DEBRIS: A Computer Program for Analyzing Channel Cross Sections

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DEBRIS is a menu-driven, interactive computer program written in FORTRAN 77 for recording and platting survey data and for computing hydraulic variables and depths of scour and fill. It was developed for use with the USDA Forest Service's Data General computer system, with the AOS/VS operating system. By using menus, the operator does not need to know any programming language. The five routines are: entering data, plotting, scour and fill, hydraulic variables, and computing x-y coordinates.

Retrieval Terms: channel surveys, cross sections, scour and fill, computer programs, Data General

Quantitative descriptions of the form and hydraulics of stream channels almost invariably involve surveying and analyzing cross sections perpendicular to the local direction of flow. Cross sections are most commonly surveyed with a self-levelling transit (level), rod, and tape or sounded along a tape or tagline strung between stakes of known elevation.[1] Cross sections provide a multitude of useful information for hydrologists. Fishery biologists, and land use planners. Incorporation of the water surface elevation in a survey enables one to compute mean depth, width, wetted perimeter, hydraulic radius, and mean velocity (when stream discharge is measured or known from a nearby gaging station). Hydraulic variables for other important stages such as bankfull flow can be estimated by drawing a horizontal fine across geomorphically recognizable datums, such as the tops of streambanks or flood levels. Repeated surveys of monumented cross sections can be used to follow channel changes over seasons, years, or even decades.[2]

But because they are two-dimensional, single cross sections cannot adequately provide meaningful data for natural channels, which commonly have large longitudinal variations. Therefore, sets of several cross sections selected by sound statistical sampling criteria must be used to characterize the mean condition and variability of reaches of natural stream channels. The use of standardized methods of surveying and analyzing cross sections and the large number of cross sections needed for most studies or monitoring programs make a package of computer programs highly desirable.

Until recently, application of data processing programs within the Forest Service has been commonly limited to the site that developed the program, because of the wide variety of data processing equipment in use. For a remote user to access any program, the user would have to pay the transmission costs and possibly some user and data storage fees. Add to this the hidden costs of the various programs needed to transfer the data from one site to another, and automatic data processing (ADP) is not as cost-effective as it should be.

With the introduction of the Forest Level Information System (FLIPS), better results and cost-effectiveness of ADP can be gained by sharing data processing techniques and programs. Transmission costs can be greatly reduced by running shared programs on-site.

This note describes DEBRIS–a menu-driven, interactive computer program written in FORTRAN 77 for recording and plotting survey data and for computing hydraulic variables and depths of scour and fill. DEBRIS was developed for use with the Data General system employed by the Forest Service, U.S. Department of Agriculture[3]

DESCRIPTION

Installation and Use

DEBRIS can be used on any Data General MV series computer using the AOS/VS operating system. A system manager can install the program and driver macro within the system without modifying the program. By using menus, the operator does not need to know any programming language. Questions asked of the operator while running DEBRIS are clear and concise. If other than a Hewlett-Packard 7221A plotter, Printronix 300 graphics printer, or Visual 500 graphics terminal are used for plotting, a programmer is required to write low-level routines. After the data are entered, all the routines can be run independently of the others. Data can be either in the Metric System or the U.S. Customary System; the output can be in either system.

Routines

Entering Data

The routine for entering data creates a file list that contains the names of the input files and a code for the method by which the data was collected, either sag-tape or rod and level. Each file contains one survey. There are also options to append more file names to the file list, to insert file names into the file list, and to remove file names from the file list. DEBRIS is capable of processing from 1 to 10 surveys from the same cross section.

Plotting

The plotting routine creates a file with the commands necessary to plot cross sections. There are three types of plots. A "quick plot" plots cross sections with keys for survey dates (*fig. 1*). Quick plots can be useful in detecting changes between surveys and checking the accuracy of the input data. The "axes plot" also plots horizontal and vertical axes (*fig. 2*). The "heading plot" also includes the stream name, cross section number, and the DEBRIS signature (*fig. 3*). Plots can be done on a Hewlett-Packard 7221A 4-pen plotter, a Printronix 300 graphics printer, or a Visual 500 graphics terminal.

Scour and Fill

The scour and fill routine computes cross-sectional area and mean depth of scour, fill, and net scour/fill (fill minus scour) of a sequence of two surveys. Results can be displayed on the terminal, saved in an output file to be used later, or printed (*fig. 4*).

Hydraulic Variables

A fourth routine computes the distance from a datum to the water level, width of the water surface, mean depth, maximum depth, wetted perimeter, and hydraulic radius. If values for Manning's "n" and slope are entered, the routine also computes discharge and mean velocity, or conversely, if discharge and slope are entered, Manning's "n" and mean velocity are computed. DEBRIS can perform these calculations on up to four water levels for each survey of a cross section. These results can be written to the printer or terminal or saved in an output file (*fig. 5*).

Computing X-Y Coordinate

This routine transforms the input data into pairs of horizontal and vertical coordinates. These can be written at the terminal or saved in an output file that is suitable for use in other programs such as MINITAB, PRESENT, etc.

ACCESS

A DEBRIS program package includes the DEBRIS program, a driver macro, and a user's guide for data entry and program execution. It is available from:

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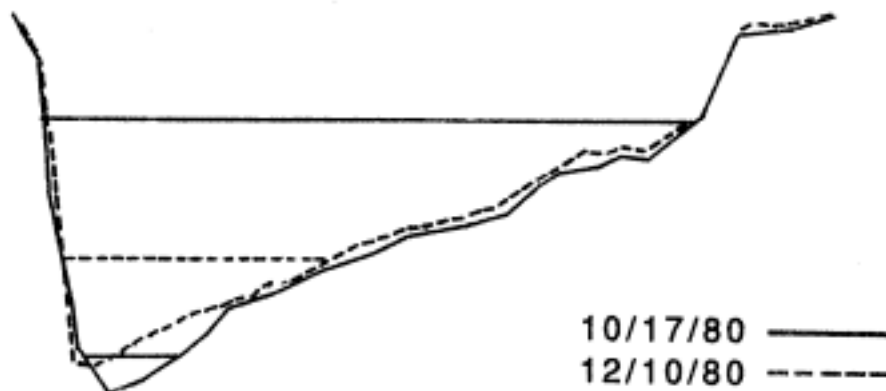1700 Bayview Drive
Arcata, CA 95521
Ph. (707) 822-3691

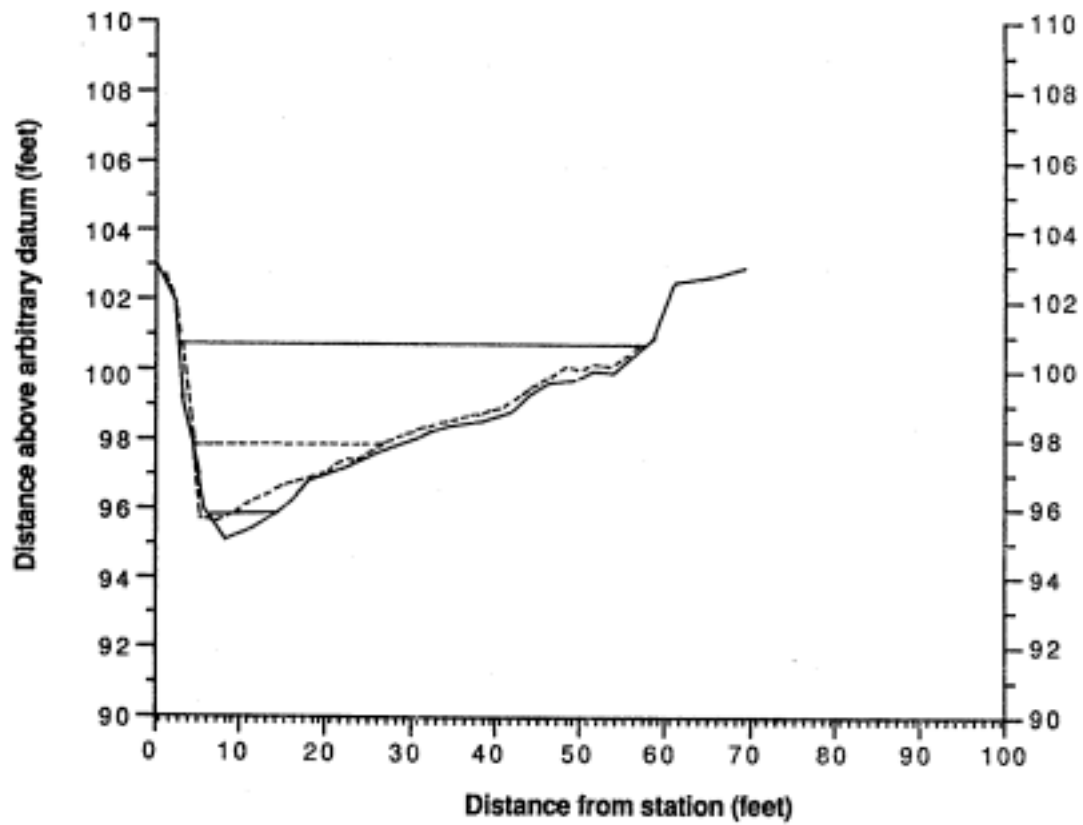**Figure 1**--Sample of a "quick" plot.

10/17/80 ———
12/10/80 ------

Figure 2–Sample of an "axes" plot with the data plotted in U.S. customary units.
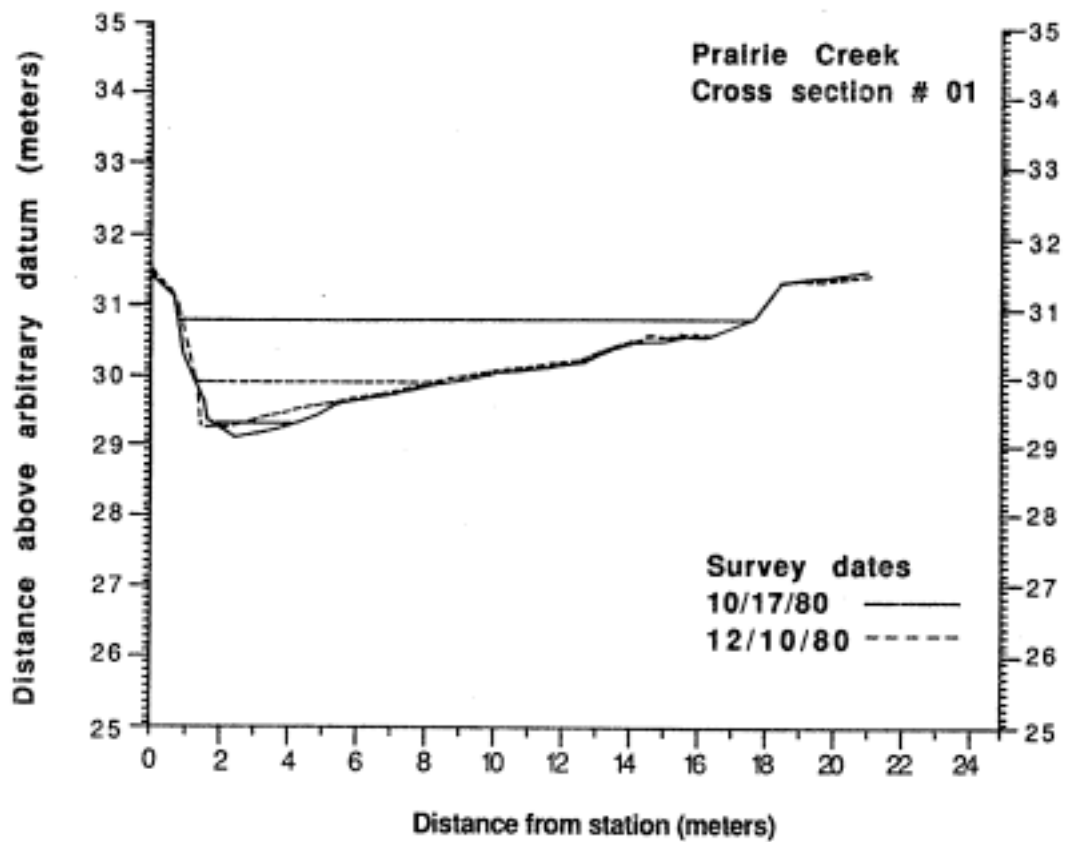

Figure 3-Sample of a "heading" plot with the data plotted in metric units.

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*** DEBRIS  REV.  5.0  SCOUR  OUTPUT  4/14/1986 ***


PRAIRIE CREEK        CROSS SECTION       01


SCOUR/FILL COMPUTATIONS FROM 10/17/80              TO         12/10/80


        scour=              1.0422         sq. ft.
          fill=             14.920         sq. ft.
           net=            -13.877         sq. ft.


HORIZONTAL  LIMITS  OF COMPUTATION  ARE  .83  -  68.80

DATA  TAKEN FROM  FILES  p001801017  AND  p001801210
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Figure 4--Sample of scour and fill output.

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*** DEBRIS  REV.  5.0  Hydraulic output 4/14/1986 ***

PRAIRIE CREEK CROSS SECTION 01
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survey Date	Distance to Water Level	Top width (feet)	Average Depth	Maxium Depth	Area (sq. ft)	Wetted Perimete	Hydraulics Radius	Slope (%)	Nannings N	Flow (CFS)	Average Velocity
10/17/80	7.15	7.90	.65	.75	5.12	8.45	.61	3.0	.061	154.85	30 22
10/17/80	2.15	54.62	3.25	5.75	177.50	59.86	2.97	3.0	.061	15457.23	87 08
12/10/80	4.91	22.34	1.31	2.24	29.20	24.66	1.18	3.0	.061	1379.37	47 23

Figure 5–Sample of hydraulic variables output.

END NOTES AND REFERENCES

[1]Ray, G.A.; Megahan, W. F. 1978. *Measuring cross sections using a sag tape: a generalized procedure.* Gen. Tech. Rep. INT-47. Ogden, UT: Intermountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 12 p.

[2]Leopold, L.B. 1973. *River channel change with time--an example.* Geological Society of America Bulletin 84: 1845-1860.

Varnum, N. 1984, Channel Changes at cross sections in Redwood Creek, California. Tech. Rep. 12, Redwood National Park, 49 p.

[3]Trade names and commercial products or enterprises are mentioned solely for information. No endorsement by the U.S. Department of Agriculture is implied.

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