HEC-2 Troubleshooting Guide

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Executive Summary:

A key part of the Indiana DNR Division of Water permit application process for projects that require hydraulic modeling is to see if a published Flood Insurance Study (FIS) already exists. When this is the case, the existing model must be run so that the output reasonably matches the published data table. This step is referred to as creating the Duplicate Effective Model. Many of these old FIS models were produced using a program developed by the Army Corps of Engineers called HEC-2. When first running a HEC-2 model, it is common to have some difficulties in obtaining a match between the model and the published data. By reviewing a sample of 65 FIS models, two categories of problems have been identified that contribute to the difficulty of developing the Duplicate Effective Model; these are run errors and mismatches between the model output and the published table. The majority of these issues can be eliminated by addressing the following suggestions.

The first challenge when working with a HEC-2 model is getting the file to execute using either Menu-2, a DOS based program, or Check-2, a Windows application. The most common problem in HEC-2 input files that prevents the model from executing is commenting errors. Comments should be made using either an asterisk or the letter C followed by a space. If Menu-2 is being run, the file name must be eight characters or less and if Check-2 is being run, each cross section identification number must be unique. Finally, check to see if all the required fields are filled out and all the columns are right justified.

After the file runs, the next task is to match the model output to the published data table. The first step in this process is to link the model cross sections, which are labeled by number, with the cross sections in the published table, which are labeled by letter. This can be achieved by locating the bridges on a map and then using the distance downstream given in the model input file to find the location of the next cross section. After the cross sections are identified, a comparison can be made between the published study data table and the water surface elevations given in the model output. It is likely, at this point, that the floodway elevations and the base run elevations will be significantly different. To correct this, make sure that the initial run is the 100-year flood; in many cases, it is the 10-year. In situations where the model output still does not match the published data, check to see if the tributary option or a skew factor has been used in the model or if backwater elevations are being used in the published table. Small discrepancies at bridges may be attributed to differences in the calculation process between different versions of HEC-2; these variations are acceptable.

Introduction:

In 1968, the Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers released a river hydraulics program under the name HEC-2. It was the second in a series of generalized computer programs issued by the Corps. It allows a user to compute the water surface elevation along a natural channel that includes bridges, culverts, buildings, piers, and other obstructions to flow.

HEC-2 computes water surface elevations that are one-dimensional and that do not vary with time. This means that the flow is considered to be at one specific velocity and elevation across the channel. Also, it is limited to gradually varied flow, which means that it cannot numerically compute sudden changes at contractions and expansions such as when flow is expanding after going through a bridge. It solves these problems by making one-dimensional flow approximations rather than a numerical solution of the two-dimensional flow at expansions and contractions.

Revisions to the program followed in 1971, 1976, 1988, and 1991. A windows version of HEC-2, named HEC-RAS, (River Analysis System) was released by the Corps in 1995. The later versions of HEC-RAS have the added capability to solve time dependent flows (unsteady). There are computational differences between HEC-2 and HEC-RAS so that they compute slightly different water surface elevations for the same input data.

The final version of HEC-2 can be downloaded from the HEC website by going to www.hec.usace.army.mil and following the link for Legacy Software under the Software menu. The latest version of HEC-RAS can also be downloaded from the main HEC webpage. Both of these downloads are free of charge.

Obtaining the Right Model

The National Flood Insurance Act of 1968 led to the development of Flood Insurance Studies (FIS) for various communities and counties throughout the State. The Federal Insurance Administration and later FEMA hired contractors to perform detailed hydrologic and hydraulic studies on selected streams and rivers. The vast majority of the detailed studies were developed in the 1970s and 1980s; many of those studies used HEC-2.

The Indiana Department of Natural Resources (IDNR) Division of Water administers a permit program for construction in the floodway of streams and rivers throughout the state. In many cases, a hydraulic model analysis is needed with the permit application. When this occurs, the applicant needs to determine if a FIS model exists on the stream involved. The Division maintains a database of most of the FIS HEC-2 models for Indiana. Copies of these models can be downloaded from the Division's Website, www.IN.gov/dnr/water.

If it is determined that a FIS model exists, the model needs to be run and the results compared with the published values in the study's floodway data table. This step in the application process is referred to as creating the Duplicate Effective Model; it ensures that the applicant is using the correct Base Model. The best way to ensure the correct Base Model is being run is to

compare the water elevations generated by the model to the published FIS data table. Unfortunately, about half of all FIS HEC-2 models cannot run without some modification due to various input data file errors. The models available from the IDNR are offered as a convenience to the public; the data file errors in these models have not been corrected. In order to obtain a model not available on the Division of Water webpage, contact FEMA.

FEMA contracted Michael Baker Jr., Inc. to store flood hazard studies and the associated data. The warehouse where this data is kept is known as "FEMA's Project Library." There is a minimum fee of $120 to find a computer model or for any other archived item(s). Various fee exemptions are discussed in the attached FEMA Flood Insurance Study Data Request sheets; read these sheets to determine if your organization qualifies. A form is included in the FIS Data Request sheets that can be faxed into Michael Baker Jr., Inc. to get the computer model that you need. Eventually, the documents in the FEMA Project Library are going to be converted to a digital format and made available on the internet. The contact information is:

FEMA Project Library
c/o Michael Baker Jr., Inc.
3601 Eisenhower Avenue
Alexandria, Virginia 22304
Phone (703) 236-7461
Fax (703) 751-7391

While developing the Duplicate Effective Model, several problems may be encountered, one of which is simply getting the original FIS HEC-2 model to run. When a model will not run, changes to the input file are needed. Once a model runs successfully, there are often concerns about the differences in elevations between the model results and the published FIS Data Tables. Each version of HEC-2 will compute the water surface elevations slightly differently than the other versions. This is because each revision to the program incorporated improvements. Large differences in computed water surface elevations are the result of data input errors, while smaller differences are often the result of the improvements made in the HEC-2 program.

This troubleshooting guide is to serve all users on how to handle problems that are either encountered while attempting to run a HEC-2 model or when trying to get the model to match the published FIS Data Tables.

Summary of Model Review:

By testing a sample of 65 FIS models downloaded from the Division's web page, the most common reasons for a file not to run were identified. Run errors are relatively easy to categorize; the issues addressed below are sufficient to get a model to run in most cases. In contrast, the problems associated with getting the output to match the FIS Data Table are more complex. Basic setup information and suggestions on how to find problems are given here; however, the problems that prevent model output from matching the FIS data table are highly

individualized and it is beyond the scope of this project to address each issue individually. Examples have been provided to illustrate the most common errors.

Running the HEC-2 Model using Menu-2 or Check-2

There are two options when it comes to running a HEC-2 model, Menu-2 and Check-2. Menu-2 is the HEC-2 main computer screen in which commands are given to run HEC-2. From Menu-2, a user can look at cross sections by using Plot-2, edit data files using Edit-2, and run hydraulic computations.

Check-2 is a collection of computer programs assembled by Dewberry and Davis for FEMA. It contains public domain programs such as Plot-2 and HEC-2 as well as programs written by Dewberry and Davis. It can run HEC-2 as well as find errors in the models. The latest version of Check-2 can be downloaded by going to the Surface Water portion of the Division of Water's website and following the link to download Check-RAS found under the Hydrologic/Hydraulic Models and Assessment heading.

Check-2 and Menu-2 complement each other in that some models will run in one of them, but not the other. For this reason, it is useful to know how to run HEC-2 from both Menu-2 and Check-2.

File Input Basics

Data records are composed of ten columns with eight characters each, as can be seen in the image replicated from the HEC-2 User's Manual (page 6). The first column is divided into two fields with the first two spaces being referred to as field zero while the rest of the columns are only one field each. Field zero is used for identifying the type of data in that row; therefore, only the subsequent spaces are used for data input. All numbers must be right justified within each field as a number moved one space out of the correct field alignment can prevent a model from running. All blanks are read as zeroes and a decimal point may be used anywhere within a field. The models made available on the internet by the Division of Water are copies of the original FIS models which were manually entered into the website. Because of this, the models on the internet contain errors from the copying process.

Basic Input Example

```
T1    SAMPLE PROBLEM SHOWING BASIC INPUT
T2    First Profile, Q = 200 cfs  WSEL = 13 ft.
T3      Sample Creek
T4    Use as many Title records (T1-T9) as necessary to define the job.

*     Profile 1 reading field 2 of QT, starting at 13 ft. elevation.
*     Zero values indicate subcritical profile starting with known elevation.
J1            2              0       0                                    13

*     Manning's 'n' = .08 overbanks & .04 channel
*     Contraction coef. 0.1 and Expansion coef. 0.3
NC   .08     .08     .04      .1      .3

*     Discharge table with 2 flows: 200 cfs and 500 cfs
QT     2     200     500

*     Cross section 1 with 7 GR stations, and bank stations at 150 and 170.
*     Reach lengths to downstream section are not required for first section.
X1     1       7     150     170
GR    20       0      15      50      12     150       5     160      12     170
GR    15     200      20     250

*     Repeat cross section, 500 ft. reach lengths, expand 10%, raise 0.4 ft.
X1     2                             500     500     500     1.1      .4

*     Revise Manning's 'n' values based on stations at Section 3
NR     4     .10     150     .08     220     .04     260     .08     300

*     Revise the discharges, starting with the next section (SECNO 3)
QT     2     180     450

*     Reach lengths: 500' left, 400' right, & 450' channel
X1     3       8     220     260     500     400     450

*     Effective area option to exclude low overbank area until flow exceeds
*     the bank elevation.
X3    10
GR    20       0      16      50      12     150      16     220       8     250
GR    12     260      16     275      20     300

*     EJ ends input of reach model.  Following data define added profiles.
EJ
T1    Second profile, only one title required

*     Read field 3 of QT records and start at elevation 15 ft.
J1            3                                                          15

*     J2 record required subsequent profiles to define profile number.
J2     2
*     ER record ends the run.
ER
```

Getting the Model to Run:

Forty-seven percent of the 65 tested models tested did not run successfully during the first attempt. The most common problems encountered were commenting errors, long file names, repeated cross section numbers, and inaccurate or missing data. Other issues include typographical errors, random characters, and spacing.

Comments for Describing the Data

There are two basic methods for providing comments to help explain the cross section data. One method is to place an asterisk in column one followed by a space in column two of the line containing the comment text. The comment will be printed in the input listing of the output file

only. Another commenting method is the use of the Comment Records in the model. In addition to showing up in the input listing, the comment will also appear in the detailed output. The Comment Record must be placed immediately before the first Title Record (T1-T9). The letter C must be placed in column one.

In many cases, the comment line was missing either the asterisk in column one or the space in column two (Example 1). When using Comment Records, it is necessary to have a blank C record before the line listing the total number of Comment Records (Example 2). The first two Comment Records (the blank record and the line containing the total number of comment records) are not counted when entering the value for the total number of data records.

Lengthy Input File Names

The IDNR named the FIS HEC-2 data files so they could be identified uniquely by their file names. Unfortunately, Menu-2 will not run when the input file name is longer than eight characters. This can be fixed by renaming the input file using eight or less characters. Check-2 does not have limitations on the length of the input file name.

Repeated Cross Section Identification Numbers

Check-2 will not run a file containing cross sections with repeated identification numbers. This happens most often at bridges where the difference between two cross section identification numbers, X1(SECNO), can be small enough that the number of decimal places allowed in the input file is insufficient to describe the difference. To address this issue, the SECNO value can be altered or the input file can be run using Menu-2.

Inaccurate or Missing Data

When inaccurate or missing data prevents a file from running, the problem most often occurs in field one of a NH, QT, BT, or C record (Example 1) or in field two of an X1 record. These fields give the total number of values or points used in either subsequent fields or records. If the total number given does not match the total number of values or points used, an error message will be given. These errors are relatively easy to identify using Edit-2 (which is part of Check-2). In some instances, the error message will even indicate what the number should be.

Additional Considerations

Additional problems include numbers being transposed (such as elevation and horizontal being reversed), random characters, and spacing. Plotting the cross sections using Plot-2 can help find these errors. Make sure that columns are right justified and that no stray characters are floating around. HEC-2 was written in Fortran, which is very sensitive to having the data entered in the correct field. If the data is not aligned correctly, the computer program will not run.

Matching the Model with the Published Data Table:

The model runs, but are the results correct? To answer this question, you need to compare the model output to the published FIS Floodway Data Table. The first challenge in doing this is determining how the cross sections in the model correspond to the cross sections in the FIS data table.

Locating Cross Sections on a Map

Finding the location of a cross section can be difficult without the original work map and some of the older HEC-2 models provide few comments within the input file to help in locating the cross sections. Keep in mind that the study limits are usually defined by county or community boundaries. Field seven of the X1 record (X1.7) will usually give the channel distance (in feet) along the stream to the downstream cross section. Compare the model's water surface elevation at a cross section with the published profile's water elevations to get in the general vicinity. To find the location of a specific cross section, first locate a bridge on the map. Measure the distance to the bridge. Then find the cross section in the model at the approximate same distance from the bridge. The spacings between cross sections in the model and on the map are like a fingerprint, which can be matched between the model and the map.

The 100-year Flood

Before comparing the model output with the FIS data table, a small amount of preliminary work should be done (Example 3, Part 1). First, verify that the initial run (profile one) corresponds to the 100-year storm. If the initial run is not the 100-year, the output will show extreme water surface elevation differences in the floodway data table (Example 3, Part 2).

Field 2 of the J1 line shows which field numbers on QT, ET, and XS records are to be used for that profile computation. For example, if the number on the J1 line in field 2 is a five, then the discharge that goes with that profile (computer run) is found in field 5 on the QT line. The discharges for the 100-year and the encroached 100-year rainfalls are the same. So make sure the 100-year rainfall is repeated for the non-encroached run and the floodway run.

In later versions of HEC-2, the number 200 was entered in the J3 line to select the floodway data table. The number 200 calls for the standard table to use for the comparison with the published FIS data table. In addition, it is helpful to either delete or comment out (put an asterisk in column one) the original values in the J3 record. This will eliminate some unnecessary output.

Common Data Input Mistakes:

Tributary Option

If the model output does not reasonably match the FIS data table, check the model to see if the tributary option is being used. A negative cross section identification number indicates the start

of new tributary backwater at that cross section. The tributary option can cause huge leaps in the water surface elevation between two consecutive cross sections on the output table. These sections can simply be removed or ignored when comparing the HEC-2 output with the published FIS data table.

Skew Factor

When a skew factor has been applied to a cross section (field 8 of the X1 record), that factor does not affect the encroachment stations in the X3 record. Therefore, it is necessary to adjust the encroachment settings for the skew and enter the data into the HEC-2 input file manually. This problem is usually easy to catch by running Plot-2. Plot-2 draws a diagram of the cross sections and is located in both Menu-2 and Check-2 as an option. If the skew has not been accounted for, one of the encroachments is likely to end up in the stream. In the output, this type of error shows up as one or two sections having a large discrepancy with the FIS data table, while the rest of the output matches up well. To account for a skew adjustment, multiply the skew factor by the difference between the encroachment station and the first station of the cross section. Then add the value to the first station. This is the corrected (skewed) value for the encroachment station (Example 4).

Backwater Elevations

The published FIS Data Table may be including backwater elevations from a larger receiving stream. For example, the elevations of the lower cross sections (A, B, C, etc.) in the published Floodway Data Table of a smaller stream may not necessarily be elevations from cross sections found in the model of the smaller stream. The elevations from the model are in the "without floodway" column in the FIS table.

Differences at Bridges between Versions of HEC-2

When comparing current output results with published results, some discrepancies in elevations may occur at bridges due to the use of different versions of HEC-2. This is expected, and can be explained by the user in a written report explaining the analysis. Each version of HEC-2 is slightly different than the others due to improvements, so expect these variations to occur.

Additional Considerations

Other problems such as typographical errors in the published Floodway Data Table and reverse station order in the GR records of the model could be to blame when the model does not match the published data. Also, be aware of the need to check for Letters of Map Revision (LOMRs).

Check to see if any additional data was entered into any cross section using an X4 card. If so, make sure that the number of the data in the X4.1 slot is consistent with the GR data contained in the X4 card.

Check to see if HEC-2 ends correctly. It should end with either an ER card or a 15 in field 1 of the J2 card (J2.1).

Example 1: Comments and Missing Data – Little Elkhart River

Does Not Run

```
*LITTLE ELKHART-BRISTOL FIS   RM 0.00-0.97
T1      HUD - FLOOD INSURANCE STUDY - BRISTOL, INDIANA
T2      CLYDE E WILLIAMS AND ASSOCIATES, INC.
T3      LITTLE ELKHART 100 YEAR
J1             4                                                    752.00
J2     1              -1
J3     1      34       3       4      27      28      26
NC                             .1      .3
NC   .12     .12     .05
QT          1820    2340    2600    3120    2600
```

Edit-2 Errors Messages

```
*LITTLE ELKHART-BRISTOL FIS   RM 0.00-0.97
 - ERROR - RECORD OUT OF ORDER - TITLE RECORD EXPECTED

*LITTLE ELKHART-BRISTOL FIS   RM 0.00-0.97
 - ERROR - UNRECOGNIZED RECORD

20010.000 - ERROR - QT RECORD - NUMQ =    0 OUTSIDE TEST RANGE
```

Runs

```
* LITTLE ELKHART-BRISTOL FIS   RM 0.00-0.97
T1      HUD - FLOOD INSURANCE STUDY - BRISTOL, INDIANA
T2      CLYDE E WILLIAMS AND ASSOCIATES, INC.
T3      LITTLE ELKHART 100 YEAR
J1             4                                                    752.00
J2     1              -1
J3     1      34       3       4      27      28      26
NC                             .1      .3
NC   .12     .12     .05
QT     5    1820    2340    2600    3120    2600
```

Example 2: Comment Records – Eagle Creek

Does Not Run

```
*  EAGLE CREEK-ZIONSVILLE FIS      RM 21.40-33.25
C     88
C     50SECTION 50.0  ABOUT 1200 FT N OF SR 100         MI 21.40
C     75SECTION 75.0                                    MI 22.00
C     99SECTION 99.0  D0S OF CY. LINE                   MI 22.40
```

Edit-2 Error Message

```
 - ERROR - C RECORD - NUMCT =   50 DOES NOT EQUAL NUMBER OF C RECORDS READ =
87
```

Runs

```
*  EAGLE CREEK-ZIONSVILLE FIS      RM 21.40-33.25
C
C     88
C     50SECTION 50.0  ABOUT 1200 FT N OF SR 100         MI 21.40
C     75SECTION 75.0                                    MI 22.00
C     99SECTION 99.0  D0S OF CY. LINE                   MI 22.40
```

Example 3: File Setup – Fishback Creek

Part 1 -- File Input

Original

```
* FISHBACK CREEK-BOONE CO. FIS      CO.LN. TO 3.95 MI. U/S OF CO. LN.
T1      HUD-FIS BOONE CO. INDIANA - 1979
T2      FISHBACK CREEK
T3      10 YEAR FLOOD
J1            2                  .00175                                855
J2     1             -1
J3    38       1      21      22       4
QT     5    3200    5000    5800    8000    5800
```

After Preliminary Setup

```
* FISHBACK CREEK-BOONE CO. FIS      CO.LN. TO 3.95 MI. U/S OF CO. LN.
T1      HUD-FIS BOONE CO. INDIANA - 1979
T2      FISHBACK CREEK
T3      100 YEAR FLOOD
J1            4                  .00175                                855
J2     1             -1
J3   200
QT     5    3200    5000    5800    8000    5800
```

Part 2 – File Output

Original Output - Table 200

Even though this table is listed as the 100-year profile, the output shows the 10-year storm elevations in the “without floodway” column and the 100-year floodway elevations in the “with floodway” column. Notice how the without floodway elevations are significantly different from the same column in the published Floodway Data Table reproduced below (page 14). (The model cross sections have already been linked to the FIS cross sections using the method described in the “Locating Cross Sections on a Map” section of this report.)

STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE	
201.000	519.	1651.	3.5	863.1	860.5	2.6	
202.000	542.	1527.	3.8	863.4	860.1	3.3	
203.000	547.	1600.	3.6	863.6	860.4	3.2	
204.000	533.	1827.	3.2	863.4	861.1	2.3	
205.000	544.	2342.	2.5	863.8	861.6	2.2	(A)
225.000	504.	3006.	1.9	864.6	862.5	2.1	(B)
250.000	603.	3206.	1.8	865.4	863.3	2.1	(C)
275.000	549.	1883.	3.1	866.7	865.1	1.6	(D)
299.000	175.	901.	6.4	870.6	869.3	1.3	
301.000	112.	883.	6.6	871.8	869.9	1.9	
304.000	112.	888.	6.5	871.8	869.9	1.9	
305.000	176.	1178.	4.9	872.3	870.1	2.2	(E)
325.000	511.	2650.	2.2	873.7	871.5	2.2	(F)
350.000	446.	2600.	2.1	875.1	873.1	2.0	(G)
399.000	187.	641.	8.4	875.9	874.6	1.3	
401.000	36.	340.	15.9	877.2	876.2	1.0	
404.000	500.	1352.	4.0	880.4	877.1	3.3	
405.000	628.	2774.	1.9	881.2	878.4	2.8	(H)
499.000	645.	4594.	1.2	881.3	878.7	2.6	
501.000	852.	4620.	1.2	881.4	878.7	2.7	
502.000	855.	5047.	1.1	881.4	878.7	2.7	
503.000	855.	5055.	1.1	881.4	878.7	2.7	
504.000	853.	4634.	1.2	881.4	878.7	2.7	
601.000	1270.	2395.	2.3	881.3	878.4	2.9	
602.000	1296.	2284.	2.4	881.4	878.4	3.0	
603.000	1299.	2320.	2.3	881.4	878.6	2.8	
604.000	1279.	2496.	2.2	881.4	878.6	2.8	
605.000	1280.	4105.	1.3	881.5	879.1	2.4	(I)
699.000	929.	3322.	1.6	881.8	879.6	2.2	
701.000	354.	655.	8.2	881.3	879.6	1.7	
702.000	626.	672.	8.0	881.3	879.6	1.7	
703.000	669.	770.	7.0	881.6	879.7	1.9	
704.000	642.	967.	5.6	881.9	879.7	2.2	
705.000	722.	1883.	2.9	882.7	879.8	2.9	(J)
725.000	615.	2078.	2.6	886.5	885.3	1.2	(K)
750.000	432.	1646.	3.3	889.4	887.9	1.5	(L)
799.000	165.	798.	6.8	890.4	888.9	1.5	
801.000	104.	743.	7.3	891.9	890.0	1.9	
804.000	513.	887.	6.1	892.3	890.1	2.2	
805.000	646.	1596.	3.4	892.9	890.3	2.6	(M)
825.000	570.	2116.	2.6	895.1	893.1	2.0	(N)
850.000	761.	2872.	1.9	896.5	894.9	1.6	(O)

Output after Initial Setup – Table 200

The output below shows the elevations for the 100-year storm in both the "with" and "without" floodway columns. Though the output still does not provide an exact match, the elevations are now much closer to those in the published table. For this example, both the Table 200 "difference" column and the "increase" column of the published table show no increase in water surface elevations due to the floodway encroachments. This may seem confusing to someone who is more familiar with a maximum surcharge of 0.14 feet. In HEC-2, only one decimal place is used; therefore, the difference column will show either a zero or a 0.1-foot increase for valid floodways.

	FLOODWAY			WATER SURFACE ELEVATION			
STATION	WIDTH	SECTION AREA	MEAN VELOCITY	WITH FLOODWAY	WITHOUT FLOODWAY	DIFFERENCE	
201.000	519.	1651.	3.5	863.1	863.1	.0	
202.000	542.	1527.	3.8	863.4	863.4	.0	
203.000	547.	1600.	3.6	863.6	863.6	.0	
204.000	533.	1827.	3.2	863.4	863.4	.0	
205.000	544.	2342.	2.5	863.8	863.8	.0	(A)
225.000	504.	3006.	1.9	864.6	864.6	.0	(B)
250.000	603.	3206.	1.8	865.4	865.4	.0	(C)
275.000	549.	1883.	3.1	866.7	866.7	.0	(D)
299.000	175.	901.	6.4	870.6	870.6	.0	
301.000	112.	883.	6.6	871.8	871.8	.0	
304.000	112.	888.	6.5	871.8	871.8	.0	
305.000	176.	1178.	4.9	872.3	872.3	.0	(E)
325.000	511.	2650.	2.2	873.7	873.7	.0	(F)
350.000	446.	2600.	2.1	875.1	875.1	.0	(G)
399.000	187.	641.	8.4	875.9	875.9	.0	
401.000	36.	340.	15.9	877.2	877.2	.0	
404.000	500.	1352.	4.0	880.4	880.4	.0	
405.000	628.	2774.	1.9	881.2	881.2	.0	(H)
499.000	645.	4594.	1.2	881.3	881.3	.0	
501.000	852.	4620.	1.2	881.4	881.4	.0	
502.000	855.	5047.	1.1	881.4	881.4	.0	
503.000	855.	5055.	1.1	881.4	881.4	.0	
504.000	853.	4634.	1.2	881.4	881.4	.0	
601.000	1270.	2395.	2.3	881.3	881.3	.0	
602.000	1296.	2284.	2.4	881.4	881.4	.0	
603.000	1299.	2320.	2.3	881.4	881.4	.0	
604.000	1279.	2496.	2.2	881.4	881.4	.0	
605.000	1280.	4105.	1.3	881.5	881.5	.0	(I)
699.000	929.	3322.	1.6	881.8	881.8	.0	
701.000	354.	655.	8.2	881.3	881.3	.0	
702.000	626.	672.	8.0	881.3	881.3	.0	
703.000	669.	770.	7.0	881.6	881.6	.0	
704.000	642.	967.	5.6	881.9	881.9	.0	
705.000	722.	1883.	2.9	882.7	882.7	.0	(J)
725.000	615.	2078.	2.6	886.5	886.5	.0	(K)
750.000	432.	1646.	3.3	889.4	889.4	.0	(L)
799.000	165.	798.	6.8	890.4	890.4	.0	
801.000	104.	743.	7.3	891.9	891.9	.0	
804.000	513.	887.	6.1	892.3	892.3	.0	
805.000	646.	1596.	3.4	892.9	892.9	.0	(M)
825.000	570.	2116.	2.6	895.1	895.1	.0	(N)
850.000	761.	2872.	1.9	896.5	896.5	.0	(O)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fishback Creek								
A	510'	498	2,245	2.6	863.6	863.6	863.6	0.0
B	1,790'	380	3,003	1.9	864.6	864.6	864.6	0.0
C	3,470'	590	3,312	1.8	865.5	865.5	865.5	0.0
D	4,950'	550	1,998	2.9	866.9	866.9	866.9	0.0
E	6,595'	440	1,096	5.3	871.8	871.8	871.8	0.0
F	7,435'	470	2,493	2.3	873.4	873.4	873.4	0.0
G	9,775'	390	2,542	2.1	875.0	875.0	875.0	0.0
H	10,626'	510	2,758	2.0	881.1	881.1	881.1	0.0
I	11,631'	1,060	3,255	1.8	881.5	881.5	881.5	0.0
J	13,029'	710	1,873	2.9	882.6	882.6	882.6	0.0
K	15,029'	600	1,902	2.8	886.2	886.2	886.2	0.0
L	16,569'	415	1,451	3.7	889.0	889.0	889.0	0.0
M	17,250'	630	1,659	3.3	893.0	893.0	893.0	0.0
N	18,550'	595	2,106	2.6	895.1	895.1	895.1	0.0
O	20,070'	750	2,893	1.9	896.5	896.5	896.5	0.0

'Feet above county boundary

Table 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

COUNTY OF BOONE, IN
(UNINCORPERATED AREAS)

FLOODWAY DATA

FISHBACK CREEK

Example 4: Skew – Little Eagle Creek

Does Not Match

```
X1   201       17     2000     2179      650      650      650     .707
X3                             1999    846.2     2180      846
GR 863.3     1330    862.8     1510    837.7     1730    838.6     1915    840.4     2000
GR   835     2019    833.2     2054    833.1     2057    833.8     2089    832.9     2118
GR 832.9     2120    835.1     2160    840.5     2179    840.1     2300    841.4     2525
GR 860.7     2715    865.6     2925
SB   .90      1.5      2.8        0      103        4      961      1.4    833.9    833.9
X1   204                              47       47       47
X2                       1    842.5      846                              .707
X3                             1999    846.2     2180    846.0
BT    12     1330    863.3    863.3     1510    862.8    862.8     1730    846.1    846.1
BT  1915    846.2    838.6     2000    846.3    840.4     2000    846.3    842.5     2179
BT 846.3    842.3     2179    846.3    840.5     2300      846    840.1     2525    848.6
BT 848.6     2715    860.7    860.7     2925    865.6    865.6
```

Matches

X1	201	17	2000	2179	650	650	650	.707		
X3				**1803**	**846.2**	**1931**	846			
GR	863.3	1330	862.8	1510	837.7	1730	838.6	1915	840.4	2000
GR	835	2019	833.2	2054	833.1	2057	833.8	2089	832.9	2118
GR	832.9	2120	835.1	2160	840.5	2179	840.1	2300	841.4	2525
GR	860.7	2715	865.6	2925						
SB	.90	1.5	2.8	0	103	4	961	1.4	833.9	833.9
X1	204				47	47	47			
X2			1	842.5	846				.707	
X3				**1803**	**846.2**	**1931**	**846.0**			
BT	12	1330	863.3	863.3	1510	862.8	862.8	1730	846.1	846.1
BT	1915	846.2	838.6	2000	846.3	840.4	2000	846.3	842.5	2179
BT	846.3	842.3	2179	846.3	840.5	2300	846	840.1	2525	848.6
BT	848.6	2715	860.7	860.7	2925	865.6	865.6			

Flood Insurance Study (FIS) Data Requests

The Federal Emergency Management Agency (FEMA) has identified seven categories into which requests for FIS data are separated. These categories are:

Category 1 - Paper copies, diskettes, or microfiche of hydrologic and hydraulic backup data for current or historical FISs
Category 2 - Paper or mylar copies of topographic mapping developed during the FIS process
Category 3 - Paper copies or microfiche of survey notes developed during FIS process
Category 4 - Paper copies of individual Letters of Map Change
Category 5 - Paper copies of preliminary map panels
Category 6 - Computer tapes or CD-ROMs of Digital Line Graph or Digital Flood Insurance Rate Map files
Category 7 - Computer diskette and user manuals for FEMA models (e.g., wave height, wave runup, alluvial fan)

A non-refundable fee of $120 will be required to initiate requests for data from categories 1, 2, and 3 from non-exempt requestors. This fee will cover the preliminary costs of research and retrieval. The costs of processing requests in categories 1, 2, and 3 will vary based on the complexity of the research involved in retrieving the data and the volume and medium of the data to be reproduced and distributed. The initial fee will be applied against the total costs to process the data request, and the requestor will be invoiced for the remainder of the fee. No data will be provided to a requestor until the entire fee has been paid.

The final fees for processing FIS data requests for Categories 1, 2, and 3 are calculated by adding labor charges (actual hours times $33 per hour); reproduction costs of materials used; and a standard charge to cover the costs related to library maintenance.

No initial fee will be required to initiate requests for data from categories 4 through 7. Each requestor will be contacted regarding the availability of the materials and the fee associated with obtaining the requested materials. No data will be provided to a requestor until the fee has been paid.

The costs of processing requests under categories 4 through 7 will not vary. Therefore, FEMA has established the flat user fees shown below for these categories of requests.

Category 4 - $40 for first letter; $10 for each additional letter
Category 5 - $35 for first panel; $2 for each additional panel
Category 6 - $150 for first county; $100 for each additional county in the same request
Category 7 - $25 per copy

Requestors must submit the user fees shown above with requests for FIS technical and administrative support data. We will charge all entities except the following for requests for FIS technical and administrative support data:

- Private architectural-engineering firms under contract to us to perform or evaluate studies and restudies;
- Federal agencies that perform or contract for studies and restudies for us (i.e., U.S. Army Corps of Engineers, U.S. Geological Survey, Natural Resources Conservation Service, and Tennessee Valley Authority);

- Communities that supply the DFIRM base map to us and request the Digital Line Graph data or DFIRM files (Category 6 above);
- Communities that request data during the statutory 90-day appeal period for an initial or revised FIS for that community;
- Mapped participating communities that request data at any time other than during the statutory 90-day appeal period, provided that the community requests the data for its use and not for a third-party user; and
- State NFIP Coordinators, provided that the data that they request are for use by the State NFIP Coordinators and not for use by a third-party user.

To initiate your request, please complete page 3 of this form.

The average request takes 2 to 3 weeks to fill.

You will be contacted after we have determined whether the requested data are available and the final fee is assessed.

Checks or money orders should be made payable to the **NATIONAL FLOOD INSURANCE PROGRAM**.

If paying by credit card, please complete the Credit Card Information Form and mail it or send a facsimile of it with your request.

Data will be released upon receipt of final payment.

Please include your check, if applicable, with your written request and mail to:

Michael Baker Jr., Inc.
3601 Eisenhower Avenue
Suite 600
Alexandria, Virginia 22304
Tel (703) 236-7461
Fax (703) 751-7391

Flood Insurance Study (FIS) Data Request Form

Please provide the following information as applicable for the area where you require data:

- Complete community name (including county and state) _____
- Community identification number, if known _____
- Name(s) of flooding source(s) and specific location(s) for which data are needed _____
  (Attach FIRM panel showing subject area if available)
  _____
  _____
- Specific data needed (see list of available products on previous page) _____
  _____
- Effective date of FIRM for which data are requested (enclose an annotated copy of FIRM/FBFM, if available, identifying area of interest) _____

Use Only If Requesting Category 6 Data

- File format of digital mapping (choose one):

  MicroStation DGN ☐
  ArcView SHP ☐
  ArcInfo E00 ☐

  Projection of digital mapping:

  UTM ☐ State Plane ☐ Other ☐ Specify _____

  Horizontal Datum:
  NAD27 ☐ NAD83 ☐ Other ☐ Specify _____

  Units:
  Feet ☐ Meters ☐

- Contact person's name _____
- Firm Name _____
- Email Address _____
- Daytime Phone/fax number: ph _____ fax _____
- Mailing Address _____
  _____
  _____
- I am employed by (choose one):

  ☐ Private Firm ☐ State Agency ☐ Federal Agency ☐ Local Gov't ☐ FEMA Study Contractor* ☐ Other

* Please provide contract number _____

Federal Emergency Management Agency

Washington, D.C. 20472

FEDERAL EMERGENCY MANAGEMENT AGENCY **CREDIT CARD INFORMATION**	**FEMA USE ONLY**	*O.M.B. No. 3067-0147* *Expires April 30, 2001*

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 6 minutes per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472, Paperwork Reduction Project (3067-0147). You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Please do not send your completed form to the above address.

If paying by credit card, this form must be completed. **THIS FORM <u>MUST</u> BE MAILED OR FAXED TO:**

Federal Emergency Management Agency
Revisions Fee-Collection System Administrator
P.O. Box 22787
Alexandria, Virginia 22304
703-317-3076

Request # _____ (if known) Amount: $_____

☐ INITIAL FEE ☐ FINAL FEE ☐ MASTERCARD ☐ VISA

CARD NUMBER

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

EXP. DATE

☐☐ – ☐☐

Month Year

_____ _____

Date Signature

NAME (AS IT APPEARS ON CARD): _____

ADDRESS: _____

_____

DAYTIME PHONE: _____

FEMA Form 81-103, JUL 00