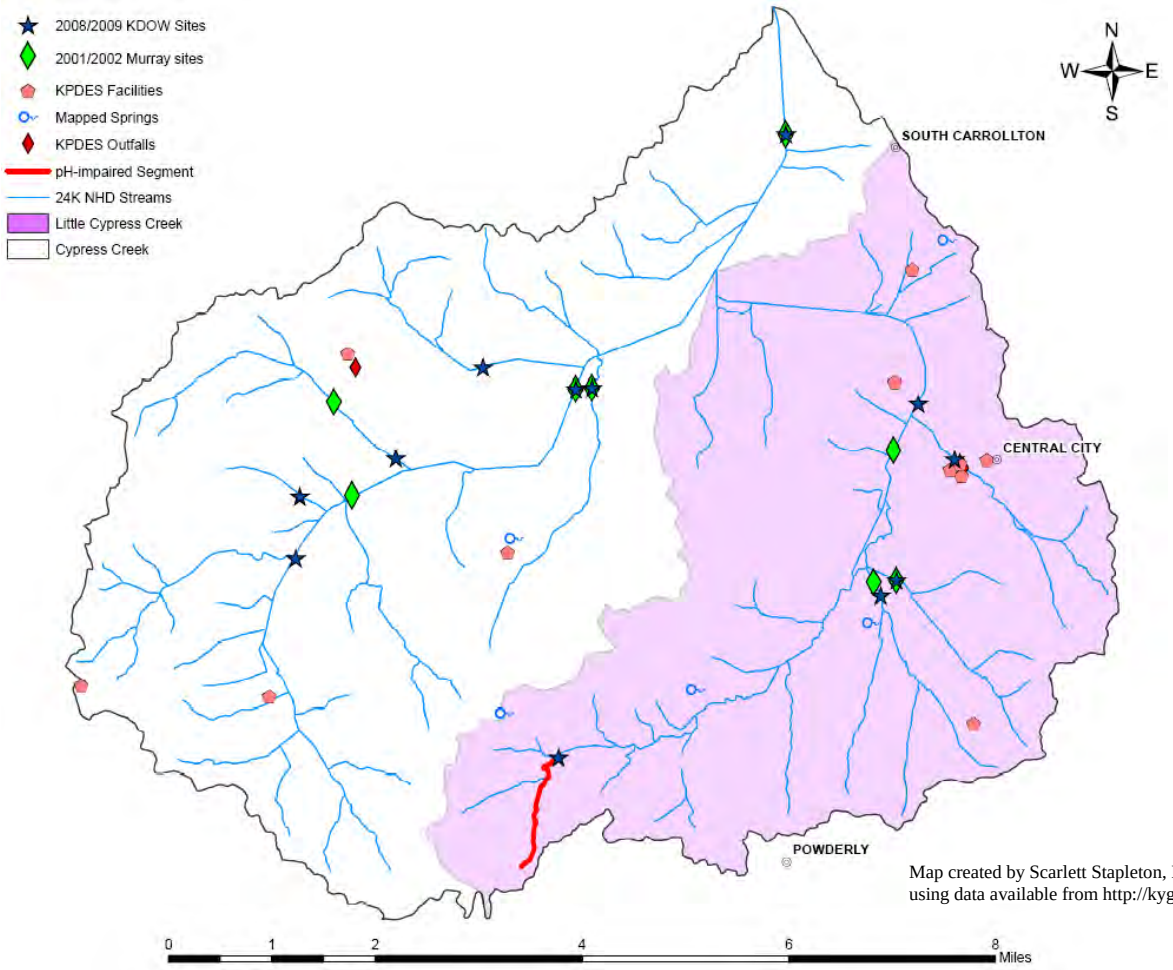
Total Maximum Daily Load (TMDL) Fact Sheet

Project Name:	Cypress Creek
Location:	Muhlenberg County, Kentucky
GNIS Number/ Waterbody ID:	KY496701_02
Scope/Size:	Cypress Creek watershed - 34,842 acres (54.44 mi^2) TMDL is for River Mile (RM) 8.7 to 10.1 in Little Cypress Creek, a tributary to Cypress Creek
Land Type:	Forest, agricultural, barren/spoil
Type of Activity:	Acid Mine Drainage (AMD) caused by Abandoned Mines
Pollutant(s):	H^+ Ion mass (pH)
TMDL Issues:	Nonpoint Sources (Abandoned Mine Lands)
Water Quality Standard/Target:	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 water quality standard (WQS) is found within 401 KAR 10:031.
Data Sources:	Kentucky Pollutant Discharge Elimination System (KPDES) Permit Historical Sampling Data, Murray State University Sampling Data, Kentucky Division of Water Sampling Data, Kentucky Division of Geographic Information Spatial Data (http://kygeonet.ky.gov)
Control Measures:	Kentucky Watershed Framework, Kentucky nonpoint source TMDL implementation plan, KPDES
Summary:	A segment in the headwaters of Little Cypress Creek was placed on the proposed 2010 303(d) list for TMDL development after it was found to not support the designated uses of primary and secondary contact recreation (PCR and SCR; swimming and wading) and warm water aquatic habitat (WAH; aquatic life). The stream segment is characterized by a depressed pH, the result of acid mine drainage from abandoned mining sites. The period of lowest pH is generally at low-flow conditions; however, the period of greatest hydrogen ion load is at higher flow conditions. The lowest mean annual flow condition in the most recent ten years was chosen as

the critical flow. Murray State was contracted to collect pH readings and corresponding stream flow measurements at eight different locations within the watershed from 2001 to 2002 (see figure below). The Kentucky Division of Water (KDOW) revisited the watershed from 2008 to 2009 collecting pH readings and flow measurements at twelve different sites.

The latest sampling indicated that previously impaired segments on the main stem of Cypress Creek were now fully supporting their PCR/SCR and WAH designated uses based upon the WQS for pH. The KDOW proposes delisting the former Cypress Creek pH impairments (RM 23.1 to 26.5 and 26.5 to 33.6) in the 2010 Integrated Report (IR). This sampling also revealed a new pH impairment in the headwaters of Little Cypress Creek. The KDOW proposes adding this stream from RM 8.7 to 10.1 to the 2010 IR as impaired for the PCR/SCR and WAH designated uses based on a 100% exceedance of pH WQS.



Monitoring Sites and pH-Impaired Segment for the Cypress Creek Watershed

TMDL Development:

TMDLs in grams H^+ ions per day were computed based on the allowable minimum pH value (6.0) for waterbodies to meet PCR, SCR and WAH designated uses. The TMDL was completed for grams of ions (subsequently converted to pounds/day) since 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, KDOW 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 KDOW was to use the 1-year duration. The use of an average annual flow as the basis for determining the TMDL provides more appropriate mechanism for determining: (1) the total annual load; (2) the total annual reduction that would be derived from an annual summation of the daily TMDLs; and (3) the associated daily load reductions for the critical year using historical daily flows.

TMDL for Little Cypress Creek:

A TMDL for pH was developed for the headwaters of Little Cypress Creek - the lowest pH condition extends along a segment from RM 8.7 to 10.1, near Site DOW03005007. The TMDL and associated load reductions are shown below.

TMDL and Associated Load Reduction in the Little Cypress Creek Watershed

Site	Upstream Contributing Area (mi2)	Critical Flow (cfs)	TMDL for a pH of 6.0 (lbs/day)	Predicted Load (lbs/day)	Load Reduction Needed (lbs/day)
Little Cypress Creek 8.7 to 10.1 (DOW03005007)	2.54	1.58	0.0085	13.3332	13.3247

New Permits: New permits for discharges to streams in the Cypress Creek Watershed could be allowed anywhere with the exception of the watershed area draining to the impaired segment of Little Cypress Creek. New permits in this area could be allowed contingent upon effluent pH permit limits in the range of 6.35 to 9.0 standard units. Kentucky WQS state that the pH value should not be less the 6.0 nor greater than 9.0 for meeting the designated uses of PCR/SCR and WAH. This range of 6.0 to 9.0 for pH is generally assigned as end-of-pipe effluent limits; however, because a stream impairment exists (low pH), new discharges cannot cause or contribute to an existing impairment. A buffered solution with nearly equal bicarbonate and carbonic acid components will have a pH of 6.35 (Carew, personal communication, 2005). Discharge of this buffered solution will use up free hydrogen ions in the receiving stream, thus it should not cause or contribute to an existing low-pH impairment. Permits having an effluent limit pH of 6.35 to 9.0 standard units will not be assigned a hydrogen ion load as part of a Waste Load Allocation (WLA). There are currently no active permits in the headwaters of Little Cypress Creek.

Distribution of Load: Because there were no KPDES-permitted (i.e. point source) discharges to the Little Cypress Creek impaired segment during the 2008/2009 study period, the hydrogen ion load for the watershed was defined entirely as a nonpoint source load. Because new permits (pH 6.35 to 9.0) would not cause or contribute to the existing impairment, no load has been provided for the WLA category.

Wasteloads and Load Allocations in the Cypress Creek Watershed

Site	Critical Flow (cfs)	TMDL for pH = 6.0 (lbs/day)	Wasteload Allocation (lbs/day)	Load Allocation (lbs/day)
Little Cypress Creek 8.7 to 10.1 (DOW03005007)	1.58	0.0085	0.00	0.0085

Implementation/ Remediation Strategy: Remediation of pH-impaired streams as a result of current mining operations is the responsibility of the mine operator. The Kentucky Department for Natural Resources is responsible for enforcing the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The Kentucky

Division of Abandoned Mine Lands (DAML) is charged with performing reclamation to address the impacts from pre-law mine sites in accordance with priorities established in SMCRA. SMCRA sets environmental problems as third in priority in the list of abandoned mine land (AML) problem types.

Practical application of pH TMDLs, especially for AML, will normally involve a phased implementation approach with associated monitoring in order to insure that the implemented measures are having the desired effect. Typical remediation strategies have involved channel restoration, re-vegetation, and the use of agricultural limestone. On sites where applicable (and funding allows) passive treatment systems have been used to treat AMD including open limestone channels, vertical flow systems, limestone dosing, and constructed wetlands.