



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

In Reply Refer To:  
Mail Stop 415

September 20, 2017

Memorandum

**OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM 2017.13**

**SUBJECT:** Identification, Correction, and Revision of Discharges Measured with SxS Pro

This memorandum establishes Teledyne RD Instrument (TRDI) SxS Pro software version 1.16 as the minimum required version for use in collecting new mid-section streamflow measurements using TRDI ADCPs that are stored in the National Water Information System (NWIS) and provides guidance on handling errors that may occur or have occurred when collecting data with SxS Pro.

The U.S. Geological Survey (USGS) Water Mission Area (WMA) Office of Surface Water (OSW) worked with field staff in Nebraska, Maine, and Alaska, colleagues in Environment and Climate Change Canada, and TRDI to evaluate hundreds of open-water and under-ice measurements made using SxS Pro and have determined that potentially 10 percent of all measurements made using SxS Pro have errors in the mmt files that could cause an error in the computed discharge. About 30 percent of the measurements with errors were made in open water and about 30 percent of those open-water measurements had errors that caused an error of 8 percent or greater in the computed discharge.

TRDI has made several modifications to the SxS Pro software in an attempt prevent errors in the mmt file, but sufficient field testing has not been completed to ensure that the problem will not persist. However, when loading a previously recorded file in SxS Pro version 1.16 the software will check the file for errors, notify the user, and request permission to fix the file (see Reprocessing Measurements). Therefore, all SxS Pro measurements, even new measurements made with version 1.16, should be reloaded and reprocessed immediately after finishing the measurement to ensure that there are no errors in the recorded data or that any identified errors are resolved before leaving the site.

[OSW Technical Memorandum 2017.07](#) states that the revision policy outlined in that memorandum applies to measurements approved after August 1, 2017. However, when feasible, WSCs are encouraged to follow these same requirements for data collected, computed, and approved before this date. Thus, SxS Pro measurements for records that have not been approved as of August 1, 2017 should be checked for potential errors and

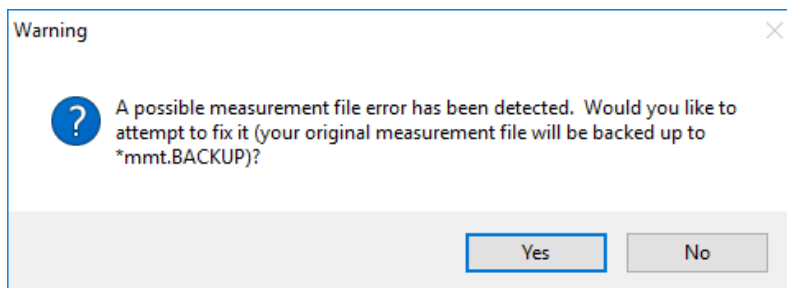
measurements with errors reprocessed, and revised as appropriate (see Identifying and Correcting Existing Measurements).

### Explanation of SxS Pro Error

SxS Pro is a software product sold by TRDI and introduced in 2010 that provides the capability of making mid-section measurements with TRDI ADCP's. SxS Pro is commonly used in the WMA for making streamflow measurements in ice-covered streams and for check measurements, although some centers are also using SxS Pro extensively for routine open-water measurements. Several reports of corrupt measurement files were reported to OSW. A SxS Pro measurement is comprised of two files; a pd0 file containing the raw data from the ADCP and an mmt file containing the data from the SxS Pro user interface. Investigation of the issue revealed there is no unique field or number associating user supplied information for a vertical stored in the mmt with the companion raw data stored in the pd0 file. SxS Pro simply reads both files sequentially so that the first set of ensembles is associated with the information of the first vertical in the mmt file. If either fails to store data properly the data from the pd0 file may be associated with the wrong vertical in the mmt file. Sometimes the mmt file will have a vertical indicating zero samples time stored in the Acquire Configuration of the mmt file but there are 1 or 2 ensembles for that vertical in the pd0 file. During playback of a measurement SxS Pro creates a Playback node which should be consistent with the Acquire Node except for manual changes made by the user. However, SxS Pro will not create a vertical in the Playback node for any vertical with zero sample time in the Acquire Configuration as it assumes there are no data in the pd0 file associated with that vertical. Therefore the 1 or 2 ensembles in the pd0 file become associated with the next vertical in the mmt file. Thus, the data in the pd0 file may be mismatched with information in the mmt file. SxS Pro prior to version 1.16 has had no checking to match the number of segments in the pd0 with the number of segments in the mmt file. While the issues in a file can be identified and corrected (with some user interaction) the cause of the problem has not been isolated.

### Reprocessing Measurements

Version 1.16 of SxS Pro will identify the problems in the mmt and prompt the user for permission to fix the file when an existing measurement is loaded in the software. If an error is detected the software will display the following message:



Clicking yes will cause SxS Pro to save the original file with an extension \*.mmt.BACKUP (so the original data is never modified) and the \*.mmt being loaded will be “fixed”. However, the “fix” cannot determine if any of the information associated with a vertical has been edited after recording of data at a vertical was started. Therefore, after a file is “fixed” the user needs to review each vertical to ensure that all user supplied information for that vertical is correct.

### **Identifying and Correcting Existing Measurements**

Water Science Centers that have used SxS Pro must check SxS Pro measurement files associated with record approved after August 1, 2017 for errors and reprocess affected files with SxS Pro version 1.16. When feasible, WSCs are encouraged to follow these same procedures for data collected, computed, and approved before August 1, 2017. Discharge measurements in ice covered streams made using SxS Pro do not need to be revised because these measurements do not affect ratings and records beyond the ice period and such measurements tend to have large uncertainties. The steps for identifying and correcting existing open water measurements are:

1. Identify SxS Pro files that have an error. This can be accomplished by manually reprocessing each file using SxS Pro version 1.16 or by using tools developed by OSW (see Appendix A).
2. Reprocess measurements using SxS Pro version 1.16 as discussed in the Reprocessing Measurements section of this memorandum.
3. Compare the new discharge to the original discharge stored in NWIS to determine if a revision is required. Guidance on the procedures for revising a discharge measurement is provided at: <https://water.usgs.gov/osw/RevisionsGuidance.html>.

If additional information is required or you have questions, please contact David Mueller (dmueller@usgs.gov).

*//signed//*

Robert R. Mason, Jr.  
Chief, Office of Surface Water

Attachment: Appendix A

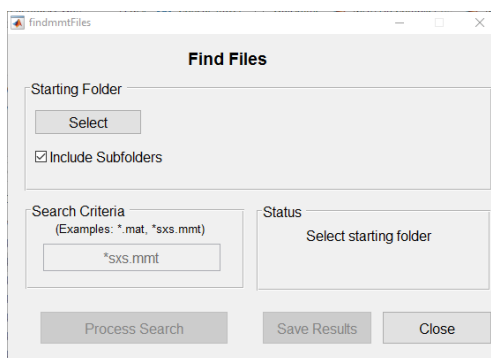
Distribution: GS-W All

## Appendix A. OSW Software Tools

The OSW has developed two software programs to assist those WSCs that (a) have made many SxS Pro discharge measurements or (b) choose to evaluate SxS Pro discharge measurements for periods of record that has already been approved. The software may be downloaded from <ftp://ftpext.usgs.gov/pub/er/ky/louisville/dsm/sxsCheck.zip> and requires Matlab Runtime Library 2015b 64-bit available from <https://hydroacoustics.usgs.gov/software/MCR1.shtml> (this is the same runtime library that is used for the 64-bit version of QRev). To use the software, unzip the zip file into a folder of your choosing, navigate to that folder, and run the software by double clicking on the appropriate exe file.

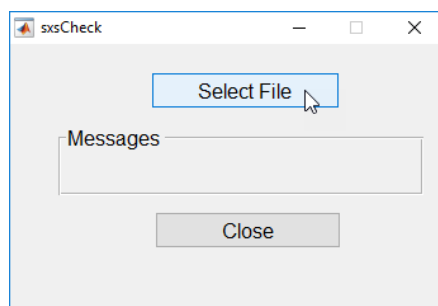
### FindmmtFiles\_64bit.exe

The first program, findmmtFiles.exe, will scan folders and subfolders identified by the user and makes a list of all files with names \*sxs.mmt (by default) which the user can save in a text file.

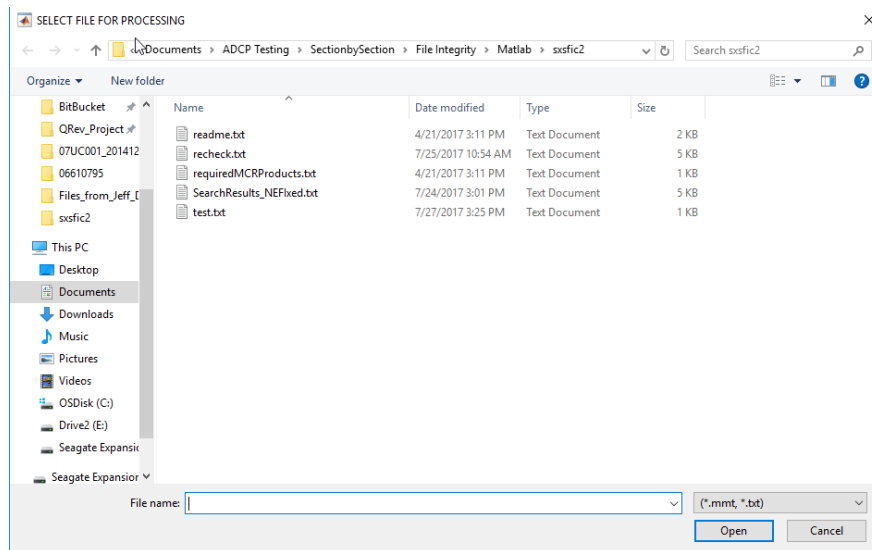
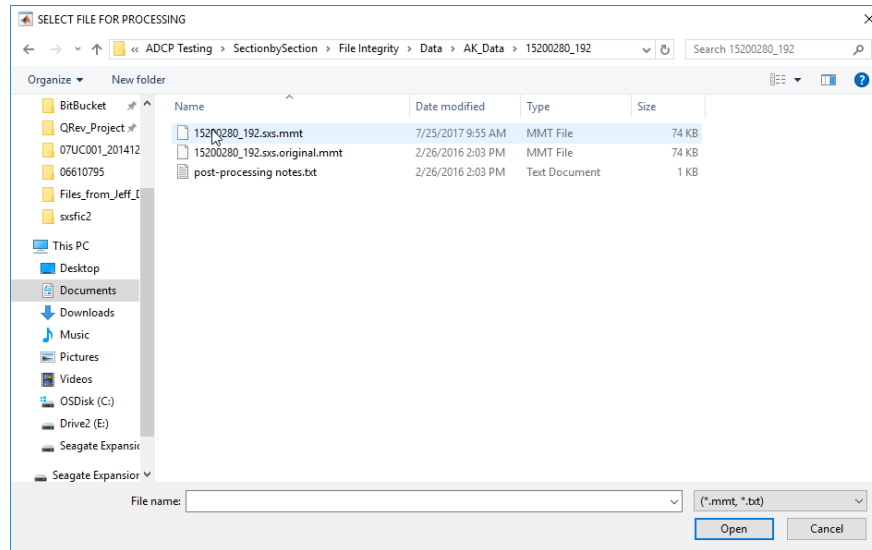


### sxsCheck\_64bit.exe

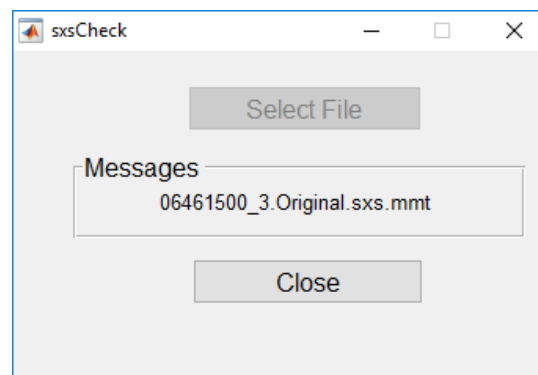
The second program, sxsCheck.exe, checks mmt files for potential errors. The program has a very simple user interface.



Clicking on Select File allows the user to select either a single \*sxs.mmt file or a text file with a list of files (typically created using findmmtFile.exe).



If a list of files is selected the measurement being processed will be shown in the Messages box.



If only one file is being processed the message box will simply say “Processing”. When processing is complete the Message will say “Processing Complete”.

sxsCheck produces an Excel spreadsheet, named *SxS\_Check\_Summary.xlsx*, which is stored in the same folder as *sxsCheck.exe*. The summary file (*SxS\_Check\_Summary.xlsx*) contains a line number

(column A), the status: Pass, Fail, Ice (column B), date of measurement (column C) and the path to the mmt file (column D). If a measurement fails the test, a second check is made to determine if it was an ice measurement. If it was an ice measurement, the status column will say "Ice". If it was an open-water measurement it will say "Fail". If an ice measurement passes the test it will say "Pass". The Excel spreadsheet can be sorted by date and status to identify the measurements that need to be reevaluated. The summary file also contains a tab named "Invalid" that includes the path to all measurements which for some reason were not able to be processed by sxsCheck. These measurements should also be reevaluated in accordance with the guidance provided herein.