
</tr>
<tr>
<td>4</td>
<td>20-40</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 40</td>
</tr>
</tbody>
</table>

Map showing where withdrawals for agriculture are critically high (category 5) and indicative of water stress (category 4).
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

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

*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-Dichloroethane
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

Contaminant Entry Locations

Source Zone (contains residual NAPLs, NAPL pools, and/or metal precipitates)

Dissolved Plume Zone

Plume advances towards receptors (wells, streams, wetlands)

Ground Water Flow
Welcome to New Jersey: Home of the first EPA superfund site!
Geology of New Jersey
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 Provinces.

<table>
<thead>
<tr>
<th>Aquifer Rank</th>
<th>Median Yield of Wells (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt;500</td>
</tr>
<tr>
<td>B-A</td>
<td>&gt;250</td>
</tr>
<tr>
<td>B</td>
<td>251 to 500</td>
</tr>
<tr>
<td>C-B</td>
<td>101 to 500</td>
</tr>
<tr>
<td>C</td>
<td>101 to 250</td>
</tr>
<tr>
<td>D</td>
<td>25 to 100</td>
</tr>
<tr>
<td>E-D</td>
<td>&lt;100</td>
</tr>
<tr>
<td>E</td>
<td>&lt;25</td>
</tr>
</tbody>
</table>

**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.

*High-capacity wells are industrial wells that are cored and tested for maximum water yields that often greatly exceed domestic-well yields for the same aquifer.
USGS Groundwater Monitoring Program
Ground Water Usage
New Jersey Aquifer

EXPLANATION
Use of fresh ground-water withdrawals during 1985, in percent

- Public supply: 32 percent
- Domestic and commercial: 44 percent
- Agricultural: 5 percent
- Industrial, mining, and thermoelectric power: 19 percent

Total withdrawals
320 million gallons per day
Water Quality New Jersey Aquifer

Values in percent of median major ion concentration, in milliequivalents per liter

- Bicarbonate: 29.1 percent
- Chloride: 11.4 percent
- Sulfate: 8.5 percent
- Calcium: 26.6 percent
- Magnesium: 12.1 percent
- Sodium + Potassium: 11.1 percent
- Nitrate + Iron: 1.2 percent

Bicarbonate-type water constituents
EPA Superfund Sites of New Jersey

Map Key: ▲ Proposed: 3  ● Final: 113  □ Deleted: 21
* marble is a form of limestone
John Roebling
1806-1869
Bridge Builder
New Jersey Officials Call on EPA to Resume Cleanup at Roebling Superfund Site

(03/11) 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

<table>
<thead>
<tr>
<th>Site Name</th>
<th>CERCLIS ID</th>
<th>Proposed Listing</th>
<th>Final Listing</th>
<th>Construction Completion</th>
<th>Partial Deletion</th>
<th>Deletion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currie Scrap Metal, Inc.</td>
<td>NJD011717584</td>
<td>1/22/87</td>
<td>7/22/87</td>
<td>9/30/97</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Fair Lawn Well Field</td>
<td>NJD980654107</td>
<td>12/30/82</td>
<td>9/08/83</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Industrial Latex Corp.</td>
<td>NJD9811725411</td>
<td>6/24/88</td>
<td>3/31/89</td>
<td>9/27/01</td>
<td>N/A</td>
<td>4/21/03</td>
</tr>
<tr>
<td>Lodi Municipal Well</td>
<td>NJD980759301</td>
<td>10/15/94</td>
<td>8/30/93</td>
<td>9/27/93</td>
<td>N/A</td>
<td>12/23/98</td>
</tr>
<tr>
<td>Maywood Chemical Co.</td>
<td>NJD980529762</td>
<td>12/30/82</td>
<td>9/08/83</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Quanta Resources</td>
<td>NJD000665442</td>
<td>1/11/91</td>
<td>9/05/02</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Scientific Chemical Processing</td>
<td>NJD070555403</td>
<td>12/30/82</td>
<td>9/08/83</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Universal Oil Products (Chemical Division)</td>
<td>NJD002005106</td>
<td>12/30/82</td>
<td>9/08/83</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Ventron/Velsicol</td>
<td>NJD980529879</td>
<td>9/08/83</td>
<td>9/21/94</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Wilco Chemical Corp. (Oakland Pit)</td>
<td>NJD045653854</td>
<td>6/24/88</td>
<td>9/28/92</td>
<td>N/A</td>
<td>9/29/95</td>
<td></td>
</tr>
</tbody>
</table>
Fairlawn Well Field #7
Witco Chemical Corp #6
Ventron/Velsicol #8
Scientific Chemical Processing #9
Universal Oil Products #10
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.
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
"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
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
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
"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
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.
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 groundwater contamination were conducted. Remedial design for the groundwater remedy is currently completed and construction on the groundwater 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 bottled 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 Phosphate (P2O5)
- Ammonium Sulphate
- Ammonium Sulphate Nitrate
- Basic Slag
- Calcium Ammonium Nitrate
- Calcium Cyanamide
- Calcium Nitrate
- Complex Fertilizer (K2O)
- Concen Superphosphate
- CRUDE FERTILIZERS -271+
- CRUDE FERTILIZERS -271
- Phosphate Fertilizers
- Phosphoric Acid
- Potash Fertilizers
- Potassium Sulphate
- Single Superphosphate
- Sodium Nitrate
National Water Quality Assessment Study

EXPLANATION
- Yellow: Begun in fiscal year 1991
- Green: Begun in fiscal year 1994
- Pink: Begun in fiscal year 1997
- Orange: Scheduled to begin in fiscal year 1999
- Not shaded: Not scheduled yet

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

<table>
<thead>
<tr>
<th>State</th>
<th>Pounds of Atrazine</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO, GA, KY, NC, ND, NY, PA, SD, TX, WI</td>
<td>Between 166,000 and 1,915,000</td>
</tr>
<tr>
<td>MI, MO, MN</td>
<td>Between 1,915,000 and 3,664,000</td>
</tr>
<tr>
<td>KS, OH</td>
<td>Between 3,664,000 and 5,413,000</td>
</tr>
<tr>
<td>NE</td>
<td>Between 5,413,000 and 7,162,000</td>
</tr>
<tr>
<td>IA, IN</td>
<td>Between 7,162,000 and 8,911,000</td>
</tr>
<tr>
<td>IL</td>
<td>Between 12,409,000 and 14,158,000</td>
</tr>
</tbody>
</table>

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
Atrazine

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
## Average Annual Use Of Herbicides 1991-1995

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Atrazine</th>
<th>Cyanazine</th>
<th>Prometon</th>
<th>Simazine</th>
<th>Acetochlor</th>
<th>Alachlor</th>
<th>Metolachlor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural use (principal crops)</strong></td>
<td>Field crops, pasture</td>
<td>Field crops</td>
<td>Rangeland, hay, forage</td>
<td>Field crops, orchards, vegetables</td>
<td>Field crops</td>
<td>Field crops</td>
<td>Field crops, vegetables</td>
</tr>
<tr>
<td>Millions of pounds a.i. applied per year</td>
<td>63.9</td>
<td>29.5</td>
<td>—</td>
<td>4.8</td>
<td>23.8</td>
<td>25.6</td>
<td>57.9</td>
</tr>
<tr>
<td>Millions of acres treated per year</td>
<td>57.0</td>
<td>15.8</td>
<td>—</td>
<td>3.4</td>
<td>11.8</td>
<td>14.5</td>
<td>31.3</td>
</tr>
<tr>
<td>Pounds a.i. applied per treated acre per year</td>
<td>1.1</td>
<td>1.9</td>
<td>—</td>
<td>1.4</td>
<td>2.0</td>
<td>1.8</td>
<td>1.9</td>
</tr>
</tbody>
</table>

| **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                                       | —        | —         | —        | —        | —          | —        | —           |
Detection frequency at or above 0.01 microgram per liter, in percent

Nonagricultural use, in million pounds active ingredient per year

$R^2 = 0.85$
$P = 0.026$
$N = 5$

EXPLANATION
- atrazine
- cyanazine
- simazine
- alachlor
- metolachlor
Atrazine in Drinking Water

EXPLANATION

- NAWQA - Shallow gw (agric)
- NAWQA - Shallow gw (urban)
- NAWQA - Drinking-water aquifers
- MWPS
- Previous studies

Frequency of detection at or above given concentration, in percent

Concentration, in micrograms per liter

Graph showing the frequency of detection at or above given concentrations for different sources of groundwater contamination.
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
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

*endocrine disrupter
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.
Depleting the
The Ogallala Aquifer:

Cause - Wheat farming

Effect - plumes of pollution migrate to sites of drawdown
Drawdown of the Ogallala Aquifer


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"

ADOPT A WHEAT FIELD
Jim Shroyer
Extension Crops Specialist

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

**U.S. Winter Wheat Condition**
Percent of Acreage Rated Good or Excellent

**U.S. Drought Monitor**
November 18, 2003

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm
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:

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

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<tr>
<th>Country</th>
<th>Total renewable water resources (cubic km)</th>
<th>Irrigation water requirements (cubic km)</th>
<th>Water use efficiency in percentages</th>
<th>Water withdrawal for agriculture (cubic km)</th>
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