



**Watershed Monitoring Section
GNSS Basics Manual
for use with
Bad Elf Flex Mini 2500 GNSS Units**

**Division of Environmental Assessment
and Restoration
Florida Department of Environmental Protection
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WATERSHED MONITORING SECTION GNSS BASICS MANUAL FOR USE WITH BAD ELF FLEX MINI 2500 GNSS UNITS

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GNSS Basics

The term Global Navigation Satellite System (GNSS) is used to describe receivers that can receive signals from multiple types of navigation satellites. Examples of these navigation satellites include the United States' GPS (Global Positioning System), the Russian GLONASS (Globalnaya navigatsionnaya sputnikovaya sistema), Chinese BeiDou, and the European Galileo systems. The GNSS is very useful in conditions where there are a lot of obstructions, such as tree canopy, blocking the receiver's view of the sky.

It's been determined that the best commercially available GNSS technology for the Watershed Monitoring Section is the Bad Elf 2500. This is the only commercially available Bluetooth receiver that receives L1 & L5 GPS, L1 GLONASS, E1 & E5A Galileo, B1I & B2a BeiDou, L1 QZSS signals. This receiver is also capable of receiving Satellite Based Augmentation Systems (SBAS) signals for differentially correcting GPS signals.

Getting Started

System Requirements

Operation of the Bad Elf Flex Mini 2500 GNSS unit requires a Bluetooth connection with a mobile device (phone or tablet computer). The connected mobile devices must meet the following operating system minimum requirements:

- iOS version 11 or newer
- Android version 4.1x or newer

The Bad Elf Flex Mini 2500 GNSS unit can also be used with devices running Windows 10.x or newer; however, the use of Windows devices is not supported for DEP Watershed Monitoring Section projects.

Software Installation

Before turning on the Bad Elf Flex Mini 2500 unit, prepare the mobile device by installing the following applications, available at no cost in the Apple App Store or Google Play Store.

Required Applications for Status and Trend Networks Projects

- Bad Elf Flex ([Figure 1](#))
- ArcGIS Field Maps
- ArcGIS Survey123

Recommended Applications

- Google Maps
- Apple Maps (only available for iOS)
- Organic Maps Offline Hike Bike



Figure 1. Bad Elf Flex application icon.

Powering On / Off

To turn on or turn off the Bad Elf Flex Mini 2500 unit, press and hold the power button for 3 seconds. The power button is located on the left side of the unit ([Figure 2](#)).

If the unit won't turn on, refer to the troubleshooting tips on [page 33](#). After the unit is turned on, it will take approximately 5 seconds to start up and begin searching for satellites.

Do not attempt to operate the GNSS receiver indoors. Ideally, turn the device on in an outdoor setting, five or ten minutes before you plan to use it for navigation or data collection. The process of turning the device on before you need it helps ensure that it can perform its best without a long wait for it to startup and settle.

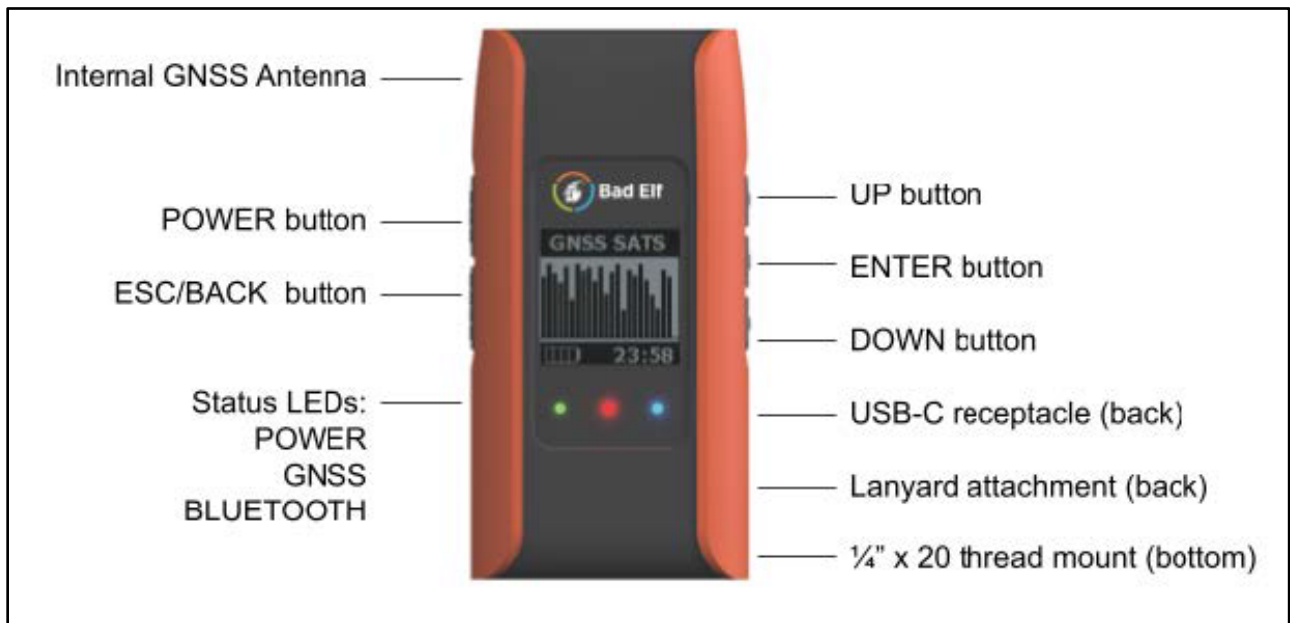


Figure 2. Bad Elf Flex Mini 2500 GNSS unit (Diagram from Bad Elf Flex Mini User Manual, 2023).

Indicator Lights

The Bad Elf Flex Mini 2500 GNSS unit has three LED indicator lights located below the screen ([Figure 2](#))(Bad Elf Flex Mini User Manual, 2023).

The left LED indicator indicates the unit's battery status.

- LED indicator off = Not charging.
- Solid Green = Fully charged.
- Pulsing Green = Charging; Battery > 75%. The speed of pulsing indicates the type of charging source (2.5 second interval indicates a high current source; 5 second interval indicates a low current source).
- Pulsing Red = Charging; Battery < 75%. The speed of pulsing indicates the type of charging source (see details described above for pulsing green).
- Fast Blinking Red = Charging Needed; If connected to a charging source, indicates that charging source is not usable.
- Fast Blinking Yellow = Internal temperature limits exceeded. Charging temporarily disabled.
- White = Firmware transfer in progress. Do not unplug USB cable until transfer completes.

The center LED indicator indicates the unit's GNSS status.

- Solid Green = GNSS satellite lock acquired.
- Solid Red = No GNSS satellite lock.

The right LED indicator indicates the unit's Bluetooth connection status.

- Solid Blue = Bluetooth connection established.
- LED indicator off = Bluetooth connection not established.

Antenna Orientation

All GNSS receivers perform best when they have a clear view of the sky, from the horizon to directly above and a full 360 degrees around them. The Bad Elf 2500 GNSS unit has an internal antenna located on the top of the unit ([Figure 2](#)). Keep the antenna correctly oriented towards the sky by positioning the unit upright (vertically) with the LCD pointed perpendicular to the ground. If the antenna is aimed towards an object or the ground, it will pick up reflected signals and degrade accuracy. This includes the time spent traveling between data collection locations.

Don't collect GNSS data with the Bad Elf on a lanyard. Although this is convenient for carrying, hanging on the lanyard blocks 50% of satellites in view. Holding the receiver close to your body is not advisable because a portion of the sky will be blocked by your body. Look for a safe surface for the receiver to be placed on that's away from obstructions.

A ¼" x 20 thread mount ([Figure 3](#)) is located on the bottom of the device. Using the mount to attach a flexible tripod or other accessories is recommended to assist with maintaining optimal antenna orientation during various use scenarios (e.g. when stationary at a well, walking to a site, or moving in a vehicle or boat).



Figure 3. Bad Elf 2500 GNSS Unit bottom with ¼" x 20 thread mount.

Weather Considerations

The Bad Elf GNSS units are designed to be water resistant. They can be used between -20°C and $+55^{\circ}\text{C}$ and can be stored between -40°C and $+75^{\circ}\text{C}$. Despite their ruggedness, there are a few things to keep in mind.

- If the unit's internal temperature exceeds $+55^{\circ}\text{C}$ ($+131^{\circ}\text{F}$), it may automatically power off and battery charging will be disabled until the temperature returns to the acceptable range for operation.
- The units are not designed to withstand prolonged exposure to water. Do not intentionally submerge the unit in water.
- Do not use the GNSS receiver when lightning is imminent. Seek shelter instead.

Connecting GNSS Receiver Unit to Mobile Device

Turn on both the mobile device and the Bad Elf Flex Mini 2500 GNSS unit. Keep the mobile device and the GNSS unit within 15 feet of each other, to ensure that a stable Bluetooth connection can be maintained. Follow the instructions below to connect the GNSS unit to the mobile device. Steps 1 – 4 are illustrated in [Figure 4](#) for iOS devices and in [Figure 5](#) for Android devices.

1. On the mobile device, open the **settings** application. Navigate to the **Bluetooth** settings section (for Android devices, Bluetooth settings are located within the Connections or Wireless & Networks settings section) and ensure the Bluetooth is turned on.
2. The Bad Elf Flex Mini unit will appear in the list of available Bluetooth devices. Select the device from the list to initiate Bluetooth pairing.
3. When the pairing request screen appears, click **Pair** or **OK** (note that the pairing number will not be visible on the Flex Mini's screen).
4. When the pairing is complete, the Bad Elf Flex Mini unit will appear in the list of paired / connected devices. If the device status immediately changes to disconnected, open the Bad Elf Flex application and then return to the Bluetooth settings and select the Bad Elf Flex Mini receiver to reestablish the connection.
5. Open the Bad Elf Flex application and confirm that the application is able to connect to the GNSS device ([Figure 6](#)). If the connection is not found or if the device becomes disconnected, return to the Bluetooth settings and select the Bad Elf Flex Mini receiver to reestablish the connection.
6. Keep the Bad Elf Flex application open and running in the background while the GNSS unit is connected and in use by other navigation or data collection applications.

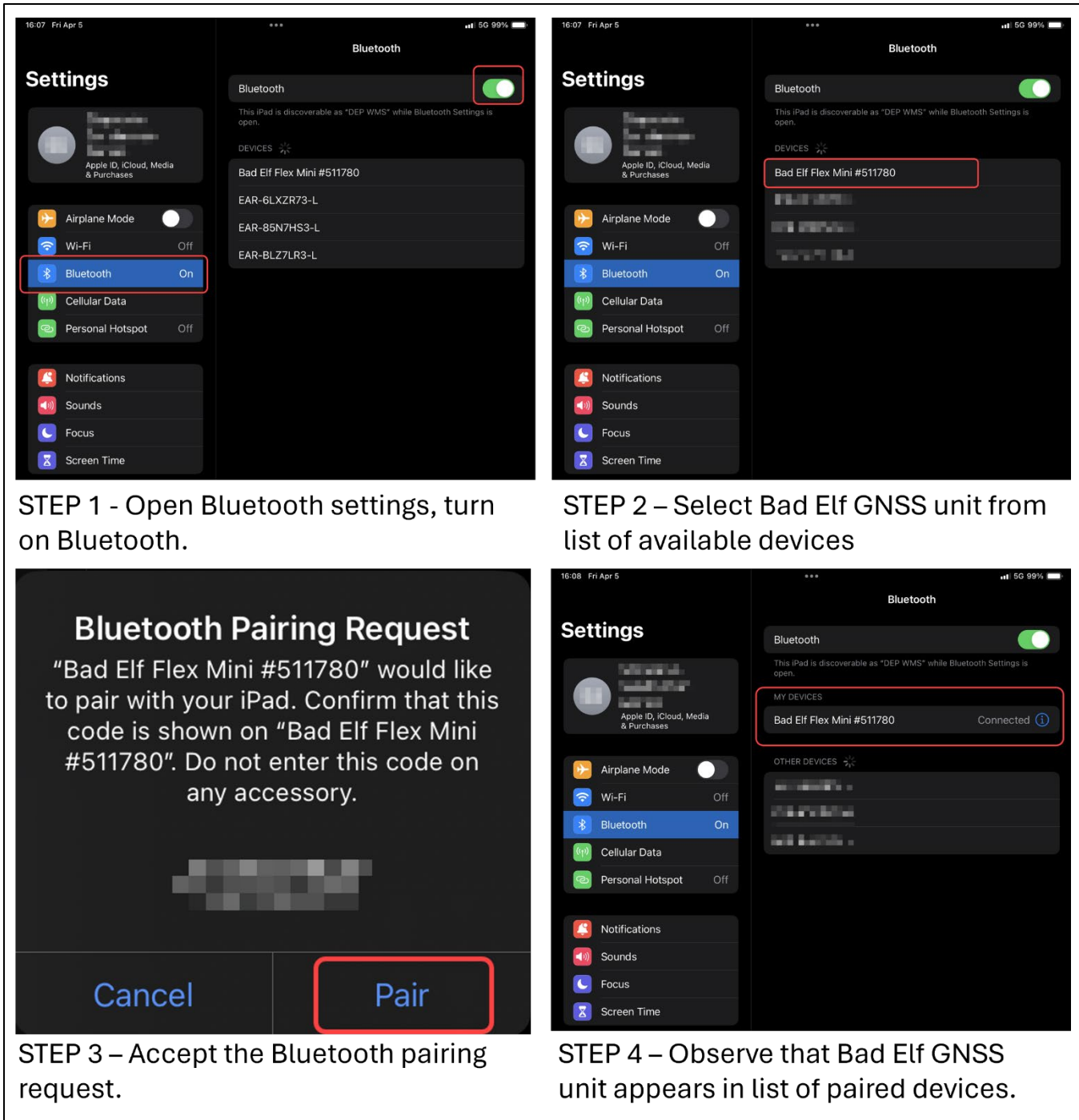


Figure 4. Screenshots showing steps 1 – 4 of Bluetooth pairing for iOS devices.

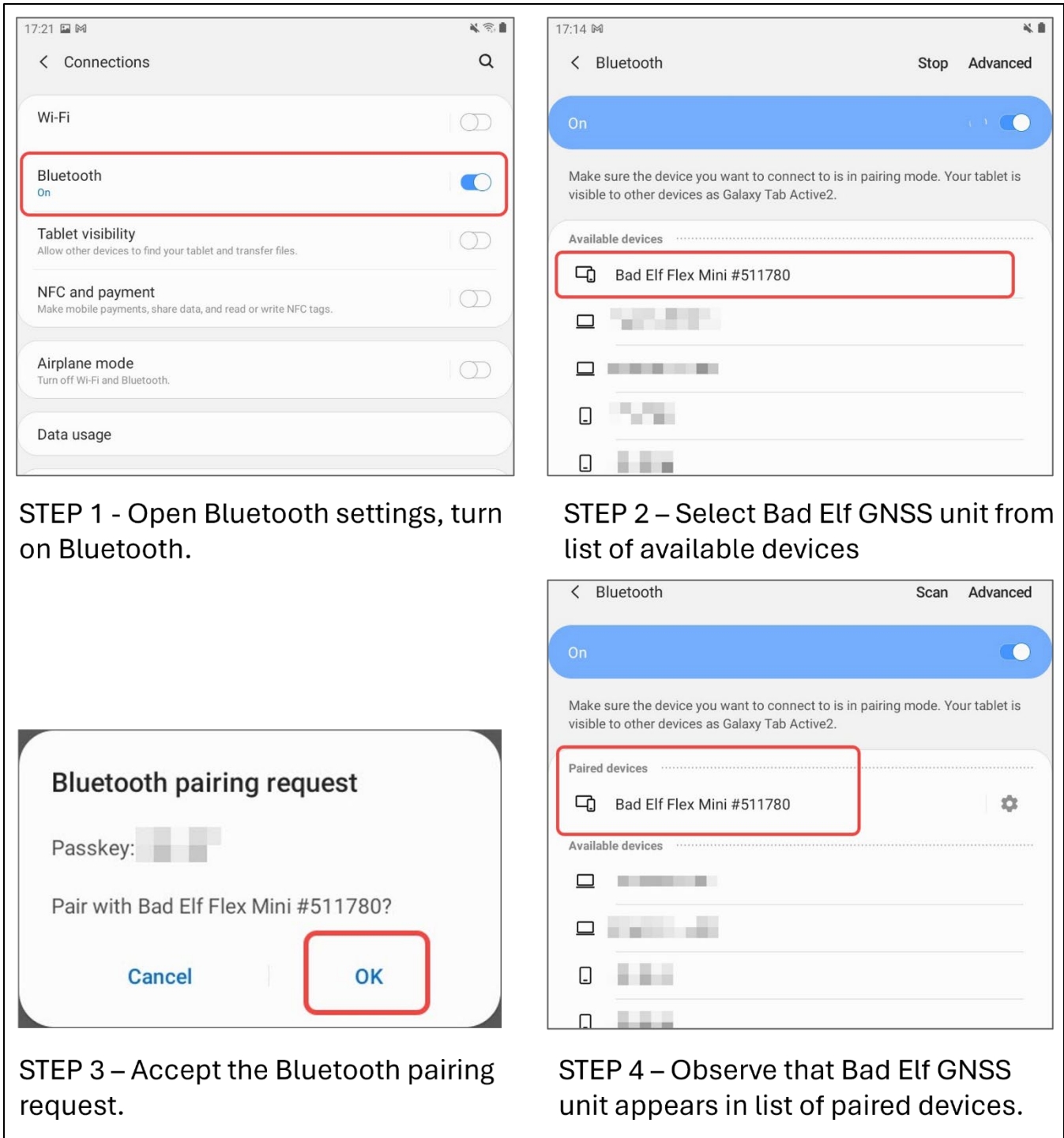


Figure 5. Screenshots showing steps 1 – 4 of Bluetooth pairing for Android devices.

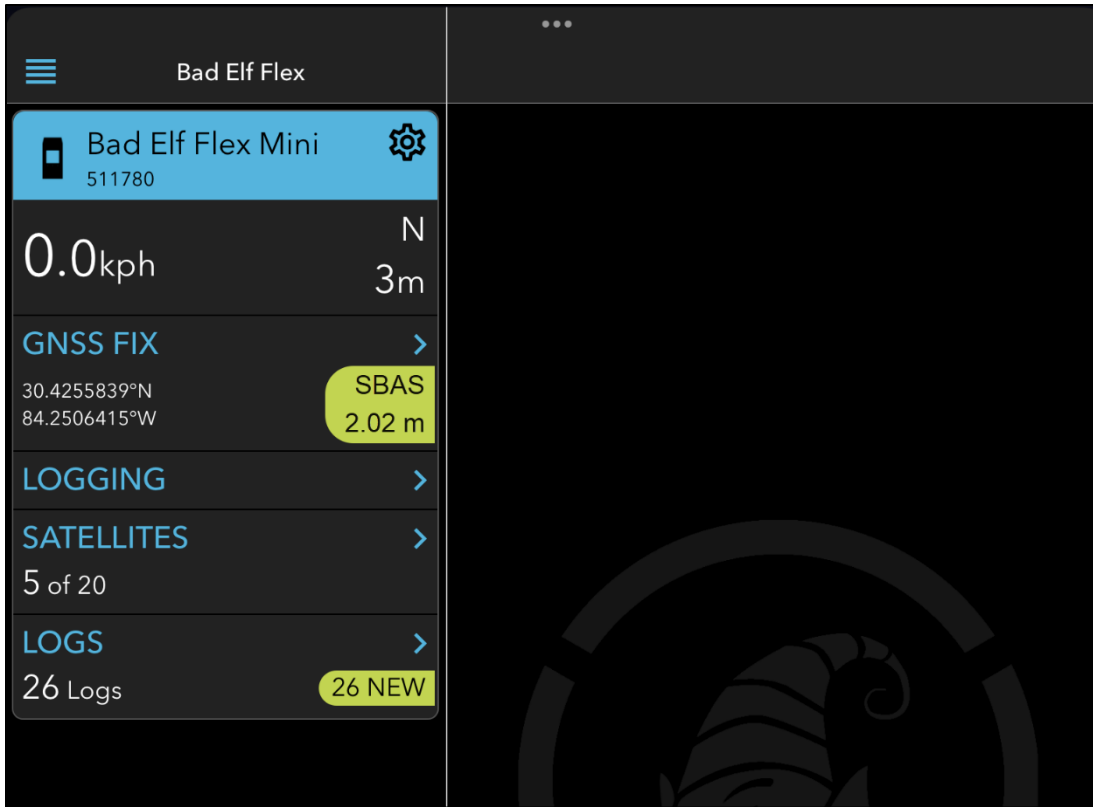


Figure 6. Screenshot of Bad Elf Flex application with a connected GNSS unit. The Bad Elf Flex Mini GNSS unit will appear on the left-side panel of the application when the GNSS unit is connected to the mobile device.

Using the Bad Elf Flex Application

The Bad Elf Flex application must remain open and running in the background on the mobile device while the GNSS unit is in use.

Selecting items in the left-side panel of the Bad Elf Flex application allows users to view additional information about the selected item in the right-side panel of the application.

Adjusting GNSS Unit Settings

Select the gear icon next to the GNSS unit name in the left-side panel to open the settings menus in the right-side panel ([Figure 7](#)).

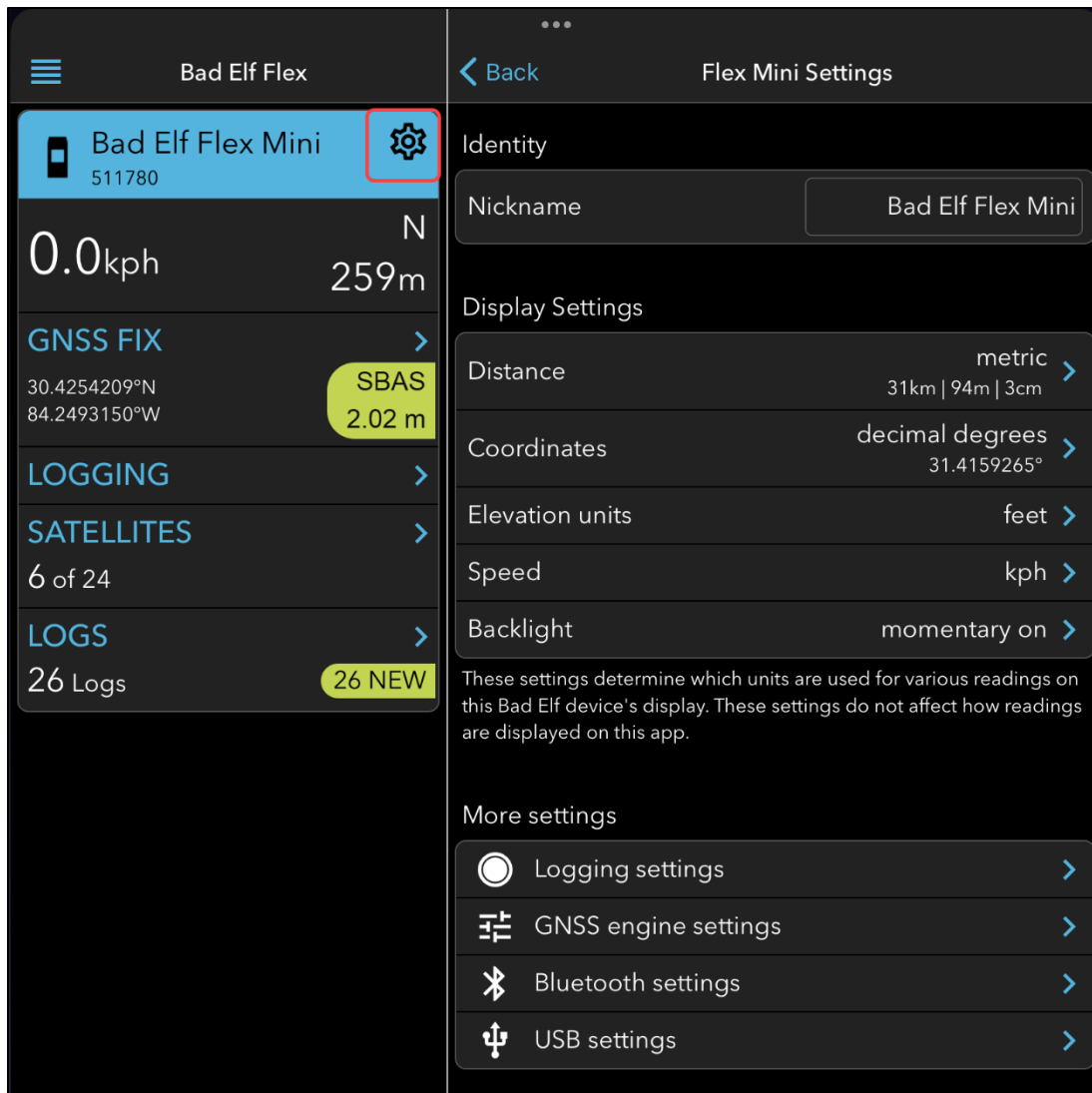


Figure 7. Screenshot of Bad Elf Flex application with a red circle showing the icon used to access the settings menus for the connected unit.

Bluetooth / NMEA Settings

The Bluetooth and NMEA settings must be checked to ensure that all location data is available for use by other applications (e.g. Survey123, Field Maps, Google Maps). From the settings menus, select **Bluetooth settings** (Figure 8). Examine the information in the **Default NMEA output** settings menu and ensure that **GNSS, with sats** is selected (Figure 9).

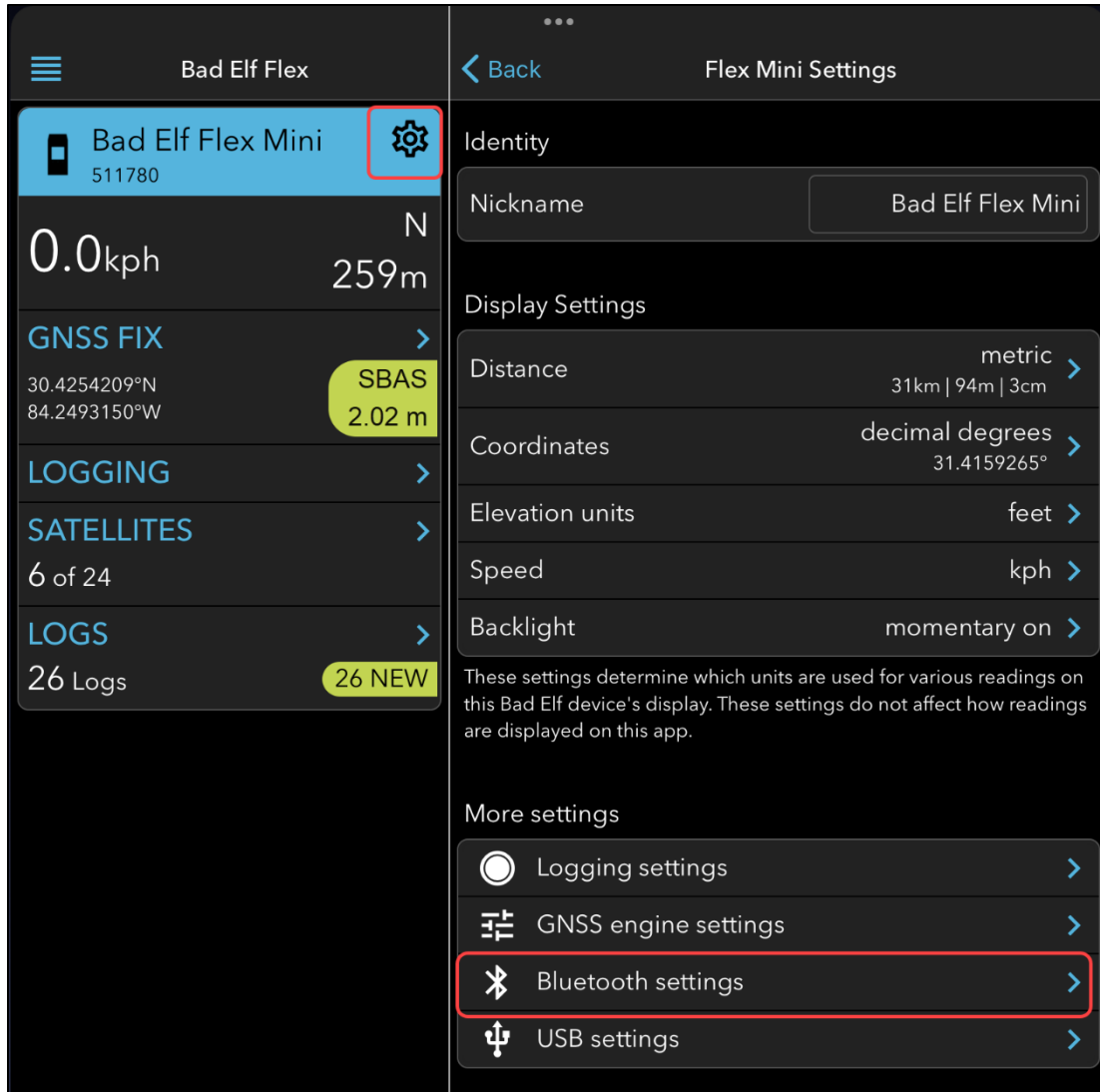


Figure 8. Screenshot of Bad Elf Flex application with red circles showing how to access the Bluetooth settings menu.

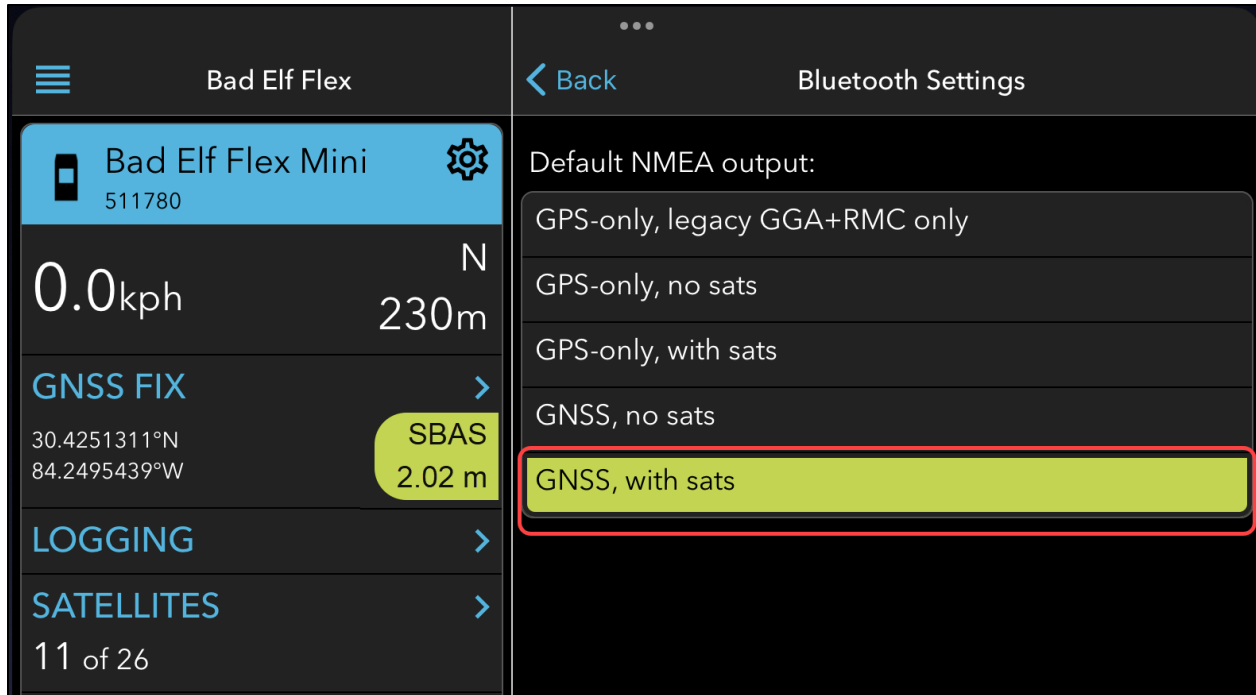


Figure 9. Screenshot of Bad Elf Flex application showing Bluetooth settings for the connected device. Select "GNSS, with sats" as the default NMEA output setting.

GNSS Engine Settings

Check the GNSS engine settings to ensure that the unit is not running in simulation mode. From the settings menus, select **GNSS engine settings** (Figure 10). Examine the information in the GNSS Simulation settings menu and ensure that **GNSS Sim Mode Disabled** is selected (Figure 11).

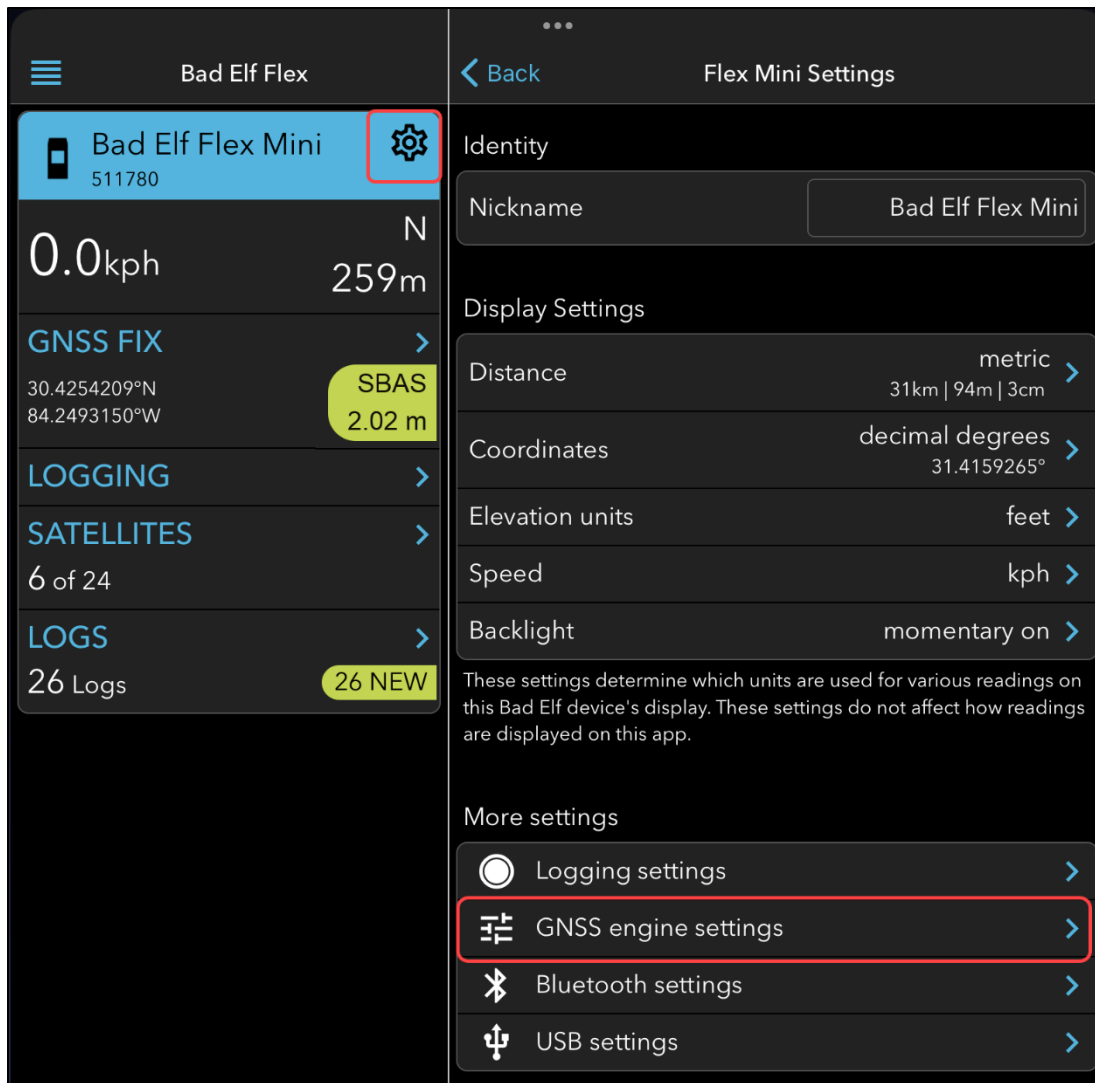


Figure 10. Screenshot of Bad Elf Flex application with red circles showing how to access the GNSS engine settings menu.

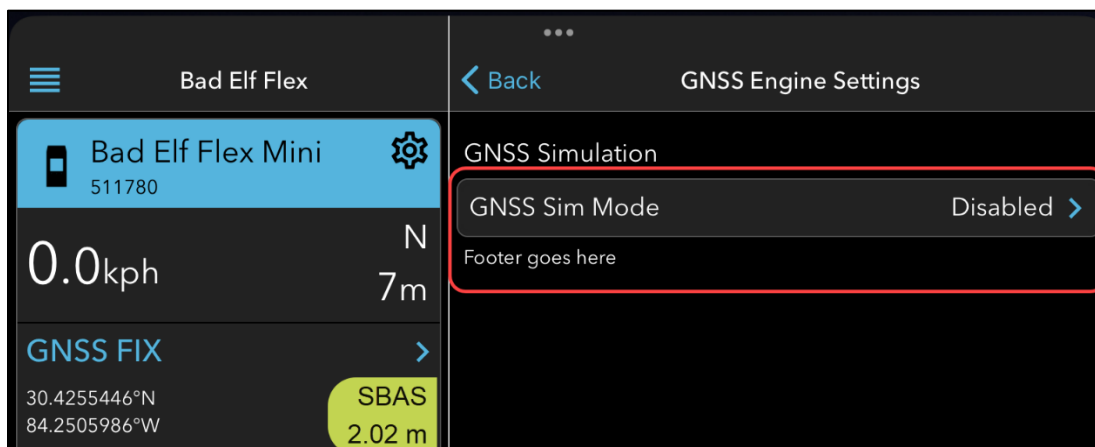


Figure 11. Screenshot of Bad Elf Flex application showing GNSS engine settings for the connected device. Select "GNSS Sim Mode Disabled" for the GNSS Simulation setting.

Display Settings (Units)

The units for various measurements displayed within the Bad Elf Flex application can be adjusted in the Display Settings section. For Status and Trend Networks projects, changing the coordinate units to decimal seconds (degrees minutes decimal seconds) is recommended, to match the format for the locations of random sampling locations displayed in the GWIS Database Utilities application. To adjust these units, select **Coordinates** from the Display Settings menu (Figure 12) and then select **decimal seconds** (Figure 13).

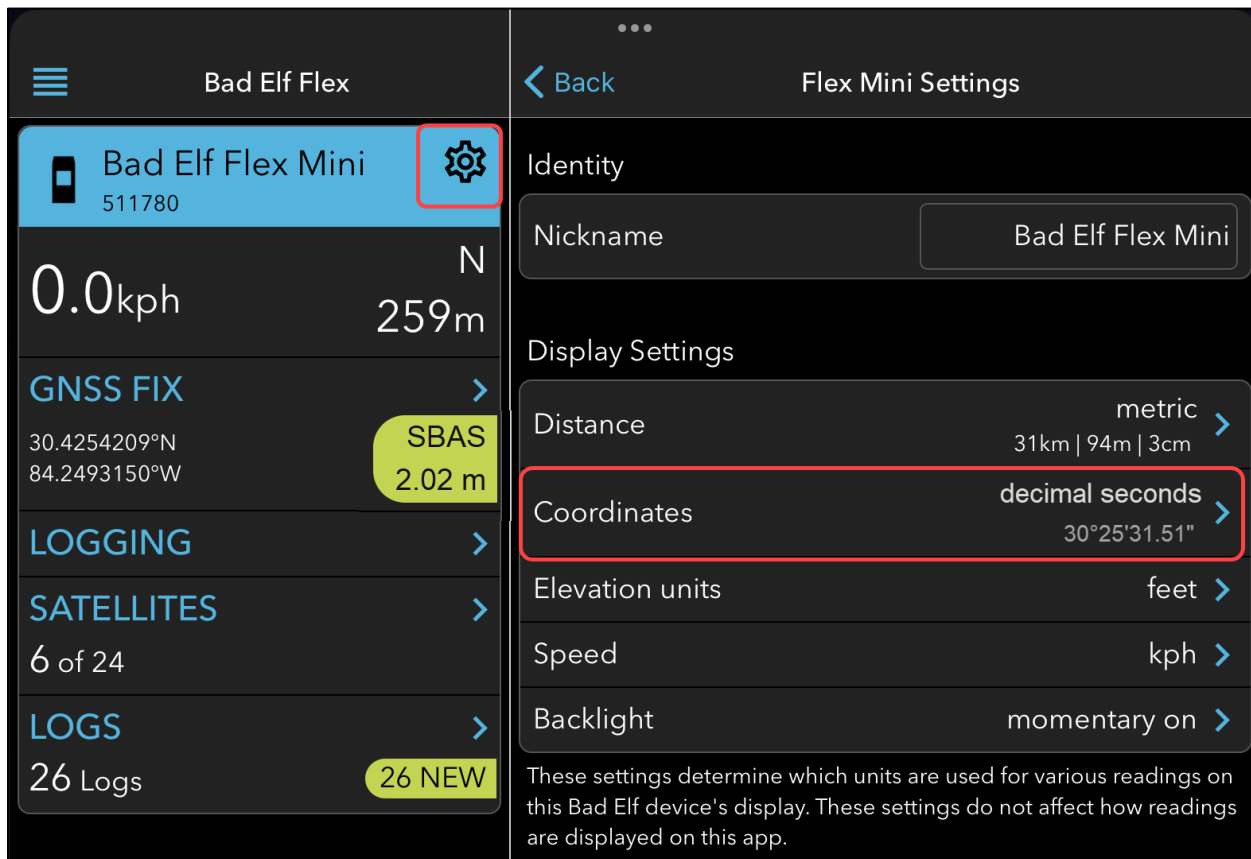


Figure 12. Screenshot of Bad Elf Flex application with red circles showing how to access the coordinates unit settings within the Display Settings menu.

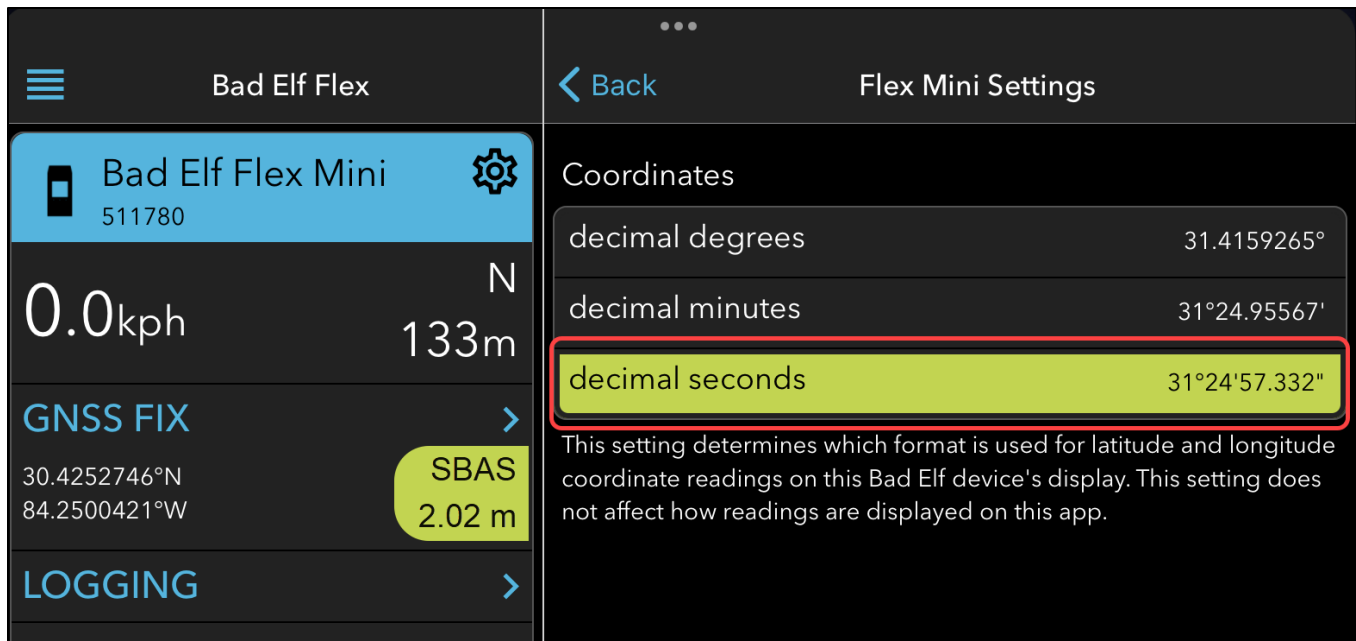


Figure 13. Screenshot of Bad Elf Flex application showing Display Settings for the connected device. Select "decimal seconds" for the Coordinates setting.

GNSS Fix Type Information

Select the Bad Elf GNSS unit device name in the left-side panel of the Bad Elf Flex application to view details about the device and current location data in the right-side panel (Figure 14).

The location data details displayed should be examined to ensure that the data quality meets the requirements for the monitoring project. The GNSS fix type is the first piece of information displayed. For all Status and Trend Networks projects, use of a **SBAS fix type** is strongly encouraged.

When the GNSS fix type is "SBAS", this indicates that the GNSS unit is utilizing correction factor data from the Wide-Area Augmentation System (WAAS) satellites or other providers. When the GNSS fix type is "3D", this indicates that the GNSS unit is operating in autonomous GNSS mode and is not utilizing correction factor data from the WAAS satellites or other providers. The accuracy of location data collected with a 3D GNSS fix type will be lower than data collected with an SBAS GNSS fix type.

If the GNSS fix type is "3D", please wait a few minutes to allow the GNSS unit to acquire additional satellite data. A GNSS fix can typically be acquired in less than 5 minutes. However, it may take up to 15 minutes to acquire a GNSS fix if it is the first time connecting the GNSS unit to the mobile device, or if it is the first time using the GNSS unit following a firmware update. Ensure that the unit is positioned with the antenna oriented towards the sky, and that the unit has a clear view of the sky. Do not attempt to operate the GNSS receiver indoors. GNSS signals are not able to be accurately transmitted through buildings or other manmade structures.

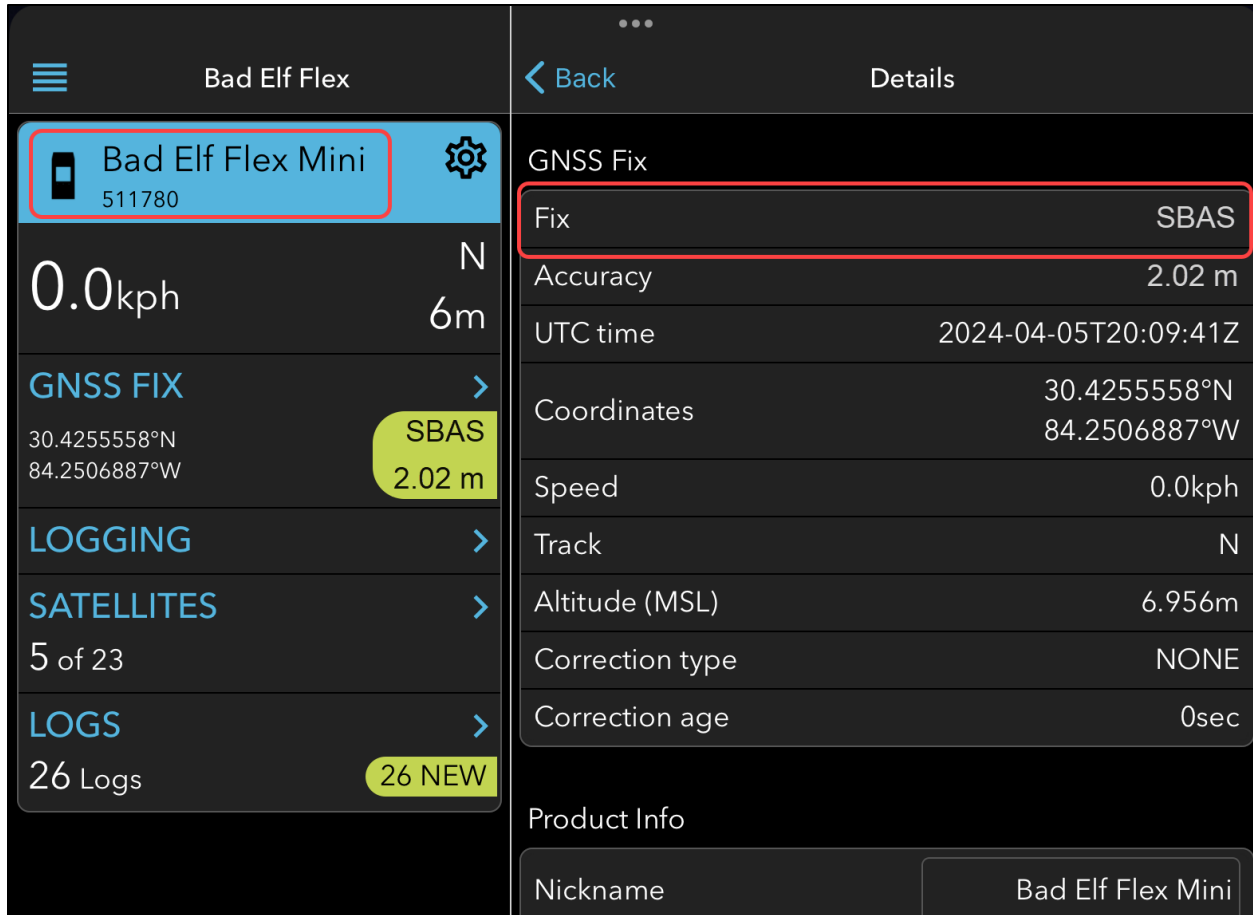


Figure 14. Screenshot of Bad Elf Flex application with details about the connected device displayed in the right-side panel. The GNSS fix type is displayed at the top of the right-side panel.

GNSS Unit Firmware Version

Details about the connected GNSS unit are found below the location data details in the right-side panel. These details include the firmware version (Figure 15). When troubleshooting problems with the GNSS receiver, the Watershed Monitoring Section (WMS) GNSS Coordinator will often ask the user to check the firmware version, to ensure that the version installed matches the current version distributed by the manufacturer.

A notification will appear in the Bad Elf Application if an updated firmware version is available. To install a firmware update, ensure that the mobile device has a reliable cellular data connection or is connected to a Wi-Fi network. Follow the on-screen prompts to download the update and install the update on the GNSS receiver via the Bluetooth connection. After the installation is complete, the GNSS receiver will typically require a manual restart to complete the update process.

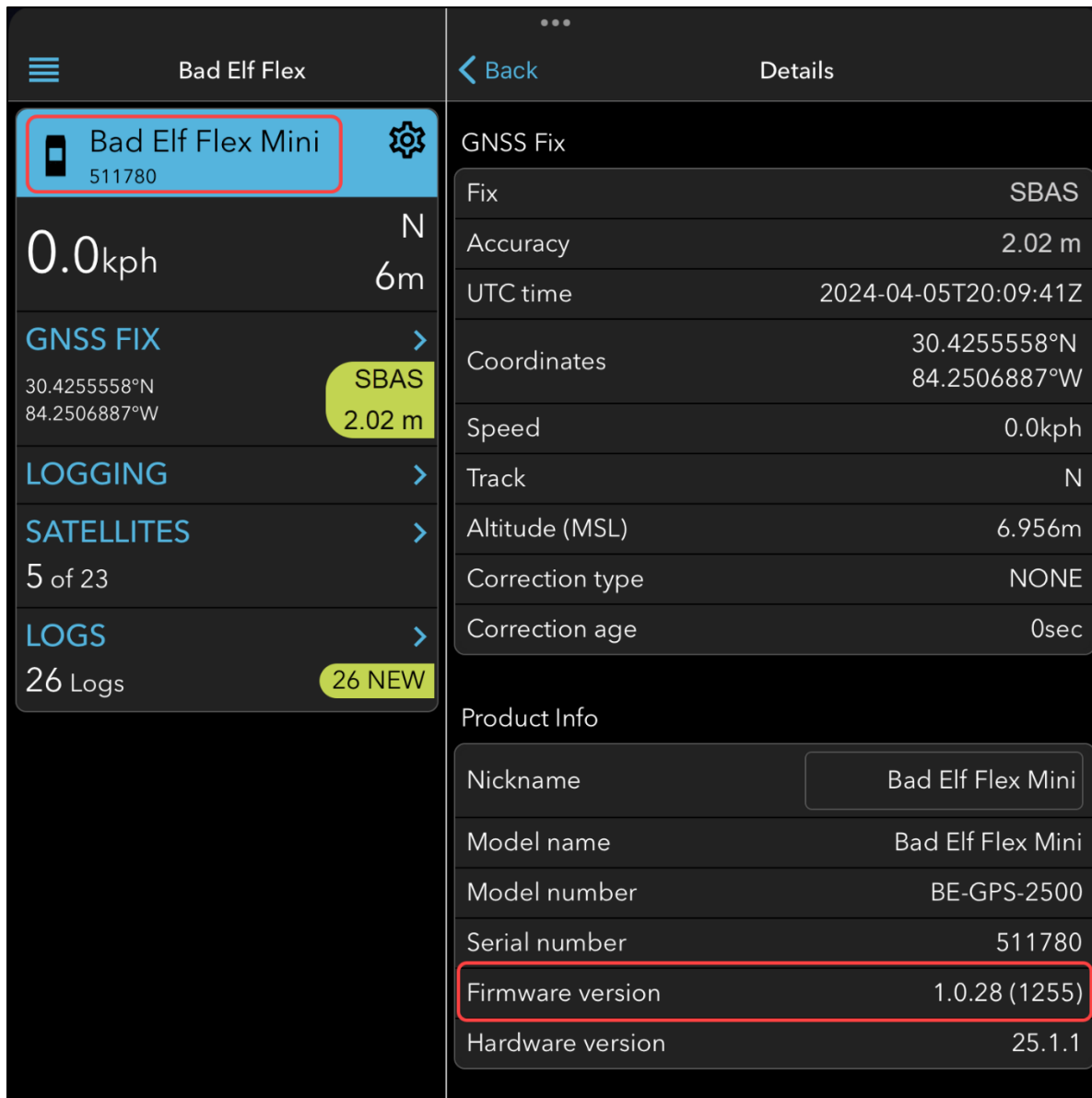


Figure 15. Screenshot of Bad Elf Flex application with details about the connected device displayed in the right-side panel. The firmware version is displayed in the right-side panel, below the location details.

Satellite Information

Select **SATELLITES** in the left-side panel of the Bad Elf Flex application to view details about the satellite signals being received by the GNSS unit (Figure 16). When troubleshooting problems with the GNSS receiver, the WMS GNSS Coordinator will often ask the user to share information about the constellations and satellites in use by the receiver.

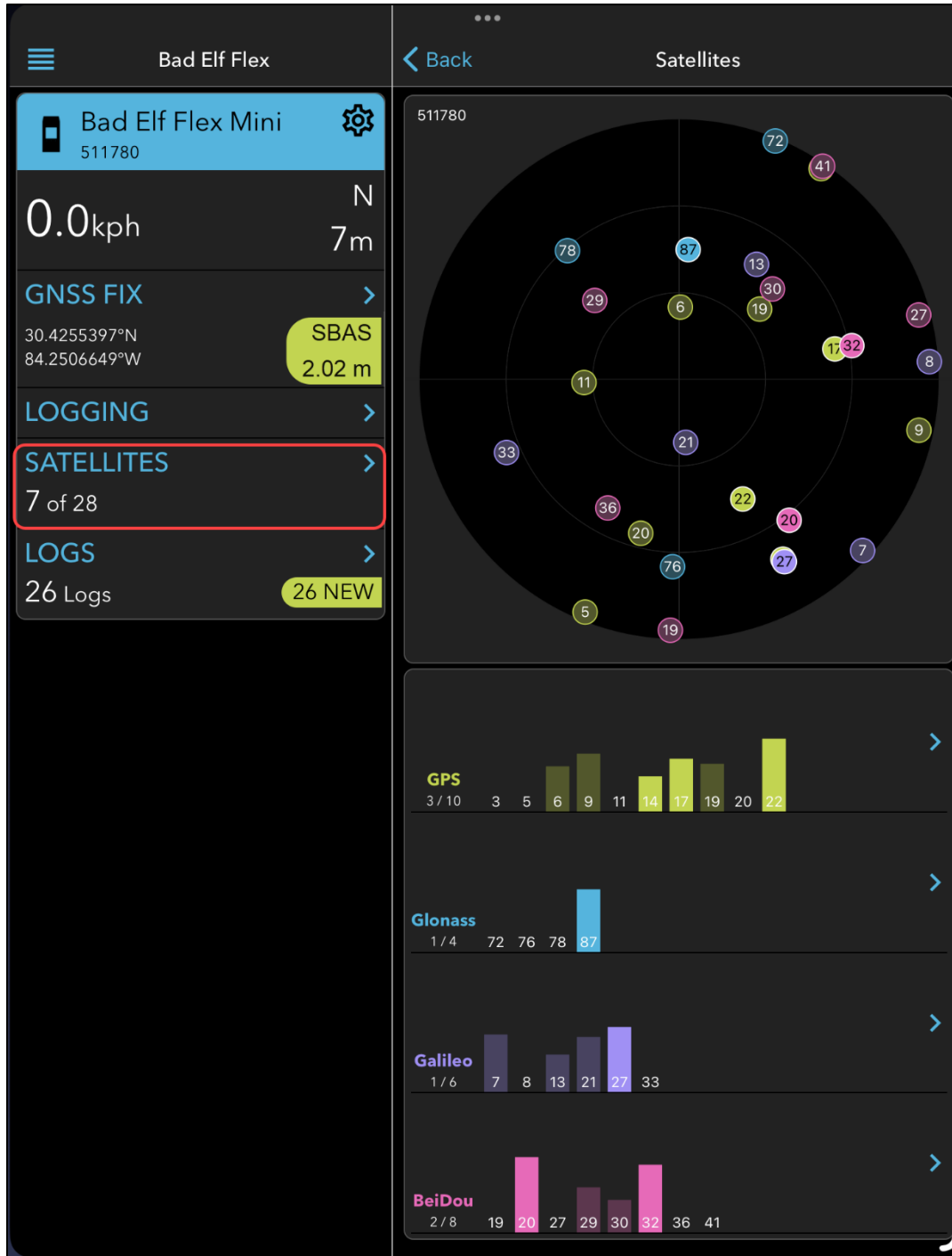


Figure 16. Screenshot of Bad Elf Flex application with satellites displayed in the right-side panel.

Location Data Logging Tools

Select **LOGGING** in the left-side panel of the Bad Elf Flex application open the location data logging tools in the right-side panel (Figure 17). These tools allow users to save the current location data as a point or track. Data are saved on the GNSS unit and can be downloaded to the mobile device via the Bluetooth connection, by selecting **LOGS** in the left-side panel of the Bad Elf Flex application. The

logging tools are not currently needed when collecting data for Status and Trend Networks projects, but these tools may be useful for other projects.

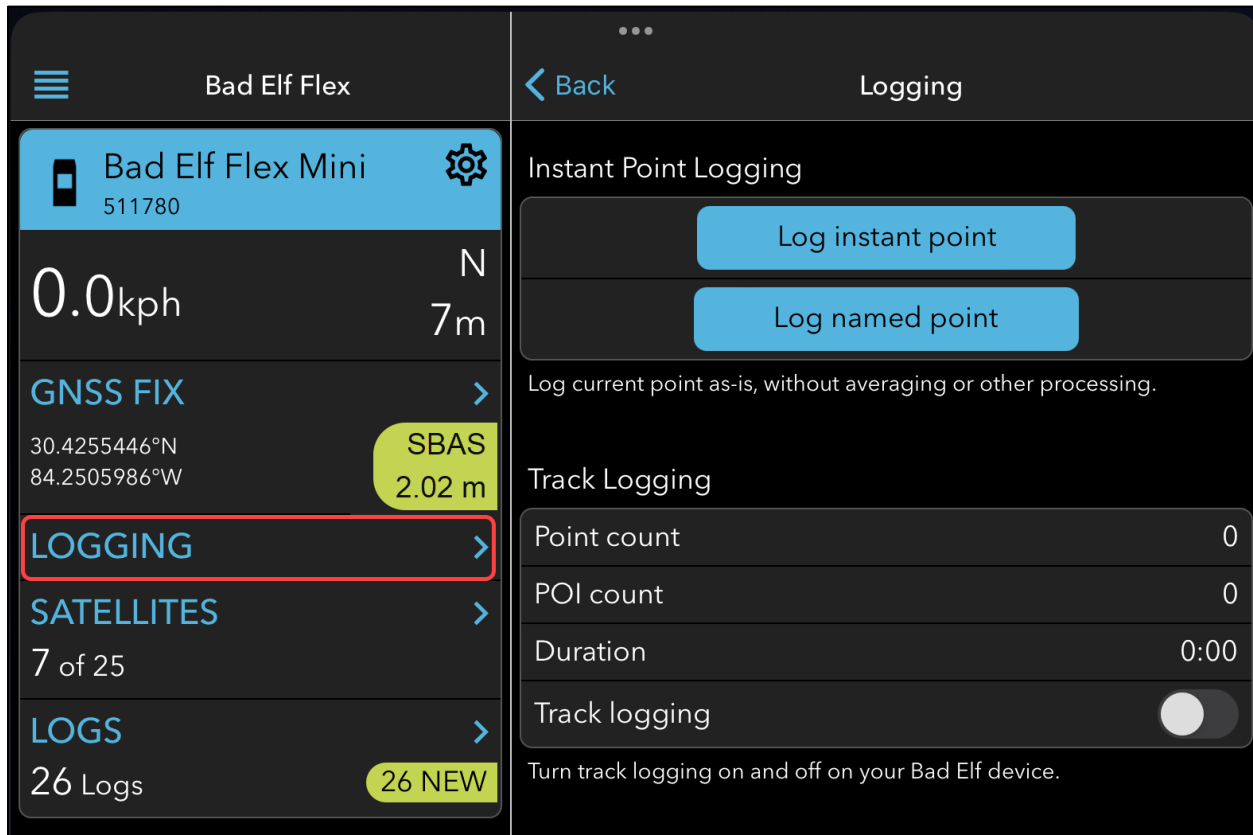


Figure 17. Screenshot of Bad Elf Flex application with location data logging tools displayed in the right-side panel.

Navigation for Status and Trend Networks

Field Maps Settings - Set Location Provider

Open the ArcGIS Field Maps application and sign in using your ArcGIS Online credentials. If you encounter difficulty signing in to the application, contact your organization's information technology support staff for assistance.

From the home screen of the Field Maps application, open the user settings menu using the icon in the upper-left corner (Figure 18).

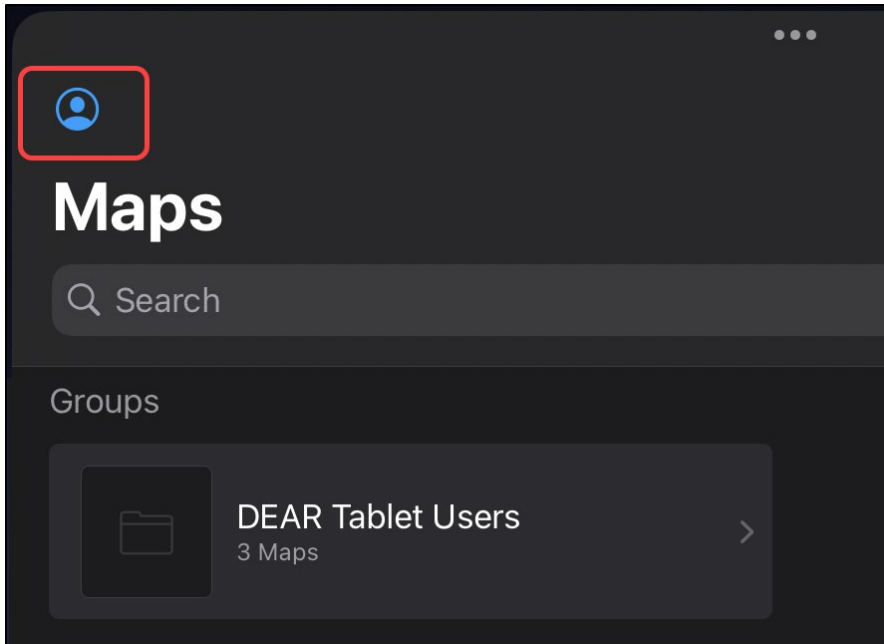


Figure 18. Screenshot of Field Maps Application showing the user settings icon location.

In the **Location** settings section of the user settings menu, select **Provider** to specify the location data source ([Figure 19](#)). The default location provider will be set to "Integrated", indicating that the location data source is the mobile device's internal location data software, which typically uses a combination of signals from satellites and cellular towers. Integrated location data provider software does not meet the data quality requirements for Status and Trend Network location data collection.

To set the Bad Elf 2500 GNSS unit as the location data provider, it must first be added to the list of available providers. Select the **Add** button on the Location Providers menu ([Figure 20](#)), then select the Bad Elf 2500 GNSS unit from the options available in the **Add Provider** menu ([Figure 21](#)). If the unit is not visible in the add provider menu, check the Bluetooth settings for the mobile device and the device status in the Bad Elf Flex application, to ensure that the unit is connected.

Return to the list of location providers and select the Bad Elf GNSS unit. A checkmark icon will appear next to the unit's name, indicating that has been set as the location provider ([Figure 22](#)).

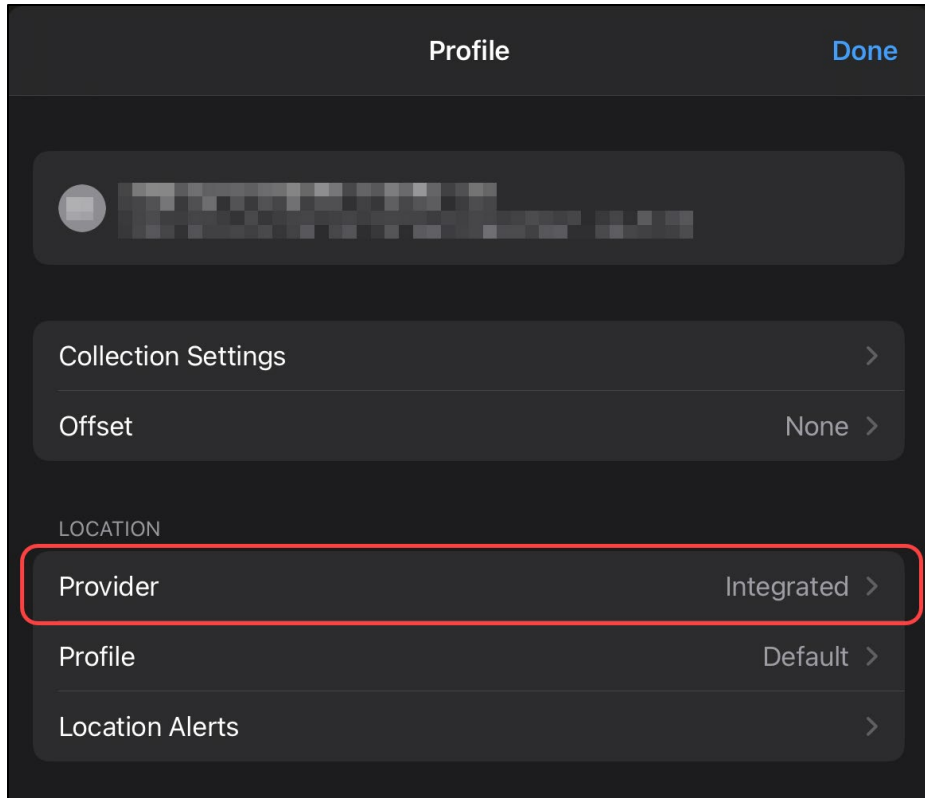


Figure 19. Screenshot of Field Maps Application user settings showing the Location Provider settings menu.

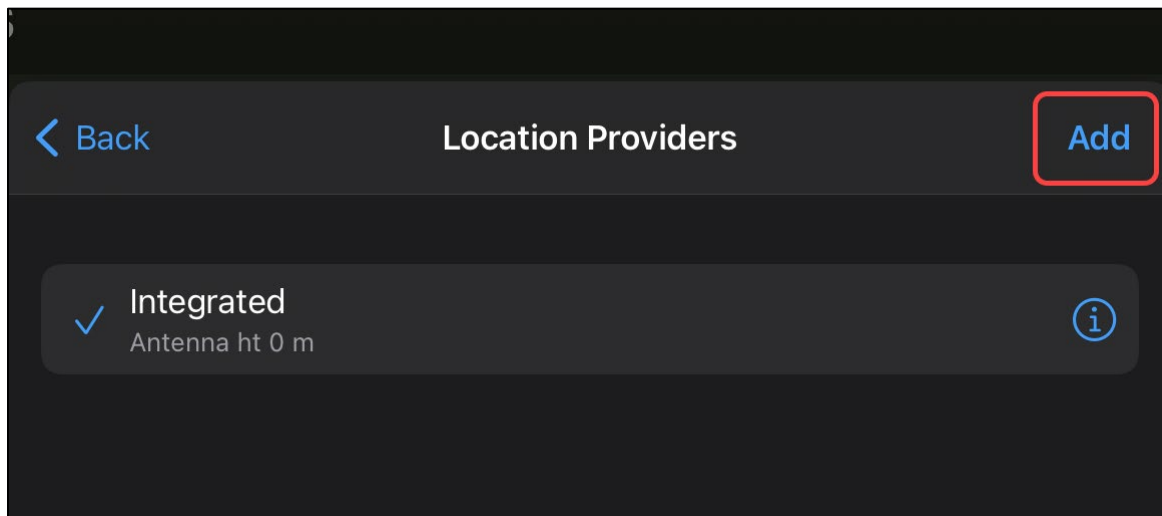


Figure 20. Screenshot of Field Maps Application Location Provider settings showing the Add Provider button.

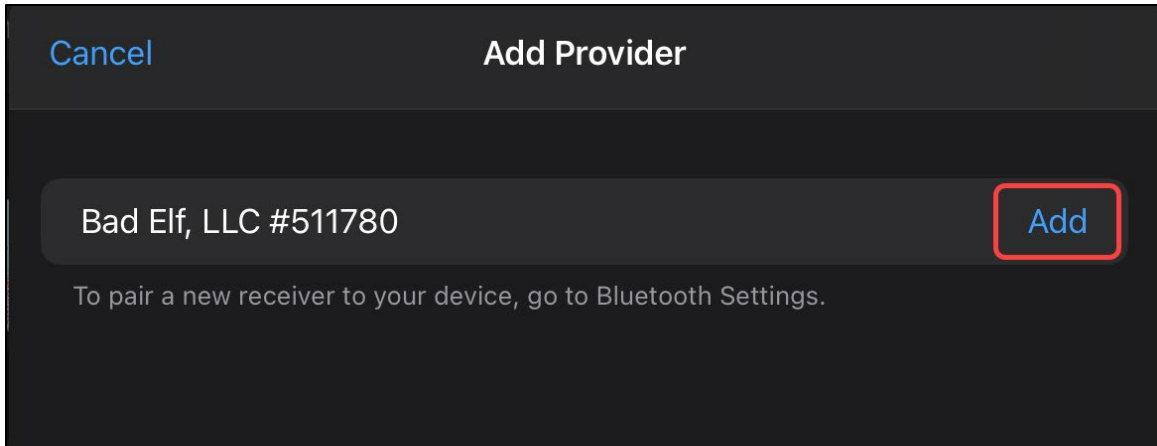


Figure 21. Screenshot of Field Maps Application showing the Add Provider options.

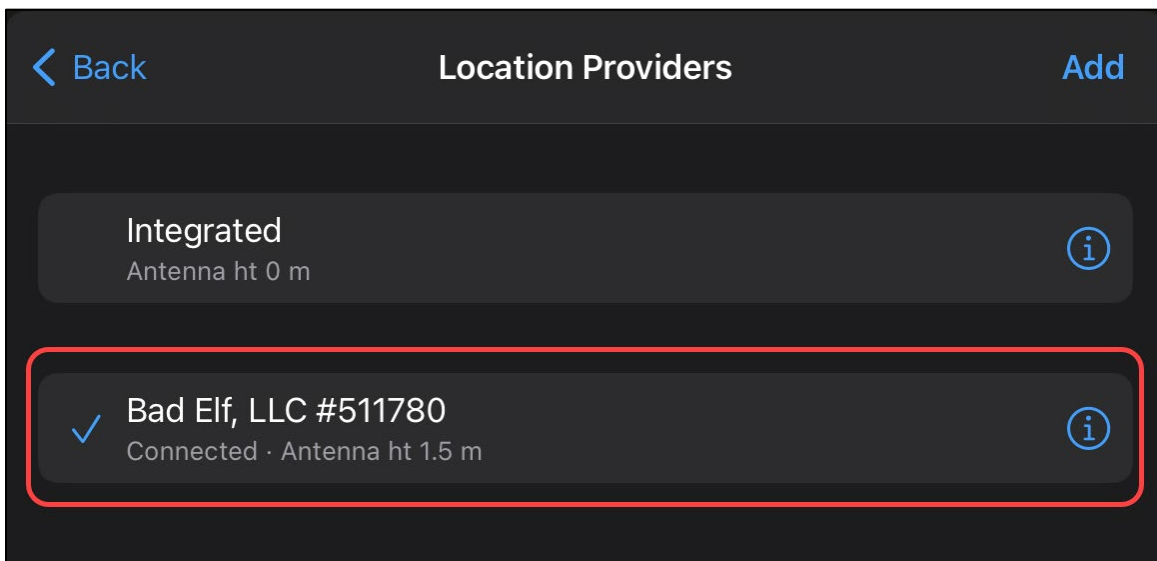


Figure 22. Screenshot of Field Maps Application user settings showing selection of the Bad Elf GNSS unit from the Location Provider settings menu.

Field Maps – Map Tools and Navigation Options

From the home screen of the Field Maps application, open the group folder for **DEAR Tablet Users** (DEP staff) or **Status and Trend Networks Survey123 Users** (non-DEP staff) and locate the **Status and Trend Networks Navigation Map**.

To use the map in areas without a reliable cellular data connection, it is necessary to download a portion of the map for offline use while the mobile device is connected to a cellular data or Wi-Fi network. Select the **more options** (three horizontal dots) icon for the Status and Trend Networks Navigation Map, then select **Add Offline Area** (Figure 23). Options for defining the area and level of details to download will be displayed. Selecting a detail level of "street" or smaller is recommended. Refer to section [Backup Plan for Offline Navigation – Organic Maps Application](#) for additional options for navigation in areas without a reliable cellular data connection.

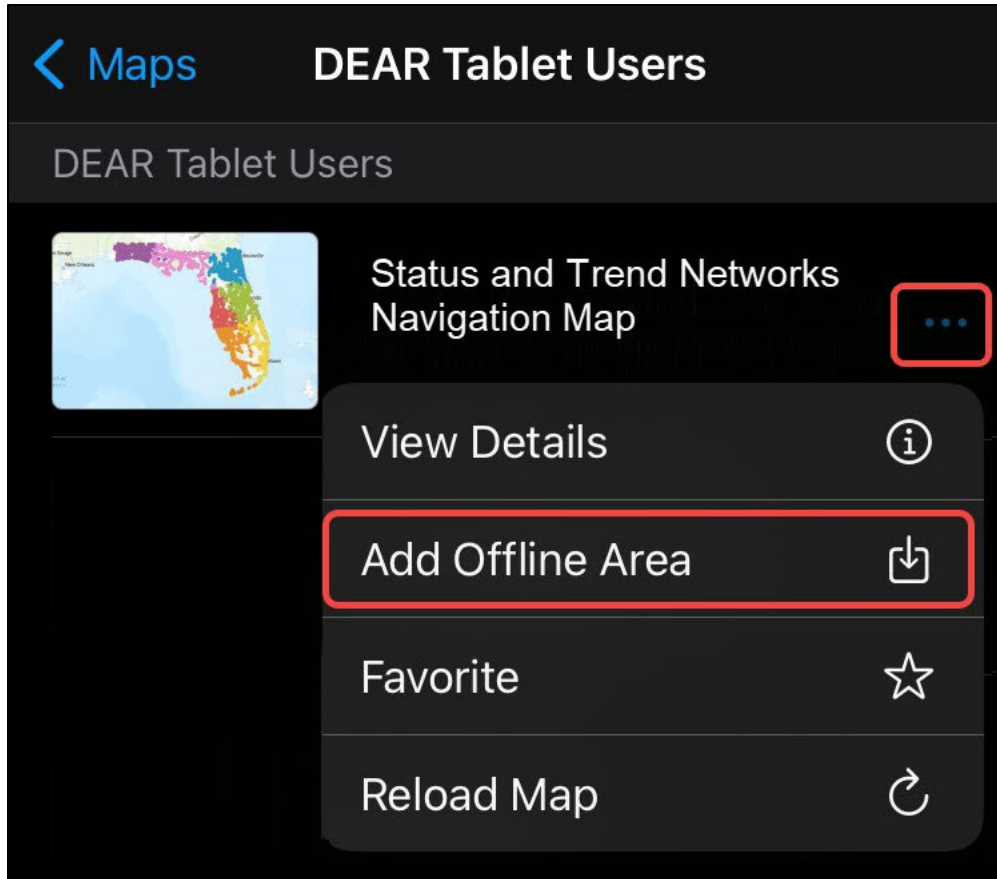


Figure 23. Screenshot of Field Maps group folder showing the Add Offline Area tool for the Status and Trend Networks Navigation Map.

To open the Status and Trend Networks Navigation Map, click on the map icon or title in the list of available maps in the group folder. Once the map has loaded, use the **More Options** (three horizontal dots icon) menu to view the available map tools (Figure 24). The **Basemap** tool provides options for switching between various online basemap layers (imagery, topographic maps, etc.). Changing basemaps typically requires the mobile device to be connected to a cellular data or Wi-Fi network. The **Legend** tool will display a small window listing the symbology used for all layers that are currently visible on the map.

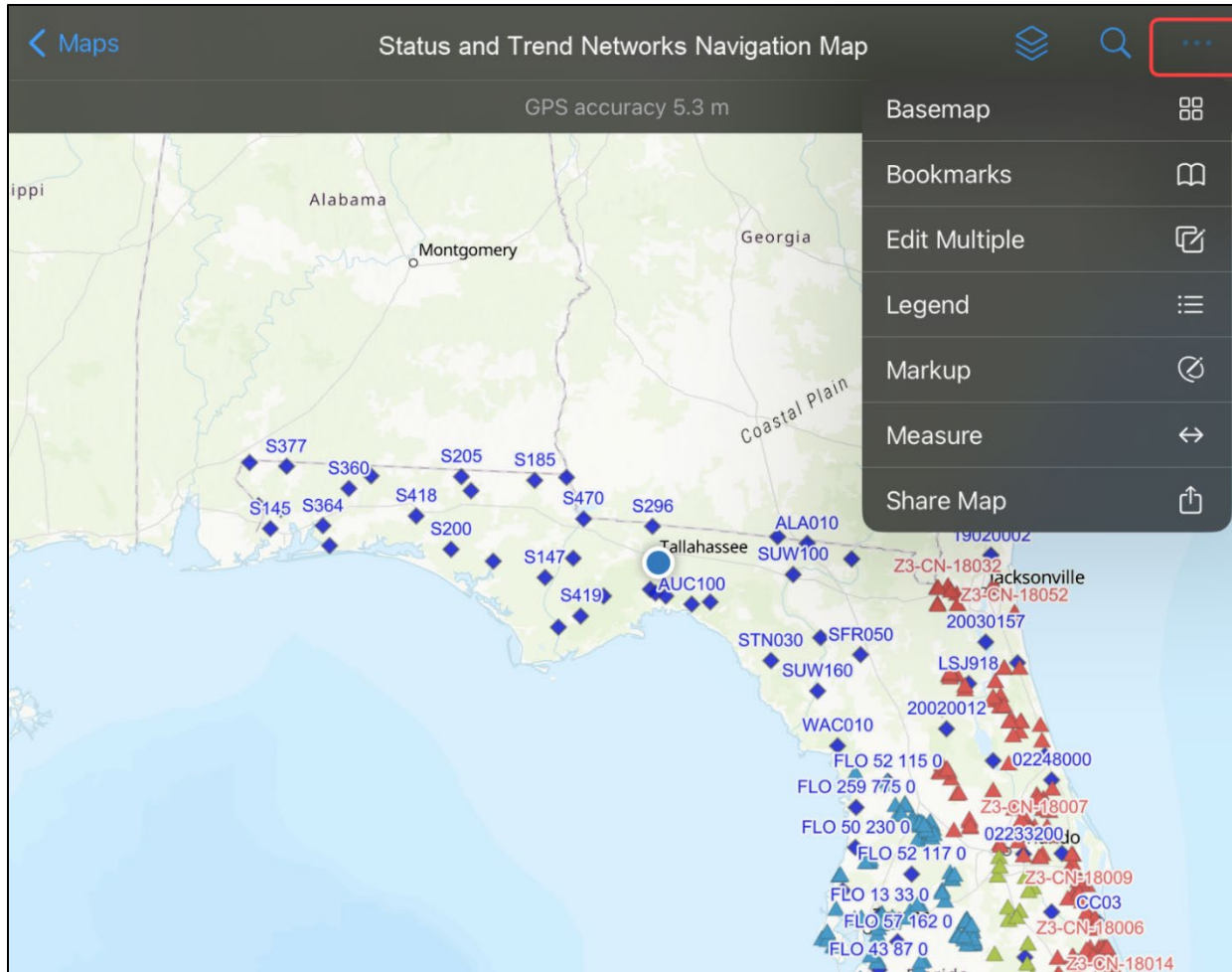


Figure 24. Screenshot of Status and Trend Networks Navigation Map in Field Maps application, showing the map tools.

Use the **Layers** menu to change the visibility for all station layers in the map (Figure 25). Separate layers are used to display the station or random site locations for each major project (Surface Water Trend Network, Groundwater Trend Network, and each of the seven Status Network resources).

Use the **Search** tool to select a specific station or random site location on the map (Figure 26). The Status and Trend Networks layers can be searched by station name, GWIS Station ID / WIN ID, Status Network random site location (e.g. Z3-CN-18001), or FLUWID (Florida Unique Well Identification) tag number. A station or random site location can also be selected by tapping on the corresponding point marker on the map.

When a station or random site location is selected, the pop-up window within the map will display details about the selected feature and provide a link for opening the corresponding Survey123 form for data collection. Tools for navigation are available within the pop-up window (Figure 27). Select the **Directions** button to obtain driving directions to the selected location using Apple Maps or Google Maps. Select the **Compass** button to display the straight-line distance and bearing from the GNSS unit's current location to the selected point. Use of the compass-style directions is recommended when navigating in a boat or when driving or walking in an off-road area. The navigation directions provided use the location of the GNSS unit, not the mobile device, as the reference point for the current location.

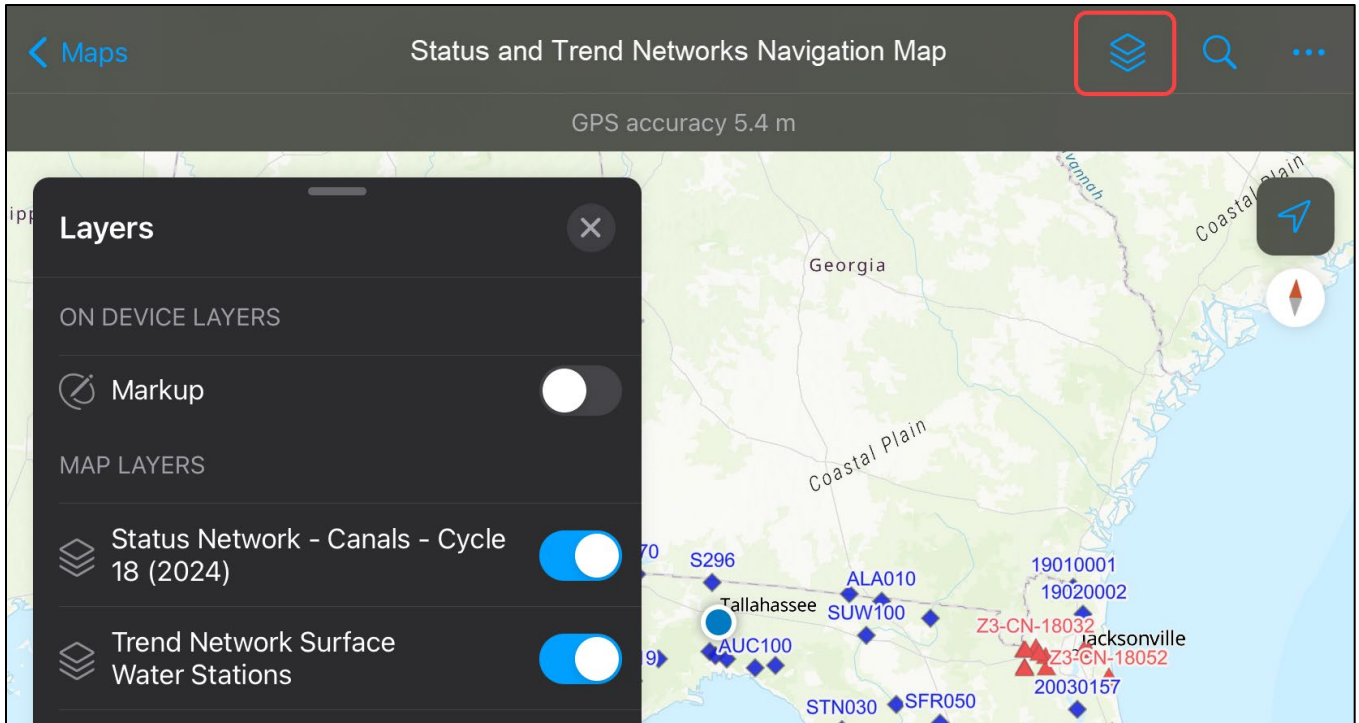


Figure 25. Screenshot of Status and Trend Networks Navigation Map in Field Maps application, showing the layers menu.

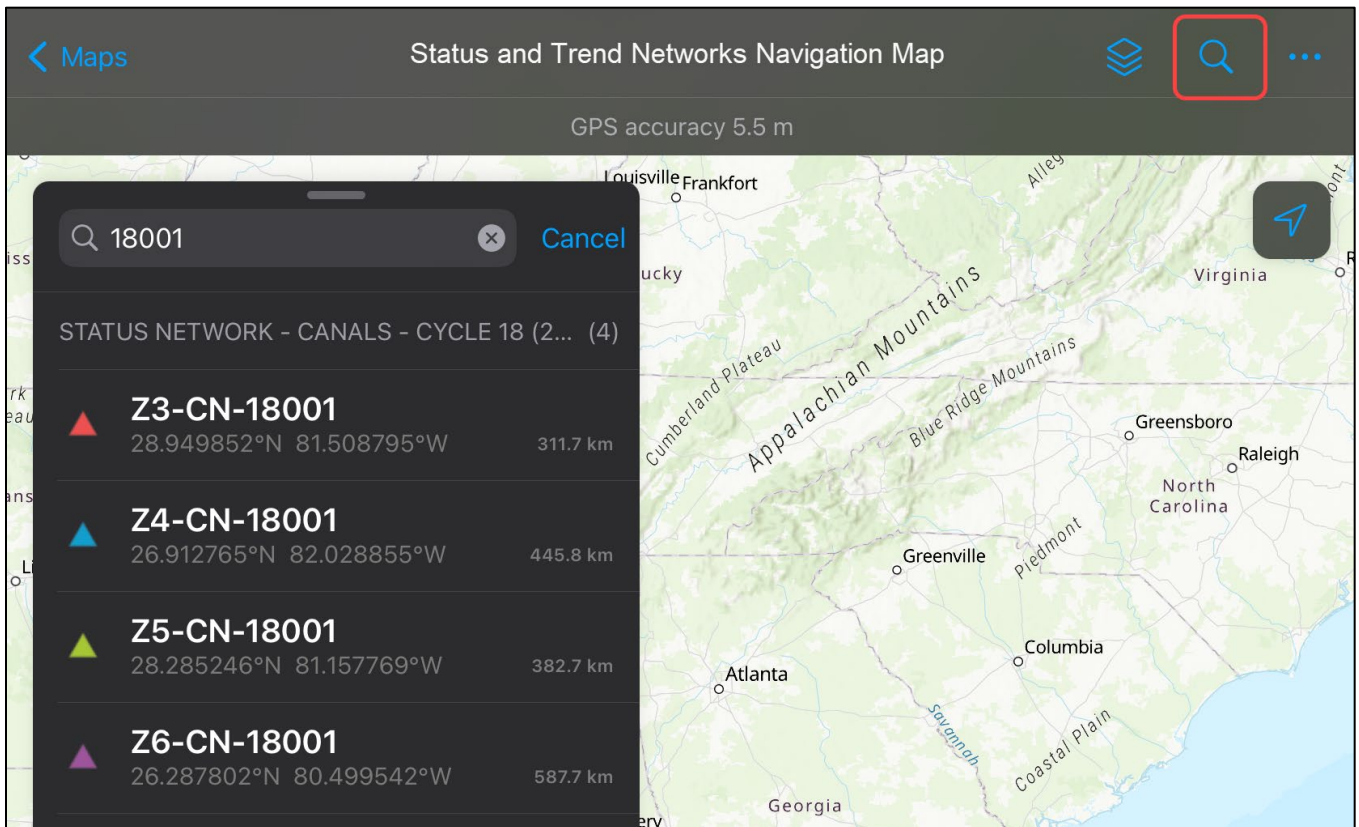


Figure 26. Screenshot of Status and Trend Networks Navigation Map in Field Maps application, showing the search tool.

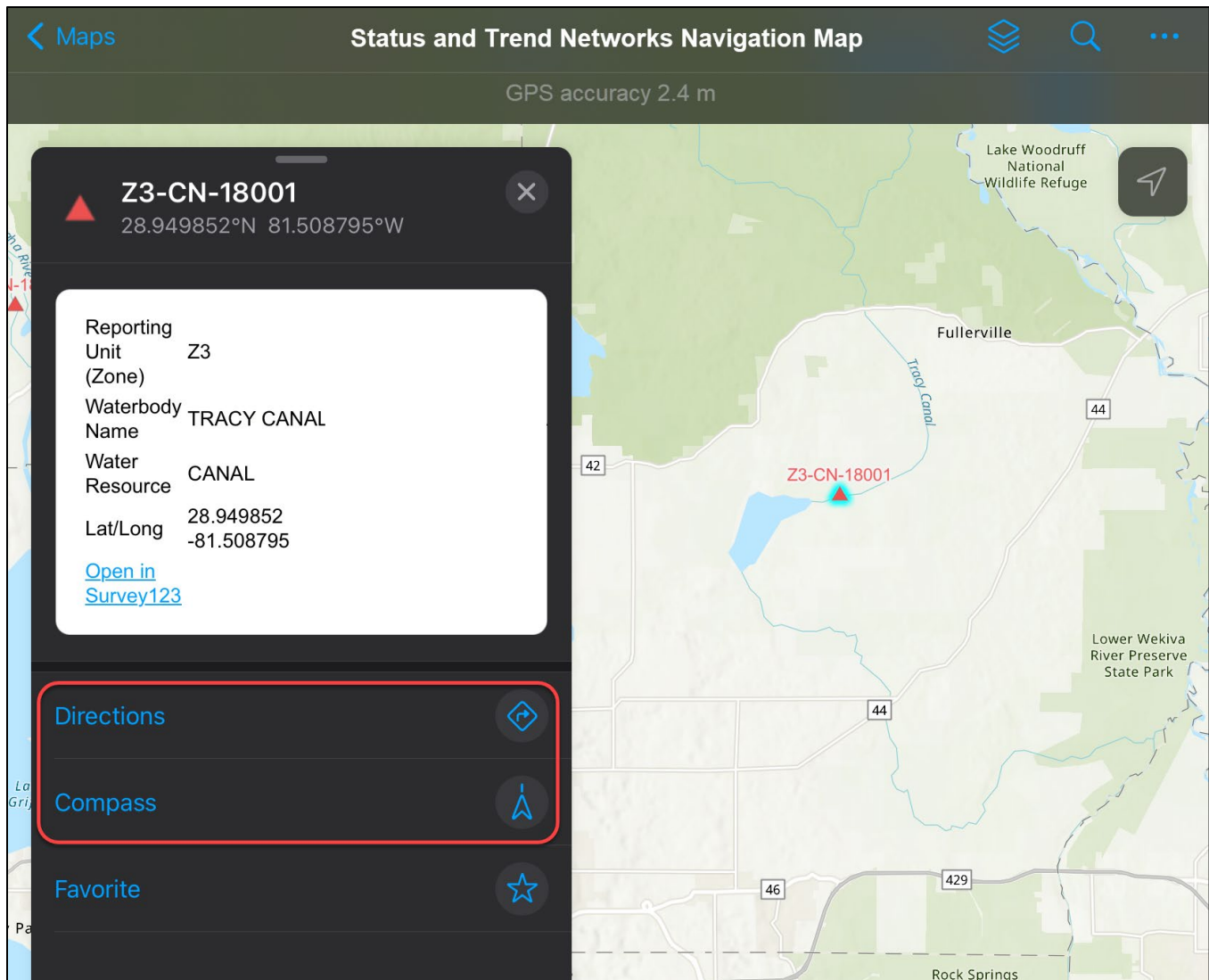


Figure 27. Screenshot of Status and Trend Networks Navigation Map in Field Maps application, showing the navigation tools.

Backup Plan for Offline Navigation – Organic Maps Application

Use of the Field Maps application is the preferred method for navigation to Status Network random site locations (refer to section Field Maps – Map Tools and Navigation Options). However, it is recommended that field staff prepare their mobile devices to use the Organic Maps application as a backup plan, in the event that difficulties are encountered when using the Field Maps applications.

The Organic Maps application allows users to download base maps for use offline. Users can import a KML file with a list of navigation target points and receive driving directions or straight-line directions to a selected point.

Prepare the map for offline use by opening the application while the mobile device is connected to a cellular data or Wi-Fi network. Select the **options** icon (three horizontal lines), then select **Download Maps**. Enter "**Florida**" in the search tool to view the map areas available for the entire state. Download all map areas relevant to anticipated sampling assignments.

KML-format navigation files for Trend Network stations and Status Network random site locations can be downloaded from the WMS FTP site (https://publicfiles.dep.state.fl.us/dear/Watershed%20Monitoring/GPS_KML_NAV_FILES/). If the downloaded files are in compressed (.zip) format, extract the files from the zip folder and save the .KML files on the mobile device. To open the KML file in Organic Maps, browse to the file location in the mobile device's **Files** application, select the navigation file and choose **Open in Organic Maps** from the list of available actions. The navigation file will be loaded into the list of available bookmarks in the Organic Maps application.

To select a navigation target, open the **Bookmarks** menu (icon with two stars and three horizontal lines) and select the list that corresponds to the navigation file name. Use the search tool or scroll through the list to locate the site that will be used as the navigation target. The Status and Trend Networks navigation files can be searched by station name, Station ID / WIN ID, or Status Network random site location (e.g. Z3-CN-18001). Select the site from the list to zoom the current map view to the site and display the navigation tool options. For driving directions or straight-line directions, select the **Route to** button near the bottom of the screen (Figure 28). For navigating using a distance and compass bearing display, select the small **arrow and distance icon** near the top of the site information pop-up window (Figure 28).

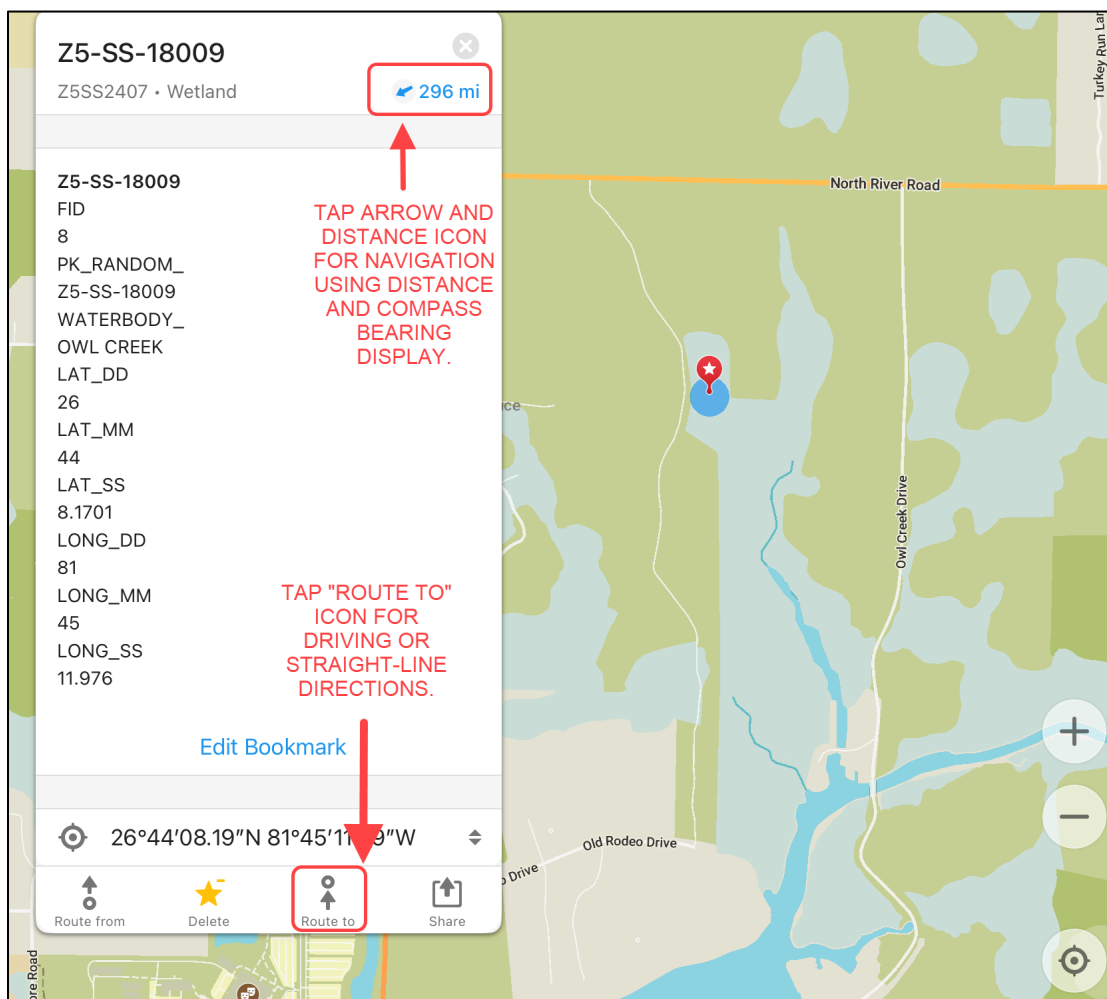


Figure 28. Screenshot of Organic Maps application, showing the navigation tools available when a point is selected.

Location Data Collection for Status and Trend Networks

Survey123 Settings - Set Location Provider

Open the ArcGIS Survey123 application and sign in using your ArcGIS Online credentials. If you encounter difficulty signing in to the application, contact your organization's information technology support staff for assistance.

From the home screen of the Survey123 application, open the **Location Status** menu using the satellite icon in the upper-left corner (Figure 29). Select the **Settings** menu (gear icon) to specify the location data source (Figure 30). The default location provider will be set to "Integrated", indicating that the location data source is the mobile device's internal location data software, which typically uses a combination of signals from satellites and cellular towers. Integrated location data provider software does not meet the data quality requirements for Status and Trend Network location data collection.

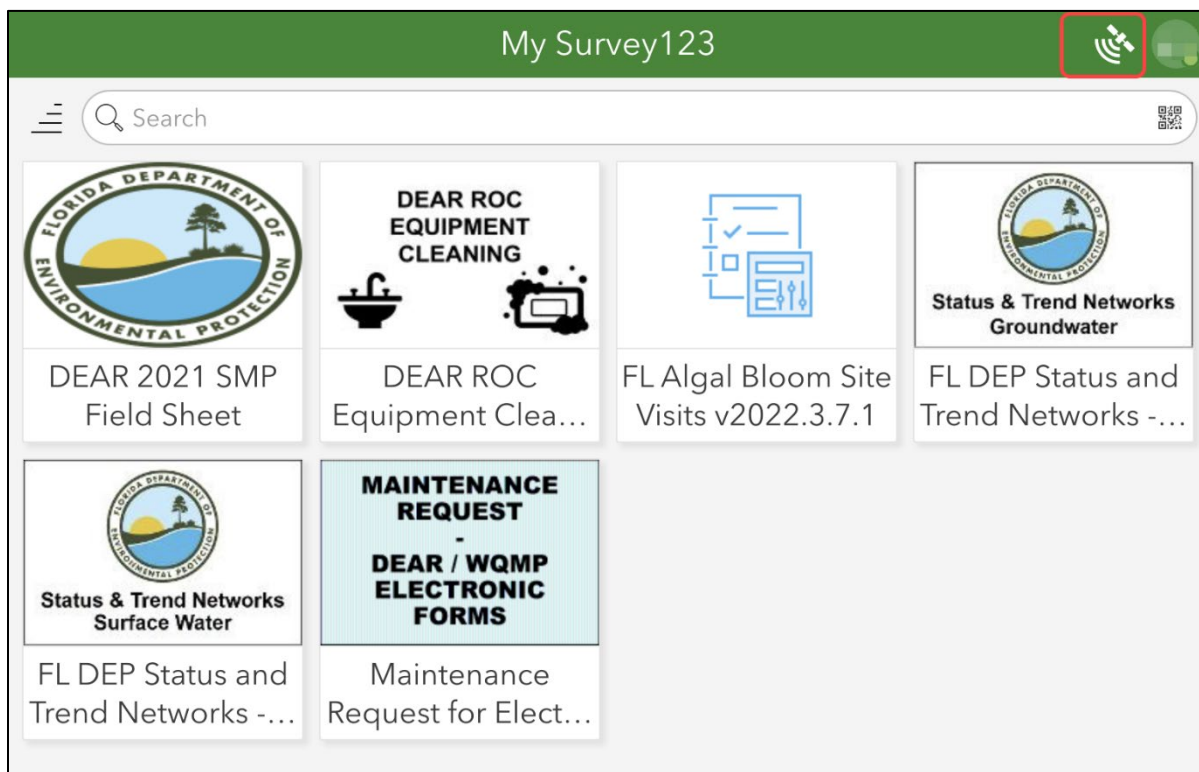


Figure 29. Screenshot of Survey123 Application home screen showing the Location Status button.

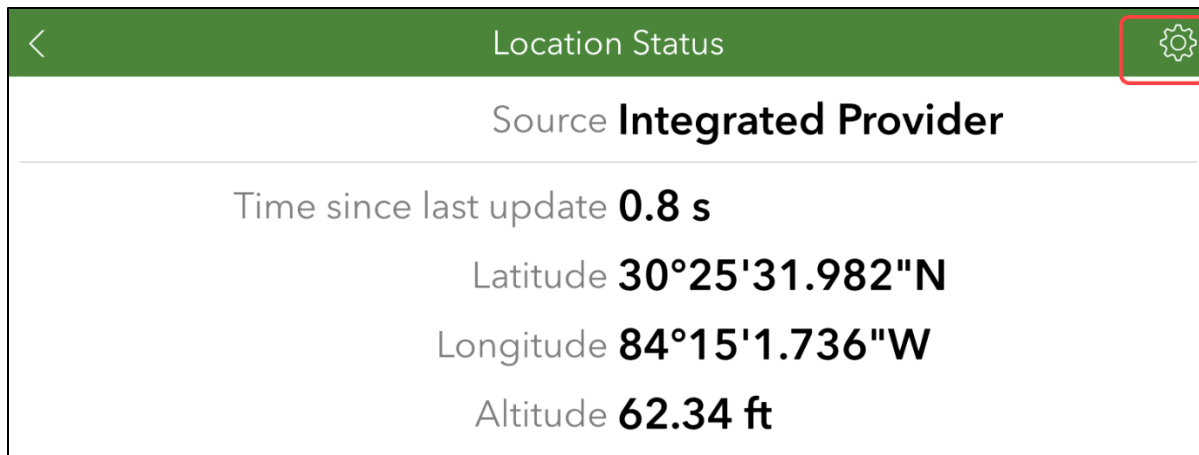


Figure 30. Screenshot of Survey123 Application Location Status screen showing the location settings button.

To set the Bad Elf 2500 GNSS unit as the location data provider, it must first be added to the list of available providers. Select the **Add location provider** button near the bottom of the Location menu (Figure 31), select **Bluetooth** as the connection type (Figure 32), and select the Bad Elf 2500 GNSS unit from the options available (Figure 33). Follow the on-screen prompts to adjust the settings for alerts about the location data source status and enter the height that the receiver will be held (1 meter or 3 feet are examples for typical estimates for receiver height). If the unit is not visible in the list of available Bluetooth devices, check the Bluetooth settings for the mobile device and the device status in the Bad Elf Flex application, to ensure that the unit is connected.

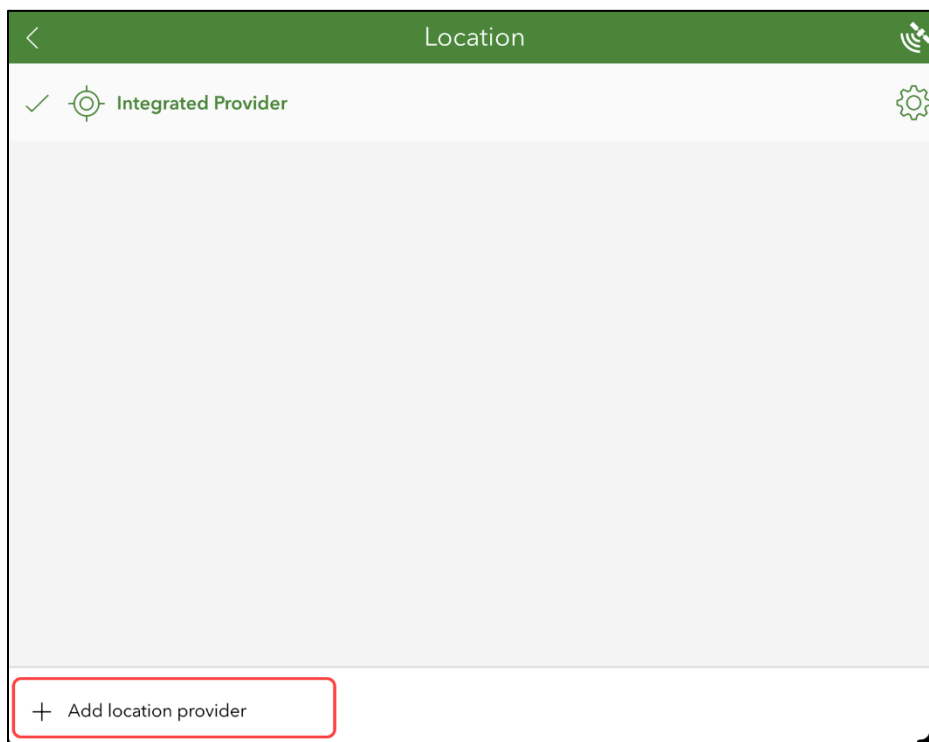


Figure 31. Screenshot of Survey123 Application location settings showing the Add provider button.

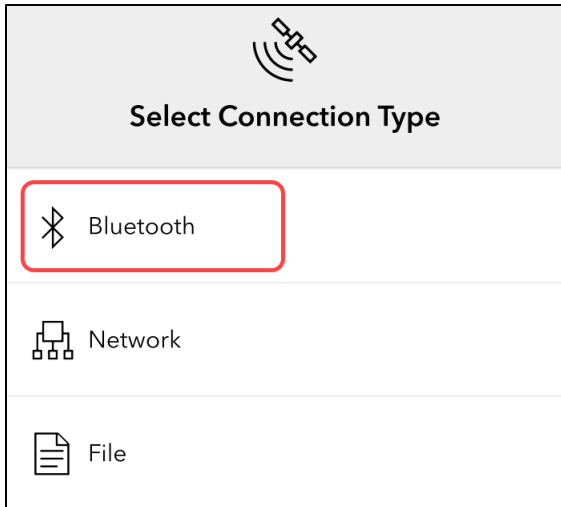


Figure 32. Screenshot of Survey123 Application showing Add provider connection type options.

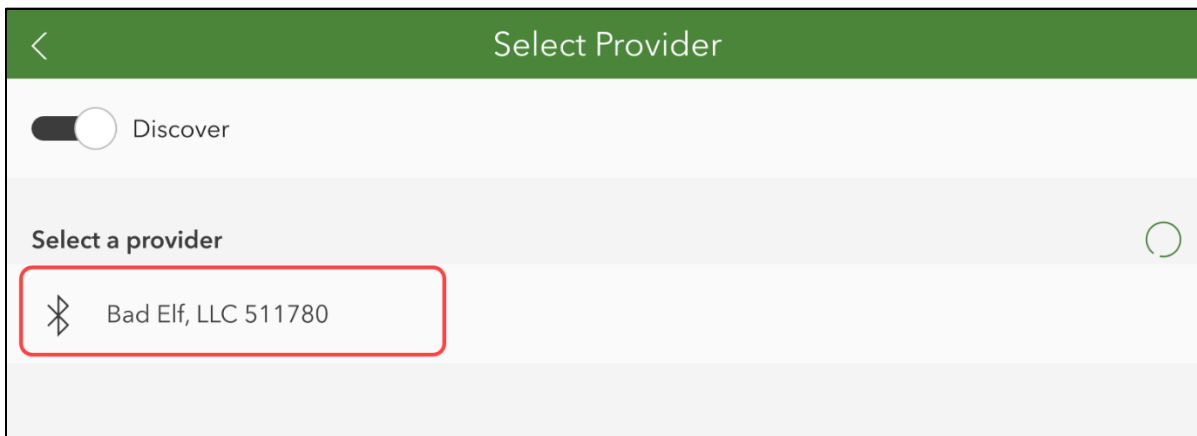


Figure 33. Screenshot of Survey123 Application showing Select Provider options.

Return to the Location menu and select the Bad Elf GNSS unit. A checkmark icon will appear next to the unit's name, indicating that has been set as the location data source (Figure 34). Return to the Location Status menu using the satellite icon in the upper-left corner to view the location data and associated metadata from the Bad Elf GNSS unit (Figure 35). The GNSS fix type, PDOP (position dilution of precision), and other metadata information can be viewed from this menu. (Note that the terminology used by the Survey123 application differs slightly from that used by the Bad Elf Flex application. A "differential-GPS" Mode value in Survey123 corresponds to an "SBAS" GNSS fix type in the Bad Elf Flex application. This is the required GNSS fix type for Status and Trend Network data collection.)

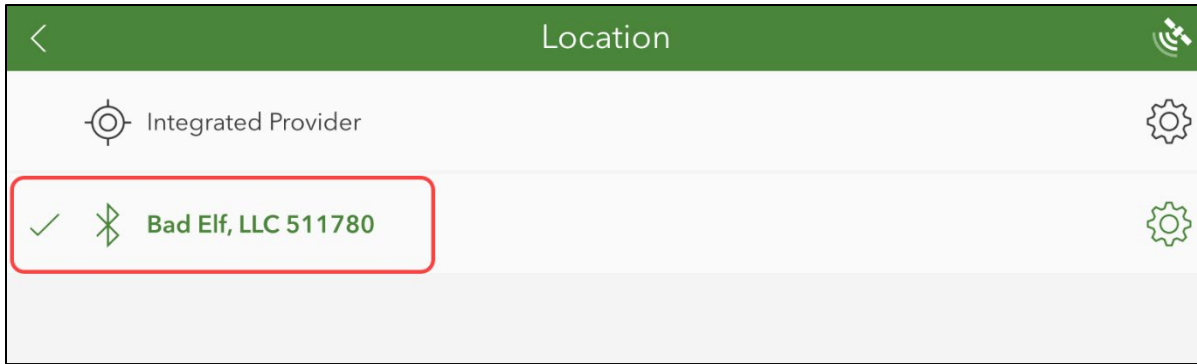


Figure 34. Screenshot of Survey123 Application showing selection of the Bad Elf GNSS unit from the Location settings menu.

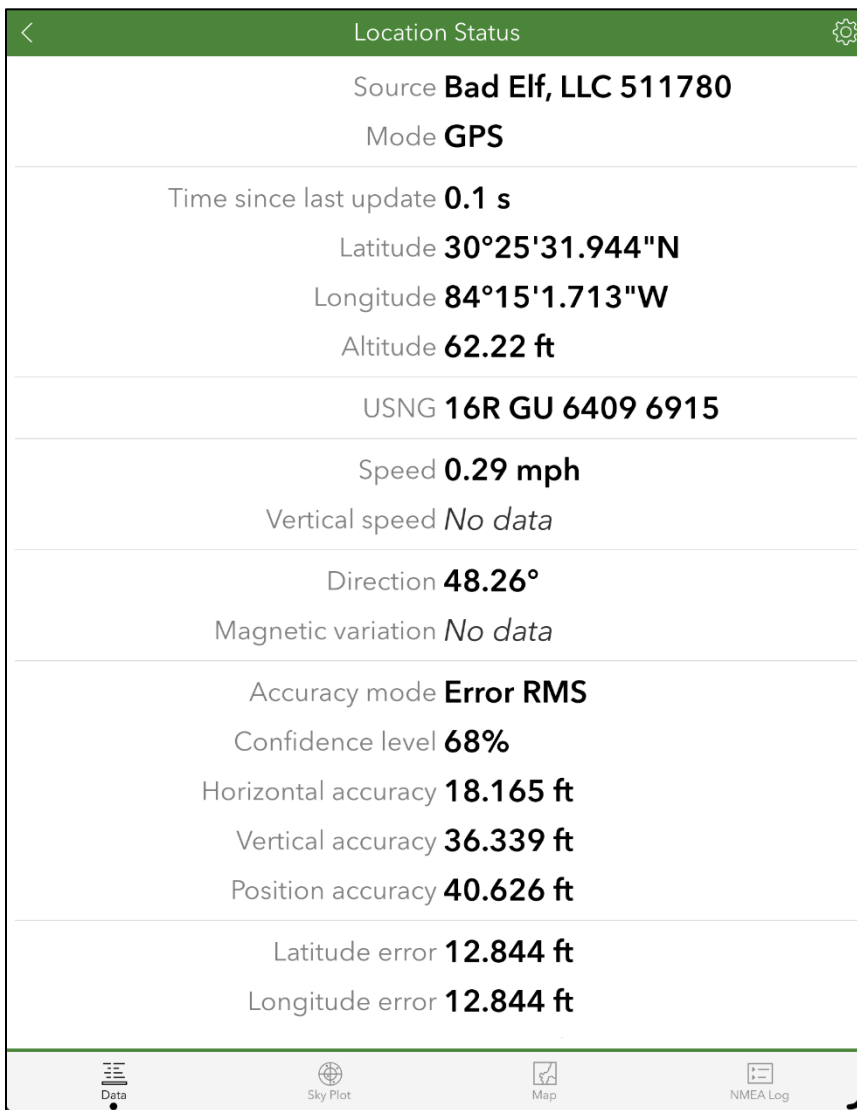


Figure 35. Screenshot of Survey123 Application showing Location Status screen with details about location data that are currently being transmitted by the Bad Elf GNSS unit.

Survey123 - Location Data Collection

Ensure that the GNSS unit is positioned where water quality data are being collected. The location data collected with the Survey123 application will reflect the location of the GNSS unit, not the location of the mobile device.

The FL DEP Status and Trend Networks - Surface Water form and FL DEP Status and Trend Networks – Groundwater form will prompt users with questions about location data collection after the station has been selected. To collect location data using the Bad Elf GNSS receiver, select "Yes" for Location Data Collected and follow the onscreen instructions (Figure 36).

1. **TAP** the circular location indicator icon to begin data collection.
2. **WAIT** for an initial set of latitude / longitude coordinates or map to appear.
3. **PRESS-AND-HOLD** the circular location icon for a few seconds to switch to position averaging mode. The number of positions averaged will be displayed below the map or below the location indicator icon.
4. **WAIT** until at least 30 positions have been averaged.
5. **TAP** the circular indicator icon again to stop location data collection.

After completing the location data collection, examine the on-screen summary of the data. If any quality assurance warnings or error messages appear, follow the associated instructions to address the concern. Examples of warnings include "External GNSS unit not connected", "SBAS GNSS fix not present during location data collection", and "Low data accuracy (PDOP > 6)". If the quality assurance issue cannot be resolved, the user will be required to enter comments describing the scenario encountered.

FL DEP Status and Trend Networks - Surface Water

✕

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▼ **Station Information**

Station Name: *

Please enter project information before completing this section.

Z6-CN-18001 ✕ ▼ ↻

▼ **Location Data**

Location Data Collected? *

Required for all STATUS sites. Required annually for TREND sites.

YES NO

Collect location data using external GNSS receiver.

- 1.) **TAP** the circular location indicator icon to begin data collection.
- 2.) **WAIT** for an initial set of lat/long coordinates or map to appear below.
- 3.) **PRESS-AND-HOLD** the circular location icon for a few seconds to switch to position averaging mode.
- 4.) **WAIT** until at least 30 positions have been averaged.
- 5.) **TAP** the circular location icon again to stop location data collection.

Location

30°26'N 84°15'W ± 4.7 m ✕

Map showing location with a blue pin and a red box around the text: Averaged 30 of 30 positions (29 seconds)

Figure 36. Screenshot of Status and Trend Networks Surface Water form in Survey123 application, showing instructions for location data collection, circular location indicator icon and information about number of averaged positions.

Troubleshooting

Low Battery

If the GNSS unit's battery charge becomes low, the unit's screen will display a warning message. If charging is not initiated, the unit will automatically shut down to avoid damaging the battery. Recharge the unit by connecting the supplied USB-C charging cable to any USB charging source. If a portable charging source is available, the unit may be powered on and used while it is charging. To protect the unit's battery, charging will be automatically disabled if the internal temperature falls outside the acceptable range of operation (-20°C to +55°C).

Dead Battery

If the unit's screen is blank and no indicator lights below the screen are on, the problem may be that the battery is completely depleted. Try letting the unit recharge by connecting the supplied USB-C charging cable to any USB charging source. A full charge may take up to 4 hours.

Resetting the Unit

A hard reset may be the solution if the unit becomes unresponsive. Hold the unit's power button for 15 seconds to perform a hard reset. If a hard reset does not work, contact the DEP Water Quality Monitoring Program's GNSS Coordinator.

Additional Information

For Information about this manual or for GNSS guidance, please contact the DEP Water Quality Monitoring Program's GNSS Coordinator:

Tom Biernacki

Florida Department of Environmental Protection

2600 Blair Stone Rd. MS 3560

Tallahassee, FL 32399-2600

Office Phone: (850) 245-8515

Thomas.Biernacki@FloridaDEP.gov

For additional information about using the Field Maps and Survey123 applications for Status and Trend Networks projects, please contact the DEP Watershed Monitoring Section's Data Analysis and Reporting Coordinator:

Stephanie Sunderman-Barnes

Florida Department of Environmental Protection

2600 Blair Stone Rd. MS 3560

Tallahassee, FL 32399-2600

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References

Bad Elf Flex Mini User Manual, Version 1.1, September 24, 2023: https://epo.bad-elf.com/webcontent/docs/manuals/Product-Manual-Bad_Elf_Flex_Mini-1.1_Sep2023.pdf

Glossary / Acronyms

Term	Definition
Ellipsoid	A 3D mathematical figure formed by rotating an ellipse around its minor axis. Earth's minor axis is the polar axis and the major is the equatorial.
Geodetic Datum	A scaling system used to calculate the Latitude/Longitude coordinate structure onto a chart.
GIS	Geographic Information Systems. A computerized database system designed to manage spatial data.
GLONASS	Globalnaya navigatsionnaya sputnikovaya sistema (GLObal NAVigation Satellite System).
GNSS	Global Navigation Satellite Systems.
GPS	Global Positioning System.
KML	Keyhole markup language. A notation format used for expressing and visualizing geographic information in Earth browser applications.
Latitude	Angular measure of 0° - 90° North and South from the equator. Latitude lines on a chart run from left to right.
Longitude	Angular measure of 0° - 180° East and West of the prime meridian (0°) at Greenwich, England. Longitude lines on a chart run up and down.
PDOP	Position Dilution Of Precision. A measure of the strength of the satellites' geometry. Better accuracies are obtained when using satellites that are a greater distance apart.
Real time correction	A correction that is applied to data at the same time it is collected. The correction is collected by a differential receiver.
Rover	The name given to a GNSS/GPS unit in the field.
Satellite Constellation	The arrangement of a set of satellites in space.
WGS-84	World Geodetic System (1984). The mathematical ellipsoid used by GNSS/GPS since January 1987.