



DEPARTMENT OF
ECOLOGY
State of Washington

Standard Operating Procedure EAP042, Version 1.2

Measuring Gage Height of Streams

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Purpose of this document

The Washington State Department of Ecology develops Standard Operating Procedures (SOPs) to document agency practices related to sampling, field and laboratory analysis, and other aspects of the agency's technical operations.

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Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Measuring Gage Height of Streams

Version 1.2

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EAP042

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SIGNATURES ON FILE

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

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Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
08/10/2015	1.1	Updated reference and link to EAP Safety Manual	9.0	Jim Shedd
08/10/2015	1.1	Made grammatical and formatting adjustments, rephrased language throughout document.		Jim Shedd
08/10/2015	1.1	Recertified	All	B. Kammin
10/16/2018	1.2	Made grammatical and formatting adjustments, rephrased language throughout document.	All	Jim Shedd
10/16/2018	1.2	Clarified/updated definitions and described more succinctly the purpose and execution of procedures. Updated Equipment, Reagents, and Supplies section.	3.0, 5.0, 6.0	Jim Shedd
10/16/2018	1.2	Added missing QA/QC section. Inserted citation to Standard Operating Procedure EAP082.	8.0	Jim Shedd
10/16/2018	1.2	Inserted reference to Standard Operating Procedure EAP082. Updated reference to EAP Safety Manual.	10.0	Jim Shedd
10/16/2018	1.2	Added title to main page and brief description of back page of Logger Note Form.	Appendix	Jim Shedd
12/14/2018	1.2	Formatting and accessibility updates.	All	Ruth Froese

Environmental Assessment Program

Standard Operating Procedure for Measuring Gage Height of Streams

1.0 Purpose and Scope

- 1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for determining the stage of a stream using a staff gage, wire-weight gage, laser level, weighted measuring tape (tape down), and crest-stage gage.

2.0 Applicability

- 2.1 This procedure is followed when determining or verifying the gage height of a stream.

3.0 Definitions

- 3.1 Gage Datum—The term datum in the context of this SOP refers to the base or the 0.00 ft. elevation plane to which all reference marks, reference points, and water surface elevations are determined. At EAP flow monitoring stations the datum is set below the elevation of zero flow and maximum scour.
- 3.2 Gage Height— Often this term is used interchangeably with stage. However gage height is more appropriately used to indicate the water surface observed on a particular indices. (Rantz et al., 1975).
- 3.3 Stage— The height of the water surface above a datum (Rantz et al., 1975).
- 3.4 Primary Gage Index— The primary gage index is the base gage for the station, directly referenced to the recording gage. The primary gage index is the most stable and reliable gage at a site. All other gages at a station are considered secondary gage indices.
- 3.5 Secondary Gage Index— Secondary gage indexes are used to confirm the primary gage index. The secondary gage is used to estimate the value of the primary gage if the primary gage is damaged or missing.
- 3.6 Recording Gage— Typically, an automated bubbler, pressure transducer, or radar gage measures and records the stage to an electronic data logger maintaining a continuous record of stage through a specified period of time. The bubbler or transducer is calibrated to match the primary gage index.
- 3.7 Reference Mark— A reference mark is a permanent marker of known elevation above the datum, installed in the ground or on a stable structure in the vicinity of the gauging station.

- 3.8 Reference Point — A reference point is a marker above the zero datum from which gage height can be determined.
- 3.9 Levels — Also known as differential leveling, levels are a specific set of procedures conducted with surveying instruments to check that reference marks, reference points, and all gage indices used to determine gage height are set correctly to the gage datum.
- 3.10 Control — The physical features of a stream that control the relationship between stage and discharge at a gage site.
- 3.11 Point of Zero Flow — Stage at which water ceases to flow over the control. The point of zero flow is the lowest point on the control.

4.0 Personnel Qualifications/Responsibilities

- 4.1 Personnel using this SOP should have training and field experience in making stream gage site visits, recording and documenting pertinent data.

5.0 Equipment, Reagents, and Supplies

- 5.1 Copies of the standard Ecology Stream Gage Logger Notes (Attachment A) for recording times, gage readings, and actions taken while at the gage site, are kept in a suitable field notebook. These forms are usually printed on Rite in the Rain™ paper for outdoor durability.
- 5.2 A laser level instrument emits a laser beam illuminating a horizontal plane of known elevation. The laser beam elevation is used to determine water surface elevation.
- 5.3 A stadia rod, placed vertically on the wetted bottom of a stream channel reflects the laser beam emitted from the laser level instrument. Observations of the height of the laser beam reflection on the stadia rod and the intersection of the water surface on the rod allows determination of the water surface gage height.
- 5.4 A circular bubble level attaches to the stadia rod to ensure the stadia rod remains vertical while measuring laser beam and water heights.
- 5.5 A crest stage gage (csg) allows for determination of peak flow stages at EAP monitoring gages.
- 5.6 An engineer's tape measure is used to measure the high-water mark on a crest-stage gage.
- 5.7 A weighted measuring tape is used for measuring vertical distance to the water surface from a reference point of known elevation above the wetted channel.

6.0 Summary of Procedure

- 6.1 Establishing Gage Datum — The stage or water surface elevation at a stream-gauging site and the elevations of all reference marks, reference points, and gages used to determine stage are relative to a common datum. At most stations, a datum is arbitrarily assigned corresponding to the elevation of the primary gage index. Primary gages are installed such that the assumed zero point of the primary gage is below the point of zero flow and expected scour of the channel.
- 6.1.1 Movement of the structures supporting the primary gage disturbs the datum. Periodic leveling surveys (levels) check the relative position of the primary gage against reference marks and points of known elevation.
- 6.1.2 Levels are run at a minimum of every three years or as soon as possible after unresolved discrepancies between gage observations or movement of gage structures, reference marks, or reference points are suspected.
- 6.1.3 When the primary gage has moved, the gage is recalibrated to the datum and/or relocated to the proper elevation when possible.
- 6.1.4 In some applications, relocation of the gage is not possible. The ways in which these circumstances are handled with respect to the existing datum are presented in the following discussions of each type of gage (sections 6.3 – 6.7).
- 6.2 Placement of Gages — Primary and secondary gages are placed collectively in the gage pool, subject to the same station control, and as close in proximity as possible to the recording gage.
- 6.2.1 Gages are not placed separately in stream sections regulated by different controls, as channel dynamics and geometry are not the same. Stage fluctuates at different rates and magnitudes, relative to changes in discharge in stream segments served by different controls.
- 6.3 Determining Stage Height by Observing a Staff Gage — A vertical standing staff gage consists of a singular or a successive series of porcelain enameled steel plates mounted to a secure structure. Most staff plates used by the Washington State Department of Ecology are graduated in 0.02 feet increments. Staff-gage observations are recorded to 0.01 feet resolution.

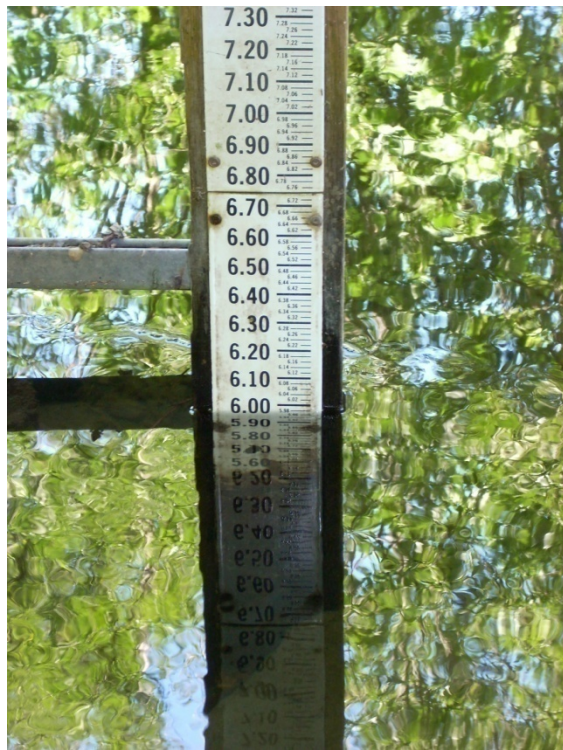


Figure 1. A typical Ecology staff gage with 0.02 feet increments. (Photo by Washington Dept. of Ecology)

- 6.3.1 In many locations, the water level may surge against the staff-gage structure, causing the water surface to fluctuate or bounce on the staff gage. If the water level fluctuates on the staff, read the average level, and note the reading with the range of water level fluctuation (uncertainty), i.e. 4.16 ± 0.04 , where 4.16 is the best deciphered center of the peaks and troughs of the waves, and ± 0.04 is the range of the peaks and troughs.
- 6.3.2 In situations where the fluctuation is excessive, use a makeshift stilling well. A good makeshift stilling well consists of a five-gallon bucket with the bottom cut out and a cut up the side to permit spreading of the bucket walls to surround the staff-gage structure. Open the bucket walls and wrap around the staff gage with the bottom of the bucket walls at a depth of 0.5 to 1 feet. This should calm the water around the staff gage enough to obtain a more reliable reading.
- 6.3.3 Take the necessary time to obtain the most accurate observation. Record the water surface fluctuation or bounce in the stream gage logger notes as an indicator of uncertainty for future analysis.
- 6.3.4 Record the date, time, the staff-gage observation, and the uncertainty on the stream gage logger notes or appropriate discharge measurement form.
- 6.3.5 In situations when the staff-gage elevation changes due to movement or damage, reposition the staff plate to the original elevation.

6.3.6 If repositioning the staff plate is not possible and the datum is tied to the original elevation of the staff gage, either discontinue use of the staff gage as the primary gage index and establish a new primary gage index relative to the existing datum, or establish a new datum adjusting related records and document accordingly.

6.4 Determining Stage Height Using a Wire Weight Gage — Wire-weight gages are stage-height-measuring instruments typically attached to a bridge railing or parapet over a stream. The gage is housed in a locked protective covering.



Figure 2. Wire Weight Gage (photo courtesy Rickly Hydrological Company)

6.4.1 The basic parts of a wire-weight gage include a drum wrapped with a single layer of cable and a weight attached to the end of the cable. A readable disc, graduated in tenths and hundredths of a foot is attached to the side of the drum. A Veeder counter, reading in whole feet is also included.

6.4.2 One complete turn of the drum represents one foot of vertical movement of the weight.

6.4.3 A threading sheave guides the cable to and from the drum. A pawl-and-ratchet mechanism holds the weight in place at any desired elevation.

6.4.4 A moveable check bar is mounted at the front of the instrument. When moved to the forward position, the weight rests on the check bar. The check bar, moved to the forward position, is the reference point for the wire-weight gage.

6.4.5 *Operating a wire-weight gage* — Open the wire-weight-gage house. Move the check bar forward so it rests in position under the weight.

6.4.6 While grasping the drum crank handle, disengage the pawl, and lower the weight until it touches but does not fully rest on the check bar.

- 6.4.7 Read the interval at the pointer on the graduated disc. The numbered hash marks correspond to tenths and five-hundredths-of-a-foot graduations (e.g. 38.45, 38.50, 38.55, etc.). The small hash marks correspond to one-hundredth-foot increments (e.g. 38.51). Record the CHECK BAR value on the Stream Gage Logger Notes in the space provided.

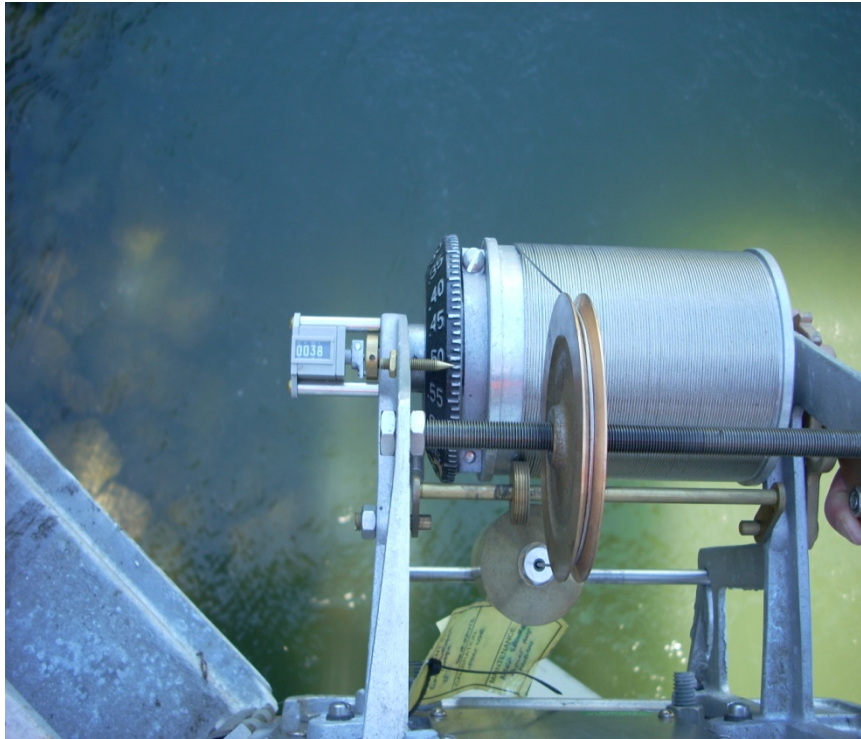


Figure 3. Prior to and after obtaining gage height, lower weight to check bar, and record this value to notes. (Photo by Washington Dept. of Ecology)

- 6.4.8 The check-bar value as read on the counter and disc should remain the same at all times. The station description notes should include the check-bar elevation and the latest date levels were run to establish or confirm the elevation.
- 6.4.9 If the check-bar value does not match, perform the following inspections: Make sure the check bar is set correctly. Check that the cable is wrapped on the drum properly, and the threading sheave is positioned properly, directly above the wrap on the drum. Make sure the graduated disc does not slip (caused by loose clutch screws). Check the Veeder counter for proper operation. Occasionally, the counter is not synchronized with the graduated disc and will not turn over to the next whole foot in synchronization with the disc.
- 6.4.10 If the check-bar value is satisfactory, slide the bar back, and slowly lower the weight to the water surface. The weight should only touch the water surface enough to form a distinct “V” shape on the water surface.
- 6.4.11 Read the Veeder counter and disc as previously described. Record the stage height in the WIRE WEIGHT space on the Stream Gage Logger Note form. Wind in the weight.

Confirm the check-bar elevation and reengage the pawl before closing and locking the wire-weight gage enclosure.

- 6.4.12 The best conditions to read a wire-weight gage is when current moves slowly under the weight with no wind. Stage-height observations can be difficult in higher velocities when surface waves are present. Attempt to discern the average surface elevation of the peaks and troughs of the waves. Conversely, it is sometimes difficult to determine when the weight touches the water surface if the water is quiescent. Windy conditions cause the cable to bow, resulting in underreporting of the water surface (Rantz, et. al., 1975).
- 6.4.13 Document difficulties encountered in reading a wire-weight gage. Quantifying errors in reading wire-weight gages can prove difficult; however, noting the potential for error without necessarily quantifying them is still useful in records and measurement evaluations.
- 6.4.14 Use secondary gage indices as a cursory check of the relative accuracy of the wire-weight gage. If there is indication that the position of the gage has changed, run a set of levels as soon as possible to verify the elevation of the gage.
- 6.4.15 The datum typically will not change when relocating a wire-weight gage. Using station reference marks, reset the gage and adjust mechanically to calibrate the check bar relative to the established datum.

6.5 Determining Stage Height Using a Laser Level

- 6.5.1 Laser levels are useful instruments to determine stage height, particularly in areas where staff gages are not practical. The laser level, a portable device mounted on a permanently installed structure or pad of known elevation emits a laser beam on a level plane.



Figure 4. Laser level mounted on laser level pad. (Photo by Washington Dept. of Ecology)

6.5.2

Determine stage height by measuring the difference between the known laser beam elevation and the water-surface elevation. Confirm the elevation of the laser level with the use of reference marks placed near the laser level pad.



Figure 5. Reference mark placed near laser level is used to confirm elevation of laser level beam. (Photo by Washington Dept. of Ecology)

- 6.5.3 *Confirmation of Laser Beam Elevation* — At the time of installation, run levels to establish the elevation of the laser level pad relative to the station datum.
- 6.5.4 The laser beam elevation consists of the elevation of the pad plus the difference between the laser beam plane and the bottom of the laser level instrument mounted on the pad. It is important to distinguish between the elevation of the pad and the laser beam plane. The pad elevation remains the same until disturbance of the pad occurs and the elevation changes. The beam elevation is variable depending on the manufacturer dimensions of the particular laser level model used. All reference-mark and water-surface elevations are noted and calculated with reference to the beam elevation.
- 6.5.5 In the immediate vicinity of the laser pad, three reference marks are installed and levels run to establish their respective elevations. The reference marks are placed in locations where a stadia rod is used with the laser level to verify elevations.
- 6.5.6 The elevations of the reference marks and the last date levels were run to confirm their elevations and are included in the station description.
- 6.5.7 To confirm the laser-beam elevation, place the laser level on the pad and power up the instrument. Most instruments will self-level if the surface upon which it is placed is close to level. The pads are installed at or near level, so unless the pad has been disturbed or the laser level is malfunctioning, the instrument should self-level.
- 6.5.8 Place the stadia rod on one of the reference marks. Using a circular bubble level as a guide, hold the rod as vertical as possible.



Figure 6. A circular bubble level is used to vertical the stadia rod. (Photo by Washington Dept. of Ecology)

- 6.5.9 With the laser level powered on and set at level, rotate the device until the laser beam intersects the stadia rod.
- 6.5.10 Read the rod to the one-hundredth of a foot resolution. The center of the laser light dot projected on the rod is the point at which the stadia rod is read. If the same model of laser level is used for each observation, the rod reading should be the same at each of the three exclusive reference marks.



Figure 7. The center of the bright red laser light dot projected on the rod is the point at which the stadia rod is read. (Photo by Washington Dept. of Ecology)

- 6.5.11 To check the elevation of the reference marks, compare the rod reading of the laser beam at each reference mark to the established rod reading value for that respective mark. Record the established rod reading for each reference mark in the station description notes. Record the established rod reading and the observed rod reading for each laser level reference mark in the appropriate space on the Stream Gage Logger Notes form.
- 6.5.12 If the laser elevation cannot be confirmed at a given reference mark, check the other reference marks. If the measured elevations of those reference marks match known elevations, assume the unconfirmed reference mark has been disturbed, but the position of the laser level has not changed.
- 6.5.13 If the rod readings of the other marks do not match, assume the laser has been disturbed and the (previously established) laser elevation is no longer valid.

- 6.5.14 If the laser elevation is no longer valid, check the differences in elevation between individual reference marks if possible. If these differences remain the same as shown by previous levels, it can be concluded until subsequent levels are run, the reference marks have not moved and only the laser level pad has been disturbed. If this is the case, assign a temporary elevation to a new position of the laser level based on the established elevations of the reference marks. The water surface elevation can be measured based on the new laser beam elevation. Consider this water surface elevation an estimate until levels are run. In most circumstances, the water surface elevation can be checked against secondary gages.
- 6.5.15 When the laser beam elevation shifts or reference marks move, run a new set of levels as soon as possible.
- 6.5.16 The datum typically will not change when relocating the laser level pad. Other reference marks at or near the station are tied to the datum elevation and used to reset the laser level at a datum relative elevation.
- 6.5.17 *Measuring Water Surface Elevation with Laser Level* — After confirming the laser level beam elevation, measure the water surface elevation.
- 6.5.18 The stadia rod handler stands the rod vertically on a solid, steady section of substrate in the calmest water practical in the gage pool subject to the station control. Place the rod as close to the primary and recording gage as possible.



Figure 8. Hold the rod perpendicular on solid substrate in calm water. (Photo by Washington Dept. of Ecology)

- 6.5.19 The instrument person rotates the laser level toward the stadia rod until the laser beam illuminates on the rod. Read the illuminated point on the rod and record in the Stream Gage Logger notes under LASER: STADIA ROD READING. Note any uncertainty in reading the laser illumination on the stadia rod (i.e. rod reading +/- n ft.)
- 6.5.20 Observe and record the water surface level on the stadia rod in the Stream Logger Gage notes under WATER SFC. ROD READING. Note fluctuations or bounce of the water surface against the stadia rod.
- 6.5.21 *Calculating Water Surface Elevation* — Subtract the WATER SFC. ROD READING from the LASER: STADIA ROD READING to give the DIFFERENTIAL and enter this value in the space provided on the Stream Gage Logger Notes. The differential is the difference in elevation between the laser beam plane and the water surface.
- 6.5.22 Subtract the DIFFERENTIAL from the LASER BEAM ELEVATION to give STAGE HEIGHT. Enter this value in the space provided on the Stream Gage Logger Notes.

Table 1. Example of calculation of stage from laser level readings on Stream Gage Logger Note form. (Washington Dept. of Ecology form)

LASER: STADIA ROD READING	6.25				
- WATER SURFACE, ROD READING	0.34				
= DIFFERENTIAL, LASER TO WATER SFC	5.91				
LASER BEAM ELEVATION	11.90				
- DIFFERENTIAL	5.91				
= STAGE	5.99				

- 6.6 Determining Stage Height by Tape Down
- 6.6.1 Measuring stage height by tape down involves lowering a weighted measuring tape to the water surface from a reference point. The reference point usually consists of a stainless steel washer secured to a bridge railing.
- 6.6.2 The degree of accuracy and reliability of tape downs in determining stage height is generally inferior to the other methods described in this document. Only use tape downs as a secondary gage.

6.6.3 Fiberglass tapes are light with a wide surface area and prone to errors even in light wind conditions. Fiberglass tapes tend to stretch over time causing biases in tape down measurements. Like the wire-weight gage, it can prove difficult to determine stage height when surface waves are present or conversely when water is extremely calm. When waves are present, try to determine the average water surface elevation between the peaks and troughs.

6.6.4 *Measuring Tape Down from Reference Point* — Locate the reference point. Lower the weighted tape to the water surface. The weight should only touch the water surface enough to form a distinctive “V” shape on the water surface.

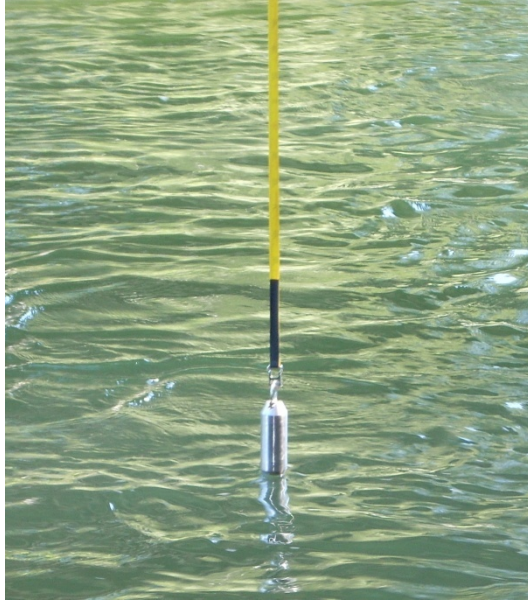


Figure 9. Tape down weight touching water surface. (Photo by Washington Dept. of Ecology)

6.6.5 Read the tape at the edge of the reference point to one-hundredth of a foot. Enter this value under TAPE DOWN in the space provided in the Stream Gage Logger notes. Note any difficulties reading the tape caused by wind or wave action.

6.6.6 Because the weight is attached to the end of the fiberglass tape, a correction factor is applied to the reference point reading. This correction factor is usually written in permanent marker on the tape housing. Enter this value under CORR. FACTOR in the Stream Gage Logger Notes.

6.6.7 *Calculating Water Surface Elevation* — Add the correction factor to the tape down and enter the sum to CORRECTED TD in both spaces provided in the Stream Gage Logger Notes.

6.6.8 Enter the reference-point elevation in the space labeled TD RP ELEVATION on the note form.

Subtract the corrected tape down from the reference point elevation to give the water surface elevation. Enter this value under = WS ELEV@TD on the note form.

Table 2. Example of calculation of stage from tape down readings on Stream Gage Logger Note form.

TAPE DOWN	16.32				
CORR. FACTOR	0.37				
CORRECTED TD	16.69				
TD RP ELEVATION:	25.33				
CORRECTED td	16.69				
=WS ELEV@TD	8.64				

6.6.9 The datum typically will not change when a tapedown reference point is relocated. Using station reference marks, reset the reference point relative to the established datum.

6.6.10 Include the reference mark elevations and the last date of levels in the station description notes.

6.7 Determining Peak Stage with Crest Stage Gage

6.7.1 The stage measurement equipment and methods previously described are designed to determine stage instantaneously. Crest-stage gages provide a valuable record of peak stages after the occurrence of high flows. The gage is reliable and relatively simple to install and operate (Rantz, et, al., 1975).

6.7.2 Crest-stage gages consist of a four-foot long, two-inch diameter galvanized pipe capped on both ends with a wooden staff contained in the pipe. The bottom pipe cap consists of an arrangement of six quarter-inch intake holes. The top cap has a small vent hole. The wooden staff rests on a bolt extending through the bottom of the pipe. The extension of the bolt on the outside of the pipe also serves as a reference point.

6.7.3 The bottom cap contains granulated cork. As water rises in the pipe, the cork floats on the water. When the water reaches its peak and begins to recede, the cork sticks to the wooden staff, marking the crest of the high-water event.

6.7.4 At a site visit subsequent to a high-flow event, remove the top cap from the crest-gage pipe. Carefully pull out the wooden staff. Measure from the bottom of the staff to the high-water mark with an engineer’s tape measure.

- 6.7.5 Clean the cork from the wooden staff to avoid confusion with subsequent high water marks. Rinse residual cork from the inside of the pipe. Replace the granulated cork in the bottom cap. Return the wooden staff into the pipe so that it rests on the bolt. Replace the top cap hand-tight. Be aware of the nail at the top of the staff for flush fit with the cap, and keep the staff vertical in the pipe.
- 6.7.6 *Calculating Crest Stage* — Record the high water mark in the space HWM ____ FT ON STICK on the back of the Stream Gage Logger Notes form (Appendix A). Record the elevation of the reference point in the space REF ELEV ____ FT adjacent to the high-water-mark entry.
- 6.7.7 Add the high-water mark and the reference-mark elevation, and enter the sum under =HWM ELEV ____ FT. on the Stream Gage Logger Notes form. This value is the crest-stage height.
- 6.7.8 The datum typically will not change when relocating a crest-stage gage. Using station reference marks, reset the gage reference point relative to the established datum.
- 6.7.9 Include the reference mark elevations and the last date of levels in the station description notes.

7.0 **Records Management**

7.1 Field Note Forms Archives

- 7.1.1 All original field note forms including levels notes, stream-gage-logger notes, and discharge measurement notes are stored in a central locations at Ecology Headquarters, regional, and field offices.
- 7.1.2 All discharge measurement notes will contain the handwritten original primary gage observations associated with a particular discharge measurement.
- 7.1.3 Streamgage logger notes contain written stage-height observations of all primary and secondary gages at a site.
- 7.1.4 Levels notes contain the original notes of gauging site surveys as well as calculations of reference marks and reference point elevations.

7.2 Stage Records in Hydstra Database

- 7.2.1 All primary and secondary gage observations are recorded and stored electronically to a Hydstra® database.
- 7.2.2 Stage height observations associated with discharge measurements are stored in the Gaugings Database within Hydstra®.

8.0 Quality Control and Quality Assurance

- 8.1 The EAP addresses variability in gage height observations by paying close attention to the amount of fluctuation or bounce in the water surface against the observed gage index. In doing so the true gage height is more accurately determined. Variability in gage height observation can influence the application of data shifts in the stage data record to correct for instrument drift (Shedd, Springer, 2012) and subsequently impact stage record error. Variability in gage height can also affect discharge measurement quality which in turn affects the certainty of ratings.
- 8.2 All discharge measurements including gage height determinations are peer reviewed.
- 8.3 In addition, all streamflow records including primary and secondary gage height entries to the Hydstra® database undergo comprehensive review by EAP senior staff at the conclusion of each water year.
- 8.4 EAP flow monitoring stations include at least one independent secondary gage index in addition to the primary gage index. Field staff use the secondary gage as a check of the relative accuracy of the primary gage.
- 8.5 If the gages do not reasonably and consistently match each other nor result in close determinations of stage, levels are run as soon as possible to resolve the discrepancy and reset the gage indices to the station datum.

9.0 Safety

- 9.1 Personal Flotation Devices are required for persons working in or near streams.
- 9.2 All EAP safety policies are followed when obtaining stage heights. Refer to the EAP Safety Manual (EAP, 2017) for further information about working in and around streams.
- 9.3 Always consider the safety and traffic situations when obtaining gage heights from a bridge, and take appropriate actions including suspension of the activity if unsafe conditions exist. Consult the EAP Safety Manual (EAP, 2017) for further guidance regarding bridge safety.
- 9.4 When operating laser levels, do not stare into the beam or direct the beam at other persons. Check the path of the beam to ensure there is no danger of inadvertently pointing the beam at people in the vicinity.

10.0 References

- 10.1 Environmental Assessment Program, 2017. Environmental Assessment Program Safety Manual, March 2017. Washington State Department of Ecology, Olympia, WA.
- 10.2 Rantz, S.E., and others. 1975. Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge. United States Geological Survey Water-Supply Paper 2175.
- 10.3 Shedd, J.R., Springer, C. 2012. Standard Operating Procedures for Correction of Continuous Stage Records Subject to Instrument Drift, Analysis of Instrument Drift, and Calculation of Potential Error in Continuous Stage Records, Version 1.1. Washington State Department of Ecology, Olympia, WA. SOP Number EAP082.

11.0 Attachment A

Front page view of EAP-FMU Stream Gage Logger Notes. Rite-in-the-Rain™ field form



Washington State Department of Ecology

DEPARTMENT OF
ECOLOGY
State of Washington

EAP-FMU Stream Gage Logger Notes

Sta. Name _____

Sta. No. _____ Party _____

DATE					
TIME (PST)					
LOGGER					
STAFF					
WIRE WEIGHT					
CHECK BAR					
TAPE DOWN					
CORR. FACTOR					
CORRECTED TD					
TD RP ELEVATION:					
CORRECTED td					
=WS ELEV@TD					
LASER: STADIA ROD READING					
- WATER SURFACE, ROD READING					
= DIFFERENTIAL, LASER TO WATER SFC					
LASER BEAM ELEVATION					
- DIFFERENTIAL					
= STAGE					
WATER TEMP				ELEVATION	READING
THERMISTER			LL BM1		
AIR TEMP			LL BM2		
THERMISTER			LL BM3		

Back page view of EAP-FMU Stream Gage Logger Notes. Rite-in-the-Rain™ field form
These notes populated by field staff to indicate routine station checks were performed as well as address station condition at time of station visit.

Batt V _____ Min _____ Max _____

Reset Stats Y/N Batt replaced Y/N

GOES Time OK Y/N

Data downloaded Y/N .NEW file erased Y/N

Desiccant condition _____ Changed Y/N

CSG checked Y/N

HWM _____ ft on stick + Ref Elev _____ ft

= HWM Elev _____ ft. Cleaned Y/N

Added cork Y/N

Remarks: