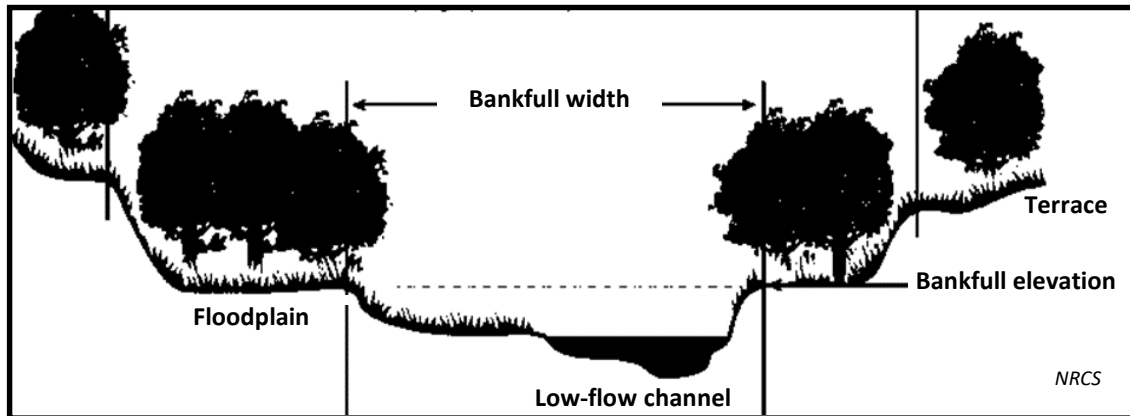


Guidance in Determining Bankfull Stream Width in Pennsylvania

Bankfull Flow (stage or elevation):

This flow stage is determined by the elevation point at which the stream accesses the floodplain. This point is typically indicated by deposits of sand or silt at the active scour mark, a break in stream bank slope, perennial vegetation limit, rock discoloration, or root hair exposure. The bankfull flow is also known as the channel-forming or dominant discharge, which is the flow that transports the most sediment over time and is the most effective in shaping and maintaining the natural stream channel. The bankfull flow roughly corresponds to a 1.5-2 year recurrence interval.

Bankfull Width – The average width of the channel at the bankfull elevation.



Finding the Natural Channel of a Stream:

Because streams vary widely in composition, slope, and manmade impacts, it is impossible to create a set of “instructions” for determining bankfull that will work on every channel. The goal when determining bankfull flow is to find an area that represents natural channel conditions either upstream or downstream of the crossing. This sometimes means moving further upstream or downstream away from the structure, or skipping sections of the stream that are unnaturally widened or constricted. **Be flexible and think logically in choosing your bankfull measurement section in order to get the best representation of the natural stream channel.**

Procedure for Determining Bankfull Width Near a Road / Stream Crossing Structure:

Location: Start at a location away from the influence of any culvert or bridge, since they often impact channel width. To do this, roughly estimate bankfull channel width, then go at least 5 times that distance away from the structure. Looking upstream is preferred, but downstream reaches can be used if necessary (*see locations to avoid below*).

Determine Bankfull: Because the bankfull flow does the greatest amount of work forming the channel, the bankfull stage is identifiable in the field. Using the indicators listed below, begin by looking up in the floodplain and then work down toward the stream. Use both sides of the channel find the elevation of the best bankfull indicators and mark those locations, using flags if necessary. Stretch a measuring tape across the stream at your bankfull mark(s), noting that the tape should be level, to measure the bankfull channel width. Continue moving upstream or downstream, taking successive measurements that are at least 1/2 bankfull width apart (for example, if the first bankfull measurement is 16 feet, move at least 8 feet away before taking another measurement). Collect at least 5 measurements and average them together. More than 5 bankfull measurements can be used to obtain a better average if needed. This is only a general guide, note the “locations to avoid” section that follows.

Be flexible and think logically in choosing the best indicators for your bankfull measurement locations.

Field Indicators of Bankfull Flow: (listed in order from the most to least reliable indicators)

- 1. Change in Bank Slope:** Bankfull flows are often associated with “benches” or the top of the stream bank, unless the stream is entrenched or has been altered in the past.
- 2. Depositional Features:** The top of features such as point bars and mid-channel bars are often indicators of the bankfull flow elevation. Use these elevations to look for additional clues on each bank at the same elevation.
- 3. Changes in Particle Size:** Streams drop sediment when they start accessing their floodplain. A Change in particle size along a stream bank (from gravelly, to silty or sandy) often indicates bankfull elevation.
- 4. Vegetation Changes:** Although not as reliable, changes in vegetation can indicate bankfull elevation.
- 5. Scour Features:** Erosion and scour lines can be used if other features cannot be located.

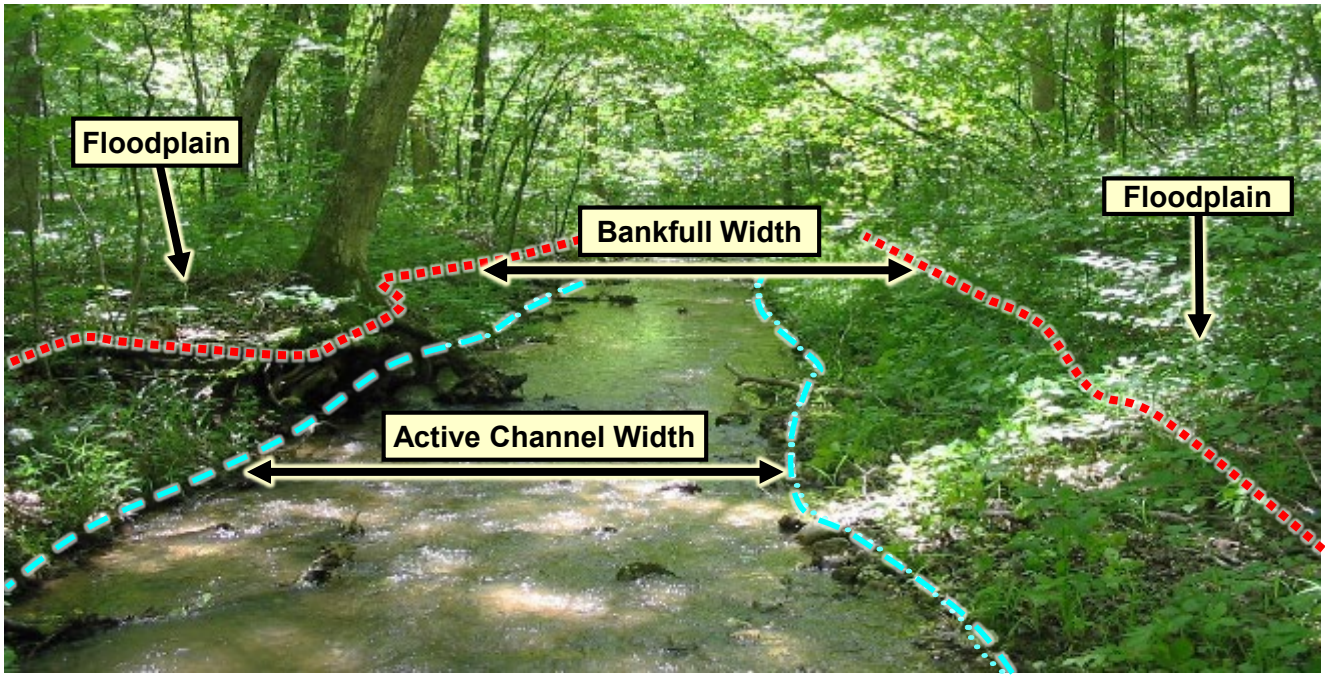


Locations to Avoid in Determining Bankfull Flow: (if possible)

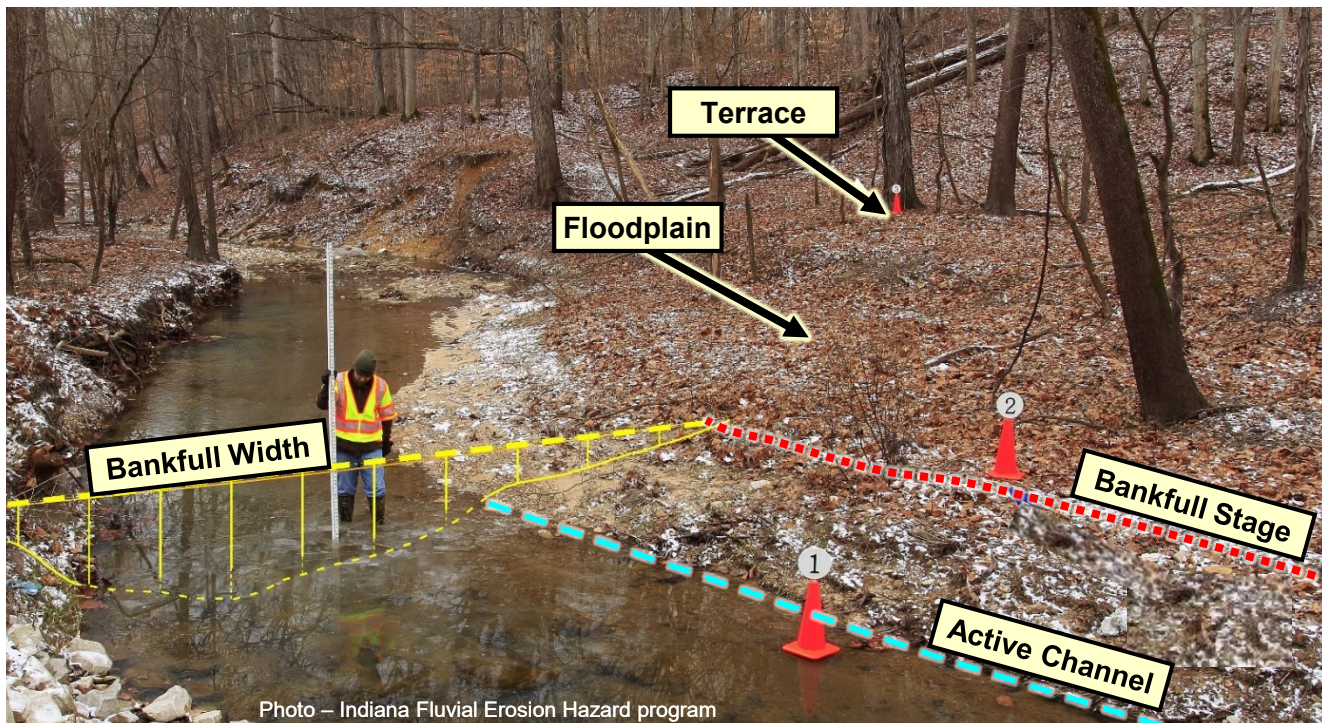
- Logjams or Fallen Trees:** These structures tend to increase the bankfull width in their immediate vicinity.
- Manmade Impacts:** Avoid locations with walls, weirs, dams, rip-rap, pipes, etc.
- Bedrock Outcroppings:** Bedrock can hide indicators of bankfull flow and alter channel width.
- Braided Channels:** Measure upstream or downstream of any braided channels if at all possible.
- Tributaries/Springs:** Measure bankfull between road crossing and any incoming flows that may increase width.
- Hard Meander Bends:** Hard bends make it difficult to find good indicators since the stream is moving laterally.

Additional Bankfull Determination Tips:

- Bankfull flows will be level across the channel, so make sure your tape is level when measuring bankfull widths. If you find strong indicators on one bank but not the other, you can stretch your tape level across the stream to get your width.
- When looking for bankfull indicators, think logically about a 1.5-2 year recurrence interval. Does it make sense that the points you are measuring as bankfull will see flow with that frequency?
- Surveyed cross-sections can be used to verify bankfull width measurements in channels where changes in bank slope are strong field indicators of bankfull.
- On entrenched streams, or streams with historically high sediment impacts (legacy sediments), bankfull elevation is often below the elevation of the “top of stream bank” due to many years of man-made impacts.
- Note that tree roots and other vegetation can exist below the bankfull elevation, especially in dry years.
- Measuring bankfull is often easier during Spring and Fall when vegetation is dormant.
- **Be flexible in your measurement locations to find the best representation of the natural channel.**



This photo shows a typical forested stream in the summer. Bankfull width is significantly wider than the active channel width. Bankfull indicators are obscured by vegetation on the right side of the photo and complicated by roots and vegetative growth on the left side of the photo.



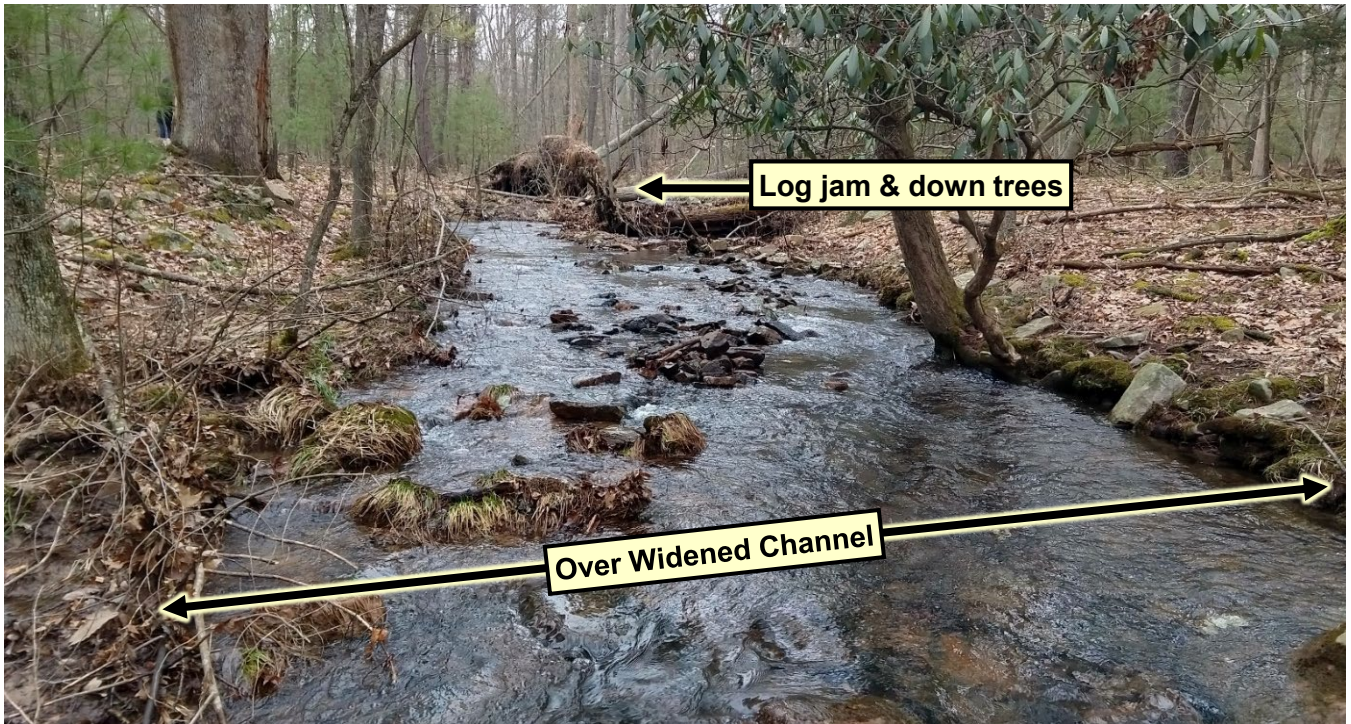
This photo shows a typical forested stream in the winter. Bankfull indicators such as changes in slope, depositional features and changes in particle size are more obvious due to lack of vegetation.



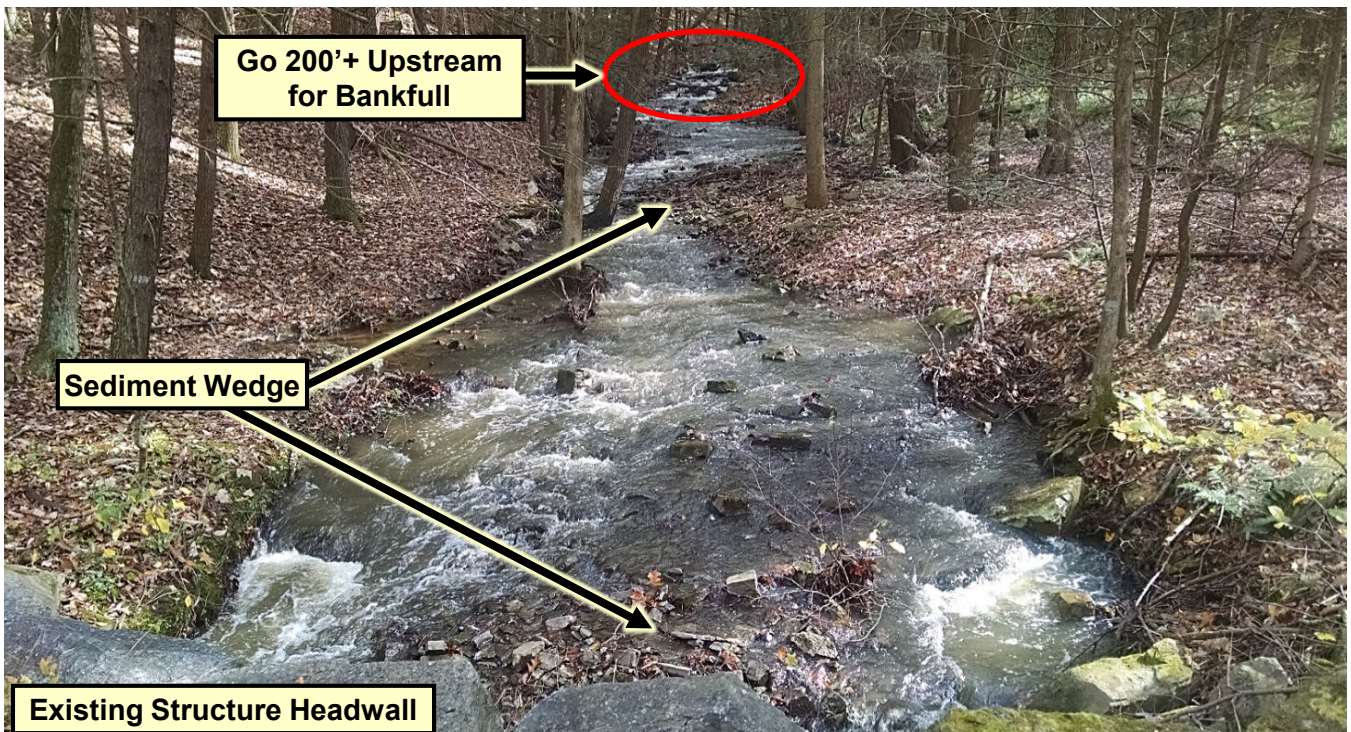
Entrenched channels are often found in agricultural settings and in high gradient streams. When measuring entrenched channels the bankfull width and channel width are the same.



Additional water sources such as tributaries, springs or tile drains add additional flow and change the bankfull width. If additional water enters above the crossing, then measurements should be taken downstream of the crossing. If additional water enters below the crossing, then measurements should be taken upstream of the crossing.



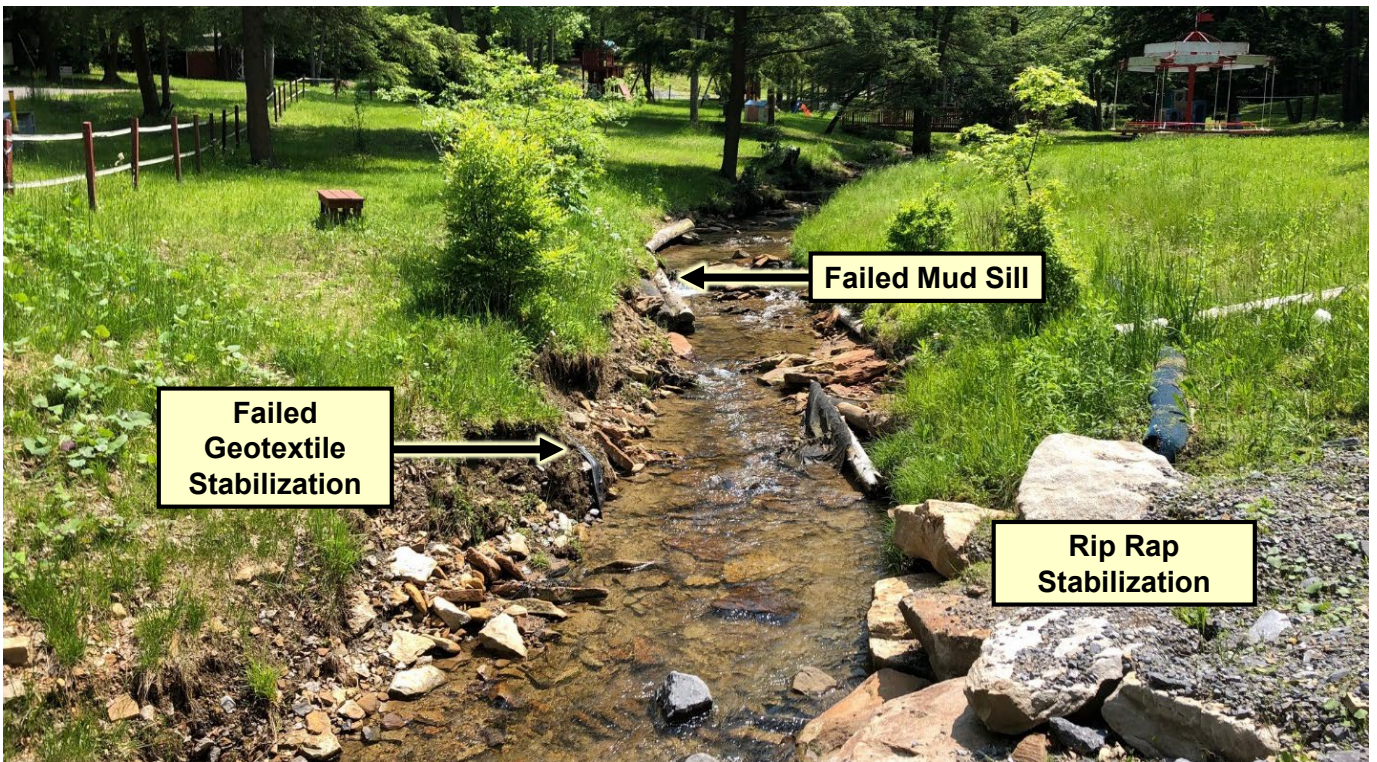
This photo shows a stream section with locations to avoid when measuring bankfull. In the foreground the channel is over widened and there is noticeable vegetation in the stream. Upstream there is a log jam and downed trees impacting the stream channel. Remember to be flexible when locating the best representation of the natural channel.



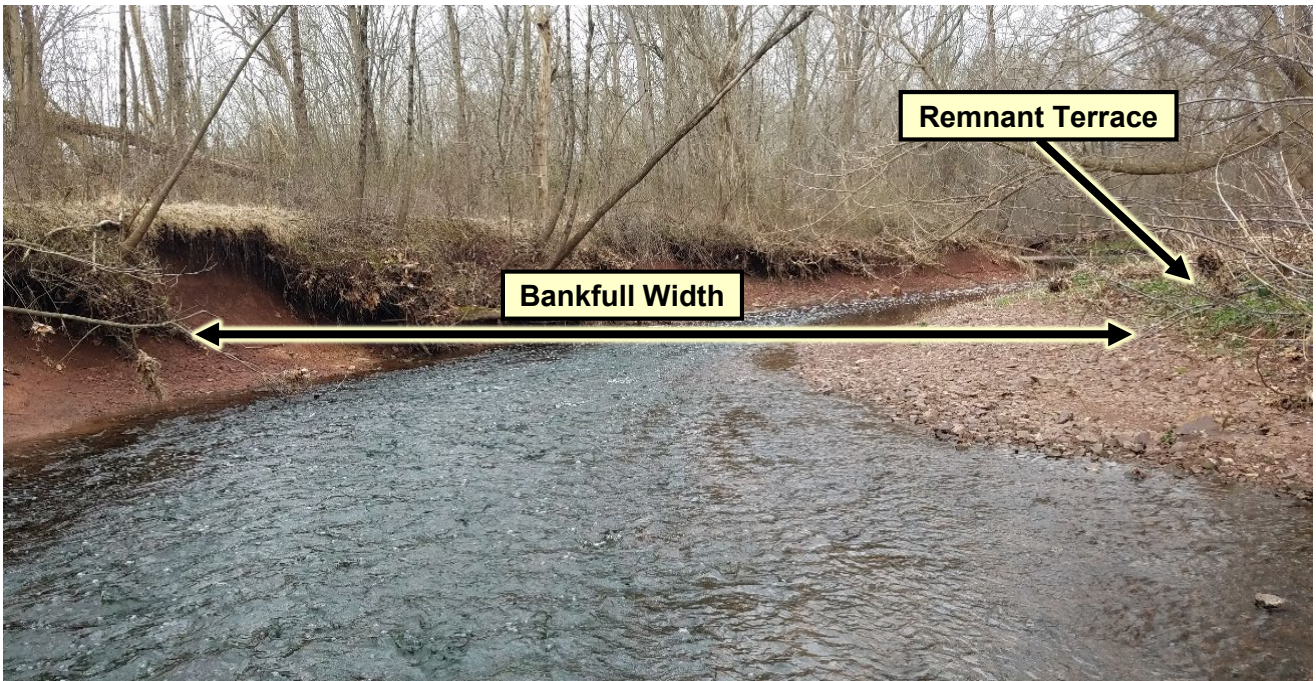
This photo shows a sediment wedge that has formed upstream of the structure causing over widening. The impacts from the undersized structure extend approximately 150 feet upstream and this section should be to avoid when measuring bankfull. The red oval shows where the natural channel begins.



Urban settings pose unique challenges due to human channel modifications. In areas with significant disturbance near the structure it is necessary to start looking for bankfull indicators more than 5 bankfull widths away from the crossing.



This creek flows through a park and shows impacts from channel modification and failed bank stabilization attempts. In areas with significant human caused disturbance it is necessary to start looking for bankfull indicators more than 5 bankfull widths away from the crossing.



This stream is aggressively adjusting both laterally and vertically. Bankfull elevation is at the top of the gravel point bar, not at the more obvious grade break at the top of the grassy bench where the stream engages its floodplain. This elevation of the grade break is the top of a remnant terrace that is engaged at flows higher than bankfull. This is also a difficult place to measure bankfull due to being on a bend.



This stream has multiple braids of the main channel and is impacted by significant amounts of large woody debris. Bankfull measurements should not be taken in this section.



In bedrock and boulder channels, bankfull indicators typically include scour lines on the rocks, fine sediment deposition and potentially vegetation changes.



Some settings call for creative bankfull measurement. This small entrenched channel in an agricultural field has a bankfull width equal to the stream bed width.