Section 319
NONPOINT SOURCE PROGRAM SUCCESS STORY
North Carolina

Implementing Best Management Practices Improves Water Quality

Waterbodies Improved

Pesticides in agricultural runoff, along with other nonpoint sources of pollution, impaired the macroinvertebrate and fish communities in North Carolina's Clear Creek. As a result, in 2000 the North Carolina Division of Water Quality (NC DWQ) added 11.7 miles of the creek to the state's Clean Water Act (CWA) section 303(d) list of impaired waters for failing to support the creek's aquatic life designated use. Watershed partners conducted planning, implemented education/outreach programs, and worked with landowners to install agricultural best management practices (BMPs). Because of these efforts, water quality has improved in a portion of Clear Creek, prompting NC DWQ to remove two segments (totaling 5.2 miles) from the impaired waters list since 2006.

Problem

Clear Creek, the largest tributary of Mud Creek, drains approximately 44 square miles of Henderson County within the French Broad River Basin in western North Carolina (Figure 1). Major watershed land uses include forest (50 percent), cropland and pastureland (45 percent), and developed land (5 percent). Apples are the primary agricultural crop in the watershed. Historically, pesticides such as dichlorodiphenyltrichloroethane (DDT) and chlordane were commonly used in agricultural and residential areas of Henderson County.

Biological data collected by NC DWQ in 1992 and 1997 indicated that the creek was not supporting its aquatic life designated use, as demonstrated by poor ratings in the macroinvertebrate EPT (short for the order names Ephemeroptera, Plecoptera and Trichoptera) index, a measure of the number and types of pollution-sensitive aquatic insects inhabiting a waterbody (Table 1). Ratings of *good-fair*, *good* and *excellent* are considered supportive of the biological integrity water quality standard. Based on these data, in 2000 NC DWQ added an 11.7-mile segment of Clear Creek (see assessment unit 6-55-11-1 on Figure 1) to the state's list of impaired waters for poor biological integrity for macroinvertebrates and fish community.

According to the NC DWQ French Broad Basin Plan, developed in 2000, in-stream monitoring indicated that pesticides might be affecting aquatic life in Clear Creek. NC DWQ recommended that local agencies (including the Mud Creek Restoration Council, a local watershed stakeholder group led by the Henderson County Cooperative Extension) work with landowners to implement management strategies in the watershed, including BMPs on orchards to reduce pesticide runoff entering Clear Creek.

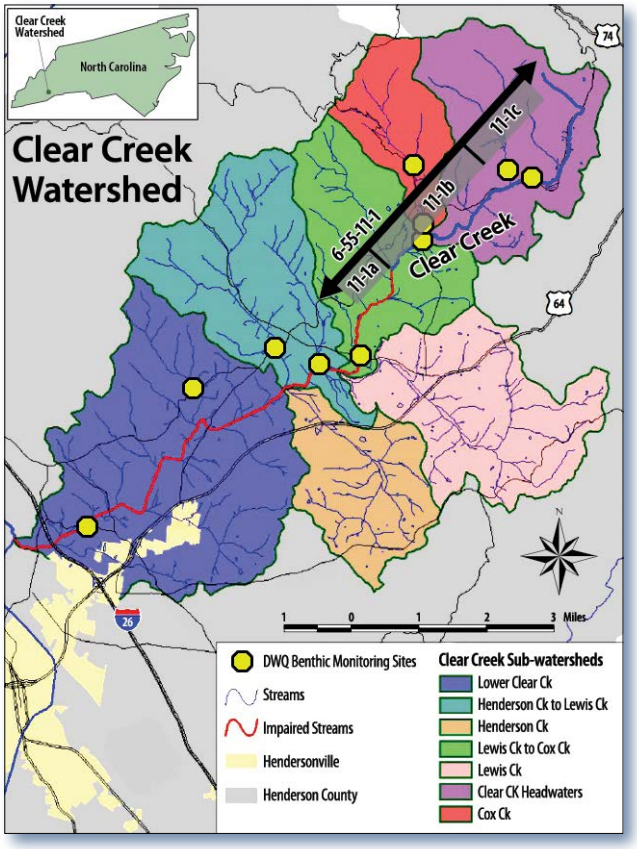

Figure 1. Clear Creek sub-watersheds, monitoring stations, impaired waters and waterbody segmentation.

In addition to pesticides from agriculture production (specifically apple orchards and row crops), NC DWQ identified sedimentation from agriculture and development, stream channelization, and lack of riparian buffer along stream banks as causes of impairment in Clear Creek watershed.

Table 1. Clear Creek Biological Sampling Data

Sampling Date	Segment	Bioclass Rating	Meets Standards
1992	6-55-11-1	Poor	No
1993	6-55-11-1	Fair	No
1997	6-55-11-1	Poor	No
2000	6-55-11-1	Good-Fair*	Yes*
2006	6-55-11-1(a)	Not Rated	No
	6-55-11-1(b)	Good-Fair	Yes
2010	6-55-11-1(a)	Good	Yes
	6-55-11-1(b)	Good-Fair	Yes

* Although data showed that the Clear Creek assessment unit 6-55-11-1 met standards in 2000, NC DWQ opted to divide it into three sub-segments to ensure a more comprehensive and accurate assessment of water quality before removing the stream from the impaired waters list.

In 2001 the Tennessee Valley Authority (TVA) developed an Integrated Pollutant Source Identification report for the Mud Creek watershed. The TVA had analyzed infrared aerial photography using a geographic information system to identify more than 2,000 feet of eroding streams adjacent to orchards and agriculture fields. The TVA also had determined that all the perennial streams in the watershed lacked adequate riparian buffers and therefore were likely contributing to toxic and sediment runoff into the creek during storm events.

Project Highlights

In January 2003, the Mud Creek Watershed Restoration Council published the *Mud Creek Watershed Restoration Plan*, which provided recommendations for addressing nonpoint sources of pollution throughout the watershed. For more than 10 years, the Henderson County Cooperative Extension Mud Creek Coordinator has played a critical role in engaging local producers and securing grant funding to support watershed restoration efforts. In 2005 the Mud Creek coordinator received a CWA section 319 grant to prepare and implement a watershed restoration plan specific to Clear Creek. Partners targeted community outreach efforts to work with landowners to identify appropriate BMPs and restoration practices to improve stream channel stability, reduce erosion/sedimentation, and adopt integrated pest management practices that reduced pesticide use.

Henderson County adopted a local sedimentation and erosion control ordinance in 2007, which helped to reduce sediment loss throughout the Mud Creek watershed. In 2008–2009, project partners implemented numerous BMPs in the Clear Creek watershed, including stabilizing and restoring streams (5,425 feet; Figure 2), adding a pasture watering system, and implementing pesticide spray reduction management measures on 392 acres (e.g., using codling moth mating disruption techniques and employing sensor-based spray technology that better controls the dose of pesticide application). Project partners conducted 100 educational programs. Forty-one professional landscapers participated in a Stream Doctor Training Program and then used their knowledge to install eight backyard stream bank stabilization projects covering 1,300 linear feet of stream.

Figure 2. Implementing a stream restoration project on a Clear Creek tributary.

Results

Restoration efforts have contributed to water quality improvement in Clear Creek. Initial biological data collected by NC DWQ in 1992 and 1997 yielded a water quality rating of *poor* in Clear Creek assessment unit 6-55-11-1, leading to its impairment listing in 2000. In 2003 NC DWQ divided assessment unit 6-55-11-1 into three segments for listing purposes (see Figure 1)—6-55-11-1(a), (b) and (c). Biological monitoring conducted on segment 6-55-11-1(b) in 2006 showed that the bioclass rating had improved to *good-fair*, prompting the state to remove the 2.5-mile segment from the impaired waters list that year. By 2010, the bioclass rating for segment 6-55-11-1(a) had improved to *good*, which indicates support of the aquatic life designated use (see Table 1). As a result, NC DWQ removed 2.7-mile segment 6-55-11-1(a) from the state's impaired waters list in 2012. The remaining 2.1-mile Clear Creek segment 6-55-11-1(c) remains listed as impaired due to a *fair* fish community rating and a *poor* biological assessment rating.

Partners and Funding

Project partners have received a total of $810,991 in CWA section 319 grant funds to implement restoration projects throughout the Mud Creek watershed. More than $420,000 in matching funds were leveraged from the following organizations: North Carolina Ecosystem Enhancement Program, Henderson County Cooperative Extension, Mud Creek Restoration Council, TVA and North Carolina State University.

U.S. Environmental Protection Agency
Office of Water
Washington, DC

EPA 841-F-12-001BBB
December 2012

For additional information contact:

Diane Silver, Mud Creek Watershed Coordinator
Henderson County Cooperative Extension
828-697-4891 • Diane_silver@ncsu.edu

Heather Jennings, NC 319 Grant Program
North Carolina Division of Water Quality
919-807-6437 • Heather.B.Jennings@ncdenr.gov