US Army Corps
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Missouri River Division

Missouri River Bedload Evaluation Through Multi-Channel Sequential Profiles

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CHAPTER V

SUMMARY AND CONCLUSIONS

A series of sequential profiles were recorded in Missouri River study reach on August 29, 1979 to indirectly measure the bedload. This study reach consists of 3815 feet of relatively straight channel alinement between I-480 and USPRR Bridges near Omaha, Nebraska. Three straight survey lines at quarter width and mid-points of the channel width were selected and five sequential profiles were observed on each of the survey lines at intervals of about two hours apart.

The bed profile measurements were made with the 16-channel sonic sounder of the District (3) and the digital printer mode was used to record the data. During measurements, the boat travelled downstream starting from I-480 Bridge and soundings were recorded at the rate of one per second. The geographic position of the boat was also recorded during profiling by obtaining fixes on markers located on the channel bank at known (about 500 ft) distance

The objectives of this study were:

1. To computerize the digital profile data for transducers no: 5,8 and 11 for runs no: 2,3,4 and 5.
2. To calculate bedload rates from the selected profiles and to determine their spatial and temporal variation.
3. To evaluate the adequacy of field data and to recommend criteria for the future measurements.

The discretization interval in the recorded series varied from 15 to 23 ft. Also,as is typical of digital sounders, some random errors were apparent in the data. As a first step, the recorded series were screened for errors and the erroneous soundings were replaced with the weighted average soundings from the neighboring points. The corrected series were then interpolated at a constant discretization interval of 10 ft (Appendix B) and plotted (Appendix C). This interval was needed to provide a sufficient length of series for analysis.

Some equispaced series were then analyzed for bed load by both cross spectral and down crossing methods. It was noted that the two methods yielded similar results exept that the cross spectral analysis computed abnormally large wave lengths. The analysis for all the profiles was therefore computed by the down crossing method (reference 2)

In the analysis for bedload, each pair of profiles was analyzed for full length of profiles, as well as for three segments - the upper-half, middle-half and lower-half. The purpose of segmented analysis was to identity the spatial variation of bed load along the study reach. Also the profiles from four runs were combined in three sequential pairs 2-3, 3-4, and 4-5 to bring out the temporal variation of transport.

The results of bed load analysis (Table 4-1) showed that some of the segments yielded negative celerity (and bed load rates). The reason for this anomaly seemed to be the rather short length of series available for segment analysis as this problem was not experienced in the full length analysis. It was also noted that the measurement time associated with the profiles was nominal time and not the actual time of observation. As such, it was not possible to compute the temporal variation of bed load from data. For these reasons, the results from the three pairs were averaged and used in subsequent analysis.

The results of sequential analysis were plotted (Figure 4-1 through 4-5). It was concluded that:

1. In the upper-half segment, the bed load increases from the left side of the channel to the right side.

2. In the middle-halt and the lower-half segments, the bed load increases along the left survey line.

3. The average bed load rate in the total profile length is about evenly distributed across the channel and the bed load concentration is 88 ppm or about 9,300 tons/day.

The spatial variation in the bedload rate is related to the planform geometry of the channel. At the entrance to the study reach, the bedload distribution across the channel reflects the effect of right handed bend immediately preceding it. It appears that despite the mild left handed curvature within the study reach, the channel crossing at the prevailing flow is developing within the middle- and lower-half segments.

Data from all the sixteen trancducers were analyzed for runs 4 and 5 along the central survey line to study the variation of computed results across the transducer line. These data (Table 4-2 and Figure 4-6) showed that:

1. The narrow beam transducers (no. 8 and 9) yield somewhat larger bed form height than neighboring wide beam transducers, that cannot be explained by the difference in the beam angle of the narrow and wide beam transducers.

2. Two perturbations in the computed celerity and bed load are apparent. These perturbations start at the two end transducers and travel to the center with a decreasing amplitude (Figure 4-6). The perturbations completely die out at about one third way to the center (transducers no: 6 and 11). These perturbations may be related to the rolling motion of the boat.

It is concluded that the multiple-channel sequential profile data provide a useful and convenient tool for evaluation of spatial and temporal variation of bedload in sand bed channels with dune and ripple beds. This information is not otherwise avalaible and needs to be collected more frequently, so that quantitative predictive relationships for bed load can be verified, and improved. The data used herein suffered from some shortcomings which were identified in the analysis. These shortcomings necessitate some changes in the scope and method of future data collection schemes which are discussed in the following section.