

# Michigan**Science**

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## CONTRIBUTORS TO THIS ISSUE



**BRUCE EDWARD WALKER** is under contract with the Mackinac Center as managing editor of MichiganScience. He has writing and editing experience in a variety of publishing areas, including reference books, newspapers, magazines, media relations and speechwriting.



**MARK CORNWELL** was Chairperson of a Salt Use Quality Improvement Team at the University of Michigan from 1995-2002.



**RUSS HARDING** is senior environmental policy analyst at the Mackinac Center. From 1995 through 2002, Harding served as director of the Michigan Department of Environmental Quality.



**DANIEL MONTGOMERY** designs MichiganScience. He is marketing and design director for the Mackinac Center for Public Policy.

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# BY THE NUMBERS

*Beyond propaganda and rhetoric, numbers tell the real story*

**THE OBAMA ADMINISTRATION** has shut down construction of two-thirds of a solar project in the Mojave Desert in order to protect an estimated 600 endangered desert tortoises inhabiting several square miles in the Ivanpah Valley. The U.S. Bureau of Land Management disputed findings by BrightSource Energy that only 38 tortoises would be harmed by the solar developer if it built a 392-megawatt plant outside Primm, Nev. BrightSource received a \$1.6 billion federal loan guarantee for the solar energy project, which the BLM now says would destroy 3,000 acres of desert inhabited by tortoises. BLM reports that building the solar plant would require moving 160 tortoises from the area in addition to the 600 that would be killed.

For more information, go to [www.latimesblogs.latimes.com/greenspace/2011/04/desert-tortoise-ivanpah-brightsource-solar-energy-san-bernardino.html](http://www.latimesblogs.latimes.com/greenspace/2011/04/desert-tortoise-ivanpah-brightsource-solar-energy-san-bernardino.html).

**JAPAN'S NUCLEAR** and Industrial Safety Agency released a report April 30, 2011, on radiation exposure for emergency workers at the country's nuclear power facilities following the 8.9 magnitude earthquakes this past March. The report measured radioactive exposure levels of workers at Onagawa NPS, Tohoku Electric Power Co. Inc., Fukushima Dai-ichi NPS and Japan Atomic Power Co. The annual radiation exposure limit for workers is 250 milliSieverts. A summary of the NISA report compiled by TEPCO revealed only two personnel with a combined total value of internal and external exposure levels between 200 and 250 mSv; eight individuals between 150 mSv and 200 mSv; and 11 exposed to 100 mSv and 150 mSv. None of the 50 workers at the Fukushima plant had reached the annual exposure limit as of

March 31. Only 21 had reached at least 40 percent of the limit, due to diligent monitoring and crew rotations. NISA also reported the general public residing outside the 20-kilometer evacuation zone received no harmful exposure levels to radiation, but recommended individuals refrain from eating leafy vegetables grown outside the zone as well as take a household shower if caught in the rain.

For more information, go to [www.nisa.meti.go.jp/english/files/en20110430-3-1.pdf](http://www.nisa.meti.go.jp/english/files/en20110430-3-1.pdf).

**THE BANGLADESH** Daily Star reports that the International Rice Research Institute has developed the world's first vitamin A-rich rice. The IRRI created what it's nicknamed "Golden Rice" by implanting beta carotene-producing genes from corn into BRRI Dhan 29, which was already the country's most productive rice variety. According to data from the World Health Organization, Vitamin A deficiency is responsible for the deaths of 6,700 children worldwide each year, and is further considered the leading cause of preventable childhood blindness — believed to afflict at least 350,000 children annually. Additionally, 25 percent of Bangladesh's preschool children and another 25 percent of the country's women suffer from vitamin A deficiency. A 150-gram serving of Golden Rice will provide one-half of the recommended daily allowance of Vitamin A for adults. Safety trials for the new rice are anticipated to conclude by 2015.

For more information, go to [www.thedailystar.net/newDesign/news-details.php?nid=182319](http://www.thedailystar.net/newDesign/news-details.php?nid=182319).

**THE LOS ANGELES** Times reports exposure to nine-banded armadillos may result in Hansen's Disease, more commonly known as leprosy. The

newspaper quotes a study published in the New England Journal of Medicine by the National Hansen's Disease Program in Baton Rouge, La. Leprosy previously was thought to only pass from human to human, but research conducted by a team led by Hansen's Director of Microbiology Richard W. Truman revealed the majority of the 100 to 150 cases of leprosy diagnosed in the United States each year occurred in Louisiana and Texas. While two-thirds of these leprosy cases may be attributed to exposure overseas, the remainder of cases may be caused by handling armadillos. The bacterium *Mycobacterium leprae* — closely related to the microbe that causes tuberculosis — is the culprit behind leprosy, which afflicts its victims with skin lesions and, in extreme cases, nerve damage and limb deformation. Repeated contact with the microbe is necessary for the 5 percent of the population prone to leprosy infection to be infected. While only 3,600 people in the United States are diagnosed with leprosy, nearly 20 percent of the armadillo population in some parts of the country is believed to be infected. Truman's team took samples from 50 leprosy patients and 33 wild armadillos and diagnosed with leprosy. DNA samples revealed that a genotype pattern known as 3I-2-V1 existed in all the armadillos and in 26 of the 29 test subjects who had not lived overseas. Further research concluded 28 of the armadillos and 25 of the human patients tested positive for the 3I-2-v1 genotype.

For more information, go to [www.articles.latimes.com/2011/apr/27/health/la-he-leprosy-armadillos-20110428](http://www.articles.latimes.com/2011/apr/27/health/la-he-leprosy-armadillos-20110428). ■

# FIELD TRIPS

Area science museums feature immune systems, ancient astronomy and water quality



## THE HENRY FORD MUSEUM

You can customize your exploration of the extensive Henry Ford Museum with activities and worksheets tailored to various curriculum themes, including “American Innovation” and “Science and Technology.”

*The Henry Ford, 20900 Oakwood Blvd., Dearborn, Mich. 48124. Open daily from 9:30 a.m. to 5:00 p.m. Field trips are \$8 per student.*

For more information on educational programs, call 313.982.6001 or visit [www.thehenryford.org/education/visit.aspx](http://www.thehenryford.org/education/visit.aspx).

## STARS OF THE PHARAOHS

In this planetarium show, watch how the ancient Egyptians used astronomy to tell time, make calendars and design buildings. Egyptians’ understanding of the stars also played a role in the construction of the pyramids, which are recreated in this show.

*Kingman Museum, 175 Limit St., Battle Creek, Mich. 49037. Open 11:00 a.m. to 4:30 p.m. Tuesday through Thursday, 11:00 a.m. to 6:00 p.m. on Friday and 1:00 p.m. to 5:00 p.m. on Saturday. Closed Sunday and Monday.*

For more information, call (269) 965-5117 or visit [www.kingmanmuseum.org/planetarium.cfm](http://www.kingmanmuseum.org/planetarium.cfm).

## DON’T MAKE ME SICK!

This exhibit demonstrates how the body protects itself from illnesses. Hands-on activities help students explore the immune system; Impression5 offers microscopes to examine tissue samples, an interactive model of a human cell and magnifying glasses for visitors to examine their skin, which is a main element of the body’s defense against disease.

*Impression5, 200 Museum Dr. Lansing, Mich. 48933. Open 10:00 a.m. to 5:00 p.m. Monday through Friday, 10:00 a.m. to 7:00 p.m. on Saturday and noon to 5:00 p.m. on Sunday. Admission is \$5 per person.*

For more information, call (517) 485-8116 ext 32 or visit [www.impression5.org/mos/view/Exhibits/Exhibits/Don-t\\_Make\\_Me\\_Sick%21/](http://www.impression5.org/mos/view/Exhibits/Exhibits/Don-t_Make_Me_Sick%21/).

## DETROIT ZOO

Visit the Detroit Zoo and take 45 minutes for programs on such topics as: biodiversity and the causes of species extinction; interaction among predators and prey and their adaptation to changes in the food chain; and how zoo designers create and maintain habitats from arctic to tropical for animals large and small.

*Detroit Zoo, 8450 W. 10 Mile Rd., Royal Oak, Mich. 48067. Open daily*

*from 9:00 a.m. to 5:00 p.m. Cost for programs is \$2 per participant, plus zoo admission, which is \$6 per person for school groups and \$4 per person for school groups from Wayne, Oakland and Macomb counties. Maximum group size is 60 participants. Call (248) 541-5717 ext. 3800 for group rates.*

For more information, visit [www.detroitzoo.org/Saving\\_Wildlife/Education\\_Catalog/School\\_Programs](http://www.detroitzoo.org/Saving_Wildlife/Education_Catalog/School_Programs).

## BELLE ISLE NATURE ZOO

Belle Isle Nature Zoo offers a multitude of hands-on programs for various grade levels. For example, the “Watershed/ Water Quality” program offers grades 5 and up the opportunity to assess a body of water by sampling and analyzing the insects and microbes present. In “Behavior,” students of any grade level can learn about how bees interact with each other and the environment to pollinate flowers and produce honey.

*Belle Isle Nature Zoo, 1928 E. Lakeside Dr., Detroit, Mich. 48207. Open daily from 10:00 a.m. to 5:00 p.m. Admission and most programs are free. Groups are encouraged to register early.*

*Call (248) 541-5717 ext 3024 for program scheduling.*

For more information, visit [www.detroitzoo.org/Saving\\_Wildlife/Education\\_Catalog/School\\_Programs](http://www.detroitzoo.org/Saving_Wildlife/Education_Catalog/School_Programs).



\*Just  
the Facts

# Just the Facts

By Russ Harding

**THE SUMMER DRIVING** season is just around the corner, and gasoline prices have steadily been climbing upwards of \$4 a gallon. There are many factors putting pressure on gasoline prices that are outside of our control, such as turmoil in the Mideast and growing demand for oil by China, India and other developing countries. There are a number of actions our policymakers can take, however, to help alleviate pain at the pump.

Many people believe America uses too much imported oil (approximately 50 percent) and that we must switch to vehicles powered by electricity, bio-fuels and natural gas. However, electric vehicles have severe range limitation and are not widely available, and hybrids vehicle sales make up only a tiny portion of new car sales. Ethanol fuel only exists with heavy government subsidies and mandates, and other bio-fuels are not economically feasible with current technology. There are no natural gas-powered vehicles for sale in the United States for individual consumers. Even if natural gas-powered vehicles were available to consumers, there is no refueling infrastructure, and building one would cost billions of dollars.

A government interested in helping to reduce gasoline prices should take the following actions:

- Reduce permitting red tape and encourage oil and gas development both offshore and onshore, including in Arctic National Wildlife Refuge.

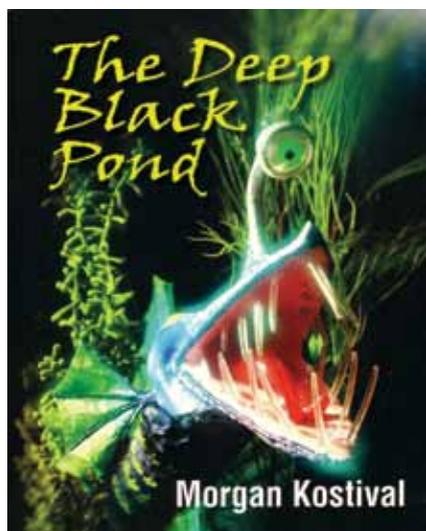


- Reduce the myriad of “boutique” fuels (specially blended fuels based on regional clean air requirements) required by the Environmental Protection Agency and state environmental departments.
- Place a moratorium on EPA rulemaking, such as proposed rules on oil refiners and CO2 emission regulations that make it more expensive to produce gasoline.

Some policymakers are calling for a release of oil from the nation’s strategic petroleum reserve, hoping this would lead to lower gas prices, but energy

policy should not be based on short-term political considerations. The Obama administration has so far resisted efforts to raid the strategic petroleum reserve, although some believe this could be because the administration supports the electric vehicle market.

Other policymakers have recommended that the United States develop all of our energy resources in North America, including off-shore oil reserves, as well as oil shale in the west and oil sands in Canada. Such an approach would lessen the United States’ vulnerability to price shocks and oil shortages. ■



Review of *The Deep Black Pond*, written and illustrated by Morgan Kostival. Eloquent Books, 48 pages, 2010.

**AS A WRITER**, Morgan Kostival is a pretty good illustrator. His book, “The Deep Black Pond,” is a fairy tale of sorts seemingly inspired by the “Just So Stories” of Rudyard Kipling.

More on Kipling later, but first to Kostival’s book. Kostival’s “The Deep Black Pond” is his first published work, and it features both his artwork and story depicting a fanciful, mythological ecosystem.

Kostival’s “once-upon-a-time” fable takes place on an unnamed island “thousands of miles away from where you are now and 15 miles beyond that.” The island surrounds the pond of the book’s title, where most of the action takes place.

The island is inhabited by Qurgo, the sole survivor of three tribes that warred over the fresh water of the pond. Qurgo’s actions resulted in the island’s fairies forcing him to wear upon his shoulders a village occupied by the tiny Peewee culture. Qurgo, like Greek mythology’s Atlas who supported the ancient world on his shoulders, is tasked with protecting the Peewee or face further penalties from the fairies.

The pond is occupied by the ravenously frightening fish, Cuddles; Baron Sheldon, who lives in a gas bubble at the bottom of the pond; Queen Lilly, who shuttles her lily pad around the pond each day seeking sustenance from the continuously shifting sunlight; and the King, who sculpts his subjects from pond scum and gives them cute names despite the fact they smell and also exhibit rude behavior.

The story’s main conflict involves the distrust among the pond’s population, which resolves itself after Qurgo accidentally drops Mimi, the tiniest member of the Peeweese, into the pond. As a result of Qurgo’s neglect, Mimi eventually becomes the very first pink pearl.

Readers of Kipling will remember his “How the Camel Got His Hump,” “How the Leopard Got Its Spots” and other stories whimsically explaining the evolution of various physiological characteristics in the animal kingdom. As with Kostival’s story, the entirely fictional reasons given for animal adaptations to their respective environments are intended entirely for entertainment.

Unfortunately, however, the creation of pearls from irritants inside an oyster’s shell is depicted pretty much as it really happens in nature rather than in the wildly imaginative stories of Kipling. If Kostival had wanted to give his readers an opportunity to learn precisely how pearls are formed, he might have spent a bit more time describing the natural processes involved.

Additionally, the cooperation that develops between Qurgo and the pond’s dwellers is a missed opportunity to explain to young readers the real-life and sometimes complex interactions necessary for sustaining the lives of creatures both on land and in the water. While concepts of photosynthesis and

eutrophication are introduced, the importance of both, respectively, as desirable and a threat to the pond’s health are never fully explored.

Furthermore, this reviewer wished Kostival had made more of the, yes, sometimes scary aspects of nature in order to teach readers that a robust environment requires both predators and prey in order to maintain a reasonable balance. The author does come close, however, to creating a world where nature isn’t portrayed as a delicate flower automatically polluted by the presence of humans. After all, humans have coexisted with bodies of water for centuries, and more often than not have become as much a part of the “natural environment” as the flora and fauna too often depicted as merely fragile by Hollywood and literature.

The story of “The Deep Black Pond” will not win awards for writing. Too often, the narrative is disrupted by vocabulary words that would easily baffle younger readers, and the author frequently relies on clichéd phrases. A glaring misspelling on page 14 (“gapping” instead of “gaping” — is in itself rather clichéd when describing the mouth of Cuddles) also stands out.

Finally, Kostival’s illustrations should be noted as inspired by the stop-action motion picture techniques of old Ray Harryhausen films as well as “The Nightmare Before Christmas” and “The Corpse Bride.” In this, Kostival exhibits his degree in video production. As reproduced on the page, however, the pictures lack the detail and clarity necessary to grab the attention of either children or adults.

As a story that could inspire young audiences to further explore the natural sciences, “The Deep Black Pond” falls short. As a fantastic allegory that could entertain as well as instruct, it also leaves much to be desired.

# MICHIGAN ROAD SALT: WHAT IS IT COSTING US?

BY MARK CORNWELL

**DRIVEN BY INCREASING** public expectations for clear roads, and fueled by relatively low costs, Michigan steadily increased its use of road salt over the last 30 years. Today, public agencies in Michigan use nearly 2 million tons of salt annually to clear snow and ice. Based on the 2010 price per ton, the nominal price of all that salt is nearly \$100 million per year. The price of salt has increased nearly 50 percent over the last five years and is projected to continue to increase dramatically as the cost of fuel directly affects the delivered price. Most of that money leaves Michigan and the country.

During the last 10 years, the state of Michigan spent billions of dollars rebuilding roads, bridges and other infrastructure. More needs to be done, and the task of rebuilding Michigan's deteriorating roadway assets has grown more challenging as financial resources have dwindled. Road salt contributes to the premature degradation of infrastructure. This burgeoning, deferred maintenance problem compromises our ability to compete with other states for new business and jobs.

The greater costs of road salt are hidden, affecting both infrastructure and environmental resources. Xianming Shi, Ph.D. with the Western Transportation Institute at Montana State University, pegged the hidden costs of a ton of road salt at \$469. Other researchers have projected costs higher than Dr. Xianming's. If one were to use a more conservative number of \$200 per ton, the hidden costs of salt would add another \$400 million to our annual costs for providing clear roads during the winter months. However, the enormous hidden cost is not immediately seen, but is added to the deferred maintenance problems which will be paid in future budgets. Over the next 10 years, Michigan will theoretically spend \$5 billion on road salt and its correlated depreciation

to infrastructure investment. This figure does not include inflationary factors.

On the environmental side of the equation, there are costs associated with increasing road salt use that seem to fly under the radar. Many other northern states and Canada have been sounding the alarm as increasing chloride levels raise concerns in ground and surface waters. Many states are beginning to take action to develop implementation strategies for sustainable winter maintenance practices that require less road salt. Increased chloride levels could impact the ecological health of inland lakes. Greater concern exists for those communities that rely on municipal well-heads for fresh drinking water supplies. Additionally, once chlorides are introduced to groundwater systems, they accumulate over time and are very costly to remove.

Reports have surfaced over the last few years of five major vehicle manufacturers issuing recalls for nearly 7.4 million vehicles because of problems stemming from road salt corrosion of vehicle safety components. Salt corrosion has led to brake line failures, gas tank issues, steering problems and axle deterioration.

A 1992 study sponsored by the Salt Institute titled "Accident Analysis of Ice Control Operations," was conducted at the University of Marquette and examined accidents (injury and property damage) and improvements in travel time. On two-lane highways, the research indicated traffic accidents were four times higher before salting applications were made. The study concluded that "During the first four hours after zero hour, the direct user benefits were \$6.50 for every \$1 spent on direct maintenance costs for the operation. Winter maintenance reduced traffic accident

# ROAD SALT

costs from “before” to after by 88 percent and reduced the average cost of an accident by 10 percent.” It should be noted that during the course of the study, no fatalities occurred either before or after salting.

In contrast, another less formal study titled “Road Salt and Traffic Injuries in Rochester,” conducted in Rochester, N.Y. in February 1982, concluded that “The toll of victims of winter traffic accidents was reduced, rather than increased, by cutbacks in the use of road salt in Rochester. Records of traffic accidents, people injured in those traffic accidents, road salt use and weather, covering 11 years showed that progressively fewer people were hurt in snow and ice-related accidents as salt use was being reduced to approximately one half.” The study further explained that “When snowy roads are salted, collisions involve higher speeds and are more likely to claim victims. Similar results were reported from Chicago.”

The Marquette study indicated that travel times were reduced after salting. A fairer appraisal of traffic delays would have to be done on an annual basis and should include traffic delays in the summer months when road and bridge repairs are also delaying traffic. Public safety is indeed serious business. So what is the solution?

Many of our state’s road agencies have taken progressive steps to try to balance public safety with reduced salt usage. These efforts have shown promise but need to be replicated across Michigan if the goal is to create a national model for a sustainable winter maintenance program. Currently, there are limited mechanisms to share best practices knowledge and experience within Michigan. This much-needed exchange of information is hampered by the fact that the various entities involved (state, county, city, public facilities, universities, etc.) operate exclusively within their own peer groups; they seldom get the opportunity to collaborate and learn from the experiences of others. Michigan needs a mechanism through which

all winter maintenance professionals can communicate challenges and success stories and then build on each others’ successes.

The Michigan Department of Transportation leverages its research funds through collaboration with other Midwest and northern states. One such collaboration is a pooled-funds research project group called “ClearRoads.” Many excellent examinations of winter maintenance best practices have come from these efforts and will continue to provide guidance. Winter maintenance agencies across North America face similar issues, and in today’s challenging economic times it is prudent that financial resources be used wisely. Shared knowledge and experience demonstrates sound fiscal responsibility.

In 1995, the University of Michigan recognized that existing salting practices on campus properties were seriously damaging university infrastructure and environmental resources. An internal cross-functional “Salt Use Quality Improvement Team,” of which I was a member, was formed to develop a new system to use salt more efficiently without compromising public safety. Winter maintenance best practices in the mid to late 1990s were just emerging, showing progress in discovery and implementation. By 2002, however, the university had cut its 10-year average salt use by 50 percent. Public safety was not compromised, and actual operational costs decreased. It will take time to see the additional benefits of the reduced salt use, but closer examination of premature depreciation of infrastructure could yield additional, and substantial, long-term savings.

Other recent Michigan success stories include the establishment of the County Road Association of Michigan’s “Pre-wet/Anti-ice Team” and the City of Farmington Hills’ winning a National Award for Excellence in Winter Maintenance Practices at this year’s American Public Works Association’s North American Snow Conference in Spokane, Wash. The seven-

member CRAM “Pre-wet/Anti-ice Team” was established in 2006 to examine winter maintenance best practices and then share their experiences with other county road agencies. Great progress has come from those efforts and continues to advance state-of-the-art practices for improving winter maintenance operations. The City of Farmington Hills operations, along with other neighboring communities, has helped to accelerate the growth and implementation of sound winter maintenance best practices in the metro Detroit area.

What are these winter maintenance best practices, and how can we advance them? There is no single “silver bullet,” but rather a collection of practices that improve overall efficiency and effectiveness. Through improved plowing technologies, greater focus on calibration procedures, operator training, materials-placement strategies, greater use of liquids, advanced forecasting of weather and pavement conditions, improved material-spreading equipment and greater public awareness, these efforts can build the foundation for winter maintenance programs that put Michigan at the national forefront. It will not happen overnight, but with a diligent, focused effort, statewide success can be achieved by 2020.

Economic challenges remain a major impediment to creating this new winter maintenance paradigm. To achieve reduced salt-use goals, agencies will need to invest in training and new technologies.

Michigan has the talent, ingenuity and emerging champions to achieve the balance between public safety and mobility, cost containment and protection of infrastructure and environmental resources through reduced salt usage. Better management of road salt will provide extensive short- and long-term benefits statewide — and nationwide. ■

*Mark Cornwell is former chairperson of a Salt Use Quality Improvement Team at the University of Michigan from 1995-2002.*

# RAISING A STINK

## Brown Marmorated Stink Bug Hitches Ride to Michigan

By Bruce Edward Walker



**THE ASIAN LONG-HORNED** beetle, Asian gypsy moth, *Sirex noctilio* wood wasp and emerald ash borer may possess names that sound like bad-guy characters in the next X-Men cinematic installment, but these real-world villains have caused billions of dollars of crop and tree damage over the course of the past decade — not to mention the overall negative environmental impact posed by insects invading Michigan from other states and countries.

Add to this list of insect evildoers the Brown Marmorated stink bug. The name “stink bug” may make readers laugh at first, but there’s more at stake in Michigan than an insect with a funny name that emits foul odors when you squash it.

During the winter months, the bug seeks to escape the cold by taking up residence in households, but when the weather turns warm and fields, orchards, nurseries and gardens once again become productive, they turn into destructive eating machines. The Michigan Department of Agriculture says stink bugs relish fruit trees, ornamental plants and field crops the same way a certain cartoon cat craves lasagna.

## ‘Exceptionally Good Hitchhikers’

Adult stink bugs grow to an average of 17 millimeters long. The stinkers are shield-shaped and feature shades of brown coloring on their top and bottom. “They are the typical ‘shield’ shape of other stink bugs, almost as wide as they are long,” said Jennifer Holton, public information officer for the Michigan Department of Agriculture and Rural Development.

“(They) superficially resemble several common species of stink bug native to Michigan,” Holton added. “Some of these native species are plant-feeding agricultural pests, while others are considered beneficial because they prey on other insects,” she said.

“To distinguish them from other stink bugs, look for lighter bands on the antennae and darker bands on the membranous, overlapping part at the rear of the front pair of wings,” Holton said. “They have patches of coppery or bluish-metallic colored punctures — small rounded depressions — on the head and pronotum<sup>1</sup>. The name ‘stink bug’ refers to the scent glands located on the dorsal surface of the abdomen and the underside of the thorax.”

Native to East Asian countries, the first stink bugs were detected in the United States about 10 years ago, said Holton. She says stink bug specimens were initially identified in Pennsylvania. They have since spread to “most states on the East Coast”

1 The pronotum is one of three portions of the stink bug’s thorax, which bears the first set of legs. The pronotum’s exoskeleton is what gives the bug its shield-like shape.

and Michigan, and their presence also has been discovered in California and Oregon.

Females lay eggs throughout their adult lives. The female lays approximately 28 eggs, totalling around 240 eggs in her lifetime.

According to Dr. Anne Nielsen, research associate in organic pest management at Michigan State University, stink bugs more than likely bummed rides on freight ships from American coastal ports, and made their way to current locations by stowing away on trucks and cars. “We believe stink bugs came from Asia through such international shipping ports as Port Elizabeth in New Jersey,” Nielsen said. “From there, they traveled in shipping containers to Allentown, Pa. They’re exceptionally good hitchhikers.”

Nielsen says although specimens have only been spotted in the state since the beginning of this year, “We’ve seen damage that indicates it’s been in Michigan for a while.”

The first actual Michigan sightings of this nasty critter occurred in Eaton and Berrien counties in the southwest portion of the state in January 2011. In March, additional stink bugs were found in Ingham and Genesee counties. Michigan State University entomologists, however, predict the stink bug population will spread widely throughout the Great Lakes region over the next few years.

## Significant Agricultural Threat

In her study, “Invasive Forest Pests: Trend and Impacts,” Dr. Deborah G. McCullough of MSU’s departments of entomology and forestry, wrote: “More than 450 non-native insect species that feed on forest trees are established in the United States, and the accumulation rate was relatively steady between 1860 and 2006. Slightly less than 15 percent of the insect species ... have caused reportable damage. Sap feeding insects such as scales, aphids, and adelgids dominated the complete list of non-native insects, while

foliage feeders were most abundant in the list of damaging pests.”

Nielsen says the BMSB is native to semi-tropical climates, but adds the bugs’ “over-winter survivalist behavior allows them to survive in Michigan.”

The BMSB rides out the winter by hunkering down in houses, where it presents no health or property damage issues. “The best method for controlling BMSB indoors is by sealing entry points like cracks around window and door trim, exhaust vents, air conditioners, ceiling fixtures,” said Holton. “Once they’ve gained entry, vacuuming live and dead bugs is the best option. Pesticide treatments are not recommended because they will not prevent additional invasions,” she said.

While acknowledging the presence of bugs in a person’s home might be annoying, Dr. Chris DiFonzo, a field crops entomologist at MSU, and Nielsen agree the real threat stink bugs pose is the damage they can do to Michigan agriculture.

Holton emphasizes that BMSB is unlike the emerald ash borer and Dutch elm disease, which decimated millions of Michigan trees. The ash borer insect and elm disease attacked and killed trees, she notes, but BMSB “attacks the fruit of the plant or tree and not the tree itself.” “However, it will be a very serious pest for producers of agricultural crops and nurseries.”

BMSBs feed on fruit fluids by puncturing the plants’ tissues with their stylet — the needle-sharp extension the bug uses to break through the fruit’s surface. This puncturing and sucking process produces dimples, deformities or scars, known as “cat-facing,” on the fruit’s skin and can make the product unmarketable.

Nielsen places stink bug damage to tree fruit in the Mid-Atlantic States in the \$37 million range, but emphasizes that the greater diversity of crops in Michigan poses a much greater risk.

“BMSB has a very wide host range unlike many pests which only feed on specific plant material,” said Holton. “Because of its wide host range and the damage resulting from its feeding, BMSB has the potential to have a

great impact on agricultural crops, particularly those that are not normally treated for insect pests during the growing season.”

Holton says the BMSB could be “devastating for a variety of fruits, vegetables, field crops and ornamental plants. Potentially impacted crops in Michigan include apples, peaches, corn, cherries and others,” she said. “It has also been reported on many ornamental plants, weeds, soybeans and beans for human consumption.”

## Detection and Elimination

Ken Nye, Michigan Farm Bureau spokesman, says his organization has been taking an active role with MSU researchers and the Michigan Department of Agriculture and Rural Development, as well as with the U.S. Department of Agriculture.

“We’ve been working with MSU’s farm extension program to disseminate information to growers,” Nye said. “The perception is that a large number of farm commodities are threatened by damage by the stink bug.”

Nye added: “We are letting growers know what control methods are going to work, and

the many different resources we’re bringing to bear — from biological controls growers can utilize to monitoring weather patterns that might help us determine a scientifically timed process based on the bug’s growth cycle and at what point the bug can be dealt with most effectively.”

Holton says early detection and rapid response programs are “crucial for dealing successfully with exotic pests which threaten the state’s agricultural interests and impact our natural resources and environment.”

She adds that while detection of BMSB is not good news, “the fact that it’s been detected early provides us the opportunity for outreach to the affected communities and to dial-up control strategy recommendations — including applying for emergency use pesticide registrations, if necessary.”

Holton also said the department will be working in concert with MSU to “identify possible controls for both agricultural and home use,” she said. “For ag-based use, other states such as Maryland and Pennsylvania have had some success with pyrethrum-based compounds.”

Nielsen said the best defense against the BMSB is to slow it from spreading. “We’re working out a rapid response protocol that

will use USDA-approved insecticides as well as control and monitoring techniques.”

The good news, according to Nielsen, is that agricultural pesticides already in use have proven effective in trials conducted by MSU, and controlling or eradicating the pest won’t require entirely new chemical compounds.

DiFonzo also says the BMSB population can be managed using what she calls “off-the-shelf” agricultural chemicals.

If that’s the case, perhaps Michigan can remove the stink bug threat and enjoy the sweet smell of success.

## Internet Information:

*Michigan Department of Agriculture and Rural Development: [http://www.michigan.gov/mda/0,1607,7-125-1572\\_28248-250475--,00.html](http://www.michigan.gov/mda/0,1607,7-125-1572_28248-250475--,00.html)*

*“Qualitative Analysis of the Pest Risk Potential of the Brown Marmorated Stink Bug (BMSB), *Halyomorpha halys* (Stål), in the United States,” United States Department of Agriculture Animal and Plant Health Inspection Service, Plant Protection and Quarantine, October 2010: [http://www.michigan.gov/documents/mda/BMSB\\_Pest\\_Risk\\_Potential\\_-\\_USDA\\_APHIS\\_Nov\\_2011\\_344862\\_7.pdf](http://www.michigan.gov/documents/mda/BMSB_Pest_Risk_Potential_-_USDA_APHIS_Nov_2011_344862_7.pdf)*

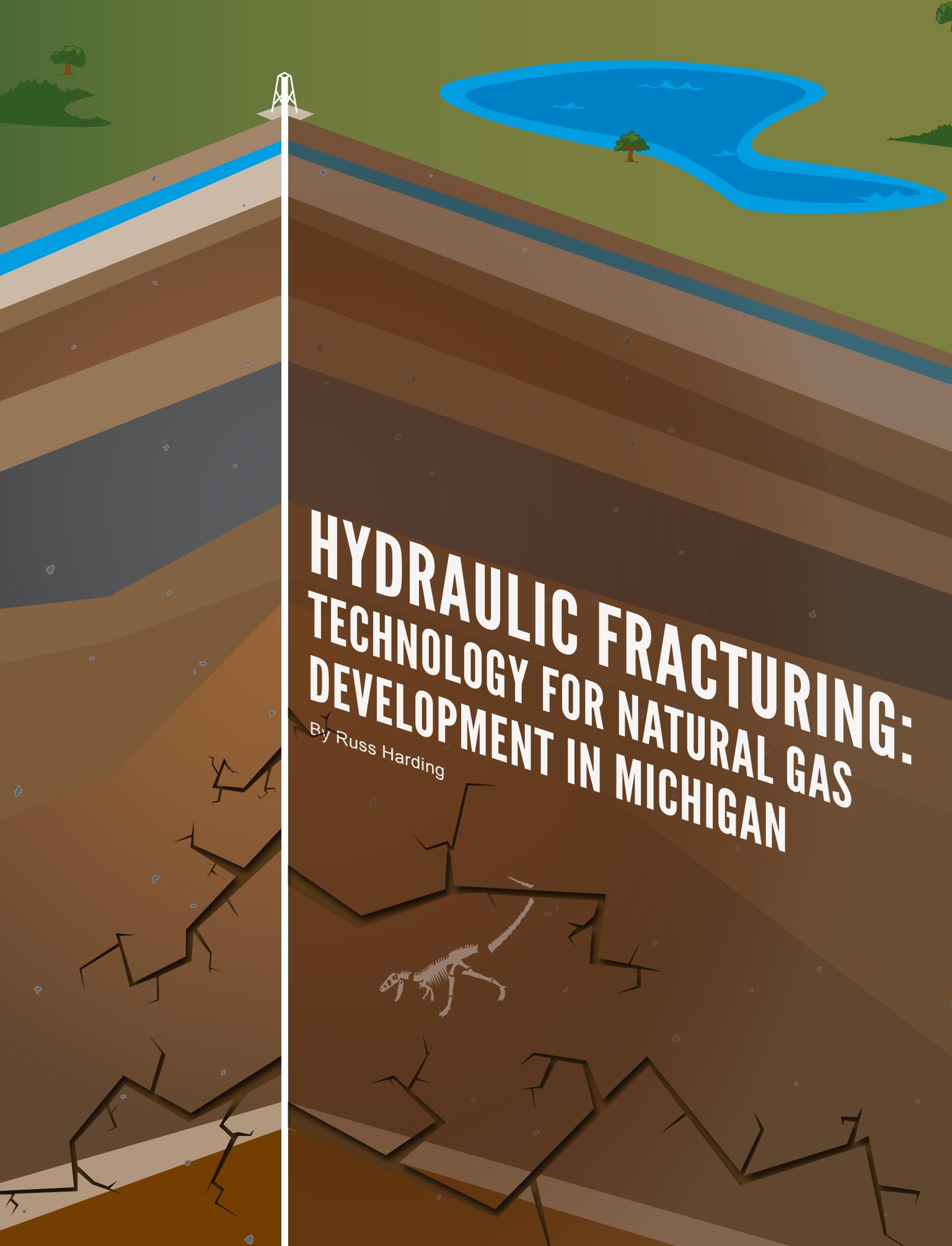
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# HYDRAULIC FRACTURING: TECHNOLOGY FOR NATURAL GAS DEVELOPMENT IN MICHIGAN

By Russ Harding

**THERE IS AN** ongoing debate regarding the preferred sources of fuel needed to meet America's future electricity needs. The United States has been dubbed the "Saudi Arabia of coal" due to its extensive coal reserves, and approximately 60 percent of the electricity generated in Michigan comes from coal-fired power plants. Coal has increasingly come under attack from environmental groups, however, because they believe emissions from coal-fired power plants contribute to global warming. If less coal is used in the future to provide electricity, that energy must be replaced in order to provide reliable sources of electricity necessary to power America's economy.

Nuclear power is another primary source of energy used to power base-load power plants. But such endeavors bring high capital cost, which can run into billions of dollars; in addition, the extensive time delays — often exceeding a decade or more — to acquire the necessary building permits are significant obstacles to replacing coal-fired power plants with nuclear ones.

Alternative energy advocates point to non-traditional sources of energy such as wind, solar and biomass as the wave of the future in supplying America's growing energy needs. Such methods, however, currently only supply a tiny fraction of the electricity demanded, and although these sources will likely increase in the future, they will not replace the loss of coal as the primary energy source to produce electricity.

For the foreseeable future, natural gas is the source of fuel most likely to replace lost base-load electric generating capacity from retired coal-fired power plants. North America has abundant reserves of natural gas — recent estimates indicate there are sufficient reserves of natural gas to supply all of America's energy needs for the remainder of the century. Natural gas fields are scattered throughout the country, but formations that are the ripest for hydraulic fracturing are the Marcellus Shale, which covers parts of Ohio, Pennsylvania, West Virginia and New York; the Antrim Shale in Michigan; and the Barnett Shale in Texas.<sup>3</sup>

According to the U.S. Energy Information Administration, America imported about 12 percent of the natural gas it consumed in 2009 — the lowest percentage since the 1990s. In 2009, natural gas supplied about 23 percent of the total electric power generated in the United States while coal supplied 44 percent and nuclear about 20 percent.<sup>3</sup>

The price of natural gas to heat homes and fuel power plants has been decreasing due to increased supply and the mounting price of oil. Like coal, natural gas has a significant advantage from a national security standpoint as reserves are located here in North America and do not have to be imported from countries that may not be friendly to the United States. Natural gas used as a fuel to generate electricity also has an environmental benefit, as it emits approximately one-third less CO<sub>2</sub> emissions than coal.

The key to developing natural gas fields in Michigan and around the nation is the utilization of hydraulic fracturing technology. Shale gas development has been rapidly expanding in North America in recent years. Unconventional natural gas extraction methods, including hydraulic fracturing, made up 42 percent of domestic gas production in 2007 and are expected to increase to 64 percent by 2020. Hydraulic fracturing has been utilized for more than 60 years. Horizontal drilling has been used commercially since the 1980s, but until recently has not been used widely for extracting natural gas from shale rock formations. The combination of these two technologies has greatly expanded the availability of commercially developable natural gas fields in Michigan and elsewhere.<sup>3</sup>

## What Is Hydraulic Fracturing?

The process of hydraulic fracturing creates fissures, or fractures, in shale formations which allow natural gas to flow horizontally to drilled bores and ultimately to a vertically drilled bore and wellhead. The fractures are created by pumping water at high pressure into the rock reservoir. Silica sand is added to the water to hold the fractures open. Several chemicals are typically added to reduce friction (which allows higher pumping rates with less pressure) and increase the viscosity of the water. In addition, chemicals are added to prevent microorganism growth, to prevent corrosion of metal pipes and to remove drilling mud damage near the wellbore.

Once the pumping pressure has been released after the hydraulic fracturing process, water-based fracturing fluid flows back through the well casing to the wellhead and may be mixed with water from the rock formation.<sup>1,4</sup>

# HYDRAULIC FRACTURING

## Environmental Concerns

- **Water Use** — Hydraulic fracturing wells require the use of considerably higher volumes of water than do traditional gas wells. In the Antrim Shale formation in Michigan, a traditional gas well requires a one-time use of 50,000 gallons of water. It is estimated that a horizontally drilled, hydraulically fractured well requires a one-time use of 5 million gallons of water, or approximately the amount of water that a 1,000 megawatt coal-fired power plant uses in 12 hours.<sup>1,4</sup>
- **Contaminated Water Management** — Flowback water typically contains small concentrations of chemicals used in the hydraulic fracturing process as well as naturally occurring salts (brines) and in some cases very small quantities of naturally occurring radioactive material such as radium. The contaminated flowback water must be properly treated and handled in order to prevent adverse public health or environmental concerns.<sup>1</sup>
- **Migration of Gas or Fracture Fluids** — A major concern is that gas or chemicals used in the hydraulic fracturing process could migrate and contaminate aquifers used for drinking water. At depths of about 2,000 feet or less, fractures are horizontal due to the natural stress of the rock which serves to confine gas and fluids to the gas reservoir. At greater depth, fractures may occur vertically but are confined by the overlying gas reservoir. In cases where groundwater contamination has occurred due to migration of hydraulic fracturing fluids, it is almost always due to improper well construction rather than hydraulic fracturing itself.<sup>1</sup>
- **Surface Spills** — Spills of chemicals or flowback water can adversely impact public health and the environment.
- **Identification of Chemical Additives** — Concerns have been raised that the public is not aware of what chemicals are being used in the hydraulic fracturing process. Companies generally consider this information proprietary.
- **Earthquakes** — Concerns have been raised that hydraulic fracturing could potentially trigger earthquakes in some localities. The Dallas-Fort Worth region in Texas experienced 11 mini quakes during

November and December 2008. Seismologist Brian Slump of Southern Methodist University analyzed data from the 11 earthquakes and determined the origin was located on a geologic fault located about 15,000 feet below the surface. Since 2002, about one dozen hydraulic fractured wells have been drilled in that vicinity. Slump commented that it is possible that stresses on this old fault could trigger earthquakes. Shaopeng Huang from the University of Michigan, however, urges caution saying, “A causal link between a given earthquake with a particular borehole is debatable.” The subject of hydraulic fracturing causing mini earthquakes remains controversial.<sup>2</sup>

## Regulation of Hydraulic Fracturing in Michigan

The Geologic Survey section of the Michigan Department of Environmental Quality is responsible for regulating oil and gas drilling and production, including hydraulic fracturing, in the state. The state of Michigan has a history of enacting and enforcing strict regulations on oil and gas development. State oil and gas regulatory officials have had considerable experience regulating the oil and gas industry due to extensive development over the years of the Antrim geologic formation in the northern region of the state.

The contamination of aquifers used for drinking water is the major concern regarding the use of hydraulic fracturing technology to extract natural gas. Regulations to prevent contamination of drinking water from oil and gas extraction in Michigan include the following requirements:

- Each oil and gas well must have a casing and cementing plan that will effectively contain gas and other fluids within the wellbore.
- Surface casing is required to be set at least 100 feet into the bedrock and 100 feet below any fresh water zones and cemented from the base of the casing to the ground surface.
- Prior to hydraulic fracturing, an additional string of production casing must be set to the depth of the reservoir and cemented in place.
- Hydraulic fracturing is prohibited within 50 feet of the base of the surface casing for wells located in shallow reservoirs.

- Flowback water is treated as an oil and gas waste and must be contained in steel tanks and transported to disposal wells where they are injected into deep rock layers that are isolated from fresh water supplies.
- Disposal wells are licensed by both DEQ and the U.S. Environmental Protection Agency and periodic testing is required to ensure well integrity.
- Secondary containment is required under tanks, wellheads and other areas where spills are most likely to occur.
- Any spill must be immediately reported and cleaned up according to DEQ requirements.
- Material Safety Data Sheets must be posted wherever chemical additives are stored, transported or used. These MSDS contain information on the chemical class and potential health and environmental effects of the chemical additives. In the event of a significant spill or health hazard, the DEQ has the legal authority to obtain the necessary details on chemical composition and concentrations.<sup>1</sup>

## Conclusions

Energy production and use will continue to play an important role in Michigan's future. Michigan is blessed with abundant natural resources, including considerable oil and gas deposits, and the state has a history of both successful regulation and development of renewable and non-renewable natural resources including oil and gas. The oil and gas industry is a significant contributor to the state's economy, especially in the northern part of the Lower Peninsula. Many northern Michigan communities have benefited from relatively high-paying jobs

associated with development and support of oil and gas wells.

To date, only one gas well has been developed in the state utilizing hydraulic fracturing technology. The potential for future development of hydraulically fractured gas wells in Michigan is currently unknown, but there is considerable potential for extracting large quantities of natural gas from the Antrim Shale utilizing the new technology. Michigan also has an advantage in the development of hydraulically fractured gas wells because of an abundant water supply that is not available in the more arid states.<sup>1</sup>

The development of gas wells using hydraulic fracturing technology poses some environmental risk. The primary environmental and public health goal should be to ensure that drinking water sources are protected from contamination. Michigan officials have the task of protecting the state's natural resources and public health, as well as promoting the development of energy sources that have the benefit of creating Michigan jobs. In reaching the balance of protecting the environment while providing economic opportunity, state officials should resist the temptation to over-regulate the process, which could result in the loss of valuable jobs and an additional source of energy to heat Michigan's homes and power its factories. ■

1. *Briefing paper on Hydraulic Fracturing – 9/23/10; written by Paul Jankowski, Office of Geologic Survey, Department of Environmental Quality.*

2. *Natural Gas: Does Hydraulic Fracturing Really Cause Earthquakes -9/27/10; written by Professor Chris Rhodes and published on OILPRICE.COM.*

3. *The Hard Facts About Fracking – by Elizabeth Svoboda, Popular Mechanics.com.*

4. *Hydraulic Fracturing fact sheet – Chesapeake Energy – March 2010.*

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