1.2b Stream Physical Characterization and Habitat Assessment Handbook

SECTION 1: Location Identification

A. STREAM NAME: This should be the official stream name from a map.

B. LOCATION: Give a brief description of your location so that another person could find locate your study site. Try to reference a permanent landmark. For example, 100 meters south of the Leonard St. Bridge is much better than at the bend near the large willow tree.

C. WATERSHED: Locate the watershed of your stream by going to the Lower Grand River of Watersheds (LGROW) Find My Watershed Mapping Tool (Figure 1). This is also located on the main page of their website as well www.lgrow.org.

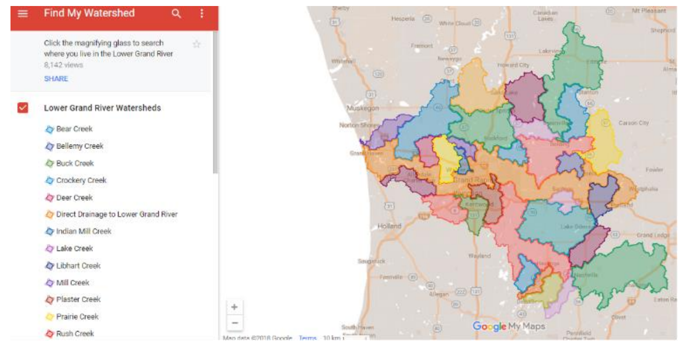


Figure 1. LGROW Find My Watershed Map

D. STREAM CLASS: Use the map below to determine your stream temperature class (Figure 2).

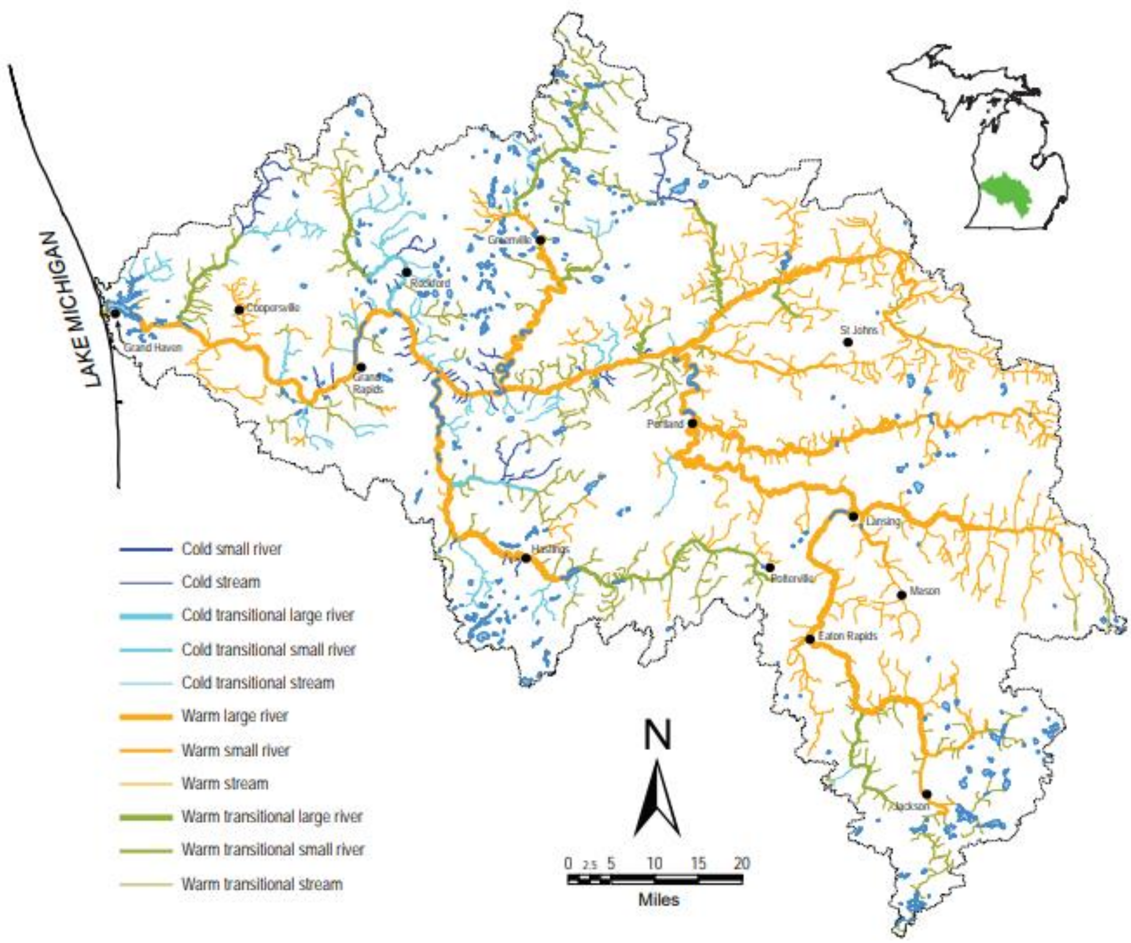


Figure 2. Thermal classification of the Grand River main stem and tributaries. Data from Zorn et al. 2008. Source Michigan Department of Natural Resources.

E. LATITUDE & LONGITUDE: Figure 2 shows the ranges for latitude and longitude values in the Great Lakes Basin. In Michigan, your latitude will be in the forties and your longitude will be in the eighties. You will want to provide at least 4 decimal places (this gives you a precision of around 11 meters).

- Prior to going to your site visit: NASA offers a very good resource for finding latitude and longitude at https://mynasadata.larc.nasa.gov/latitudelongitude-finder/ you can use the map to zoom in to where you will be conducting your research and finding your latitude and longitude coordinates.

Figure 3. Source NOAA

- While on site: If you do not have a GPS unit for capturing points, a cell phone can provide somewhat accurate locations. You can either download an app MyGPSCoordinates is free and tells you how accurate your coordinates are (Figure 4), or you can drop a pin in Google Maps and then click on the bottom bar to expand the information on the pin, this will show the GPS Coordinates (Figure 5).

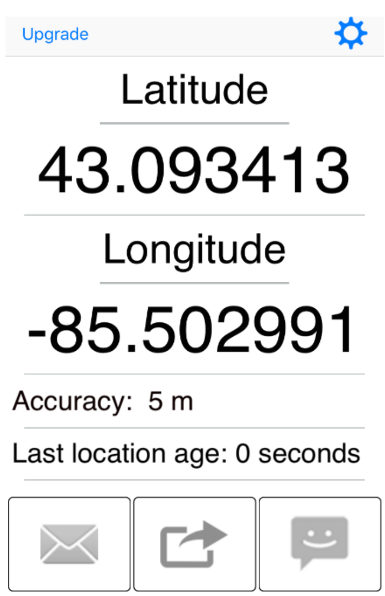


Figure 4. MyGPSCoordinates

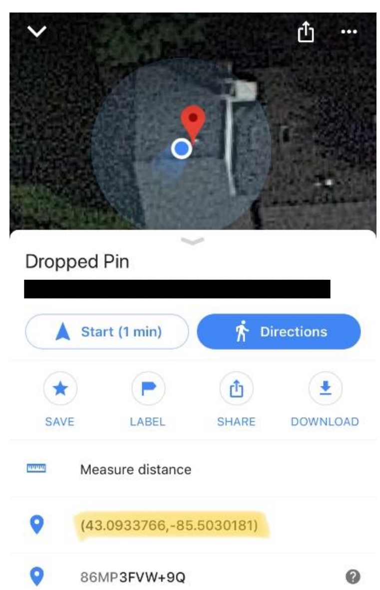


Figure 5. Google Maps Pin Drop

F. FORM COMPLETED BY: Be sure to give the names of all people working on this report.

G. DATE/TIME: Record the date and time the form is completed in the field.

SECTION 2: Weather Conditions

Note the present weather conditions on the day of the survey and day before the survey. This information is important to interpret the effects of storm events.

- If you are unsure of the prior day's weather, you can find NOAA data at https://www.weather.gov/. Use the large map to select your location, continue clicking to narrow your location until you get to the current conditions for your local weather station. You can then click on the 3 Day History to obtain the information you need (Figure 6).

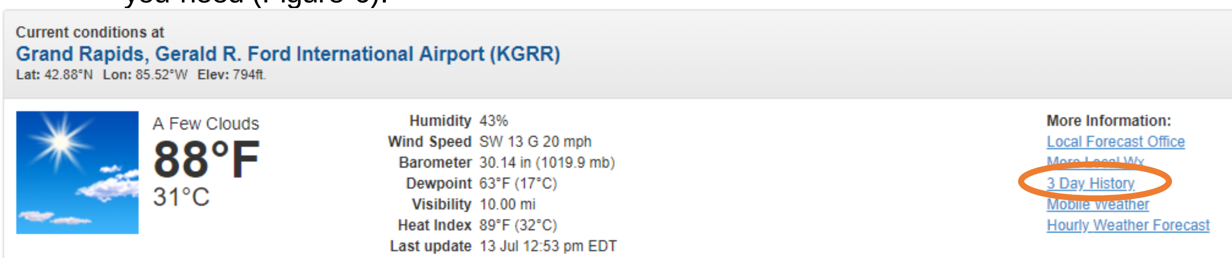


Figure 6. NOAA Weather Data

Make sure your record the air temperature using Fahrenheit (°F).

SECTION 3: Physical Characteristics

A. SURROUNDING LANDUSE TYPE: Indicate the dominant land use type for the watershed upstream of your sampling site. If you do not have access to the internet, you can do a visual survey of what you can see. If you do have access to the internet, you can use the satellite images from Google Maps to determine land use. Remember to zoom in on the map that shows to the area that shows the upstream watershed of your site (use the USGS Watershed Locator tool if you need to remember your watershed boundaries).

- **Land Use Types:**

Forest: primarily trees 	Agriculture: land being used to grow crops 	Commercial: stores, restaurants, and parking lots 
Field/Pasture: open land - not growing crops 	Residential: mostly single family homes 	Industrial: factories 

B. STREAM BANK VEGETATION. In general, the riparian area for a stream is 18 m from the bank. However, if your stream is more than 4 m wide, than you will need to observe a larger distance. Vegetation in the riparian area helps to filter out pollutants from surface water before the water enters the stream. Riparian vegetation improves stream water quality.

- **Vegetation Types** Indicate the dominant vegetation found for your stream's riparian area.

Woody Stem		No Woody Stem	
Tree	**Shrub**	**Grass**	**Herbaceous**
• Single trunk • Over 6 m tall	• Multiple stems • Under 6 m tall	• Slender leaves • Flowers not showy	• Broad leaves • Often showy flowers
			 *Image source U.S. Fish and Wildlife service*

- **Width of vegetation.** Make sure to measure the width of the vegetation the left and right bank. Use Figure 7 to help determine left and right banks.

C. INSTREAM FEATURES:

- **Reach Length (in meters):** Measure the length of the sampling reach. Make sure to follow the stream path when measuring and not to miss bends and curves. Ideally, a stream reach is 100 m (about a football field) or 40 times the width of the stream. This information is important if reaches of variable lengths used by different groups.

- **Stream Width (in meters):** Estimate the width of the water surface at a location representative of the stream in the reach. If there are variable widths, use an average of several measurements.

- **Stream Depth (in meters):** Estimate the vertical distance from water surface to stream bottom at a representative depth. Take this measurement in an area that is the most common habitat type of your stream reach.

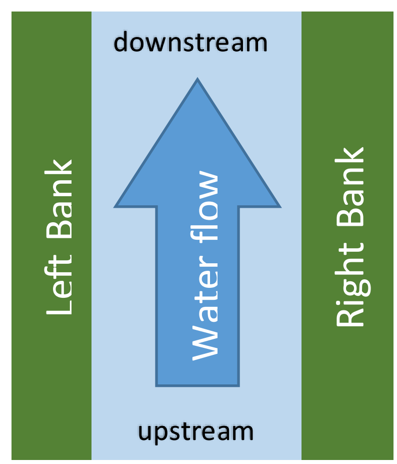


Figure 7. Bank Side Determination

- **Water Temperature (in Fahrenheit):** Streams are classified as cold water or warm water depending on their monthly maximum river temperatures. What water temperature classification a stream fits into determines the organisms that can survive and reproduce in the stream. Figure 8 shows the maximum temperatures for cold and warm water streams in Michigan by month. You can use your measurement to verify the classification given by the Michigan Department of Natural Resources in Figure 8.

Monthly Maximum River Temperatures Allowed

	Month											
Stream	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Coldwater streams	38	38	43	54	65	68	68	68	63	56	48	40
Warmwater streams	41	40	50	63	76	84	85	85	79	68	55	43

Figure 8.Data from Michigan Department of Environmental Quality, Water Bureau

- If you are using a digital thermometer, follow the directions given by the product.
- To take an accurate temperature reading with an alcohol thermometer (the type with red liquid in the center).
    - Hold the thermometer at the top above the current air temperature.
    - Expose the thermometer to the air in shade (out of direct sunlight) for 60 seconds
    - Submerge the thermometer completely under water for 60 seconds.
    - Read the thermometer immediately after removing it from the water. If you cannot read the thermometer within a second or two, repeat the water submergence and try again.

Once you know what type of stream you have warm or cold water, you can determine what types of fish might live in your stream. The Michigan Department of Natural Resources has conducted fish surveys and created reports to show what fish can be found in different areas of the Grand River.

- To find a list of all fish species, information about their habitat needs, and where in the watershed each species has been found you can look at Table 26 of the 2017 Grand River Assessment from the Michigan Department of Natural Sources
- To find maps of known fish distributions and fish habitats within the Grand River watershed you can look at Appendix A of the 2017 Grand River Assessment from the Michigan Department of Natural Sources
- Both of these can be found at this link: https://www2.dnr.state.mi.us/PUBLICATIONS/PDFS/ifr/ifrlibra/Fisheries/reports/FR20.pdf

The article on the following page to explains why coldwater streams are important to watersheds.

It's cool to be cold: the importance of coldwater streams

It's not nice when someone gives you the cold shoulder or a cold stare,
but when it comes to streams, it's cool to be cold!

What are coldwater streams?

Coldwater streams are fed by groundwater and they remain cold all year. These streams often flow during dry periods because they are not dependent upon precipitation or other surface water. Coldwater streams are generally less than 68˚F. Healthy coldwater streams have native vegetation along their stream banks, fast flowing waters, and habitats such as riffles, pools and runs.

Stonefly © EcoSpark

Why are coldwater streams important?

Coldwater streams are important regulators within a watershed. They improve water quality and biodiversity by reducing excess sediment and nutrients from traveling downstream. Coldwater streams are a hub of biodiversity. They support insects such as mayflies, caddisflies and stoneflies. Insects can indicate water quality and are a source of food for fish!

Many fish species in the Grand River Watershed, such as lake whitefish, brook trout, chinook salmon and mottled sculpins require coldwater streams to live and reproduce.

Mottled sculpin © Troutnut.com

Brook trout - US Fish & Wildlife Service

Threats to coldwater streams:

There are several threats to the health of coldwater streams including:

Urbanization: Increased development causes erosion, sedimentation, and an expansion of impervious surfaces. Together, these can contribute to a rise in stream temperatures.

Climate Change: Water temperature is affected by air temperature. Warmer air results in warmer water. Increased heavy rainfall events will increase warm surface runoff entering streams.

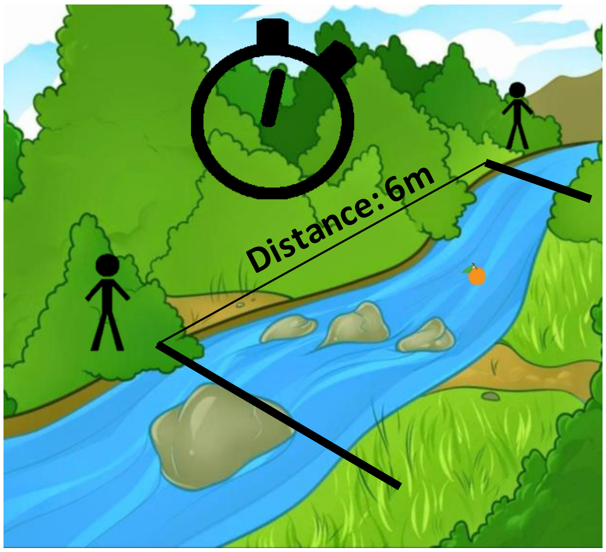
Commercial use: The use of groundwater for commercial purposes (e.g. municipal, golf courses, and bottled water) reduces the amount available to recharge coldwater streams.

How can we protect coldwater streams?

- Increase the vegetation in riparian areas (stream banks) to decrease the amount of warm surface runoff and sediment that enters streams.
- Reduce non-point source pollutants entering streams.
- Educate others on the importance of coldwater streams.

Adapted with permission from the Ontario Nature Blog written by Joyce Chau on February 18, 2018.
https://ontarionature.org/its-cool-to-be-cold-the-importance-of-coldwater-streams/

Stream Velocity (meters/second): Sand and sediment introduced into slow streams will drop to the streambed. In fast streams, sand and silt will stay in the water longer. Because of this, slow streams often have sandy bottoms, while fast streams often have gravel or stone streambeds. Fast-moving streams generally have higher levels of dissolved oxygen than slow streams. Because velocity affects habitat and water quality, stream velocity determines the kinds of organisms that can live in the stream (some need fast-flowing areas; others need quiet pools).



Method adapted from EPA Water: Monitoring and Assessment

If you do not have a way to measure stream velocity directly, you can use an orange to get an estimate. An orange is a good to use because will float just below the water surface so it will not have any air resistance slowing it down.

1. Marking off a 6 m section of the stream that is typical for the reach. Have one person at the start of section and one person at the end of the section.
2. Have the person at the start place the orange at the upstream start of the section. Place the orange in the stream where the water is moving fastest.
3. Released the orange into the fastest current at the start of the section.
4. Time how long it takes the orange to reach the end of the 6 m section.
5. Have the person at the end of the section scoop the orange out of the water after it passes the end of the section.
6. This "time of travel" measurement should be conducted at least three times and the results averaged--the more trials you do, the more accurate your results will be.
7. To determine the velocity in m/s, divide your average time traveled by 6.

Canopy Cover – Measures how much of the stream is shaded by trees, bushes, and tall grass. The canopy provides several important functions in the stream. It can provides cover for fish and wildlife, and when leaves/branches fall into the stream if add organic material for other organisms to eat. The shade cools the water and removal of vegetation raises water temperatures. Lawns in a stream's riparian zone may indicate that pesticides and grass clippings are a possible problem, and that little habitat and shading are available. Bare soil and pavement might indicate problems with erosion and runoff. To determine canopy cover consider how much of the stream will be shaded by vegetation during the day. If you are doing the assessment in the early spring/fall, take into consideration what the cover would be when vegetation is out.

  - **Mostly Open** - Little to no shade covering the river
  - **Partially Covered** – Some shade provided, some areas are open.
  - **Mostly Covered** – Most areas of the stream will be shaded for part of the day.
- **Morphology Type** – Give the percent of each type in the reach being assessed. Use the descriptions in the table below along with Figures 9 and 10 on the next page to best identify the different stream morphologies.

Riffles

These are shallow stretches where water runs fast and there are gravel/ rocky streambeds. They have the steepest slopes and shallowest depths. They have similar depth across the streambed. In general, they have gravel/rocky bottoms.

Who lives here? Riffles are a good place for mayflies, stoneflies, and caddisflies to live because they offer plenty of cobbly gravel to hide in. The only plants you will find here are diatoms and small algae.

Connecticut Department of Environmental Quality

Runs & Glides

These may look similar from the surface. Both are places where water runs smoothly downstream.

Runs- They are deeper and slope of the streambed is less than that of riffles. Runs will often have a well-defined deepest part of the streambed.

Glides -are located immediately downstream of pools. The streambed through a glide is going slightly uphill.

Who lives here? Fishes, like minnows, too small to compete for pools often end up in runs.

Pools

The deepest portions of the stream where water moves the slowest. Often on the outside of stream bends. Streambed is often covered in sand/silt/clay.

Who lives here? Trout, clams, snails, and worms. Organic matter falls out of the water here and can be a food source. If the stream levels lower, this can be a safe place to be.

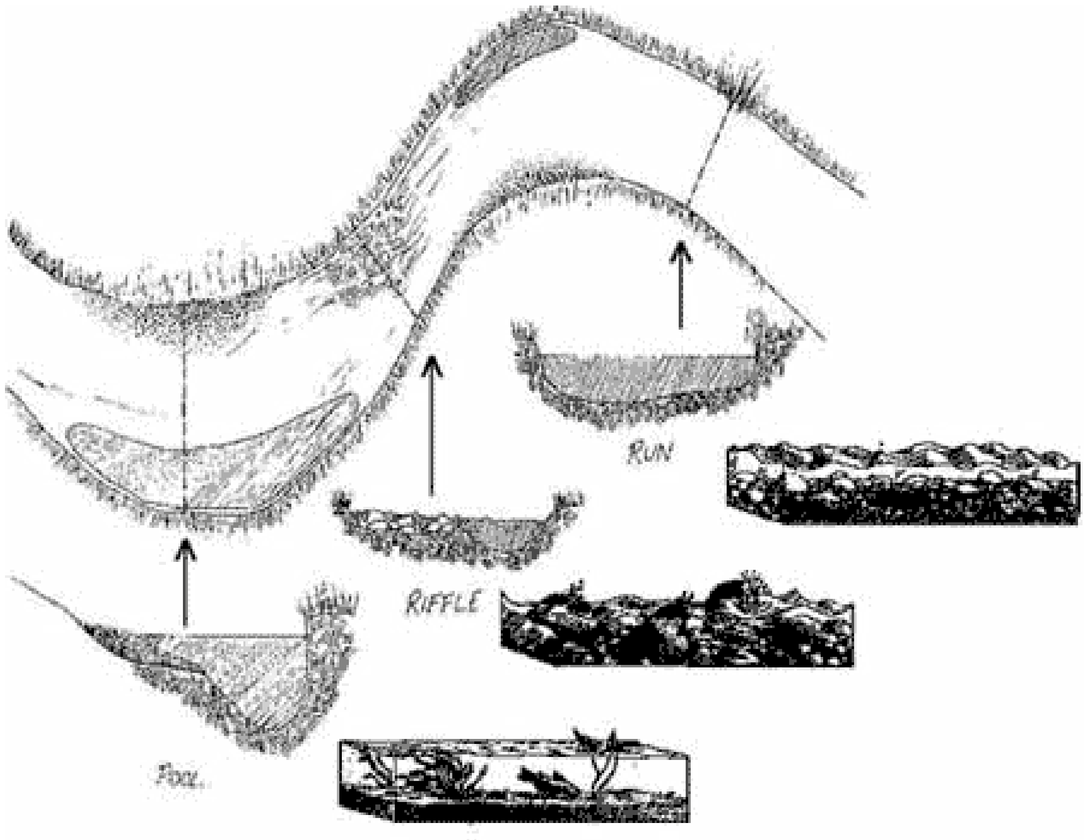


Figure 9. Source http://www.epa.gov.owow/monintoring/volunteer/stream/vms41.html

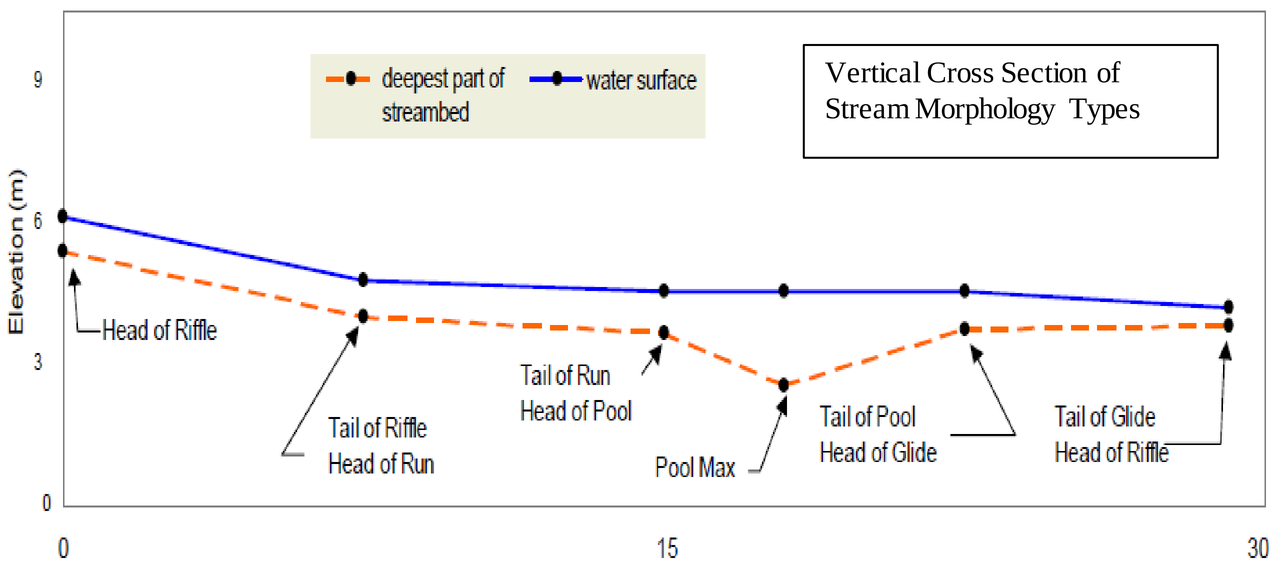


Figure 10. Adapted from VT Agency of Natural Resources Stream Geomorphic Assessment

A. SUBSTRATE COMPONENTS: What material makes up a streambed indicates what types of organisms can live in stream and stream velocity. Quickly moving streams will have streambeds composed mostly of gravel, cobbles, and bolder, while slow moving streams will have mostly sand, silt, and clay streambeds. Within your stream reach, you can tell where the water is moving more quickly and more slowly based on the type of streambed present. Streams that have many different substrate types have a higher diversity of organisms that can live in the stream.

To determine your stream stubstrate types, give the percent of each type present. Use the descriptions below along with the ruler on the next page to determine substrate types. All your substrate types should total to 100%.

Substrate Type	**Diameter**	**Physical Description**
Silt/Clay	Less than 0.06 mm	Feels smooth, individual pieces not visible
Sand	0.06 – 2 mm	Feels gritty, individual pieces visible
Gravel	2 – 64 mm	Pea to tennis ball in size, can be picked up with one hand
Cobble	64 – 256 mm	Tennis ball to basketball diameter, pick up with two hands
Boulder	More than 256 mm	Basketball to car diameter, cannot be picked up
Bedrock	N/A	Large solid surface

- Additional Notes: Be sure to add anything that you notice about the stream that might help you understand it better. Specifically look for:
  - Dams or changes to the stream channel made by humans
  - Potential source of pollution
  - Areas that have been impacted by humans
  - Evidence of pollution – smells, oil sheens, foam
    - Oil Sheens – If they break up when poked with a stick they are most likely natural and not from human pollution
    - Foams *** – If they feel gritty they are most likely natural, if they feel soapy, they are most likely artificial/human sourced

****** Warning – if you are in an area where PFAS have been reported in the groundwater, do not touch or ingest any foams. Most PFAS cannot pass through skin to enter our bodies, but a few can. In addition, foams in the Rouge River have recently been measured as having over 20,000 the limit of current PFAS for surface water standards. (https://www.accesskent.com/News/2018/06052018.pdf)****

Source: http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/SOPpebble.aspx
http://www.vendian.org/mncharity/ir3/paper_rulers/

Basic pebble categories

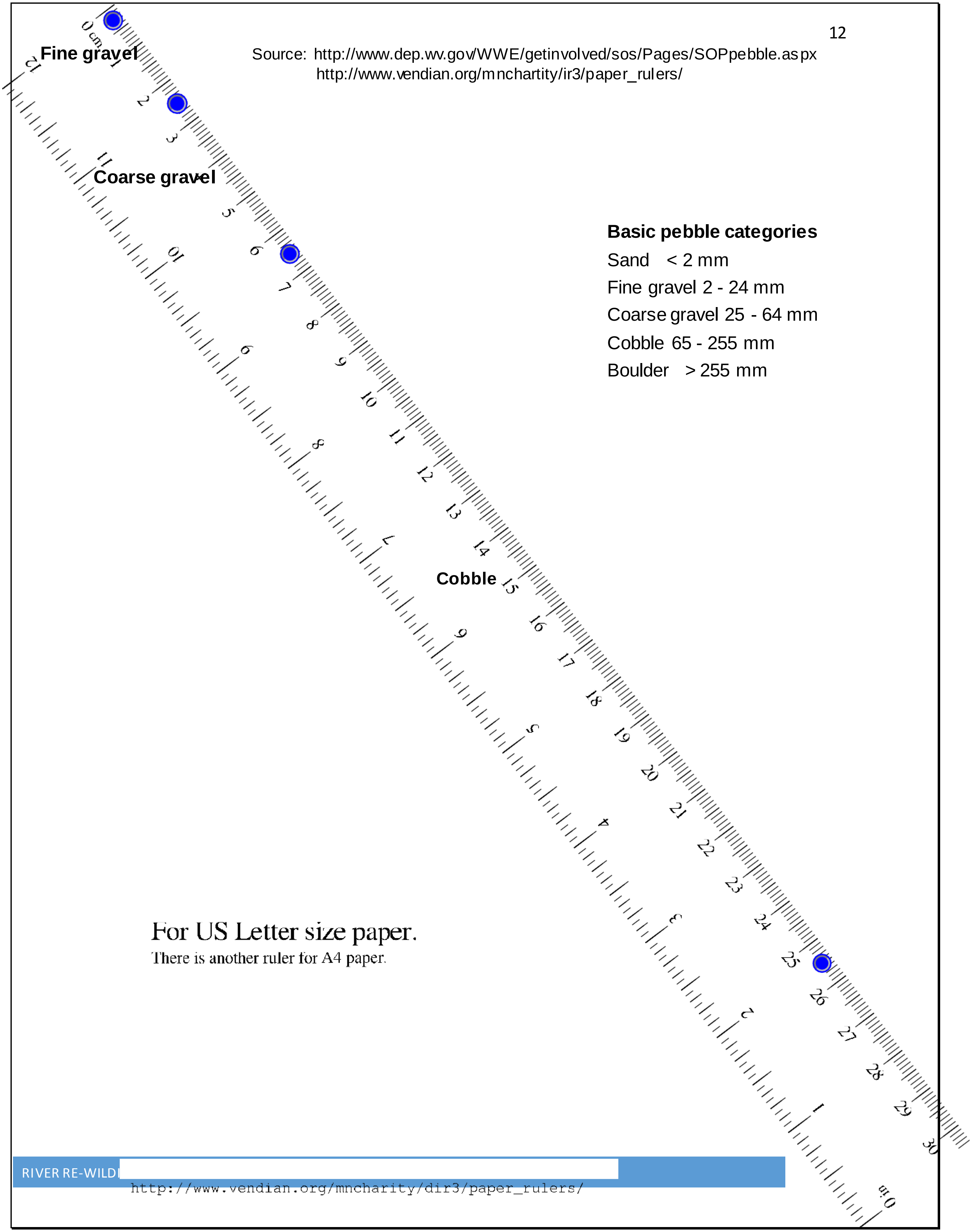
Sand < 2 mm

Fine gravel 2 - 24 mm

Coarse gravel 25 - 64 mm

Cobble 65 - 255 mm

Boulder > 255 mm



For US Letter size paper.

There is another ruler for A4 paper.

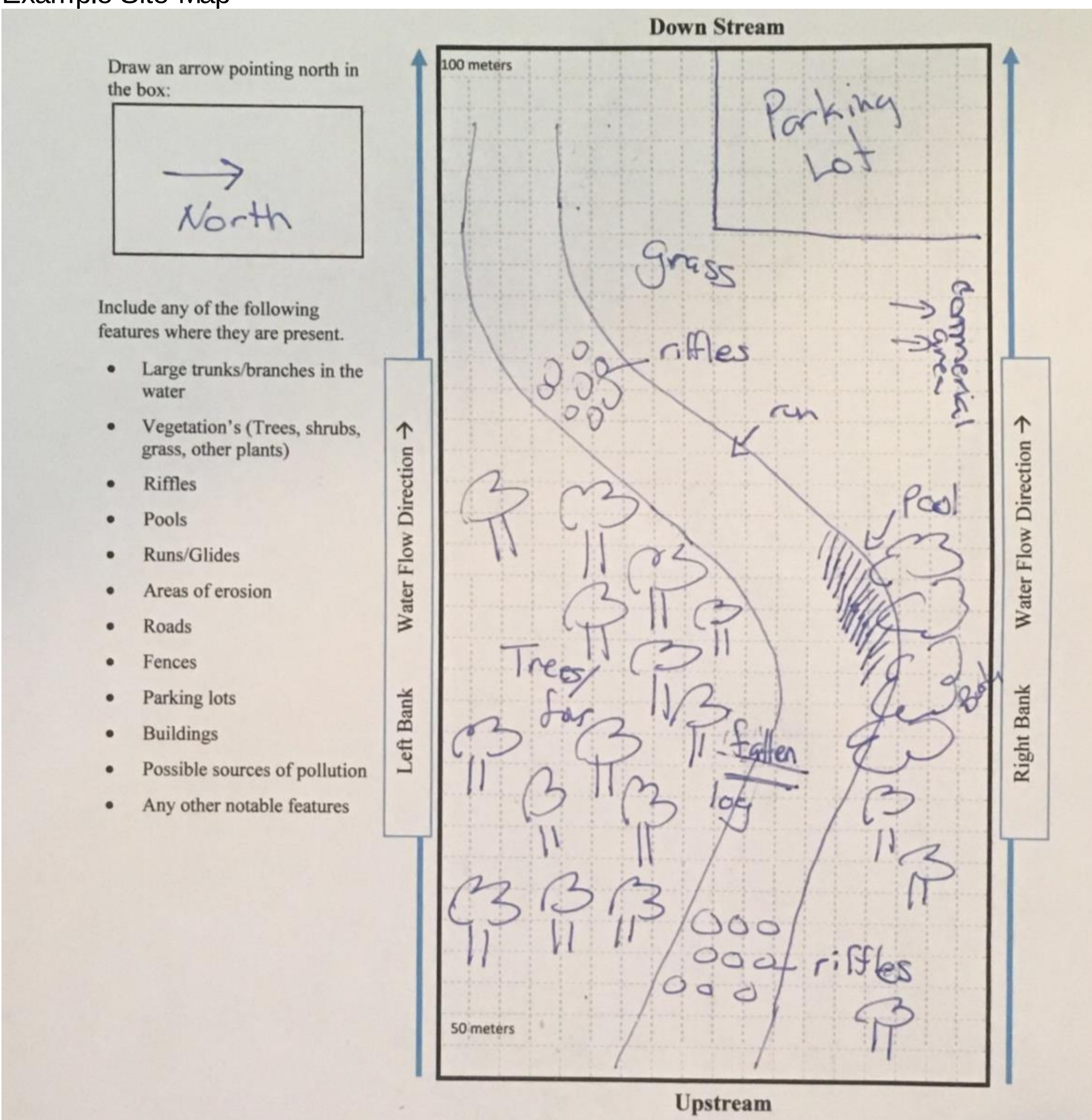
http://www.vendian.org/mncharity/dir3/paper_rulers/

SECTION 4: Site Map

To complete this, photographs may be helpful in identifying the location in the future. Be as detailed as you can and make sure to include any features that could affect water quality and the organisms that live in the stream such as:

- Large trunks/branches in the water
- Vegetation's (trees, shrubs, grass, other plants)
- Riffles
- Pools
- Runs/Glides
- Areas of erosion
- Roads
- Fences
- Parking lots
- Buildings
- Possible sources of pollution
- Any other notable features

Example Site Map



SECTION 5: Stream Habitat Assessment

Roughly 3.5 million miles of rivers and tributaries in the United States connect us to the sea, even if we live far inland. River habitats vary from high, stony streams, flowing channels for ships and boats, to shallow wetlands. A river bed may be stony or soft, lush with underwater vegetation, murky and slow or cold and clear, but each provides an ideal environment for different species in various life stages.

Trout thrive in highland streams, while catfish lurk near the bottom of slow-moving water. Migrating fish, like salmon, must swim up to cooler, stony beds to reproduce. Even the smallest fish play an important role. "Forage fish" swim upriver to multiply, then head out to sea, providing food for commercially valuable seafood.

Rivers have three distinct habitat areas: river bed, river banks, and the floodplain. The river bed is the water channel itself, while the river banks, called the "riparian zone", include the land, trees, and water-loving animals and plants along the channel. The low, flat land spreading out from the channel, called the floodplain, periodically floods during heavy rains and snow melt. Sometimes floodplains stay soggy for a long time, creating rich wetland habitat.

The Value of River Habitat

- Sixty percent of our drinking water comes from American rivers.
- Food—irrigating crops.
- Electricity—generating hydroelectric power.
- Transportation—bringing grain, coal, ore, and imports to market.
- Recreation and tourism—providing significant economic boost to waterfront areas.
- Rivers are home to fish and wildlife.
- When waters rise floodplains can absorb large amounts of water, providing natural flood control for communities, preventing damages.

Challenges for Rivers

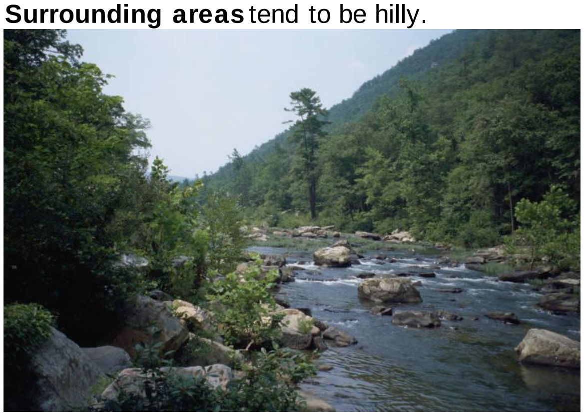
- Dams block migratory fish from returning to their historic spawning grounds, reducing fish populations. Dams also alter the amount of water and sediment traveling downstream, changing living conditions above and below the dam.
- Hard shorelines decrease fish populations and increase water velocity, increasing erosion.
- Digging channels or straightening rivers destroys nearby floodplains and wetlands, and can lead to development where flooding is inevitable.
- Farm runoff containing fertilizers, herbicides, and pesticides contaminates water with toxins and excess nutrients, causing algal blooms and dead zones.
- Combined stormwater and sewage systems can overflow and pour untreated human waste into rivers, creating disease risk and adding nutrient pollution. The resulting algae overgrowth can be toxic to fish and people.
- Riverside development can reduce shade, which can lead to warmer waters that reduce reproduction in many species. Hard surfaces also increase pollutant runoff from roadways, parking lots, and roofs.

Stream habitat description adapted from NOAA Fisheries (https://www.fisheries.noaa.gov/national/habitat-conservation/river-habitat)

For this assessment, we assess 10 parameters rated in the ranges of optimal, suboptimal, marginal, or poor. Some parameters have separate criteria for riffle-run streams and pool-glide streams. Assess each parameter in groups of at least two. Take pictures of the habitat to help with analysis afterwards. Add information to your stream site sketch as you work through the assessment. Use the descriptions and example images on the following pages to complete the assessment.

STREAM TYPE

Determine which type of stream you are assessing (Riffle-Run Stream or Glide-Pool) using the descriptions below. Select the type of stream based on the characteristics pictured below. When assessing the stream, take into consideration your entire stream reach, not just your sample site for macroinvertebrates.

<table>
<tr><th>Riffle-Run Streams</th><th>Glide-Pool Streams</th></tr>
<tr><td>Morphology (river shape) mostly riffles and runs. Many areas where the surface of the water is rough or has rapids.
</td><td>Morphology (river shape) is a glides and pools sequence. The surface of the water is mostly smooth.
</td></tr>
<tr><td>Streambed is mostly course sand/gravel or larger particle sizes.
</td><td>Streambed is mostly fine sand and smaller. Very infrequent gravel or larger rocks in the bottom deep pools or along the edge of some stream reaches.
</td></tr>
<tr><td>Surrounding areas tend to be hilly.
</td><td>Surrounding area tends to be flat and may have wetlands along the stream.
</td></tr>
</table>

Parameter 1 – Instream Habitat (Epifaunal Substrate/Available Cover)

- **Rate this the same for Riffle-Run & Pool-Glide Streams**

This parameter looks at the physical structures present for stream for organisms. It includes riffle areas, large rocks, fallen trees, large woody debris (logs and branches), and undercut banks. These structures provide protection from predators, places to feed, and sites for young to grow.

- A wide variety and/or amount of underwater structures in the stream creates a diversity of habitats, allowing a greater variety of organisms to live in the stream.
- Riffle/Run Streams-- Riffles and runs are critical for maintaining a variety and abundance of insects. They serve as mating (spawning) and feeding sites for fish.
- Pool/Glide Stream-- Old fallen trees and submerged logs provide habitat structure for macroinvertebrates and fish in low-gradient streams. Often river restorations will involve putting in fallen trees/logs into the river; however, it can take several years of decaying in the river before the "new fall" will be good habitat.
- When the variety and amount of underwater structures decreases, organisms do not have as many habitat options and the ability of organisms to recover from disturbances (such as pollution or construction in or near the stream) decreases.

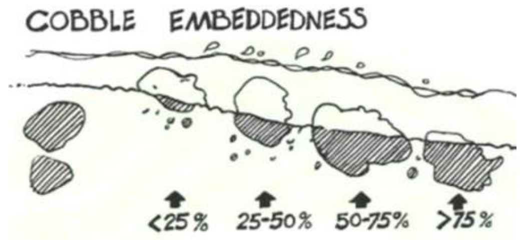
	Optimal Range	Poor Range
Riffle/Run Streams		
Pool Glide Streams		

Parameter 2 – Streambed

- **Use the separate categories for Riffle-Run & Pool-Glide Streams**

For Riffle-Run Streams, look at Embeddedness.

This parameter measures the degree to which rocks (gravel, cobble, and boulders) and fallen trees are covered or sunken into the silt, sand, or mud of the stream bottom.



West Virginia EPA

- Observations should be taken in the upstream and center portions of riffles. This ensures you are not looking at sediment deposits (another habitat parameter).
- If cobble and gravel are easy to remove from the riffle and there is little sand or silt released into the water, embeddedness is minimal.
- When rocks become embedded, habitat available to macroinvertebrates and fish (shelter, spawning, and egg incubation) is decreased.
- Embeddedness is a result of large-scale sediment movement and deposition. This can indicate erosion or runoff with lots of sediment entering the stream.

	Optimal Range	Poor Range
Riffle/Run Streams		

For Pool-Glide Streams, look at Pool Streambeds (Substrate).

Examine the bottom substrates found in pools.

- Firmer sediment types (e.g., gravel, sand) and rooted aquatic plants support a wider variety of organisms.
- A pool substrate dominated by mud or bedrock with no plants does not offer much habitat.
- In addition, a stream that has a uniform substrate in its pools will support far fewer types of organisms than a stream that has a variety of substrate types.

	Optimal Range	Poor Range
Pool/Glide Streams		

Parameter 3 – Water Column Variability

- **Use the separate categories for Riffle-Run & Pool-Glide Streams**

For Riffle-Run Streams, look at Speed & Depth Combinations.

Having a variety of depths and velocity provides more habitat types. The highest quality streams will have 4 patterns present: (1) slow-deep area, (2) slow-shallow areas, (3) fast-deep areas, and (4) fast-shallow areas. The occurrence of these 4 patterns relates to the stream's ability to provide and maintain a stable aquatic environment. In general, there should be

- 0.5 m difference in depth to separate shallow from deep.
- 0.3 m/sec difference in stream velocity (speed) to separate fast from slow (the orange velocity measuring method explained in Section 3 to compare velocities can be used).

	Optimal Range	Poor Range
Riffle/Run Streams	 *Mary Kay Corazalla, U. ofMinn.* (arrows emphasize different velocity/depth regimes)	 *William Taft, MI DNR*

For Pool-Glide Streams, look at Pool Variability.

Look at the mixture of pool types found in the stream, according to size and depth. The 4 basic types of pools are (1) large-shallow, (2) large-deep, (3) small-shallow, and (4) small-deep. A stream with many pool types will support a wide variety of aquatic species. Streams with low sinuosity (few bends) and little pool variability do not have sufficient quantities and types of habitat to support a diverse aquatic community. In general, there should be:

- Large pools that extend **more than half** the width of the stream, while small pools extend **less than half** the width of the stream.
- The difference in the depth of small and large pools should be more than 1 m.

	Optimal Range	Poor Range
Pool/Glide Streams		

Parameter 4 –Sediment Deposition

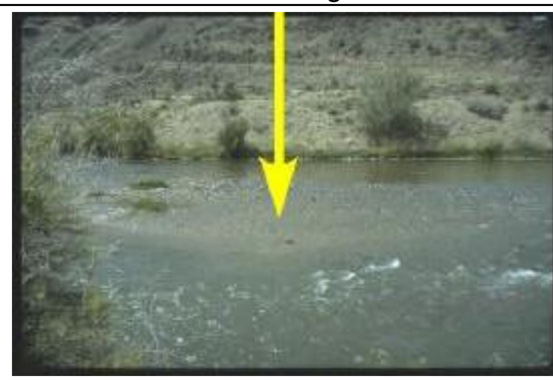
- **Rate this the same for Riffle-Run & Pool-Glide Streams**

This parameter measures the amount of sediment that has accumulated on the stream bottom because of deposition. The most common causes for deposition in most streams are human activity (e.g., structures such as bridges, roads, culverts etc. too close to the stream or built so that the stream is narrowed) and bank erosion. Steep sloping banks with exposed surfaces are more likely to erode. Undercut banks can often erode but can be stable if covered with vegetation, tree roots and rocks.

- Look for deposition around eroding banks, especially if they show bare soils consisting mostly of fine materials (fine gravel, sand and silt). Hard surfaces, no matter how steep or undercut, are less likely to erode
- Sediment deposition may cause the formation of islands, point bars (Figure 11), shallows, or result in the filling of runs and pools.
- Usually deposition is evident in areas that are obstructed by natural or manmade debris, and in areas where the stream flow decreases, such as bends.

Figure 11. Point bar on inside of stream bend. Image courtesy of Jean-Christophe BENOIST.

- High levels of deposition are symptoms of unstable and continually changing environments and are unsuitable for many organisms. Usually island formation, especially in small streams/headwater streams, is an indication of excessive deposition.

	Optimal Range	Poor Range
Riffle/Run Streams		 arrow pointing to sediment deposition
Pool Glide Streams		 arrow pointing to sediment deposition

Parameter 5 – Channel Flow Status

- **Rate this the same for Riffle-Run & Pool-Glide Streams**

This parameter measures the degree to which the stream is filled with water. The flow status will change if the streambed enlarges or if flow decreases because of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the amount of suitable habitat for organisms is limited.

Channel flow is especially useful for interpreting biological condition under abnormal or lowered flow conditions. When interpreting this, it is important to look at the last rainfall event and how this might affect your streamflow. In general, streams have higher water levels in the spring and lower water levels in fall.

Visually you can identify low flow status by looking at:

- In riffle-run streams: how much of the gravel/cobble substrate is exposed in riffle areas.
- In pool-glide streams: how many logs and fallen trees are exposed.

	Optimal Range	Poor Range
Riffle/Run Streams		 arrow showing that water is not reaching both banks
Pool Glide Streams		 *James Stahl, IN DEM*

Parameter 6 – Channel Alterations

- **Rate this the same for Riffle-Run & Pool-Glide Streams**

This is a measure of large-scale, human-made changes in the shape of the stream. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels, often for flood control or irrigation purposes. Altered streams have fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering (curving) streams.

Channel alteration is present when:

- Artificial stream banks, riprap (Figure 13) and other forms of artificial bank stabilization or structures are present
- the stream is very straight for significant distances
- dams and bridges are present
- Scouring (large-scale erosion after heavy rain events) occurs, which is often associated with channel alteration (Figure 12).

Figure 12. Rip rap next to culvert

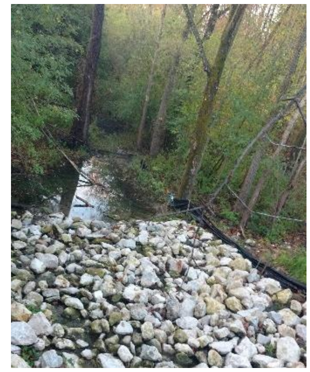


Figure 13. Scour from resulting from bridge placement.

	Optimal Range	Poor Range
Riffle/Run Streams		
Pool Glide Streams		 *John Maxted, DEDNREC*

Parameter 7 – Stream Diversity

- **Use the separate categories for Riffle-Run & Pool-Glide Streams**

Riffles and bends in streams are a source of high-quality habitat and diverse organisms. Increased frequency riffles and bends enhances the diversity of the stream community. In addition, a high frequency of riffles and bends allows the stream to better handle surges resulting from storm water. The absorption of energy from storm water by bends protects the stream from excessive erosion and flooding, and provides places of safety for invertebrates and fish during storm events. The longest possible length of the stream should be used for this. If you can go beyond your stream reach, do.

For Riffle-Run Streams look at Frequency of Riffles (or Bends)

- If riffles are continuous in the stream, than measure the distance between bends.

To calculate this metric:

<u>Step 1</u>. Find the average distance between riffles/bends. Do this by measuring the distance between as many riffles/bends in the stream as you can and then finding the average distance (sum of distances divided by number of distances measured).

<u>Step 2</u>. Take the average distance from Step 1 and divide it by the average stream width. Use this result to determine the condition category.

	Optimal Range	Poor Range
Riffle/Run Streams	 *(Arrows show frequency of riffle/bends)*	

For Pool-Glide Streams look and the bends (meandering) in the stream

To calculate this metric:

<u>Step 1</u>. Measure the actual stream length following all curves in the stream.

<u>Step 2</u>. Measure a straight line from the start of end of your reach. This should be the shortest possible distance the beginning and end your reach; think of it as the "how the crow flies" distance.

<u>Step 3</u>. Divide the actual stream length (Step 1) by the straight-line measurement (Step 2). Use this result to determine the condition category.

	Optimal Range	Poor Range
Pool/Glide Streams		

Parameter 8 – Bank Stability

- **Rate this the same for Riffle-Run & Pool-Glide Streams**

This parameter measures whether the stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks, and are therefore considered unstable. Eroded banks indicate a problem of sediment movement and deposition, and suggest a lack of cover habitat for fish and invertebrates. They also indicate a lack of input of plant matter to the stream, which is food for many organisms. Evaluate each bank separately.

Signs of erosion include:

- Crumbling
- Unvegetated banks
- Exposed tree roots
- Exposed soil

	Optimal Range	Poor Range
Riffle/Run Streams	 (arrow highlighting stable streambanks)	 *MD Save Our Streams* (arrow highlighting unstable streambanks)
Pool Glide Streams		 (arrow highlighting unstable streambanks)

- Note that in both optimal range images, there is some undercutting of the banks, but tree roots and other vegetation also stabilize them. The plants provide stability, addition cover locations, and are a food source for organisms

Parameter 9 – Vegetative Protection

- **Rate this the same for Riffle-Run & Pool-Glide Streams**

This parameter measures the amount of vegetative protection afforded to the stream bank (this is just the area right next to the streambed/water). High quality areas will have a mixture of trees, bushes, and plants growing near the streambank. There are many benefits to having plants right up to the stream.

Vegetative protection will:

- Reduce erosion as roots hold soil in place.
- Help to remove nutrients from the water –farming or lawn care can add excess nutrients to the water.
- Lower stream temperature by providing shade.
- Provide quality habitat for fish and macroinvertebrates.

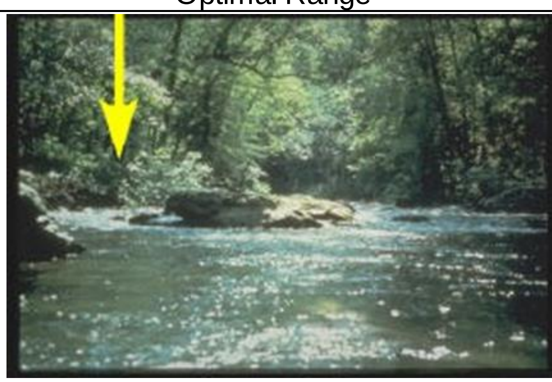
Common Invasive Species Found Near Streams in Michigan.

Purple Loosestrife

Phragmites

Native vs. Non-Native (Invasive) Vegetation.
Native plants are more effective at providing protection than are non-native invasive plants. In some regions, the introduction of non-native plants has virtually replaced all native vegetation. Where there is a great deal of livestock grazing, or where residential and commercial development activities are present, the growth of native plants is often reduced.

As shown in the images below, some right and left banks have very different levels of vegetative cover, so it is important to evaluate each bank separately.

	Optimal Range	Poor Range
Riffle-Run Streams	 (arrow pointing to high level of vegetative cover)	 (arrow pointing to streambank with almost no vegetative cover)
Pool- Glide Streams	 *Peggy Morgan, FL DEP*	 (arrow pointing to channelized streambank with no vegetative cover)

Parameter 10 – Riparian Vegetative Zone

- **Rate this the same for Riffle-Run & Pool-Glide Streams**

The riparian zoon is the area 18 meters (or for very small streams, at least 4x the stream width when the stream is full of water) from either side of the stream bank. The riparian vegetative zone serves as a filter of pollutants entering a stream from runoff; controls erosion; and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports a robust stream system.

- Narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank.
- Residential developments, urban centers, golf courses, and rangeland are the common causes of negative human impacts on the riparian zone.
- Conversely, the presence of "old field" (i.e., a field not currently in use), paths, and walkways in an otherwise undisturbed riparian zone do not have significant impact and may be given relatively high scores.

	Optimal Range	Poor Range
Riffle-Run Streams	 arrow emphasizing an undisturbed riparian zone	 arrow emphasizing lack of riparian zone
Pool- Glide Streams	 arrow emphasizing an undisturbed riparian zone	 *MD Save Our Streams* arrow emphasizing lack of riparian zone

Sources

Images:

All images used are public domain, unless otherwise noted. Credit given to source material whenever possible. Images of habitat parameters are primarily from the United States EPA unless otherwise noted.

Procedures adapted from:

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