

NWSTC

HPM Job Sheets

A Supplemental Resource for Senior Service Hydrologists, Service Hydrologists, and Hydrologic Focal Points

National Weather Service Training Center
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Table of Contents

Hydrologic Focal Point Spin-up Information.....	3
Locating and Utilizing “New” Gages – AWIPS I.....	6
Locating and Utilizing “New” Gages – AWIPS II.....	10
Adding a new location to AHPS	13
Obtaining a National Inventory of Dams Account	14
Utilizing the National Inventory of Dams	15
Establishing Forecast Service/Changing Flood Stage Checklist	17
Instructions for Leveling	18

Hydrologic Focal Point Spin-up Information

Locate the Hydrologic Services Manual (HSM). Is the document up to date?

- YES – use it to learn about the program and the Hydrologic Service Area (HSA)
- NO – learn about the program while updating the manual, using [NWSI 10-925](#)

Use the following NWS Directives as references

- [10-901 – Hydrologic Program Management](#)
- [10-921 – Weather Forecast Office Hydrologic Operations](#)
- [10-922 – Weather Forecast Office Hydrologic Products Specification](#)
- [10-924 – Weather Forecast Office Hydrologic Reporting](#)
- [10-925 – Guidelines for WFO Hydrologic Service Manuals](#)
- [10-950 – Definitions and General Terminology](#)

Are [HydroBase](#) and the station folders up to date?

- If not, print a list of Data Collection Platforms (DCPs) in the HSA from the Hydrometeorological Automated Data System ([HADS](#))
- Make sure all the sites are in [HydroBase](#) and have a file folder, too

Are the templates for WarnGen and [RiverPro](#) up to date?

- If not, contact [WHFS](#) (WFO Hydrologic Forecast System) support or go to the [AWIPS Systems Administration](#) page

Contact the [U. S. Geological Survey \(USGS\)](#), [U. S. Army Corps of Engineers \(USACE\)](#), and mesonet operators to determine whether you know about all the gages in the HSA.

How-to pages

- [WHFS](#)
- [National Inventory of Dams](#)

Create a “library” – either hard copies or electronic documents – of reference information

- Emergency action plans (EAPs) from high hazard dams
- [USGS Publication Warehouse](#) is the portal to annual Water Data Reports (WDR), Water Supply Papers (WSP), and Water Resources Investigations Reports (WRIR).
- Hydrology papers from the [American Meteorological Society \(AMS\) web site](#).
- [NOAA Precipitation Frequency Data \(return periods\)](#)
- [Online list of Service Hydrologist reference materials](#) (including sample hydro drills)

Training goal - ensure the forecast staff is operationally proficient at

- Assessing the hydrologic situation (antecedent conditions, synoptic pattern recognition)
- Utilizing “lead in” products (ESF, HWO, FFA)
- Use of software (RiverPro, HydroView, Multisensor Precipitation Estimator (MPE), time series, Graphical Hazards Generator (GHG), WarnGen, Flash Flood Monitoring and Prediction (FFMP))
- Who, what, where, when, why and how
- Whom do I call for help with...?
- A gage is not reporting – call the gage operator; if it’s a DCP, contact [HADS](#)
- There’s a problem with my Advanced Hydrologic Prediction Service (AHPS) page
- Check HydroView to see if there is a problem with the gage

- If it is a forecast problem, contact the servicing River Forecast Center (RFC)
- If it is a gage problem, contact the gage owner
- Is it configured correctly? Check [AHPS Configuration Management System](#)
- [How do I update an E19?](#)
- [How do I submit E3, E5, activity reports, and E19s](#) a web interface with a link to instructions
- I'm having RiverPro template problems...contact [WHFS](#) Support
- [What are the responsibilities of the job?](#)

Coordinate with the Science and Operations Officer (SOO) on a training schedule (dependent on climate...ice jam breakup, spring snow melt, etc)

Most Service Hydrologists are meteorologists; include information on other factors leading to flooding/flash flooding including topography, antecedent conditions, impervious areas, etc.

[COMET Hydro information](#)

NETWORK! Meet the staff at the USGS, USACE and alert system offices, visit with emergency managers, get to know other SH's and focal points.

Calendar

Daily – Check the SHEF error logs for data rejected by the SHEF decoder; also look in the “Rejected Data Trash Can” and “Questionable and Bad Data” sections of HydroView. Correct as needed.

Weekly – Look for bad crest data in HydroBase. From the “Reports” menu, go to “Flood Reports”. Delete any bad values and save the changes to the database.

Monthly – By the 15th of the month, submit E3 (if needed), E5, and activity reports. Check the HADS page for gages in your area without have site id's (check the [New Gages](#) link).

Seasonally – change the RTP/STP templates to add or remove snow and snowfall columns.

Annually – hydro drills/training, familiarization trips, update the crest and low water sections of HydroBase when the USGS Water Data Report for your state (s) is completed. Also, review the HSM.

ETC – Every five years (or more often if there is flooding), update E19's. Send copies to regional office, backup offices, RFC's.

Network types –

A – Basic climate network. At a minimum, an “A” station must report 24-hour precipitation (most also send in 24-hour max/min temperatures). “A” stations must be about 20 miles apart, 60 or more in homogeneous climates.

B – Cooperative stations are put in the “B” network when observed data support hydrologic programs. “B” stations include 24-hour precipitation and often one or more of the following...river stage, lake level, max/min temperatures, evaporation, and soil temperature.

AB – supports both climatological and hydrological programs.

C – Stations in the “C” network support meteorological forecast and warning services.

Preparing for Floods

During Dry Weather

- Determine the usefulness of data points – consider upgrading the site a forecast point or relocating the equipment.
- Verify impact statements.
- Working with emergency managers, determine what responses they have when they hear “major flooding”.
- Are there impacts to utilities...water, sewer, electricity?
- Be aware of low water crossings and other points where access to a gage could be cut off. Do not put an observer in danger to obtain a reading!
- Have fact sheets ready to put on the office’s intranet.
- Obtain crest-stage relations for data points.

During an Event

- Remain in contact with the USGS to determine the sites from which they are obtaining flow measurements.
- Ask the RFC for a contingency forecast using more QPF (quantitative precipitation forecast).

Locating and Utilizing “New” Gages – AWIPS I

The Hydrometeorological Automated Data System (HADS) collects information, including hydrologic information, from data collection platforms (DCPs). Check the HADS page occasionally to find “new” gages – ones transmitting data, but not being utilized at your office.

STEP 1 Open the “New” Gages Section of HADS

Step	Action	Notes	
1	Open a web browser session and navigate to http://www.nws.noaa.gov/oh/hads/		
2	Choose one of the following methods from the left hand menu to locate the gages - map interface or a list of gages.		
Step	Map	Step	List of New Sites
1	On the left hand menu, under the Google Map Displays, click ‘New DCP’ Locations .	1	On the left hand menu, under RealTime Pages, click Active New DCPs .
2	Click on the map near your HSA. Use the Google Map tools to zoom to the area.	2	Scroll through the list (alphabetized by state) to locate sites in your HSA.
3	Click on the red icon for basic information on the site. Map contains basic information (owner, NESDIS, lat/lon, location description).	3	Click the NESDIS ID for more a map of the gage location. In addition to what the map has, the list provides the transmit interval, DCP type, SHEF code of the data transmitted, and the Julian date of the metadata.

STEP 2 Contact the Gage Owner

Step	Action	Notes
1	Contact the gage owner for additional information.	For example, the USGS publishes Station Descriptions for all of their gaging locations.
2	Locate abbreviated site information at the following site: http://waterdata.usgs.gov/xx/nwis/nwisman	Replace ‘xx’ with the two-letter state identifier.

STEP 3 Apply for a Site ID in NWSLI

Step	Action	Notes
1	Open a web browser session and navigate to https://ops13web.nws.noaa.gov/nwslimain/nwsl_home.main	
2	Click the User Interface link.	
3	Enter the username and password. username: john.doe password: ldap_password	
4	Select Query Station Information .	Ensure the site ID (SID) you want is not used.
5	After determining the SID is not in use, click SID Transaction Form the on the left hand menu.	

STEP 4a Add a Data Point to HydroBase

Step	Action - AWIPS	Notes
1	Left- click on the background and highlight AWIPS start-up menu.	
2	Select "Hydro Apps" then select "Hydro Database Manager"	This launches the HydroBase application
3	From the Location pull down, select Add Location .	
4	In the data entry fields, enter the following information: lat/lon county/state HSA WFO time zone	Lat/lon is required, the other fields will remain default values unless updated.
5	If the the <i>shef_load_ingest</i> token is set to ON , skip steps 6-10.	
6	From the Data Ingest pull down, select Ingest Filter.	
7	From the Ingest Filter GUI, click the New button at the bottom of the interface.	
8	Enter the new location id in the Location: box.	
9	Select the Duration, TypeSource and Extremum parameters from the pull-down menus below and	
10	Select the Physical Element from the scrolling menu on the right.	
11	Highlight the Master Switch checkbox is highlighted.	If this is not highlighted, data will not be ingested.
12	NEVER click the check boxes to the right of the "Set Switches for All Listed Above" button! This changes all the flags in your database, and you probably do not have a record of them to restore them!	
13	Click the Apply and Ok buttons to add the data item to the ingest filter.	
14	From the Location menu, add optional information to the Contacts, County/Zone UGC, Gage History, and Data Sources menu.	
15	From the Data Ingest menu, select Stop/Start SHEFdecoder . <ul style="list-style-type: none"> • Select Stop and wait at least 30 seconds. • Select Check to make sure that it is no longer running. • Select Start to re-start the shefdecode process • Wait for about 2 minutes and then select the Check option again to verify shefdecode re-started. 	Shefdecode must be stopped and re-started to read the list of all gages it is supposed to handle for your site.

Step 4b Add a Forecast Point to HydroBase

Step	Action - AWIPS	Notes
1	Left- click on the background and highlight AWIPS start-up menu.	
2	Select "Hydro Apps" then select "Hydro Database Manager"	This launches the HydroBase application
3	From the Location pull down, select Add Location .	
4	In the data entry fields, enter the following information: lat/lon county/state HSA WFO time zone	Lat/lon is required, the other fields will remain default values unless updated.
5	From the River Gage menu, enter the following information: Flood Category Impact Statement Low Water Statement Flood Damage Crest History Low Water	
6	Assign the gaging location to a forecast group.	
7	From the River Gage -> Unit Hydrograph menu, define a hydrograph for the location (work with gage owner or RFC).	
8	If the the <i>shef_load_ingest</i> token is set to ON , skip steps 9 - 13.	
9	From the Data Ingest pull down, select Ingest Filter.	
10	From the Ingest Filter GUI, click the New button at the bottom of the interface.	
11	Enter the new location id in the Location: box.	
12	Select the Duration, TypeSource and Extremum parameters from the pull-down menus.	
13	Select the Physical Element from the scrolling menu on the right of the interface.	
14	Highlight the Master Switch checkbox to ensure data ingest.	
15	NEVER click the check boxes to the right of the "Set Switches for All Listed Above" button! This changes all the flags in your database, and you probably do not have a record of them to restore them!	
16	Click the Apply and Ok buttons to add the data item to the ingest filter.	
17	From the Location menu, add optional information to the Contacts, County/Zone UGC, Gage History, and Data Sources menu.	
18	From the Data Ingest menu, select Stop/Start SHEFdecoder . <ul style="list-style-type: none"> • Select Stop and wait at least 30 seconds. • Select Check to make sure that it is no longer running. • Select Start to re-start the shefdecode process • Wait for about 2 minutes and then select the Check option again to verify shefdecode re-started. 	Shefdecode must be stopped and re-started to read the list of all gages it is supposed to handle for your site.

STEP 5 Additional Steps

Step	Action	Notes
1	Contact your servicing RFC an E-19A so they can download the new document.	Although it is likely not a forecast point, the data is still useful to the RFC.
2	Contact backup offices an E-19A so they can download the new document.	This information needs to be added to their HydroBase.
3	Update materials in your office, such as lists of forecast and data points, manuals, etc.	

Locating and Utilizing “New” Gages – AWIPS II

The Hydrometeorological Automated Data System (HADS) collects information, including hydrologic information, from data collection platforms (DCPs). Check the HADS page occasionally to find “new” gages – ones transmitting data, but not being utilized at your office.

STEP 1 Open the “New” Gages Section of HADS

Step	Action	Notes	
1	Open a web browser session and navigate to http://www.nws.noaa.gov/oh/hads/		
2	Choose one of the following methods from the left hand menu to locate the gages - map interface or a list of gages.		
Step	Map	Step	List of New Sites
1	On the left hand menu, under the Google Map Displays, click ' New DCP' Locations .	1	On the left hand menu, under RealTime Pages, click Active New DCPs .
2	Click on the map near your HSA. Use the Google Map tools to zoom to the area.	2	Scroll through the list (alphabetized by state) to locate sites in your HSA.
3	Click on the red icon for basic information on the site. Map contains basic information (owner, NESDIS, lat/lon, location description).	3	Click the NESDIS ID for more a map of the gage location. In addition to what the map has, the list provides the transmit interval, DCP type, SHEF code of the data transmitted, and the Julian date of the metadata.

STEP 2 Contact the Gage Owner

Step	Action	Notes
1	Contact the gage owner for additional information.	For example, the USGS publishes Station Descriptions for all of their gaging locations.

STEP 3 Apply for a Site ID in NWSLI

Step	Action	Notes
1	Open a web browser session and navigate to https://ops13web.nws.noaa.gov/nwslimain/nwslimain_home.main	
2	Click the User Interface link.	
3	Enter the username and password. username: john.doe password: ldap_password	
4	Select Query Station Information .	Ensure the site ID (SID) you want is not used.
5	After determining the SID is not in use, click SID Transaction Form the on the left hand menu.	

STEP 4 Add the New Site to HydroBase

Step	Action - AWIPS	Notes
1	Left- click on the background and highlight AWIPS start-up menu.	
2	Select "Hydro Apps" then select "Hydro Database Manager"	This launches the HydroBase application
3	From the Location pull down, select Add Location .	
4	In the data entry fields, enter as much information as possible. Lat/lon is required to define a site!	Enter County/State, HSA, WFO, and time zone or default values will remain in the database.
5	If the the <i>shef_load_ingest</i> token is set to ON , skip steps 6-10.	
6	From the Data Ingest pull down, select Ingest Filter.	
7	From the Ingest Filter GUI, click the New button at the bottom of the interface.	
8	Enter the new location id in the Location: box.	
9	Select the Duration, TypeSource and Extremum parameters from the pull-down menus below and	
10	Select the Physical Element from the scrolling menu on the right.	
11	Highlight the Master Switch checkbox is highlighted.	If this is not highlighted, data will not be ingested.
12	NEVER click the check boxes to the right of the "Set Switches for All Listed Above" button! This changes all the flags in your database, and you probably do not have a record of them to restore them!	
13	Click the Apply and Ok buttons to add the data item to the ingest filter.	
14	Add information in the River Gage menu - Flood Category, Impact Statement, Low Water Statement, Flood Damage, Crest History, and Low Water should be set to their proper values.	These must be set for RiverPro to work properly.
15	From the River Gage -> Unit Hydrograph menu, define a hydrograph for the location.	Contact the gage owner for a hydrograph. This must be set for SiteSpecific to work properly.
16	From the Location menu, add optional information to the Contacts, County/Zone UGC, Gage History, and Data Sources menu.	
17	From the Data Ingest menu, select Stop/Start SHEFdecoder . This brings up a GUI to allow you to Check , Stop , or Start the shefdecode process. <ul style="list-style-type: none"> • Select Stop and wait at least 30 seconds. • Select Check to make sure that it is no longer running. • Select Start to re-start the shefdecode process • Wait for about 2 minutes and then select the Check option again to verify that shefdecode re-started and stayed up. 	Shefdecode must be stopped and re-started to read the list of all gages it is supposed to handle for your site.

STEP 5 Additional Steps

Step	Action	Notes
1	Contact your servicing RFC an E-19A so they can download the new document.	Although it is likely not a forecast point, the data is still useful to the RFC.
2	Contact backup offices an E-19A so they can download the new document.	This information needs to be added to their HydroBase.
3	Update materials in your office, such as lists of forecast and data points, manuals, etc.	

Adding a new location to AHPS
 Adapted from Mike Callahan WFO – LMK
 January 4, 2011

Objective: Add a new location to AHPS.

STEP 1 Setup Station in HydroBase

Step	Action - AWIPS	Etc.
1	Enter all available data for the station in HydroBase.	
2	Click Setup: HydroGen Configuration .	
3	Fill in the information (including all possible gage types/sources) for the new locations and click Save .	
4	AWIPS I only - click Data Ingest: Start/Stop SHEFdecoder . Click Stop .	
5	AWIPS I only - Click Check to see if the decoder is stopped.	
6	AWIPS I only - Click Start . Once the decoder is running, click Close .	
7	Open a terminal window and type: /awips/hydroapps/precip_proc/bin/run_create_mpe_gage_file	Precip sites only.

STEP 2 Setup Station in AHPS CMS

Step	Action - Browser	Etc.
1	Type the following URL in the address bar of a browser. https://nwscms.weather.gov/nwscms/index.php?p=login	
2	Click AHPS and select the HSA.	
3	For a new river, select Options: Admin Rivers and click on the first letter of the new river name.	If the river already exists, skip to Step 5.
4	Enter river name in the blank box and click New .	
5	Under Options , click Admin Gages .	
6	Fill in the location ID and click New .	
7	Complete the first section and click Update .	
8	Click Edit HSA Plot . Fill in the data and click Preview . When edits are complete, click Update .	
9	Click Edit Up/Down Streams . Edit as needed and click Update .	
10	Click Edit HydroGen and select Update .	
11	If it is a site with inundation maps, click Edit Inundation and change Enable Inundation to Yes , and click Update .	
12	Click Edit Datums , fill in the information, and click Update .	
13	Enter the location's Zone and FIPS codes one at a time and click New .	
14	Upload photos (optional) by clicking Click Here . <ul style="list-style-type: none"> • Log on to the server, select your office, and the gage location. • Select Browse and click Preview. • Confirm the upload in approximately 20 minutes. • Click the thumbnail, fill in a caption, and click New. 	Do not do this during a server upgrade!
15	Select Options: Dropdown Navigation . For new groups, fill in the bottom box and click New . To place it in an existing group, click Edit .	
16	Select the new river at the bottom box and click New . Change the order by changing the Display Order numbers and clicking Update .	
17	Click + or - to set the default zoom and select Update .	
18	Log off and check the AHPS page.	

Obtaining a National Inventory of Dams Account

Use the following procedures to obtain a National Inventory of Dams account.

Step	Action	Notes
1	Open a web browser session and navigate to https://nid.usace.army.mil/	
2	Click the "Enter the National Inventory of Dams" link at the center of the page.	
3	At the top right, select the "Login here for full access" tab.	
4	Click the link below the data entry fields to request an account.	
5	Fill in all of the fields and click the "Request Username" button.	

The screenshot shows the 'Enter User Details' form on the CorpsMap website. The form includes the following fields:

- First Name:
- Last Name:
- Email Address:
- Organization:
- Organization Type:
- Street Address:
- City:
- State:
- Zipcode:
- Country:
- Purpose of using NID:

At the bottom of the form is a button labeled "Request Username".

Note
If password doesn't arrive within one business day, please send an email to the NID Data Team at nid@usace.army.mil.

Utilizing the National Inventory of Dams

Use the following procedures to access the National Inventory of Dams and download data for dams in your hydrologic service area.


STEP 1 View NID Data

Step	Action	Notes
1	Open a web browser session and navigate to https://nid.usace.army.mil/	
2	Click the "Enter the National Inventory of Dams" link at the center of the page.	
3	At the top right, select the "NID By State" tab.	
4	From the drop down menu, select a state.	
5	View information on hazard potential, EAPs, location, etc.	


STEP 2 Apply for a NID User Account

Recommendation: Check this information to see if your AWIPS DamCat is out of date. If you notice discrepancies, contact WHFS Support and ask for a new download.

Step	Action	Notes
1	Open a web browser session and navigate to https://nid.usace.army.mil/	
2	Click the "Enter the National Inventory of Dams" link at the center of the page.	
3	At the top right, select the "Login here for full access" tab.	
4	Click the link below the data entry fields to request an account.	
5	Fill in all of the fields and click the "Request Username" button.	



STEP 3 Download Data from the NID

Step	Action	Notes
1	Open a web browser session and navigate to https://nid.usace.army.mil/	
2	Click the “Enter the National Inventory of Dams” link at the center of the page.	
3	At the top right, select the “Login here for full access” tab.	
4	Enter your username and password in the data entry fields. 	
5	Read the terms of use and click the box next to the asterisk.	
6	Click the “Accept” button.	
7	Select the “Downloads” tab.	
8	Choose a two-letter state identifier from the list.	
9	From the “File Download” dialog, choose the “Open” or “Save” option for the file.	To convert from Access format to Excel, right click on the table name and choose “Export”, and click “Excel” and follow the steps in the wizard.

Establishing Forecast Service/Changing Flood Stage Checklist

Task	Completed
1. Coordinate with an outside party, such as an Emergency Manager, to request forecast service for a location. Send the written request to the MIC and HIC at the servicing RFC, making sure the letter defines the type of forecast and the forecast frequency.	
<p>River gage not established...complete step 2</p> <p>2. Check with other agencies to see if there are any plans to install a gage at or near the requested location.</p> <p>Site with gage and established flood stage...complete step 3</p> <p>3. Determine the availability of a rating and real-time stages for the site (needed for site-specific).</p>	
4. If establishing or expanding local flood warning systems, make sure there is a signed MOU between the cooperator(s) and NWS.	
<p>5. Establish a flood stage for the site.</p> <p style="margin-left: 20px;">a. Contact EMA, USGS, COCORAHs observers, police, fire department and others to get their feedback on flood prone areas. Note dates of floods and compare to gage heights if possible.</p> <p style="margin-left: 20px;">b. Check FEMA maps and county GIS maps for areas likely to flood.</p> <p style="margin-left: 20px;">c. Visit the new gage site and survey to help establish a flood stage.</p>	
6. Coordinate the request with the RFC. The RFC will be able to tell if the site will be acceptable or what else is needed to make it a forecast point.	
7. Request a NWSLI id.	
8. The Service Hydrologist shall send a written request/letter through the MIC/HIC to the Regional, Hydrologic Services Division (HSD) with comments as to their assessment of the need for the service (request may take several months, depending on RFC workload).	
9. Add/update the site in HydroBase .	
10. Send a copy of the E-19 to the RFC and regional HSD.	
11. Coordinate with the affected hydrologic users (emergency managers, other hydrologic agencies, and media).	
12. Put a public information statement (PNS) on the NWS website and NWR announcing the new service.	
13. Alert the media with a press release.	

Instructions for Leveling

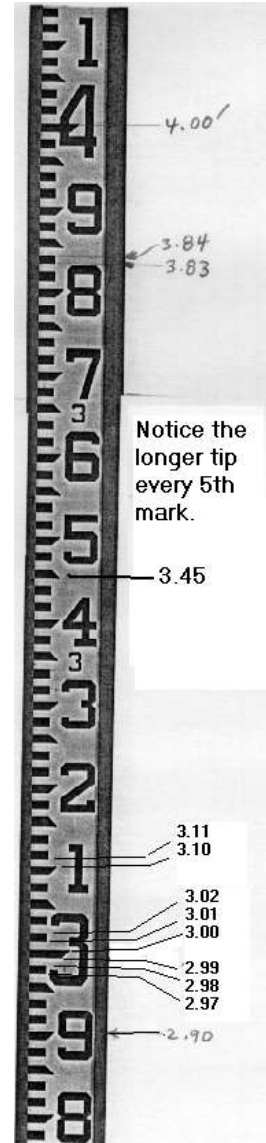
Use the following job sheet and work sheet to survey in a new gage or find the level of a point of interest for use in an E-19 report.

Step	Action	Notes
1	Using an E-19, locate a benchmark (BM) or reference mark (RM) (the starting elevation) and convert the height to a height above gage datum. BM elevation (msl) - Gage Datum (msl) = BM_{above datum}	
2	Select an initial placement for the tripod and level so when looking through the level you can see the location of the benchmark (BM) .	
3	Attach the instrument (level) to the tripod with the levelling knobs on the instrument placed directly over the tripod legs.	
4a	Set the tripod on the ground and extend the legs to raise the instrument to a comfortable viewing height (chin height).	
4b	Firmly set the tripod legs into the ground. The height of the instrument should be a short distance above the BM or TBM.	
4c	Rotate the top of the level to place the round bubble level halfway between two of the leveling screws on the base of the instrument.	
4d	Turn two of the leveling screws either side of the round bubbling level and turn at the same time, but in opposite directions.	
4e	Turn the leveling screws to move the air bubble to a position centered between the two leveling screws.	
4f	Adjust the third leveling screw until the bubble is near the center.	
4g	Readjust the first two screws to bring the bubble into the center of the circle.	
4h	Turn the instrument 90° so the bubble level is directly between the next two leveling screws.	
5	Take a backsight reading (toward a BM or TBM) and a foresight reading toward the new elevation. Record the results in the worksheet.	
6	Calculate the Height of Instrument (HI) and record the results. HI = BM elev + BS	
7	Have the rod holder move to a new location and set it on an object, called Temporary Bench Mark 2 (TBM₂) .	Note TBM ₂ in order to recheck measurements.
8	Calculate the elevation of the ground at TBM₂ by subtracting the foresight reading from the height of instrument (HI) to get the elevation of the temporary benchmark (TBM) . TBM elev = HI – FS	
9	Have the rod holder remain at the TBM while moving the tripod and level to a new position.	Repeat steps 2 - 8 until you reach the gage site.
10	Once the level elevation matches the staff gage, calculate the Height of the Instrument (HI) above gage datum.	
11	After setting the staff gage, work back toward the benchmark to verify observations and calculations.	

Tip 1. BM/RMs can be mason marks on structures or bronze tablets, set in concrete, and stamped with the exact elevation above sea level.

Tip 2. Ask the person holding the rod to slide their fingertip or a pencil up and down the edge of the rod until it appears next to the cross hair in the telescope of the level. This works as a good double check scheme so a reading like 3.05 is not mistaken for 3.50.

Tip 3. When working downhill, the backsight reading will normally be a low value because it is from the bottom of the rod. Keeping the rod vertical is not as critical as when reading numbers toward the top of the rod. Obtain a reading in one of the two following ways. One is by holding a carpenter's level against the rod to keep it vertical. The second is for the person holding the rod to rock it toward and away from the instrument. Use the vertical cross hair to tell them if they have it leaning to one side of the other. With it rocking, the lowest value observed on the rod should be the proper reading.



Leveling Worksheet

BM (msl) - gage datum (msl) = BM abv datum	Describe bench mark here:		
BM (msl) + BS = HI	BS =		
			FS =
HI - FS = TBM ₁ abv datum	Description of temporary bench mark:		
	BS =	TBM ₁ + BS = HI	
			FS =
HI - FS = TBM ₂ abv datum	Description of temporary bench mark:		
	BS =	TBM ₂ + BS = height of instrument (HI)	
			FS =
HI - FS = TBM ₃ abv datum	Description of temporary bench mark:		
	BS =	TBM ₃ + BS = HI	
			FS =
HI - FS = TBM ₄ abv datum	Description of temporary bench mark:		

Legend

BM = benchmark

BS = looking back at bench mark (backsighting)

HI = instrument height

FS = looking ahead toward temporary bench mark

TBM = temporary bench marks

Alternate Leveling Technique Using Handheld Level

This alternate technique assumes familiarity with the primary technique of using the level and tripod. The photo below shows a typical handheld level, its case, and a ballpoint pen. This type of level is easy and quick to use. Simply orient the small rectangular light hole to the top and look through the eyepiece. The small bubble centers vertically when the instrument is level.

Step 1. Take a blank worktable. Calculate the height of the benchmark above gage datum or use a reference mark. Fill out the worktable.

Step 2. Have an assistant take the rod and place it on top of the benchmark. Find a viewpoint location slightly down the hill (eye will be slightly above the elevation of the benchmark). Hold the instrument at eye level; level it while viewing the rod (backsight reading). Without moving, record the reading to the nearest 1/10th foot in the log. Calculate the Height of eye (abv datum) and place in the box for HI. Again, do not move since the elevation of your eye is replacing the height of the instrument.



Step 3. Have the assistant move to a new position down the hill (picked to be TBM2), extend the rod, and use a carpenter's level to hold it vertical. Without moving from the original position, turn to face the rod, hold the handheld level up, take a foresight reading, and record it in the table. The assistant and rod should stay in place.

Step 4. Calculate the elevation of the ground under the rod (TBM1) and record in the table.

Step 5. Move to a new position down the hill as needed, find another comfortable viewing spot, hold up the level, take a new backsight reading, and record in the table. Do not move!

Step 6. Calculate the new height of eye (above gage datum).

Step 7. Have the person with the rod move to a new TBM. Repeat the process until the eye is at the desired elevation of the object (gage, terrain, etc). Once at the desired elevation above gage datum, set a staff gage at eye height (Example: Eye level is 6 feet, then the 6-foot mark on a staff gage should be at the same level as your eye).

Do not use this procedure for reestablishment of missing staff gages. However, it is an excellent procedure for deriving the elevation of flood prone features.

Glossary

Bench Mark (BM) - A permanent marking with an established elevation (msl). The best such mark is one established by a United States Geological Survey, USGS. It is usually a bronze tablet set in concrete with the elevation stamped into it. Bench Marks can also just be an "X" or "+" etched in concrete, rock, or some other permanent type structure (used in place of a benchmark at many river locations).

Reference Mark - A permanent marking, typically an "X" or "+" sign etched in concrete, a bolt, or other "permanent" feature whose elevation is defined as the height above gage zero. When no USGS benchmarks are available, USGS section maps approximate the elevation of gage zero is. Hydrologists make these markings so they can re-establish staff gages destroyed by flood or other reasons.

Temporary Bench Mark (TBM) - A marking, or location, with a known elevation. These markings are not usually permanent and are intermediate points when carrying a known elevation from one point to another. TBMs can be a scratch in the ground surface, the top of a rock or wooden stake, or an "X" or "+" scratched into concrete or rock. It is desirable for TBMs to be something easily locatable to recheck elevations.

Gage Datum or Gage Zero - This is the elevation above mean seal level (msl) of the established Zero gage height. Most often, this elevation represents the level of zero flow for a river or stream. However, because of shifting sand and other sediments in the river bottom, the point of zero flow can significantly deviate (by several feet) from the gage datum.

Bench Mark Above Datum (BM_{abv datum}) - This is the relative height of the Bench Mark or Reference Mark above gage zero (gage datum). When setting staff gages, it is desirable to deal in elevations above gage datum rather than true elevations.

Rod - A survey tool, typically a three section graduated wooden pole. When extended, they have a length of 12 feet (typically graduated in tenths and hundredths of a foot).

HI (Height of Instrument) - This is the elevation of the crosshairs, or viewing elevation of the level (typically measured as a height above gage datum).

Backsight (BS) Reading - A reading off the rod, generally to the nearest 1/100th foot, taken when looking through the instrument (level) back toward a point of known elevation. This point is typically a Bench Mark or Temporary Bench Mark. This reading when added to the elevation of the benchmark yields the height of the instrument (level).

Foresight (FS) Reading - A reading off the rod, generally to the nearest 1/100th foot, taken when looking through the instrument (level) forward toward a point of unknown elevation. This point is typically a temporary benchmark elevation. When subtracted from the height of instrument (HI), it yields the elevation of the surface under the bottom of the rod.

