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# Handbook of Scour Countermeasures Designs

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## BACKGROUND

Scour critical bridges across New Jersey, depending on the bridge ownership, are retrofitted using different countermeasure standards. This handbook has been prepared with a goal to provide a unified guideline for design of scour countermeasures for both new and old bridges in New Jersey.

## HERE'S THE PROBLEM

Use of different countermeasures results in a potentially inefficient retrofit and a reoccurring problem.

## AND, HERE'S THE SOLUTION…

A handbook on scour countermeasures that presents detailed guidelines on developing countermeasure designs and reducing scour problems at bridges based on current state of the practice across the country has been developed. The Manual can be used as a standard guideline across the state to retrofit all scour critical bridges, including those owned by counties and cities.

## THESE ARE OBJECTIVES…

The focus of the handbook is on scour mitigation of both existing and new bridges. Old and new bridges need different solutions. Existing scour critical bridges vary in the severity of scour. The following types of simple solutions are required:

a. Monitoring only
b. Repairs
c. Rehabilitation
d. Replacement

For each simple solution, monitoring and nominal countermeasures will be necessary. In severe scour cases, river training measures such as constructing relief bridges may be required.

The contents of the handbook are based on a review of all available resources on bridge scour and countermeasures. Primary objectives of the Handbook are to:

1. Identify scour conditions specific to New Jersey bridges and address scour for both existing and new NJ bridges.
2. Provide a matrix for the selection of countermeasures by developing recommendations specific to New Jersey.
3. Provide solutions for the design of state-of-the-art countermeasures, including remote monitoring techniques and underwater inspection methods.
4. Provide an easy to follow countermeasure design approach by providing all important information/guidelines in a sequence of a design process.
5. Implement or supplement the provisions of FHWA Publications HEC-18 and HEC-23.
6. Develop a standard handbook for use by all engineers across New Jersey.
7. Develop various tables highlighting advantages and disadvantages of various countermeasures.
8. Develop detailed guidelines on constructability, environmental considerations and permitting issues specific to New Jersey.
9. Provide a method of solutions and practical examples.

A detailed review of AASHTO Codes, the NJDOT Bridge Structures Design Manual, NJDOT Soil Erosion and Sediment Control Standards, FHWA Hydraulic Engineering Circulars (HEC) Nos. 11, 18, 20 and 23 has shown that the following issues need to be addressed in the handbook:

1. The importance of inspection and monitoring.
2. Use of structural and a more stable countermeasure than riprap.
3. Repair details for concrete and masonry footings for existing bridges.
4. Evaluation of unknown foundations by applying NDT techniques.
5. Addressing environmental issues; such as, meeting the requirements of a stream encroachment permit application.
6. Emphasizing the need for teamwork and coordination between structural, hydraulic and geotechnical engineers.
7. Developing a uniform scour report writing format.

Additional objectives of the Handbook are:

1. Understanding erosion science and failure types.

2. Identifying field data and variables for a parametric study of erosion and scour depths.
3. Applying the correct methodology and understanding limitations of scour theory.
4. Making it easy for selecting appropriate countermeasures.
5. Identifying and using the correct software.

HERE IS WHAT WE DID…

A scour countermeasure design handbook that addresses all objectives described above has been developed for engineers in New Jersey. The handbook can be used for planning and design of a new bridge, design of countermeasures for an existing bridge and provides guidelines for in-depth scour study of a bridge site.

All important conditions specific to scour conditions in New Jersey have been identified through an in-depth review of NJDOT Phase II inspection reports of scour critical bridges. A detailed review of all available resources on scour countermeasure design, including HEC 11, 18, 20 and 23, CIRIA Manual (2002), NCHRP 24-07 report, scour countermeasure drawings by Maryland State Highway Administration and numerous research articles on scour countermeasure design has been carried out to recommend effective countermeasures suitable to river conditions in New Jersey. Guidelines proposed for selected countermeasures are based on their effectiveness during past applications around the world, physical tests and the best design practice followed in the subject area.

CONCLUSION:

The handbook presents comprehensive guidelines on all aspects of various scour countermeasures, including constructability and environmental constraints specific to New Jersey. The design guidelines presented in this handbook supplement Hydraulic Engineering Circulars and have been developed with an aim to provide the engineers all important aspects of scour countermeasure design for New Jersey conditions in a collective and systematic manner.

WHAT IS THE NEXT STEP?

The Handbook doesn't cover the following aspects of scour design:

1. Scour of embankments
2. Tidal flow

New scour countermeasures for bridge abutments may be available because of soon-to-be completed research funded by NCHRP. The handbook should be updated to include these aspects in future.

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A final report is available online at

http://www.state.nj.us/transportation/refdata/research/ReportsDB.shtm

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:

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