A3961

Walking on Water:

Essays for the Central Sands

This page left intentionally blank.

A3961

Walking on Water:
Essays for the Central Sands

Editors: A.J. Bussan, George Kraft, Justin Isherwood

This collection of essays represents the opinions of different authors and provides a framework for the presentation of varying points of view about water and agriculture-related issues in Central Wisconsin. This is a starting point. By opening-up communications, we hope to identify and shape implementation strategies for the preservation of Wisconsin's ground and surface waters.

Acknowledgement of Authors:

David Ankley, Retired Portage County Extension Agent

Bill Berry, Writer, Editor, Communications Specialist

Bill Bland, Professor, Department of Soil Science, University of Wisconsin-Madison

AJ Bussan, Associate Professor, Department of Horticulture, University of Wisconsin-Madison/UW Extension

Denny Caneff, Executive Director, River Alliance of Wisconsin

Andy Diercks, Farmer, Coloma Farms

Patty Dreier, Portage County Executive

Stu Grimstad, Portage County Resident and Trout Unlimited Representative

Andrew Halverson, Mayor, Stevens Point

Justin Isherwood, Farmer, Isherwood Family Farms

George Kraft, Professor, College of Natural Resources, University of Wisconsin-Stevens Point/UW Extension

Dan Mahoney, Village of Plover Administrator

Pete Nowak, Honorary Associate and Fellow, Nelson Institute for Environmental Studies, University of Wisconsin/UW Extension

Dick Okray, Farmer, Okray Family Farms

George Rogers, Former Editor, Stevens Point Journal

Ken Schroeder, Portage County Extension Agent

Sharon Schwab, Chairman, Town of Grant, Portage County

Marilyn Williquette, Central Wisconsin Resident

Contents

Foreword: Water is the Issue

by Justin Isherwood

In general terms we all know the stats. Water covers 70% of the earth's surface. The earth's water is 97% salt water and 3% fresh with 2% in the form of ice and 1% in surface and groundwater. Agriculture uses 70% of the fresh water consumed globally. Growing human population continues to increase the need for fresh water and expanded agricultural production. Agriculture has to meet increasing demand for food, feed, and fiber, and now energy. Water problems are occurring all across the globe as supplies become more limiting.

Water and public policy is a front burner debate in many parts of the world, and it is an evolving issue in Wisconsin. We've seen many elements of change in our water policies. A resource we once took for granted, within a generation we've seen water qualities improve dramatically. Public water management has taken the initiative of duplicating natural systems to reduce or mitigate water problems. Levees on the Mississippi are being reengineered to dissipate the flood stage over a larger area and reduce flooding and structural damage. Original oxbow bends in rivers, once straightened by the Army Corps of Engineers, are now being recreated to slow flood accumulation and reduce surge velocity.

Swamps and marshes were once considered wastelands and sources for disease vectors such as mosquitos, but are now known contributors to improved water supply and quality. Cities like Boston are rebuilding wetlands to buffer tidal floods and heavy rain events. The risk of street flooding combined with sewage overflows into open water is being minimized through municipal wetlands that intercept runoff and minimize potential for untreated sewage to reach surface waters. One acre of wetland stores 1.5 million gallons of rainwater.

Water has a ritual presence in most human societies. We gain a sense of place and self from water. Water serves a canonical role in a majority of the world's religions. Jews and Christians baptize with water. Shinto considers water the most intimate act of deity. Muslims wash their feet before entering the mosque. Hindus consider the Ganges a holy river that flows beyond earth to the realm of Moksha.

Water, shortage and excess, has its extremes. In the lee side of the Andes is Chungungo, Chile, a small village where water must be trucked from 30 miles away. Naturalists first noted eucalyptus trees flourished on the mountain ridge overlooking the town, catching and condensing the nightly fog in their leaves and branches. To mimic this, a high-tech plastic mesh has been installed at this same location to harvest the fog and collect water droplets. The collected water is piped to the village each day. Eighty fog collectors yield 2,600 gallons per day. This is new wealth for Chungungo. Local water consumption has doubled to eight gallons per person per day. The water system requires no energy.

The mighty Colorado River no longer reaches the Sea of Cortez at Baja. The Aral Sea in Central Asia, complete with its ships and fishery, has disappeared as this massive fresh water body has been depleted by Soviet-era irrigated cotton projects. In northern India, the ground aquifer is dropping at a foot per year due to expansive agricultural use and limited recharge. The Ogallala aquifer of the High Plains irrigates a third of the nation's food and fiber, some 175,000 square miles with 5 trillion gallons pumped annually. A Texas Tech study demonstrated the Ogallala generated $1.6 billion and 17,000 jobs in a 26-county area of Texas alone. The Ogallala is non-rechargeable, and pumping is restricted or unavailable in some areas.

Technology has advanced center pivot irrigation so that corn and potato yields have doubled in Central Wisconsin, but both are dependent on the Central Wisconsin aquifer. Even a moist region with 32 inches of nominal rainfall can suffer a use/recharge deficit if use is unheeding. The purpose of this little book is to begin conversations that will ensure the preservation of the Central Wisconsin aquifer. A select group of citizens face the responsibility of a shared aquifer. Beyond lie many questions. What is the role of the agriculture sector in maintaining the aquifer? What is the responsibility of the municipalities to safeguard the resource? What does the science of aquifer management suggest? In the end, can we agree that a parity water level is possible, and can we identify optimal water use for promoting economic activity, protecting the water resources, and promoting happy and productive communities?

These essays present opinions on the water debate already under way. The editorial collection plate was passed around the community that share this resource to see what farmers, residents, scientists and elected officials would throw in the pot. *Walking on Water* is a litmus test to ascertain

our collective state of mind on the water issue in Central Wisconsin. The backdrop is stark, with potential long-lasting negative effects to the surface environments, altered qualities of life, and risk of overwhelming the water resource until it fails.

The aquifer in Central Wisconsin is not the Ogallala. As an aquifer it's not really that big, and recharge from annual precipitation is essential for its existence. It is ours to keep, sustain and nurture for generations to come. These letters are matters of conscience, and the authors have biases. Those of us in agriculture know what we accomplished with our share of the aquifer. Sharing this resource doesn't come easy. Some of these essays reflect this fact. The hope is to find common threads, common goals, despite the disparate points of view. ❧

Introduction: What is the Central Sands Region?

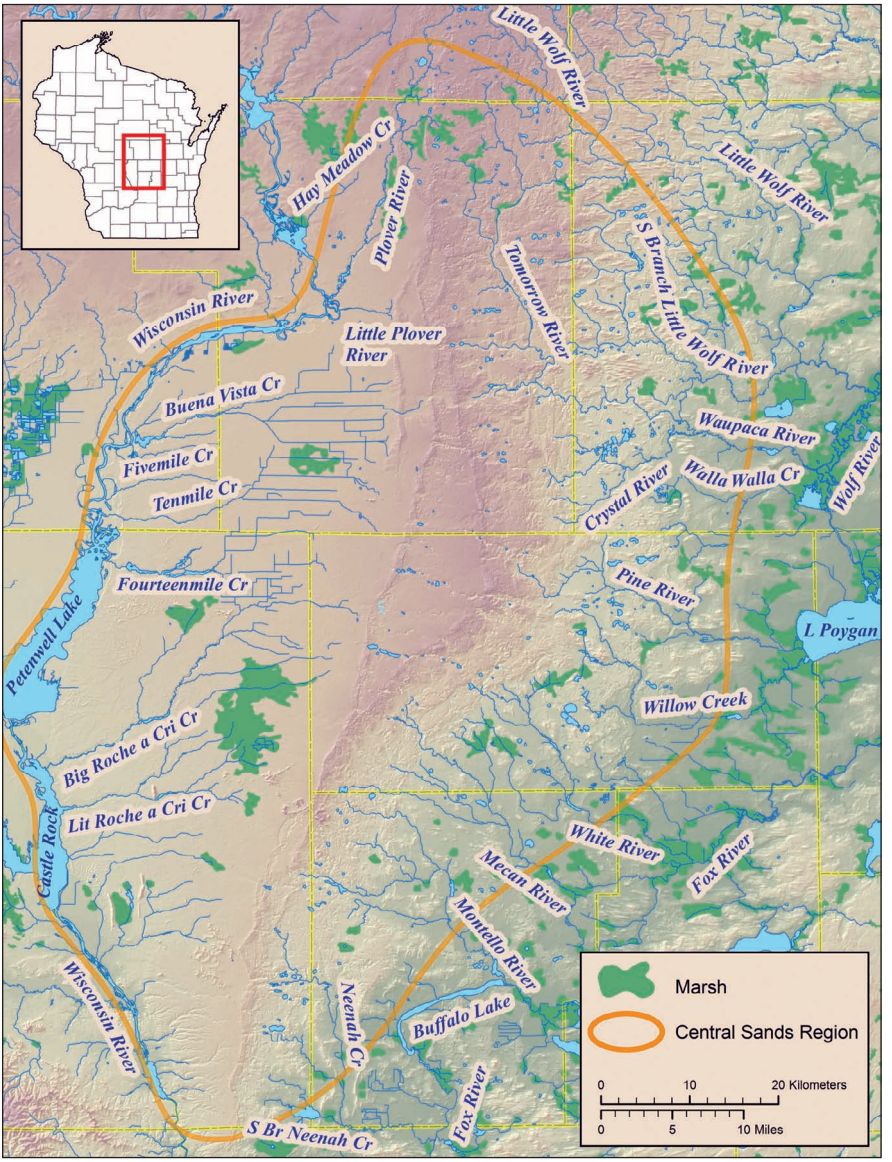
by George Kraft

The Central Sands Region of Wisconsin has been defined in many different ways. Here we define the Central Sands as the region north to south from southern Marathon County to southern Adams County, west to east from the Wisconsin River to western Waupaca and eastern Waushara Counties. This area is characterized by sandy soils and underlying sands and gravels deposited by glaciers 10,000 years ago. Some could correctly say important sandy areas prevail west of the Wisconsin River in Wood County, but the area we have chosen as the Central Sands contains a density of highly prized lakes and streams and land irrigated for agriculture.

Geologists tell us that the sculpting of central Wisconsin began two million years ago with the glaciers during what is popularly known as the "Ice Age," more properly the "Pleistocene." By the start of the Pleistocene, the earth had already experienced 4,400 million years of change. In Wisconsin this change included collisions and tearing of tectonic plates, sometimes accompanied by the building and eroding of mountain ranges, and alternate submergence and lifting from seas. These geological processes formed the granites and "crystalline" basement rock found exposed in the north-

ern half of the state, and the sandstone that covers the crystalline rock through the southern half of Portage and Waupaca counties, the western half of Wood County, and almost all of Waushara, Adams, Juneau, and Marquette counties.

After Wisconsin emerged from the seas for the last time about 360 million years ago, erosion and soil-forming processes began to modify the existing



rock. Erosion removed the Central Wisconsin sandstone entirely where it was thin and partially where it was thicker, leaving behind prominent features like Mosquito Bluff near Bancroft or the mound at Roche-A-Cri State Park.

Fast-forward to the Pleistocene, in particular the stage called "Wisconsin Glaciation" (so named because it was first studied in detail in this state) which ended about 10,000 years ago. The Wisconsin stage glaciers advanced across the state in tongues or lobes whose direction and rate of movement were controlled by land topography and the rate of ice accumulation in their locale. The lobe that most affected Central Wisconsin, the Green Bay lobe, generally followed Green Bay and the lowlands of the Fox Valley, moving into central Wisconsin from the east and northeast.

The behavior of glaciers is hard to comprehend without understanding they were huge—thousands of feet thick. Ice thousands of feet in thickness flows very slowly because the weight of accumulating snow compresses underlying layers and makes the ice at the bottom of the glacier behave like a viscous liquid. The glacier moves from where ice and snow accumulate toward an edge where it stops advancing and melts. Along the way, the glacier's bottom acts like a conveyor that grinds, plucks, and erodes loose soil, gravel, and boulders.

The eroded material is redeposited under the moving ice in layers called "ground moraines," or carried to the edge of the ice lobe to form long ridges called "end moraines." Prominent end moraines run north-south through or near Custer, Almond, Plainfield, Hancock, and Coloma.

The edges of glaciers are wet places because of melting snow and ice. Streams were formed and carried away sand and sediment that the glacier picked up along the way. The sand and gravel were left behind in broad outwash plains while the silt and clay washed away. Pits formed behind the ice margin where buried blocks of ice melted or ice dammed valleys to create lakes. Glacial Lake Wisconsin was formed when the outlet of the glacial Wisconsin River was dammed near Baraboo, backing up water as far north as Wisconsin Rapids and west to east from Tomah to eastern Adams County.

All of these processes influenced the present-day Central Wisconsin landscape. Ice smoothed off the tops of hills and filled valleys. Glacial streams deposited sands and gravels—sometimes a hundred feet or more thick—at

the edge of the glacier or in Glacial Lake Wisconsin, creating the sand plain and its coarse soils and prolific aquifer. Lakes now occupy some of the pits formed when buried ice blocks melted as well as former tunnels under the ice near the glacial margins. We know some of these lakes as Sunset, Emily, Wolf, Pickerel, Huron, Pine, and Patrick.

People were already on the scene 10,000 to 12,000 years ago at the end of the last glaciation. Woodland caribou, giant beaver, mastodons (browsers filling a deer-like niche along with stag-moose), mammoths, bison, musk ox, elk, and possibly horses were hunted as soon as vegetation took hold at the ice front. These people quarried tool stone in Jackson County and transported it to Central Wisconsin on waterways 12,500 years ago.

The Central Sands contains more than 80 lakes, 600 miles of headwater streams, and thousands of acres of wetlands. Groundwater is the invisible part of the hydrology, but a real the part of the water cycle that makes the rest of the system work. Groundwater is the water in saturated spaces between sand grains or cracks in the bedrock. This is called an "aquifer" and the top surface of the aquifer is the "water table." In the Central Sands, the principal aquifer is the glacial sand and gravel sediment left by the glacier.

All groundwater originates as precipitation, about 31 inches per year in Central Wisconsin on average. A little of the precipitation runs off directly to streams. The majority percolates into the soil where it is either evaporated from plants and other surfaces ("evapotranspiration") or percolates through the soil and becomes groundwater.

Evapotranspiration from forest and prairie is about 19 inches each year, which leaves 10 to 12 inches to become groundwater recharge under natural land covers. Areas where groundwater enters the aquifer are called "recharge areas." If the groundwater just sat there we'd eventually be up to our eyeballs in it, but it flows, under the force of gravity, to the nearest stream. Streams are groundwater discharges, and continue to flow in the absence of rain and do not freeze solid in the middle of winter. The region's lakes are connected to groundwater, behaving like holes through the sand and gravel to the water table. Most lakes are flow-through groundwater, receiving water on one side, discharging it out the other. ❧

What Should Be Done

by George Rogers

Irrigation isn't the sole cause of Central Wisconsin's water problems. Don't forget dry weather, industrial pumping, long showers and those big, thirsty lawns.

Yes, those high-capacity wells that keep the potatoes and beans growing are a sizeable factor. Should we shut them down? Only an idiot would go that route. Irrigated farms, and the food processors that rely on them, are an economic mainstay of Central Wisconsin.

Talk to an old-timer who farmed on our sandy soils in a hot, dry summer before irrigation and he'll tell you what fun it was. But that doesn't mean everyone who wants to sink a well should be allowed to do it.

Years ago some people said our groundwater supply was inexhaustible, and they probably believed it. But it isn't. Witness the Little Plover River which is (or used to be) a class-1 trout stream. In recent years part of it has gone dry repeatedly due to agricultural and municipal pumping. Yes, dry weather was a contributing factor but the stream always used to flow, drought or monsoon.

This little creek is now a poster child for water conservation. Or maybe it's the canary in the mine shaft, warning that bigger and more famous streams could suffer the same fate.

So what should be done? I'm no hydrologist but I think we should have a moratorium on new high-capacity irrigation wells. The same goes for high-cap industrial wells, high-cap municipal wells, high-cap anything. Water is water no matter how it's used or misused, and we don't need to pump it into water-ski lakes, as has been done in bone-dry Arizona.

After a pause, following the adoption of appropriate legislation, any application for a new high-capacity well permit should trigger a hydrologic study. Would this well impact a lake, a stream or another well? If so, reject it. This assumes, perhaps wrongly, that the Wisconsin Legislature has the courage to enact any kind of strengthened groundwater law.

I once heard a man, a sincere, intelligent man, say a person's livelihood was more important than his recreation. What he was getting at was people

have to eat and they have to make a living, and they can't do either with a fishing rod unless they're a lot better with it than I am. Good point. But the recreation industry is big in Wisconsin, too, and it's largely water-based.

Then there's the matter of law. The Northwest Ordinance of 1787, older than the American Constitution but still valid, says navigable waters are public, and even trickles like the Little Plover are considered navigable. What good to the public is a lake or stream that has no water?

Yes, the irrigator must be allocated water. So must the fisherman, but I'm not so sure about the guy with the big lawn. Alternatives to lawns exist and they're not bad.

In his book, *Unquenchable*, Robert Glennon wrote that the lawn acreage in the United States is equal in size to the states of Connecticut, Massachusetts, Rhode Island, Vermont and New Hampshire combined. "No wonder the Scotts Company is happy," he said. Those urban pastures grow no food but use a heck of a lot of water. (Glennon is a professor of law and public policy at the University of Arizona and an authority on water law.)

One problem: What do we do in the Little Plover watershed, which already seems to have too many wells for the good of the stream? Simply order them to shut down? It's not going to happen. The people who put in the wells may have relied on a U.S. Geological Survey study in the 1960s which concluded that the amount of water then being pumped wasn't significantly affecting the Little Plover. But that was then. A lot more is being pumped now.

Maybe some of the wells should be bought by the state and retired. And maybe we should invest more in research on how to grow the same amount of potatoes and beans with less water. Drip irrigation doesn't seem feasible on a 160-acre potato field, but that doesn't mean center-pivot rigs are the final answer.

The problem has not gone away just because the weather turned wet in the summer of 2010.

We Need New Thinking for Groundwater Stewardship

by Bill Bland

The phrase "tragedy of the commons" entered modern debates over how societies might manage natural resources when ecologist Garret Hardin published a paper by this title in 1968. Hardin explored a couple of ideas: that some very challenging problems cannot be solved by science alone, and that the actions of individuals as they make use of a natural resource may harm the resource and their own best interests. The phrase and the paper touched off a great explosion of scholarship, much of it taking issue with Hardin's examples and suggested solutions, and arguing that lots of commons do not end tragically. Perhaps the legacy of the paper is the poignant phrase that is its title and the great deal of thinking that it inspired about how societies such as ours might govern the use of Earth's bounty to everyone's broadest benefit.

Hardin's commons was a pasture, presumably open for use by members of a group of cattle owners, but without restrictions on how many cows each could graze on it. The tragedy was the inevitable (in Hardin's eyes) outcome that with no incentive to do otherwise, many group members would continue to add cows until the pasture could no longer meet expectations, and perhaps be damaged irreparably.

In my mind the groundwater of the Central Sands is a sort of commons, originating as water vapor in the atmosphere, falling to Earth as precipitation, filtering through the soil, and slowly moving toward points of discharge, where groundwater rejoins surface water—lakes, streams, rivers—or is pumped through a pipe for some human use. In the Central Sands, groundwater is always on the move, perhaps catching a glimpse of sunlight as it passes through a lake, but always draining toward a river, stream, or ditch where it can become flowing surface water, bound for the Wisconsin River. We humans often intervene in this slow flow, perhaps by digging a ditch to expedite groundwater's escape to the surface, or capturing it through a well to supply the water needs of homes, industry, fountains, and thirsty crops. Every human intervention alters in some small way the patterns of flow and discharge that would have existed in the absence of our actions. Each of these flow alterations has the potential to

reduce the usefulness of the resource by lowering the usual elevation of the water table, thus reducing lake levels and stream flows. One more well in the groundwater, like one more cow on the pasture, benefits the owner but may harm the resource and interests of others.

In Wisconsin law, surface waters are considered to be held in trust by the state, on behalf of all citizens. This is known as the "public trust doctrine," and it is why you are free to take your fishing boat most anywhere that it will float (provided that there is a place to launch it). The rights of owners of the land adjacent to surface waters ends at a line along the shore termed the "ordinary high water mark," a line where the water's presence over the years has caused a distinct change in vegetation or land characteristics. Of course there are many situations where this is ambiguous, but the important point is that a shoreline owner does not have the right to exclude your use of adjacent surface waters. Wisconsin law and tradition clearly identifies surface waters as a commons.

The legal status of Wisconsin's groundwater is not so clearly defined. Until 1974, a landowner could use the groundwater without regard for how that use might affect others. The 1974 legal finding in the case State v. Michels Pipeline Const., Inc., put in place the concept of reasonable use—a user may withdraw groundwater so long as this does not cause unreasonable harm to others. What is unreasonable harm is clearly open to interpretation that must still be sorted out case-by-case in courts of law. Thus it appears that groundwater legally falls somewhere between being the exclusive property of the owner of the overlying land and falling under the public trust doctrine.

As in law, science once separated surface and ground waters, but this has come to an end over the past 30 years. We now understand the many and complex ways that the two are really just different faces of the same resource, a concept that can be readily demonstrated by a number of scientific measurements. While there are places where we need not consider the close linkage of surface and groundwater, the Central Sands is not one of them—here they are clearly one resource.

Should surface and ground waters continue to be treated separately in legal and management questions? It is inconceivable that we would dismantle the public trust doctrine and auction off pieces of Lake Mendota, although there are those who would be supportive of this. Conversely, the public trust doctrine could conceivably be extended to include groundwater. The

first option is politically unimaginable and not really that attractive in a practical sense—a boat is most fun when you can steer it anywhere on the lake, and fishing in your little spot would become tedious. The second option is quite politically radical, but readily rationalized from a scientific standpoint. Neither strategy for treating surface and ground waters equivalently in the legal realm seems likely to come about anytime soon.

But the inadequacy of our current management of groundwater is becoming clear in an increasing number of spots around Wisconsin, including the Central Sands. The growing number of conflicts could be battled-out in courts—call it the "lawyers full employment act" option—or we can develop new forms of water governance. By governance I mean rules and institutions for making decisions and working through conflicts—every town board or curling club that we are members of has a governance system. We are all familiar with multiple layers of governance, and this makes good sense for many issues. For example, national defense is sensibly left to the federal government, given the tremendous cost, the complexity of the decisions to be made, and the international challenges to our security are the same whether you are in Tampa or Wausau. Conversely, town, village, city, or county government is the best place to manage garbage collection and local parks, so the values and resources of the community can be applied to the task, and officials can be held accountable.

Most thinking about new forms of water governance emphasizes local scale solutions and the importance of equity as a central principle. Equity here means that all affected persons, including those who speak for nature, are meaningfully represented in the governance system. This emphasis on equity means that more than just economic interests should be considered—traditions and non-economic values of community members ought to be included. Scientific knowledge, made accessible to all, will be an important part of these new governance systems. But as Hardin pointed out in his paper, solving some problems requires more than just getting the science right.

It does not appear that existing forms of governance are suited to the challenges of groundwater management. Existing local governments, while important stakeholders, are probably too small for comprehensive and wise planning and decisions about groundwater. On the other hand, state government is too large and remote to appreciate the important local knowledge, values, and groundwater behavior that can lead to the best solutions.

Probably what is needed are special districts that are sized correctly—small enough to respond to the local economy and values, and yet large enough to include the entire area facing a groundwater challenge.

There are countless examples around the world where societies have failed to manage natural resources thoughtfully, and almost everyone involved is worse off for it—tragedies that might have been preventable. Our demands on Central Wisconsin's incredible groundwater resource have grown to the point that we need new ways of collaboration if the Wisconsin traditions of stewardship of natural resources, an abundant agriculture, and basic fairness for all can be realized. We should seek to be one of the exceptions to Hardin's gloomy 1968 prediction. ❧

Eau Eau!

by Dick Okray

There can be no doubt that water is the single most important compound on this planet. No known living organism survives without it, including humans. Sixty-three percent of us is it. Remove the fat, and our chemical makeup is almost identical to any ocean on this orb. If we are anything, we're (semi) intelligent water. Eau, how we need you!

And farmers know this better than anyone. Food doesn't grow in a desert. In the late 1950s, local farmers went to Madison to fight for the right to pump water from the seemingly vast reservoir beneath the Central Sands area. At the time reverse hydraulic irrigation was discovered, much of Portage County had only jack pine and sand burrs growing there. The water table, some 25 or so feet down, was thought to be in danger of being sucked dry. Rivers and lakes would dry up forever, leaving exactly the aforementioned desert. A moratorium on permits was put in place for a year giving hydrologists time to study the issue. Since then, thousands of high-capacity wells have been drilled, and the lakes and streams remain with nary a drop in the water table. Recent droughts have drawn down some lakes, but they've dropped in the northern part of the state as well, an area with almost no high-capacity wells, and one year of over-average rainfall has put most of them back to full. So the water is back, but the controversy continues, after all these years. If anything should determine future water policy, it should be science and sound science at that. I'm talking the

old-fashioned vetted, double-blind, and peer reviewed kind of science that, although it may still be wrong, stands the best chance of being right. Emotion needs to stay out of it, but that gets harder and harder to do with an ever increasing population. Take for example the creek I grew up on.

The Little Plover, a six-mile-long, spring-fed, class-1 trout stream, has long been a jewel in the community which bears its name. As children, we would walk from our home by the dam two miles from its mouth, up river to the Department of Natural Resources conservation dam, and then upstream through the multiple underwater weirs until we would reach the headwaters, water springing from the side of the hills. This was a four mile trek in all, enough to appease our mom for the afternoon most every summer Saturday. Somewhere in the next few decades, the conservation dam and the weirs were removed, perhaps to speed the water downstream. And the creek seemingly got drier and drier. This creek is now being studied and seems to be the basis for current water legislation. My questions are, why not return the dams to their past state and compare apples to apples? Is it good science to do anything else? Is a six-mile-long stream suitable as the basis for state water policy? Really?

The last part of this picture, of course, is the people. As much as I know that it is not politically correct these days, I like people! Oh, I know they make mistakes, pollute the environment, kill each other and generally are the cause of almost all mayhem on earth, but deep down, we mean well. And I believe we are getting smarter and perhaps even better. Water policy needs to include people in the final draft, or it will make no sense at all. It should include, but not be limited to, agriculture, municipalities, industry, institutions, recreational users, as well as individuals.

Winston Churchill once said, "You can always count on Americans to do the right thing—after they've tried everything else." I have no doubt that we will derive the world's best water policy, eventually. Until then, I'll hold my water!

Farmers Should Say, "Bring on the Water Regulations. They're Good for Us."

by Denny Caneff

I believe it is unequivocally and immutably in farmers' self-interest—those farmers pumping a lot of groundwater to grow vegetables or water cows—to get behind more regulation of the water they use for agriculture. I know it's embedded in the DNA of farmers to resist the meddling of loathsome bureaucrats who don't know agriculture. I know times are tight, and regulation often ends up costing money.

But what are you, and what do you have, if you don't have water?

"I don't have water?" you ask, incredulously. "In Wisconsin? In 2010?"

YES. Despite the fact that we are all able, from small dairy farmer to microbrewer to car wash operator to suburban cappuccino maker, to turn on the tap and get instant, seemingly infinite, and damn good water, we ought to pay attention to just how long we can expect that luxury to last. On the issue of predicting how much water is underground for the taking, I see agriculture as more vulnerable to that great unknown than people and industries in our settled areas of the state. You can bet municipalities are paying close attention to, and keeping avid track of, just how much good water they have. For proof, see anything said or published about the city of Waukesha and water in the past two years.

Agriculture consumes enormous quantities of groundwater. Yes, the rest of the citizens of Wisconsin benefit economically, and we all get to eat the fruits of that pumping as well. But that is all the more reason to be more careful with how we use it—all of us, farmers included.

I see agriculture both politically and hydrologically vulnerable to shrinking water supplies. I will take up the hydrological question first. You can argue all you want about climate change. That it's a liberal scare-mongering myth or sunspots, as one public official has contended. I will not use this forum to convince you about whether or not the climate is changing. But a term I like is "global weirding." This is simply to say that with nearly 7 billion people on the planet, with the increased burning of hydrocarbons all over the globe (China expects to add hundreds of thousands of cars per year to their roads in the coming years), with fresh water is only a very small frac-

tion of the total water available on this planet, AND with that fresh water ever more vulnerable to any number of perturbations and depredations, this resource, this essence of life on the planet, needs not just our attention, but our love.

Cities along the Great Lakes get their water from those bodies, but the rest of us Wisconsinites depend on groundwater. Think about how hard it is to restore that water once it's pulled out of the ground. In urban areas, all that groundwater is dumped into a river and thrown away once it's been used. In any place where we pave or put down hard surface, land no longer absorbs rain and snowfall; that water too is essentially piped away and shipped downriver. We sacrifice wetlands for all kinds of things, and thereby we sacrifice their ability to recharge aquifers.

You might say the groundwater that farmers use gets recirculated: irrigated water not used by a crop (and not running off) percolates back in; same thing may happen with manure (with the hope that the soil purifies it before it hits the aquifer). True enough, but the science is not at all clear about just how much irrigation water is making its way back to the source, and clearly much of the water used in dairy operations is, as fully expected, being exported out and away as milk.

There is another hydrologic vulnerability which will take me nicely into the political vulnerability I see looming for farmers and groundwater use. Given how easily accessible, high quality, and apparently abundant groundwater is in this state, especially in the Central Sands, and given how much more vulnerable water is in other parts of this country, the demand for Wisconsin's water will only increase. I'm thinking in particular of the water bottling companies. They will be back here, sometime soon, and they will export millions of gallons per day.

There's no getting around the fact that you farmers are huge water users and this is where you are vulnerable politically. You essentially don't pay for the water itself (though I appreciate the fact it costs something to extract and distribute it). You have lakes and rivers drying up in the Central Sands, and residents of those water bodies are getting organized and vocal. You have people looking at the volumes of water needed for mega-dairies, which are unpopular for other reasons but their opponents are glad to have another weapon to use against you. You have no obligation whatsoever to put any of that water back—by that I mean there's no expectation of you to provide aquifer recharge capability to help replenish the water you use.

A final political vulnerability I see is actually a legal one, and that is the connection between surface water and groundwater. There was a Wisconsin Court of Appeals decision last June which determined that a high-capacity well near Lake Buelah in Walworth County has the potential to affect the level of Lake Buelah. In other words, as goes groundwater pumping, so will go the nearby surface water, in not just a hydrological but also a legal sense. The fancy legal term you may have heard of regarding this phenomenon is the "public trust doctrine" that the waters of the state belong to the people of the state. This Lake Buelah decision could lead to clearly extending the public trust to groundwater.

And so this is why I say it is in farmers' business self-interest and the self-interest of the agriculture community generally to support more careful use of groundwater. You want some predictability about how much water will be available and who has access to it. Right now you have none of the former, and as for the latter, it's a near total free-for-all that can't be good over the long term for farmers, especially those with existing wells when new guys come in and want even more. Yes, it may mean that you eventually cannot have all the water you want whenever you want it, for free. But that has never been a reasonable and sustainable proposition. It would be far better for agriculturalists to be at the table determining the how, why, how much, and when of groundwater pumping so it is not imposed on you by the Department of Natural Resources, abetted by court decisions.

It seems to me you wouldn't like operating your businesses without some certainty. You need to be in the conversation to protect your interests, but fully accounting for those other interests, too.

You may think you could hold this off politically or that you have the cards necessary to keep groundwater legislation at bay. I'd say that may be true for a few years, but with more people's water getting harmed, the groundwater "lobby" getting ever more organized, and the natural world's process of "making" water ever more disrupted, it's only a matter of time before the pumping picnic gets called off by public pressure and the authorities. Without that dialogue now, there eventually will be a fight, which would be no fun and not honor anyone. Farmers shaping groundwater policy would befit their well-earned tradition of good citizenship and stewardship, conservatism in conservation, and good business planning. ❧

To Manage the Riches

by Bill Berry

When it comes to most issues involving water quality and quantity in Wisconsin, the obvious isn't far from reach.

Here are some examples of the obvious:

- Wisconsin remains relatively rich in water resources, both beneath and above the ground, and our futures are tied to how we manage those resources and the array of services they provide.
- Many stakeholder groups lay claim to these resources, often for different sets of reasons.
- Most concerns about water resources can be addressed and resolved. The technical ability to do this is already in our hands. What we lack is the societal will.
- Our best hope for addressing water issues rests in efforts to find the great middle ground among stakeholders, so that they might agree on how to give, take and leave something for the living creatures that follow us.
- If we are able to do this, we can avoid the dreaded tragedy of the commons, whereby individuals acting independently in their own self-interest deplete a shared and limited resource when it is clear this would benefit no one in the long run.

A few years ago, an organization tasked me with collecting a set of case studies on watershed- and landscape-scale conservation success stories from around the United States. The exercise was a bit Pollyannaish, since we were only looking for success amidst, frankly, many failures. But the stories that emerged taught some powerful lessons. Foremost is this: When it comes to watershed- and landscape-scale conservation, if you are able to gather together all the stakeholders in the defined region, you have accomplished an important first step. If you are able to encourage a dialogue among these stakeholders, so that they might better understand each other's needs, you have accomplished an important next step, for they realize at some point that they are all in it together.

Then comes the hard work of assessing needs, with the realization that you cannot separate one group's needs from another's, or subordinate one

group's to another's. This is hard work. The groups we surveyed often met hundreds of times to discuss and, indeed, often argue about how to meet the needs of many.

In the process of doing this, many groups found success in places they never expected. They sometimes found that agricultural and environmental groups had quite similar goals and were just separated by differing opinions about how to get there. Similarly, they learned that the goals of seemingly unrelated entities, such as Rotary clubs and kayakers, often dovetail at certain key points. Remarkably, they learned that in some cases various government agencies charged with overlapping responsibilities for a resource had never bothered to share with one another the information they had collected. The dialogue led to better cooperation and information sharing.

In the end, success seemed to flow from the simple realization that we are, indeed, all in this together.

Unfortunately, we don't do so well at this unless we are compelled to do so. I have found it interesting in my own relationships to listen to environmentalist friends rail about big agriculture while chomping on a hamburger and drinking cranberry juice. It is as though what we think has little or no connection to what we do.

Likewise, I have listened too often to speakers who tell me that farmers are the only true stewards of the land, when reality clearly shows us that many farmers willfully ignore what they know is best for water resources in order to reap another harvest.

They're not alone, either. Many city water utilities continue to encourage over-consumption in their rate policies and ignore the importance of protecting water resources beyond their own boundaries.

Elected officials respond to the loudest and most persistent voices hollering in their ears, even though they know it would be better to address big problems with long-term cures, rather than short-term anodynes.

How do we get past this willful dissonance? I propose that we all add another place identifier to our addresses. In addition to zip codes, we should know what watersheds and aquifers we call home. Then let's get down to business and have some serious dialogue, recognizing that the needs of one watershed or landscape aren't necessarily the same as those of another.

All stakeholder groups need to come to the table. Those who don't want to participate will just have to trust those of us who do.

We have the resources of University of Wisconsin-Extension, land conservation departments, resource conservation and development councils and other agencies that can convene and manage the discussion. Let's get on with it.

Of Blood and Water

by Andrew J. Halverson

Water is going to be the oil of the 22nd century and perhaps 21st. Water must be respected for the human, economic, and aesthetic driver that it is in all of its forms. It is our life blood literally and our economic life blood figuratively in Central Wisconsin: for through water all else flows.

Points on the Resolution of Water Issues in Central Wisconsin

by Patty Dreier

Pointing fingers at others is not the answer. It interferes with solutions and elevates pointer above pointee. It purports that a pointer has no responsibility in water quality and water quantity issues—that only the pointee should do something to fix the problem.

Regardless of whether or not I use less water or safeguard water quality differently than my neighbor, I share an equal responsibility for participating in finding and sustaining a solution that ensures our vital future in Portage County and Central Wisconsin.

We must all pitch in and do our best to:

- Conserve—on the farm, at home, at work, at play—every day of the year.
- Reduce the use of chemicals on our lawns, gardens, and fields.

- Buffer shorelines and let wetlands do their important jobs of reducing runoff and purifying water quality.
- Change our landscapes to fit our soil's natural capacities—and perfectly green, weed-free lawns aren't natural!
- Enhance biodiversity.
- Transform our ideas, standards, rules, and regulations to reflect our commitment to shared responsibility and protection.
- Dialogue.
- Develop and act on plans that engage people from all walks of life in advancing solutions.
- Promote models that demonstrate and teach.
- Incentivize change: Provide economic alternatives.
- Increase awareness by celebrating progress.

In order to resolve water issues, the only finger-pointing should be at the person in the mirror. ❧

Groundwater

by Dan Mahoney

It is used by municipalities to provide clean, safe drinking water to its residents and to provide water to its businesses. It is an integral part of many businesses, whether it is used in a manufacturing process, or as a byproduct of that process. It is essential for the agriculture industry, especially in the Central Sands, where farmers use high-capacity wells and irrigation systems to grow crops such as potatoes, cranberries, and sweet corn. The farmers sell many of these crops to local food processors who then distribute them throughout the United States. Groundwater is also essential to maintaining a healthy environment. Wetlands, forests, meadows, prairies, springs, streams, rivers, and lakes are all shaped by groundwater. These natural areas are in turn important to people who hunt, fish, hike, watch wildlife, or enjoy looking at plant life. For all these reasons, there is a need to manage groundwater withdrawals in Wisconsin. Why?

Groundwater is a limited resource. If we do not properly manage groundwater resources, communities will not flourish, the economy of the region and Wisconsin will falter, wildlife will decline, rivers and streams will be depleted or dry up, and recreational opportunities will diminish.

For groundwater management to be successful on a statewide basis, specific management areas will need to be identified and recommendations will need to be developed for these areas. Groundwater protection cannot be accomplished under a "one size fits all" umbrella because groundwater aquifers vary from geographic area to geographic area, the users of groundwater vary, and the impacts on the environment vary. Specific strategies and solutions must be developed to address the local issues in each area of concern. In addition, voluntary solutions should be pursued prior to mandating legislative solutions. Locally led efforts that involve users of groundwater and environmental interests should work together to develop solutions. Only if these efforts fail should statewide mandated requirements be implemented.

On a local basis, high-capacity groundwater withdrawals have resulted in reduced stream flows on the Little Plover River. The Village of Plover has been working with the Little Plover River Work Group to develop voluntary solutions that will restore healthy flows to the river. The Work Group comprises representatives from the Wisconsin Department of Natural Resources (DNR), Portage County Planning and Zoning Department, Village of Plover, Village of Whiting, University of Wisconsin-Stevens Point Groundwater Center, Wisconsin Potato and Vegetable Growers Association (WPVGA), Trout Unlimited, the Wisconsin River Alliance, and Friends of the Little Plover River.

One of the most important aspects of the Work Group's effort was the establishment of a Public Rights Stage for flows on the Little Plover River. The Public Rights Stage establishes minimum flow targets for the river. The purpose of minimum flows is to ensure a healthy flow of the river and promote adequate trout, wildlife and plant life populations. With a minimum flow guideline established, the group is now working towards increasing flows on the river. Examples of voluntary efforts that are intended to improve river flows include the following:

- The Village of Plover has altered its municipal pumping regimen so that 85% of municipal water is pumped from well 3, which is located two

miles from the Little Plover River (wells 1 and 2 are located one-half mile south of the river).

- Del Monte Corporation has acquired approximately 150 acres of land that is one half mile south of the river. The acquisition of this property results in the elimination of 150 acres of irrigated agriculture. Furthermore, Del Monte deposits millions of gallons of cooling and process water to this site, which adds water to the aquifer.

- The Villages of Plover and Whiting, in conjunction with the DNR are funding a study that looks at the viability of moving Plover's wells to the Whiting well field. If viable, Plover's two municipal wells that are located one-half mile south of the Little Plover River could be taken out of production. The new wells would be located 1.8 miles away, which would help to lessen municipal pumping impacts.

- The Village of Plover has targeted a 140-acre area for acquisition immediately south of the Little Plover River, between County Highway R and Kennedy Avenue. The purpose of the acquisition is to reduce irrigated agriculture immediately adjacent to the river by converting the property to a park that would be used for hiking, biking, and other purposes. The Village also proposes that the park include informational signage that discusses Little Plover River groundwater issues and efforts to improve stream flows on the river. As a first step in the proposed acquisition the Village has submitted an application to the Portage County Land Acquisition Committee for the purchase of 40 acres of this land. This acquisition is also supported by the DNR. While DNR staff cannot commit to funding requests because funding is based on competitive applications, they have agreed to assist the Village in preparing an application to the DNR for land acquisition funds.

- The Village has proposed that 300 acres of land immediately north of the Little Plover River (between County Highway R and Kennedy Avenue) be converted from irrigated agriculture. The Del Monte Corporation has discussed this issue with the Village and is currently exploring options for purchasing this property.

- The Village of Plover intends to propose the acquisition of 500 acres of land adjacent to the headwaters of the river. The Village intends to work with the Wisconsin Department of Transportation (WDOT) to gain concurrence that this area is appropriate for wetland restoration projects required of the WDOT. The goal would be to convert irrigated agricul-

tural land to wetlands at the headwaters of the river. If the WDOT is not able to commit to this project, the Village intends to work with the WPVGA to assist with the acquisition of this property.

- The Village and Rural Water Association acquired flow metering equipment that was placed in the Little Plover River near County Highway R. This equipment measures stream flows twenty four hours a day. The Village of Plover also acquired weather collection equipment so that weather conditions immediately adjacent to the Little Plover River can be monitored and recorded. The recently purchased equipment will serve as an important tool for the Little Plover River Work Group as they continue their efforts to restore stream flows to a healthy level.
- The Village has initiated discussions with our local utility company about implementing a rebate program for those who would buy and install moisture data sensors that would be linked to irrigation systems. These moisture sensors would ensure that lawns and gardens would only be watered when water was needed, thereby reducing groundwater withdrawals and reducing energy consumption at the same time.

Truthfully, getting to this point has been difficult. Municipalities, agricultural related businesses, farmers, county officials, university researchers and environmentalists are not used to rubbing elbows and solving problems together. It is important to recognize that this is probably the first time such disparate groups have come together to attempt to develop solutions for the Little Plover River. While it is clear to me that trust does not exist between all groups, the overall efforts of the group have led to progress towards establishing healthy flows on the river. I also recognize that we have a ways to go. It is extremely encouraging that Del Monte, the Village of Plover and the Village of Whiting have already made significant financial commitments toward improving river flows. I am optimistic that Del Monte, the villages, Portage County, the DNR, the WDOT, and area farmers will step forward to make the remaining necessary financial commitments to ensure that we reach our ultimate goal of restoring healthy flows to the river.

The first effort to pass statewide groundwater legislation failed. From my perspective there are three key reasons the legislation failed. First and foremost, while the information gathering/sharing stage of the process was very open and public, when it came time to write the legislation, the doors were slammed shut and the process became closed. No public input was

sought on crafting the language. The language was not even submitted to the committee overseeing the issue (Groundwater Work Group) prior to going to public hearings. The second problem was that the legislation was put to public hearing at the very end of the 2010 legislative session. It became obvious that legislative leaders were attempting to beat the deadline (end of the legislative session) rather than focus on the concerns presented at the public hearings. The third failing was that the key legislators failed to grasp the economic impacts of the legislation they proposed. Communities, businesses, farmers and the agriculture industry faced significant costs associated with the legislation. For example, the villages of Plover and Whiting could have been forced to move their wells at a cost of $17.5 million.

Protecting groundwater resources in Wisconsin is of paramount importance. Locally-led efforts should be pursued prior to legislative solutions. The efforts of high-capacity well users in the Little Plover River aquifer have demonstrated they are making a difference. If our efforts to restore healthy flows to the Little Plover River fail, then legislative solutions should be required. Such legislation, however, must represent a fair balance in protecting groundwater resources while ensuring that communities can provide safe, reliable drinking water to their residents and that businesses and the agriculture industry can operate in our state. ❧

Watery Thoughts

by Sharon Schwab

y family has lived near the Buena Vista Marsh for nearly 30 years. When we first moved to our home, the 40 acres just east of us was wet. Really wet. Each spring our Black Labrador would celebrate spring by wallowing in the expanse of shallow depressions filled with water. We wore knee boots to tag along. I recall a lot of splashing. No more. The last time I can remember that was 1993.

The Buena Vista Marsh used to be a tamarack swamp. Drained during the "Swamp Buster" era and beyond, it now represents the largest grassland complex in the state of Wisconsin. Ironically, it is the last stronghold of the greater prairie-chicken. Other grassland obligate species, including northern harriers, upland sandpipers, short-eared owls, and Henslow's sparrows,

depend on this surrogate landscape to survive.

In 1990, we refurbished our old farmhouse and installed a groundwater heat pump. We loved it philosophically, but the reality was it dissolved iron—lots of it. After 13 years of babying the system along, we changed the open-loop design that used groundwater to a closed-loop system that uses a mixture of synthetic fluids. These fluids inhabit nearly a mile of tubing lying precariously in soil a few feet down. The soil must be moist year-round to maintain a constant temperature. It's making me nervous because we depend on constant and reliable water. Based on recent history, I'm not certain it will be there for us.

Our once wet backyard now showcases xeric prairie species. We can see lupine, pale purple and yellow coneflowers, creamy indigo, and rattlesnake master. I'm not complaining really. The landscape is beautiful, but the water, and the splashing of the past, is gone.

Enormous pressure now exists for the ground and surface waters of the Buena Vista Marsh. There are agricultural needs of potato and vegetable growers, and upland cranberry producers. There are residential and commercial needs of homeowners and businesses.

I guess we just didn't see it coming. I presume neither did the marsh. It's been renamed the Buena Vista Grassland. ❧

What Price Memories?!

by Marilyn Williquette

My family made its home in Milwaukee. My dad worked at American Linen, a commercial laundry, at first in the plant and later delivering, servicing and in-stalling roll towel cabinets at schools and various local businesses. My mom took care of our house and home. My parents and Aunt "Putz," who was a single nurse and who served under General Eisenhower during World War II, bought the family cottage on Long Lake by Plainfield in 1956. We are eternally grateful to Aunt Putz for enabling the acquisition of this property by splitting the purchase price and the upkeep costs. At this time my sister Judy was 6, I was 7, my brother Mike was 10, my brother Don was 12, and my brother Ken was 14.

It was our place "up north." Though we lived in Milwaukee, entire summers were spent at the cottage with our mother (who didn't drive). Our father and aunt came up on weekends and vacations.

This beloved cottage originally was just a hunting shack with no central heating or plumbing and just a pitcher pump for water. (This pitcher pump is now a cherished lawn decoration.)

I could write an entire book on our childhood memories. We built sand castles and forts on the beach. We hiked. We biked. We swam. We played baseball. We played volleyball. We played horseshoes. We played badminton. We went fishing and turtle hunting in a rowboat, even with lower water levels during the drought years. I have pictures of us wading in the lake during those dry years of the late '50s and early '60s. The lake never got as dry as it did in 2006 and afterwards, and the fish were never killed out.

I remember on Friday nights my dad and I would sit by the fieldstone fireplace and eat sardines and crackers after everybody else went to bed. MEMORIES!

Our mother taught us how to play Sheepshead (only for pennies). We read, and we listened to the radio. (No television.) We watered the vegetable garden our dad planted with collected rain water. MEMORIES!

We picked wild strawberries on the beach, and we picked blueberries and blackberries in the woods. MEMORIES!

It wasn't quite the Waltons, but we considered ourselves fortunate to be in the country by a lake instead of in the hot city during the summertime. Boy, we were so healthy and happy. MEMORIES!

Speaking of hot, I remember catching an overabundance of grasshoppers during dry times to use as fishing bait. MEMORIES!

I remember friends of our parents visiting with their kids. Oh, how they loved being there. To this day they love to come up north. MEMORIES!

I remember paddling in inner tubes on the lake with my son and niece. COOL MEMORIES!

I remember feeding bluegills stale bread off the pier. I remember the neighbor's labs playing fetch in the lake with me. MEMORIES!

I remember my son and niece catching bullheads off the pier and not

being able to get them off the hook. MEMORIES!

I remember my son and niece playing water Olympics one summer. MEMORIES!

I remember teaching my son how to ride a bike up north (even though he swore he was born to walk). MEMORIES!

I remember neighbors and friends playing Sheepshead and howling at the moon with us. MEMORIES!

I remember when my husband remodeled the cottage in 1984 and added indoor plumbing and running water. Our son and niece (who were 7 and 10 respectively) were so thrilled. No more outhouse! No more hand pumping water! MEMORIES!

I remember my cousins' and siblings' families visiting and enjoying the camaraderie at the cottage. PRECIOUS MEMORIES!

I remember local residents coming and fishing at our lake in boats or off our pier. MEMORIES!

I remember canoeing, kayaking, paddle boat rides, pontoon boat rides. MEMORIES!

I especially remember my nephew and his wife and my three great nieces, Katie, Stacy, and Julie joining in a boat parade (in some of the motor less boats listed above) on the Fourth of July, their cute little hands waving the American flag. IRREPLACEABLE MEMORIES!

Now my two great nephews, Jacob and Samuel (12 and 9, respectively) are sad because of the low lake level. Sammy's dog (a black lab) is also sad. Sammy wants the lake back. So do I! MEMORIES!

Initially when the lake pretty much vanished, I was angry every time I saw an irrigation spigot spraying water in the air, even during rainstorms. Then I was depressed and sad every time I looked at our missing lake. Now I'm still sad, but I want to go forward and encourage cooperation. I realize we probably won't achieve optimal levels, but an extra three feet of water would go a long way toward restoring Long Lake's previous beauty! PRICELESS MEMORIES!

Where should we go from here? Until we get this all figured out, a sane society would certainly put a ban on constructing new wells, wouldn't it?

And then some sort of pumping plan would be developed to ensure that pumping would be in keeping with healthy lakes, healthy fish, and respecting the rights of those who live and recreate on Wisconsin lakes and streams. I'm not one who would ban pumping, just get it in line with what the lakes and streams could support. ❧

Directions for Groundwater Management

by George J. Kraft

Dry Central Wisconsin lakes and streams in the absence of drought, dramatic drops in water levels in the Fox Valley and Waukesha areas, and increasing harmful groundwater contaminants have contributed to an awareness that groundwater is not infinite and groundwater pumping is not being effectively managed.

Wisconsin does a pretty good job of protecting its surface waters from drying if someone wanted to pump directly from them, but a poor job of protecting surface waters from drying due to groundwater pumping. The peculiar notion that groundwater and surface water can be managed separately and that they are unconnected is termed by some hydrologists as "hydro-schizophrenia." The scientific fact of this connection, and that pumping groundwater depletes surface water, has been known for a very long time. Some point to Ecclesiastes (1:6-7) as an early source of knowledge on water connections, though it really describes the water cycle generally and not groundwater specifically:

"All streams flow into the sea, yet the sea is never full. To the place the streams come from, there they return again."

Foundational work more explicit to groundwater and surface water connections was produced more than a century ago by Henry Darcy in 1856 in Dijon, France, and in pioneering work done here in Wisconsin by famous scientists such as T.C. Chamberlin (1885), C.S. Slichter (1899), and F.H. King (1899). Work specific to groundwater, surface water, and irrigation pumping was done in the Central Sands by Edwin Weeks and his colleagues at the U.S. Geological Survey (USGS) in the 1960s and 1970s. The predictions that Weeks and colleagues made when irrigation was in its infancy have come to pass, including that irrigation development could

lower water levels in headwaters lakes by three to five feet and dry up headwaters streams.

Presuming it is undesirable to dry lakes and streams or lower their levels so they are winter-killed or otherwise harmed, it seems a good idea to manage how much water can be pumped out of an aquifer.

One extreme in groundwater management is unlimited pumping. This is pretty much what we have now. (One can quibble and say that pumping is managed within 1,200 feet of a trout stream or a handful of lakes, but there are no lakes and streams truly protected from harm by groundwater pumping laws.) Stop and think about this for a moment: if unlimited pumping continues, how might Wisconsin look in another 50 years of unlimited access by countless potential users? Even if one is inclined to write off Central Wisconsin lakes and streams, will we write off the Waupaca Chain of Lakes, the Minocqua lakes, and God knows how many streams to avoid dealing with the groundwater pumping issue?

The other management extreme, no pumping, makes little sense. A reasonable amount of water is available and can be pumped without excessive environmental harm in most places.

So a sensible idea seems to be to abandon the extremes and work toward a management scheme that allows access to groundwater while limiting harms to the water resource.

A few years ago, I had the pleasure of working with a few Wisconsin Potato and Vegetable Growers Association (WPVGA) leaders, the executive director of the River Alliance of Wisconsin, and a couple USGS and university scientists on model groundwater pumping legislation that sought this middle ground. I served as science advisor and also as a sort of scribe who kept notes and helped with organization. I despaired when the industry walked away from the consensus that was put together (I put several hundred hours of work on this and hated to see a very good piece of work die). Recently, I have been impressed that the industry has seemingly re-embraced the work and points to it as a model of their commitment to sound water management. (See, for instance, the April 21, 2010, Argus).

Here I summarize the salient pieces of the WPVGA and River Alliance effort, emphasizing that this was the consensus of the participants from the two groups.

Objectives and Philosophy

The WPVGA and River Alliance effort started with objectives and a philosophy for groundwater management. A few important points are summarized below:

1. Protect groundwater levels as well as lakes, streams, wetlands, springs, and their fish and wildlife.

2. Manage groundwater by renewable, fixed-term pumping permits.

3. In areas where multiple users in aggregate cause excessive impacts, the state determines how much groundwater may be allocated and local planning processes determine how that water is apportioned among users.

4. Give businesses, agriculture, and communities planning horizons.

5. Move beyond well-by-well management to basin and regional management where needed.

6. Avoid getting too tightly wound. Be somewhat conservative and protective; this means less regulatory and monitoring overhead, longer permitting horizons.

7. Actively gather and use relevant information to refine our knowledge about hydrologic systems, and incorporate that knowledge into permitting system.

So, the specifics...

With objectives and philosophy in mind, the group penned some specifics as to how these might be written into statute. I've gathered them under a few headings.

Permitting and Start-up

1. Permitting. All groundwater pumping gets a permit, a general permit for small groundwater amounts and individual permits for high-capacity wells. Permits state how much water may be pumped and when. Permits are generally issued for 10 years, after which they are reviewed and renewed or modified if there is evidence of problems.

2. Permit review. Every permit application gets a review to ensure that the well will not cause a significant adverse environmental impact to sur-

face waters, and that it complies with management plans for designated groundwater management regions, where they exist.

3. Adjustment period during start-up. Existing approved high-capacity wells are automatically permitted for 10 years.

4. Permit streamlining. The permitting process should be as simple as possible and only as difficult as necessary to manage risk.

Groundwater Management Regions

5. Regional management. In areas of the state where pumping by multiple parties requires management of all, such areas shall be designated as "groundwater management regions." Groundwater in these regions will be managed in accordance with an approved groundwater management plan.

6. Groundwater management regions. In groundwater management regions, the state determines the amount of allocable groundwater; a local planning process determines how that allocable groundwater is apportioned among competing users.

7. Planning in groundwater management regions. After a groundwater management region is established, a groundwater management plan is written for it. The plan describes groundwater management objectives and potential means for meeting them. An advisory committee reflecting the variety of water users, water interests, and governments in the region, is appointed to guide the process.

Getting Better Information on Watershed Conditions

8. Flow and water level monitoring. A stream flow and water level monitoring plan for areas where such information is most needed shall be implemented.

Compensation and mitigation fund

9. Compensation and mitigation fund. In situations where a small number of wells are close enough to a water body to cause direct and deleterious depletion to the water body, a fund shall be established for replacing high-capacity wells that are impacting aquatic resources.

Paying for it

10. Fees and revenue. Revenue for operating a groundwater quantity

management program would be generated through user fees to cover permitting, monitoring, groundwater management area planning, and the compensation and mitigation fund. New well permit fee on all new wells drilled in the state: $150 per new well; on high-capacity wells: $1 per million gallons pumped.

Where to go from here?

The WPVGA and River Alliance effort is as relevant today as when it was written by the two parties in 2002. Perhaps all could benefit by using this piece as a starting point for discussion rather than reinventing wheels. ❧

A Look Back and Ahead on Central Wisconsin Irrigation

by David Ankley

What would Central Wisconsin farms look like without irrigation? As we think about that question, we quickly realize that it would look a lot different than what we see around us today. I expect we would find it basically a mix of field crops, livestock farms, woodlands and pastures somewhat similar to what you see in the non-irrigated lands in Wood, Waupaca and other counties. There wouldn't be the center pivots, vegetable crops and all the related irrigation, agriculture service, and processing industries. It would be quite a bit different from what we have become accustomed to over the years.

The point is that we have taken for granted the valuable resource that Central Wisconsin agriculture has been able to develop as a multimillion dollar industry. This didn't come easy and required a lot of work by local farmers and industry leaders over the years.

As we look back to the drought years of the 1930s, which was before irrigation started, farms were small family units with a combination of livestock (mainly dairy), field crops, pastures and some vegetables, all dependent on Mother Nature for rainfall. Without irrigation, farmers on sandy soils had to manage their crops for lower yields, as water was the limiting factor. For comparison, corn populations were 12,000 to 13,000 plants per acre, ver-

sus the 30,000 plants and 200 bushels per acre today. Potato varieties that yielded well on dry land were Sebago, Chippewa and Red Pontiac. Yields were 120 to 180 hundredweight per acre, versus the 400 to 500 hundredweight with today's irrigated varieties.

The first pioneers in irrigation had access to a stream, lake or shallow water pit that had a high water table. The first pumps were centrifugal that were run off a tractor or stationary engine. These were good pumps that were limited to small acreage. The hand-laid pipes had to be moved every two hours or so.

It wasn't until the late 1950s that a well driller from Nebraska was brought to Almond to tap the groundwater. This was the first well that was drilled by what is called the reverse hydraulic process, and high-capacity wells of 1,000 gallons per minute were developed. Of course, these high-capacity wells wouldn't have happened if the water levels and sandy soils were not available. To deliver the water there was a need for a mechanism to apply the water uniformly, which led to the introduction of the center pivot.

Potatoes and field corn were the first crops that responded to irrigation. Soon the vegetable processing plants of Del Monte, American Potato and Ore-Ida followed. In addition, peas, snap beans and sweet corn were good rotational crops with potatoes. The irrigation development and improved corn varieties led to a large expansion in corn acreage. The result has been Portage County becoming a corn exporting county for livestock feed to the surrounding corn deficit counties.

As soon as vegetable crop acreage expanded, processing plants and potato packaging sheds followed. The result is a Central Sands irrigated agriculture that is known throughout the United States. This is a diversified multi-million dollar industry that is vital to the Central Wisconsin economy and its people.

The key ingredient that keeps the crops growing is water. Certainly rain helps, and 2010 has been a near-record rainfall year. However, rain is undependable and a growing crop can't develop without water. This is especially so on 80 and 90 degrees F sunny days on sandy soils. Irrigation is the insurance that is needed to get the crop to maturity and get the operating bills paid.

As we look ahead, there will continue to be a greater demand on ground-

water as more land is irrigated and crop expansion takes place. The biggest expansion in recent years has been the Buena Vista Marsh. Vast acres of pasture land have been converted to fields of irrigated vegetable crops and cranberries. Other demands on groundwater will result from an increase in population, jobs, industries and municipalities.

Not surprisingly, some private wells, as well as small lakes, have run dry. Is this due to overuse of irrigation wells, as some are suggesting? I can't concur on that question and leave that to others to address. Certainly there is a need for expanded groundwater research as these questions will continue to be raised in the future.

We need to realize that groundwater tables fluctuate from year to year and tend to follow cycles. For example, prior to this year, several years of lower precipitation has resulted in a lowering of water tables. This year (2010) has been a record rainfall year so lake levels and water tables have mostly recovered, but some deficit remains.

Low water tables raise questions about quantity. Other issues related to agriculture and groundwater have arisen. In the last 10 to 20 years, water well tests found nitrates and several pesticides above minimum Wisconsin groundwater standards. Pesticide names such as Aldicarb and Atrazine will refresh memories. Moratorium or restricted zones were drawn identifying where these pesticides could not be applied. Growers helped minimize the groundwater problem by switching to other products and using the best management practices that improved the groundwater quality. Today, new pesticide products have replaced what was traditionally used. These products can be applied at extremely low rates and have reduced environmental problems.

Recognition needs to be given to the vegetable industry and the University of Wisconsin specialists in horticulture, plant pathology, and entomology. Specialists Walt Stevenson, Larry Binning, Jeff Wyman, and the University of Wisconsin Hancock Agriculture Research Station developed models and computer programs that led the way in irrigation application, disease, insect, and weed forecasting that helped reduce agricultural impacts on groundwater quality.

There are no easy solutions to regulations on water usage. We do know there has been enough to go around to meet current needs. If you travel, you likely have observed that very few areas in the U.S. have the quality of

drinking water that we have in Central Wisconsin. So would you support the permitting of a water bottling plant here?

When rules and regulations are proposed, agriculture interests get the feeling that they are about to lose something they have come to depend on. Certainly groundwater is at the center of attention in this regard. We need to protect our valuable resource for all.

There is no going back to the old days. Too many things have changed and the users of water need to work together, sharing if you will, to provide the needs of all. ❧

What Is the Nature of the Water Issue in Central Wisconsin?

by Ken Schroeder

An adequate supply of water for crop irrigation on the Central Wisconsin Sands Plain is critical to production agriculture in the region. Without irrigation, much of the area's vegetable production would likely not be profitable due to significantly reduced yields and quality (University of Wisconsin-Extension publication A3422, *Commercial Vegetable Production in Wisconsin,* 2010, and Sexson and Connell, *BioIPM Potato Workbook*, 2004). This could in turn lead to loss of the vegetable processing industry in Central Wisconsin. With high input costs, production of corn and soybeans on the Central Sands would also likely cease to be profitable. Our sandy soils simply cannot hold enough moisture to maintain satisfactory growth of these crops between rains. For example, sand, loamy sand, and sandy loam soils of the region can only hold 0.7 to 1.0 inch of plant-available water per foot of soil. Effective rooting depth of potato in these soils is about one foot. During July and August, daily crop water needs due to evapotranspiration (water loss from evaporation off the soil surface plus transpiration from these plants) are about 0.2 inch per day, requiring rain every three days, depending on crop being grown and stage of development, to maintain satisfactory crop yields and quality (Curwen and Massie, University of Wisconsin-Extension publication A3600, *Irrigation Management in Wisconsin-The Wisconsin Irrigation Scheduling Program*).

Lack of available water for irrigation would undoubtedly change the eco-

nomics of Central Wisconsin. A recent study by Stewart, Schroeder, and Deller of the University of Wisconsin-Extension (using 2008 data), indicates that agricultural production and agricultural-related processing accounts for thirteen percent of Portage County's jobs and eighteen percent of its total economic activity, emphasizing the importance of agriculture to the region.

Where to from here?—moving forward. First, we need to recognize there is water missing from several lakes and streams in Central Wisconsin. Secondly, this is a complex issue and everyone needs to go into this with an open mind. It is important to avoid finger pointing which leads to defensiveness and hindrance of progress toward a solution. The dialogue needs to continue. We are all stakeholders in this water issue (production agriculture, agricultural processing, the paper industries, other commercial businesses, municipalities, private homeowners, etc.) and ALL need to be a part of the solution.

Towards a solution. Through my recent involvement with groundwater workgroups and attendance at multiple discussions on the groundwater issues of Central Wisconsin, it appears there is a need for more education and understanding of all the factors involved. The population needs to understand the basics of how surface water and groundwater are interrelated, the hydrologic cycle (cycling of water from the atmosphere to the ground and back again), what constitutes a watershed, and the specific influences on each watershed of interest. We need more research in the areas of groundwater recharge, water infiltration under various vegetation types (evergreen forests, deciduous forests, native prairies, annual and perennial cropping systems, and urban areas) and the evapotranspiration that occurs from these vegetation types. A one-year study conducted by Weisenberger, Lowery, and Bland of the University of Wisconsin-Madison (*Groundwater recharge and water balance trends under irrigated, forest, and prairie vegetation in Central Wisconsin*, 2009, M.S. Thesis, Weisenberger, A.M.) found significant differences in groundwater recharge patterns under different vegetation types. To be able to fully understand these differences, it is important that this research continues at least one to two more years and other similar studies are undertaken. Additionally, the amount of water plants transpire depends on length of growing season, plant density, depth of rooting, rainfall distribution, temperature, and humidity. Thus it is important to understand the land management and cropping history leading up to this issue in order to develop a workable system moving forward.

Viability of agriculture and agribusinesses in the area depends upon profitable cropping systems. Which brings up another question, are there alternative crops that could be profitably grown in Central Wisconsin that transpire less and could be successfully grown using no irrigation or less irrigation? Field trials and economic analyses are needed to answer this question.

We can do this! I am willing to facilitate further education and understanding of the groundwater situation in Central Wisconsin and assist in data collection, field trials and research necessary to move forward. I see this water issue as an opportunity for improvement. The vegetable growers in the region have always been willing and able to meet challenges head on and find solutions to problems as they arise. I am confident that through science, research, education, and the working together of all stakeholders involved, we can solve the water issues in Central Wisconsin. ❧

Water's Role in Agriculture

by AJ Bussan

I first learned the value and importance of water in the landscape, especially for a farmer, during the summer of 1988. It was my first full attempt at farming as a way of life in the rolling hills south of Cuba City, Wisconsin. As you likely recall, 1988 was a severe drought and I spent months planting, cultivating, and then watching fields dry and suffer under the intense sunlight alongside my uncle. I spent days cutting and windrowing acres of hay to harvest a few dozen bales from fields that should have produced several thousand and filled the barns to the rafters. The coup de grâce was then buying hay with half the quality of what we would have harvested to feed the dairy cows and young stock, as feed was gone by the end of December.

A mere 10 years later, I had finished graduate school and was working as a new extension specialist at Montana State University. I met many farmers throughout "big sky country" who were growing crops with average rainfall of 8 to 16 inches per year. Of course, this was average and for every year when rainfall amounted to 16 to 20 inches of rain there were multiple years when crops only received 4 to 6 inches. I learned about the importance of soils for holding moisture, use of fallow and other strategies

for conserving and storing water, and the innovation deployed by farmers practicing low-input agriculture. The ingenuity in managing water in lands where little was available (every inch meant bushels) was incredible!

I returned to Wisconsin and the University of Wisconsin as a new vegetable extension specialist in 2001. I returned to my home state where average annual rainfall was over 30 inches and producers were growing crops with high cost of production, high management requirements, and high economic risk and potential for reward. Within days of returning, it became obvious that the key to the whole vegetable production system of Wisconsin was water. Even with the relatively high rainfall patterns of the state, slight mismanagement of irrigation could have large ramifications not just for crop yields, but also for quality which in many ways is more important than crop productivity. The future of the Wisconsin vegetable industry is tied to having access to the water resources of the state. I will talk about the economic impact of the industry, challenges facing the food supply chain, the importance of meeting those challenges, and the role the vegetable producers can play in preserving Wisconsin's water resources.

The Wisconsin vegetable industry is generally composed of three market groups: potato and other wholesale market growers and packers, processing vegetable growers and companies, and fresh or direct market vegetable farmers and retailers. According to the National Agricultural Statistics Service, vegetables are grown on approximately 300,000 acres across the state of Wisconsin, by 3,300 farmers. Wisconsin farms harvested over 50 vegetable crops ranging from acorn squash to zucchini with 2,100 farms growing for the fresh market and over 1,200 growing vegetables for processing. At least 180,000 acres of vegetables are grown under irrigation. Of the irrigated vegetable crop, approximately 80% is grown in the seven-county region of Central Wisconsin. Total irrigated land in Wisconsin was 380,000 acres based on the 2002 and 2007 censuses. The farm gate value of potato and processing vegetable production was estimated at over $500 million, making Wisconsin second in production of processed vegetables nationally. Wisconsin, Minnesota, and Illinois form the largest concentrated vegetable production region in the country. Accurate estimates of direct market produce sales are unavailable.

The total economic impact of vegetables and other specialty crops cannot be assessed by simply evaluating farm gate receipts. Dozens of industries and businesses have sprung up to serve the special needs of farmers pro-

ducing vegetables, cranberries and even ginseng. Keene and Mitchell estimated specialty crop production results in just over $1 billion in economic activity and accounts for nearly 10,000 jobs in Wisconsin; the vegetable industry accounts for nearly 70% of this activity. (Arledge-Keene, A., and P. D. Mitchell. *Economic Impact of Specialty Crop Production in Wisconsin.* Agricultural and Applied Economics, University of Wisconsin-Madison, 2010). The processing of specialty crops creates an additional $5.2 billion in economic activity and 25,000 jobs in Wisconsin. The Wisconsin specialty crop industry is conservatively estimated to generate over $6 billion in economic activity and 35,000 jobs. I think these are conservative estimates as an entire industry has sprouted up in support of the processing industry. For example, every can used by Wisconsin vegetable processing plants is cut and formed in the Fox River Valley, and this is not necessarily accounted for in the above calculations. Specialty crops represent almost 11% of the agricultural economic activity (over 4% of the state's economic activity) on just 2.5% of the farmland.

Most of this economic activity related to the specialty crop industry is located in rural Wisconsin communities where the farms and processing facilities are located. Towns such as Janesville, Beloit, Cambria, Markesan, Gillette, Bear Creek, Cumberland, Tomah, Wisconsin Rapids, Almond, Plover, and others dot the state, providing jobs and infrastructure for people living in numerous small towns and communities. Many of them are in fact located in Central Wisconsin where most of the irrigation occurs. However, the chip factories located in Beloit require raw potatoes produced in Central Wisconsin to operate at capacity. Vegetables produced in Central Wisconsin are trucked all across the state to supply processing plants from Janesville to Manitowoc.

The vegetable industry has developed and expanded in Wisconsin because of its people, geography, climate, farms, and resources (especially water). The industry was spread across the United States a mere 20 to 30 years ago, but is now consolidated in three to four regions. The vegetable processing industry has remained in Wisconsin due to the advantages of the production systems of the state. Wisconsin has an impressive manufacturing history and highly trained work force that supports operations of processing facilities, and also has local machine and technological capacity to meet plant equipment, maintenance and facility needs. The summer is long enough, with little to no threat of frost, to allow for production of numerous high quality vegetable crops. Freezing winters are harsh enough to kill

pests, eliminate volunteers, and eliminate the potential for green bridges, and this improves the efficiency of management systems. The strong dairy industry also has been a positive as it provides manure which is an economical and beneficial nutrient source that builds soil fertility for vegetable production. Several million acres of alfalfa grown to meet the forage needs of the dairy and livestock herds provide flexible acres for vegetable production. Corn, soybean, wheat, and other agronomic crops are subsidized and government programs limit crops that can be grown, eliminating potential production of vegetables without risk of losing future grain subsidies. Wisconsin has good to excellent soils for growing high quality vegetables with limited risk of catastrophic losses due to flooding, drought, or other natural phenomena. Furthermore, 25 million people live within a 250-mile radius of Stevens Point. Wisconsin is 1,500 to 2,000 miles closer to over 50% of the U.S. consumers than California, Oregon, Washington, Idaho, or other vegetable producing states.

The most important resource in Wisconsin is its abundant and high quality supply of water. Despite justifiable concerns regarding the current groundwater levels, Wisconsin does in fact have an abundant supply of fresh water for crop production in Central Wisconsin; it is one of the few food crop production regions in the country where the annual precipitation exceeds annual crop water use. The crop with the longest growing season in Wisconsin would only use 27.5 inches of water per year, and that's if it experienced maximum water use every day. That is three to six inches less than average annual precipitation. By contrast, in vegetable production regions in California, Idaho, New Mexico, and Arizona, the annual crop water use exceeds precipitation by 15 inches or more per year. Most irrigation in Wisconsin is derived from groundwater. By contrast, irrigation from surface water is common from Michigan to California. Sourcing irrigation from groundwater rather than surface water minimizes potential contamination of food crops with human or plant pathogens, making for a safer food supply.

Irrigated vegetable production is crucial for long-term success of the Wisconsin vegetable industry. Potato production is compromised by 50% or more if exposed to severe drought stress. Realistically, potato, onion, carrot and some other crops could not be profitably produced without irrigation in Wisconsin. Restrictions on irrigation could potentially reduce yields by10 to 15% even if irrigation were only withheld for 5 to 10 days. This loss in productivity would threaten the entire potato production and process-

ing industry if restrictions were implemented as a means to conserve water. Nearly 50% of the peas, snap bean, sweet corn, and all of the cucumber for pickling are grown on irrigated lands to optimize productivity every year as a means of guaranteeing high quality raw product for vegetable processing facilities. This guarantee is crucial for planning contracted acres, harvest scheduling, and processing plant operations. In many ways, the irrigated production capacity is the foundation of the vegetable processing industry of Wisconsin.

The unique aspects of the Wisconsin vegetable industry make it an extremely important component of U.S. and global food systems now and into the future. Increasing global population, climate change, less availability of fresh water, decreasing acreage of high quality farmland (in part due to salinization and urban sprawl), and high energy requirements present substantial challenges for future food production capacity. The production capacity and efficiency of Wisconsin's vegetable system suggests potential for long-term capacity to continue meeting at least domestic demand for vegetables across the U.S.

Average U.S. citizens consume approximately three servings of fruits and vegetables a day even though United State Department of Agriculture recommends a minimum of five servings per day and some nutritionists recommend seven to ten. Total vegetable consumption continues to grow, but this is primarily due to increasing population and not changes in consumption habits. At the same time, U.S. production of fruits and vegetables declines annually, resulting in increasing imports. Future security of the U.S. food supply chain will likely require at least maintenance of current production capacity. Furthermore, shifts in consumer diets toward consumption of more fruits and vegetables in hopes of improving the health of every American could create economic development opportunities for states such as Wisconsin with production and processing infrastructure.

There is no denying that the future of the Wisconsin vegetable industry will depend on continued access to an adequate supply of irrigation water. The industry must recognize the need for the preservation of groundwater resources to insure long-term sustainability of the industry. It has already demonstrated success in adoption of more sustainable production systems including the wide-scale adoption of integrated pest management (IPM), preservation and restoration of native plant communities in non-cropland areas, and implementation of energy conservation practices in irriga-

tion and vegetable storage systems. IPM has had measurable impacts on groundwater quality and mitigation of pesticide contamination of this valuable resource.

Moving forward will require improved understanding of the crop systems, native ecosystems, and their interaction with cropland in influencing natural resources, especially water. Research and extension programs are committed to multiple approaches to evaluate the influence of crop production systems on water use, nutrient recovery, development of alternative production systems, and evaluation of methods to reduce water use by crops. Specific examples include the following:

1) Estimation of evapotranspiration and operation of weather stations in Central Wisconsin to monitor crop growth and pest development, and provide support for crop management.

2) Surveying and monitoring of irrigation wells across Central Wisconsin. Methodology and ground truthing protocols are being developed to guarantee reliability and accuracy in the data.

3) Establishing monitoring wells in strategic locations to verify survey results and further demonstrate changes in groundwater levels. Monitoring wells will quantify pumping and land use effects on groundwater levels and confirm theoretical and predicted relations to surface water.

4) Evaluating influence of drainage ditches on groundwater levels.

5) Quantifying recharge and water use under different vegetation. Species influence water use and recharge in agricultural and native landscapes. How can land be managed to optimize water use and minimize impacts of pumping on groundwater relative to natural landscapes?

6) Estimating water use across the vegetable production landscape. Growers and processors have collected data on planting and harvest dates for multiple crops. This data is being used to predict water use by vegetation across Central Wisconsin.

7) Creation of a land use database across Central Wisconsin. This will facilitate siting of monitoring wells and research activities over the landscape.

8) Improving sustainability of potato and vegetable production. Development of alternative management strategies to optimize water use and improve water quality.

9) Developing improved irrigation scheduling tools.

10) Evaluating the influence of deficit irrigation on crop production. Identify strategies that allow for maintaining crop productivity and quality with less water.

11) Evaluation of drip irrigation strategies in potato.

12) Developing new cropping systems that decrease risk of nutrient movement to groundwater and surface waters.

This is by no means a complete list, yet it illustrates the potential range of approaches that can address the situation in Central Wisconsin. Community commitment to addressing groundwater issues will be necessary for compromise and resolution of differences. Part of this process will require confirmation and demonstration of research to date and scientific study to further understand processes that influence groundwater levels and quality. The Water Task Force includes Wisconsin Potato and Vegetable Growers, Midwest Food Processors, local government officials (Town of Plover and Portage County), University of Wisconsin specialists, and local business leaders who are committed to promoting groundwater preservation while maintaining the economic productivity of the Wisconsin vegetable industry. This group has generated resources to begin addressing research needs and has written proposals to state and federal agencies to fund even broader research and extension efforts.

The goal is to not simply do research, but to conduct research that leads to changes in land management that will preserve the groundwater in Central Wisconsin and across the rest of the state and country. Wisconsin has been a leader in sustainable food systems for several decades. Wisconsin must provide leadership in the single largest issue facing the future sustainability of food systems across the planet—WATER. ❧

Water, Water, Everywhere But ??

by Andy Dierks

Growing up in northern Wisconsin during the 1960s my first contact with water use was moving irrigation pipe and guns east of Antigo in the White Lake area. Unlike Central Wisconsin, that area of

Wisconsin did not have a readily available water supply from groundwater. Our water sources for irrigation were the Wolf River, Spring Creek, and a few 300-gallon-per-minute wells. Even at that time I remember my grandfather taking stream depth readings of surface waters that we were pumping out of and reporting them to the state. I remember some dry summers when the river level was low that we simply made a channel to the pumps from the riverbeds. It seemed to me at that time we would never have to worry about an abundant supply of water for that farm. Today, most of that farm no longer is irrigated because it was restricted from pumping from surface water by the Wisconsin Department of Natural Resources.

In 1961, my father and his brothers bought land west of Coloma in Waushara County. The lure of an earlier harvest date, no stones, and an abundant supply of water was a strong draw. They were told that the Central Sands had a giant lake under the surface which would never run out of water. Also at that time, the use of a new well-drilling technology made reaching this water much easier. The 1970s saw the introduction of center pivot irrigation in the area. The '70s and '80s also saw potato and vegetable processors move into Central Wisconsin. With these developments, more land became irrigated and many acres cleared to expand farms.

The expansion of irrigated acres during that period also began to create problems that forced growers and University of Wisconsin researchers to look for ways to minimize the impact of this type of farming activity on the environment. The coarse soil and the shallow aquifer were allowing nitrogen fertilizer and some pesticides to reach the groundwater. Dr. Champ Tanner was working on these problems in the early 1970s and was joined by Dr. David Curwen and Dr. Leonard Massie in the 1980s. Their work led to the development of the Wisconsin Irrigation Scheduling Program (WISP). The program attempted to give the growers the information they needed to only apply the water to grow the crop and not overapply water that would cause materials to leach into the groundwater. Our use of WISP allowed us to reduce our water use by 10 to 20% and save a considerable amount of energy. This was also the beginning of a long relationship between the growers and UW researchers that continues to this day. The growers at that time decided to become proactive on issues and created a check-off fund on potatoes; the fund would pay for research that addressed the problems they were facing.

The 1990s and early 2000s saw more pressure on the Central Sands as more crop protection products were found in the groundwater. New

groundwater legislation driven by the proposed water bottling plant in the area brought more attention to irrigated agriculture. The growers in the area have cooperated with state and national agencies to allow test wells to be put on their farms to provide data so new laws and regulations are based on good data. Crop rotations have changed, pesticide use has changed, and irrigation equipment has been improved to try to reduce the impact on the groundwater. Are we doing enough to protect this important resource or is there more we can do? ❧

A Budget Analysis of Groundwater Shortages in Central Wisconsin

by Stu Grimstad

In the late 20th and early 21st centuries, we enter the age of global resource shortfalls, including oil and fresh water. Against this background, Wisconsin's Central Sands agricultural area faces a first-time depletion of groundwater leading to the drying of portions of class-1 trout streams and the lowering or drying of a number of seep lakes in the eastern watershed. University of Wisconsin studies demonstrated that despite a recent moderate drought climate, the decisive factor is the constantly increasing demand on area groundwater for agricultural, municipal and manufacturing demands, in that order.

This situation, among other groundwater shortages around Wisconsin, has demanded the state's attention. The legislative attempt to strengthen the state's groundwater protection failed during the 2009-2010 sessions, but promises to resurface in the immediate future.

Major water use interests demanded a closer look before moving forward with wide-ranging groundwater rules, a reasonable demand. The science seems to be solid, though, and this leaves the citizens of Wisconsin a thorny conundrum. We Wisconsinites pride ourselves on caring for our natural resources, and at the same time pride ourselves on having one of the most productive food producing areas in the country, as well as a strong manufacturing sector, and growing population. Like learning to walk, Wisconsin now struggles with this challenge.

Since the issue is currently open to discussion, we might consider ap-

proaching the problem as we do in other difficult decisions in life. Often, a budget analysis proves useful. In the case of groundwater, it is possible to approach the problem using such a budget analysis. Simply put, the amount of rain we receive will determine how much stored rain we'll have in a given watershed's groundwater reserve. The reserve is, admittedly, constantly draining into streams and larger river systems, as well as lakes and wetlands, but this aspect of the water cycle is a relatively slow process. UW studies clearly demonstrate that today's overwhelming drawdown factor is human use for agricultural and municipal demands.

At this point, Wisconsin is faced with a difficult conflict between historical wide-open groundwater use and the protection of the state's streams and other surface water resources. This discussion is still in progress, and the outcome is less than certain.

For purposes of this discussion, let's assume that Wisconsin decides to strengthen the protection of the health of the state's surface waters. In this case, a groundwater budget will become absolutely necessary. Such a budget will need to include the constantly changing balance between precipitation and groundwater demands, but this is well within the range of our current science. Monitoring wells combined with ongoing precipitation records can provide the needed data to manage water in stressed areas.

It is important to realize that management of groundwater in a stressed area might be required over a relatively short period of time. Rainfall patterns are famously unpredictable, and today's area of shortfalls may well prove to be tomorrow's area of overabundance.

For this reason, large water users might consider creating a cushion fund to assist areas currently suffering groundwater shortages. Today's shortfall areas may well be among tomorrow's support areas, and vice versa. This approach reflects the way healthy biological systems function—using stored reserves when needed—and should perhaps be used as a guiding principle for a stable economic system.

One overriding debate would pivot on the question of who should bear the load of such a stabilization fund. A reasonable argument could be made that such a fund should be supplied by all of the state's water users, based on the amount of groundwater used. Larger groundwater users should, of course, pay a comparatively higher fee. Such a formulation could be relatively simple. All high-capacity wells, based on consumption, would kick

into a running fund to cover water shortages in shifting areas of Wisconsin. If properly managed, such a surface water guardian fund would be fair, effective, and flexible.

The larger question, of course, is whether Wisconsin is capable of effectively wrestling with this challenge, a challenge likely to continue, considering nature's shifting rainfall patterns coupled with the ever-increasing demands on groundwater supplies. In some situations, hard facts may demand hard groundwater use decisions if we are to live up to our state's pledge to defend the wellbeing of our natural resources.

The key questions that need to be kept central to this discussion are which interests are benefitting from large extraction of fresh groundwater and who should pay to offset reductions by these major users, whether they be agricultural, municipal, or manufacturing users.

If Wisconsin's history of responsibility and fairness is used as a guideline, these issues will be addressed in a reasonable and intelligent manner. Let us be proud of our environmental stewardship while being mindful of financial stewardship, as well. With these principles in mind, we can arrive at sound policy standing on firm ground. ❧

Letter of a Central Wisconsin Water Conscience: A Science of Common Sense

by Pete Nowak

Dear Neighbors:

I have noticed opening salvos in the latest "water war" consist of generalizations being put forth that we have too much water over here, but too little water over there. Polluted waters and pointing fingers are coupled with guilt by occupation. One side is accused of the agricultural equivalent of raping and pillaging the groundwater resources of Central Wisconsin, while the other is viewed as out-of-touch idealists who value butterflies and bumblebees more than jobs and family farms. Glib generalizations, stereotypes, and innuendo characterize the dialogue while the answers are still the same as we heard the last time these water wars broke out.

Calls for more regulation or more science are viewed as the panacea by the

respective sides. I would fall into the more science camp if we only had a science of common sense. We have several sciences dealing with water in the ground and on the surface. We also have sciences associated with crop production and markets. We have a political science that informs us how regulations and laws are developed and implemented. Several engineering sciences develop technologies to overcome our penchant for characterizing these situations as the economy versus the environment. Yet where in all this science and the application thereof is common sense?

I thought it was common sense that the groundwater of Central Wisconsin is a highly variable resource. An old-timer told me to think of it as an egg under the surface, shallower in some areas and deeper near the edges. This means any uniform production techniques or regulations applied equally across the region will be grossly ineffective. The development that occurred in this area over the last half century was based on the assumption that the groundwater resources are an endless bounty waiting to be used. It is time for this assumption to be confronted with the science of common sense.

I thought it would be common sense that in very specific areas of Central Wisconsin where these groundwater resources are limited, some combination of three things should happen: the market should reflect higher prices for the land, stricter regulations in these situations should enforce limitations on water withdrawals, and efforts should be made to induce water conservation.

Do we really believe "one-size-fits-all" solutions should be forced onto this situation? I thought it was common sense that the inefficiencies of such an approach would override any gains to either the economy or the environment. Do we really have so little faith in a collaborative process bringing vested interests together to work out a solution that we are willing to forego this for partisan politics and shouting matches? I thought it would be common sense that those interests who would be most directly impacted by any action should be meaningfully involved in the design of any remedial action.

Yes, the water wars are under way, again. As is typical, so much attention is put on winning that common sense is left behind. That is why these events happen, repeatedly. Let's be different this time. Let's apply common sense to the competing demands for the water resources of Central Wisconsin.

Sincerely, Pete Nowak ❧

Walking on Water

by Justin Isherwood

The water issue in Central Wisconsin has evolved so incrementally as to surprise if not assail the farm community. A community that once believed what is for them of first order Genesis, that the groundwater in Central Wisconsin was endless, immense, fathomless and unbreachable, extending from the hem of the Laurentian Shield in Wood and Portage counties through Adams and Juneau. A thousand square miles, underlain by one stupendous body of cold, crystal-clear … water and covered by thirty meters of permeable membrane containing an estimated 250 trillion gallons. An aquifer to last indefinitely.

The term fathomless was of course relative to the use and technology of irrigation in the ’50s and ’60s, when the center pivot was still on the drawing board and wheel moves and set lines were the methods available. The range of total irrigated acres was modest, mixed with a bulk portion that was not irrigated, including most of the Antigo silt loams and Buena Vista muck, both deemed unnecessary to irrigate. In the space of a decade, center pivots went from expensive, rare contrivances to routine practice, three-phase power supply became the norm. With the advent of the high-span pivot, crops once unirrigated became irrigated rotations the same as potatoes. Fertility rates were expanded, hybrids adapted, optimum holding capacity became part of the center pivot dogma, and crops were pushed as never before. Center pivot irrigation established a new standard for moisture available to the crop. What had been a modest addition via gun lines and wheel moves, with the center pivot became a hallmark practice. Dryland corn, once a good crop at 100 to 120 bushels/acre, with a pivot and a high-cap well pushed 200 bushels/acre. The standard dryland bean yield of three to four tons per acre was correspondingly underachieving. Soon dairy farmers were pushing alfalfa fields, even wheat and oats were irrigated, peas likewise. Moderately priced second-hand pivots found utility in ever smaller fields, forties were irrigated, marsh lands, hill lands, stony lands, even the corners of fields as farmers took full advantage of “their aquifer” and the center pivot. Potato yields in Central Wisconsin have averaged a 5 to 9% increase in yield for a period of 25 years. A common yield in 1950 was 100 hundredweight (cwt)/acre. By 1960, this was 150 to 200 cwt/acre. In 2010, averages range from 400 for fresh market to

500 plus for process potatoes; beyond are the heroic rumors of 600 to 700 cwt. All pushed by an ever advancing irrigation technology and ready use of the aquifer.

What was a minor agricultural use of groundwater has become one of geologic dimension, a 25 billion gallon annual use, averaging 10.8 inches per acre. To make equivalent comparison, this amounts to adding a second, third and fourth Wisconsin River disgorging from the center of the state for a period of three months every summer, each at a rate of 10,000 cubic feet per second. Irrigation, as now practiced, is a geologic component as real as if new rivers were suddenly pierced in the side of the Wisconsin landscape. Widespread use of center pivot technology has made possible an enormity of impact that still surprises the ag community that still believes we only borrow the water, that the bulk somehow returns to the source as percolate. This notion combined with the initial myth of a fathomless aquifer explains why the ag sector has been slow to acknowledge a water conscience. Further complicating matters is agriculture's special dispensation… after all, we are the food guys. We are the freckled, sunburned yeomen, we the entrepreneurial farmers, we the state and national treasure who work cheap and produce abundantly. America eats well and lives long because of us. The resulting ethic is that water use trumps every other because ours is about food. Not recreation, not watering lawns, not bass boats and water skis or cottages on a lake; instead, honest sustenance. Explaining why water use couldn't possibly be a farm problem.

Yet in the end the water issue of Central Wisconsin can be viewed as just another budgetary crisis. At what point does the ag sector spend more water than we are worth? Put another way, use more water than our landscape contributes? At what point is agriculture just another welfare client, unwilling or unable to do the math? In this case, the math is about spending a future generation's share; not about social security benefits, but the aquifer's benefits; not the annual dividend of the aquifer, but the principal itself. It's about spending water beyond our means to save, without adequate routines of replenishing the source. The crux of the debate is a straightforward economic formula, where recharge must match the expenditure.

Few farmers believe, at least out loud, that agriculture has the right to spend the water principal of the state of Wisconsin or of future generations. Despite that the aquifer is 30 meters deep, in practice our water budget is an aquifer one meter deep. A budget predicated on what the total land

complex can replace within climatic conditions. In general the ag sector has been reluctant to engage in what amounts to a clerical response, in other words, a systematic nuts and bolts management of the aquifer. Not because it's particularly hard to do, not because we can't adapt to sophistication and technique, but because we haven't had to do the math. Added to this is the sterling caveat somewhere within the farm psyche that land ownership is cosmic. We who own not only the land surface but the sky above, the stars, our personal volume of the universe. Beneath we own the rocks, the sand, the Laurentian Shield, the magma, the ores, to the center of the earth; and its waters. Except we can't own just our water without also "owning" our neighbors' water. If aquifers were like other mineral property rights, it wouldn't be the same problem. Water use as a shared resource becomes a ledger book entry—again to reference the function of an economy—of how one farm and its ecosystem utilizes, enhances, or depletes recharge capacity and what at the bottom line is their fair share. Enter the hated word, regulation; but sustainable aquifer utility cannot be gained without regulation. If more capitalistically stated, it is the principle of the balance ledger. This is what is well-known to any farm operation large or small; debits to one side, assets to the other. Water use in practice is nothing more than doing the math of the system.

Problem is we have had sixty years of groundwater use without doing the math and this precedent frightens, intimidates and maybe even insults agriculture. The water issue in Central Wisconsin is a product of maturation: somewhere underneath we didn't think it would ever happen to us. Sure, water is an issue in California, Texas, Nebraska… but Wisconsin? The land of 12,000 lakes? Thousands of miles of rivers and streams? Water in our part of the world is everywhere, it's endless and we are doing good with it. That agriculture might feel picked on for the sake of a resource like the Little Plover River or a smattering of lakes that are perhaps geologically over-the-hill is natural. Historically, agriculture has dried up thousands of streams, some like the Little Plover River; large-scale application of land clearing and cultivation affects local discharge. What farm in the undulates of Central Wisconsin does not have the ghostly shadow of a former creek bed snaking through its fields? Or fields that yet turn tannic from a buried tamarack swamp? Fields that with hard work and patent agricultural zeal have been rendered highly productive? We know how to dry out landscape because that is what agriculture does. Crops do better, get an earlier start, and thrive when soil is slightly dry versus too wet. This land management scheme is the routine statistical wager of agricultural practice. We practice the drying cul-

tivation to propel production. Damp fields rot tubers, they resist weed control, complicate planting and harvest. Well might agriculture see the Little Plover as but another casualty on the path to a higher, more profitable land use. Why should a community care about this little stream? Why are battle lines formed because of it? This has been hard for some in the ag sector to comprehend, who in their everyday practice see the landscape of the former age, the once creek, the former wetland.

What after all is the worth of 160 acres of beans, potatoes, or sweet corn? What is the total worth of the Little Plover's trout? The comparison here is almost Biblical for the farm community; the Little Plover, in truth a paltry stream that never was very big, traded for the chance to feed the multitude. Once when advocating agricultural value over that of a new shopping mall, I attempted to calculate the total social worth of that potato field before it became a well-known shopping emporium. When converted to eight-ounce servings at franchise prices the field was worth, by rough estimate, $50,000 per acre, many times what it sold for as high-end commercial real estate. And its value could be cycled year after year, home-grown money, not another thinly disguised conduit to the China National Trust.

The up-side is ag's true market value equals any consumer product made or sold in this country, including the novel contraptions of Bill Gates and Steve Jobs, none of which provide breakfast, lunch, and supper. Agricultural value is inherently and historically biased, as every practitioner knows. Accordingly, any product slightly long in supply suffers an obscene negative effect on its market value. As this distinctive nugget of knowledge has become better known to the ag sector, the recognition comes that basic sector health requires production limits. Limits that can be artificially imposed or derived from an environmental balance sheet, where, for example, a water source is protected from excessive use, for example. There is nothing anti-agriculture about irrigation water having a price tag attached and being partnered to landscape function. A pattern of aquifer management, whether in Central Wisconsin or the Great Plains or the Valley of the Klamath, is nothing more than an insurance plan for a fair end-value of the crop. Beyond is the possibility that consumers might learn that Wisconsin growers are not merely singing the platitudes of the sustainable chorus but putting them to function. In the end, at the bottom of that ledger, the bushel of corn, the hundredweight of potatoes and that cool pool of brook trout balance out, both values sustained by water policy affected on farm fields.

The Little Plover is an environmental as well as a cultural litmus test. Less an argument over water rights than a nuts-and-bolts confrontation with economic

function. At one end of this sometimes bitter squabble is an inconsequential stream; at the other is the ability to underwrite farm value by balancing a regional water budget. The imposition of a Madison-based aquifer management is not only awkward, it is insincere. Water policies, irrigation practice, recovery zones, crop inches must be thrashed out on a regional or even subregional basis, calculated by farmers and the stakeholders. In essence, acre-by-acre management of field productivity, water use, and local recharge potential.

What the storm over the Little Plover River and Long Lake tell us is that the pioneer days of irrigation are over. The Wisconsin map of high-cap wells has matured. If you aren't irrigating now and haven't been in the last decade, this suggests there isn't much need to add to that list of high-cap wells. Agriculture needs to examine its water use; what production difference is gained by an irrigation scheme of 8 acre-inches versus 10 or 12? Is the popular method of fertigation merely using water in the place of a tractor? Can a system of hedges and corner plantings reduce evapotranspiration values? Can field corners totaling 25% of the land area be utilized for recharge potential? How has the addition of corner systems affected the water budget and at what production gain? For the sake of the farm sector we need to level the playing field, for farm systems as well as land zoning, to factor in recharge capacity as part of agricultural practice. Particular attention must be paid to the benefits of high quality recharge areas such as mature woodlands, marshes, and swales that define the northern land mosaic. In the end, agriculture will come to understand that wild-land areas like the little-loved prairie chicken reserves are doing the sector a significant favor.

Like many farmers, I believe irrigation has transformed Central Wisconsin agriculture. Irrigation has been our metamorphosis, where the ugly worm turned into a beautiful butterfly. My childhood and middle age were used up in the holy quest of ever-improving irrigation. At the same time I have long felt that my agriculture, my community of dirtballs, hasn't taken to heart the moral responsibility for the husbandry of our unique aquifer. Too often the Idaho land image has taken precedence in Wisconsin, but we are not a desert waste rendered productive by copious water use. By western standards our water use of 10 to 11 inches is trivial when they use 24 to 36 inches to bring off the same crop. We have a landscape to protect that the western grower doesn't. Wisconsin isn't a reclamation project. Our water use comes with an ethic attached, and, like it or not, the Little Plover is the voice of that conscience. ❧

Afterword

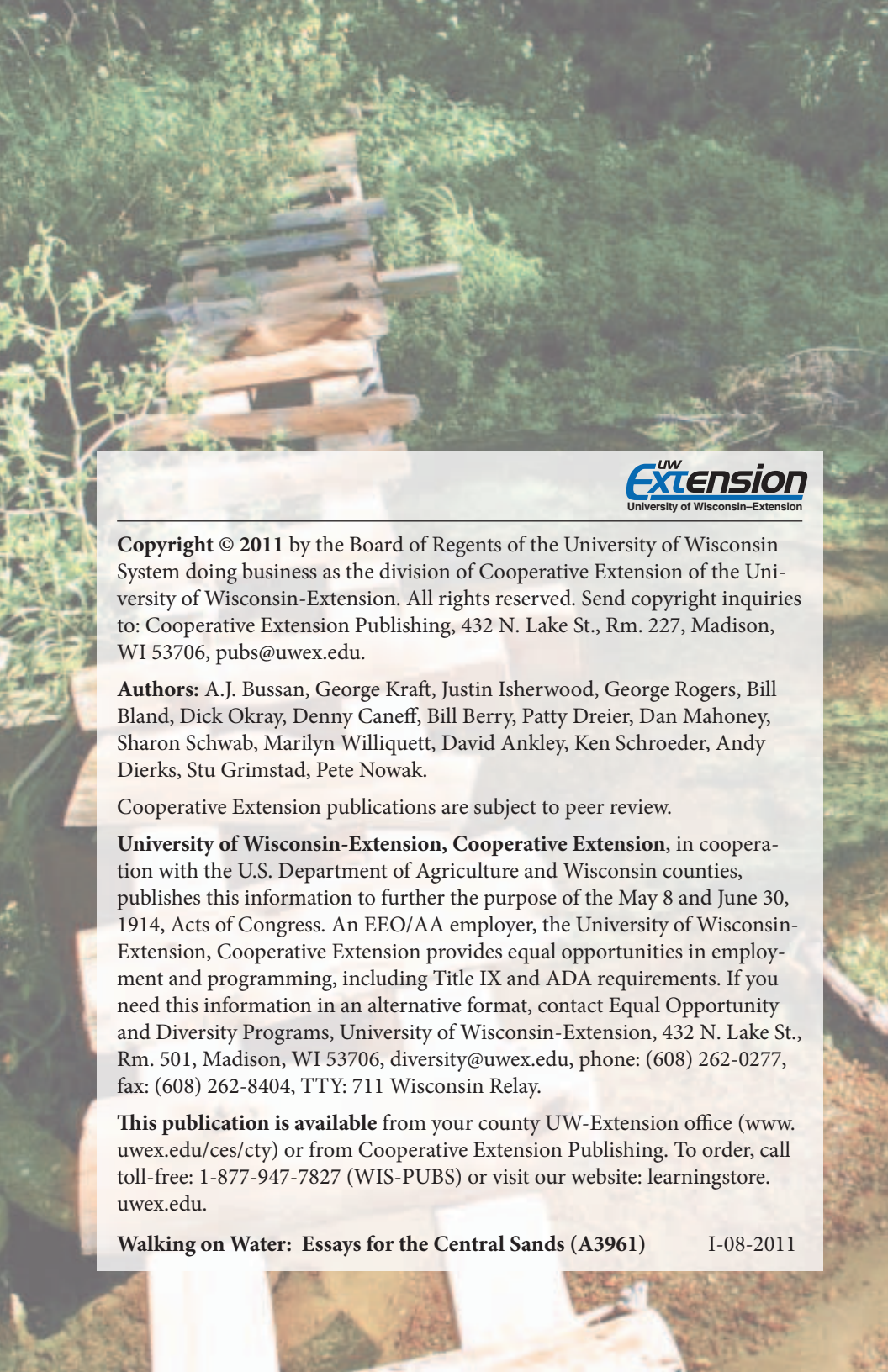
by Justin Isherwood

Walking on Water is a collection of essays with diverse views on water issues in Central Wisconsin, issues that sometimes magically go away with surplus precipitation making low-lying homeowners wonder when local farmers will start to irrigate and alleviate problems with wet basements.

We attempted to assemble the water sense of Central Wisconsin, an accessible overview of the water debate, something short, readable, and representative.

Honestly, we wanted a more numerous farm sector expression. We wanted that visceral ag ownership sense of groundwater expressed. The one that runs quite naturally through the water issue; that sense that agriculture "discovered" the water, agriculture utilized it, agriculture remade Central Wisconsin and accordingly "owns the water." The deepest intuitive level of this debate is the spiritual if not real ownership of water. I don't think the farm community is ordinarily literate, because we have better things to do; so it has always been in agriculture. Never mind, it may be therapeutic.

These essays collectively suggest we are a lot closer to common ground and shared water than we think. The water issue isn't as polarized as we imagine. The ag sector has historically tackled an enormous array of practical and economic problems. I often think the reason farmers became farmers is not just a love of the land and heritage but because they indelibly love to solve problems, the daily Rubik's Cube of farm operation; half mechanic, half vet, half certified applicator, half botanist, and, in this case, half hydrologist. The ag sector we know and love can come to grips with the core water issues of Central Wisconsin farm by farm. With aid of fertility and varietal consultants, landscape planners and geo-hydrologists, we can retrofit the farm sector to both satisfy production and become the most active participant in groundwater recharge. The portent of climate change (whether or not you believe) has the possibility of disrupting our sense of climatic normalcy. Early engagement in the water issues of Central Wisconsin will serve as cautionary preparation for the farm sector to deal with any subsequent water effects. In other words, an insurance policy against catastrophic water failure fifty years from now, when we might thank our lucky stars that we in Central Wisconsin had this water debate. ❧



Authors: A.J. Bussan, George Kraft, Justin Isherwood, George Rogers, Bill Bland, Dick Okray, Denny Caneff, Bill Berry, Patty Dreier, Dan Mahoney, Sharon Schwab, Marilyn Williquett, David Ankley, Ken Schroeder, Andy Dierks, Stu Grimstad, Pete Nowak.

Cooperative Extension publications are subject to peer review.

University of Wisconsin-Extension, Cooperative Extension, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914, Acts of Congress. An EEO/AA employer, the University of Wisconsin-Extension, Cooperative Extension provides equal opportunities in employment and programming, including Title IX and ADA requirements. If you need this information in an alternative format, contact Equal Opportunity and Diversity Programs, University of Wisconsin-Extension, 432 N. Lake St., Rm. 501, Madison, WI 53706, diversity@uwex.edu, phone: (608) 262-0277, fax: (608) 262-8404, TTY: 711 Wisconsin Relay.

This publication is available from your county UW-Extension office (www.uwex.edu/ces/cty) or from Cooperative Extension Publishing. To order, call toll-free: 1-877-947-7827 (WIS-PUBS) or visit our website: learningstore.uwex.edu.

Walking on Water: Essays for the Central Sands (A3961) I-08-2011