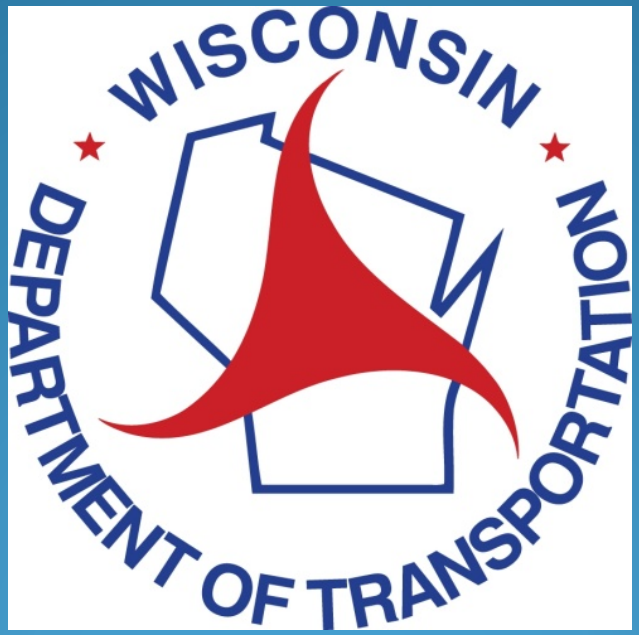
Bridge Scour Repair Workshop

2.0 Design Considerations

Session Facilitator: Jim Bakken



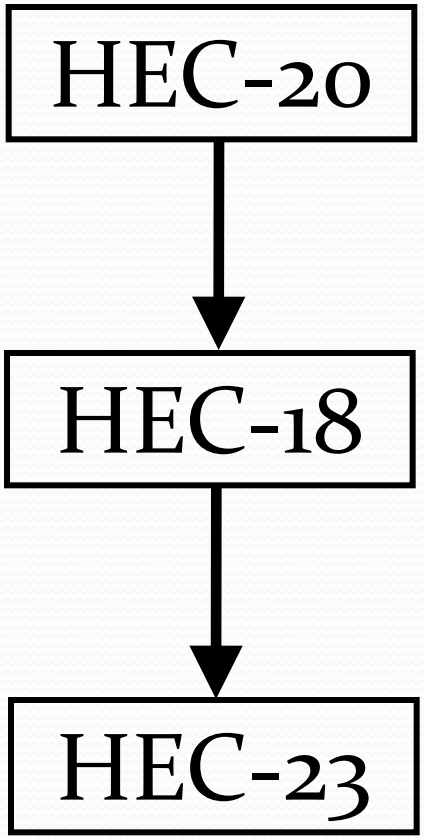
This presentation was prepared by Ayres Associates engineers and is part of National Highway Institute coursework.

Bridge Scour

1. Inspection

2. Countermeasure selection

COMPREHENSIVE METHODOLOGY



1. Bridge Scour Inspection

- Stream instability
- Scour components

LONG-TERM DEGRADATION

- What factors cause change?

CHANNEL DEGRADATION

CHANNEL DEGRADATION AND LOCAL SCOUR

ESTIMATING LONG-TERM CHANGE

- Bridge inspection records
- Geology and stream morphology

CHANNEL INSTABILITY (HEAD CUT)

AGGRADATION

- What factors cause change?

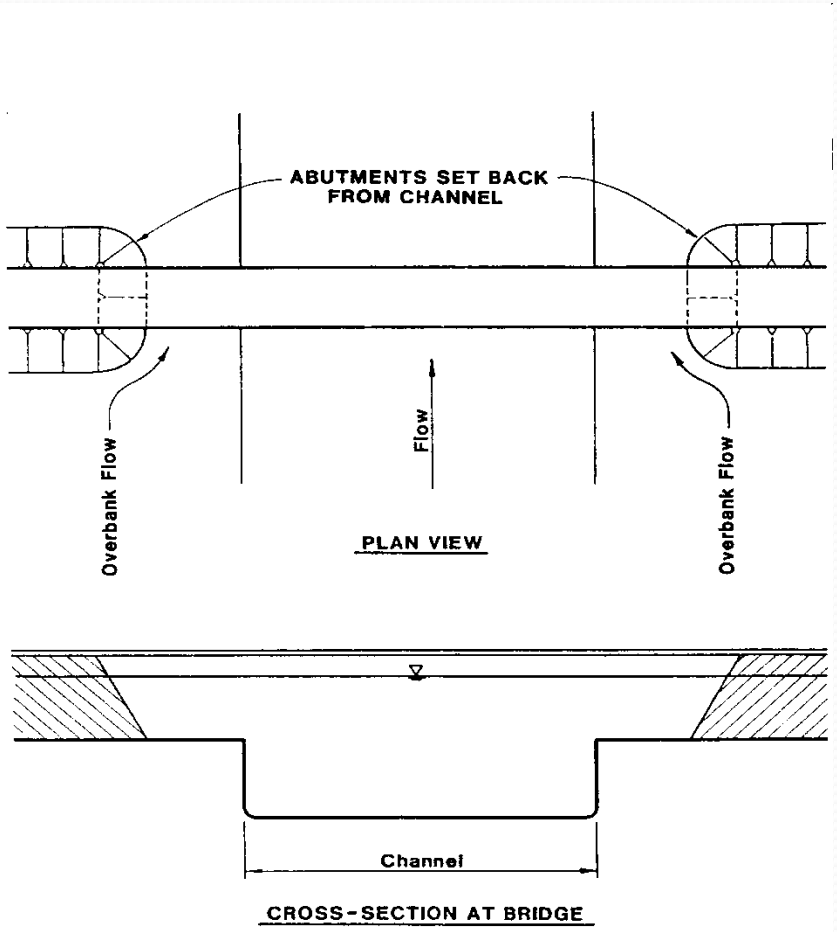
AGGRADATION

CONTRACTION SCOUR

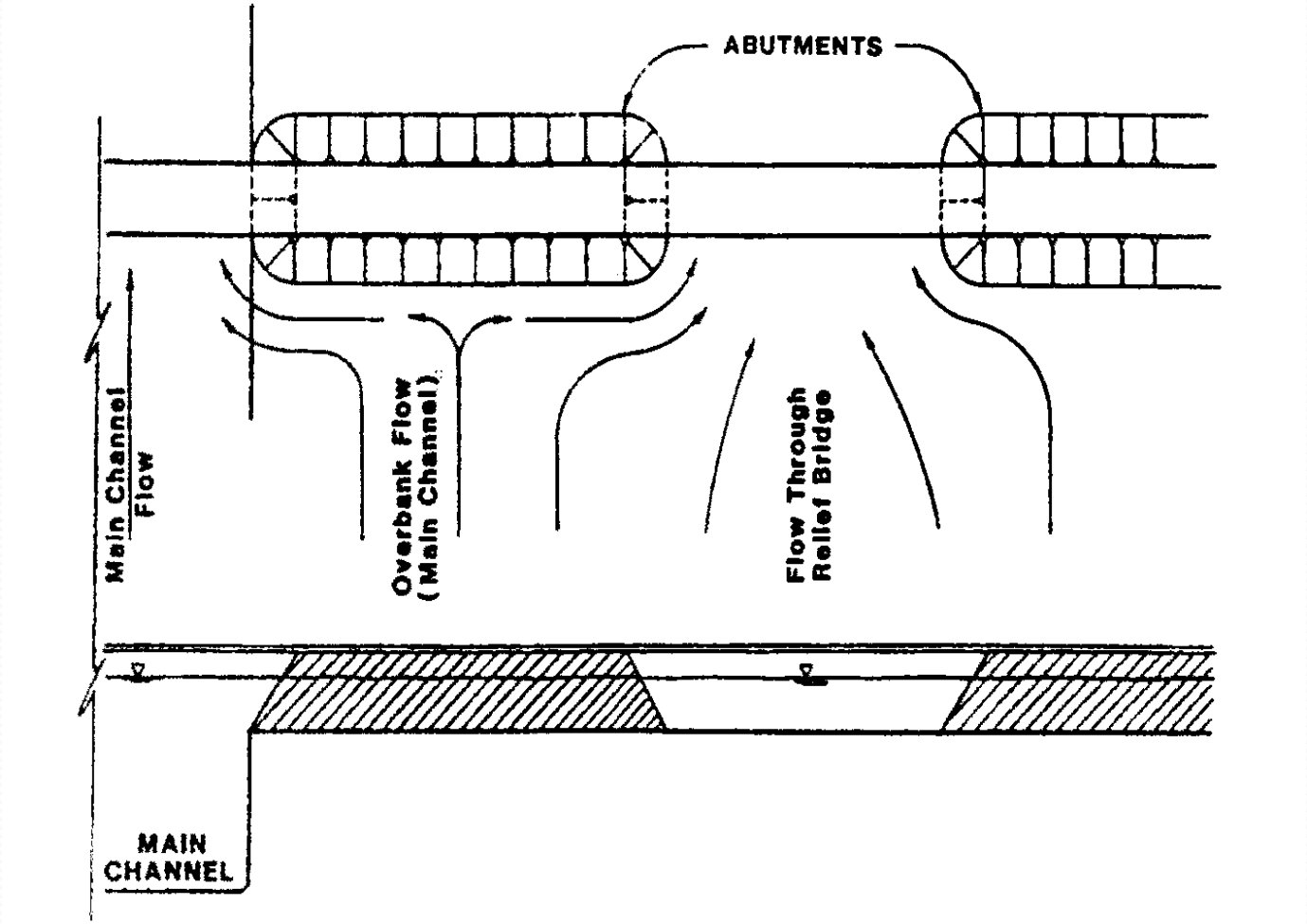
- General lowering across bridge opening
- May not be uniform in depth
- Scour may be cyclic

CONTRACTION SCOUR

CONTRACTION SCOUR (ABUTMENT SET BACK FROM CHANNEL)

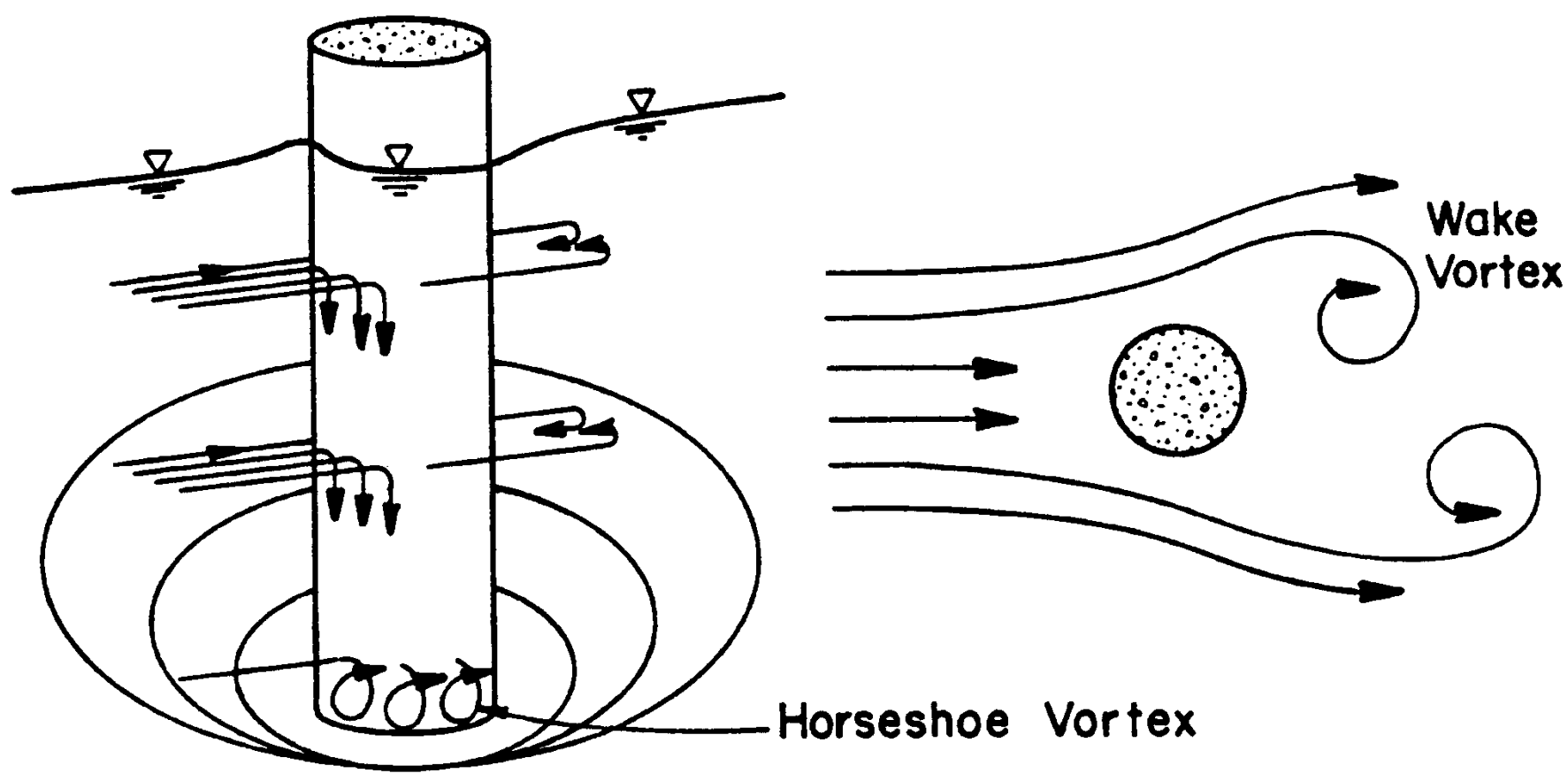


CONTRACTION SCOUR
(RELIEF BRIDGE OVER FLOODPLAIN)

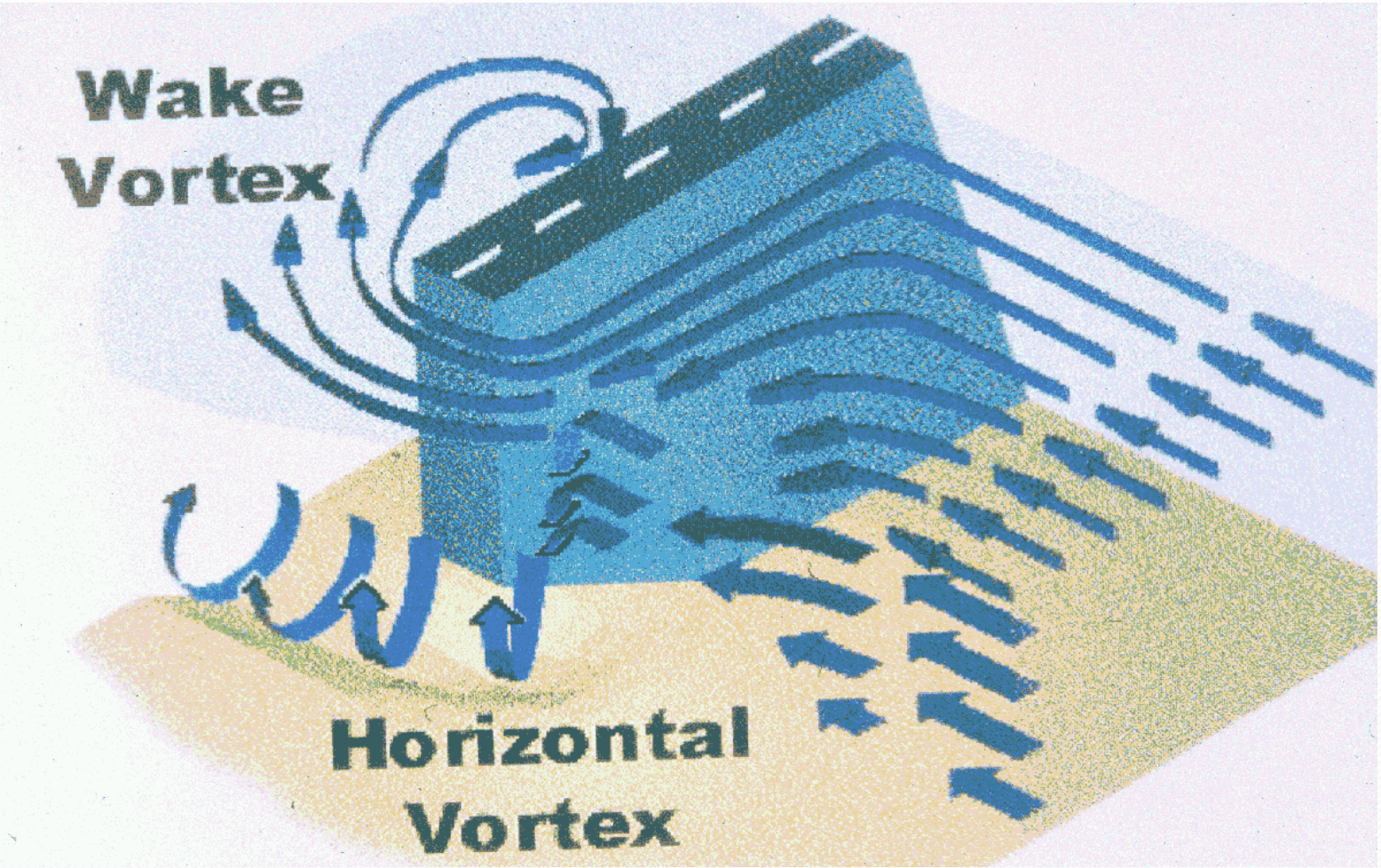


CONTRACTION SCOUR

LOCAL SCOUR AT PIERS



LOCAL SCOUR AT ABUTMENTS



EVALUATING SCOUR AT BRIDGES

Technical Advisory T 5140.23

http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/t514023.cfm

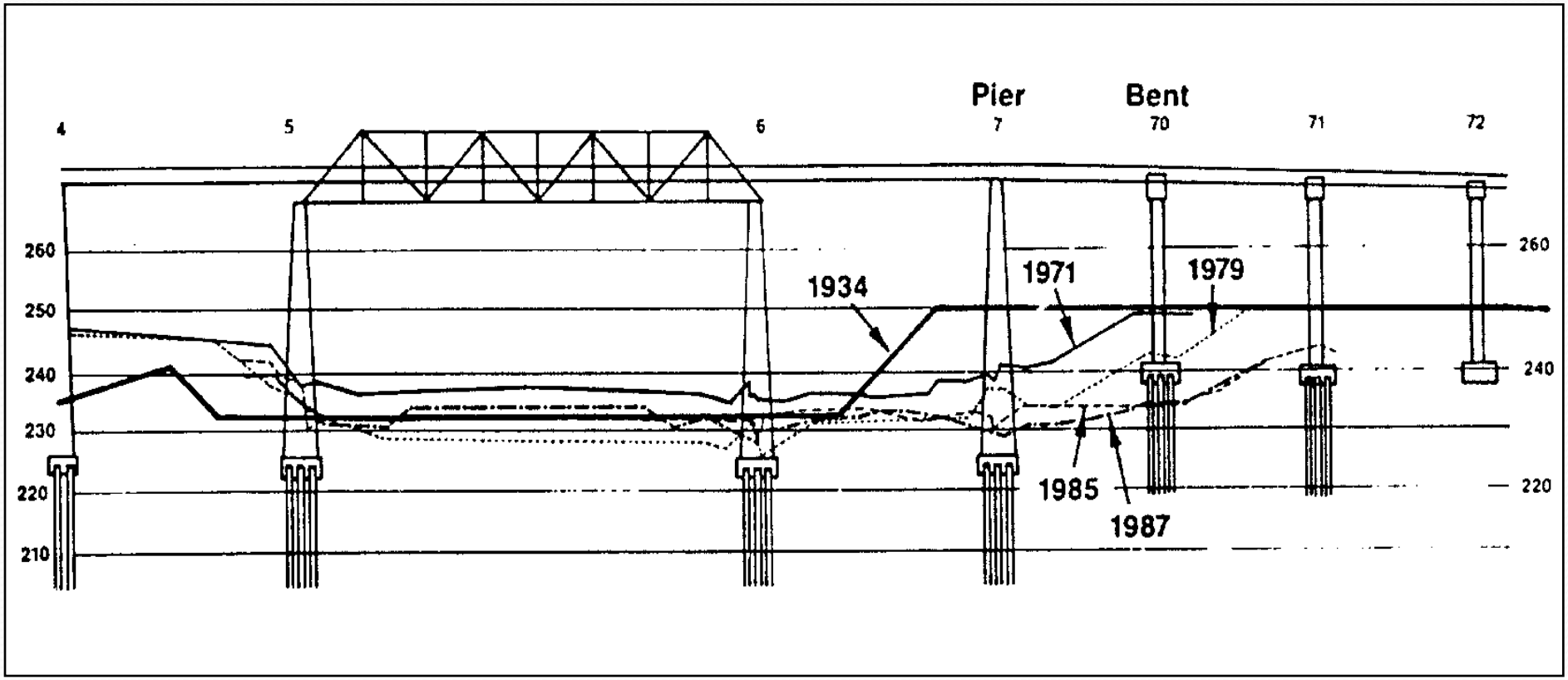
SCOUR EVALUATIONS

- Bridge inspectors should receive training and instruction in inspecting bridges for scour
- Results of evaluation coded in Item 113
- A Plan of Action (POA) shall be developed and implemented for scour critical bridges

BRIDGE INSPECTORS

- Should accurately record the present condition of the bridge, including cross section measurements

HATCHIE RIVER CHANNEL MIGRATION



BRIDGE INSPECTORS

- Should identify conditions indicative of potential problems with stream instability and scour
- Effective notification procedures should be available to permit proper communication of scour findings

2. Bridge Scour Countermeasures

- A countermeasure controls, inhibits, changes, delays, or minimizes stream instability and scour problems
- Monitoring is considered a countermeasure but does not fix the problem

BRIDGE SCOUR
General Categories

- Long-term degradation
- Contraction scour
- Local scour

COUNTERMEASURES FOR DEGRADATION

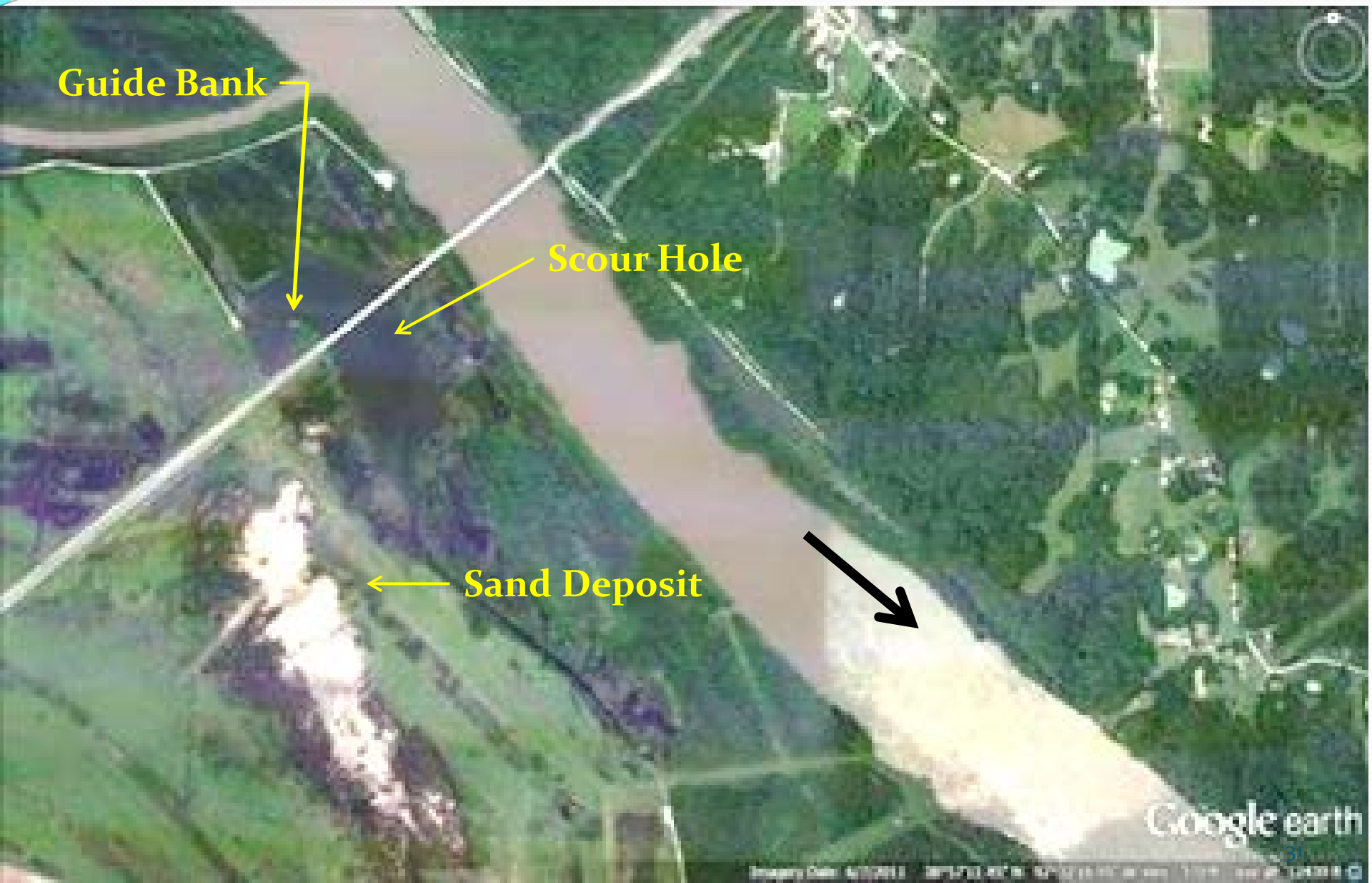
- Check dams
- Drop structures

COUNTERMEASURES FOR CONTRACTION SCOUR

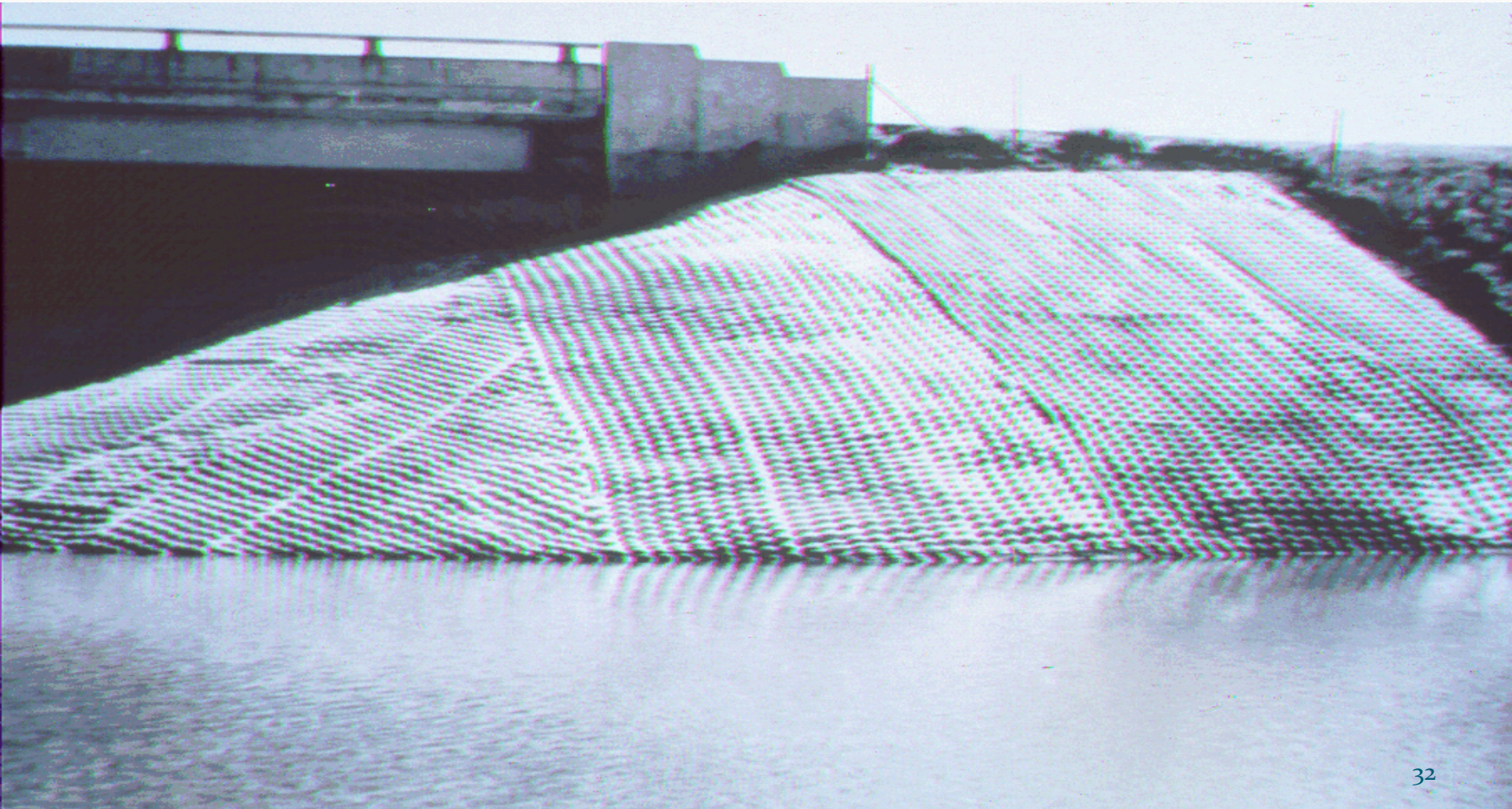
- Increase bridge opening
- Decrease discharge through bridge opening by adding a relief bridge
- Improve alignment of flow

ABUTMENT SCOUR COUNTERMEASURES

- Guide banks
- Revetments
- Bulkheads
- Riprap


Guide Bank
Scour Hole
Sand Deposit
Google earth

GROUT FILLED MATTRESS



COUNTERMEASURES FOR SCOUR AT PIERS

- Streamline and align piers to flow
- Increase spacing of piers and columns
- Riprap is not recommended as a countermeasure for pier scour at new bridges
- Riprap can be considered as a countermeasure to reduce the risk at existing bridges, but only with monitoring after high flows

MONITORING

- Fixed instruments
- Portable instruments
- Inspection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SELECTION OF COUNTERMEASURES

- Identify stream instability and scour countermeasures implemented by various DOTs
- Provide a matrix which summarizes countermeasure application throughout the US
- Provide guidance for selecting countermeasures for a Plan of Action

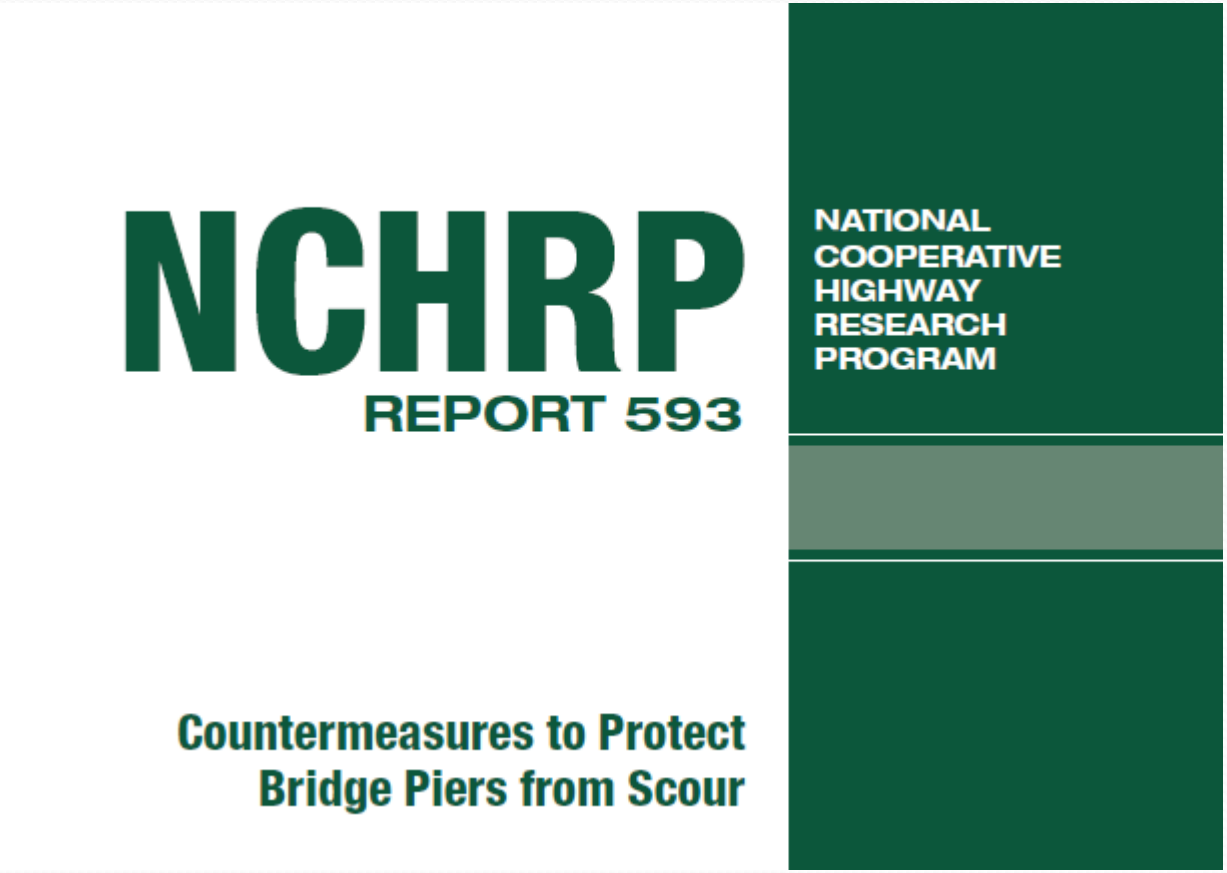
THE COUNTERMEASURES MATRIX

- Countermeasure Groups
- Functional Applications
- Suitable River Environment
- Maintenance
- Installation Experience by State
- Design Guideline References

SCOUR COUNTERMEASURES

- Given a stream stability and/or bridge scour problem, select appropriate countermeasures to correct the problem(s) considering functional applications and river characteristics

PIER SCOUR COUNTERMEASURE SELECTION SUPPORT SYSTEM



PIER SCOUR COUNTERMEASURE SELECTION SUPPORT SYSTEM

$$SI = (S1 \times S2 \times S3 \times S4)/LCC$$

Where:

SI = SELECTION INDEX

S1 = Bed Material Factor

S2 = Ice/Debris Loading Factor

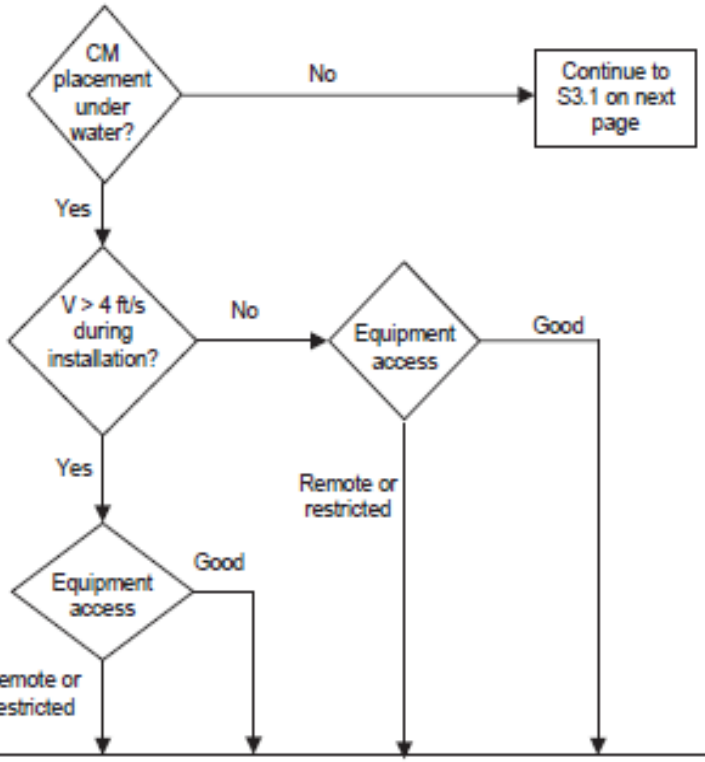
S3 = Constructability Factor

S4 = Inspection/Maintenance Factor

LCC = Life-Cycle Cost

(Appendix B in NCHRP Report 593)

Factor S3: Construction Considerations



Recommended values for S3	SF*	DF	SF	DF	SF	DF	SF	DF
Riprap	0	2	1	5	1	3	2	5
Partially Grouted Riprap	0	0	0	0	2	4	0	5
Articulating Concrete Blocks	0	0	1	1	2	2	0	4
Grout-Filled Bags	0	1	1	2	1	3	1	5
Grout-Filled Mattresses	0	0	0	0	3	3	0	4
Gabions, Gabion Mattresses	0	0	0	1	1	1	0	3

*Note: Armoring countermeasures not recommended for these conditions.

SF = Shallow Pier, e.g. Spread Footing DF = Deep Footing

Review

- Bridge Scour Inspection
  - Scour components
  - Inspection documentation
- Countermeasure Selection
  - Stream stability
  - Suitability
  - Monitoring