RIGHT-TO-FARM GUIDE

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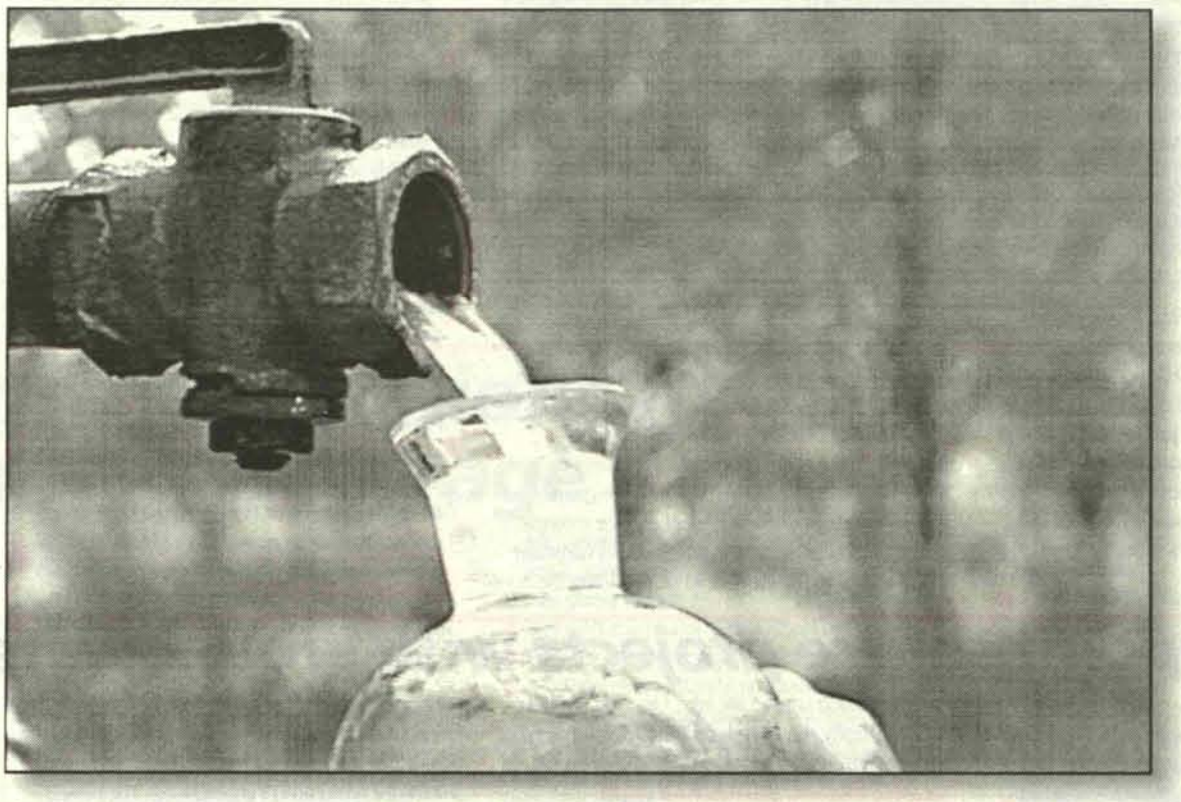
Groundwater stewardship guide



The third in the Right-to-Farm series provides Michigan Farm News readers with the Generally Accepted Agricultural and Management Practices for Nutrient Utilization recently updated by the Michigan Commission of Agriculture. This eight-page supplement provides management recommendations for managing soil nutrients and ways to protect the soil and water resources when applying added nutrients.

Groundwater: A step-by-step guide to the basics

by Bill Single, Groundwater Conservationist

Groundwater. Just how much do you know about this important natural resource? What exactly is it? Where can it be found? And why does it need protection?

Understanding groundwater is easier when you look at it with the benefit of knowing some of the truths and myths, and basic terminology.

We all take water for granted. Why not? There's enough in the world for everybody, right? Wrong. Of the earth's water, salt water accounts for 97 percent of the total. Another 2 percent is frozen, tied up in glaciers and at the polar ice caps. Basically, unusable. The fact is, only .65 percent of the earth's water is fresh water. Less than 1 percent! And of that 1 percent, only a small amount is considered "available" and uncontaminated or too deep to extract. We need to take care of what's "available," and that includes groundwater.

What is groundwater? Groundwater is water that exists beneath the surface of the earth. You may believe that groundwater is a series of massive underground streams and lakes. Actually, water saturating a sponge more accurately describes groundwater. Just as water fills the void spaces within a sponge, in the ground, water fills the pore spaces between the soil particles.

Where is groundwater? Water in the soil's upper layers may be utilized by plant uptake in an area called the unsaturated zone. Deeper in the ground, water exists in the saturated zone. The water we depend on to drink, bathe in, cook with and use on the farm is drawn from the saturated zone through private and public wells.

Where does groundwater come from? Groundwater begins with rain and snowmelt that seeps or infiltrates into the ground. Depending on the type of land surface present, some water percolates through the soil, some evaporates into the atmosphere, and some runs off the land surface and into other surface water bodies.

Does groundwater move underground? You bet it does. The flow of groundwater is irregular; it could move a few inches to a few feet each day. It depends in part on gravity, depth and geologic formation, as well as other factors. The point here is that contaminated water will travel.

How can we protect something we can't see? The reality is, groundwater is the unseen resource. So it's easy to abuse. By the time something contaminated reaches the groundwa-

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This publication made possible by a grant from the

Michigan Groundwater Stewardship Program

Michigan's Groundwater Stewardship Program

Mission: To provide information and assessment tools for pesticide and nitrogen fertilizer users that help them identify risks to groundwater associated with their pesticide and nitrogen fertilizer use practices and to coordinate local, state, and federal resources to help individuals reduce those risks.

The Michigan Groundwater Stewardship Program is designed to be voluntary, to be locally driven, to address the concerns of individuals, and to maintain a focus on the financial and technical constraints that drive real-world decisions.

The Michigan Groundwater Stewardship Program is relatively narrow in focus, addressing only risks to groundwater associated with pesticide and nitrogen fertilizer use. However, it has a wide scope and addresses the many uses of these materials, including agricultural, turfgrass and household uses.

Local programs

Local groundwater stewardship programs are being funded through a competitive grants program. Technical assistance personnel are hired to help individuals complete an on-site evaluation of risks and help implement practices that reduce those risks.

- Farm*A*Syst is used to perform an evaluation of farmstead practices. Fact sheets help raise awareness of groundwater issues and alternative practices while worksheets are used by the landowner to rank on-site risks faced by the landowner.
- Technical assistance personnel may work with landowners to develop a groundwater stewardship plan describing the cost-share and technical assistance resources available to implement specific groundwater stewardship practices.
- The final stage in the implementation process is the actual construction of facilities and use of groundwater stewardship practices.
- Spill Response Program provides technical assistance for individuals dealing with pesticide, fertilizer, and manure spills.
- The Cooperative Groundwater Monitoring Program is available for private well owners interested in their drinking water quality.
- Clean Sweep is a pesticide pick-up program that helps dispose of unused and unwanted pesticides in an environmentally sound manner.
- Container Recycling boosts efforts for collecting plastic and aerosol pesticide containers and works with the Michigan AgriBusiness Association to ensure an environmentally friendly outcome.

All of the program areas being supported by the Michigan Groundwater Stewardship Program are coordinated through representatives from Michigan State University Extension, Michigan Department of Agriculture, and the Natural Resources Conservation Service. Close coordination is also maintained with Michigan Farm Bureau, Michigan AgriBusiness Association, and the Michigan Association of Conservation Districts.

A 23-member private and interagency Groundwater Advisory Council serves to integrate local, state, and federal resources to help individuals implement practices which reduce their risk of having a groundwater problem.

Funding

Funds for this program come from industry-supported pesticide and fertilizer registration fees on specialty and agricultural products. Registration fees are paid for by companies that register their products for use in Michigan. A tonnage fee on bulk nitrogen fertilizers is also a source of funding. Nitrogen tonnage fees are paid directly by bulk fertilizer users.

Pesticide registration fees account for about 72 percent of the revenues with the remaining being provided by nitrogen fertilizer users. Specialty (household) products generate approximately 40 percent of the total revenues with the remaining coming from agriculture and other wide-area pesticide uses.

Over 85 percent of the revenues generated by these fees are returned directly to pesticide and fertilizer users through education, technical-assistance, applied research, and cost-share programs.

Many local programs are also coordinating demonstration programs that showcase and evaluate practices that have the potential to reduce the risk of groundwater contamination.

Local program direction is determined by Groundwater Stewardship Teams. These teams decide the mixture between cost-share, technical assistance, and/or demonstration provided by the local program. They ensure coordination of local resources and make sure the local program meets the groundwater protection needs of local pesticide and fertilizer users.

Local stewardship teams also serve as a collective voice for pesticide and fertilizer users in setting priorities for the statewide program. Efforts are currently underway to expand program coverage from its agricultural commodity basis to include a wide array of pesticide and fertilizer uses.

Commodity Programs

The Michigan Groundwater Stewardship Program also supports a variety of specific commodity-based programs for orchards, vegetable production, rights-of-way, Christmas tree production, turfgrass, corn producers, and household pesticide and fertilizer users. In these programs, surveys are used to provide information on existing pesticides and fertilizer use practices. This information supports an analysis of the relative risks and benefits of individual pesticide and fertilizer use practices between commodities.

Custom Farm*A*Syst on-site assessment tools are being developed for pesticide and fertilizer use practices that are significantly different from those addressed in the original Farm*A*Syst package.

Specific Groundwater Stewardship Practices, such as the development of alternatives to the use of simazine for weed control in orchards, are being developed and tested through an applied research program. Specific methods for supporting the implementation of Groundwater stewardship practices (one-on-one technical assistance, education programs for interest groups, support of school programs, cost-share, site certification, etc.) are being developed and tested.

Because of upcoming EPA State Management Plans requirements, priority is being given to commodity projects that address the use of atrazine, alachlor (Lasso), metolachlor (Dual), simazine, and cyanazine (Bladex).

Successful commodity programs should serve to balance favorably the risks and benefits associated with pesticide and fertilizer use and help retain the safe and effective uses of these materials in the State Management Plan process.

Other program areas

The Michigan Groundwater Stewardship Program is supporting a variety of other activities that relate to pesticide and fertilizer use and groundwater protection.

Accomplishments

Local groundwater stewardship teams covering the majority of the upper and lower peninsulas have been or are currently being established.

By the end of 1996, close to 5,000 Farm*A*Syst evaluations will have been conducted. As a result, over 1,000 abandoned wells have been properly plugged utilizing technical assistance and

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The final supplement in the Right-to-Farm series

A stream's humble beginning

If you've ever followed a Michigan stream upstream as far as you can go, you've probably found that the stream begins where groundwater emerges from the ground. This area may be a damp, soggy area (shown right), or an area where water is bubbling out of a stream bank.

Because nonpoint source pollution can impact both surface and groundwater resources, and because almost half of the people in the state rely upon groundwater for their drinking water supply, DEQ's Nonpoint Source Program has funded several projects to protect groundwater.

One example is the Sycamore Creek watershed, a southern Michigan creek and a recharge area for aquifers serving metropolitan Lansing and Ingham County. In 1988, DEQ staff began monitoring the creek to help identify and prioritize nonpoint sources in the watershed. Staff worked with the Natural Resources Conservation Service and Ingham Soil Conservation District to identify the water quality practices needed in the watershed.

To coordinate efforts in the watershed, a steering committee of federal, state and local agencies was formed. Megan McMahon is a member of this committee, and like other DEQ Nonpoint Source staff serving on local watershed committees, promotes systems of water quality practices that protect both ground and surface water. She also administers a Section 319 Nonpoint Source grant with the Ingham County Drain Commission to address nonpoint sources in Willow Creek, a tributary to Sycamore Creek.

Another Sycamore Creek Watershed Steering Committee member is Sid Hawkins. On his 2,400-acre farm, Sid removed underground fuel tanks and replaced them with above-ground tanks placed on concrete. He also is using "nurse tanks" and mix-load pads. Nurse tanks hold only water, rather than pesticides or fertilizers mixed with water, thereby reducing the likelihood of large pesticide/fertilizer spills to and from the field. The pesticides/fertilizers (which are in separate containers) are added (mixed) in the field. Mixing is done over mix-load pads designed to prevent small spills. Sid is featured in a recently printed document highlighting the successes of DEQ's Nonpoint Source Program.

In addition to participating on watershed project steering committees, DEQ Nonpoint Source staff also share information learned in one watershed with other watersheds. For example, as part of the Mitchell Creek Nonpoint Source Watershed Project, planners incorporated language in a local ordinance that protects groundwater recharge areas in the watershed. By highlighting this "overlay zone" concept in a success document, newsletters and during one-on-one meetings with other watersheds, DEQ nonpoint source staff pass this idea on to others throughout the state.

DEQ staff also help watershed planners throughout the state incorporate practices that allow rainwater to infiltrate back into the ground and replenish groundwater supplies. One example is using modular pavement, which allows rainwater to infiltrate into the ground, while providing the stability of conventional pavement.

Members of the recently formed DEQ Drinking Water and Radiological Protection Division are also heavily involved in groundwater protection. Staff work with watershed councils, Groundwater Education in Michigan (GEM) centers, and local governments to identify potential point and nonpoint sources of pollution within wellhead protection areas. DEQ staff also:

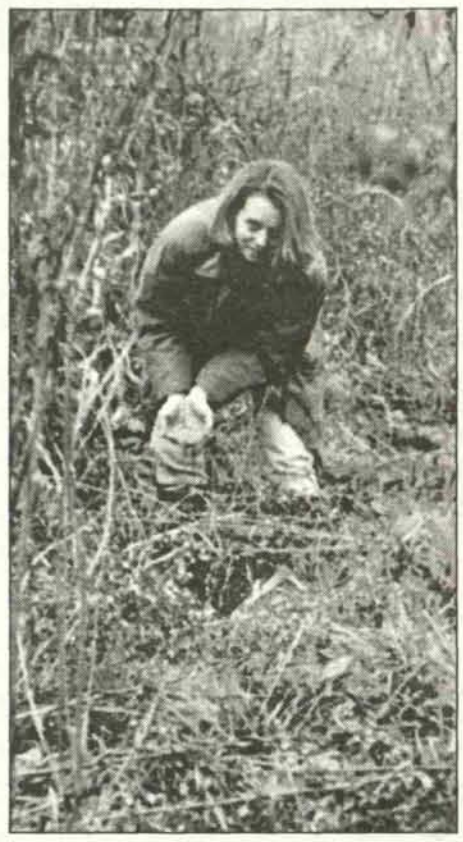
- Develop fact sheets and other written materials to assist with the management of point and nonpoint source pollution within delineated wellhead protection areas
- Provide groundwater expertise to Section 319 groundwater projects
- Support implementation of the Farm*A*Syst and other A*Syst projects
- Provide workshops and other training opportunities to learn about protecting groundwater in wellhead protection areas.

TERMINOLOGY

Nonpoint Sources: pollution carried off the land by wind or rain, including runoff from agricultural fields, construction sites and roadways.

Point Sources: discharges from industrial and municipal areas, such as wastewater treatment plants and manufacturing facilities.

Best Management Practices: systems of practices needed on any given site to treat or prevent nonpoint sources of pollution.



Megan McMahon, DEQ Nonpoint Source Program, showing the source of Willow Creek.

DEQ nonpoint source projects with groundwater components

Donnell Lake

This 4,659-acre watershed, located in the richest agricultural township in Cass County, was part of a three-year, Section 319 monitoring study conducted by the Michigan State University Institute of Water Research. The study demonstrated that water from most shallow wells in the watershed exceeds the drinking water standard for nitrate (10 mg/l). The intensive swine production which ranks the county first in Michigan, has resulted in the over application of manure to a watershed that possesses an abundant but very vulnerable groundwater supply. In addition, herbicides are also found in shallow well samples.

To address this problem, the University set as a goal 100 percent cooperation of the landowners in the watershed, with integrated cropping plans being developed for all farms. The plans provide for soil testing, pest scouting and manure management. Other activities include moving pigs off sensitive lands, building manure management facilities, providing erosion control, and buffering wetlands and other waterbodies.

To develop plans and install best management practices, the university pulled together the financial resources and expertise of several agencies, including NRCS, Soil Conservation District, DEQ Nonpoint Source, Western Michigan University, Michigan Department of Public Health, University of Michigan, Van Buren/Cass County Health Department, MSU Extension, and Penn Township, in addition to the agricultural community and homeowners.

To date, the project has made contact with all 19 producers and only one has refused to cooperate. Plans have been developed with the producers and Best Management Practices installed. Public participation has pulled together homeowners and farmers throughout the watershed; while farmers are installing BMPs, homeowners are financing sewer construction around the lake. Ongoing monitoring has already shown reduced nitrate concentrations in one area of the watershed.

Sanilac County abandoned wells

In Sanilac County, abandoned wells were identified as direct pathways for surface contaminants to reach groundwater supplies located in the Cass River, Black River and Lake Huron watersheds. Since groundwater is the primary source of drinking water for the residents in these watersheds, the Sanilac Conservation District pursued and was awarded a Section 319 Nonpoint Source Program grant to begin sealing the wells. To date, 1,500 wells have been mapped, cataloged and prioritized, and over 90 abandoned wells have been sealed.

By requiring pesticide and fertilizer management on all agricultural fields that received Section 319 funds, the threat of pesticide and fertilizer runoff has been reduced on approximately 38,000 acres of Michigan farmland.

Garden Peninsula

Groundwater in the Garden Peninsula in Michigan's Upper Peninsula, provides all residents in the area with drinking water. With limestone and dolomite bedrock being close to the land surface, there is little soil to filter surface contaminants and the aquifer is currently suffering from elevated levels of bacteria and nitrates. Potential sources of these pollutants include on-site sewage disposal, abandoned and poorly constructed drinking water wells, fertilizers and livestock waste.

In 1996, the Delta-Menominee Health Department received a Section 319 Nonpoint Source Program grant to develop an aquifer protection plan. The plan identifies the known and potential sources of groundwater pollution affecting the aquifer and the tools that will be implemented. Implementation of an information/education strategy and detailed site planning of Best Management Practices began in August, 1997.

Implementation will include installation of innovative sewage disposal systems, sealing abandoned wells, manure management practices, fencing, filter strips and exploring options for planning and zoning for protection of groundwater. The project also has a very strong information/education program directed at the primary pollutants.

Presque Isle aquifer protection

The Presque Isle aquifer is covered by thin glacial-lacustrine sand overlying limestone bedrock with fractures and karst features, making it extremely vulnerable to contamination. To protect this groundwater resource — which covers some half a million acres — the Presque Isle Soil Conservation District, working under a Section 319 Nonpoint Source Program grant, pulled together federal, state and local agencies. A comprehensive Geographic Information System was used to consolidate land use data, tax parcel identification, structure location and address, soil survey, karst features, oil and gas well information and water well information, all of which was used to identify the high-risk portions of aquifer. Once areas at high risk to water contamination were identified, systems of Best Management Practices needed to protect the aquifer were identified, and an information/education program initiated to educate local residents of the risks to water quality and the potential impact their actions might have. Implementation of the best management practices began this year.

Paw Paw River

The Paw Paw River Basin Groundwater Project was initiated through the collaboration of the Van Buren Conservation District and the Shelter Environment Section of the Michigan Department of Public Health (MDPH). The project, which was funded with a nonpoint source grant from 1990 through 1995, focused on eight key Van Buren County townships in the Paw Paw River basin.

The project began in response to elevated levels of nitrates and detectable pesticides in drinking water wells, particularly agricultural labor camps, identified in 1984 by the U.S. Geological Survey (USGS) and by MDPH in 1989. Out of 87 agricultural labor camps tested by the MDPH, 8 percent exceeded the 10 parts per million (ppm) drinking water standard for nitrates, and nearly half had detectable nitrates. The USGS testing found 22 percent of the wells in four key townships met or exceeded 10 ppm for nitrates.

As part of the nonpoint source project, technical and financial assistance was provided for agrichemical containment facilities for fertilizers and pesticides, chemical induction units for field application of agrichemicals, irrigation scheduling and irrigation system evaluations, irrigation well buffer strips, irrigation well check valves to prevent backsiphoning, integrated crop management, and abandoned well closures.

Sycamore Creek Watershed Steering Committee member Sid Hawkins (far right) with Sue Tangora of the Ingham Conservation District. At left is Sid's son-in-law, Tony Igl.

Groundwater: A step-by-step guide to the basics

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ter, the soil will have cleaned it up anyway, right? Not necessarily. The natural purification capability of the soil is limited. Many different and interdependent soil characteristics determine whether a contaminant actually reaches the groundwater – characteristics that are out of your control, which illustrates the importance of understanding not only how your actions can impact the groundwater, but how those actions ultimately affect the soil's natural ability to protect groundwater.

What are potential sources of groundwater contamination? Groundwater is an equal opportunity victim of contamination. Contamination can come from anywhere, from urban and rural sources. Farm operations can be a source of animal wastes, pesticides, fertilizers and petroleum products, and each can affect groundwater quality differently.

But what can you do? If you are an agricultural producer – large or small – start by participating in the Michigan Groundwater Stewardship Program offered through the Cass and Berrien County Conservation Districts. We can provide the education, technical assistance and, in some cases, the financial assistance necessary to help you identify and reduce risks to groundwater on your farm. It's a free service. It's voluntary. And it's confidential.

Groundwater. Your water. Go out and apply what you know so the water remains good for all.

Michigan's Groundwater Stewardship Program

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cost-share at the 90 percent level provided by the Michigan Groundwater Stewardship Program.

Other practices being demonstrated and implemented with support of the program include using portable mix/load pads, well backflow prevention, pre-sidedress soil nitrate testing, pesticide storage, fertilizer containment and sprayer calibration.

For additional information please contact:

- Kalamazoo Regional Office:
  Terri Smith (MDA) or Sally Stuby (MSU-E)
  (616) 383-8830
  E-Mail: stuby@msue.msu.edu
- Traverse City Regional Office:
  Kip Miller (MDA) or Roberta Dow (MSU-E)
  (616) 922-4620
  E-Mail: dowr@msue.msu.edu
- Grand Rapids Regional Office:
  Dave White (MDA) or Charles Gould (MSU-E)
  (616) 456-6988
  E-Mail: gouldm@msue.msu.edu
- Michigan Department of Agriculture — PPPM — Groundwater Stewardship Program
  4th Floor, North Ottawa Building
  Lansing, MI 48909
  (517) 335-6529

Osceola-Lake Conservation District

The Osceola-Lake Conservation District has been participating in the Groundwater Stewardship Program since 1995. Here are some programs they have implemented.

Farm*A*Syst — a voluntary and confidential program to help farmers evaluate farmstead practices that may pose a risk to groundwater. Participants in the Farm*A*Syst program include 151 farmers in Osceola County and the east half of Lake County.

Technical assistance and cost-share practices that are available through the groundwater program are:

- Temporary chemical storage
- Nurse tanks
- Portable mixing and loading pads
- Abandoned well closures
- Pre-sidedress nitrogen tests
- Split applications incentives
- Manure testing and analysis
- Cover crops.

Manure Calibration Workshop — held to determine the tons of manure applied per acre. The net weight of a load of manure was determined by using portable scales. The area that this load covered was measured. With this information, tons of manure per acre was determined. Nutrient value of the manure can be measured with a current manure test. From this, a balanced fertilizer recommendation can be made based upon the crop needs.

Demonstration plots — established for manure application using three different tillage methods. No-till, conservation tillage and conventional tillage were evaluated.

A 28 percent nitrogen applicator and nurse trailer — was purchased by the district. A concern arose on the amount of nitrogen that is leaching out of the root zone when all the nitrogen is applied at corn planting time. Until the purchase of the applicator, area corn growers did not have a convenient way of applying nitrogen after the corn was planted. Following a nitrate test, the 28 percent nitrogen is applied as indicated by the test.

Osceola-Lake Conservation District members learned how to determine tons of manure applied per acre through a manure calibration workshop.

Common-sense suggestions for practicing safer on-farm petroleum storage

What is the least I should do?

Use above-ground storage.

- Keep individual tank size less than 1,100 gallons, no more than three tanks per site, and separated by a minimum distance of three feet.
- Place the tank(s) on some kind of impermeable surface and a minimum of one foot off the ground.
- Keep tank(s) downslope more than 50 feet from private drinking water well, minimum of 40 feet from buildings, and at least 25 feet from property lines.
- Utilize some kind of barrier to prevent traffic from running into tanks.
- Utilize some kind of metering or recordkeeping system to ascertain fuel loss or leaking, and inspect site on a regular basis.
- Maintain protection against tampering (padlock), and utilize signage (Flammable - Keep Fire and Flame Away).
- Maintain appearance and integrity of tank with corrosion-resistant paint.
- If you have an unused underground storage tank, have it properly removed, or cleaned out and filled with inert material.
- Do not use old underground storage tanks for above-ground fuel storage.
- If you have an underground storage tank that was installed before 1988, upgrades must be made before 1998!

Other good ideas:

- Stay with equipment during fill and dispensing.
- Fill equipment over impermeable surface.
- Keep absorbent material on hand.

Petroleum storage tanks on Michigan farms are regulated by the following agencies, according to the size of the tank and the location – above or below the ground.

- Above-ground tanks of less than 1,100-gallon capacity — Michigan State Police, Fire Marshall Division, 7150 Harris Dr., Lansing, MI 48913, phone (517) 322-1755. Law controlling this size and type of tank is NFPA 395 with Michigan amendments.
- Aboveground tanks of more than 1,100-gallon capacity or underground tanks of less than 1,100-gallon capacity — Michigan State Police, Fire Marshall Division, 7150 Harris Dr., Lansing, MI 48913, phone (517) 322-1755. Laws controlling this size and type of tank are NFPA 30 & 30A with Michigan amendments.
- Underground tanks of more than 1,100-gallon capacity — Michigan Department of Environmental Quality (MDEQ), Underground Storage Tank Division, Towne Center, Second Floor, P.O. Box 30157, Lansing, MI 48909-7657, phone (517) 373-8168.

Protect your water supply from agricultural chemical backflow and contamination

Preventing contamination and pollution of water (drinking water, surface water and groundwater) is everyone's responsibility. Water contamination can occur from presumably innocent actions. Backflow from a polluted or contaminated source into a water supply system by way of a cross-connection is one way contamination can occur. A cross-connection is a connection or arrangement of piping through which backflow could occur. The following events actually happened.

Herbicide in the water system

"Yellow, gushy stuff" poured from faucets in a small Maryland town. The state banned drinking, cooking, bathing or using the water for any purpose except for flushing toilets. Pesticides had contaminated the water supply, and among the contaminants was a commonly used, potent agricultural herbicide.

Investigation of the problem revealed that water pressure in the town water main was temporarily reduced because of a water pump failure. Coincidentally, a gate valve between a herbicide holding tank and the town water supply piping had been left open. A cross-connection had been created that permitted the herbicide to flow into the portable water supply system. Upon restoration of water pressure, the herbicide flowed to faucets and other outlets throughout the town.

Insecticide contaminates water supply

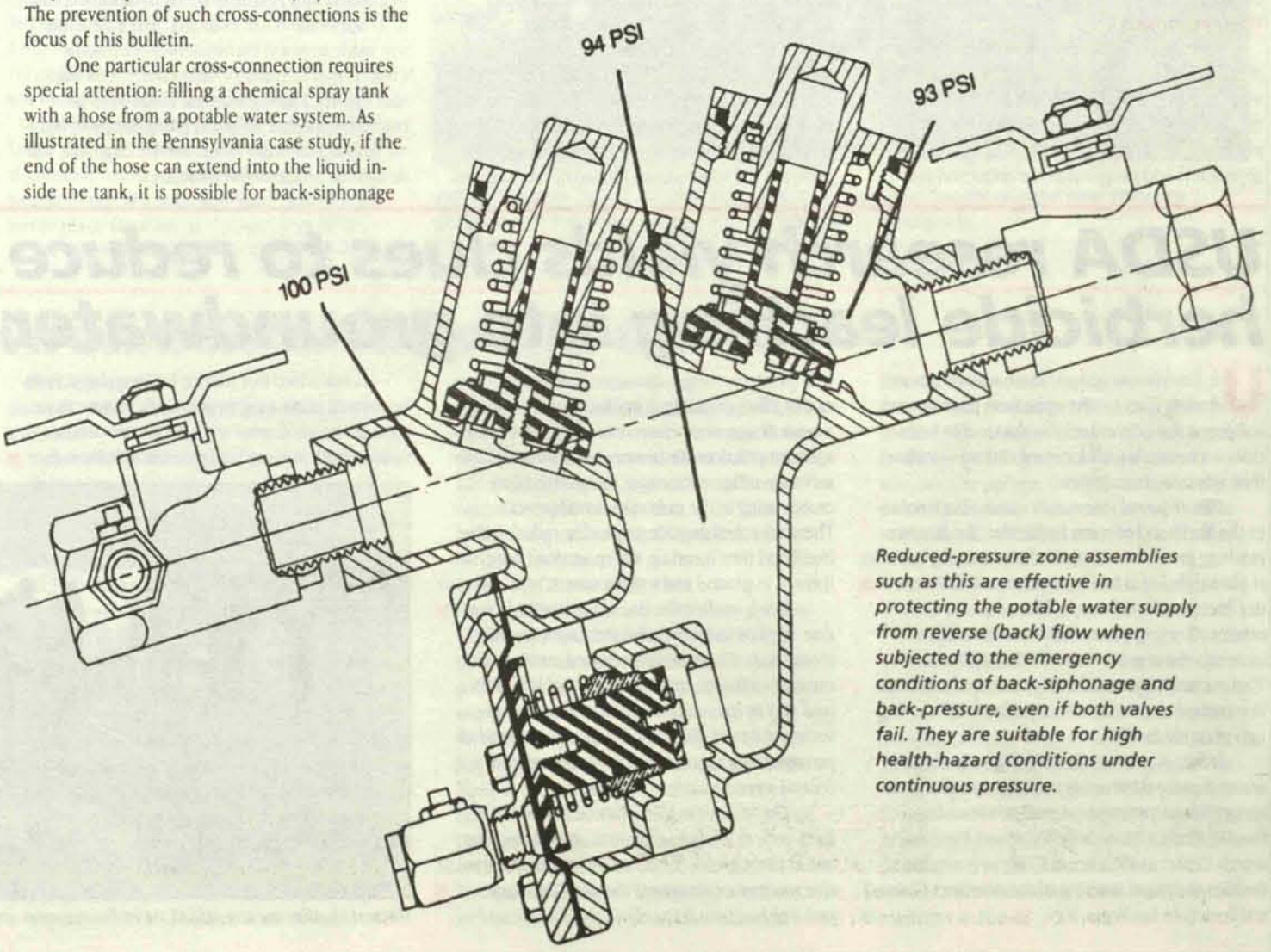
Insecticides entered the water pipes of a large apartment complex in Pennsylvania when a pest control operator used a garden hose from one of the apartment buildings to dilute an insecticide in a tank truck. At the same time, a city worker was cutting a 6-inch main line to install a valve.

The end of the garden hose was submerged in the tank containing the insecticide when water to the area was shut off and lines were partially drained prior to the valve installation. When the 6-inch water line was cut, water started to drain out of the cut. The insecticide was siphoned out of the exterminator's truck through the garden hose and into the water system, contaminating the water supply. Repeated efforts to clean and flush the lines were not satisfactory and the entire plumbing system had to be replaced. Fortunately, these situations were discovered and corrected before they caused permanent human injury or death. The prevention of such cross-connections is the focus of this bulletin.

One particular cross-connection requires special attention: filling a chemical spray tank with a hose from a potable water system. As illustrated in the Pennsylvania case study, if the end of the hose can extend into the liquid inside the tank, it is possible for back-siphonage backflow to occur if pressure in the water system is lost for any reason. Back-siphonage backflow could result in the spray tank chemical solution being drawn back into the water system or well, with disastrous results.

This back-siphonage backflow example can be prevented by using a technique as simple as an "air gap." That is, do not let the hose come into contact with the tank solution. Or use an approved backflow prevention device.

Pesticides can present human health hazards. Therefore, pesticides are classified as high-hazard materials when working with and around water supply sources.



Reduced-pressure zone assemblies such as this are effective in protecting the potable water supply from reverse (back) flow when subjected to the emergency conditions of back-siphonage and back-pressure, even if both valves fail. They are suitable for high health-hazard conditions under continuous pressure.

FOCUS ON SUCCESS

The Montcalm County Groundwater Stewardship Program

by Don Meister, Groundwater Technician
Montcalm County Soil Conservation District

The saying "ask, and it shall be given you; seek, and you will find" was literally fulfilled in Montcalm County last year. In 1995, 400 surveys were sent to agricultural pesticide and fertilizer end-users asking for their ideas and feelings on groundwater protection issues. The response was overwhelming and their message was clear – farmers want to do more to protect groundwater. The following are some of the concerns identified by the survey, and what the Montcalm County Groundwater Stewardship Program is doing to address them.

Reduce fertilizer costs

Free soil nitrate tests were provided last spring prior to sidedress time on 20 different fields. The average nitrogen savings over 500 acres was approximately 70 pounds per acre, for a total cost savings of about $7,000.

The goal for this year is to pull soil nitrate tests on 2,000 acres. Ten farmers have requested soil nitrate sampling this spring, many of whom were participants from last year.

Reduce nitrate movement from root zone

Seven farms reduced the potential for nitrate leaching from over-irrigation by using the Natural Resources Conservation Service's computerized irrigation scheduler. The scheduler program provides weekly information to the grower, based on crop and field inputs, on when to irrigate. In addition, an assessment was performed on 10 irrigation wells. None of these wells were found to be conduits for groundwater contamination.

Fifteen irrigation well samples will be pulled this summer and analyzed for nitrate content.

Protect groundwater from direct sources of contamination

A well closure demonstration was held last summer. Those attending learned the importance of decommissioning or "closing" abandoned wells and how to do it properly. In 1995, 10 wells were properly decommissioned. An additional 40 wells were closed in 1996. One result of these well closures is that a well driller has recently upgraded his equipment to better close abandoned wells.

Reduce impact farm structures and management activities have on groundwater quality

As a result of completing Farm*A*Syst assessments, farmers have implemented other practices to protect groundwater around their farms. Examples include building permanent pesticide and fertilizer mix/load pads, installing backflow prevention devices on water lines from wells, and putting in secondary containment structures around liquid fertilizer and fuel tanks.

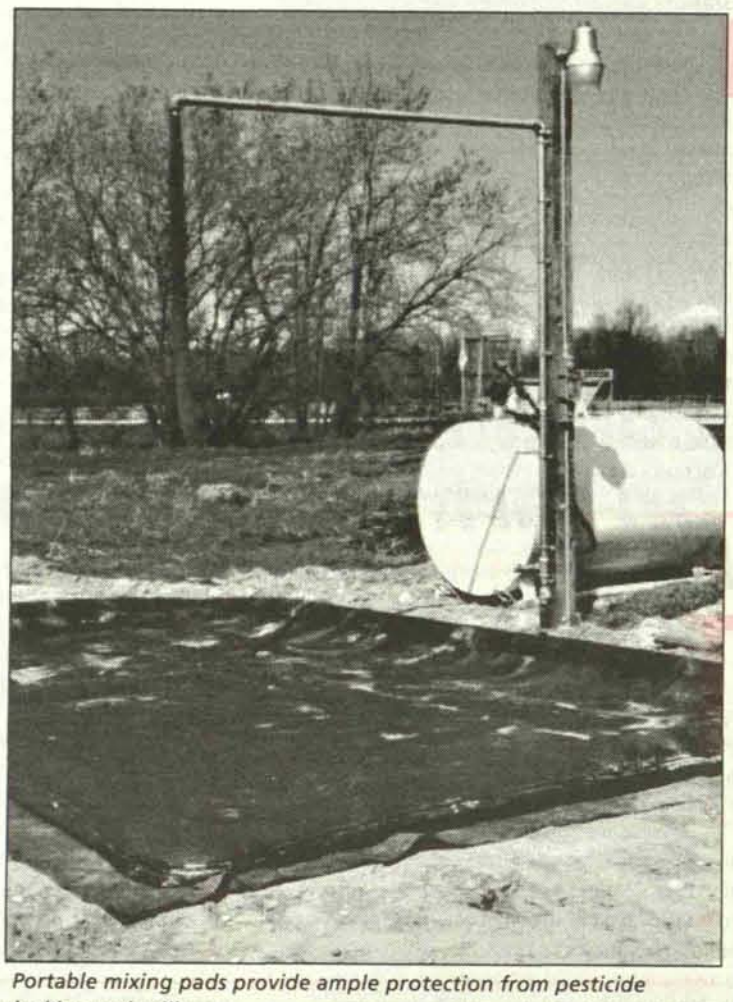
Montcalm MSU Extension and the Montcalm County Soil Conservation District recently sponsored a pesticide sprayer calibration clinic for county farmers. Work with farmers on nutrient analysis and correct application of manure is planned for this spring. Extension and the Soil Conservation District are also working with MSU crop and soil scientists to reduce N applications on potatoes through petiole analysis.

Address needs of fertilizer and pesticide end-users

In May of 1995, the Montcalm Water Quality Stewardship Committee was formed. This advisory group meets on a quarterly basis to provide guidance to both the Groundwater Stewardship Program and the Fish Creek 319 Watershed Program. The advisory group consists of farm organizations, farmers, government agencies and private citizens.

The challenge

The survey results have provided a rock-solid foundation for the Montcalm County Groundwater Stewardship Program to build on and will contribute heavily to its continued success in years to come. Success will be measured as the needs of agricultural pesticide and fertilizer end-users are met.



Portable mixing pads provide ample protection from pesticide leaking and spills.

Innovative farmers of Huron County

by Jim LeCureux, Agricultural Agent
Huron County Extension

The Innovative Farmers of Huron County was organized in 1994 in response to agricultural-related water quality concerns in the Saginaw Bay area. The intent of this group of farmers is to show the agriculture industry's willingness to address water quality concerns identified throughout the Thumb region.

Their approach

The group's initial efforts were in developing alternative tillage systems that reduced erosion while maintaining yields and family farm income – hence, the "innovative" in their name. While this is still a major area of emphasis, they are using the same approach to address groundwater protection concerns. Through on-farm demonstrations, ground and surface water protection practices are being modeled for farmers in the Thumb. Their results are drawing state as well as international attention.

Survey and Farm*A*Syst results

A survey of the group indicated that secondary fertilizer containment and herbicide injector systems were two priority areas of interest for groundwater protection practices. Results from Farm*A*Systs completed with area farmers by Sally Comer, MSU Extension water quality agent, and Joyce Muz, MSU Extension water quality program assistant, also supported the need for these practices. With this information as a foundation, a grant proposal to cost-share on these practices was submitted to and subsequently funded by the Michigan Groundwater Stewardship Program.

Fertilizer containment structures

Applications were distributed to farmers interested in containment structures. The response was overwhelming. Jim LeCureux, MSU Extension agricultural agent in Huron County and grant administrator, called a Groundwater Stewardship Team meeting to develop a system to evaluate and prioritize the applications. A total of 27 applicants were evaluated and a decision was made to place four structures in Tuscola County, four in Huron County and one in Saginaw County. Later, additional funds were received for another structure. Russ Shepard, Natural Resources Conservation Service engineer, will design the containment structures.

Herbicide injector systems

Farmers were interested in herbicide injector systems for several reasons. First, it allows the farmer flexibility to spot spray fields with specific weed problems. Second, injector systems drastically reduce the rinsate problems associated with conventional spraying systems. Both reasons protect groundwater quality.

The challenge

Protecting water quality is a serious matter for this 76-member group. They are a 501(c)3 organization and they used 100 percent of their grant for cost-share purposes (no overhead). Farmers and the public can see the results of their on-farm research during the annual "plot tour." Their challenge is to send a clear message that agriculture cares about water resources.

USDA research yields clues to reduce potential herbicide leaching into groundwater

U.S. Department of Agriculture researchers are finding clues to why some farm practices and soil properties help reduce the chance that herbicides — chemicals used for weed control — make their way into groundwater.

"We've found that conservation tillage reduces the likelihood of some herbicides like atrazine reaching groundwater, particularly in sandy, coastal plain soils," said I. Miley Gonzalez, USDA's Under Secretary for Research, Education and Economics. "Leaving plant residue on the surface increases the organic matter in the top soil layer. That increases the soil's ability to retain herbicides like atrazine and reduces the potential for leaching into groundwater."

Jeffrey M. Novak of USDA's Agricultural Research Service is currently studying the effects of various tillage practices on pesticide leaching at the ARS Coastal Plains Soil, Water, and Plant Research Center in Florence, S.C. He presents his findings today at a meeting of the American Chemical Society in Las Vegas, Nev.

"Once we better characterize all the processes that affect pesticide degradation and leaching, we can design more environmentally friendly management practices for farmers," said Novak. "Conservation tillage encourages the growth of microbes living in the carbon-enriched topsoil. These microbes degrade pesticides, reducing the likelihood they'll end up where we don't want them — in ground and surface waters."

Novak studied the fate of the herbicide atrazine, applied to Iowa glacial and Carolina sandy coastal soils. The scientists selected atrazine because of its use on millions of acres of U.S. cropland and its frequent detection in ground and surface water. In Illinois and Nebraska, millions of pounds of the chemical are used each year to control weeds, mainly in corn fields.

Novak added that atrazine leaching may actually be reduced in low-lying areas of fields because those spots are poorly drained and have greater carbon buildup. With increased carbon more atrazine is absorbed so less gets leached into groundwater.

Herbicide leaching and runoff is being studied at several ARS laboratories including Beltsville, Md.; Tifton, Ga.; Ames, Iowa; and Morris, Minn.

Recent studies by the USDA have found new clues to help fight against herbicide leaching.

FOCUS ON SUCCESS

Gratiot County Groundwater Stewardship Program liquid fertilizer storage

by Angie Reeves, Groundwater Technician
Gratiot County Soil Conservation District

In Gratiot County, there are a significant number of on-farm liquid fertilizer storage facilities. Very few of them, however, are protected with secondary containment in the event of a spill or leak. Case in point as told to me by a local farmer. This farmer visually inspected his liquid fertilizer tanks from time to time, and they appeared structurally sound and in good shape. He said he was confident they wouldn't leak. One day a tank sprung a leak. Fortunately, his hired help noticed the leak soon after it developed, so the amount of fertilizer leakage was kept to a minimum. However, with no secondary containment, the results could have been disastrous. Afterwards, upon close inspection with a heavy hammer, numerous weak areas on the verge of rupturing were discovered around the tank.

This incident, combined with other related concerns, prompted the local Groundwater Stewardship Team to identify secondary containment for on-farm storage of liquid fertilizer as a high priority of the Gratiot County Groundwater Stewardship Program. The team decided to cost-share three containment facilities at 50 percent, up to $5,000. They then chose three sites to receive funding. MSU Extension provided information about alternative types of secondary containment structure, and then each facility was individually designed by a Natural Resources Conservation Service engineer to fit the unique needs of the producer.

The first site was the Randy Litwiller farm. A 64' x 36' earthen berm was formed and a geomembrane material laid on top. Vertical steel tanks, with the potential of storing up to 70,000 gallons, were placed on 6-inch platforms of pea-gravel within the berm. The advantage of an earthen berm is the low cost of expanding or moving the facility. The total cost for this facility was $6,730.

Protection from the elements was important at the second site, the Don and Roger Gable farm. A 36' x 46' treated lumber berm, lined with geomembrane material, was constructed under a pole-type building to help protect six 6,500-gallon polypropylene tanks from the sun's damaging rays. The cost for this facility was $11,970. The advantage of this type of facility is that the liner and tanks can be removed and the building used for other things if at some point there is no longer a need to store liquid nitrogen.

The third site, the Weburg farm, wanted an enclosed, roofed facility. A 30' x 42' cement berm, covered with a geomembrane liner, was constructed and six 12,000-gallon fiberglass tanks placed on cement pads inside it. The floor of the containment is 8 feet below the ground with an entrance door at ground level. A catwalk enables the producer to gain access to the storage tanks for loading and unloading. The cost of this facility exceeded $20,000.

Our experience with these three different designs indicates the most cost-effective secondary containment structure is the earthen berm. Its only undesirable feature is the routine need for pumping out rainwater. Randy Litwiller sums up his feelings about his secondary containment with one sentence, "Just knowing it is there allows me to sleep better at night."

Property owners hear water quality speaker

The quality of water in Bear Lake is of particular concern to everyone who lives in this area, but it was pointed out by a guest speaker at the recent Bear Lake Property Owners meeting that the quality of the "lake" that exists under our feet may have just as much impact as the water that laps the shore in front of our homes.

Murray Stall, groundwater technician with the Mason Lake and Manistee County Conservation Districts, detailed a new program available to homeowners in the county called Home*A*Syst, which lets property owners evaluate the water and waste treatment systems in their own homes and determine where problems may occur. The group was asked to divide a pie chart into salt water, fresh water and "available" fresh water and were surprised to discover that salt water takes up well over two-thirds of the chart, and a very small sliver represents the fresh water that is available.

After delineating the material in the Home*A*Syst packets (site assessment, managing household trash and hazardous waste, yard and garden care, well management, septic systems, and handling liquid fuels), Stall discussed common problems that affect groundwater and possible solutions. Groundwater is fairly easy to protect with some common-sense forethought, but very hard to clean up once contaminated.

One of the initial thrusts of the Michigan Groundwater Stewardship Program is the closing of abandoned wells – not a small problem in this part of Michigan where there are so many old farmsteads. Closing an abandoned well costs about $100, and can only be done legally by a property owner or a licensed well-driller. However, under the auspices of the Groundwater Stewardship Program, there is money to reimburse property owners for about 80 percent of the cost, and Stall is available to give technical assistance.

Dug or driven wells that are not closed are a permanent "straight pipe" to the aquifer below, with any surface contamination (pesticides, herbicides, hazardous waste) easily entering our drinking water. Stall urges anyone who knows of the existence of such wells to consider closing them permanently. Stall can be reached through the Manistee County Conservation District at 8840 Chippewa Hwy. (near Nine Mile Rd.), phone (616) 889-4761 for further information.

Discussion after Stall's presentation centered around several topics. The fact that Manistee County has no method of disposal for household hazardous waste was lamented. Counties surrounding this area have all managed to hold at least annual "Household Hazardous Waste Disposal Days," but Manistee County has not yet been able to provide this service for its citizens.

Attendees also questioned the continued problem of storm drains that deposit runoff directly into Bear Lake. One person mentioned that a new U.S. 31 drain is presently being constructed on the north edge of Bear Lake Village that has no retention area. Salt, oil and other fluids generated by automobiles are dumped directly into the lake.

Another ongoing problem is lakefront lawns that are fertilized. Homeowners should, if possible, leave a stretch of natural vegetation between the lawn and water and should never place fertilizer any closer than 30 feet to the water. Even fertilizers that are considered non-toxic (such as "Milorganite") are nutrient-rich and can aid weed growth.

Malfunctioning septic systems can provide similar nutrients, if not actual bacteria. Some older systems were placed quite close to the shoreline before there were any rules regarding placement, and some "systems" consist of just a 50-gallon oil drum. Owners who aren't sure about the efficacy of their systems should have them inspected by a knowledgeable person or plumbing firm.

Officers of the property owners group were directed to write letters to the state and county highway departments, drain commission, and county and township boards, regarding the continued neglect of some form of water retention or cleansing of storm water runoff into Bear Lake, with a decision to begin a petition to those bodies at the annual meeting. Individual members were in turn urged to contact their own local officials or to attend local meetings.

Earlier this year, Bear Lake property owners in Manistee County learned how they can protect their environment through the Home-A-Syst program.

Agricultural environmental facts and trends

It is useful to summarize some of the recent trends in pesticide and fertilizer use, and water quality. They all indicate that agriculture is working to reduce the amount of inputs applied and increasing the efficiency of use of those inputs that are applied.

- Crop protection chemical use on corn, soybeans, wheat and sorghum was down 24 percent between 1982 and 1992. For these crops, insecticide use was down 50 percent and herbicide use was down 21 percent.

Source: Agricultural Resources and Environmental Indicators. 1995, USDA ERS Agricultural Handbook Number 705. P 90

- Integrated Pest Management (IPM) reduced insecticide use on cotton by 74 percent over a six-year period from 1976 to 1982. During that time, planted acreage declined only 2.5 percent and average cotton yields increased by 27 percent.

Source: USDA

- Nitrogen-use efficiency of U.S. corn grain (based on a five-year rolling average) is up 21 percent from 1980 to 1993.

Sources: USDA and Potash and Phosphate Institute

- Since 1986, Farm Bureau's Cooperative Well Water Testing Program has assisted over 58,000 farm families in 24 states to test their well water for nitrate. As of January, 1995, Heidelberg College's Water Quality Laboratory in Tiffin, Ohio, has tested 42,983 of those samples. Only 3.9 percent of those samples were above the Safe Drinking Water Act standard of 10 parts per million (ppm) nitrate-nitrogen. Over 84 percent of the wells fell below 3 ppm, which is generally considered to be within natural background levels.

Sources: AFBF and Heidelberg College

- Erosion on 36.5 million acres of Conservation Reserve Program land is down 90 percent to around 1 ton/A/yr. (Most soils naturally regenerate at rates of 2 to 12 tons/ac/yr.)

Source: SWCS 1992

- The government's conservation compliance requirements for 135 million acres of highly erodible land will reduce erosion an additional 5 tons/A/yr, or 50 to 60 percent compared to levels existing in 1990 when compliance began. However, voluntary erosion control efforts before 1990 had already produced 14.1tons/A/yr of erosion control on highly erodible land, or 2.75 times more erosion control than all the efforts of conservation compliance will produce.

Sources: SWCS and AFBF 1992

- Crop residue management (CRM) leaves at least 15 percent of the soil surface covered with old stalks and leaves which dissipate raindrop impact and wind erosion. Various forms of CRM are now used on 61 percent of all planted acres. No-till soybean acreage rose dramatically from 2.2 million acres in 1989 to 15.8 million acres in 1995. No-till is one form of CRM and can reduce erosion by 90 percent. Favorable yields and reduced costs have keyed CRM's rapid growth.

Source: CTIC 1995

- The National Resources Inventory found the average sheet and rill erosion on cropland fell from 4.1 tons per acre per year in 1982 to 3.1 tons per acre per year in 1992 (a 25 percent reduction). The average rate of wind erosion cropland fell from 3.3 tons per acre per year to 2.5 tons per acre per year over the same period (a 24 percent reduction). These rates are well within most soils' natural ability to sustain productivity.

Source: 1992 NRI, USDA SCS

- Wetlands drainage due to agriculture averaged only 29,000 acres per year between 1987 and 1991. (That's down from 157,000 acres per year between 1974 and 1983, and is about one-fourteenth as much as the annual loss estimate of 398,000 acres per year for the period 1954 to 1974.) And, that does not count the restoration of over 400,000 acres of wetlands during the last five years via the Conservation Reserve Program, Wetlands Reserve Program and other private programs. Meanwhile, urban drainage of wetlands now accounts for over 54 percent of wetland losses each year.

Source: 1992 NRI, USDA SCS & Agricultural Handbook # 705

Plugging abandoned wells

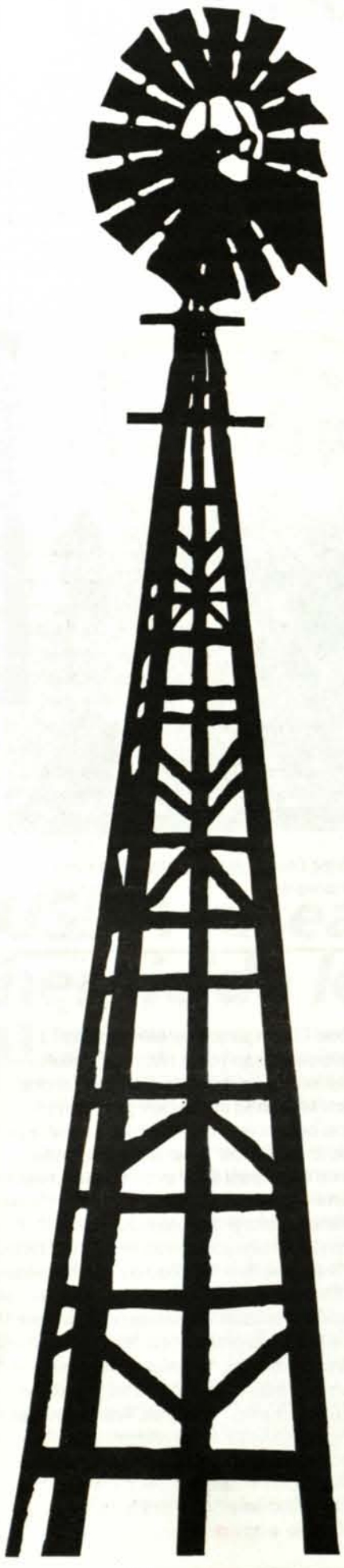
What is an abandoned well?

An abandoned well is a well that is no longer in use or that is in such disrepair that groundwater can no longer be obtained from it. Wells that are contaminated and pose a health risk also meet Michigan"s legal definition of an abandoned well.

No one knows exactly how many abandoned wells there are in Michigan, but experts estimate that there may be more than one million! Each year, many wells are abandoned when they are replaced with new wells or when homes are connected to community water systems. An abandoned well that is not plugged, or that is plugged improperly, is a hazard to the health and safety of the people living around it. If you are not sure if you have an abandoned well on your property, please refer to the section entitled, "How can I find out if I have an abandoned well on my property?"

What problems do abandoned wells present?

- They are a public safety hazard. People (especially children) and small animals may be injured or killed by falling into wells that are left open.
- They are a health hazard because they serve as potential routes for groundwater contamination. Many of these wells are poorly constructed or badly deteriorated, and can allow runoff water (carrying bacteria, sediment, fertilizer, pesticides, and other chemicals) to flow directly down into groundwater. This bypasses the natural filtering and degradation processes that can take place as these materials move through the soil.
- They may allow contaminated or poor quality water to move between aquifers. An abandoned well that connects two water-bearing geologic formations (aquifers) of different quality may allow lower-quality water to migrate into and degrade a higher-quality aquifer.
- They may lead to unnecessary waste of water (if the abandoned well is an artesian or flowing well).



Why must abandoned wells be plugged?

Merely capping an abandoned well is not enough to prevent it from becoming a problem. In order to protect the health and safety of the people living near them, these wells must be properly plugged (or sealed) soon after abandonment.

You should realize that you are required by state law to have your unused well(s) properly plugged. You may save money by having your old well plugged at the same time a new well is being drilled. Protecting the quality of your new well by having your old well(s) properly plugged is a wise investment!

You should also be aware that you may be held potentially liable under Michigan's Polluter Pay Law (1982 PA-307 as amended by 1990 PA-234) if groundwater contamination is shown to have been caused by your abandoned well. Thus spending a few dollars now to properly plug your abandoned well may prevent you from having to pay large sums of money for restoration and cleanup costs in the future!

Procedures common to the plugging of all wells

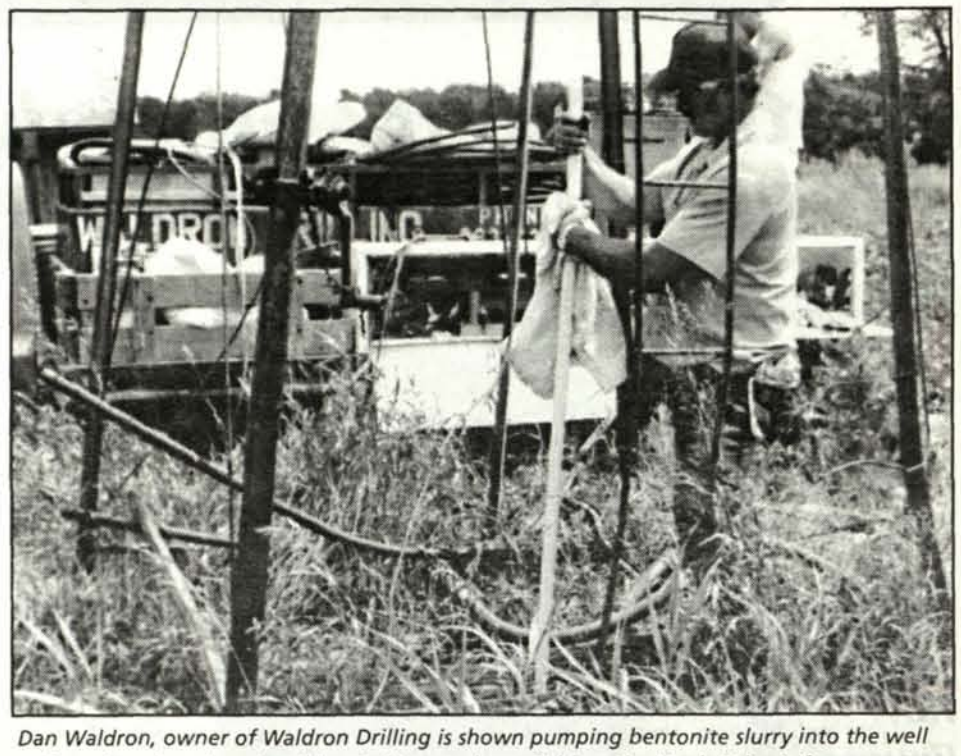
There are three types of water wells used in Michigan, and the recommended plugging procedures differ for each type of well.

Though the particular method to be used for plugging a well depends upon the type of well and the existing geological conditions, several steps are common to the plugging of all abandoned wells:

- Contact your local health department to request a copy of the well log. This is a record filed by the well driller upon completion of the well. It provides information on well depth, casing diameter, depth to water, geologic formations penetrated, and more.
- Remove all pumping equipment, pipes, debris, and other obstructions from the well.
- Measure the well depth and casing diameter to determine the volume of plugging material needed. A weighted tape or string is suitable for this purpose.
- Plug the well using the materials and procedures described in the next two sections of this bulletin.
- Remove/cut off the well casing at least 4 feet below ground level to eliminate interference with future use of the site and damage to excavation equipment. Generally, well casings are not required to be removed entirely.
- Mound and compact low permeability soil over the plugged well to prevent ponding of surface water above the site.

It is important for you to know the type of abandoned well you have prior to plugging. The three types of wells are:

- **Driven wells —** consist of a pointed well screen attached to 1 .25- or 2-inch steel pipe driven into the ground, generally to depths of 30 feet or less.
- **Dug wells —** are large diameter wells (12 inches or greater) excavated generally into shallow aquifers, with the well bore supported by stone, brick, concrete, tile, or other curbing material.
- **Drilled wells —** are wells generally deeper than 30 feet, eased with 2- to 6-inch steel pipe or 5-inch plastic pipe. When plugging a drilled well, it is important to know whether it is a rock well or a sand/gravel (screened) well.



Dan Waldron, owner of Waldron Drilling is shown pumping bentonite slurry into the well casing of an abandoned well located in a soybean field on the Hugh Roberts farm near Carson City. Once the casing was sealed with the bentonite, the well casing was cut off three feet below the surface. The windmill and rigging are to be removed and the well pit filled with soil so the land over the old well can be farmed without causing the groundwater to be contaminated.

Can I plug the well myself?

In most cases, driven wells and large diameter dug wells can be successfully plugged by non-professionals with a minimal amount of special equipment. Be aware, however, that a poor well plugging job is no better than an open well! The use of improper materials or methods can lead to groundwater contamination. Also, once a well has been plugged improperly, it is quite costly to correct, since the defective plug must be drilled out. Thus, it is often wise to seek qualified help by contacting a Michigan licensed water well drilling contractor. They have the special tools, equipment, and skills needed to properly plug wells.

It is recommended that wells with one or more of the following characteristics be plugged by well drilling professionals only:

- Drilled wells
- Flowing wells
- Wells greater than 100 feet deep
- Wells where water is seeping from around the casing
- Wells that produce gas
- Wells where pumping equipment is difficult to remove.

Specific plugging requirements based on well type

- **Driven wells —** can be abandoned by extracting the casing and filling the remaining hole with neat cement, bentonite slurry, or bentonite chips or pellets. The casing may also be left in place. The plugging materials should be applied as described in the next section.
- **Dug wells —** due to the large volume of these wells, fill materials (such as clean soil) may be used to reduce plugging costs. A layer of bentonite chips or pellets at least 6 inches thick should be placed at the bottom of the well and at the water level. Layers of clean soil not more than 10 feet thick are then placed alternately with layers of bentonite chips or pellets (at least 6 inches thick) between each soil layer. The upper 4 feet of concrete crock, stone, or brick should be removed. Prior to backfilling and mounding, a layer of bentonite chips or pellets at least 6 inches thick should be laid down, followed by the addition of water to expand the bentonite.
- **Drilled wells —** should be plugged by well drilling professionals only! These wells may be several hundred feet deep, and removal of pumping equipment may require special equipment. The specific plugging procedures depend on whether the well is a sand/gravel (screened) well or a rock well (i.e. drilled in bedrock).
- **Sand/gravel wells —** should be plugged by filling with neat cement, concrete grout, high-solids bentonite slurry, bentonite chips, or bentonite pellets. Apply materials as described in the next section.
- **Rock wells —** should be plugged by filling with neat cement or concrete grout from the bottom of the well to at least 20 feet above the top of the bedrock. Bentonite is not acceptable for plugging the rock portion of the well! The remainder of the well (from 20 feet above the bedrock up to the surface) should be plugged with neat cement, concrete grout, high-solids bentonite slurry, bentonite chips or bentonite pellets.

Well plugging materials and placement recommendations

Careful selection and use of materials are essential to effective well plugging. Never use waste materials for well plugging! Plugging materials are used to prevent water from migrating into or between aquifers. They are less permeable to water than native soil or rock. The following well plugging materials are approved for use in Michigan:

- **Neat cement —** a mixture of one 94-pound bag of Portland cement (Type I or IA) to not more than six gallons of water. Portland cement is readily available at building supply stores.
- **Concrete grout —** a mixture of neat cement with 1 cubic foot of sand or aggregate added per bag of cement.
- **Bentonite clay —** a swelling clay available as granules or powder that can be mixed with water to form a high-solids slurry, or as chips or pellets that swell in water to form an effective plug. Bentonite clay can be purchased from water well drilling supply stores.

Other plugging materials and methods may be used on a case-by-case basis if prior approval is given by the local health department.

Neat cement, concrete grout, and high-solids bentonite slurry must be placed continuously from the bottom of the well up to the surface through a pipe (1"- 2") extending to the bottom of the well. The pipe is gradually withdrawn as the plugging material is placed. The use of neat cement or bentonite slurry requires special mixing and pumping equipment, which well drilling contractors have.

Bentonite chips or pellets are effective well plugging materials that are simple to use. These materials do not require special mixing or pumping equipment and are placed into the well by pouring. The large particle size (3/8"- 3/4") falls rapidly through water. However, bridging may occur if the bentonite is poured too fast or if fine powder that accumulates in the shipping contain-

er is not sifted out. Bridging is when the plugging material fails to fall and accumulates above an open space. The bridge may collapse later, resulting in an incomplete and ineffective seal. The chips or pellets have a greater chance of bridging in small diameter wells and in deep wells. A pouring rate not to exceed 10 pounds of material per minute is recommended for 4-inch diameter or larger wells. For 2- or 3-inch diameter wells, a rate not to exceed 5 pounds per minute is recommended. When plugging 1.25-inch driven wells, the chips or pellets should be placed individually.

Bentonite chips or pellets should be poured into the well through a funnel with a spout about half the diameter of the well. A simple 2' x 2' trough made of hardware cloth with .25-inch openings can be placed on the edge of the funnel to sift out the fine powder. During plugging, check the well periodically with a pipe or a weighted tape to make sure that bridging has not occurred. If a bridge has formed, it should be broken with the pipe or drilled out. Once the chips or pellets have been brought to the surface, water should be poured in to expand the bentonite above the water in the well.

How much plugging material do I need?

The table is useful in determining how much plugging material is needed. When plugging wells drilled in bedrock, it is a good idea to have additional material on hand. Borehole irregularities increase the volume of plugging material required.

Are there any reporting requirements?

Yes. You are required by state law to file a record of the well plugging with the local health department. This report should include the type of plugging material used and the method of placement. Forms for this purpose are available from the local health department. A copy of the plugging report should also be filed with the property deed.

How much will plugging my abandoned well cost?

Costs vary depending on the well depth, casing diameter, the amount of plugging material used, and other factors. A shallow driven well may be plugged for as little as $25, whereas a deep municipal well may cost several thousand dollars to plug. Costs can be reduced by having your old well plugged at the same time your new well is being drilled. Since an unplugged abandoned well can contaminate your water supply well, the cost of plugging is a worthwhile investment.

How can I find out if I have an abandoned well on my property?

A simple look around may help you identify an abandoned well. The most obvious evidence of an abandoned well is a pipe sticking out of the ground. Typically, a well casing will be a metal pipe that is 1.25 to 6 inches in diameter. A small concrete slab or a manhole cover may be the sign of a pit where an abandoned well is located. A ring of rocks, bricks, or concrete 12 to 36 inches or more in diameter may be sign of a dug well. Windmills are often located over abandoned wells, and an old shed may be an old well house. Also, a broken or inoperative hand pump may be connected to a well that should be plugged.

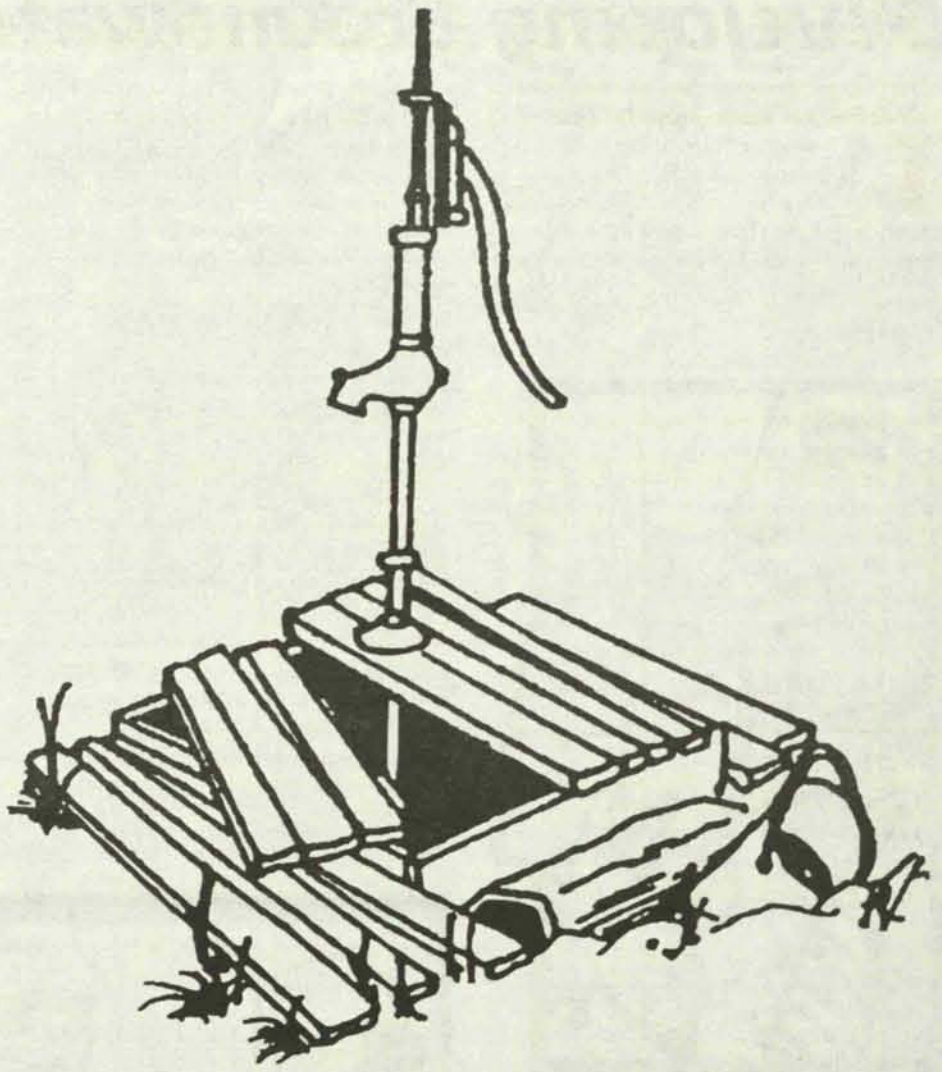
Some abandoned wells may be more difficult to identify. Many are hidden amongst weeds or patches of brush. A depression in the ground may occur where an old well was buried. A wet area may indicate that a flowing well was never properly plugged.

To help you determine if you have an abandoned well on your property, you may wish to consult:

- Former property owners or neighbors, who may remember where a well was located
- Old photographs, which may show windmills, sheds, houses, or other locations where old wells might be found
- Well drillers, who may remember (or have records of) where they drilled a well that is no longer being used
- Fire insurance plan drawings, which may contain information about old wells
- Your local health department, which may have records of wells located in your area.

Who can I contact for information and/or assistance?

- Your local health department
- Licensed well drilling contractors (in the Yellow Pages under Water Well Drilling & Service)
- The Michigan Well Drillers Association at (313) 428-0020
- Your local Soil Conservation District office
- The Michigan Department of Public Health Well Construction Unit at (517) 335-9183



Well Diameter	Volume per lineal foot		Feet of well plugged	
			Neat cement	Bentonite chips
(inches)	(cubic feet)	(gallons)	(per 94 lb. Bag)	(per 50 lb. Bag)
1 .25	0.01	0.07	118.0	70.0
2	0.02	0.17	51.3	31.3
3	0.05	0.38	23.1	14.3
4	0.09	0.66	13.4	7.9
5	0.14	1.00	8.5	5.1
6	0.20	1.50	5.9	3.5
8	0.35	2.60	3.4	2.0
12	0.80	6.00	2.1	0.9
18	1.77	13.20	0.7	0.4
24	3.14	23.50	0.4	0.2
36	7.07	53.00	0.2	0.1

Grand Traverse Bay Watershed Initiative

The 1,000-square-mile watershed of nearly pristine Grand Traverse Bay, which empties into northern Lake Michigan, is one of Michigan's fastest-growing areas. In 1990 residents formed the Grand Traverse Bay Watershed Initiative to preserve the region's water resources. The membership includes approximately 100 economic development corporations, citizen organizations, land conservancies, local governments, chambers of commerce and educational interests. Commitment of staff and funding is totally voluntary.

In its four years of existence, the partners have undertaken 55 projects. One innovative initiative involved developing a master plan for a subwatershed that is rapidly urbanizing. City and township planners in three communities worked together to formulate the plan. The resource base was inventoried to categorize sensitive areas, and existing zoning ordinances were examined to determine areas where the laws have compatible language. The goal was to develop a plan that all three communities could buy into.

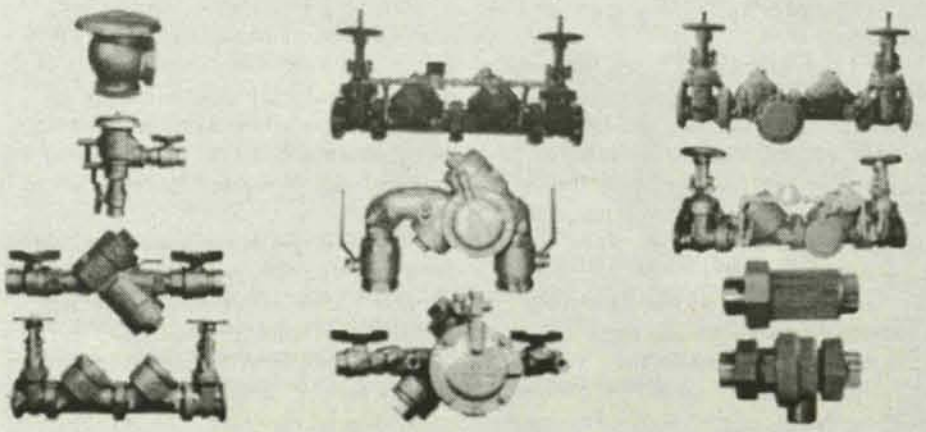
The process was proactive, nonconfrontational, open and participatory. Newspaper advertisements and postcards mailed to residents actively encouraged attendance at public meetings. Those who participated were shown natural resource maps that delineated individual land parcels, enabling owners to identify their own property. One parcel was selected, and the meeting's leader suggested various options to the owner. Rather than saying the landowner should not develop the property, the leader noted that subdivision could be designed to accommodate natural resources.

The International Joint Commission, a treaty organization between the United States and Canada for resolving disputes over boundary waters, has recommended Grand Traverse Bay as a model for other rapidly developing localities around the Great Lakes.

Selecting the proper backflow prevention device

Backflow prevention devices are available in a wide range of types and styles. They range from small, simple units to large, complex assemblies. The selection of the most appropriate device depends on the particular situation. Pesticides are considered a health hazard and require a device that will protect the water supply from high hazard conditions and materials. Exercise considerable care when selecting a device. Any device selected to protect the potable water supply from cross-connection backflow contamination must be approved for use by the state and meet local and state plumbing codes.

Additional help in developing suitable cross-connection controls is available from experienced licensed plumbers, representatives of the manufacturers of approved backflow prevention devices, your local supplier or the Agricultural Engineering Department at Michigan State University. Extension Bulletin E-2099. "Using Chemigation Safely and Effectively," available from MSU, discusses backflow prevention in chemigation. Also, the American Society of Agricultural Engineers (ASAE) has developed a standard for safety devices. "Safety Devices for Chemigation" addresses backflow prevention for chemical injection into irrigation and similar water systems. This publication, ASAE EP 409, can be obtained by calling the ASAE at (616) 429-0300, FAX (616) 429-3852, or writing ASAE, 2950 Niles Rd., St. Joseph, MI 49085-9659.



An example of the many types and styles of backflow prevention devices on the market.

Operation Green Stripe

Just 10 feet of vegetation along a stream can trap up to 70 percent of the sediment that erodes from fields. Vegetative buffer strips can also reduce chemical runoff and provide wildlife habitat. FFA chapters are recruiting farmers to plant buffer strips under Operation Green Stripe. Agricultural retailers provide free grass seed, and Monsanto Company contributes educational grants to FFA chapters based on the number of farmers the students recruit. The program is voluntary and proactive, as well as educational.

Operation Green Stripe was inaugurated in 1992 with a demonstration program in Wisconsin. By 1993 it had expanded to 16 states. The Natural Resources Conservation Service helps promote Operation Green Stripe with farmers and provides technical assistance on planning and installing the buffer strips. The midwestern region of the U.S. Fish and Wildlife Service has committed financial resources to expand the program.

Environmental organizations also are becoming involved. Organizations such as Pheasants Forever provide advice on the best grasses for attracting wildlife. The Nature Conservancy has identified watersheds where Operation Green Stripe can help maintain biodiversity.

Markets for pesticides include the agricultural industry, forestry, utility lines, municipal landscaping, and homeowners. Rather than taking the unrealistic approach of eliminating pesticides, the chemical industry believes that it is the practice itself that should be addressed. With Operation Green Stripe, Monsanto has taken a proactive approach that reduces runoff of pesticides while greatly decreasing siltation in streams.

Developing Groundwater Stewardship Teams

Your chance to make the Groundwater Stewardship Program work for you!

The Groundwater Stewardship Program is designed to meet the groundwater protection needs of local pesticide and nitrogen fertilizer users. Through these efforts, the Groundwater Stewardship Program is promoting the development of local Groundwater Stewardship Teams.

What are Groundwater Stewardship Teams?

Groundwater Stewardship Teams (GST) are part of Michigan's Groundwater Stewardship Program (GSP). They provide a collective voice for pesticide and nitrogen fertilizer users in determining the direction of the statewide program.

GSTs help ensure that local information, technical assistance, demonstration projects and cost-share opportunities supported by the Michigan Groundwater Stewardship Program meet local needs and interests. They can also serve as local forums to communicate the groundwater protection activities, needs, and concerns of the pesticide and nitrogen fertilizer users to the nonagricultural community.

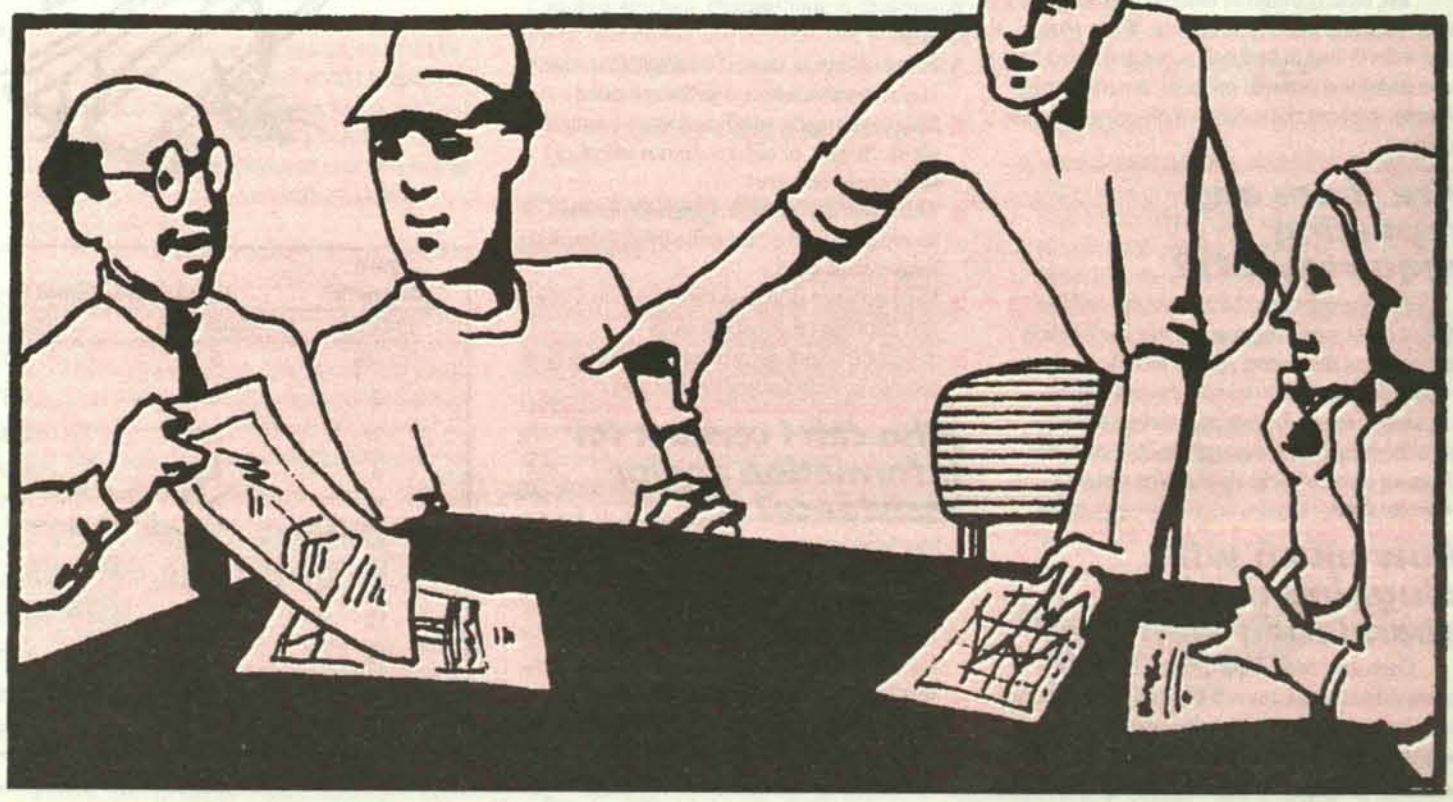
Who belongs on a Groundwater Team?

Anyone who has an interest in protecting Michigan's groundwater may join a Groundwater Stewardship Team. People who make their living as pesticide and nitrogen fertilizer users are needed to ensure that the GSP meets their needs. Representatives from various agencies and/or organizations with an interest in agriculture and groundwater should also consider membership. Commodity groups, agribusinesses, local health departments and general citizens offer valuable input, and are welcome to join as well.

Groundwater Stewardship Teams provide information and access to resources for groundwater protection at the local level. They serve to request and give input for the local groundwater technician. Technical assistance and cost-share opportunities are reviewed and prioritized by the team. Team members offer unique and innovative approaches for addressing groundwater concerns. These team members are part of the local community, so they provide visibility and credibility to the groundwater program and its activities.

Groundwater Stewardship Teams:

- Discuss local groundwater issues and concerns
- Provide a collective voice for direction of Michigan's Groundwater Stewardship Program
- Prioritize local needs for education, demonstration and cost-share
- Determine cost-share practices, rates and recipients
- Generate and share innovative ways to rescue groundwater risks
- Support farmer-to-farmer education
- Provide feedback on implementation of statewide GSP
- Serve as an educational resource.



Existing activities for groundwater protection

Throughout Michigan, there are many success stories of organizations and individuals taking a proactive role to protect their groundwater supplies. The existing programs outlined in this section are intended to serve as models and offer ideas for protecting groundwater. Each community is different. A terrific program in one region may not be suitable for another. However, community involvement and action will help in selecting potentially successful groundwater protection projects.

The highlighted projects offer a cross-section of programs throughout Michigan. Some are organized at a state level, but implemented at a local level. Other projects are community groups educating neighbors and influencing elected officials to make changes to protect their valuable resource. Also highlighted are programs that aim to educate individuals so they will realize that changing their behavior can make a difference.

What is agriculture doing?

Individuals in the agricultural sector are working hard to maintain their role as stewards of the land. Through practices such as crop rotation, no-till farming, soil testing, the use of filter strips, and programs such as pesticide container recycling and certification for pesticide applicators, negative impacts on our natural resources are being reduced. Described below are some programs currently being implemented by the agricultural sector.

Integrated pest management

Issue: Over-application of pesticides may lead to chemicals leaching to groundwater.

Integrated pest management (IPM) is utilization of all available tactics and strategies to manage pests, which results in an acceptable yield and quality product with the least amount of environmental degradation. IPM is an economically viable method of pest management.

Scouting, the process of examining fields to gather important information, is a critical aspect of IPM. Scouting can be done by the farmer or can be contracted out to a Certified Crop Adviser. Without a thorough knowledge of the biological and environmental interactions, IPM will not be successful.

Some of the questions asked when scouting may include:

- What type of species are in the field?
- Is it a pest species?
- What stage of development is the pest in?
- Is the pest above or below economic threshold?

After these questions are addressed, a management system is designed for each specific field. It may include utilizing crop rotation systems, using pest-resistant varieties of plants, destroying the pest's habitat or breeding areas, removing infected plants, or changing irrigation or ventilation patterns.

IPM is a very practical way to help reduce the threat of groundwater contamination from pesticides, and can be very successful in reducing sole reliance on pesticides. With a more diversified management practice for a farmer to employ, less pesticides are being applied in a more reasonable and economic manner.

Farm*A*Syst

Issue: Farmstead practices may be placing an individual's drinking water and surrounding surface water at risk.

Farm*A*Syst is a voluntary and confidential farmstead assessment program. Technical assistance is provided by Michigan State University Extension (MSUE) and the Natural Resources Conservation Service (NRCS). With their help, a survey of various farmstead activities is performed. A number of activities are ranked according to the risks they pose to groundwater. Some of the topics include:

- Drinking water well condition
- Pesticide storage and handling
- Petroleum product storage
- Hazardous waste management
- Livestock management
- Silage storage.

The results from the assessment provide both a measure of the relative risk of various farmstead activities on groundwater and how site-specific conditions affect the risk level.

The Farm*A*Syst program does not:

- Report actual groundwater contamination
- Determine if you have a clean groundwater supply
- Guarantee your groundwater will never be contaminated.

This program is effective because farmstead operators are provided with technical assistance to assess their current practices on a confidential, voluntary basis without fear of regulation. Many farmers have discovered that their actions may pose a risk to groundwater and have found alternatives that can be simple and inexpensive.

The success of this assessment program has paved the way for other programs that are currently being developed, including Field*A*Syst, Turf*A*Syst and Home*A*Syst.

Contact MSUE or NRCS for more information about the Farm*A*Syst program.

Clean Sweep Program

Issue: Over the years, farmers have stored unwanted chemical pesticides on the farm because of a lack of proper disposal methods. These chemicals pose health, fire, and groundwater contamination hazards.

Clean Sweep is a one-day drop off event that collects unwanted pesticides from farmers. In 1994, 34 counties disposed of 54 tons of unusable pesticides. They were safely disposed of in hazardous waste landfills and incinerators at an approximate cost of $1.77 a pound. The Environmental Protection Agency (EPA) funds a large amount of this disposal cost.

The Michigan Department of Agriculture (MDA) directs the Clean Sweep Program, but delegates the planning and publicity to local community members. Local farmers, area commodity groups, or Extension agents may take the lead in the program.

Communities may charge a small fee for disposal, especially if someone has an unusually large amount of material. As one participant stated, "It was the best insurance policy money could buy. The fee was worth it to know the chemicals were safely removed from my farm."

The collection sites change yearly to focus on different regions of Michigan. In the future, MDA plans to open three to six permanent drop-off sites throughout the state.

If you are interested in this program, contact your local Extension office or the MDA.

What is the residential sector doing?

Everyday living can have an impact on groundwater quality. The way you clean your home, manage your lawn, or maintain your septic system impacts groundwater. The residential sector is becoming involved in activities such as recycling and waste reduction, all steps in groundwater protection.