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Standard Operating Procedure #15: Managing Time-Series Data, Version SCPN_WATER_QUALITY_SOP15_20160901

Contents

1 Time-series data	3
2 Aquarius continuous time-series data management software	4
2.1 Aquarius learning resources	4
2.2 Using the NPS servicewide Aquarius Time-Series licenses	4
3 Workflow for time-series data processing	5
4 Revision history	6

Standard Operating Procedure #15: Managing Time-Series Data

Version SCPN_Water_Quality_SOP15_20160901				
Revision History Log				
Previous version number	Revision date	Section and paragraph	Change(s) made	Approved by
Only changes in this specific SOP will be logged here. Record the previous version number and date of revision; identify sections and paragraphs where changes were made, who approved the revision, and the new version number. More detailed descriptions of the changes made and the reason for the changes is provided at the end of this SOP.				

This Standard Operating Procedure (SOP) introduces the reader to time-series data, the Aquarius Time Series software and online resources that provide training for using the software. It also summarizes the workflow, however, the user should consult the online resources for specific instructions.

1 Time-series data

Time-series data are a set of quantitative observations that are measured in succession at evenly spaced intervals. The purpose of collecting and analyzing time-series data is to identify and describe short and long-term patterns in water quality or hydrologic data (e.g. trends and seasonal variation).

The Southern Colorado Plateau Network (SCPN) uses automated data loggers, such as water level pressure transducers, temperature thermistors, and water quality sondes, to record continuous time-series data at

monitoring sites in network parks. These instruments generate a tremendous amount of data. To ensure the accuracy of the data, it is imperative that proper data management techniques are employed through all phases of these projects, from pre-deployment calibration of equipment through reporting, data processing. Key steps are data retrieval and data processing, which include data correction and QA/QC prior to analysis and reporting.

The pre-deployment programming and post-deployment downloading of automated data loggers is carried out using various proprietary software that are provided with the data loggers. The user must be familiar with the operation of software prior to programming any data logger to ensure that data are properly recorded, stored, and are available for retrieval. SOP 5 and SCPN's Integrated riparian monitoring protocol for the South-

ern Colorado Plateau Network (Monroe et. al. in review) provide step by step instructions on the proper use of software needed to program each automated data logger.

SCPN staff who are responsible for processing continuous time-series data should be familiar with the network's monitoring sites and have a general knowledge of water quality and hydrologic daily cycles and parameter relationships. We recommend that staff read the Record Computation section (pp 22–35) of Wagner et al. (2006) prior to processing time-series data, which provides guidance for correcting data for possible fouling and calibration drift.

2 Aquarius continuous time-series data management software

NPS utilizes the Aquarius Time Series software (Aquatic Informatics 2015) for the management and analysis of continuous time-series data. Two visual platforms—the Aquarius Whiteboard and Springboard—simplify workflow to process and analyze large time-series datasets. These platforms interact with NPS's Aquarius Database. An NPS servicewide Aquarius license has been made available by the NPS Water Resources Division (WRD). Instructions for logging on to the shared license can be found at: <http://nrdata.nps.gov/programs/water/aquarius/AquariusVideos.htm>. We anticipate SCPN will use Aquarius Time-Series software to manage and process continuous time-series data. Please note, the use of Aquarius Time Series by SCPN does not constitute an endorsement by the U.S. Government.

The Aquarius Time-Series software includes toolboxes needed to complete each stage of data management, from importing data to saving it to the database. Another feature of the software is that it tracks data processing steps—it tracks all changes to the raw dataset, creates a corrected data file, and stores this information in a comma separated value (.csv) file that can be exported for metadata tracking purposes. This feature standardizes the way in which changes to raw data are tracked. It should be noted that Aquarius

Time-Series software may not directly meet the network's quantitative data analysis needs, but the data can be easily exported for subsequent analysis in other programs.

2.1 Aquarius learning resources

Both the NPS and Aquarius provide online resources for training on how to use Aquarius Time-Series. The NPS WRD provides NPS Aquarius system overview documents and videos, which are regularly updated, at: <http://nrdata.nps.gov/programs/water/aquarius/aquariusvideos.mht>.

Aquatic Informatics has also developed videos that train people how to use the Aquarius Time-Series software. The videos are available at: <http://aquaticinformatics.com/resources/aquarius-resources/video-library/#>. New users should contact Aquatic Informatics for a log-in and password. The following is a list of videos that should be watched prior to beginning work in Aquarius.

- Learn more about Aquarius
- Manage your locations online
- Easily import your data
- Edit and correct your data
- Report and publish your data

2.2 Using the NPS servicewide Aquarius Time-Series licenses

After watching the videos and reading the documented instructions from WRD, users must first request access to the NPS servicewide Aquarius Time-Series licenses from Dean Tucker in the NPS WRD, and then acquire the AQAssistant.rdp file, also from Dean Tucker. This will enable the user to connect to Aquarius through the remote desktop, but you will have to be behind the NPS firewall, or on VPN to do so. Place the .rdp file on the computer desktop and double click to pull up the remote desktop log-in screen. Your log-in information is the same as that used to log-in to your computer.

The Aquarius Springboard to access the NPS Aquarius server can be found here: <http://>

inp2300fcvgett1.nps.doi.net/aquarius/. Once you have access, Your log-in information is the same as that used to log-in to your computer.

3 Workflow for time-series data processing

1. Retrieve data logger and download electronic data file(s).
2. Complete SCPN Calibration and Maintenance Log for the same deployment period as the log file.
3. Complete SCPN *Water Quality datasheet*.
4. Label data files following the proper file naming convention described in SOP #5.
5. Export raw data from proprietary file format to comma separated value (.csv) or text (.txt) format.
6. Place a copy of all data files on the SCPN common drive (Z: drive).
7. Import .csv and .txt files into Aquarius Time Series software (<http://www.aquaticinformatics.com/main/>).
8. Conduct the following data processing steps where necessary.
 - signal trimming
 - gap tolerance
 - correct for sensor fouling, drift, or offset
 - interpolation of missing data
 - threshold flagging
 - data grading
 - append multiple files
9. Create graphs and descriptive statistics.
10. Export QA/QC checked data and record of correction history in .csv format from Aquarius Time-Series software for import into database and data analysis and reporting.

4 Revision history

Provide the following information for each revision made to SOP #15.

New version:

SCPN_WATER_QUALITY_SOP15_YYYYMMDD

Date:

Author:

Sections affected:

Changes & reasons: