

3.5 Hydraulic Design Development for Structure Type Studies

3.5.1 General

The preliminary design phase for structures is referred to as the Structure Type Study Phase. The purpose of this submission is to provide alternative structures that may be feasible based on design criteria and environmental conditions.

It is important at this stage of the structural design not only to develop water surface models with structures that are hydraulically adequate but also to develop models that consider the environmental permit requirements as related to fish passage, floodplain management and stream channel encroachment line involvement.

3.5.2 Procedure

The procedure to prepare the hydraulic studies associated with the Structure Type Study for crossings conveying a drainage area equal to or greater than 2.59 km² (1.0 square mile) includes the following:

Step 1... Ensure that the hydraulic engineer performing the hydraulic design is approved by ConnDOT. Given the complexity and time required for hydraulic analyses, it is important that the hydraulic engineer is familiar and understands the Department's procedures and requirements for advancing a hydraulic design. The procedure and guidelines for approval are outlined in Section 1.2.4 of this Manual.

Step 2... Submit the hydrology to the Department with recommended discharges for the crossing. Chapter 6 of this Drainage Manual discusses the various accepted methodologies that can be applied for drainage areas of this magnitude. The documentation that should be included in this submission is discussed in Section 6.1.5.

Step 3... Following approval of the design discharge rates, develop the preliminary hydraulic and environmental models as necessary. Chapter 9, (Bridges) outlines the requirements for the design model. The hydraulic engineer should also refer to the guidelines prepared by ConnDEP entitled "**Hydraulic Analysis Guidance.**" The engineer should prepare the necessary hydraulic computer models and incorporate the various alternates in the design runs.

The potential for scour should also be addressed for each structure. Chapter 9, (Bridges), discusses the scour aspects and requirements for a structure.

Step 4... Submit the preliminary hydraulic models, preliminary scour report and environmental models in accordance with the Documentation sections outlined throughout this manual. The foundation type should be selected with consideration to scour at the bridge.

For deck or superstructure widening or replacements, the scour vulnerability of the substructure should be evaluated. Countermeasures may be required or complete replacement may be recommended based on the scour history and safety aspects. Addressing the impacts of scour early in the design phase will provide a better understanding not only of the vulnerability of the substructure but also will provide a basis for modifying the scope of the project if a full replacement is economical.

The structure type selection must consider environmental permitting conditions and requirements. An alternate may be feasible with respect to hydraulic adequacy and scour, but may not be practicable with respect to floodway impacts, fish passage or floodplain involvement. Therefore the structure type study needs to address all the impacts to the site to ensure that any of the structure types recommended can be constructed and can meet the necessary permit requirements. The procedure for the design of culverts with tributary watershed less than 2.59 km² (1.0 mi²) is outlined in Section 3.8 in more detail.

3.5.3 Submissions

The Structure Type Study Report is typically submitted concurrently with the Preliminary Design Submission and should include:

- Hydrology Report which was approved prior to performing the hydraulic analysis
- A Preliminary Hydraulic Analysis including the approved design discharges with all the requirements outlined in the various chapters of this Manual.

For a structure crossing an established Floodway...

- A Floodway Model with all the associated runs is necessary to evaluate the potential impacts to the floodway. This model incorporates the FEMA discharges that were used to establish the floodway limits. **These discharges may be different from the design discharge used in the hydraulic model.**

For a structure within stream channel encroachment lines...

- A Stream Channel Encroachment Line model is necessary. **This model uses the SCEL discharges that were used to develop the water surface profile for the stream channel encroachment limits of the site.** Similar to the Floodway model, the proposed alternates should be evaluated using the stream channel encroachment line discharges.

For a new or rehabilitated bridge...

- [Chapter 9 (Bridges) describes the various reports generated under the Department's Bridge Scour Evaluation Program for all existing bridges over waterways with span lengths greater than 6.1 m (20 feet).] The designer should review this information, as it may prove useful in developing the scour design and recommended course of action for a specific structure. A scour analysis will not be required for existing structures that have an NBIS 113 rating of 8 and do not require substructure replacement or modification.
- For a structure with an NBIS rating less than 8 and new bridges, a preliminary scour report should be included with this submission. As scour parameters differ depending on the substructure being recommended, a qualitative scour assessment report should be developed to support the selection of foundation type for each recommended structure.
- A rehabilitated structure should be carefully evaluated to determine any evidence of scour or scour history. Scour corrective measures should be addressed in the report. Structures assessed as low risk, should be assigned an appropriate NBIS Item 113 rating.

In summary, the Structure Type Study and preliminary design submission should include enough information for the Department to evaluate the approach and feasibility of the design. The preliminary hydraulic models required for waterway crossings need to be developed at this stage to ensure that any of the proposed structure types would be suitable for the site. Based on all the available information, the designer should offer a recommended alternate.