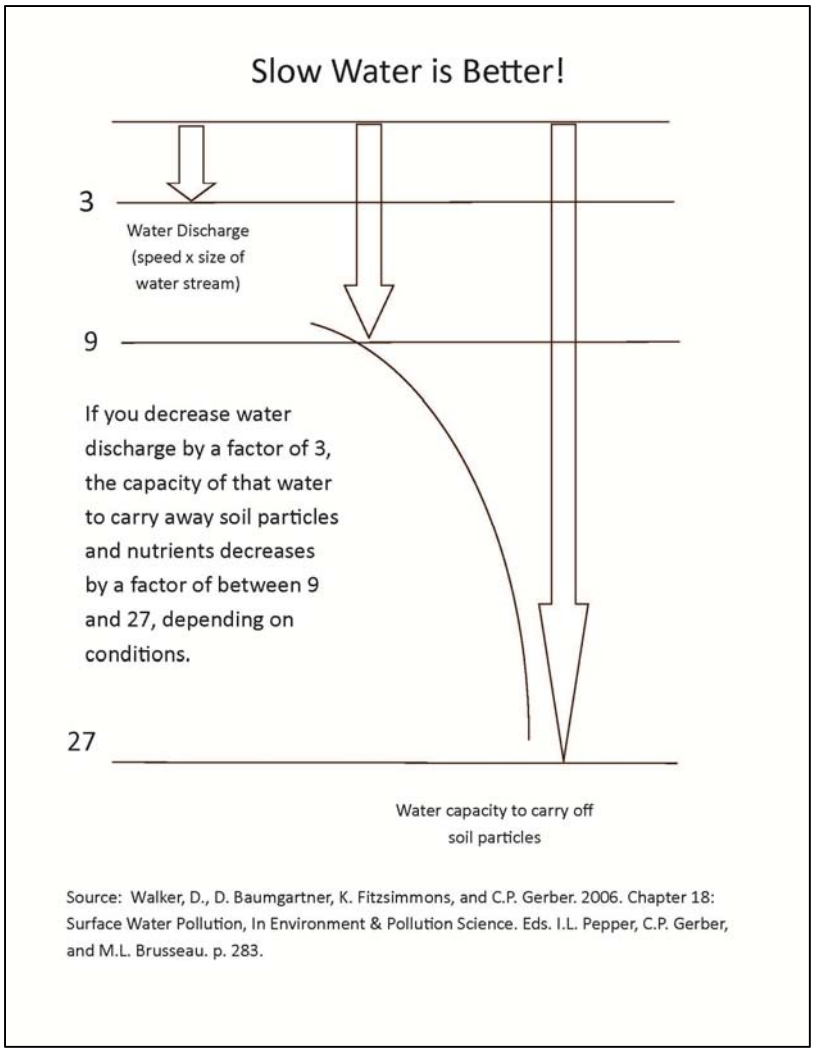
Water Quality Management

Sustainable agriculture practices detailed in other sections of this publication are important ways to maintain or improve water quality on the farm and downstream from the farm.

- Crop rotations and cover crops can help cut down nitrogen fertilizer applications, which reduces nitrogen leaching into groundwater or runoff into streams and rivers.
- Properly applied manure used as a fertilizer can reduce problems of livestock manure runoff into surface waters.
- Agroforestry practices like buffer strips between fields and waterways can slow water runoff and trap soil particles and agricultural chemicals, preventing them from entering the waterway.
- Cover crops help hold nutrients, pesticides and soil particles in place. They do so by keeping roots in the ground to hold onto soil, and by cushioning the impact of raindrops and slowing down water runoff.

Water runoff with no surface cover to slow it down can be devastating to soil. Consider an example from May 4, 2003. Researchers tracked rainfall, runoff, and soil erosion over the entire state of Iowa on that date. Three townships in western Iowa received 5 inches of rain. They had average water runoff rates of 0.6 to 1.25 inches, and had average soil losses of 4.5 tons/acre from that single rainfall event (1). If the water discharge rate had been slowed down by a factor of three through use of conservation practices, then the capacity of that water to carry away sediment and nutrients could have dropped by a factor of nine to 27, so the soil loss from that heavy rain could have been limited to 0.5 tons/acre or less (2).



Wetland Restoration

Restoring wetlands on the farm is another idea to consider for water quality improvement. We use the term "restoring" or "restoration" for wetland construction because in most cases, low-lying or wet areas on the farm were once wetlands before the land was first converted to agriculture. Wetland restoration projects are often put in place on areas of a farm that are marginal or poor for growing corn or soybeans — acres that are producing yields of half or even less of the farm's average yields. Well-designed and placed wetlands can reduce nitrate losses from surrounding fields into surface waters by 40% to 90% (3). They can serve as water-quality buffers for more than one farm, and indeed for an entire watershed. The Wetlands Initiative estimates that putting less than 8% of the land area around a creek into carefully placed wetlands could reduce the nitrate pollution of that creek by 43% (4).

Wetlands can attract a variety of wildlife including frogs, ducks and other waterbirds, and turtles and other reptiles; as well as mammals like deer and raccoons that may visit the wetland to find food or drink. The NRCS reports that its Wetland Reserve Program has restored 2.6 million acres of private wetlands nationwide, providing essential breeding habitat for waterbirds and wintering habitat for 3.5 to 4.5 million waterfowl every winter. According to The State of the Birds report, "…private lands have critical conservation value, and … landowners can measure their yield not only in bushels and head and cords, but also in bluebirds, hawks, and canvasbacks (5)." There may be a "hassle factor" for a farmer in maneuvering equipment around the wetland; but that may be balanced by the reduced hassle of no longer trying to till and plant an area that was perpetually wetter than the rest of the field.

A retiring farmer or landowner who wants to see wetlands established on their property should make a plan for who will work with federal or state agencies or private organizations to get cost-share assistance and negotiate contracts and/or easements for those wetland acres. Will that background work be done by the retiring farmer or landowner, or will it be the new farm operator? If it is to be the new farm operator, that person should receive some form of compensation or credit for the background and paperwork they do prior to the actual construction of the wetland. Alternatively, a landowner who doesn't want an easement agreement with a public or private entity may choose to self-finance the wetland establishment and hire a contractor to do the construction work; or the new farm operator may put "sweat equity" into the construction work and receive a land value or rent credit for that work.

Once established, wetlands can be treated as a feature of the farm landscape. Fields around the wetland can be handled with annual rent, short-term or long-term lease, or sale of the land. Any rent, lease, or sale agreement should specify the boundaries of the wetland and include statements preventing destruction of any part of the wetland. If a conservation easement is established with a federal or state agency or private organization, that easement provides another level of protection for the wetland.

In the future, there may be a market for the ecosystem services such as nitrate removal that a wetland provides. Organizations such as The Wetlands Institute (TWI) are researching the potential for such markets (4). Investment in a wetland now could be partially a speculative move with an eye toward future payments for ecosystem services.

Nitrate Removal Services

Wetlands are effective at removing nitrate from waters that flow into the wetland. Monitoring of CREP-funded wetlands in Iowa found that they removed 40% to 90% of nitrate flowing in, when water flow levels were low to moderate (1). During floods, water may enter and leave the wetland too quickly for nitrate removal to occur.

The figures used in the following calculation come from research conducted at Michigan State University, published in 2001 (2). More recent figures presented by The Wetlands Initiative (3) indicate that the dollar figures used in the 2001 research are still relevant in 2013.

The Hennepin Levee District in Illinois involved 2,490 acres of wetlands and could remove an estimated 494 tons of nitrate per year, based on a 75% nitrogen removal rate (2).

- 494 tons nitrate per year / 2,490 acres = 0.2 tons nitrate/acre/year removal by wetland
- Cost of nitrate removal by a water treatment plant: $36,000/ton (2)
  Cost range: $30,000/ton to $94,000/ton (3)
- Cost of nitrate removal by wetland, based on cost of taking land out of production and cost of construction: $5,500/ton
  Cost range: $540 to $5,500/ton (2)
- $36,000/ton cost of nitrate removal by treatment plant, less $5,500/ton cost of nitrate removal by wetland = $30,500/ton of nitrate in “free” or “net profit” ecosystem services provided by the wetland
- $30,500/ton of nitrate removed x 0.2 tons/nitrate/acre/year removal by wetland = $6,100/acre/year ecosystem services value of the wetland
- $30,500/2 = $15,250/ton of nitrate removed: half of the value of the “net profit” in ecosystem services is an estimate of what a watershed district might be willing to pay to purchase the nitrate reduction credit (2).
- $15,250/ton of nitrate removed x 0.2 tons nitrate/acre/year removal by wetland = $3,050/acre/year potentially marketable ecosystem services value of the wetland.

continued on next page …

Nitrate Removal Services, continued (pg. 2)

Note that nitrate removal is only one ecosystem service of the wetland, one that happens to be fairly measurable. Other wetland services such as wildlife habitat are valuable, but harder to calculate.

References:

(1) **2012 Annual Report on Performance of Iowa CREP Wetlands: Monitoring and Evaluation of Wetland Performance.** William Crumpton and Greg Stenback. Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA. http://iowacrep.ag.iastate.edu/sites/default/files/2012%20CREP%20Wetland%20Monitoring%20and%20Evaluation.pdf (accessed 8/15/13).

(2) **Using Illinois River Floodplains for Nitrate Removal: TWI's Hennepin Levee District Example.** Chapter 3.3 in Cheng, C.W., & Pierre, J.M.S. (2001). *A Resting Place for Ducks: A Multidisciplinary Analysis of Floodplain Restoration of the Hennepin Levee District, Illinois: A Master's Project Submitted in Partial Fulfillment … for the Degree of Master of Science and Master of Landscape Architecture (School of Natural Resources and Environment) …University of Michigan.* www.snre.umich.edu/ecomgt/pubs/wetlands/hennepin/3.3.PDF (accessed 8/15/13).

(3) **Growing Wetlands for Clean Water: Using markets to pay for efficient nutrient removal in the Farm Belt.** December 2012. The Wetlands Initiative. www.wetlands-initiative.org/images/pdf-docs/growing_wetlands_for_clean_water.pdf

Potential funding and information sources for wetland restoration (not a complete list):

- NRCS Wetland Reserve Program (WRP)
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/
- Farm Service Agency (FSA) Conservation Reserve Enhancement Program (CREP)
  www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep
- North American Wetland Conservation Act (NAWCA)
  www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm
- The Wetlands Initiative (TWI)
  www.wetlands-initiative.org/
- The NRCS and Farm Service Agency (FSA) usually share office space. Find your local office: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs

Wetland Restoration			
	- Column	**+ Column**	
Qualitative Benefits of the practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Reduces sediment, nitrogen and other chemical runoff into streams and rivers Creates wildlife habitat Flood mitigation Increases plant and animal species diversity **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Loss of net income from cash crop on the wetland acres: $115/acre/year *(See Corn & Soybean Profitability text box in Crop Rotation section; wetlands can be placed on acres producing less than 50% of the farm average yield.)* Wetland establishment cost, national average of $1,280/acre, 2009 dollars (6)	Benefit to society: Value of nitrate removal services: $6,100/acre of wetland/year *(No, this is not a typo. See Nitrate Removal Services text box)* Up to 100% of wetland restoration cost from NRCS in exchange for a permanent easement; 75% of cost for a 30-year easement (7). Cost-sharing may also be available from other public or private sources. Annual payment for conservation contract with state or federal agency or private organization (varies) – or – upfront purchase of easement, spread over 15 years: $80 to $150/acre/year.	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by number of acres devoted to the practice: Multiply by a time frame (30 years?) Total value over time:

References:

(1) **Daily estimates of rainfall, water runoff, and soil erosion in Iowa**. 2006. R. Cruse, D. Flanagan, J. Frankenberger, B. Gelder, D. Herzmann, D. James, W. Krajewski, M. Kraszewski, J. Laflen, J. Opsomer, and D. Todey. *Journal of Soil and Water Conservation*. 61(4):191-199.

(2) **Chapter 18: Surface Water Pollution**. 2006. In *Environment & Pollution Science*. Walker, D., D. Baumgartner, K. Fitzsimmons, and C.P. Gerber. Eds. I.L. Pepper, C.P. Gerber, and M.L. Brusseau. p. 283.

(3) **2012 Annual Report on Performance of Iowa CREP Wetlands: Monitoring and Evaluation of Wetland Performance.** William Crumpton and Greg Stenback. Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA. http://iowacrep.ag.iastate.edu/sites/default/files/2012%20CREP%20Wetland%20Monitoring%20and%20Evaluation.pdf (accessed 8/15/13).

(4) **Growing Wetlands for Clean Water: Using markets to pay for efficient nutrient removal in the Farm Belt.** December 2012. The Wetlands Initiative. www.wetlands-initiative.org/images/pdf-docs/growing_wetlands_for_clean_water.pdf (accessed 8/15/13).

(5) **The State of the Birds 2013: Report on Private Lands, United States of America**. www.stateofthebirds.org (accessed 8/15/13).

(6) **Wetland Reserve Program: Final Programmatic Environmental Assessment**. January 2009. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_006911.pdf (accessed 8/15/13).

(7) **Wetland Reserve Program**. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/ (accessed 8/15/13).

Further Resources:

Practices to Improve Water Quality. June 2012. Leopold Center for Sustainable Agriculture, Iowa State University. www.leopold.iastate.edu/sites/default/files/pubs-and-papers/2012-06-practices-improve-water-quality.pdf (accessed 9/04/13).
This publication presents a brief introduction to nine practices that farmers and ranchers can use to help maintain or improve the water quality on their property. Discussions of the mechanisms of each practice are also included.

Agricultural Nitrogen Management for Water Quality Protection in the Midwest. Heartland Regional Water Coordination Initiative. www.ksre.ksu.edu/waterquality/nitrogen%20pub.pdf (accessed 9/04/13).
Provides an overview of factors influencing nitrogen loss to ground and surface waters in the four-state Heartland region of Iowa, Kansas, Missouri, and Nebraska; and practices to reduce or mitigate losses.

Proceedings of Practical Farmers of Iowa annual conferences, 2012 and 2013. http://practicalfarmers.org/events/annual-conference.html (accessed 9/04/13).
Videos and presentations on a variety of topics, including soil and water conservation.

Managed Grazing in Riparian Areas. 2003. Barbara Bellows. Appropriate Technology Transfer for Rural Areas (ATTRA). https://attra.ncat.org/attra-pub/summaries/summary.php?pub=116 .
This publication is designed to help farmers and ranchers identify and use locally appropriate grazing practices to protect riparian resources. Methods include keeping livestock from stream banks, properly resting pastures to restore degraded land, and determining the proper duration and season for grazing pastures.

Protecting Riparian Areas, Farmland Management Strategies. 2003. Barbara Bellows. Appropriate Technology Transfer for Rural Areas (ATTRA). https://attra.ncat.org/attra-pub/summaries/summary.php?pub=115 .
This publication is designed to help farmers, watershed managers, and environmentalists understand what healthy riparian areas look like, how they operate, and why they are important for the environment and society. It also provides information on the costs and benefits of riparian management.

Protecting Water Quality on Organic Farms. 2003. Barbara Bellows. Appropriate Technology Transfer for Rural Areas (ATTRA). https://attra.ncat.org/attra-pub/summaries/summary.php?pub=114 .
This publication deals with environmental concerns related to organic farming in the areas of the transition period from conventional to organic, nutrient management planning practices, and improper storage of manure or compost materials. It discusses strategies for preventing water pollution by addressing those concerns.