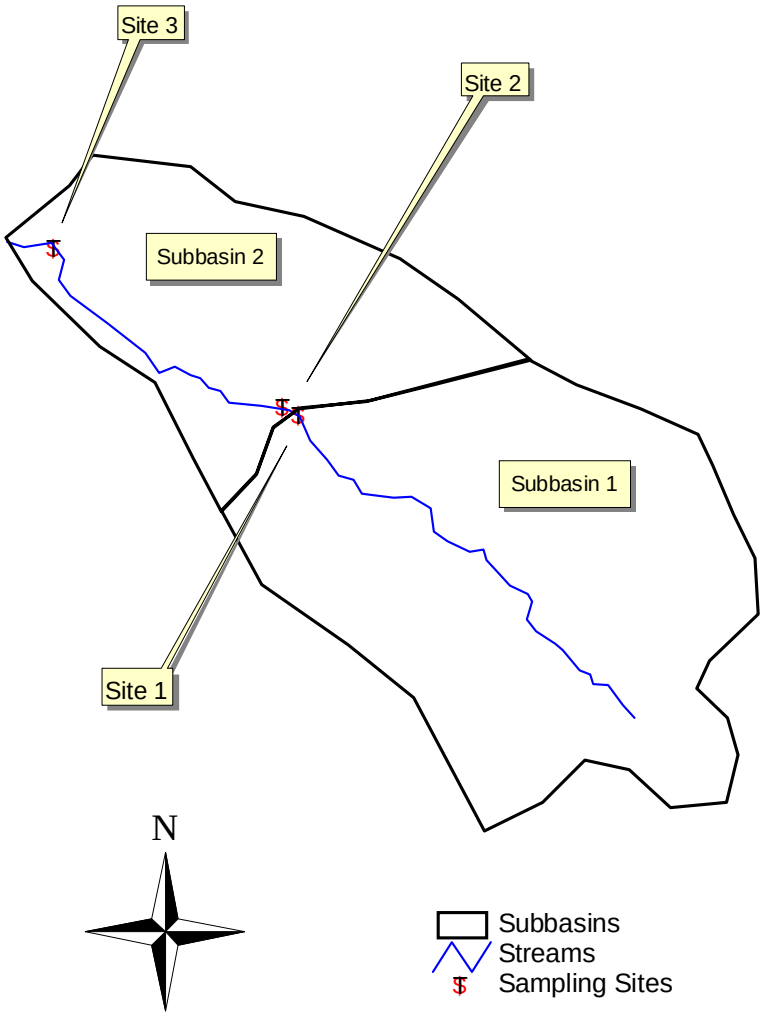
Mussin Branch of Moore Creek

Total Maximum Daily Load (TMDL) Fact Sheet

Project Name:	Mussin Branch of Moore Creek
Location:	Marion County, Kentucky
Scope/Size:	Mussin Branch Watershed 740 acres (1.16 mi^2) Stream Segment: River Mile 0.0 to 1.7
Land Type:	forest, agricultural, barren/spoil
Type of Activity:	acid drainage caused by highway construction
Pollutant(s):	H^+ ion mass, sulfuric acid
TMDL Issues:	nonpoint sources
Water Quality Standard/Target:	The pH shall not be less than six (6.0) or more than nine (9.0) and shall not fluctuate more than one and zero tenths (1.0) pH unit over a 24-hour period. This standard is found within regulation 401 KAR 5:031.
Data Sources:	Kentucky Division of Water (KDOW) Data Collection
Control Measures:	Kentucky nonpoint source TMDL implementation plan, Kentucky Watershed Framework
Summary:	Mussin Branch was determined as not supporting the designated uses of primary and secondary contact recreation (swimming and wading) and warm water aquatic habitat (aquatic life). Therefore, the creek was placed on the 2002 and subsequent 303(d) lists for TMDL development. The creek segment is characterized by a depressed pH, the result of leaching of the embankment (fill) material. In developing the TMDL for Mussin Branch, pH readings and corresponding streamflow measurements were made at three different locations within the watershed. The most recent sampling supports the conclusion that Subbasin 1 (Site 2) and Subbasin 2 (Site 3) do not support acceptable pH levels. The watershed is impaired because of low pH at these sites.



Most Recent Sampling Locations on Mussin Branch

TMDL Development:

TMDLs in grams H^+ ions per day were computed based on the allowable minimum pH value of 6.0 for creeks and streams to meet primary and secondary contact recreation (swimming and wading) and aquatic life uses. The TMDL was done for grams of ions (subsequently converted to pounds/day) because the units for pH do not allow for the computation of a quantitatively useful load or reduction amount.

In recognition of the inherent difficulties associated with imposition of a "no-exceedance" pH criteria on potentially intermittent streams, the KDOW has decided to use the

lowest one year average discharge of the most recent 10-year flow record as the flow basis for setting the appropriate TMDL and associated loading reduction. Previous pH TMDLs have used a 3-year recurrence interval of the average flow as the critical flow. However, this flow resulted in a target discharge that frequently was significantly greater than any of the observed flows for the sites as collected over several years. Thus use of a 3-year flow would require an extrapolation of the observed ion vs. flow model, well beyond the upper limit of the observed data. The selection of the 10-year frequency was based on a consideration of water quality standards (i.e. 7Q10). However, since many of these streams have a 7Q10 of zero, a greater duration was needed. The consensus of the KDOW was to use the 1-year duration. The use of an average annual flow as the basis for determining the TMDL provides a convenient mechanism for determining the total annual load, the total annual reduction that would be derived from an annual summation of the daily TMDLs, and the associated daily load reductions for the critical year using historical daily flows.

TMDL for Mussin Branch:

In developing a TMDL for Mussin Branch, there are two possible strategies. Either a cumulative aggregate TMDL may be obtained for the downstream extent of the impaired portion of the watershed, or separate TMDLs (and associated load reductions) may be developed for each individual subbasin. As a result of the availability of sampling data at multiple sampling points, individual TMDLs were developed for Subbasins 1 and 2. The low pH condition extends to Site 3, which is close to the outlet of Subbasin 2. The TMDLs and associated load reductions for Subbasins 1 and 2 are shown below.

Summary of Flow Rate and TMDL for each Subbasin in the Mussin Branch Watershed

Subbasin	Upstream contributing area (mi^2)	Incremental critical flow (cfs)	Incremental TMDL for a pH of 6.0 (lbs/day)	Predicted incremental load (lbs/day)	Load Reduction needed (lbs/day)
1	0.7609	0.3215	0.0017	0.0177	0.0160
2	0.3953	0.1670	0.0009	0.0000	0.0000
Total Watershed	1.1600	0.4901	0.0026	0.0177	0.0160

Distribution of Load: Because there were no observed point source discharges during the study period, the existing hydrogen ion load for the watershed was defined entirely as a nonpoint source load and that is what is reflected in the above table. The table given below splits the TMDL (which is based on meeting the minimum water quality standard value for pH of 6.0) evenly between the Waste Load Allocation (WLA) and the Load Allocation (LA) as a means of defining a conservative approach for each subbasin in the watershed.

Wasteload and Load Allocation for Each Subbasin in the Mussin Branch Watershed

	Incremental Critical Flow Rate (cfs)	TMDL for pH = 6.0 (lbs/day)	Wasteload Allocation (lbs/day)	Load Allocation (lbs/day)
Subbasin 1	0.3215	0.0017	0.00085	0.00085
Subbasin 2	0.1670	0.0009	0.00045	0.00045

Implementation/ Remediation Strategy: Remediation of pH-impaired streams, as a result of leaching from the pyritic fill material used in highway construction, is the responsibility of the entity that owns and maintains the highway. In the case of Mussin Branch, the cause of impairment is the fill material that was used in the construction process of the upgrading/relocation of U.S. Highway 68/Kentucky Highway 55 just south of Lebanon in Marion County. The remediation of this stream is thus the responsibility of the Kentucky Transportation Cabinet that owns and maintains these highways. This is the first TMDL to be developed for a stream impaired by highway construction related activities and will be used in the future as guidelines for any other similar impairment in streams. Permanent mitigation measures may involve sealing the pyritic fill material in the road embankments from surface water infiltration with lime and topsoil. For Mussin Branch, remediation needs to be done on the embankment and possibly the exposed road cuts on either side of the embankment. Before the permanent mitigation is implemented, the stream can be treated with limestone to bring the stream to acceptable limits of pH (6.0 – 9.0).