303(d) Listing Methodology for Algae Blooms
WVDEP

In 2011 the Requirements Governing West Virginia Water Quality Standards (47CSR2) were modified to include language that prohibited algae blooms which impair or interfere with the designated uses of a stream. In order to scientifically define what levels of algae would impair or interfere with the uses of a stream, DEP hired the research firm Responsive Management to survey West Virginians on their tolerance levels for filamentous riverine algae growth. DEP worked closely with Responsive Management to develop the public survey of over one thousand West Virginians in 2012.

West Virginia Residents' Opinions On And Tolerance Levels Of Algae In West Virginia Waters found that a clear majority of West Virginians (over 70%) regarded 39% algal cover as impairing their use. Roughly half of the people regarded 26% algal cover as an impairment. Approximately three fourths (72%) of those surveyed indicated that algal cover of 20% would not interfere with their use of the stream.

Other factors related to filamentous algae blooms that will affect the recreational use of a stream include duration of the bloom, longitudinal extent, and location of the bloom relative to houses, camps, and public access sites.

Further, algae blooms may impair other uses of a stream. DEP has determined that algae blooms have at times affected some streams' use as a drinking water supply. Specific guidance is also provided in this document for determining impairment in cases impacting public water supplies (47-2-3.2.d and 3.2.h).

DEP will use the following guidelines to evaluate compliance with the narrative standards and/or determine impairment of a stream's use(s) caused by filamentous algae blooms:

1. A filamentous algae cover of greater than 20% will be judged to interfere with the recreational use of a stream whenever that bloom extends for a longitudinal distance greater than three times the average stream width in the impacted segment of stream, as determined by a minimum of three stream measurements taken using the SOP for Filamentous Algae Monitoring developed by DEP.

2. A filamentous algae cover of greater than 40%, regardless of the location or longitudinal extent of the bloom, will be judged to interfere with the recreational use of a stream.

3. Whenever a stream has filamentous algae covering more than 20% of a transect, and the algae bloom is located immediately adjacent to any occupied dwelling, campground, or developed public access site, DEP may determine that the recreational use of a stream is impaired after considering such factors as duration of the bloom, frequency of occurrence, longitudinal extent, bloom location relative to the stream access site, level of use, type of use, length of filaments, and size of floating mats.

4. Guidelines 1-3 are intended only for nontoxic filamentous algae blooms and do not address, for example, growth of periphyton, sestonic algae blooms, or bloom events involving toxic or otherwise harmful algae. (This is not to say that these blooms could not ever impair a stream; only that these blooms are beyond the scope of this guidance.)

5. Relating to filamentous or any other algae blooms causing taste or odor that interferes with the use of the water and/or causing additional (unreasonable) treatment to be required at drinking water plants, DEP considers any treatment beyond "conventional treatment" (see 47-2-2.1) that is required as a result of taste and/or odor complaints associated with algae blooms to be grounds for classifying a stream as impaired (47-2-3.2.h). DEP will also judge a stream to be impaired under 47-2-3.2.d whenever multiple taste or odor complaints about finished drinking water are documented during the algae growing season, regardless of whether any additional treatment beyond conventional treatment is being performed at the drinking water plant.

Rationale for Guidelines

The guidelines developed by DEP for determining impairment represent a balanced, rational, and scientific approach to maintaining the recreational use of streams that are impacted by filamentous algae blooms.

1. DEP interprets the Responsive Management study to demonstrate that use of a stream is not impaired by an algal coverage of less than 20%.

2. In the Responsive Management research, 49% of all people surveyed and 52% of boaters (the most sensitive user group) indicated that a 26% algal coverage of stream would interfere with their use of the stream. This level of algal development represents the "tipping point" for the majority of people. However, *a stream condition in which half the users find it to be impaired can hardly be considered to be fully meeting its designated uses*. Therefore, DEP is setting the standard for this guideline at a more protective level. The Responsive Management survey found that when the coverage was reduced to from 26% to 20%, 3 in 4 people found it to be acceptable. This slightly lower standard provides protection for another quarter of users.

   Recognizing that 20% coverage at a single transect on a stream would not necessarily impair the use of a stream in all cases, additional guidance on the longitudinal component is provided. Guideline #1 provides an allowance for 20-40% algal coverage for a distance up to three times the average width (between the ordinary high water mark on the banks) of the stream segment. Given the special consideration provided for dwellings, campgrounds, and public access sites in Guideline #3, the longitudinal allowance is meant to provide a reasonable limit to the distance that boaters and fisherman would encounter potentially undesirable levels of algae. The length of the longitudinal component is also a practical limit to what can typically be assessed without having to use a boat in the assessment.

3. Guideline #2 establishes a "ceiling" for algae cover on a stream which should not be allowable under any circumstance. It is made necessary especially by the longitudinal allowance given in Guideline #1 (3X river width). For example, a 200 foot wide river with 22% bottom cover may still be considered acceptable for wading and fishing if the bloom persists even for 500 feet, but use of a river that is 80% covered by algae for 500 feet is impaired significantly. There needs to be some upper limit for this longitudinal allowance. There is near universal agreement that 47% coverage impairs use of a

stream. The ceiling established by this guideline (40% coverage) establishes a reasonable limit to the amount of algae that can cover a stream in the longitudinal allowance provided in Guideline #1.

4. Most boaters and fisherman are mobile river users, often floating stream reaches several miles in length, where a moderate algae bloom (of limited magnitude as prescribed in Guidelines 1 and 2) would not significantly impact their use. However, DEP recognizes that special consideration may be needed for river uses associated with fixed locations like residences or a public access sites. A property owner should be able to utilize the river bordering his property and all should be able to utilize the stream at public access sites.

   Implementation of Guidelines 1 and 2 may result in a limited distance algae bloom, considered unacceptable by the majority, to overlap fixed use locations. As such, Guideline #3 allows DEP the flexibility to determine use impairment associated with algae coverage of magnitudes less than the thresholds established in Guidelines 1 and 2, when the impacted zone is located adjacent to dwellings, campgrounds, or developed public access sites. Whenever the coverage exceeds 20% at these sites, DEP may make a site specific determination of use impairment after considering the described factors.

5. The Responsive Management survey only utilized photos of filamentous algae blooms to determine tolerance levels of algae coverage in a stream. Applying the results of this study to other types of algae would not be appropriate. Periphyton, for example, could cover 100% of a stream bottom without interfering with the recreational use of the stream. A toxic form of algae could impair a stream with very little areal coverage.

6. Algae blooms, and particularly the decomposition of algae, can cause a strong musty, earthy, or grassy odor in drinking water. This odor is not removed during conventional drinking water treatment processes (sedimentation, filtration, and disinfection) and causes a similar taste in the finished drinking water. The odor and taste issues associated with algae blooms are often attributed to the presence of geosmin and MIB (2-Methylisoborneol), which can be smelled at a very low (parts per trillion) level. To reduce the unpleasant taste and odor caused by the algal blooms, activated carbon is often used as an absorption media; potassium permanganate may also be added as an oxidizing agent to reduce odor. Each of these chemical additives is removed during the treatment process prior to delivery of treated water supply.

   47CSR2-3.2.d lists “Taste or odor that would adversely affect the designated uses of the affected waters” as a Condition Not Allowable in state waters. Whenever the characteristic taste or odor complaints are received about water supplied from systems where the intake is located within or immediately downstream of the zone of an algae bloom, there is an indication that the odor is caused by the algae bloom, and DEP may classify the stream as impaired whenever such complaints are received – regardless of whether they are corrected by the addition of chemicals to the treatment process. Taste and odor complaints are not limited to filamentous algae blooms, but can also be associated with sestonic algae, phytoplanktonic algae, or algal periphyton.