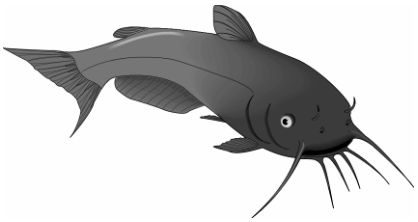
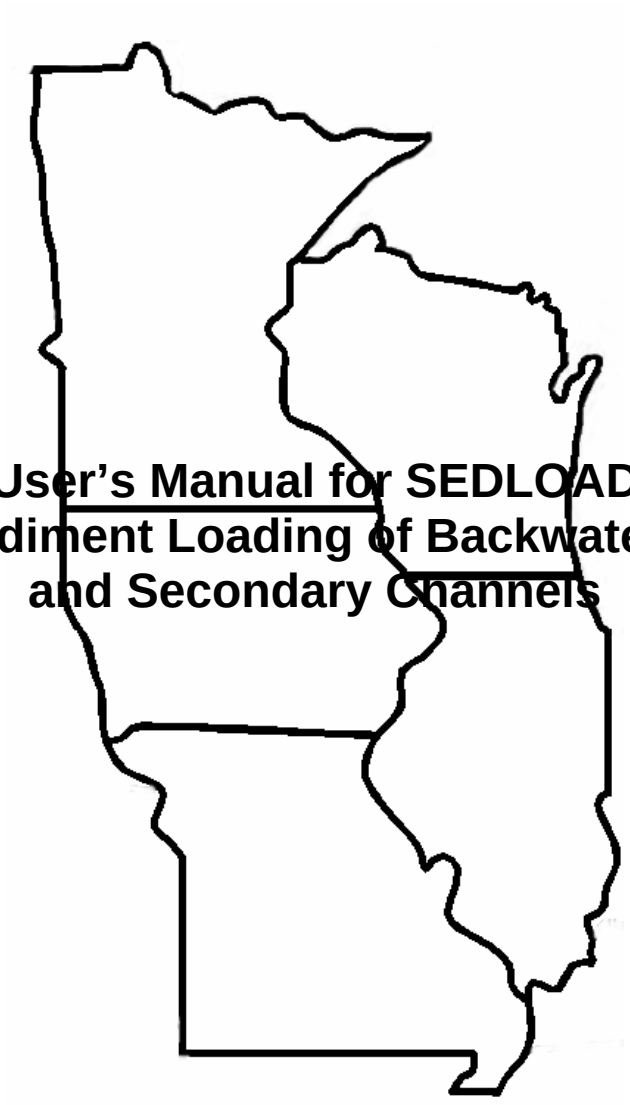
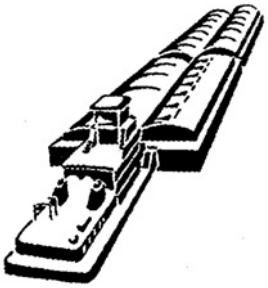
Interim Report For The Upper Mississippi River – Illinois Waterway System Navigation Study





User's Manual for SEDLOAD Sediment Loading of Backwaters and Secondary Channels



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User's Manual for SEDLOAD Sediment Loading of Backwaters and Secondary Channels

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ABSTRACT:
The SEDLOAD package is a group of programs designed to determine the sediment load delivered to the inlets of backwaters and secondary channels of a river due to river traffic, specifically tow traffic. This user's manual describes how to set up batch files, input and output file formats, example outputs, and source code listings in order to run the program.

Contents

Preface

The work reported herein was conducted as part of the Upper Mississippi River—Illinois Waterway (UMR-IWW) System Navigation Study. The information generated for this interim effort will be considered as part of the plan formulation process for the System Navigation Study.

The UMR-IWW System Navigation Study is being conducted by the U.S. Army Engineer Districts of Rock Island, St. Louis, and St. Paul under the authority of Section 216 of the Flood Control Act of 1970. Commercial navigation traffic is increasing, and in consideration of existing system lock constraints, will result in traffic delays that will continue to grow in the future. The system navigation study scope is to examine the feasibility of navigation improvements to the Upper Mississippi River and Illinois Waterway to reduce delays to commercial navigation traffic. The study will determine the location and appropriate sequencing of potential navigation improvements on the system, prioritizing the improvements for the 50-year planning horizon from 2000 through 2050. The final product of the System Navigation Study is a Feasibility Report, which is the decision document for processing to Congress.

This study was conducted in the Coastal and Hydraulics Laboratory (CHL), U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS. The work was conducted under the direction of Mr. Thomas A. Richardson, Director, CHL. This report was written by Mr. W. Clay Lahatte and Dr. Stephen T. Maynord, CHL, ERDC.

At the time of publication of this report, Director of ERDC was Dr. James R. Houston. COL James R. Rowan was Commander, ERDC.

This manual was last modified on Tuesday, March 30, 2004.

1 Overview

General

The SEDLOAD package is a group of programs designed to determine the sediment load delivered to the inlets of backwaters and secondary channels of a river due to river traffic, specifically tow traffic. The program treats backwaters and secondary channels differently. Technical background for this user's manual is provided in Pokrefke et al. (2003).

The programs in the SEDLOAD package are run in series, meaning the results from one program are used by the next program.

The final result for a given backwater or secondary channel area will be expressed as

a. Volume delivered to the backwater or secondary channel through all of the inlets of that backwater or secondary channel (acre-ft/year).

b. Rate of accumulation averaged over the entire area of a backwater or secondary channel (cm/year). This assumes all sediment delivered to the backwater or secondary channel there.

c. Intensity of sediment delivery at an individual inlet (acre-ft/year/meter of inlet opening width).

For a given section of a river, called a "pool," an entire sediment loading scenario can be run by issuing one command. This automated method is accomplished using MS-DOS batch files to execute the various programs in the SEDLOAD package.

SEDLOAD Components

SEDLOAD is composed of four Fortran codes that are run sequentially. The first three codes are independent of the amount of traffic. Description of the codes follows.

a. **VOLUME.EXE** - Determines the vessel-induced exchange of water between the main channel and backwater or secondary channel as a result of the

drawdown created by the vessel. Program formulation is described in Appendix A of Pokrefke et al. (2003). The program ouputs volume exchanged for all 108 tow types at each cell that represents a backwater or secondary channel for each of the nine combinations of stage and sailing line. Input and output files and source listing are provided in Appendix B.

b. **SEDMASS.EXE** - Uses as input the volume exchange caused by the tow drawdown from VOLUME.exe, the river flow into the backwater or secondary channel, and the sediment concentration at the edge of the main channel (from NAVSED). Determines the mass of sediment delivered to the backwater or secondary channel inlet per tow from the tow drawdown and from the river flow while the sediment concentration is elevated due to tow passage. Output is for all 108 tow types, each of the nine combinations of stage and sailing line, for each month of the navigation season. Input and output files and source listing are provided in Appendix C.

c. **BWMASSPROB.EXE** - Determines the sediment delivered to the inlet per tow in a probability of non-exceedance by a single tow ranging from 0.0 to 1.0 in increments of 0.1 based on a random sample of 5,000 tows. A probability of 0.0 represents the minimum value from the random sample of 5,000 tows. A probability of 1.0 represents the maximum value from the 5,000 random events. This step combines all 108 tow types and all nine combinations of stage and sailing line but keeps separate each month of the navigation season. Input and output files and source listing are provided in Appendix D.

d. **SED2BW.EXE** - The final code is the only step where the amount of traffic is an input. Based on a selected probability (such as 0.5 in UMR-IWW backwater/secondary channel studies), the sediment mass/tow for each month of the navigation season is multiplied by the number of tows for that month. The monthly sediment mass is summed to define the annual sediment mass delivered to the inlet. Input and output files and source listing are provided in Appendix E.

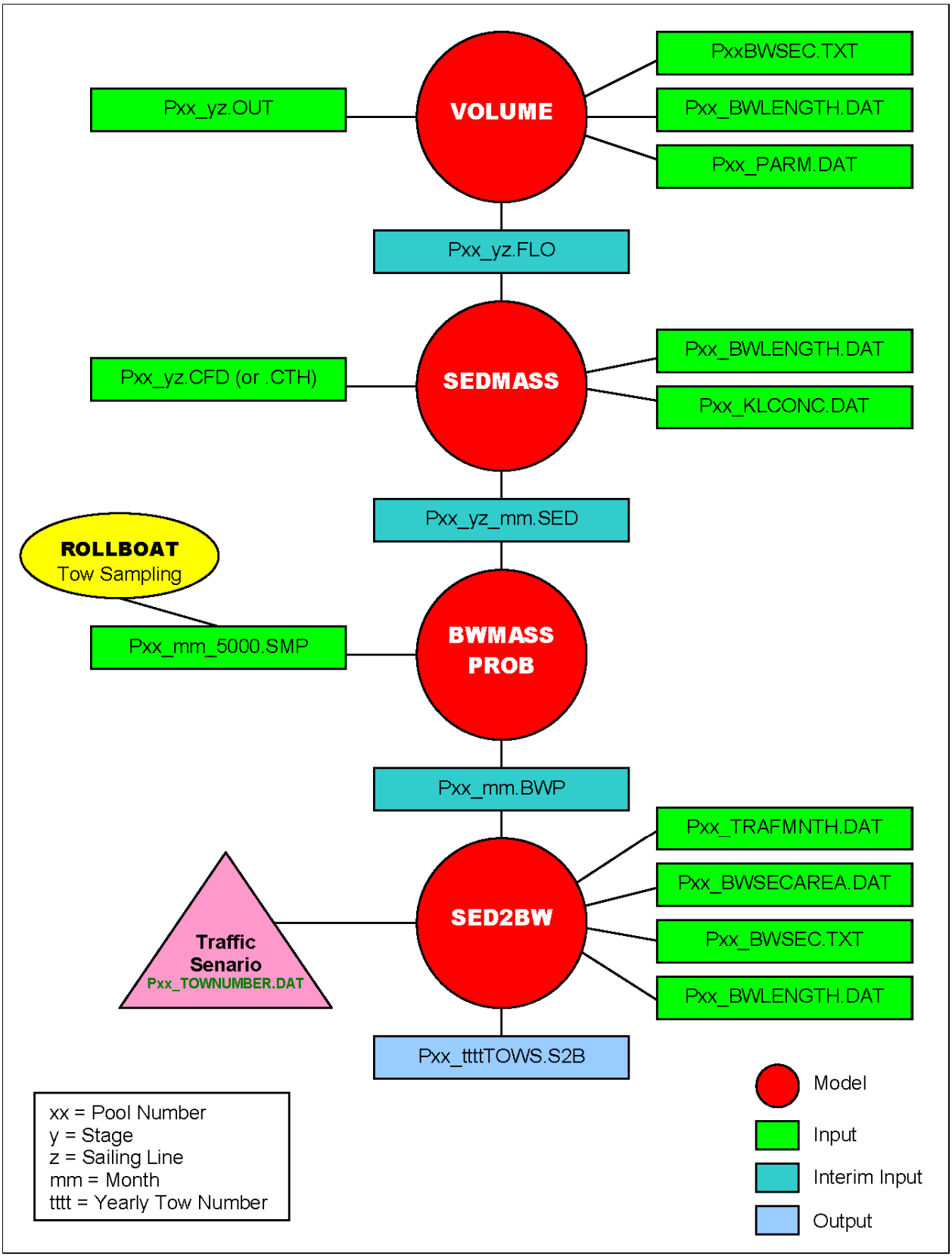
There are primarily two ways to run the SEDLOAD programs:

a. **Full Run** - This may be a new project or significant changes to an existing project. Prior to SEDLOAD, NAVEFF must be run to determine tow drawdown and NAVSED must be run to determine sediment concentration at the edge of the main channel. VOLUME.exe, SEDMASS.exe, BWMASSPROB.exe, and SED2BW.exe are then run sequentially.

b. **Traffic Scenario Run** - In cases where the fleet characteristics, sediment type, channel, and backwater geometry are established and don’t change but different levels of traffic must be evaluated, only SED2BW.exe must be run.

Data Flow Chart

The flow of data through the SEDLOAD process is shown in the flow chart below.


Pxx_yz.OUT
VOLUME
PxxBWSEC.TXT
Pxx_BWLENGTH.DAT
Pxx_PARM.DAT
Pxx_yz.FLO
Pxx_yz.CFD (or .CTH)
SEDMASS
Pxx_BWLENGTH.DAT
Pxx_KLCONC.DAT
Pxx_yz_mm.SED
ROLLBOAT
Tow Sampling
Pxx_mm_5000.SMP
BWMASS
PROB
Pxx_mm.BWP
Traffic
Senario
Pxx_TOWNUMBER.DAT
SED2BW
Pxx_TRAFMNTH.DAT
Pxx_BWSECAREA.DAT
Pxx_BWSEC.TXT
Pxx_BWLENGTH.DAT
Pxx_ttttTOWS.S2B
xx = Pool Number
y = Stage
z = Sailing Line
mm = Month
tttt = Yearly Tow Number
Model
Input
Interim Input
Output

System Requirements

FYI: These programs have been tested only on a Windows-based personal computer.

No exhaustive testing has been done with these programs concerning system requirements. It is assumed you will need at least a Pentium or AMD processor-based computer with 128 MB RAM.

Disk space requirements

Because of the sizes of the files involved with the backwater loading modeling processes, a large amount of hard disk space will generally be required. Typically you may want to have at least three GB of free space available for an entire project, and more if it is a large project with many pools and backwater inlets.

2 Installation

Step By Step

Listed below are the steps required to prepare for a new project and a complete run of the SEDLOAD package. Details can be found in the sections to follow.

Set Up Directories:

For more information, see “Set Up Directories” on page 7.

(1) Create a Project directory for the study.

(2) In the Project directory, create a subdirectory for each Pool to be studied (**pool**xx).

(3) In each Pool directory, create two subdirectories: **bw** and **sc**.

Install Programs:

For more information, see “Programs” on page 8.

(4) Copy all SEDLOAD executable (.exe) and batch files (.bat) into the Project directory.

Install Pool Data Files:

(5) Copy the nine NAVEFF output files (.out) for the **Pool** of interest to the matching **Pool** subdirectory under the Project directory. (These nine files are the combinations of three stages—low, medium, and high flow, and three sailing lines—left, middle, and right.)

(6) Copy the nine NAVSED output files (.cfd or .cth) for the **Pool** of interest to the matching **Pool** subdirectory under the Project directory.

(7) Copy the 12 (or less) monthly traffic rollup files (.smp) for the **Pool** of interest to the matching **Pool** subdirectory under the Project directory.

(8) Create a text file called **p**xx_**townumber.dat** in the Pool subdirectory. Edit this file in a text editor. The first two lines of this file are reserved for comments. The data must begin on the third line. On the third line, put an integer value specifying the total number of tows for the year. This number can be changed to model traffic conditions for past or future years. Follow the format indicated in Appendix A.

(9) Create a text file called **p**xx_**trafmnth.dat** in the Pool subdirectory. This file contains the percentage of tows to pass in this Pool for each month of the year. The actual number of monthly tows is calculated based on these values and the total tows for a year. Edit this file in a text editor. The first two lines of this file are reserved for comments. The data must begin on the third line. Follow the format indicated in Appendix A.

(10) Create a text file called **p**xx_**klconc.dat** in the Pool subdirectory. This file contains the ambient concentration data for this Pool. Edit this file in a text editor. The first two lines of this file are reserved for comments. The data must begin on the third line. Follow the format indicated in Appendix A.

Install backwater data files

(11) Create a text file called **p***xx*_**bwsecarea.dat** in the **bw** subdirectory of the Pool subdirectory. This file contains the surface areas of the backwaters of interest in this Pool. Edit this file in a text editor. The first two lines of this file are reserved for comments. The data must begin on the third line. Follow the format indicated in Appendix A.

(12) Create a text file called **p***xx*_**bwlength.dat** in the **bw** subdirectory of the Pool subdirectory. This file contains the lengths of the backwaters, as well as the sediment types. Edit this file in a text editor. The data must begin on the first line. Follow the format indicated in Appendix A. If this file already exists, be sure it contains only data related to backwaters (no secondary channel data).

(13) Copy the file **p***xx***bwsec.txt** (no underscore) to the **bw** subdirectory of the Pool subdirectory. This file is from the GIS. Edit this file and remove any secondary channel (SEC*xx*) data, leaving only backwater data. This file contains backwater inlet data. Follow the format indicated in Appendix A. *Be sure it contains only backwater data.*

Install secondary channel files

(14) Create a text file called **p***xx*_**bwsecarea.dat** in the **sc** subdirectory of the Pool subdirectory. This file contains the surface areas of the backwaters of interest in this Pool. Edit this file in a text editor. The first two lines of this file are reserved for comments. The data must begin on the third line. Follow the format indicated in Appendix A.

(15) Create a text file called **p***xx*_**bwlength.dat** in the **sc** subdirectory of the Pool subdirectory. This file contains the lengths of the backwaters, as well

as the sediment types. Edit this file in a text editor. The data must begin on the first line. Follow the format indicated in Appendix A. If this file already exists, be sure it contains only data related to secondary channels (no backwater channel data).

(16) Copy the file **p*xx*bwsec.txt** (no underscore) to the **sc** subdirectory of the Pool subdirectory. This file is from the GIS. Edit this file and remove any backwater channel (BKW*xx*) data, leaving only secondary channel data. This file contains secondary channel inlet data. Follow the format indicated in Appendix A. *Be sure it contains only secondary channel data.*

After these steps are completed, you should be ready to make an automated run. See “Making a Full Run” on page 11.

Set Up Directories

To successfully run the SEDLOAD package, a specific directory structure must be used. A general outline showing the directory structure is shown below.

`- Project Directory`	Root of the project, executables are here.
`  - Pool 01`	One of the pool data directories.
`    - bw`	Subdirectory for **backwater** data for the pool.
`    - sc`	Subdirectory for **secondary channel** data for the pool.
`  - Pool 02`	Another pool data directory.
.	
.	… and so on, for all pools in this project.

Tip: You can create the data directories as you install the input data files for the pools that you need.

Project directory

The project directory is the root of the project. All data associated with this project will be located in subdirectories of this project directory.

All SEDLOAD executable programs and batch files are to be stored in the project directory.

Example:

Project Directory:
`C:\Windows\Desktop\Uppermiss`

Data directories

The Data Directories will hold the pool data. Each pool will have its own data directory.

Example:

One or more Data Directories:
`C:\Windows\Desktop\Uppermiss\pool`**`xx`**

Where **`xx`** = pool number

Example:

```
C:\Windows\Desktop\Uppermiss\pool13
```

Backwater and secondary channel specific subdirectories

Each data directory also should contain a subdirectory for input data specific to backwaters (`bw`), and a subdirectory for input data specific to secondary channels (`sc`), in that pool.

Example:

```
C:\Windows\Desktop\Uppermiss\pool13\bw
C:\Windows\Desktop\Uppermiss\pool13\sc
```

These are separated because there can be cases in which the same cell number will apply to both a backwater and a secondary channel.

Programs

All the executable programs and batch files associated with the SEDLOAD package are to be installed in the project directory. The SEDLOAD package consists of these files:

Batch Files	Executable Files
GO_SEDLOAD.BAT	VOLUME.EXE
GO_SED2BW.BAT	SEDMASS.EXE
GO_VOLUME.BAT	BWMASSPROB.EXE
GO_SEDMASS.BAT	SED2BW.EXE
GO_BWMASSPROB.BAT	

To install the program files:

(1) Create a directory to contain the current project.

(2) Copy all SEDLOAD executable (`.exe`) and batch files (`.bat`) into the project directory.

Input Data Files

Overview

You will need all the files described below in order to make a complete automated run.

Data Directories (Pools). These files should be in the pool data directories.

- NAVEFF output (`.out`).
- NAVSED output (`.cth` or `.cfd`) (`.cfd` files result from assigning a fixed depth when running NAVSED).
- .SMP files (traffic rollup sampling files).
- Pxx_KLCONC.DAT (monthly ambient concentration data).
- Pxx_TRAFMNTH.DAT (percentage of traffic for each month).

Backwater (bw) and Secondary Channel (sc) Subdirectories. These files must be in the **`bw`** and **`sc`** subdirectories for the pool.

- PxxBWSEC.TXT (from GIS, file name contains no underscore).
- Pxx_BWLENGTH.DAT (contains the sediment type information).
- Pxx_PARM.DAT (tow characteristics).
- Pxx_BWSECAREA.DAT (surface area in acres of each backwater).

Separate backwater and secondary channel data

The backwater and secondary channel input data must be kept separate for the results to be accurate. You should make sure the backwater data is in its own input files in the **`bw`** subdirectory, and secondary channel data is in its own files in the **`sc`** subdirectory. The two files that might originally have both types combined are the following:

- Pxx_BWLENGTH.DAT. Backwater data contains **BW** in the last column. Secondary Channel data contains **SEC** in the last column.
- PxxBWSEC.TXT. Backwater data begins with **BWK.** Secondary Channel data begins with **SEC**

If not already separate, split these two files into four files, with the two backwater related files going into the `bw` subdirectory, and the two secondary channel related files going into the `sc` subdirectory.

- **Important:** Be sure this data is kept separate. To ensure reliable results, all the cell numbers in any one file should be unique.

3 Executing the Programs

Types of Runs

There are primarily two ways to run the SEDLOAD programs:

Full Run

This may be a new project or significant changes to an existing project. Prior to SEDLOAD, NAVEFF must be run to determine tow drawdown and NAVSED must be run to determine sediment concentration at the edge of the main channel (these programs are outside the scope of this document). VOLUME.exe, SEDMASS.exe, BWMASSPROB.exe, and SED2BW.exe are then run sequentially.

Traffic Scenario Run

In cases where the fleet characteristics, sediment type, and channel and backwater geometry are established and don't change, but different levels of traffic must be evaluated, only SED2BW.exe needs to be run.

Making a Full Run

The process for running the entire SEDLOAD package has been made fairly simple. Once all the input files are in the proper locations, starting a run involves only the following steps:

(1) If in Windows, open an MS-DOS command session.

(2) Navigate to the directory of the pool in which you are interested. Example: `cd C:\Windows\Desktop\Uppermiss\pool13`

(3) Start the processes by typing `..\go_sedload` *`xx`* where *`xx`* = the pool number. Example: `..\go_sedload 13.` This will execute the batch file `go_sedload.bat` located in the project directory, i.e., `c:\Windows\Desktop\Uppermiss`, and begin the SEDLOAD run.

Making a Traffic Scenario Run

If you need to make a change only to the yearly traffic number for the pool, you need to rerun only `SED2BW.EXE` to obtain the new results. The input files required to run only SED2BW are shown in “Data Flow Chart” on page 2. The new yearly tow number can either be input via the keyboard or read from the `Pxx_TOWNUMBER.DAT` file, depending on the choice made while answering the SED2BW prompts.

If all the previous steps of the SEDLOAD process already have been performed, do the following to make a new traffic scenario run:

(1) If in Windows, open an MS-DOS command session.

(2) Navigate to the backwater or secondary channel data directory of the pool in which you are interested. Example:

```
cd C:\Windows\Desktop\Uppermiss\pool13\bw
```

(3) Run SED2BW.EXE by typing `..\..\sed2bw` *xx* where *xx* = the pool number. Example: `..\..\sed2bw 13`

The results are stored in the backwater (`bw`) or secondary channel (`sc`) subdirectory in a file called `Pxx_ttttTOWS.DAT`, where `xx` is the pool number and `tttt` is the yearly number of tows used for the run.

4 Output

Final Results

The final output of SED2BW consists of a file called **p***xx_tttt***tows.s2b** written in both the **bw** and **sc** subdirectories of the pool subdirectory, where *xx* is the pool and *tttt* is the yearly number of tows used. This file reports the backwater or secondary channel, and the corresponding worst case sediment loading based on the input traffic scenario.

The result for a backwater or secondary channel is given as a level of significance for the three loading types as follows:

Loading by…	BLUE Negligible Impact Potential	YELLOW Medium Impact Potential	RED High Impact Potential
Volume	< 1.0 acre-ft/year	≥ 0.1 acre-ft/year	No criteria
Rate	< 0.1 cm/year	≥ 0.1 cm/year < 1.0 cm/year	≥ 1.0 cm/year
Inlet Intensity	< 0.01 acre-ft/year/m	> 0.01 acre-ft/year/m	No criteria

The following are included in the output:

- The area in acres of the backwater or secondary channel
- The cell ID associated with the backwater or secondary channel
- Sediment type in the backwater/secondary channel
- Traffic Impact by Volume given as acre-ft/year, and as a severity color
- Traffic Impact by Rate given as cm/year, and as a severity color
- Traffic Impact by Unit Volume given as acre-ft/year/meter, and as a severity color
- The worst of the three traffic impact types is provided in summary for the backwater/secondary channel as a severity color.

Example Output

SEDIMENTS TO BACKWATER OR SECONDARY CHANNEL (SEE FEATURE), POOL13
BASED ON 50 percent ROLLUP
Total tows for year: 2361

FEATURE	AREA Acres	CELLID	SEDIMENT_TYPE	IMPACT_BY_VOLUME acre-ft/year	IMPACT_BY_RATE cm/year	IMPACT_BY_UNIT_VOLUME acre-ft/year/meter	WORST_CASE
BKW01_01	746	315L5560	Cohesive-Medium	.00001 BLUE	.00003 BLUE	.00000 BLUE	BLUE
BKW01_02	746	105L5555	Cohesive-Medium	.00071 BLUE	.00003 BLUE	.00001 BLUE	BLUE
BKW02_01	33	65L5520	Noncohesive	.00384 BLUE	.00355 BLUE	.00003 BLUE	BLUE
BKW04_01	876	115R5465	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW05_03	782	355L5400	Cohesive-Medium	.00000 BLUE	.01968 BLUE	.00000 BLUE	BLUE
BKW05_05	782	135L5390	Cohesive-Medium	.18336 BLUE	.01968 BLUE	.00075 BLUE	BLUE
BKW05_06	782	125L5390	Cohesive-Medium	.32091 BLUE	.01968 BLUE	.00137 BLUE	BLUE
BKW05_07	782	85L5385	Cohesive-Medium	.00068 BLUE	.01968 BLUE	.00000 BLUE	BLUE
BKW06_01	934	195R5410	Cohesive-Soft	.47150 BLUE	.01539 BLUE	.00112 BLUE	BLUE
BKW07_01	399	265L5370	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW07_03	399	395L5345	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW07_04	399	385L5345	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW07_05	399	545L5340	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW07_06	399	565L5335	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW09_01	127	235R5345	Cohesive-Medium	.00571 BLUE	.00137 BLUE	.00025 BLUE	BLUE
BKW10_01	1181	315R5335	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW10_04	1181	165R5310	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW10_05	1181	325R5305	Noncohesive	.00001 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW10_07	1181	685R5300	Noncohesive	.00000 BLUE	.00000 BLUE	.00000 BLUE	BLUE
BKW11_01	1122	455L5330	Cohesive-Soft	.30954 BLUE	.44665 YELLOW	.00525 BLUE	YELLOW
BKW11_02	1122	445L5330	Cohesive-Soft	.01047 BLUE	.44665 YELLOW	.00024 BLUE	YELLOW
BKW11_03	1122	435L5330	Cohesive-Soft	.01314 BLUE	.44665 YELLOW	.00037 BLUE	YELLOW
BKW11_07	1122	95L5325	Cohesive-Soft	4.02252 YELLOW	.44665 YELLOW	.02174 YELLOW	YELLOW
BKW11_08	1122	475L5310	Cohesive-Soft	.33900 BLUE	.44665 YELLOW	.00030 BLUE	YELLOW
BKW11_09	1122	75L5300	Cohesive-Soft	.20700 BLUE	.44665 YELLOW	.00397 BLUE	YELLOW
BKW11_12	1122	15L5290	Cohesive-Soft	11.54011 YELLOW	.44665 YELLOW	.02410 YELLOW	YELLOW

Appendix A
File Formats

General

This section contains some of the file formats for files used as input to the various components of the SEDLOAD package. These file format descriptions are provided for reference in the event custom input files may need to be created.

Pxx_TOWNUMBER.DAT

The number of tows passing through a given pool for the period of a year.

Used by: SED2BW

ASCII Text File, Free field. Data starts on the third line.

Line	Column	Type	Description
1, 2	Any	N/A	User Comments.
3	1	Integer	Number of tows for the year.

Example:
Total tows for year 2000 – Pool 13
Other comments
2306

Pxx_TRAFMNTH.DAT

Traffic percentage by month.

Used by: SED2BW

ASCII Text File, Free field. Data starts on the third line.

Line	Column	Type	Description
1, 2	Any	N/A	User Comments.
3-14	1	Real	Values for months 1 through 12, one per line, listed as the percentage of the total number of tows to pass for the particular month.

Example:
Traffic percentage by month - Pool13
Other comments
0.0
0.0
0.0761
0.1196
0.1313
0.1184
0.1353
0.1223
0.0979
0.1039
0.0849
0.0105

All these values should sum to 1.

Note: `0.0` indicates no navigation for that month, usually due to winter shutdown.

Pxx_KLCONC.DAT

File contains ambient concentration values for 12 months.

Used by: SEDMASS

ASCII Text File, Free field. Data starts on the third line.

Line	Column	Type	Description
1, 2	Any	N/A	User Comments.
3-14	1	Character*2	Two-character number specifying the month.
3-14	2	Real	The ambient concentration for the month specified.

Example:
Ambient Concentration Values – Pool 13
Other comments
01 -1.0
02 -1.0
03 51.6
04 83.0
05 72.0

06 58.0
07 48.5
08 33.1
09 34.3
10 34.7
11 30.1
12 -1.0

◗ **Note:** `-1.0` indicates no navigation for that month, usually due to winter shutdown.

Pxx_BWSECAREA.DAT

File contains surface areas in acres of the specified backwaters/secondary channels.

Used by: SED2BW

ASCII Text File, Free field. Data starts on the third line.

Line	Column	Type	Description
1, 2	Any	N/A	User Comments.
3-??	1	Character	The backwater/secondary channel, in the form of: BKW*xx* or SEC*xx*, where *xx* is a two-digit number.
3-??	2	Integer	The surface area in acres of the backwater/secondary channel specified.

Example:
Backwater Areas – Pool 13
Other comments
BKW01 746
BKW02 33
BKW03 83
BKW04 876
BKW05 782
BKW06 934
BKW07 399
BKW09 127
BKW10 1181
BKW11 1122

Pxx_BWLENGTH.DAT

File contains the lengths and sediment types of the backwaters/secondary channels.

Used by: VOLUME, SEDMASS, SED2BW

ASCII Text File, Free field. Data starts on the first line.

Line	Column	Type	Description
Any	1	Character	Cell ID at backwater/secondary channel inlet.
	2	Integer	Length in meters of the backwater/secondary channel.
	3	Integer	Sediment Type. Cohesive sediments = 2 Non-cohesive sediments = 3
	4	Integer	Sediment Class—applicable only to cohesive sediments. Soft = 1 Medium = 2 Hard = 3
	5	Character	Indicates the backwater/secondary channel number.

Example**:**

315L5560	1200	2	2	BW1
105L5555	400	2	2	BW1
65L5520	800	3	9999	BW2
455L5475	850	9999	9999	BW3
115R5465	1700	3	9999	BW4
345R5455	3000	9999	9999	BW4
355L5400	1600	2	2	BW5
135L5390	300	2	2	BW5

- **Note:** 9999 indicates no data or not applicable.

PxxBWSEC.TXT

File contains various types of data from the GIS.

Used by: VOLUME, SED2BW

Line 1 is for user comments. In the case of the example below, the meanings of the values are presented.

The data starts on line 2. The file contains these values, separated by commas:

(1) Feature, in the form of BKW*xx_yy* or SEC*xx_yy*, where *xx* = backwater/secondary channel number, and *yy* = inlet/outlet number.

(2) Cell ID at backwater/secondary channel inlet

(3) Actual river mile

(4) Inlet width, meters

(5) Low flow cross-sectional area of inlet, square meters

(6) Medium flow cross-sectional area of inlet, square meters

(7) High flow cross-sectional area of inlet, square meters

(8) Low flow average inlet depth, meters

(9) Medium flow average inlet depth, meters

(10) High flow average inlet depth, meters

(11) Low flow rate of inlet, cubic meters per second

(12) Medium flow rate of inlet, cubic meters per second

(13) High flow rate of inlet, cubic meters per second

(14) Specifies whether the channel is an inlet or outlet. SEDLOAD deals only with inlets.

Example:

```
FEATURE,CELL_ID,ACTUAL_RM,WIDTH,L_XAREA,M_XAREA,H_XAREA,L_AVGDEP,M_AVGDEP,H_AVGDEP,L_FLOWRATE,M_F
LOWRATE,H_FLOWRATE,IN_OUT
BKW01_01,315L5560,555.9,91.0,124.0,193.3,382.0,1.3,2.1,4.2,1.90,6.07,-999.00,INLET
BKW01_02,105L5555,555.7,121.5,99.9,192.5,436.9,0.8,1.6,3.6,2.28,6.71,-999.00,INLET
BKW01_03,125L5555,555.5,116.7,185.9,274.9,509.6,1.6,2.3,4.4,2.29,5.62,-999.00,OUTLET
BKW01_04,145L5500,550.0,378.0,715.5,957.5,1602.7,1.9,2.5,4.2,4.72,14.58,-999.00,OUTLET
BKW02_01,65L5520,552.1,133.0,150.6,239.7,483.0,1.1,1.8,3.6,2.83,8.85,-999.00,INLET
BKW02_02,155L5505,550.5,217.3,183.6,322.8,700.4,0.8,1.5,3.2,3.89,11.16,-999.00,OUTLET
BKW03_01,445L5475,547.4,267.9,30.3,185.5,601.9,0.1,0.7,2.3,-999.00,-999.00,-999.00,INLET
BKW04_01,115R5465,546.2,27.0,24.3,38.3,77.8,0.9,1.4,2.9,0.58,1.42,-999.00,INLET
BKW04_02,345R5455,545.4,37.6,64.2,83.7,137.5,1.7,2.2,3.6,-999.00,-999.00,-999.00,INLET
BKW04_03,335R5415,541.3,123.5,162.0,210.9,361.5,1.3,1.7,2.9,2.62,9.06,-999.00,OUTLET
BKW05_03,355L5400,540.1,49.5,14.5,34.2,88.5,0.3,0.7,1.8,0.16,0.92,-999.00,INLET
BKW05_05,135L5390,539.1,243.5,728.5,810.1,1069.9,3.0,3.3,4.4,31.71,80.76,-999.00,INLET
```

A value of -999.00 indicates the inlet is submerged at that flow condition.

Note: The first line has been wrapped in the example. It should be one long line of text.

Appendix B
VOLUME Program

Files

Input

PxxBWSEC.TXT (from GIS)

Pxx_PARM.DAT (tow characteristics)

Pxx_yz.OUT (NAVEFF output file)

Pxx_BWLENGTH.DAT (length of the channels)

where
xx = Pool Number
y = Stage, z = Sailing Line

Output

Pxx_yz.flo

where
xx = Pool Number
y = Stage, z = Sailing Line

Brief Output Description.

Field	Description
1	Cell ID
2	Traffic scenario
3	Stage/sailing line
4	Wave period, in seconds
5	Inlet area, in square meters
6	Channel length, in meters
7	Water depth, in meters
8	Input drawdown, in meters

9	Modified drawdown at the inlet, in meters
10	Channel type (backwater or secondary channel)
11,13,15	Discharge for wave
12,14,16	Wave duration, in seconds
17	Low flow rate, cubic meters per second
18	Medium flow rate, cubic meters per second
19	High flow rate, cubic meters per second
20	Total volume, in cubic meters

Source Code

```
      program compute_flux
c
c The program reads the lengths of channels from chlength.dat,
c the cell_ids and dimensions of channels from the
c Backwater/Secondary-channel data file,
c and the drawdowns from NAVEFF output.
c
c The program then calls subroutines BACKWATER and SIDE_CHANNEL to
c compute the flow rate of water. It is assumed that the rate is constant
c for each cycle as a step functon.
c
c The results units are m**3/sec

    character*2   pool, flowchan
    character*200 PATH, naveffpath

    real          rm
    character*1   dir,speed,size,draft,turbine,stage,sl_pos

    character*8  feature,id1,id2,id3,ch_type*2,cellid(1000)
    character*6  in_out
    character*256 lin

    real*8         q(3), time(3)
    real           n
    real*8         width
    real*8         ldepth,mdepth,hdepth
    real*8         lxarea,mxarea,hxarea
    real*8         lfrate,mfrate,hfrate
    real*8       drawdown, drawdownx

    character*5   traffic, stg_sl*2

    character*64 BWDAT,BWDATTMP,NAVOUTDAT,NOUTDATTMP,CHANLENDAT,OUTDAT

cccc ccccccc ccccccc cccccccccccccccccccccccccccc

    write (*,*) 'This program requires files...'
    write (*,*) 'PxxBWSEC.TXT'
    write (*,*) 'Pxx_yz.OUT'
    write (*,*) 'CHLENGTH.DAT'
    write (*,*) '  where xx=Pool Number'
    write (*,*) '        y=Stage, z=Sailing line'
    write (*,*) '----'
    write (*,*) ' '

    n = 0.020  ! Default

    write(*,*) 'Enter the Pool Number (2 characters - Ex: 13):'
    read (*,*) pool
    write(*,*) 'Enter the Flow/Channel (2 characters - Ex: LR):'
    read (*,*) flowchan
*   write(*,*) 'Enter directory for reading data (. for current):'
*   write(*,*) '  **** DO NOT ADD TRAILING BACKSLASH ****'
*   read (*,*) PATH
```

```
*   PATH = 'c:\windows\desktop\uppermiss\pool'//trim(pool)//'\'
    PATH=''

    write(*,*) 'Enter the path for the NAVEFF output files.'
    write(*,*) 'If the same as the default, enter 0 (zero)'
    read(*,*) naveffpath

    BWDAT=trim(PATH)//'p'//pool//'bwsec.txt'
    BWDATTMP=trim(PATH)//'p'//pool//'bwsec.tmp'
    if(naveffpath .eq. '0')then
      NAVOUTDAT=trim(PATH)//'p'//pool//'_'//flowchan//'.out'
    else
      NAVOUTDAT=trim(naveffpath)//'p'//pool//'_'//flowchan//'.out'
    end if
    NOUTDATTMP=trim(PATH)//'VOLUME.TMP'
    CHANLENDAT=trim(PATH)//'P'//pool//'_bwlength'//'.dat'
    OUTDAT=trim(PATH)//'P'//pool//'_'//flowchan//'.flo'

c   goto 12

      open(20,file=BWDAT,status='old')
      open(21,file=BWDATTMP,status='unknown')
      open(30,file=NAVOUTDAT,status='old')
      open(35,file=NOUTDATTMP,status='unknown')

    write(*,*) 'Extracting useful information from ',NAVOUTDAT
    read(20,*) lin ............................ ! Skip first line of text.
    nid = 0
    do
        read(20,*,end=100) feature, id1, actual_rm, width,
     &                     lxarea,mxarea,hxarea,
     &                     ldepth,mdepth,hdepth,
     &                     lfrate,mfrate,hfrate,
     &                     in_out
        i_pos=scan(in_out,'I')
     if (i_pos .ne. 0) then
*    if (in_out .eq. 'INLET ') then
         if (lfrate.eq.-999.0 .and. mfrate.eq.-999.0
     &.and. hfrate.eq.-999.0) then
           ! Ignore cells with no flow data.
       else
         nid = nid + 1
         cellid(nid) = id1
c        do i=1, nid
c          if (cellid(i) .eq. id1) then
c            num_occur(i) = num_occur(i) + 1
c          end if
c        end do
           write(21,21) feature, id1, actual_rm, width,
     &                     ldepth,mdepth,hdepth,
     &                     lxarea,mxarea,hxarea,
     &                     lfrate,mfrate,hfrate,
     &                     in_out
  21       format(a8,',',a8,',',f6.2,',',f9.3,',',1x
     &       ,f9.3,',',f9.3,',',f9.3,',',1x
     &       ,f9.3,',',f9.3,',',f9.3,',',1x
     &       ,f9.3,',',f9.3,',',f9.3,','
     &       ,a6)
       end if
     end if
     end do
 100  write(*,*) nid, ' cells with INLETs used from ',BWDAT

    ! Write to temp file.
      do
         read(30,*,end=299) rm,dir,speed,size,draft,
     &                      turbine,stage,sl_pos,
     &                      traffic, stg_sl,
     &                      id1,depth,ret_vel,drawdown

         do j = 1, nid
            if (trim(id1).eq.trim(cellid(j))) then
               write(*,*) id1,' ', traffic,' ', stg_sl
               write(35,200) id1,traffic,stg_sl,drawdown
```

```
            end if
          end do
        end do
c 202  format(a10,2x,a5,2x,a2,f10.3)
 299   close(35)
      close(30)
    close(21)
    close(20)



 12   open(10,file=CHANLENDAT,status='old')
      open(20,file=BWDATTMP,status='old')
      open(30,file=NOUTDATTMP,status='old')
      open(50,file=OUTDAT,status='unknown')

      i = 0
      DO
       read(10,*,end=999) id1, ch_length  ! , ch_type
c 90    format(2x,a8,f10.1,3x,a2)

*       ch_length = ch_length*41000.0*2.54/100.0  ! Use Only if input file
is in inches.

      rewind (20)
      DO
          read(20,*,end=500) feature,id2, actual_rm, width,
     &                     ldepth,mdepth,hdepth,
     &                     lxarea,mxarea,hxarea,
     &                     lfrate,mfrate,hfrate,
     &                              in_out
 95       format(a8,2x,a8,7f8.1,3f8.2,a8)

            if (trim(id1).eq.trim(id2)) then
               rewind (30)
               DO
                  read(30,200,end=501) id3, traffic, stg_sl,drawdown
 200              format(a8,4x,a5,2x,a2,f12.6)
                  if (trim(id3).eq.trim(id1)) then
                     speed = traffic(2:2)
                     size = traffic(3:3)
                     stage = stg_sl(1:1)

                     call conv(j,speed,size,stage,
     &                    ldepth,mdepth,hdepth,
     &                    lxarea,mxarea,hxarea,
     &                    T,Area,H)

c                 ~~~~~~~~~  Computing the volume of water ~~~~~~~~~~~

                     Perimeter = width + 2.0*H
                     R = Area/Perimeter

                   drawdownx = drawdown.....  ! Retain drawdown for writing       out

                     if (lfrate.eq.0.0 .and. mfrate.eq.0.0
     &               .and. hfrate.eq.0.0) then
                      ch_type = 'BW'
                        n = 0.020
                        call backwater(drawdownx,H,Area,R,
     &                                 ch_length,n,T,q,time,vsum)
                     else
                      ch_type = 'SC'
                        n = 0.020
                        call side_channel(drawdownx,H,Area,R,
     &                                 ch_length,n,T,q,time,vsum)
                     end if

                     write(50,300) id1,traffic,stg_sl,T,Area,ch_length,
     &               H,drawdown,drawdownx,ch_type,
     &                           q(1),time(1),q(2),time(2),q(3),time(3),
     &                           lfrate,mfrate,hfrate,vsum
 300              format(a8,2x,a5,2x,a2,3f10.2,
     &                 f10.3,2f10.4,3x,a2,2x,
```

```
     &                  3(f11.4,f12.2),3f11.2,2x,f11.3)

                   end if

                 END DO

 501         end if

           END DO

 500    i = i + 1
          write(*,*) 'Processed cell ', i

       END DO


 999   close(50)
       close(30, status='delete')
       close(20, status='delete')

       stop
       end

ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

       subroutine conv(j,speed,size,stage,
      &                ldepth,mdepth,hdepth,
      &                lxarea,mxarea,hxarea,
      &                T,Area,H)

       real         Lb

       real*8         ldepth,mdepth,hdepth
       real*8         lxarea,mxarea,hxarea
       real*8         lfrate,mfrate,hfrate
       character*1  speed,size,draft,stage

       if(speed.eq.'F') Vb = 3.58
       if(speed.eq.'M') Vb = 2.91
       if(speed.eq.'S') Vb = 2.24

       if(size.eq.'B') Lb = 297.18
       if(size.eq.'M') Lb = 237.74
       if(size.eq.'S') Lb = 178.31
       if(size.eq.'L') Lb =  45.72

       if(stage.eq.'H') then
          H = hdepth
          Area = hxarea
       else if(stage.eq.'M') then
          H = mdepth
          Area = mxarea
       else if(stage.eq.'L') then
          H = ldepth
          Area = lxarea
       end if

       T = 2.0 * Lb/Vb

       return
       end


ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

       SUBROUTINE SIDE_CHANNEL(A0,H,AREA,R,L,n,T,q,time,vsum)
c
c The routine computes the volumetric flux (q) for a side channel
c due to the drawdown. Initial three cycles are used.  In calculating
c the water volume only V1 & V4 are used.
c
c Inputs:
c     L    channel length
c     n    0.050
c     H    water depth
```

```
c     AREA x-sectional area of the backwater
c     R    hydraulic radius
c     T    period
c Outputs:
c     q    flow rate
c     A0
c     vsum
c
    real*8  A0,A1,A2,A3,A4,A5,A6,V1,pi

      real    L,n
    real*8  q(3),time(3)

      pi = 4.0*atan(1.0)
      g = 9.8

      vsum=0.0

    DO I = 1, 3

         CALL ENT_LOSS(A0,A1,H)              !

         V1 = Area*A1*sqrt(g/H)*T/pi         ! Add  volume using A1

         CALL FRICTION(A1,A2,H,R,n,L)        ! friction loss

C         V2 = Area*A2*sqrt(g/H)*T/pi        ! Volume using A2, the
negative
                                             ! wave leaving the channel
draws
                                             ! water into the channel

         CALL ENT_LOSS(A2,A3,H)
         CALL ENT_LOSS(A3,A4,H)

         V4 = Area*A4*sqrt(g/H)*T/pi         ! Volume using A4, a + wave
                                             ! entering the channel

         CALL FRICTION(A4,A5,H,R,n,L)        ! friction loss

         CALL ENT_LOSS(A5,A6,H)

         A0 = A6

         stuff=2.0*L/sqrt(g*H)
       if(stuff.gt.400.0)then !After 1200 seconds, most activity is done.
         stuff=400.0
       end if
       time(i) = float(i)*stuff
         q(i) = (V1 + V4)/stuff !(2.0*L/sqrt(g*H))

       vsum=vsum+V1+V4

      END DO

      RETURN
      END

ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

      SUBROUTINE ENT_LOSS(A0,A1,H)

c input  amplitude: A0
c output amplitude: A1
    real*8  A0,A1
    real*8  pi

      pi = 4.0*atan(1.0)

      A1 = (2.0*H)/pi*(-1.0 + sqrt(1.0 + pi*A0/H))

      RETURN
      END

ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```

```
      SUBROUTINE FRICTION(A0,A1,H,R,n,X)

c input  amplitude: A0
c output amplitude: A1
c X: the channel length
    real*8  A0,A1
    real*8  pi

      real    n

      pi = 4.0*atan(1.0)
      g = 9.8

*      A1 = A0 - A0/(1.0 + pi/(4.0*H)*(n/(R**(2.0/3.0)))**2*g*A0*X)
      A1 = A0 - (pi/(4.0*H)*(n/(R**(2.0/3.0)))*g*A0*A0*X)/
     &    (1+(pi/(4.0*H)*A0))
    if (A1 .lt. 0.00001) then
      A1 = 0.0
    endif

      RETURN
      END

ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

      SUBROUTINE BACKWATER(A0,H,AREA,R,L,n,T,q,time,vsum)
c
c The routine computes the volumetric flux (q) for a backwater
c due to the drawdown. Initial three cycles are used.  In calculating
c the water volume only V1 and V4 are used. The reflection coefficient
c is assumed to be 1.0.
c
c Inputs:
c     L    channel length
c     n    0.050
c     H    water depth
c     AREA x-sectinal area of the backwater
c     R    hydraulic radius
c     T    period
c Outputs:
c     q    flow rate
c     A0
c     vsum
c
    real*8  A0,A1,A2,A3,A4,A5,A6,V1
    real*8  pi

      real    L,n
    real*8  q(3),time(3)

      Rc = 1.0                            ! reflection coeff.

      pi = 4.0*atan(1.0)
      g = 9.8

      vsum=0.0

    DO I = 1, 3

         CALL ENT_LOSS(A0,A1,H)             ! (1)

         V1 = Area*A1*sqrt(g/H)*T/pi        ! (2) Volume using A1


         X = 2.0*L                          ! no reflection loss

         CALL FRICTION(A1,A2,H,R,n,X)       ! friction loss

c         V2 = Area*A2*sqrt(g/H)*T/pi         ! volume using A2

         CALL ENT_LOSS(A2,A3,H)
         CALL ENT_LOSS(A3,A4,H)
```

```
      V4 = Area*A4*sqrt(g/H)*T/pi         ! Add volume using A4

      CALL FRICTION(A4,A5,H,R,n,X)        ! friction loss

      CALL ENT_LOSS(A5,A6,H)

      A0 = A6

      stuff=4.0*L/sqrt(g*H)
    if(stuff.gt.400.0)then !After 1200 seconds, most activity is done.
      stuff=400.0
    end if
    time(i) = float(i)*stuff
      q(i) = (V1 + V4) /stuff !(4.0*L/sqrt(g*H))

      vsum=vsum+V1+V4

END DO

  RETURN
  END
```

Appendix C
SEDMASS Program

Files

Input

Pxx_yz.CTH (or CFD (fixed depth), currently used - 11/14/01) (NAVSED output file)

Pxx_BWLENGTH.DAT (lengths of channels)

Pxx_yz.flo (Output from VOLUME program)

Pxx_KLCONC.DAT (Monthly ambient concentration data)

where
xx = Pool Number
y = Stage, z = Sailing Line

Output

Pxx_yz_mm.SED

where
xx = Pool Number
y = Stage, z = Sailing Line
mm = month

Brief Output Description.

Field	Description
1	Cell ID
2, 3	Traffic scenario
4	Mass added due to tow drawdown, in kilograms
5	Mass added due to disturbed sediment added to the river from tow passing, in kilograms
6	Total mass added to the backwater/secondary channel, in kilograms
7	Total volume, in cubic meters

Source Code

```
      program sedmass

c The program computes the mass of sediment due to boat passage given
c flows and concentration values for each cellid and tow configuration
given.
c
c From TMPDATA:
c The program reads times and calculates time increments.
c The program reads concentration time histories in mg/l
c (concentration at each time) for appropriate cell_id's.
c
c From FLOWDATA:
c The program reads flows (q1, q2, and q3)
c at times (t1, t2, and t3), and river flows at low, medium,
c and high stages for each cell_id.
c
      common/com/timehist

    character*10 PROGNAME

    character*256 lin

    character*2 pool, flowchan
    character*255 PATH, navsedpath, navsedfileext, klconcpath

      real        reflq(3), refltime(3)
    real timehist(1000)
    integer deltaT(1000)
    real conc(1000)

    real*8 massriv, massboat !, mass_sc
      integer     noflow, nohflow
    character   cnoflow*2, cnohflow*10

    character*2 month, m

      real lfrate,mfrate,hfrate
      real q_river

c     values from FLOW file.
      character ........cellid_f*9, last_cellid_f*9, traffic_f*5, stgsl_f*2
c     values from CONCENTRATION file.
      character ........................cellid_c*9, traffic_c*5, stgsl_c*2

    character...................cell_c*18, cell_f*18  !cellid+traffic+stgsl

      character*2 ch_type

    integer npts  ! read from CONCENTRATION file.
    Integer nlns, nrm

    real klac

    integer index0........! array index of time zero in CONCENTRATION file.

    Integer errfile1

    real        flowlins, conclins, pcentcmp

    character*1 ccc

    character*64 TMPDATA, FLOWDATA, OUTFILE1, ERRFILE
    character*64 CHANDATA, CTHDATA
    integer UNITCONC, UNITFLOW, UNITOUT1, UNITERR

    integer WRITE_AT

    !number of reflections in secondary channel or backwater
    integer REFLECTS
```

```
cccc ccccccc ccccccc cccccccccccccccccccccccccccc

c     Define 'constant' values...

    PROGNAME= 'SEDMASS'

      write (*,*) 'This program requires files...'
    write (*,*) 'Pxx_yz.CTH'
    write (*,*) 'CHLENGTH.DAT'
    write (*,*) '  where xx=Pool Number'
    write (*,*) '        y=Stage, z=Sailing line'
    write (*,*) ' '
    write (*,*) 'Output file is Pxx_yz.SED'
    write (*,*) '----'
    write (*,*) ' '


      write(*,*) 'Enter the Pool Number (2 characters - Ex: 13):'
      read (*,*) pool
    pool=trim(adjustr(pool))
    if(pool(1:1) .eq. '') then
      pool(1:1) = '0'
    endif
      write(*,*) 'Enter the Flow/Channel (2 characters - Ex: LR):'
      read (*,*) flowchan
*     write(*,*) 'Enter directory for reading data (. for current):'
*   write(*,*) '  **** DO NOT ADD TRAILING BACKSLASH ****'
*     read (*,*) PATH
    write(*,*)'Enter the number corresponding to the month (2 chars)'
    read (*,*) month
    month=trim(adjustr(month))
    if(month(1:1) .eq. '') then
      month(1:1) = '0'
    endif

*   write(*,*) 'Enter the Kevin Landwehr ambient concentration:'
*   read (*,*) klac

*     PATH = 'c:\windows\desktop\uppermiss\pool'//trim(pool)//'\'
      PATH=''


      write(*,*) 'Enter the path for the concentration file KLCONC.DAT'
    write(*,*) 'If the same as the default, enter a period (.)'
    read(*,*) klconcpath
    ! Add backslash if necessary
    i_ccc=len(trim(klconcpath))
    ccc=klconcpath(i_ccc:i_ccc+1)
    if (ccc .ne. '\') then
    .....................................klconcpath = trim(klconcpath)//'\'
    end if

      write(*,*) 'Enter the path for the NAVSED output files'
    write(*,*) 'If the same as the default, enter a period (.)'
    read(*,*) navsedpath

    write(*,*) 'Enter the NAVSED file extension (cth or cfd)'
    read(*,*) navsedfileext
    ! Remove any leading period
    if (navsedfileext(1:1) .eq. '.') then
    .....................................navsedfileext = navsedfileext(2:199)
    end if

      klac = -1.0
    open(unit=23,file=trim(PATH)//trim(klconcpath)//'P'//pool//
    & '_klconc.dat', status='old',action='read')
    ! Read two comment lines
    read(23,*) lin
    read(23,*) lin
    ! Read the data
      do
      read(23,*, end=23) m, klac
      if(m .eq. month) then
        goto 24
```

```
      end if
    end do
  23  klac = -1.0
  24 close(23)
      if(klac .eq. -1.0) then
      write(*,*) ' '
      write(*,*) '*** No KL Concentration for month ', month
      stop
    end if

      CHANDATA=   trim(PATH)//'P'//pool//'_bwlength'//'.dat'
      if(navsedpath .eq. '0' .or. navsedpath .eq. '.')then
      CTHDATA =   trim(PATH)//'P'//pool//'_'//flowchan//'.'//
    & trim(navsedfileext)
    else
      CTHDATA =   trim(navsedpath)//'P'//pool//'_'//flowchan//'.'//
    & trim(navsedfileext)
    endif
    TMPDATA = trim(PATH)//trim(PROGNAME)//'.tmp'
    FLOWDATA= trim(PATH)//'P'//pool//'_'//flowchan//'.flo'
    OUTFILE1= trim(PATH)//'p'//pool//'_'//flowchan//'_'//
     &                      month//'.sed'
    ERRFILE= trim(PATH)//'nocels'//flowchan//'.txt'
    UNITCONC= 40
    UNITFLOW= 50
    UNITOUT1= 60
    UNITERR= 90

    WRITE_AT=   10000

    !number of reflections in secondary channel or backwater
    REFLECTS= 3

cccc ccccccc cccccccc ccccccccccccccccccccccccccccc

      write (*,*) 'Program running...'

      write (*,*) 'Output file is ',OUTFILE1
    write(*,*) ' '

c     Extract necessary cellid's from concentration data file.
c       Write a temporary and smaller concentration data file
c       for processing by this program.

      call concmake(CHANDATA,CTHDATA,TMPDATA)

c     Count the number of lines in flow data file (used for percent
complete).
      call cntlines(FLOWDATA, flowlins)
     ! flowlins is returned.

    open(unit=UNITCONC,file=TMPDATA,status='old')
      open(unit=UNITFLOW,file=FLOWDATA,status='old')
      open(unit=UNITOUT1,file=OUTFILE1,status='unknown')

c     Read the times.
    call gettimes(UNITCONC,starttm,endtm,npts,nlns,nrm)
       ! All parameters except UNITCONC are returned.

c     Find time zero.
    call gettime0(timehist, npts, index0)
     ! index0 is returned.

    if (index0 .lt. 0) then
      write(*,*) 'No time zero in file ', TMPDATA
      stop
    end if

c   Get the time intervals.
    call getdeltaT(timehist, npts, deltaT)
     ! deltaT() is returned.

c   Print a heading at the top of the output file.
    call outhead(UNITOUT1)
```

```
      conclins = 0.0

    do

 301 ........  read(UNITFLOW,*, end=901) cellid_f,traffic_f,stgsl_f,T,Area,
     *            ch_length,H,dddummy,drawdown,ch_type,
     *            reflq(1),refltime(1),reflq(2),refltime(2),
     *            reflq(3),refltime(3),
     *            lfrate,mfrate,hfrate,vsum
 300    format(a9,2x,a5,2x,a2,3f10.2,3f6.3,3x,a2,
     &         3(f8.4,f8.0),3f8.2,2x,f9.3)

*   if(cellid_f .eq. '345R5315 ')then
*   d=1
*   endif

        conclins = conclins + 1
c       Calculate percent complete.
      pcentcmp = 100 * (1 - (flowlins - conclins)/flowlins)

      cell_f = cellid_f//' '//traffic_f//' '//stgsl_f
      ! Check for immediately following duplicates
      if (cell_f .eq. cell_c) then
        goto 301
      end if

c       Write something on the screen to show activity.
        if(cellid_f .ne. last_cellid_f)then
          write(*,15) cell_f, pcentcmp
  15      format('  Processing cell ', a18, 2x, f5.1, '%')
          last_cellid_f = cellid_f
        i_cell_found=0
        end if

c       Skip past the times in the concentration time history file.
      call resetconcfile(UNITCONC, nlns, nrm)..............................

      do

         read(UNITCONC,*, end=902) cellid_c, traffic_c, stgsl_c


        cell_c = cellid_c//' '//traffic_c//' '//stgsl_c

        if(trim(cell_f) .eq. trim(cell_c)) then
          ! The Meat!!!

          i_cell_found=-1

          call getconc(UNITCONC, nlns, nrm, klac, ch_type, conc)
       ! conc() is returned.

            call pickq_river(stgsl_f,lfrate,mfrate,hfrate,q_river)
           ! q_river is returned.

      if(cell_f .eq. '325R5305  UMBEO HM')then
    d=1
    endif

          call calcmass(npts,timehist,deltaT,conc,reflq,refltime,
     *       index0,q_river,REFLECTS,massriv,massboat,
     *       noflow,nohflow)
           ! massriv, massboat, and noflow and nohflow are returned.

            cnoflow = '   '
          cnohflow = '           '
            if (noflow .eq. 1) then
            cnoflow = 'BW'
          end if
            if (nohflow .eq. 1) then
            cnohflow = 'No Hi Flow'
            goto 810  ! Skip this info
          end if

          write(UNITOUT1,20) cell_f, massriv, massboat,
```

```
     *                          massriv+massboat,vsum,cnoflow,cnohflow
  20        format(1x,a18,1x,f13.2,2x,f13.2,2x,f13.2, 2x,f11.3,
     &             3x,a2,3x,a10)

          ! Go on to the next cell/tow_config in FLOWDATA.
        goto 800
        else
c           Skip past the current set of values in the concentration time
history file.
          call skipconc(UNITCONC, nlns, nrm).............................

        end if

 810  end do

        if(i_cell_found .eq. 0) then
        write(*,*)'** Cell ',cell_f,' not found in ',TMPDATA
       end if

 902  continue
*     if (errfile1 .eq. 0) then
*       errfile1=1
*   ......................open(unit=UNITERR,file=ERRFILE,status='unknown')
*       write(UNITERR,*) trim(PROGNAME), ' Program'
*       write(UNITERR,201) TMPDATA
* 201      format('Cell ids and tow configurations that were not'
*     *           ' found in data file ', a64, /)
*     end if
*     write(UNITERR,*) cell_f
 800 continue

    end do

 901 close(unit=UNITFLOW)
    close(unit=UNITOUT1)
    close(unit=UNITERR)
    close(unit=UNITCONC, status='delete')


    stop
      end

c
c --------------------------------------------------------------------------
-
c
    subroutine gettimes(UNITCONC,starttm,endtm,npts,
     *           nlns,nrm)
c      All parameters except UNITCONC are returned.
      common/com/timehist


    real.....................................................timehist(1000)
    integer..................................................npts
    integer.....................................................nlns, nrm
    integer.....................................................i,j,k
    integer..................................................UNITCONC

    read(UNITCONC,*)
    read(UNITCONC,*) starttm, endtm, npts
    read(UNITCONC,*)
    nlns = npts/ 10
    nrm = mod(npts,10)
    k=1
    do i = 1, nlns
      read(UNITCONC,15) (timehist(j), j=k, k+9)
      k=k+10
    end do
    if (nrm .gt. 0) then
      nrmm1=nrm-1
      read(UNITCONC,15) (timehist(j), j=k,k+nrmm1)
    end if

  15 format(10f10.2)
```

```
      return
      end

c
c ---------------------------------------------------------------------
-
c
      subroutine resetconcfile(UNITCONC, nlns, nrm)
c       Skips past the times in the concentration time history file.

      integer nlns, nrm
      integer UNITCONC

      rewind(unit=UNITCONC)

      read(UNITCONC,*)
      read(UNITCONC,*)
      read(UNITCONC,*)
      do i = 1, nlns
        read(UNITCONC,*)
      end do
      if (nrm .gt. 0) then
        read(UNITCONC,*)
      end if

      return
      end

c
c ---------------------------------------------------------------------
-
c
      subroutine skipconc(UNITCONC, nlns, nrm)
c       Skips past the current set of values in the concentration time
history file.

      integer nlns, nrm
      integer UNITCONC
      integer flag
      real    dummy

        read(UNITCONC, *) flag, dummy

      if (flag .eq. 1) then

        do i = 1, nlns
            read(UNITCONC,*)
        end do
        if (nrm .gt. 0) then
          read(UNITCONC,*)
        end if

        end if

      return
      end
c
c ---------------------------------------------------------------------
-
c
      subroutine gettime0(timehist, npts, index0)
c       index0 is returned.

      real.....................................................timehist(1000)
      integer..................................................npts, index0

      do index0 = 1, npts
        if(timehist(index0) .eq. 0) then
          return
        end if
      end do

      index0 = -1

      return
```

```
    end

c
c ----------------------------------------------------------------------
-
c
    subroutine getdeltaT(timehist, npts, deltaT)
c      deltaT() is returned.

    real.....................................................timehist(1000)
    integer.....................................................npts
    integer.....................................................deltaT(1000)

    integer i

    do i = 1, npts - 1
      deltaT(i) = timehist(i+1)-timehist(i)
    end do

    return
    end
c
c ----------------------------------------------------------------------
-
c
    subroutine getconc(UNITCONC, nlns, nrm, klac, ch_type, conc)
c      conc() is returned.

    integer.....................................................nlns, nrm
    real.....................................................klac, conc(1000)
    character*2 ch_type
    integer UNITCONC
      integer flag
    real    ambientc
    integer i, j, k

      read(UNITCONC, *) flag, ambientc

    if (ch_type .eq. 'BW') then

      if (flag .eq. 1) then
          k=1
        do i = 1, nlns
          read(UNITCONC, 15) (conc(j),j=k,k+9)
          do j=k,k+9
            conc(j)=conc(j)-ambientc+klac
      end do
          k=k+10
        end do
        if (nrm .gt. 0) then
          nrmm1=nrm-1
          read(UNITCONC, 15) (conc(j),j=k,k+nrmm1)
          do j=k,k+nrmm1
            conc(j)=conc(j)-ambientc+klac
      end do
        end if
      else
        conc(1) = klac
        do i = 2, (nlns*10) + nrm
          conc(i) = klac
        end do
      end if

    else

      if (flag .eq. 1) then
          k=1
        do i = 1, nlns
          read(UNITCONC, 15) (conc(j),j=k,k+9)
          k=k+10
        end do
        if (nrm .gt. 0) then
          nrmm1=nrm-1
          read(UNITCONC, 15) (conc(j),j=k,k+nrmm1)
        end if
```

```
      else
        conc(1) = ambientc
        do i = 2, (nlns*10) + nrm
          conc(i) = ambientc
        end do
      end if

    end if

  15 format(10f10.2)

    return
    end
c
c -------------------------------------------------------------------------
-
c
      subroutine pickq_river(stgsl,lfrate,mfrate,hfrate,q_river)
c      q_river is returned.

    character.............................................stgsl*2, stg*1
      real .......................................lfrate,mfrate,hfrate
    real.....................................................q_river

      if (lfrate.le.0.0 .and. mfrate.le.0.0 .and. hfrate.le.0.0) then
      q_river = -1.0  !Backwater
      goto 800
      end if
      if (hfrate.le.0.0) then
      q_river = -2.0  !No computation to make
      goto 800
      end if

      stg = stgsl

    if (stg .eq. 'L') then
      q_river = lfrate
    else if (stg .eq. 'M') then
      q_river = mfrate
    else if (stg .eq. 'H') then
        ! Check for no value for hfrate.
      if (hfrate .le. 0.0) then
          ! Return error code.
        q_river = -3.0 ! no hi flow value
        goto 800
      end if
      q_river = hfrate
    else
      q_river = -9.0  !No stage value found.
    end if

 800  return
    end
c
c -------------------------------------------------------------------------
-
c
    subroutine calcmass(npts,timehist,deltaT,conc,reflq,refltime,
     *               index0,q_river,REFLECTS,massriv,massboat,
     *               noflow,nohflow)
c    massriv, massboat, and noflow and nohflow are returned.

    integer.....................................................npts
    real.....................................timehist(1000), conc(1000)
    integer.................................................deltaT(1000)
    real................................reflq(3), refltime(3), q_reflect
    integer     REFLECTS

    real*8............................mass_sc, massriv, massboat, thisdirt
    integer.................................................noflow, nohflow

    real    con

    integer i, j, k, addons
```

```
    massriv = 0.0
    massboat= 0.0
    mass_sc = 0.0

c     Add extra time increments if necessary to go through flow reflection
times.
      addons = 0
    do j = 1, REFLECTS
      if (refltime(j) .gt. timehist(npts+addons)) then
        addons = addons + 1
        timehist(npts + addons) = refltime(j)
        deltaT(npts + addons-1) = refltime(j)-timehist(npts+addons-1)
      end if
    end do
c

    q_reflect = reflq(1)
    k = 1
    noflow = 0
    nohflow = 0

    do i = index0+1, npts + addons
        if(k.le.REFLECTS)then
          if(timehist(i) .gt. refltime(k)) then
          k = k + 1
          if (k .lt. REFLECTS+1) then
            q_reflect = reflq(k)
          else
            q_reflect = 0.0.....! no more reflection flow
          end if
        end if
        else
          q_reflect = 0.0 .....! no more reflection flow
      end if

      !if q_river is indicating the 'no value condition'...
        if (q_river .lt. 0.0) then
        if (q_river .eq. -1.0) then
          noflow = 1      !set flag indicating cell has no initial flow
        end if
          if (q_river .eq. -3.0) then
          nohflow = 1
          return
          end if
        q_river = 0.0.......     !set q_river to 0 for calculation below...
      end if

        if (i .gt. npts) then
        con = conc(1)
      else
        con = ((conc(i-1)+conc(i))/2)
      end if

        thisdirt = (con-conc(1)) * q_river * deltaT(i-1) /1000
      if (thisdirt .lt. 0.0) then
        thisdirt = 0.0
      end if
      massriv = massriv + thisdirt

      if(noflow .ne. 0) then
        thisdirt = con * q_reflect * deltaT(i-1) /1000
      else
        thisdirt = (con-conc(1)) * q_reflect * deltaT(i-1) /1000
      end if
      if (thisdirt .lt. 0.0) then
        thisdirt = 0.0
      end if
      massboat = massboat + thisdirt

      end do

    return
    end
c
c ---------------------------------------------------------------------------
```

```
-
c
    subroutine outhead(UNITOUT1)

    integer UNITOUT1

      write(UNITOUT1,*) 'MASS per cell of sediment moved due to'
    write(UNITOUT1,*) 'the river and to the boat passage (units: kg)'
    write(UNITOUT1,*) ' '
    write(UNITOUT1,20)
    write(UNITOUT1,30)
   20  format(' Cell     Tow Config    kg(River)       kg(Boat)'
     *       '         Total       Volume     ---- Other ----')
   30  format('-------------------------------------------------'
     *       '-------------------------------------------------')
    return
    end

c
c ---------------------------------------------------------------------------
-
c
    subroutine cntlines(filename, numlines)
    ! counts number of lines in the given file.
    ! Returns numlines

    character*64 filename
    real         numlines

      open(unit=10,file=filename,status='old')
      numlines = 0.0
    do
      read(10,*,end=10)
      numlines = numlines + 1
    end do
   10  close(10)

    return
    end
c
c ---------------------------------------------------------------------------
-
c
    subroutine concmake(CHANDATA,CTHDATA,TMPDATA)

      common/com/timehist

    character*64  CHANDATA,CTHDATA,TMPDATA

      integer npts, nlns, nrm

    character*9 cellid(1000), cell
    character   traffic*5, stgsl*2
    real.....................................................conc(1000)

    real starttm, endtm
    real timehist(1000)

      integer flag
    real    ambientc

    integer i, j, k, l, cellcnt


      write (*,*) '  Extracting useful data from ', CTHDATA
    write (*,*) ''

    open(unit=10,file=CHANDATA,status='old')
    open(unit=11,file=CTHDATA,status='old', action='read')
    open(unit=12,file=TMPDATA,status='unknown')

      do cellcnt = 1, 1000
      read (10,*, end=910) cellid(cellcnt)
    end do
  910 .....................................................close (10)
```

```
      cellcnt=cellcnt-1

c     Read the times.
    call gettimes(11,starttm,endtm,npts,nlns,nrm)
       ! All parameters except the first are returned.

    write(12,*)
    write(12,*) starttm, endtm, npts
    write(12,*)
    k=1
    do i = 1, nlns
      write(12,15) (timehist(j), j=k, k+9)
      k=k+10
    end do
    if (nrm .gt. 0) then
      nrmm1=nrm-1
      write(12,15) (timehist(j), j=k,k+nrmm1)
    end if


      do

        read (11,*, end=911) cell, traffic, stgsl

      do l = 1, cellcnt
        if(trim(cell) .eq. trim(cellid(l))) then
            read(11, *) flag, ambientc
          if (flag .eq. 1) then
              k=1
            do i = 1, nlns
              read(11, 15) (conc(j),j=k,k+9)
              k=k+10
            end do
            if (nrm .gt. 0) then
              nrmm1=nrm-1
              read(11, 15) (conc(j),j=k,k+nrmm1)
            end if
          end if


            write (12,120) cell, traffic, stgsl
 120        format (a9, 2x, a5, 1x, a2)

          write (12,121) flag, ambientc
 121        format (1x, i1, 1x, f8.2)

            if (flag .eq. 1) then
              k=1
            do i = 1, nlns
                write (12, 15) (conc(j),j=k,k+9)
              k=k+10
              end do
            if (nrm .gt. 0) then
              nrmm1=nrm-1
              write (12, 15) (conc(j),j=k,k+nrmm1)
            end if
          end if

            goto 400

          end if

      end do  !end of l

        read(11, *, end=911) flag, ambientc
      if (flag .eq. 1) then
          k=1
        do i = 1, nlns
          read(11, 15) (conc(j),j=k,k+9)
          k=k+10
        end do
        if (nrm .gt. 0) then
          nrmm1=nrm-1
          read(11, 15) (conc(j),j=k,k+nrmm1)
```

```
      end if
     end if

400  end do

911 ..........................................................close (11)
   close (12)

 15 ...................................................format(10f10.2)

     write(*,*) ' '
     write(*,*) ' '

   return
   end
```

Appendix D
BWMASSPROB Program

Files

Input

Pxx_mm_5000.SMP (Tow data)

Pxx_yz_mm.SED (SEDMASS Output file)

where
xx = Pool Number
y = Stage, z = Sailing Line
mm = month

Output

Pxx_mm.BWP (sediment loading probabilities)

where
xx = Pool Number
mm = month

Brief Output Description. The BWMASSPROB program output contains three sets of 11 values. Each set is a range of probabilites from 0.0 to 1.0 in increments of tenths.

The data sets are as follows:

Set 1:	Total mass added
Set 2:	Mass added due to tow drawdown
Set 3:	Mass added due to disturbed sediment added to the river from tow passing

Source Code

```
      program bwmassprob

      USE MSFLIB

      character*7 flowtype
      character*5 towconfig(50000) !, last_tr, tc_last
      character dumb, d1, d2, d3 !, d4*2
      integer linesread, numevents(9) !, done_tc
      character*2 sl(9)

      integer confignum(50000)
      dimension i_noread(9),i_cellcnt(9) !,i_numread(9)
      dimension i_done_file(9) ! , i_done_sorted(9), i_skip_rmfile(9)

      character*254 PATH, samplefile, smppath
      character*2 monthnum

      character*3 month
      integer i_month

      character*22 dum22

      character*6 rm,last_rm,current_rm !,first_rm,rmx(9)
      character*10 id1,last_id1

      character cellid(800000)*10,traf_sed(10000)*5
      character*254 line(800000)

      character*2 pool

      LOGICAL(4)  result

      data sl/'hl','hm','hr','ml','mm','mr','ll','lm','lr'/

      i_debug=0
      ih_debug=0

      write(*,*) 'What is the pool (2 characters - Ex: 08)?'
      read(*,*) pool

      write(*,*)

      write(*,*) 'What is the month (2 characters - Ex: 04)?'
      read(*,*) monthnum
      monthnum=trim(adjustr(monthnum))
      if(monthnum(1:1) .eq. '') then
        monthnum(1:1) = '0'
      endif

c     This one is for when running in the debugger
*     PATH = 'c:\windows\desktop\uppermiss\mass\pool'//trim(pool)//'\'

      PATH = ''

      write(*,*) 'What is the path to the .SMP file (0 for current)?'
      read(*,*) smppath
      if (smppath .eq. '0') then
      smppath = PATH
      end if


      samplefile=trim(smppath)//'p'//trim(pool)//'_'//trim(monthnum)//
      &'_5000.smp'

      open(300,file=samplefile,status='old',err=12000
      & ,action='read')

      i_probout=60

      do
      read(300,*,end=305) flowtype
      linesread=linesread+1
```

```
c               Pull out the month...
                if(linesread.eq.6) then
                read(300,304) dum22, month, i_month
 304            format(a22,a3, 3x,i2)
                goto 305
                end if
                end do
 305            rewind(300)

                i_firsttime= -1

                write(*,*) ' '

                rewind(300)
                linesread=0
                do
                read(300,*) flowtype
                linesread=linesread+1

                if (flowtype .eq. 'File.HL') then
                rewind(300)
                goto 20
                end if
                end do
  20            do 100 i=1, linesread-1
                read(300,*) dumb
 100  continue

                i_cont=0

                i_infile_tmp=20
                i_celfile=30
                i_tmpsortfile=40

                open(i_tmpsortfile,file=trim(PATH)//'tmpsort.tmp',
                & status='unknown')

                open(i_celfile,file=trim(PATH)//'cel.tmp',
                & status='unknown')

                do i_infile=1,9
c               Initialize value
                i_line=0
                i_done_file(i_infile)=0

c               Get the tow data
                read(300,*) flowtype,d1,d2,d3,numevents(i_infile)
                do 110 i=1, numevents(i_infile)
                read(300,*) d1, configgnum(i), towconfig(i)
 110            continue
                write(*,*) flowtype, '  ', sl(i_infile)

                if (numevents(i_infile).eq.0) then
                if(i_infile.eq.9) then
                last_rm = current_rm
                current_rm = rm
                end if
                goto 221
                end if
                call heapsort(numevents(i_infile), configgnum, towconfig)

                open(i_infile+10, file=trim(PATH)//'p'//trim(pool)//'_'//
                & sl(i_infile)//'_'//trim(monthnum)//'.sed',status='old'
     &          , action='read')
                write(*,*) 'Opened .sed file ', sl(i_infile)

                call resetinfile(i_infile+10)

                i_cellcnt(i_infile)=0
                i_noread(i_infile)=0

                do
                i_line = i_line + 1
                read(i_infile+10,160, err=161) line(i_line)
 160            format(a254)
```

```
               traf_sed(i_line) = line(i_line)(12:16)
               end do
 161           i_line = i_line - 1
               close(i_infile+10)

               call heapsort3(i_line, traf_sed, line)

               i_traf_sed=0
               i_bartell=0
               i_dups=0
               i_wrote=0
 400           i_bartell = i_bartell + 1 + i_dups
               i_dups=0
               if(i_bartell .gt. numevents(i_infile)) goto 490
 403           if(towconfig(i_bartell+i_dups+1) .eq.
     &         towconfig(i_bartell)) then
               i_dups = i_dups + 1
               goto 403
               end if
               i_gotone=0
 401           i_traf_sed = i_traf_sed + 1
               if(i_traf_sed .gt. i_line) goto 400
 420           if(trim(towconfig(i_bartell)) .eq.
     &         trim(traf_sed(i_traf_sed))) then
               i_gotone = -1
               do i=1, i_dups+1
               i_wrote = i_wrote + 1
               write(i_tmpsortfile,402) line(i_traf_sed)
               end do
 402           format(a254)
               i_traf_sed = i_traf_sed + 1
               goto 420
               else
               if(i_gotone .eq. 0) then
               goto 401
               else
               i_traf_sed = 0
               goto 400
               end if
               end if
               goto 400

 490           write(*,*) 'Number of events for ', sl(i_infile),': ',
     &         numevents(i_infile)
               write(*,*) 'Wrote ',i_wrote,' items for ',sl(i_infile)

 221           end do
               close(i_tmpsortfile)

               open(i_tmpsortfile, file=trim(PATH)//'tmpsort.tmp',
               & status='old')
               i_line=0
               do
               i_line = i_line + 1
               read(i_tmpsortfile,.......................160, end=450) line(i_line)
               cellid(i_line)=line(i_line)(2:10)
               end do
 450           i_line = i_line - 1
               close(i_tmpsortfile, status='delete')

               write(*,*) 'Sorting...'
               call heapsort2(i_line, cellid, line)
               write(*,*) 'Sorted ',i_line,' items by cellid'

               open(72,file='sortline.txt', status='unknown')
               do 383 iq=1,i_line
                 write(72,*) trim(line(iq))
 383           continue
               close(72)

*      open(i_probout, file=
*              & trim(PATH)//'bwprob/p'//pool//'_'//trim(monthnum)//'.bwp',
*              & form='formatted',status='unknown')
      open(i_probout, file=
               & trim(PATH)//'p'//pool//'_'//trim(monthnum)//'.bwp',
```

```
              & form='formatted',status='unknown')

              i_line_cf=0
              i_done=0
              last_id1=line(1)(2:10)

              write(i_probout,120) pool, i_month
 120          format ('MASSPROB Output,  Pool ', a2, ', Month ',i2)
              write(i_probout,*) 'Mass Units: kg/tow'
              write(i_probout,*) '3 data sets, 11 values/set,',
              &' Probabilities 0% - 100%'
              write(i_probout,*) '0% is the smallest tow contribution'
              write(i_probout,*) '100% is the largest tow contribution'
              write(i_probout,*) 'Set 1: Total Mass'
              write(i_probout,*) 'Set 2: Mass due to tow drawdown'
              write(i_probout,*) 'Set 3: Mass due to disturbed sediment added',
              &' to the river from tow passing'
              write(i_probout,*)
              write(i_probout,127)
127   format('CELL ID',4x,
              &12x,'0%',14x,'10%',13x,'20%',13x,'30%',13x,'40%',
              &13x,'50%',13x,'60%',13x,'70%',13x,'80%',13x,'90%',13x,'100%',
              &12x,'0%',14x,'10%',13x,'20%',13x,'30%',13x,'40%',
              &13x,'50%',13x,'60%',13x,'70%',13x,'80%',13x,'90%',13x,'100%',
              &12x,'0%',14x,'10%',13x,'20%',13x,'30%',13x,'40%',
              &13x,'50%',13x,'60%',13x,'70%',13x,'80%',13x,'90%',13x,'100%')
              write(i_probout,128)
 128  format(540('-'))

              do
              open(i_celfile,file=trim(PATH)//'cel.tmp',
              & status='unknown')

 471          i_line_cf = i_line_cf + 1
              if(i_line_cf .gt. i_line) then
              i_done = -1
              goto 472
              end if
              id1 = line(i_line_cf)(2:10)
              if(id1 .eq. last_id1) then
              write(i_celfile,160) line(i_line_cf)
              goto 471
              end if
              i_line_cf = i_line_cf - 1
 472          close(i_celfile)

              call hist(PATH, 'cel.tmp', i_month, last_id1,
              & i_tows1992,i_tows100pc,ambientc_inp, i_probout)
              if(ih_debug .eq. -1) then
              write(*,*) ' '
              write(*,*) ' '
              write(*,*) ' '
              end if
              i_cont = i_cont + 1
              write(*,*) 'Processed cell number ',i_cont,'... ID: '
              & , last_id1
              write(*,*) ' '

              last_id1 = id1

              if(i_done .ne. 0) goto 1001

 900          end do

1001          open(i_celfile,file=trim(PATH)//'cel.tmp',
              & status='unknown')
              close(i_celfile, status='delete')

              close(i_probout)

  30          format(f5.1,',',a1,',',a1,',',a1,',',a1,',',a1,',',a1,',',a1,',',a1,',',
              &  a5,',',a2,',',a10,',',f5.2,',',f6.3,',',f6.3,',',f8.1,',',f6.3,
              &  f10.4,',',f9.4,',',f12.6,',',f12.6,',',f9.4)

              goto 90000
```

```
12000          write(*,*) 'ERROR! Sample File '//trim(samplefile)//
     &         ' was not found.'

90000          stop
               end


*********************************************************************


               subroutine hist(path, infil, i_month, cellid,
     &            i_tows1992, i_tows100pc, ambientc_inp, i_probout)
*
               character*254 path
               character*64 infil
               character*10 cellid
               integer i_month

               dimension val(10)

               character TRAFFIC*5, STG_SL*2, ID1*10
               DIMENSION PFP(5,5001), CLASS(4001), SUMCLASS(4001)
               DIMENSION PCGCLASS(4001), PROB(11), CUMPCT(4001)

               real massriv, massboat, masstotal

               integer CLASSNUM

      sumx = 0

               ih_debug=0

      i_loop=1

      write(*,*) 'In HIST subroutine using cellid ',cellid
*
               open(115,file=trim(path)//trim(infil), form='formatted',
     &         status='old', action='read')
* NAVFPROB STATEMENT
               read(115,*) id1, traffic, STG_SL, massriv, massboat, masstotal

      do 1400 i_loop=1,3

      sumx=0
               avgx=0

2       CONTINUE

               rewind(115)

               PFPMIN = 100000000.
               PFPMAX = 0.

      do i_c=1,5000
        PFP(i_loop, i_c)=0.0
               end do

*
*       READ AND STORE DATA IN ARRAY, FIND MAX AND MIN
*
               I = 1

* NAVFPROB STATEMENT
1              read(115,*, end=50) id1,traffic,STG_SL,massriv,massboat
               masstotal=massriv+massboat
      val(1)=masstotal
      val(2)=massriv
               val(3)=massboat

* NAVF      if (val(i_loop) .ge. 9999.0) goto 1   ! No data

               PFP(i_loop,I)= val(i_loop)

               sumx=sumx+val(i_loop)
```

```
               IF(PFP(i_loop,I).GT.PFPMAX) PFPMAX = PFP(i_loop,I)
               IF(PFP(i_loop,I).LT.PFPMIN) PFPMIN = PFP(i_loop,I)
               I = I + 1
      if (I .gt. 5001) then
                 write(*,*)'More than 5000 tows. Data truncated'
                 goto 50
               end if
               GOTO 1
*

50    NUMDAT = I-1
      if (NUMDAT .lt. 5000) then
                 write(*,*)'Less than 5000 tow data elements. This cell skipped.'
*       Exit and Go to the next cell
                 goto 1500
               end if
               RNUMDAT = NUMDAT

               avgx=sumx/RNUMDAT
               if (avgx .eq. 0.0) then
               ratio = 1.0
               else
               ratio=10*PFPMAX/avgx
               end if
*     COMPUTE CLASS WIDTH
               if(ratio .gt. 1000.0) ratio = 1000.0
               if(ratio .lt. 25.0) ratio = 25.0
               CLASSWID = avgx/ratio

      NN = 4 * ratio
               CLASSNUM = NN
*
               CLASS(1) = PFPMIN
               CLASS(NN+1) = PFPMAX
               SUMCLASS(1) = 0.0
               DO 100 II = 2 , NN
               CLASS(II) = CLASS(II-1) + CLASSWID
               SUMCLASS(II) = 0.0
100     CONTINUE

*
*       DETERMINE NUMBER OF VALUES IN EACH CLASS
*
               DO 300 II = 1, NUMDAT
               DO 400 I =  1, NN
               IF(PFP(i_loop,II).LT.CLASS(I)) GOTO 400
               IF(PFP(i_loop,II).GT.CLASS(I+1)) GOTO 400
               SUMCLASS(I) = SUMCLASS(I) + 1.
400     CONTINUE
300     CONTINUE
450     CONTINUE
*
*       FLAG = 0 (ALL INTERVALS HAVE AT LEAST ONE VALUE)
*       FLAG = 1 (ONE OR MORE INTERVALS HAVE NO VALUES WHICH MEANS
*       CLASSNUM WILL HAVE TO BE REDUCED FOR PROGRAM TO RUN)
*
               flag = 0.0
               SUMPCT = 0.0
               CUMPCT(1) = 0.0
*              WRITE(*,*) 'CLASS  LOWLIM  HILIM  CLASSREP  #HIT CLPROB CUMPROB'
               DO 500 J = 1 , NN
               if(sumclass(j).eq.0.0) flag = 1.0

*      write(*,*) 'RNUMDAT = ',RNUMDAT,'I=',I,'J=',J,'NN=',NN,
*     &  'i_loop=',i_loop

               if(RNUMDAT .le. 0.00001)then
                 write(*,*) 'RNUMDAT = ',RNUMDAT,' in HIST. I=',I
                 stop
               else
                 PCGCLASS(J) = SUMCLASS(J)/RNUMDAT
               end if
               SUMPCT = SUMPCT + PCGCLASS(J)
               CUMPCT(J+1) = SUMPCT
```

```
500     CONTINUE
*
*       test for flag = 1, if so go to end and REDUCE CLASSNUM BY 1
*
***             IF(flag.eq.1.0) goto 1000
*
*       FIND PFP AT PROB 0-1.0 IN 0.1 INCREMENTS USING LINEAR INTERP
*       THIS IS BEING STORED IN THE SAME ARRAY AS THE ORIGINAL VALUES
*       WHICH ARE NO LONGER NEEDED. PFPMIN IS USED FOR PROB = 0,
*       PFPMAX IS USED FOR PROB = 1.0
*
                PROB(1) = 0
                PFP(i_loop,1) = PFPMIN
                DO 600 J=2,11
                PROB(J) = PROB(J-1) + 0.1
                DO 700 I = 1,NN
                IF(PROB(J).LT.CUMPCT(I)) GOTO 700
                DELT = PROB(J)-CUMPCT(I)

                if(PCGCLASS(I) .le. 0.000001)then
*                 write(*,*) 'PCGCLASS(I) = ',PCGCLASS(I),' in HIST, I = ',I
                  goto 700
                else
*                 write(*,*) 'PCGCLASS(I) = ',PCGCLASS(I), ' I = ', I
                  RATIO = DELT/PCGCLASS(I)
                end if
                DIFF = RATIO*CLASSWID
                PFP(i_loop,J) = CLASS(I) + DIFF
700     CONTINUE
600    CONTINUE
                PROB(11) = 1.0
                PFP(i_loop,11) = PFPMAX

                goto 1401
1000   CONTINUE

1401            WRITE(*,14) NUMDAT,i_loop
14              format(' NUMBER OF DATA POINTS = ',i6,' LOOP ', i2)

1400            continue

                WRITE(i_probout,126)   cellid,
      &     (PFP(1,ii1),ii1=1,11),
      &     (PFP(2,ii2),ii2=1,11),
      &     (PFP(3,ii3),ii3=1,11)

125             format(6x,f3.1,6x,f12.3,1x,f12.3,1x,f12.3,1x,f12.3,1x,f12.3)
126             format(a10,1x,32(f15.3,','),f15.3)

1500            CLOSE (115)

2000            return
                end

*************************************************************
c
c --------------------------------------------------------------------------
c
                subroutine heapsort(n, ra, ca)
c                ra is the "control"  !
                integer ra(n)
                character*5 ca(n),cca
c                !
                if(n .le. 1) then
                  return
                end if

                l=n/2+1
                ir=n

 10   continue
       if(l .gt. 1) then
                    l=l-1
                    rra=ra(l)
                    cca=ca(l)    !
```

```
                else
                  rra=ra(ir)
                  ra(ir)=ra(1)
                  cca=ca(ir) !
                  ca(ir)=ca(1) !
                  ir=ir-1
                  if(ir .eq. 1) then
                    ra(1)=rra
                    ca(1)=cca !
                    return
                  endif
                endif
                i=l
                j=l+l
 20             if(j .le. ir) then
                  if(j .lt. ir) then
                    if(ra(j) .lt. ra(j+1)) j=j+1
                  endif
                  if(rra .lt. ra(j)) then
                    ra(i)=ra(j)
                    ca(i)=ca(j) !
                    i=j
                    j=j+j
                  else
                    j=ir+1
                  endif
                goto 20
                endif
                ra(i)=rra
                ca(i)=cca !
              goto 10
              end
c
c --------------------------------------------------------------------------
c
              subroutine heapsort2(n, ra, ca)
c              ra is the "control"  !
              character*10  ra(n),rra
              character*254 ca(n),cca
c              !
              if(n .le. 1) then
                return
              end if

              l=n/2+1
              ir=n

 10   continue
        if(l .gt. 1) then
                    l=l-1
                    rra=ra(l)
                    cca=ca(l)    !
                  else
                    rra=ra(ir)
                    ra(ir)=ra(1)
                    cca=ca(ir) !
                    ca(ir)=ca(1) !
                    ir=ir-1
                    if(ir .eq. 1) then
                      ra(1)=rra
                      ca(1)=cca !
                      return
                    endif
                  endif
                  i=l
                  j=l+l
 20               if(j .le. ir) then
                    if(j .lt. ir) then
                      if(ra(j) .lt. ra(j+1)) j=j+1
                    endif
                    if(rra .lt. ra(j)) then
                      ra(i)=ra(j)
                      ca(i)=ca(j) !
                      i=j
                      j=j+j
```

```
                  else
                    j=ir+1
                  endif
                goto 20
                endif
                ra(i)=rra
                ca(i)=cca!
              goto 10
              end
c
c --------------------------------------------------------------------------
c
              subroutine heapsort3(n, ra, ca)
c              ra is the "control"  !
              character*5  ra(n),rra
              character*254 ca(n),cca
c              !
              if(n .le. 1) then
                return
              end if

              l=n/2+1
              ir=n

 10   continue
        if(l .gt. 1) then
                  l=l-1
                  rra=ra(l)
                  cca=ca(l)    !
                else
                  rra=ra(ir)
                  ra(ir)=ra(1)
                  cca=ca(ir) !
                  ca(ir)=ca(1) !
                  ir=ir-1
                  if(ir .eq. 1) then
                    ra(1)=rra
                    ca(1)=cca !
                    return
                  endif
                endif
                i=l
                j=l+l
 20             if(j .le. ir) then
                  if(j .lt. ir) then
                    if(ra(j) .lt. ra(j+1)) j=j+1
                  endif
                  if(rra .lt. ra(j)) then
                    ra(i)=ra(j)
                    ca(i)=ca(j) !
                    i=j
                    j=j+j
                  else
                    j=ir+1
                  endif
                goto 20
                endif
                ra(i)=rra
                ca(i)=cca!
              goto 10
              end

c
c --------------------------------------------------------------------------
c
              subroutine gettimes(UNITIN,starttm,endtm,npts,
     *          nlns,nrm,timehist)
c      All parameters except UNITIN are returned.
*      common/com/timehist


              real.....................................................timehist(50000)
              integer..................................................npts
              integer.....................................................nlns, nrm
              integer.....................................................i,j,k
```

```
              integer.....................................................UNITIN

              read(UNITIN,*)
              read(UNITIN,*) starttm, endtm, npts
              read(UNITIN,*)
              nlns = npts/ 10
              nrm = mod(npts,10)
              k=1
              do i = 1, nlns
                read(UNITIN,15) (timehist(j), j=k, k+9)
                k=k+10
              end do
              if (nrm .gt. 0) then
                nrmm1=nrm-1
                read(UNITIN,15) (timehist(j), j=k,k+nrmm1)
              end if

  15          format(10f10.2)

              return
              end

c
c ----------------------------------------------------------------------
c
              subroutine resetinfile(UNITIN)
c      Skips past the times in the concentration time history file.

              integer UNITIN
              character*254 line

              rewind(unit=UNITIN)

              do i = 1, 4
                read(UNITIN,*) line
              end do

              return
              end
c
c ----------------------------------------------------------------------
c
              subroutine getconc(UNITIN, nlns, nrm, conc, ambientc)
c      conc() is returned.

              integer.....................................................nlns, nrm
              real........................................................conc(50000)
              integer UNITIN
              integer flag
              real    ambientc
              integer i, j, k

              read(UNITIN, *) flag, ambientc

              if (flag .eq. 1) then

       k=1
                do i = 1, nlns
                  read(UNITIN, 15) (conc(j),j=k,k+9)
                  k=k+10
                end do
                if (nrm .gt. 0) then
                  nrmm1=nrm-1
                  read(UNITIN, 15) (conc(j),j=k,k+nrmm1)
                end if
              else
                conc(1) = -999.0
*               do i = 2, (nlns*10) + nrm
*                 conc(i) = 0.0
*               end do
              end if

  15          format(10f10.2)

              return
```

```
               end
c
c ---------------------------------------------------------------------
c
               subroutine getdeltaT(timehist, npts, deltaT)
c      deltaT() is returned.

               real.....................................................timehist(50000)
               integer..................................................npts
               integer..................................................deltaT(50000)

               integer i

               do i = 1, npts - 1
                 deltaT(i) = timehist(i+1)-timehist(i)
               end do

               return
               end
c
c ---------------------------------------------------------------------
c
               subroutine get_rm(id1, c_rm, rm)
               character*10 id1
               real rm

               character*6 c_rm, cc_rm

               i_pos=scan(id1,'LR')
               c_rm=trim(id1(i_pos+1:i_pos+6))
               c_rm=adjustr(c_rm)
               cc_rm=c_rm(6:6)
               c_rm=trim(c_rm(2:5))//'.'//cc_rm
               c_rm=adjustl(c_rm)
c     Convert rivermile string to a real
               open(401,file='temp.tmp',status='unknown')
               write(401,102) c_rm
 102           format(a)
               rewind(401)
               read(401,103) rm
 103           format(f5.1)
               close(401, status='delete')
c
               return
               end
```

Appendix E
SED2BW Program

Files

Input

Pxx_TOWNUMBER.DAT (annual number of tows – in the poolxx directory – this file is optional based on runtime preferences – the value can optionally be input at the keyboard)

Pxx_TRAFMNTH.DAT (in the poolxx directory – percent values of traffic per month)

Pxx_BWSECAREA.DAT (area in acres of each backwater)

Pxx_mm.BWP (sediment loading probabilites)

Pxx_BWLENGTH.DAT (contains the sediment type information)

PxxBWSEC.TXT (from GIS)

where
xx = Pool Number
mm = month

Output

Pxx_ttttTOWS.S2B (traffic impact potentials)

where
xx = Pool Number
tttt = number of yearly tows used

Note: See “4Output“ on page 13 for a complete description of the output format.

Source Code

```
program sed2bw
```

```
c              poolxx is the working directory...
c              This program requires input from:
c              TRAFMNTH.DAT
c              Pxx_BWSECAREA.DAT
c              Pxx_mm.BWP
c              Pxx_BWLENGTH.DAT
c              PxxBWSEC.TXT

c              Variable prefixes used...
c              i_ = integer
c              r_ = real
c              c_ = character
c              rec_ = record (structure)

      USE MSFLIB  ! for the $MAXPATH, PATH routines, etc.

* ------------------------------------------------------------------------

               ! Final storage for all resulting bw/sec channel information
      STRUCTURE /bwsec_info/
         CHARACTER*5 c_number
                  integer i_area
                  real r_totalacre_ft_peryear
                  real r_cm_peryear
                  integer i_color_by_rate  ! via cm_peryear
      END STRUCTURE
               record /bwsec_info/ rec_bwsecinfo(100)

      STRUCTURE /bw_length/
         CHARACTER*10 c_cellid
         integer i_sedtype ! Cohesive, Noncohesive
                  real r_sedspecweight
      END STRUCTURE
               record /bw_length/ rec_bwlength(100)
c              Cohesive sediment is represented by 2, specific weight, 78.0 pounds/ft^3
c              Non-cohesive sediment is represented by 3, specific weight, 96.3 pounds/ft^3
               real specweight_sedtype(10)
               character*15 c_sedtype(10)

      STRUCTURE /bw_sec/
         CHARACTER*8 c_feature
                  character*10 c_cellid
         real r_width
      END STRUCTURE
               record /bw_sec/ rec_bwsec(100)

      STRUCTURE /bw_prob/
                  character*10 c_cellid
         real r_prob(11)
      END STRUCTURE
               record /bw_prob/ rec_bwprob(100)

               ! Final storage for all resulting cell information
      STRUCTURE /bw_cellinfo/
         CHARACTER*8 c_feature
                  character*10 c_cellid
         real r_probvalue
                  real r_mass(12)
                  real r_tonsperyear
                  real r_acre_ft_peryear
                  integer i_color_by_volume  ! via acre_ft_peryear
                  real r_acre_ft_peryear_permeter
                  integer i_color_by_unit_volume  ! via acre_ft_peryear_permeter
                  integer i_sedtype  ! Cohesive, Noncohesive
      END STRUCTURE
               record /bw_cellinfo/ rec_cellinfo(100)
               !

               character*6 c_colors(3)
               integer i_worst_color

               character*256 PATH, bwprobdir

               character*10 c_totaltows
```

```
                character*2 pool, month
                integer i, i_month, i_percentile
                integer i_dum

                character*10 c_lastcellid

                character*1 c_readtows_how

                real r_trafmonthpercent(12)
                real i_towspermonth(12)
                integer i_trafmonth
                character*255 c_trafpercentfile

                integer i_notows(12)

                character*10 c_cellid
                character*6 c_inout

                integer i_sedtype

                character*8 c_feature
                character*5 c_bwsec
                character*255 c_bwsecareacomment1, c_bwsecareacomment2

      real r_width
                integer bwsec_i_totalcells
                integer bwlength_i_totalcells
                integer bwprob_i_totalcells

                real r_us_tonspermonth(12)

                character*255 c_infile
      character*255 c_lin
                character*255 c_trafpercentcomment1, c_trafpercentcomment2
                character*255 c_townumbercomment1, c_townumbercomment2

                CHARACTER($MAXPATH)  dir
                INTEGER(4)  length

                character*1 ccc

* ------------------------------------------------------------------

c               Assign Values...

                specweight_sedtype(1) = 0.0   ! ??
                specweight_sedtype(2) = 78.0
                specweight_sedtype(3) = 96.3
                specweight_sedtype(9) = 9999  ! No data

                c_sedtype(1) = 'Do Not Know'
                c_sedtype(2) = 'Cohesive'
                c_sedtype(3) = 'Noncohesive'
                c_sedtype(4) = 'Cohesive-Soft'
                c_sedtype(5) = 'Cohesive-Medium'
                c_sedtype(6) = 'Cohesive-Hard'
                c_sedtype(7) = 'Cohesive- ???'
                c_sedtype(9) = 'No Sedtype Data'

                c_colors(1) = 'BLUE'
                c_colors(2) = 'YELLOW'
                c_colors(3) = 'RED'

                do 99 i=1,12
                i_notows(i) = 0
  99            continue

* ------------------------------------------------------------------


                write(*,*) 'What is the pool (2 characters - Ex: 08)?'
                read(*,*) pool

*               write(*,*) 'What is the month (2 characters - Ex: 04)?'
```

```
*               read(*,*) monthnum
*               monthnum=trim(adjustr(monthnum))
*               if(monthnum(1:1) .eq. '') then
*                 monthnum(1:1) = '0'
*               endif


c               This one is for when running in the debugger
*               PATH = 'c:\windows\desktop\uppermiss\pool'//trim(pool)//'\sc\'
                PATH = ''

                ! Show the working path...
                if (PATH .eq. '') then
                ! Get current directory for display info...
                dir = FILE$CURDRIVE
                length = GETDRIVEDIRQQ(dir)
                ! Add backslash if necessary
                i_ccc=len(trim(dir))
                ccc=dir(i_ccc:i_ccc+1)
                if (ccc .ne. '\') then
                dir = trim(dir)//'\'
                end if
                !
                IF (length .GT. 0) THEN
                WRITE (*,*) 'Current directory is: '
                WRITE (*,*) trim(dir)
                ELSE
                WRITE (*,*) 'Failed to get current directory'
                END IF
                PATH = trim(dir)
                else
                write (*,*) 'Current path is ', trim(PATH)
                end if

                bwprobdir = ''
                write(*,*)
*               write(*,*) 'What is the subdirectory containing ' //
*               & 'BW or SC Probability data (.bwp files)?'
*               write(*,*) 'Normally BWPROB.'
*               write(*,*) 'If the same as the default, enter a period (dot)'
*               read(*,*) bwprobdir
*               if (trim(bwprobdir) .eq. '0' .or. trim(bwprobdir) .eq. '.') then
*               bwprobdir = ''
*               else
*               i_ccc=len(trim(bwprobdir))
*               ccc=bwprobdir(i_ccc:i_ccc+1)
*               if (ccc .ne. '\') then
*               bwprobdir = trim(bwprobdir)//'\'
*               end if
*               end if

                write(*,*) 'How many total tows pass for the year? '
                write(*,*) '"E" = Enter value, "F" = Read from file'
                read(*,*) c_readtows_how
                if (c_readtows_how .eq. 'E' .or. c_readtows_how .eq. 'e') then
                write(*,*) 'How many tows?'
                read(*,*) i_totaltows
                else
                open (10, file=trim(path)//'..\p'//trim(pool)//'_townumber.dat',
                & status='old', action='read')
                read(10,550) c_townumbercomment1
                read(10,550) c_townumbercomment2
                read(10,*) i_totaltows
                close(10)
                end if

 207            write(*,*) 'What percentile value do you wish to use?'
                write(*,*) 'Choose 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100%'
                read(*,*) i_percentile
                if (i_percentile .ne. 0 .and. i_percentile .ne. 10
                &  .and. i_percentile .ne. 20 .and. i_percentile .ne. 30
     &  .and. i_percentile .ne. 40 .and. i_percentile .ne. 50
                &  .and. i_percentile .ne. 60 .and. i_percentile .ne. 70
                &  .and. i_percentile .ne. 80 .and. i_percentile .ne. 90
                &  .and. i_percentile .ne. 100) then
```

```
               write(*,*) 'Invalid percentage value, re-enter: '
               goto 207
               end if
               write(*,*)

c              Read the Traffic Percentages...
               c_trafpercentfile=trim(path)//'..\p'//trim(pool)//'_'//
               & 'trafmnth.dat'
               open(10, file=c_trafpercentfile, status='old', action='read')
               !Skip the first two header lines
               read(10,550,end=906) c_trafpercentcomment1
               read(10,550,end=906) c_trafpercentcomment2
               do 102 i_trafmonth=1,12
               read(10,*) r_trafmonthpercent(i_trafmonth)
               if (r_trafmonthpercent(i_trafmonth) .gt. 0) then
               i_towspermonth(i_trafmonth) = i_totaltows /
               & r_trafmonthpercent(i_trafmonth)
               else
               i_towspermonth(i_trafmonth) = 0
               end if
 102  continue
               goto 107
 906           write(*,*) 'Unexpected end of file reading ',
               & trim(c_trafpercentfile)
 107           continue


               ! Read the backwater/secondary channel areas...
               c_infile = trim(path)//'p'//trim(pool)//'_bwsecarea.dat'
               open(25, file=c_infile, status='old', action='read')
               i = 0
               ! Read first two comment lines
               read(25,550) c_bwsecareacomment1
               read(25,550) c_bwsecareacomment2
               do
               i = i + 1
               read(25,*, end=916) rec_bwsecinfo(i).c_number,
               & rec_bwsecinfo(i).i_area
               end do
 916           continue
               close(25)
               i_totalbwsecs = i - 1


 550           format(a255)



               i_found_tow_data = 0
               ! Open .bwp files for the 12 months and prepare to read the data...
               do 105 i_month=1,12
               ! Convert integer i_month to two characters
               write(month,505) i_month
 505           format(i2)
               month=trim(adjustr(month))
               if(month(1:1) .eq. '') then  ! Fill blank space with zero
               month(1:1) = '0'
               endif
               !
               c_infile = trim(path)//trim(bwprobdir)//'p'//
               & trim(pool)//'_'//month//'.bwp'
               write(*,*) trim(c_infile)
               open(10+i_month, err=301, file=c_infile, status='old',
               & action='read')
               ! Skip past header info
               do
               read(10+i_month,506, end=903, err=903) c_lin
 506           format(a255)
               if (c_lin(1:2) .eq. '--') then
               goto 201
               end if
               end do
               goto 201
 903           continue  ! If a read error...
               write(*,*)
```

```
              write(*,*) 'Error reading data from ', trim(PATH),
              & trim(c_infile), '. File is not in the correct format.'
              write(*,*)
              goto 301
 201          continue

              i_found_tow_data = 1  ! Found some data - flag

              goto 305
 301          continue
              i_notows(i_month) = 1
              write(*,507) i_month
 507          format(' ... No tows for month ', i2)

 305          continue

 105          continue
              !

              ! If no tow data found then exit...
              if (i_found_tow_data .eq. 0) then
              write(*,*) 'No .bwp files were read. No tow data. Exiting...'
              stop
              end if

c             Aquire the .bwp data...
              i_cell = 0! Cell Counter
              do
              i_cell = i_cell + 1 ! Cell Counter
              rec_bwprob(i_cell).c_cellid = ''
              rec_cellinfo(i_cell).r_tonsperyear = 0.0 ! Initialize value for sum
              i_haveread_thiscell = 0
              do 106 i_month=1,12
              if (i_notows(i_month) .ne. 0) then
              goto 106
              end if
              if (i_haveread_thiscell .ne. 0) then
              c_lastcellid = rec_bwprob(i_cell).c_cellid
              end if
              ! Read the cellid and first set of 11 values (Mass Totals)...
              read(10+i_month,*,end=904)
              &  rec_bwprob(i_cell).c_cellid,
              &(rec_bwprob(i_cell).r_prob(ii1),ii1=1,11)
              if (i_haveread_thiscell .ne. 0) then  ! Check for cellid sync
              if (trim(rec_bwprob(i_cell).c_cellid) .ne.
              &trim(c_lastcellid)) then
              write(*,*)'Problem: .bwp input files cellids',
              &' do not sync.'
              stop
              end if
              end if
              i_haveread_thiscell = 1
              ! Calculate tons per month for cell i
              r_us_tonspermonth(i_month) = i_towspermonth(i_month) *
              &rec_bwprob(i_cell).r_prob((i_percentile/10)+1) *
              &2.203 / 2000
              ! Keep a running total of tons for cell i for the year
              rec_cellinfo(i_cell).r_tonsperyear =
              &rec_cellinfo(i_cell).r_tonsperyear +
              &r_us_tonspermonth(i_month)
 106          continue
              ! Store the cellid in the 'Results' array
              rec_cellinfo(i_cell).c_cellid =
              &rec_bwprob(i_cell).c_cellid
              end do

 904          do 108 i_month=1,12
              close(10+i_month)
 108          continue

              bwprob_i_totalcells = i_cell - 1


c             Must match cellids in other files with those in .bwp file
```

```
c               Open pxx_bwlength.dat, read cellid and sediment type into array
                open(10, file=trim(path)//'p'//
                &trim(pool)//'_'//'bwlength.dat', status='old', action='read')
                i_cell = 0
                do
                i_sedtexture = 0
                read(10,*, end=901) c_cellid, i_dum, i_sedtype, i_sedtexture
                ! Find the matching cellid stored earlier in the 'Results' array
                do 115 i=1,bwprob_i_totalcells
                if(rec_cellinfo(i).c_cellid .eq. c_cellid) then
                i_cell = i_cell + 1
                rec_bwlength(i_cell).c_cellid = c_cellid
                rec_bwlength(i_cell).i_sedtype = i_sedtype
                if (rec_bwlength(i_cell).i_sedtype .gt. 3) then
                rec_bwlength(i_cell).i_sedtype = 9

*               write(*,*) 'No "Type of sediment" data for cell ',
*               &trim(rec_bwlength(i_cell).c_cellid)
                end if
                rec_bwlength(i_cell).r_sedspecweight =
                &specweight_sedtype(rec_bwlength(i_cell).i_sedtype)
                rec_cellinfo(i).i_sedtype =
                &rec_bwlength(i_cell).i_sedtype
                if (i_sedtype .eq. 2) then
                if ((i_sedtexture .ge. 1) .and.
     &          (i_sedtexture .le. 3)) then
                rec_cellinfo(i).i_sedtype = i_sedtype + 1 +
                &i_sedtexture
                else
                rec_cellinfo(i).i_sedtype = 7
                end if
                end if
                goto 116
                end if
 115            continue
 116            continue
                end do
 901            close(10)
                bwlength_i_totalcells = i_cell
*               call heapsort1(bwlength_i_totalcells,rec_bwlength.c_cellid,
*               &rec_bwlength)


c               Open pxxbwsec.dat, read cellid and other stuff
                open(10, file=trim(path)//'p'//
                &trim(pool)//'bwsec.txt', status='old', action='read')
      read(10,*) c_lin  ! Skip first line (description line)
                i_cell = 0
                do
                read(10,*, end=902) c_feature, c_cellid, dum, r_width, dum,
                & dum,dum,dum,dum,dum,dum,dum, c_inout
                if (trim(c_inout) .eq. 'INLET') then
                ! Find matching cellid in rec_cellinfo array
                do 117 i=1,bwprob_i_totalcells
                if(rec_cellinfo(i).c_cellid .eq. c_cellid) then
                i_cell = i_cell + 1
                rec_bwsec(i_cell).c_feature = c_feature
                rec_cellinfo(i).c_feature = c_feature.......! Fill in the feature value
                rec_bwsec(i_cell).c_cellid = c_cellid
                rec_bwsec(i_cell).r_width = r_width
                goto 118
                end if
 117            continue
                end if
 118            continue
                end do
 902            close(10)
                bwsec_i_totalcells = i_cell
*               call heapsort2(bwsec_i_totalcells,rec_bwsec.c_cellid,rec_bwsec)


                ! Calculate Acre-ft/year, need density value based on sedtype
                do 120 i_cell = 1,bwprob_i_totalcells
                if ((rec_bwlength(i_cell).r_sedspecweight .eq. 0) .or.
                &(rec_bwlength(i_cell).i_sedtype .gt. 3)) then
```

```
              write(*,*) 'Cannot calculate Acre-ft/year for cell ',
              &trim(rec_bwlength(i_cell).c_cellid), '. ',
              &'No "Type of sediment" data for this cell.'
              end if
              .! Find Matching cellid in rec_bwlength array for Specific Weight Value
              do 121 i=1,bwlength_i_totalcells
              if (rec_cellinfo(i).c_cellid .eq.
              &rec_bwlength(i_cell).c_cellid) then
              rec_cellinfo(i).r_acre_ft_peryear =
              &rec_cellinfo(i).r_tonsperyear * 2000 /
              ! Density value
              &rec_bwlength(i_cell).r_sedspecweight /43560  ! 43560 ft^2/Acre
              ! Assign Impact Potential color by VOLUME
              if (rec_cellinfo(i).r_acre_ft_peryear .lt. 1.0) then
              rec_cellinfo(i).i_color_by_volume = 1
              else
              rec_cellinfo(i).i_color_by_volume = 2
              end if
              goto 122
              end if
 121          continue
 122          continue

 120          continue
              !


              ! Calculate cm/year into each backwater/secondary channel for all associated
inlets
              do 126 i_bwsec=1,i_totalbwsecs
              rec_bwsecinfo(i_bwsec).r_cm_peryear = 0.0
              rec_bwsecinfo(i_bwsec).r_totalacre_ft_peryear = 0.0
              ! Find matching bw/sc numbers in rec_bwsecinfo array
              do 127 i_cell=1,bwprob_i_totalcells
              c_bwsec = rec_cellinfo(i_cell).c_feature(1:5)
              if (rec_bwsecinfo(i_bwsec).c_number .eq. c_bwsec) then
              ! Sum the Acre-ft/year for this Backwater/Secondary channel
              rec_bwsecinfo(i_bwsec).r_totalacre_ft_peryear =
              &rec_bwsecinfo(i_bwsec).r_totalacre_ft_peryear +
              &rec_cellinfo(i_cell).r_acre_ft_peryear
              end if
 127          continue
              ! Finish the cm/year calculation
              rec_bwsecinfo(i_bwsec).r_cm_peryear =
              &( rec_bwsecinfo(i_bwsec).r_totalacre_ft_peryear /
              &rec_bwsecinfo(i_bwsec).i_area ) *   30.48  ! Convert ft to cm
              ! Assign Impact Potential color by RATE
              if (rec_bwsecinfo(i_bwsec).r_cm_peryear .lt. 0.1) then
              rec_bwsecinfo(i_bwsec).i_color_by_rate = 1
              else
              if ((rec_bwsecinfo(i_bwsec).r_cm_peryear .ge. 0.1)
              &.and.
              &(rec_bwsecinfo(i_bwsec).r_cm_peryear .lt. 1.0)) then
              rec_bwsecinfo(i_bwsec).i_color_by_rate = 2
              else
              rec_bwsecinfo(i_bwsec).i_color_by_rate = 3
              end if
              end if

 126          continue

              ! Calculate Acre-ft/yr/meter for each cellid in rec_cellinfo array
              do 130 i_cell = 1,bwprob_i_totalcells
              ! Find matching cellid from the rec_bwsec array
              do 131 j_cell = 1, bwsec_i_totalcells
              if (trim(rec_bwsec(j_cell).c_cellid) .eq.
              &trim(rec_cellinfo(i_cell).c_cellid)) then
              if (rec_bwsec(j_cell).r_width .eq. 0) then
              write(*,*) 'Width for cell ',
              &trim(rec_cellinfo(i_cell).c_cellid),
              &' is 0. Must skip this cell.'
              goto 130
              end if
              rec_cellinfo(i_cell).r_acre_ft_peryear_permeter =
              &rec_cellinfo(i_cell).r_acre_ft_peryear /
```

```
                &rec_bwsec(j_cell).r_width
                ! Assign Impact Potential color by UNIT VOLUME
                if (rec_cellinfo(i_cell).r_acre_ft_peryear_permeter
                &.lt. 0.01) then
                rec_cellinfo(i_cell).i_color_by_unit_volume = 1
                else
                rec_cellinfo(i_cell).i_color_by_unit_volume = 2
                end if
                goto 130
                end if
 131            continue
 130            continue

c               Write Results
                ! Cloodge to convert integer to character
                open(101,file='sed2bw.tmp',status='unknown')
                write(101,*) i_totaltows
                rewind(101)
                read(101,*) c_totaltows
                close(101, status='delete')
                !
                open(10, file=trim(path)//'p'//
                &trim(pool)//'_'//trim(c_totaltows)//'tows.s2b',
                &status='unknown')
                write(10,*) 'SEDIMENTS TO BACKWATER OR SECONDARY CHANNEL ',
                &'(SEE FEATURE), POOL',
                &trim(pool)
                write(10,530) i_percentile
 530            format (' BASED ON ', i3, '% ROLLUP')
                write(10,*) 'Total tows for year: ', i_totaltows
                write(10,*)
                write(10,531)
 531            format( 'FEATURE    AREA     CELLID     SEDIMENT_TYPE',
                &'            IMPACT_BY_VOLUME ',
                &'     IMPACT_BY_RATE   ',
                &'     IMPACT_BY_UNIT_VOLUME   WORST_CASE')
                write(10,532)
 532            format( '           acres                              ',
                &'            acre-ft/year     ',
                &'     cm/year          ',
                &'     acre-ft/year/meter')
                write(10,533)
 533            format(135('-'))


                ! Sort rec_cellinfo array by c_feature
                call heapsort1(bwprob_i_totalcells, rec_cellinfo.c_feature,
                &rec_cellinfo)
                do 135 i_cell=1,bwprob_i_totalcells
                do 136 i_bwsec=1,i_totalbwsecs
                if (rec_bwsecinfo(i_bwsec).c_number .eq.
                &rec_cellinfo(i_cell).c_feature(1:5)) then
                i_worst_color=max(rec_cellinfo(i_cell).i_color_by_volume,
                &rec_bwsecinfo(i_bwsec).i_color_by_rate,
                &rec_cellinfo(i_cell).i_color_by_unit_volume)
                write(10,536) rec_cellinfo(i_cell).c_feature,
                &rec_bwsecinfo(i_bwsec).i_area,
                &rec_cellinfo(i_cell).c_cellid,
                &c_sedtype(rec_cellinfo(i_cell).i_sedtype),
                &rec_cellinfo(i_cell).r_acre_ft_peryear,
                &c_colors(rec_cellinfo(i_cell).i_color_by_volume),
                &rec_bwsecinfo(i_bwsec).r_cm_peryear,
                &c_colors(rec_bwsecinfo(i_bwsec).i_color_by_rate),
                &rec_cellinfo(i_cell).r_acre_ft_peryear_permeter,
                &c_colors(rec_cellinfo(i_cell).
     &          i_color_by_unit_volume),
                &c_colors(i_worst_color)
                end if
 136            continue
 135            continue
 536            format(a8,2x,i7,3x,a10,1x,a15,2x,
                &4x,f10.5,2x,a6,
     &          4x,f10.5,2x,a6,
     &          4x,f10.5,2x,a6,
     &          11x,a6)
```

```
               close(10)


               stop
               end


*************************************************************************
c
c -------------------------------------------------------------------------
c
               subroutine heapsort1(n, ra, ca)
c               ra is the "control"  !
               character*8 ra(n), rra
      STRUCTURE /bw_cellinfo/
         CHARACTER*8 c_feature
                  character*10 c_cellid
         real r_probvalue
                  real r_mass(12)
                  real r_tonsperyear
                  real r_acre_ft_peryear
                  integer i_color_by_volume  ! via acre_ft_peryear
                  real r_acre_ft_peryear_permeter
                  integer i_color_by_unit_volume  ! via acre_ft_peryear_permeter
                  integer i_sedtype
      END STRUCTURE
               record /bw_cellinfo/ ca(n), cca

c               !
               if(n .le. 1) then
                 return
               end if

               l=n/2+1
               ir=n

 10   continue
        if(l .gt. 1) then
                    l=l-1
                    rra=ra(l)
                    cca=ca(l)    !
                  else
                    rra=ra(ir)
                    ra(ir)=ra(1)
                    cca=ca(ir) !
                    ca(ir)=ca(1) !
                    ir=ir-1
                    if(ir .eq. 1) then
                      ra(1)=rra
                      ca(1)=cca !
                      return
                    endif
                  endif
                  i=l
                  j=l+l
 20               if(j .le. ir) then
                    if(j .lt. ir) then
                      if(ra(j) .lt. ra(j+1)) j=j+1
                    endif
                    if(rra .lt. ra(j)) then
                      ra(i)=ra(j)
                      ca(i)=ca(j) !
                      i=j
                      j=j+j
                    else
                      j=ir+1
                    endif
                  goto 20
                  endif
                  ra(i)=rra
                  ca(i)=cca!
               goto 10
               end
c
```

```
c -------------------------------------------------------------------------
c
               subroutine heapsort2(n, ra, ca)
c               ra is the "control"  !
               character*10 ra(n), rra
      STRUCTURE /bw_sec/
         CHARACTER*8 c_feature
                  character*10 c_cellid
         real r_width
      END STRUCTURE
               record /bw_sec/ ca(n), cca

c               !
               if(n .le. 1) then
                 return
               end if

               l=n/2+1
               ir=n

 10   continue
        if(l .gt. 1) then
                    l=l-1
                    rra=ra(l)
                    cca=ca(l)    !
                  else
                    rra=ra(ir)
                    ra(ir)=ra(1)
                    cca=ca(ir) !
                    ca(ir)=ca(1) !
                    ir=ir-1
                    if(ir .eq. 1) then
                      ra(1)=rra
                      ca(1)=cca !
                      return
                    endif
                  endif
                  i=l
                  j=l+l
 20               if(j .le. ir) then
                    if(j .lt. ir) then
                      if(ra(j) .lt. ra(j+1)) j=j+1
                    endif
                    if(rra .lt. ra(j)) then
                      ra(i)=ra(j)
                      ca(i)=ca(j) !
                      i=j
                      j=j+j
                    else
                      j=ir+1
                    endif
                  goto 20
                  endif
                  ra(i)=rra
                  ca(i)=cca!
               goto 10
               end
c
c -------------------------------------------------------------------------
c
               subroutine heapsort3(n, ra, ca)
c               ra is the "control"  !
               character*10 ra(n), rra
      STRUCTURE /bw_prob/
         CHARACTER*10 c_cellid
         real r_prob(11)
      END STRUCTURE
               record /bw_prob/ ca(n), cca

c               !
               if(n .le. 1) then
                 return
               end if

               l=n/2+1
```

```
              ir=n

10   continue
       if(l .gt. 1) then
                    l=l-1
                    rra=ra(l)
                    cca=ca(l)    !
                  else
                    rra=ra(ir)
                    ra(ir)=ra(1)
                    cca=ca(ir) !
                    ca(ir)=ca(1) !
                    ir=ir-1
                    if(ir .eq. 1) then
                      ra(1)=rra
                      ca(1)=cca !
                      return
                    endif
                  endif
                  i=l
                  j=l+l
20                if(j .le. ir) then
                    if(j .lt. ir) then
                      if(ra(j) .lt. ra(j+1)) j=j+1
                    endif
                    if(rra .lt. ra(j)) then
                      ra(i)=ra(j)
                      ca(i)=ca(j) !
                      i=j
                      j=j+j
                    else
                      j=ir+1
                    endif
                  goto 20
                  endif
                  ra(i)=rra
                  ca(i)=cca!
                goto 10
                end
```

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14. ABSTRACT

The SEDLOAD package is a group of programs designed to determine the sediment load delivered to the inlets of backwaters and secondary channels of a river due to river traffic, specifically tow traffic. This user's manual describes how to set up batch files, input and output file formats, example outputs, and source code listings in order to run the program.

15. SUBJECT TERMS

Backwaters
Computer program
Navigation
Sediment
User's manual

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