BLM's Aquatic Assessment, Inventory, and Monitoring (AIM)
2017 Field Season

Data Management & Stream and River Assessment Hub (SARAH) Protocol

VERSION 1.0
Produced by BLM National Operations Center (NOC) and the BLM/USU National Aquatic Monitoring Center (NAMC) – 05/2017

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How to Use this Protocol

The purpose of this protocol is to define and describe the Data Management, Quality Assurance (QA), and Quality Control (QC) steps for all aquatic Assessment, Inventory, and Monitoring (AIM) efforts at different levels of management - Project Leads, Field Crews, State Monitoring Coordinators, the National Aquatic Monitoring Center (NAMC), and the National Operations Center (NOC). This protocol provides an overview for how to minimize data errors and establishes clear responsibilities for each party involved in monitoring data collection and QA/QC (pg. 6) In addition to providing a high level overview of the general QA/QC process, this protocol should be used as a quick reference guide for completing QA/QC steps that occur during data collection (pg. 20), data backup (pg.26), submission (pg. 29), and mid-season/post season check-ins (pg. 43) (Table 1). Additionally, this protocol includes specific instructions on how to use the Stream and River Assessment Hub (SARAH) iPad application for data collection and submission (pg. 14) and frequently asked questions and troubleshooting (pg. 33). Crews should frequently consult both the field protocol ([TR 1735-2](#)) and this protocol when questions about data collection or data submission arise. Instructions for completing QA/QC steps that occur during other processes such as training and design management are not described in detail here, as there are separate protocols that address these steps. However, these additional protocols are referenced where appropriate.

What is Data Management and QA/QC?

Data management: processes, and means of organizing and storing data. Data management is a key tenet of AIM and is critical to the success of the AIM program. The following is a list of all the different types of AIM data with the aquatic data management tool in parenthesis: management and monitoring objectives (Monitoring Design Worksheet), geospatial design input layers (Monitoring Design Worksheet), geospatial design files (GIS and Design Management Spreadsheet), final status of sample design points (Design Management Spreadsheet), quantitative field data (SARAH), calibration data (SARAH), field and quality assurance and quality control notes (SARAH, Design Management Spreadsheet, and Mid-season and Post-season check lists), and the final interpretation and assessment of these data (AquaDat and Benchmark Tool) (Figure 1).

Quality Assurance: A proactive process intended to minimize the chance of an error being inserted into the data. The actions included for quality assurance include: training, calibration, data management, electronic data capture, and data checks.

Quality Control: A reactive process of detecting, noting, and if possible fixing, errors which occurred in the data collection and storage process. The goal is to identify errors/problems after the data are collected but before they are released. The actions included for quality control include: identifying missing data, conducting data checks, and data management.

Importance of Data QA and QC: Although practicing QA and QC may seem tedious, it is a critical step in the monitoring process. Careful attention must be paid to the QA and QC processes because errors in the data will be amplified as the data are used to make land

management decisions. QA and QC should be implemented throughout the data life cycle, but in this document we focus in detail on measures that can be taken during and just after data collection.

The spirit of these requirements is to protect us all from a bad investment in monitoring! Rigorous QA and QC strategies make our datasets stronger and more defensible.

QA and QC checks are composed of the following components:

Data accuracy: a measure of how close the data is to the "truth".
Data precision: a measure of how repeatable data is.
Data completeness: ensures all data is collected, saved, and stored.
Chain of custody: a form that tracks the individuals responsible for the data at different points in time, as the data are transferred from field crew, to project lead, to NAMC, and to final storage at the NOC.
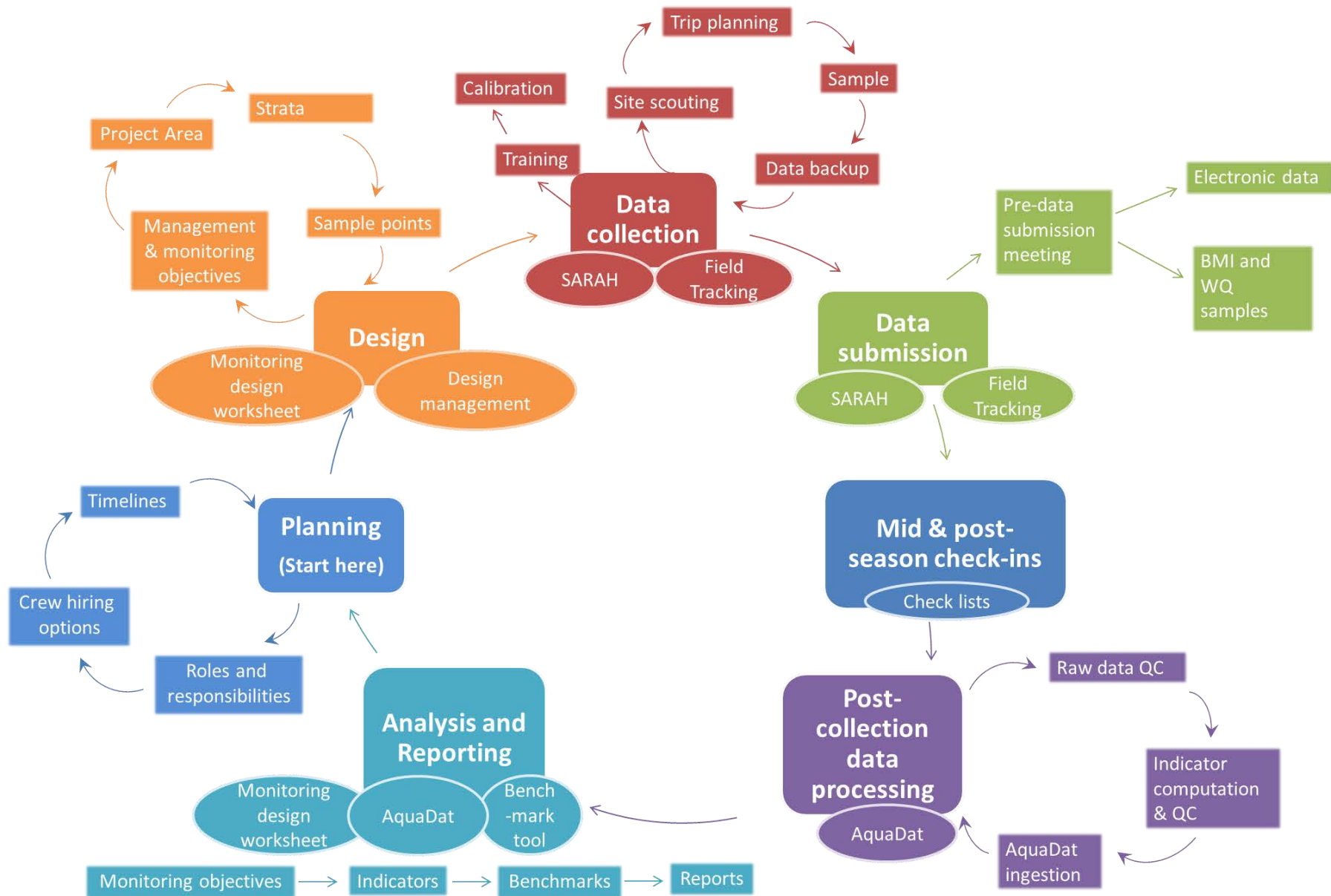
Figure 1. Summary of the aquatic AIM workflow and data flow. Seven main steps are highlighted in the large boxes: planning, design, data collection, data submission, mid & post season check-ins, post collection data processing, and analysis and reporting. Each main step then has an associated sub-workflow. Mid & post season check-ins do not have a sub-workflow but should address issues that arise during the all the other six main steps. Tools to assist in implementation and data management of the step are contained in the ovals below each main step.

Aquatic AIM QA/QC Roles and Responsibilities

Overview
Aquatic AIM QA/QC consists of QA/QC steps that occur during six general processes: 1. training; 2. data collection; 3. data submission; 4. check-ins; 5. post-collection data processing; 6. design management. The tables below describe the QA/QC steps that that need to be completed during each of these processes. Table 1 details why these steps are important. Table 2 describes who is responsible for each step, and Table 3 describes when each step occurs and what additional tools and documents should be referenced when completing an individual step. A written description of each party's roles in each step follows the tables. Note that this protocol should be referenced for the data collection, data submission, and check in steps, while the AIM-NAMF Field Protocol (TR-1735-2) and the AIM-NAMF Design Management Protocol should be referenced for the training and design management steps respectively. Links to these two documents are below:
http://aim.landscapetoolbox.org/wp-content/uploads/2015/09/TR_1735-01.pdf
http://aim.landscapetoolbox.org/wp-content/uploads/2017/05/AIM-NAMF_ScoutingSampleFrameMgmt_Final_2017.pdf

Members of an Aquatic AIM Implementation Team

Project Lead: Anyone below the State level who is playing a more active management role in data collection. Oftentimes the project lead is someone at the field office or district level. In some cases, multiple people can participate in the Project Lead roles and responsibilities.

Field Crew: The people responsible for collecting the data. Field crews c can consist of individuals hired specifically for data collection or BLM field office staff members.

State Lead or Monitoring Coordinator: State-level BLM staff members who are either dedicated to working specifically on AIM-related tasks or have been tasked with certain AIM-related responsibilities. State leads and State Monitoring Coordinators should be actively engaged with AIM data collection throughout their entire state for the entire field season. .

Partner Hiring Organizations: Organizations that are responsible for hiring field crews.

NAMC/NOC: In the tables and descriptions below, identification of roles and responsibilities associated with NAMC/NOC are referring to tasks that will be completed by the aquatic analysts and data management team at the BLM National Aquatic Monitoring Center at Utah State University, and the BLM National Operations Center in Denver, CO. These individuals are dedicated to QA&QC at the national level as well as computing indicators, aggregating the data, and serving data back out for BLM staff to analyze and use in land management decisions. Questions about protocols/methods can always be directed at NAMC at (435)797-3673; whereas questions about data submission or the iPad application should be directed to NAMC at (985)502-7530. Aquatic AIM NAMC and NOC members and roles are listed below:
- Scott Miller – Aquatic AIM Lead swmiller@blm.gov

- Robin Jones – Implementation Lead (handles project implementation for NM, UT, CO, NV, AZ, MT) robin.jones@usu.edu
- Nicole Cappuccio – Data Analyst (also handles project implementation for WY, ID, OR, WA, CA) ncappuccio@blm.gov
- Colin Brady – Alaska Implementation Lead cbrady@blm.gov
- Jennifer Courtwright – Data Analyst and Data Manager jennifer.courtwright@usu.edu

Table 1. The aquatic AIM QA/QC steps and their purpose.

Process	QA/QC Step	Purpose			
		Accuracy	Precision	Completeness	Chain of Custody
Training	Field training	X	X	X	
	Calibration	X	X		
Data collection	Electronic data capture	X	X	X	
	Data backup			X	
Data submission	Field tracking			X	X
	Pre-data submission meeting	X	X	X	X
	Electronic data submission to NAMC			X	X
	BMI & WQ sample submission to NAMC			X	X
Check-ins	Mid-season check in and post-season debrief	X	X	X	X
Post-collection data processing	Repeat sampling by independent field crew		X		
	Raw data & indicator QC	X	X	X	
	AquaDat ingestion	X			X
Design management	Point evaluation (scouting and field tracking data)	X		X	
	Iterative management of designs	X		X	
	Submission of design management spreadsheet to NAMC			X	X

Table 2. Aquatic AIM roles and responsibilities with respect to QA/QC. See written descriptions below for more detail on what each step entails for each respective member of an Aquatic AIM implementation team.

Process	QA/QC Step	Crew	Project Lead	Partner organization	State lead or monitoring coordinator	NAMC/ NOC
Training	Field training	X	X			X
	Calibration	X	X			X
Data collection	Electronic data capture	X				
	Data backup	X				
Data submission	Field tracking	X	X			X
	Pre-data submission meeting	X	X			optional
	Electronic data submission to NAMC	X				
	BMI & WQ sample submission to NAMC	X	X			
Check-ins	Mid-season check in and post season debrief	X	X	optional	X	X
Post-collection data processing	Repeat sampling by independent field crew					X
	Raw data & indicator QC					X
	AquaDat ingestion					X
Design management	Point evaluation (scouting and field tracking data)	X	X			optional
	Iterative management of designs	Optional	X			optional
	Submission of design management spreadsheet to NAMC		X			

Table 3. A quick reference guide for timing of each aquatic AIM QA/QC step and where to find the implementation tools to assist with completing each step.

Process	QA/QC Step	Timing	Implementation tools	
			Instructions	Data management tool
Training	Field training	2 weeks each spring (project leads only attend 1st week)	TR 1735-2	SARAH[1]
	Calibration	During training	TR 1735-2	SARAH[1]
Data Collection	Electronic data capture	Throughout the field season	TR 1735-2; this document	SARAH[1]
	Data backup	After every site visit if Wifi access allows. MUST happen after every third site; Crews with unreliable wifi access (AK) can use external USB devices to backup	This document	SARAH[1]
Data Submission	Field tracking	After every site or field trip	This document	Field tracking tab within design management spreadsheet on google drive
	Pre-data submission meeting	Preferably after every field trip but at least once a month	This document	csv on google drive, site summary, and photos accessed in SARAH[1]
	Electronic data submission to NAMC	As frequently as possible **but only after pre-data submission meeting** has occurred	This document	SARAH[1]
	BMI & WQ sample submission to NAMC	Throughout the field season or at the end of the field season	This document	Field tracking tab within design management spreadsheet on google drive
Check-ins	Mid-season check in and post-season debrief	Once in the middle of the field season and once at the end of the field season	This document	Mid-season and post season check list

[1]Stream and River Assessment Hub iPad application

Table 3 continued. A quick reference guide for timing of each aquatic AIM QA/QC step and where to go to find implementation tools to assist with completing each step.

			How?	
Process	**QA/QC Step**	**When?**	**Instructions**	**Data management tool**
Post-collection data processing	Repeat sampling by independent field crew	Throughout the field season	NAMC will communicate with project leads for sampled site lists and access information	SARAH[1]
	Raw Data & Indicator QC	Throughout the field season and the fall following the field season	NA	SQL database and R scripts
	AquaDat ingestion	Around Jan-Feb following the field season	NA	Geodatabase
Design data	Point evaluation (scouting and field tracking data)	Spring and throughout the field season	AIM-NAMF Design management protocol, webinar, and video	Design management spreadsheet on google drive
	Iterative management of designs	Throughout the field season	AIM-NAMF Design management protocol, webinar, and video	Design management spreadsheet on google drive
	Submission of design management spreadsheet to NAMC	At end of field season	AIM-NAMF Design management protocol, webinar, and video	Design management spreadsheet on google drive

[1]Stream and River Assessment Hub iPad application

Training

Training: NAMC runs an annual 2 week spring aquatic AIM training to teach field collection methods in TR 1735-2. All crews must attend and project leads are strongly encouraged to attend

Calibration: comparison between data collectors. This will occur in week 1 and week 2 of the training. NAMC will present the results of calibration to training attendees, discuss any discrepancies, use them as a learning opportunity, and store the results. Questions about protocols/methods can always be directed to NAMC at (435)797-3673. Project leads are also encouraged join the field crew throughout the season.

Data Collection

Electronic data capture**:** data will be collected electronically using an iPad that NAMC will provide the crew. The data collection application, SARAH, has numerous QA/QC checks included within the system. These include but are not limited to: providing pop-ups when there are missing data or data that are outside typical or possible ranges for a specific measurement. Additionally, when data collection has concluded at a site, the program will list all of the missing data and outlier values. This will allow corrections and collection of data in the field before leaving a site. Use of the data collection program will be part of the training in May.

Data backup: The crew will need to do data backups during each field trip whenever wifi access is available. Preferably this occurs after every site but it MUST occur after every three sites. This will allow data recovery if, for example, the iPad is lost or stolen. External backup USB drives will be provided for crews that have poor access to wifi (AK). Field data sheets are also provided as a backup for data entry in case the iPad battery dies or malfunctions, but all data entered on data sheets must eventually entered electronically into SARAH.

Data Submission

Field tracking: The field tracking spreadsheet is a tab within the design management spreadsheet on the google drive that is intended to help track the status of sites throughout the season. This spreadsheet is critical for ensuring that all members of the implementation team know what sites were sampled and what data should have been submitted. The field crew should fill out the field tracking spreadsheet at the end of each site or field trip documenting the sites that were sampled and rejected, and any important sampling comments. All sites visited should be recorded in this spreadsheet, including failed sites or targeted sites. After resolving any data issues found in the pre-data submission meeting (see below) project leads should sign off on the data in this spreadsheet. Any unresolved issues should be noted in the comments field next to the appropriate site. Then, NAMC will confirm submitted data was received in this spreadsheet.

Pre-data submission meeting: Field crews and project leads are expected to meet and review a data summary before the field crew submits their final data for a given field trip. To facilitate this process, a .csv file from the iPad will be automatically saved to the project-specific folder within the Aim_Aquatic FieldWork folder on the google drive when a crew backs up data via wifi. This is a spreadsheet that contains a limited summary of the data and specific fields that have been

found to have frequent errors in previous years. The project lead should review this file along with site photos, which crews can export from the iPad at the end of a field trip and consult the crew with any questions that arise. Crews and project leads can consult the Appendix A for specifics on common errors. This meeting must occur prior to field crews submitting final data. Therefore, the meeting would ideally occur after every multi-day field trip but should occur at least once per month.

Electronic data submission to NAMC: After making any final data edits, field crews will send the data to NAMC through the SARAH application on the iPad after the pre-data submission meeting. **Crews should submit data as frequently as possible to avoid memory issues on the iPad and so that NAMC can start additional QC of data.**

BMI and WQ sample submission to NAMC: Crews or project leads should submit all bug samples and water quality samples to NAMC at the end of the field season along with a paper data sheet that lists the site codes, date, and number of jars. All of this information should be tracked on the field tracking tab within the design management spreadsheet, which can then be printed prior to submission. Arrangements can be made to submit samples mid-season if needed.

Check-ins

Mid-season check in and post-season debrief: Meeting of the crew, project lead, state lead and/or monitoring coordinator, partner organization (where appropriate), and NAMC to make sure QA/QC steps are being completed and that there is communication among all members of the implementation team. During this meeting, the mid-season and post-season check lists can provide a starting point of questions to address related to unresolved protocol questions, app and iPad quirks, or logistical and gear issues such as YSIs malfunctioning. We suggest that for states that having monitoring coordinators, coordinators should lead and schedule these meetings and for states that lack these coordinators state leads should lead and schedule these meetings. Partner hiring organizations, the crew, and project lead should come prepared to discuss any issues that have arisen thus far throughout the season. NAMC will participate in these meetings and follow up on any unresolved issues.

Post-Collection Data Processing

Repeat sampling by independent crew: NAMC will have a dedicated crew to revisit and sample a proportion of sites sampled throughout the field season. Note, this will assess crew and indicator precision rather than crew and indicator accuracy.

Raw data and indicator QC: NAMC will run QC reports on raw data for missing data, legal, or typical value, violations, logic checks, and outliers. Project Leads and field crews may be contacted with specific data questions generated from QC reports if further information is needed to resolve issues. Final edits and decisions on questionable data will be made and appropriately documented. Indicators will then be calculated and a final round of QC reports will be run on computed indicators reviewing these in ecoregional and other ecological contexts. Final edits and decisions on data will be made and appropriately documented.

AquaDat Ingestion: NAMC will send computed indicators to the NOC for ingestion into AquaDat. Ingestion scripts check for data outside the possible range of values for a given indicator as a last final data check.

Design data

Point evaluation (scouting): This can be completed be the project lead or the crew lead. Evaluation of sample points involves screening them to see if they are part of the target population and are feasible to sample. Point evaluation may be conducted by the project lead or the crew lead. Office point evaluation should be completed before the start of the field season by the project lead and associated ID team and recorded in the design management spreadsheet found on the google drive. For more information on this step, consult the guidance provided in the AIM-NAMF Design management protocol and corresponding webinars (https://drive.google.com/open?id=0B1hu9Yn_LxR5TXIxQlliMjUwajg). If the webinar link doesn't work, contact Robin Jones at NAMC for a video of these webinars. Additional point evaluation occurs in the field before sampling a point. Office and field rejection criteria can be found in the field protocol as well as the above mentioned document.

Point evaluation (field tracking): Crews fill out what sites were visited after every field trip in the field tracking spreadsheet see description above.

Iterative management of designs: Throughout the field season, project leads should manage their sample design according to the guidance provided in the AIM-NAMF Design management protocol and corresponding webinars (https://drive.google.com/open?id=0B1hu9Yn_LxR5TXIxQlliMjUwajg).

Submission of design management spreadsheet: At the end of the field season, project leads should submit a final version of this spreadsheet to NAMC with the final status of each sample point (Sampled, Non-Target, Inaccessible, or Unknown) filled in.
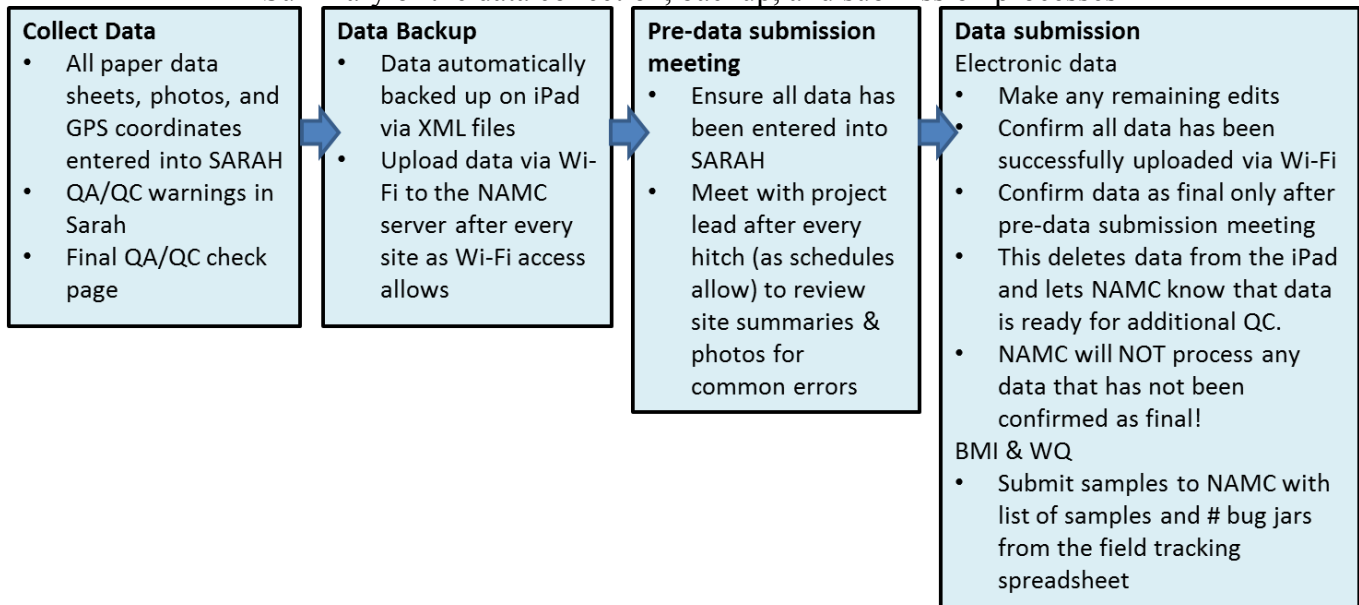
SARAH-Field Data Collection and Submission

Overview

The Stream and River Assessment Hub (SARAH) application is a FileMaker iPad data application developed in conjunction with EcoTechSolutions. SARAH is revised every year to address any quirks that arise throughout the field season and to continually improve data QA/QC and crew efficiency. Updates to the application can be made during the field season if any serious issues arise. Questions about iPad or SARAH use should be directed to Jennifer Courtwright at (985)502-7530.

All aquatic AIM data should be collected using the SARAH application and any data entered on paper data sheets must be entered into the SARAH application as soon as possible and prior to submitting data to NAMC for ingestion into AquaDat. Data entry should be intuitive to the user if they are familiar with the field protocol. Most layouts match closely to the protocol and do not require additional explanation. However, a few layouts are specific to the app and are described in more detail here.

SARAH is designed to allow as much flexibility in data collection workflow as possible, while still insuring data integrity and preventing missing data. Therefore, the app is designed for data entry in a semi-flexible order specified below. This protocol goes over the main screens of SARAH and the data entry workflow. SARAH QA/QC checks are then described to ensure crews understand the errors and warnings that SARAH gives and when they can and can't move on without fixing the errors. This protocol then describes the data backup and data submission process including the field tracking and pre-data submission meeting steps.

## Summary of the data collection, backup, and submission processes

Collect Data	Data Backup	Pre-data submission meeting	Data submission
• All paper data sheets, photos, and GPS coordinates entered into SARAH • QA/QC warnings in Sarah • Final QA/QC check page	• Data automatically backed up on iPad via XML files • Upload data via Wi-Fi to the NAMC server after every site as Wi-Fi access allows	• Ensure all data has been entered into SARAH • Meet with project lead after every hitch (as schedules allow) to review site summaries & photos for common errors	Electronic data • Make any remaining edits • Confirm all data has been successfully uploaded via Wi-Fi • Confirm data as final only after pre-data submission meeting • This deletes data from the iPad and lets NAMC know that data is ready for additional QC. • NAMC will NOT process any data that has not been confirmed as final! BMI & WQ • Submit samples to NAMC with list of samples and # bug jars from the field tracking spreadsheet

Field Tracking – chain of custody of data from data collection to data submission
• Crew records sites visited, field status, date sampled, sampling comments, and number of bug jars • Project lead signs off on data after pre-data submission meeting and makes notes on any unresolved data issues • NAMC confirms data was received

Main Menu

1. Open the "SARAH" app icon.
   - If the SARAH app does not automatically open, then tap the "FileMaker Go" app icon (both the FileMaker Go and SARAH apps will take you to the same program).
   - If the app opens at a previous site or different screen, exit out to the main screen using the provided "Main Menu" buttons before proceeding with data collection.

2. Once inside the app, the main menu has the below options to navigate. Buttons are in the general order that you would use them, going from data collection to data submission. The subsequent "Collect Data" section of this protocol focuses on the "Collect Data" and "View/Edit Previous Data" buttons. For information on the "Upload Data via Wifi" button and "Exit app" button see the Data Backup section of this protocol. For information on the "View Site Summaries", "View Site Photos", and "View Upload Status and Confirm Final Data" buttons see the Data Submission section of this protocol.
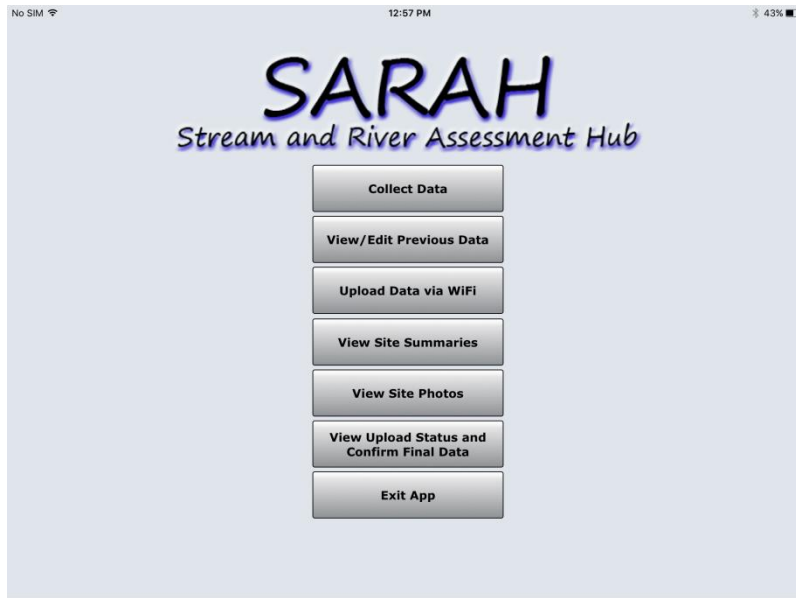
- ○ Collect Data = Initiate a New Site (most common option!)
- ○ View/Edit Previous = Search for an existing site
- ○ Upload Data via Wifi = Backup your data from the iPad to NAMC's online server
- ○ View Site Summaries = View summaries of your data during the pre-data submission meeting
- ○ View Site Photos = View photos and/or export them to a computer and for reference during the pre-data submission meeting
- ○ View Upload Status and Confirm Final Data = This button should be used to submit your data to NAMC. You can confirm that NAMC received your data via WiFi and submit your data as final after reviewing your site summaries, photos, and field tracking spreadsheet with your Project Lead or NAMC.
- ○ Exit App = Will take you to file storage within the app so that you can view exported photos, app files, and xml and csv backup files

3. To return to the main menu of the SARAH app from any screen, tap the BugLab logo in the upper left next to the text "Main Menu"
   - "Finish Site" will mark run "Final QA/QC"
   - Return to Main Menu and Finish later using "View/Edit Previous"

Collect Data

You can collect all data within one session and run final QA/QC data checks or you can exit back to the main menu at any time without running the final QA/QC data checks. To return to the site and finish data collection, use the "View Edit" previous button with appropriate filters. You can use as many or as few filters as you want but always make sure to double check that you are returning to the appropriate site and that there are not multiple records with the same site code. To view all sites that match your filters, use the < > arrows at the top to switch between records.
   - Troubleshooting tips:
     - If you accidently start a site by mistake, select "Test or Fake Data" as the Project and exit back to the main menu.
     - If you selected the wrong contingent indicators to collect, flag indicators that you are not collecting as not collected. DO NOT ENTER FAKE DATA. If you need to collect additional indicators that were not selected you will need to start the site over again.

General Layout/ Workflow

Navigating major screens and pages within a site:
   1. Indicator selection:
     - Consult your project lead for which indicators you are measuring
       - Select any contingent indicators that you are collecting
     - Two protocol modifications are also available
       - Alaska which collects only 5 pebbles per transect and does not collect pools
       - Adding additional bank stability plots to match MIM protocols
     - **Make sure that you select the correct indicators or modifications because you cannot return to this screen**

2. Verification page:

This must be filled out first and all fields on the first page must be completed! The comments page (access via the arrow at the bottom of the page) can be filled in during this time or revisited at the end of the site.

- Note that all random site codes associated with a project should be found in the site ID dropdown. However, targeted sites must be added using the "+" button. **TAKE ESPECIAL CARE TO ENTER TARGETED SITE CODES CORRECTLY!!!** All targeted site codes should also be entered on the design management spreadsheet. **Targeted site code naming conventions are slightly different from 2016 and must be gotten from NAMC!!!**
- Note that if your design management file indicates a site was merged. Make sure to indicate this on the comments page!

3. Additional pages:

Once the verification page is filled out you can move on to other pages in any order. In general, each page represents a set of protocols that "pass" of the reach. The current page is highlighted in blue. In general navigating from one page to another will initiate missing data checks. However, navigating between 'Transect,' 'LWD,' and 'Photos' will not initiate missing data checks.

4. Submenus:

Within a page, you have submenus. For example, within transects the page you have up to 7 submenus with the active submenu highlighted in blue. Additionally on the transects page, you have a transect bar on the left to navigate among transects. The active transects is displayed in a lighter color. Side channels will appear under the

'Bank' protocol tab. Intermediate transects will appear as a second column of buttons next to the main transect buttons if thalweg is not being collected. If thalweg is collected, intermediate transects can be accessed via a separate button on the thalweg page.
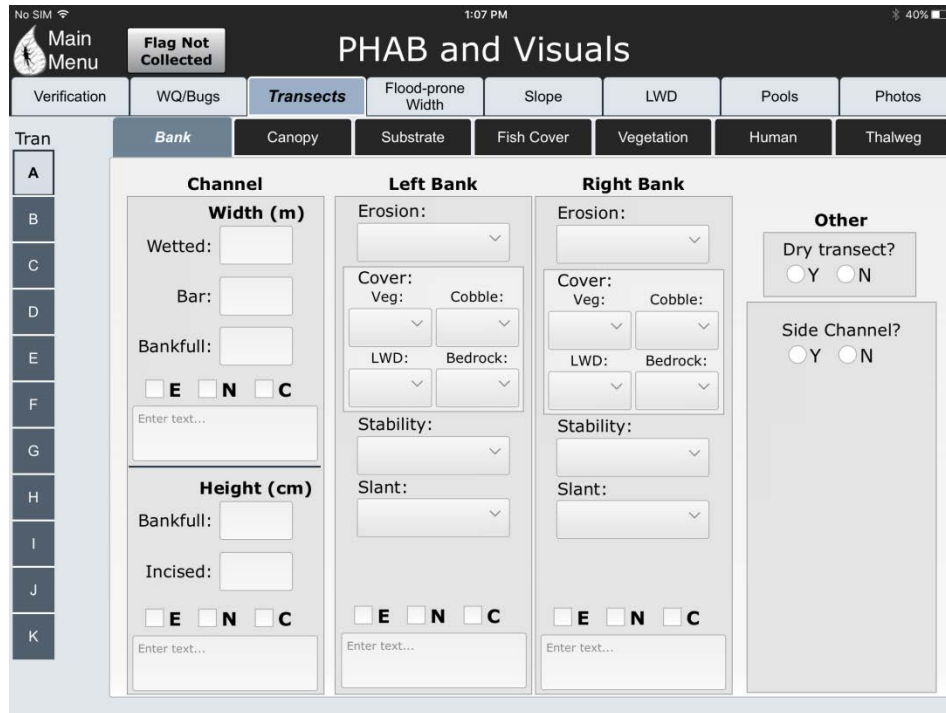
5. Workflow:
   - Verification - Must fill out all fields before filling out any other pages
     o Sampling comments can be filled out at any time during sampling, but are required for failed sites and will reappear on the final QA/QC page prior to finishing the site.
   - WQ - All information should be filled out at once
   - Bugs - may be filled out at any time but once you start this page you must fill in all fields except number of jars used.
   - Transects
     o Has three different workflow options:

       ▪ Physical habitat only-
         • Example use - If in a three-person crew, one person can do visual estimates on paper (entering data into the app later) while the other two do all other transect data collection.
       ▪ Visual estimates only-
         • Example use -While one person is doing bugs and water quality, another can be doing visual estimates. Once bugs are

complete, the crew can switch to collecting "PHAB only" or "All transect data" if the crew member doing visuals did not finish before the bugs were done.

- All transect data-
  - Example use - Bug data collection was very quick and the crew decided to do PHAB and visuals together in one pass.
- Within each of the workflow options, data can be collected in any order but all data at a given main transect (e.g. A) or intermediate transect (e.g. A-B) should be collected before moving on to the next transect. Otherwise the app will warn you that you having missing data, but you may return to enter it later.
- You cannot jump to an intermediate transect before collecting data at the corresponding main transect.
- You may jump between a transect and either the LWD page or the photos page without having any missing data checks run.
- Thalweg – if this is selected as a contingent indicator, it can be collected with the transect data (default) or can be collected as a separate pass. This option can be toggled on and off on the verification page.
- Bank stability – this should typically be collected within the transects workflow. However, if the more bank stability plot modification is selected, this will appear as a separate pass and tab not associated with transects.
- Flood Prone width – can be collected at any time
- LWD, slope and pools - can be collected at any time.
- Photos - can be taken at any time and can switch between any page and photos without missing data checks running

Good Data Entry Practices

Entry assistance

- For field data collection to proceed quickly, the fields, tabs, and buttons are given in the suggested workflow.
- To quickly navigate between fields (boxes), you can click the blue "Next" button that appears above the keyboard or you can click the return/enter button on the keyboard.

- Dropdown menus will automatically jump to the next field after a selection is made.

Flags and Comments

- Use the following flags to alert data analysts of potential issues with the data:
  - E = Estimated values. Comment should specify why the measurement is suspect, why it was estimated, or alternate methods used. When in doubt, record a value in the field, flag it as estimated, and leave a comment rather than leaving it blank and recording the estimated value in the comments.

- o N = Sample not collected. This includes areas blocked by barriers, such as brush or deep water that cannot be visually estimated. Comment should specify why the measurement could not be taken.
  - o C = Custom flag. This is for any other reason a comment is needed, such as noting odd conditions like high turbidity, or providing additional information not captured by the provided options. Comments should be detailed.
- Do NOT make extraneous comments such as "the sky is blue". This clutters the data and makes it hard to sort through the important comments.
- The "Sample Comments" field on the final QA/QC screen should be the comment field used to tell the data analyst of any general data issues such as any data needs to be omitted or changed.

Zeros are data too!!!!
- Make sure all fields are filled in or flagged "N" for not collected.
- Entering 0s can be onerous for certain fields such as fish cover, human influence and LWD. For these fields, a button is provided in the app that says "No fish cover" for example. This button will fill in all blank fields with 0 and leave the filled in fields alone.
- If a whole transect is not collected, select the "Flag Not Collected" button in the upper left corner of the screen when you are on the bank page associated with the transect that was not collected. This function can also be used on intermediate transects. This will flag any missing fields as not collected but leave collected fields alone.

Paper field forms
- All paper field forms should be entered into the iPad by the end of the day if at all possible. If this is not possible, data from field forms should be entered into the site prior to final data submission.
- All paper field forms or data notebooks should be scanned and uploaded to your project folder on the google drive. If no scanner is available, take a photo of the field form with the iPad and save the image to the google drive.

SARAH QA/QC Checks
1. Missing data
   - Missing checks are run according to the above workflow.
   - SiteID, Sample Status, pool survey status, reach length surveyed for pools, and whether slope was collected are all required fields prior to exiting a site regardless of where in the workflow you are.

- o If the site was entered by accident, select "Test or Fake data" as the project and site ID.
- If there are no missing values, no window appears and the app will proceed to the next page or transect.
- If there are missing values, they will be flagged in red and remain red until filled in. You can proceed without filling them in, by clicking "continue to next page".


Error: Empty Fields

Please review the empty fields before continuing to the next transect. If you are not sampling something, flag it and leave a comment.

| Continue to next page | Return to current page |

Angle:
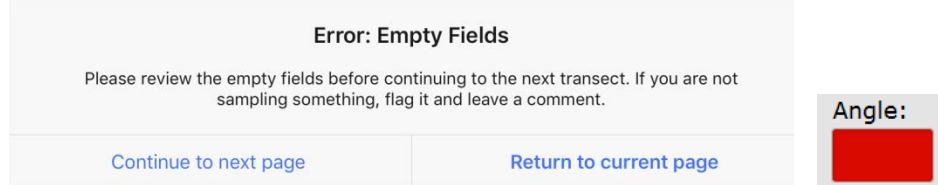
- Any values still missing at the end of the site without a proper "N" flag for "not collected" will be flagged again on the final QA/QC page before finishing the site.
- Missing data checks on transects only warn you of missing data the first time you try to change transects but missing fields remain red.
- Verification page fields are not optional but if they are all filled out and it still won't let you move on to transects try moving on to WQ first and then jump to transects.
- If an entire transect is not collected or most of a transect is not collected, there is a "Flag Not Collected" button that appears in the upper left hand corner next to the main menu when you are on the bank page. Selecting this will automatically flag all unpopulated data at that transect as "N" for not collected.

2. Legal values
- Certain fields have very specific ranges of possible values. For example:
  - o pH cannot be <0 or >14.
  - o Canopy cover cannot be <0 or >17.
- If you enter a value that is not within the range of legal values, the app will not let you leave the field without changing the value.

Error

pH must be between 0 and 14

OK
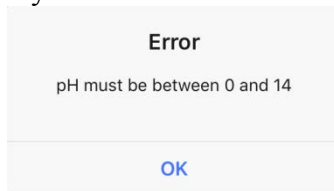
3. Typical values
- Certain fields (particularly water quality) have ranges that are not very likely to occur in nature. For example:
  - o pH can be <6 or >8.5 but it is pretty unlikely
- If you enter a value that is not within the range of typical values, the app will flag the value in yellow and you will get a pop window that tells you the "typical" range of values for the field.

- You can move on without changing the value but you should think carefully about whether your value makes sense.
- For water quality fields, you should recalibrate before deciding on a final value.
- If you choose to leave the value, you should flag the value and make a comment as to why you left the value.

4. Cross validation
   - These are logic checks based on the protocol. For example:
     - Wetted width cannot be greater than bankfull width
     - Bank height cannot be greater than incision height
   - You cannot leave the field without changing the value.

5. Final QA/QC page

- Outlier checks
  - At the end of a site, the app calculates the mean and standard deviation of bankfull width, bankfull height, and incision height across all transects.
  - Bankfull width and height and incision height should be determined using relatively continuous surfaces throughout the reach. Therefore, there should be minimal variation in these measurements.

- o Any values that are outside 2 standard deviations of the mean are flagged with hyperlinks.
- o 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.
- o Re-measure, omit, or flag the value if you do not feel confident in the measurement.
- o Note reasons for any remaining outliers in the final confirmation page.
- Final missing data checks
  - o Any remaining missing data will be flagged with a hyperlink that will take you back to the field to fill it in.
  - o Any data that was not collected should have the appropriate flag "N" (see below). Note that 0s are data to and should be filled in.
  - o Fields that have "N" flags will not be flagged as missing in this final check.
  - o Make sure if slope or pools were not collected that they are recorded as such in the dropdowns on each respective pages.
  - o If one or more transects of PHAB were not completed, classify the site as "partial" and note how many transects of PHAB 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.

6. <u>Indicator specific checks and automatic calculations</u>
   - Verification
     - o Reach length and transect spacing is computed by averaging the five typical bankfull widths. The number of thalweg stations and the location of the middle station are also based on the computed reach length.
       - ▪ Because this is such an important field, there is an outlier check to make sure that these values are correct. If flagged, please check over these values carefully before proceeding and consider if your values are "typical" of the reach.
     - o The point coordinates are compared to the original design coordinates and if they are more than the allowable moving distance a warning pops up.
   - WQ/Bugs
     - o The sampling area and total area sampled for benthic macroinvertebrates is automatically calculated based on the style of sampler net and the collection method that the user selects.
     - o There is a cross validation check on the # of locations sampled and the bug method used. If reachwide is selected, then the # of locations sampled should be 11 and if the targeted riffle is selected then the # of locations sampled should be 8.

- o If it has been more than 7 days since the recorded YSI calibration date, the app will warn you that you need to calibrate or provide a comment.
  - o Adding additional instrument ids (WQ-sonde) is possible, but should only be done if the desired value is not in the dropdown menu. Extreme care should be taken to enter data in the same format every time so that data can easily be tracked an analyzed.
  - o All YSIs should have the capability for collecting temperature corrected conductivity values so if "No" is selected for "Temp Corrected?" you will receive a warning that a comment should be provided.
- Transects
  - o If an entire transect is not collected or most of a transect is not collected, there is a "Flag Not Collected" button that appears in the upper left hand corner next to the main menu when you are on the bank page. Selecting this will automatically flag all unpopulated data at that transect as "N" for not collected.
  - o Bank angle is automatically subtracted from 180° if the angle is obtuse. Do not perform this calculation in your head, or you will receive a warning message.
  - o Substrate
    - o Non-measureable substrate types are automatically defaulted to the desired alpha numeric values as follows:
      - ▪ Fine = 1 (too small to measure)
      - ▪ Sand = 2 (too small to measure)
      - ▪ Bedrock = 4097 (too large to measure)
      - ▪ Hardpan = 4098 (compacted fines, but acts like bedrock)
    - o The app checks to make sure there are at least 5 pebbles collected from the "wetted" channel or "dry-middle". If there are not enough it will warn you, and add the number of additional pebbles needed to the top of the screen. Replace the -99 value with the approximate location. The location must be unique. If the distance from the left bank is exactly the same as a previous pebble but upstream or downstream add a ".1" to the value.
    - o There is an "All wet" button on substrate that auto-populates the location with "wet". If the transect is flagged as dry on the "bank" page, then an "All dry button" also appears with similar functionality.
  - o Visuals
    - ▪ The "no fish cover", "no land use", and "no development" buttons fill in 0 for any blank fields but do not replace the measurements already entered.
    - ▪ Fish cover is automatically populated as all "0" if the transect is selected as dry.
    - ▪ The total % cover of each vegetation layer (canopy, understory, ground) can't exceed 100. Therefore, the app will not allow the user to enter two 4s or a 3 and a 4 for the same layer. If this is accidently done, a pop window

<u>will appear and you can only move on after changing the value that was most recently entered.</u>

- Flood-prone height
    - Flood-prone height is automatically calculated when the user enters the max water depth in the flood-prone width layout. If the flood-prone width is > 3 times the bankfull width, the user may tap the "Set Max" button to automatically calculate the max flood-prone width.
- Slope
    - Slope is calculated by subtracting the Start and End Heights. This can result in both positive and negative values, so make sure you are working in a consistent direction for each Pass.
    - When you tap the "Finish or add new pass" button, individual shots are summed and checks are run to see if multiple passes are within 10% of one another. If the first two passes are within 10%, it will not let you add a third pass.
    - At the end of slope, the two passes within 10% are averaged to get the Mean Elevation Change and then this number is converted to m and divided by the slope reach length (automatically calculated as the distance between the start and end transects) to get the Percent Grade for the reach. Both the Mean Elevation Change and Percent Grade are displayed so that the user can double check that these summary statistics are reasonable.
- Pools
    - Pools are checked to make sure the maximum depth is greater than 1.5 times the tail depth, as required to be a qualifying pool.
    - Pool reach length is automatically filled in with the total reach length if "Collected is selected" or 0 if "Not Collected" is selected.
    - Pool tail fines are also checked to ensure that the sum of the number of <2 mm intersections and non-measurable intersections or the sum of the number of < 6 mm intersections and non-measureable intersections is less than 50. Additionally the number of < 2mm intersections must be ≤ the number of < 6 mm intersections.
    - Once you start a row within the pool tail fines grid, you must fill out <2 mm, < 6mm, and Non-Meas.
- LWD
    - Tapping the "plus" button will add one to the measurement in the cell allowing easy tally of LWD.
    - The "No pieces within bankfull" or "no pieces above bankfull" will populate all unfilled out cells with "0"s. It will not replace any already entered data with a "0".

Data Backup

<u>Automatic data backup</u>

Data is automatically backed up on the iPad after running the final QA/QC checks or after exiting back to the main menu. This process should take a minute or less. If it is taking more see the troubleshooting section below. Note that there is no save button within a site because data are automatically saved when you enter data in a field. However if the app crashes while entering data on a page, data on the current page may be lost.

- Backups of data are in the form of XML files that are named with the site code, unique database ID, and the date the backup was created. A new backup file is created for each day that you edit that site's data. Backups of data remain on the iPad even after data has been confirmed as final and deleted from the main database.
- Csvs with site summary data are also automatically generated and are saved with the iPad device ID and the week that the csv was generated. Csvs are over written every time data is edited, and all sites from the field season should appear in them regardless of whether the data has been confirmed as final and deleted from the main database. However, a new csv will be generated each week as a backup. Make sure you are always viewing the csv from the most recent week.
- Backups XMLs and csvs can be accessed using the "Exit App" button described below.
- Troubleshooting Tips
  - The automatic backup process should take a minute or less.
    - If it is taking more than 10 minutes, make sure the screen was active for the whole 10 minutes. You can change the timeout duration by going to "settings", "general", "auto lock", and selecting "Never".
    - If you still get a never ending spinning wheel, swipe up to close the app and try entering and exiting the site again after moving to a different window within the site. Additionally, check to make sure that a backup was created by going to the "View all Backups" button within the "View Upload Status and Confirm Final Data" button.

<u>Upload Data via Wi-Fi</u>

As soon as you get Wi-Fi, backup all collected data to date to NAMC's online server by clicking the "Upload Data via Wi-Fi" button on the main menu. Do this as frequently as possible, preferably after every site if access to Wi-Fi connection allows. It MUST be done at least after every three sites. <u>You must re-upload data via Wi-Fi after any edits are made.</u> You will receive a pop-up window indicating whether the backups were successfully received or not. You have the ability to back up your photos at this time or later when you have a better connection.

Success!

1 backup(s) out of 1 sent were successfully uploaded to the server.

OK
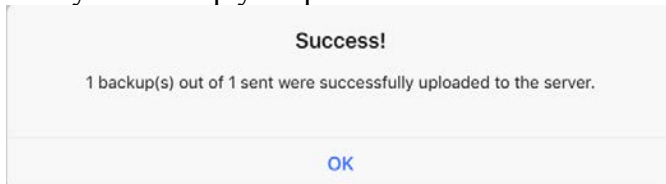
- Troubleshooting Tips
  - If the data upload process takes more than 10 minutes, you likely have a slow internet connection and may want to wait until a better connection is available. Additionally, uploading data more frequently will lessen the amount

of data transferred each time you upload and therefore can also lessen the time it takes to upload.

  o If you get a failure message for 1 or more backups, try submitting data again with a different or better Wi-Fi connection.
  o If you still get a failure message, go to the "View all Backups" button within the "View Upload Status and Confirm Final Data" main menu button to view which backups failed to upload. Make note of the site code and date the backup was created. Then go to "exit app" to find the XML file with that site code and date. Upload this xml file to your project folder on the google drive and then send Jennifer (jennifer.courtwright@usu.edu) an email detailing issue. Make sure to include the site code, date of the backup, and date and time you tried to submit the data, as well as any other useful information about quirks in the data collection process that might have caused the issue.

Exit App

The "Exit App" button on the main menu should generally only be used for backup troubleshooting purposes and to get access to raw backup files such as exported photos or XMLs. This function is also used if you need to download a new version of SARAH.

- To view backup XMLs and csvs, click the "Exit App" button on the main menu. This should take you to a file viewer that should have the SARAH application database (file folder icon) along with any backup XMLs and csvs.
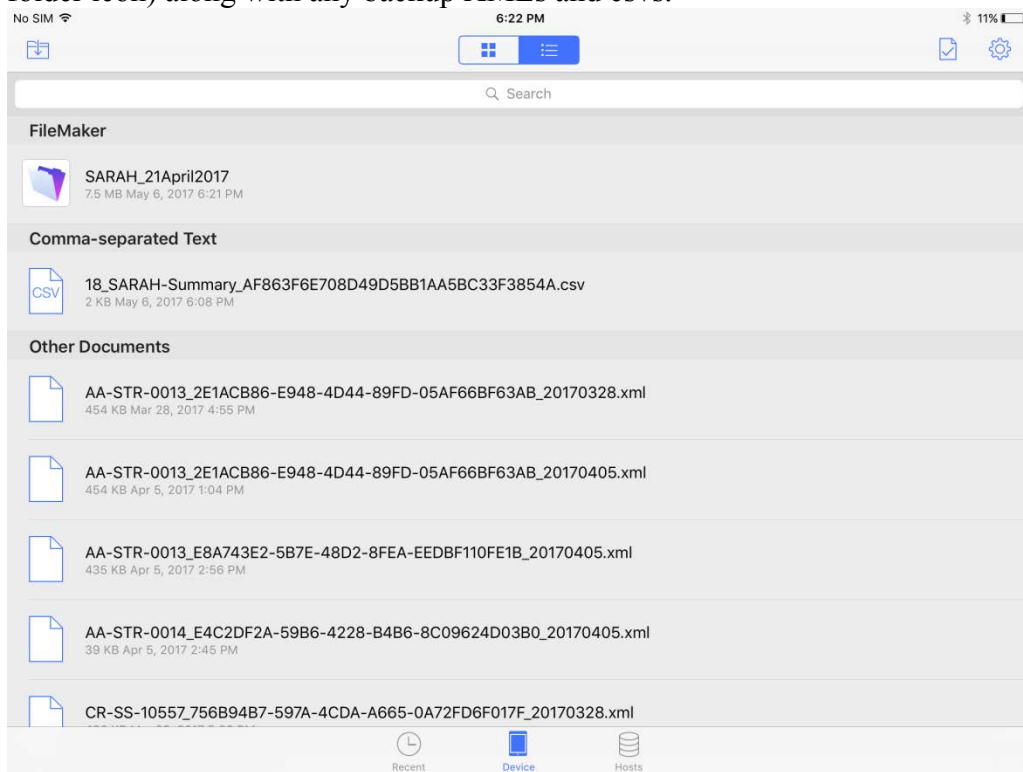
- If you can't find the files you are looking for, make sure you have selected "device" on the bottom of the screen rather than "recent".
- To upload files to the google drive or to email files from this screen, select the paper with the check box in the upper right hand corner of the screen (See picture above). Then click

the upload button (box with the arrow) and select the google drive or mail icons (see picture below).
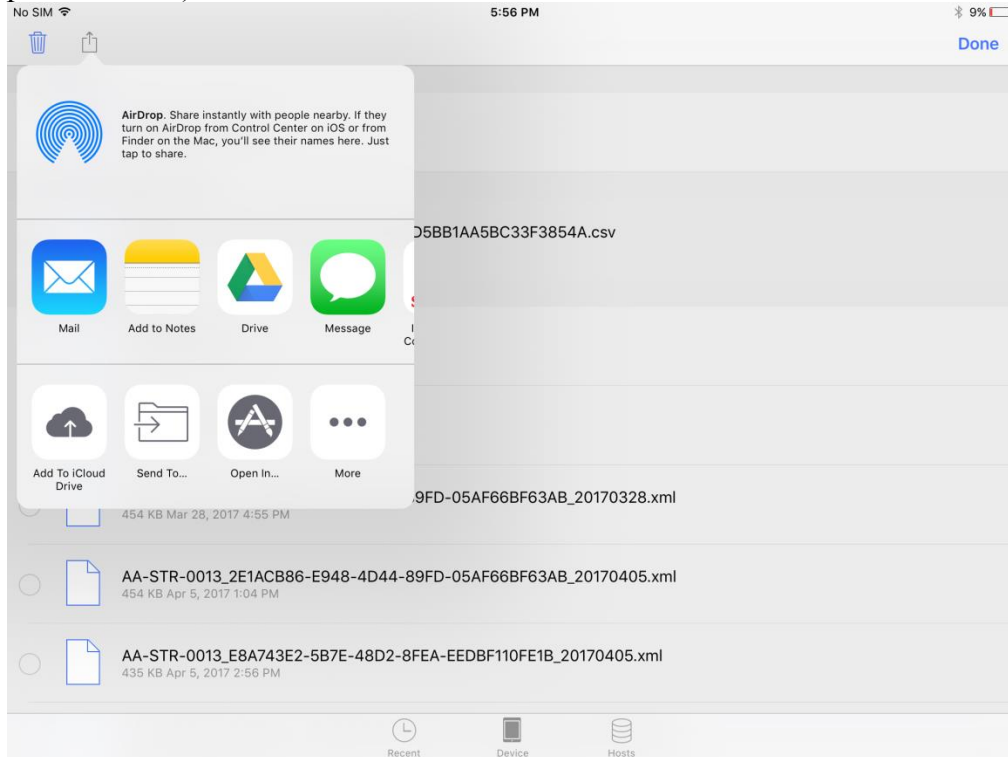
- NEVER delete files from this screen unless you have uploaded them to the google drive or are told to by Jennifer.
- Site photos that have been exported using the "View Photos" button on the main menu can be found here. Photos remain in this window even after deleting data from the main database. Photos may need to be deleted periodically from this screen manually to prevent app file size from getting too large.
- If you have multiple versions of the SARAH app on your iPad, you can use this screen to select which one you want to collect data with.
- You should NEVER delete a SARAH app on your iPad without uploading the file first to the google drive. If the file is too large to upload, contact Jennifer (jennifer.courtwright@usu.edu) for further instructions.
- You can view the version of SARAH that you are using by clicking on the Filemaker app file. A start up screen will appear with the SARAH, BLM, and NAMC logo. In the lower right hand corner, there should be a version number with a prefix of "v". Always make sure you are using the most up to date version.

Data Submission

Field Tracking

The field tracking is a spreadsheet should be filled out for any site that was visited and is used both for design management purposes as well as a chain of custody form for electronic data submission and BMI and WQ sample submission. Fill in the Field Tracking tab within the Design Management spreadsheet on the google drive for all visited sites. This can be done after each site or all at once at the end of the hitch.

1. Crews fill out the site code, date visited, field status, field comments, and # bug jars. These fields can all be copy and pasted from the automatically exported csv saved on the google drive after uploading data via wi-fi.
2. Project leads sign off on the data after the pre-data submission meeting described below.
3. NAMC verifies that submitted data was received.

Field Tracking

Trip	StartDate	SiteCode	StreamName	Latitude	Longitude	ScoutComment	PlanningNotes	Visit Date	Field Status	Field Comments	# bug jars	Data Checked by Project Lead	Data Received by NAMC
1	6/12/2016	PR-SS-10044	Ford Creek	39.784	-110.949	Straight forward	Longer hike	6/12/16	Sampled - Full Reach		3		
1	6/12/2016	PR-SS-10108		39.430	-110.659	Straight forward	Easy access form road	6/13/16	Sampled - Full Reach	Heavily impacted by cattle	4		
1	6/12/2016	PR-LS-10812	Soldier Creek	39.590	-110.643	Possibly Dry	Easy access, just off of Soldier Creek Rd.	6/14/16	Revisit - Different route or permission	Could not get in contact with the landowner. Schedule a revisit.	NA		
1	6/12/2016	PR-LS-10812	Soldier Creek	39.590	-110.643	Possibly Dry		6/14/16	Sampled - Partial Reach	4 dry transects	2		
1	6/28/2016	PR-LS-11836	Soldier Creek	39.678	-110.624	Straight forward	Only needed if PR-LS-10812 is dry; Call landowner Jane Doe 435-888-1234 the day before sampling to make arrangements to pick up a gate key	NA		not needed			

Visit Date	Field Status	Field Comments	# bug jars
6/12/16	Sampled - Full Reach		3
6/13/16	Sampled - Full Reach	Heavily impacted by cattle	4
6/14/16	Revisit - Different route or permission	Could not get in contact with the landowner. Schedule a revisit.	NA
6/14/16	Sampled - Partial Reach	4 dry transects	2

✓ **Field Crew** fills out visit date and "**Sample Status**" columns after every trip

✓ **Project lead** checks data

✓ **NAMC** verifies that data has been submitted

Pre-data submission meeting

After completing data collection, use the "View Site Summaries" and "View Photos" buttons on the main menu to view the site summary paired with site photos with your project lead to catch any frequent data errors prior to submission.

Steps
1. Make sure any external data collection such as GPS coordinates, photos, or paper field forms get input into the correct fields in SARAH prior to the pre-data submission meeting.
2. Meet with your project lead to review the site summaries and photos as a final step in your QA/QC process.
   - If your project lead can meet in person, click the "View Site Summaries" button on the main menu and the "View Photos" button on the main menu to review the data.
     - Photos within the "View Photos" screen are larger than within the main app screen to facilitate better viewing, but if desired, photos can be exported using the "Export" button. This exports photos as separate jpegs that can be viewed within the FileMaker app. To access the photos and upload them to the google drive or email, see "exit app" instructions under the data backup section.
   - If your project lead can't meet in person to view the site summary on the iPad, a csv is automatically exported and saved to the project folder on google drive. This file can also be found on the iPad by exiting the app and viewing all the files on the device (see "exit app" instructions under the data backup section).
3. The purpose of the meeting is the following:
   a. Verify the sample status of all sites.
   b. Verify the crew did not move the point more than the allowable distance, and if there are any concerns, plot the coordinates.
   c. Verify the crew collected all needed indicators.
   d. Verify all paper data was entered into the app.

e. Verify that all WQ and bug samples are appropriately logged and labeled.
f. Review pH and conductivity measurements and the paper calibration log in each YSI case.
g. Review photos and incision and bankfull height and width means.
h. Review all general site comments to discuss any other special protocol situations that might have arisen such as partial data, side channels, dry transects, or beaver impacts.

4. See Appendix A for tables describing all fields in the csv and common problems or things to check associated with each field. **This list can seem overwhelming but keep in mind that checking for missing data in any of these fields and reviewing accuracy of geomorphic surfaces are the most important things to focus on for this check.** NAMC will do additional checks on the rest of fields. However, missing data can't be easily corrected once sent to NAMC, and accuracy of geomorphic surfaces is best assessed via conversations with crews. Making sure crews are following special protocol situations such as interrupted flow sites is also best assessed via conversations with crews and is important to catch any errors early in the field season.

5. Make corrections as needed to the raw data after the meeting and upload data via Wi-Fi again after all edits have been made.

6. Record all unresolved issues in the notes column within the field tracking spreadsheet.

<u>Submit data</u>

Electronic data submission
Use the "View Upload Status and Confirm Final Data" button on the main menu to submit your final data. Confirming data as final will notify NAMC that the data is final and further QC and statistics are ready to be run and calculated. NAMC will NOT process any data that has not been confirmed as final so make sure that this step is completed for all sites!

No SIM		6:20 PM			⚡ 11% 🔋
🌀 **Main Menu**	**View all Backups**	**View Upload Status And Confirm Final Data**		**Confirm Final Data and Delete Checked**	
Site ID	**Location Name**	**Sample Date**	**Backup Date**	**All Backups Uploaded**	**Final Data?**
TestorFake Data	TestorFake Data	5/1/2017	5/3/2017 10:14:04 AM	Yes	
TestorFake Data	TestorFake Data	5/4/2017	5/4/2017 1:38:55 PM	Yes	✕

Steps
1. Click the "View Upload Status and Confirm Final Data button. This will take you to a screen that has a list of all sites collected throughout the field season.
2. Make sure your project lead has signed off on your field tracking sheet prior to confirming data as final.
3. Make sure all desired data edits have been made and all backups were successfully uploaded via Wi-Fi. If all backups were not successfully uploaded, see the troubleshooting directions within the data backup section. Do NOT mark data as final if all backups have not been uploaded! Doing so and then clicking "Confirm Final Data and

Delete Checked" will permanently delete data unless backups have been separately uploaded to the google drive!

4. Check the final data button next to the desired site. This step can be reversed if need be.
5. Then click the "Confirm Final Data and Delete Checked" button. This step is <u>irreversible</u>, will remove the raw data from the FileMaker database, and edits for this site will no longer be able to be made. Deleting the raw data from the iPad prevents the database from getting to large and causing app quirks. You will still be able to access the site summary, any exported photos, and any backup XML files or csvs.

BMI and WQ data submission

It is important to track the chain of custody of BMI and WQ samples.

Steps
1. Throughout the field season, use the field tracking spreadsheet to record number of bug jars.
2. Prior to submission, make a copy of the field tracking spreadsheet, delete any unsampled sites, delete all columns except for the following: site code, date sampled, # of bug jars.
3. Count all bug jars to make sure that the number sent to NAMC matches that on the spreadsheet.
4. If your project collected WQ but WQ was not collected at all sites, make sure to note which sites should not have WQ samples on this same spreadsheet.
5. Print the spreadsheet and save it on the google drive. Send the paper copy in with BMI and WQ samples.
6. Make sure to contact NAMC to let us know they are coming. If bug data for 3-5 samples are higher priority than others, please indicate this as well on the spreadsheet and when contacting us.

Frequently Asked Questions and Troubleshooting

1. Q: I accidently clicked on data collection and am not ready to enter data but I can't get back to the main menu.
   A: To get back to the main menu, you need to continue through the indicator selection page and then select "Test/Fake Data" as the project and site code. Select that pools and slope were not collected, then exit the site to the Main Menu.

2. Q: I selected the wrong contingent indicators.
   A: If you selected the wrong contingent indicators to collect, flag indicators that you are not collecting as "not collected." DO NOT ENTER FAKE DATA. If you need to collect additional indicators that were not selected you will need to start the site over again.

3. Q: What site code do I use for targeted sites?
   A: Project leads should contact NAMC for site codes for targeted sites. All targeted sites should then been added to the bottom of the design management spreadsheet with proper site codes. Contact NAMC for a site code if this was not done! Note targeted site code naming conventions are slightly different than 2016.

4. Q: I can't get off of a page because of the missing data checks or other QC checks.
   A: Go to the appropriate missing data or QA/QC section above that matches where you are stuck and determine why you can't move on. In general, missing data checks should never prevent you from moving on. Exceptions are SiteCode, Sample Status, pool survey status, reach length surveyed for pools, and whether slope was collected, which are all required fields prior to exiting a site regardless of where in the workflow you are. You must complete all fields on the WQ or bug pages once you start them, except for the number of bug jars used. Never enter fake data to move on to the next screen. If you did not collect data, make sure to flag data as "N" for not collected. QA/QC checks should only prevent you from moving on if you entered an illegal value. The message should tell you what legal values are for the field. If all else fails, double click the home button and swipe up to exit the app and then try going back into the app and the site again.

5. Q: I get a spinning wheel of "death" that never stops. What should I do?
   A: If it is taking more than 10 minutes, make sure the screen was active for the whole 10 minutes. You can change the timeout duration by going to "settings", "general", "auto lock", and selecting "Never". If you still get a never ending spinning wheel, double click the home button and swipe up to close the app and try entering and exiting the site again after moving to a different window within the site. Additionally, if the spinning wheel occurred when you tried to exit a site, check to make sure that a backup was created by going to the "View all Backups" button within the "View Upload Status and Confirm Final Data" button. If a backup was not created and all attempts to enter and exit the site again don't fix the problem, call Jennifer (985-502-7530) ASAP to troubleshoot!

6. Q: How and when do I backup my data?
    A: Your data are automatically backed up on the iPad via XML files every time you exit a site. However, we additionally require you to back up your data via Wi-Fi, using the upload data via Wi-Fi button. This should be done after every site if Wi-Fi connection allows but at a minimum should be done after every 3 sites. Note that there is no save button within a site because data are automatically saved when you enter data in a field. However if the app crashes while entering data on a page, data on the current page may be lost.

7. Q: What do I do if I get a failure message when I try to upload data?
    A: Try again with a different or better Wi-Fi connection. If you still get a failure message, go to the "View all Backups" button within the "View Upload Status and Confirm Final Data" button to view which backups failed to upload. Make note of the site code and date the backup was created. Then go to "exit app" to find the XML file with that site code and date. Upload this xml file to your project folder on the google drive and then send Jennifer (jennifer.courtwright@usu.edu) an email detailing issue. Make sure to include the site code, date of the backup, and date and time you tried to submit the data, as well as any other useful information about quirks in the data collection process that might have caused the issue.

8. Q: How and when do I confirm my data as final?
    A: You can confirm your data as final after you have meet with your project lead or NAMC to review your site summaries and field tracking sheet. Then make sure all desired data edits have been made. To confirm the data as final, click the "View upload status and confirm final data button". Find the desired site and make sure all backups have been uploaded via Wi-Fi. If so, check the final data button next to the desired site. Then click the "Confirm Final Data and Delete Checked" button. This step is irreversible, will remove the data from the Filemaker database, and edits for this site will no longer be able to be made.

9. Q: When is it OK to delete data?
    A: You should be confirming data as final after meeting with your project lead or NAMC, after all desired edits have been made, and after you have confirmed that all backups for the site have been successfully uploaded. This confirmation does three things:
    1. It deletes the raw data from the iPad.
    2. It sends a message to NAMC that further QC and analysis can be done on the data.
    3. It prevents the Filemaker app from taking up too much memory/space, which could start to cause app malfunctions.
    You will still be able to access the site summary, any exported photos, and any backup XML files or csvs. Never delete the backup XML files or csvs. You may want to delete exported photos at some point to prevent Filemaker app size from getting too large.

10. Q: What do I do if my iPad cracks or is overheating?

A: If your iPad cracks make sure that you keep it as waterproof as possible.Put packing tape over the crack to keep water out and to keep the glass in place. Call Jennifer (985-502-7530) to let her know what happened ASAP to determine if a replacement iPad is needed.

If you iPad is overheating, make sure the case and screen are waterproof and then splash a little bit of water on the outside of the case and/or screen to cool it off. Try to shield the screen from direct sunlight as much as possible.

11. Q: How do I tell if I have the most recent version of SARAH?
    A: Click "exit app" from the main menu to get to the BLM logo and start up screen below. The version number can be found on the lower right hand corner of the screen with a "v" in front of it. Check aim.aquatics email for any recent messages from Jennifer indicating what the latest version of the app should be.

Appendix A. Description of fields in the site summary csv and guidance to check for common errors

Data Type	Column	Description	Possible values or example data	Common problems or things to check
Site Information	z_Week	Week of the year	18	NA
	pk_Sample Event	UID- unique database identifier.	C582F88B-DDF6-4CA3-865E-F50E519E9930	NA
	Project	Project assigned in the design phase to the site	UT_WD_STANDARD_2016	NA
	Site ID	Design site code	SL-SS-12345	Make sure you don't have multiple rows in the csv with the same site code for a sampled site. If you do, this indicates that the crew entered some of the data is in one record while the rest is in another. If the data is minimal in one record have the crew entered all data into only one record. If there is too much data to feasibly do this, record this error in the field tracking spreadsheet so that NAMC can merge the two datasets after the fact (this should be reserved for a last resort, it is very difficult).
	Location Name	Stream name	Big Creek	Make sure targeted sites have a stream name. This facilitates easy querying of data.
	Date Collected	Date the site was sampled	5/4/2017	NA
Comments	Sample Comment	Comment crew made on verification page regarding any data related issues such as missing data or transects that need data switched	Full site except ran out of time for slope	Bring any unresolved critical issues raised in the comments to NAMC's attention by adding them to the notes column in the field tracking spreadsheet. This field can also be used to check the site status and designation categories.
	Access Comment	Comment crew made on verification page regarding how they accessed the site	Take HWY 2 off of I70 and site is easy access right off the road	This can be used to assist other crews that might reattempt the site and can also be used to check the site status and designation categories.

Data Type	Column	Description	Possible values or example data	Common problems or things to check
Site Information	Site Status	The highest level site evaluation categories	One of the following categories: Sampled-Wadeable, Sampled-Boatable, Revisit, Permanently inaccessible, Non-target	Make sure crews are distinguishing properly between sites that can be revisited and successfully sampled at a later date vs. those that should be written off as permanently inaccessible. Additionally, make sure crews are distinguishing properly between sites that are non-target vs. inaccessible because this distinction has implications for design management and bias introduced into designs. Consult pg 15-20 of TR 1752-2 and the rejection criteria and directions in the design management protocol if questions arise.
	Designation	More specific site evaluation categories	One of the following categories: Sampled, Partially Sampled, Interrupted Flow Sampled, Different route or permission needed, Other, Access denied - Private, Access denied Terrain, Non-Wadeable -Too High, Non-Wadeable - Boatable, Dry - Ephemeral, Dry-Intermittent, Lentic system, Map error	Make sure crews are properly distinguishing between sampled, partially sampled, and interrupted flow sampled. These categories influence what indicators are able to be computed and assist with QC checks that make sure the crew followed the appropriate special situations protocols. Consult crew comments, additional fields in the csv (special situations) and pg 15-20 TR 1735-2 if unsure about what category the site should have been. Properly distinguishing among failed site categories assists with knowing what additional information is needed to successfully sample the site or if the site is permanently inaccessible what bias not sampling the site might impart on the data (i.e. remote sites might be in better condition that sites along a private road).
	Indicators Used	A list of the contingent indicators that the crew selected to be collected	Bank Angle Thalweg Profile Fish Cover Pool Tail Fines Total Nitrogen Total Phosphorous Turbidity	Make sure the crew selected the appropriate contingent indicators for the project as specified in the monitoring design worksheet.

Data Type	Column	Description	Possible values or example data	Common problems or things to check
Bug and WQ	Bug Collection Method	Bug protocol used	One of the following categories: Reach Wide, Targeted Riffle	Used to check the bug area sampled. This is a required field and critical information.
	Bug Sampler	The kind of net used to sample bugs	One of the following categories: Hess Net, Kick Net, Mini Surber Net, Surber Net	Used to check the bug area sampled. Note hess nets should have an area of 0.086 and mini-surbers have an area of 0.041 vs. 0.93 for a surber or kick net so if these are used the total area will differ from the 2 values listed below.
	Bug Area Sampled	Total area sampled for bugs in m^2 (number of locations sampled * net area). This information is critical to calculate BMI densities.	Should be 1.02 for reach wide methods or 0.74 for targeted riffle methods if a kick net or surber net was used	If the value is something other than 1.02 or 0.74, ask the crew how many locations were sampled and why they deviated from the protocol. This is a required field and critical information
	Bug Num Jars	Number of jars used to preserve bug samples	Typically around 3-4 jars are used	If crews consistently have a large number of jars (7+), they may be incorrectly applying the protocol and digging too much in the muck. If crews consistently have only one jar per site they may not be sufficiently collecting bugs or may be removing all vegetation. Crews may frequently forget to fill this field out but it is important for making sure all jars are submitted to NAMC.
	pH	Value measured by crew (SU)	Typical pH values are 6-8.5	Check with crew to confirm values if outside typical range. For any extreme values ensure the crew checked the YSI calibration.
	Conductivity	Value measured by crew (uS)	Typical Conductivity values are 30-1,000	Check with crew to confirm values if outside typical range. For any extreme values ensure the crew checked the YSI calibration. Add a comment in the Field Tracking spreadsheet if local knowledge of the site confirms this outlier (e.g., local geology has large salt deposits and conductivity is naturally high)
	Temp Corrected	Whether conductivity was corrected for temperature.	Y, N	All YSIs should have this capability and any samples not corrected for temperature should be suspect.
	Temperature	Value measured by crew (°C)	Typical values are 5-30	Check with crew to confirm values if outside typical range.
	Turbidity	Value measured by crew (NTU)	Typical values are 0-4000	Check to make sure units are NTU; crews in the past have recorded values in AU, which can't be easily converted to NTU.

Data Type	Column	Description	Possible values or example data	Common problems or things to check
Channel Measurements	Mean Floodplain Height	Average floodplain height (cm) across all 11 transects	Typical values are 0-250	Look at pictures to make sure these geomorphic surfaces were correctly identified. This should at least be done on the first couple hitches but should be done any time the crew is unsure or values are outside the typical range.
	Mean Bankfull Height	Average bankfull height (cm) across all 11 transects	Typical values are 0-250	Look at pictures to make sure these geomorphic surfaces were correctly identified. This should at least be done on the first couple hitches but should be done any time the crew is unsure or values are outside the typical range.
	Mean Wetted Width	Average wetted width (m) across all 21 transects	Typical values are 0.1 -10	This can be used for context to evaluate other fields in the csv.
	Mean Bankfull Width	Average bankfull width (m) across all 11 transects	Typical values are 1-30	Look at pictures to make sure these geomorphic surfaces were correctly identified. This should at least be done on the first couple hitches but should be done any time the crew is unsure or values are outside the typical range.
	Mean Elevation Change	Average change in elevation from the top of the reach to the bottom of the reach (cm) as measured by the average of the two passes of slope that are with 10% of each other.	Typical values are 20 -1800	Unit issues are common with slope so check values to make sure they are not an order of magnitude off based on photos and other available site context information.
	Pct Grade	Percent slope of the reach- the mean elevation change (converted to m) divided by the reach length for which slope was measured.	Typical values are 0.1 -14	Unit issues are common with slope so check values to make sure they are not an order of magnitude off based on photos and other available site context information.

Data Type	Column	Description	Possible values or example data	Common problems or things to check
Special Situations	Beaver Signs	Categorical assessment of the amount of beaver signs within the reach	One of the following categories: Absent, Rare, Common	This field should be used to double check the site status and designation and for fodder to discuss any protocol questions the crew may have had regarding the beaver special situation protocol.
	Beaver Flow Modifications	Categorical assessment of the amount of beaver flow modification within the reach	One of the following categories: None, Minor, Major	This field should be used to double check the site status and designation and for fodder to discuss any protocol questions the crew may have had regarding the beaver special situation protocol.
	Water Withdrawals	Whether water withdrawals were present within the reach	Absent, Present	This field is useful immediate information for the field office and can also be used to double check the site status and designation.
	Num Dry Transects	The number of transects recorded as dry out of 21	Typical values are 0-11	This field should be used to double check the site status and designation and for fodder to discuss any protocol questions the crew may have had regarding the interrupted flow special situation protocol. If there are any dry transects the site's Designation should be Interrupted Flow Sampled.
	Pools Collected	Categories of indicating whether pools were collected	One of the following categories: Collected, Partial Collected/Partial Flow, No Flow, No Pools, Not Collected	This designation should be examined carefully in the presence of dry transects to make sure the crew only assessed flowing portions of the reach and if there was no flow indicated this and did not collect pool data. Additionally check that crews are distinguishing properly between No Pools and Not Collected.
	Pool Reach Length	The length of the reach assessed for pools	Possible values are 150-4000	This field should be examined carefully in the presence of dry transects to make sure the crew only assessed flowing portions of the reach. This field is required but is often inaccurate. If pools were Collected, this field should equal the reach length. If Partial Collected/Partial Flow is selected, this field should be the length of reach assessed for pools and must be less than the reach length.

Data Type	Column	Description	Possible values or example data	Common problems or things to check
Special Situations	Partial_ Num Incomplete Transects	The number of transects not sampled or incompletely sampled	Possible values are 0-6	This field should be used to double check the site status and designation and for fodder to discuss any protocol questions the crew may have regarding the partial data collection special situation protocol.
	Partial_ Reach Length	The reach length sampled if less than the total reach length supposed to be sampled according the average bankfull width for the stream.	Possible values are 75-4000	This value is most important for calculating sinuosity and this should correspond to where the bottom and top of reach coordinates were taken. Additionally this field should be used to double check the site status and designation and for fodder to discuss any protocol questions the crew may have regarding the partial data collection special situation protocol.
	Reach Length	Automatically calculated field from average bankfull widths. Note this is reach length is not the sampled reach length for partial reaches, rather it is the reach length that should have been sampled according to the protocol.	Possible values are 150-4000	This field provides context for the rest of the csv information including the partial reach length so one can determine how much of the reach was not sampled. Additionally, this is an automatically calculated field so if reaches were shorten to maintain compatibility with historical monitoring and is different than the value in this file that should be highlighted in the field tracking notes for NAMC. Reach lengths for boating sites have been calculated incorrectly in the past so this value should be double checked with bankfull width and BR and TR coordinates for boating sites.

Data Type	Column	Description	Possible values or example data	Common problems or things to check
GPS Locations	Reach Slid	Was the original point moved to meet sampleability requirements	Y,N	If this was the first time the crew moved the point make sure to ask the crew if they understood Moving the point coordinates protocol (page 18-20 of the field protocol). Additionally, always make sure the point was moved within the allowable distance (250 m for reaches 150-500 m or reach length/2 for reaches >500 m) using the Meters From Original Point field.
	Meters From Original Point	The straight line distance (m) between the design coordinate and the coordinate the crew sampled	Typical values 0-250. If the point is a targeted site, no original coordinates are within the app and the value will be blank or a question mark.	We encourage plotting coordinates on google earth for any values over 100 m, and values exceeding 500 m generally either indicate GPS/app errors, crew applying the moving the point coordinates incorrectly, or the crew selecting the wrong site code.
	Lat_ Mid Reach	F transect coordinate decimal degrees NAD 83	46.3454	Use the meters from original point field to determine if plotting coordinates is necessary.
	Long_ Mid Reach	F transect coordinate decimal degrees NAD 83	-110.12434	Use the meters from original point field to determine if plotting coordinates is necessary. Make sure all longitude values are (-).
	Lat_ Top Reach	Top of the reach coordinate decimal degrees NAD 83	46.554	Make sure the top of reach, bottom of reach coordinates, and mid reach coordinates are independent locations.
	Long_ Top Reach	Top of the reach coordinate decimal degrees NAD 83	-110.17434	Make sure the top of reach, bottom of reach coordinates, and mid reach coordinates are independent locations. Make sure all longitude values are (-).
	Lat_ Bottom Reach	Bottom of the reach coordinate decimal degrees NAD 83	46.4454	Make sure the top of reach, bottom of reach coordinates, and mid reach coordinates are independent locations.
	Long_ Bottom Reach	Bottom of the reach coordinate decimal degrees NAD 83	-110.32434	Make sure the top of reach, bottom of reach coordinates, and mid reach coordinates are independent locations. Make sure all longitude values are (-).

Appendix B. Mid-season check list

Logistics	
	Are crews maximizing productivity? (6-8 hours per site)
	Are crews on track to get all desired sites sampled by the end of the field season?
	Are crews being provided with adequate scouting information to get to sites?
	Is any gear damaged and needs to be replaced or fixed?
	Are crews clear on which sites they should be sampling?
Data	
	Are crews clear on what indicators should be collected?
	Is the field tracking spreadsheet being filled out and completed properly?
	Are pre-data submission meetings occurring at a regular time interval?
	Are any unresolved data issues noted on the field tracking spreadsheet?
	Have crews submitted data for any sites to NAMC?
	Are BMI and WQ samples being properly labeled and stored to be sent to NAMC?
	Are all targeted sites being added to the data management and field tracking spreadsheets?
	Are designs being managed iteratively according to guidance in the design management protocol?
	Are there any SARAH app glitches that are preventing expedient data collection and submission?
Protocol	
	Are there any sections of the field protocol (TR-1735-2) that are still unclear? Specifically:
	Are crews clear on how to implement the protocol on the following kinds of reaches:
	Interrupted flow
	Major beaver impacts
	Partial data collection
	Can crews confidently identify bankfull, floodplain height, and scour line in diverse reach types?

Action items and notes from meeting:

Appendix C. Post-season check list

Logistics	
	Are there any sites that were not sampled this year that should be sampled next year?
	Are there any boating sites that need to be sampled by NAMC in subsequent years?
	Is any gear damaged and needs to be replaced or fixed?
Data	
	Is the field tracking spreadsheet completed with all sites that were visited?
	Has all electronic data been sent to NAMC?
	Have you coordinated with NAMC to submit BMI and WQ samples?
	Have you coordinated with NAMC to return iPads?
	Has the final designation for all sites been filled out on the design management spreadsheet?
	Have all sites that were merged been properly noted as such with the merged site code in the design management spreadsheet? Sites that were intended to be merged but not sampled should not have any final designation.

Feedback on training, field protocol, other protocols, or SARAH app: