



BLM's Lotic Assessment, Inventory, and Monitoring (AIM)

Data Management and Quality Assurance and Control Protocol – 2020 Field Season



VERSION 3.2

**Produced by BLM National Operations Center (NOC) and the BLM/USU National Aquatic
Monitoring Center (NAMC) – 8/13/2020**

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PROTOCOL OVERVIEW

The purpose of this protocol is to detail steps for managing data and assuring data quality (i.e., data quality and assurance procedures) during the field season (Figure 1). The protocol describes nine steps and includes responsible parties and required files and tools for each step.

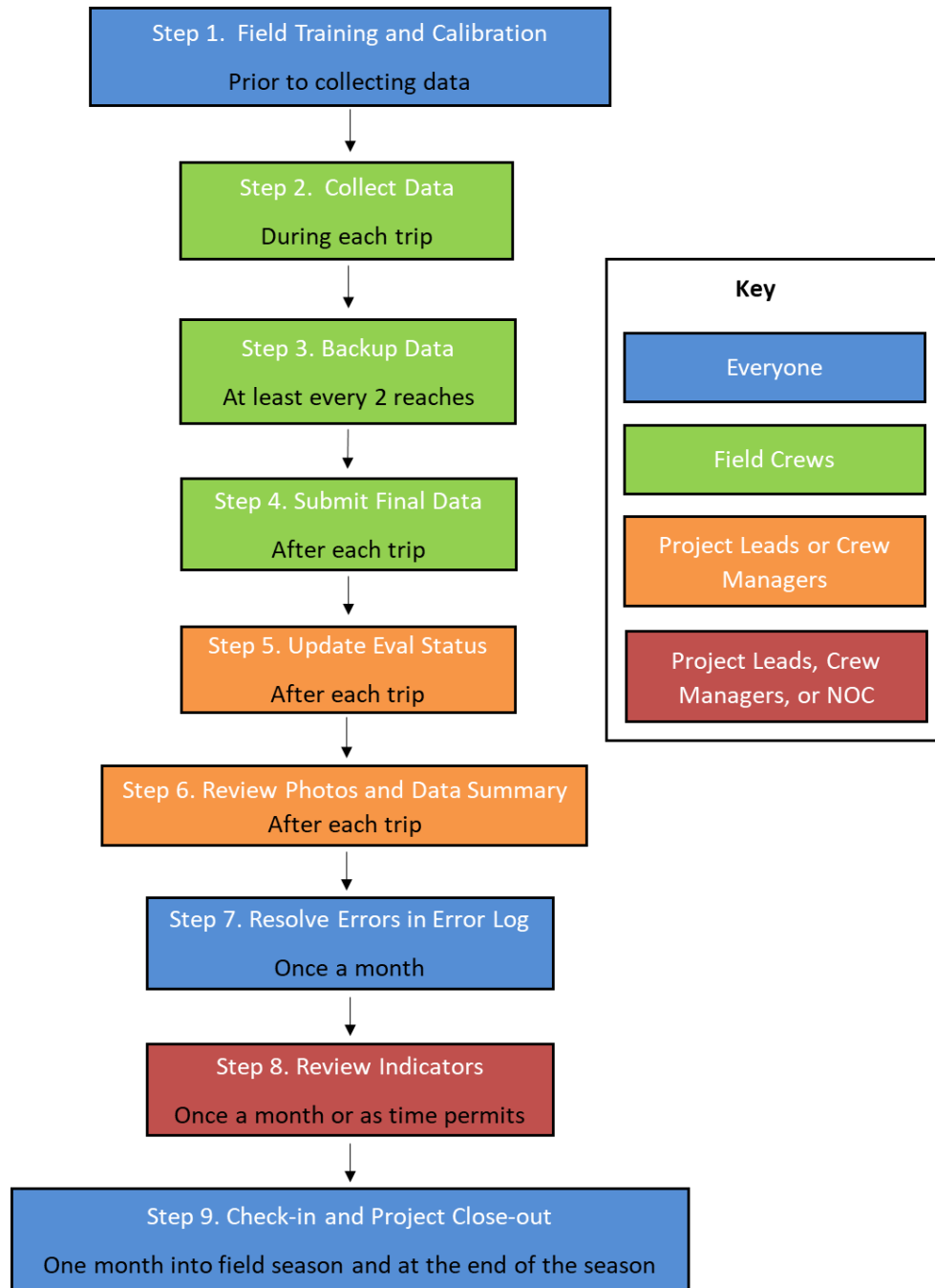


Figure 1. Nine steps during the field season for managing data and assuring data quality. Steps are color coded by responsible parties and the timeframe for completing.

Users should consult this protocol for data collection, management, and ensuring data quality. Refer to the Technology and Application Manual for details on how to use data collection tools such as SARA and Collector. If questions remain after reading this protocol, the Lotic Technology and Applications Manual, or the Evaluation and Design Management Protocol, please reach out to your contract lead, BLM Project Lead, or State Lead. If you need additional support, please contact the appropriate National AIM Team member:

- Design related questions: Nicole Cappuccio (ncappuccio@blm.gov; 303-236-6112)
- General project coordination and implementation support: State Lead and Kate Lunz (klunz@blm.gov; 303-236-0473)
- Field data collection questions (e.g., SARA and protocol): Logan Shank (lshank@blm.gov; 303-236-1161)
- Technology and applications questions (e.g., Teams, Collector, Box, Companion): Jacob Shipman (jshipman@blm.gov; 303-236-0476)
- If someone from the list above is not available and there is an immediate issue please contact Jennifer (jennifer.courtwright@usu.edu; 985-502-7530), Nicole Cappuccio, or Scott Miller (swmiller@blm.gov; 720-545-8367)

STEP BY STEP DIRECTIONS

Step 1 – Field Training and Orientation

Overview

The National AIM Team leads annual lotic AIM field methods trainings following TR 1735-2 Version 2, which include pre-training online coursework. The main objective of this field-based training is for participants to be proficient in the application of AIM lotic core and contingent field methods. Training requirements vary among participants and include:

- Contractor/agreement staff must complete online training materials before attending field methods training.
- Contractor/agreement staff responsible for data collection must have successfully completed lotic AIM field methods training during the year in which data will be collected.
- Contractor/agreement staff responsible for Multiple Indicator Monitoring (MIM) data collection must have successfully completed MIM training within the last two years. Furthermore, the field botanist must be proficient in species level identification of riparian plants including difficult taxa (e.g., *Salix* and graminoids such as Cyperaceae, Juncaceae, and Poaceae).
- Project leads overseeing data collection should attend the first 3.5 days of field methods training at least one out of three years and should review protocol updates every year.
- BLM personnel collecting data must have successfully completed lotic AIM field methods training within the last two years and should review protocol updates and training materials every year.

Field training cannot fully introduce individuals to the diversity of stream types present on BLM lands and so a local orientation to critical geomorphic concepts and riparian vegetation is required. Two field orientation activities are recommended depending on BLM Project Leads and contractor staff availability and expertise. At a minimum, Field Orientation Activity #1 (Field Tour Critical of Concepts and Protocol Review) is required.

Similarly, field calibration is an important quality assurance step. The purpose of field calibration is to: 1) ensure the precision of collected data among field technicians; 2) assess the accuracy of collected data to the ‘known truth’ established by BLM and/or contractor staff; and 3) provide supplemental training opportunities for field technicians. Calibration occurs twice during field methods training, but similar calibration in local streams where data will be collected is critical for ensuring protocols are mastered and properly applied to local systems.

Responsible Parties

Field training: The National AIM Team develops and leads content delivery for field methods training and State and Project Leads are recruited to host and/or serve as trainers. BLM project leads, contractor management staff (if applicable), field crews, and other BLM and contractor staff are required to attend as specified in the overview above.

Field orientation and calibration: BLM project leads, contractor management staff (if applicable), field crews, and other BLM and contractor staff as appropriate or available. Ideally, subject matter experts in hydrology, geomorphology, and riparian vegetation would be present.

When and Estimated Time

Field training: Attend a weeklong field training conducted annually in late spring and early summer.

Field orientation and calibration: Occurs after field training on TR 1735-2 Version 2 and prior to the start of data collection. It is recommended that field calibration be repeated any time crews switch to new areas that possess unique hydrologic, geomorphic, or vegetative conditions from that which they have been oriented and working. Field orientation takes 1 – 2 days and calibration ½ to a full day.

Tools and Files

- [Lotic Field Protocol for Wadeable Systems TR 1735-2 Version 2](#)
- [Lotic Field Protocol for Wadeable Systems TR 1735-2– Changes](#)
- [Pre-training videos and quizzes](#)
- [Lotic Master Gear List](#)
- Local riparian vegetation identification guides (See state specific Teams channel)
- [Post-training calibration data forms](#)

Instructions

Field training

- A. Watch pre-training videos and complete video-based quizzes and activities
- B. Attend training
- C. Complete two calibration exercises while at training

Field Orientation Activity #1 - Field Tour of Critical Concepts and Protocol Review

- A. Tour a variety of stream systems that represent the hydrologic, geomorphic, and riparian vegetation diversity crews will encounter throughout the field season. At a minimum, visit three different systems, but the more the better!
- B. At each of the visited systems, conduct the following exercises:
 - I. Work as a group to walk the reach and identify:
 - a. Scour line height
 - b. Bankfull height
 - c. Bench height

Review protocol section 2.2 and discuss what features were helpful indicators of scour, bankfull, and bench height versus unhelpful. Encourage crew members responsible for data collection to lead these discussions.

- II. Review priority noxious and native woody vegetation at each system.
- III. Walk the reach to review the protocol related to bank stability and cover. Specifically, have the crew identify:
 - a. Erosional and depositional banks
 - b. Covered and uncovered plots

- c. Erosional features (fracture, slumps, sloughs, vertical banks)
 - IV. Walk the reach to identify 3 – 4 pools. For each pool have the crew identify or measure:
 - a. Pool tail
 - b. Pool head
 - c. Max pool depth
 - d. Pool length
 - V. If measuring greenline vegetation composition, review greenline location and riparian plant species at each of the visited systems with the field botanist.
 - a. Ideally at least one BLM staff or contractor present would have knowledge of local riparian vegetation and the MIM greenline vegetation protocol. If so, work with the crew field botanist to perform these steps while other individuals are working on steps c and d.
 - VI. If the crew is measuring other contingent indicators (e.g., nutrients, turbidity, bank angle, pool tail fines), ensure they are confident in the application of protocols to local systems.
- C. At the conclusion of the field tour, review major discussion points and reiterate any protocol application clarifications or corrections. If questions or clarifications exist for the National AIM Team, capture those and identify who is reaching out to continue the conversations.

Field Orientation Activity #2 – Photo Review

- A. Locate past stream and river system photos taken during AIM, MIM, PFC or other field inventory, assessment, and monitoring activities. Photos should represent the diversity of stream and river systems the crews will encounter.
 - I. AIM photos can be found on Box. To facilitate easy searching of these photos, the National AIM Team has created a Box account for general lotic AIM use.
 - II. To access this account and photos, go to <https://account.box.com/login> and log in using aim.aquatics@gmail.com as the username and stonefly2020 as the password.
 - III. Photos are stored by project/field office and year and named with the PointID. Within the “Older images” folder, navigate to the desired project folder and type the PointID in the top search bar.
- B. Review photos with crews to identify and discuss critical geomorphic concepts – scour line height, bankfull height, and bench height.
- C. Have field technicians annotate 3 – 5 photos with critical concept heights (Section 10.4) and bank stability and cover plot locations (Section 10.5), as they would for sampled lotic AIM reaches.

Calibration

- A. Identify a stream reach having representative hydrologic, geomorphic, and vegetative conditions similar to those the crew will be working with. If the crew is working among multiple field offices or districts, more than one field calibration might be required.
 - I. Do not calibrate on the same system used for field orientation activities.
 - B. Do not discuss critical concepts or other aspects of the sample reach with field technicians prior to conducting calibration exercises.
 - C. Set up 5 transects for field technicians to perform calibration.
 - I. Guidance from Section 4.0 of TR 1735-2 Version 2 – Setting Up the Reach does NOT need followed for this exercise. Rather, optimize transect locations for:
 - a. Diversity of bank types
 - b. Presence of pools and large wood in the reach (Not all reaches will have large wood, but try to select reaches with pools. If wood is not present, consider staging logs in the stream or measuring on uplands)
 - c. Riparian plots containing priority noxious and/or native woody species
 - D. Have field technicians work in groups of two or three to perform the following measurements:
 - I. Bankfull and wetted width (Section 7.1)
 - II. Bankfull and bench height (Section 7.2)
 - III. Thalweg depth – at main transects only (Section 7.2.1)
 - IV. Bank stability and cover (Section 7.3)
 - V. Large wood (Section 7.6)
 - VI. Pools dimensions (Section 7.7)
 - VII. Flood-prone width for a single representative riffle (Section 7.9)
 - VIII. Priority noxious and priority native woody vegetation (Section 8.0)
 - IX. Bank angle (contingent) (Section 7.11)
 - X. Pool tail fines (contingent) (Section 7.8)
- All calibration data should be collected on the provided paper data forms.
- E. BLM and contractor staff (i.e., trainers) work together to take their own measurements for each of the above measurements and take photos of all transects and plots.
 - F. BLM and contractor staff review results with crews and provide course corrections.
 - I. Table 1 provides a guide for the desired level of precision among repeat measurements. Use these values as a starting point for when transects and/or plots should be revisited and differences discussed.
 - II. Crew values should be compared to “trainer” values, but keep in mind that we do not know the truth and any differences should be discussed and consensus achieved.
 - G. Crew and BLM and contractor staff results and pictures should be uploaded to Teams. Pictures of field forms are welcomed.

Table 1. Desired level of precision among repeat measurements taken as a part of calibration exercises. Use these values as a guide to determine when transects and/or plots should be revisited and differences in results discussed. Percent differences are to be assessed individually for each measurement per transect unless otherwise noted in relation to trainer values.

Measurement	Precision among repeat measurements
Wetted width	≤10%
Bankfull width	≤10%
Bankfull height	≤15%
Bench height	≤15%
Thalweg depth	≤15%
Bank type ¹	90% of assessed plots in correct category
Bank cover ¹	90% of assessed plots in correct category
Bank erosional feature ¹	90% of assessed plots in correct category
Bank cover categories	≤10%
# of pools ²	0 – 5 pools +/- 1; 6 – 10 pools +/- 2; > 10 pools +/- 3
Max pool depth	≤15%
Pool tail depth	≤15%
Pool length	≤10%
Large wood (# of pieces) ³	± 1 or 15%, whichever is greatest
Flood-prone height	≤15%
Flood-prone width	≤10%
Bank angle	≤10°
Pool tail fines	± 2 or 15% of intersections, whichever is greatest
Priority noxious	All priority noxious species identified in all plots
Priority native woody	All priority noxious species identified in all plots

¹Assess bank type, cover, erosional features, individually for each plot, but then compute the percent correct among the 10 assessed banks.

²Total number of pools observed throughout the reach

³Percent difference is assessed across all measurements taken throughout a calibration reach. For example, if 5 pieces of qualifying large wood were observed throughout the reach, acceptable crew values for large wood would be between 4 and 6 qualifying pieces.

Step 2 – Collect Data

Overview

Electronic data collection and submission is centrally managed by the National AIM team. The Stream and River Assessment Hub (SARAH) is used to collect field data and Collector is used for navigating to points and to record which points were field visited. Use of SARAH and Collector are part of field training, but proficiency is only gained through consistent use. To prevent information overload when learning the field protocol, we recommend that first time users watch the Collecting Data with SARAH and Data Backup and Submission pre-training videos, following along with an iPad if possible. Detailed instructions on using SARAH and Collector can be found in the Lotic Technology and Applications Manual. Best data entry practices and requirements are detailed below.

Responsible Parties

Field Crew

When and Estimated Time

Data collection should occur when water levels are at baseflow between June 1 and September 30, with exceptions for climatic conditions that preclude data collection during this time. Data collection takes 4-8 hours per reach.

Tools and Files

- [Lotic Master Gear List](#)
- [Lotic Field Protocol for Wadeable Systems TR 1735-2 Version 2](#)
- Local riparian vegetation identification guides
- [Paper copies of field data collection forms](#)
- [Macroinvertebrate](#) and [water quality](#) labels
- iPad
- [SARAH application](#)
- Collector application

Instructions

- A. Record field evaluation and reach statuses using Collector.
- B. Record all field data in SARAH including photos and GPS coordinates.
 - I. Pay attention to app warnings and checks. Some warnings will not let you move on, while others will. If values are left after being warned, comments should be made (see Appendix A for more information).
 - II. Follow the Comment and Estimation protocols in Appendices A and B to make comments and estimate values where appropriate. Do NOT make extraneous comments. Only estimate values where allowed and flag any estimated or suspect values as “E”.
 - III. Appropriately mark what data was not collected vs. zeros
 - a. Zeros are data too! Refer to the Lotic Technology and Applications Manual for how to fill out 0s for many fields at once to ease data entry for things like large wood.
 - b. Make sure all fields are filled in or flagged “N” for not collected.

- IV. Review all errors in the “Final QA page”
 - a. Outlier checks
 - 1. Bankfull width and height and bench height are especially important measurements and should be determined using relatively continuous surfaces throughout the reach. Therefore, there should be minimal variation in these measurements unless valley geomorphology also changes.
 - 2. At the end of a reach, SARA H calculates the mean and standard deviation of bankfull width, bankfull height, and bench height across all transects. Any values that are outside 2 standard deviations of the mean are flagged with hyperlinks.
 - 3. For any outliers that appear, think back to the channel dimensions at the transect. Was there a constraining feature such as a hillslope that caused the channel to change shape partway throughout the reach? Verify that you did not use a local feature that was not continuous throughout multiple transects to determine channel dimensions.
 - 4. Re-measure, omit, or flag the value if you do not feel confident in the measurement.
 - 5. Note reasons for any remaining outliers in the final confirmation page.
 - b. Final missing data checks
 - 1. Any remaining blank fields not flagged as “Not Collected” will appear on this screen and users should resolve these errors following the guidance above.
 - 2. If one or more PHAB transects were not completed, classify the reach as “partial” and note how many PHAB transects were not collected and the reach length for PHAB. This reach length is used for calculating sinuosity and should match the corresponding bottom of reach and top of reach coordinates.
- V. Exit out of a site and go back to the main menu to initiate automatic data backup on the iPad.
- C. If electronic data collection is impossible (e.g., iPad battery dies), record all data on paper datasheets and then enter into SARA H at a later date. All data must be entered into Collector or SARA H for the National AIM Team to ingest it into AquADat. Additionally, photos should be taken of paper datasheets and sent to the National AIM Team.

Step 3 – Backup Data

Overview

The crew will need to backup both SARAH and Collector data during each trip whenever internet access (4G or Wi-Fi) is available. Backups will allow data recovery if, for example, the iPad is lost or stolen. Uploading files to Teams or external backup USB drives can be used as alternative backup methods until better internet can be obtained or if issues occur with the SARAH or Collector backup processes.

Responsible Parties

Field Crew

When and Estimated Time

Preferably this occurs daily after every sample reach, but it **MUST** occur after every two reaches. How long data backup takes depends on internet connection. With a reasonable internet connection speed, two reaches should take ~15-30 min to backup. However, photos may take ~ 1 hour to backup all photos depending on the number and internet speed. If there is a poor internet connection, backing data up on USB drives will be considerably faster (i.e., 1-2 min). However, data will need to be backed up eventually using the internet prior to submitting final data.

Tools and Files

- SARAH
- Collector
- Teams
- External USB drive
- Photos on Box

Instructions

- A. Sync field visit information to the Office Webmap using Collector
- B. Backup SARAH field data
 - I. Back up data to the National AIM team servers. Use the “Upload Data via WiFi” button on the SARAH main menu to do this.
 - a. At a minimum, backup all XML field data
 - b. If internet connections allow, also back up photos. After backing up photos, they should appear on Box within a few hours, but at most within a day.
 - II. You will receive a success or failure message. If you receive a failure message, try again ensuring that you have a good internet connection.
 - III. If there are errors with XML data, use “View Upload Status and Confirm Final Data” button within SARAH to determine which files did not upload. Then manually backup files by uploading them to your project folder on Teams or if concerns exist about internet connections, back up data to an external USB drive. Send an email with the file(s) location and a description of the problem to Logan Shank (lshank@blm.gov).
 - IV. If there are errors with photos, identify which photos were not uploaded successfully by reviewing uploaded photos on Box. Log into

<https://account.box.com/login> or the Box application on an iPad with aim.aquatics@gmail.com as the username and stonefly2020 as the password. If photos are missing, use the “Export Photos” button within the “View Photos” main menu button to export photos. Then follow the above directions and instructions in the Technology and Application Manual to upload any problem files to Teams or an external USB drive.

Step 4 – Submit Final Data

Overview

Crews should submit final data as soon as the trip is finished and an internet connection can be obtained using the SARAH and Collector applications. Confirming data as final will notify the National AIM Team that data is ready for additional review by project leads and crew managers. The National AIM Team will NOT process data unless it has been confirmed as final so make sure that this is completed for all reaches!

Responsible Parties

Field Crews

When and Estimated Time

Data should be submitted after each trip. This should only take 15-30 minutes, but it could take longer if photos have not been backed up recently.

Tools and Files

- SARAH
- Collector
- Teams

Instructions

- A. Field data should be submitted as final using the “View Upload status and Submit Final Data” button in SARAH. Note all data for a reach including photos must be first Uploaded via Wi-Fi before it can be confirmed as final.
- B. Upload the Data Summary csv from SARAH to Teams so that project leads and crew managers can review it.
- C. In Collector, record that field data was submitted as final for each field visit. Then resync the field visit to the Office Webmap
- D. Please make sure to complete the above steps as frequently as possible. If a crew has more than one trip worth of backed-up but unfinalized data, the National AIM team will record this as an error in the Error Log (see Step 7 below).

Step 5 – Update Evaluation Status

Overview

The ‘Eval Status’ in the Points layer of the Office Webmap tracks which reaches have been sampled or not. This status and the ‘Reason Not Sampled’ (if applicable) will need to be updated after a crew field visits a point. This step overlaps with the Evaluation and Design Management Protocol Step 6. This is an iterative step in design management throughout the field season but is also relevant for data management. Updating evaluation statuses in the Office Webmap ensures that the crew is sampling the correct reaches and that the design is being implemented and tracked properly and consistently.

Responsible Parties

Project leads and crew managers

When and Estimated Time

Evaluation status should be updated after each trip, and the process of verifying and updating statuses should take less than 30 min per trip.

Tools and Files

- Office Webmap
- Teams
- Data summary on Teams or on the iPad
- Photos on Box

Instructions

- A. Field evaluation statuses for all visited points should be recorded in both the webmap and the data summary. Navigate to your project on Teams to find the Data Summary csv. If it is not there, follow up with the crew to make sure they uploaded it to the correct folder. Check that all records in the data summary have a matching record in the Office Webmap Field Visits layer. Review the Field Visits layer ‘FinalDataSubmitted’ column to ensure all data from the past trip was submitted as final to the National AIM Team.
- B. Ensure the crew visited the correct location and did not incorrectly move the point coordinates. The ‘PointMoved’ column in the data summary indicates if the point was moved and the design and sampled coordinates can be viewed on the Office Webmap. See section 3.2.2 in TR 1735-2 for guidance on moving the point coordinates.
- C. Ensure that you agree with the crew’s field evaluation status after reading comments and reviewing photos. To view photos in Box, go to <https://account.box.com/login> and log in using aim.aquatics@gmail.com as the username and stonefly2020 as the password. Photos are organized by project and year. They can be searched for by typing the PointID in the top search bar (using double quotes ensures an exact match). There should be photos for all visits to a reach even if it wasn’t sampled.
 - I. Common errors are misclassifying not sampled points (e.g. dry vs. inaccessible) or not properly recording partially sampled reaches. Ensure that partially sampled reaches are limited to instances where some transects are truly inaccessible. Targeted points should rarely, if ever, have a field evaluation status of ‘partially

sampled'. Partially sampled reaches should not make up more than 10-15% of sampled random points.

- II. If you agree with the status, then update the 'Eval Status' in the Points layer to match that of the Field Visits layer or to the corrected 'Eval Status' if you disagreed with the crew's status mark as a Reattempt or update appropriately in the 'Eval Status' in the Point layer. See the Evaluation and Design Management Protocol Step 6 for detailed instructions on how to do this.
- D. Record any errors found in A-D in the error log and follow up as needed with the crew. See step 7 for more details on how to fill out the error log.

Step 6 – Review Photos and Data Summary

Overview

Within a week after a trip, project leads and/or crew managers should review photos and the data summary generated by SARAH for all sampled reaches. This does NOT need to be done prior to submitting final data. The National AIM team has identified concepts that are most error prone and are the highest priority for addressing with the crew prior to additional data collection. This high priority data is included in a csv file that crews save to Teams and contains data related to the following concepts: 1) Critical concepts, 2) Flood-prone width, 3) Bank cover and stability and 4) Special situation protocols. After reviewing the data and corresponding photos project leads and/or crew managers should contact the crew to discuss any issues and record them in the Error Log (See Step 7 below).

Responsible Parties

Project leads and crew managers

When and Estimated Time

Review should occur after each trip and may take 1-2 hours.

Tools and Files


- Photos on Box
- Teams
- Data summary on Teams or on the iPad
- Error Log table

Instructions

Data summaries and photos can be viewed in two different ways: on a computer or on the iPad.

- The Site Summary page within SARAH (Figure 2) can be easier to review data than in a csv format on a desktop computer, while photos might be easier to view on a desktop computer with multiple screens.
- If viewing files on a desktop computer, navigate to your project on Teams to find the Data Summary csv. To view photos in Box, go to <https://account.box.com/login> and log in using aim.aquatics@gmail.com as the username and stonefly2020 as the password. Photos are organized by project and year. They can be searched for by typing the PointID in the top search bar.
- If viewing files on the iPad, use the “View Site Summaries” button within SARAH to view the Data summary. To view photos, log into the Box application using the above credentials and then view and search for photos.

12:44 PM Fri Apr 24 78%

 **Main Menu** **Site Summaries** Current Week Only: Y N

Point ID: AR-LS-8002 **Review/Edit Event** **Date Collected:** 4/21/2020

Location: Fitzhugh Creek **Event ID:** 0A452A24-5795-4313-9EDC-30E14C532F07

Site Information

Project CA_NC	Site Status Sampled-Wadeable	Designation Sampled
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Channel Measurements (Means)

Bench Height	Bankfull Height	Bankfull Width	Channel Dimensions Comment:
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Floodprone Measurements

	Location 1	Location 2	Floodprone Comment:
Floodprone Width	<input type="text"/>	<input type="text"/>	<input type="text"/>
Bankfull Width	<input type="text"/>	<input type="text"/>	<input type="text"/>

Bank Stability and Cover

Covered Banks (%)	Stable Banks (%)	Bank Stability and Cover Comment:
<input type="text" value="57.1"/>	<input type="text" value="42.9"/>	<input type="text"/>
# Erosional Banks	# Depositional Banks	
<input type="text" value="5.0"/>	<input type="text" value="2.0"/>	

Indicators

Bankfull and Bench Height

PA Noxious Species

Large Wood

More Bank Stability Plots

Site Comments

General:

Access/

Other Info

Reach Length	# Side Channels	Beaver Flow Mods	# Photos
<input type="text" value="150"/>	<input type="text" value="1"/>	<input type="text"/>	<input type="text"/>

Crew Lead:

Latitude **Longitude**

X-Site:

Reach Slid:

Figure 2. Site summary page in SARA that can be used to review crew data in relation to photos and local knowledge following each trip.

- A. Ensure the correct core and contingent methods and resulting data were collected. The field methods to be collected are specified in the contingent method specific columns or Supplementals column in the Points layer of the Office Webmap. The ‘IndicatorsUsed’ column in the data summary specifies which contingent indicators were actually collected, but will not list selected supplementals.
- B. Ensure that critical concept, flood-prone width, and bank cover, and stability photos were taken and uploaded to Box for each reach. If photos are missing, check that the number of photos on Box matches the number recorded in the csv.
 - I. If the number of photos does not match, have the crew try the following troubleshooting steps:
 - a. Reupload photos with a better internet connection.
 - b. Ensure the proper PointID was selected before uploading photos and if not check for photos under the PointID originally used.
 - c. Export photos using the “View Photos” button in the app and send the project lead/ crew manager these exported photos.
 - d. Contact the National AIM Team for further troubleshooting and to upload missing photos to Box.
- C. Critical concepts – Scour line, bankfull, and bench heights

- I. Determine if scour line, bankfull, and bench heights are correct on the annotated photos. Do the heights correctly correspond to recorded data in the csv or other local knowledge such as gage data?
 - II. If there are questions about any of the lines or critical concepts data, reference the field protocol and ask the crew the following questions:
 - a. What features from section 2.2.3 (Identifying Scour Line) were used to identify scour line?
 - b. What features from section 2.2.1 (Identifying Bankfull) did the crew use to identify bankfull?
 - c. Was the guidance in section 2.2.2 properly used to identify bench height?
 - III. If any issues were identified during the above review or discussion, record the error in the Error Log (See Step 7 below). Possible outcomes are:
 - a. Critical concepts were slightly off, but no major changes are needed. Protocol is clarified for the crew for future reaches.
 - b. Scour line placement was incorrect:
 - 1. Bank stability and cover data at a minimum may need to be omitted but see bank stability and cover section below.
 - 2. The rest of physical habitat data for the reach may be suspect; Consult the National AIM Team for next steps.
 - c. Bankfull placement was incorrect:
 - 1. Bankfull height can be inferred from bench height (i.e., bankfull heights should be replaced with the data recorded for bench height). If this is the case, consider how wrong bankfull widths are. If bankfull widths, would be drastically different, physical habitat data for the reach may be suspect; Consult the National AIM Team for next steps.
 - 2. Bankfull is incorrect and can't be inferred from other data. Physical habitat data for the reach may be suspect; Consult the National AIM Team for next steps.
 - d. Bench placement was incorrect:
 - 1. Bench height should be changed to equal bankfull height.
 - 2. Bench height was incorrect and should be omitted.
- D. Flood-prone width
- I. Did the crew take flood-prone width in two representative riffles parallel to the valley? If locations are not representative, record incorrect location(s) in the Error Log so the National AIM Team can review and possibly omit this data.
 - II. Review photos and consider if the flood-prone width values make sense given the observed valley confinement of the reach? If one or both values do not make sense, consider if the value(s) should be omitted and have a discussion with the crew to ensure they know how to properly measure flood prone width.
- E. Bank stability and cover
- I. Did the crew place the plot in the right location (e.g., correct identification of scour and bankfull features)?
 - II. Did the crew correctly identify depositional vs. erosional banks?
 - III. Did the crew correctly estimate cover?
 - a. Did the crew correctly estimate foliar rather than basal cover?

- b. Did the crew correctly include perennial vegetation (including senesced vegetation) and exclude annual vegetation as cover?
- IV. Did the crew properly identify erosional features (i.e., fracture, slump, slough, eroding)?
- V. If the answer to any of the above questions is no, ensure that the protocol is clarified for the crew for the future and record one of the following options in the Error Log for this specific reach:
 - a. Bank cover data should be omitted.
 - b. Bank stability data should be omitted.
 - c. Bank cover and stability data should be omitted.
- F. Special situations – Side channels, interrupted flow, partial data, beaver impacts, or braided channels
 - I. Review the data summary and photos for evidence that the crew encountered special situations Review specific photos taken of these special situations and verify that the crew properly documented these situations using the columns listed below from the Data Summary.
 - Side channels- ‘SideChannelCount’
 - Interrupted flow and Partial Data- ‘Designation’
 - Beaver impacts- ‘BeaverFlowModifications’
 - Braided channels- ‘Channel Dimensions Comment’
 - II. The best way to ensure the crew is clear on how to implement the applicable special situations protocol is to have a discussion. Ask the crew if they encountered any of the above special situations and if they have questions. They should have at least one question the first time each protocol is implemented. The following questions could be used to start conversations:
 - a. Side channels: Were multiple side channels present and if so was it clear which one to sample? Are you sure there were islands present and that these were not just mid-channel bars?
 - b. Interrupted flow: Was it difficult to collect macroinvertebrates and water quality? Were any concerns about the quality of these samples noted in the comments?
 - c. Partially Sampled: Did the crew do everything in their ability to collect all possible data?
 - d. Beaver impacts: Was there any question about if this was a lotic vs. lentic reach?
 - e. Braided Channels: Was it difficult to set up the reach?

Step 7 – Resolve Errors in Error Log

Overview

The Error Log is a table used to track data errors after crew data submission. The National AIM Team will run checks on raw data and post any errors in this file on a weekly basis. The file is located within a folder called “QC” on the General Channel of the Field Work team. Project leads and crew managers will also record any errors found during photo and data summary or indicator review in this log. At least once a month, project leads and crew managers should review and resolve errors with the help of the crew. The National AIM Team will review resolved errors and make data edits once a week.

Responsible Parties

Everyone

When and Estimated Time

Errors should be resolved monthly, but preferably after each trip; There should only be a handful of errors per trip and it should take less than an hour to investigate errors and resolve them.

Tools and Files

- Error Log table
- Photos on Box

Instructions

General Error Log Use

- The Error Log has two main components:
 - Field identified errors in the Field Reported Errors worksheet
 - This worksheet will be used by all projects and cannot be filtered or sorted.
 - NOC identified errors in Project specific worksheets
 - These worksheets may be filtered and sorted.
- Teams will show how many users are in the file and where they are. If multiple users are in the same worksheet:
 - Ensure that you are both working in different rows.
 - Do not apply any filters because these filters will also filter things for the other user.
 - Always close the file when you are finished or taking an extended break
- Within each tab columns are color coded by who should populate them.
 - Green columns are automatically populated and are not editable.
 - Orange should be filled out by project leads, crew managers, or crews and are editable.
 - Blue will be filled out by the NOC and are not editable.
- The file can be edited on a computer or iPad. If editing on an iPad, open the document in Teams and then launch the Excel application. All edits must be done online.

- When you are finished recording or resolving your errors, CLOSE the document. If you leave the document open, it will still show you active in the document and this could cause problems for others.

Field Identified Errors

If errors are identified during the data summary review by crew managers and/or project leads, these errors and their resolutions should be recorded using the Field Reported Errors worksheet. Any errors recorded in this worksheet will be automatically copied over into the project specific worksheets.

- Choose your project from the dropdown options.
- Next be extremely careful to properly enter the correct PointID.
- Column I, J, and Q (Data Type, Indicator Method Or Field, and Resolution) have common types of data errors as options in the dropdowns. If these match the error that you are recording, use these preestablished options. Note you need to first select a data type for the indicator Method Or Field dropdown to populate. If you do not find an appropriate option in the dropdown list, you can type in your error.
- Record today's date as the Date Reviewed and your name as the IndividualReviewed.
- If there is a known resolution (e.g. bank cover data should be omitted), fill that in. You might identify and record an error, but need to follow up with the crew before a resolution is known.
- The National AIM Team will review the proposed resolution, record their intended action (i.e. implementing your resolution) in the NOC Completed Data Edits field (Column R). Then they will change the resolved column from No to Yes.

NOC Identified Errors

If errors are identified by the National AIM Team while running QC checks on submitted raw data, the errors will be posted to the Error Log by project which will each appear as its own worksheet. To review and resolve these errors:

- Locate your project's worksheet.
- Respond to recorded errors in the orange columns (O-Q) by recording the date, your name and the resolution. Project leads and crew managers should reach out the crew as needed to clarify the protocol or to determine an appropriate resolution.
- The National AIM Team will review the proposed resolution, record their intended action (i.e. implementing your resolution) in the NOC Completed Data Edits field (Column R). Then they will change the resolved column from No to Yes.

Step 8 – Review Indicators

Overview

The objective of indicator review is to ensure the accuracy of collected field data and resulting indicators. Indicators will be calculated and posted once a month for review. Project leads should review calculated indicators for 2020 data following instructions in Step A. Indicator review would ideally occur once a month but must be done at least once at the end of the season. Crew managers may also review calculated indicators as desired. In addition, the National AIM Team will assess the precision of collected data through time and factors that could confound trend analyses for any reaches having revisit data (Step B).

Responsible Parties

Project leads, crew managers (optional), and the National AIM Team

When and Estimated Time

Once a month or at least once at the end of the field season; 1-2 hours if done monthly

Tools and Files

- Calculated Indicator Table (located within the “QC” directory on the General Channel of the Field Work team).
- Photos on Box

Instructions

- A. Project leads should use the following guidance to evaluate data in the ‘2020 data’ column of the computed indicator file:
 - I. Go through the computed indicator file one reach at a time. First view photos on Box to get a feel for the nature of each reach. For example, is the reach high versus low gradient, confined versus unconfined, or highly impacted by management or unaltered?
 - II. Given what you observed in the photos, do the covariate values such as slope, sinuosity, and bankfull width make sense? For example, do entrenchment, sinuosity, and slope values follow patterns expected by stream typologies like the Rosgen Classification (e.g., It is rare to observe reaches with both high slope and high sinuosity or high slope and low entrenchment).
 - III. Next, review the crews field comments for the reach.
 - a. You can use the ‘Filter’ column, to select all comments for the reach.
 - b. Do any comments warrant omitting or flagging an indicator value as suspect? Flagging data as suspect allows data users to consider data use on a case by case basis for a given analysis. In contrast, omitting data should be done if there are no situations in which data use is appropriate.
 - IV. Do groups of indicators tell a consistent and/or logical story at each reach? If not, review pictures, crew comments, and consider the reasons this could be the case. For example:
 - a. Are there consistent patterns between bank overhead cover and bank cover? For example, both low bank overhead cover (BankOverheadCover) and low bank cover (BankCoverFoliar). It is rare to have high bank

- overhead cover and low bank cover unless the overhead cover is all greater the 0.5 m in height.
- b. If bank stability is low (BankStability), is the percent of covered banks (BankCoverFoliar) also low? It is rare to have a large percent of banks covered and yet low bank stability.
 - c. Does the number of pools (NumPools) and percent pools (PctPools) seem practical for the observed slope, sinuosity, and general reach characteristics? The number of pools generally increases as sinuosity increases and slope decreases, for example. Exceptions include high slope reaches with step-pool geomorphic features.
 - d. Do floodplain connectivity and entrenchment ratio indicator values tell a consistent story? For example, stream channels with well-connected floodplains connectivity are generally associated with little to no entrenchment. However, exceptions exist where minor channel incision is present. Similarly, in V-shaped valleys with no potential to support benches, floodplain connectivity values should be 1, as bankfull and bench heights are measured as equal.
- V. To record the outcomes from step A, record your name in the ‘EvaluatorName’ column. If no errors were found, record “No errors” in the ‘EvaluatorComments’ column for every row for each reach. If potential errors were identified, record the errors with clear action items for the National AIM Team in the “OmitOrEditData’ column. For example, percent pools was 90%, which is an unrealistic value. The crew clearly misapplied the protocol and classified runs as pools. Record any general comments during this process in the ‘EvaluatorComments’.
- B. The National AIM Team will compare indicator values among visits if the reach has been sampled multiple times.
- I. 2020 Data are provided and if revisit data is available it is provided in the ‘Visit 1’ and ‘Visit 2’ columns.
 - II. Photos and reach coordinates are reviewed to determine if sampling conditions and reach placement were similar or if major changes occurred at a reach.
 - III. Covariate values are compared to the photos and through time. Any large differences in covariates are particularly concerning because things such as stream slope should not change appreciably among years.
 - IV. Sample dates are compared among visits to determine if any protocol changes or natural temporal variation were likely.
 - V. Logical groups of indicators are compared among sample events keeping in mind which indicators should or shouldn’t be expected to change much through time. Absolute value changes through time should be considered in an ecological or geomorphic context.
 - VI. Notes are recorded following the instructions below:
 - a. If any values are clearly wrong and all data from that visit for a given indicator should be omitted, the ‘Omit Or Edit Data’ column is populated with the description of the issue specifying which visit to omit and why. For example, if bench height was incorrectly identified during the first visit (measured abandoned terrace above floodplain height accidentally)

and only bench height and subsequent floodplain connectivity values are correct for the second visit.

- b. For questionable values and differences among visits the 'EvaluatorComments' column is used to make appropriate comments. For example, percent pools from visit one was 5% and 20% for visit two, but there is no reason to expect large geomorphic changes between years and it is unclear from photos which one is correct.
- c. If possible, reasons for observed differences among visits should be recorded. Possible reasons for differences include:
 1. Crews – One crew may have improperly implemented the protocol during a specific visit.
 2. Protocols – changes in protocol methods through time. The following are key changes to be aware of:
 - i. Change in 2019 to collecting bank foliar cover rather than bank basal cover. These will appear as separate indicators but could result in higher cover values from 2019 on, and lower values from 2013-2018.
 - ii. Changes in location of canopy cover measurements along the bank (i.e., from water's edge to scour), which could result in higher canopy cover values from 2016 on, than those measured from 2013-2015.
 - iii. Changes in the extent of collected streambed particles (e.g., scour to scour vs. wetted edge to wetted edge). Data from 2013 could be biased towards higher median particles sizes and lower percent fines, for example, than data post 2013.
 3. ReachPlacement – Differences in reach placement or length among repeat visits.
 - i. Assess changes in reach location or length that could confound comparisons through time (e.g., channel morphology, land use, or stream size).
 4. Year-To-Year Variability – indicator differences may occur through time due to interannual climatic variability or seasonal management actions.

Step 9 – Check-in and Project Close-out

Overview

A check-in meeting should be held one month into the field season with the crew, project lead, state lead and/or monitoring coordinator, crew manager, and the National AIM Team to make sure data management and data quality steps are being completed and that there is good communication among team members. During this meeting, the one-month check list and agenda topics can provide a starting point of questions to address unresolved protocol questions, app and iPad quirks, or logistical and gear issues such as YSIs malfunctioning. The state leads or monitoring coordinators should schedule and lead this meeting and all other parties should come prepared to discuss issues that have arisen thus far throughout the season. If the state lead or monitoring coordinator is not able to schedule and lead these meetings, they should coordinate with the project leads to ensure these meetings occur.

The project close-out meeting should be scheduled by the state lead and/or monitoring coordinator before the end of contracts such that crews and crew supervisors are still available to clear up any data questions that may arise. The end of season check list below should serve as an exhaustive list of everything that needs to be done to close out the project. In summary, all final data should be submitted and the evaluation statuses in the Point and Field Visits layers in the Office Webmap should be finalized. Project leads or crew managers should submit all macroinvertebrate samples and water quality samples to NAMC following the protocol found [here](#).

Responsible Parties

Everyone

When and Estimated Time

One month into data collection and at the end of the season while the crew is still working;
1-2 hours per meeting

Tools and Files

- Check lists below
- Error Log Table
- Teams
- Sample Size Dashboard
- Bug and Water Quality Submission Protocol

One-month check list and agenda topics

The purpose of the one-month check-in meeting is to discuss data quality processes for design management, data collection, and data submission to date with the goal of resolving any questions or issues so they don't propagate throughout the field season.

Pre-meeting preparation checklist:

- The project lead has prepared a quick assessment of number of points sampled and crew productivity.
- The crew has submitted ~1 month's worth of data 1 week prior to this meeting.
- The crew has selected bankfull, scour, and floodplain photos from at least 3 reaches and posted them on the google drive for meeting discussion. Photos should include: 1) a normal reach, 2) the most quirky reach visited to date, and 3) something in between or that warrants discussion.
- All parties involved have prepared a list of protocol questions and clarifications and potentially some photos to facilitate discussion.
- All parties involved have prepared a list of design management and data questions to discuss during the meeting.
- The National AIM Team has a list of questions in regards to any final data to discuss during the meeting.

Discussion topics and questions:

If crews are taking more than 4-8 hours per site, or not sampling 1-1.5 sampled sites per day, what can we do to help improve efficiency. Consider:	Action Items and Notes
Does the crew feel they have been provided with adequate office evaluation information to get to point coordinates? Are trip plans organized in a realistic manner? If not, what do they suggest for improvements?	
Does the project lead feel that it is realistic to meet the project's total sample size by the end of the summer? If not, how do we adjust and prioritize, what's in the contract, etc.?	
Is it clear to the crew who they are supposed to call for protocol questions, access issues, trip schedule issues, etc.?	
Design management	Action Items and Notes
Is the crew updating the Field Visits layer often and completely?	
Is the crew labeling macroinvertebrate samples with an inside and outside label, storing appropriately, and recording number of jars collected in the Field Visits layer?	
Is the crew clear that they should be collecting duplicate and blank WQ samples for total nitrogen and phosphorus at 10% of sites and labeling these samples appropriately? How many reaches has the crew collected duplicates and blanks for so far?	
Are project leads finalizing eval statuses so that designs can be managed iteratively? Are there questions in regards to this?	
Are the trip planners managing the design iteratively according to guidance in the design management protocol? Is the Points layer being properly and completely updated?	

Table continued on next page	
Has the project lead assigned merged PointIDs properly and is the crew clear on what coordinates and PointIDs should be used?	
Local Field/District Office orientation training and calibration:	Action Items and Notes
Who was able to make it to this local training? How many and what types of reaches were visited?	
Did this enhance everyone's understanding (especially the crew) of how to identify the critical concepts? Which critical concept caused the most discussion?	
Which other indicators caused a lot of discussion and why?	
Was calibration data saved electronically on Teams?	
Photo review:	Action Items and Notes
The crew presents bankfull photos and discusses their experience at 3 sampled reaches: 1) a typical reach, 2) a challenging reach, and 3) 1 other reach that you would like to share. Does everyone agree on the critical concept locations? Is the crew confident identifying the three critical concepts across a diversity of reaches? Other discussion about these reaches?	
Does anyone else have photos or specific indicators they want to discuss?	
Has the crew encountered any of the below special situations (TR 1735-2 Appendix C) yet this field season, and how did they go? What indicators were difficult in these systems?	Action Items and Notes
Interrupted flow	
Beaver impacts	
Partial data	
Side Channels	
Braided systems	
SARAH and QAQC	Action Items and Notes
Has the crew found any SARAH glitches preventing efficient data collection, QAQC, backup, and submission that the National AIM Team can fix?	
Is the crew backing up data after at least every two reaches? If not, why?	
Are there reoccurring themes or issues being discussed at the weekly QAQC meetings? Who is attending? If these meetings are not occurring, why not? How can we improve?	
How often is the project lead able to review indicator values? What issues have arisen?	
Does the National AIM Team have questions for the team about final data?	
Are there any other unresolved data issues?	

End of season check list

The purpose of the end of season meeting is to ensure all that all data questions have been resolved, all design and field data have been finalized, and no more information or tasks are required prior to the end of the field season.

Pre-meeting preparation checklist:

- Crews have submitted all final data.
- Project Lead has reviewed all indicator data and will come to the meeting with any questions.
- National AIM team has reviewed final data and will come to the meeting with any questions.
- All questions in the Error Log have been resolved or will be resolved during the meeting.
- The National AIM Team has reviewed the finalized Evaluation Statuses in the Office Webmap and will come to the meeting with any questions.
- Crews prepare a list of gear that needs to be replaced, replenished, or fixed and share with whomever is responsible for gear (using the master gear list as a checklist could be helpful).
- Contractors have coordinated with NAMC to submit macroinvertebrate and water quality samples following [this protocol](#).
- State Lead/Coordinator organizes meeting with National AIM Team, project leads, contractors, and crews. Keeps notes in the Teams Mid and End of season check folder.

Pre-meeting table to be completed by Project Lead:

Project Lead Name	
Project Area	
Year of design (e.g., first year of 3)	
Field season start and end dates (e.g., May 1-August 31)	
Contract/agreement company and crew members	
Number of random sampled reaches	
Number of targeted sampled reaches	
List of reaches that were suppose to be sampled this year but for various reasons will need to be sampled next year (discuss list)	
List of boatable reaches support is needed for sampling	
Preliminary notes about the design (e.g., next year we will need more points in Field Office A, next year we will want an intensification because there are not enough points in X allotment, or the design was great and should continue as is next year) National AIM Team will follow up during the planning stages.	

Discussion topics/questions, and final checks at minimum:

Design management

- Resolve any disagreements on final eval status in Points Layer in the Office Webmap.
- Resolve any other questions in regards to the Points or Field Visits layers in the Office Webmap.
- Is there any other follow up needed on reaches that should be revisited in future years?
- Have all PointIDs that were merged been properly noted as such with the merged site code in the Points layer?

Data

- Discuss any remaining problem reaches, photos, indicators, or field methods.
- Final data questions follow-up.
- Have macroinvertebrate and WQ samples been submitted? If not, what is the plan?
- All electronic data, photos, etc. have been sent to National AIM Team. If not, resolve issues at meeting.

APPENDIX A. COMMENT PROTOCOL

Crews should be judicious when recording comments in SARAH. Any general comments related to difficulty implementing the protocol are very helpful. To assist crews with understanding what other kinds of comment are helpful, comment types are listed below with a description of the kinds of information that should be included in each comment type. General and access comments are required. Photo and water quality and macroinvertebrates comments are not required in all cases but are frequently used. The rest of comment types listed below are rarely used.

General Comment

Comment used to

- Justify why a reach was not sampled, partially sampled, or classified as interrupted flow. If partially sampled or interrupted flow, it should specify which transects were not collected or were dry.
- Note general observations about the reach. For example:
 - Was any management history about the reach evident? (e.g., livestock, recreation, wildlife, roads, culverts)
 - Was any additional information gained from talking to adjacent landowners or permittees?
 - Did flow conditions change while at the reach?
 - Was there more than one side channel present at the reach?
- Note if there were any drastic geomorphic changes throughout the reach (e.g., tributaries coming in or drastic changes in valley confinement)

Other critical data comments that are not included elsewhere should also be included in this comment. For example, if two iPads were used for data collection at one reach and the data from each iPad needs merged. Other common general data comments include:

- Uncertainty with special situation protocols (e.g., interrupted or side channel)
- Data for an entire transect entered under the wrong transect.
- Any changes needed to PointIDs should be fixed before submitting, but photos may still be improperly labeled depending on when they were uploaded!
- Any app errors that impeded data entry

Access Comment

Comment used to provide information about

- Exactly how the reach was accessed (e.g., which roads were taken and any hiking routes).
- Any special gear needs, and length of time to access and sample
- It should NOT include landowner contact information as this is sensitive personal information not to be recorded in the database.

Photos Comment

Appropriate comments should be made for each photo taken. Paired photos with comments are the best kind of comments if there are any questions about protocol application! Please make sure any comments and photos taken are specific enough that they can be easily reviewed with project leads and crew managers within a week or two of sampling the reach.

Water Quality and Macroinvertebrates Comment

Comment used to note the following:

- Concerns about compromised samples (e.g., broken or lost jars)
- Low flows or stagnant water
- Observations of water color or odor
- Observations of excessive algae, biological films, or salt deposits
- Instrument or calibration concerns
- Justifications for measurements outside typical value ranges and MUST include
 - whether the instrument was recalibrated
 - measurements double checked by retaking the measurement in the field
 - whether this value was discussed and confirmed by local BLM staff
- Any known anthropogenic impacts to water quality such as proximity to acid mine drainage or oil and gas wells
- Any known natural water quality oddities such as geothermal features or natural highly saline condition
- If conductivity was not temperature corrected, a comment should be made indicating that the device was not capable of measuring specific conductance.

Channel Dimensions Comment

Comment used for bankfull width, wetted width, bankfull height, or bench height. Specifically, to justify any outliers for bankfull widths and heights or widths and heights outside of typical value ranges. In particular, comments should be made for large bankfull widths and bankfull heights equal to 0 due to beaver dams. Crews should not be sampling when water is at bankfull so it should be very rare to have bankfull heights equal to 0 and any such cases should be noted. This comment should also include any notes about drastic geomorphic changes throughout the reach or challenges applying the protocol to a braided channel. Any specific questions about identification of scour line, bankfull, or bench surfaces should be specified in the critical concepts photo comments.

Bank Stability and Cover Comment

Comment should specify any transects where there were Bank Stability and Cover questions and the general nature of those questions. These transects should have accompanying photos and photo comments specifying what the exact questions were for each plot. Comments should be made if there is clear livestock or wild horse and burro trampling of banks.

Other Physical Habitat Transect Comment

Comment should specify the number of streambed particles, thalweg depths, or densiometer measurements that were estimated and why these measurements were estimated if applicable.

Large Wood Comment

Comment should specify if any log jams were present and estimated.

Vegetation Comment

Make a comment if there were circumstances that made plant identification was difficult (e.g. early or late in the season or heavy cattle grazing). If there were any questions about species at

the reach, photos and notes should be recorded outside of SARAH and sent to project leads to discuss to prevent questions at future reaches.

Human Influence Comment

Comment should specify if there were any questions about which categories to put things into.

Flood-Prone Width Comment

Comments should be made if the two flood-prone width measurements differ by more than 20%. Under such circumstances crews should verify that the riffles were representative and parallel to the valley. Comments should be made on any geomorphic changes or difficulty taking the measurement.

Pools Comment

Note if any pools were beaver pools.

Slope Comment

Make clear comments about if equipment differed from a metric stadia rod with a transit level. Only submit data if slope is recorded in cm. If you must collect in feet, make a comment that this was collected in feet until you are able to convert the values in case you forget before submitting. Once converted add a comment confirming that values are in cm.

APPENDIX B. ESTIMATION PROTOCOL

Estimating values is only allowed for specific methods (Table 1) and in specific circumstances. This appendix specifies these circumstances and if a scenario is not included below, estimation is not allowed.

Table 1. Summary of lotic AIM methods for which field measurements and resulting values can be estimated. Field methods are organized by the BLM's Fundamentals of Land health applicable to lotic systems.

Fundamentals	Method	Estimates allowed
Water quality	pH	No
	Specific conductance	No
	Temperature (instantaneous and seasonal)	No
	Total nitrogen and phosphorous	No
	Turbidity	No
Watershed function and instream habitat quality 1 (i.e., physical habitat)	Pool dimensions	Yes
	Streambed particle sizes	Yes
	Bank stability and cover	No
	Floodplain connectivity: Bankfull and Bench Heights	Yes
	Large wood	Yes
	Bank angle	Yes
	Thalweg depth profile	Yes
	Pool tail fines	No
	Bankfull width	Yes
	Wetted width	Yes
	Slope	No
Flood-prone width	No	
Biodiversity and riparian habitat quality	Macroinvertebrate biological integrity	No
	Frequency of occurrence of priority noxious vegetation	No
	Frequency of occurrence of priority native woody riparian vegetation	No
	Canopy cover	Yes
	Greenline vegetation composition	No
Other	Photos	No
	Human influence	No

Pool Dimensions

- Pool too deep or thalweg is too difficult to stand in
 - In this scenario, first try to measure max pool depth using a stadia rod instead of a depth rod; If it is still not possible to take a measurement, take the measurement at an angle and record the depth and angle. To measure pool length in this scenario, try floating the tape in the thalweg, hooking the tape on overhanging vegetation, or hovering the tape over the pool using your depth rod/stadia rod to measure the pool length. Alternatively if the bank is accessible try stretching the tape along the bank trying to account for the shape of the thalweg instead of through the thalweg.
 - If max pool depth or pool length can't be measured using the guidance above, estimate by getting the deepest or longest measurement possible and then estimate what the correct measurement is to the nearest 0.5 m or smaller. Record which measurements were estimated and why.
- Walking the thalweg to determine streambed concavity is required to delineate pools, in some systems walking the entire stream thalweg is not possible either due to fast or deep water or due to dense vegetation.
 - For any sections of the reach <15 meters, that you can't access, estimate the amount of pool habitat available following the guidance above and record the length assessed for pools as the full reach length.
 - For any sections of the reach where you can't walk >15 meters of the reach, do not assess pool habitat and record only the length that was assessed for pools as pool reach length. If you can't assess more than 50% of the reach for pools, do not collect pools.

Streambed Particle Sizes

- Can't see particles or can't pick it up because it is too large or embedded
 - Estimate visible or embedded portion using depth rod. If not visible or can't be felt, use depth rod to determine what substrate "sounds" like; Fine sediment has a very different sound than cobble for example. Make a comment estimating how many particles you've estimated throughout the reach. Keeping a tally might be the best way to do this in the comments and then summarize at the end.

Large Wood

- Log Jams
 - Take photos and do your best to count large wood. Record how many log jams there were and that these were estimated in the comments.

Bank Angle

- Can't fully get depth rod at right angle due to vegetation on bank. First try to use a shorter flat object such as your iPad, ruler (if a non-flexible ruler is being used), or the compass itself if the angle is conducive to this.
 - Do your best to get the depth rod at the correct angle and then estimate what the correct angle should be. Record which measurements were estimated.

Thalweg depth profile

- Depth is too deep
 - In this scenario, first try to measure depth using a stadia rod instead of a depth rod; If it is still not possible to take a measurement, take the measurement at an angle and record the depth and angle.
 - If depth can't be measured using the guidance above, estimate by getting the deepest measurement possible and then estimate what the correct measurement is to the nearest 0.5 meters. Make a comment estimating how many measurements you've estimated throughout the reach. Keeping a tally might be the best way to do this in the comments and then summarize at the end.
- Water can't be accessed with a depth rod (e.g., goes under boulders) but is still visibly flowing. Estimate the correct measurement to the nearest 0.5 meters and estimating how many measurements you've estimated throughout the reach. Keeping a tally might be the best way to do this in the comments and then summarize at the end.
- Water is less than 1 cm but has water. Record as 1 cm.

Bankfull Width

- Dense vegetation or other obstructions prevent being able to reach the bank with a tape
 - First try
 - Using your depth rod to stick through vegetation.
 - If the angle is not correct for the above option attach the measuring tape to depth rod and try to stick depth rod through the vegetation to the bank.
 - For very large systems laser range finders may also be used.
 - If the measurement still can't be obtained, stretch a tape as far as possible and visually estimate the rest of the width. Record which measurement were estimated.

Bankfull and Bench Height

- At transects where there are not clear bankfull or bench surface indicators, use upstream and downstream transects to inform an estimate and then record which measurements were estimated.

Wetted Width

- Dense vegetation or other obstructions prevent being able to reach the bank with a tape
 - Follow same guidance as for bankfull width but there is no need to record which measurements were estimated.

Canopy Cover

- Vegetation is too dense or water is too deep to stand in the proper location
 - If the vegetation is so dense that the value can clearly be estimated as 17, record as 17.
 - Conversely if there is no vegetation at all and the value can be clearly estimated as 0. Record as 0.
 - In the comments record the number of values estimated as 17 and the number of values estimated as 0 for the entire reach. We recommend that you keep a tally and summarize at the end of collecting transect data.
 - Do not estimate any other values.