<table>
<thead>
<tr>
<th>Stream Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berms</td>
</tr>
<tr>
<td>Floodplain</td>
</tr>
</tbody>
</table>
Berms Definition

An earthen embankment or wall, usually built to provide protection or a result of side casting during stream channel dredging.
Berms
Berms
Berms – Failure
Berms – Failure
Floodplain

The floodplain is part of the river during storm conditions
If large areas of the floodplain are filled, then there will be an increase in the land area needed to store flood waters. This means your home, farm, or business may be impacted.
When the channel is disconnected from the floodplain...

- Velocity and energy of Stream increases
- Erosion increases
- More damage to infrastructure from debris
- The flood stage is higher
Filling in the Floodplain

4 foot of fill in the Floodplain
Development on the Floodplain

- Buildings
- Bridge approaches
- Roads
- Parking lots
- Etc.
When the floodplain is developed...

- More threat to life and property
- Velocity and energy increases
- Erosion increases
- More damage to infrastructure
- The flood stage downstream is higher
- Higher cost of flood damage
- Increased flood insurance
Development on the floodplain can lead to significant stream issues including erosion & infrastructure damage.
Unstable Channels
General Channel Responses to Instabilities

- Instability progresses **downstream** when there is a change in local sediment supply
  - **Increased supply** (landslide or gravel rich tributary) results in deposition downstream
  - **Decreased supply** (as from a dam or concrete or heavy stone lined channel) results in downstream erosion
General Channel Responses to Instabilities

- Instability progresses **upstream** when there is a change in local channel form
  
  - **An incised channel** (dredged or severely down-cut) results in bed erosion upstream
    - Usually in the form of a head-cut
  
  - **An aggraded channel** (as from a dam or overly wide) will result in deposition upstream
Incised or Entrenched Channels

- Streams that cannot access their floodplain at the bankfull flow are said to be incised or entrenched.
- Incised streams display high velocities & erosive forces during floods.
- Incised streams are almost always unstable.

After Rosgen 1996
Headcut Definition

- Instability that progress **upstream** and **downstream** from a local disturbance.
Headcut
Avulsion
Avulsions Definition

- **Avulsions are where the stream is no longer in its original channel**

- Is it ...
  - A threat to water quality?
  - A threat to property?
  - A better alignment?

- Is it possible to work with this new alignment?
Avulsions

- Do **NOT** work if there is no immediate danger to property or necessary infrastructure

- *Notify the municipality and local SWCD that there is an avulsion*
Avulsions

- Do work if property or infrastructure is in danger
- Ask for assistance from local SWCD or NYSDEC office
- If the repair must be made immediately
  - Bring the “new” bank up to the same elevation as the existing ground
  - Armor with large rocks if any are available
  - Notify local SWCD or NYSDEC office of the repair immediately

This repair will be temporary and will require careful monitoring
Platte Kill Avulsion 2009
Platte Kill Avulsion 2011
West Brook Avulsion 2006
West Brook Avulsion 2011 - Realignment
Flood Response
Flood Response

- Immediate Priority Items
- High Priority Items
- Assessment
- Repair
- Documentation and Further Needs
Immediate Priority

- **Immediate priority** items are those facilities and infrastructure which need to be repaired and/or kept open in order that further recovery may be allowed to continue, or to prevent immediate loss of human life.
Immediate Priority Items

- During or right after a flood some things must be done, including, but not necessarily limited to:
  - Opening clogged bridges
  - Opening closed roads
  - Keeping important installations functioning:
    - Power Plants
    - Fire Stations
    - Rescue Centers
    - Hospitals
    - Water Wells & Systems
    - Sewage Treatment Plants & Systems
Flood Repair

“Emergencies” – obvious problems

- Bridges plugged
- Roads severely damaged/closed
- Buildings (especially inhabited buildings) endangered
High Priority Items

- **High priority items** are those items that are necessary for the first part of the cleanup process.
- This course concentrates on getting channels back into some acceptable condition:
  - Open clogged channels
  - Put avulsed channels back in place
  - Stabilize actively eroding streambanks
  - Stabilize (even if only temporarily) landslides
  - Return the channel to a condition such that the natural processes of streams can begin to return it to its natural state
Assess the Stream Channels

- To decide where to work and where not to work
- To decide where to work first
- To identify the equipment and work force that will be required
- To identify reaches that require technical assistance
Where to Work – Channel Problems

- Actively eroding high banks
  - Eroding bank is heading toward infrastructure or homes
  - High sediment load from eroding bank
  - Another “small flood” would “blow out” the bank

- Channel blocks
- Debris at culverts
- Undermined revetments
- Impaired channel capacity
Actively Eroding High Banks
Channel Block
Debris at a Culvert
Undermined Revetment

- Revetment may become undermined due to:
  - Improper installation depth
  - Stream downcutting
Impaired Channel Capacity
Where Not to Work

- The channel dimensions are ok, or there has been little damage
- Banks are stable
- The channel bottom is imbricated
  - The gravel is “shingled” and is difficult to move
  - Moving the gravel around loosens it and erosion at the reach and deposition downstream
Caution – Steep Streams

- If the slope is over 4% the stream will probably be a step-pool system
- If the slope is 2-4% it could be a step-pool system
- If debris jam, remove debris
- Don’t try and clean the channel except for gravel material or logs at a debris jam
Would you work here?

- Single channel
- Meanders
- Floodplain
Would you work here?

- Single channel
- Some meander
- Stable banks
Is this what you would do here?
The lack of a floodplain will cause the stream to build one to maintain its natural functions.
This downstream adjustment created a head-cut upstream...
This slope was actively migrating as the stream continued to lower its bed to adjust its profile. This increased potential risk to those downstream.
Post-Flood Work

- Improper post-flood work can negatively affect:
  - Stream function
  - Stream stability
  - Aquatic habitat
  - Water quality
  - Local resources

- Improper post-flood work can add costs to future repair
Understanding Imbrication

- As storm flows subside bed material overlap and become wedged together like shingles
- Caused by water velocity
- Materials are less mobile
Understanding Imbrication

Rearranging the bed and banks loosens the material and makes it more transportable
Post-Flood Problem Itemization Sheet

- This is located in Appendix A in the Training Manual
- It lists problems commonly found after a flood
- Use a sheet for each stream reach
- Check off problems; add any notes/sketches that are necessary
- Customize the sheet to suit your needs
- Photos should be taken during the assessment
Post-Flood Problem Itemization Sheet

The advantages to using the Itemization Sheet are:

- Identify the location, number and types of problems on each reach
- Identify the most severely impacted reaches (keep in mind that some streams or reaches may not be impacted at all)
- Prioritize work on the most severely impacted reaches
- Determine manpower & equipment needs
- Revision of priorities may be required throughout assessment period
Post-Flood Problem Itemization Sheet

• The Itemization Sheet can serve as a record:
  
  • To document work done for state or federal reimbursement
  
  • This document can be attached to a permit application as additional information
  
  • To document work done under an emergency permit
**Immediate Post Flood Emergency Stream Intervention**

**Problem Itemization Sheet**

**Date:** 3/16/09  
**Time:** 2:30 PM

**Crew:** Joel V. Gale

<table>
<thead>
<tr>
<th>Stream</th>
<th>Platte Kill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Debris Jam at Bridge/Culvert</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge/Culvert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scour at Bridge/Culvert</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings exposed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undermining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mass Failure</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated height (avg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated length (avg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of failures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Debris/Log/Gravel Jams</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Avulsion</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated length</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Estimated width</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scouring/Down Cutting</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated depth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Head Cut</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated depth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gravel Deposits</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location - left side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>right side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated height</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Estimated length</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eroded Banks</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated length</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Further Documentation

- Recommended documentation during construction:
  - Before and After photos
  - Description of the work
    - Date
    - Time
    - Equipment
    - Material
    - Labor Force
Further Documentation

- Post Construction Review
  - Was the work performed satisfactorily and completely, and does it meet the needs identified on the Post-Flood Problem Itemization Sheet?

- Contact local SWCD or NYSDEC offices for assistance with:
  - Vegetation
  - Structures
  - Long Term Monitoring
Channel Sizing
Bankfull Flow

- Bankfull flow is the channel forming discharge

“The bankfull stage corresponds to the discharge at which the channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing the work that results in the average morphologic characteristics of the channel.”

Dunne and Leopold, 1978
Bankfull Flow

Adapted from Newbury & Gaboury, 1993
Channel Forming Discharge

- Channel forming discharge, effective discharge, and bankfull all have the same meaning.
- In Delaware County the channel forming discharge is approximately equal to the 1.5 year storm.
- The regional curves that give information about the size of the channel are based on the bankfull or channel forming discharge.
Effective Discharge
How the stream is created and maintained

After Wolman and Miller, 1960
Using an Existing Stable Reach

- Use of the tables may not be required
- A relatively undamaged reach may exist either upstream or downstream
- Measure the undamaged reach AT A RIFFLE & duplicate it in the damaged reach (draw a sketch)
  - Bankfull width and depth, floodplain width, bottom width, meander curve radius, and stream slope
- Call your local SWCD or NYSDEC office for assistance
Using an Existing Stable Reach

Points to measure on a stable riffle cross section

Survey rod or Ruler
Level
Bankfull
Thalweg
Channel
Floodplain

Note: Measure (and record) all horizontal distances with cloth tape.
Meander radius & slope
Regional Curves

- Based on USGS Data
- Information given is based on Drainage Area
- Represents the size & cross section of natural streams in this region
- Dimensions given – Bankfull Dimensions
  - Cross sectional area
  - Bankfull top width
  - Average bankfull depth (mean depth)
MAR<2.3

\[ W_{bf} = 8.05 \times DA^{0.60} \]
\[ R^2 = 0.94 \]

MAR<2.3

\[ A_{bf} = 7.01 \times DA^{0.93} \]
\[ R^2 = 0.95 \]

MAR<2.3

\[ D_{bf} = 0.87 \times DA^{0.33} \]
\[ R^2 = 0.88 \]
Regional Curves

- After a flood the channel dimensions have often been changed – too big or too small

- Sometimes it is difficult to determine the original size of the stream

- Use the Regional Curves to get reasonable bankfull dimensions
Regional Curves

- Proper width and depth are important

- For hydraulics
  - Sized to carry the bankfull flow
  - Moves the proper size and amount of sediment
  - Avoids erosion
  - Avoids deposition

- For the environment
Regional Curves

- Channel dimensions and aquatic habitat

Proper width and proper depth

Too wide and too shallow
Find Bankfull Channel Dimensions

- Tables have been provided that give the suggested construction dimensions in the Training Manual

- You need to know –
  - The drainage area at your site (square miles)
  - What basin you are in
What is a Drainage Area?

The drainage area is the area of the watershed that flows to the point that you are working.
Find Bankfull Channel Dimensions

• Drainage Area can be found:
  • Static maps for New York State are being developed
  • Streamstats New York:
    
    http://water.usgs.gov/osw/streamstats/new_york.html

• Instructions for use are on the left side of the webpage. Click on State Applications to access New York
  ❖ See Appendix D for the version that is up and running now

• Streamstats New York will provide regional curve data that can be used with the tables provided to generate construction dimensions