Stream Hydrology Trailer

Lesson Plans and Instructions for use with the USU Water Quality Extension Stream Hydrology Trailer

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http://extension.usu.edu/waterquality

UtahStateUniversity
WATER QUALITY EXTENSION

INTRODUCTION:

The stream hydrology trailer is a hands-on educational tool that allows participants to examine the natural movement of streams and rivers. The stream hydrology trailer contains a large flat "land area" composed of plastic grit. Water is pumped through the trailer to create a "stream" that moves along the length of the trailer. The stream trailer demonstration instructions included in this binder, focus on how slope, flow, and structure affect stream formation. Participants learn how streams behave under natural conditions and what happens when those conditions change.

In this introductory section you will find pictures of the stream trailer, requirements for using the trailer, and instructions on transporting and setting up the trailer. You should read over this entire section and familiarize yourself with the trailer before starting.

To avoid problems, you should practice set-up and lesson procedures in advance to become familiar with the controls and observe the response of the model.

REQUIREMENT FOR USING THE STREAM TRAILER:

- ½ ton (or larger) vehicle with a class III trailer hitch
- Source of water at demonstration site
- Source of power (110-120 volts) at the demonstration site, OR fully charged batteries
- An area approximately 40' x 10' to accommodate truck and trailer

INSTRUCTIONAL MATERIALS INCLUDED WITH THE STREAM TRAILER:

- Binder with set of instructions
- Activity container 1
    - Riparian vegetation
    - Silt fence
- Activity container 2
    - People
    - Animals
    - Tiles
    - Cars
    - Marbles

BEFORE YOU START:

- Charge batteries
    - Check to make sure charger switch is set to auto and switch 2 is set to 12A 12V
    - Turn battery switch to all (see Picture I)
    - Plug in charger (charger can remain plugged in during trailer use)

TRANSPORTING THE STREAM TRAILER:

1. If needed, a ball and hitch receiver (class III) and electrical adapters are located in the right side storage compartment of the stream trailer. Use the key found in the magnetic box just behind the jack to unlock the storage compartment.

2. Connect trailer to the transporting vehicle and ensure that all trailer lights work (taillights, brake lights and turn signals). Check safety chains and tires.

3. Before driving please check the following:
    a. Right and left storage compartments are locked
    b. Lid covering the pumps is installed correctly and locked
    c. Cover supports are installed correctly
    d. Cover is attached securely (all bungees are attached to trailer)

4. In case of flat tire, the spare tire and lug wrench are located in the storage compartment. Use the rear stands to jack up the trailer.

SET-UP PROCEDURES (Allow at least 1 hour):

1. Unhook trailer from transporting vehicle.

2. Set the front to back slope using the electric jack (trailer should be slightly higher in the front).

    <u>To use the electric jack</u>
    a. Set the battery switch to "ALL"
    b. Use the left switch (indicted with arrow in picture at right) on the jack to move trailer up or down

3. Level the trailer from side to side using the rear jack stands.
    a. Pull the pin on each rear jack and rotate them down.
    b. Crank the jack until it contacts the ground
    c. Check bubble in level near front of trailer to make sure trailer is level

Electric Jack with left switch indicated

To manually operate the jack

a. Remove hand crank and small slotted key from tool box in right storage compartment.
b. Remove the rubber coverings on the top and side of the jack.
c. Place the hand crank in the hold (indicated at right) on top of the jack and the slotted key in the side hole.
d. Pull the key forward (hold onto the hand crank as you do this) then rotate the hand crank counterclockwise to extend the jack and clockwise to retract the jack.
e. Once the jack is in the desired position slide the key back and remove the hand crank.
f. Replace the rubber coverings and return the key and hand crank back to the tool box.

Electric Jack with hand crank hold indicated

4. Remove the cover and cover supports from the trailer.

5. If 110-120 volt service is available, the trailer can be plugged in using an ordinary extension cord (found in the storage compartment). Plug in the charger following the same procedure as charging batteries under "Before You Start".

6. If 110-120 volt service is not available usage time is limited to battery charge.

7. Check that outlet filters are in place at the back end of the trailer. If cleaning is needed, filters can be removed and flushed out. This should only be done before water is added to trailer and the area around the filters is completely dry and free from grit. Be sure to reinstall all filters before running water.

8. Use the same key that opens the side doors to open the tank cover, located behind the hitch on the front of the trailer. Slip the metal frame that holds the white hoses and the plastic valve over the top edge of the trailer. The valve should be pointing toward the grit bed.

9. Keep the end of the clear hose in the tank because it is the return hose for Pump 1. Place the black hose near the location of the other valve using the large clip.

10. Before filling the tank:
    a. Make sure the white overflow pipe is screwed into place (hand tight).

b. Check that Valve A, located on the left side of tank, is open (valve parallel to pipe).

11. Using the garden hoses stored in the left front compartment, fill the trailer up at the pump compartment. The tank is full when water reaches the top of the white overflow pipe (approximately 110 gallons).

12. Prepare the grit bed:
    a. Use the electric jack to make the front of the trailer slightly higher than level. ***Water will leak out the overflow in the back of the trailer if it is too high.***
    b. Use a rake to smooth and level the grit, making it a constant depth throughout the upper three-fourths of the trailer bed (near the water inlet). Leave the lower one-fourth end of the trailer empty (near the water outlet).
    c. Excavate a "reservoir" at the upper end of the trailer bed, about 1 foot in diameter with rocks lining the inlet.

CLEAN-UP PROCEDURES

1. Rinse all materials (buildings, vegetation, etc.) to remove grit and dry them before returning them to the appropriate activity box. Return the activity boxes to the proper storage compartment.
2. Turn the pump switches, battery switches and storage compartment light switch off.
3. Drain the trailer
    a. Raise rear jacks and rotate them back to driving position
    b. Raise the hitch jack to allow water to move to the drain at the back end of trailer
    c. Lower hitch jack and remove the white overflow pipe to drain. Make sure drain valve (Valve C) located under pump compartment is open to drain all water from the trailer.
4. Place hoses in pump compartment and lock it.
5. Lock the front compartments, return the keys to the magnetic key storage, and place under the water tank.
6. Put cover supports and cover in places
7. Fasten all bungees to the trailer
8. Check that rear jacks are fully up and locked and the hitch jack is fully up.
9. If transporting, properly hitch to your vehicle and check that taillights are working.

Please report any malfunctions or missing or broken items to USU Water Quality Extension (435-797-2580)

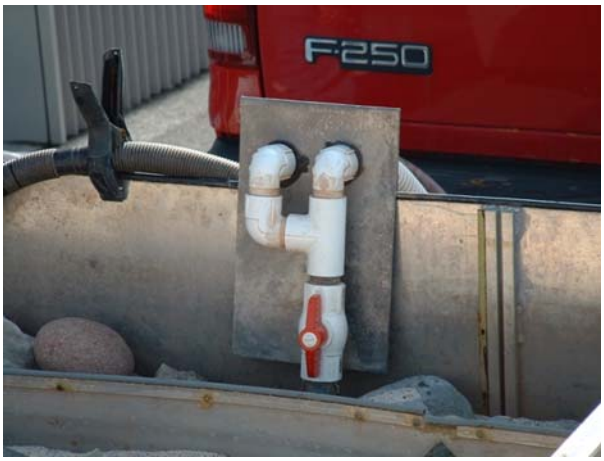
Stream Trailer Pictures:

Picture A: Side View

Picture B: Rear View

Picture C: Right Side Compartment

Picture D: Left Side Compartment



Picture E: Valve B

Picture F: Pump Compartment

Picture G: Pump switch/fuses

Picture H: Batteries

Picture I: Battery Switch

Picture J: Grit filter and screen

BACKGROUND

A watershed is an area of land from which all the water drains to the same location such as a stream, pond, lake, river, wetland or estuary. A watershed can be large, like the Colorado River watershed, or small, such as all the water that drains to a small farm pond. Large watersheds are often called basins, and contain many small watersheds.

Rivers and streams are paths where surface water collects and moves from high to low elevation. Initially, water moves downhill in small streams. The small streams flow into larger streams until they eventually merge into rivers and flow into lakes or oceans. Flowing water cuts a path into the surface of the earth. Velocity (speed of water), water quantity, vegetation, and the geography of the landscape (i.e., slope, geology) all determine the shape of a river's path, or channel. Most river and stream channels develop a meandering (curving) pattern naturally as they flow across the landscape.

The riparian zone is the strip of water-loving vegetation near streams, lakes, and other bodies of water. The word "riparian" comes from the Latin word "*ripa*", which means riverbank. Riparian vegetation is crucial to the health of a river. It provides bank stability, habitat for diverse communities of plants and animals, shade (which plays a major role in determining water temperature), organic materials, protection from flooding, and storage for a sustained summer flow. In turn, the river provides water for the riparian vegetation. When the riparian zone is cleared of vegetation, or degraded, the health of the river suffers as a direct result.

Flooding occurs when water exceeds the capacity of a body of water such as a river or lake. Floods can also occur from the oceans when heavy storms, high tides, or tsunamis cause water to overflow into coastal lands and communities. Periodic flooding of rivers occurs naturally and is usually the result of heavy rain or rapid snowmelt. This flooding results in the creation of floodplains that can help hold excess water.

Communities are often developed on floodplains. As a result, land is converted from fields or woodlands to roads and parking lots (impervious surfaces), and the land loses its ability to absorb rainfall or rapid snowmelt. Impervious surfaces increase runoff in urban areas by two to six times that which would occur on a natural landscape. Flooding can be especially dangerous and destructive in urban areas where streets create corridors for swift moving water. In order to prevent flooding of developed areas, sometimes artificial levees are constructed. A levee is a natural or artificial slope or wall usually made of earth and placed parallel to the course of a river. Levees can successfully prevent flooding of the adjoining landscape. However, they can also confine the flow of the river, resulting in higher water levels and faster flows.

As water flows, it carries sediment (soil particles such as sand, clay, and rock). The movement of sediment plays an important role in shaping stream channels. Various sizes of sediment particles, ranging from clay to boulders, can move along with the water. Fast-moving water can pick up, suspend, and move larger particles more easily than slow-moving water. This is one reason why rivers can become muddier during heavy rainstorms. They are carrying much

more sediment than they carry during periods of low-flow. Heavy storms can make a significant impact on sediment movement. Over half of the sediment moved during a year can be from a single storm period.

DEMONSTRATIONS

Demonstration 1: Slope

- Adjust stream trailer so that it is almost level, with the front barely higher than the back.
- Create a shallow (1/2-1 inch) groove through the center of the grit, from the inlet reservoir to the outlet drain. The groove should be gradually deeper at the outlet (end).
- Start a low flow.
- After several minutes the water should create meanders. Talk with students about how areas with low slopes generally have slower moving water that form greater meanders.
- Increase the slope. As the slope increases velocity of the water will also increase and the stream will meander less.

Demonstration 2: Riparian Vegetation

- Adjust stream trailer so that it is almost level, with the front barely higher than the back.
- Starting at the inlet, use the large scoop to trace an S-shaped channel.
- At one of the bends cover the banks with vegetation (felt mats and plastic plants). Leave the banks of the other bend bare.
- Start the flow and watch the difference riparian vegetation can make. The bend without vegetation erodes much faster and more sediment is carried downstream. The bank with riparian vegetation shows very little erosion.

Extension: Put a house near the edge of the bend with vegetation. Turn on the flow and explain to the students that the homeowners decide they want to remove the vegetation so they can have easier access to the river. Remove the vegetation in front of the house. Have the students watch as the river erodes away the bank. Ask the students what they think will happen. Once the house falls in, discuss with students the importance of riparian vegetation.

Demonstration 3: Levees

- Adjust stream trailer so that it is almost level, with the front barely higher than the back.
- Use the rake or scoop to form a long mountain along one side of the trailer.
- Create a large, flat bed of grit about a ½ inch high in the center of the trailer.
- Pile excess grit on the other side of the trailer to form a small mountain.
- Use scoop to excavate a simple arc-shaped channel along the base of the larger mountain stretching from the inlet to the outlet drain.
- Discuss with students what levees and floodplains are and how they function.
- Start the flow. Have students observe the floodplain flooding as you increase the flow.
- Turn off the flow and construct a levee using square tile slabs.
- Start the flow again and have students watch how the levee will keep the water from going onto the floodplain.
- To demonstrate how a levee can fail, turn the valve so it is completely open and simulate rain by using the watering can until the levee fails.

Demonstration 4: Wetlands

- Adjust stream trailer so that it is almost level, with the front barely higher than the back.
- Create a wetland by installing bunches of plastic plants at the end of the channel.
- Start the flow and talk about wetland functions.
    - **Flood control**-wetlands act as sponges by capturing, storing, and slowly releasing water. Wetlands slowly release water over weeks and months.
    - **Coastal protection**-wetlands act as storm buffers. Roots hold soil in place and stalks reduce the energy from storm waves and wind.
    - **Groundwater recharge**-wetlands contribute to groundwater through aquifer recharge.
    - **Sediment traps**-wetland vegetation can slow water velocity and particles settle out as velocity decreases. Pesticides, heavy metals, and other potentially harmful residues can settle out. Too much sediment in water can cause clogged gills in aquatic animals, and fluctuations in water temperature.
    - **Pollution interception**-wetland plants can take up and filter some pollutants like nitrogen and phosphorous, some pollutants settle into the soil and are chemically reduced over time, other pollutants may be processed by bacteria.

    - **Habitat**-wetlands provide food, shelter, resting places, or predatory opportunities to a variety of animals.
    - **Waste treatment**-wetlands have a high rate of biological production that leads to a large waste consuming capacity. Also, sediment deposition buries waste and bacterial activity can break down and neutralize waste.
- Lift up the plants in the wetland to show the students how much sediment has been deposited there.

Demonstration 5: Flow

- Construct a channel with meanders.
- Start a low flow and watch to see if and how the stream is affected.
- Increase the flow and discuss what affects the students think the high flow will have on the river formation of a meandering stream (low flows will generally keep the meandering channel while high flows may cause the channel to straighten).