

New Jersey
Bridge Scour Evaluation Program
Stage II – Phase 4

SCOPE OF WORK

The consultant shall perform the following tasks as part of the in-depth scour evaluation:

1. Data Collection and Review

The consultant shall collect, organize and review available data which is pertinent to the in-depth scour evaluation of each of the waterway bridges listed in the consultant's contract. The data that will be required shall be either obtained or, where possible, provided to the Consultant:

- Stage I Bridge Scour Evaluation Report
- Contract Plans
- FEMA Flood Insurance Studies
- Bridge Evaluation Survey & Underwater Inspection Reports
- Foundation Reports and Boring Logs
- Existing Hydraulic and Hydrologic Models

As part of the data collection effort, the consultant will be responsible for determining if any computer based hydraulic/hydrologic models are presently available for the site and their validity to current conditions and configurations for the channel. Typically, this information is in the form of a HEC-2 analysis, which if undertaken as part of the FEMA Flood Insurance Study, can be obtained from the NJDEP Bureau of Flood Plain Management. In addition to the NJDEP, existing hydraulic models from prior FEMA studies can be obtained from FEMA through their consultant. If this approach is proposed it should be noted in the proposal and the appropriate amount of out-of-pocket expenses included.

2. Field Investigation

The consultant shall perform a field investigation of each bridge site listed in their contract. An interdisciplinary team of licensed structural, hydraulic and geotechnical engineers will perform this survey. The investigation will include, but is not limited to:

- a. Visual observations, verification or collection of the required information. The appropriate Sections of HEC-18 and HEC-20 (titled "Stream Stability at Highway Structures") can be utilized for guidance in the evaluation of existing conditions.

As part of the field investigation, probing of the soil adjacent to any substructure unit is required. This investigation is limited to only those substructure units that are being evaluated and are accessible by foot or wading. This probing should be used to identify areas of loose sediment, scour holes or organic debris as well as the approximate location of the footing. The results of this investigation should be documented in the Scour Evaluation Report.

- b. Photographic documentation of the bridge elevation, and the general configuration of the substructure elements and the upstream and downstream channel and any existing scour related conditions
- c. Measurement of soundings at each fascia for all bridges. For bridges with roadway widths greater than two lanes, soundings will also be measured along the centerline of roadway. These soundings should be in accordance with the procedures included in the Department's Guidelines Manual for the Underwater Inspection and Evaluation of New Jersey Bridges.
- d. Evaluation of waterway and channel characteristics, including the evaluation of channel and overbank roughness coefficients, and the location of additional waterway cross-sections as required to reflect conditions that are substantially different than those utilized for the hydraulic study.
- e. Collection of soil samples adjacent to the footings at any bridge substructure unit that is being evaluated and in the stream channel. The samples shall be collected using augers or other hand excavation methods.

3. Determination of Scour Analysis Variables

The consultant shall determine the variables required to calculate the potential depth of scour and evaluate susceptibility of the existing foundations to scour damage. The level of effort at each site will depend on both the availability of data collected as part of the prior tasks. The information required for the analysis, which is described in more detail below, pertains to the following four categories:

- a. Hydraulic/Hydrologic - Flood discharges, velocities, etc.
- b. Survey - Channel configurations at bridge, upstream, downstream, etc.
- c. Geotechnical - Available soil parameters, historic scour limits, etc.
- d. Foundation Details - Type, configuration, etc.

Additional information on the procedures and requirements for obtaining information for each of the following items are provided in the Stage II Guidelines Manual.

a. Hydraulic/Hydrologic

For all bridges, information based upon a hydraulic study of the waterway for various flood conditions is required for the scour analysis. The bridge sites included in the scope will consist of two general types: those that have prior hydraulic studies and those for which no prior hydraulic studies are currently available.

For those bridge sites that have been determined to have an acceptable hydraulic study available, the consultant will be responsible for obtaining the prior study, performing a review and determining if any significant physical changes have occurred either along the waterway or in the watershed that would make the validity of the results questionable.

Examples of studies that would typically be considered acceptable include those performed by FEMA, the U.S. Army Corps of Engineers, U.S. Soil Conservation Service, U.S. Geological Survey and the NJDEP.

For those bridges where it has been determined by the consultant that there is no prior hydraulic study available or significant changes have occurred either along the waterway or in the watershed which invalidate the results of the prior hydraulic study, the consultant will be responsible for determining flood discharges and other variables necessary for the scour analysis.

The techniques utilized for determining the variables at non-tidal waterways will typically be the same as those established by the NJDEP in their “Technical Manual for Land Use Regulation Program Bureau of Inland and Coastal Regulations Stream Encroachment Permits”. In addition to the HEC-RAS (or HEC-2), set forth as one evaluation method, the FHWA’s WSPRO Computer model can also be utilized.

The techniques used for determining the variables at tidal waterways should follow the recommendations provided in the “Tidal Hydraulic Modeling for Bridges” Users Manual (dated December 1997), which was prepared by Ayres Associates as part of the Pooled Fund Study. For the NJDOT Bridge Scour Evaluation Project, either the approximate methods (i.e., Tidal Prism Approach and Orifice Approach) or the use of the one-dimensional UNET model will be adequate for most locations.

b. Survey

As part of the evaluation of the distribution of flood flows at the site, cross sections at the bridge and at the upstream and downstream channels are necessary. For bridges with a prior hydraulic study, cross-sections will generally be available for this purpose. Where no hydraulic study is available, or the conditions are such that the available sections are not representative of the current conditions, survey for cross-sections may be necessary. The consultant in accordance with current Department technical requirements used for bridge design projects will obtain surveyed cross-sections.

c. Geotechnical

For all bridges, available subsurface information will be reviewed to help evaluate potential scour depths and evaluate historic scour related conditions at the bridge site.

d. Foundation Details

In order to evaluate the potential vulnerability of a bridge to scour damage, information on the foundation details is required. The bridges in the project will generally fall into three categories in regard to available foundation information: bridges with adequate foundation details; bridges with limited or missing foundation details; and bridges with no foundation information.

The consultant should make a determination of what foundation data is available based upon a review of available plans. Additional efforts may be required to further research

Department and/or county files if the plans provided are incomplete and it appears more data is possibly available either for the bridge to be studied or for an adjacent structure (which may provide supplemental information).

If no or only limited foundation details are available, the consultant will follow a phased approach for the scour evaluation process. The approach to these structures will vary depending on the extent of information available, as well as the type of foundation present. The first phase of the evaluation process will not involve the use of nondestructive testing (NDT) techniques, unless specifically authorized by the Department.

In the first phase, for bridges with missing foundation information related to the approximate depth and dimensions of the footing, the consultant will use probing, hand augers or other available data to determine the approximate dimensions of the footing. The methodology and/or rationale for the approach used should be documented in the Field Survey Results portion of the Report.

For bridges where piles are known to exist, the consultant, in the first phase, should evaluate the existing information to determine if an approximate pile length or other details can be established. For example, if it is known that piles are present and information on the plans is available to determine average or approximate pile lengths, the inferred length will typically be sufficient to perform the evaluation. The methodology and/or rationale for the approach used should be documented in the Field Survey Results portion of Section 2 of the Report. If no information is available to establish pile length or other details, the data available should also be documented in the Report.

With this information, the consultant will perform the scour depth calculations and the scour evaluation in accordance with the remaining provisions of the scope of work. For bridges on spread footings, or where piles are not known to exist, the scour critical evaluation will be made based upon the calculated scour depth and its relationship to the approximate dimensions of the footings.

For bridges known to be founded on piles, the length of pile exposed due to scour should be determined as part of the first phase. If the length of exposure is five feet or less, the bridge will be classified as stable and SI&A Item 113 will be given a rating of "4" or "5". An exception to this would be a case where pile lengths can be estimated and are known to be twenty feet or less. In this case, the consultant should evaluate whether the bridge requires additional evaluation or should be classified as scour critical and SI&A Item 113 given a rating of "3". If the exposed length is greater than twenty feet, the bridge should be classified as scour critical and SI&A Item 113 should be given a rating of "3".

For bridges with an exposed pile length of between five and twenty feet, the consultant should evaluate the extent and cost of the additional analysis or non-destructive testing that will be required to determine the scour critical classification of the bridge. For these bridges, the estimated cost of scour countermeasures should also be determined for any potentially scour critical substructure element. The consultant should compare the two estimates and make a recommendation on a course of action that should be included in

the scour evaluation report. If the Department decides to undertake the additional study, it will be performed as extra work in a second phase of the analysis.

In cases where the consultant feels that it is necessary to obtain additional foundation data, the use of nondestructive testing (NDT) techniques are recommended. Information on the types and applications for the various testing methods are available in FHWA's Geotechnical Engineering Notebook Issuance GT-16 "Determination of Unknown Subsurface Bridge Foundations", dated August 27, 1998.

Data Collection Memorandum:

Based upon the information collected as part of Tasks 1 and 2, the consultant will make an assessment of the amount of data presently available and the amount of additional data required to complete the scour analysis. Based upon this assessment, the consultant shall prepare and submit for Department review three (3) copies of a Data Collection Memorandum for all bridges in the contract. This document should include a discussion on: the information currently available; recommendations and rationale for use of particular methods for obtaining additional required information; estimated direct expense, labor costs and time required to collect the additional information for the recommended methods. The consultant should prioritize the recommendations for additional information in order to stay within the cost ceiling established for the contract.

After Department review of the memorandum, a meeting will be held to review the findings and decide on a course of action to be followed. When an outside subconsultant is required, the consultant will be responsible for preparing contract documents and obtaining a minimum of three (3) cost proposals to perform these services. The consultant is also responsible for review of the proposals, recommendation of award and administration of the subcontract.

Prior written approval must be obtained from the Department before employing any outside services (reimbursable expenses). Consultants will not be reimbursed for expenses incurred prior to such written approval.

4. Scour Analysis and Evaluation

The consultant shall calculate the depth of scour and develop and evaluate cross sections showing the scour depth at the bridge site. All work will be carried out in accordance with the procedures documented in the current FHWA publication HEC-18 titled Evaluating Scour at Bridges. The analysis will also include an assessment of the effects of long-term changes in the streambed.

In accordance with this FHWA Publication, HEC-18, this effort should include the evaluation of long-term bed elevation changes and the determination of the proper scour analysis method. Computations should be performed for the magnitude of: contraction scour; local scour at pier(s), if required; and local scour at the abutments.

The consultant should calculate contraction and local scour values for the 50-year, 100-year and 500-year discharge events. If the discharge value for the 500-year event is not available, it can be estimated in accordance with the procedures given in HEC-18. In accordance with the procedures and methodology presented in HEC-18, the equations should be utilized for both riverine and tidally influenced waterways.

Based upon the results of the calculations and evaluations, scour depth cross-sections should be developed for each discharge event which illustrate: the general configuration of the bridge; the location and depth of the bridge foundations; and the depths of the various scour components (long term, contraction, local)

Based upon these cross-sections, the existing substructure units shall be evaluated/analyzed for horizontal and vertical stability. The depths of scour should be evaluated/analyzed for reasonableness based upon actual records for storms and/or scour holes and the potential effect of lateral stability of the waterway.

The "scour critical" classification for the bridge should be determined based upon the coding criteria given for Item No. 113 in the FHWA Recording and Coding Guide. The results and commentary on this evaluation shall be included in the Bridge Scour Evaluation Report. In addition, the existing codings for Item Nos. 61 and 71 should be reviewed based upon the information obtained during this study and coded with commentary as required.

5. Bridge Scour Evaluation Report

The consultant shall prepare a report documenting the results of the Stage II in-depth bridge scour evaluation will be prepared for each bridge site. The report will be GBC bound and in the format provided in Guidelines Manual.

The consultant shall submit two (2) copies of the first preliminary report to the state for review and general approval of format within six (6) months of the notice to proceed. Two (2) copies of all remaining Preliminary Reports shall be submitted to the state for review within eight (8) months of the notice to proceed. The county shall receive one (1) additional copy of all reports for their review according to the same schedule.

The consultant should submit the required number of the final Bridge Scour Evaluation Reports within twelve (12) months of the notice to proceed. The reports should incorporate all Preliminary Report comments, unless otherwise specified. All copies of the reports shall contain color copies of the digital images. In one copy of the final report, a disk containing the hydraulic analysis should be provided.

After the reports have been reviewed and accepted, the Final Reports shall be scanned in accordance with the current NJDOT scope and specifications. The consultant shall review the quality of the scanned images to verify that they are acceptable and in accordance with the Department guidelines. Two copies of the CD-ROM containing all of the bridges in the contract should be submitted for state scour projects. For county bridge projects, the number of copies will be determined on a case-by-case basis.