United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

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May 3, 2012

OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM 2012.04

SUBJECT: Publication of the Techniques and Methods Report Book 3-Section A23 "Computing Discharge Using the Index Velocity Method" and important policy and guidance for index velocity stations

This memorandum (1) announces the availability of the Techniques and Methods (T&M) report "Computing Discharge Using the Index Velocity Method" (Techniques and Methods Report Book 3-Section A23) by Victor Levesque and Kevin Oberg and (2) summarizes important policy and guidance for application of the index velocity method in USGS programs. The report, available at http://pubs.usgs.gov/tm/3a23/, presents techniques and guidance for collecting, analyzing, and computing discharge records using the index velocity method. The report presents a logical step-by-step approach of the index velocity method, from site and instrument selection, to acoustic Doppler velocity meter (ADVM) installation and configuration, to routine field and office techniques, to development and analysis of stage-area and index velocity ratings, and finally to the computation and analysis of discharge.

The techniques and policies described in this T&M report represent the most up-to-date guidance on the application of the index velocity method to discharge record computation and are based on the experience of U.S. Geological Survey (USGS) employees, USGS training classes, and published reports and papers. Although Rantz and others (1982) provided information on the index velocity method, until now the USGS has had no formal technique and methods report documenting the index velocity method. The policies and guidance provided in this report take precedence over any previous USGS guidance.

A summary of some important new policies is provided below.

1. ADVMs must be installed such that index velocity data are not affected by boundary effects and flow disturbances. Best results are typically obtained when the instrument is configured to measure that part of the cross section which exhibits maximum velocity.
2. For routine time-series measurements, an optimal measurement interval and averaging period should be determined for each index velocity gaging station. However, when making discharge measurements, it is recommended that the index velocity measurement interval and averaging period be set to 1 minute. If the measurement interval and averaging period are not changed during discharge measurements, an adequate technical justification must be provided in the station analysis.

3. The salinity at the site needs to be determined and configured in the ADVM in order to more accurately compute the speed of sound in the water and measure water velocity. When salinity varies over time at an index velocity gaging station, the midpoint of the salinity range should be used to set the fixed value in the ADVM configuration to reduce the potential for bias in velocity measurements.
4. The ADVM coordinate system should be set to XYZ to prevent compass errors from being introduced into the index velocity data.
5. For those sites equipped with telemetry and subject to limited telemetry bandwidth, the following data, in priority order, should be telemetered for ADVM-equipped index velocity sites: (a) Upstream/downstream (X) range-averaged velocity, (b) Water temperature from ADVM, (c) Cell end, (d) Cross-stream (Y) range-averaged velocity, (e) Vertical (Z) range-averaged velocity (if applicable), and (f) Mean signal-to-noise ratio (SNR) or signal amplitude.
6. ADVM data not routinely transmitted via telemetry must be recorded on the ADVM (if an internal logger exists), downloaded and reviewed during every site visit, and archived for future review.
7. During every site visit hydrographers are required to record and analyze a beam (signal amplitude) check and obtain an independent water temperature measurement near the ADVM (see also OSW Technical Memo 2010.07). Other routine field techniques documented in the report also must be followed. Two new field forms for ADVM installation and configuration and for site visits to index velocity streamgages are provided and either the paper form or an electronic equivalent should be used.
8. Both transmitted and internally-recorded ADVM data must be reviewed at regular intervals in order to ensure the quality of the ADVM data being stored in the USGS database and provided to the public. See the Routine Office Techniques section of the T&M for details.
9. For stage-area ratings, the rated cross section must be re-surveyed every year for first 3 years of operation. After that period, if the stage-area rating has proven stable, then a re-survey is necessary only once every 3 years or after the following: (a) an unexplained divergence in the index rating has been noted, (b) high-flow event(s) have occurred, or (c) an evident change in the rated section is documented.
10. The process for creation of an index rating described in the report should be followed so that a simple linear, compound linear, or multiple linear rating is developed. In rare instances a more complex form for the rating may be necessary, but most often this can be attributed to poor ADVM deployment location or configuration.

Many more details and policies regarding the index velocity method are contained within the report; therefore the above list is not exhaustive. Hydrographers engaged in the application of the index velocity method should become very familiar with the procedures documented in the report. Eight appendices provide many examples and details on subjects such as ADVM mounts, selection of an ADVM measurement volume, application of index velocity shifts, evaluation of changes in a stage-area rating, and how to implement ratings in NWIS.

Preparation of this report was a cooperative effort with contributions from many people. It reflects more than 20 years of experience and practice by USGS personnel. Many instructors and students have provided inspiration and information for this report. Persons who made substantial contributions to the report are acknowledged therein. However, James B. DeRose of the California Water Science Center was inadvertently omitted, and is hereby acknowledged.

Questions or comments about the policies and guidance in this memo should be directed to Kevin Oberg (kaoberg@usgs.gov), Victor Levesque (levesque@usgs.gov), or the OSW Hydroacoustics Work Group.

/signed/
Robert R. Mason, Jr.
Acting Chief, Office of Surface Water

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