Prepare for high-accuracy data collection

Android | OTHER VERSIONS

Android

iOS

The accuracy required when collecting location data depends on the project you are working on. For some projects, such as damage assessments, points within 10 feet of the damage may provide enough information. For other projects, such as managing underground pipelines, the location collected must be within a few centimeters of the actual location. When collecting location information using a device's location service, position information can be determined from various sources, such as GPS, cellular, Wi-Fi, or Bluetooth networks. The accuracy of these sources varies, and the device's location service is not always reliable. For those who perform data collection that requires better accuracy and reliable quality control, using a professional-grade or high-accuracy GPS receiver is usually the best option.

Note:

Global Navigation Satellite System (GNSS) is the standard generic term for navigation satellite systems. GNSS receivers are capable of using various navigation satellite systems, while GPS receivers can only use the navigation satellite system called the Global Positioning System. Due to the widespread use of the term GPS to refer to both kinds of receivers, the term GPS is used as the generic term in this help documentation.

A high-accuracy GPS receiver precisely calculates geographic locations using information from GPS satellites. The accuracy of these receivers ranges from submeter to centimeter, depending on their ability to track and process satellite signals. GPS satellite signals are transmitted on different frequencies. The more frequencies the GPS receiver uses—and, consequently, the more signals it receives—the more accurate it is. This is also true for GNSS—the more systems the receiver uses (and the more signals it receives), the more accurate it is. Today, multiple navigation satellite systems are available. However, in most cases, the more accurate a GPS receiver is, the more expensive it is and the more difficult it is to carry in the field. You can also improve the accuracy of your position information through differential corrections of the data, supported by some receivers and covered later in this topic.

Complete the following steps to use a high-accuracy receiver with ArcGIS Field Maps:

- Prepare your data to record GPS metadata
- Choose a receiver
- Configure your receiver
- Connect your receiver to your device
- Configure Field Maps to use the receiver:

    - Set your receiver as the location provider
    - Set up a location profile (optional)
    - Specify the required accuracy and confidence
    - Enable GPS averaging (optional)
- Postprocess recorded altitudes (z-values)

Prepare your data to record GPS metadata

In addition to geographic coordinates, you can also save other GPS metadata associated with a feature, such as its accuracy and fix type. Storing this metadata can be valuable to assess data quality and ensure data collection standards have been met. If you include GPS metadata fields in your point feature layer, Field Maps can write GPS metadata to the respective fields when editing point features. You should also configure the feature pop-up to hide some of the data from your mobile workers.

> **Note:**
> While this topic is focused on high-accuracy receivers, these steps enable recording the metadata from any GPS, including the internal GPS of a device. If using the internal GPS, not all metadata fields are populated.

Keep the following in mind before configuring GPS metadata storage:

- GPS metadata is populated on point layers only.
- GPS metadata is cleared if the point's location is provided or updated without using the GPS or while metadata is not available.

The recommended way to add the fields depends on how you prepare your layers:

- If you use templates in ArcGIS Online or ArcGIS Enterprise, check the **Capture GPS receiver information** check box while creating your feature layer.
- If you use ArcGIS Pro 2.2 or later, use the Add GPS Metadata Fields tool after creating your feature class.
- If you use ArcMap or a version of ArcGIS Pro earlier than 2.2, use the Python scripts available on GitHub.

Supported GPS metadata

The following GPS metadata values are recorded by Field Maps when using a configured feature layer:

- Receiver name
- Latitude—Position received from the GPS receiver before applying data transformations in the location profile
- Longitude—Position received from the GPS receiver before applying data transformations in the location profile
- Altitude—Ellipsoidal height received from the GPS receiver (not orthometric height, as used for z-values)
- Fix time
- Direction of travel
- Speed (km/h)

- Azimuth
- Position source

If using a single GPS location to set a point's location, the following metadata values are also recorded:

- Horizontal accuracy
- Vertical accuracy
- PDOP
- HDOP
- VDOP
- Fix type
- Correction age
- Station ID
- Number of satellites

If performing GPS averaging to set a point's location, the following metadata values are also recorded:

- Average horizontal accuracy
- Average vertical accuracy
- Number of positions averaged
- Standard deviation—An indication of the variation in distance between your final, averaged location and each individual location recorded during averaging. A high value indicates that your position was influenced by outliers.

You can choose which of these you record with your data: the values are ignored for any fields you don't add to your feature layer. Similarly, you can set up your data for single GPS locations, averaged locations, or both: when averaging is enabled, the associated fields are populated and those for single location collection are left blank, and vice versa.

Note:

If you enable a 95 percent confidence level for accuracy in the Field Maps settings, a 95 percent confidence level is used to determine if your accuracy is acceptable for data collection. The recorded accuracies are still calculated using root mean square (RMS). As such, the level of confidence in the recorded accuracies is 63 percent to 68 percent for horizontal accuracy and 68 percent for vertical accuracy.

Choose a receiver

Field Maps can make use of the GPS built into your device or you can add an external GPS receiver to obtain high-accuracy data. There are many GPS receivers available on the market; however, not all of them work directly with Field Maps. To use a GPS receiver with Field Maps, the receiver must support the output of NMEA sentences. To improve the accuracy of your positions, consider using a GPS receiver that supports differential corrections. If you are using an iOS device, you must also choose one of the GPS receivers supported on iOS. While Esri doesn't publish a list of supported GPS receivers for Android, a list of receivers used in testing Field Maps on Android is provided.

Tip:

Most high-accuracy GPS receivers support the NMEA sentences that Field Maps uses; however, it's recommended that you check whether your receiver supports these NMEA sentences in the receiver's user manual before you try to connect it to Field Maps.

NMEA support

NMEA 0183 is the data specification standard that Field Maps uses to communicate with GPS receivers. NMEA messages contain lines of data called sentences. Field Maps derives GPS information such as latitude, longitude, height, and fix type by reading specific sentences in NMEA messages.

Field Maps supports NMEA 4.00 and 4.10. It can read the following NMEA sentences:

- GGA: Time, position, and fix-related data
- GSA: GNSS DOP and active satellites
- GSV: GNSS satellites in view
- RMC: Recommended minimum specific GNSS data
- VTG: Course over ground and ground speed
- GST: GNSS pseudorange error statistics

If Field Maps receives GST sentences, which contain accuracy information for a particular coordinate, it uses them to determine accuracy. By default, the horizontal and vertical accuracy numbers are specified in root mean square (RMS). The level of confidence using RMS is 63 percent to 68 percent for horizontal accuracy, and 68 percent for vertical accuracy. If the **95% confidence** accuracy setting is enabled, Field Maps applies a conversion factor to the RMS calculation and reports horizontal and vertical accuracy with a 95 percent confidence level.

Note:

The internal GPS of some Android devices outputs NMEA. If a device outputs invalid NMEA, Field Maps uses the accuracy reported by the device's location service.

Estimated accuracy

If Field Maps doesn't receive a GST sentence from a GPS receiver, but does receive a GSA sentence, Field Maps estimates accuracy using horizontal dilution of precision (HDOP) and vertical dilution of precision (VDOP). The estimated horizontal accuracy is calculated by multiplying HDOP by 4.7, and the estimated vertical accuracy is calculated by multiplying VDOP by 4.7.

Differential corrections

To improve the accuracy of your positions, consider using a GPS receiver that supports differential corrections. Differential correction technology further improves accuracy by leveraging reference stations, which are also known as base stations. A reference station is another GPS receiver that is established on a known location. The reference

station estimates its location based on satellite signals and compares this estimated position to the known position. The difference between these positions is applied to the estimated GPS position calculated by the user's GPS receiver, also called the rover, to get a more accurate position. The user's receiver must be located within a certain distance of the reference station for differential corrections to occur. Differential corrections can be applied in real time in the field or when postprocessing data in the office.

Note:

While Field Maps stores the information to use in postprocessing, it doesn't directly support it.

Differential corrections can be provided by public or commercial sources. One of the most widely used and publicly accessible real-time correction sources is the Satellite-Based Augmentation System (SBAS), which is also commonly referred to as the Wide Area Augmentation System (WAAS) in the United States. It is free to use SBAS, but your GPS receiver must support it. Using commercial correction services typically requires a subscription and may also require purchasing a particular type of GPS receiver that can receive these correction signals. See "Differential GPS Explained" in ArcUser for more information.

GPS receivers supported on iOS

To directly connect a Bluetooth receiver with an iOS device, the receiver must be part of the MFi program as well as support the output of NMEA sentences. The following receivers can be used directly with Field Maps on supported iOS devices.

Tip:

To find out the version of firmware your GPS receiver uses, pair your receiver with your device, open your device's **General > About** settings, and tap the name of your paired receiver.

- Asteri X1i—Firmware version 1.0.0 or later
- Bad Elf Flex, Bad Elf GNSS Surveyor, GPS Pro+, GPS Pro, and GPS for Lightning Connector

  The GNSS Surveyor and GPS Pro+ require firmware version 2.1.40 or later. The GPS Pro requires firmware version 2.0.90 or later. The GPS for Lightning Connector requires firmware version 1.0.24 or later.

- Dual XGPS160—Firmware version 2.5.4 or later
- Eos Arrow Lite, Arrow 100, Arrow 200, and Arrow Gold—Firmware version 2.0.251 or later
- Garmin GLO and GLO 2

  The GLO requires firmware version 3.00 or later and the GLO 2 requires firmware version 2.1 or later.

- Geneq SxBlue II and SxBlue III—Firmware version 2.0.251 or later
- Juniper Systems Geode—Firmware version 1.0.0 or later
- Leica Zeno GG04 plus—Processor board firmware version 1.0.20 or later
- Trimble R1, R2, and R10 Model 2.

The Trimble R1 requires firmware version 5.03 or later, the Trimble R2 requires firmware version 5.14 or later, and the Trimble R10-2 requires firmware version 5.34 or later.

You must configure these receivers directly in Field Maps. Don't use the GNSS Status app provided by Trimble. See Configure your receiver.

GPS receivers tested on Android

Field Maps works with any receiver supported on Android that outputs NMEA0183 sentences. While the development team doesn't certify any device, the following is a list of devices it has used:

Caution:

This is not a comprehensive list of all devices that work with Field Maps.

- Bad Elf Flex, Bad Elf GNSS Surveyor, GPS Pro+, and GPS Pro
- Carlson BRx6+
- Dual XGPS150A and XGPS160
- Eos Arrow Lite, Arrow 100, Arrow 200, and Arrow Gold
- Garmin GLO
- Juniper Systems Geode
- Leica GG03, GG04, and Zeno 20
- Spectra Precision SP20, SP60, SP80, and SP85
- Trimble R1, R2, R8s, R10, R10 Model 2, R12, Catalyst, TDC100, TDC150, TDC600, and Nomad 5

  You must use Trimble Mobile Manager to configure your receiver. Do not use the Trimble GNSS Status app.

Configure your receiver

Not all receivers that support the output of NMEA sentences are configured to do so out of the box. The device's user manual should have instructions on how to configure it to output NMEA.

If you'll be using real-time kinematic (RTK) positioning, you need to provide access information for the correction source being used. Use your GPS device's companion app and reference the device's user manual for details.

Connect your receiver to your device

Field Maps supports receivers integrated into devices as well as external receivers connected via Bluetooth. If your receiver is integrated into the device, proceed to the next section, Set your receiver as the location provider. If you are using an external receiver, follow these steps to connect it to your device:

1. Verify that your GPS receiver is compatible with Field Maps.

   Your receiver must support the output of NMEA sentences and be configured to do so. See Choose a receiver and Configure your receiver. These instructions must be completed before connecting the receiver to Field

Maps.

2. Turn on your receiver and place it near your device.

   Go to your device's Bluetooth settings and view the available devices. Wait for your receiver's name to appear in the list.

   Tip:

   If your Bluetooth receiver doesn't appear in the list, make sure it isn't connected to another device.

   - To disconnect your receiver from an Android device, in the device's Bluetooth settings, tap the settings icon next to the receiver, and tap **Unpair** or **Forget**.
   - To disconnect your receiver from an iOS device, in the device's Bluetooth settings, tap the information icon next to the receiver, tap **Forget This Device**, and tap **Forget Device**.

3. Tap the receiver's name to pair it with your device.

Set your receiver as the location provider

Once your GPS receiver is connected to your device, specify that you want the receiver to provide GPS locations in Field Maps. Once a receiver is chosen, this is the only source of positions that is used until a new receiver is chosen.

1. While viewing the **Maps** list, tap **Profile** .
2. In the **Location** section of the profile, tap **Provider**.
3. If your receiver isn't listed, add it by completing the following steps:
   a. Tap **Add provider** to display a list of paired receivers.
   b. Select your receiver.
   c. If you are mounting the receiver to a pole or vehicle, enter the antenna height.

      This is important if you use the altitude of your positions.

   d. Tap **Done**.

   You are returned to the **Location providers** list and your receiver is listed.

4. Tap your receiver in the **Location providers** list.

   Note:

   If you're using an iOS device and adding a Trimble GNSS receiver for the first time, you will be prompted to browse to the **Mobile Manager** folder on the device. This allows Field Maps to use the real-time correction settings that you configured using the Trimble Mobile Manager app.

5. If you need to change the antenna height, view the details of the provider, provide a new antenna height, and tap **Done**.
   - On Android, view the details of a provider by tapping the **Overflow** menu of the provider and tapping **Details**.

- On iOS, view the details of a provider by tapping **Info** .

6. Return to your profile, and return to the **Maps** list.

Set up a location profile (optional)

Once you have connected your receiver, your mobile workers need to use a location profile to define the coordinate system of the data from the receiver and apply a datum transformation to the data if one is required. If you are using corrections and the location provided to you is based on a different geographic coordinate system than your map, you must provide datum transformation information. See Datum transformations for details.

Note:

The location profile applies to both internal and external receivers. It's recommended to use a location profile when you're using a correction service. If you don't set up a location profile, the default profile is used. The default profile assumes that provided locations are in the WGS 1984 Web Mercator (Auxiliary Sphere) [WGS84] coordinate system.

When using a location profile other than the default, basemaps that don't match the spatial reference of the location profile are unavailable.

1. While viewing the **Maps** list, tap **Profile** .
2. In the **Location** section of the profile, tap **Profile**.
3. If your profile isn't listed, add it by completing the following steps:
   a. Tap **Add profile** to display a list of coordinate systems.
   b. In the **GNSS coordinate system** list, tap the coordinate system used by your receiver's correction service. You can search by the name or ID of the coordinate system to filter the results in the list. If using an Android device, tap **Next**.
   c. In the **Map coordinate system** list, tap the coordinate system used by your map (determined by the basemap it uses). You can search by the name or ID of the coordinate system to filter the results in the list. If using an Android device, tap **Next**.

   Caution:

   Some projected and geographic coordinate systems have the same name. Make sure you choose your coordinate system from the correct category.

   d. If a datum transformation between the coordinate systems of your receiver's correction service and your map is not required, tap **Next** (Android) or **Done** (iOS) and skip to step g (naming the profile).
   e. If a datum transformation between the coordinate systems of your receiver's correction service and your map is required, set the map extent to the area where data is going to be collected and tap **Next**.

   Note:

   You can only specify the data collection area when your device has access to online data via Wi-Fi or a cellular network. When offline, specifying a data collection area is skipped.

f Tap the desired datum transformation in the list of available transformations and tap **Next** (Android) or **Done** (iOS).

If you are on an iOS device and the datum transformation is grid based and needs to be downloaded, **Download** displays next to it. Tapping the transformation downloads the required files before you can continue making your location profile. If you'd rather copy the files directly to the device (sideload them), you need to do so before creating the profile.

> **Tip:**
> On Android, grid-based datum transformations must be copied directly to the device before creating the profile. Support for downloading them is coming to Android.

> **Note:**
> The datum transformation list is sorted by relevance, with the most relevant transformation listed first. Field Maps uses the GNSS coordinate system, map coordinate system, and (if provided) the extent where data is going to be collected to provide and sort this list of applicable datum transformations.

g Provide a name for your profile and tap **Add** (Android) or **Save** (iOS).

You are returned to the **Location profiles** list and your profile is listed.

4. Tap your profile in the **Location profiles** list.

> **Tip:**
> To verify the profile's coordinate systems and transformation, view the details of the profile. On Android, access the details through the **Overflow** menu ⋮. On iOS, tap **Info** .

5. Return to your profile, and return to the **Maps** list.

Datum transformations

The locations provided by your receiver may be based on a different geographic coordinate system than the map you are using in Field Maps. If this is the case, use a datum transformation to maintain the accuracy of your data.

When you receive a location from a GPS and use it to add or update a feature, that location is in geographic coordinates that are referenced to a geographic coordinate system (GCS). Your map also has a coordinate system, determined by the basemap it uses, which may be a GCS or a projected coordinate system (PCS). If the location and map are based on different geographic coordinate systems, the location being added or updated must be transformed to match the map's coordinate system. This conversion process is called a datum transformation. While there are both horizontal and vertical datum transformations, Field Maps only supports horizontal transformations.

Since coordinates, maps, feature layers, and databases all have coordinate systems, a datum transformation (or transformations) should occur anytime your coordinate system doesn't match that of where the data is being used:

between the GPS and the map, the map and the feature layer, or the feature layer and the geodatabase. Whenever a datum transformation is used, error is introduced into your locations. By choosing the right coordinate systems for your map, feature layers, and databases, you can limit the number of transformations, as well as the error introduced each time. See ArcGIS Geographic and Vertical Transformation Tables for details on the error introduced through various transformations.

Note:

If the coordinate systems don't match and no datum transformation is provided, the data is used as it is provided. As a result, its location won't align with the locations of other data already in place. Similarly, you'll see incorrect positions if you provide the wrong datum transformation.

In Field Maps, you can set up a location profile prior to collection and specify the specific datum transformation to use. While creating a location profile, the coordinate systems of both the GPS data and the map are specified. Based on this information, you are presented with only relevant transformation methods, with the recommended method listed first. As the map author, you should either set up the location provider and profile in Field Maps or provide to your mobile workers the coordinate systems of the GPS and the map, as well as the transformation method they should use when they configure Field Maps.

If you are using one of the basemaps provided by Esri in ArcGIS Online, it is in the WGS84 coordinate system. Similarly, WGS84 is the default coordinate system for GPS data received in Field Maps. If you are using an ArcGIS Online basemap and the default location provider, no datum transformations are necessary in Field Maps.

Grid-based transformations

Grid-based transformations are supported in Field Maps. These transformations use files to calculate positions and require the files to be on your device. To use a grid-based transformation, the files must be downloaded (iOS-only) or copied (sideloaded) onto your device.

- On iOS—If your datum transformation is grid based and requires files, you'll be prompted to download it when setting up your location profile. If you'd rather copy the files directly to your device, you can do so.
- On Android—You must copy any files required for a grid-based datum transformation directly to your device.

To copy the files directly to your device, get them from an installation of ArcGIS Pro or ArcMap (you may need to install the Coordinate Systems Data setup in addition to the main product setup to get specific grid-based transformation files). Copy them to your device in one of the following ways:

- On Android—Plug your device or SD card into your computer. Using a file explorer on your computer, browse to \Android\data\com.esri.fieldmaps\files\PEData (if that folder doesn't exist, create it). Copy the files for the grid-based transformation to that PEDdata folder.
- On iOS—Use the Files app or iTunes to copy the files for your grid-based transformation to the documents for Field Maps, placing them in a PEData folder.

  Tip:

To update a folder in the app's documents using iTunes, first save the folder from the device, make your changes to it, and then upload it. The new folder replaces the previous one.

You must maintain the folder structure in the PEData folder the same as it is structured for ArcGIS Pro or ArcMap. For example, to copy the files for the Old_Hawaiian_To_NAD_1983_HARN_Hawaii + ~NAD_1983_To_HARN_Hawaii transformation, add to the PEData folder on your device a folder named harn, containing the files ohdhihpgn.las, ohdhihpgn.los, hihpgn.las, and hihpgn.los.

Specify the required accuracy and confidence

Your organization may require that all data collected meet a specific minimum accuracy and confidence interval. In Field Maps, you can set the required accuracy of GPS positions and whether the positions must meet a 95 percent confidence level. This ensures that data you collect meets your organization's data collection standards.

For detailed steps, see Configure Field Maps—Specify the required accuracy and confidence.

Note:

This topic assumes you'll set up the devices for your mobile workers. If this is not the case, make sure you communicate to them what accuracy to require and whether they need a 95 percent confidence level.

If your mobile workers use decimal degrees, by default coordinates are displayed with six decimal places of precision. This can be configured as part of the units setting in Field Maps.

Enable GPS averaging (optional)

Your organization may require that you collect a number of points for a single location and average their information to get a final location and accuracy. In Field Maps, you can set the required number of points to be averaged to get a single location. Any time you use GPS location when collecting data, the required number of points is collected and averaged. When enabled, averaging is done for point features as well as for the individual vertices of lines and polygons.

For detailed steps, see Configure Field Maps—Enable GPS averaging.

Note:

This topic assumes you'll set up the devices for your mobile workers. If this is not the case, make sure you communicate to them about whether they should enable GPS averaging and if so, how many points to average.

Postprocess recorded altitudes (z-values)

When recording altitude, Field Maps records orthometric height based on the geoid model of your receiver (often EGM96, but see your device's user manual). If you require a different geoid model, postprocess the values to use the required geoid model.

Your receiver is now providing locations to Field Maps. As you collect data, you will provide your organization with high-accuracy data that meets its standards.