

Karst in Southeast Michigan

A multi-year (2001 to 2008) educational initiative of the Monroe-Lenawee- Washtenaw Groundwater Stewardship Program

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What is Karst?

Karst is defined as a landscape with topographic depressions such as swallows, sinkholes or caves, caused by underground solution of limestone or dolomite bedrock.

What is a sinkhole?



A sinkhole is a natural depression in the landscape caused by solution and subsidence of earth materials.

Why the concern?

- The hollow nature of karst terrain results in a very high pollution potential of water.
- Streams and surface water (runoff) entering sinkholes or caves bypass natural filtration through the soil.
- This "filtration bypass" provides a direct conduit for contaminants to travel some distance without filtration or purification.

Some local influences on Ground-water Quality

- A. Rural and older septic systems and highly fertilized lawns in residential areas
- B. Pesticides, fertilizers, manure and biosolids in agricultural areas
- C. Roads, railroads, pipelines and industry
- D. Geology, especially soft bedrock at or near the soil surface
- E. Shallow well depth and ground-water age

Groundwater use for drinking in Monroe County

Source of drinking water in Monroe County according to the 1990 U.S. Census.

- 14,102 households using drilled wells for drinking water (29%)
- 1,442 households using dug wells for drinking water (3%)
- 593 households using "other" wells .01%
- 32,171 households using public water 67% (48308 Total households)

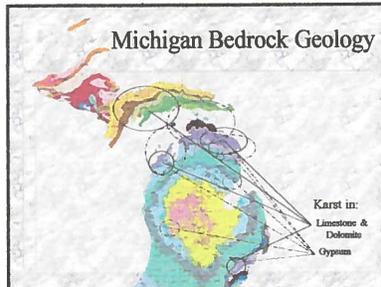
Where in the world is karst? Do we have karst in the U.S.?

Karst regions, areas underlain by limestone, dolomite, marble, gypsum and salt constitute about 25 percent of the land surface of the world.

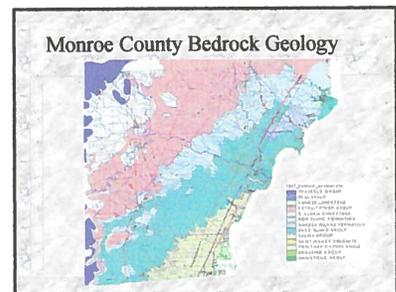
Major karst areas occur in 20 states and numerous smaller karst regions throughout.

40 percent of the groundwater used for drinking comes from karst aquifers in the United States.

Michigan Bedrock Geology



Monroe County Bedrock Geology



We live in a karst area



- Monroe and Lenawee counties:
- have limestone and dolomite bedrock at or near the soil surface
 - have sink holes
 - have springs and flowing "artesian" wells
 - have at least one "blue hole" at Lake Eric

Karst committee of the Groundwater Stewardship Team

- Allison MacArthur-Ruesink, MDEQ, Chair
- Amy Gilhouse, GST
- Lea Cox
- Bill Basch
- Catherine Pigott and Marlene Rogers of Monroe Co SWCD
- Alists Tumas, AmeriCorp
- Ned Birkey, MSU Monroe Extension
- Dr. Rane Curt, U of M AI Norwood, USDA NRCS
- Keth Stebarth
- Royce Maniko, Monroe Co. Planning Dept
- Rodney Blanchard, Monroe Co. EHD
- Dan Stefanski, Monroe County Drain Comm.

Local Partners

- Monroe-Lenawee-Washtenaw Groundwater Stewardship Team
- Monroe Conservation District
- Lenawee Conservation District
- Monroe County Planning Commission
- Monroe County Env. Health Dept.
- Monroe County Drain Commission
- Monroe County MSU Extension
- Monroe County Farm Bureau

Karst sub-committee goals

- ◆ Awareness of karst by public officials and the general public
- ◆ Secure local partners to help with grant proposals for study of local karst areas
- ◆ Secure grants to better identify and rank karst areas in Monroe and Lenawee counties

Karst sub-committee goals

- ◆ Assist township and county officials and land developers with the identification of karst areas and the relative hazards of individual karst areas for land use planning
- ◆ Produce an educational booklet about Living on Karst for Michigan landowners
- ◆ Produce an educational display and presentation (video) about karst

USGS, MDEQ, Monroe County EHD, MSU, Township (grants)

- * To identify and map karst areas of Monroe and Lenawee counties
- * To conduct dye tracing water movement
- * To rank karst areas as to their potential vulnerability to contamination
- * To provide water quality testing to residents with well water in suspected karst areas

Sinkhole drains into groundwater

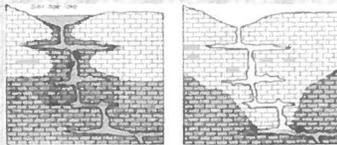


Figure 13.—An effective primary porosity in carbonate rocks results in added ground-water storage.

Monroe County Geological References

- I. W.H. Sherzer, Geological Report on Monroe County, Michigan (Michigan Geological Survey, vol. 7, 1900)
- II. A.J. Mozola, Geology for Environmental Planning in Monroe County, Michigan (Michigan Geological Survey Report Investigation 13, 1970)

Monroe County References cont.

- III. W.J. Michno, Location and Identification of Sinkholes, Artificial Sumps and Their Contribution to Groundwater Pollution, Whiteford Township, Monroe County, MI (April, 1972 thesis, Eastern MI University)
- IV. Siting the Superconducting Super Collider in Michigan, State of Michigan proposal, 1987, volume 3, Geology and Tunneling
- V. Hydrology, Water Quality and Effects of Drought in Monroe County, Michigan USGS Report 94-4161

Geological References continued

- VI Guidelines for Wellhead and Springhead Protection Area Delineation in Carbonate Rocks, US EPA, Region 4, 904-B-97-003
- VII Ground-Water Quality and Vulnerability to Contamination in Selected Agricultural Areas of Southeastern Michigan, Northwestern Ohio and Northeastern Indiana, USGS, Water-Resources Investigations Report 00-4146

Michno report on Whiteford Twp

- More than 100 sinkhole locations mapped in Whiteford Township
- Ottawa Lake was a sinkhole "lake"
- Big Sink and Little Sink are very active
- Sinks vary in depth from 1 to 25 feet deep and 2 to +100 feet across

Monroe County water concerns

- Availability: wells going dry
- Health issues: E coli and coliform bacteria
- Taste: sulfur water
- Hardness: mineral content
- Sinkholes: soft bedrock and dissolution
- Lack of overburden to groundwater
- Porous soils or confining clay layers
- Water holding tanks
- Poor soil conditions for septic systems
- Proximity of wells and septic systems
- Lake Erie water quality

Water quality problems in Monroe County

- Hard: 10x of "normal" hard water
- Sulfur: deeper aquifers have more sulfur
- Black: generally the highest level of sulfur
- Turbid: when wind is strong from the east and Lake Erie is all stirred up

Contaminants found in Monroe County groundwater samples

Previous water samples in Monroe County have found the following "contaminants"

- ◆ Pesticides, such as atrazine
- ◆ Fecal bacteria and other forms
- ◆ Inorganic chemicals such as nitrates, nitrites, and mercury
- ◆ Organic chemicals such as sulfur, iron, copper, zinc and manganese
- ◆ Benzene and Toluene
- ◆ Water softener discharge

Groundwater use in Monroe County

1994 USGS estimate of groundwater use; 30 million gallons per day

- 20 million gallons of de-watering by quarries
- 1 million gallons by agriculture
- 5 Million gallons by industrial
- 4 Million gallons by residential

Artesian well in northwest county

Most townships of Monroe County have one or more of:

1. sinkholes;
2. artesian wells;
3. quarry (new or old)
4. springs;
5. drain wells



Artesian well in eastern Monroe

- Artesian well in eastern Monroe County which has produced water since the well was drilled in 1937.
- It was used for livestock watering and a lawyer's coffee!



Sinkhole in southwest county



Sinkhole in northeast county



Filter strips installed around sinkholes in farm fields



Sinkhole under a county road



Big Sink April 30, 2007



Accident on US 23 at Big Sink



Sinkholes in Plum Creek



Great Sulphur Spring at the Lake Erie Marsh

- "blue hole" near Lake Erie in The Nature Conservancy marsh
- bug was put in the outlet in 2001 and 02
- outlet flow estimated at 100 gal/ second



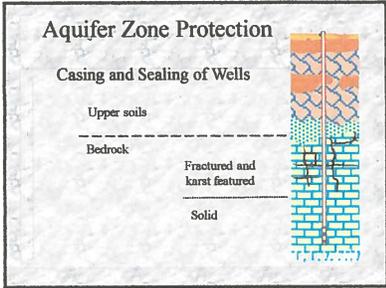
Ag and Road Commission Drainage wells



2001 Dye Tracing Project at Big Sink



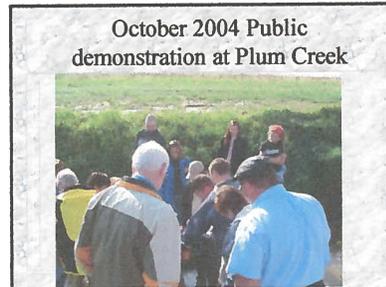
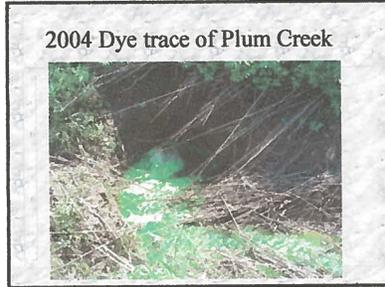
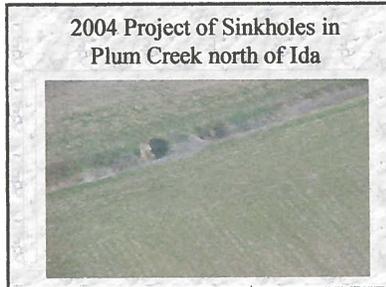
- green Fluorescein dye was put into Big Sink on Thursday, May 17
- 18 volunteers put dye trap "bugs" in their water to detect if any dye was present
- 19th bug in Widgeon Spring on Lake Erie



2002 Dye Tracing Project at Big Sink again

- 326 homeowners targeted within 2 miles of Big Sink
- Dye put in May 31
- 90 participants
- Positive results in the southwest of Big Sink

A map showing the location of the dye tracing project, with a red dot indicating the site.





**Ground Water Concerns;
water quantity and quality**

Water well:

1. installation
2. maintenance
3. abandoned
4. Records

Aquifers

Transportation,
Industrial,
Residential

1. leaks
2. spills
3. waste disposal
4. septic fields

"Fixes" to karst geology

- Cement used in Burwitz drain
- Repair of Wittkop drain sidewall
- Case well deeper near Big Sink
- Repair of Plum Creek
- Filter strip used around sinkhole
- Dye trace to identify groundwater travel

Understanding karst is important

Though some areas have karst features, all areas of Monroe County have people who use wells for drinking water.

Unless watersheds are protected, these direct connections between the surface water and subsurface (groundwater) can threaten the quality of our drinking water.