Nutrient & Sediment Control System

NPS 319 DEMONSTRATION PROJECT

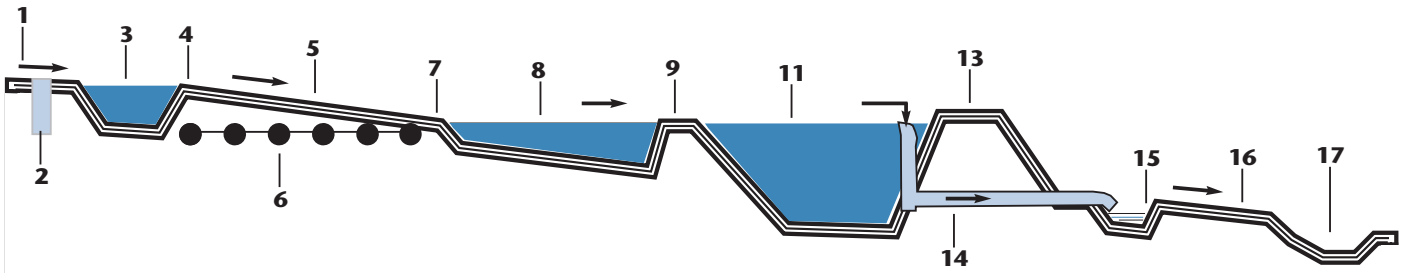
WATER QUALITY IMPROVEMENT THROUGH TECHNOLOGY

Uncontrolled soil erosion in an agricultural watershed and water-quality degradation go hand-in-hand; if you have the first, the second will follow.

This is a story of a farmer who wanted to do something about it and the agencies that helped him. This project was constructed from August through October, 2001.

NUTRIENT & SEDIMENT CONTROL SYSTEM (NSCS)
PROFILE VIEW • WESTFIELD, MAINE

(NOT TO SCALE)



1. Contributing area to the NSCS
2. Curtain drain
3. Sediment basin
4. Level lip spreader
5. Grassed buffer
6. Subsurface drains
7. Transition zone
8. Vegetated shallow pond
9. Training dike
10. Stable outlet (not shown)
11. Deep pond
12. Vegetated emergency spillway (not shown)
13. Embankment
14. Principal spillway
15. Distribution spreader
16. Vegetated "polishing" area
17. Stable outlet

A diversion ditch was constructed to redirect runoff from crop land, direct it into sediment basins, and eventually into the deep pond.

Ponds act as biological filters, preventing silt and nutrients from entering tributaries.

The Problem

1) Ever since he joined his father on the family farm, Greg Smith of Smith's Farm in Westfield, Maine, has watched valuable topsoil wash away at the rate of two to three tons per acre per year. "It's hard to watch so much of your effort wash away, year after year," noted Smith. This is a costly phenomenon for many farmers. For Smith, it was costly for two reasons:

- Sediment from the runoff was filling his man-made irrigation pond, a significant source of water during dry growing seasons, and
- Costly fertilizer was washing away with the runoff.

"The fine particles go first," explained Keith Roble, engineer with the Natural Resources Conservation Service (NRCS), "and they contain the most nutrients."

2) Water quality in portions of the Prestile Stream was found to be impaired. In the 1980s rock baskets were placed in streams all over the state, including the Prestile Stream. "We were looking for invertebrate bugs, which colonize the rocks in the bottom of the stream," explained Kathy Hoppe, nonpoint-source grant project director with Maine Department of Environmental Protection (MDEP). "Depending on which bugs and how many colonize the rocks, we can determine the health of a stream or river. Results of those tests became our model." Comparison testing in the mid-1990s demonstrated that the Prestile Stream had suffered serious degradation.

These two problems begged a common solution because the Prestile Stream Watershed was a recipient of the runoff from Smith's Farm, via an unnamed tributary connecting Smith's irrigation pond with the Prestile Stream.

Water quality degradation in any given watershed can be traced to multiple causes. Crop land frequently is identified as a significant contributor to that degradation, in agricultural watershed. "Soil is the #1 pollutant in Maine waters," explained Hoppe, who regularly monitors water quality in numerous watersheds in northern Maine.

Watershed Improvement Financial Assistance Partnership (WIFAP)

Once the seriousness of the stream's degradation was quantified, Skip Babineau, District Conservationist for the NRCS, and Tim Hobbs, Executive Director of the Central Aroostook Soil and Water Conservation District (CASWCD) worked with Greg Smith to determine which acreage was having the most impact on the stream. They quickly identified 110 acres that were feeding the irrigation pond, small tributary, and the Prestile Stream, and decided the best solution was a Nutrient and Sediment Control System.

A unique partnership was formed to plan and implement a nonpoint-source (NPS) 319 grant from the EPA. Section 319 funds are used in Maine to provide financial and technical assistance for comprehensive watershed protection projects, usually managed by the local conservation district.

"This project is one of the first in the state of Maine to utilize funding arranged by an agreement between the Maine Department of Agriculture, MDEP, and the Maine Association of Conservation Districts," explained Hobbs of CASWCD. Funding was provided at a cost share rate of 60% federal (EPA) money via MDEP and 40% state. CASWCD provided project oversight, with Hoppe serving as project manager.

Nutrient & Sediment Control Systems

Nutrient and Sediment Control Systems (NSCS) are a proven conservation practice. They trap sediment and remove nutrients from runoff. They also provide an aesthetic wildlife habitat, an additional source of water, and added value to farmland. NSCS combine the settling and straining abilities of wetlands with the accelerated biological filtering and breakdown principles of sewage treatment systems. They are designed to reduce nutrients (especially phosphorus), sediments, bacteria, some chemicals and other organic matter in agricultural runoff. Several NSCS have been installed by farmers in northern Maine's St. John Valley—in the Cross Lake/Long Lake watersheds—and have resulted in significant filtering of crop land runoff.

"We wanted to capture as much runoff as feasible without eliminating too much crop land." —Skip Babineau

The design of each NSCS is tailored to the specific site, but all feature common design standards and basic components:

Diversion ditches direct the flow of runoff into the treatment system.

The sediment basin regulates and distributes water flow and allows large suspended solids to settle out before the water flow moves on. Farmers periodically empty the sediment basin on an as-needed basis.

The level lip spreader eliminates a channel flow, which would lead to further erosion, replacing it with a rocky strip designed to create sheet flow across the grass filter strip. The grass filter strip—the first filtering component—removes some suspended particles, allows some nutrient uptake and maintains an even flow.

The wetland, or shallow pond, with its cattails, saturated soil, and shallow water, provides a good medium for thriving microorganisms, which remove nitrates, ammonia, bacteria, and other nutrients. Densely growing aquatic plants also take up nutrients and trap sediment.

A chief construction consideration was the need to accommodate a large center pivoting irrigation system.

The deep water pond is designed to be the primary aquatic biological filter for removal of nutrients and fine sediment. It contains microorganisms, shellfish, frogs and bait fish, all of which extract nutrients from the water. The animal population is maintained through natural predation and life cycles.

**According to a brochure produced by South Point Media for St. John Valley Soil and Water Conservation District, with a grant from The Maine Potato Board*

Smith's Farm NSCS

Together, Skip Babineau of NRCS and Greg Smith identified the best location for an NSCS to ensure optimum runoff and minimum loss of tillable acreage. "A key element of success in a project of this nature is the landowner's involvement," Babineau stressed. "We wanted to capture as much runoff as feasible without eliminating too much crop land."

Keith Roble of NRCS brought his engineering skills to bear on designing the appropriate NSCS for Smith's Farm. This particular system includes all of the components identified above. "Each component was sized by the number of acres draining into it," explained Roble. "There are two formulas used in designing NSCS," he continued. "One is for optimum treatment of the water; the other is for safety of the structure, to prevent overflow."

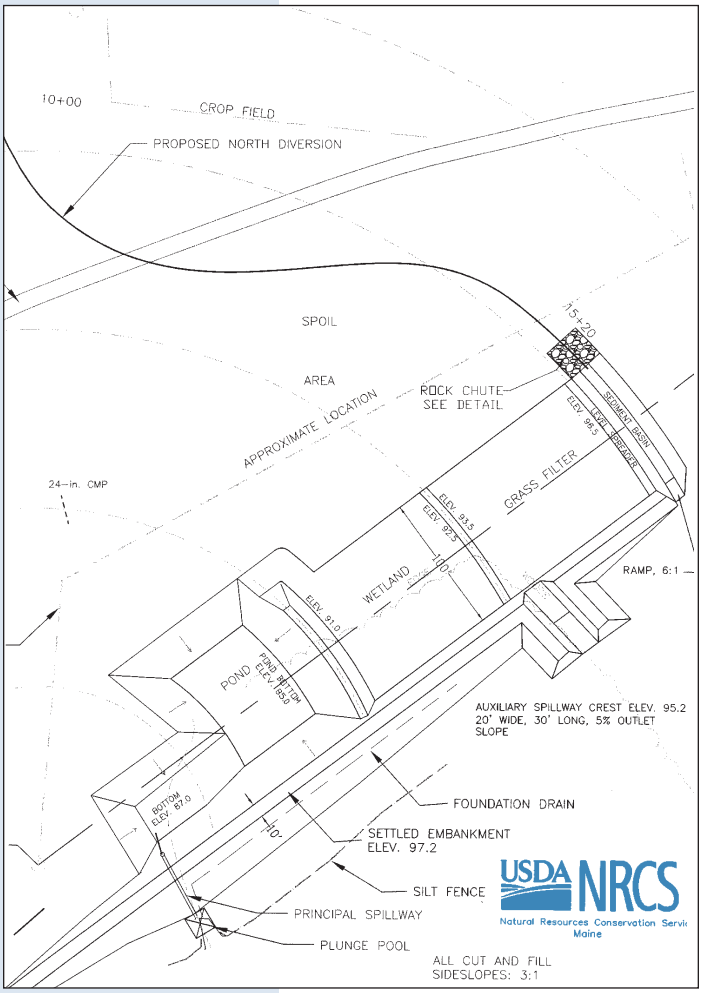
There are two features which make the Smith's Farm NSCS design unique:

1) A second diversion ditch with three sediment basins was constructed to collect runoff from 55 acres of crop land to the west of the structure. This flow is diverted directly to the deep pond. (The primary diversion to the north of the structure diverts runoff from 53 acres of crop land through the system.)

2) Smith's Farm has a center pivoting irrigation system adjacent to the area of construction. The NSCS had to be located in a manner that would not interfere with the irrigation system's rotational sweep. "I know this was a challenge for them," commented Greg Smith. "I appreciate their efforts to avoid the pivot, which could not be moved. They did a good job."

Construction of the Smith's Farm nutrient and sediment control system was completed in October, 2001. The project was funded by a unique agreement by the Maine Department of Agriculture, the Maine Department of Environmental Protection, and the Maine Association of Conservation Districts to provide 40 per cent of the cost, while the federal Environmental Protection Agency shared 60 per cent.

PLAN OF THE PROJECT



"Any time you can remove sediment and nutrients from that amount of acreage," stated Ray Harris, CASWCD board member who provided oversight for much of the project, "it's a significant accomplishment."

Expectations

With construction of the Smith's Farm nutrient and sediment control system completed in October of 2001, the spring and summer of 2002 will be the first opportunity to observe it in action. A grass filter was planted with a seed mix of reed canary grass, creeping red fescue, smooth brome grass, red top, and Kentucky blue grass. Volunteer cattails are expected to appear this first growing season after the pond's completion. They will capture nutrients, especially phosphorus, which sticks to the cattails.

Two other NSCS systems were monitored in 1990-1991, resulting in an average of 96% total suspended solids removal rate and 82% phosphorus removal rate. Based on these results, the Smith's Farm NSCS is expected to result in the removal of 13,200 kilograms (14.5 tons or one 10-yard dump truck load) of total suspended solids per year, including 27 kilograms (60 pounds of phosphorus or 10,000 pounds of fertilizer) of total phosphorus. Removal efficiency for the northern diversion—the 53 acres running through the entire system—is expected to be 96% for total suspended solids and 82% for total phosphorus. Removal efficiency for the westerly diversion—the 55 acres diverted directly to the deep pond without passing through the rest of the system—is expected to be 75% for total suspended solids and 50% for total phosphorus.

Worth It?

Because of the uniqueness of this particular system, its ability to accomplish the anticipated objectives will be monitored very closely, especially the first season and during periods of heavy runoff. Is it worth it?

"Any time you can remove sediment and nutrients from that amount of acreage," stated Ray Harris, CASWCD board member who provided oversight for much of the project, "it's a very significant accomplishment."

Greg Smith added his vote. "I appreciate the opportunity to capture sediment and nutrients, to avoid silt buildup in my irrigation pond, and knowing that my fields aren't degrading the Prestile Stream water quality. It's important for farmers and the appropriate state and federal agencies to work cooperatively in an effort to maintain the quality of Maine's waterways," he added. "I'm a farmer, but I like to fish, too."

The Future

And hopefully the fish will be there, for Smith and everyone else who likes to fish. As pointed out by MDEP's Hoppe, however, "the Smith's Farm NSCS is only the the first step in a long line of actions that need to be taken to help protect and improve water resources in the Prestile Stream and Aroostook County. We aren't done," she added, "and I'm sure Greg (Smith) would agree. There is more to be done on his land and other land in the watershed, which is why MDEP has provided a grant to the SWCD to work with the landowners and municipalities in the watershed to develop a watershed management plan."

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