National Water-Quality Assessment Program

Water Quality of the Glacial Aquifer System

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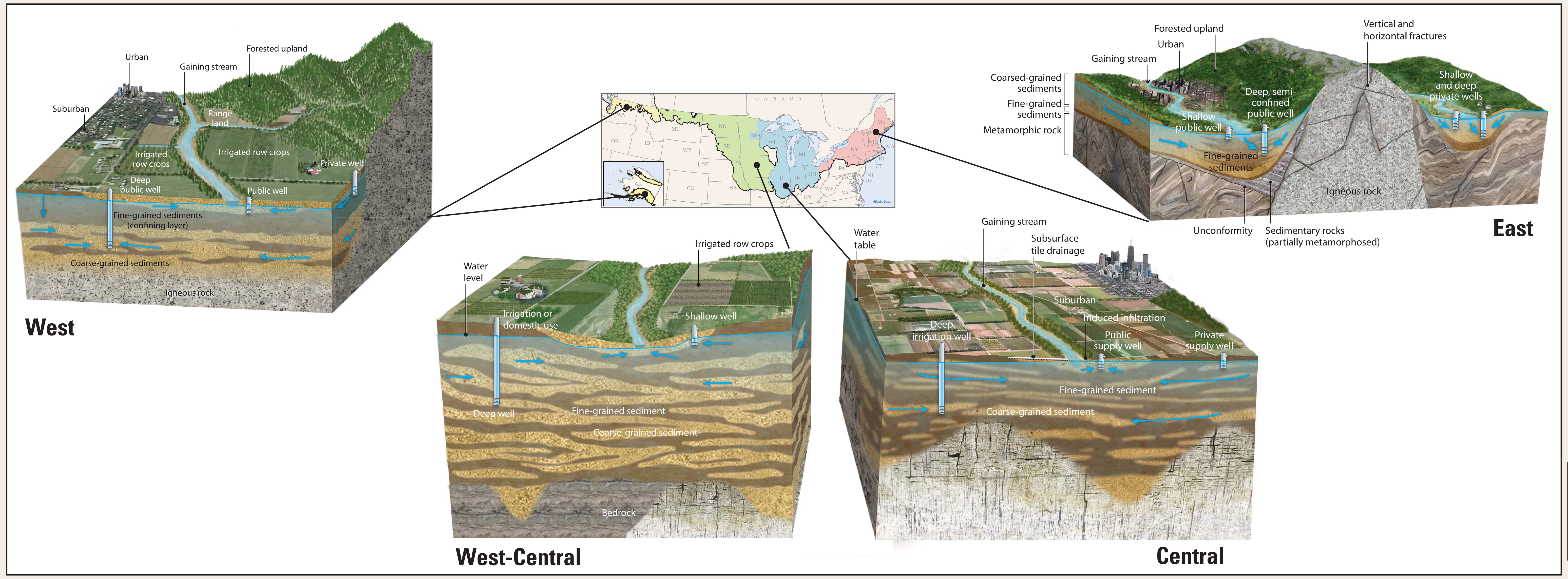
Overview of findings and implications – *Forty-one million people—one in every six—living in the United States rely on the glacial aquifer system for drinking water. Large suburban parts of major metropolitan areas such as Chicago, Boston, Minneapolis/St. Paul, and Detroit use water from the glacial aquifer system for part of their public water supply. These are the fastest growing areas of new residential development. Also, there are many public-water supplies (such as in Dayton, Peoria, Indianapolis, Des Moines, and Cedar Rapids) located near rivers. These supplies rely on the induced infiltration of surface water to recharge ground water captured by the public-supply wells. Withdrawals for public supply are the largest in the Nation and play a key role in the economic development the region, where the population has grown by about 15 million people over the last 40 years. The glacial aquifer system also provides drinking water for domestic use to individual homes and small communities in rural areas. NAWQA findings show where, when, why, and how specific water-quality conditions occur in groundwater and lead to science-based implications for assessing and managing the quality of this water resource.*



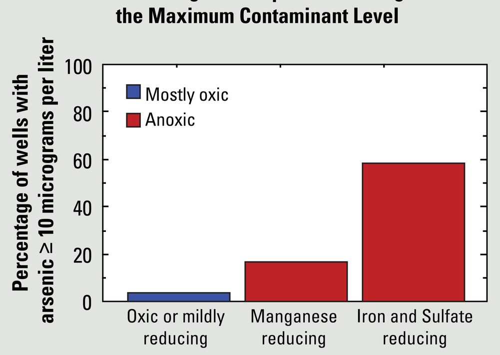
Naturally occurring arsenic and manganese are a potential drinking-water concern

Naturally occurring arsenic and manganese are a potential drinking-water concern – Naturally occurring arsenic and manganese were measured at concentrations of potential concern for human health in 20 percent of samples of untreated drinking water—far more frequently than man-made contaminants. Consumption of drinking water containing high levels of arsenic (a carcinogen) and manganese (a neurotoxin) poses a potential human-health risk. Concentrations of arsenic and manganese in the glacial aquifer system are high because ground-water in many parts of the aquifer system is anoxic —a condition that allows both contaminants to be present in groundwater. Water treatment to lower concentrations of arsenic can cost millions of dollars- even for small community water systems where there are fewer people to bear the cost. Testing and treatment are not required for domestic wells, underscoring the need for characterization and public education to help well owners learn about testing and treatment options.

Percentage of wells with manganese > 300 µg/L

	Redox	
	Anoxic	Oxic
pH < 7	41%	16%
pH ≥ 7	25%	10%

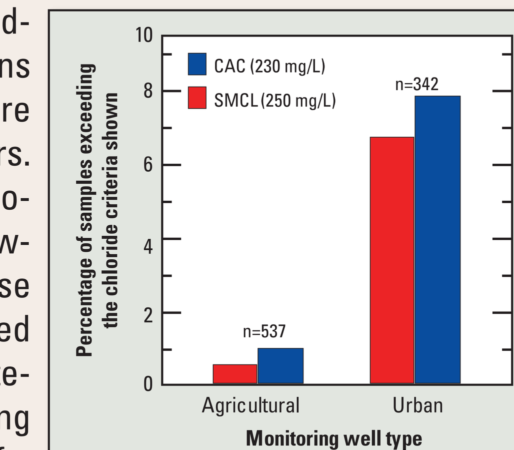
The percentage of groundwater samples with concentrations of manganese greater than the human-health benchmark of 300 micrograms per liter was greatest (41%) in samples that were anoxic and slightly acidic (pH < 7).



Concentrations of arsenic greater than the USEPA MCL of 10 micrograms per liter are found more frequently in strongly anoxic groundwater—conditions common in the central and west-central regions.

Chloride concentrations in groundwater are increasing in urban areas

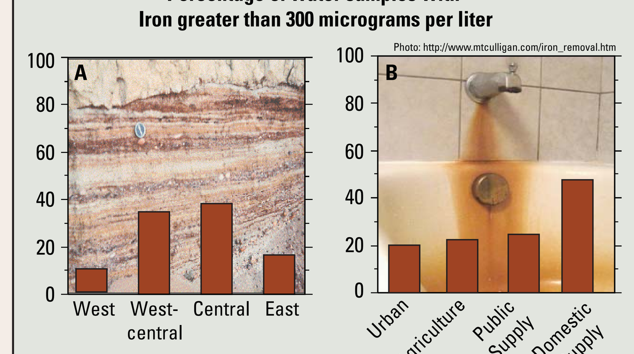
Chloride concentrations in groundwater are increasing in urban areas – Increasingly, salt is being used to make icy roads safe for winter driving. Since the 1970s, the use of deicing salt (containing chloride) in the glacial aquifer has increased threefold. As a result, chloride concentrations in groundwater in some regions have increased by more than 20 mg/L in 20 years. During dry periods, chloride in groundwater flowing to streams can cause stream chloride to exceed the chronic aquatic criterion (230 mg/L), harming fish and other aquatic life. Limiting the use of deicing salt is controversial, but some communities have reduced use by targeting salt application and by investigating alternatives. Groundwater moves slowly and natural processes do not degrade chloride in groundwater so it could take decades to see improvements resulting from management actions.



The percentage of wells with concentrations of chloride in groundwater that exceed the secondary maximum contaminant level (SMCL) of 250 milligrams per liter and the chronic aquatic criterion (CAC) of 230 milligrams per liter is highest in urban well samples.

"Nuisance" constituents in groundwater may limit its use

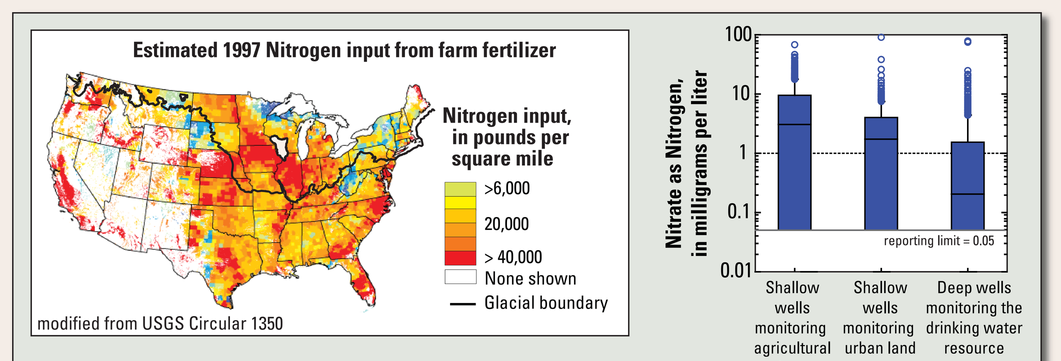
"Nuisance" constituents in groundwater may limit its use – Three-quarters of samples from drinking-water wells contained "nuisance" constituents, such as iron, manganese, chloride, sodium, sulfate, and aluminum, at concentrations exceeding the Secondary Maximum Contaminant Levels (SMCL) set by the U.S. Environmental Protection Agency for aesthetic quality. For example, iron exceeds its SMCL (300 µg/L) in more than one-half of domestic well samples. Nuisance constituents frequently occur with hard water and high dissolved solids concentrations —indicators of poor water quality—especially in the central and west-central regions. Nuisance constituents signal that other chemicals of concern for human health might also be present. Although the glacial aquifer system provides a plentiful supply of groundwater, nuisance constituents cause many consumers to purchase bottled water costing hundreds of dollars per year. Systems that remove nuisance constituents can be costly to install and maintain.



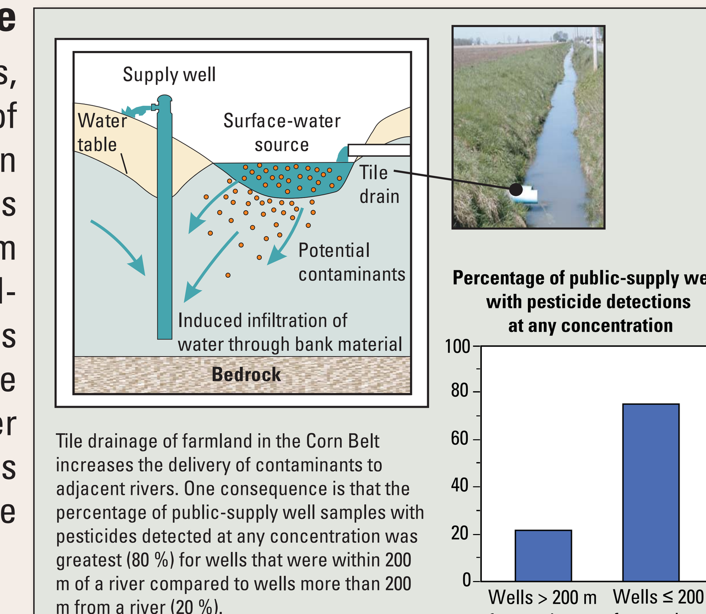
Iron causes red staining of laundry, dishes, and plumbing fixtures: (A) High concentrations of iron are more common in the west-central and central regions where anoxic conditions increase its solubility in groundwater. (B) Domestic wells have water with iron that exceeds the nuisance level of 300 micrograms per liter almost twice as often as public-supply wells.

Concentrations of nitrate and pesticides in groundwater were low in areas of fine-grained sediment despite widespread agricultural inputs of these chemicals

Concentrations of nitrate and pesticides in groundwater were low in areas of fine-grained sediment despite widespread agricultural inputs of these chemicals – Surprisingly, in the Corn Belt less than 10 percent of nitrate samples, and less than one percent of pesticides samples from groundwater, exceeded human-health benchmarks. This is because much of the glacial aquifer system in agricultural areas consists of fine-grained, organic-rich sediment, leading to high rates of denitrification and degradation. By contrast, some of the highest concentrations of nitrate in the country are measured in the glacial aquifer system where coarse-grained sediment occur near the land surface. Additionally, agricultural activity in much of the Corn Belt requires tile drains to lower the water table below the root zone. These tile drains intercept groundwater and contaminants near the water table and redirect them to rivers. An unintended consequence is that public-supply wells near rivers capture those river-borne contaminants through induced infiltration.



Median concentrations of nitrate in Corn Belt for drinking water was low despite high application rates; however, high concentrations occurred in shallow wells.



Tile drainage of farmland in the Corn Belt increases the delivery of contaminants to adjacent rivers. One consequence is that the percentage of public-supply well samples with pesticides detected at any concentration was greatest (80 %) for wells that were within 200 m of a river compared to wells more than 200 m from a river (20 %).