

*Stage or elevation records.*

# Process of Analyzing, Approving and Auditing of Stage or Elevation Records

## Analyzing Stage or Elevation Records

Prior to beginning the record-analysis process, it is the responsibility of the hydrographer who performed the field work to finish any field notes and process levels to the point of completion (including any checks or verifications needed). As per [OSW TM 14.08](#), “all USGS Science Centers shall correct time-series stage...data (by applying indicated datum, and data corrections) within 2 business days of a field measurement if the computed real-time data on NWISWeb do not match...” (in this case) field stage measurements within their rated accuracy. All entries to databases, archival of electronic files, and any other storage and updating of data collected, such as back up data or levels summaries, are to be completed by the party who collected the data, or by another designated person as per the Center’s surface-water quality assurance plan. Field data need to be verified for transcription errors and evaluated for consistency and proper technique prior to beginning the analysis process. The station description should be examined and updated if needed. A station analysis must be written using the established Station Analysis Template and stored in the Record Management System (RMS).

The record-period analyst executes the following steps to bring the time-series record to an analyzed state:

- Ensure that required verification and evaluation of field data have been done and documented, as per WSC procedures, before the analysis begins.
- If levels were due during the analysis period, they should be completed before the analysis begins. If levels are overdue and the record is analyzed and then approved, revisions may be required as per established revisions criteria.
- Update the Station Description with any relevant changes that have occurred at the site during the analysis period, including any updates resulting from station levels.
- *[If station levels were run during the analysis period]* Examine the levels notes and any applied datum corrections to ensure they were applied correctly to both the current period and other previously approved periods since the last set of levels. Make adjustments to applied datum corrections as needed. Correct all reference gage observations and associated gage heights assigned for all site visits affected by a datum correction. Document the results of the level run, provide the reasoning / justification for

any datum correction, and explain how the datum correction was applied (including dates) in the **Gage Height or Elevation Record: Datum** section of the station analysis.

- Merge any backup time-series data where needed and available. Document the source of the merged data, the reason for the gap in the primary time-series record, and the period that contains the merged data in the **Gage Height or Elevation Record: Backup Data** section of the station analysis.
- Examine the recorded gage height or elevation time series and identify periods of erroneous values. Periods when recorded gage heights or elevations are affected by ice should be provided in the **Gage Height or Elevation Record: Ice Affected** section of the station analysis. Edits should be made to erroneous values to remove them from further analysis. Discuss all edits to the recorded gage heights or elevations, including reasoning for the erroneous values and methods used in making edits, in the **Gage Height or Elevation Record: Edits** section of the station analysis. Remaining periods with gaps in the data should be documented in this section, as well. The quality of the recorded gage height or elevation for the analysis period must be explicitly stated in the **Gage Height or Elevation Record** first order heading of the station analysis.
- Review (or revise, if necessary) all applied gage height corrections for the analysis period. This includes comparing all reference gage readings to the recorded values and verifying the application period for the corrections. The analyst is responsible for making any adjustments to previously applied gage height corrections to the working period. The reasoning and timing for any gage height corrections must be clearly described in the **Gage Height or Elevation Record: Gage Height Corrections** section of the station analysis for the period.
- Ensure that any needed flushing- or purge-related corrections are applied to the record. The reasoning and application period for these corrections are to be documented in the **Gage Height or Elevation Record: Other Corrections** section of the station analysis.
- Continue, or develop, any other types of corrections (not described above) as needed. An example would be the application of a developed draw-down correction curve. A detailed discussion on how such corrections were developed, their period of applicability, and why they were deemed necessary for the analysis period must be included in the **Gage Height or Elevation Record: Other Corrections** section of the station analysis.
- Determine the peak stage or elevation for the analysis period. This includes following the procedures of [OSW TM 14.06](#) "Requirements for the collection, validation, and input of peak-stage verification data at U.S. Geological Survey streamgages." The **Gage Height or Elevation Record: Peak Stage** section of the station analysis must contain both the maximum recorded peak stage value, and the independent peak stage value (including the independent peak stage device type and uncertainty associated with the value) for the analysis period. The results of the verification procedure should be documented. Indicate how this peak value compares to the previous peaks from previous analysis period peaks of the same water year.
- If required, develop estimates of unit value gage heights or elevations for any identified gaps in the time series. Estimates should be developed by following recommended best practices (reference pending policy release). Periods of estimated gage heights or

elevations and the methods used in developing the estimates are to be documented in the **Gage Height or Elevation Record: Estimates** section of the station analysis.

- Provide any pertinent remarks or comments for the analysis period that are not contained in other sections in the **Comments** section of the station analysis.

After completing the above described tasks, the analyst should set the record for the analysis period to the analyzed state in NWIS and in the records tracking system.

## Approving Stage or Elevation Records

Each stage or elevation record is subject to a quality control process that involves a thorough examination of the methods and procedures used, and to verify the accuracy and interpretations of the analyzed record period. The examination includes the checking for gross errors in the record computation process as well as verifying that interpretations and justifications for the decisions made during analysis are sound and valid. Verification of the analyst's work may require updates to the analyzed period. The record approver documents this examination in RMS using the established Approval Guidance. Analysis periods that are determined to have errors are documented and returned to the record analyst for corrections. Contentious changes are negotiated among the parties, with the Data Chief or Field Office Chief resolving any disputes. After all issues are resolved, the record for the analysis period will be set to the approved state in NWIS and the records tracking system. The record-period approver executes the following steps to bring the time-series period to an approved state:

- Verify that field notes and level notes were reviewed and the reviews were documented in accordance with WSC procedures. This task must be completed before continuing on with the remaining approval tasks.
- Ensure the Station Description is current and relevant and has been properly updated to reflect any changes made or observed during analysis period.
- Determine that levels are up-to-date and if levels were run during the period ensure they were done in compliance with [T&M 3-A10](#); that is, they are valid for verifying that the reference gage is properly set to gage datum. Periods wherein levels are overdue, or when levels policies were not fully satisfied, should not be approved until a proper set of levels are run and any needed changes are made to the record. If levels are overdue, or determined to be invalid, and the record is approved, follow established revision criteria if the reference gage is found to have moved when levels are eventually run (as revisions to approved record may be required).
- Evaluate the accuracy and documentation of any defined datum correction (set 1). This includes verifying the correction value, verifying that application of the correction in time is valid, and ensuring all adjustments to observed reference gage readings were done properly.
- Verify that any edits to the recorded gage height record were done properly, and that they were documented in the station analysis. The approver should verify the period(s) of the record identified as affected by ice.

- Evaluate the accuracy and documentation of all defined gage height corrections (set 2). This includes verifying the correction value and verifying that application of the correction in time is valid.
- Evaluate the accuracy and documentation of all defined other types of corrections (set 3) such as drawdown, flushing, or purge corrections. This includes verifying the correction value and verifying that application of the correction in time is valid.
- Ensure peak stage values were verified following the requirements of [OSW TM 14.06](#) and that peaks for the analysis period were compared with previous peaks from the water year.
- Determine if estimates are appropriate, consistent, and were done using appropriate methods and data and in accordance with existing guidance.
- Provide a brief written final assessment of the analysis period.

After completing the above described tasks, the approver should set the record for the analysis period to the approved state in NWIS and in the records tracking system.

## **Auditing Stage or Elevation Records**

### **Routine Auditing of Stage or Elevation Records**

A minimum of 10 percent of a WSC's stage or elevation records should be audited at intervals of about 1 year or less. More frequent audits are welcome, however no more than 90 percent of the data can be left un-audited for longer than fifteen months. If significant issues are found at a number of sites during routine audits, the percent of stations being audited should be expanded. Routine audits are performed by Field Office Chiefs, senior hydrographers, surface-water specialists or the Data Chief. It is highly encouraged to have a subset of routine audits done by other offices within the WSC or offices in other WSCs. The purpose of the routine audits is to ensure proper methods were applied throughout the process of obtaining the stage or elevation data and computing the record. Errors found during a routine audit are to be revised if they meet revision criteria. Contentious changes should be coordinated among the parties, with the Center designee resolving any disputes. Routine audits are to be documented by filling out the Audit Template in RMS. It is the responsibility of the record auditor to review the following:

- Station analysis
- Approval documentation
- Datum corrections, gage height corrections, and other types of corrections
- Edits to recorded stage data
- Peak stage values for water year
- Estimated values
- Stated record quality
- The station description should be reviewed for completeness and accuracy.

## Non-routine Auditing of Streamflow Records

Non-routine audits occur anytime an aspect of an approved record is examined outside of the previously defined routine audit process. For example, an end user may have a question about the gage height record for May and June two years ago. Errors found during non-routine audits are subject to defined error threshold criteria for revisions. Non-routine audits do not have any required tasks aside from documentation of the audit to include; the date of the audit, the auditor, what was examined, why it was examined, and the outcome of the audit to include a discussion of potential revisions, if any. Another example of a non-routine audit would be a record that is examined during a triennial discipline review. In this case, most aspects of a designated record period are examined (superficially or in detail) and the documentation should include the notes or forms that were filled out by the reviewer. Non-routine audits are to be documented by filling out the Audit Template in RMS.