Level 1 Scour Evaluations

Michigan Bridge Scour Workshop
March 10, 2009
What is a Level 1 Scour Evaluation?

- It is an initial assessment of a bridge’s scour susceptibility.
- No calculations are done.
- It is used to determine the NBIS Item 113 Code and whether it needs a Level 2 Analysis or a Plan of Action.
- A Level 1 Evaluation should be done on all existing bridges.
Date:_________  By:_______    Structure No:_____  Control Section:________
Job No._________    Route:____________
Watercourse:__________________________________

All references are to HEC-20, 3rd Edition.

Data Collection

___ Plans
___ Bridge Inspection Reports (Maintenance Division)
___ Underwater Inspection Reports (Maintenance Division)
___ Review existing items 60, 61, 71, 92, 93, and 113 of the NBIS
___ Review available construction, design, and maintenance files for repair
  and maintenance work done on structure
Field Investigation       Date:__________

____ Channel bottom width approximately one bridge span upstream = _____feet

____ Overbank and channel Manning's roughness coefficients

__________ Left ___________ Channel ___________ Right

____ Is there sufficient riprap?   Abutments ___________   Piers ___________

____ Photographs

____ Cross sections at upstream and downstream faces of bridge

Comments:
<table>
<thead>
<tr>
<th>STATION</th>
<th>READING</th>
<th>ELEVATION</th>
<th>DESCRIPTION</th>
<th>READING</th>
<th>ELEVATION</th>
<th>DESCRIPTION</th>
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</table>
Stream Characteristics

Complete the attached Figure 2.6 from HEC-20.

Comments:

**Land Use:** Identify the existing and past land use of the upstream watershed:

- **Urban Area**
  - Yes__ Yes__ No__
  - Comments:

- **Sand and Gravel Mining**
  - Yes__ Yes__ No__
  - Comments:

- **Undeveloped Land**
  - Yes__ Yes__ No__
  - Comments:

**Lateral Stability:** Refer to HEC-20, Section 2.3.9 on Channel Boundaries and Vegetation for channel bank stability. Comment:
<table>
<thead>
<tr>
<th>Stream Size (Sec 2.3.2)</th>
<th>Small (&lt; 30 m (100 ft.) wide)</th>
<th>Medium (30-160 m (100-500 ft.))</th>
<th>Wide (&gt; 160 m (500 ft.))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Habit (Sec 2.3.3)</td>
<td>Ephemeral</td>
<td>Intermittent</td>
<td>Perennial</td>
</tr>
<tr>
<td>Bed Material (Sec 2.3.4)</td>
<td>Silt-Clay</td>
<td>Silt</td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Gravel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cobble or Boulder</td>
</tr>
<tr>
<td>Valley Setting (Sec 2.3.5)</td>
<td>No valley, alluvial fan</td>
<td>Low relief valley (&lt; 30 m (100 ft.) deep)</td>
<td>Moderate relief (30-360 m (100-1000 ft.) deep)</td>
</tr>
<tr>
<td>Floodplains (Sec 2.3.6)</td>
<td>Little or none (&lt; 2 x channel width)</td>
<td>Narrow (2-10 x channel width)</td>
<td>Wide (&gt; 10 x channel width)</td>
</tr>
<tr>
<td>Natural Levees (Sec 2.3.7)</td>
<td>Little or none</td>
<td>Mainly on concave</td>
<td>Well developed on both banks</td>
</tr>
<tr>
<td>Apparent Incision (Sec 2.3.8)</td>
<td>Not Incised</td>
<td>Probably Incised</td>
<td></td>
</tr>
<tr>
<td>Channel Boundaries (Sec 2.3.9)</td>
<td>Alluvial</td>
<td>Semi-alluvial</td>
<td>Non-alluvial</td>
</tr>
<tr>
<td>Tree Cover on Banks (Sec 2.3.9)</td>
<td>&lt; 50 percent of bankline</td>
<td>50-90 percent of bankline</td>
<td>&gt; 90 percent of bankline</td>
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<tr>
<td>Sinuosity (Sec 2.3.10)</td>
<td>Straight Sinuosity (1-1.05)</td>
<td>Sinuous (1.06-1.25)</td>
<td>Meandering (1.23-2.0)</td>
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<tr>
<td>Braided Streams (Sec 2.3.11)</td>
<td>Not braided (&lt;5 percent)</td>
<td>Locally braided (2-33 percent)</td>
<td>Generally braided (&gt; 35 percent)</td>
</tr>
<tr>
<td>Anabranching Streams (Sec 2.3.12)</td>
<td>Not anabranching (&lt;35 percent)</td>
<td>Locally anabranching (2-33 percent)</td>
<td>Generally anabranching (&gt; 35 percent)</td>
</tr>
<tr>
<td>Variability of Width and Development of Bars (Sec 2.3.13)</td>
<td>Narrow point bars</td>
<td>Wide point bars</td>
<td>Irregular point and lateral bars</td>
</tr>
</tbody>
</table>

Figure 2.6. Geomorphic factors that affect stream stability (adapted from Brice and Blodgett). (10)
Stream Characteristics

___ Complete the attached Figure 2.6 from HEC-20.

Comments:

**Land Use:** Identify the existing and past land use of the upstream watershed:

- Urban Area: Yes__ No__ Comments:
- Sand and Gravel Mining: Yes__ No__ Comments:
- Undeveloped Land: Yes__ No__ Comments:

**Lateral Stability:** Refer to HEC-20, Section 2.3.9 on Channel Boundaries and Vegetation for channel bank stability. Comment:
Vertical Stability:

- streambed elevation change from as-built plans? Yes _____ No _____
- exposed pier footings (degradation)? Yes _____ No _____
- exposed abutment footings (degradation)? Yes _____ No _____
- channel bank caving in (degradation)? Yes _____ No _____
- eroding floodplain (aggradation)? Yes _____ No _____
- crossing at confluence or tributaries? Yes _____ No _____
- bridge sites upstream and downstream? Yes _____ No _____
- grade or hydraulic controls, i.e. dams, weirs, diversions? Yes _____ No _____
- foundation on rock Yes _____ No _____
- channel armoring potential Yes _____ No _____
Stream Stability: Make a qualitative assessment of the overall stream stability by referring to the above information and Figure 2.6 and Table 3.2 from HEC-20 (attach copies of figures).

Stable_____ Unstable_____ Degrading _____ Aggrading _____

Comments:

RECOMMENDED NBIS ITEM 113 CODE: _____

LEVEL TWO ANALYSIS NEEDED: YES___ NO___

Worksheet approved by: ____________________ P.E. License # __________

Date __________
ITEM 113 CODES

U

Bridge with “unknown” foundation that has not been evaluated for scour. Until risk can be determined, a plan of action should be developed and implemented to reduce the risk to users from a bridge failure during and immediately after a flood event.
ITEM 113 CODES

9

Bridge foundations (including piles) on dry land well above flood water elevations
ITEM 113 CODES

8

Bridge foundations determined to be stable for the assessed or calculated scour condition. Scour is determined to be above top of footing by assessment, by calculation or by installation of properly designed countermeasures.
ITEM 113 CODES

6

Scour calculation/evaluation has not been made.

4

Bridge foundations determined to be stable for assessed or calculated scour conditions; field review indicates action is required to protect exposed foundations.
ITEM 113 CODES

3

Bridge is scour critical; bridge foundations determined to be unstable for assessed or calculated scour conditions:

• Scour within limits of footings or piles.
• Scour below spread-footing base or pile tips.
ITEM 113 CODES

2

Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations, which are determined to be unstable.
ITEM 113 CODES

1

Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic.

0

Bridge is scour critical. Bridge has failed and is closed to traffic.
ITEM 113 CODES FOR CULVERTS

Culverts with structural bottoms may be coded as 8, UNLESS there is evidence of soil loss or road settlement.

If there is evidence of erosion around the culvert that may cause instability of the culvert or roadway, code the culvert as 0 through 3 as appropriate.
ROADWAY

CULVERT

SCOUR OCCURRED HERE
Abutment Scour Equation

\[ \frac{y_s}{y_a} = 2.27 K_1 K_2 \left( \frac{L'}{y_a} \right)^{0.43} Fr^{0.61} + 1 \]