



**WagNet**<sup>®</sup>  
Wireless • Agricultural • Network  
**MOBILE**



**REMOTE FARM MANAGEMENT**

# WagNet<sup>®</sup> Mobile for Android<sup>™</sup> User's Guide

*Version 1.0*

*October 20, 2013*



*Presented by AgSense, LLC  
Huron, SD*



*Developed by SajWorks, LLC  
Las Vegas, NV*



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Version	Release Date	Description
1.0	October 20, 2013	Initial release of WagNet Mobile for Android User's Guide. Covers up to WagNet Mobile V4.1.

### WagNet Mobile for Android User's Guide Revision History



# 1 Scope

This document describes the functionality and usage of WagNet Mobile for Android (up to Version 4.1) developed by SajWorks, LLC. It presents screenshots of the application and details all of the functions that users are able to perform.

## 2 Introduction

AgSense LLC, located in Huron, SD specializes in providing remote management solutions for agribusinesses. Customers can conveniently control and monitor their irrigation equipment using WagNet (**Wireless Agricultural Network**) developed by AgSense. Using WagNet, customers can remotely manage all of their irrigation equipment from their desktop or laptop computer. With the release of WagNet Mobile for Android, customers can now control and monitor their irrigation pivots from anywhere using their Android phone or tablet!

The latest version of WagNet Mobile (Version 4.1) provides AgSense customers with access to their Pivot Point, Field Commander, Precision Link, Aqua Trac, and Crop Link units and allows them to view current data, send and schedule commands, add notes, edit and send speed and endgun tables, edit the main configuration of Pivot Points, Field Commanders, and Precision Links, and view historical data for Aqua Tracs and Crop Links. The following sections describe these functions in detail with corresponding screenshots of the app interface. This version of WagNet Mobile requires Android version 2.3.3 or higher.

## 3 WagNet Mobile Features

The following subsections describe logging in to the app, navigating through the various views, and using the available features. The subsections are presented in the following order:

- Logging In
- At A Glance View
- List View
- Pivot View
  - Sending Commands, Speed & Endgun Tables, Main Configuration
- Precision Link View
  - Sending Commands, VRI & Endgun Tables, Auxiliary Tables, Sending T&L Commands, Main Configuration
- Aqua Trac View
  - Viewing Current Soil Data, Viewing Historical Soil Data
- Crop Link View



- Viewing Current Sensor Data, Soil Data, and Grain Bin Data, Viewing Historical Data

### 3.1 Logging In

Immediately upon launching the application, the login view is presented which prompts the user to login with a username and password using the “Login with Username” button or login to the demo account using the “Demo Account” button. The demo account is the same demo account that can be accessed on the WagNet website and is intended for use by potential customers who may not have a valid user account. If the user is an existing customer, then his/her existing username and password can be used to log in to the app. Figure 1 below shows the initial login view. A checkbox at the bottom of the screen will allow the user to be automatically logged in to the app when it’s launched if they have previously input valid login credentials. Leaving this box unchecked will require a user to input their username and password each time the app is used.



Figure 1: Login View

After a user inputs a username and password, they will be validated before presenting the next view. In the event that the login credentials are invalid, an alert will appear indicating that the login was invalid and the user will be prompted to input new credentials. Once a valid username and password are entered (or if the user simply chooses to view the demo account), the app will transition to the At A Glance View and begin downloading the user data.

## 3.2 At A Glance View

The At A Glance View is the first view that displays the data for all of the user's units. The data is presented in a scrolling table that is organized according to the groups that the user has set up. One cell in the table is dedicated to each group and inside that cell a small graphic is shown for each unit along with the name of the unit.

Pivot Points, Field Commanders, and Precision Links are denoted by the familiar round pivot graphic (or rectangular graphic in the case of a lateral unit) found on the WagNet website. The pivot graphic is color-coded according to the current status of the unit.

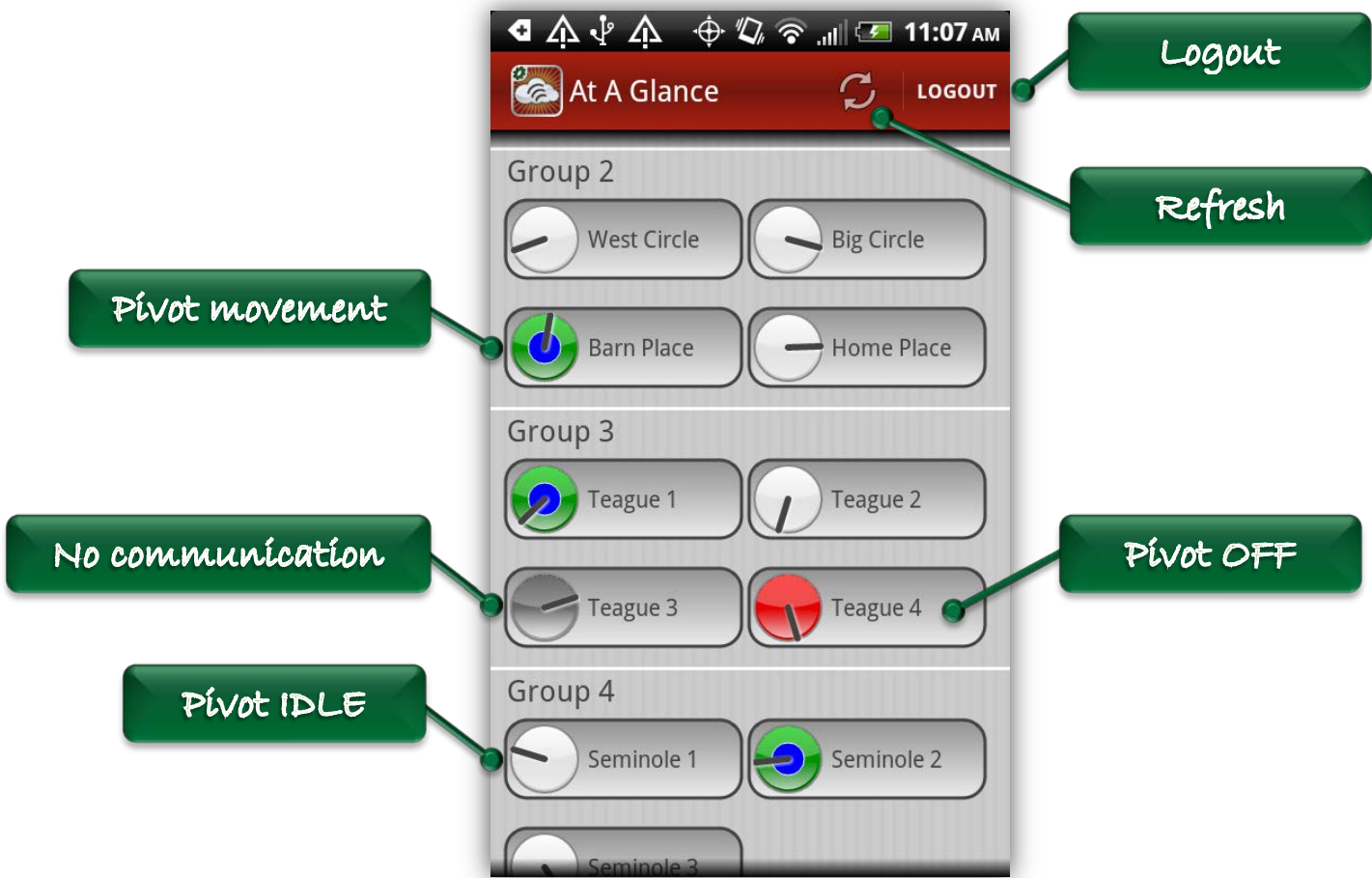
- **White** – Pivot Power On
- **Red** – Pivot Power Off
- **Green** – Pivot Movement
- **Gray** – No Communication

Aqua Tracs are denoted by a small soil probe graphic next to a red-green-blue gradient that represents the current soil moisture content. A colored arrow indicator is drawn to show the current soil moisture content relative to the FULL and REFILL values for the unit. The same color is also displayed at the top of the probe graphic.

Crop Links can be denoted in several ways in the At A Glance View depending on what devices are attached to them. If a Crop Link has an attached soil moisture probe, then it will be denoted by the same small soil probe graphic used for Aqua Tracs. If the Crop Link has a grain bin board attached, it will be denoted by a small grain bin icon. If the Crop Link has any other combination of sensors attached besides a soil probe or a grain bin board, it will simply be denoted by the letters "CL".

Figure 2 and Figure 3 below show examples of the different types of units as they're displayed in the At A Glance View.





**Figure 2: At A Glance View – Pivots**

Figure 2 shows examples of the pivot graphics that are used to represent the states of Pivot Points, Field Commanders, and Precision Links. In this example, the unit Barn Place is currently moving and measuring positive water pressure. The unit Seminole 1 is IDLE. The unit Teague 4 is powered OFF, and the unit Teague 3 is currently out of communication.





**Figure 3: At A Glance View - Aqua Tracs & Crop Links**

Figure 3 shows examples of Aqua Tracs and Crop Links displayed in the At A Glance View. The unit V3 Prototype 47320 is an Aqua Trac, so it is denoted by the soil probe graphic with an indicator arrow along the left side of the image. The current soil moisture content being measured by that probe is within the FULL area so the indicator arrow is blue and located at the top of the image. Notice that the top of the probe is colored blue as well to match the indicator arrow.

The unit 35112 (Front Wrap) is a Crop Link with a soil moisture probe attached and therefore is denoted by the soil probe graphic. That unit is currently measuring a soil moisture that is somewhere in between the defined FULL and REFILL values so the indicator arrow and the top of the probe are both colored green. The unit 32193 is a Crop Link with a grain bin board attached which is why it's displayed with a grain bin icon. Unit 50006 has neither a soil probe nor a grain bin board attached, but has some other combination of sensors, therefore it's simply displayed with the letters "CL".



The Refresh button in the upper right reloads the data from WagNet and the Logout button next to it logs the user out. Using this button to log out will erase any saved username and password from memory and the user will have to provide login credentials again the next time the app is launched.

When the user selects a group from the table, the app transitions to the List View and gives additional information about all of the units in the selected group.

### 3.3 List View

The List View displays a table of all the units in a selected group. For Pivot Points, Field Commanders, and Precision Links, each cell in the table shows information about a single unit including the following:

- The name of the unit
- The time at which the last reading was taken
- The current angle of the pivot (if the unit is a lateral, then this will show N/A)
- The current direction of motion
  - OFF – The unit is powered off
  - IDLE – The unit is powered on but not moving
  - ON – The unit is powered on but the direction data is unavailable
  - FWD – The pivot is moving in the forward direction
  - REV – The pivot is moving in the reverse direction
- The current speed expressed as a percentage of the full speed for Pivot Point and Field Commanders and expressed as inches per minute for Precision Links
- The current water pressure in pounds per square inch (psi) (if the data is unavailable, then this will show N/A)

If a piece of data hasn't been downloaded yet, or if there is no communication with the unit, then the text will be shown in gray.

In addition, each cell shows the color-coded pivot graphic for the unit with the blue water pressure indicator in the middle if there is positive water pressure. If there is a stop angle set for the pivot, it will be shown as a solid white line on the pivot graphic. If there is no communication with a unit, the data from the last reading will be displayed, but both the pivot graphic and all of the text will be shown in gray to indicate that the data is not current.

For Aqua Tracs, each cell in the table shows information about a single unit including the following:

- The name of the unit
- The time at which the last reading was taken





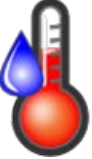

- The FULL value that's been set for the unit
- The REFILL value that's been set for the unit
- The current SUM value for the unit

A vertical red-green-blue gradient is shown in the cell that indicates the current SUM value as it relates to the FULL and REFILL values. The colored border around the List View graphic matches the indicator color of the current SUM value for a quick visual reference of the current soil moisture status.

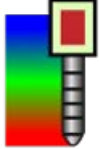




For Crop Links, each cell in the table shows information about a single unit including the following:

- The name of the unit
- The time at which the last reading was taken
- The devices that are attached to the unit
- The states of any of the relays that are enabled

For Crop Links, the configuration of the List View cell gives a basic description of everything that's connected to the unit. If the unit has any analog or digital sensors, a soil moisture probe, or a grain bin board attached, then an icon will appear for each device. If one or both of the relays for the unit is enabled, then the state of each enabled relay will be listed below the icons. The border around the List View graphic for Crop Links will be green if the unit is powered on or red if the unit is powered off. The list below shows each of the icons that represent devices that may be attached to a Crop Link.

-  Pressure Transducer
-  Temperature Sensor
-  Relative Humidity Sensor
-  Wind Direction Sensor



-  Soil Moisture Probe
-  Digital Flow Meter
-  Wind Speed Sensor
-  Tipping Bucket
-  Grain Bin

As in the At A Glance View, there is a Refresh button in the upper right corner of the List View. This button has the same function it has in the At A Glance View. The app icon at the top of the screen can be used to navigate back to the previous view from anywhere in the app. Selecting a cell from the table will prompt the app to download the data for the selected unit and the loading view will appear. Once the data is successfully downloaded, the app will transition to the appropriate view depending on which type of unit was selected.

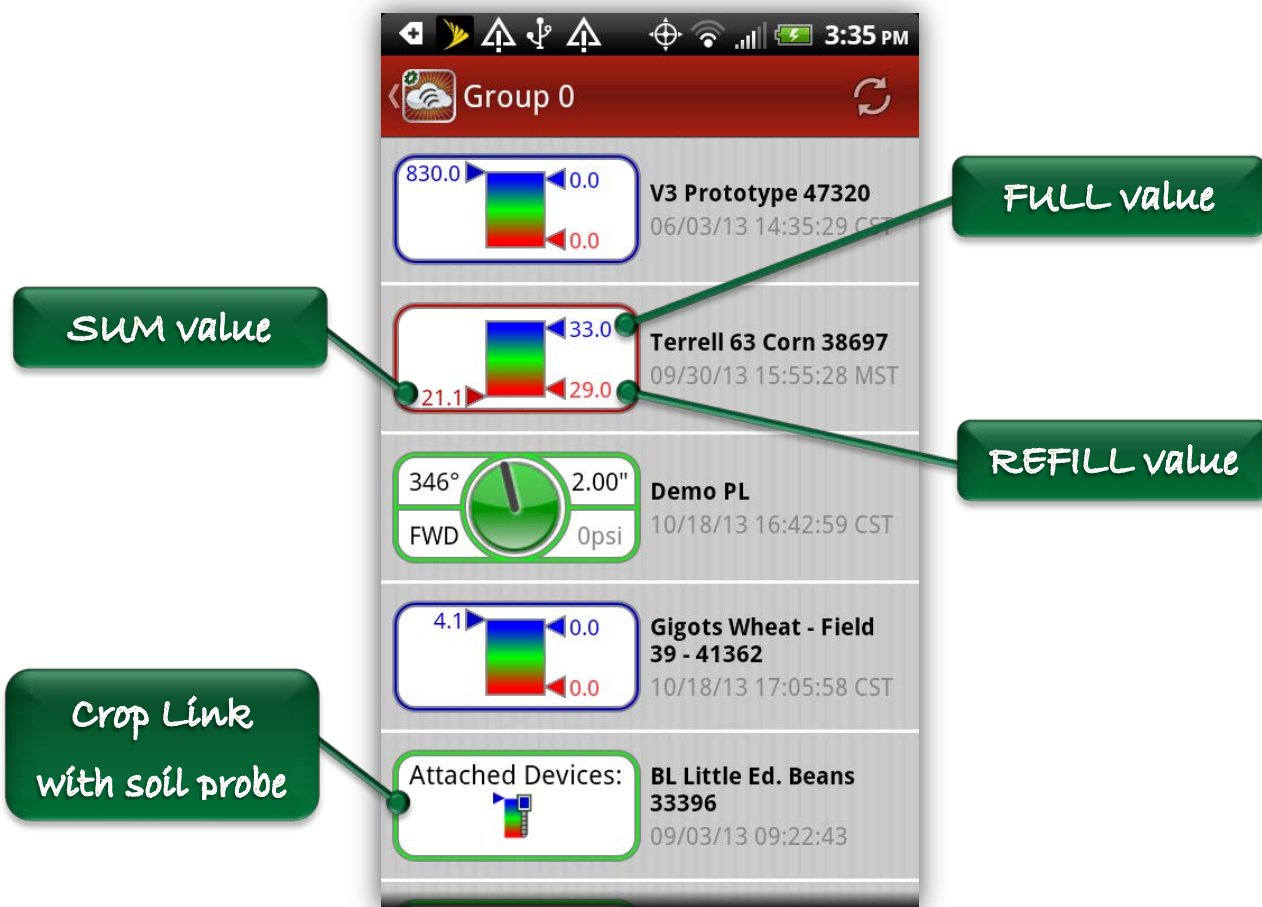




**Figure 4: List View – Pivots**

Figure 4 shows examples of pivot information as it's displayed in the List View. The unit Teague 1 is currently on and moving in the Reverse direction at a speed of 30% and measuring a water pressure of 4 psi. Its current angle is 226°. The last reading from Teague 1 was taken at 06/27/13 12:42:17 CST. The unit Teague 2 is currently IDLE at an angle of 197° and measuring 0 psi for the water pressure. The unit Teague 3 has not communicated recent data and therefore all of its data values are shown in gray to indicate that they may be stale. The unit Teague 4 is currently powered OFF and the pivot is at 163°. In the List View, Pivot Points and Field Commanders display the duty cycle for the speed of the pivot, whereas Precision Links and Field Commanders attached to T&L pivots display the speed measured in inches per minute.





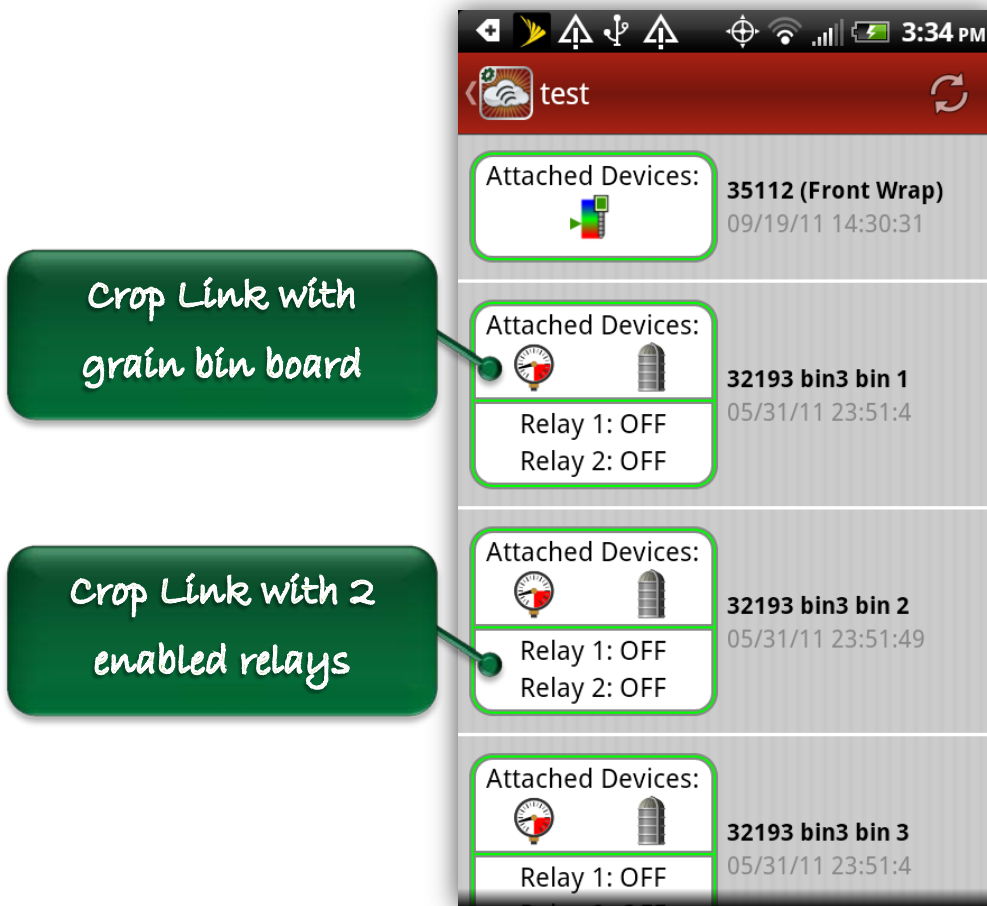
**Figure 5: List View - Aqua Tracs & Crop Links**

Figure 5 shows examples of an Aqua Trac and a Crop Link displayed in the List View. The unit Terrell 63 Corn 38697 is an Aqua Trac that has values of 33.0 and 29.0 set for the FULL and REFILL. That unit shows a red-green-blue gradient labeled along the right side with the FULL value at the top next to a blue indicator arrow and the REFILL value labeled at the bottom next to a red indicator arrow. The current SUM value is labeled along the left side of the gradient next to an indicator arrow that is colored based on the SUM value as it compares to the FULL and REFILL values. Since the current SUM value is 21.1, which is lower than the REFILL value, the indicator is dark red and is positioned below the REFILL indicator. The outer border of the List View graphic for Aqua Tracs is colored to match the SUM value as well.

The Crop Link in this example, BL Little Ed. Beans 33396, has a soil moisture probe attached and nothing else. The soil probe icon is used instead of the red-green-blue gradient for Crop Links in the List View because a Crop Link may have other sensors attached besides a soil probe all of which would be indicated by additional



icons. Some examples of other sensors attached to a Crop Link are shown in Figure 7 below.



**Figure 6: List View - Crop Links**

Figure 6 shows several more examples of Crop Links displayed in the List View. The unit 35112 (Front Wrap) is a Crop Link with a soil moisture probe attached and nothing else. The unit 32193 is displayed separately for each grain bin board that's attached just as it is on the website. That unit also has a pressure sensor attached and both of the relays are enabled and currently in the OFF state. All of the Crop Links in this example are currently powered ON due to the fact that the outer borders are green.





**Figure 7: List View - Crop Link Sensors**

Figure 7 shows some examples of Crop Links that have other sensors besides soil probes and grain bin boards attached. The AgSense Weather unit has five attached devices: a relative humidity sensor, a wind direction sensor, a temperature sensor, a wind speed sensor, and a tipping bucket. It doesn't have either of the relays enabled, so the relay states aren't listed. The 0-10v VFD Pump unit has a pressure sensor and a flow meter attached and both of the relays are enabled and in the OFF position. The Flow Demo unit just has a flow meter attached. As indicated by the outer border color, the AgSense Weather unit and the 0-10v VFD Pump unit are currently powered ON, whereas the Flow Demo unit is currently powered OFF.

### 3.4 Pivot View

The Pivot View is a tabbed view with four tabs across the top of the view. These four tabs are Pivot Info, Commands, Tables, and Main Configuration. By default, the Pivot Info tab is always selected initially. A user can navigate back and forth through any of these four tabs to perform functions or view data for the unit. At any time, the app icon at the top of the view can be used to go back to the List





View and select another unit. The following sections describe the four tabbed views and the functions that can be performed in each one.

### 3.4.1 Pivot Info View

The Pivot Info View is always selected by default as the first view that the user sees immediately after selecting a specific Pivot Point or Field Commander from the List View. At the top of the view there is a small map that shows the pivot graphic drawn on top of it with the pivot centered on the latitude and longitude coordinates that are saved for the unit. In addition to being color-coded according to the current status of the pivot, the graphic also has the current endgun table drawn as a blue line (or lines) around the perimeter of the pivot. If there's a stop angle set, it will be drawn on the pivot graphic as a solid white line. In the case of a lateral unit, the rectangular field will be drawn on the map according to the four coordinates defined for the corners of the field.

To the right of the map is a list of the current data for the unit including the angle of the pivot, the current direction of motion, the speed of the unit, the water pressure, and the current status of the endgun. At the bottom of the view is a set of three buttons that allow the user to see the last five commands sent to the unit, any timed commands that are scheduled, or any notes that have been recorded for the unit. By using the Add Note button, a user can type his or her own note and add it to the unit.

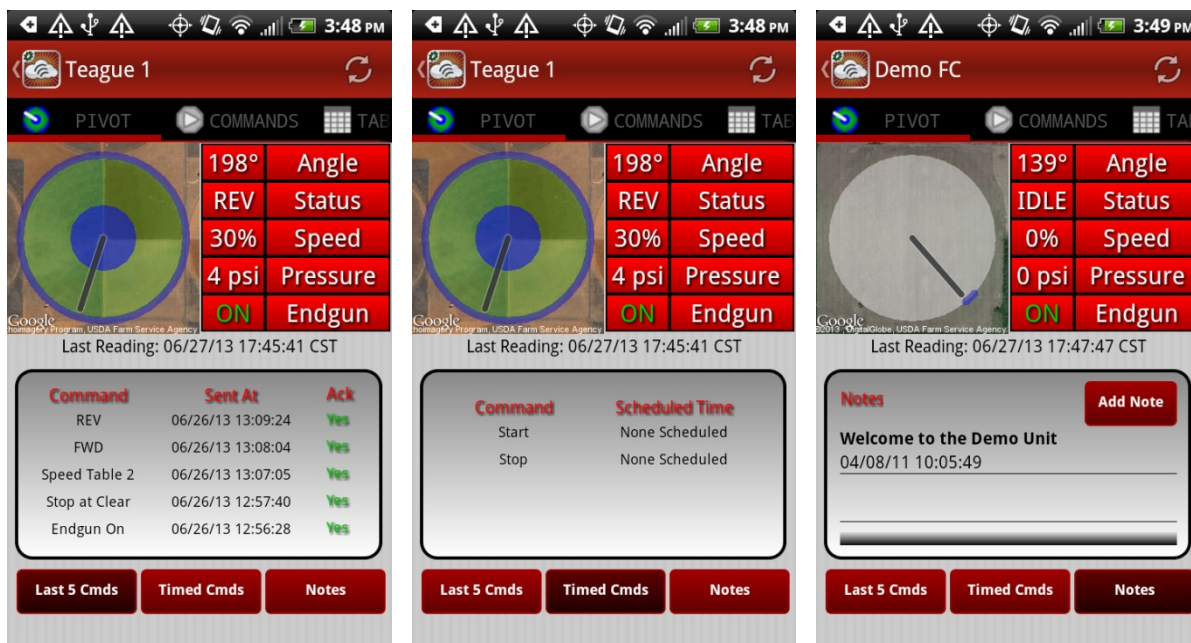


Figure 8: Pivot View - Pivot Info Tab



Figure 8 shows three examples of the Pivot Info View: one showing the last five commands for the unit (Last 5 Cmds), one showing the timed commands (Timed Cmds) and one showing the notes that are saved for the unit (Notes).

### 3.4.2 Sending Commands

By selecting the Commands tab of the Pivot View, a user can send new commands, schedule commands, and view or clear previously scheduled commands. The Commands View is divided into four sections for the different types of commands that can be sent. These are "Start", "Change Direction", "Stop", and "Stop at Angle". Each section contains one or more selectable cells that allow the user to configure the details of the command.

At the top of the screen the names of the active speed and endgun tables are listed so the user will know what tables are currently running or will be running if a Start command is sent. If the unit doesn't have speed or endgun control, then "None" will be listed for the corresponding table name.

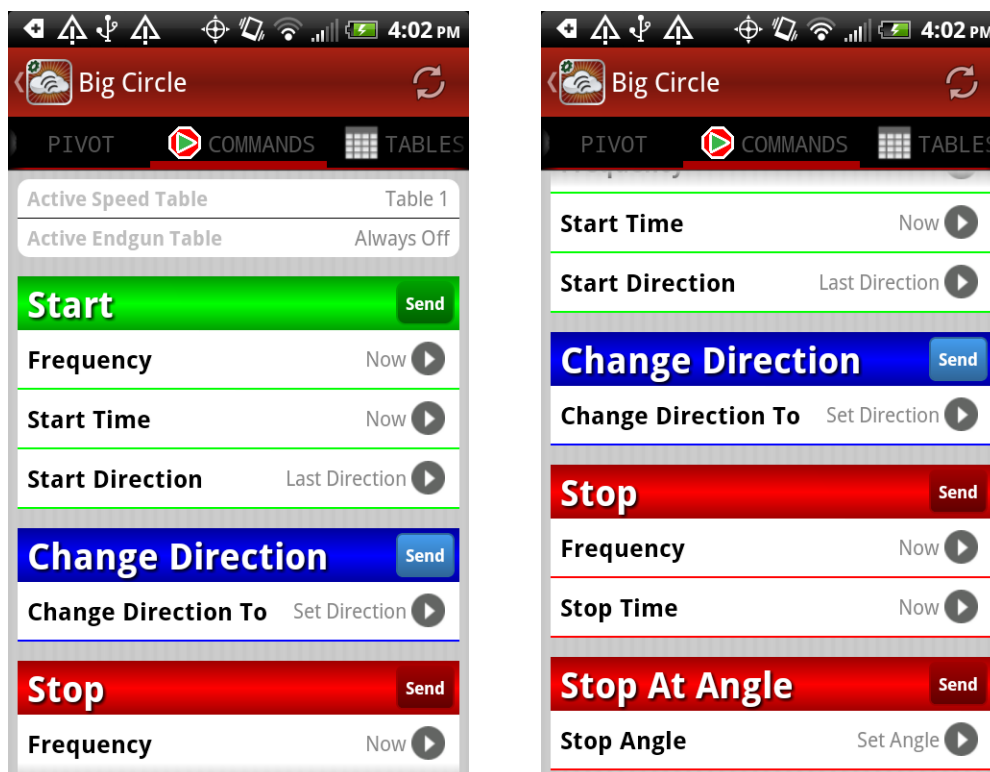


Figure 9: Pivot View - Commands Tab

Figure 9 illustrates the sections of the Commands tab on the Pivot View. The commands that can be sent to a unit are divided into four basic categories: START, CHANGE DIRECTION, STOP, and STOP AT ANGLE. Depending on the user's permissions and the type of service for the unit, some of the commands may not be



available. Also, only the types of commands that can be sent to the unit according to its current power status are available. The following subsections describe how to send and clear specific commands.

### 3.4.2.1 START and CHANGE DIRECTION Commands

This section describes how to send a START or CHANGE DIRECTION command. Each one of these basic commands can be configured by defining the appropriate parameters using the given selections. For example, in order to send a Start command, the user must select the frequency and the time for the command. Available frequencies are Start Now, Start Once, and Start Always. The Start Now command will command the unit to start immediately. The Start Once command will schedule a single Start command for some date and time in the future. The Start Always command will schedule a daily, recurring time at which to send a Start command to the unit. In the event that there is already a start command scheduled for the unit, the scheduled start time will appear in the Start Time cell and there will be a green Clear button that is available if the user chooses to clear the scheduled command.

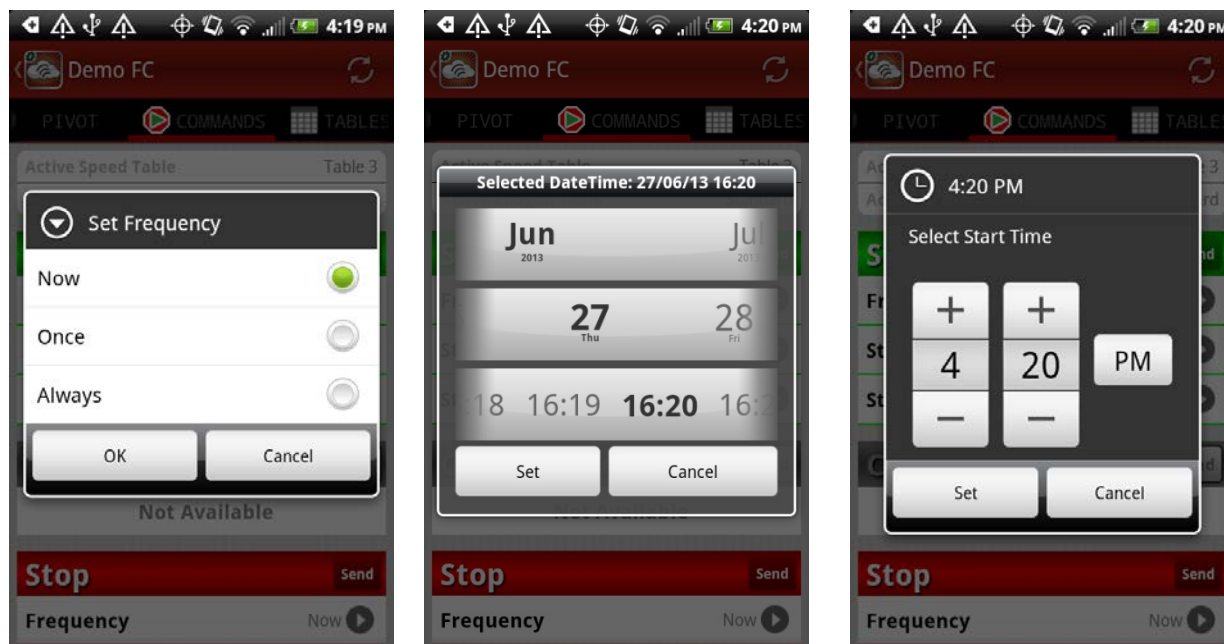


Figure 10: Start Frequency Options

Figure 10 shows the three options that are available for the start frequency. Selecting the Frequency cell will bring up this list of options. If the frequency is set to “Now”, then the user doesn’t need to input a time for the command and the start time for the command will automatically be set to “Now”. If the user sets the frequency to “Once”, then the start date and time for the command can be set using the datetime picker shown above. If the frequency is set to “Always”, then



the time for the command can be set using the time picker shown above. If the pivot is already in motion, then a Start Now command is not available and “Once” or “Always” are the only available selections for the frequency.

Depending on the type of service for the unit, the direction may be selectable for a Start command. Setting the value in the Start Direction cell to “Forward” or “Reverse” will start the pivot in that direction, and selecting Last Direction will start the pivot in its previous direction of motion. Selecting “Forward” or “Reverse” is only available for the Start Now command, so if one of these directions is selected, the frequency and start time will automatically be set to “Now”. Conversely, if the user sets the start frequency to “Once” or “Always”, the start direction will automatically be set to “Last Direction”.



**Figure 11: Unavailable Commands**

The CHANGE DIRECTION command can change the direction of a unit that is currently in motion by setting the value in the Change Direction To cell to “Forward” or “Reverse”. This command is only available if the pivot is in motion and the service for the unit supports it. None of the commands are available if the user is a



shared user. If any of the commands are unavailable due to the current power state of the unit or the permissions of the user, those commands will be grayed out as shown in Figure 11 above.

Pressing the green Send button for the START command or the blue Send button for the CHANGE DIRECTION command brings up an alert with the summary of the command that is about to be sent and requires the user to confirm the intent to actually send the command. Figure 12 shows an example of the confirmation alert for a Start Once command. After a user confirms the command, the command is sent to the unit. When a response is received from WagNet, an alert will appear to tell the user whether or not the command went through successfully.

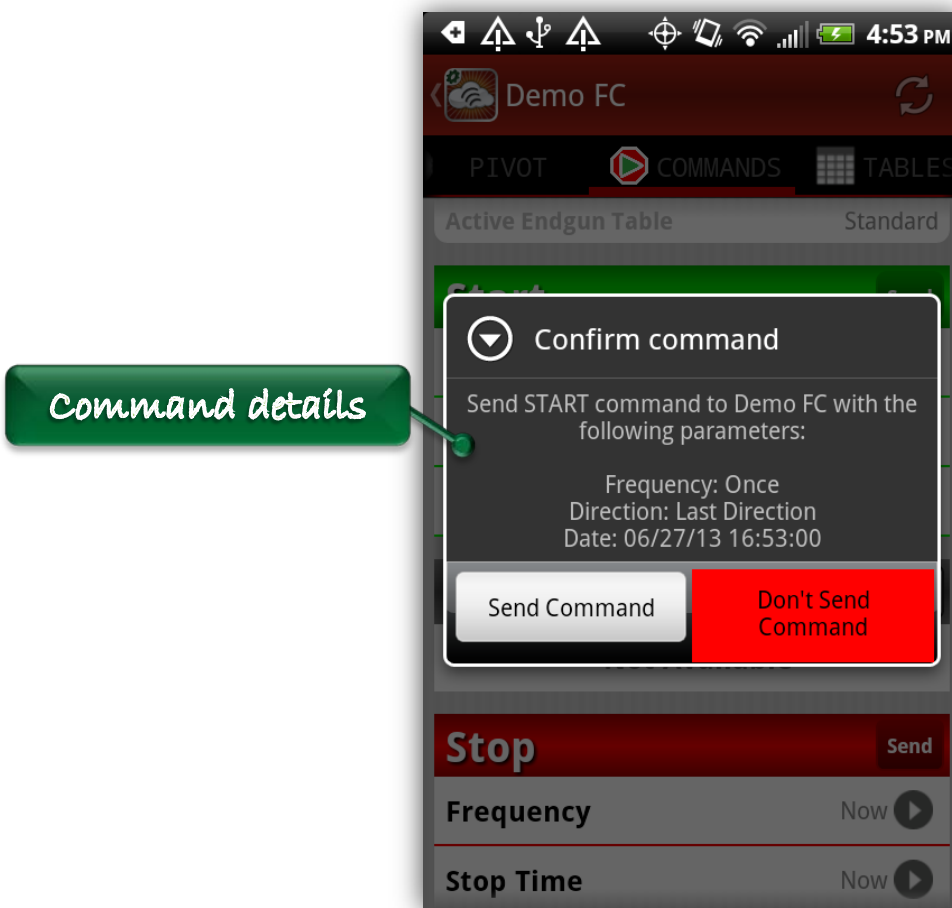


Figure 12: Start Command Confirmation Dialog

### 3.4.2.2 STOP and STOP AT ANGLE Commands

This section describes how to send a STOP or STOP AT ANGLE command. Each one of these basic commands can be configured by defining the appropriate parameters using the given selections. For example, the STOP command has the same three



frequency options as the START command: "Now", "Once", and "Always". Selecting these different options and choosing the desired STOP times works the same way as it does for the START commands. Stop Now will send a command to stop the pivot immediately. Stop Once will schedule a Stop command to be sent the unit at the specified date and time in the future. Stop Always will schedule a daily, recurring time at which to send a STOP command to the unit. If the pivot is not in motion, then the Stop Now command will be unavailable. In the event that there is already a Stop command scheduled for the unit, the scheduled stop time will be shown in the Stop Time cell and there will be a red Clear button that is available if the user chooses to clear the scheduled command as shown in Figure 13 below.

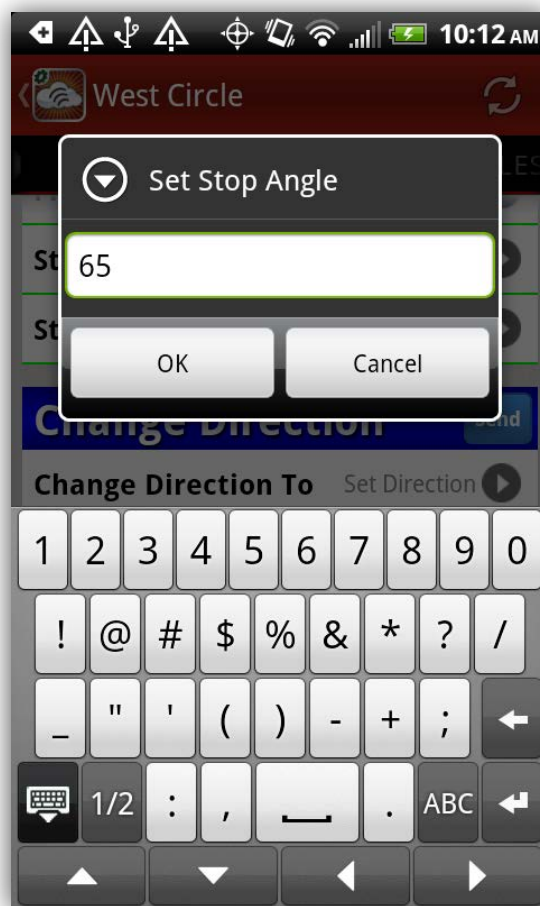


**Figure 13: Stop Command Scheduled**

The STOP AT ANGLE command defines an angle at which to stop the pivot. By selecting the Stop Angle cell, a user can input an angle between 0° and 359° as shown in Figure 14. The STOP AT ANGLE command will only be available if the pivot is currently in motion and the service for the unit supports it. If a stop angle has already been set for the pivot, then the angle will be shown in the Stop Angle cell and there will be a red Clear button available if the user chooses to clear the



angle. If the user is a shared user, then neither the STOP nor STOP AT ANGLE commands will be available.



**Figure 14: Stop Angle Input**

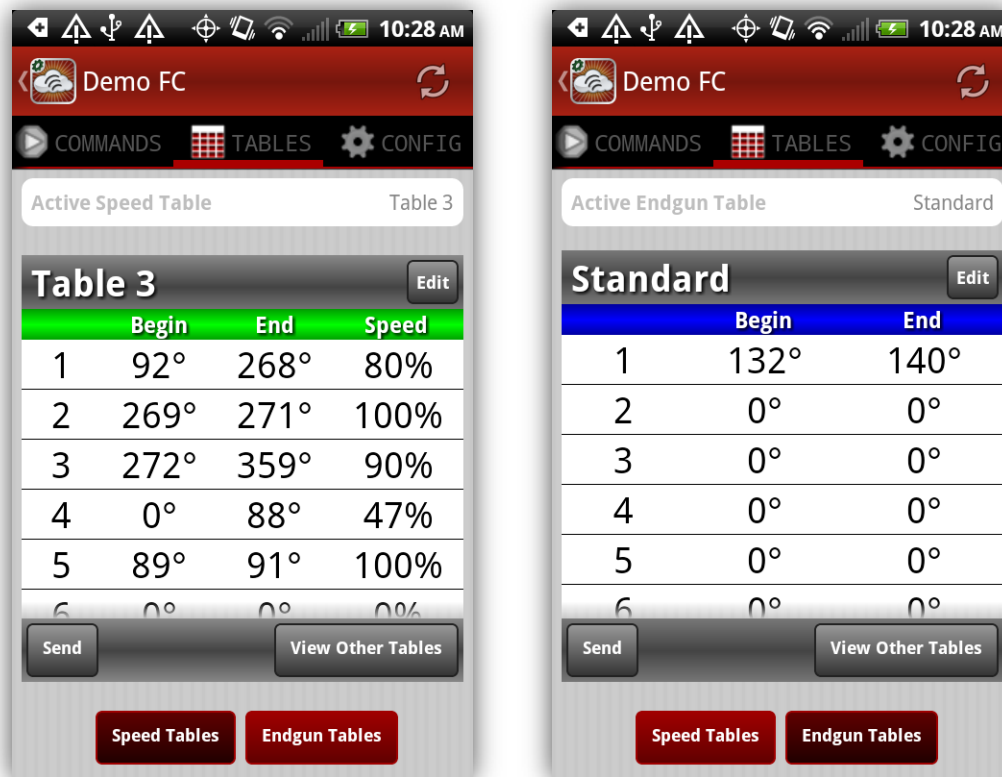
Pressing the red Send button for either the STOP command or the STOP AT ANGLE command will bring up an alert with the details of the command similar to the alert shown in Figure 12. The alert will prompt the user to confirm the intent to send the chosen command. Once the confirmation is given, the command will be sent to the unit. Upon receiving a response to the command from WagNet, an alert will appear to tell the user whether or not the command went through successfully.

### **3.4.3 Speed & Endgun Tables**

By selecting the Tables tab of the Pivot View, a user can view, edit, or send speed and endgun tables. The Tables View allows the user to switch between speed tables and endgun tables using two buttons at the bottom of the view. At the top of each section, the name of the active speed table or active endgun table is listed.



By default, the active speed or endgun table is initially displayed, but the user can edit the table or view other tables using the available features.



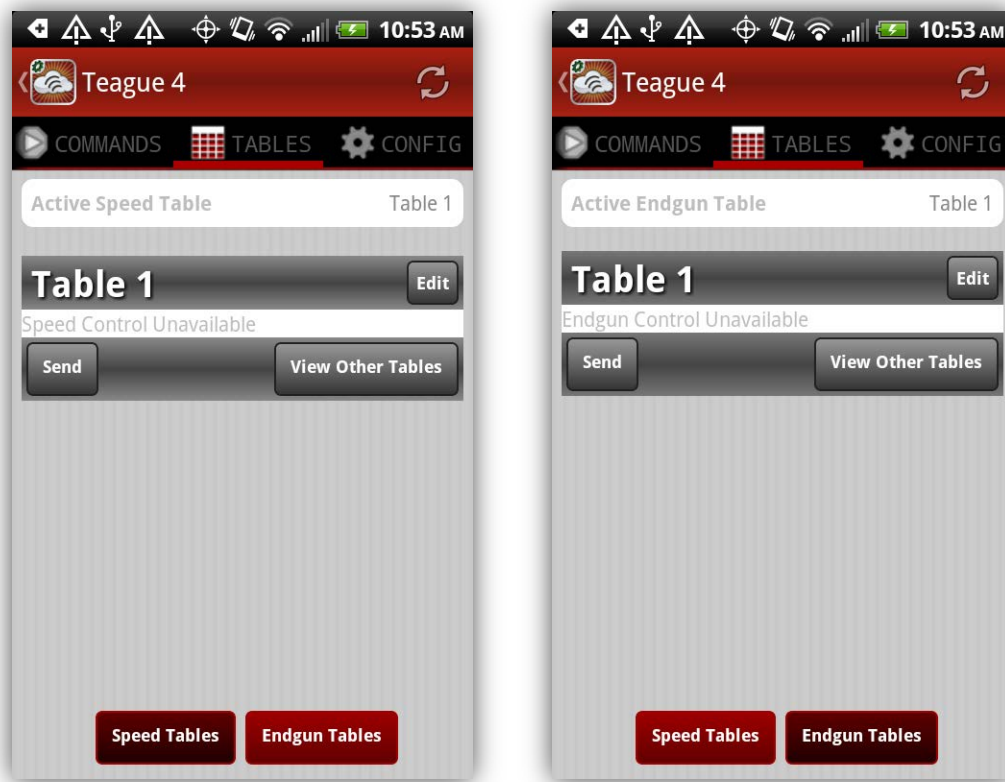
**Figure 15: Pivot View - Tables Tab**

Figure 15 illustrates each of the table types on the Tables View. Each of the two sections shows one table at a time and includes an Edit button, a Send button, and a View Other Tables button. The name of the table that's being viewed is shown in the black title bar. The Speed Table section has a heading with a green background and three columns of data: Begin, End, and Speed. The Endgun Table section has a heading with a blue background and two columns of data: Begin and End. Depending on the type of service for the unit, speed and/or endgun control may be unavailable. If either type of control is unavailable, then instead of displaying a table, this view will simply display a label indicating the control is unavailable as shown in Figure 16 below.

If the user is a shared user, then the Send and Edit buttons for both speed and endgun tables will be unavailable since a shared user does not have permission to send or edit tables. Both of the View Other Tables buttons will still be available, however, since a shared user can still view any tables that have been defined for the unit. The following subsections describe how to view, send, and edit tables.







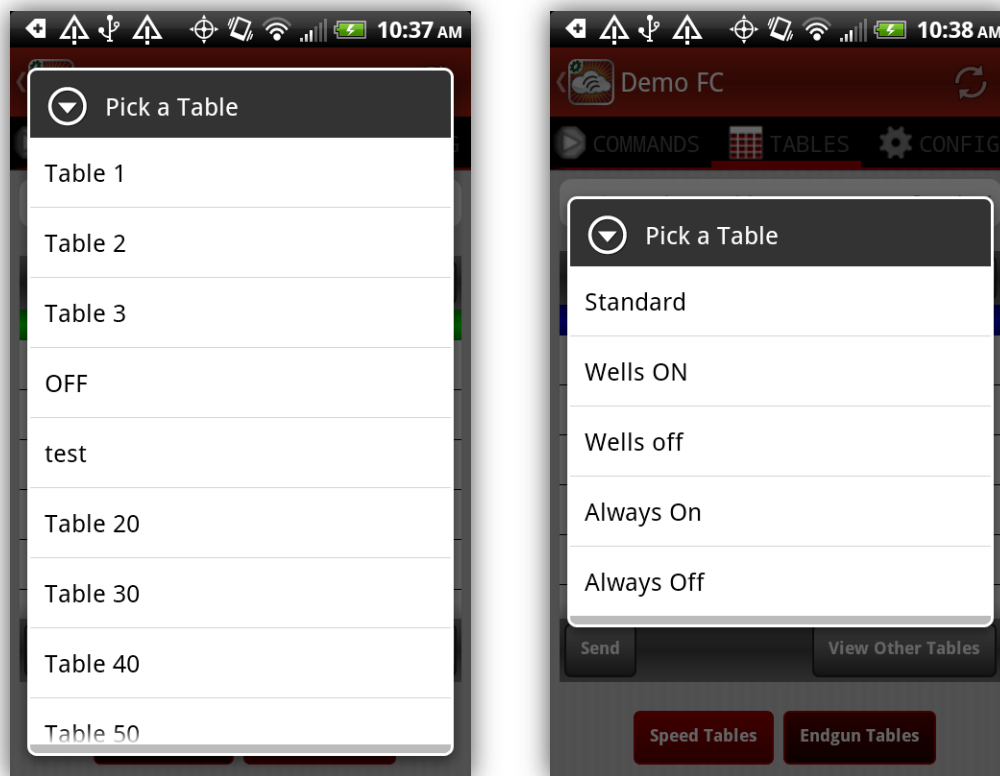
**Figure 16: Speed and Endgun Control Unavailable**

### 3.4.3.1 Viewing & Sending Tables

A user can view and send any previously defined speed or endgun table directly from the Tables tab. The process of editing a table is discussed later in Section 3.4.3.2. Initially, the active speed and endgun tables are the tables that are displayed. In order to look at the other tables that are defined for the unit, the user can press the View Other Tables button in either the Speed Table or Endgun Table section. This will bring up an alert for the user to choose the table to view. Both user-defined and predefined tables will appear in these alerts. For example, there is a predefined speed table titled OFF that simply has all of the begin, end, and speed values set to zero. There are two predefined endgun tables: Always ON and Always OFF. The Always ON endgun table simply sets the values in the first row of the table to begin = 0° and end = 359° so that the endgun will be on throughout the entire revolution of the pivot. The Always OFF endgun table has all zero values so that the endgun will always be off.

Selecting a table from the alert will display the selected table on the screen. The name of the selected table will appear in the black title bar. Figure 17 below shows examples of the speed table alert and the endgun table alert.





**Figure 17: Speed and Endgun Table Alerts**

In order to send one of the defined speed or endgun tables to the unit, the user can simply press the Send button after the desired table has been selected from the picker. This will bring up an alert which requires the user to confirm the intent to send the chosen table to the unit. Once the user confirms the intent to send the table, it will be sent to the unit. Upon receiving a response from WagNet, an alert will be displayed telling the user whether or not the table was sent to the unit successfully.

### 3.4.3.2 Editing Tables

In order to edit a table, the user can select the desired table and then press the Edit button. If the user doesn't have sufficient permission to edit tables or if the table is one of the predefined tables (OFF, Always ON, Always OFF), then an alert will appear after pressing the Edit button that explains why the user can't edit the table. However, for any speed or endgun table that can be edited, pressing the Edit button will make all the rows in the table selectable. Selecting any of the table rows will bring up an alert with fields for each value in the row where the user can input the desired values. The name of the table will also be selectable allowing the user to input a new name for the table.



During the table editing, there are checks in place to ensure that the values entered into the table are valid. For example, begin and end angles must be between 0° and 359°, speed values must be between 0% and 100%, and each end angle must be larger than the begin angle in that row. Figure 18 below shows the dialog that appears after a row is selected for editing. Notice that a message will appear if necessary to ensure that the begin angle is less than the end angle. Since the maximum speed is 100%, if the user inputs any value larger than that, it will be automatically reduced to 100. Figure 18 shows an example of editing a speed table row, but endgun table rows can be edited in the same manner with the obvious exception that there is no speed value in an endgun table.



**Figure 18: Editing a Table Row**

After inputting all of the desired values, the user has several options. The Cancel button will remove all the edited values and return the table to its original state. The Save button will perform a validation check on the entire table and save the table locally on the device so that the user can continue viewing other tables. Note that this is only local to the device and the table will not be sent to the unit. The Send button can be used to actually send to table to the unit and make it the new



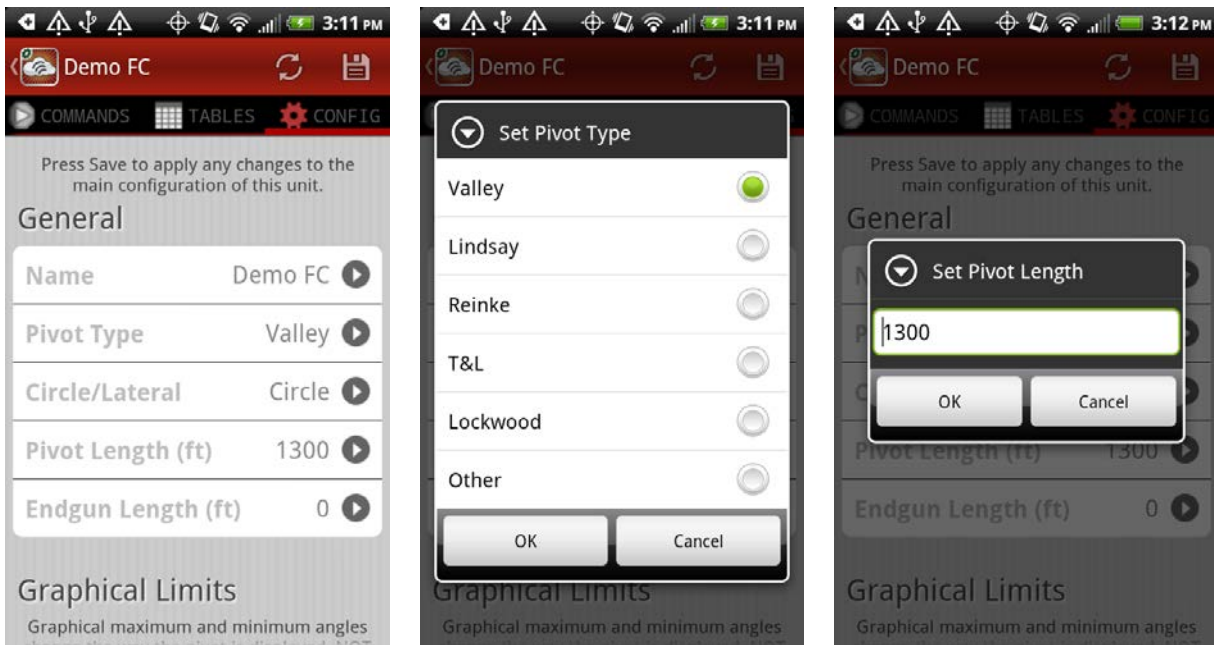
active table. (The only exception is if the table is a big speed table. In this case, the user will have the option to save the table and send it to the unit or save it only without sending it to the unit.) Upon receiving a response from WagNet, an alert will appear to tell the user if the table was sent to the unit successfully. Figure 19 shows the different buttons that provide table editing options.



Figure 19: Table Editing Options

### 3.4.4 Main Configuration

By selecting the Main Configuration tab of the Pivot View, a user can view and edit the main configuration parameters for a unit. The Main Configuration View is a scrolling table of parameters with selectable cells for each editable parameter. Selecting any of the cells in the table will either bring up a list of values to choose from or an input view that allows the user to input a value for the parameter.



**Figure 20: Main Configuration Examples**

Figure 20 shows an example of the Main Configuration tab and an example of each of the two types of alerts that can appear when a parameter is selected. The Main Configuration tab has a Save button at the top right of the view. None of the edits that a user makes using this interface are saved until the user presses the Save button and confirms the intent to actually change the configuration. If the user is a shared user, then the main configuration parameters can be viewed but not edited. In this case, none of the cells will be selectable and the Save button will not be shown.

The pivot type example in Figure 20 is an example of a parameter that has a list of possible values. The pivot type is selectable from a list of manufacturers as shown. Choosing a particular selection and pressing "Ok" will populate the cell with the newly selected value. As stated above, this change won't actually be applied to the unit until the user presses the Save button. The pivot length example in Figure 20 is an example of a parameter that allows the user to input data. Pressing "Ok" will return to the Main Configuration tab and update the pivot length with the new value. Again, these changes will not be saved until the user presses the Save button. The following table describes all of the parameters that are included in the Main Configuration tab. The list of parameters is slightly different for Field Commanders and Pivot Points. Note that some parameters, particularly the pressure sensor voltages, may or may not be editable depending on which type of pressure sensor is selected.



Parameter Name	Description	Possible Values
Name	Name to be displayed for the unit	User input (up to 32 characters)
Pivot Type	Brand of the pivot	Valley, Lindsay, Reinke, T&L, Lockwood, Other
Circle/Lateral	Defines whether the unit is on a circular pivot or a lateral	Circle, Lateral N/S, Lateral E/W
Pivot Length (ft)	Length of the pivot in feet	User input
Endgun Length (ft)	Length the endgun reaches in feet	User input
Maximum Angle	Maximum graphical angle to be drawn for the pivot	User input (0° -359°)
Minimum Angle	Minimum graphical angle to be drawn for the pivot	User input (0° -359°)
Full Run Time	Amount of time it takes the pivot to complete a full revolution	User input (hours and minutes)
Sensor Type*	Type of attached pressure sensor	None, 100 PSI PT, 200 PSI PT, 250 PSI PT, Pressure Switch, Irrrometer 200psi
Sensor Type**	Type of attached pressure sensor	Transducer, Raw Data, Pressure Switch, 200 psi, Other, None
Low Pressure Limit (psi)*	Low pressure limit (psi) to trigger an alert	User input
High Pressure Limit (psi)*	High pressure limit (psi) to trigger an alert	User input
Voltage at 0 psi (V)	Pressure sensor voltage when it measures 0 psi (V)	Defined based on Sensor Type
Voltage at 100 psi (V)**	Pressure sensor voltage when it measures 100 psi (V)	Defined based on Sensor Type
Flow Rate (gal/min)	Volumetric flow rate of water through the pivot (gal/min)	User input
Display Type**	Type of display interface on the unit	AgSense, T&L
External Device 1*	First external device attached	TL Hydraulic, Tipping Bucket, None
External Device 2*	Second external device attached	TL Hydraulic, Tipping Bucket, None
Safety required for speed and endgun*	Safety required for speed and endgun	Checkbox (YES or NO)
Water required for endgun*	Water required for endgun	Checkbox (YES or NO)
Latitude	Latitude of the center of the pivot (or of the NW corner for a lateral)	User input
Longitude	Longitude of the center of the pivot (or of the NW corner for a lateral)	User input

\* Parameters only available for Field Commanders

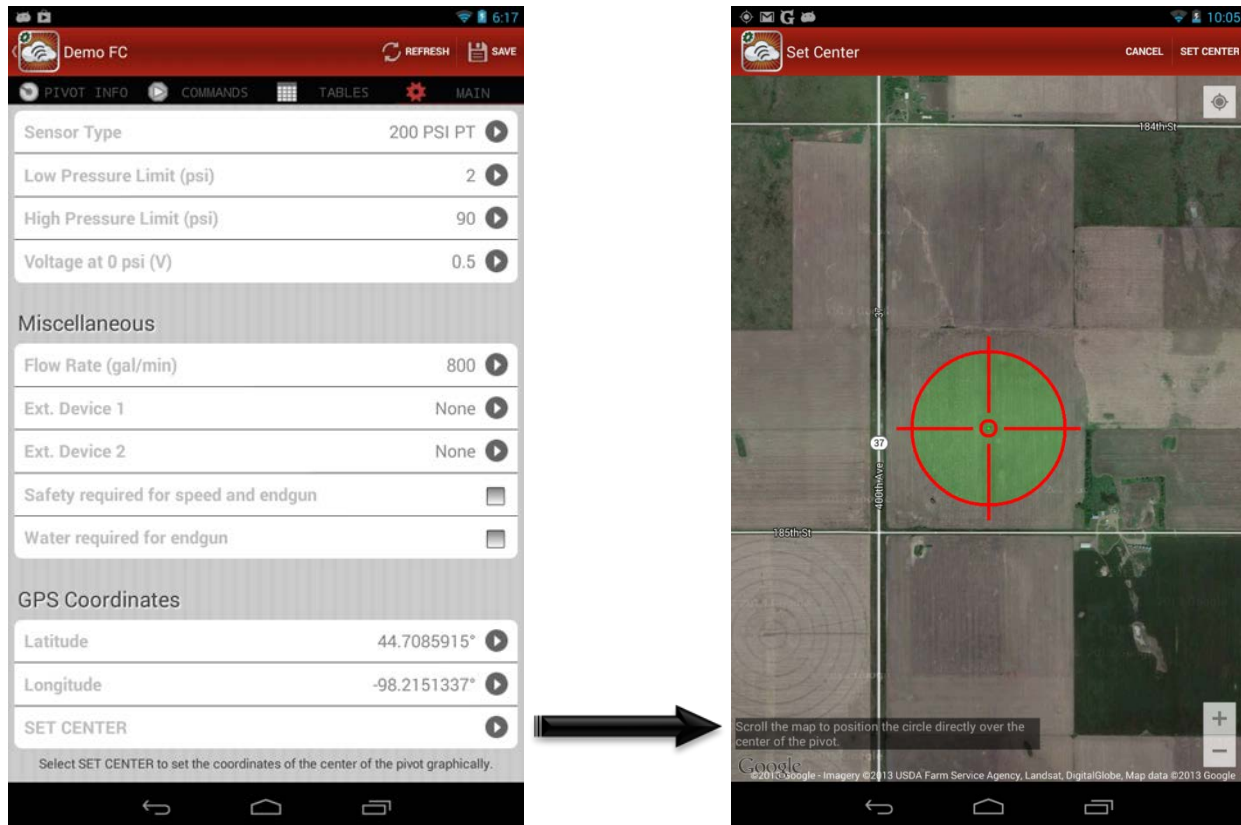
\*\* Parameters only available for Pivot Points

**Table 1: Main Configuration Parameters**



### 3.4.4.1 SET CENTER Function

At the bottom of the Main Configuration tab, directly beneath the latitude and longitude parameters is a cell labeled SET CENTER (see Figure 21 below) which will bring up a view that allows the user to define the latitude and longitude of the center of a pivot by selecting the point on a map. The SET CENTER function is unavailable for a shared user.

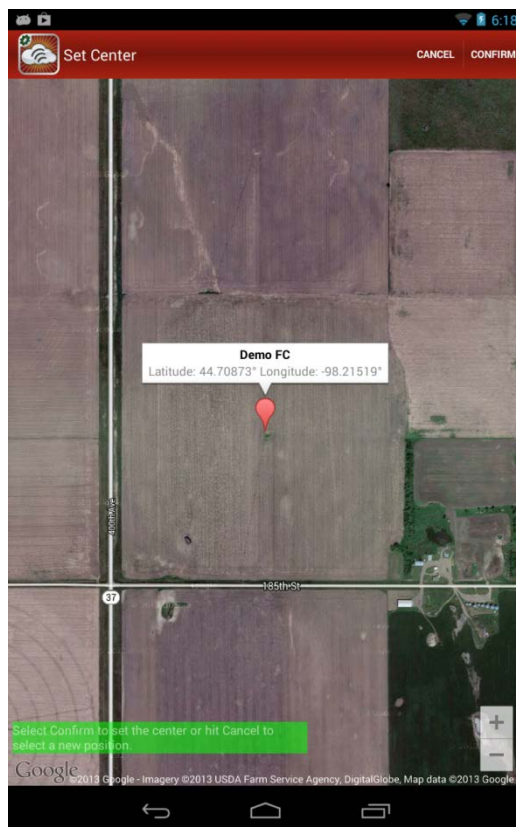


**Figure 21: SET CENTER in Main Configuration Tab**

The Set Center View shows a map that is centered on the current latitude and longitude that are saved for the unit. At the top right is a Cancel button that will simply return to the Main Configuration tab without changing the latitude and longitude values. On top of the map is a circular, green target outlined in red. The radius of the target is the current value for the pivot length. The user can scroll, pinch, and zoom the map to position the target directly over the center of the pivot. Once the target is positioned as desired, pressing the Set Center button at the top right will drop a pin precisely on the center of the target indicating the new latitude and longitude values. The Set Center button will change to a button titled Confirm which the user can press to return to the Main Configuration tab if the location of the pin is satisfactory. If the location is not satisfactory, the user can press the Cancel button to continue to scroll and reposition the map to drop a new pin as



many times as necessary until the result is satisfactory. In addition, the default My Location button on the Google Map will be available in the upper right corner of the map if the user's device has location services enabled. This button automatically centers the map on the user's current location which can be useful if the user is in the field near the pivot's center point. Figure 22 below shows the Set Center view after a pin has been dropped at the center of the target.



**Figure 22: Dropped Pin in Set Center View**

As with the other main configuration parameters, the latitude and longitude values set using the SET CENTER function will not be saved until the user presses the Save button on the Main Configuration tab. The following section describes the SET CORNERS function that can be used to define the corners of a field for a lateral.

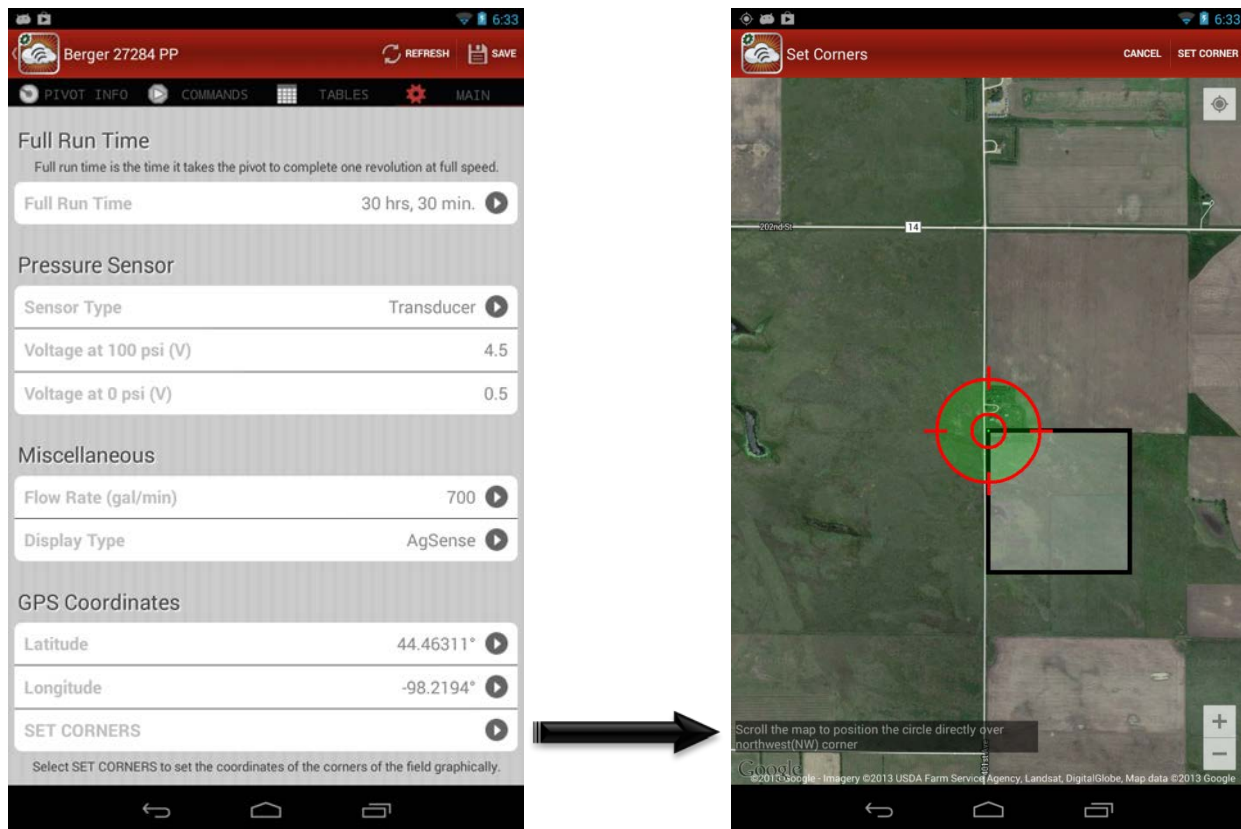
### **3.4.4.2 SET CORNERS Function**

If the value for the Circle/Lateral parameter is set to "Lateral N/S" or "Lateral E/W", then instead of a SET CENTER function there will be a SET CORNERS function directly beneath the latitude and longitude parameters. The SET CORNERS function allows the user to graphically define the four corners of a field in which a lateral operates. As with the SET CENTER function, the SET CORNERS function is not available for a shared user.





Figure 23 below shows the Set Corners View. It has a Cancel button in the top right that can be pressed at any time to return to the Main Configuration tab without editing the corner coordinates. The view shows a map with a target outlined in red in the center and a gray rectangle representing the rectangular field. The gray rectangle is not meant to show the length or width of the field. Its purpose is to prompt the user to drop pins on the corners of the field in the proper order.



**Figure 23: SET CORNERS in Main Configuration Tab**

The four corner coordinates must be defined in a clockwise order starting with the northwest corner (NW, NE, SE, SW). Therefore, the initial target is positioned over the northwest corner of the gray rectangle and the text at the bottom of the view is instructing the user to position the target over the northwest corner of the field. After scrolling or zooming the map to the desired position, pressing the Set Corner button at the top right of the view will drop a pin on the northwest corner of the field.

After dropping a pin on the northwest corner of the field, an animation will move the target over to the northeast corner of the gray rectangle to prompt the user to drop a pin on the northeast corner of the field. Again, the size of the gray rectangle doesn't change to match the size of the field; it simply indicates the next corner of



the field on which to drop a pin. The process repeats to allow the user to drop pins on the southeast and southwest corners of the field as well.

After there are pins on each of the four corners of the field, the Set Corner button will change to a Confirm button. Pressing the Confirm button will return the user to the Main Configuration tab. If any of the coordinates doesn't look satisfactory, the user can simply scroll the map to start over and define the coordinates again. The new corner coordinates will not be saved until the user presses the Save button on the Main Configuration tab.

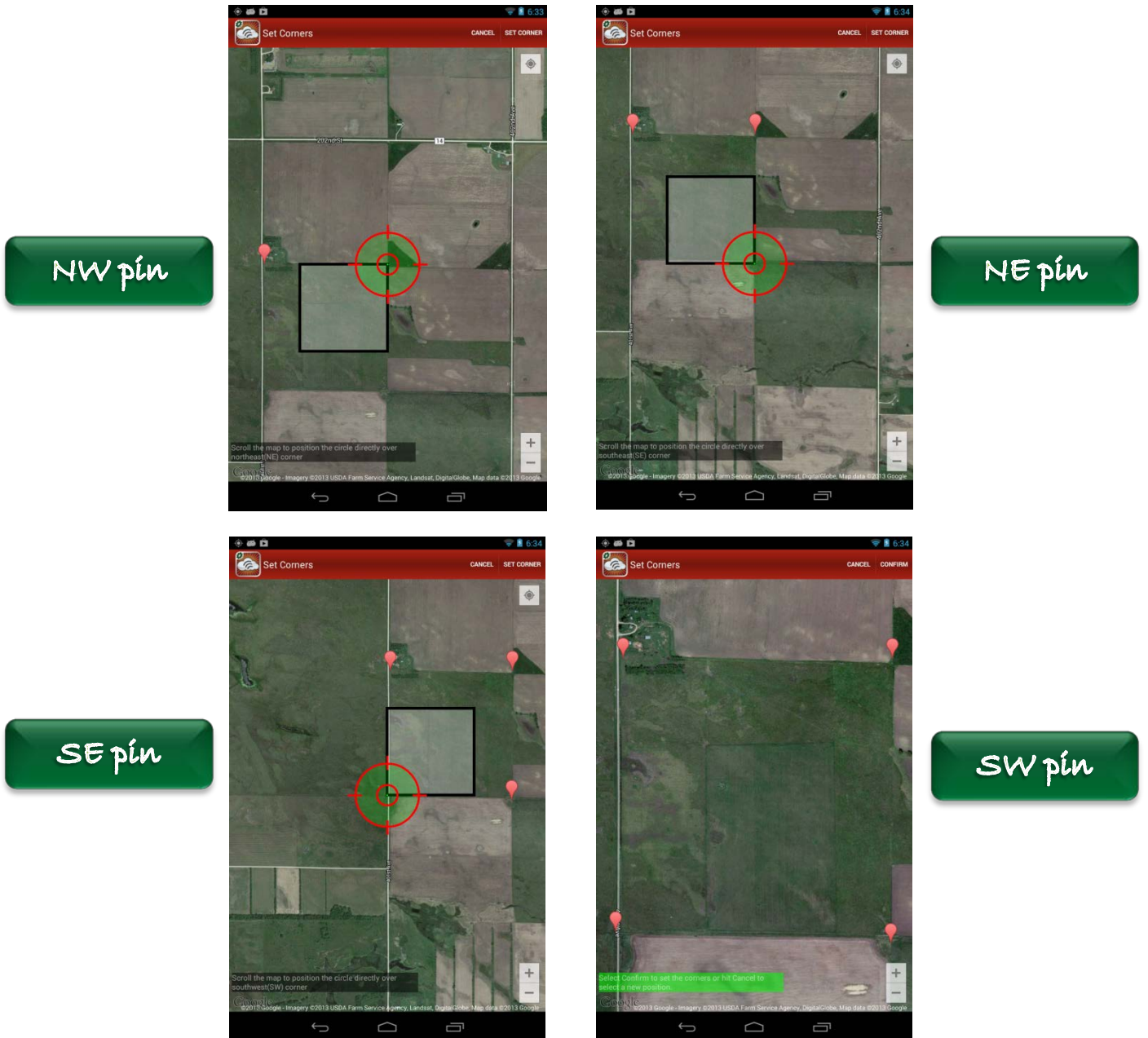


Figure 24: Dropped Pins in Set Corners View



Figure 24 illustrates how the Set Corners view changes after each of the four pins is dropped. As each pin is dropped, the target moves clockwise around the gray rectangle prompting the user to drop the next pin. After the pin is dropped on the southwest corner, the Confirm button appears.

## 3.5 Precision Link View

The Precision Link View is a tabbed view with five tabs across the top of the view. These view tabs are Pivot Info, Commands, Tables, T&L Commands, and Main Configuration. By default, the Pivot Info tab is always selected initially. A user can navigate back and forth through any of these five tabs to view data for the unit. At any time, the app icon at the top of the view can be used to go back to the List View and select another unit. The following sections describe the five tabbed views and the functions that can be performed in each one.

The Precision Link is a pivot controller specifically designed for use with a T&L pivot. The WagNet Mobile interface for the Precision Link has some features which are identical to the Pivot View interface for Pivot Points and Field Commanders and other features which are unique. The following sections describe the features that are unique to Precision Links and contain references to the sections that describe features that are common to all pivot controllers.

### 3.5.1 Pivot Info View

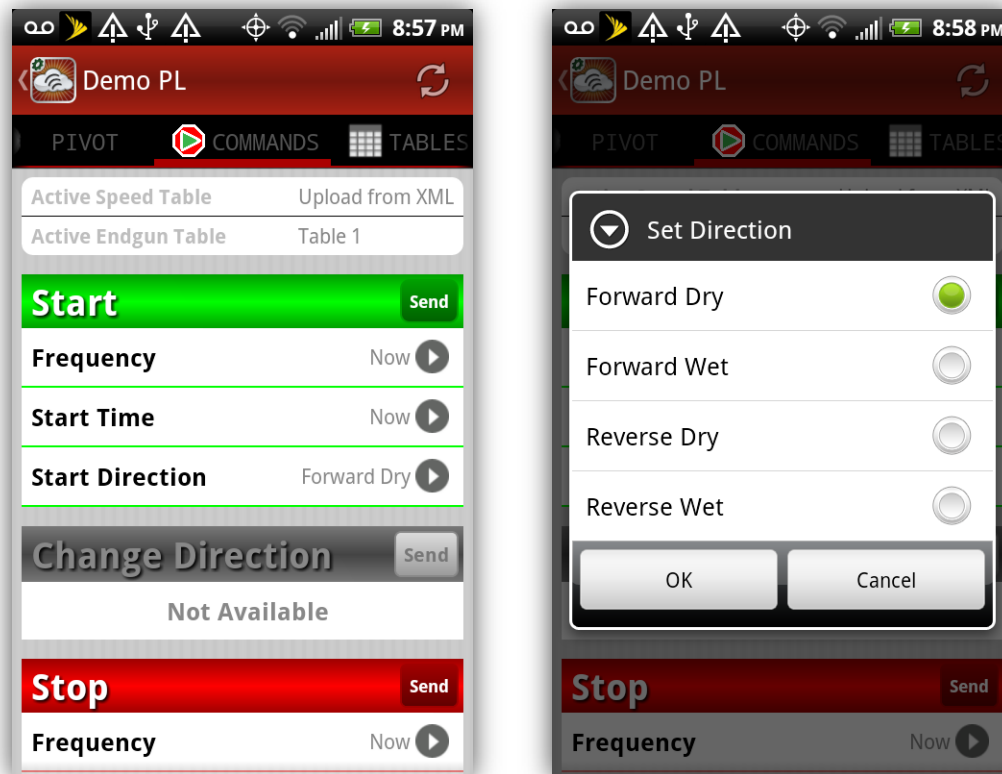
The Pivot Info View is always selected by default as the first view that the user sees immediately after selecting a specific Precision Link from the List View. The Pivot Info view for Precision Links is nearly identical to the Pivot Info View for Pivot Points and Field Commanders which is described in Section 3.4.1. It shows a map of the pivot location with the overlaid pivot graphic. To the right of the map is a list of the current data for the unit including the angle of the pivot, the current direction of motion, the current application rate, the current water pressure, and the current status of the endgun. At the bottom of the view is a set of three buttons that allow the user to see the last five commands sent to the unit, any timed commands that are scheduled, or any notes that have been recorded for the unit. By using the Add Note button, a user can type his or her own note and add it to the unit.

### 3.5.2 Sending Commands

By selecting the Commands tab of the Pivot View, a user can send new commands, schedule commands, and view or clear previously scheduled commands. The Commands View is divided into four sections for the different types of commands that can be sent. These are "Start", "Change Direction", "Stop", and "Stop at Angle". Each section contains one or more selectable cells that allow the user to configure the details of the command. These are the same functions that are



available for Pivot Points and Field Commanders with only some minor exceptions. The full details of these basic commands are given in Section 3.4.2. The main difference for Precision Links involves the START commands. For any START command sent to or scheduled for a Precision Link, a direction must be selected.



**Figure 25: Precision Link Start Direction Options**

Figure 25 shows the various options that are available for the start direction for Precision Links. They are Forward Dry, Forward Wet, Reverse Dry, or Reverse Wet. A direction must be chosen no matter what frequency is selected for the START command (Start Now, Start Once, or Start Always). Forward Dry is the default option if the user doesn't specifically choose a direction. The CHANGE DIR, STOP, and STOP AT ANGLE command features for Precision Links are all the same as the features for Pivot Points and Field Commanders.

### **3.5.3 VRI & Endgun Tables**

By selecting the Tables tab of the Pivot View, a user can view, edit, or send VRI (Variable-Rate Irrigation) tables and endgun tables. The Tables View allows the user to switch between VRI tables and endgun tables using two buttons at the bottom of the view. At the top of each section, the name of the active VRI table or active endgun table is listed. By default, the active VRI or endgun table is initially



displayed, but the user can edit the table or view other tables using the available features. Figure 26 below shows the VRI Tables section of the Tables tab.



**Figure 26: Tables Tab - VRI Tables View**

Unlike Pivot Points and Field Commanders, VRI tables for Precision Links have the speeds specified by the application rate measured in inches. When entering values for the application rates, the values entered by the user will automatically be bounded by the minimum and maximum application rates that are set for the unit and they will be rounded to the nearest 0.05".

Precision Links don't necessarily have to have any VRI table enabled. If that's the case, then the active VRI table will be listed at the top of the section as "VRI Disabled" as shown in Figure 26. If VRI tables are disabled, then choosing any table and pressing the "Send" button will enable VRI tables and set the chosen table as the active table. In order to disable VRI tables, the user can simply select the active table. While viewing the active VRI table, the button in the lower left will read "Disable" and it can be used to disable VRI tables. Editing VRI tables and viewing and editing endgun tables are described fully in Section 3.4.3.



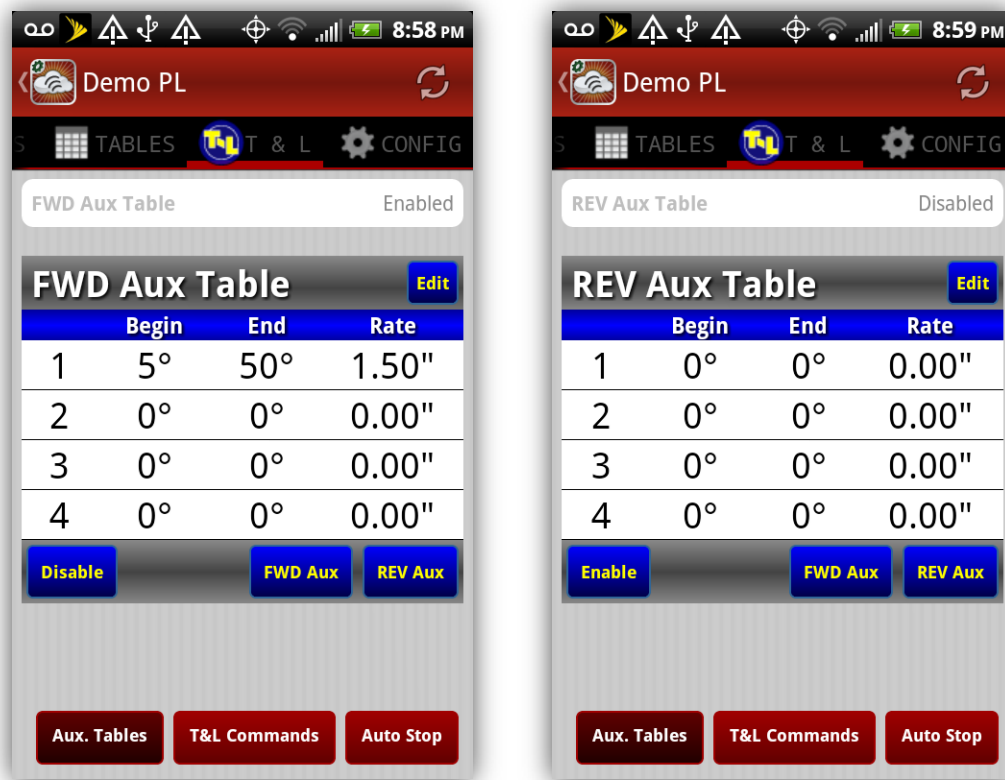
### 3.5.4 Sending T&L Commands

By selecting the T&L Commands tab, users can view and edit auxiliary tables and send all commands that are only available to Precision Link units. These commands include Auto Restart, Change Application Rate, and Auto Stop/Auto Reverse. The main T&L Commands view has three buttons across the bottom that allow the user to switch between auxiliary tables, T&L commands, and Auto Stop/Auto Rev commands. The following subsections describe the functions that can be performed in each one of these subviews.

#### 3.5.4.1 Auxiliary Tables

The default subview visible when the user selects the T&L Commands tab is the Auxiliary Tables view. Auxiliary tables can be defined that specify the application rate in up to four discrete sections of the field. These values override the values that may be specified for any given section of the field in an active VRI table. One table can be defined for times when the pivot is moving in the forward direction and another, independent table can be defined for the reverse direction. These two tables can be accessed by the FWD Aux and REV Aux buttons at the lower right side of the view. Figure 27 shows the FWD Auxiliary Table and the REV Auxiliary Table displayed under the T&L Commands tab.





**Figure 27: T&L Commands Tab – Auxiliary Tables**

At the top of the view, the current status of the selected table is displayed as either “Enabled” or “Disabled”. The corresponding action button in the lower left will be titled either “Disable” or “Enable” depending on the current status of the table. Editing the auxiliary tables follows the same rules as editing VRI tables for Precision Links. The speeds are specified as application rates measured in inches and the entered values will be automatically bounded by the minimum and maximum rates defined for the unit. The will also be rounded to the nearest 0.05”. The other details for editing the auxiliary tables are identical to editing any other type of table and can be found in Section 3.4.3.2.

### 3.5.4.2 T&L Commands

The T&L Commands subview allows the user to set the Auto Restart status and to immediately change the application rate. The two buttons at the top of the view enable or disable the Auto Restart feature of the Precision Link. Depending on the current status of the unit, only one of the two buttons will be available. In Figure 28 below, the Auto Restart is currently enabled, hence the “Cancel Auto Restart” button is available and the “Auto Restart” button is not. The liability warning associated with the Auto Restart feature is written directly below the two buttons and it’s displayed again as an alert when a user tries to enable the feature.





**Figure 28: T&L Commands Tab - T&L Commands**

The buttons for changing the current application rate of the pivot are located beneath the Auto Restart buttons. The text field in the middle of the view displays the current application rate. To enter a different rate, the user can simply select the text view to bring up a keyboard and input a new rate. This new rate will automatically be bounded by the minimum and maximum rates defined for the unit and will be rounded to the nearest 0.05". To the left and right of the text view are buttons titled "Min. Rate" and "Max. Rate". These are simply for convenience and will populate the text view with the minimum or maximum application rate automatically without requiring the user to enter the value manually. Below the text view is a message that prompts the user to enter a value between the defined minimum and maximum rates. In order to actually send the new rate to the unit, the user must press the blue "Change Application Rate" button and then confirm the command on the alert that's presented. For more information about these commands see the *Precision Link Installation, Operation, and Troubleshooting Manual*.

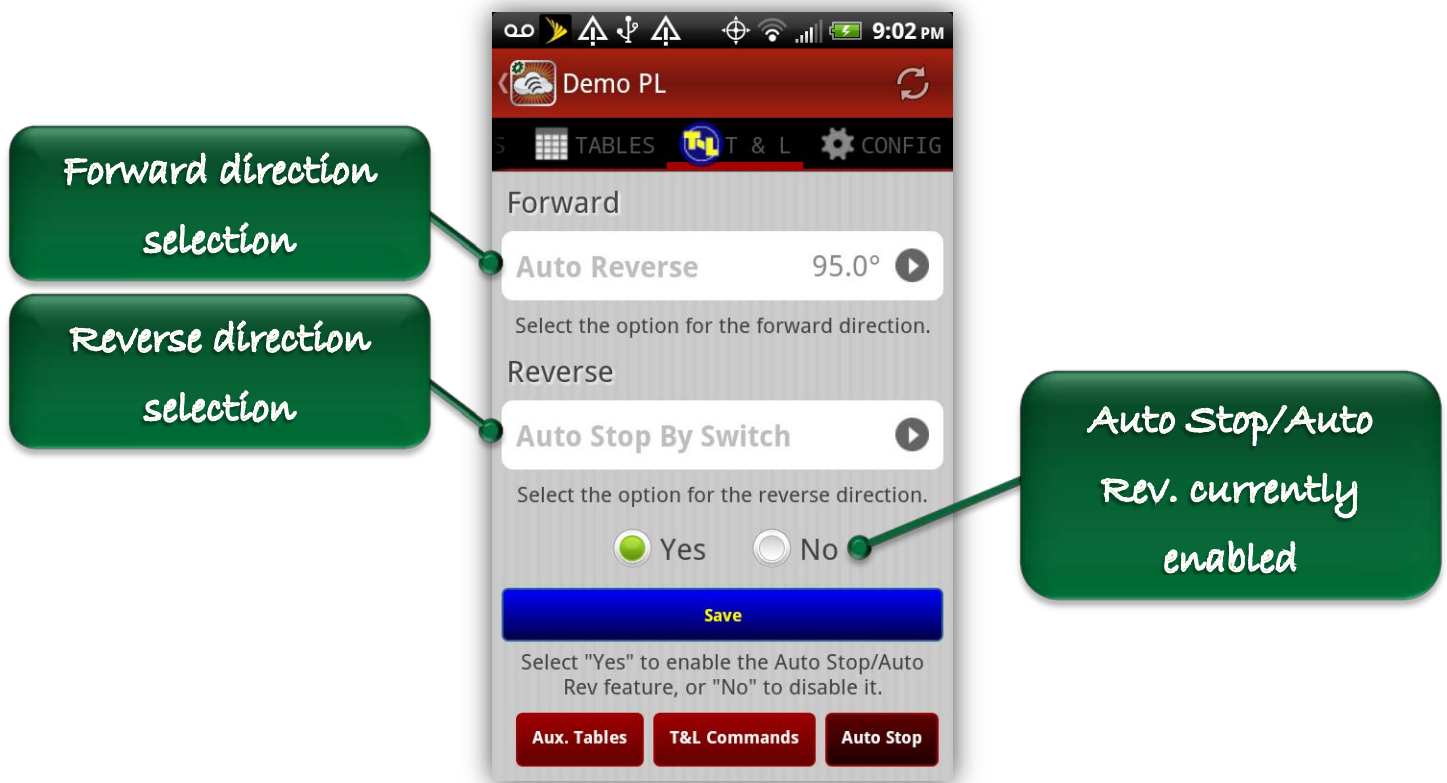
### 3.5.4.3 Auto Stop/Auto Reverse

The Auto Stop/Auto Reverse subview allows the user to enable, disable, and configure the Auto Stop/Auto Reverse feature on a Precision Link. The Auto





Stop/Auto Reverse feature allows the user to set a condition for each direction of motion of the pivot that will either stop the pivot or reverse its direction automatically when that condition is met. The condition can either be an angle or the state of an Auto Reverse Switch at the end tower. Figure 29 below shows the Auto Stop/Auto Reverse view.



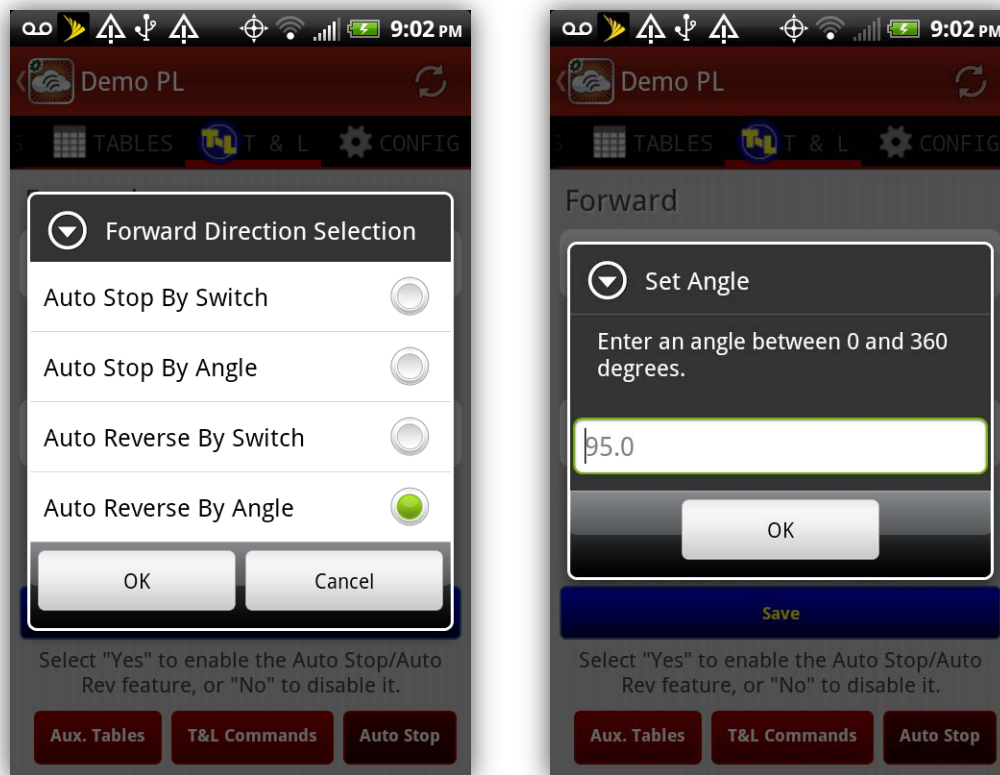
**Figure 29: T&L Commands Tab - Auto Stop/Auto Reverse**

At the top of the view are the current selections for the Forward direction and Reverse direction of motion of the pivot. In this example, the Forward direction is currently set to Auto Reverse By Angle at 95.0° and the Reverse direction is set to Auto Stop By Switch. The radio buttons labeled “Yes” and “No” define whether or not the Auto Stop/Auto Reverse feature is currently enabled. In this example, the feature is enabled because “Yes” is checked.

In order to configure and enable the Auto Stop/Auto Reverse feature, a user can select the cell for either the Forward or Reverse direction which will bring up a dialog with the possible selections. Figure 30 shows an example of the dialog that appears after selecting the Forward direction cell. It shows the four possible options for either direction which are Auto Stop By Switch, Auto Stop By Angle, Auto Reverse By Switch, and Auto Reverse By Angle. If the user makes a selection



from this list that requires an angle to be defined, then another dialog will appear to allow the user to input the value.



**Figure 30: Auto Stop/Auto Reverse Options**

After configuring the selections for the Forward and Reverse directions as desired, the user can select "Yes" and then press the blue Save button to enable the Auto Stop/Auto Reverse feature with the chosen configuration. To disable the Auto Stop/Auto Reverse feature, the user can simply select "No" and press the blue Save button. For more information about these commands see the ***Precision Link Installation, Operation, and Troubleshooting Manual***.

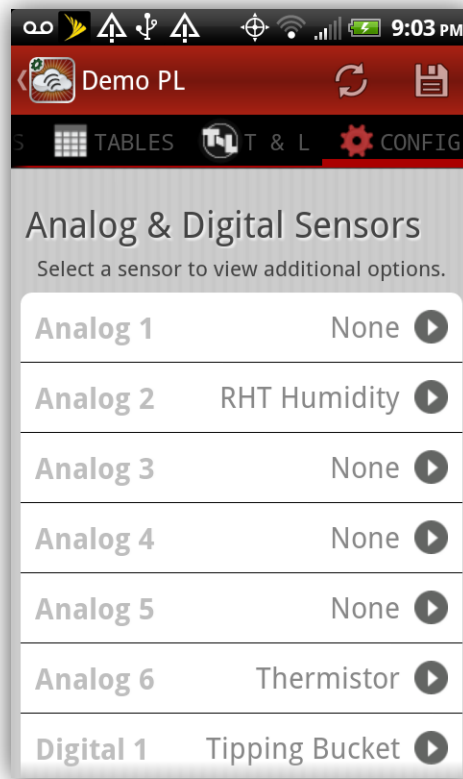
### **3.5.5 Main Configuration**

By selecting the Main Configuration tab of the Pivot View, a user can view and edit the main configuration parameters for a unit. The Main Configuration View is a scrolling table of parameters with selectable cells for each editable parameter. Selecting any of the cells in the table will either bring up a list of values to choose from or an input view that allows the user to input a value for the parameter. The Main Configuration tab has a Save button at the top right of the view. None of edits that a user makes using this interface are saved until the user presses the Save button and confirms the intent to actually change the configuration. Many of



the parameters that can be configured for Precision Links are similar to parameters for Pivot Points and Field Commanders. Selecting and editing those parameters is described fully in Section 3.4.4.

This section describes the configuration options which are unique to Precision Links. Those options involve the sensors that are attached to the Precision Link's 6 analog inputs and 2 digital inputs. The type of sensor can be selected for each input and there may be various additional options available for each particular type of sensor. Figure 31 shows the portion of the Main Configuration tab that displays the current analog and digital sensors.

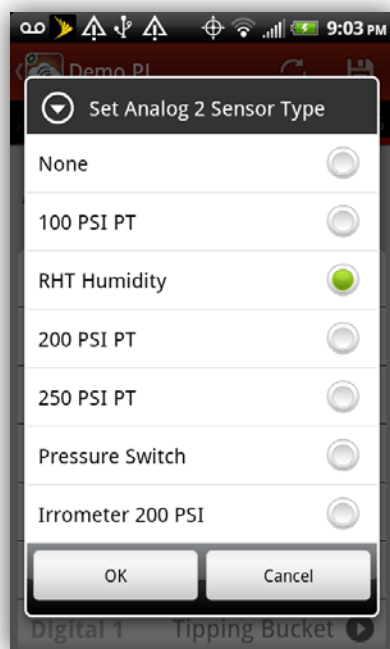


**Figure 31: Main Configuration Tab - Analog & Digital Sensors**

By selecting a particular analog or digital input from the list, a user can view the current options that are defined for that sensor or configure a new sensor. There are currently six different types of sensors that can be attached to analog inputs 1 through 4. There is one type of sensor that can be attached to analog input 5 or 6. Figure 32 shows the types of analog sensors that can be chosen for any of the analog inputs.



Analog  
Inputs 1-4



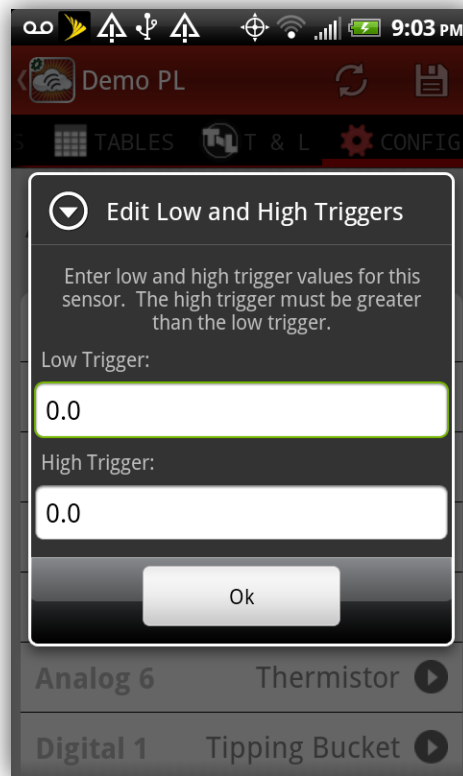
Analog  
Inputs 5-6



**Figure 32: Main Configuration Tab - Analog Sensor Options**

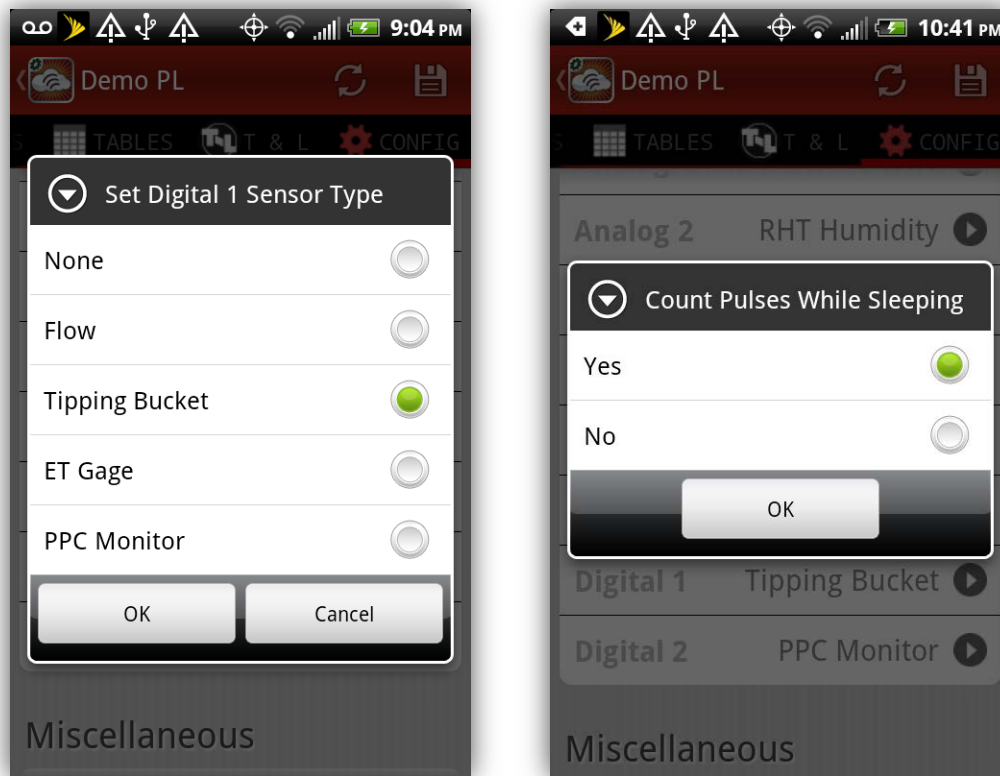
Some of the analog sensors can be configured with low and high trigger values that will send a text message to the user when the sensor value goes out of range. If a sensor type can be configured with trigger values, a dialog will immediately appear after selecting the sensor from the list and pressing Ok. This dialog will show the current trigger values for the particular sensor if they've already been defined. Figure 33 below shows the trigger value dialog. The value entered for the high trigger must be higher than the low trigger.





**Figure 33: Main Configuration Tab - Analog Trigger Values**

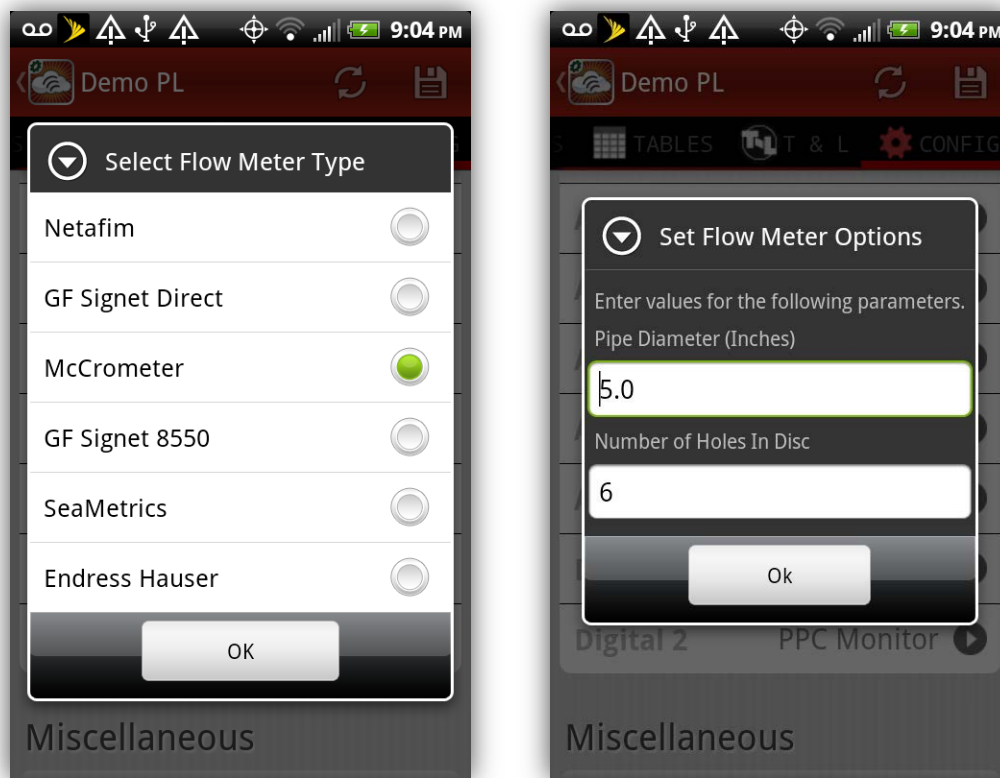
The two digital inputs can have one of four different types of sensors attached: Flow Meter, Tipping Bucket, ET Gage, or PPC Monitor. The Tipping Bucket, ET Gage, and PPC Monitor each have a single additional parameter that can be configured. They can be set to count pulses while sleeping. Figure 34 shows the digital sensor options and the additional parameter that can be configured for the Tipping Bucket, ET Gage, and PPC Monitor.



**Figure 34: Main Configuration Tab - Digital Sensor Options**

There are several different flow meters that are available each with slightly different additional parameters that can be configured. Figure 35 shows the list of different flow meters that can be attached to the unit and an example of the additional parameters that can be configured for one of them. Table 5 gives a complete list of the different flow meters and the available parameters that can be configured for each.





**Figure 35: Main Configuration Tab - Flow Meter Options**

The GPS coordinates for the center of the pivot can be set graphically for Precision Links using the SET CENTER function as described in Section 3.4.4.1. By scrolling the map to the appropriate position, the user can visually define the center of the pivot using Google Maps and use the device’s GPS location as a reference point if the device has location services enabled.

The following tables describe all of the parameters that are included in the Main Configuration tab. Table 2 lists all of the parameters that can be configured and their possible values. Table 3 and Table 4 provide further details about the configuration options for the analog and digital sensors. Table 5 provides details about the configuration options for the various types of flow meters that can be attached to the digital inputs.



Parameter Name	Description	Possible Values
<b>Name</b>	Name to be displayed for the unit	User input (up to 32 characters)
<b>Circle/Lateral</b>	Defines whether the unit is on a circular pivot or a lateral	Circle, Lateral N/S, Lateral E/W
<b>Pivot Length (ft)</b>	Length of the pivot in feet	User input
<b>Endgun Length (ft)</b>	Length the endgun reaches in feet	User input
<b>Maximum Angle</b>	Maximum graphical angle to be drawn for the pivot	User input (0°-359°)
<b>Minimum Angle</b>	Minimum graphical angle to be drawn for the pivot	User input (0°-359°)
<b>Full Run Time</b>	Amount of time it takes the pivot to complete a full revolution	User input (hours and minutes)
<b>Analog 1</b>	Type of sensor attached to analog input 1	See Table 3
<b>Analog 2</b>	Type of sensor attached to analog input 2	See Table 3
<b>Analog 3</b>	Type of sensor attached to analog input 3	See Table 3
<b>Analog 4</b>	Type of sensor attached to analog input 4	See Table 3
<b>Analog 5</b>	Type of sensor attached to analog input 5	See Table 3
<b>Analog 6</b>	Type of sensor attached to analog input 6	See Table 3
<b>Digital 1</b>	Type of sensor attached to digital input 1	See Table 4
<b>Digital 2</b>	Type of sensor attached to digital input 2	See Table 4
<b>Flow Rate (gal/min)</b>	Volumetric flow rate of water through the pivot (gal/min)	User input
<b>Latitude</b>	Latitude of the center of the pivot (or of the NW corner for a lateral)	User input
<b>Longitude</b>	Longitude of the center of the pivot (or of the NW corner for a lateral)	User input

**Table 2: Precision Link Main Configuration Parameters**





Analog Input	Possible Sensors	Configurable Parameters
Analog 1-4	None	None
	100 PSI PT	Low Trigger
		High Trigger
	RHT Humidity	Low Trigger
		High Trigger
	200 PSI PT	Low Trigger
		High Trigger
	250 PSI PT	Low Trigger
		High Trigger
Pressure Switch	None	
Irrrometer 200 PSI	Low Trigger	
	High Trigger	
Analog 5-6	None	None
	Thermistor	Low Trigger
		High Trigger

**Table 3: Precision Link Analog Sensor Configuration Parameters**

Digital Input	Possible Sensors	Configurable Parameters
Digital 1-2	None	None
	Flow	See Table 5
	Tipping Bucket	Count pulses while sleeping (YES or NO)
	ET Gage	Count pulses while sleeping (YES or NO)
	PPC Monitor	Count pulses while sleeping (YES or NO)

**Table 4: Precision Link Digital Sensor Configuration Parameters**



Flow Meter Type	Configurable Parameters	Possible Values
Netafim	Gallons per pulse	User input
GF Signet Direct	K factor	User input
McCrometer	Pipe diameter (inches)	User input
	Number of holes in disc	User input
GF Signet 8550	Gallons per pulse	User input
SeaMetrics	Flow meter size	4"
		6"
		8"
		10"
Endress Hauser	Gallons per pulse	User input

**Table 5: Precision Link Flow Meter Configuration Parameters**

## 3.6 Aqua Trac View

The Aqua Trac View is a tabbed view with three tabs across the top of the view. These three tabs are Aqua Trac Info, Soil Data, and Graphs. By default, the Aqua Trac Info tab is always selected initially. A user can navigate back and forth through any of these three tabs to view data for the unit. At any time, the app icon at the top of the view can be used to go back to the List View and select another unit. The following sections describe the three tabbed views and the functions that can be performed in each one.

### 3.6.1 Aqua Trac Info View

The Aqua Trac Info View is always selected by default as the first view that the user sees immediately after selecting an Aqua Trac from the List View. This view presents some basic information about the unit including the serial number, version, time of the last reading, battery voltage, and signal strength. At the bottom of the screen is the same view that's used for Pivot Points and Field Commanders that allows the user to see the last five commands sent to the unit and any notes that have been recorded. If the user has sufficient permission, there will be an Add Note button available that allows the user to add new notes. Figure 36 below shows an example of the Aqua Trac Info tab.



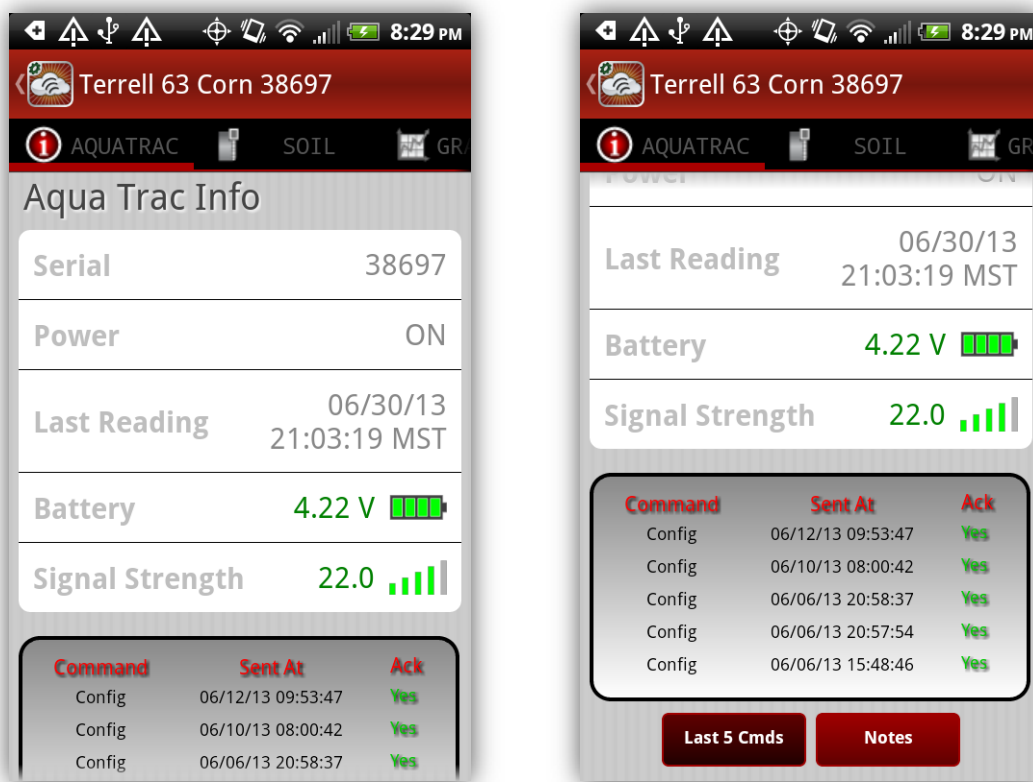


Figure 36: Aqua Trac View - Aqua Trac Info Tab

### 3.6.2 Soil Data View

The Soil Data View shows the current status of the soil according to the latest reading from the probe. The illustration in this view shows a cross-section of soil with the probe in the ground. Each of the soil sensors is drawn at the appropriate depth and the reading from that sensor is listed directly to the right of the probe. If the probe includes temperature sensors and their data is available, the temperatures at each depth are listed to the right of the probe as well.

At the top of the view, the current sum value is shown along with the current FULL and REFILL values. There's also a vertical scale running along the right side of the view that visually shows the current soil moisture content relative to the FULL and REFILL values. The color on the top of the soil probe also indicates the current soil moisture content on the red-green-blue color scale relative to the FULL and REFILL values. Figure 37 shows an example of the Soil Data tab.



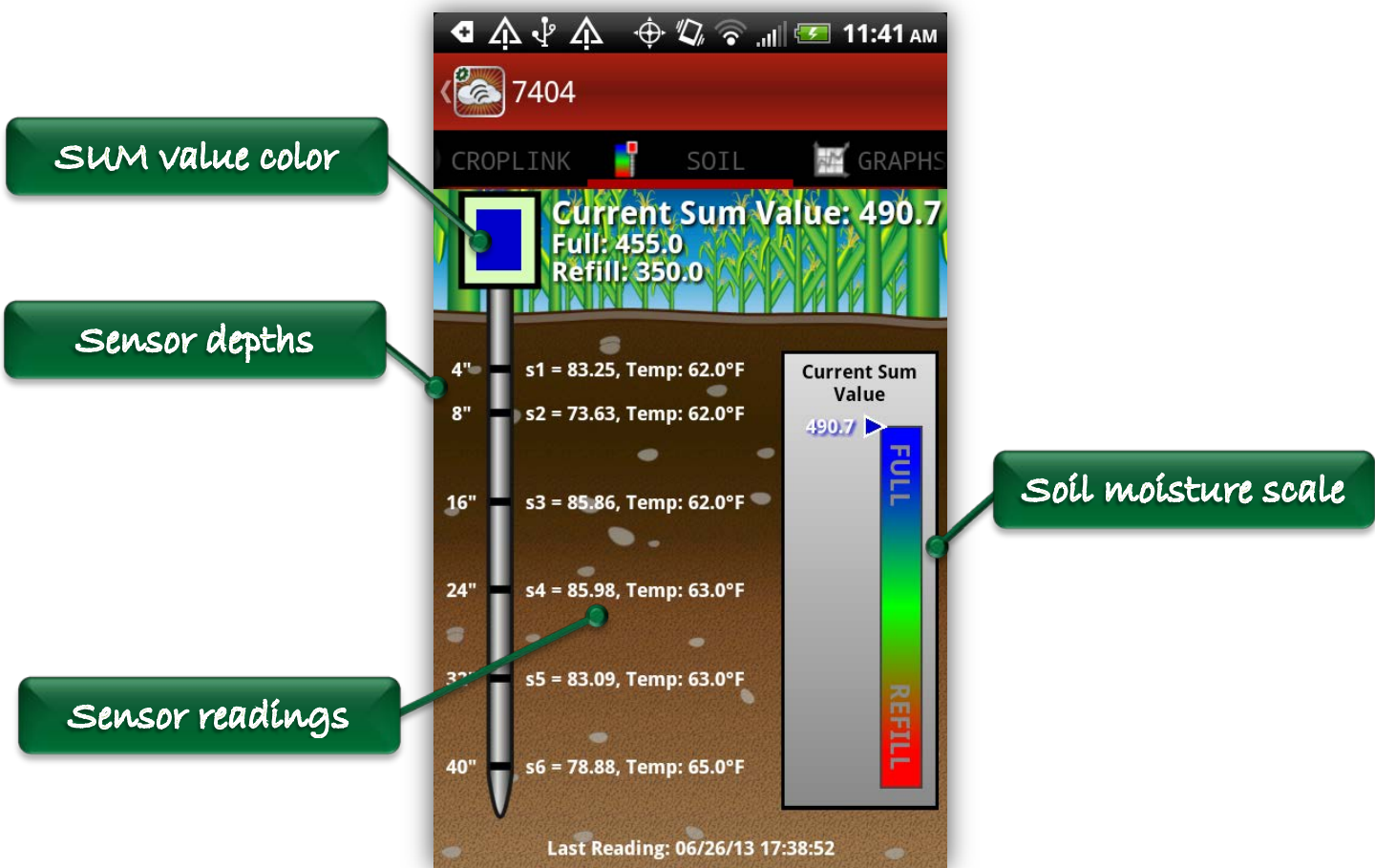


Figure 37: Aqua Trac View - Soil Data Tab

### 3.6.3 Graphs View

The Graphs view allows the user to view historical data from the soil probe. This view supports both portrait and landscape orientations of the device for optimal viewing. The user can view soil moisture content data, battery voltage, or signal strength data from up to the last thirty days. There are several types of graphs that can be shown, and in landscape mode the user can touch the graph to view the data values at any particular point in time. The following subsections describe the portrait and landscape interfaces and the different graph types.

#### 3.6.3.1 Portrait Graph Interface

In portrait orientation, the Graph View shows a graph at the top of the screen with a scrolling table beneath it. At the top of the graph is a descriptive title of the data currently being viewed. Beneath the title is a set of three buttons that read "Day", "Week", and "Month". These buttons switch the time period of data being viewed. If there's no data for a particular time period, then a label will appear on the graph



that reads “No Data Available”. The X-axis is labeled with dates across the bottom of the graph and the Y-axis is labeled along the right side. The limits of the graph in the Y-direction are chosen automatically to fit the data within view.

The scrolling table shows all of the different data lines that can be viewed and allows the user to turn each one of them on or off. Each row in the table has the name of a particular data line on the left and a checkbox on the right. The color of the text in the row corresponds to the color of that data line on the graph and the checkbox turns the line on or off.

Depending on the type of data each line represents, there are several rules that define which data can be viewed simultaneously on the same graph. For example, the sum value, the battery data, and the signal strength data can only be viewed by themselves. Selection of any one of these lines will deselect all other lines. Any number of soil sensors can be viewed simultaneously on the graph, so multiple soil sensors can be selected at once.

### **3.6.3.2 Standard Line Graph**

The most basic graph type is the standard line graph. This graph type is a standard XY plot that plots the data versus time and shows that date labels on the X-axis and the numerical labels on the Y-axis. When applicable, there’s a text label along the left side of the graph that describes the measurement units of the data. For Aqua Trac units, the battery data, signal strength data, and sum value are examples of data that is plotted on a standard line graph.

When the sum value is being plotted, there’s an additional feature which colors the FULL and REFILL zones on the graph. The FULL zone is colored blue, the REFILL zone is colored red, and the area in between is colored green.

### **3.6.3.3 Soil Sensor Graph**

The soil sensor graph is a special type of line graph that’s used specifically for soil sensor data. This graph type is particularly useful for comparing the relative changes in moisture content over time at the various soil depths. The numerical data labels are omitted from the Y-axis and each of the data lines are evenly distributed in the vertical direction. From top to bottom, the lines are distributed according to the sensor depth from shallowest to deepest, so the plot represents a cross-section of the soil. The relative changes in soil moisture content at different depths can easily be compared without the data lines crossing on top of each other. Figure 38 below illustrates an example of the soil sensor graph type. Notice the lack of labels along the Y-axis and the vertical distribution of the data lines.



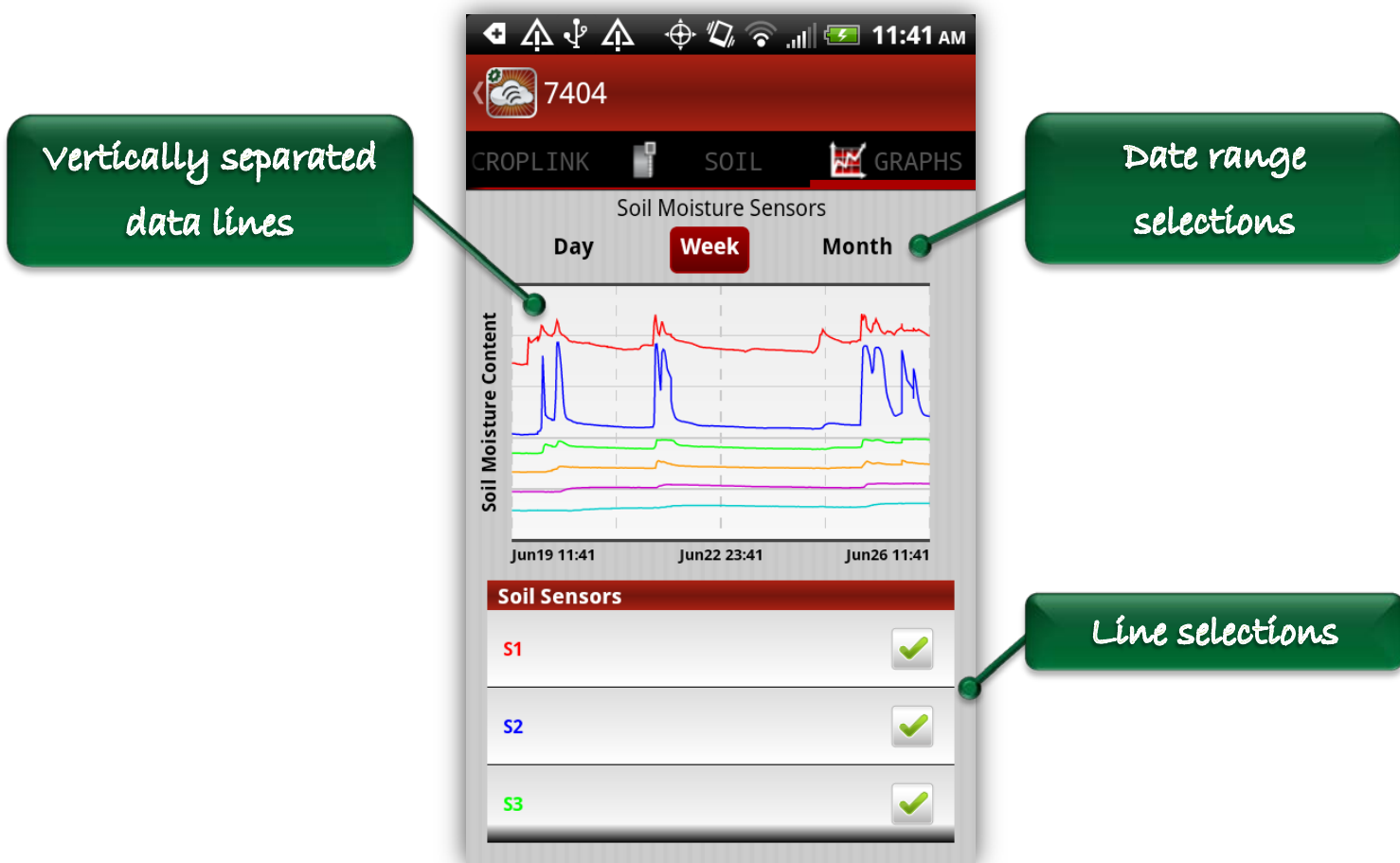


Figure 38: Soil Sensor Graph

### 3.6.3.4 Cumulative Change Bar Graph

The cumulative change bar graph is used specifically for the sum value data. This graph type is a bar graph that shows the change in soil moisture content over periods of time within the date range being viewed. For example, if the date range is set to one month or one week, the cumulative change bar graph shows the change in soil moisture content over each day. If the date range is set to one day, then the graph shows the change in soil moisture content over each hour. The bars are colored according to whether the change is positive or negative for that time period. A blue bar indicates a positive change and a red one indicates a negative change.

In order to activate this graph type, a button titled "Bar Graph" will appear in the scrolling table when the sum line is selected. This button will switch back and forth between the standard line graph and the cumulative change bar graph.



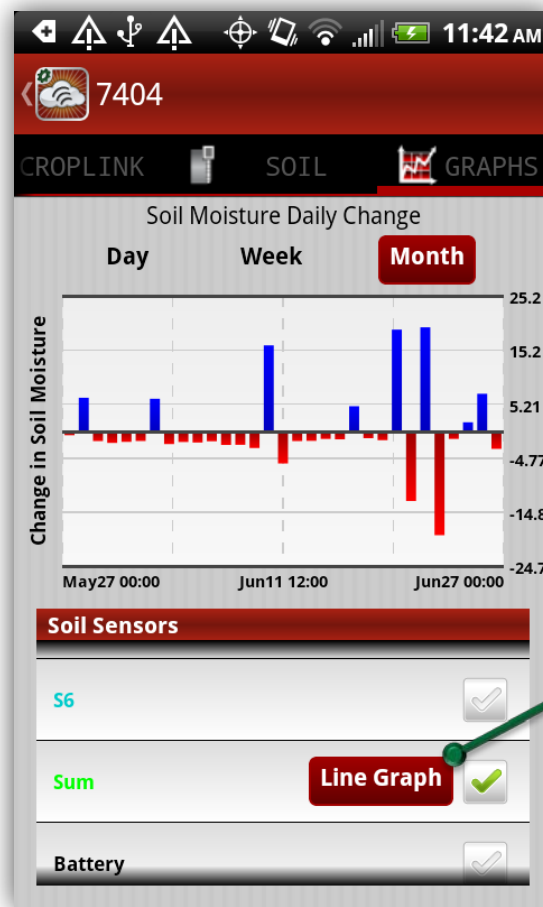


Figure 39: Cumulative Change Bar Graph

### 3.6.3.5 Landscape Interface

At any time while viewing the Graphs tab, the user can rotate the device into landscape orientation to view the graph in a full-screen mode. The landscape mode shows the name of the unit and the date range being viewed at the top of the screen. Along the left side of the screen is a scrolling line selection table that allows the user to turn data lines on or off. Instead of checkboxes, this selection table switches the background color of each row as lines are selected and deselected. The same line selection rules and graph types apply in the landscape interface and the portrait interface. There's a button titled "Options" at the top right side of the screen that will bring up an alert that allows the user to switch between the three possible date ranges of Day, Week, and Month.

In addition to the main graph, there's a small lower graph with a white background that's specifically dedicated to the battery and/or signal strength data. These two data lines are always plotted on this lower graph for easy reference and comparison to other data on the main graph. There's a battery label on the right side of the



lower graph if there's available battery data and a signal strength label along the left side of the lower graph is there's available signal strength data.

In the landscape interface, the user also has the option of viewing the numerical values of data at any given point in time simply by touching the screen at the desired location. While the user is actively touching the screen on the graph, a vertical line will appear at the touch location and the corresponding value of each of the data lines will be marked with a circular indicator. The date of the touch point will be displayed at the top of the screen and the numerical value of each data line being viewed on the main graph will be updated on the line selection table. The value of the battery and/or signal strength data on the lower graph will be updated as well and their icons will change to reflect the different values (i.e. high/low signal or high/low voltage). The user can continue to drag to any point on the graph and the values will constantly update. When the user stops touching the screen, the titles at the top of the screen and the values in the line selection table will return to their default values.

The figures below (Figure 40 - Figure 42) illustrate graphical soil moisture data being viewed in landscape mode. Notice the lower graph with the battery and signal strength data. Notice the colored FULL and REFILL areas and the Bar Graph button in Figure 42 that appear when viewing the sum value data.

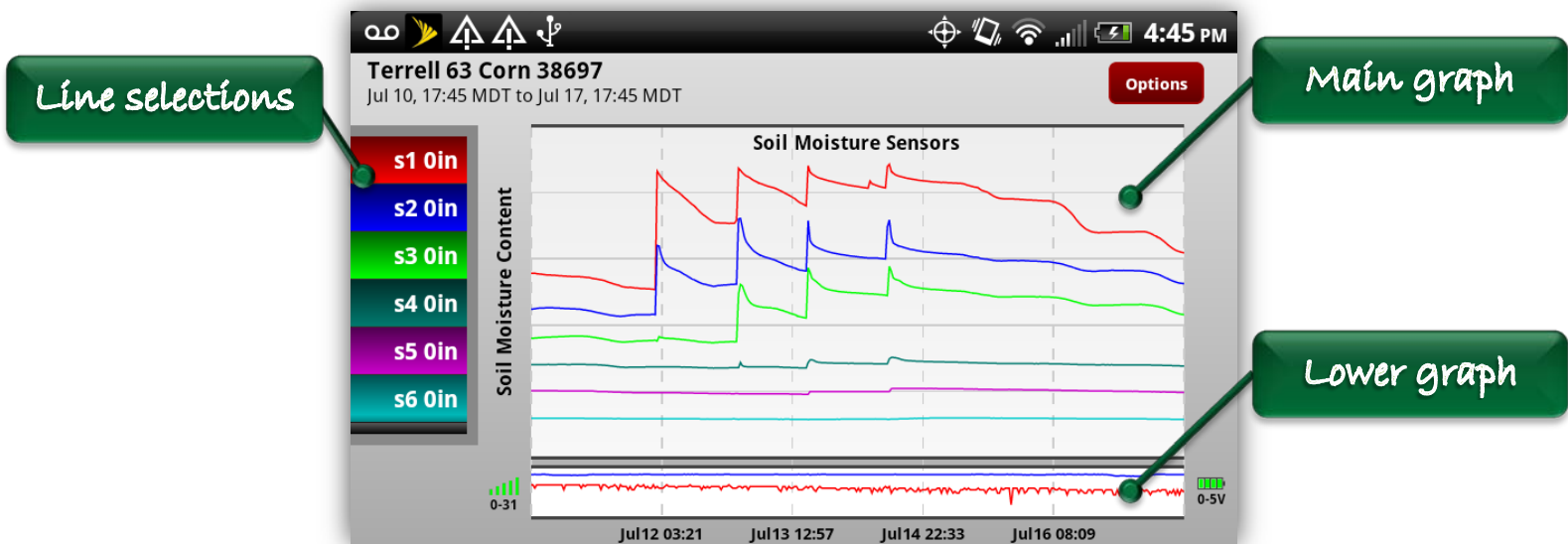
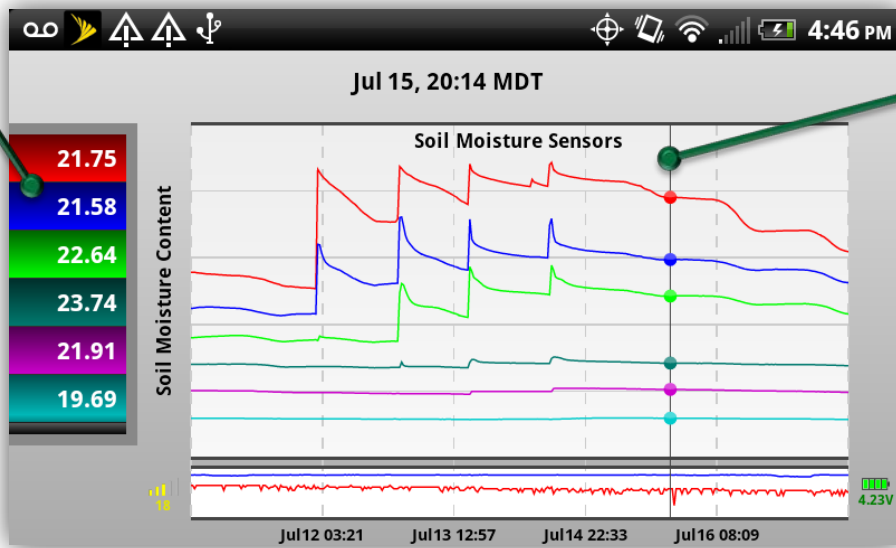


Figure 40: Soil Sensor Graph - Landscape View





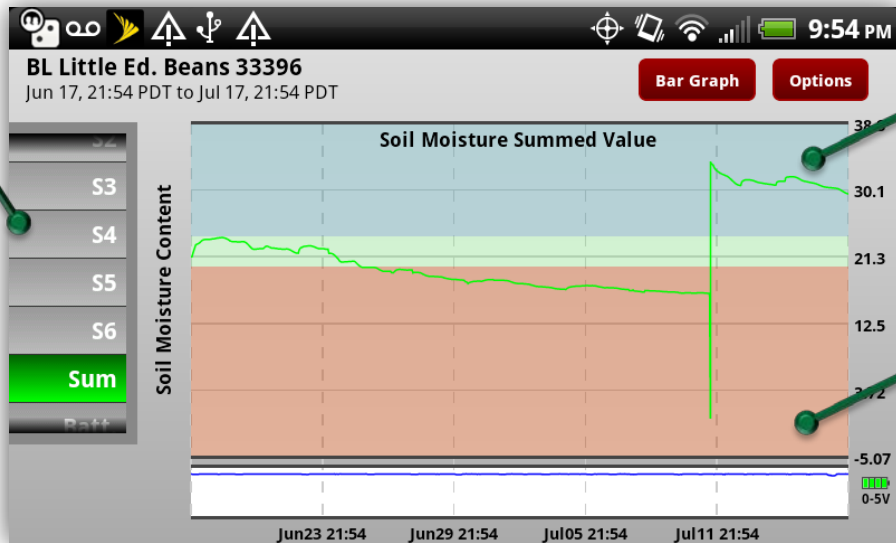
Data values



Touch point

Figure 41: Screen Touch in Landscape View

Line selections



Full area

Refill area

Figure 42: Soil Moisture Summed Value - Landscape View

### 3.7 Crop Link View

The Crop Link View is a tabbed view with up to five tabs across the top of the view depending on the types of sensors that are attached to the unit. These five tabs are Crop Link Info, Sensors, Soil Data, Grain Bin Data, and Graphs. The Sensors tab will be available if the unit has any analog or digital sensors attached or if either of the unit's two relays is enabled. The Soil Data tab will be available if the unit has a soil moisture probe attached, and the Grain Bin Data tab will be available if the



unit has a grain bin board attached. A user can navigate back and forth through any of these tabs to view data for the unit. At any time, the app icon at the top of the view can be used to go back to the List View and select another unit. The following sections describe the tabbed views and the functions that can be performed in each one.

### 3.7.1 Crop Link Info View

The Crop Link Info View is always selected by default as the first view that the user sees immediately after selecting a Crop Link from the List View. This view presents some basic information about the unit including the serial number, version, time of the last reading, and battery voltage. At the bottom of the screen is the same view that's used for Pivot Points and Field Commanders that allows the user to see the last five commands sent to the unit and any notes that have been recorded. If the user has sufficient permission, there will be an Add Note button available that allows the user to add new notes. Figure 43 below illustrates the Crop Link Info Tab.

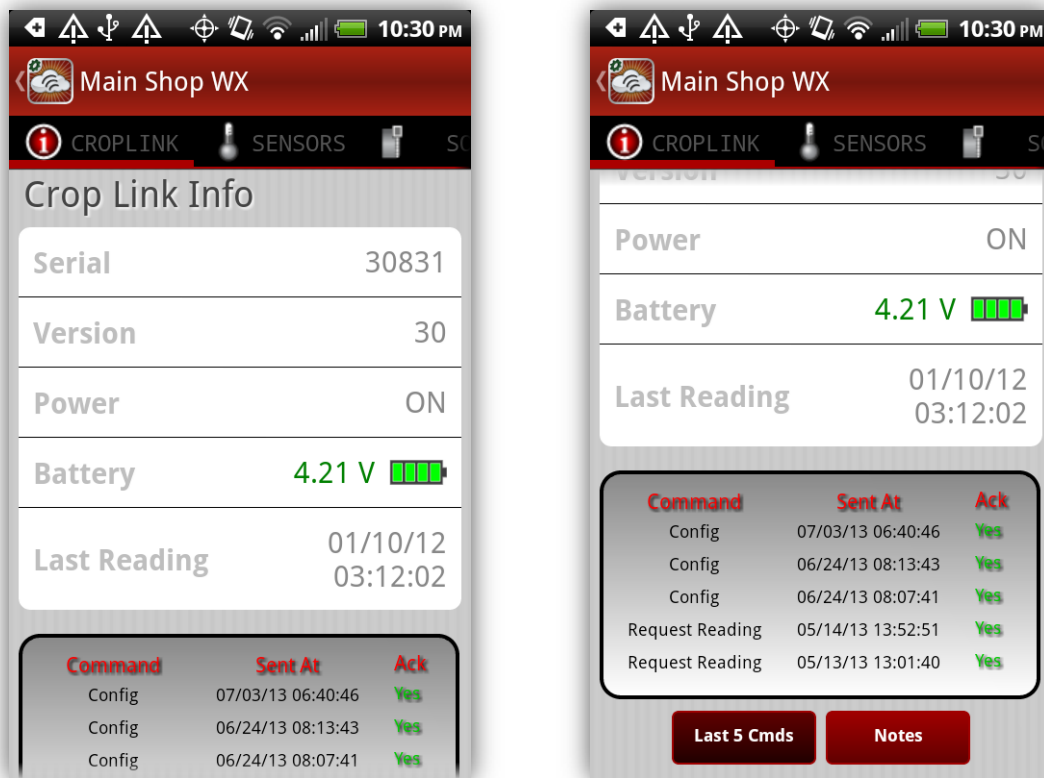


Figure 43: Crop Link View - Crop Link Info Tab



### 3.7.2 Sensors View

The Sensors View displays the current reading of every analog and digital sensor attached to the unit. For reference, the channel number to which the sensor is attached is also displayed. If there's historical data available for the sensor, then a selection indicator arrow will appear next to the reading and the row will be selectable. Selecting the sensor row will automatically transition the view to the Graphs tabs and the data for that sensor will be displayed. Sensors without any available historical data will simply display the most recent reading and will not show the selection indicator arrow.

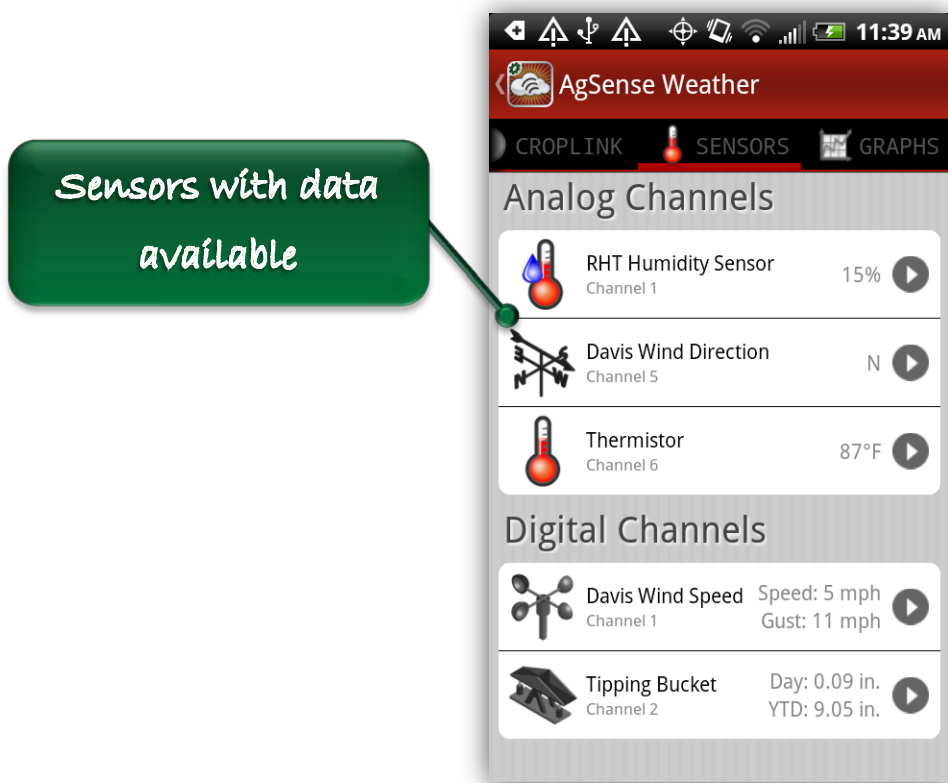


Figure 44: Sensors View - Sensor Data Available

The Sensors View also allows the user to send commands to any relays that are enabled (assuming that the user has sufficient permission to send those commands). Persistent relays will be shown with an ON/OFF switch indicating their current state and momentary relays will have a button labeled "Activate". Switching the ON/OFF switch or pushing the Activate button will bring up a dialog asking the user to confirm the intent to send a command to that relay. After a command is sent, an alert will appear to tell the user whether or not the command was sent successfully.



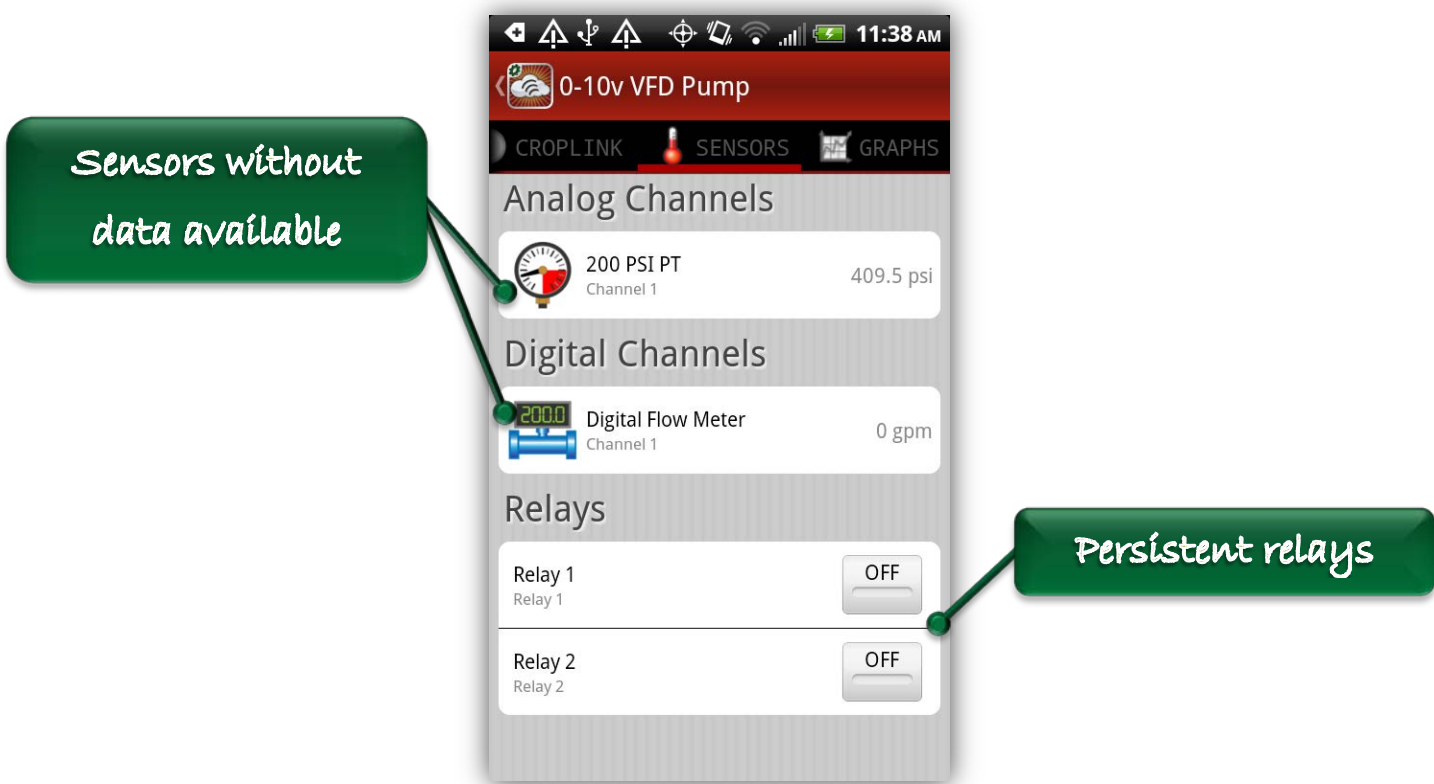


Figure 45: Sensors View - Relays

### 3.7.3 Soil Data View

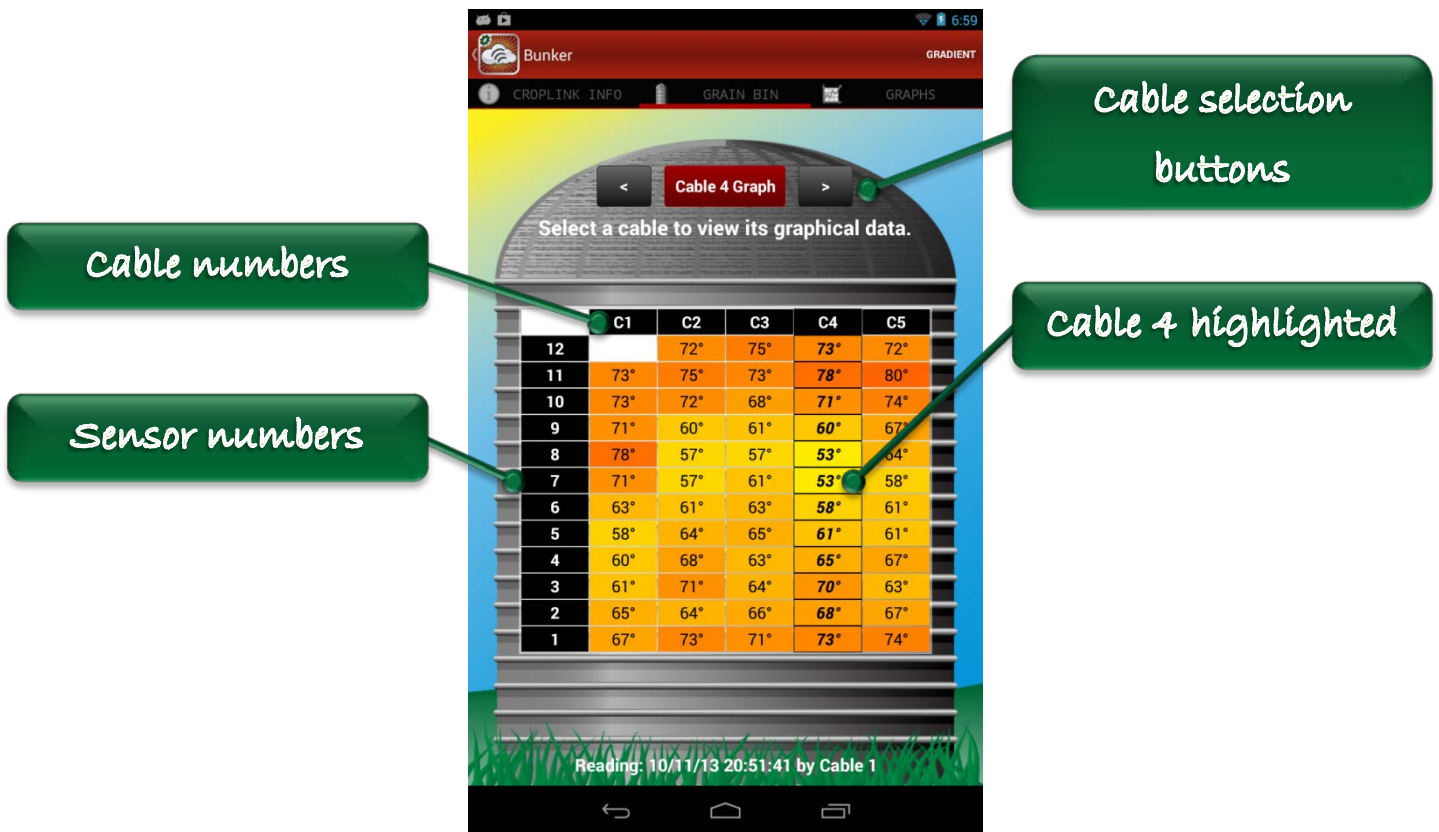
The Soil Data View for Crop Links is identical to the Soil Data View for Aqua Tracs and it displays the same current readings from a soil moisture probe. See Section 3.6.2 for a description of the Soil Data View.

### 3.7.4 Grain Bin View

The Grain Bin View displays the current temperature readings from all sensor cables attached to a particular grain bin. The user has the option to view the temperature data in either a list format or a gradient format. The list format is the default and it presents the numerical temperature readings of the sensors in a table. The sensor numbers are listed along the left side of the table and the cable numbers are listed across the top. The individual cells in the table represent a single sensor and display the current temperature reading from that sensor with a color-coded background. There are some instances where a sensor will have a non-numeric value. See Table 6 below for a description of these values. Above the table are three buttons that allow the user to scroll the table back and forth and select a given cable to view its graphical data. The currently selected cable is listed on the middle button and is highlighted on the table. Pressing the middle button will



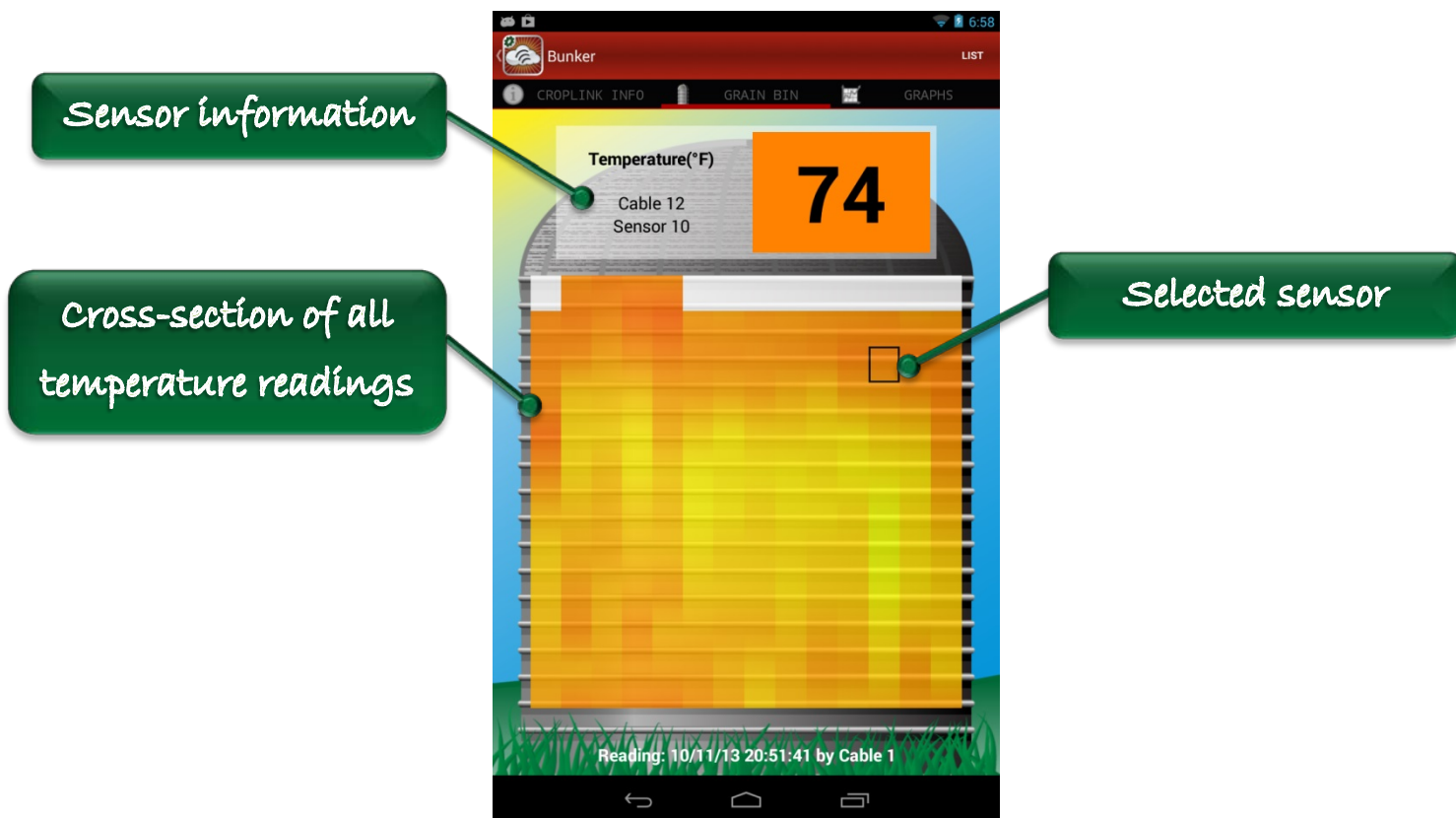
prompt a transition to the Graphs View and display the data for the selected cable. Figure 46 below shows an example of the list format with Cable 4 currently selected.



**Figure 46: Grain Bin View - List Format**

Often, the number of cables is too large to fit on the screen at once. The gradient format offers the user a view of the entire temperature profile of the bin showing all of the cables and all of their sensors. Pressing the Gradient button at the top right of the screen will switch between the list format and the gradient format. The gradient format displays a colored cross-section of the grain bin based on the reading from every cable and every sensor. In order to view the numerical values of any of the sensors, the user can simply touch the corresponding location on the view. The labels at the top of the screen will update with the selected cable and sensor numbers and the current reading of that sensor. There are some instances where a sensor will have a non-numeric value. See Table 6 below for a description of these values.

Figure 47 shows an example of the gradient format. In this example, Sensor 10 on Cable 12 is selected and its current reading is 74°F. When viewing the gradient format, the List button at the top right of the screen can be used to switch back to the list format.



**Figure 47: Grain Bin View - Gradient Format**

As described above, there are certain sensors that may have non-numeric values or cables may have different numbers of sensors. In these cases, the background color for that sensor will simply be white in either the list format or the gradient format. The following table describes the meanings of the various non-numeric sensor readings.

Sensor Reading	Description
<i>empty</i>	If the reading is empty, the cable has no sensor at this location
<b>OP</b>	Open Circuit
<b>SH</b>	Short Circuit
<b>OR</b>	Out of Range

**Table 6: Non-numeric Grain Bin Sensor Readings**

### 3.7.5 Graphs View

The Graphs View for Crop Links is very similar to the Graphs View for Aqua Tracs. This view supports both portrait and landscape orientations of the device for optimal viewing. The user can view analog & digital sensor data, soil moisture content data, grain bin temperature data, or battery voltage from up to the last thirty days. There are several types of graphs that can be shown, and in landscape



mode the user can touch the graph to view the data values at any particular point in time. See Section 3.6.3 above for a full description of different graph types and instructions for utilizing the graphical interface. All of the different graph types described for Aqua Tracs in Section 3.6.3 are also supported for Crop Links. The following subsections describe the graphing features that are unique to Crop Links.

### 3.7.5.1 Switching Data Groups

Depending on the types of devices that are attached to a Crop Link, the data may be organized into data groups that represent different categories of sensors. In particular, the data can be organized into any of the following groups: Analog & Digital Sensors, Soil Sensors, or Grain Bin Cable Sensors. Only one set of data lines can be plotted at any given time. Switching between the various data groups can be done by touching the DataGroups button on the Action Bar when the device is in portrait mode. When the device is in landscape mode, the Options button in the upper right corner will bring up an alert that gives the user the option of either changing the date range on the graph or changing the data group. If a unit doesn't contain types of sensors that can be divided into multiple data groups (for example if a unit only has an attached soil moisture probe or it only has analog sensors) then there won't be an option to switch between data groups on either the portrait or landscape view. Figure 49 shows the location of the DataGroups button on the Action Bar in portrait mode and Figure 48 shows the dialog that appears that allows the user to change the data group after pressing the Options button in landscape mode.

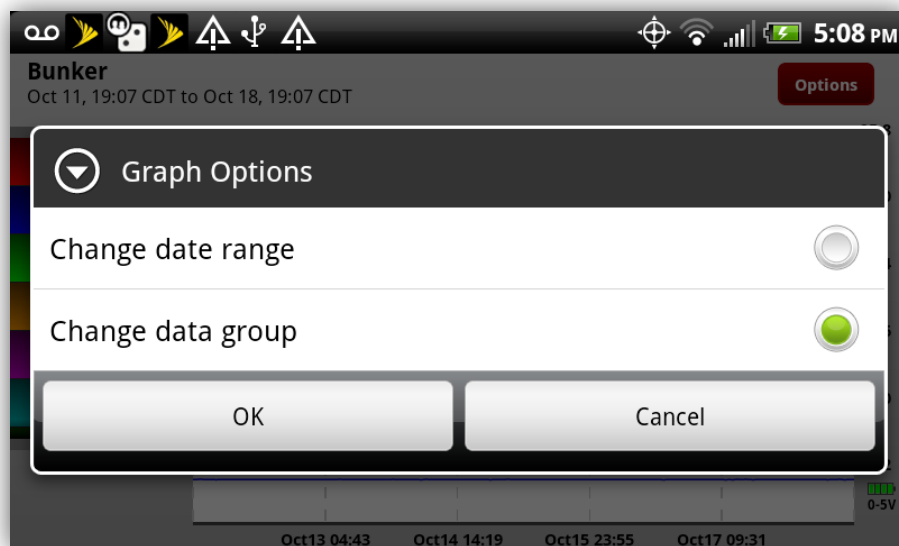
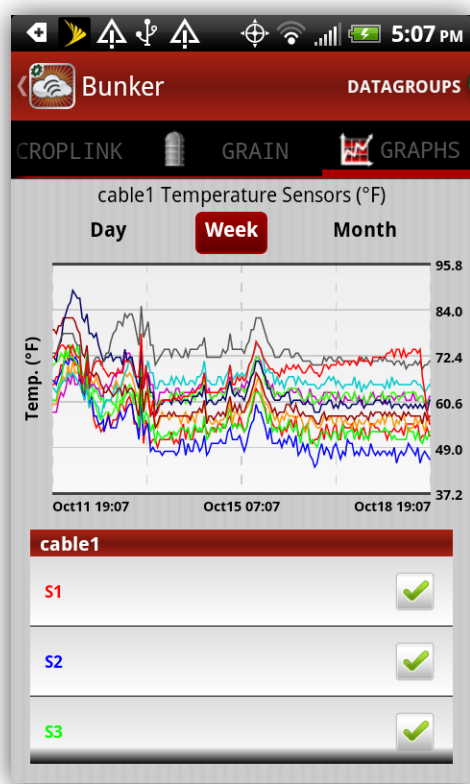


Figure 48: Change Data Group - Landscape View





Change data group

Figure 49: Change Data Group - Portrait View

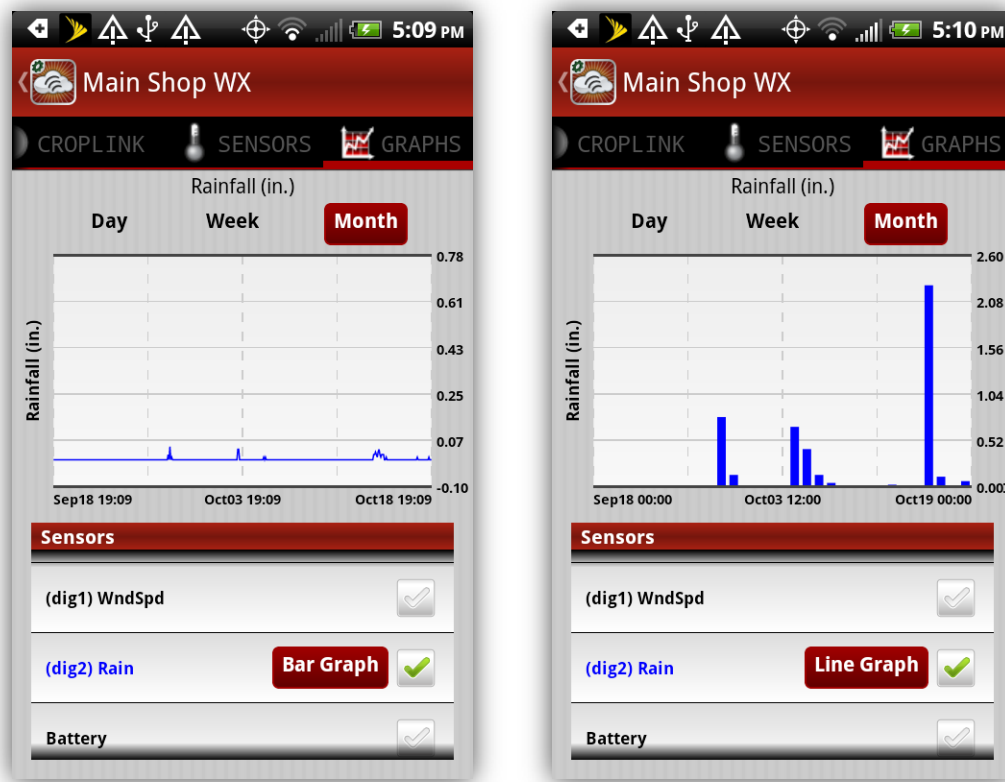
### 3.7.5.2 Bar Graph

The bar graph plot type is a standard graph that shows the sum of the data over various incremental time periods. In contrast to the cumulative change bar graph that's used for soil moisture sum values and described in Section 3.6.3.4, the standard bar graph simply adds all the data together in each incremental time period instead of calculating the total change throughout the time period. If the date range is set to one month or one week, the bar graph shows the summation of the data over each day. If the date range is set to one day, then the graph shows the summation of the data over each hour.

There are two types of sensors that can be attached to Crop Links that have data that can be viewed as either a standard Line Graph or a Bar Graph: a tipping bucket and a flow meter. If either one of these types of sensors is being plotted by itself, there will be a Bar Graph button that appears in the scrolling table next to the sensor label that can be used to switch between the bar graph and the standard line graph. In the landscape view, the Bar Graph button will appear at the top of the screen next to the Options button.

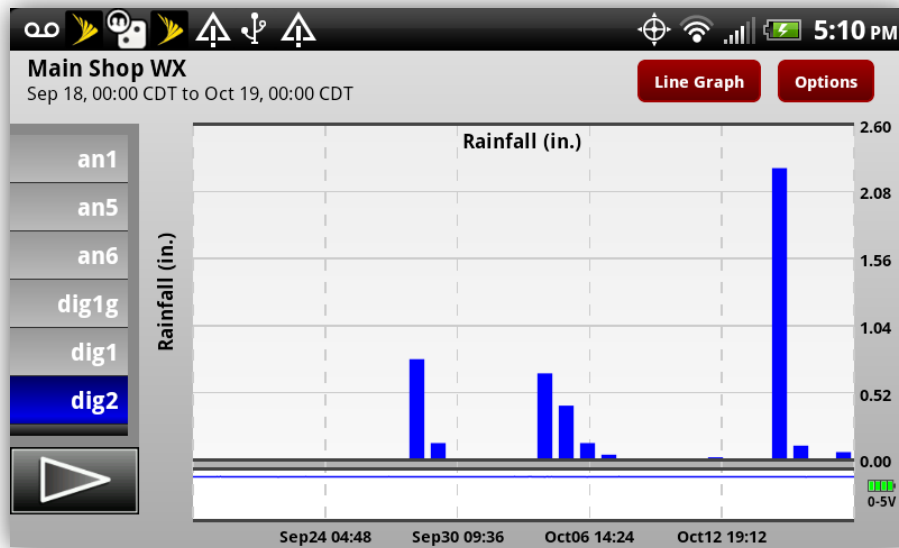






**Figure 50: Bar Graph - Portrait Mode**

Figure 50 shows an example of the bar graph option for a tipping bucket. Note the Bar Graph button that appears next to the line title in the scrolling table. This button switches the graph between a bar graph and a line graph. If the user selects any other line from the scrolling table, that graph will automatically be converted back to the standard line graph.



**Figure 51: Bar Graph - Landscape Mode**

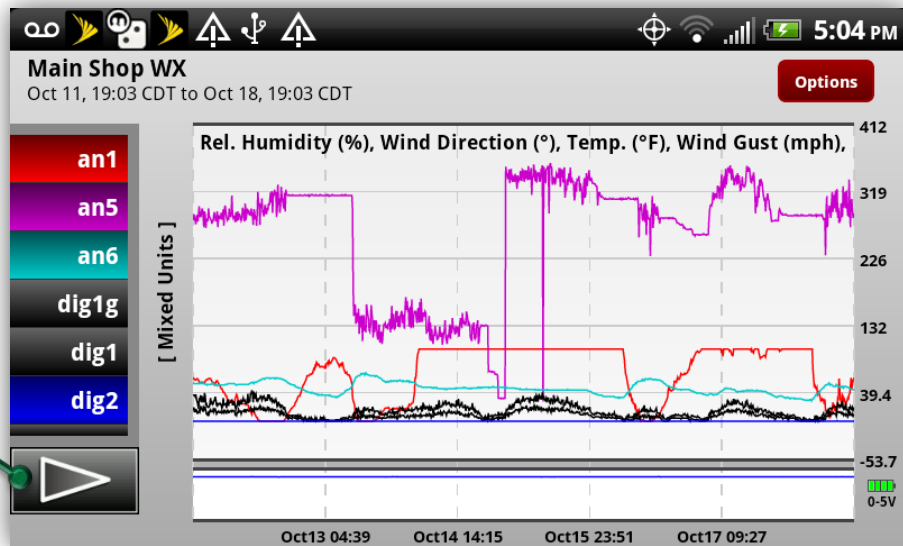
Figure 51 shows an example of the same bar graph for the tipping bucket in landscape mode. When the tipping bucket data line is the only line selected, a button appears in the upper right of the view next to the Options button. This button switches the graph between a bar graph and a line graph in the same manner and the graph will automatically be converted back to the standard line graph if the user selects any other lines.

### 3.7.5.3 Sensor Label View

In the landscape view, the line selections are made using the scrolling line selection table along the left side of the view as described in Section 3.6.3.5 above. The default labels in the line selection table read "S1", "S2" etc. for soil sensors or grain bin cable sensors and they read "an1", "an2", "dig1", "dig2" etc. for the analog and digital sensors. When the Analog & Digital Sensors data group is being viewed, the scrolling line selection table can slide out from the left side of the screen to reveal the type of sensor connected to each channel and the measurement units for that sensor. A black button with a direction arrow will appear beneath the selection table if there is additional information that can be revealed about the sensors.



Reveal sensor details



Hide sensor details

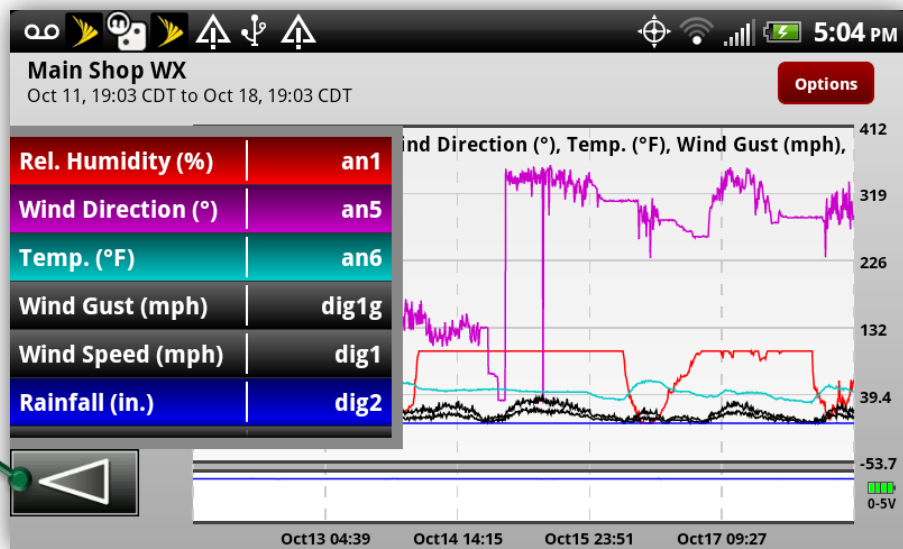


Figure 52: Showing Sensor Details - Landscape Mode

Figure 52 shows the black button that allows the user to reveal additional data about the sensor lines. The additional information describes the quantity being measured by each sensor and the measurement units of the data. When the additional information is revealed, the user can still scroll the table normally and select or unselect lines. If the user touches the graph or presses the Options button, the selection table will automatically retract to its default position.



## 4 System Requirements

This version of WagNet Mobile, version 4.1, requires Android 2.3.3 or higher. Also, installing WagNet Mobile requires the use of the following system services:

### Your location

- approximate location (network-based)
- precise location (GPS and network-based)

### Network communication

- full network access
- view network connections

### Storage

- modify or delete the contents of your USB storage

### Your accounts

- read Google service configuration

### System tools

- test access to protected storage

Trying to install the app from either the Google Play Store on a device or the Google Play Web Store will prompt the user to accept these permission requirements before the installation can begin.

## 5 Support

WagNet Mobile for Android can be found in the Google Play Store on your mobile device in the Business and Weather categories or by using the following link:

<https://play.google.com/store/apps/details?id=net.wagnet.wagnetmobile>

For comments, questions, suggestions for feature enhancements, or to report bugs, please email:

Steve Sveum

VP – Marketing and Sales

[ssveum@agsense.net](mailto:ssveum@agsense.net)

or send an email to AgSense customer support at:

<http://www.agsense.net/html/contactus.htm>

WagNet Mobile was developed by SajWorks, LLC of Las Vegas, NV. For technical questions or to request a quote, please email:

Matt Boyd – Owner, SajWorks LLC

[mboyd@sajworks.com](mailto:mboyd@sajworks.com)

