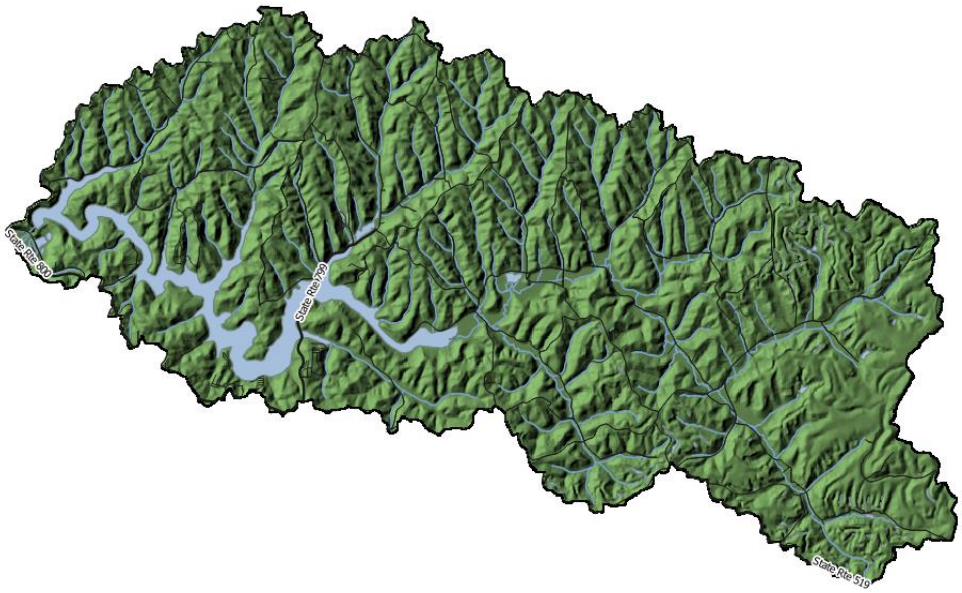
CLENDENING LAKE



9/30/2014

RAPID WATERSHED ASSESSMENT

Profile Contents

INTRODUCTION

Clendening Lake Watershed encompasses 44,776 acres in eastern Ohio is a single12-digit hydrologic unit, Brushy Fork (HUC 050400011402). The entire watershed is located within Harrison County. The watershed had a population of 2,589 people as of 2010. The watershed is largely forested, with 29,812 acres of forest, followed by 9,647 acres of agricultural land, and 2,382 acres of developed land.

Clendening Lake

RAPID WATERSHED ASSESSMENT

PHYSICAL DESCRIPTION

The area defined in this report as the Clendening Lake Watershed is the Brushy Fork sub watershed (HUC 050400010705. The outlet of the Clendening Lake Watershed is the mouth of Brushy Fork where it empties into Stillwater Creek. The west end of Clendening Lake is located approximately a quarter mile upstream of the mouth of Brushy Fork, where the United States Army Corp of Engineers (USACE) maintains the dam. Hefling Run, Long Run, Coleman Run, Huff Run, McFadden Run, Brushy Fork, and numerous unnamed streams feed into Clendening Lake. Along with several unnamed tributaries, Lees Run, Slab Camp Run, Elk Run, and South Fork Brushy Fork feed into Brushy Fork. The other streams have only unnamed tributaries.

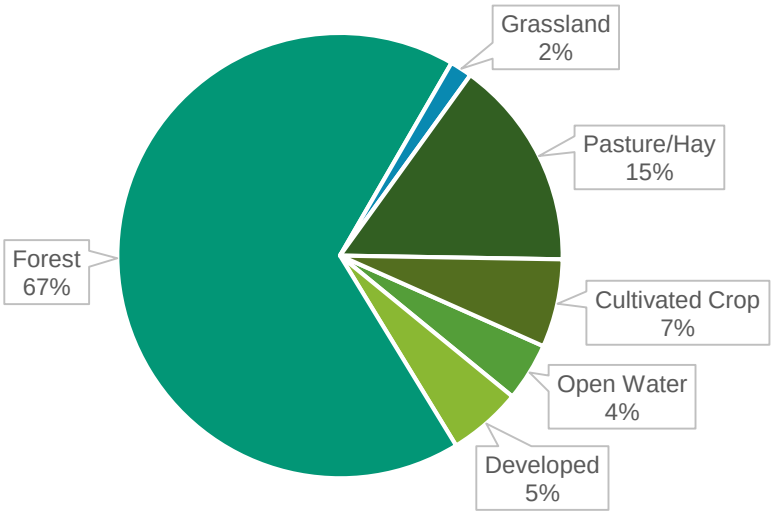


FIGURE 1: Breakdown of Land use in Clendening Lake Watershed

Land use in the Clendening Lake Watershed is 67% forested land and 22% agricultural use (Figures 1 & 2), with 15% pasture/hay and 7% cultivated crops. Minor land uses are

developed (5%), water (4%), grasslands (2%), scrub/shrub (<0.1%), and wetland (<0.1%) (Fry, 2011). There are 17,062 acres of the land classified as prime farmland in the watershed and 39,923 acres are classified as highly erodible land (ODNR, 2014). Conservation and recreational land encompass 6,040 acres of land. The USACE maintains 2,486 acres, including a portion of the lake, while the remaining 3,554 acres are owned by Muskingum Watershed Conservancy District.

Annual precipitation in the watershed is 41 inches, with May, June, and July being the wettest months, receiving 4.5 inches per month. Meanwhile, October, December, January, and February receive 2.5 inches per month (ODNR, 2014). The average annual maximum temperature is 83.2° F and the average annual low temperature is 19° F (ODNR, 2014).

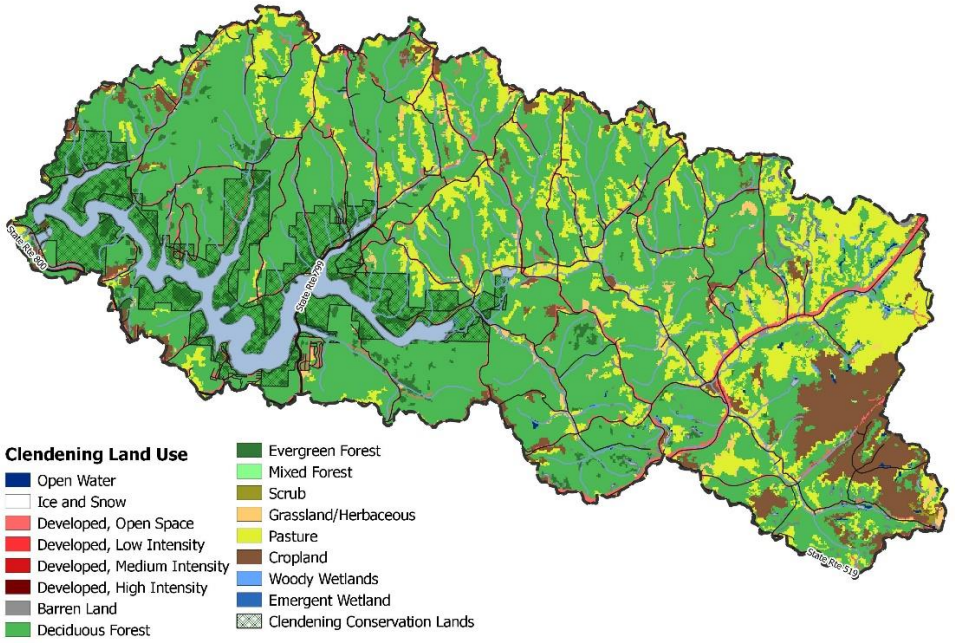


FIGURE 2: Map of Land Use within Leesville Lake Watershed

While Clendening Lake Watershed is located entirely within the Western Alleghany Plateau, it is split between the Unglaciated Muskingum River Basin ecoregion in the western portion and the Monongahela Transition Zone to the east. The western region is defined by hilly terrain with extensive forested areas, historically mixed oak and mixed mesophytic forests. Broad, silt filled valleys hold low gradient streams and rivers which are small in comparison to the wide valleys. Agricultural in the Western Allegany Plateau

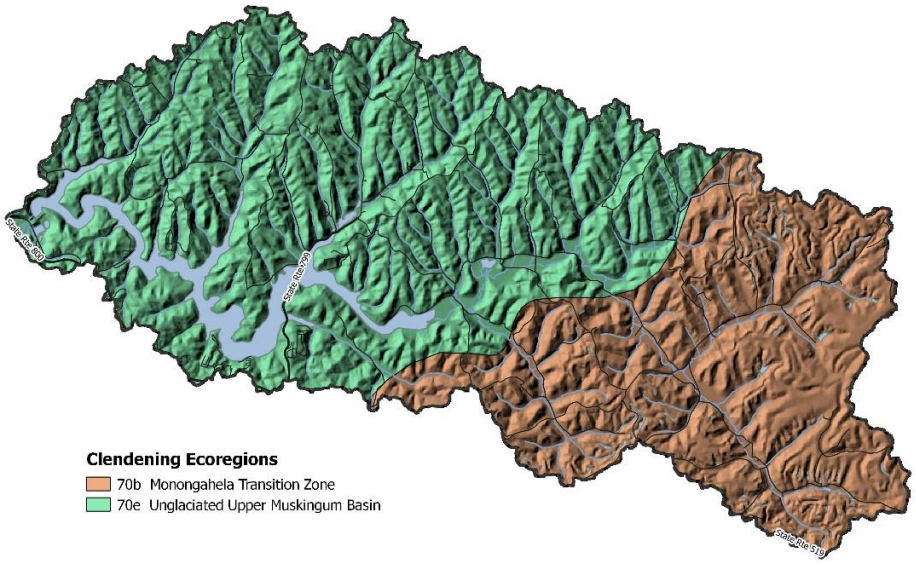


FIGURE 3: Map of ecoregions within Tappan Lake Watershed

is focused in these valleys, with dairy, livestock, hay, and row crop operations occurring in the lowlands while the hillsides remain largely forested. The ecoregion has sedimentary bedrock layers and has been mined for coal (US EPA, 1998). The eastern end of the watershed (the Monongahela Transition Zone) is more degraded by coal mine effluent than the Unglaciated Upper Muskingum Basin. Gas wells, coal mining and reclaimed lands are common as is the associated stream degradation. Other land uses are similar between the two regions (US EPA, 1998).

RESOURCE CONCERNS

TABLE 1: Ohio EPA aquatic life use attainment for Clendening Lake Watershed sites.

Stream	River Mile	Attainment Status	Causes of Impairment
Brushy Fork	18.85	NON	Total Dissolved Solids, Coal Mining
Brushy Fork	12.5	PARTIAL	Total Dissolved Solids, Coal Mining
Brushy Fork	0.29	NON	Hydrogen Sulfide, Dissolved Oxygen, Dam or Impoundment
Elk Run	0.2	PARTIAL	Other Flow Regime Alterations, Dam or Impoundment

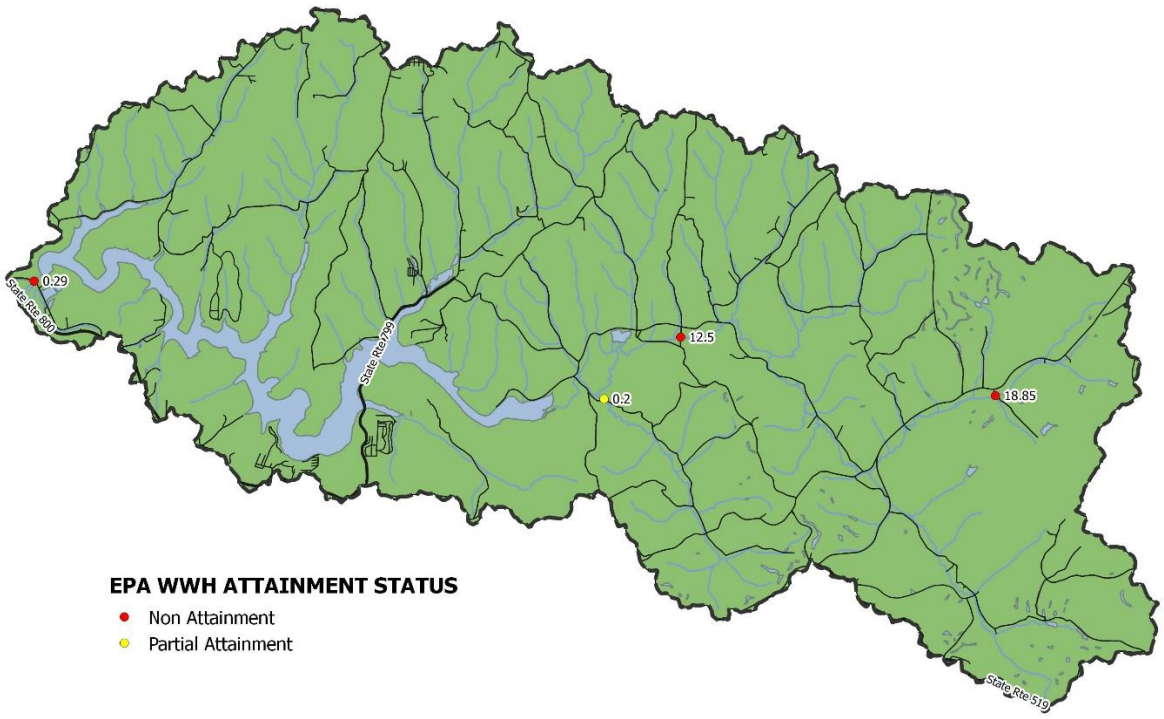


FIGURE 3: Ohio EPA attainment status for warmwater habitat. Non-attaining sites failed EPA criteria for both macroinvertebrates and fish, partially attaining sites failed one but not the other.

Ohio Environmental Protection Agency (OEPA) has designated the entire Clendening Lake Watershed as warmwater habitat for aquatic use. The most recent US Environmental Protection Agency (EPA) Water Quality Assessment Report for the two watersheds lists aquatic life use as impaired and all other uses as not assessed (Table 2).

TABLE 2: Assessment of 2010 Designated Uses from EPA Water Quality Assessment Report (USEPA)

DESIGNATED USE	BRUSHY FORK
Aquatic Life Use	Impaired
Human Health Use	Not Assessed
Public Drinking Water Supply Use	Not Assessed
Recreational Use	Not Assessed

Nutrient Enrichment & Algal Blooms

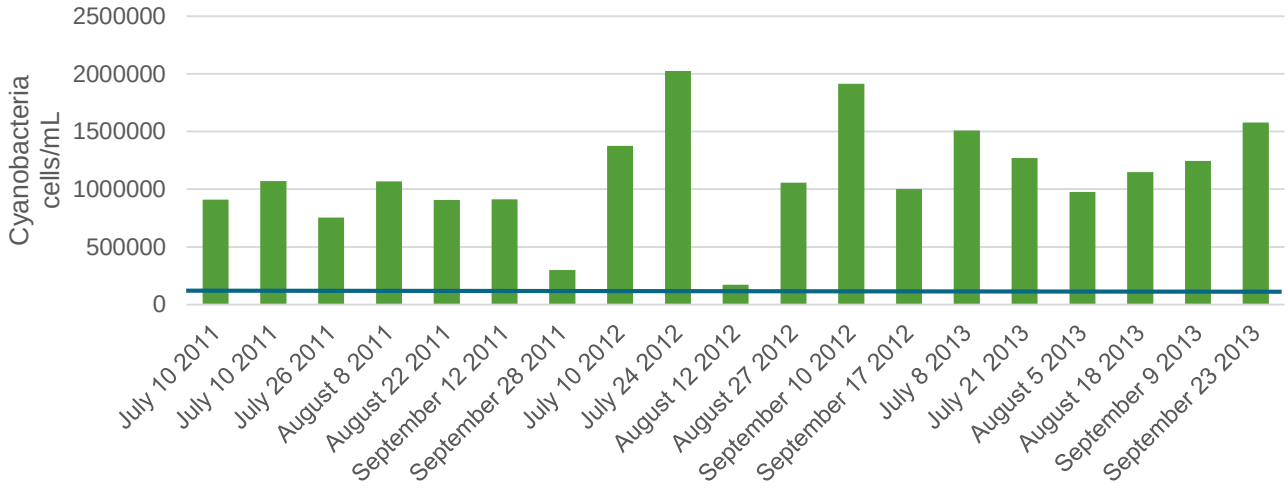


FIGURE 3: Concentration of cyanobacteria in Clendening Lake. Values above the blue line are classified by the Ohio EPA as a severe bloom.

One of the primary concerns for the health of the watershed is eutrophication of the streams and Clendening Lake. The concerns have arisen from problems occurring at other locations around the state including Lake Erie and Grand Lake Saint Mary's. Sampling conducted by the Ohio Lake Management Society has found very low levels of microcystin in 2011, 2012, and 2013 on multiple sampling dates. While microcystin was detected, it occurred at concentrations below limit of quantification. These toxins are produced by the cyanobacteria that cause Harmful Algal Blooms (HABs) (OLMS, 2013). While the amount of toxins found in the lake have been very low, substantial HABs have been occurring with regular occurrence (Figure 3). Numerous possible sources of nutrient pollution exist within the watershed. While there are no wastewater treatment facilities in the watershed, poorly functioning or non-functioning septic systems likely occur throughout the region. Additionally, improper storage of animal waste from livestock operations or unsuitable field applications of manure can result in heavy runoff of nutrients. Heavy use of fertilizers also contributes to nutrient pollution and occurs at homes and farms within the watershed.

Oil and Gas Industry

The oil and gas industry has recently grown rapidly in the region. Currently, two practices becoming much more widespread across the watershed. The first is the drilling of

horizontal wells and hydraulic fracturing. There are currently permits issued for 36 wells located at 7 different well pads within the Clendening Lake Watershed (Figure 4). Nine wells are currently producing product, 5 others are drilled, 9 are being drilled, and 13 are permitted, but yet to be drilled. Public concern for these wells include worries about contamination to groundwater supplies, excessive use of surface/groundwater resources for fracking operations, and runoff/erosion from pad sites, particularly during the construction process or an accidental spill.

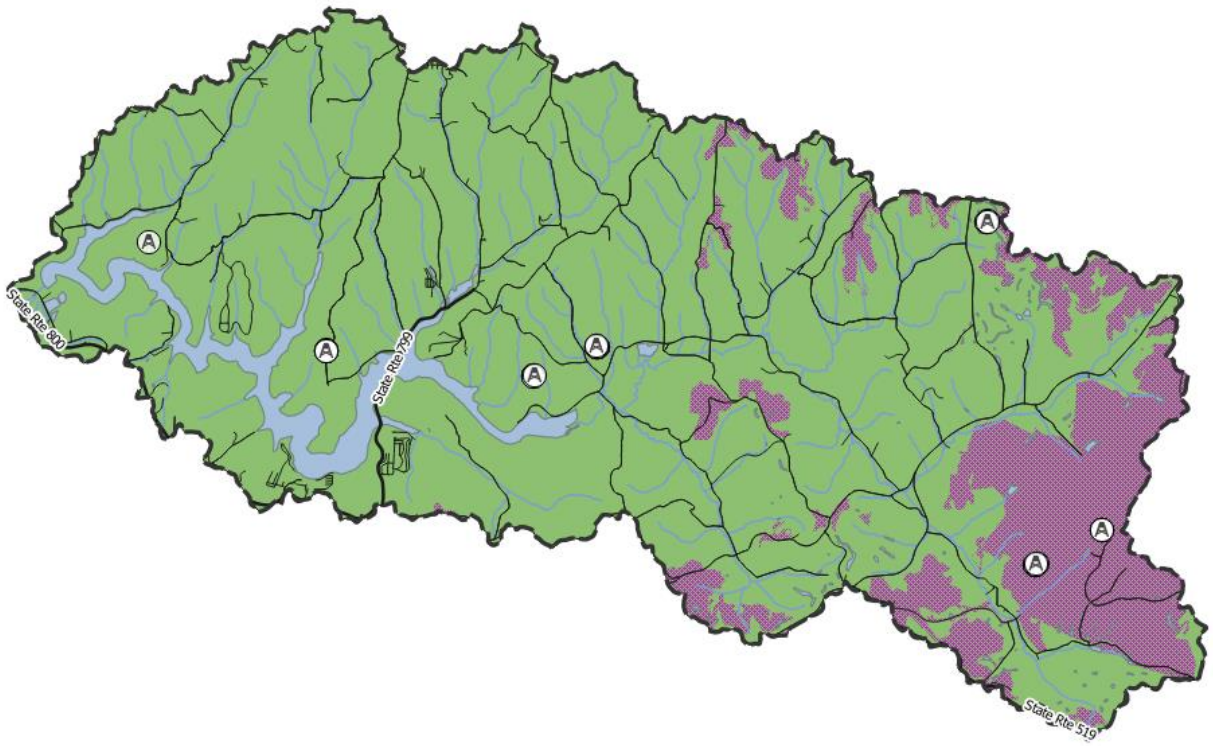


FIGURE 4: Coal, Gas, and Oil Activity in the Leesville Lake Watershed. Horizontal wells mark with well symbol (Note: some locations have multiple wells at a single pad). Locations of coal surface mining activity shaded purple. (ODNR DMRM, 2009-2012)

The second practice is the construction of pipelines across the watershed and surrounding counties. Currently, the largest water quality concern with pipelines is the disturbance of soil during the construction process and the potential increase in runoff and sedimentation into streams and the lake. The second concern associated with the increasing miles of pipeline across the region is the possibility of future breaks or malfunction in the lines causing a release into the air or water supply.

Sedimentation

While sedimentation is one portion of the concern surrounding the oil and gas activity in the watershed, it is also a concern for other land uses, primarily agriculture and construction sites. Historically, sedimentation from erosion from cropland, overgrazed pastures, and construction sites has been one of the largest issues within the region (Palone, 1992, Stillwater) and it remains a top priority.

Acid Mine Drainage & Abandoned Mine Lands

Coal mining began in Harrison County in the late 1800's (HERITAGE/HISTORY) and the Clendening Lake Watershed has 16,025 acres of documented coal surface mines (175 mining sites) and several abandoned underground mines within its boundary (ODNR DMRM, 2009-2012). Mining activity has been focused on the eastern end of the watershed, mostly in the headwaters of Brushy Fork and South Fork of Brushy Fork. Seepage from these mines can increase the acidity of the streams and inputs heavy metals such as iron and aluminum into the water bodies. Conversely, AMD can result in an increased alkalinity when limestone and similar strata exist. Sulfates may also be leached from rock layers containing sulfide minerals. The Ohio Department of Natural Resources (ODNR) Division of Mineral Resources Management (DMRM) has identified this watershed as being impacted by Acid Mine Drainage (Calhoun, 2012).

CENSUS AND SOCIAL DATA

The Leesville Lake Watershed had an estimated population of 2,589 as of 2010. The community was 86% rural and 32% urban according to 2000 census tract data. In 2000 45% of the population was in the labor force.

STATUS AND HISTORY OF MANAGEMENT EFFORTS

MWCD has several monitoring partnerships in place to gather data on the water quality in Atwood Lake. MWCD works with the Water Management Section of the Huntington District of the USACE to sample the lake and its main incoming streams and discharge. MWCD also collaborates with OLMS to fund the CLAM volunteer monitoring program. Through the program turbidity, water temperature, water color, nutrients, total suspended solids, chlorophyll α, dissolved oxygen, and HAB (Figure 3) are documented.

OEPA has conducted some sampling within the watershed at various points. Fish tissue was sampled from the lake in 1993 and 1994 as a part of the statewide assessment for fish consumption advisories and no specific advisories were issued. The watershed was a part of the Stillwater Creek Study (OEPA, 2014) and was monitored in 2012-2013 as a part of the Statewide Biological and Water Quality Monitoring and Assessment program and to develop a Total Maximum Daily Load for the watershed area (Figure 3).

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