February 7, 2011

Final Report

Drainage Water Management Ad Hoc Action Team

On September 21, 2010, a team was formed to provide recommendations for strategic actions the Natural Resources Conservation Service can take to increase successful producer adoption of Drainage Water Management (DWM) within the Mississippi River Basin Initiative (MRBI), especially in the Upper Mississippi. The team was charged with assessing the current use of the practice, identifying barriers to the adoption of DWM, determining and considering lessons learned through past experience, and developing strategic action recommendations that will increase adoption of DWM.

The team consisted of the following individuals:

Bill Gradle, STC-Illinois, Team Leader
John Russell Davis, Natural Resources Specialist, NHQ
Doug Toews, National Water Management Engineer, NHQ
Keith Admire, Director, National Water Management Center, AR
David Buland, Economist, CNTSC, TX
Ivan Dozier, ASTC-Programs, IL
Don Pitts, Water Quality Specialist, IL, retired
Jody Bell, Sociologist, IL
Tom Coffman, District Conservationist, MN
Deena Wheby, MRBI Coordinator, KY
Troy Daniell, Initiatives Coordinator, NHQ
Ruth Book, State Conservation Engineer, IL

Drainage Water Management Overview

Tile-drainage systems in the Midwest are designed to efficiently drain agricultural fields to allow access and planting of the fields in the Spring. Tile drainage was introduced to the region in the 1860's. These drainage systems also reduce damage from growing crops from prolonged soil saturation. There are approximately 50 million acres of tile drained agricultural land in the Midwest.

Concentrations of nitrogen (primarily NO_3-N) in water flow from tile drains are typically several times larger than concentrations of nitrogen in overland flow and surface field runoff. In a tiled field, precipitation infiltrates the first several feet of the soil, is subsequently intercepted by the tile-

drain system, and is efficiently conveyed to a receiving ditch or stream. During infiltration, highly soluble NO_3-N in the soil is incorporated into the infiltrating water, transported to the tile system and subsequently conveyed to the receiving surface water body via the tile flow.

Tile-drain systems are typically constructed in the Midwest without any control mechanisms and allow the soil to drain whenever soil water levels are above the elevation of the tile lines. Since the early 1990's, NRCS has been working with landowners/producers on installing water control structures which allow the operator to manage/contain the flow of water leaving the tile system during the winter months. Research in North Carolina has shown that managed drainage can reduce NO_3-N transference from soils to surface water by as much as 45%. These retrofitted systems may include flash board structures attached directly to the tile outlets, wetlands placed at the end of the tile lines, riparian buffer strips in areas where lateral seepage is the dominant flow, or constructing bioreactors utilizing denitrification walls or trenches to intercept tile flow. A new concept, the Saturated Buffer, is yet to be studied, researched, and evaluated.

Barriers to Adoption

In order to actually "manage" a drainage system, there are some criteria that come into play:

1. The practice is site specific, particularly as implemented with flash board structures attached directly to tile outlets. Field slopes less than 0.5 percent are recommended, to remain within established limits of cost effectiveness. Systems to facilitate DWM can be implemented on fields with slopes greater than 0.5 percent, but special considerations such as placing the tile lines on elevation contours would be needed in the design and layout of the subsurface tile. More water control structures would also be required, which would increase the cost. Many fields have land slopes that exceed the 0.5% recommendation and are thus not practical candidates for implementation, presenting a barrier to the adoption of DWM.
2. Many fields with land slopes less than 0.5 percent are part of a much larger drainage district, with extremely large "mains" functioning to drain large areas of land. The physical size of these mains, along with the large affected area, prevents the implementation of DWM even on these very flat fields.
3. In response to the 1977 Executive Order on the Protection of Wetlands, the NRCS stopped providing financial assistance for on-farm drainage (National Bulletin 450-4-3, October 18, 1983). Since then, farmers have continued to upgrade (redrain) their existing drainage systems, with more systematic layouts and closer drain spacings. Industry experts estimate that less than 1 percent of these redrained systems include control structures to facilitate DWM, although adding such would increase the total cost of installation by only 10 percent. Although drainage practices are eligible for EQIP as long as there is an identifiable benefit or resource concern, NRCS policy has prevented the use of EQIP financial assistance for redraining existing drained cropland with infrastructure to facilitate DWM because of the provisions of the 1977 Executive Order and because of the potentially serious ramifications to producer compliance with the provisions of the Food Security Act.

4. Knowledge of the existing tile-drainage system is needed to retrofit any existing tile system with water control structures. This information is not contained in one location in any county. Given the magnitude of tile systems in areas with flatter field slopes, obtaining information on the existing systems can present a great challenge.
5. Alternative systems to facilitate DWM are currently being studied, but are not ready for mainstream application. Bioreactors and saturated buffers are still in the research and demonstration phase. Limited data exist to show effectiveness of these practices in reducing levels of surface water nutrients, or design criteria for proper sizing to achieve reasonable water quality benefits. As a result, the well-studied approach of implementation using flash board structures attached to tile outlets remains the primary implementation method for DWM, with associated limitations as identified in item 1, above.
6. Lack of Technical Service Providers (TSPs) in Tech. Reg. to write DWM Conservation Activity Plans (CAPs) prevents an immediate increase in DWM planning, even with the availability of financial assistance. In addition, lack of available training for potential TSPs presents a barrier to accelerating the certification of qualified TSPs.
7. Early adopters of the DWM practice grasp the concept and the need to periodically retain water in the tile systems. However, drainage has been practiced since the 1860's to remove the water in the soil profile quickly. The cultural expectation of removing the water in the soil profile through tile-drain systems is hard to overcome unless the producer understands the benefits to his bottom line and the environment. Drainage water management is a concept that takes some time to sell.
8. Using constructed wetlands to accomplish treatment of drainage water is potentially a logical approach for sites where conditions preclude the use of water control structures attached directly to the tile outlets. However, placement of constructed wetlands poses challenges as well, because of the need for placement of the wetland lower in elevation than the tile outlet. Since many tile drained fields are low on the landscape, there is often inadequate elevation difference between the tile drain and the surface water (drainage ditch or stream) to place a constructed wetland cost effectively.
9. Research in some States show yield increases, however none of the long-term field research studies in the Upper Mississippi Basin have showed statistically significant changes in average yields. While NRCS has the program ability to cost-share on installation and the early years of management on this practice, the farmer is receiving no long-term yield benefits to maintain this practice. Because there are currently no regulatory authorities requiring implementation of drainage water management, and because the practice carries no long term direct benefit to the producer, encouraging adoption of drainage water management may require financial assistance at a higher rate than most conservation programs would allow: possibly as high as 100%.
10. Available financial assistance in some States is not an adequate incentive to promote a high level of participation among producers. The FY-2011 EQIP Payment Schedules for DWM-

related practices in the 12 MRBI States were analyzed. The following observations are noted: DWM (Conservation Practice Standard – CPS – 554) is not offered in four of the 12 States; of the eight States offering 554, six States use payment units in acres, while two States use payment units in number. Rates for DWM (CPS 554) vary from a low of $4.80 per acre to a high of $45.00 per acre; and DWM Plan (CAP 130) is offered in only two of the 12 States.

Lessons Learned

1. Level or nearly level topography is very important to Drainage Water Management (Practice Code 554) because costs increase significantly with increased slopes.
2. The existing subsurface drainage system should be exclusively on the property of the cooperator and not shared by adjacent landowners, unless all affected landowners participate in a joint agreement specific to the proposed drainage water management plan. Raising the water table on the proposed site should not be allowed to have an impact on the drainage of properties adjacent to the project boundaries.
3. Drainage water management will likely have the greatest environmental benefit on fields with soils that have high water conductivities. These high conductivities will, however, make it more difficult to control boundary conditions. So the higher the conductivity, the larger the size of field needed to effectively demonstrate drainage management.
4. The more extensive the subsurface drainage system, the more likely benefits will result from DWM. Pattern tile systems with close spacing are best candidates for applying DWM utilizing control structures on the tile outlets.
5. To enable DWM (554) utilizing control structures, a tile-drain system must be designed or retrofitted structurally to allow control/management of subsurface water. Structure for Water Control (CPS 587) is necessary for DWM (554) to be implemented with the flash board structure method. These structures may be either manual or automated (solar powered).
6. Denitrifying Bioreactor (747) was introduced as an Interim CPS in 2009. The practice is currently available for use in Iowa and Indiana. A state component conservation innovation grant was also awarded in Illinois for the installation of three (3) bioreactor demonstration sites. Preliminary data suggest that the bioreactor concept has the potential to reduce nitrate-N loading by 17% – 100%. Research is still on going to determine design parameters for sizing the bioreactor, and to quantify risks associated with production of methyl mercury observed in the water released from bioreactors.
7. Conservation Practice Standard 391 – Riparian Forest Buffer was revised in 2010, to address the modification of existing drains to accommodate the emerging practice of Saturated Buffers. Caution is advised that saturated conditions in the riparian and adjacent areas may limit existing land use and management. No data have been published to date on the benefits or design parameters of Saturated Buffers.

8. Drainage Water Management should be coordinated with a state approved nutrient management plan to maximize the efficient use of available nutrients and to minimize the loss of nitrate through tile. Making use of available nutrients reduces production costs and will likely increase farm profits.

Comments from the Industry Perspective

1. ADMC is creating on-line soil and water/ DWM CEU training tools for Certified Crop Advisors (CCAs). This will begin with a module providing an introductory overview if DWM, followed by several more targeted topic modules on various aspects of DWM. We discussed the potential for these modules to be used for NRCS, SWCD, and TPS training as well. Drainage contractors could also benefit from these modules. The education component is critical to building the comfort level among people in the field regarding DWM practices so that they are comfortable in recommending and supporting them. Work with NRCS to be sure the modules are designed to meet their needs.
2. ADMC wants to certify contractors as TSPs. We could set up a process that would allow trainees to get their certificate on-site at the completion of the training requirements. ADMC could administer it if appropriate. We could extend this service to NRCS, SWCD, and others if that would help NRCS to expedite implementation.
3. Remove the requirement for a P.E. to sign off on a DWM plan designed by a TSP. The limited number of P.E.s available could slow the process of implementation of DWM practices/systems. Are there alternatives? *NRCS Note: Tech Reg certification criteria for CAP 130 offer 4 options for TSPs to become certified, only one of which requires a Professional Engineer (P.E.). This should not be a barrier.*
4. Engage the NACD and CTIC and other interested parties like crop advisers, in outreach efforts and possibly use Cooperative Conservation Partnership Initiative (CCPI) funds, RFP coming soon and we will learn more
5. Retrofit stream bank buffers with subsurface drains with a coefficient of 1" or greater to be "Saturated Buffers". NRCS is interested in this approach, but there is little research information available. Hopefully the next round of CIG projects will offer an opportunity to demonstrate some saturated buffers and get some experience to share.
6. Cost share "Manageable Mains" new and retrofit. In many cases upgrading mains is a key first step to implementing improved drainage management for a field.
7. Incorporate DWM in to CPS 590 Nutrient Management The current draft of the 590 rules includes DWM as a prominent option.
8. Ask ARS to complete system management recommendations for agronomics.
9. Engage Drainage Districts as they upgrade their systems.
10. Make Drain Mod and the NRCS Nutrient Trading Tool more user friendly.

11. Support a market based approach to provide incentives and eliminate the threshold requirement that must be met before a nonpoint source can trade.
12. Promote data on the fact that DWM can reduce flooding and compensate the producer for providing that public benefit.
13. Encourage all states to provide and actively promote *Income Foregone* provisions to support summer retrofits. Illinois, Indiana, Iowa, are among the states that allowed this in FY2010.
14. Create CSP enhancements involving DWM.
15. Set higher priority for DWM in States' EQIP ranking.

Recommendations to Accelerate the Practice of Drainage Water Management (CPS 554)

General Communication

1. Develop fact sheets explaining the environmental benefits of the practice, to facilitate understanding and awareness by NRCS, consultants, and producers.
2. Design and implement a survey for obtaining input from producers, conservation partners and NRCS staff about Drainage Water Management. Use the results of the survey to potentially adjust the direction of the DWM implementation initiative.
3. Sponsor a national Summit to assess the state of the science. Bring together high level policy makers, technical people from industry, academia, and government, as well as producers, to identify opportunities and barriers relating to DWM, and to share technical information.
4. Establish a DWM Action Team to evaluate this list of recommendations and put them into action as feasible. This team should be led by an individual with authority to ensure that national policy and regional activities are addressed.

Technical and Training

5. Engage the National Cartography and Geospatial Center to query existing datasets and identify locations of land with high potential for successful implementation of DWM: flat land slopes (0.5% or less), with soil types that are likely to need drainage to produce crops (soil drainage group). Use the resulting mapped acreages to determine target states and areas within those states on which to focus efforts. For the focus areas:
    a. Hire LiDAR data collection companies to create topographic maps at 6" (0.5 ft) contour intervals for the focus areas identified above. These maps will be used to plan and design DWM systems. The precise topographic data will allow planners to readily determine the economic and technical feasibility of implementing site specific DWM infrastructure, and will also streamline the design process.

b. Engage teams of experts from the Agricultural Drainage Management Coalition (ADMC) to provide practical, hands-on training for NRCS engineers, technicians and district conservationists located in the States with focus areas as identified above. This training should be provided in small group sessions (no more than 30 participants at each workshop). The curriculum should include background information on the documented benefits of DWM, to enable the conservation planners to "sell" the practice to agricultural producers. The training should also provide enough technical detail that a field practitioner could then design a successful drainage management system using a topographic map and a tile map, and determine the area of influence for each control structure. The training should also present alternative methods of accomplishing DWM (in addition to flash board structures on tile outlets, include practices such as constructed wetlands, bioreactors.)

c. Add and train technical staff (i.e., engineers or civil engineering technicians) to be able to write DWM plans and design systems. Locate at least one staff member dedicated solely to DWM activities for each 10-20 county area in each state where significant percentages of DWM-potential land are identified. These technical staff members could initially be part of the national SWAT team effort, but permanent staff would eventually need to be located in the focus areas to accommodate the increased DWM workload generated by the SWAT teams.

d. Identify non-federal conservation partners who would be able to provide matching funds for EQIP planning and implementation of DWM systems. Develop Memoranda of Understanding (MOUs) with these partners in the target locations (identified above) to offer essentially 100% financial assistance for DWM to eligible landowners.

6. Implement a contribution agreement with representatives from industry and/or academia (such as the Agricultural Drainage Management Coalition – ADMC) to train prospective TSPs to create DWM plans. This proposed training will develop a pool of qualified TSPs certified in TechReg to write Conservation Activity Plans for Drainage Water Management (code 130).

<u>Policy and Program</u>

7. Revise NRCS wetland policies to allow conversion of existing drainage systems to allow for installation of water control structures on lands with steeper slopes and on systems with mains draining large areas. This would remove the most obvious NRCS programmatic barrier now limiting the adoption of DWM. This would also improve program consistency between drainage and irrigation, both primarily production practices, but with minimal environmental damage when designed and managed properly. The potential to increase adoption of DWM systems in the 12 MRBI States, where 35 percent of the cropland is drained (54 million acres) and only 7 percent of the cropland is irrigated (10 million acres), is evidenced by the 2010 PRS Summary for the MRBI states, with DWM (CPS 554) applied on 552 acres and IWM (CPS 449) applied on 209,484 acres.

8. Actively promote proposals for Conservation Innovation Grants to further study and demonstrate alternative implementation systems for drainage water management, such as bioreactors and saturated buffers.

9. Revise MRBI ranking and proposal selection procedures at the state and national levels to promote DWM. FY-2010 was the first year of the four-year MRBI, offered in response to the urgent need to improve water quality in 12 States draining to the Mississippi River and Gulf of Mexico. DWM (CPS 554) was identified as a Core Practice, considering 35 percent of the cropland in the MRBI is artificially drained. Under the EQIP portion of the program in FY-2010, Core Practice DWM (CPS 554) was planned on 3,365 acres, while Supporting Practice IWM (CPS 449) was planned on 39,072 acres. In contrast, the Core Practice Nutrient Management (CPS 590) was planned on 84,888 acres. This indicates that the process for ranking and selecting MRBI proposals should be revised in each state and at the national level to strongly encourage and promote DWM (CPS 554), in keeping with the status and elevated importance of this Core Practice. In addition, the initial 41 Focus Area Watersheds should be reviewed and potentially amended, to ensure that regions of drained cropland that would be most feasible and adaptable for DWM are included in the MRBI.

10. Increase financial assistance per acre for DWM, and ensure that all 12 MRBI States offer financial assistance for DWM (CPS 554), Structure for Water Control (CPS 587) and DWM Plans (CAP 130). Provide template payment scenario workbooks for 554, 587 and 130 which include components that are sometimes missing from States' scenarios, such as labor for obtaining the required topographic survey of the cropland, along with multiple scenarios for different levels of management intensity (number of structures per land unit to be operated) and foregone income for losing a crop when installing structural measures during the cropping season.

11. Initiate a pilot program to focus specifically on some of the alternative methods of implementing structural measures for DWM which are currently not ready for mainstream NRCS programs. This would involve state adoption of interim practice standards such as the Denitrifying Bioreactor (CPS 747) and new standard(s) created at the regional or national level for concepts such as saturated buffers. The pilot program would utilize the existing policy for interim practice standards, including the requirement for annual reporting by states for a 3 year period. Such a pilot program would have the potential to substantially increase implementation of experimental concepts; however, implementation without water quality monitoring would not provide data on environmental benefits of the practices. To maximize the potential of the pilot program, a contribution agreement with partners who have the capability to perform water quality testing should be implemented to monitor nitrate reductions in the pilot installations.