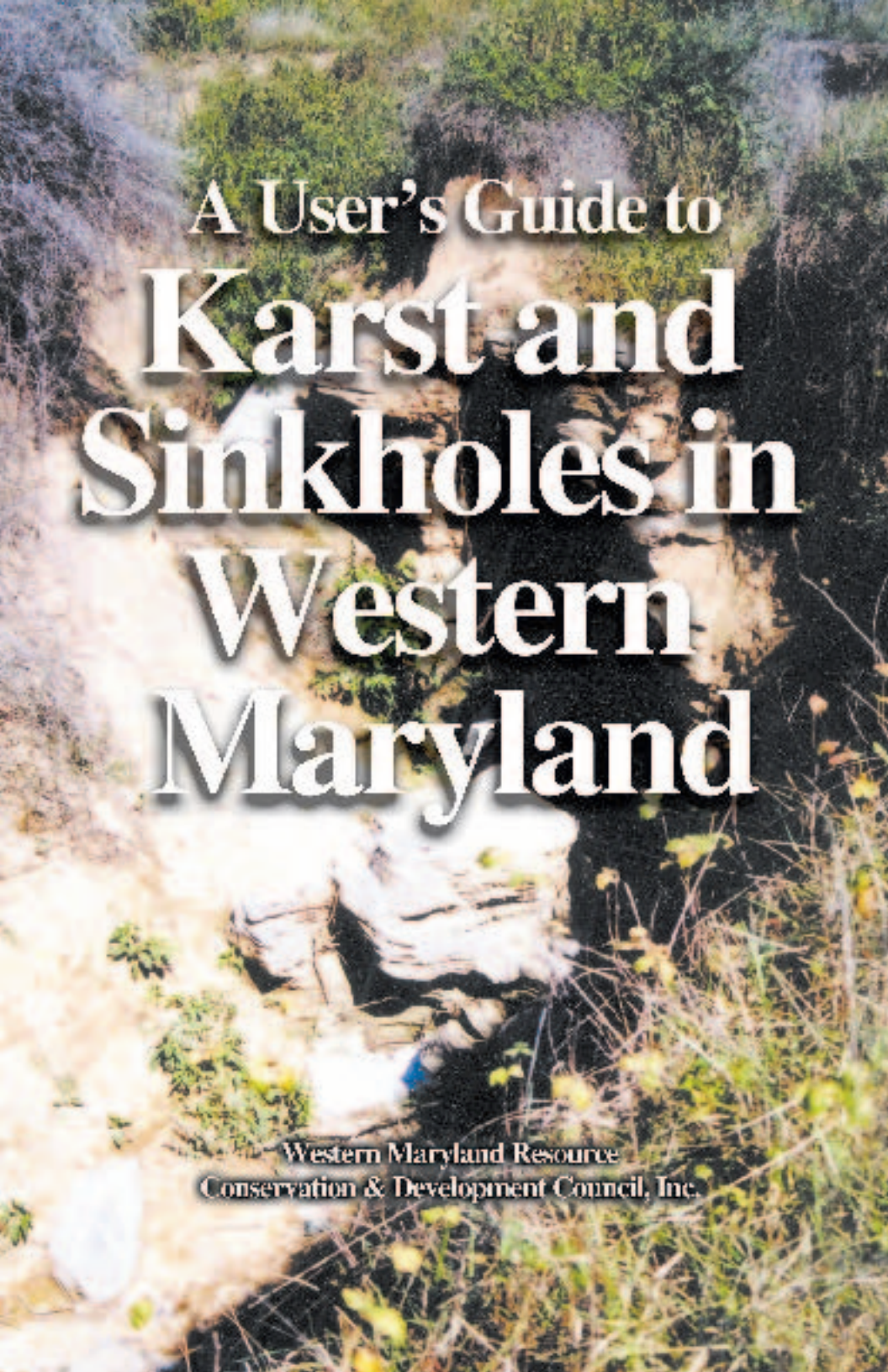

A User's Guide to Karst and Sinkholes in Western Maryland

Western Maryland Resource
Conservation & Development Council, Inc.

A User's Guide to

Karst and Sinkholes in Western Maryland

By Topper Sherwood

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CONTENTS

Note: The photos in this guide are of Western Maryland karst and sinkholes. The back cover, however, shows an enormous Mexican sinkhole, El Sotano de las Golondrinas ("Cellar of the Swallows").

INTRODUCTION: WHY THIS GUIDE?

This guide was written to help people who live and work in Maryland to be more aware of the issues presented by **karst topography**, a geological terrain whose most well-known characteristics are solution cavities, caves, and **sinkholes**.

The developers of this guide represent local agencies that assist residents and business owners with questions about land, water, and karst. We work to help others understand the nature of land and water in our region, and to become more aware of the need for good conservation practices. We have developed this guide to be of specific use to:

- residents — farmers and home owners who live and work in karst areas;
- mortgage and real-estate professionals;
- state and local policy makers and planners;
- insurers;
- educators;
- members of the media; and
- construction and utilities contractors.

Questions about karst and sinkholes can be directed to members of the agencies listed on pages 16-20 of this guide. Questions and comments about the guide itself should be forwarded to the Western Maryland Resource Conservation & Development Council (RC&D).

The Western Maryland RC&D is grateful to all the partners who have joined in the development of the guide, which was supported by a Chesapeake Bay Small Watersheds Grant from the National Fish & Wildlife Foundation (www.nfwf.org).

We are also grateful to those who read this guide, those who use the information offered here, and to those who share it with others.

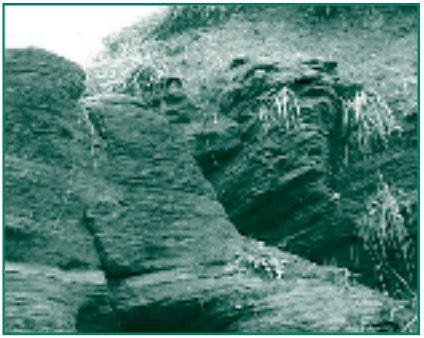
Doug Hutzell

WHAT IS KARST TOPOGRAPHY?

"Karst" describes terrain that's characterized by sinkholes, caves, underground streams, and other features that are formed by the slow dissolution of calcium and magnesium oxides in limestone, dolomite, or marble bedrock. Karst landscapes are often spectacularly scenic areas. Examples include the sinkhole plains and caves of central Kentucky, the large crystal-clear springs of Florida, and the complex, beautifully decorated caves of New Mexico. Karst terrains are areas of abundant water supplies, limestone quarries, and minerals. In the United States, 20 percent of the land surface is karst and 40 percent of the groundwater used for drinking comes from karst aquifers.

People who settle in karst areas, however, can find themselves dealing with associated problems. Karst regions can be prone to unpredictable or easily contaminated groundwater supplies or unusual surface water drainage. Karst landscapes are also among the most susceptible to environmental impact, including ground subsidence. Following storms, droughts, and changes in land use, sudden subsidence features known as sinkholes, can cause damage to buildings, roads, parking lots, and farmed land.

In unpopulated and undeveloped areas, a sinkhole may pose little or no danger. In populated and developed regions, however, sinkholes are more likely to cause problems. They present us with two kinds of hazard: 1) the physical danger of falling into them, as well as the danger to structures — buildings, roads, airport runways, etc.; and 2) the threat to ground and surface water quality by the potential for direct introduction of contaminants. People living and working in karst regions need to be particularly sensitive to issues of land use and water quality protection.



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The stakes are high for communities confronting the physical danger of sinkholes. Recent collapses have been occurring along Interstate 70, in Frederick County, and one sinkhole that opened suddenly on a state highway in Carroll County in 1994 caused a fatal auto accident there. Sinkholes appearing in fields have injured livestock and damaged farm equipment. The threat to water quality is well documented and can pose a significant and quick hazard. Stream water or surface runoff that enters a sinkhole or cave can bypass natural filtration through soil and sediment. Groundwater can travel quite quickly through these underground networks —up to thousands of feet per day — carrying surface contaminants to wells and springs.

We will discuss this issue further in the section on water quality, beginning on page 5.

MARYLAND'S KARST AND SINKHOLES

Where are Maryland's karst areas? The most-affected counties are Washington, Carroll, Frederick, and Baltimore, with less extensive areas in Allegany County. (See Figure 1. below) While we cannot know every detail of what lies in the ground below every piece of property, geologic mapping by the Maryland Geological Survey (MGS) has provided an excellent understanding of Maryland's subsurface. [For access to MGS maps and other information, visit www.mgs.md.gov.]

Soil surveys conducted by the National Cooperative Soil Survey also provide clues to potential areas of sinkhole development. Soil maps identify areas where soils originate from or overlie limestone and other material with some potential for developing sinkholes. To access soil survey maps and interpretive information, visit www.sawgal.umd.edu/nrcsweb/Maryland/index.htm and navigate to a particular county. [The current Frederick County Soil Survey (2002) contains a soil-interpretation table outlining the relative potential for sinkhole formation by soil series.]

MGS staff members estimate that Frederick County alone contains a vulnerable karst topography covering about 35 square miles. Washington County is estimated to have a karst area of two or three times that size. The Geological Survey has identified more than 1,000 "karst features," including 125 sinkholes, in a relatively small portion of Frederick County. From this, we know that hundreds of sinkholes are likely to exist in each of the three most-affected counties, Washington, Frederick, and Carroll.

Karst, Land Use, and Water Quality

All uses of land affect an area's groundwater. Those of us who live and work in karst country, however — homeowners, real-estate professionals, public planners, farmers, or contractors — should be especially aware of the terrain's tendency to form sinkholes and the implications for our water resources.

Figure 1

Most karst areas are underlain by limestone which may be composed of varying degrees of openings. Sometimes large, sometimes small most have the ability to transmit water and soil. Sinkholes occur when a

"bridge" of loose stones and soil collapses into a fissure or opening in the rock, sending surface material and water into underground cavities. (See Figure 2 on the opposite page.) Such sinkhole collapses occur naturally; they also may be prompted by human activity. Examples would be ponding water, extracting groundwater for water supply or quarrying, blasting, grading or soil disturbance.

Some common features that may warn of eventual sinkhole collapse include:

- Circular and linear cracks in soil, asphalt, and concrete paving or floors;
- Depressions in soil or pavement that commonly result in the ponding of water;
- Slumping, sagging, or tilting of trees, roads, rails, fences, pipes, poles, sign boards or other structures;
- Downward movement of small-diameter vertical structures such as poles or posts;
- Fractures in foundations and walls, often accompanied by jammed doors or windows;
- Small conical holes appearing on the surface of the ground during a relatively short period of time;
- Sudden muddying of water in a well that has been producing clear water; or
- Sudden draining of a pond or creek.

An open sinkhole—as big as a house, or as small as a coffee mug—may carry untreated surface water, directly and immediately, to local aquifers affecting any number of springs, and well sources. Sinkholes may threaten water quality, for example, when they occur near underground water and sewage systems. Karst-area water resources and wells have been damaged by cracked sewer lines, and drain fields placed where natural soil filtration can be bypassed. There have been accidental or inadvertent discharges from gas stations, treatment plants, and other facilities with underground storage tanks and associated piping causing materials to leach into and move quickly through the karst subsurface, polluting local water supplies. In the worst cases, sinkholes have been used as dumping grounds for old appliances, tires, car batteries, household garbage, agrochemical containers, and dead animals.

Runoff, spills, or pesticides and fertilizers from lawns and farms can leach through the many spaces in the rock, unfiltered by the soil, enter the groundwater system, and lead into water sources. Thousands of residents in our region get their water from home wells; and hundreds of new wells and septic systems are installed here each year. Problems already have occurred. Residents of Frederick County recall when one small town's entire water system had to be shut down for nine months, after a broken sewage line sent polluted water directly into the karst aquifer that supplied the town's water system.

Drinking water sources "were polluted almost as soon as the leak was

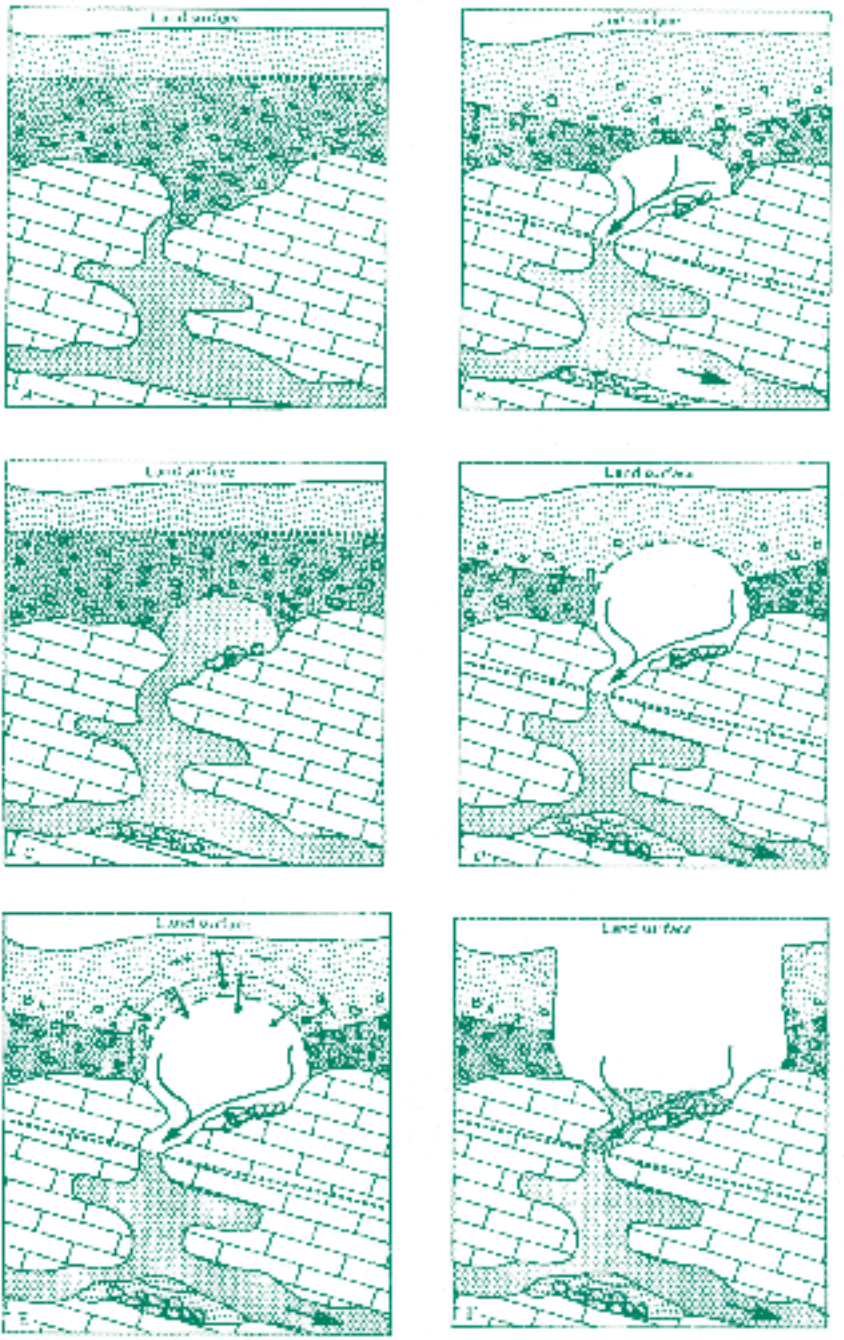


Figure 2

MYTHS & FACTS ABOUT KARST AND SINKHOLES

MYTH: Putting things down a sinkhole won't bother anyone. "Out of sight, out of mind."

FACT: Contrary to the "out of sight, out of mind" approach, we should consider sinkholes in terms of Karst's 'Reverse' Law of Gravity: "What goes down, eventually returns."

MYTH: Seal or cover the sinkhole — say, with dirt, rocks, or asphalt — and it will go away.

FACT: Covering or "plugging" the sinkhole, without paying attention to the subsequent movement of water, can give a false sense of security.

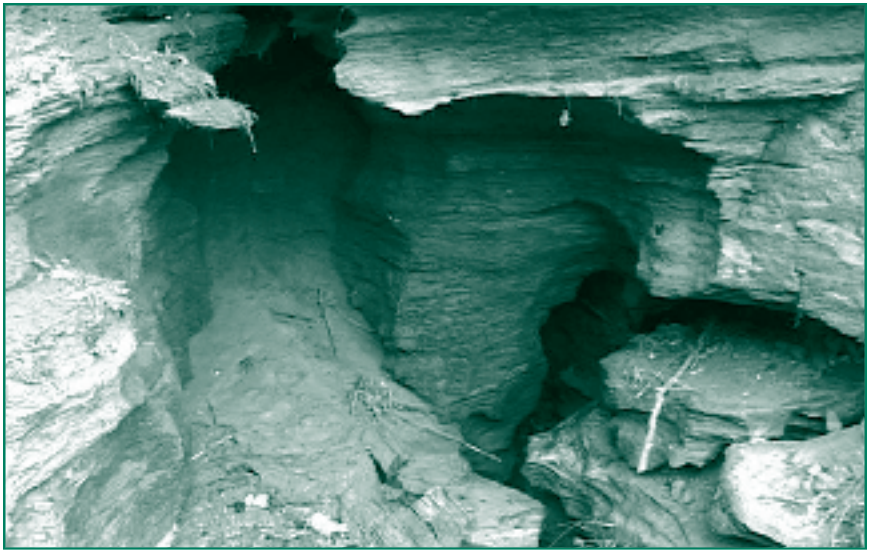
MYTH: If you leave a sinkhole alone, it will eventually take care of itself.

FACT: Sinkholes are a natural phenomenon, but we can't always ignore them — especially in populated areas. Nothing is simple. We have to examine sinkholes and, on a case by case basis, determine what should be done.

MYTH: All sinkholes imply natural void spaces or caves.

FACT: Actually, every depression in the ground — or even a hole — isn't necessarily a sinkhole. Such a hole could be caused by excavation for utilities, an old trash dump, or an abandoned well. It could be a "pseudo-sinkhole." How do the experts assess such 'artificial sinks?' For starters, they examine a hole's: 1) shape; 2) location; and 3) land use history. They also consult geologic or soils maps to see if limestones, dolostones, or marble exist in the area. (See the online Geologic Maps Series at www.mgs.md.gov/)

Consider the shape of a depression or hole. Is it open or closed? Round or rectangular? Genuine sinkholes often start as depressions and open as funnel-shaped pits, depending on terrain. A closed, rectangular depression may suggest a collapsed trench or buried object, like an old brush pile or settling trash dump. What about location? What do you know of the history of the site? Does it suggest a refuse pit, abandoned well or cistern, a submerged tank, or a utility trench? In some western counties, terrain is shaped by collapsed mine tunnels. One often brings questions like these to the examination of ground depressions and apparent sinkholes.



Topper Sherwood

discovered," one soil conservationist observed.

Surface runoff carrying contaminants can also pose danger to underground biological life. Cave-dwelling organisms thrive in underground cracks and crevices, in relatively dry environments and underwater. Understanding these organisms and their habitats requires that we learn more about karst and prevent surface contamination where we can.

PROBLEM: RUNOFF

Runoff refers to the water from rain or melted snow that does not infiltrate the soil but flows over the land surface as drainage. This is the water that flows, for example, from streets and parking lots. Such water may be directed to constructed ponds or other stormwater management structures or, untreated, through storm drains into rivers and streams.

Runoff can carry motor oil, antifreeze, salt, sand, litter, pet waste, fertilizer, yard and garden debris, and consumer chemicals that have been dumped on the ground. In one study, by the Environmental Protection Agency (EPA), some of the most toxic samples of runoff were collected from residential roofs, carrying such pollutants as bird droppings, roofing-material chemicals, and heavy metals leached from gutters.

In karst areas, sinkholes act very much like storm drains, carrying runoff into fissures and caves, ultimately discharging into rivers, streams, lakes — or into wells, springs and other local sources of drinking water.

Studies show that sinkhole development can be reduced by dispersing water runoff, allowing it to infiltrate the ground over a wide area, as opposed to concentrating it in ditches and swales. Developers attend to the special needs of karst areas, for example,

by designing and constructing driveways and parking lots which disperse, rather than concentrate, rainwater runoff. This allows the water that would otherwise be directed into drainage ditches and culverts to be dispersed around the perimeter of the paved area.

Some county officials in Maryland's karst areas have considered special karst-sensitive water-management practices and specifications. Such policies have been passed by local governments in other states.

County and local governments in other states have legislated special water-management practices for industrial or commercial sites located in karst areas.

What You Can Do:

- Never dump anything onto a parking lot, into a storm drain, or down a sinkhole.
- Divert water run-off away from sinkholes.
- Recycle motor oil at a local gas station or recycling center.
- Use fertilizers wisely. Have soils tested to determine proper amounts.
- Keep pesticide use to a minimum. Use least-toxic alternatives.
- Maintain vegetation on steep slopes to keep soil in place.
- Compost yard and garden debris.
- Do not overfill car radiators and fix leaks.
- Move down spouts from roof gutters so water discharges onto grassy areas, away from your foundation and septic system. This allows runoff to filter into the soil, where harmful pollutants are broken down by soil organisms.
- Sinkholes that receive runoff should be remediated as soon as possible.
- Find and use the best practices for dispersed stormwater management in karst areas.

SEPTIC SYSTEMS AND KARST

To most of us, septic systems are happily "out-of-sight" and "out-of-mind." Proper operation and maintenance of septic systems are important, however, to make sure they work well and last longer.

When a septic system fails, inadequately treated sewage can reach the groundwater, raising the risk of serious diseases including dysentery, hepatitis, and typhoid fever. Nitrate and phosphate from domestic wastewater can cause excessive algae growth in springs and streams and impair aquatic life. Nitrate is also the cause of methemoglobinemia, or "blue baby syndrome," a condition that prevents the normal absorption of oxygen in the blood of infants.

In karst areas, according to the EPA and other researchers, failing septic systems are a major source of groundwater pollution. Many of these failures are attributed to the presence of karst bedrock, old systems with outdated designs, and poor system maintenance. Many times septic system failures in

Topper Sherwood

Compaction grout is sometimes used to fill large karst cavities under roads and highways. Compaction grout is an extremely stiff grout composed of sand, fly ash, and cement.

karst areas are not noticeable on the surface. The effluent "short circuits" or bypasses natural soil filtration, and enters the groundwater system. The partially treated or untreated discharge can then spread throughout the aquifer.

What You Can Do:

- Plant nothing but grass near your septic system. Roots from shrubs and trees can damage the tank and lines. Roots can also become conduits for partially treated sewage. To protect tank connections and distribution lines, prevent vehicles from driving or parking on any part of your system.
- Divert other water sources, such as roof and street runoff, away from your septic field. Excess surface water can result in subsidence and septic system failure.
- Consider alternative, comparably priced low-pressure dosing systems that: 1) increase the contact time between wastewater and soils; 2) equalize the dispersion of waste water throughout the drain field (for less channeling), or 3) otherwise maximize the natural absorption and filtration properties of the soil.
- Work with the local health department and extension services to select the best system for your site. Contact health officials if you believe you have a malfunctioning system.

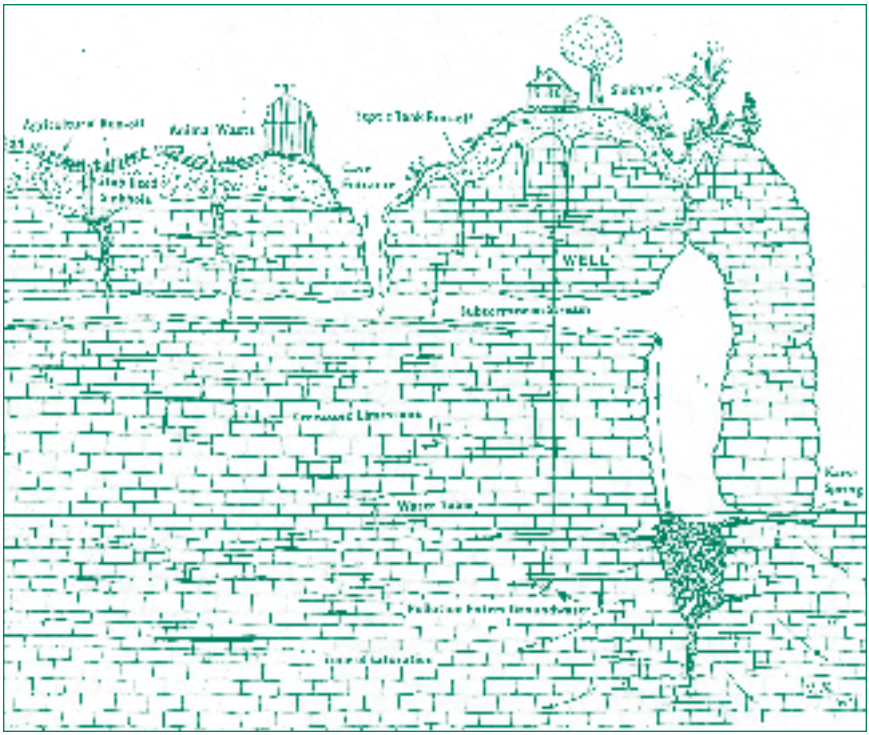
PROTECTING WELL WATER

Many rural home owners don't think about the source of their groundwater, believing it to be protected from surface activity. In karst country, however, wells can draw from groundwater pollution that originates on one's own property, on

surrounding land, or miles away. In karst areas, the direction of surface runoff (down-slope) may be different than the direction of underground karst drainage. Household wells and springs can be contaminated by common and seemingly harmless activities occurring in any direction, so everyone must be cautious about such activities as boarding or pasturing livestock; over-applying pesticides, herbicides, or fertilizers; storing home heating oil or gasoline; vehicle maintenance; and on-site sewage disposal.

The best way to protect your household groundwater supply is to become "proactive," before contamination happens, as opposed to "reactive," when it's too late. Proper well siting is essential to keeping polluted surface water out of the aquifer, and to avoid drilling into void spaces. (Local cavers and water management districts sometimes develop maps that can assist in locating your well away from subsurface cave passages.) Isolate the well as much as possible, siting it at least 100 feet away from barns, feed lots, livestock pens, sinkholes, dumps, septic systems, fuel tanks and other potential sources of contamination.

Landscape so that standing water doesn't accumulate near the well, and fence any livestock out of the spring or well-head area. Wells should be lined or "cased" with welded lengths of steel pipe, grouted into place. The top of the



SINKHOLES AND ZOIs

Under a 1991 Amendment to Maryland's Surface Mining Law, the Maryland Department of the Environment (MDE) is required to establish and define Zones of Influence (ZOIs) around limestone and marble quarries in Baltimore, Carroll, Frederick, and Washington counties.

Limestone mining operations are required to repair a sinkhole within a ZOI if MDE determines that the sinkhole resulted from quarry dewatering. Extraction companies also are required to replace a water supply that fails due to declining water levels caused by a quarry's water-pumping operation. If the sinkhole damage cannot be restored to its pre-subsidence condition, the quarry owner must pay monetary compensation to the affected property owner(s). MDE investigates complaints of sinkhole or water-supply failure within a Zone of Influence.

A quarry's ZOI is based upon local topography, watersheds, geologic and hydrologic factors. When establishing Zones of Influence, MDE conducts field investigations and evaluates any available information such as groundwater studies and well-monitoring data.

Anyone wishing to report complaint of a sinkhole or water-supply failure should contact MDE's Mining Program at (410) 537-3557. Those purchasing homes within limestone (karst) terrains should inquire about limestone mining. MDE should be contacted to acquire ZOI maps.

well should be surrounded by a concrete pad and tightly capped or sealed.

Become familiar with the geology and hydrology of your watershed. Work diligently with neighbors to clean up dumps, and limit potentially polluting activities in key water source areas.

What You Can Do:

Homeowners and prospective home buyers should be aware of "best practices" and local requirements for well drilling and testing. Detecting groundwater contamination requires regular testing. Some counties recommend that wells be tested for bacteria and nitrates and other suspected compounds at least annually; others recommend every six months.

For those living in karst areas, it's a good idea to keep a record of tests as a "background" for evaluating any future pollution. The record should also include the dates that muddiness or low water level problems occur, as well as the existing climate conditions when these events occur.

Test your water any time you notice unusual odors, color, or cloudiness, or if you note an interrupted supply such as pumping air or sediment. Contact the county health department's water quality division for information on which tests might be appropriate. Ask whether or not the department performs such tests, or request a list of Maryland-certified water-testing laboratories serving your area.

DEALING WITH PROBLEM-CAUSING SINKHOLES

There are right and wrong ways to deal with a sinkhole. When a sinkhole opens, it cannot simply be "plugged" by piling in various amounts of rock, dirt, or other debris. If a collapsed sinkhole presents a danger to health, safety, or to structures, it should be stabilized in a way that restores drainage patterns but insures structural integrity; otherwise the sinkhole could return or "find" a new location.

In repairing sinkholes, planners and crews draw upon a variety of potential responses, and tailor the remediation to fit specific site conditions. While no site is the same, sinkhole repairs should **always** pay as much attention to maintaining water quality (hydrogeology) as to structural challenges. Repair techniques include reverse-grade fill, building berms, and grouting. It's best to contact a geologist or engineer experienced in sinkhole repair before attempting to backfill or "seal" a sinkhole. The Natural Resources Conservation Service has standards and specifications for sinkhole remediation.

Septic systems, feed lots, animal waste lagoons, and stormwater basins should not be located near known or suspected sinkholes or caves. Appropriate methods should be used to minimize any unnatural or flood drainage entering the sinkhole, and to prevent any and all runoff from bacteria-contaminated areas from entering. Similarly, one should refrain from applying fertilizer, pesticides, or other chemicals within at least 100 feet of an active sinkhole. One should always be aware of any sinkholes on your property, and share that information with contractors, county health officials, and others. The right approach to repairing sinkhole damage changes according to the hole's size and location. The good news: help and expertise are available, from informal consulting by local authorities to professional excavation and engineering services.

If you purchase property where trash has already been dumped into a sinkhole, clean it out and restore vegetation to improve water quality. Check with your local Natural Resources Conservation Service (NRCS), Soil Conservation District, utility district, state conservation agency, or US Fish and Wildlife Service office. Volunteer labor and equipment also can be a big help. Contact local cave clubs or the county recycling officer for support. (See Resource List on Page 19).

Insurance coverage is available for geologic hazards, although it varies from state to state. Collapses that occur near a house or other structures should be inspected by an engineer who is knowledgeable about karst problems. New homes and structures in karst areas should be built with the help of a geotechnical engineer.

AGRICULTURE ON KARST

The region's karst limestone rock has helped nurture some of the best agricultural soils in the mid-Atlantic region. Farmers have long been familiar with sinkholes and the implications for their lives and work. Good observers of the land can spot the early warning signs of sinkhole development, and take quick action to stop soil erosion around one.

Farmers may be largely concerned about the sinkhole that opens up and damages farm equipment, but pollution of groundwater from livestock waste, fertilizers, and pesticides can also be a major problem. Farmers and soil conservationists have developed conservation and environmental farming practices that protect the groundwater in karst terrain. Farmers who are interested in learning more about crop management and conservation practices in karst areas may contact the Western Maryland RC&D, local Soil Conservation Districts, or the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture. Soil Conservation Districts can provide specific ideas on drainage diversion designs, filter strips, fencing, and basins. Maryland SCDs also provide other techniques to reduce the impacts of erosion, sedimentation, manure, and agricultural chemicals on springs, streams, wells, marshes, lakes, and ponds.

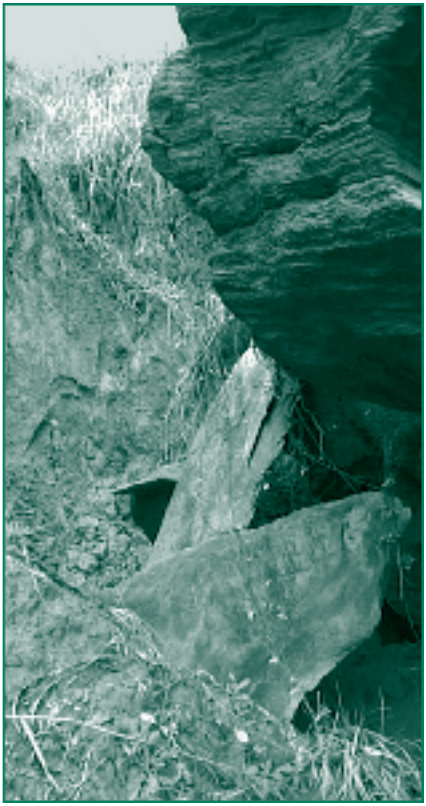
Public programs aimed at limiting agricultural runoff help farmers keep livestock away from eroding stream banks, unprotected stream crossing, subsiding sinkholes, sinking streams, and natural waterways. (See "MACS and BMPs," on this page.) Countless Maryland farmers have contributed to higher water quality by limiting overgrazing and restricting their livestock's access to streams, conserving valuable soil fertility while minimizing the amount of sediment and nutrients entering the watershed.

MACS & BMPs

The Maryland Agricultural Water Quality Cost-Share (MACS) Program funds construction of eligible Best Management Practices (BMPs) to protect water quality. Animal waste storage facilities, grassed waterways, spring developments, buffers, and cover crops are among the BMPs currently eligible for funding. Newer BMPs include stream protection practices, conservation cover, and nutrient management services. MACS pays up to 87.5 percent of the cost for installing eligible BMPs. Repairing a sinkhole that is draining surface water into a clean groundwater source **may** be eligible for MACS funding. Consult local NRCS and county Soil Conservation District offices for more information about MACS.

What You Can Do:

- Avoid structures that concentrate water flow, especially into areas that are not accustomed to the increase. Soil-lined diversion ditches often collapse when stormwater erodes through to caves and underground cavities.
- Leave a wide natural buffer of trees and under-story vegetation around sinkholes and caves when clearing land, harvesting timber, or disturbing ground in the drainage area.
- Never dump trash, dead animals, or debris into sinkholes. This is illegal in most areas because it can directly and rapidly funnel leachate to springs and wells.
- Divert the flow of run-off away from sinkholes.
- Keep cattle fenced away from the area around a sinkhole.



What To Do If You Suspect a Sinkhole

The following are some steps to follow if you suspect sinkhole activity:

STEP 1

Is the sinkhole located in or adjacent to a karst area? At least two resources can be contacted to help make this determination:
1) The Maryland Geological Survey's online Geologic Maps Series at *www.mgs.md.gov/* helps determine the presence of karst-prone limestones, dolostones, or marble; or 2) Consult local soil maps to identify areas where soils originate from or overlie limestone and other material with some

potential for developing sinkholes. Soil survey maps and interpretive information are accessible through local Soil Conservation Districts or by visiting www.sawgal.umd.edu/nrcsweb/Maryland/index.htm. [The 2002 Frederick County Soil Survey contains a soil interpretation table outlining the relative potential for sinkhole formation by soil series.]

If the sinkhole is not within or near a karst area, subsidence may be due to conditions caused by past human practices (i.e. old foundations, abandoned wells, buried debris, etc.).

STEP 2

If a sinkhole is within a mile of a quarry operation, it may fall within the Zone of Influence (ZOI), established by the Maryland Department of the Environment. [See page 13.] If it affects a Maryland state road, contact the State Highways Administration Engineers Office at 301-791-4790.

STEP 3

If the sinkhole is not within a ZOI, the following local agencies should be contacted:

Baltimore County

Department of Environmental Protection and Resource Management will inspect and determine appropriate steps for all sinkholes.
(Voice: 410-887-7428)

Carroll County

Sinkholes Associated with Agricultural Uses:
Carroll County Soil Conservation District will inspect and determine if a sinkhole is eligible for repair/mitigation cost share. (Voice: 410-848-8200)

Other sinkholes:
Carroll County Bureau of Resource Management
Program developed to map locations, provide technical assistance with repairs, and education on sinkhole occurrences. (Voice: 410-386-2639)

Frederick County
Sinkhole affecting county roads and rights-of-way:
Frederick County Office of Highway Operations.
(Voice: 301-694-1564)
Sinkhole on Private Property:
Frederick County Soil Conservation District.
(Voice: 301-695-2803)

Washington County
Sinkholes on County Roads or Highways:
Washington County Highway Department.
(Voice: 240-313-2720);
Washington County Engineering Department provides technical assistance/advice on sinkhole related problems on construction sites or existing dwellings:
(Voice: 240-313-2400);
For general assistance or advice or to report sinkholes affecting streets in Hagerstown city limits, contact the City Engineers Office
(Voice: 301-790-3200);
The County Soil Conservation District inspects and determines whether a sinkhole is eligible for MACs. (See page 15.)
(Voice: 301-797-6821).

Most local jurisdictions do not have programs or funding for sinkhole repair on residential or commercial/industrial property. The level of technical assistance available depends on the jurisdiction, but might include an approximation of the sinkhole's cause, potential for future occurrences or growth, proper repair techniques, and best-management practices to help avoid future occurrences.

LOCAL RESOURCES

Baltimore County

Questions about and reports of sinkholes are generally referred to the Department of Environmental Protection and Resource Management (DEPRM), Department for Public Works. The department generally sends an inspector to examine the sinkhole and determine "next steps." Voice: 410-887-7428.

Carroll County

The Carroll County Planning Department offers technical assistance to landowners and others. The office has documented approximately 500 sinkholes in the county— logging their location, size and treatment history. The office has given technical assistance to land owners on some sites, while conducting repair on those that endanger roads, sidewalks, or municipal and county wells. [Questions about private well and septic systems should be directed to the Environmental Health Division of the County Health Department (410-876-1884).] Department of Planning, Carroll County Office Building, Room 204, 225 N. Center Street, Westminster, Maryland 21157. Voice: 410-386-2145.

Frederick County

Questions about and reports of sinkholes on private properties are generally referred to the Soil Conservation District and/or Natural Resources Conservation Service, 92 Thomas Johnson Dr., Suite 230, Frederick, MD 21702-4300; Voice: 301-695-2803.

Washington County

If the sinkhole affects a county road or highway, residents are asked to call the Highways Department, at 240-313-2720. The department will take information about the sinkhole and send a supervisor to examine the site.

If the sinkhole affects a public project during construction, the problem goes to the project manager. If the problem occurs on a residential project or an existing dwelling, it is referred to a field inspector of the Engineering Department (Voice: 240/313-2400). Although unable to give material assistance, field engineers are generally able to advise residents on their karst-related problems.

NATURAL RESOURCES CONSERVATION SERVICE (NRCS) FIELD OFFICES AND COUNTY SOIL CONSERVATION DISTRICTS

Allegany County
11602 Bedford Road, NE
Cumberland, MD 21502
Voice: 301-777-1494

Baltimore County
Agricultural Building
9831 Van Buren Lane
Cockeysville, MD 21030
Voice: 410-666-1188

Carroll County
1004 Littlestown Pike
Suite B-2
Westminster, MD 21157-300
Voice: 410-848-6696

Frederick County
92 Thomas Johnson Dr.
Suite 230
Frederick, MD 21702-4300
Voice: 301-695-2803

Washington County
1260 Maryland Ave., Suite 101
Hagerstown, MD 21740-7204
Voice: 301-797-6820

When called upon by landowners in any county, **NRCS** staff are able to offer limited technical assistance. The Maryland office of NRCS has drafted an approved standard method (No. 725) for "treating sinkhole areas to reduce contamination of groundwater resources." [The updated soil surveys for Frederick and Washington counties provide a soil-interpretation rating for potential sinkhole occurrence by soil series.]

The **Maryland Geological Survey (MGS)** offers geological information obtained through applied geological studies and mapping. MGS develops information on Maryland's earth resources, and nurtures the wise and orderly development of these resources through geologic and hydrologic studies, assessments, and evaluations. (The Maryland Geological Survey observes its 110th anniversary in 2006.)

Private consultants can be found in area phone listings. When using an engineering firm, ask about geo-technical training, experience, and references.

Western Maryland Resource Conservation & Development Council (RC&D) — The Western Maryland RC&D is a private, nonprofit organization promoting environmental sustainability, education, natural resources stewardship, rural viability, and economic opportunities in Allegany, Carroll, Frederick, Garrett, and Washington counties. The RC&D Council manages natural resources projects in partnership with private foundations, businesses, non-profit organizations, and government agencies. The RC&D maintains a library of information about karst regions.

INFORMATION ON DISPOSING OF HOUSEHOLD HAZARDOUS WASTE

Carroll County Recycling Operations
225 North Center Street
Westminster, MD 21157
Voice: 410-386-2633

Frederick County Dept. of Waste Management/Recycling
URL: www.co.frederick.md.us/Recycling/
Voice: 301-694-1848

Washington County Solid Waste Department
Recycling: 240-313-2796
URL: www.washco-md.net/public_works/solid_waste/solidw.htm

Baltimore City Bureau of Solid Waste
URL: www.baltimorecity.gov/government/dpw/waste.html

Baltimore County Department of Environmental Protection and Resource Management (DEPRM)
Voice: 410-887-4066
URL: www.co.ba.md.us/Agencies/environment/hazwaste.html

NATIONAL LINKS

National Speleological Society
The National Speleological Society
2813 Cave Avenue
Huntsville, AL 35810-4413
Voice: 256-852-1300
www.caves.org

US Geological Survey
water.usgs.gov/ogw/karst/index.htm

Paula Grgich

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18450 Showalter Road, Suite 111 • Hagerstown, MD 21742-1383
Voice: (301) 733-2973 • Fax: (301) 733-7643
E-mail: wmarylandrcd@starpower.net
URL: users.erols.com/wmarylandrcd/