

# POLLUTION TOLERANCE INDEX (PTI)

(Adapted from *Volunteer Stream Monitoring: A Methods Manual*, United States Environmental Protection Agency, Office of Water, Draft Document #EPA 841-B-97-003, November 1997 AND Mitchell and Stapp, *Field Manual for Water Quality Monitoring*, 1996.)

This Pollution Tolerance Index (PTI) is currently used by all Pennsylvania volunteer citizen monitoring groups and the Department of Environmental Protection for their stream organism sampling. It is based on the concept of indicator organisms and tolerance levels. The procedures are designed to be done quickly and easily; they provide a rapid means of sampling riffle and other shallow areas to detect moderate to severe stream quality degradation.

The advantages of the PTI are that it provides a relatively rapid means of assessing stream quality, it is useful in developing an information base, and it develops concepts of tolerance ranges of organisms. However, to determine the true health of a stream you should also conduct chemical tests and perform a land use/habitat assessment.

Organisms are collected and identified by comparing them with the drawing on the attached chart or by using a key. They are then divided into three groups based on their tolerance for pollution. Each of the three groups is given an index value, with the least tolerant group having the highest value. The general abundance of each kind of organism is also noted and factored into the index.

## Procedure

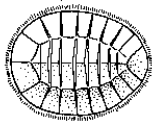
1. Choose a 1-meter by 1-meter area that is representative of the riffle or shallow area being sampled. Use the kick screen method to sample this area.
2. Three samples (each 1m x 1m) should be taken at a site to be sure a representative sample is collected. Samples may also be taken from different microhabitats at the site, such as rocks, in slow-moving water, or near banks; different organisms may be found in these microhabitats.
3. Samples can be placed in containers of 70 percent alcohol solution for later identification. Be sure to pick clinging organisms off the kick net. If you do not want to preserve the organisms, and if time allows, you may be able to identify and release the macroinvertebrates at the site.
4. Using the attached data sheet, record the number and kind of each organism collected in the kick samples. Data from the three trials may be pooled on this data sheet.
5. After all organisms have been recorded, assign each type of organism an abundance code as follows:
  - R (Rare) = 1 to 9 organisms found in the sample
  - C (Common) = 10 to 99 organisms found in the sample
  - D (Dominant) = 100 or more organisms found in the sampleRecord the code next to the actual count on the data sheet.
6. Note that the data sheet divides the macroinvertebrates into three groups based on their ability to tolerate pollution. The three tolerance groups are:
  - Group I – Organisms that are sensitive to pollution and are typically found in good quality water.
  - Group II – Organisms that are somewhat sensitive to pollution and are typically found in fair quality water.
  - Group III – Organisms that are tolerant of pollution and are typically found in poor quality water.
7. Follow the instructions on the data sheet to calculate the stream water quality rating.

# Macroinvertebrates Grouped by Level of Pollution Tolerance

(Adapted from EASI and the Senior Environmental Corps, *Volunteer Water Quality Monitoring Field Manual*.

Images from McCafferty, *Aquatic Entomology*, 1981 AND Kellogg, *Monitor's Guide to Aquatic Macroinvertebrates*, 1994.)

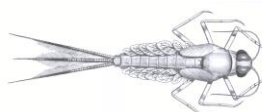
**Group I: Generally sensitive to pollution. Large numbers of these types of organisms normally indicate GOOD WATER QUALITY.**



Water Penny Beetle Larva



Riffle Beetle Adult



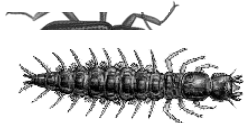
Mayfly Nymph



Stonefly Nymph



Gilled Snail  
(has a thin, horny plate to seal shell opening)



Hellgrammite & fishfly larva



Non-Net-Spinning Caddisfly Larva



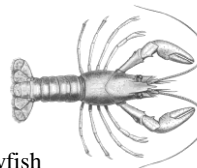
**Group II: Can exist under a wide range of water quality conditions. Large numbers of these organisms, in the absence of Group I organisms, normally indicate MODERATE**



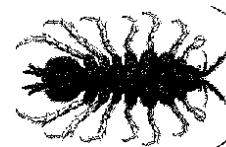
Damselfly Nymph



Cranefly Larva



Crayfish

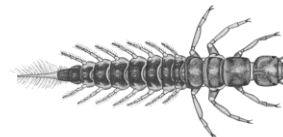


Aquatic Sowbug



Scud

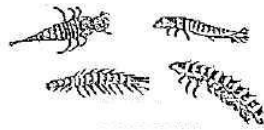
Alderfly Larva



Net-spinning Caddisfly Larva



Clams & Mussels



Beetle Larvae

**Group III: Generally tolerant of pollution. Large numbers of these types of organisms normally, in the absence of Group I and Group II organisms, indicate POOR WATER QUALITY.**



Blackfly Larva



Midge Larva



Leech



Aquatic Worms



Other Snails (Not Gilled)

NOTE: These organisms are the only macroinvertebrates used to calculate the PTI. Other organisms will be found; to identify them, refer to other macroinvertebrate identification sheets in this section of the handbook.



# DATA SHEET : POLLUTION TOLERANCE INDEX

Sample Date: \_\_\_/\_\_\_/\_\_\_

Sampling time \_\_\_\_:\_\_\_\_

Site Name \_\_\_\_\_

School \_\_\_\_\_

Names of Testers / Class \_\_\_\_\_

Observations: \*Creek Appearance (velocity, color, frozen, etc.) \_\_\_\_\_

\*Weather in past 24 hours (rain, snow, clear, etc.) \_\_\_\_\_

\*Relative Depth (higher/lower than normal, etc.) \_\_\_\_\_

## Macroinvertebrate Count

Identify the macroinvertebrates (to order) in your sample using the identification sheet. We are only concerned with organisms that appear on the identification sheet. Record the number of organisms below and then assign each organisms an abundance code:

R (rare) = 1-9 organisms; C (common) = 10-99 organisms; or D (dominant) = 100 or more organisms

Example: 20 (C) Water Penny Larvae

### GROUP I – SENSITIVE

- |  |  |
|--|--|
| _____ (____) Gilled Snails                     | _____ (____) Riffle Beetle Adults          |
| _____ (____) Mayfly Nymphs                     | _____ (____) Stonefly Nymphs               |
| _____ (____) Non-Net-Spinning Caddisfly Larvae | _____ (____) Water Penny Larvae            |
|  | _____ (____) Hellgrammites & Fishfly larva |

### GROUP II – SOMEWHAT SENSITIVE

- |                               |  |
|-------------------------------|--|
| _____ (____) Alderfly Larvae  | _____ (____) Damselfly Nymphs              |
| _____ (____) Aquatic Sowbugs  |  |
| _____ (____) Beetle Larvae    | _____ (____) Net-Spinning Caddisfly Larvae |
| _____ (____) Clams & Mussels  |  |
| _____ (____) Crane-fly Larvae | _____ (____) Scuds                         |
| _____ (____) Crayfish         |  |

### GROUP III – TOLERANT

- |                              |                           |
|------------------------------|---------------------------|
| _____ (____) Aquatic Worms   | _____ (____) Midge Larvae |
| _____ (____) Blackfly Larvae | _____ (____) Snails       |
| _____ (____) Leeches         |                           |

## Water Quality Rating

To calculate the index value, add the number of **letters** (not numbers of macros) found in the three groups on the other side and multiply by the indicated weighing factor.

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### Group I – Sensitive

$$(\# \text{ of R's}) \times 5.0 = \underline{\hspace{2cm}}$$

$$(\# \text{ of C's}) \times 5.6 = \underline{\hspace{2cm}}$$

$$(\# \text{ of D's}) \times 5.3 = \underline{\hspace{2cm}}$$

$$\text{Sum of Index Value for Group I} = \underline{\hspace{2cm}}$$

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### Group II – Somewhat Sensitive

$$(\# \text{ of R's}) \times 3.2 = \underline{\hspace{2cm}}$$

$$(\# \text{ of C's}) \times 3.4 = \underline{\hspace{2cm}}$$

$$(\# \text{ of D's}) \times 3.0 = \underline{\hspace{2cm}}$$

$$\text{Sum of Index Value for Group II} = \underline{\hspace{2cm}}$$

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### Group III – Tolerant

$$(\# \text{ of R's}) \times 1.2 = \underline{\hspace{2cm}}$$

$$(\# \text{ of C's}) \times 1.1 = \underline{\hspace{2cm}}$$

$$(\# \text{ of D's}) \times 1.0 = \underline{\hspace{2cm}}$$

$$\text{Sum of Index Value for Group III} = \underline{\hspace{2cm}}$$

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To calculate the water quality score for the stream site, add together the index values for each pollution tolerance group. The sum of these values equals the water quality score.

$$\text{Water Quality Score} = \underline{\hspace{2cm}}$$

Compare this score to the following number ranges to determine the quality of your stream site:

Good > 40

Fair 20 – 40

Poor < 20

Note: The tolerance groupings (Group I, II, III) and the water quality rating categories were developed for streams in the Mid-Atlantic states.