

**SGERC Stream Monitoring Program  
Discharge Measurement Guidelines  
Vers. 11/23/02**

**TASK:** To measure the discharge (flow) of water at specified sites along selected streams in the San Gregorio watershed.

**PURPOSE:** To collect weekly, monthly and yearly data to learn how much water moves through the stream. This data will help determine the health of the waterway and locate problem areas.

**METHODOLOGY OVERVIEW:** The width of a stream channel is measured and points across the channel are chosen for flow measurement. A current meter is used at each point to measure water speed at certain depths. The meter, attached to a "rating rod", is a wheel placed in the current that clicks with each rotation. The clicks are sent to headphones and are counted over time using a stop watch. The data is recorded on a form and certain simple calculations are made to complete the discharge measurement.

To ensure that the collected data is useful, it is important that the collection method be consistent and reliable. The following procedure was established to ensure that reliability. Please follow it carefully.

**EQUIPMENT & MATERIALS:** You will need the following equipment to take flow measurements:

- Rating Rod (we use the "top setting" model)
- Headphones
- Current Meter (Price AA or Price Pygmy)
- Tape Measure or Folding Measurement Stick in tenths of a foot
- Stopwatch
- Calculator
- Screwdriver
- Blank Measurement Forms
- Rating Curve Table
- Clipboard
- Pencils
- Hip Boots or Waders
- Towels

## CHOOSE A SITE

The general sites for flow measurements will be predetermined. However, since the stream is always changing, you will have some discretion each visit as to the exact spot that you take measurements. Choose a segment where the stream is fairly straight with good flow and no major obstructions (boulders, logs, eddies etc.) It should be away from any “rapids” and have fairly well defined edges. The depth must be at least 3/10 of a foot across the entire channel , so a narrow channel with reasonable depth may be better than a flat wide passage. After choosing a site, it’s all right to relocate minor obstructions (twigs, small rocks) to create an unobstructed area. You may also adjust a few rocks to create well defined edges.

## ASSEMBLE EQUIPMENT

(see Illustration of rod and meter)

### CHOOSE THE PROPER CURRENT METER FOR YOUR SITE.

Price AA meter, FROM a minimum depth of 1.5 and up, greater than 2.5 ft, use .2/.8 method.

Pygmy meter, FROM a minimum depth of 0.3 ft to 1.5 ft, greater than 1.5 ft, use the .2/.8 method

Use the same meter for all measurements across the stream, even though a few spots may not prove to fit the 1.5 requirement.

**ATTACH METER TO ROD.** Use a screwdriver but don’t over tighten. The Price AA meter has two parts: the meter, which attaches to the front of the rod, and a fin, which attaches to the back. The Pygmy meter has just one part.

**ATTACH CONTACT LEAD WIRE FROM ROD TO SCREW CONNECTION ON METER.** Hand tighten this screw. On the Price AA meter, there are two connection points for the wire. Which point is used depends on the velocity of the water flow: the top point provides one click for every revolution of the wheel; the lower is for faster flow and provides one click for every five revolutions of the wheel. The Pygmy meter has just one connection point.

**PERFORM A ‘SPIN TEST’.** Hold the rod straight, give the wheel a firm spin and use the stop watch to time how long it spins. The Price AA meter should spin for at least 1.5 minutes. The Pygmy meter should spin for at least 30 seconds. Note the results on the front page of the measurement form.

- If the meter does not pass the spin test, have an experienced member of your team adjust it.

**PLUG THE HEADPHONES INTO THE TOP OF THE ROD AND PUT THEM ON.** Give the wheel a spin to make sure you are hearing clicks as it spins.

## DETERMINE THE OBSERVATION POINTS

Lay your measuring tape squarely across the channel to be measured, placing the start of the tape on the left bank as you face down stream. The ends of the tape should be well onto the bank of the stream. The place where your tape starts is the “initial point” and the left edge of the water (LEW), the “0 point:”.

You must determine a minimum of fifteen observation points, preferably twenty across the stream. If there are variations in the stream bed, such as sand bars or obstructions, you will want to use more points. To find these points, note the width of the channel between the left and right edges, divide that distance by the number of observation points. For example, if you want to measure at 20 points, divide the width of the stream by 20. This will give you the distance between each observation point. It may be difficult to take measurements at the edges of the stream due to lack of depth so you may use more points where there is greater flow.

All measurements are made in 10ths of a foot rather than inches. Both the rod and measuring tape are in tenths.

## FLOW MEASUREMENT

### MEASURE THE DEPTH AND ADJUST THE ROD

(don't forget to mark LEW in the first row of the measurement form)

**DETERMINE STREAM DEPTH:** Read the hash marks on the bottom of the rod:

- single hash = 1/10 ft (or 0.1)
- double hash = 1/2 ft (or 0.5)
- triple hash = 1 ft

**PRICE AA METER:** If the depth is consistently over 1.5 feet, use the Price AA Meter and the 0.6 depth method. If the water is over 2.5 ft, take two flow measurements at each observation point using the .2/.8 depth method.

**PYGMY METER:** If the depth is under 1.5 feet the measurement is taken at 0.6 of the depth of the stream, measured from the top of the water. If the depth is over 1.5 feet take two measurements at each observation point using the .2/.8 method.

- **To take an 0.6 measurement:** Determine the stream depth. At the top of the rod you will see an upper scale on the main rod in tenths of a foot and foot marks on the thin rod. Push the release button and slide the thin rod up or down the handle until the upper scale matches your depth. For example, if you've measured a depth of 1.3 ft, slide the thin rod up or down until the 1 ft mark on the thin rod points to "0.3" on the main rod. This will place the meter in the water at 0.6 of the depth. (see illustration).
- **To take a 0.2 measurement:** Double your stream depth and slide the thin rod up or down until the upper scale points to double your depth. (see illustration).
- **To take a 0.8 measurement:** Halve your stream depth and slide the thin rod up or down until the upper scale points to half your depth. (see illustration).

### TAKE A FLOW MEASUREMENT

Place the rod in the water as straight as possible at the first observation point from the left edge of water. Stand about 1.5 feet downstream and to the side of the rod so as not to affect the flow.

Set your stopwatch to 0:00. Put the headphones on and listen for the clicks. Start the stopwatch on any click and begin counting on the next click you hear. **Count clicks for 40 - 70 seconds.** Keep counting until your clicks reach one of the following numbers : **3, 5, 7, 10, 15, 20, 25, 30, 40, 50, 60, 80, 100, 150, 200, 250.** Once you've counted clicks for over 40 seconds, keep going until you reach one of the above numbers and then stop the stopwatch on that click. Note the results on your measurement form as described below.

Move to the next observation point and repeat above procedure.

## FILLING OUT THE MEASUREMENT FORM

- Fill out the form in pencil
- All measurements should be noted in tenths or hundredths of a foot (e.g. 0.5 = 1/2 ft or 0.05= 5/100 ft.)
- Perform the discharge calculations before leaving the stream in case you discover inconsistencies and need to remeasure flow.

### DEFINITIONS:

**POINT:** A location along the width of a stream channel.

**INITIAL POINT:** The beginning of the tape measure on the left bank as you face downstream.

**0 (ZERO) POINT:** The left edge of the water (LEW) as you face downstream.

**DISTANCE FROM INITIAL POINT:** The distance in tenths of inches from the initial point to any other point.

**DEPTH:** The depth of the stream at a given point.

**OBSERVATION POINTS:** The locations along the width of the stream at which you will measure the flow.

**OBSERVATION DEPTH:** The method used to take a measurement (0.6 or .2/.8).

**REVOLUTIONS:** The number of clicks heard in a measured period of time.

**TIME IN SECONDS:** The measured period in which you count clicks.

**ANGLE COEFFICIENT:** A fraction used to adjust data when the stream flow is not straight at a given observation point.

### SITE & INSPECTION INFORMATION (Front page of the Measurement Form)

- Station number, date, names of data collectors, meter information, measurement rating, gauge reading, weather.
- (\* update this when form is ready)

### RECORDING FLOW MEASUREMENT

Each column of your form records a particular type of datum, as described below. The data for each observation point is recorded in a row going across. Since two measurements are taken when using the .2/.8 method, the data for that point will utilize two rows.

Remember that the INITIAL POINT is the start of the measuring tape on the stream bank. Initial point is not filled in on the form, it's only used as a reference point.

### ENTERING THE MEASUREMENTS

**FIRST ROW:** Left Edge of Water

MARK "LEW" on the far left of the row.

- 1) DIST. FROM INITIAL POINT (4.0 ft in our example)
- 2) DEPTH (since it's the edge of the water, it's usually zero).

**SECOND ROW:** 1st observation point.

- 1) DIST. FROM INITIAL POINT to the observation point.
  - 2) DEPTH of the water at this point.
  - 3) OBSERVATION DEPTH METHOD. Enter **.6, .2 or .8**. If you took two measurements you will use two rows on the form. Not all information is duplicated in this second row. (see measurement form examples).
  - 4) REVOLUTIONS. The number of clicks heard during the measured time period. This number must be **3, 5, 7, 10, 15, 20, 25, 30, 40, 50, 60, 80, 100, 150, 200, 250**.
  - 5) TIME IN SECONDS. The period of time in which you counted clicks. Must be between **40 and 70** secs.
- ANGLE COEFFICIENT, if any, measured at this observation point.

**THIRD & SUBSEQUENT ROWS:** Move to the next observation point & repeat instructions for the second row.

**LAST ROW:** Right Edge of Water.

MARK "REW" on the far left of the form in the last row.

- 1) DIST. FROM INITIAL POINT, record the distance from the initial point to the right edge of water.
- 2) DEPTH is usually zero. If not, take a measurement at this point.

## CALCULATIONS

The following calculations determine the total flow, or discharge, of the stream. Since we only take measurements at a few points across the stream, these calculations use those measurements to determine the total discharge.

1) **WIDTH:** Calculates the distance either side of a point halfway to the next observation point. (see illustration)

To calculate the **WIDTH:**

**FIRST ROW (LEW):** Subtract the first row DIST. FROM INITIAL POINT (DFIP) from the second row DFIP, then divide the difference by 2 and enter in the WIDTH column of the first row.

- In our example:  $5.0 - 4.0 = 1$ , divided by 2 = .5.

**2ND ROW (First Observation Point):** Subtract the first row DFIP from the third row DFIP, then divide the difference by 2 and enter in the WIDTH column of the second row.

- In our example:  $5.5 - 4.0 = 1.5$ . 1.5 divided by 2 = .75.

**SUBSEQUENT ROWS:** Continue subtracting the DFIP in the row below from the row above and dividing by 2 and entering result in the current row.

- In our example: at 5.5,  $6.0 - 5.0 = 1.0$ , then divide by two = .5 entered in Width of third row.

**LAST ROW (REW):** Subtract the second to the last row DFIP from the last row DFIP, then divide the difference by 2 and enter in the WIDTH column of the last row.

- In our example:  $16.0 - 13.0 [3.0]$  divided by two = 1.5.

2) **AREA:** (see illustration)

To calculate **AREA:**

**Multiply WIDTH times DEPTH**, enter result in AREA.

- In our example: Width 0.75 x Depth 0.32 = Area 0.24.

3) **VELOCITY AT POINT:** The speed of the water at a given observation point and depth.

To calculate **VAP:** Using the RATING CURVE TABLE, find the square where the REVOLUTIONS and TIME IN SECONDS from each row intersect. Enter that number in the VELOCITY AT POINT box on the measurement form.

- In our example: 40 revolutions in 48 seconds has a velocity of .842.

4) **VELOCITY MEAN IN VERTICAL:** Use this only when using the .2/.8 method. This gives the mean velocity of our two observation depths.

To calculate **Velocity Mean In Vertical:** Add the two Velocity At Points and divide by two. Enter in the upper column for Mean In Vertical.

- In our example:  $.272 + .245 = .517 / 2 = .259$ .

**ANGLE COEFFICIENT:** The fraction used to adjust the velocity when there are deviations from a straight flow. If you have measured any angle coefficients, CALCULATE: VELOCITY x ANGLE COEFFICIENT; enter result in ADJUSTED FOR HOR. ANGLE OR.

(\*no example) (\*no illustration)

5) **DISCHARGE:** the amount of water flowing through each AREA of the stream.

To calculate: VELOCITY AT POINT x AREA = DISCHARGE. (For .2/.8 measurements use VELOCITY MEAN In VERT.)

- In our example:  $.165 \times .24 = .040$ . (or  $.259 \times .80 = .207$ )

6) **TOTALS:**

**VELOCITY:** The total velocity of water flowing through our measurement area.

Add all measurements in VELOCITY column for TOTAL VELOCITY. Enter total at bottom of Velocity column.

**AREA:** the total area of the stream.

Add all measurements in the AREA column. Enter total at bottom of Area column.

**DISCHARGE:** The total volume of water flowing through our measurement area.

Add all measurements in DISCHARGE column for TOTAL DISCHARGE. Enter total at bottom of Discharge column.

## DISASSEMBLE & RETURN EQUIPMENT

**PERFORM SPIN TEST ON METER.** Mark the results on the front page of the measurement form.

**DRY OFF METER AND REPLACE IN BOX.**

**RETURN ALL EQUIPMENT** to the SGERC storage area.