Hydraulic Simulation in Instream Flow Studies: Theory and Techniques

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by

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APPENDIX E

COMPUTER SOFTWARE FOR HYDRAULIC SIMULATIONS
IN INSTREAM FLOW ASSESSMENTS

At the outset, it must be emphasized that a methodology for assessing instream flow requirements is not the same as a hydraulic simulation model. All references to the R-2 Cross program, WSP program, stage-discharge approach, etc., refer to methods of predicting hydraulic variables at different discharges. An instream flow assessment method interfaces these measured or predicted hydraulic variables with some type of implied or expressed biological criteria to measure the habitat available for a given species at each discharge investigated. Therefore, the type of model used to predict hydraulic conditions in a stream is interchangeable in many methodologies.

However, if the IFG incremental method is to be used, only a select few computer programs are currently compatible for use with the IFG-3 (HABTAT) program. These hydraulic simulation programs will be pointed out during the discussion.

Three basic types of hydraulic simulation software are currently available from various sources. Input requirements are functions of the assumptions according to by the approach. Output varies by program.

TYPE 1 - MANNING EQUATION ASSUMING UNIFORM FLOW

R-2 Cross (U.S.Forest Service)

IFG-1 (IFG, USFWS) (IFG, U.S. Fish and Wildlife Service)

The IFG-1 program is a modified version of the U.S. Forest Service R-2 Cross program. The depth and velocity distributions may be predicted using the Manning equation, with input data either from sagtape or level measurements. Program outputs are:

1. Distance to channel edge (ft)
2. Channel width (ft)
3. Cross sectional area (ft^2)
4. Wetted perimeter (ft)

5. Surface width (ft)

6. Hydraulic radius (ft)

7. Average Depth (ft)

8. Discharge (cfs)

9. Average velocity (fps)

The primary difference between IFG-1 and R-2 Cross is that IFG-1 outputs widths of stream having specified depths. Both R-2 Cross and IFG-1 are to be used for single cross section methods only.

TYPE 2 - MANNING/BERNOULLI EQUATIONS ASSUMING GRADUALLY VARIED FLOW

Three "step-backwater" programs are available, and all are somewhat similar. However, at this time only the PSEUDO program of the U.S. Bureau of Reclamation is compatible with the IFG-3 program.

PSEUDO (Bureau of Reclamation)

This program utilizes an energy balance model, using the Manning equation and one set of calibration measurements which require level-surveying precision. The program has been modified to produce outputs compatible as inputs to the IFG-3 (HABTAT) program, which is described below. The PSEUDO program requires data inputs as described under the section concerning data collection. Program outputs include for up to 9 cross section subdivisions:

1. Station index which indicates distance upstream from initial cross section

2. Thalweg elevation at cross section

3. Thalweg slope

4. Centroid length - average distance between a cross section and the next downstream cross section

5. Conveyance (cross sectional) areas (ft^2)

6. Top widths (ft)

7. Hydraulic radii (ft)