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

Data Management Protocol

Produced by BLM National Operations Center and ARS-USDA Jornada Experimental Range

January 2024

Highlights for the Version 7:

Added Photo Management Guidance

Added Targeted Plot Protocol

Updated screenshots throughout

Consolidate some of the QAQC documentation throughout.

Updated FAQ

This page is intentionally left blank.

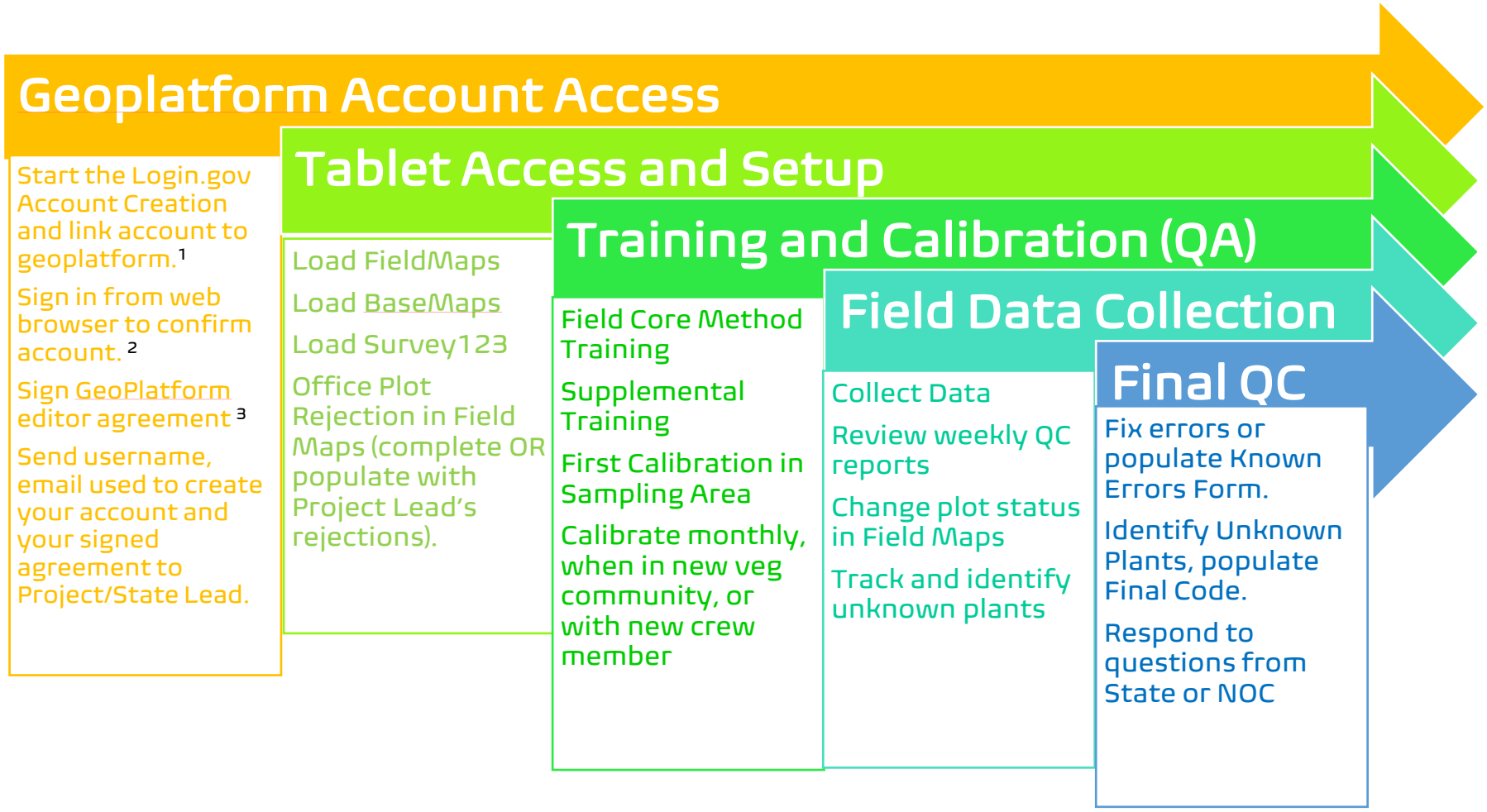
Table of Contents

Table of Contents 3
Data Management Workflow 6
Introduction to Terrestrial AIM Data Management 7
Purpose: 7
AIM Roles: 7
Communication: 7
Data management: 7
Introduction to Field Maps and Survey123 9
ArcGIS Field Maps 9
ArcGIS Survey123 9
Contacts 9
Project Lead Data Management 10
Project Lead Quality Assurance (QA): During Data Collection 10
Project Lead Quality Control (QC): After Data Collection 11
Field Crew Data Management 13
Field Crew Quality Assurance (QA): During data collection 13
Field Crew Quality Control (QC): After data collection 14
Photo Management Guidance 15
Web map Submissions 15
Survey123 Submissions 16
Targeted Plot Protocol 16
What is a targeted plot? 16
Targeted Plot Options 17
Calibration Protocol 19
Why Calibrate? 19
Before Getting Started 19
What Methods to Calibrate on 19
When to Calibrate 19
How to Calibrate 19
Equipment 19

Steps to Calibrate for Required Methods 20
Steps to Calibrate on Soil Texture (Optional) 21
What If the Calibration Criteria is Not Met? 21
Calibration in Survey123 21
Calibration Criteria 23
Calibration Resources 24
How to Calculate Indicators 24
Rejection and Moving a Plot Protocol 26
Office Rejection Criteria 26
Field Rejection Criteria 26
Project Specific Rejection Criteria 27
Rejecting a Plot in Field Maps 27
Moving a Plot 27
Move Reason Definitions 28
Road 28
Riparian/Wetland 28
References 30
Appendix I: Preparing tablets for field collection: 31
Set up Field Maps 31
Download Offline Maps: 31
Using a pre-packaged basemap VTPK file from your state lead: 32
If you need to use iTunes to copy basemap file to your iPad 32
Copy Basemap Files to Android 34
Setting up Survey123 34
Appendix II: Plot Completion Checklist 35
Appendix III: Survey123 Forms 36
Plot Characterization Form 38
Plot Observation Form 44
LPI Form 49
Gap Intercept Form 54
Soil Stability Form 56
Species Richness Form 58
Known Errors Form 61

Photos Form 62
Unknown Plants Form 65
Returning from the Field 68
Appendix IV: Frequently Asked Questions 70
Data Collection 70
Field Maps 72
QA & QC 73
Troubleshooting 74
Setup 75

Data Management Workflow



Hyperlinks from Above: [1]https://kb.geoplatform.gov/gp-agol/creating-a-login-gov-account-and-signing-in.html [2]https://geoplatform.maps.arcgis.com [3]https://www.blm.gov/sites/default/files/docs/2023-01/Signable%20BLM%20GeoPlatform%20Information%20Security%20Rules%20of%20Behavior.pdf

Introduction to Terrestrial AIM Data Management

Data are the infrastructure of science. Sound data are critical to form the foundation for good scientific decisions and adaptive management.

Purpose:

To provide protocols related to data management and to define the Data Management, Quality Assurance (QA), and Quality Control (QC) steps for collecting Terrestrial Assessment, Inventory, and Monitoring (AIM) data. The goal of this protocol is to be a guide for how to achieve low levels of error.

- **Quality Assurance:** The proactive processes that prevent errors from being introduced to data at any point in the data's lifecycle.
- **Quality Control:** The reactive processes that identify and record errors that are in data and, if possible, correct those errors before they become problems.

AIM Roles:

- ***Field Crews*** are the folks collecting the data on the ground – this can be a crew hired specifically for data collection or BLM employees.
- ***Project Leads*** can refer to anyone below the State level who is playing a more active management role in data collection. Often a specialist operating from a BLM Field or District Office. In some cases, multiple people will participate in the Project Lead roles and responsibilities. There should be BLM staff engaged in this role and this person should have final OK on the data before it is passed to the state level.
- ***State Monitoring Coordinators*** may be specifically dedicated to AIM or tasked with the responsibilities but is someone engaged with AIM data collection throughout the entire season, for their entire state. The State Lead has final approval of the data before it is passed to the National Operations Center.
- ***The National Operations Center*** refers to the Data Management Team at the NOC who are dedicated to QA & QC at the national level as well as aggregating and serving the data back out.

Communication:

Communication should happen down the chain of the above list of users. Field crew members with questions about methods or data should reach out to their project leads. Project leads should ask their State Lead questions that they themselves cannot answer, and the State leads will involve the NOC if there are lingering questions.

Data management:

The process, and means of organizing, and storing data so that data can be used appropriately to create information and guide sound management decisions. Data management is a key tenet of AIM and is critical to the success of the AIM program. AIM data includes, but are not limited to, management and monitoring objectives (*Monitoring Design Worksheet*), sample design decisions (*webmaps managed by crew in the Field Map app*), field quantitative data (*Survey123*), calibration data, and quality assurance and quality control notes (*Survey123 Known Errors Form*), and the final interpretation and assessment of these data.

Table 1. Required AIM Data elements and Associated Data Collection Tool.

Required Data Elements	***Survey123/Field Map* Data Collection Tools**
AIM Field Data	*Survey123 Forms submitted for each plot*
AIM Calibration Data	*Survey123 Forms submitted for calibration*
Plot Status	*Plot Status populated in Web Map accessed via Field Maps or ArcGIS Online portal*
Missing data (errors in dataset)	*Survey123 Known Errors Form*
Photos	*Survey123 Photos Form*
Description of the project, season, issues/concerns, successes, etc.	*Implementation Summary Template*

Introduction to Field Maps and Survey123

Field Maps and Survey123 are data collection applications used by the BLM Terrestrial AIM program. They were created by ESRI and are used together to facilitate quality monitoring data collection. For more information on the applications, visit ESRI's website (www.esri.com).

The Field Maps application is used by crews to navigate to sampling plots and record plot sampling status, while the Survey123 application is used by crews to collect monitoring data. These applications require a tablet (iPad or newer model android tablet, tablets older than three years should be avoided) and an ESRI mobile account. The ESRI mobile account is either a BLM Mobile Editor account (for BLM credentialed users) or a GeoPlatform account (for non-BLM credentialed users).

ArcGIS Field Maps

ArcGIS Field Maps is a new mobile app solution that allows user to streamline field workflows and take maps anywhere. Mobile workers can use Field Maps to explore the maps, collect and update data, and track their location—all from one app. Field Maps allows mobile workers to take their maps anywhere, including offline and indoors—and it allows you to deploy maps and content to a single location. https://www.esri.com/en-us/arcgis/products/arcgis-field-maps/overview

ArcGIS Survey123

Survey123 was chosen as the data collection form application because of the dynamic capabilities to create tailored forms for each method. Survey123 is used to create complex forms, allowing for robust data quality assurance, and is launched from the Field Maps application to link data with relevant plot information maintained in the web map used by Field maps. https://www.esri.com/en-us/arcgis/products/arcgis-survey123/overview

Contacts

If you have questions or concerns about this process, please reach out. Send an email to all folks to ensure your question can be answered.

Nathan Redecker for general questions, ArcGIS Online, Field Map and Survey123 questions
nredecker@blm.gov 303-236-2716

Mike Rock for ArcGIS Online, Field Map and Survey123 questions
mrock@blm.gov 303-236-0233

Kyle Martin for crew/field level QA and QC questions
kmartin@blm.gov 303-236-3585

Walker Morton for crew/field level QA and QC questions
wjmorton@blm.gov

Project Lead Data Management

Project Lead Quality Assurance (QA): During Data Collection

Although the bulk of the QA is done by the field crew, there are specific QA guidelines for the project lead at the field office or district office:

1. Understand the AIM data management process and work to maintain this process year-round. Where needed, build local data management practices to handle *supplemental data* and address additional data needs.

   Ensure all field crew members understand the AIM methods, have used online training resources, and data collectors meet training requirements. A dispersed training run by the state counts for a single year when the self-certification process is completed in addition to the training itself.

   a. Seasonal BLM data collectors or contractor/agreement staff responsible for Terrestrial AIM data collection must have successfully completed Terrestrial AIM Core methods training during the year in which data will be collected.
      i. In rare circumstances, staff responsible for Terrestrial AIM data collection will be hired after all the trainings have been concluded. All data collectors must be trained before collecting and submitting Terrestrial AIM data. Contract/agreement managers, or BLM supervisors for BLM seasonals, must communicate all staff changes throughout the field season with the appropriate State Monitoring Coordinator and the National Terrestrial AIM team so that contingent training options can be identified.
      ii. Crew members that were unable to attend training should receive training from a trainer that has attended Train the Trainer in the last 3 years before they begin collecting data.
      iii. The calibration event that happens before data collection begins should be used to make use that all persons in the crew understand the methods and procedures.
   b. Contractor/agreement staff not collecting Terrestrial AIM data directly, but responsible for Terrestrial AIM crew management and data QA & data QC should attend training at minimum every other year.
   c. BLM staff collecting Terrestrial AIM data must have successfully completed a Terrestrial AIM Core Methods or Train the Trainer training within the last three years.
      i. BLM data collectors who only collect 1-10 points during the field season should calibrate at the beginning of the field season.
2. Participate in the Office Plot Rejection process – either assist your crew lead in evaluating the plots in the office prior to field sampling or perform this task yourself. For more information see the Rejection Protocol.
   a. Make sure to provide your field crew with any pertinent geospatial information such as road layers, gate maps, recent land ownership, etc.
   b. Document these evaluations in the webmap in your state's Geoplatform group or

save the information to have your field crew document the evaluations in the webmap through the Field Maps application.

3. Keep communication open with the field crew lead or contracting project lead, answer any questions that may arise during the field season. Reach out to your State Monitoring Coordinator if additional guidance is required to address a concern from the field.
4. Plant identification and soils may require extra assistance. Direct the crew towards experts if you cannot answer the questions directly. Depending on the question this could be a botanist, soil scientist, or the state lead.
5. Review the webmap for your project throughout the season to ensure data collection, plot order, and calibration completion occurs.

Project Lead Quality Control (QC): After Data Collection

The project lead gets all data from their field crew lead at the end of the field season and conducts the following QC:

1. Check field crew calibration results, once after their first hitch and periodically throughout the field season.
2. Review the species identifications for a few plots from the first hitch and at set intervals throughout the season.
3. Review the ecological site identifications for a few plots from the first hitch and coordinate with regional experts to ensure the ecological sites determinations are appropriate throughout the season.
4. Field Maps/Survey123 QC, check over the plots your crews have done in the webmap and expect error report questions from the NOC.
    a. Keep track of species Identification in the Unknown Species Form – if the plant has been identified it will have Final Code populated – determine if this is an appropriate identification.
        i. Field crews should fill out as much relevant information about the unknown plant as possible (Family, Genus, Scientific Name).
    b. Verify that the Final Code is a valid species code according to USDA Plants or other state source.
    c. If the crew identifies ESD – confirm that the Soils information and Vegetation Community are appropriate.
5. Maintain communication with the field crew lead/contractor project manager during the QC process.
6. Confirm that each sampled plot has all forms collected. According to the expected implementation for the design the plot is a member of.
7. Update the Monitoring Design Worksheet (MDW) with any relevant information about the season – changes to the design, challenges addressed, future modifications, etc.
    a. Existing MDWs can be found here.
8. Confirm that for each rejected plot, the rejection criteria field is populated in Web map, to analyze the data, the NOC needs the reason why the plot was rejected.
    a. If rejections are made in the office, access the webmap via the ArcGIS Online Geoplatform group and update the appropriate plots.

    b. If rejections are made in the field, access the webmap via the Field Maps application, update the appropriate plots and sync the edits when internet connection is available.
9. Confirm each plot has all forms collected. Then, document any missing data, missing forms, or errors in the dataset by creating a known error form via Survey123.
    a. Provide the necessary information to the National AIM Team as requested to ensure that any resolution to documented errors can be addressed in a timely manner.
10. Assist your field crew lead, if necessary, in completing the End of Field Season Implementation Summary.

Submit or transfer all data/documents as soon as possible to your state AIM monitoring coordinator (see contact list on the SharePoint here). When submitting your final data and documents please confirm all required data/documents are sent (See Table 2 on Page 8).

Field Crew Data Management

Field Crew Quality Assurance (QA): During data collection

Do not underestimate the importance of QA steps. Any decisions made in the field will have direct effects on how the data are portrayed at the many levels of use in the future; meaning one data error could be magnified as data are analyzed and interpreted. Follow the basic steps below to help ensure data integrity (Herrick et. al., 2015):

1. Practice proper techniques for all field methods (follow the guidelines in the Monitoring Manual (Herrick et. al., 2015)).
2. Adhere to training requirements for data collectors (see Project Lead Quality Assurance (QA): During Data Collection section above)
3. All data collection should be collected in Survey123 Forms in the field. Paper should NOT be used unless tablet failure occurs in the field.
    a. If collecting data on paper, input data into Survey123 as soon as possible and have a second field crew member check the work (on your data sheets document which crew member entered the data and which crew members checked the data).
    b. If data can't be collected in the Survey123 forms, opening the Survey123 forms at the plot will ensure that the forms record the correct GPS coordinates. If this is not possible, **ensure that GPS coordinates are taken and entered in the forms manually.**
    c. All photos should be submitted through the Photos Survey123 form. This will prevent improper photo naming. If this is not possible reach out to your Project Lead and State Lead about next steps.
4. Review data forms for completeness and correctness. It is preferable to do this while still at the plot and before transect tapes are rolled up in case information is missing and data has to be collected. Field Maps/Survey123 crews can use the checklist (Appendix II.) to keep track of what forms have been completed.
    a. Designate a crew member (likely crew lead) to be responsible for this at every plot.
    b. A plot checklist may help to make sure all plot components, including supplementals have been collected.
    c. Verify that the end calculations align with your ocular observations.
5. Document errors
    a. If you are still on the plot and can collect or fix the missing data or error, then please do.
    b. If you cannot, then record any missing data or known errors in the Known Errors Form in Survey123.
    c. If there is an error that is fixable, but you cannot make the fix (e.g. form opened directly in Survey123 and is missing Plot information) please generate a Known Error Form that indicates the error and how the NOC might fix it. Notes in the forms will not be checked. If you want an error fixed you must create a Known Error form.

d. Identify unknown plant species. Update those species codes within the Unknown Plant form in Survey123 in the field ***Final Code***.
    i. You should not spend a lot of time at a plot identifying unknown plants.
    ii. If you are unable to quickly identify a plant on a plot, you should follow the Plant Identification Standard Method on page 14 of the 2nd Edition of the Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume I (Herrick et. al., 2015).
    iii. If you have attempted to key out unknown plant species and are unable to, seek out a botanist or nearby crews for assistance, if available.
    iv. ***Do not leave all species identification to the end of your season*** - specimens will not last an entire field season unless you are pressing them properly in a plant press and storing them in a safe and dry place.
6. Solicit expert advice if needed – especially for plant identification and soils.
7. Data Collectors should calibrate for each method each month or in a substantially different plant community and vegetation structure than you have previously encountered (e.g., mountain sagebrush to cheat grass, grassland to PJ encroachment, etc.) (See Calibration Protocol).
8. Once all data forms have been uploaded including the known errors and the identified unknown plants, inform the State Monitoring Coordinator.

Field Crew Quality Control (QC): After data collection

Field crews are responsible for the bulk of the quality control conducted throughout the monitoring process. Remember the easiest time to fix a problem is when you are still out at the plot, so always check your data before rolling up transect tapes and leaving the plot for the day.

1. The NOC will be sending State Leads an error report every week.
    a. The error reports are set up with a notes section and action section. The notes describe what the error is, and the action is what either the state or the NOC needs to do to fix the error
    b. Fix any errors that have been assigned to the field crew to fix.
2. Generate Known Error Form for any errors that cannot be fixed.
    a. Provide an explanation why the error cannot be fixed.
3. There will be a list of unknown codes that do not have an Unknown Plant form under the error list. The notes and action sections will be blank. This unknown code list is to let crews know they need to make Unknown Plant forms.
4. Unknown Codes will be updated within Field Maps/Survey123 by the NOC. Crews should only enter the Final Code in the Unknown Plants form when the species has been identified.
    a. The State lead will assist with the identified unknown species list to ensure all codes make sense for the state.
    b. During the field season as unknown plants are identified and verified to be valid they can be attributed and added to the State's Species List if not already present.

5. Ensure each form has the correct coordinates, especially the Plot Observation form. This form's coordinates are used for the final location of the plot.
6. Check your state's webmap via the BLM-EGIS or Geoplatform portals for plot completeness and make sure all forms were uploaded. If any methods have missing data, make sure the information is documented in the Known Errors form. The NOC will be fixing errors during the season.
    a. 3 Canopy Gap forms (unless a different plot layout was used)
    b. 3 Line-Point Intercept forms (unless a different plot layout was used)
    c. 1 Species Richness form
    d. 1 Soil Stability form (if applicable)
    e. 1 Plot Observation form
    f. 1 Plot Characterization form. (if applicable)
    g. 1 Photo form with at least the photos as designated by project parameters (default is 4 photos: 1 per transect, 1 soil pit)
    h. Any supplemental method forms.
7. Make sure each plot in the web map has an appropriate status.
    a. All plots that were completed should be marked as ***"Sampled"***
    b. All plots that were rejected should be marked as ***"Rejected"*** and a Rejection Reason populated, this is crucial to the understanding of how the design was implemented.
    c. All plots that were attempted to be sampled but temporary conditions made it not possible, should be marks as ***"Reattempt needed"***
8. Assist your project lead with the End of Field Season Implementation Summary.

Photo Management Guidance

Photos should always be submitted via the AIM Photos Survey123 form and guidance in the form should be always adhered to ensuring that all photos make it into the Terrestrial AIM Database. If guidance is not followed the NOC can't guarantee that photos collected will make it into the database at the end of the field season.

Web map Submissions

The web map submission should only be used if you are unable to submit photos via the Survey123 Photos form. Photos should be jpeg filetype and filenames when uploading should start with a unique name followed by a dash and then additional description can be added to the filename or the date. If core photos are being uploaded, use the reserved filename strings to name the uploaded photos followed by the date. If transect 1 photo taken from plot center is uploaded through the web map the filename should be T1-01012024 and a jpeg filetype. A common photo that might be uploaded is transect end photos, in that case the photo for transect 1 look back at plot center from the end of the transect could be T1End-01012024.

Reserved Filename Strings: T1-, T2-, T3-, T4-, T5-, Soil-, MiscPhoto1-, MiscPhoto2-, MiscPhoto3-, MiscPhoto4-, MiscPhoto5-, MiscPhoto6-, MiscPhoto7-, MiscPhoto8-, MiscPhoto9-,

MiscPhoto10-,PlotDrawing-,PlotDrawingPhoto-,SoilStabDry-

Figure 1: Adding Photos via the web map using Map Viewer

Survey123 Submissions

Survey123 Photos form has default naming conventions in **background** that can't be accessed from the form. Use the Camera icon to open an in-app Camera to take photos and add to the form or the Folder icon to open the local file directory, select the photo and add to the form.

Targeted Plot Protocol

What is a targeted plot?

A targeted plot is a location that is unassociated with a spatially balance random sampling design set of plots. Targeted plots can be generated in the office based on historic monitoring locations that might need to be revisited. In addition to historic sites, targeted plots can be generated at locations where additional information is needed for a management question. Include all required information as outlined in the Plot Schema

Description and submit the plots using the PlotsSchema.gdb (found here).

Targeted Plot Options

1. **Option 1**: Use the existing plot location information from a historic monitoring location and create a targeted plot at that location and include it with the plot submission that includes the rest of the random plots for state.
2. **Option 2**: Identify the area where additional information might be needed to answer a management question and create as many targeted plots as need per the specific parameters (specific range of elevation, specific distance from disturbance or management actions in an area, etc.) needed to best answer the issue in question. These plots will be created within the bounds of the Plot Schema filling in all the necessary information required to collect data and then appending them via an append geoprocessing task in ESRI ArcPro Desktop.
3. **Option 3**: Create targeted plot via the tools available the Field Map. Targeted plots can be created in the office or in the field. In the office this option allows you to add a few plots independent from a batch append as Option 2 relies on. Once a plot is created and added to a map then the data collectors that needs to plot will have to sync their tablets to have the feature become available on their tablets. In field, offline, data collectors can create a plot as a location in the field per the given parameters from the state, district, or field office project leads.

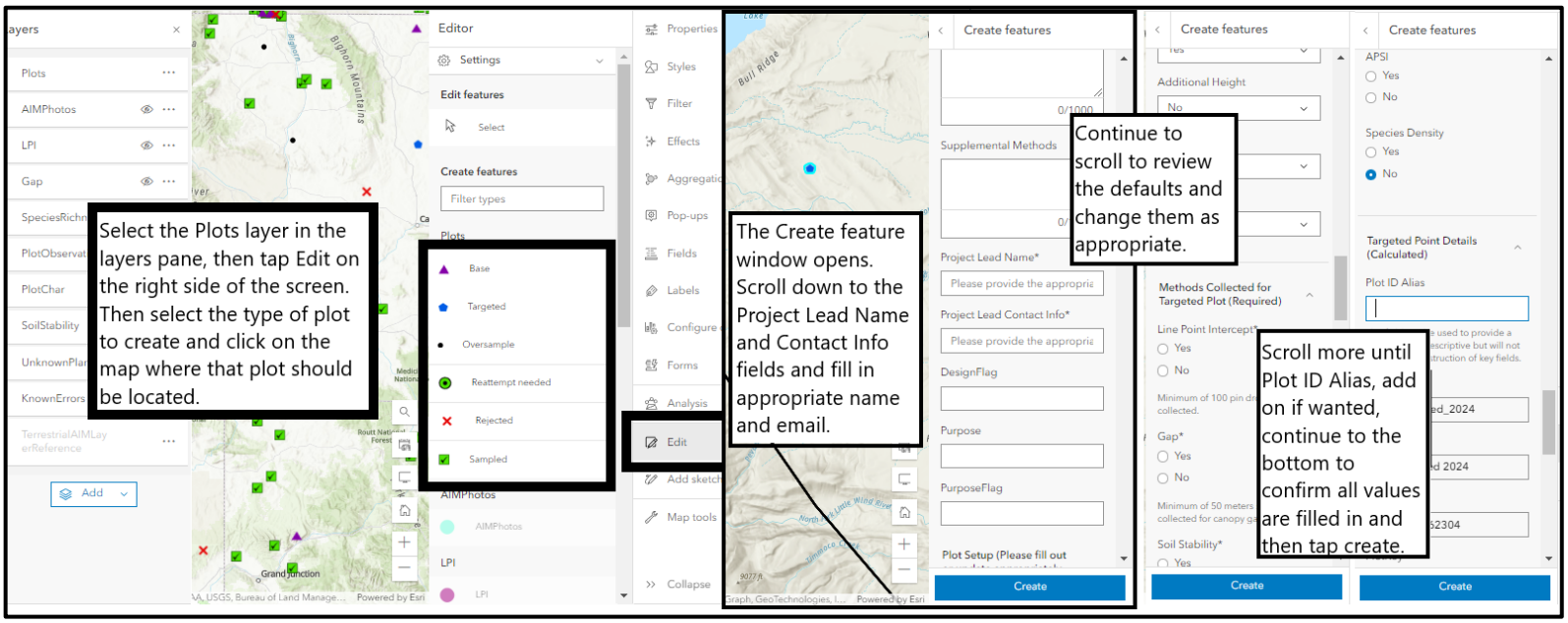


Figure 2: Creating a Targeted plot a web map using Map Viewer

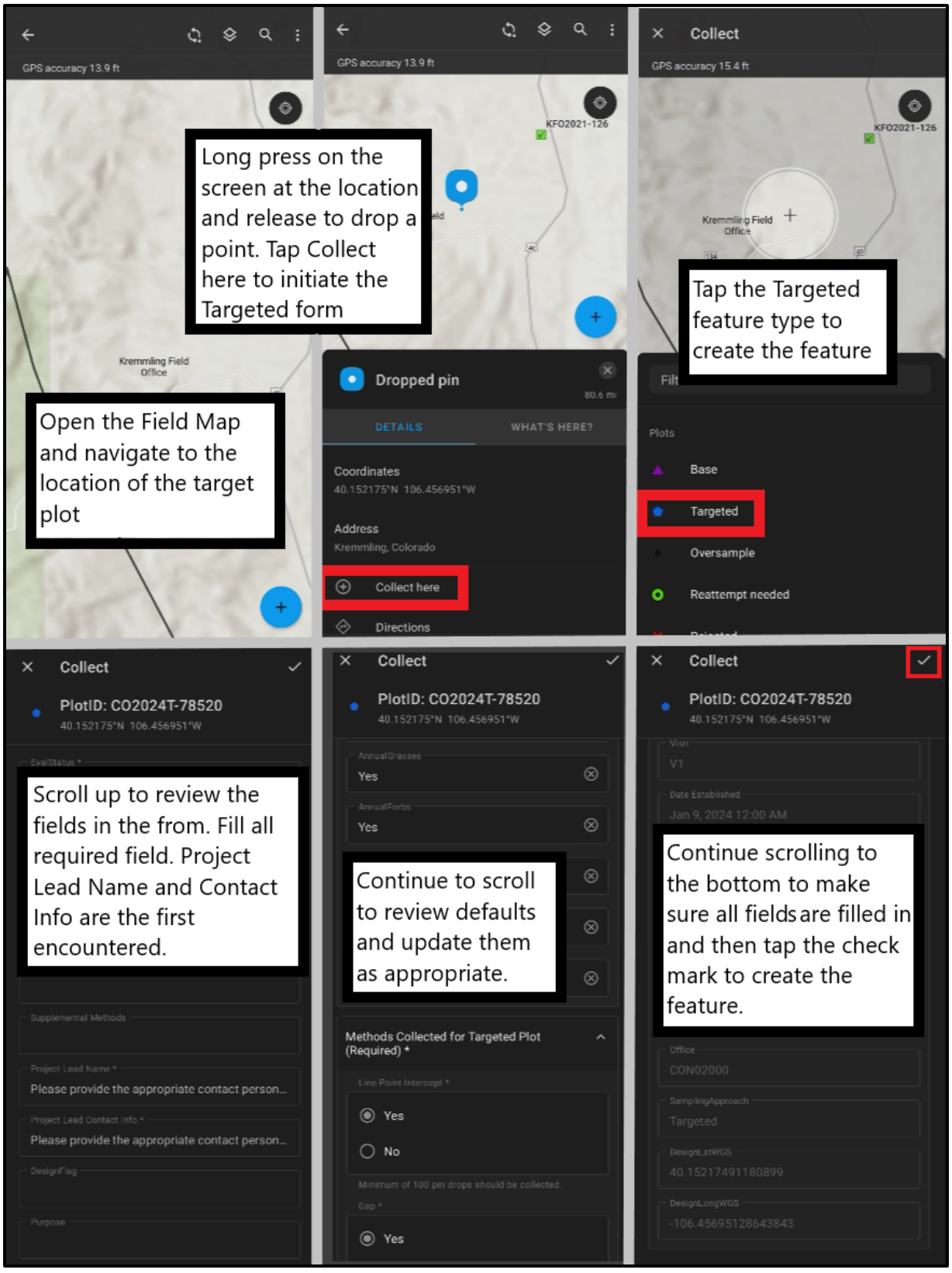


Figure 3: Creating a Targeted plot in Field Maps mobile app

Calibration Protocol

Why Calibrate?

"Calibration of data gatherers is an integral component of the quality assurance process. Calibration ensures that a data gatherer collects data accurately each time and that data are collected consistently with other data gatherers…" (Herrick et. al., 2015).

Calibration ensures the defensibility and integrity of data by providing evidence that the data are consistent and trustworthy.

Before Getting Started

Calibration can be time consuming, please allow for adequate time in your work plan to complete Calibration according to the prescribed schedule.

What Methods to Calibrate on

1. Line-point intercept (LPI) (required)
2. Canopy Gap Intercept (Gap) (required)
3. Vegetation Height (Height)(required)
4. Species Inventory (required)
5. Soil Texturing (recommended)

When to Calibrate

- A significant change in vegetative community
- A new data collector joins the team.
- A month has passed since the last calibration.
- Optional: soil texturing calibration to be completed once per month

Calibration and Vegetative Communities

Vegetative communities can be *significantly different* in assigned design stratum. It is up to the discretion of the Project Lead or Crew Lead to decide whether the difference in the vegetative community is great enough to call for a calibration.

Examples

A crew may have only encountered grass-dominated sites in the design stratum ROCK. If the next plot in hitch, in this stratum or not, is shrub-dominated then a calibration is in order.

If this scenario occurs and the crew returns to a grass-dominated plot within the same work hitch or within a month, then the crew does NOT need to recalibrate to collect data in that grass-dominated community.

How to Calibrate

Equipment

- Transect tape (Remember to take care to not trample the sample area along the transect or to move the tape)
- Chaining pins (or other anchoring tools for the transect)

- Paper data sheets or electronic data capture device (Survey123)
- Pins for LPI (flag pins, laser, or similar. Must be consistent.)
- Multi-tool or other means of measuring vegetation height and canopy gap
- Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition
- **Optional:** Soil samples (5 minimum) that have been lab tested and/or verified by a soils expert that represent a range of textures (e.g., sand, sandy loam, loam, clay, silt).
- **Optional:** Soil texture worksheet
- **Optional:** Spray bottle and water (deionized, reverse osmosis, or distilled) for texturing

Steps to Calibrate for Required Methods

1. Establish a standard length transect for your project (e.g., 25 m) in a location representative of the ecosystem where AIM data will be collected. Conduct each calibration using the same transect length and method implementation as required by normal data collection. For example, if you normally collect data along a 25 meter transect with LPI pin drops each 50 cm, height measurements each 250 cm, minimum gap size of 20 cm, continue with that during calibration.
2. Have each data collector complete LPI, Vegetation Height, and Canopy Gap Intercept along the transect.
    a. Take care to protect the left side of the transect, as multiple runs through a line may change the observed environment.
    b. If there are many observers to calibrate, set up a separate transect for each method.
3. For species inventory, establish a second standard length transect 120 degrees from the transect used for LPI.
    a. This will create a wedge, simulating one of the wedges that a standard AIM plot with three transects would create.
    b. Walk the wedge following species inventory protocol outlined in the Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition (Herrick et. al., 2017), recording the number of species found in 5 minutes.
4. Calculate the calibration indicators for each observer. You may do this manually with a calculator or using an indicator report on the last page of the Survey123.
5. Compare results between observers. Verify the ranges between observers against the calibration criteria (Tables 1-3).
6. If any range between observers (see Tables 1-3) is greater than the acceptable range, attempt to identify why calibration was not achieved.
7. All indicators for a method must meet the defined criteria for that method to be considered calibrated. The data collectors must repeat the whole method, for all indicators, if they demonstrated that they were not calibrated for one or more indicators. However, if the data collectors calibrate on one method's criteria but not another method's criteria, then they only repeat the calibration for the method that did not meet the criteria. See example on page 9.
8. Repeat the calibration exercise on a new transect until each method is completely

calibrated. If you are concerned that one transect will be insufficient sample size to achieve successful calibration, you may calibrate all methods across more than one transect as long as the number of transects is determined prior to commencing a calibration event. Species Inventory may have additional 2 minute "popcorn" time additions if crew members continue to find more species within the 120-degree wedge once the 5 minute time increment is reached.

Steps to Calibrate on Soil Texture (Optional)

1. Select a minimum of 5 samples that have been lab tested and/or verified by a soils expert that represent a range of textures (e.g., sand, sandy loam, loam, clay, silt).
2. Each crew member will texture and record their classification for each sample on a soil texture worksheet (see page 25).
3. To meet calibration criteria, each crew member must exactly match the official soil classification for 2 or more samples (40% of the sample population) and match the official classification or an adjacent classification (using the soil texture triangle) for 4 or more samples (80% of the sample population).

Example

Casey records a tested soil sample as being a sandy loam. The lab testing had determined that the soil was a loam. Casey cannot count this as one of their two exact matches, but loam and sandy loam polygons are adjacent on the soil texture triangle and so they can count it towards their four soils for the lower precision criterion.

What If the Calibration Criteria is Not Met?

1. Identify the methods and indicators that exceeded the acceptable range of variation.
2. Discuss possible reasons with one another and compare technique and definitions.
3. Remember that an outlier value may be the correct observation value.
4. Consider equipment used (e.g. Did all the collectors use the same pin?)

Examples

If Jack collects a litter cover of 22%, Pablo collects a litter cover of 10%, and Amina collects a litter cover of 12% then the range of values is 12% (22 - 10 = 12) which is greater than the maximum permitted range of 10% and the crew must repeat the LPI calibration for *all* indicators.

If Pablo, Amina, and Jack do not meet the criteria for all canopy gap intercept indicators but do calibrate on all LPI indicators, each collector will repeat *only* the canopy gap intercept method until collectors meet the acceptable range of variation for all canopy gap intercept indicators.

Calibration in Survey123

For Calibration purposes only, launch the form directly from the Survey123 application. Calibration locations should not be at the same spatial location of any other data collection location for the year. If Calibration will be done before completing a data collection point, please perform the calibration at least 100m away from the other data collection location. Calibration data is not associated with an existing plot and should not overlap with any data collected for the current data collection season.

The Calibration form will not have a Plot ID, but it will have a Line Key or other unique Key in the form of **STCrewNumber_Person#Try#_COMMUNTIY_CALIBRATION_Date**.

1. LPI, Gap, and Species Richness forms have a Calibration option.
2. Launch the form directly from Survey123 application when you arrive at your calibration location.
3. Complete all required fields on page 1 of each survey form before moving on with data collection.
    a. Enter the **Crew Number** associated with you crew as assigned to you by State Monitoring Coordinator, Contractor Project Manager or Project Lead
    b. For LPI and GAP select **CALIBRATION** for Line Number; for Species Richness select **Yes** to the question "**Is this Calibration?"**.
    c. Enter the **Try Number** (in case of multiple attempts). Ensure you are consistent with your attempts for all persons on the crew.
    d. Enter the **Community Type**. This should be consistent for all attempts and all persons, try and maintain the same capitalization across persons and attempts as well.
    e. Enter the **Observer** and **Recorder** from the dropdown. If a name is not available, please use the generic placeholder and define the name in the Comments question of the form.

Calibration Criteria

Table 2 Calibration Criteria for each method Calibration can be collected for.

Method	Indicator	Calibration Criteria
Gap	Gaps 25 cm to 50 cm	Absolute difference ≤ 10%
Gap	Gaps 51 cm to 100 cm	Absolute difference ≤ 10%
Gap	Gaps 101 cm to 200 cm	Absolute difference ≤ 10%
Gap	Gaps >201 cm	Absolute difference ≤ 10%
Species Richness	Total species recorded inside a wedge	Absolute difference ≤ 2 height records
Vegetation Height	Count of Woody Plants 0-50 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Woody Plants 51-100 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Woody Plants 101-200 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Woody Plants >200 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Herbaceous Plants 0-10 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Herbaceous Plants 11-30 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Herbaceous Plants 31-50 cm	Absolute difference ≤ 2 height records
Vegetation Height	Count of Herbaceous Plants >50 cm	Absolute difference ≤ 2 height records
Line Point Intercept	Foliar Cover	Absolute difference ≤ 10%
Line Point Intercept	Basal Cover	Absolute difference ≤ 10%
Line Point Intercept	Rock Fragments Cover	Absolute difference ≤ 10%
Line Point Intercept	Litter Cover	Absolute difference ≤ 10%
Line Point Intercept	Standing Dead Cover	Absolute difference ≤ 10%
Line Point Intercept	Bare Ground	Absolute difference ≤ 10%
Soil Texture (Optional)	Exact match to official classification	Sample proportion ≥ 40%
Soil Texture (Optional)	Match official or adjacent classification	Sample proportion ≥ 40%

Calibration Resources

How to Calculate Indicators

LPI data sheets contain information for LPI indicators, Vegetation height, and Species inventory. Canopy gap intercept data sheets record information for canopy gap and basal gap observations.

Examples of calculating LPI indicators can be found in the Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems: Volume 1 2nd Edition (Herrick et al., 2017) – on pages 13 and 35.

Calculating LPI Indicators:

For each of the following, divide by the total number of points recorded and multiply by 100. For a transect with 25 LPI points, the math is 100 / 25, the same as multiplying by 4.

% Foliar Cover = Total # of points with a species recorded in the Top Layer column
% Basal Cover = Total # of points with a species code at the soil surface
% Rock Fragments = Total # of points with a rock code ("R", "CB", etc.) at the soil surface
% Litter = Total # of points with a litter code ("L", "WL", etc.) recorded in a Lower Layer column
% Standing Dead = Total # of points with one or more species codes circled
% Bare Ground = Total # of points with no species recorded and "S" at the surface.

Calculating Gap Intercept Indicators:

Find the length of each gap (End - Start = Length) and record it under the appropriate size class.
Find the sum of all the gap lengths in each listed size class.
Divide each sum by the length of the transect and multiply by 100 to find % of line in each gap class.

Note: Gaps less than 25 cm are not recorded in any size class and are not counted towards calculations.

Examples:
A gap starting at 120 cm and ending at 162 cm would be 162 - 120 = 42 cm long and would be recorded in 25 to 50 cm class. A gap of 125 cm would belong to the 101 to 200 cm class.
If your recorded gaps were a 27 cm gap, a 40 cm gap, and a 33 cm gap, the sum in the 25 to 50 cm class would be 27 + 40 + 33 = 100 cm.
A total of 100 cm in gaps 25 to 50 cm on a 25 m transect would make up
100 cm / 2500 cm * 100 = 4% of the transect.

Calculating Vegetation Height Indicators:

Record the heights of woody and herbaceous plants according to the protocol.
Tally the number of plants recorded by height category and growth habit.
Compare the tallies by category to confirm that the ranges in counts are ≤ 2.

Examples:
A grass species recorded at 8 cm would count as one record for herbaceous plants 0 to 10 cm. If for woody plants 11 to 30 cm tall, one observer had 11 records, and another had 14 the range would be |11 - 14| = 3 and because 3 is not ≤ 2 they therefore would not be calibrated.

Calculating Species Richness Indicators:

- Refer to the Species inventory data sheet.
- Tally the number of unique species codes, including unknown codes, recorded in the wedge in the allowed time by each data collector.
- The number of species recorded by each observer should not differ by more than 2.
- Note: For calibration, do not consider whether the codes match between observers, only how many unique codes were used

Other Resources:

- Soil Calibration Form (For each soil sample, use the soil texture key to determine the texture by feel. Record the texture class, estimated % clay, and the position on the texture triangle for each texture.)
- Monitoring Manual (pages 4,9,11-13, 29, 60)

Rejection and Moving a Plot Protocol

Rejection criteria set thresholds for failing to sample a point and clearly define the reasons for sample point rejection. Rejection criteria preserve statistical inference while also maximizing efficiency and promoting safety during field sampling. Rejection criteria must be carefully considered because they limit the inferences that can be drawn from the data. For example, if all plots on slopes greater than 50% are rejected, then the monitoring data only tell you about resource status on slopes less than 50%.

By following this exact protocol to determine whether to sample or not sample a randomly selected point, the unbiased nature of the sample design is preserved. Sample points should be reviewed against rejection criteria in the office using ancillary data sources (e.g., ownership maps, topographic maps, and aerial or satellite imagery) and the same GIS data used during sample design. If a point is accepted in the office, the field sampling team should review the rejection criteria again once they have arrived at the point in the field. If a point is rejected, it is important to document the reason(s) for rejection as this information is incorporated into data analysis. Make every effort to avoid rejecting a point, including evaluating if a plot could be moved in the field to keep it in the sample.

Office Rejection Criteria

A sample point is rejected only if one of the following is true **AND** moving the plot in the field would not prevent rejection

- Sample point is unsafe to sample
- Sample point is >3 miles walking distance from the closest point accessible by a vehicle
- Sample point is not on Bureau of Land Management lands
- Slope at sample point exceeds 50%
- Access to the sample point was denied
    - Access route unsafe or impassable
    - Access requires passage through non-BLM land and access was denied
        - Coordinate with resources staff of the local BLM office to determine if landowner permission can be obtained and access granted before rejecting.
    - Locked gate
- (Optional, determined by the monitoring objectives) The sample point transect crosses a boundary between different management units (e.g., in an allotment-scale monitoring project, the sample point intersects two allotments)
- (Optional, only recommended if forested areas are already covered by a monitoring effort) Plot center (point), and at least a one-acre area contiguous to the plot center, has canopy cover of woody vegetation of greater than 25%. Pinyon-juniper should not be excluded from sampling using this criterion.

Field Rejection Criteria

A sample point is rejected only if one of the following is true **AND** moving the plot would not prevent rejection.

- Sample point is unsafe to sample (e.g., unstable soil surface, cliffs, hazardous wildlife, law enforcement concerns)
- Sample point is >3 miles walking distance from the closest point accessible by a vehicle
- Slope at sample point exceeds 50%
- Sample point transect intersects a **road** or **primitive road** (see definition below)
- (Optional, determined by the monitoring objectives) Sample point transect intersects wetland, riparian, or aquatic feature (see definition below)

Project Specific Rejection Criteria

Depending on the management objectives, monitoring objectives, and sample design, additional rejection criteria may be warranted. For instance, in treatment effectiveness monitoring it would be appropriate to reject a point if it does not fall within the target treatment. Be sure to clearly describe your rejection criteria to eliminate bias. **Please approve additional plot rejection criteria to the Terrestrial AIM Team at the BLM National Operations Center.**

Rejecting a Plot in Field Maps

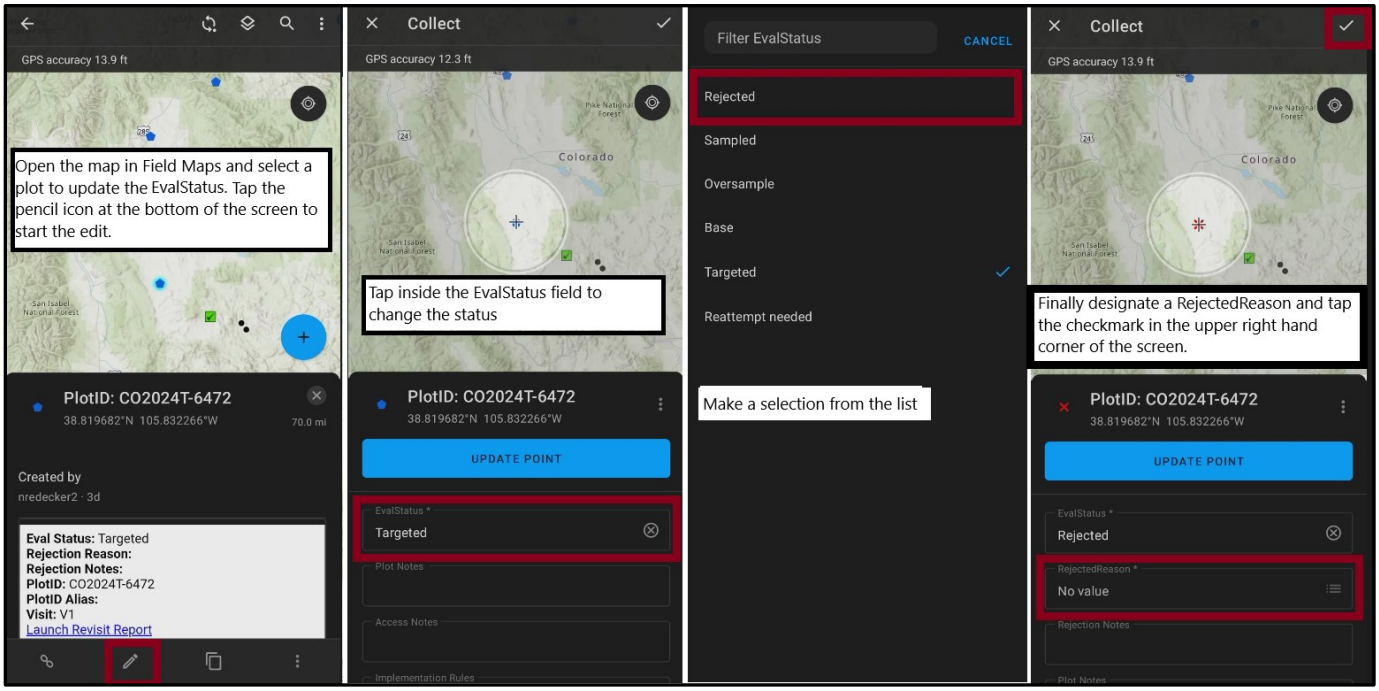


Figure 4: Rejecting a Plot in Field Maps

Moving a Plot

From the original plot center point, move 50 m North (0 degrees). With this location as the center of a new potential plot, evaluate the rejection criteria. If the new plot is not rejected, sample that plot. If it is rejected, move 50 m East (90 degrees) of the original plot center point and evaluate the rejection criteria again. Each time the new plot is rejected, repeat for the remaining cardinal directions--South (180 degrees) then West (270 degrees). If 50 m in all 4 cardinal directions of the original plot center point are rejected, reject the plot. If one of the new locations is accepted as the new plot center, the crew must verify that the plot is still in the study area (BLM land, allotment, etc.). The Plot Observation Form is used to document the

movement of a plot by where to establish the plot center on page 2 of the form.

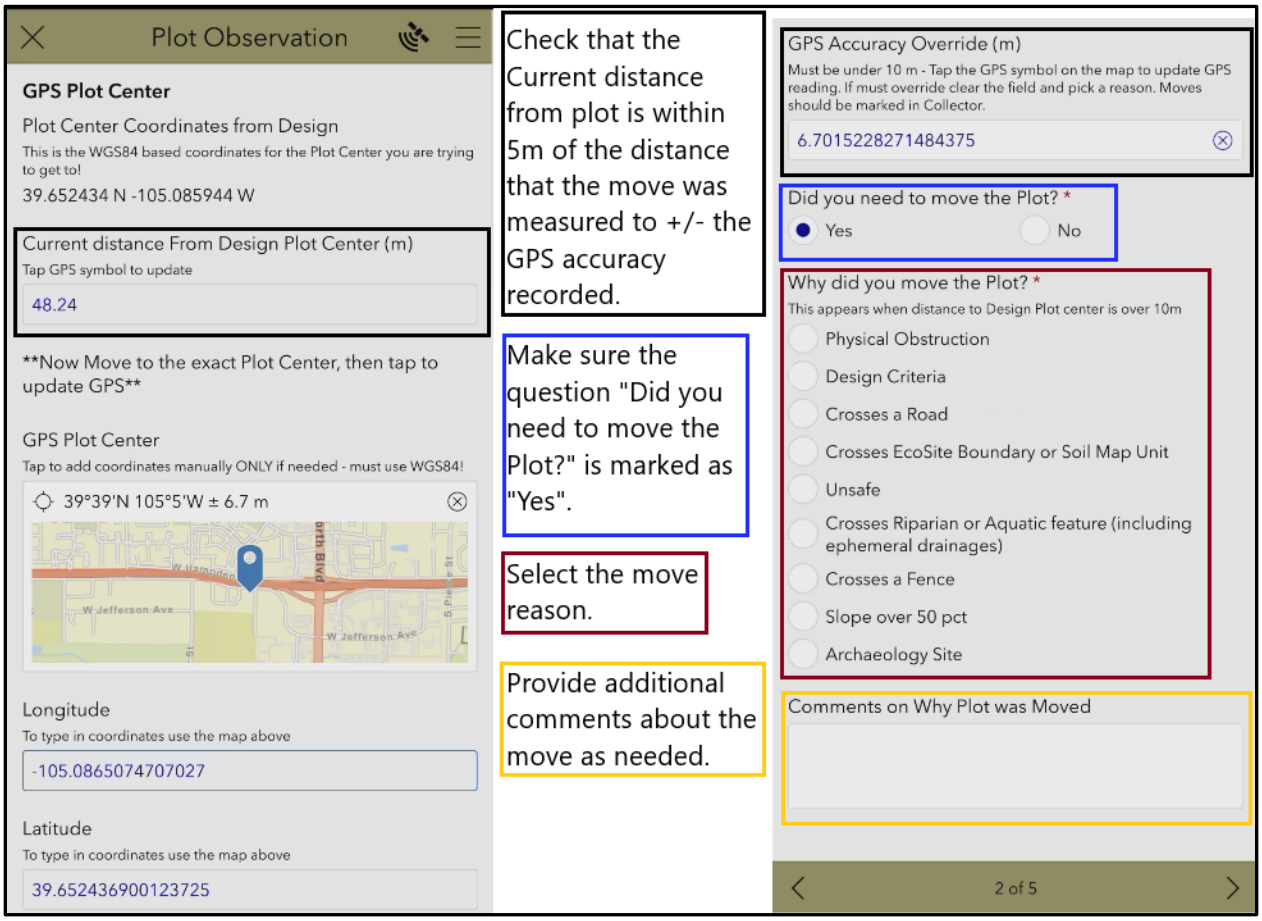


Figure 5: Document a move in Survey123

Move Reason Definitions

Road

BLM Tech Note 422:
https://www.blm.gov/sites/blm.gov/files/documents/files/Library_BLMTechnicalNote422.pdf
Road: A linear route declared a road by the owner, managed for use by low-clearance vehicles having four or more wheels, and maintained for regular and continuous use. An AIM plot may not intersect a road.
Primitive Road: A linear route managed for use by four-wheel drive or high clearance vehicles. Primitive roads do not normally meet any BLM road design standards. An AIM plot may not intersect a primitive road.
Trail: A linear route managed for human-powered, stock, or off-highway vehicle forms of transportation or for historical or heritage values. Trails are not generally managed for use by four-wheel drive or high-clearance vehicles. An AIM plot may intersect a trail.

Riparian/Wetland

Army Corps of Engineers:
https://www.nae.usace.army.mil/Portals/74/docs/regulatory/JurisdictionalLimits/wlman87.pdf

The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for the identification and delineation of wetlands. Whether wetlands are sampled within a monitoring program depends on the monitoring objectives.

1) Definition. The CE (Federal Register 1982) and the EPA (Federal Register 1980) jointly define wetlands as: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
2) Diagnostic environmental characteristics. Wetlands have the following general diagnostic environmental characteristics:
    a) **Vegetation.** The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in a above. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), growth ability, effectively compete, reproduce, and/or persist in anaerobic soil conditions. Indicators of vegetation associated with wetlands.
    b) **Soil.** Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. Indicators of soils developed under reducing conditions are listed in paragraphs 44 and 45.
    c) **Hydrology.** The area is inundated either permanently or periodically at mean water depths 6.6 ft, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation. Indicators of hydrologic conditions that occur in wetlands are listed in paragraph 49.
3) Technical approach for the identification and delineation of wetlands. Except in certain situations defined in this manual, evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found to make a positive wetland determination.

Note: The above definition is for your reference. Whether wetland areas are sampled within a monitoring program depends on monitoring objectives. For the purposes of terrestrial AIM monitoring, a quick, visual inspection of the vegetation and hydrology of the area is sufficient to determine whether the plot meets the criteria. This is not wetland delineation—please do not dig multiple soil pits to determine extent of hydric soils. Most ephemeral washes will not meet wetland criteria and should be sampled. This is because ephemeral washes only run-in response to precipitation events and are not usually tied to the groundwater table. Therefore, they do not support riparian vegetation because the water is not there long enough to support hydric species. They should be sampled with upland monitoring efforts because they will have similar species. Perennial, intermittent, and interrupted systems do tend to have water long enough or frequent enough to support hydric plants.

References

Herrick, J.E., J.W. Van Zee, S.E. McCord, E.M. Courtright, J.W. Karl, and L.M. Burkett (2015) *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems 2nd Edition, Volume I: Core Methods*. Las Cruces, NM: USDA – ARS Jornada Experimental Range. https://www.landscapetoolbox.org/wp-content/uploads/2021/06/MMGSSE_20210628.pdf

Appendix I: Preparing tablets for field collection:

Set up Field Maps

Download Offline Maps:

1. For Android Users: https://doc.arcgis.com/en/field-maps/android/help/download-maps.htm
2. For iOS Users: https://doc.arcgis.com/en/field-maps/ios/help/download-maps.htm
3. To see the map in the field, you need to download both a basemap and the project data (plots) ahead of time.
4. Identify the map you will be using. It is important to use the correct one, as your state might have multiple maps. You should either see the map icon, or the icon for the group you are in, with the maps being in that group folder.

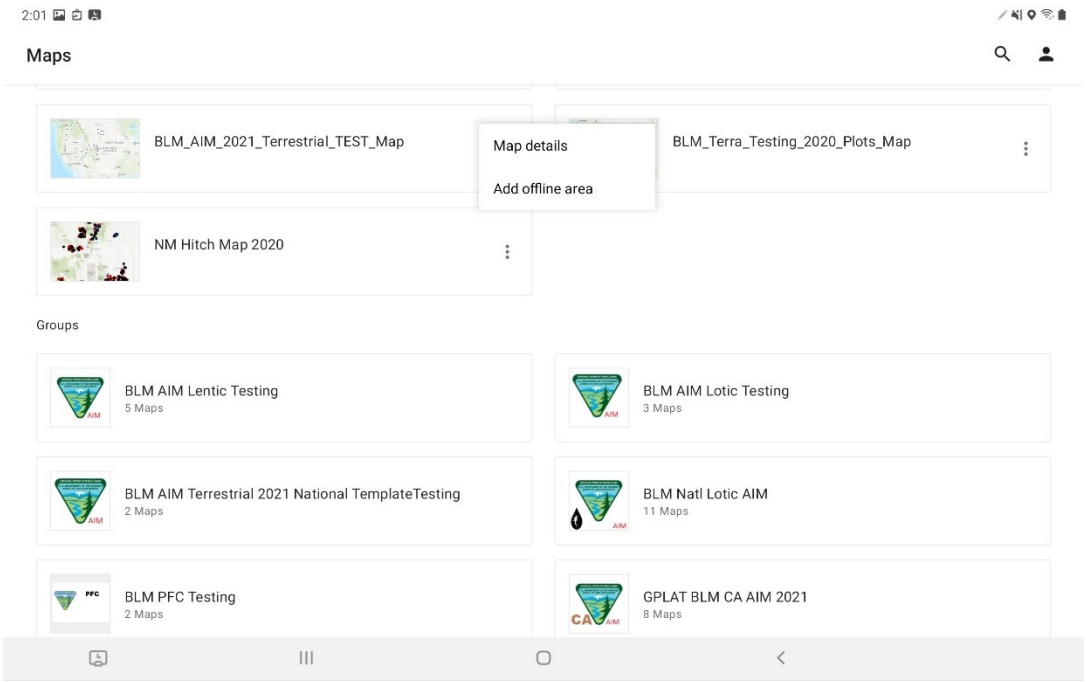


Figure 6 Interface Showing Map and Groups

5. Once level of detail is selected [if you are using a pre-packaged basemap file, you can use a low level of detail here and rely on that file as your basemap instead]. Depending on how big the project area is, if you choose a high level of detail the basemap download might take a very long time. If you are depending solely on Field Maps to navigate, a higher level of detail might be necessary. Be sure to be on a fast connection while downloading! Another option is to only download the area for the next hitch or two, if you know you will be back in fast WiFi range soon.
6. You can rename the offline area and add additional offline areas as well.
7. iPad users – be sure to go to the Profile settings and go to Download & Sync and turn off "Auto-Sync".

Using a pre-packaged basemap VTPK file from your state lead:

Recommended method for iOS 13 and up

a. Copy the basemap file onto an external memory device. This could be a mobile hard drive, memory card, or USB drive, anything that you can connect to your iPad. You need iOS 13 or higher for the iPad to recognize the device and access the iPad File app folders.
b. Connect the memory device to your iPad. For example, use a USB memory stick that has one end USB to plug into the computer, and one end USB-C or Lightning to plug into the iPad (not at the same time!).
c. In the Files app click on the memory device, navigate to the basemap file and long press to bring up the Copy option.

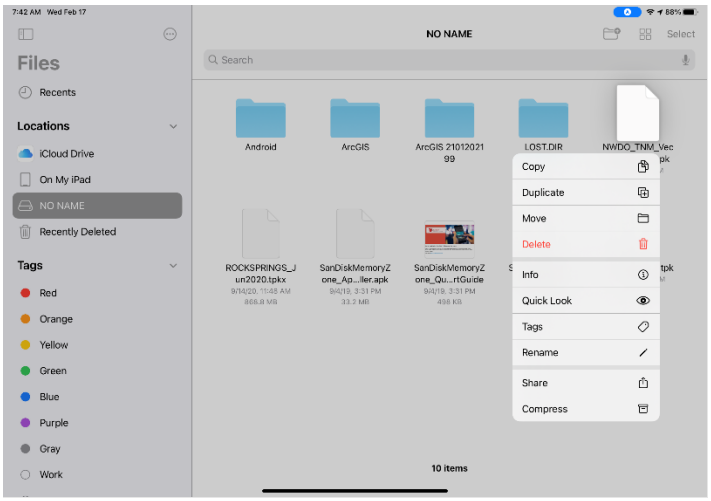


Figure 7: iPad Copy Basemap from External Memory Device

d. Navigate to "On My iPad" and then "FieldMaps". If the folder "Basemaps" does not exist, create it (long press). Paste the file into the Basemaps folder.
e. Restart Field Maps and you should see the new basemap as an option in the map. Test in Airplane mode to make sure the basemap is working!

If you need to use iTunes to copy basemap file to your iPad

1. Plug your device in to your computer.
2. Open iTunes and select your device.

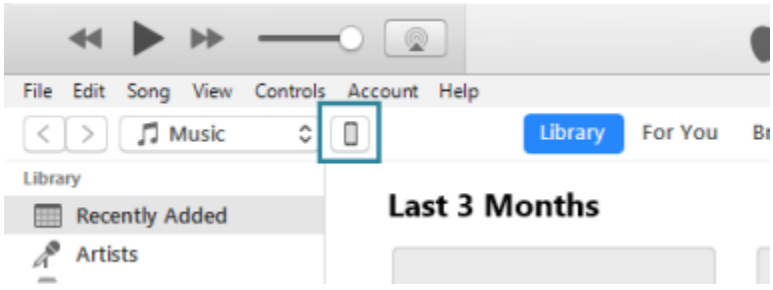


Figure 8: iTunes Select Device

3. Under **Settings**, click **File Sharing**.

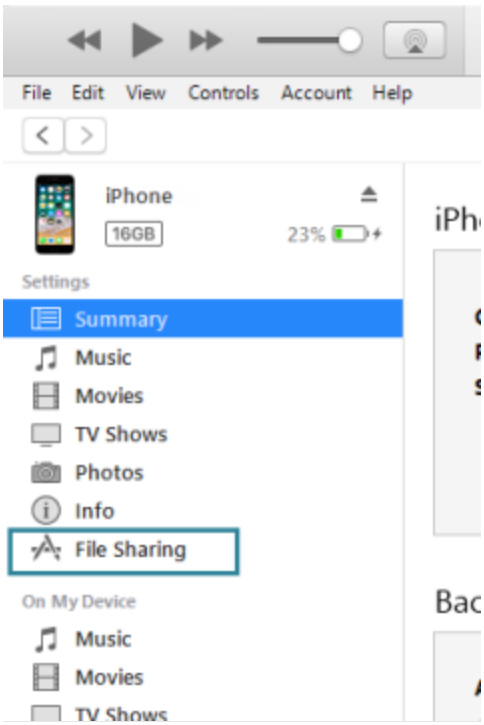


Figure 9: iTunes File Sharing

4. In the **Apps** list, select **Field Maps.**

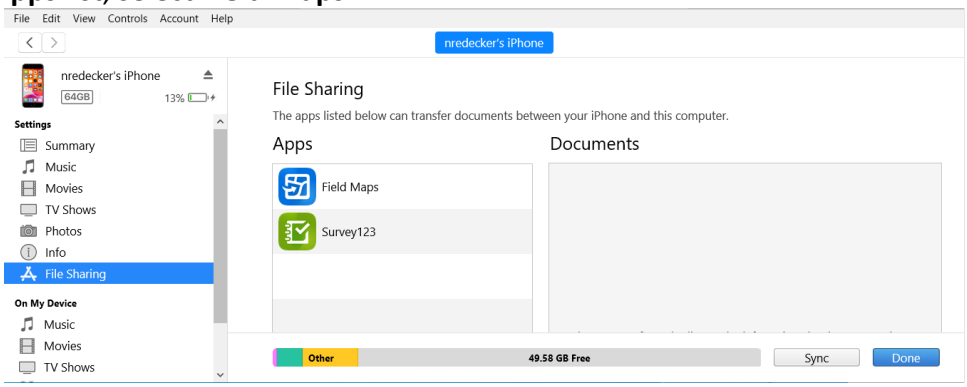


Figure 10: iTunes share to Field Maps

5. Drag the files into the **Field Maps Documents** section. If a basemap folder is not created, one will automatically be created and place the file into it after syncing.

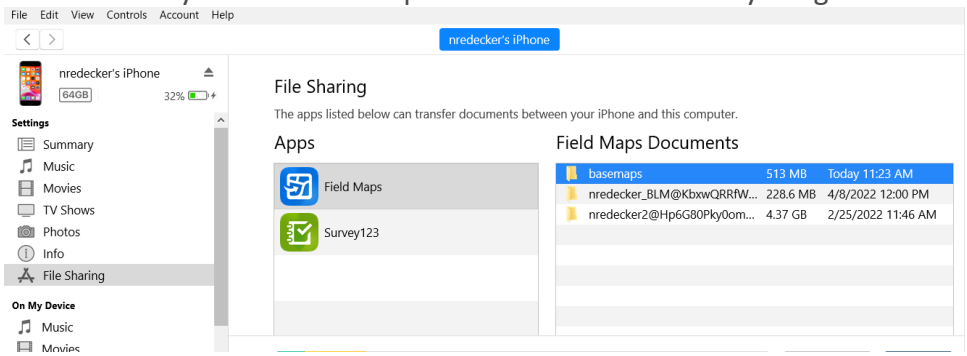


Figure 11: iTunes Field Maps Sharing

6. Click **Sync** to copy the file to your device.

Figure 12: iTunes Sync new TPK

7. Restart Field Maps on your device. Test in Airplane mode to make sure the basemap is working and available.

Copy Basemap Files to Android

1. Plug your Android device into your computer. Using file explorer on your computer, browse to \Android\data\com.esri.fieldmaps\files\basemaps (if that folder doesn't exist, create it). Copy the basemap file (.tpk, .tpkx, or .vtpk) you want on your device to that basemaps folder.
2. Restart Field Maps on your device. Test in Airplane mode to make sure the basemap is working!

Setting up Survey123

1. Download the Survey123 for ArcGIS app onto your tablet from applicable app store. Make sure to turn OFF auto-update for Survey123.
2. Sign into Survey123
    a. BLMers – Under “Enterprise login” type “BLM-EGIS” in the box. Click the DOI Account button.
    b. Contractors - Under “Enterprise login” type “geoplatform” in the box. Click the GeoPlatform Login.gov Account button.
3. Click on the three lines in the upper right-hand corner and select Download Surveys.
4. You should have a list of AIM forms under Download Surveys. If you do not please contact your AIM state lead.
5. Download all 9 AIM forms by clicking on the cloud icon on the right side of the screen for each form. Before the name below- there will be the name of your project e.g., BLM NV AIM 2021.
    a. Plot Observation
    b. Plot Characterization
    c. Known Errors
    d. Unknown Plants
    e. Photos
    f. Gap
    g. Species Richness
    h. Soil Stability
    i. LPI

Appendix II: Plot Completion Checklist

Forms opened through Field Maps	
Plot Observation (Plot Center and Line Start Coordinates are Required)	
Coordinates taken for all forms	
Plot Characterization	
Soil Stability	
LPI	
LPI Line 1	
LPI Line 2	
LPI Line 3	
Gap	
Gap Line 1	
Gap Line 2	
Gap Line 3	
Photographs	
Line 1	
Line 2	
Line 3	
Soil Pit (If Required)	
Species Richness	
Unknown Plants	
Known Errors	

Appendix III: Survey123 Forms

IMPORTANT: Before Data Collection and going offline all forms need to be opened at least once directly in Survey123 Application from the My Survey123 Screen. This ensures that all species and people list are downloaded onto the tablet.

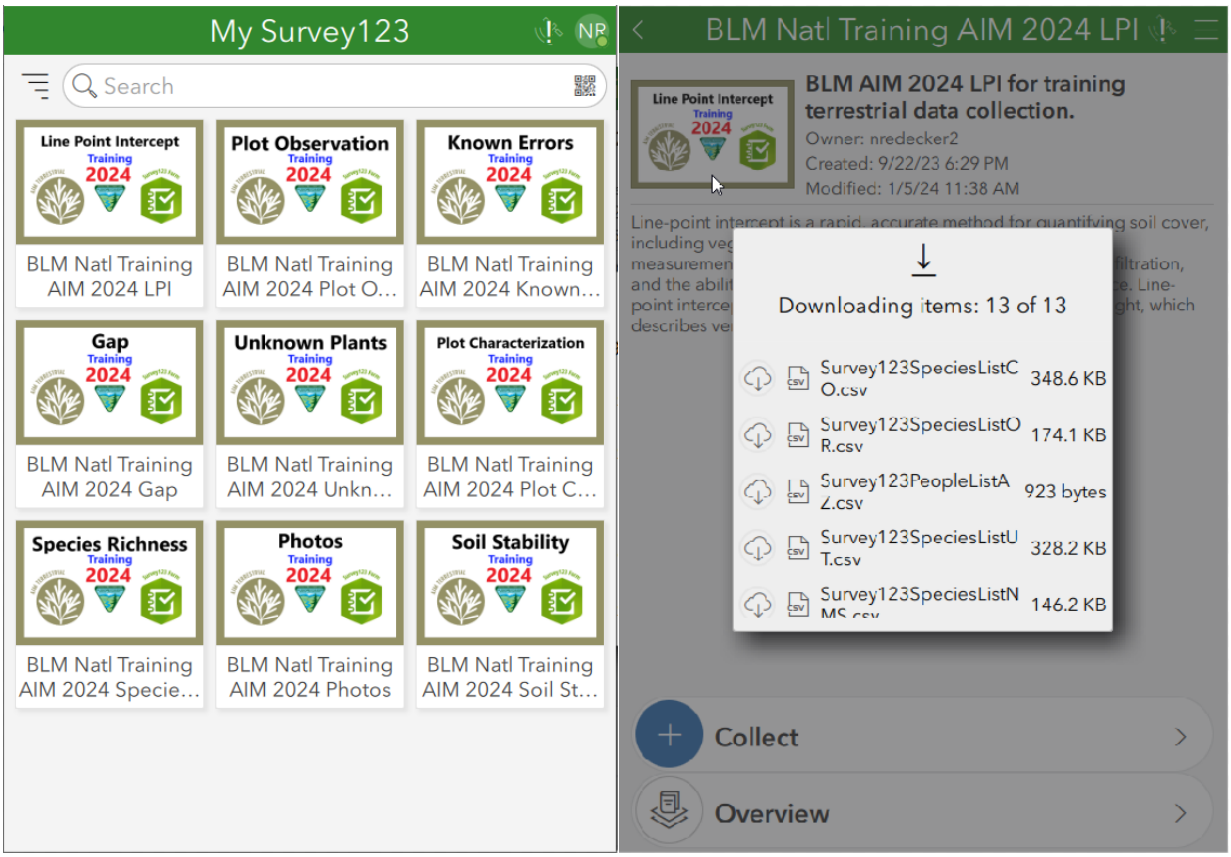


Figure 13. Survey123 Form's CSV list downloads during first open of form

For Date Collection ALWAYS load forms from Field Maps (except for calibration). Select your plot on the map and view the info window. Then click the link to the form. This passes the plot information (like plot ID) to the form. That is critical!

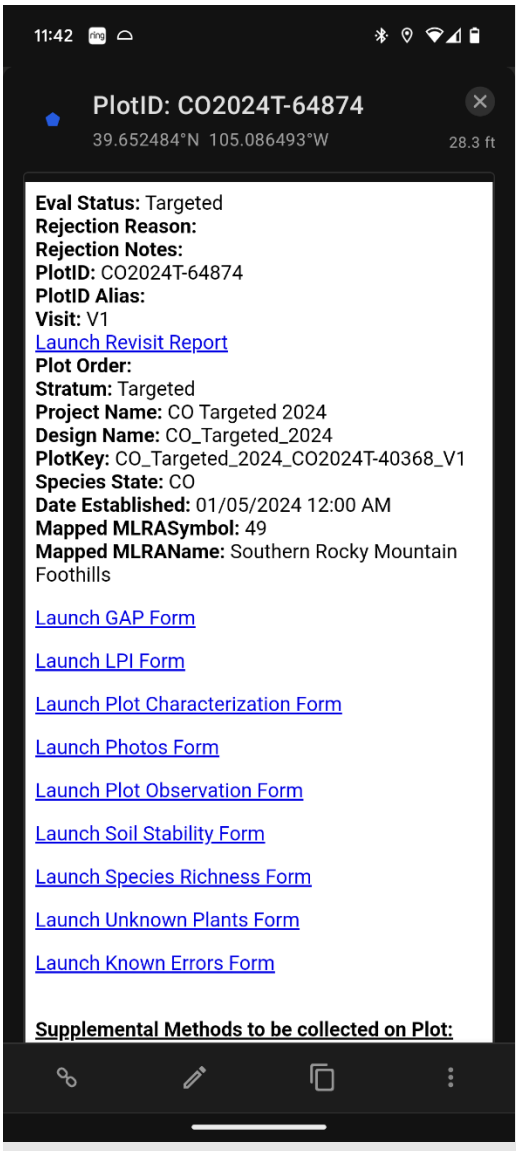


Figure 14 Launch Survey123 form through Field Maps

Plot Characterization Form

1. Office, PlotID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure to launch the forms from Field Maps.
2. Add Crew Number

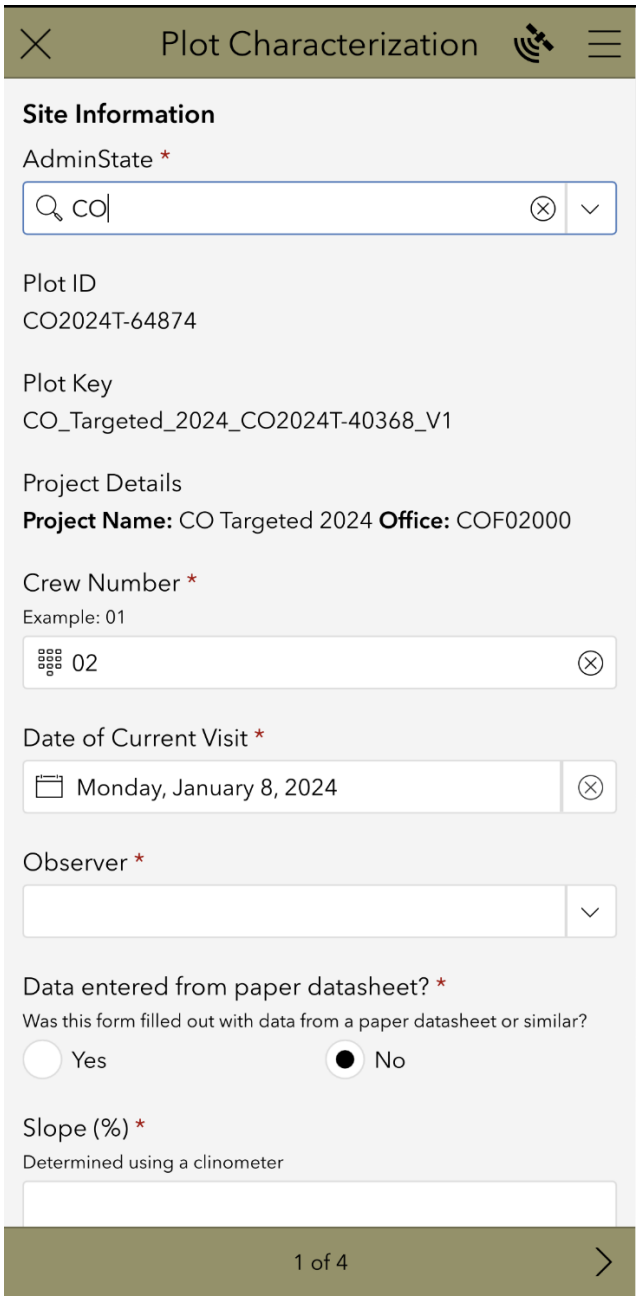


Figure 15 Data Imported from Field Maps

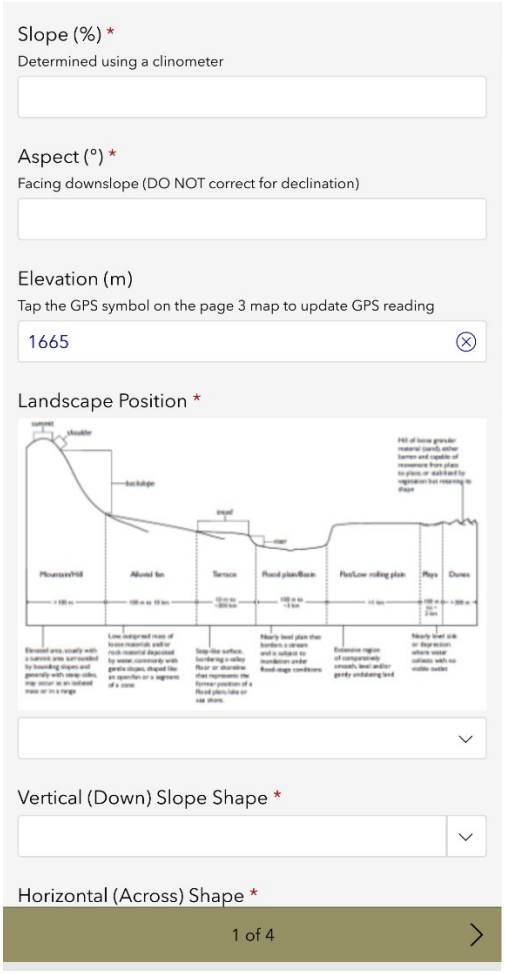


Figure 16: Plot Characterization 1st Page

3. Elevation will auto populate, if it looks off - follow the instructions (navigate to page 3 and update the soil pit location - at the location of the soil pit – by pressing the compass symbol to the left of the current coordinates) this should update the elevation value. You can also use an external GPS or altimeter and manually type it in.

4. On Page 3 of the form enter the total soil pit depth. There is also an option to indicate no soil pit needs to be dug. This may be due to a site revisit or other management considerations. If so, simply collect soil texture for the soil surface and enter that as the only horizon.

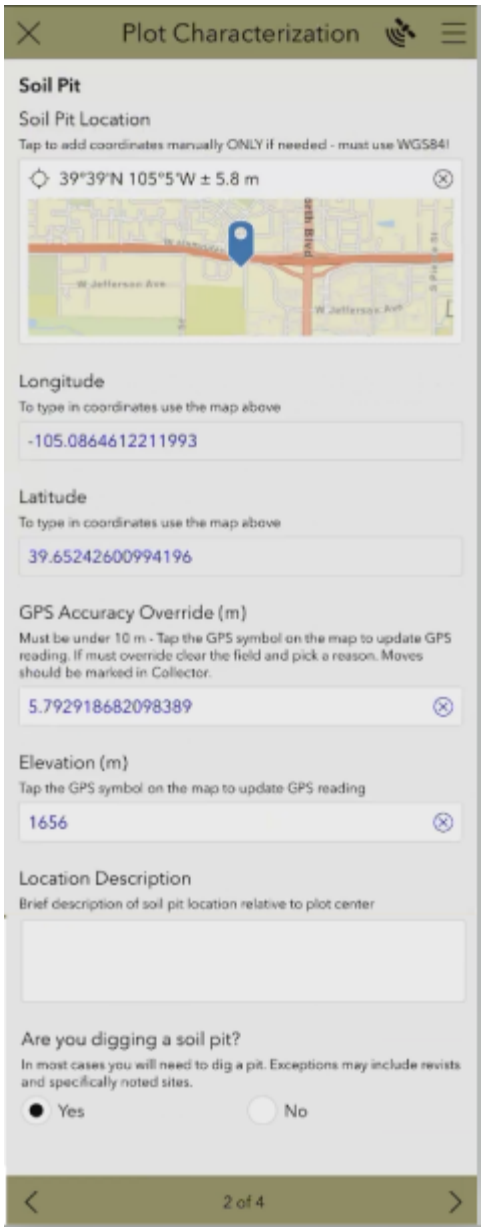


Figure 17: Plot Characterization 3rd Page

5. The soil characterization (Page 4) is collected in a repeat group. Add information for the first horizon, then click the + symbol at the bottom of the page to add each additional horizon.

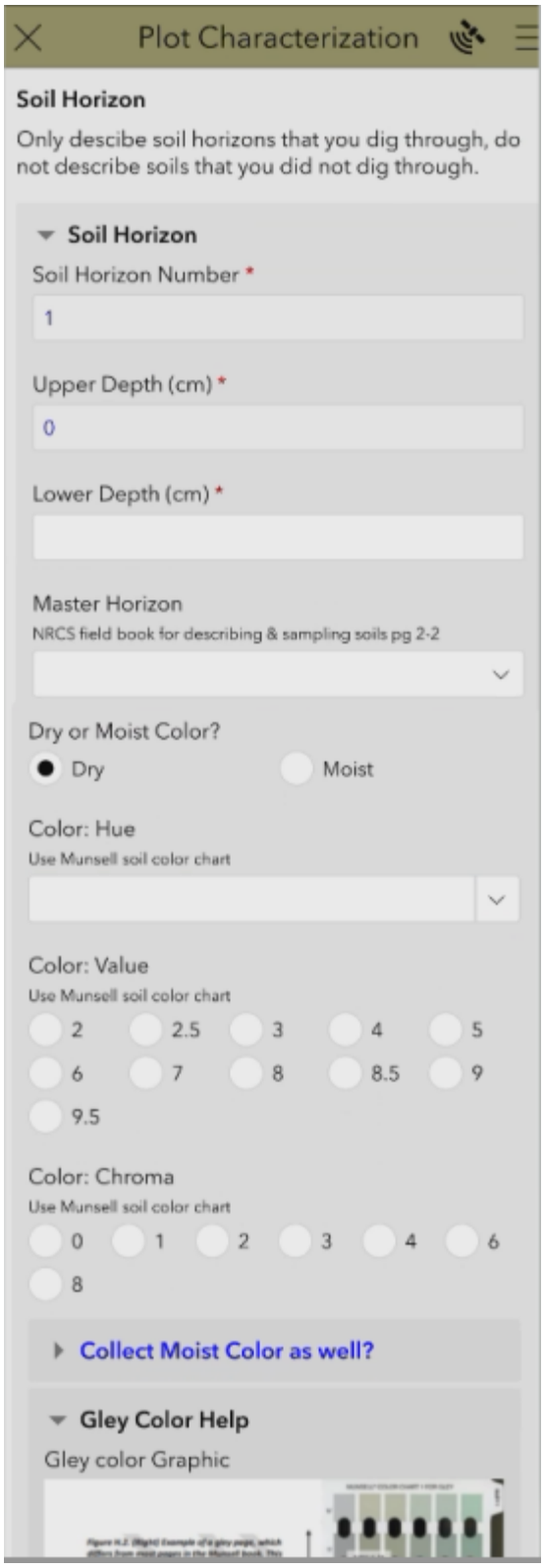


Figure 18: Plot Characterization 4th Page

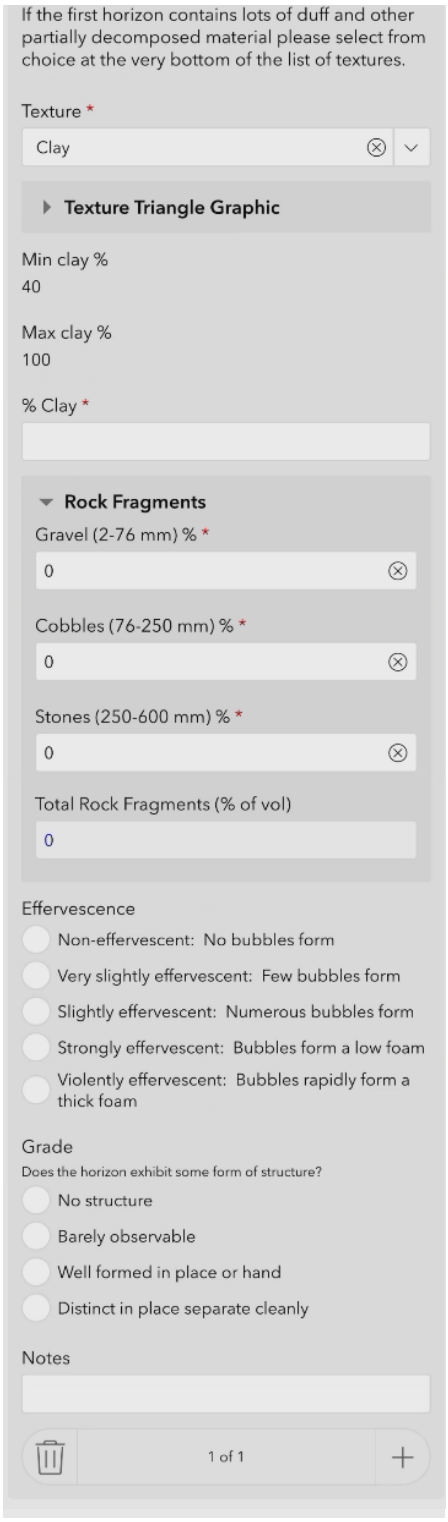


Figure 19: Plot Characterization 4th Page Bottom

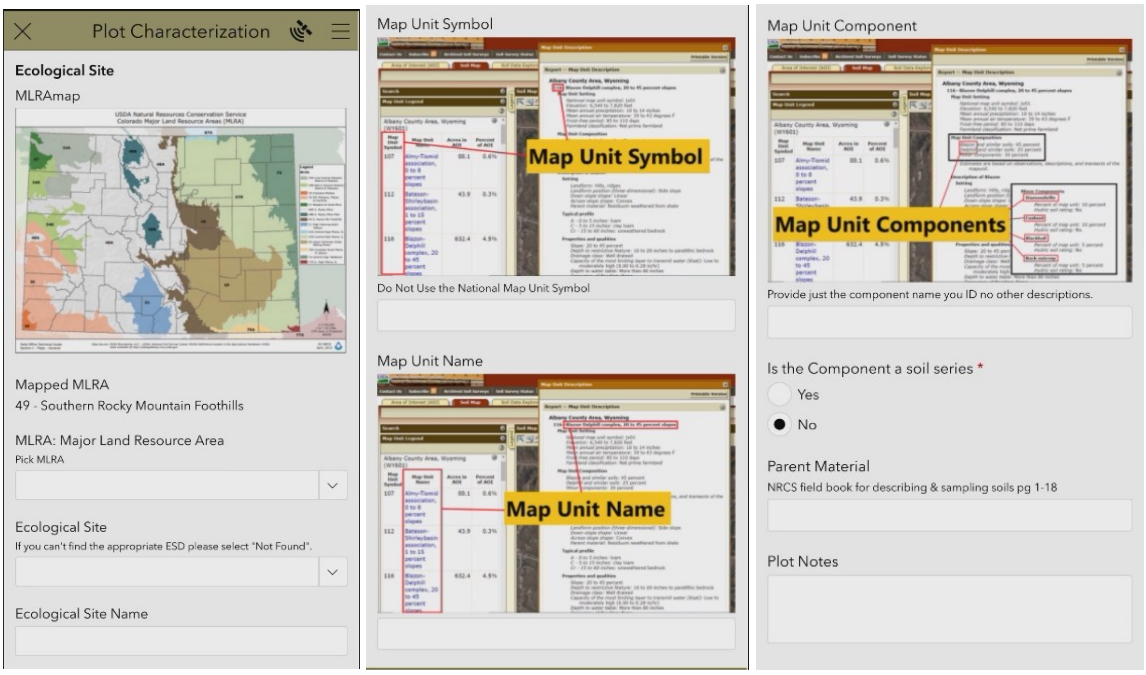


Figure 20: Plot Characterization 5th Page

6. **Required Fields: Crew Number, Observer, Slope, Aspect, Slope Shape, Soil Horizon Number, Upper Depth, Lower Depth, Texture, % Clay, Gravel %, Cobble %, and Stone %.**

Plot Observation Form

1. Office, PlotID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number.

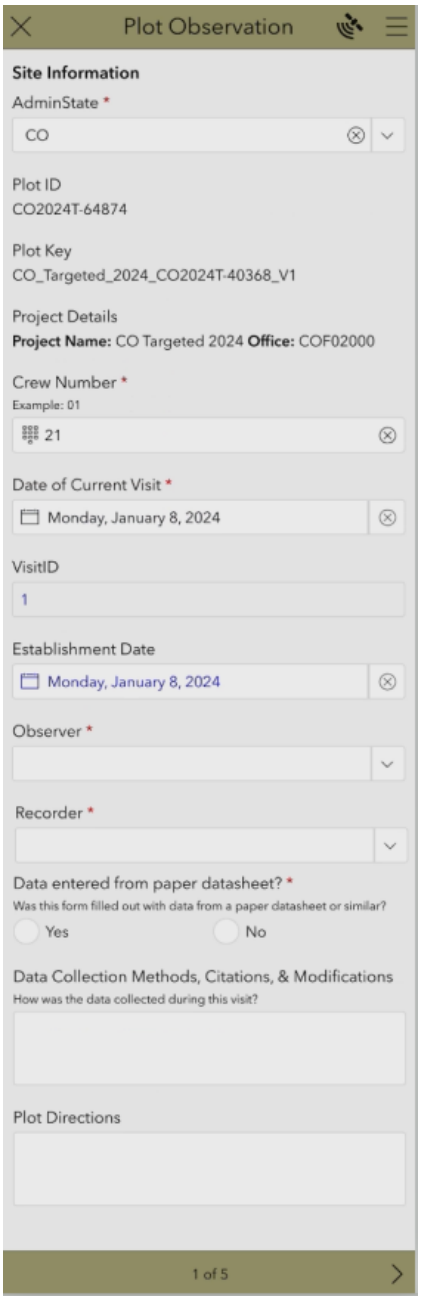


Figure 21: Plot Observation 1st Page

3. Page 2 - GPS Plot Center. Navigate to Plot Center and click the compass symbol in the GPS Plot Center window. Longitude and Latitude will auto populate from the GPS Plot Center. Document if a monument is used

4. Plot lines are now captured in Plot Observation. Record the starts, ends, azimuth and elevation of all the lines that data will be collected on. The repeat is specific to the number of lines entered on the first page of the form. Document if a monument is used/present at each start and end.

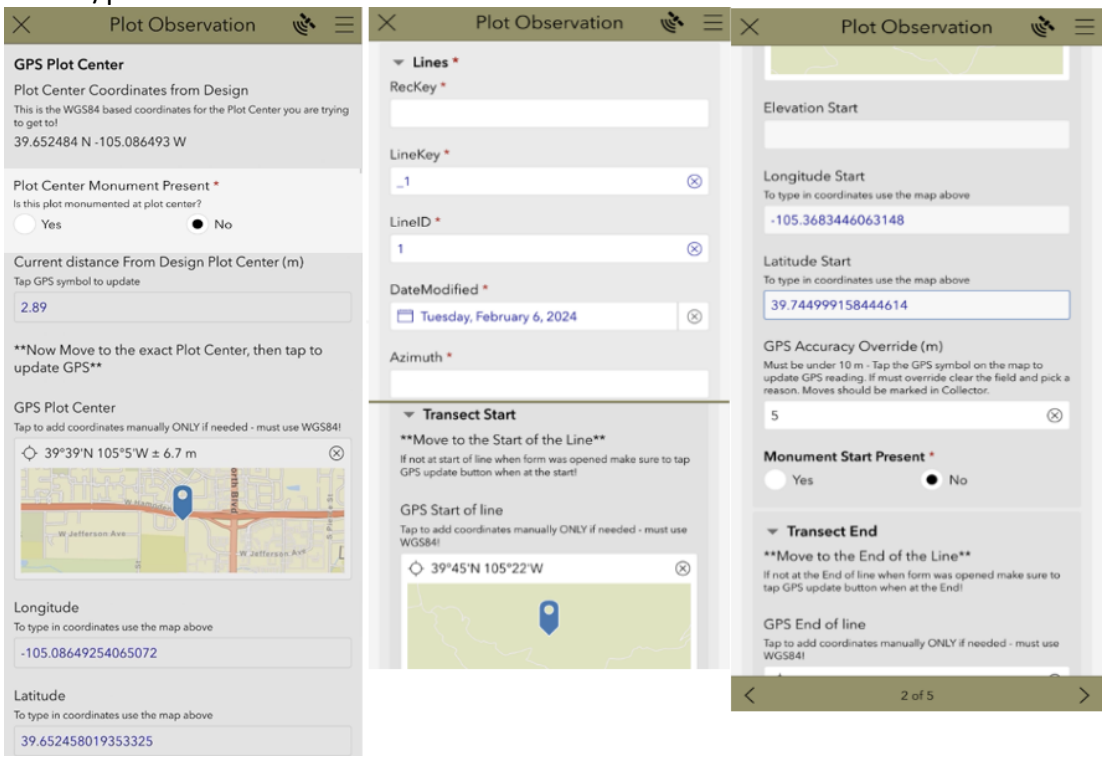


Figure 22: Plot Observation 2nd Page

5. If you are more than 10m away from plot center, the form will ask you if you moved the plot. If you did not, make sure you are at plot center and the GPS accuracy is less than 10m. If you did move the plot, select why you moved the plot.

6. GPS Accuracy Override. We require GPS accuracy to be under 10m, if it is not, you should wait and click the double arrows refresh button next to the GPS accuracy value. To use the refresh button, make sure the GPS Accuracy Override is blank.

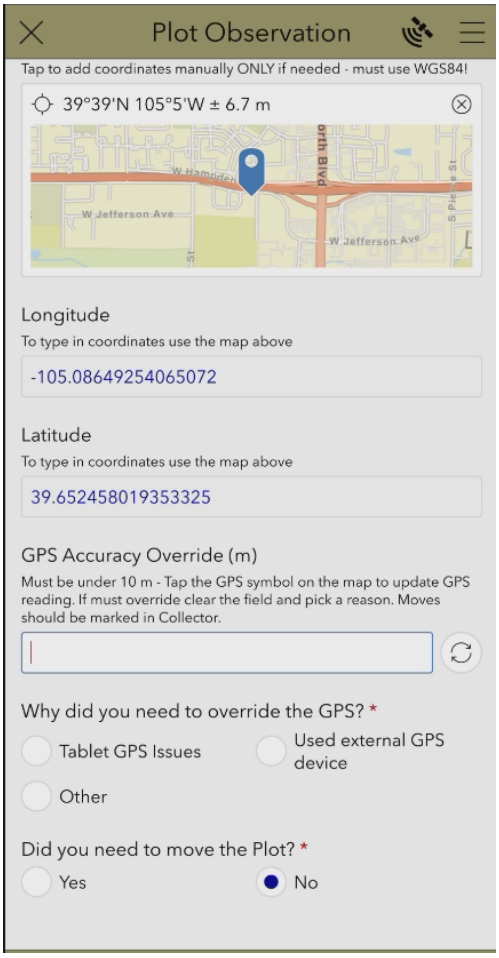


Figure 23: GPS

Note some forms require the GPS accuracy to be 10m or less. Tap the compass to update as many times as needed. As you stand still it should get better and better (it will never read under 3 however). Press and hold the compass until it starts blinking and this will begin point averaging for the question. If your GPS will not get below 10m you can tap the X and remove the GPS Accuracy value. When you do, a question will appear asking why you had to override the GPS. You can also manually type in WGS84 base coordinates on the map from an external GPS (NOT NAD83!). Please do not just type in what it should be - we want to know where you were! When you do the GPS Accuracy field will blank and the why question will appear.

Figure 24 Plot Drawing page in Plot Observation form

7. Plot drawing is in Plot Observation now. Take a picture of a hand drawn depiction of the plot or use the in-app drawing feature to draw the plot feature directly in the form.

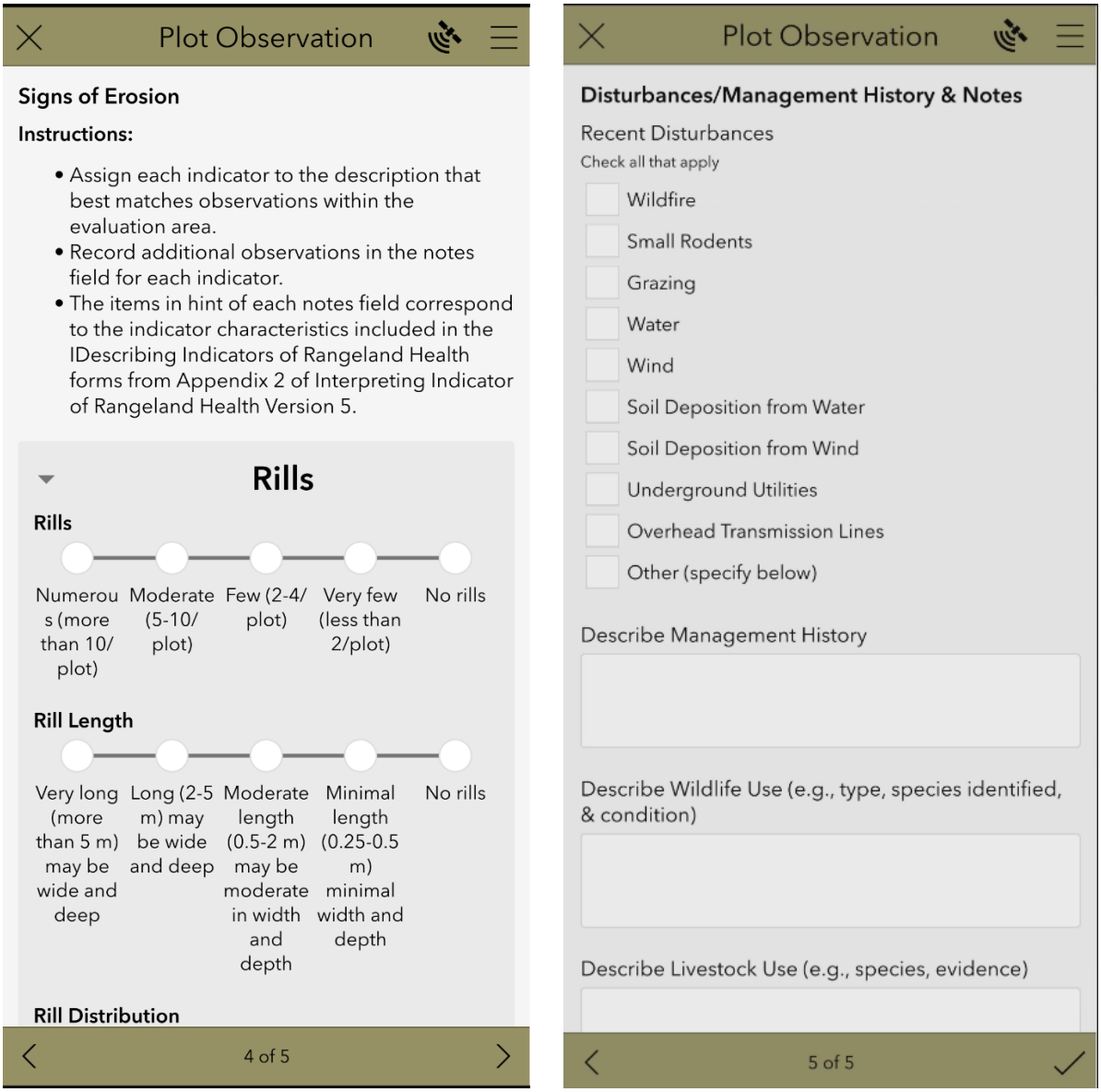


Figure 25: Signs of Erosion and Disturbance/Management History

8. Signs of Erosion (Similar to the observational components of Interpreting Indicators of Rangeland Health) and Disturbance and Management History are present on the last two pages of Plot Observation.
9. **Required Fields: Crew Number, Observer, Recorder, Date of Current Visit, Plot Center Coordinates, Lines Start Coordinates.**

LPI Form

1. Office, PlotID, Plot Key, Line Length, Interval, Height Interval, and Show Sagebrush Shape will be brought over from Field Maps - if they are blank return to Field Maps and make sure you've launched the forms from Field Maps.
2. Add Crew Number.

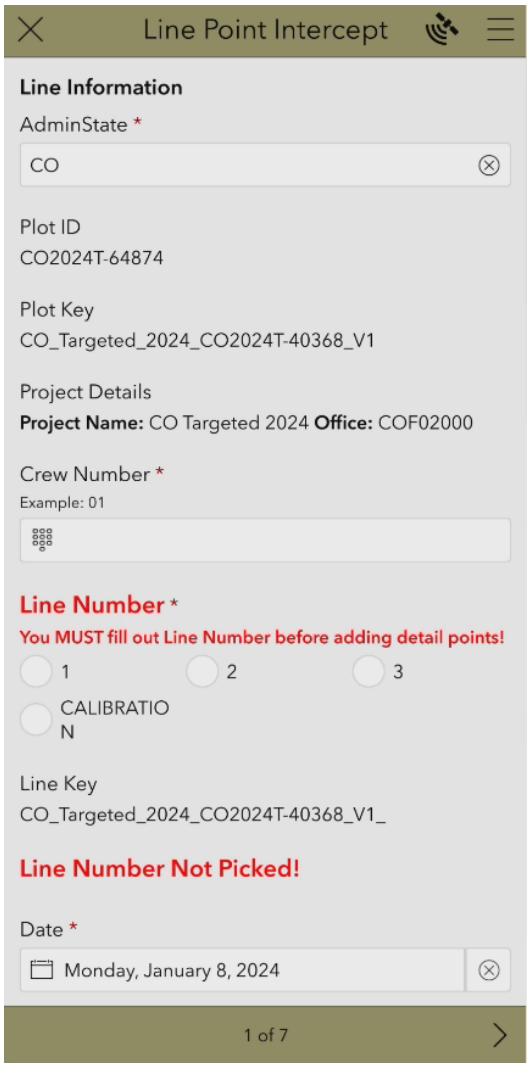


Figure 26: LPI 1st Page

3. You must select which line you are on and crew code, this will auto populate Line Key. Note if you forget which lines you have done already simply look in your Outbox or Sent box and it will show you the list of completed forms by LineKey. You can also check the webmap or Field Maps if you have wifi.
4. On the Line Default page, you can enter the plant codes you will be encountering the most on the line. This makes filling out each point a bit faster. Optional.

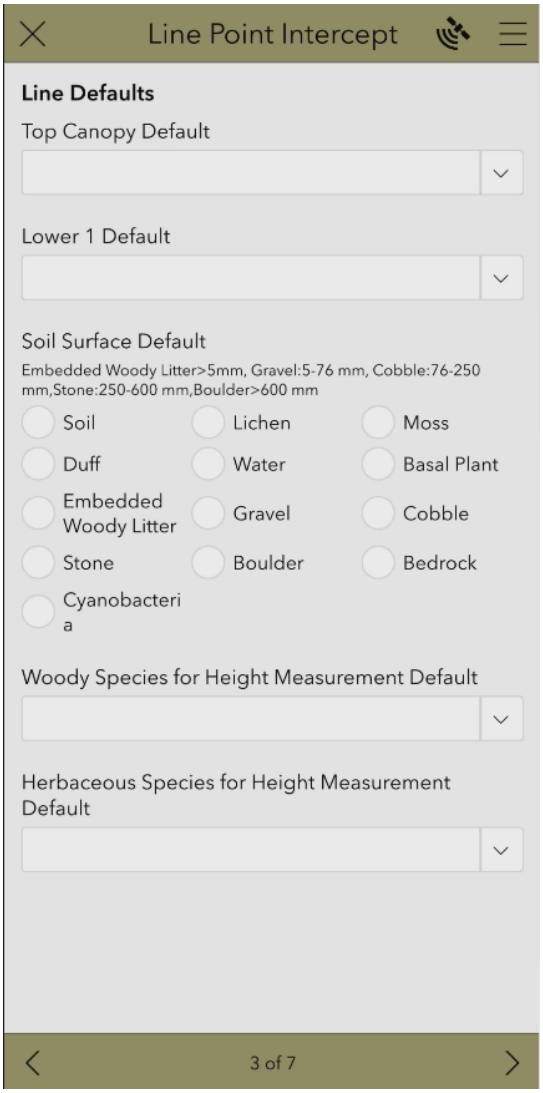


Figure 27: Defaults Page

5. Pick a direction along the line and click the plus sign to start.

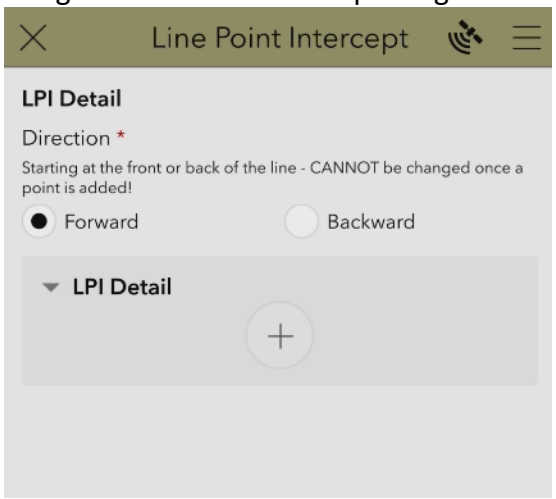


Figure 28 LPI Line Capture

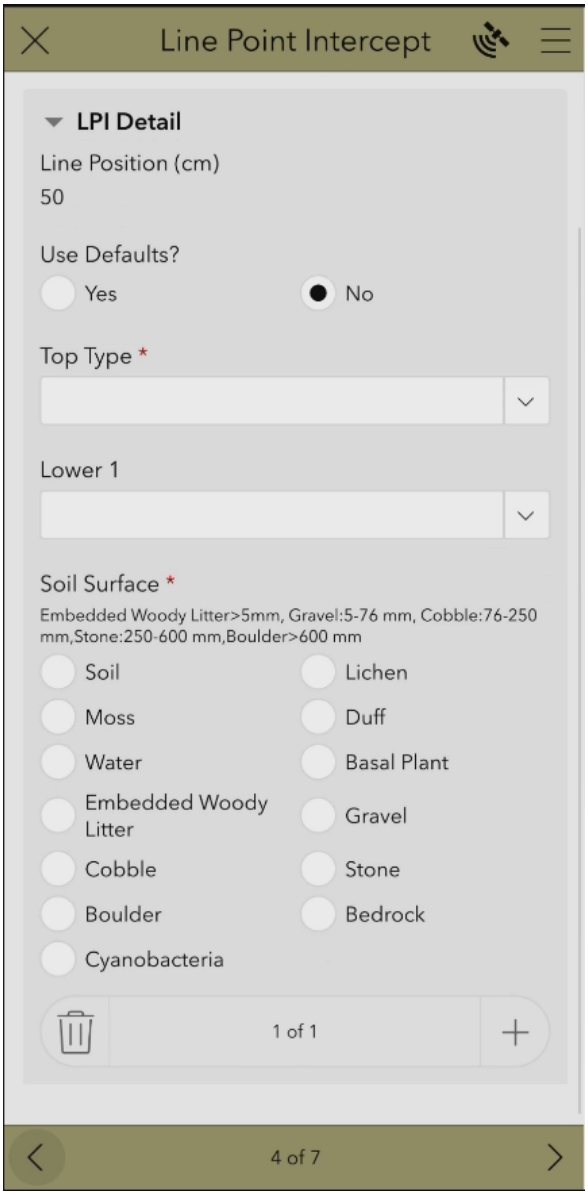
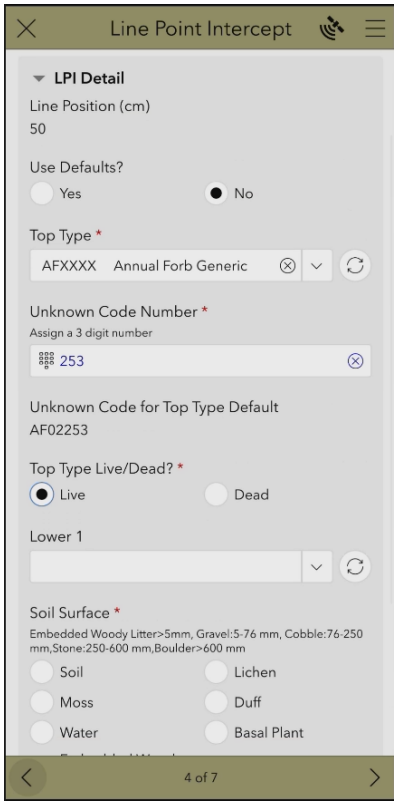


Figure 29: LPI Detail Page

6. Within the repeat group several fields are required. **Only the Top and Soil Surface are required in addition to Vegetation Height and Live/Dead or basal plant type for plants.** Up to 5 lower layers can be collected, which will appear as you keep adding layers - Lower 2-5 are not always visible until you fill information into the previous lower layer. Leave Lowers blank if not using. Select the default if useful for this point.
7. For choosing plants from plant list, you can start typing the plant code, the scientific name, or the common name, and the list will be narrowed to present the available plants. This autocompleting function also works for litter codes, none (no plant) as well as unknown plants.
8. **You must make a selection for Top Canopy. If you do not hit any plant species, select "None".** After the Top Canopy layer, fill out as many lower layers as needed.
9. **Live/Dead selection is required for each plant species.**

10. Litter codes (HL, WL, and NL) cannot be in the Top Layer. Litter codes are appropriate in the Lower Layers.

Figure 30: Unknown Plant Code entry in LPI form



11. If you hit an unknown plant and you can identify the growth habit and duration (ex: Perennial Grass), select PGXXXXX Perennial Grass Generic (or whatever is appropriate). The unknown Code for the layer field will then open - you will see PG in red. Click in the box and delete the 3 spaces after the PG and crew number, then enter your own 3 digit number. We have given 5 digits assuming the first 2 numbers are a Crew number and the last 3 are for tracking within the crew. Crew 04 would start numbering with PG04001 and crew 10 would start with PG10001. We suggest calling over another tablet to complete an Unknown Plants form right away so it is not lost. Note you can also use the copy/paste list of Unknown codes at the end of the form to copy into Excel for example.

12. The soil surface is required. Choose the most appropriate surface code from the dropdown menu. **NOTE: If you select "Basal Plant" an additional line appears, and you can select the appropriate basal plant.**

13. Every designated interval (As designated in the htinterval of the PlotsSchema) of point (In in the form will show additional required lines for collecting vegetation height. Select the appropriate species and record the height in cm. **NOTE: if there is not an herbaceous or woody species select "None" and the height value will auto populate with 0.**

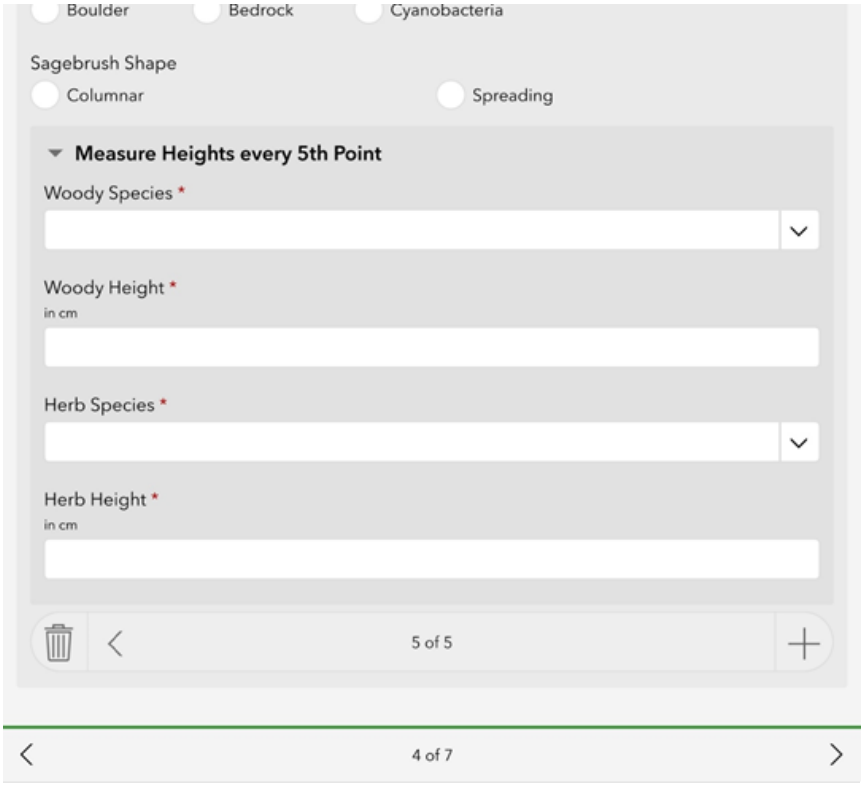


Figure 31. LPI Form page 4 showing heights questions

14. Tap the **+** button at the bottom of the form to move to the next point. When you reach the last point, use the arrow to move to the next page.
15. The Survey123 LPI form is big, please have patience when tapping the **+** button. It will take a few seconds.
16. **Required Fields: Observer, Recorder, Direction, Top Layer, Soil Surface.**

Gap Intercept Form

1. Office, PlotID, Plot Key, Gap Type, and Line Length will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number.
3. Pick a Line Number for the transect– must be done BEFORE collecting gaps!
4. Gap fields will appear after you select Yes for "Are Canopy Gaps Present" and the direction you will be observing along the transect. **NOTE: For the very first gap if the Direction is Forward a -2 is used as a placeholder for Last Gap End so that if your gap starts at 0, an error will not be flagged for having a gap smaller than 2 cm.**

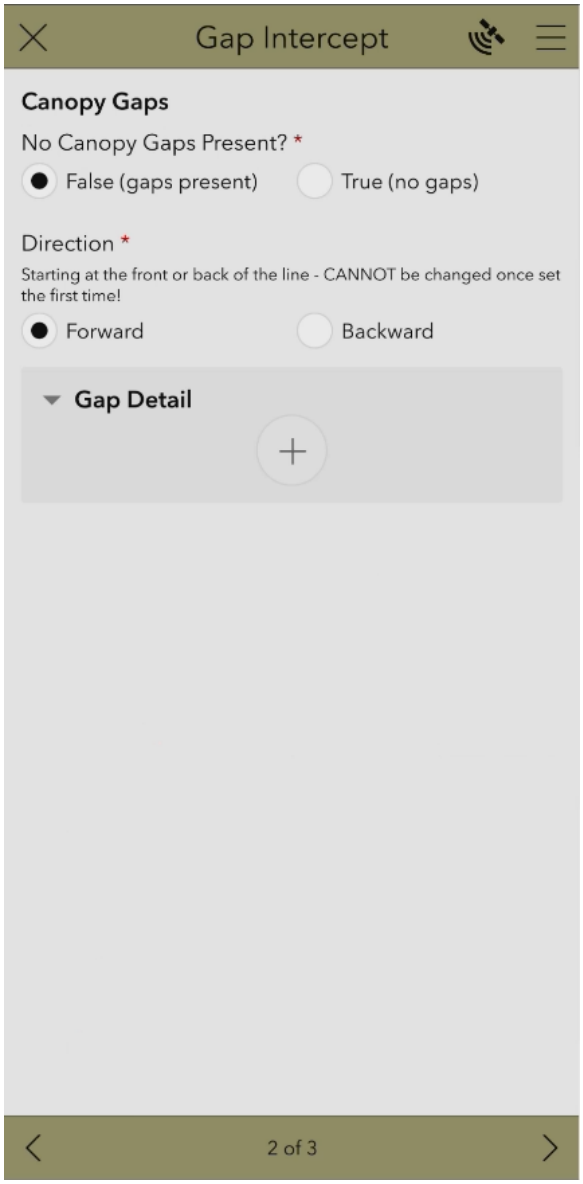


Figure 32: Gap Detail Page

5. Under Gap Detail you will add in gaps using the +
6. Required Fields: **Observer, Recorder, Are Canopy Gaps Present, Direction, Start, End.**

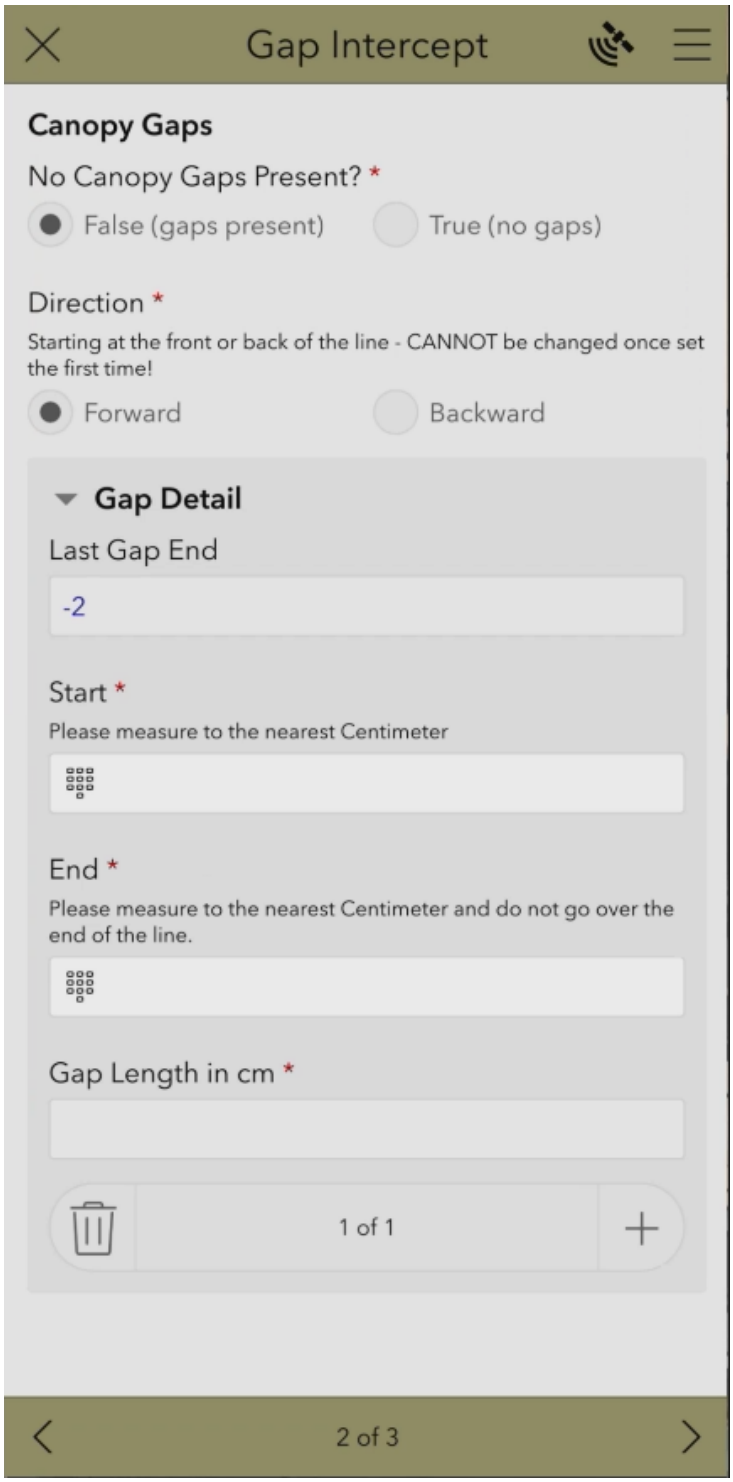


Figure 33: Gap Detail Page

Soil Stability Form

1. Office, PlotID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number.

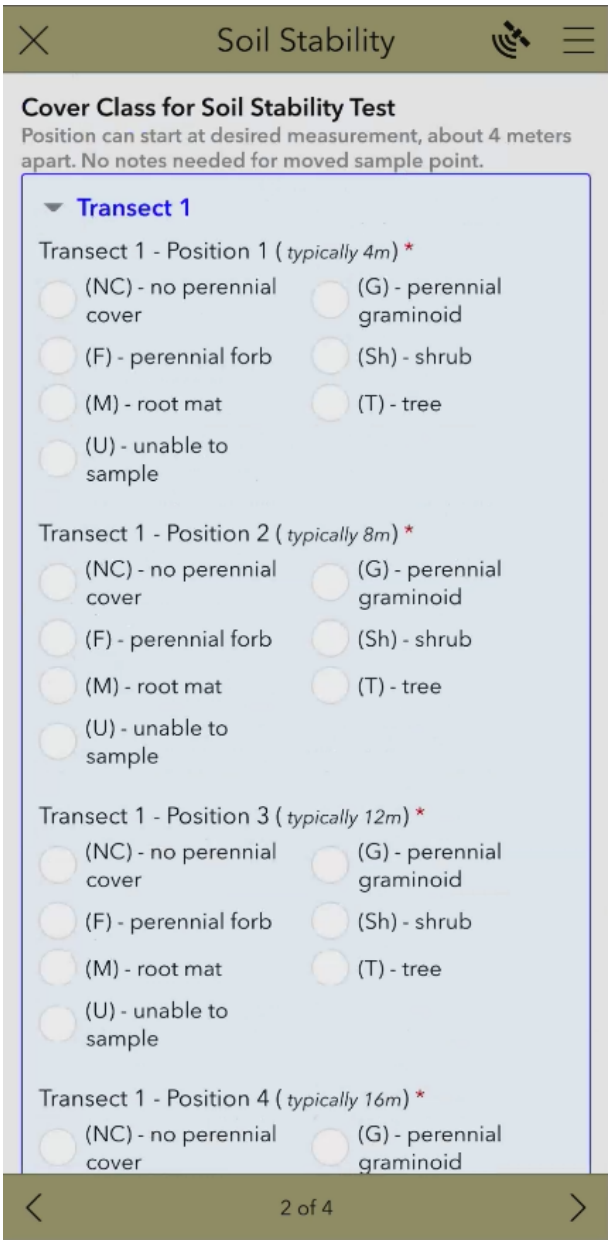


Figure 34: Soil Stability Cover Class Page

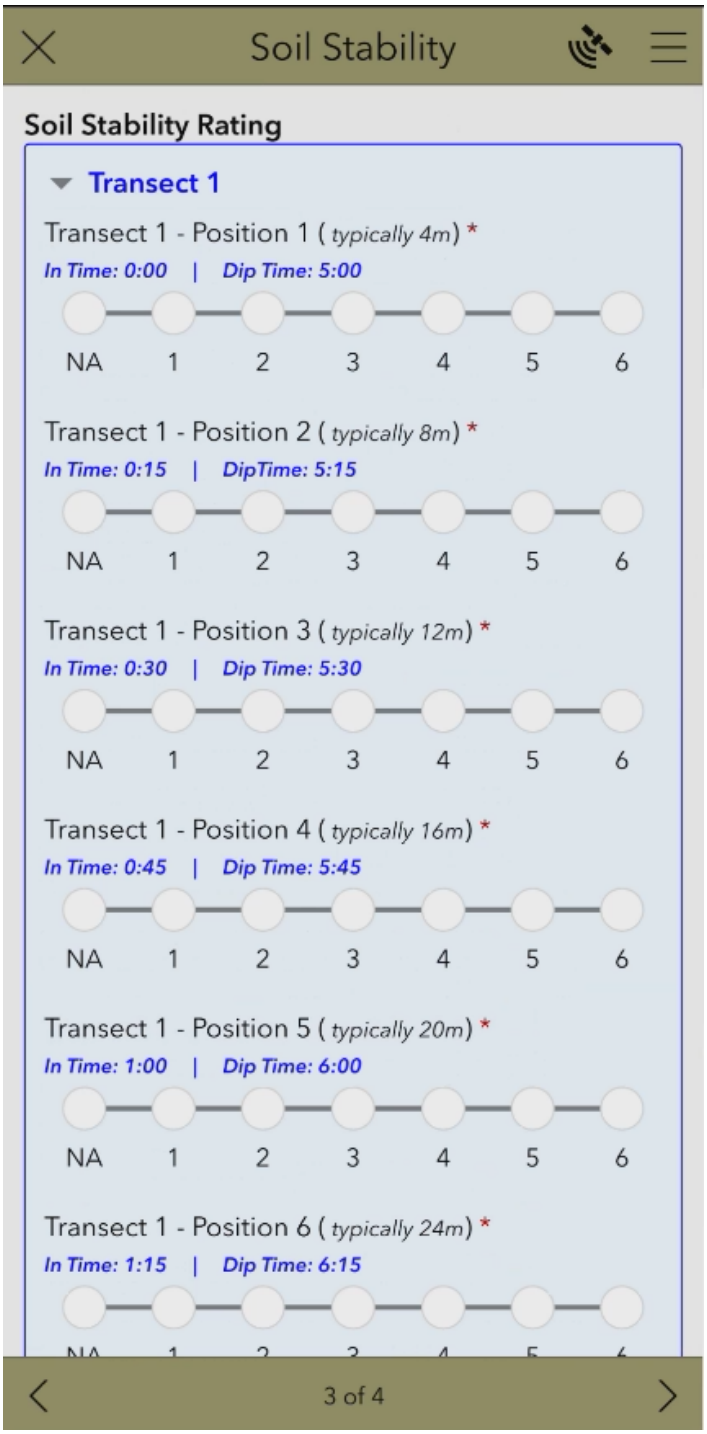


Figure 35: Soil Stability Rating Page

3. Note when you select "Unable to Sample" in Cover Class, the equivalent point in Rating will be set to NA and Read Only. To change the Rating if necessary, go back to Cover Class and pick any other choice, then return to Rating and edit.

4. **Required Fields: Recorder, Observer, Cover Class for Transect 1-3 Positions 1-6, Rating for Transect 1-3 Positions 1-6.**

Species Richness Form

1. Office, PlotID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number.
3. Select yes or no for calibration.

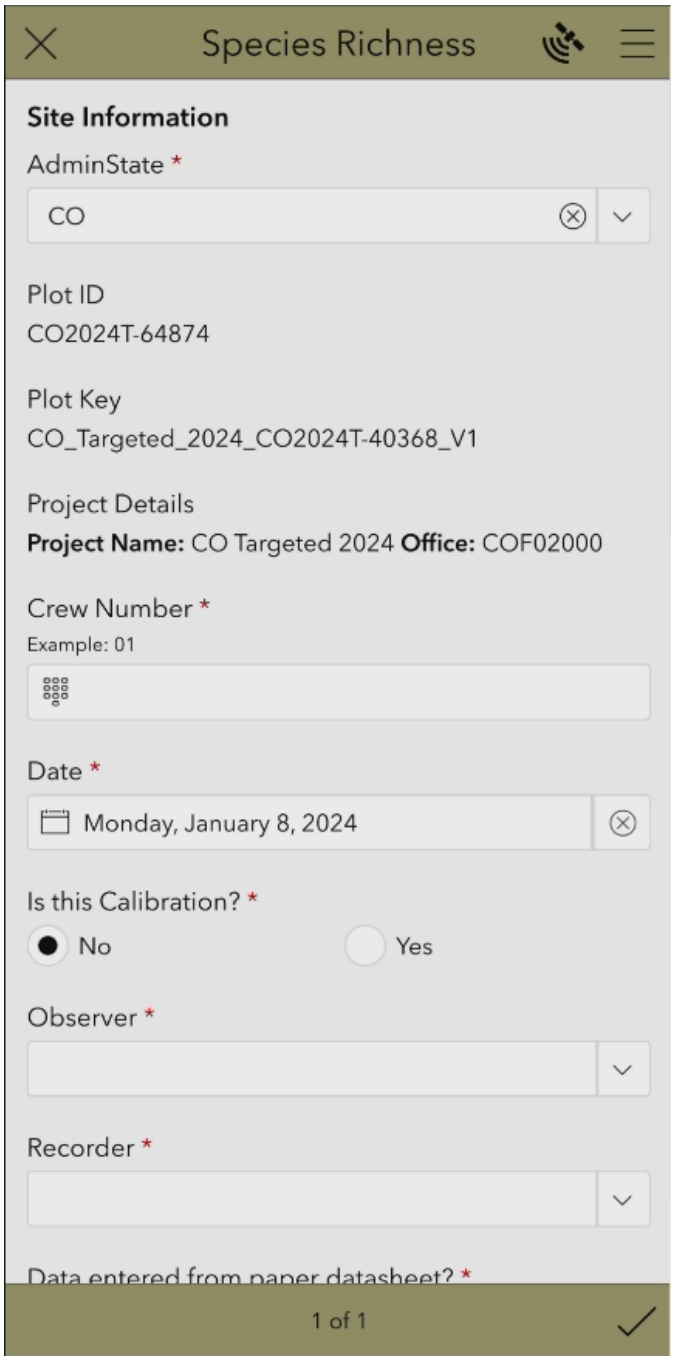


Figure 36: Species Richness Page 1

4. In Plant Species Observed add each Plant that you encounter. Currently there is no option to populate from LPI (since it may be on a different tablet) so you'll have to enter all the species encountered on LPI.

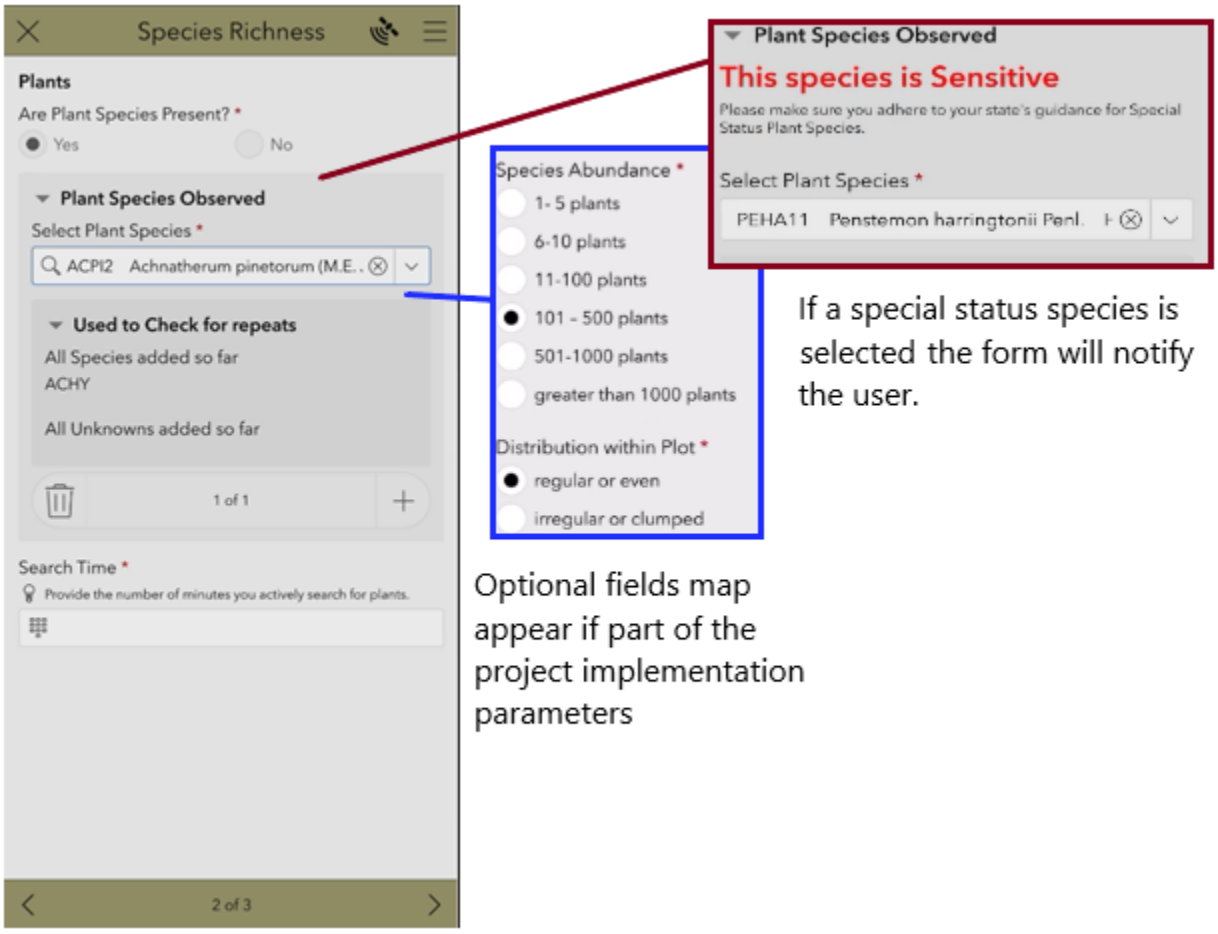


Figure 37: Species Richness Species Observed Page

5. The amount of time you actively searched for species for the Species Richness method is required to be record in the Search Time field.
6. Under "All Species added so far" you'll see a running list of all the plants that you've selected - DO NOT EDIT THIS FIELD.

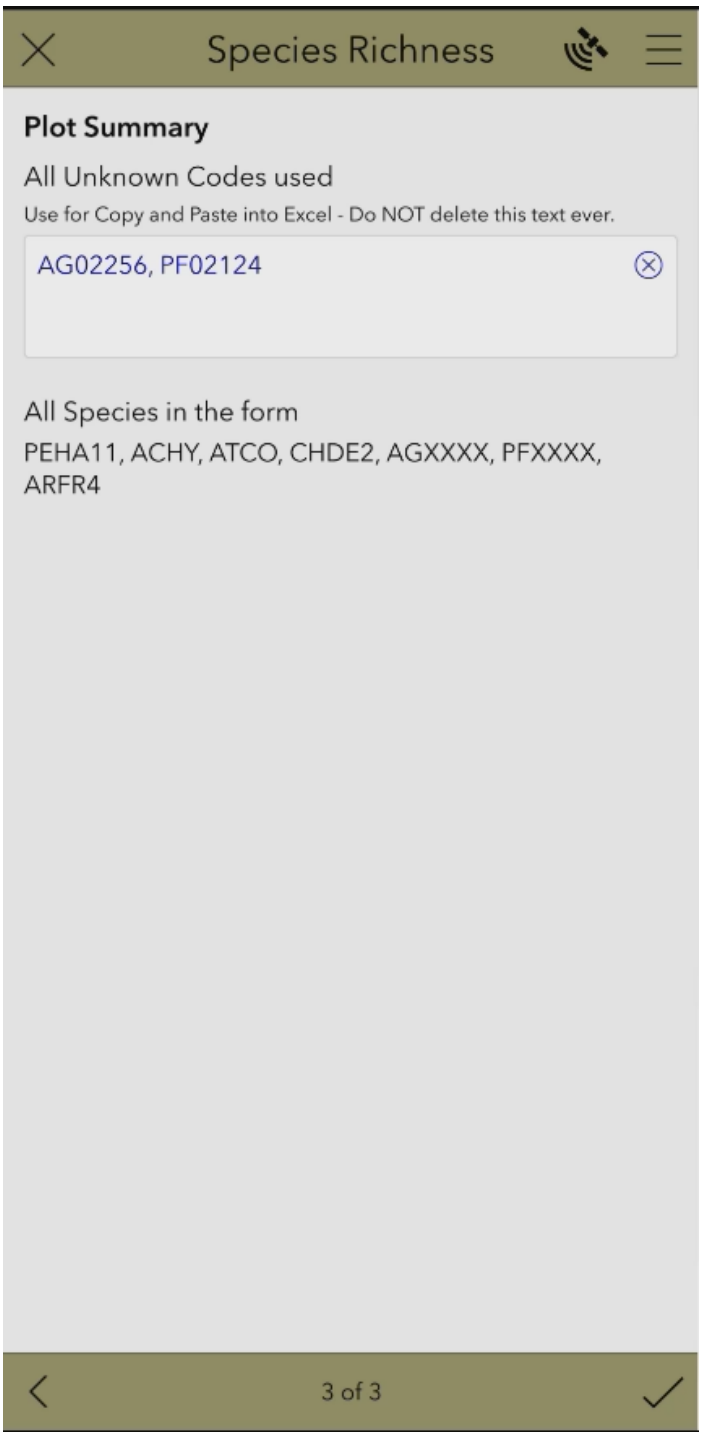


Figure 38: Species Richness Summary Page

6. All Unknown Codes used is a running list of all the unknowns you have encountered in Species Richness - you can use this to compare against the Unknown plants form entries to make sure you have described each of the unknowns. DO NOT EDIT THIS FIELD. A good use of this is to copy/paste into Excel for tracking.
7. **Required Fields: Observer, Recorder, Crew Number, Search Time.**

Known Errors Form

1. Office, Plot ID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number.

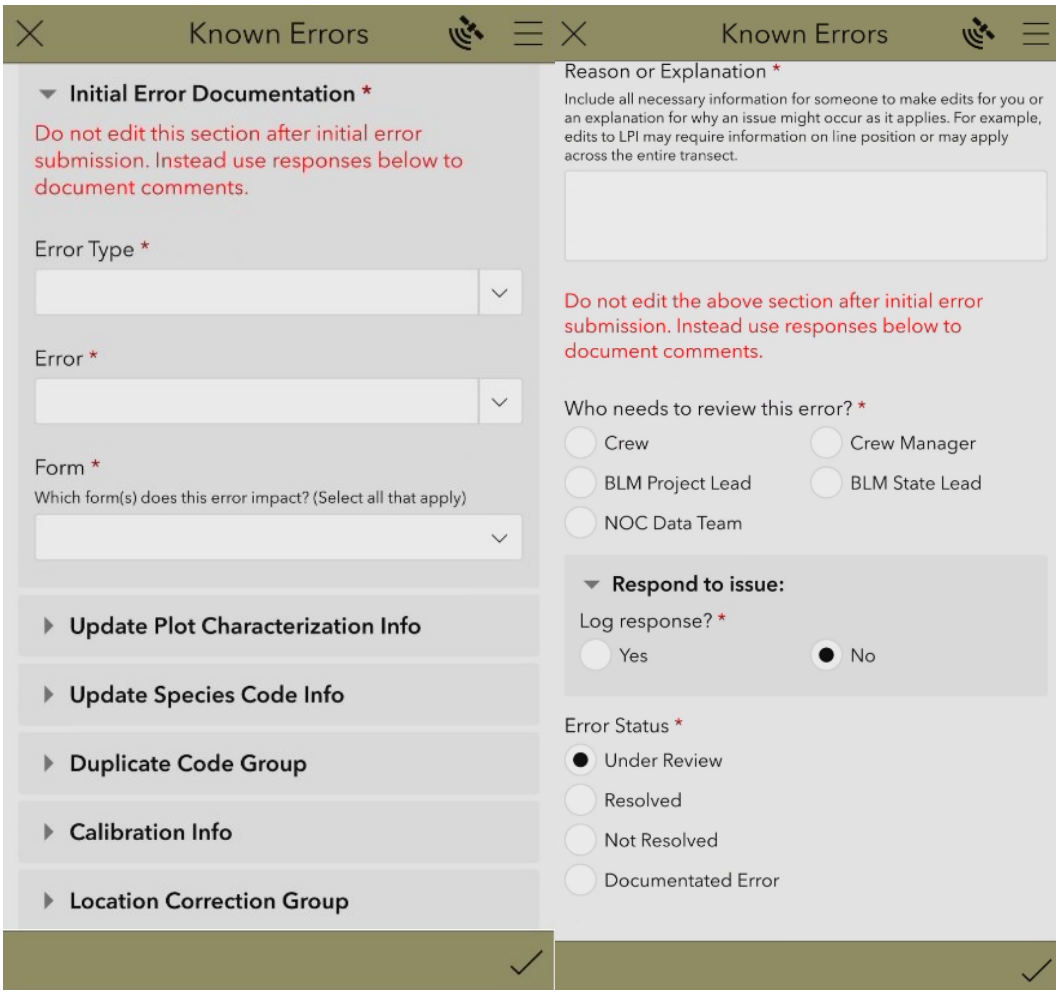


Figure 39: Known Errors Form

3. Select the method the error was found in.
4. Tap the type of error and describe what happened in Reason/Explanation (provide enough detail is shared so that a resolution can be implemented)
5. This should be used for things that you absolutely cannot fix, likely this will be populated as you are QCing the data, not at the plot. **If you are at the plot and can fix the error, please fix it!**

Photos Form

1. Office, Plot ID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number and make sure that the Line Count and Soil Pit questions represent the plot as this will impact what required photos appear.

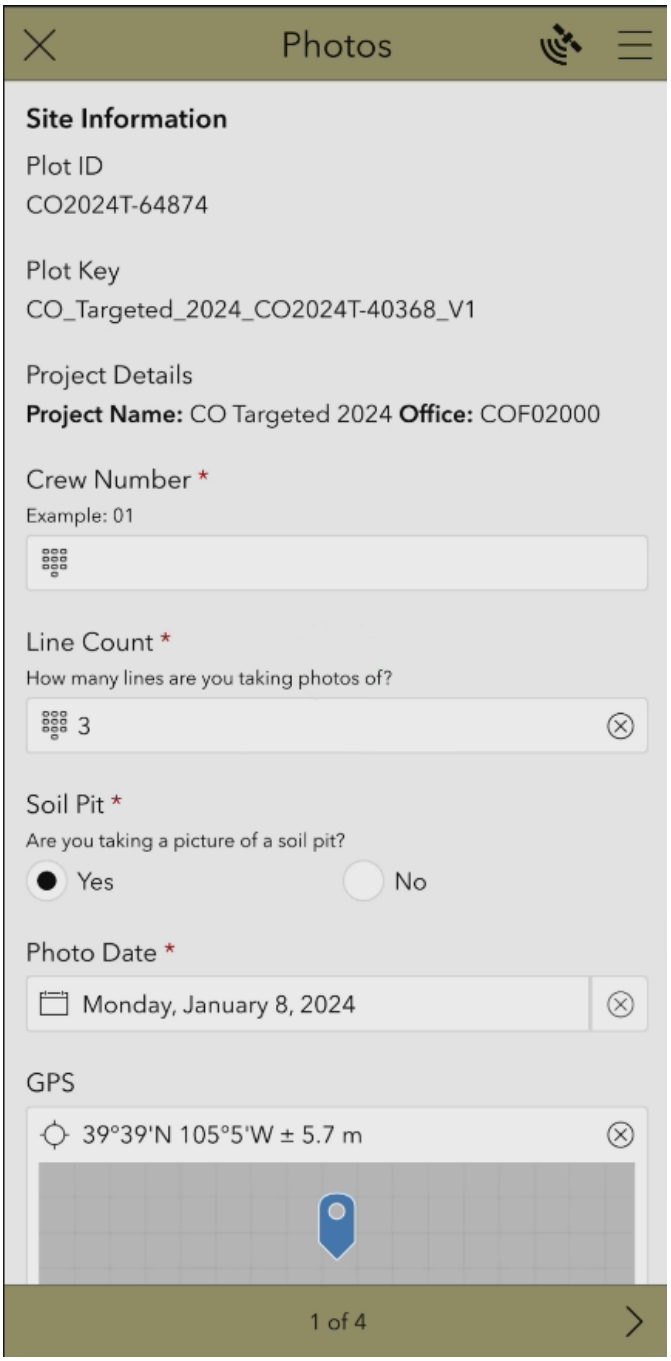


Figure 40: Photos 1st Page

Figure 41: Photos Required Page

3. You should take a photo (with the tablet) for each of the required photos. All Transects where data is collected and soil pit face when soil pit is dug are required. If there are additional photos to take you can take those in the Miscellaneous photos page. Add comments to describe what the photos are as needed.

Figure 42: Photos Misc. Page

4. Check to make sure the photos are not blurry or if there is a wayward digit covering the lens.

5. **Required Fields: CrewNumber, PhotoDate, Transect Photos and Soil Photos dependent on project parameters.**

Unknown Plants Form

1. Office, Plot ID, and Plot Key will be brought over from Field Maps - if they are blank return to Field Maps and make sure you have launched the forms from Field Maps.
2. Add Crew Number.

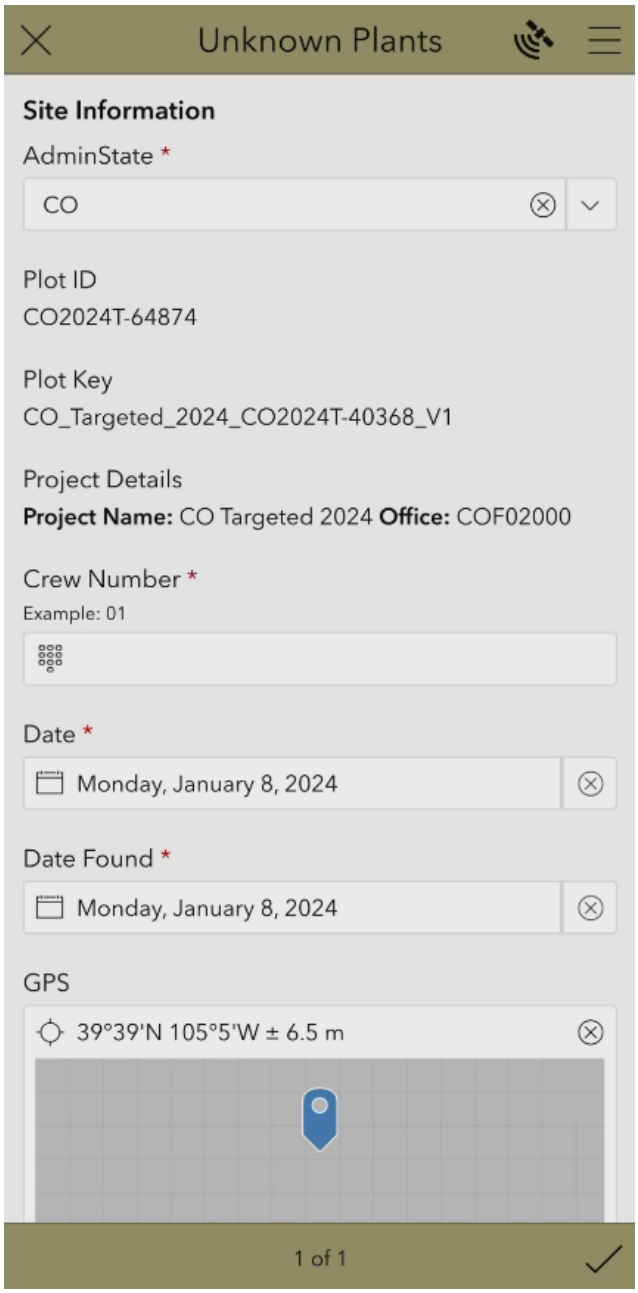


Figure 43: Unknown Plants 1st Page

3. This form is used to describe unknown plants found on the plot. All plants will be added to the form via a repeat, one form launched per plot. Tap the + to add details about unknown plants.

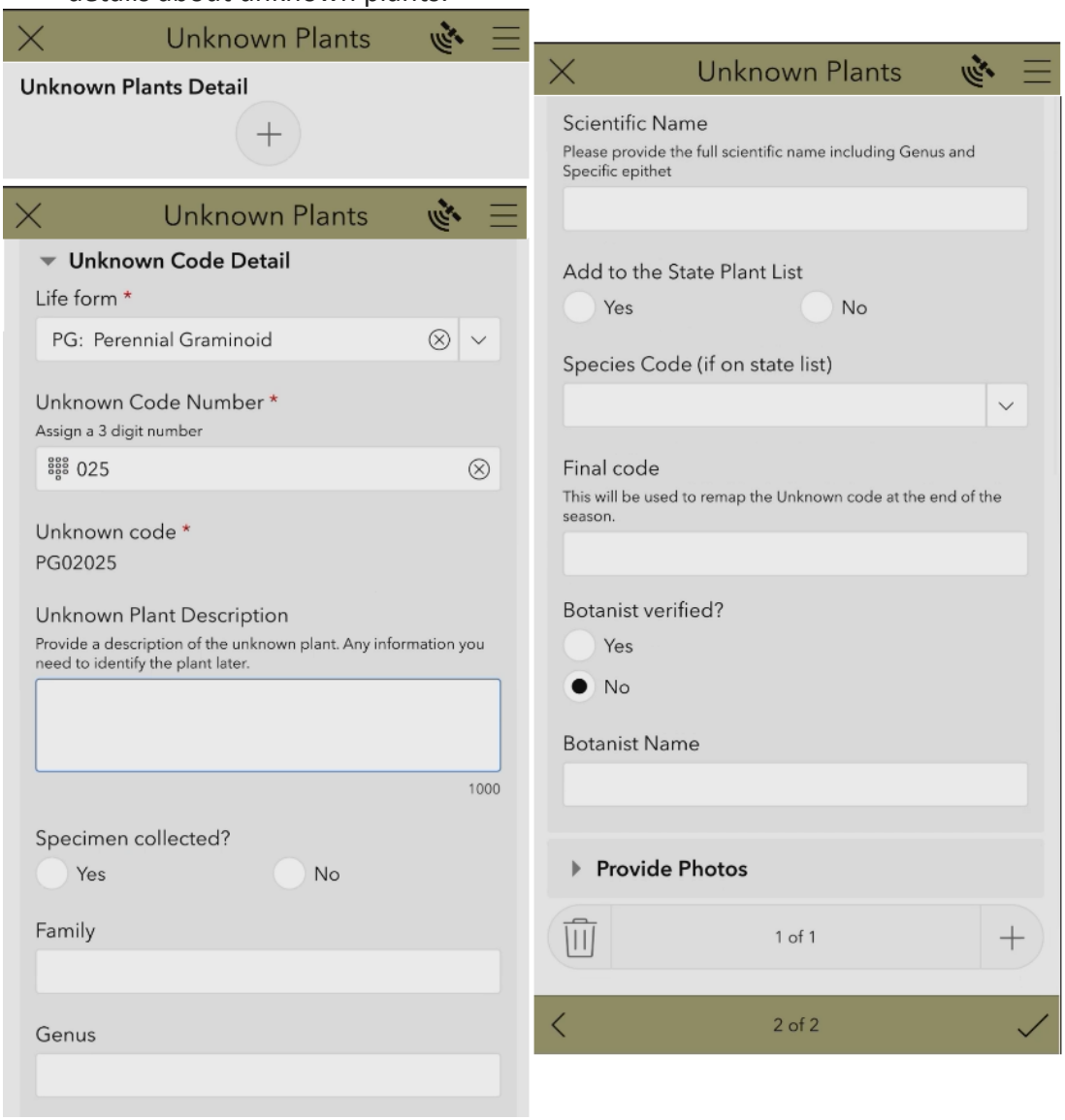


Figure 44: Unknown Plants 2nd page

4. Enter a crew code before any other data is collected then select the Life Form, then enter a unique unknown code number to create the Unknown Code. For example, PG25253 for the perennial grass found by crew 25.
5. Enter information about the plant as well as take photos of the unknown plant for future identification.
6. The NOC will take care of remapping Unknowns to known Final Codes.

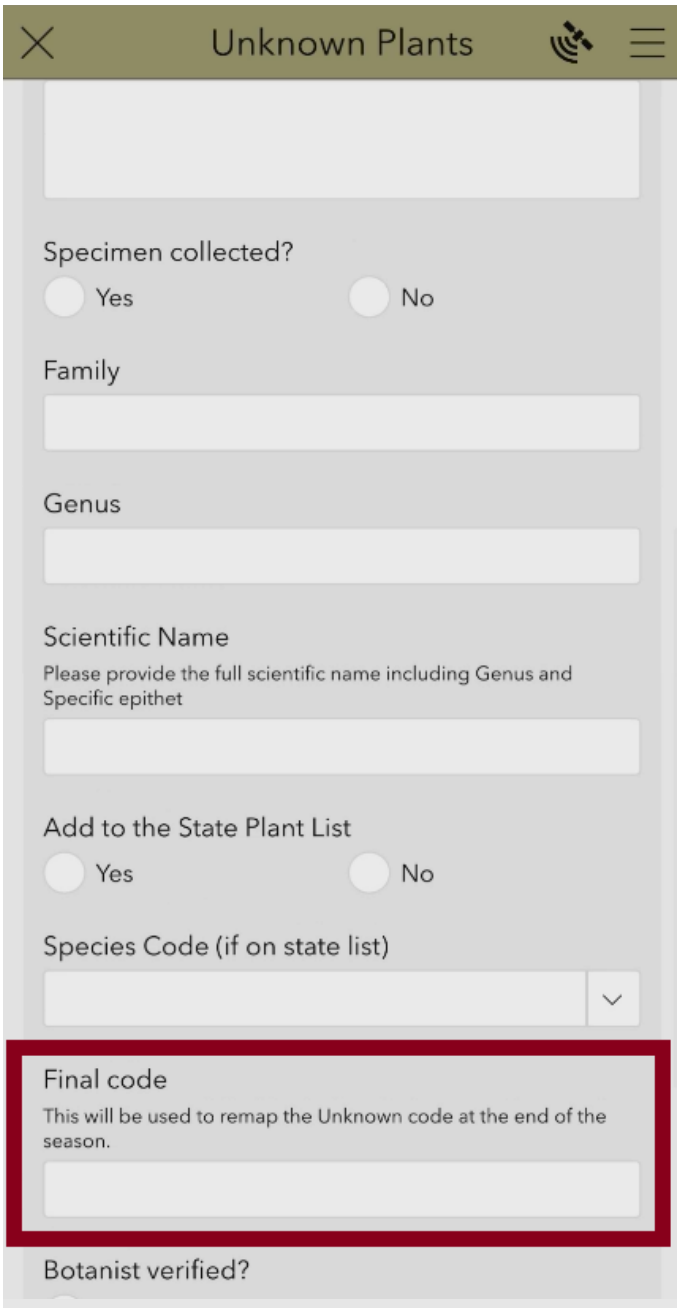


Figure 45: Unknown Plants Final Code

7. Remember to update unknown forms once you identify a plant. Keep a log sheet of all unknown plant codes a crew uses throughout the field season and don't reuse unknown codes in the same season.
8. **Required Fields: Life form, Unknown Code Number, Date Found, Plot First Found.**

Returning from the Field

Once you can connect to WiFi or are back in the office, you need to **Sync** Field Maps to update the plots, then **Send** any forms in the Survey123 Outbox. Note sometimes it may seem like you have WiFi but that WiFi has no Internet connection which may cause strange errors. Open Chrome (or any web browser) and try connecting to a site as a test.

1. To **Sync** the edits to the Plots in Field Maps, go find all of the offline maps you have downloaded. Each map will have a note below the title designating if offline areas are present and how many local edits have been made on it (syncable data in the map). Tap the map to be reconciled and then work through each offline area syncing the data by tap the three horizontal dots to the right of each offline area and tapping sync. Auto-Sync should be set to off.

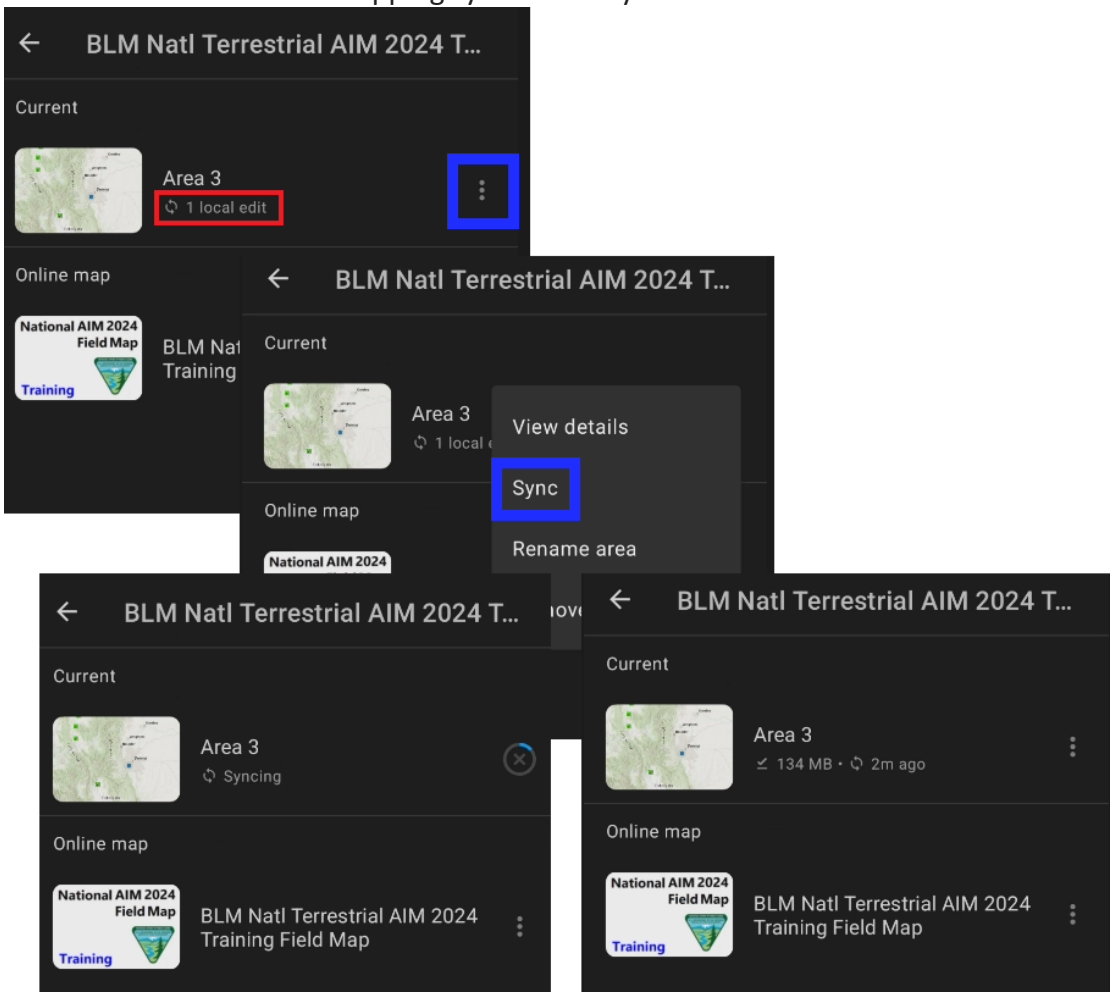


Figure 46 Field Maps Sync

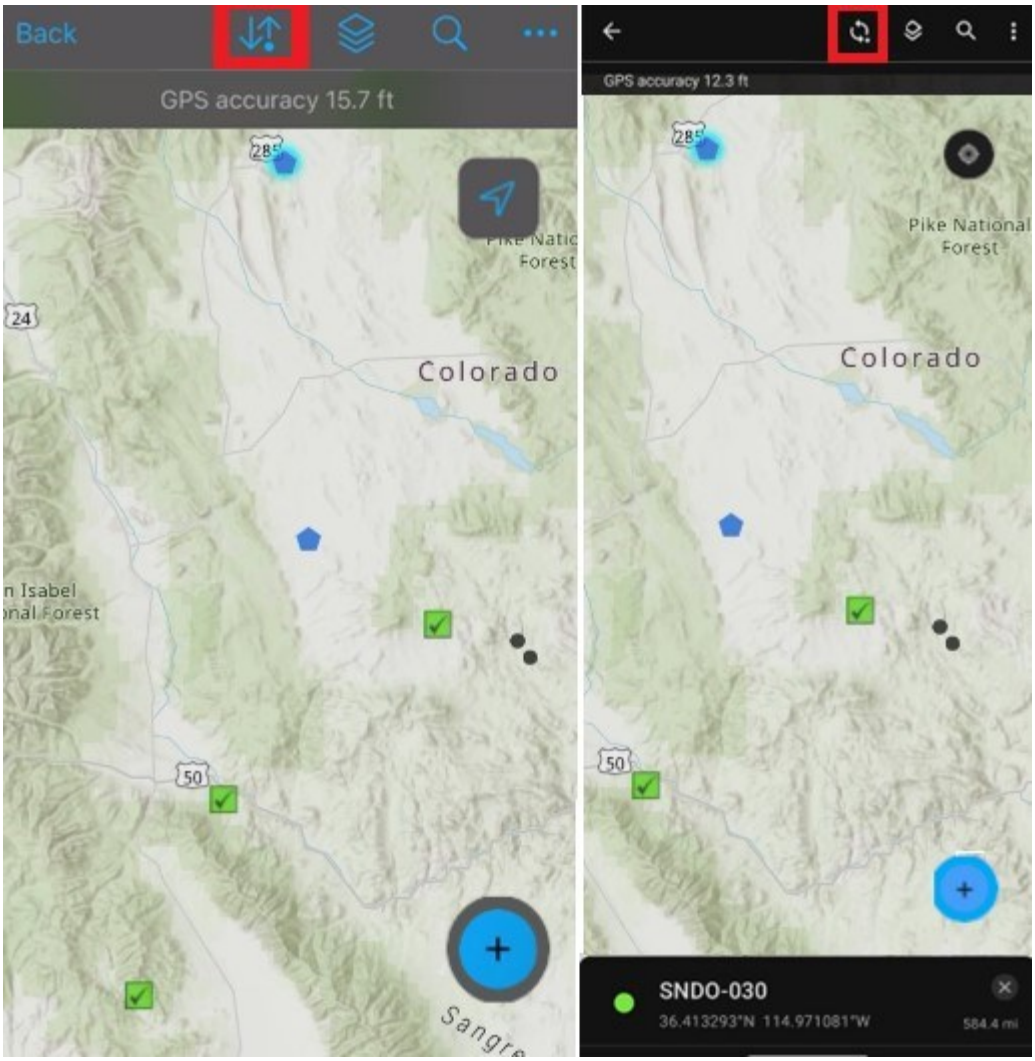


FIGURE 47 FIELD MAPS SYNC WITHIN A MAP, DOT INDICATES SYNCS ARE AVAILABLE (LEFT: IOS RIGHT: ANDROID)

2. To **Send** saved Survey123 forms, launch Survey123.
   - Tap on each survey form that has completed saved forms.
   - Tap “Outbox”, then tap “Send”.

Appendix IV: Frequently Asked Questions

Data Collection

What if I need to use paper data sheets?
We would like you to always enter data straight into the tablet, but we know that is not always possible. Remember to always have your tablet charged, bring a power bank into the field with you, or have Field Maps and Survey123 on your phone for a backup. If you need to use paper sheets, enter the data into Field Maps and Survey123 as soon as possible. Make sure you are entering the data through Survey123 and not straight to Field Maps or the AGOL map. If you are using paper forms, make sure you are collecting GPS points for all required points with a handheld GPS.

To manually enter a point, you can select the map and enter the coordinates at the top where it says, "Search location or map coordinate". Example: 36.578597 -118.292145. Make sure you tap the checkmark at the bottom right or your coordinate change will not be saved. Make sure you **do not** click on the compass after, or it will change the location to your current location.

If you are in LPI, Plot Observation, or Plot Characterization, you will need to make sure the "GPS Accuracy Override" is blank and select "Used external GPS device" for the question "Why did you need to override the GPS?"

Enter GPS locations for every form except Known Errors! The locations will be used for QA/QC to keep forms with the correct plots.

How do I move a Plot?
DO NOT move the point in Field Maps! Only edit the Moved question in Field Maps. There will be a "MOVED" option where you can choose why the plot was moved.

Plot GPS recording is now done in Plot Observation in Survey123. The design lat/long of the plot is sent from Field Maps into Survey123. In Plot Observation page 2, this design lat/long will be used to determine the distance from your current location to the given lat/long. Try to get as close as you can - using the round circle GPS icon to update your location as you get closer.
If you need to move the plot, set the "Did You Move" field to yes and choose a reason for the move. Comments can also be added. If you are over 10m away the "Did You Move" question will automatically change to Yes, BUT this can be overridden.

How do I log and use an Unknown Plant? How are the new codes supposed to be used across crews?
If possible, choose a generic code, such as PFXXXXX, so that the lifeform data is collected. (Calculations later will use the starting letters of the Unknown codes). If lifeform cannot be determined, UNK can be used - this should be a last resort. Once a generic code is chosen a new box will appear with the first 2 letters, "PF" for example,

filled in for you along with your crew code and 3 blank spaces. Delete the 3 blank spaces and add your crew based 3-digit code. So, crew 4 would start with 04001 and crew 10 could start with 10001. We suggest calling over another tablet to complete an Unknown Plants form right away so it is not lost. Note you can also use the copy/paste list of Unknown codes at the end of the form to copy into Excel for example. NOTE: if you do not know your crew number, please reach out to your project lead, or state lead.

There is currently no way to automate unknown plant code tracking due to the offline nature of our work. To help with this, at the end of each LPI and Species Richness form there is a field that shows all unknown codes collected in the form. This list was made to be copied! Highlight the list and copy into Excel or other programs on the table for easier tracking. You could also use Google Sheets to share this list across the crew. There is not a formal process on how to manage these codes, but the crew should stay on top of these codes to limit the chances that duplicate unknown codes show up in the data, that must be reconciled later in the season.

How do I identify a plant that was listed as an Unknown Plant?
For each unknown plant encountered you should fill out an Unknown Plant form. When you've identified the plant, anytime during the season, navigate back to the unknown form in Survey123 for that plant and populate the "Identified to" field with the correct code! We will fix the raw data with this information at the end of the season. **DO NOT REUSE UNKNOWN CODES EVEN IF YOU'VE IDENTIFIED THE SPECIES.**

How do I log Plot Center?
Field Maps will be considered the reference map for location. This means the GPS location in Field Maps should **never** be changed! Even on a plot move. GPSing of plot center will now occur in the Plot Observation form. A distance from given design plot center is displayed on the form. The GPS accuracy field is also used to make sure your GPS has locked in before taking a reading.

If your GPS has issues and you want to use an external, you can! Tap the map, type in the coordinates manually, then save. When you do this, Accuracy will blank, and a new question will ask you why you had to override the tablet GPS. Note ALL coordinates in Survey123 are regular **GPS WGS84 and NOT NAD83!!!**

If farther than 10m, a question asking if you moved the plot will appear and another asking why.
Also note that since the latitude/longitude are static fields they DO NOT update automatically. So if a new plot is created in the field, the Distance feature will not work. This can be added if the plot is added from the office however. Contact the NOC if you need this. Plots can be added or removed at any time during the field season.

Can I GPS a route instead of writing directions?

Yes, a lines feature class called Routes is available in Field Maps. It can do full tracking as you drive. Note this has not been used or tested yet but feel free to try it.

How do I go back to a previous repeat in LPI while collecting data for a line?
If you entered data incorrectly and added another entry already and need to fix the previous entry, use the trash can icon in the lower left hand corner of your repeat questions to remove the active entry. This will take you to the latest filled in entry where you can enter the edit and then continue on with the line.

What if I find a species that is not on the list?
If you know the species code but it is not on the list you must use an unknown code and fill out an unknown plant form. Fill out a Unknown Plants form and provide all of the information in the form for the known species. Contact your lead and they can get the species added to the list - even during the season.

What should I do if my tablet GPS will not get under the 10m limit?
In the GPS accuracy field tap the X to clear the field. Once cleared a "GPS Override Reason" field will appear. Mark a reason why. Note when entering lat/long from an external GPS, the accuracy field will blank automatically and a reason question will appear. Note Survey123 is **ALWAYS traditional WGS84 lat/long!!** Please make sure your external GPS is using WGS84.

What does WGS84 coordinates mean? How does NAD83 fit in now?
Survey123 is ALWAYS traditional WGS84 lat/long!! This is of course a major shift from previous years of using NAD83. WGS84 is the traditional coordinates used in all GPS units by default.
The lat/longs in Field Maps are also now WGS84! Google maps also uses WGS84.

What do I do if my Plot ID is blank in Survey123?
Close the form and relaunch from Field Maps. If this still does not work, contact your lead. If you are out in the field it is ok to leave it blank to get the job done. Just make sure the GPS points in the forms are correct, so we can fix it later. If you created a brand new point, make sure you changed the PlotID AND PlotKey (with PlotKey being the most important).

Field Maps

How do I change the Plot status to Eval?
In Field Maps, edit the plot. Change EVALSTATUS to Eval. Or let your AIM lead know and they can change it. AIM leads can change this in the AGOL webmap if they prefer that workflow. This way the lead could use the new Completed Forms and Issues section of the popup in AGOL to make sure the plot is really complete first (no it will not work in Field Maps yet - but users can access the AGOL map using a web browser in the tablet just like on a PC IF they have wifi).

How do I reject a Plot?
In Field Maps, edit the plot. Change EVALSTATUS to Rejected, then select rejection reason in REJECTEDREASON. Or let your AIM lead know and they can change it. AIM leads can change this in the AGOL webmap.

How do I add a brand new Plot?
See the Targeted Plot Protocol

How to find and use an Oversample Plot?
Oversample Plots are in Black. Simply pick and use according to the protocol. If you need to convert a number of Oversample Plots to Not Evaluated please reach out to your project or state lead.

QA & QC

How can I check to see how many Lines I did? How do I know I numbered them correctly?
In the Field
On the tablet that collected the lines, in Survey123, open the Outbox (or Sent box if already submitted) and see a list of LineKeys collected. There will be a list of forms - look for _1, _2, _3 for each Plot.

In the Office
In the AGOL map, click on a Plot to bring up the Plot Pop-Up window. Scroll down to the Completed Forms and Issues section. The number of each form found will be listed. If the number of forms is wrong (for example only 2 Gap forms) an error will appear in Red. An error will also appear if lines were numbered incorrectly (for example 1,1,3). No this will not work in Field Maps yet - but users can access the AGOL map using a web browser in the tablet just like on a PC IF they have wifi.

If I duplicated Line numbers what should I do?
A line change requires that the main form AND all point repeats be corrected. Please just let your lead know and they will fix it in the correct way.

How can I check that we did all the forms on a Plot in the Field?
Assuming the tablets are offline there is no automated way to check. You can open the Outbox for each form, on each tablet, and see a form list by PlotID with no need to open each form. Check with all tablet owners to make sure all forms were completed. Users can access the AGOL map using a web browser in the tablet just like on a PC IF they have Wi-Fi.

How can I check that we did all the forms on a Plot in the Office
In the AGOL map. Click the plot you want to check to bring up the popup box. Scroll down to the Forms Completed and Issues section. It will give a total for each form. You can also see this in the attribute table of Plots. Any errors will be shown in Red.

How can we run QA on collected data to date?
There are some tools in the AGOL web map popups such as number of forms completed and checks for lines 1, 2, 3. Other checks require a download and analyze script. The NOC will work towards running a full QA once per week during the season.

How can I see all the data my team has collected, In the Field?
If offline the tablet will not be able to see forms that have not been submitted yet. Once all tablets have synced via Wi-Fi, you can sync Field Maps and all the data will then be available in the Field Maps map. Note photos from other tablets will NOT download since it becomes too slow.

How can I see all the data my team has collected, In the Office
Once the tablets submit the forms over Wi-Fi, the AGOL map will update instantly.

How can I tell if all my forms sent?
In Survey123 each form will have a blue number in the top right corner to indicate surveys in your Outbox.

How can I add a photo to a plot when I don't have access to the survey123 form?
See the Photo Management Guidance

Troubleshooting

Can a crew use more than one tablet? What should I do if a tablet fails? Can I use my phone?
Yes, you can use as many tablets as you want with Android and iOS able to mix and match. Just note that forms will reside only in the Outbox on the tablet they were created on. Once all the forms are submitted you will then be able to see them all in Field Maps or the AGOL map.
You can use a BLM phone, just make sure you keep Field Maps and the Survey123 forms up to date.

If a tablet totally fails, the NOC may be able to recover the data so keep the tablet! But if you are out on plot, it may be a good idea to recapture what was lost.

What if I launched the forms from the same Plot twice?
If the GPS on the forms was set correctly this is something, we can fix! It does require a standardized approach to make sure all features and tables are corrected. Please fill out the Known Errors form and let your lead know right away. If the issue is a duplicate form and needs to be deleted, specify which form in a corresponding known errors form.

Who do we call with questions? Tech vs how vs broke vs data fix
Field crews should contact their lead with any questions. If it is a "how" question, a lead should be able to help. If something seems broken, contact the GIS lead and the NOC as needed.

What if I have a form that will not submit but I cannot figure out why?
If a form keeps giving an error and you cannot figure it out, simply save the form as a Draft. Then it can be fixed and submitted later with help from you lead.

Setup

How do I go offline in Survey123 and Field Maps?
Survey123 is always offline. The only difference will be if online, the Survey123 form will ask if you want to send now or later. When you reach Wi-Fi, open each form, open the Outbox, and tap Send. The first time you go offline, make sure your Survey123 forms are downloaded, or you will not be able to use the forms! Make sure you are on good Wi-Fi whenever sending forms, especially for photos.
To go offline in Field Maps, tap Download next to the name of the map in the map list. Choose your work area (map extent) and map detail, then tap Download again. Note the area you can take offline is limited by size and Wi-Fi speed so choose carefully. When you are done with that map extent, select the 3 dots on the right, select Remove, then select "Remove features and basemap". Now you can go back and select another map extent. Your state lead should be supplying you with a BLM basemap for use in Field Maps. This will allow for a much better basemap and the ability to take a larger area offline.

How do I add a new crew member?
If they are a BLM user with credentials, submit a remedy ticket to get a BLM SAML account and elevate them to BLM Contributor. Send this info to your lead.

If they are a contractor or BLM without credentials, create a GeoPlatform account using the **GeoPlatform SOP instructions.**

- Login to AGOL the first time.
- Sign and send back the GeoPlatform Data editor agreement.
- Send username and signed doc to your lead.
- Leads will submit a remedy ticket to upgrade you AND add you to the group.