Wiyot Tribe
Environmental Department

Clean Water Act §319 Non-Point Source Pollution Control Program

NON-POINT SOURCE POLLUTION EDUCATION CURRICULUM

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1.0 Introduction

The Wiyot people have a strong dependence on the Eel River, Humboldt Bay and its tributaries, and the Mad River for the valuable resources that serve tribal sustenance and cultural purposes. Non-point source (NPS) pollution threatens the quality of these water-bodies and their respective watersheds, and by extension threatens the ability for those water-bodies to provide the resources upon which the Wiyot people depend. Educating tribal youth about the causes, impacts, and prevention of non-point source water pollution is an important means of instilling environmental stewardship in future generations and protecting tribal waters and their resources.

The Environmental Department of the Wiyot Tribe has been working with the Boys & Girls Club of Wiyot Country to improve environmental education for tribal youth. Currently, the Tribe's youth program has 20-40 tribal youth members participating in both cultural and environmental activities. The purpose of this curriculum, developed by the Wiyot Tribe Environmental Department, is to strengthen the tribal youth's knowledge on issues relating to non-point source pollution.

2.0 Program Summary

The following curriculum was established to refresh the tribal youth on their knowledge of non-point source pollution on entire watersheds and introduce new concepts that were not covered in the previous year. The first lesson will serve as an overview of what the students learned in last year in order to guide them towards further understanding of non-point source pollution. The first lesson will begin with an introduction to the water cycle, watersheds, and non-point source pollution. Later, the students will dive deeper into their understanding of aquifers/groundwater and learn about how non-point source pollution affects their drinking water. Next, the students will build off their understanding of non-point source pollution in urban/rural areas by learning more about the impacts of construction activities in these environments. Similarly, the students will also learn more about the effects of non-point source originating from dairy/agricultural settings and how, through proper management, farmers/ranchers can play a large role in keeping the environment clean. Next, the students will visit an important cultural area at the Eel River to perform water testing and discuss possible ways non-point source pollution can enter rivers and eventually our oceans. Lastly, the curriculum will conclude with a lesson aimed at showing students the many ways that non-point source pollution can contaminate our environment and what steps they can personally take to avoid adding to the non-point source pollution problem.

3.0 Environmental Education Curriculum

Lesson 1: "Revisiting NPS Pollution"

During this lesson, students will review watersheds, the water cycle, the amount of available freshwater on Earth, non-point source pollution, and how to distinguish non-point from point source pollution. The lesson will begin by introducing the water cycle and how water moves through a watershed. Students will review the difference between point and non-point source pollution and learn how pollution can affect all environments of a watershed. The lesson will also cover how pollution affects soil and air as it moves from one environmental medium to the next.

Activity:

"*Global Water*" – This activity will show the students how much water on Earth is available for human use. First, a beaker labeled "All the Water in the World" will be filled to 1000 mL. Next, eight jars will be labeled to symbolize the environments in which water would be found. These categories are:

- ✓ Oceans
- ✓ Ice Caps/Glaciers
- ✓ Groundwater
- ✓ Saline Lakes
- ✓ Freshwater Lakes
- ✓ Soil Moisture
- ✓ Atmosphere
- ✓ Rivers

Water from the beaker labeled "All the Water in the World" will be used to fill up the eight categories listed above according to percentages of water found in each environment. Next, the students will be asked if water can be used from each category and if so, how much do they think is readily available for human use. If water is available from a specific category, it will be added to a jar labeled "Readily Available Water." The remaining water that is not readily available for humans will be placed back into the beaker labeled "All the Water in the World" for direct comparison to the jar labeled "Readily Available Water." As the subject of non-point source pollution is addressed, the students will be asked to think of how much of the "Readily Available Water" cannot be used due to NPS pollution. The students will be surprised to learn that less than 1 percent of the amount of water in the world is available for human consumption and use.

- *Supplies:*
  - Beaker (1000 mL)
  - Jars (9 count)
  - Eye dropper (1)

- Label tape
- Permanent ink marker (1)

Lesson 2: "NPS Pollution and Your Drinking Water"

This lesson will aim to improve upon the concepts related to aquifers and drinking water that the students learned about last year. We will revisit the major concepts of aquifers, how we access these water sources, and the common uses of well water in our society today. Lastly, the students will learn the common non-point source pollutants responsible for groundwater contamination, how they affect the water quality within the aquifer, and how this pollution can be prevented.

Activities:

"*Model Aquifer*" – A model aquifer will be constructed to give a larger depiction of aquifers, how we drill wells to access the water, and potential ways NPS pollution can infiltrate water sources. The design will include confined and unconfined aquifers, several "geological layers" represented by sand and gravel, drinking water wells, and colored drink powder/food coloring for NPS pollution. First, students will pour water over the landscape to imitate a rain event. As water begins to collect in areas, student will then "drill" a well in order to access the water source. Once they have determined that they have "tapped" into an aquifer, they will use an aquarium pump and hose to retrieve the resource. Next, NPS pollution will be added to the landscape and again water will be applied to imitate a rain event. Students will track the pollution as it travels down into separate aquifers. Again, students will "drill" wells in order to retrieve the water via the aquarium pump. Students should observe colored water as NPS pollution may have infiltrated their aquifers.

- *Supplies:*
  - Aquarium (1)
  - Sand (1 10-lb. bag)
  - Gravel (1 10-lb. bag)
  - Modeling clay (1 10-lb. bag)
  - Colored drink powder (1 jar)
  - Food coloring (3 1-oz. bottles)
  - Aquarium pump (1)
  - Spoons (10 count)
  - Watering jug (1)

"*Aquifer in a Cup*" – Students will design their own aquifers in clear, see-through cups using sand, gravel, clay and water. First, students will design an unconfined aquifer using sand and gravel. A few drops of food coloring will be added to the top layer, rain will be simulated by sprinkling water on top, and students will observe how pollution travels through the soil to reach the aquifer. Next, in a separate cup, students will design both a confined and unconfined aquifer in the same cup using sand, gravel, and clay (which will act as a confining barrier).

Students will begin by pouring sand and gravel up to the halfway line of a clear cup. Next, students will pour in a 1/4 cup of water to simulate an aquifer. Students will then place a layer of clay on top of this aquifer to act as a barrier, confining the bottom aquifer. Lastly, students will pour sand, gravel, and a 1/4 cup of water on top of the barrier to create both a confined and unconfined aquifer (see Appendix 2: Environmental Curriculum Activities – Figure 1).

- *Supplies:*
  - Clear plastic cups (100 count)
  - Sand (1 10-lb. bag)
  - Gravel (1 10-lb. bag)
  - Modeling clay (1 10-lb. bag)
  - Colored drink powder (1 jar)
  - Food coloring (3 1-oz. bottles)
  - Watering jugs (2)

Field Trip:

Table Bluff Reservation Wells – The community drinking water wells for the Table Bluff Reservation community are located in the southeastern and western boundaries of the reservation near neighboring farmlands, residential properties, and a public road. During this trip, introduced concepts on aquifers will be related to the Tribe's well and students will be asked to think about the origins of potential sources of non-point source pollution that may affect the tribe's water quality.

Lesson 3: "Construction in Your Neighborhood"

During this lesson, students will focus on non-point source pollution generated in construction areas. We will cover important concepts such as Best Management Practices (BMP's), the relationship between water uptake/runoff and impervious/permeable ground cover, water discharges and the effect on streambeds, and the types of pollutants most commonly found in construction settings. Examples will be provided to give students an idea of how non-point source pollution can have devastating consequences if proper BMP's are not followed on a construction site. Students will also learn how these pollutants travel through our environment, the impacts of these pollutants, and the steps that can be taken to prevent non-point source pollution.

Activity:

"Construction Runoff Table" – Students will use this hands-on activity to observe how non-point source pollution can occur in their own backyards. Two demonstration boxes will be used; one will contain conceptual models of both an urban and a rural environment, and another that will contain a conceptual streambed. On one side of the first box, students will use concrete pavers (impermeable surface), sand and gravel to construct an environment representative of a large urban area; on the other side of the same box, students will use carpet covering sponges

(permeable surface), sand, and gravel to construct an environment representative of a rural area. Within these environments, students will add potential pollution sources in the form of miniature houses/buildings, cars, tractors, and farm animals. Pollutants will be added to the landscape in small quantities using food coloring (drops) and in large quantities using dry, colored drink powder. Additionally, sediment in the form of sand and gravel (simulating construction site runoff) will be identified as a non-point source pollutant. Rain will be simulated using a water jug and students will observe how pollution moves through both environments. Students will experiment with biological pollution buffers such as grass by moving pieces of sod and sponges (representing straw mats/silt fencing/etc.) around the environment in order to "trap" non-point source pollution. A second box containing sand, gravel, and rock (representing a streambed) will be constructed beneath the outlets (a storm drain for the urban setting) of the first box to demonstrate the effect of flow rates on the hydrology of a streambed. Students will also observe the ways non-point source pollution moves through different settings, and the different rates of pollutant transmission from source to streambed. This will also give the students an opportunity to distinguish between pollution types, as storms drains are point source pollution sites (see Appendix 2: Environmental Curriculum Activities – Figure 2).

- *Supplies:*
  - Silicone sealant (1 tube)
  - Low VOC deck polyurethane (1 gallon)
  - Food coloring (3 1-oz. bottles)
  - Colored drink powder (1 jar)
  - Water jugs (1)
  - Sponges
  - Sod (1' X 1')
  - Miniature construction vehicles
  - Miniature houses (Monopoly game pieces)

Field Trip:

Arcata Marsh & Wildlife Sanctuary – During this field trip, students will visit the Arcata Marsh to see wetland ponds that were constructed in 2008-2009. The new ponds show how construction in a wetland setting can be accomplished if proper Best Management Practices are put into place and monitored throughout the project. During the field trip, students will be asked to point out some of the pollutants that could affect the wetland areas and nearby Humboldt Bay. The students will be introduced to some of the BMP's that were established in order to protect the environment from NPS pollution damage. While at the wetlands, students will revisit the concepts of why wetlands play an important role in filtering out pollutants and the importance of preserving these environments.

Lesson 4: "A Day on the Farm"

During this lesson, students will learn how farms and dairies, if not properly managed for non-point source pollution, can cause large environmental destruction. The students will learn how pesticides, coliforms, high sediment loads, and other non-point source pollutants on a farm or dairy can migrate offsite and have devastating effects on human health and environments downstream. Local examples will be given to show the impacts of improperly managed farmlands and how proper steps could have been taken to avoid contamination.

Field Trip:

Redwood Roots Farm – Students will travel to Redwood Roots Farm in Arcata to learn about non-point source pollution in farm settings. Redwoods Roots Farm offers an interactive environment where youth groups can get their hands dirty while learning about potential non-point source pollution on a farm situated near Jacoby Creek. Non-point source topics to be discussed will be pesticides, fertilizers, manure, bacteria such as coliforms, sediment from runoff, etc. The staff at the farm will have some demonstrations, displays, and information available for the tribal youth to enjoy.

Lesson 5: "The Last Stop for NPS Pollution"

During this lesson, students will learn how non-point source pollution can affect the water quality of large water bodies (i.e. rivers, lakes, and oceans) and affiliated tributaries. Using what they have learned up until this point, students will trace some pathways that non-point source pollution may take to eventually reach its final destination. Students will learn some of the common non-point source contaminants, where they may have originated from, and some preventative methods that can be taken at the source to safeguard water quality for the entire watershed.

Activity:

"The Health of Your River" - Students will visit a local river in order to investigate NPS pollution. During this activity, students should be able to better understand how NPS pollution travels through several environments. Students will be asked to picture what they believe to be the entire Eel River Watershed. Next, they will be shown a topographical map depicting the large Eel River Watershed and asked how NPS pollution can enter the river and eventually the ocean. The use of water quality equipment from the Wiyot Tribe's Environmental Department will be demonstrated. Similarly, students will use a Hach test kit to collect their own data (pH, nitrite/nitrate, phosphorus, etc.) and draw up their own hypotheses and conclusions on the results. Students will review non-point source pollutants commonly found in the river and, if pollution is found to be present, where they believe the pollution originated from.

- *Supplies*:
  - YSI 6600 series water sampling sonde (1)
  - YSI 650 data logger (1)
  - Hach water quality testing kit (1)

- Hazardous waste buckets (3)
- Topographic Map (1)
- Notebooks (3)

Field Trip:

Cock Robin Island (Eel River) – For the Wiyot people, the Eel River is an important cultural spot for old and reoccurring traditions such as eeling, fishing, and dancing. The river and its stretches are so important that it literally defines the Tribe as Eel River is called "Wiyot" in traditional Wiyot language. Connecting the tribal youth to the Eel River and instilling environmental stewardship is important in order to continue Wiyot tribal traditions.

Lesson 6: "The NPS Pollution Future for TBR"

In this lesson, students will review all the concepts previously covered concerning non-point source pollution and the effect that contamination can have on our environment. The connection will be drawn that even though contamination may occur in one environment, the entire ecosystem may suffer as pollution travels from one environmental medium to the other. Students will review all the topics that were covered in previous lessons in order to close the program with the take-home message that pollution in all forms can have an effect on all environments associated within a watershed.

Field Trip:

Table Bluff Reservation – During this field trip, students will learn about all the potential pollutants that are present on Table Bluff Reservation and ways we can mitigate potential problems. We will address all the topics that we discussed in the curriculum and how the tribal youth can play a big role in helping to prevent NPS pollution. These topics include: the drinking water wells on TBR, future construction and agricultural/farming activities on TBR, and the impacts these activities can have on nearby Humboldt Bay. Students will be reminded of past NPS pollution projects that have been put forth on the Reservation and they will be introduced to projects the Tribe plans to undertake in the future.

Appendix 1. Map of Activity and Field Trip Sites

Appendix 2. Environmental Curriculum Activities

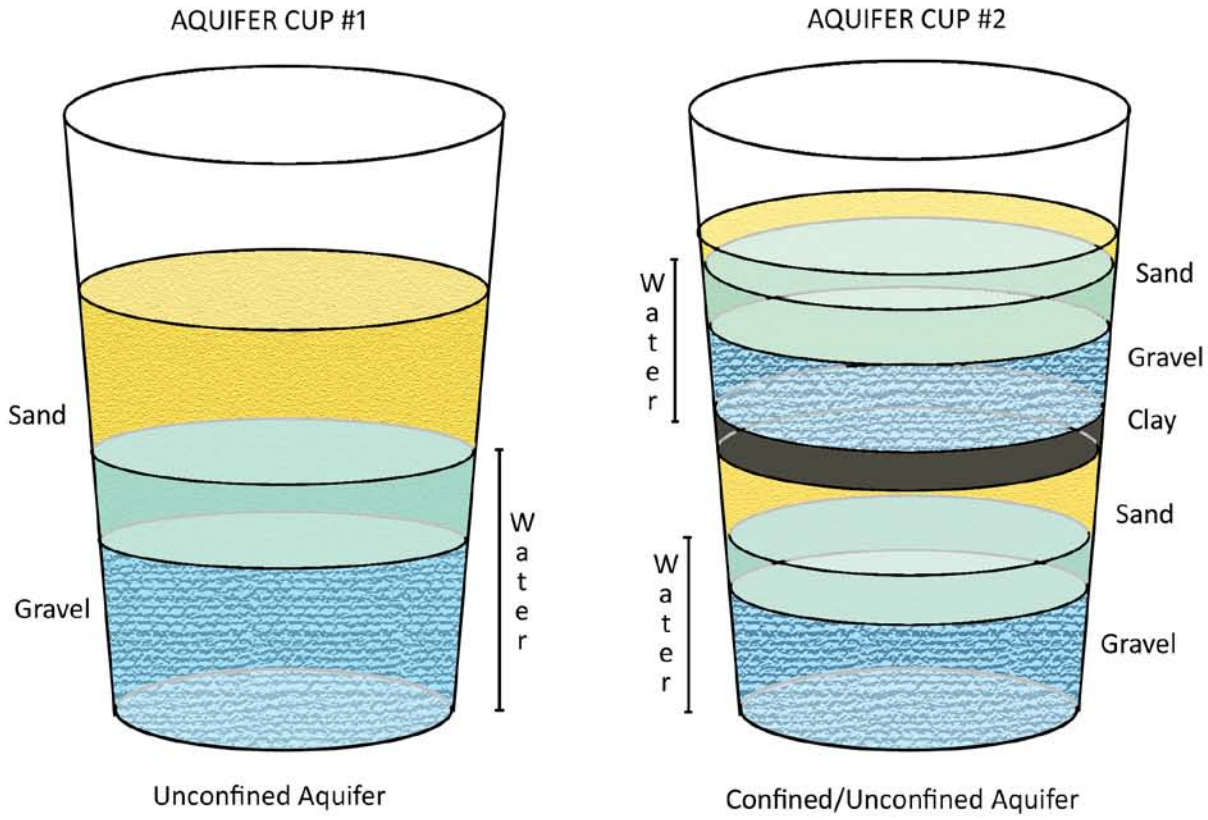

Figure 1. Aquifer in a Cup. An activity designed to display concepts relating to aquifers. An unconfined aquifer will be constructed to show how water is easily accessed just beneath the surface. A second aquifer, named a confined/unconfined aquifer, will be constructed to show how aquifers can be contained by layers of impermeable material such as clay. Non-point source pollution is added separately to each aquifer using dry, colored drink powder to visually represent aquifer contamination.

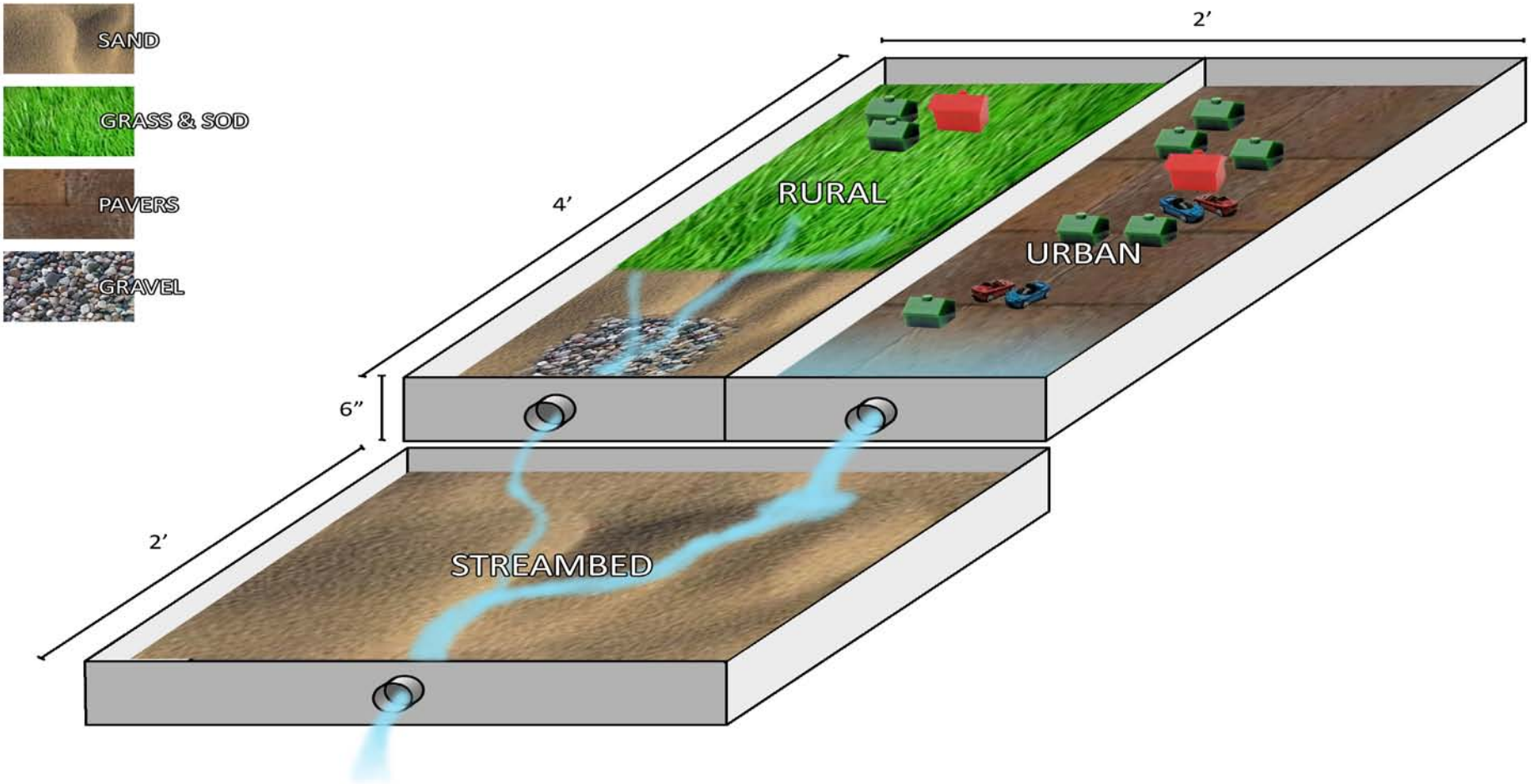

Figure 2. Construction Runoff Table. An activity designed to demonstrate non-point source pollution from construction sites in the urban and rural environments. The rural environment will contain permeable surfaces such as carpet (representing grass), sand, and gravel while the urban environment will contain impermeable surfaces such as concrete pavers. Non-point source pollution is added to the environments using food coloring, colored drink powder, and silt/sand. A second box containing a streambed is placed below the first box in order to show how large water discharges alter the hydrology of a waterway.