Appendix 4 – Guidance for educators

How to use the action guide and the four step process ***to take students from education to action.***

The action guide is designed for all levels of citizens, including educators and students. The Council has used the GM Global Rivers Environmental Network (GREEN) education model for the past eight years, which included the Protecting Our Watersheds (POW) curriculum. The POW includes eight steps designed to allow students to carry out research, produce and verify results and design and implement actions based on their findings. Once the actions are implemented the POW process allows students to evaluate and reflect on what had been done.

However, because teachers are required to teach to certain standards (the POW and the four step process meet many science, math and social studies standards) and have limited amount of class and field time available, the Council, in conjunction with GM Spring Hill, Friends of Henry Horton State Park and Chapel Hill Elementary School, condensed the POW process into four steps that can easily be accomplished in four to five sessions. The key to the process is to ask students open ended questions about their data, its meaning, conclusions they may draw, and what they can do to change poor water quality or maintain good water quality. Once you have asked the question, make sure to be silent and let the students answer! It is important to note that, as the facilitator, you may have to define and provide examples of words like analysis, synthesis, conclusions and meaning. The steps include:

1) Introduction to watersheds (Time required: 1- 2 hours)
    a. Setting the research questions
        i. In most cases the research question is "what is watershed and water quality and how does our local stream compare to known clean streams?"
        ii. While the focus of the watershed action guide is on watersheds, other research questions could cover air quality, outdoor recreation, forests, etc.
    b. Water quality assessment and field sampling techniques
        i. Appendix 1 and 2 in the action guide
        ii. Most teachers who want to utilize the guide are likely to have their own methods for water quality sampling, so it is not necessary to use the exact methods presented in Appendix 1 and 2.
2) Field studies (Time Required: 2.5 – 4 hours depending on travel time)
    a. General science principles applied during this process, but not covered in the guide
        i. Scientific method
            1. Standard methods
            2. Repetition in data collection
        ii. Validity
        iii. Reliability
    b. Watershed Science and Mapping (Appendix 1)

        i. Before you go:
            1. Identify the boundaries of the watershed
            2. Find the stream sampling point(s) on a map
            3. Identify land use surrounding your sampling points and stream
        ii. Field work should verify your classroom assessment
            1. Visual assessment in Appendix 2
    c. Water Quality (see Appendix 2)
        i. Visual assessment
        ii. Aquatic insect (creek critters) assessment
        iii. Physical /chemical assessment

3) Data processing by facilitated discussion
    a. Data analysis and synthesis
        i. It is best if data are entered into an excel spreadsheet, but it is not necessary, as data can be graphically represented on a white board and photographed for presentation and distribution. In addition, visual survey data may be qualitative (i.e. drawings) and represented as a picture.
        ii. Basic questions to ask students during data analysis and synthesis include:
            1. Verifying results – have others collected data in the same stream?
                a. Did we use the correct methods? Did we make mistakes, were there sampling errors?
                b. How do our results compare to others' data?
                    i. TDEC, local stormwater programs (see Table 3) and industries have collected samples from many streams in Tennessee, so be prepared to have students ask.
                    ii. Sampling during different seasons, times of day, for example, may affect results.
                c. What conclusions were they able to draw from their data?
            2. What do these data mean?
            3. What conclusions can you draw from the data?
        iii. Visual Data
            1. How can this data be presented to give it meaning, such as graphically represented.
                a. Charts and graphs?
                b. Comparison?
                c. Consistency?
            2. How do the right and left banks differ? How are they similar?

iv. Aquatic insect data analysis/synthesis
    1. Bar chart showing sensitivity to pollution (Figure 1 and 2 below). What does the bar chart of aquatic insects tell us about stream health?
    2. Do aquatic insects reflect water quality over time?
    3. Why not sample fish?

v. Chemical/Physical data
    1. Bar charts to show data and analysis of data
        a. comparisons
    2. How do repetitions of the same chemical test compare and contrast? How can we use all of our chemical data for one test to give it meaning?
        a. Are their outliers? Average, mean, median, mode? Distribution?
        b. Frequency distribution (stem and leaf diagram)

b. Drawing conclusions
    i. Is the river or stream clean and healthy or polluted?
        1. Would you swim in the river? Fish?
        2. Drink the water?
        3. Why or why not based on the data collected?
    ii. Were there factors identified during the land use survey (Appendix 1) that might affect the visual survey data, aquatic insect and/or physical/chemical characteristics of the water as represented by the data?
    iii. Were those factors confirmed during the field survey?
        1. Visual assessment?
        2. Aquatic insect survey?
        3. Physical/chemical assessment?
    iv. What other factors could be affecting water quality (making it bad or good)?

c. Conclusions about your data and developing a problem statement
    i. Is there a problem with water quality in the stream?
        1. What did the data show?
        2. What about habitat?
        3. What about the chemicals in the stream?
    ii. What is the problem, how do the data represent it in the stream sampled?

d. Developing solutions
    i. Restate the problem to keep students focused on what they have identified.
    ii. What can you (students) do about the problem?
        1. What needs to be done to physically fix (practice) the problem?

        2. Are there others (such as storm water coordinators or business and government officials) who can help students fix the problem?
            a. Are they directly causing the problem? Why or why not?
            b. Do they control policies (laws, regulations and rules) that affect the problem?
                i. Who and what policies?
                ii. Do they understand how the policy affects the stream?

4) Taking actions and evaluation/reflection
    a. Based on the student data, what is the specific problem identified and possible solutions?
    b. What specific actions can the students take to have a positive impact on the problem? See Appendix 3.
    c. Students will amaze us with their creative approach to solving a problem, as long as we make sure to let them.
    d. Once students have identified an action, ask them how they can make it happen?
        i. Who do the students need to talk to about the proposed action?
        ii. Whose permission do they need?
            1. See Appendix 5.
            2. What about landowners?
        iii. What resources do they need?
            1. See Appendix 3.
            2. What is the order of actions to take place?
    e. Take the action
    f. Evaluate and reflect on the action
        i. What happened that was good?
        ii. What went wrong?
        iii. Did the action change the problem?
            1. Immediately?
            2. Long term?
        iv. Write the answers to these questions in an essay form and discuss how and why the actions worked or did not work.

**It is important to note that having the stormwater coordinator, public works director and/or other resource professionals (see Table 3 in the text and Appendix 5) engaged in this process is key to helping students have the physical and technical resources necessary to accomplish the designed action.

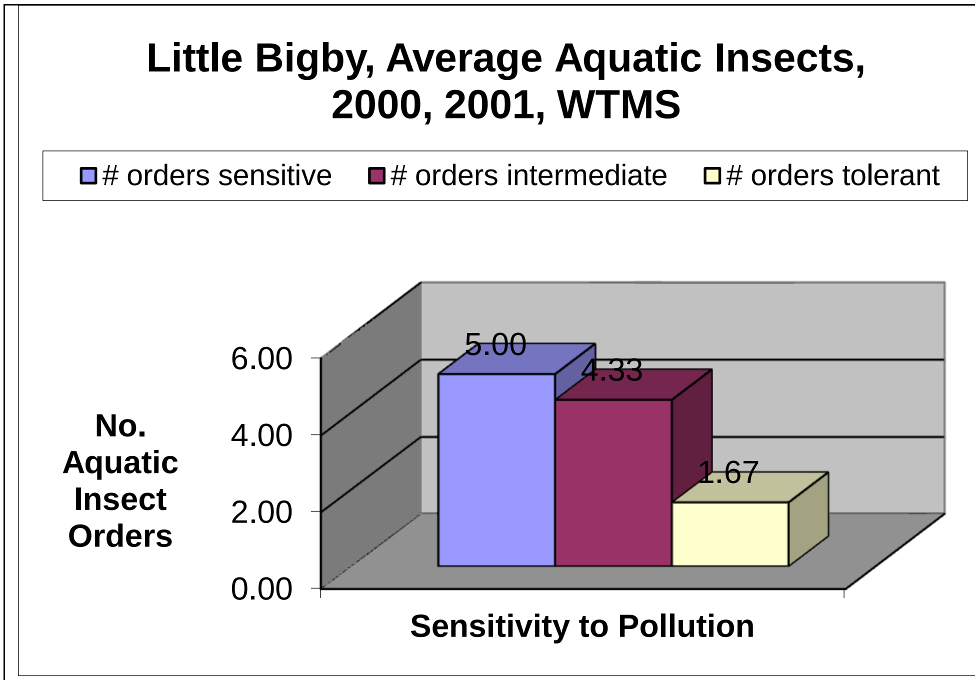

Figure 1 - Bar chart showing healthy stream insect population

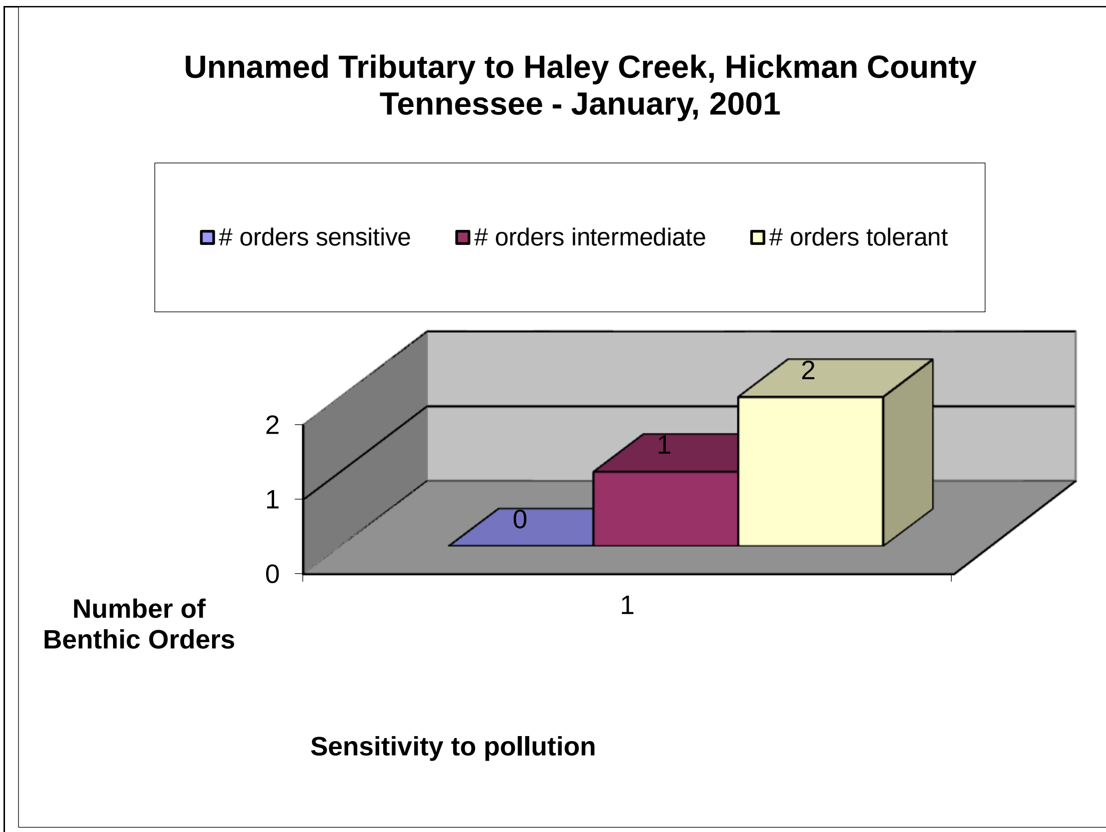

Figure 2 - Bar chart showing unhealthy stream insect population.