



# FlowTracker2

**June 13<sup>th</sup> 2016**

**OSW Webinar**

**Mike Rehmel**

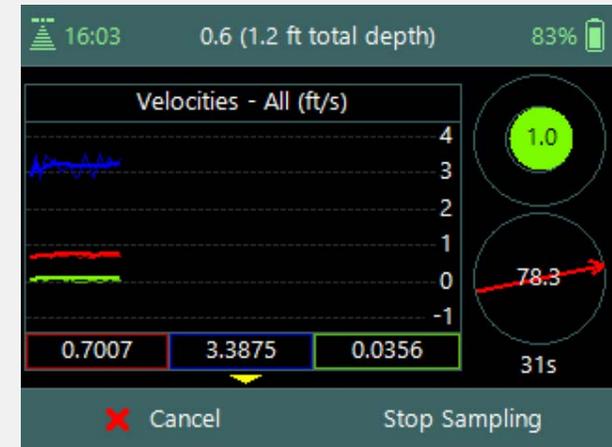
**Alex Laffoon, Iowa WSC**

**U.S. Department of the Interior**

**U.S. Geological Survey**

# FlowTracker 2

- New Hardware
- New Software
- USGS Testing So Far
- Sharing comparison data



# FlowTracker2 Hardware -Separate Handheld and Probe



# Handheld

- Color screen
- Data graphs
- Tactile Button
- Built-in GPS
  - Geolocation tagging
  - Set clock
- Audible alerts



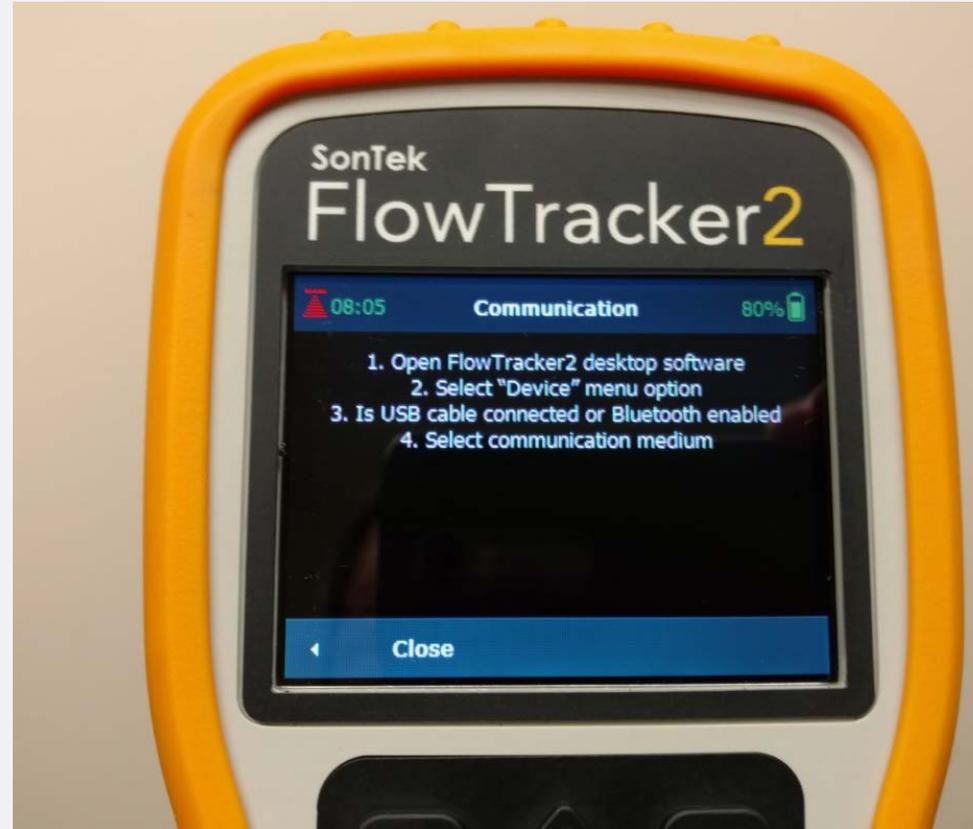
# Power

- 8 AA batteries
- Approx. 15 hours
- Can change batteries during data collection and still resume measurement



## Communications to PC

- Built-in Bluetooth
- Waterproof micro USB for wired connection
- Download data
- Update Firmware



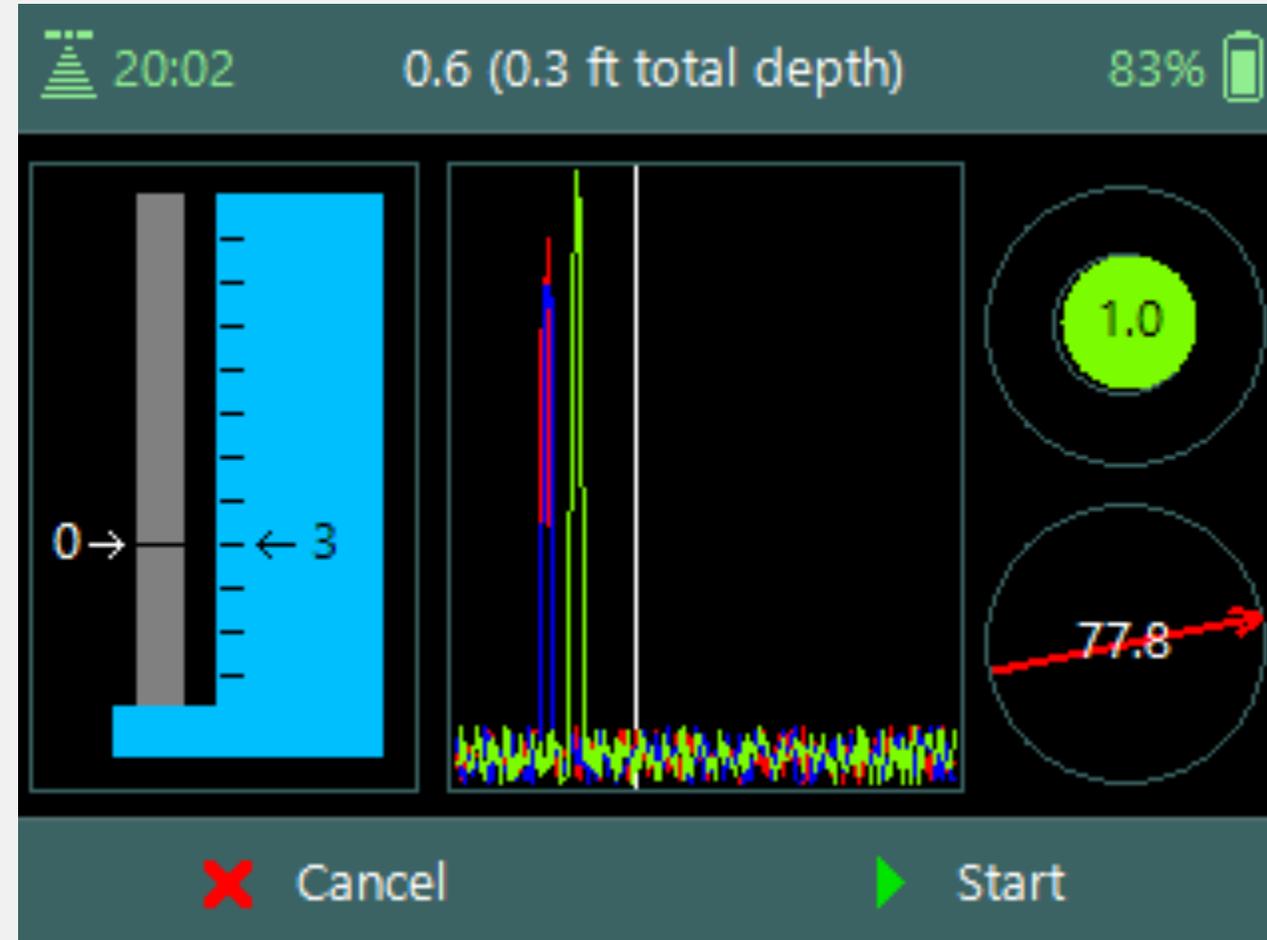
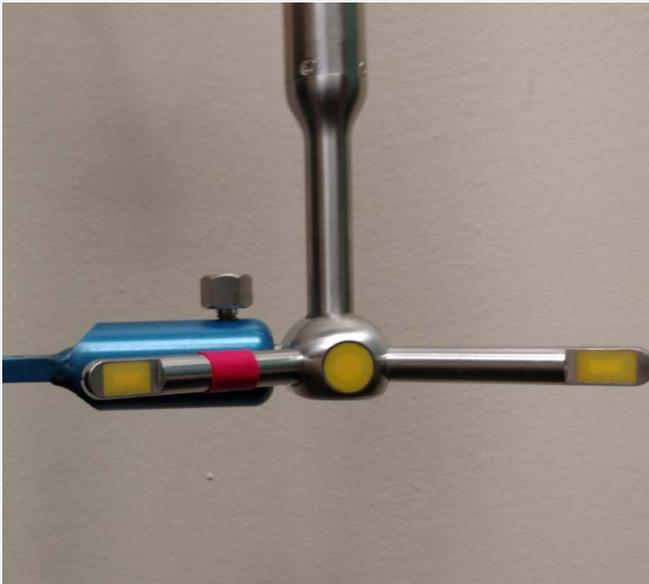
# Probe

- Similar transducer design to FlowTracker1
- ADV electronics now in Probe
  - Allows probe to be separate
  - Better SNR response
  - Can purchase cable extension
- Pings at 40 Hz ( vs 10 Hz)
- Stores data at 2 Hz (vs 1 Hz)



# Probe

- Built in tilt sensor – ensure probe is level



## New “J”-Bracket

- Larger setscrew that mates with recess in probe mounting arm
- Provides more consistent mounting
  - Easier Alignment
  - More secure
- Suggested use by SonTek

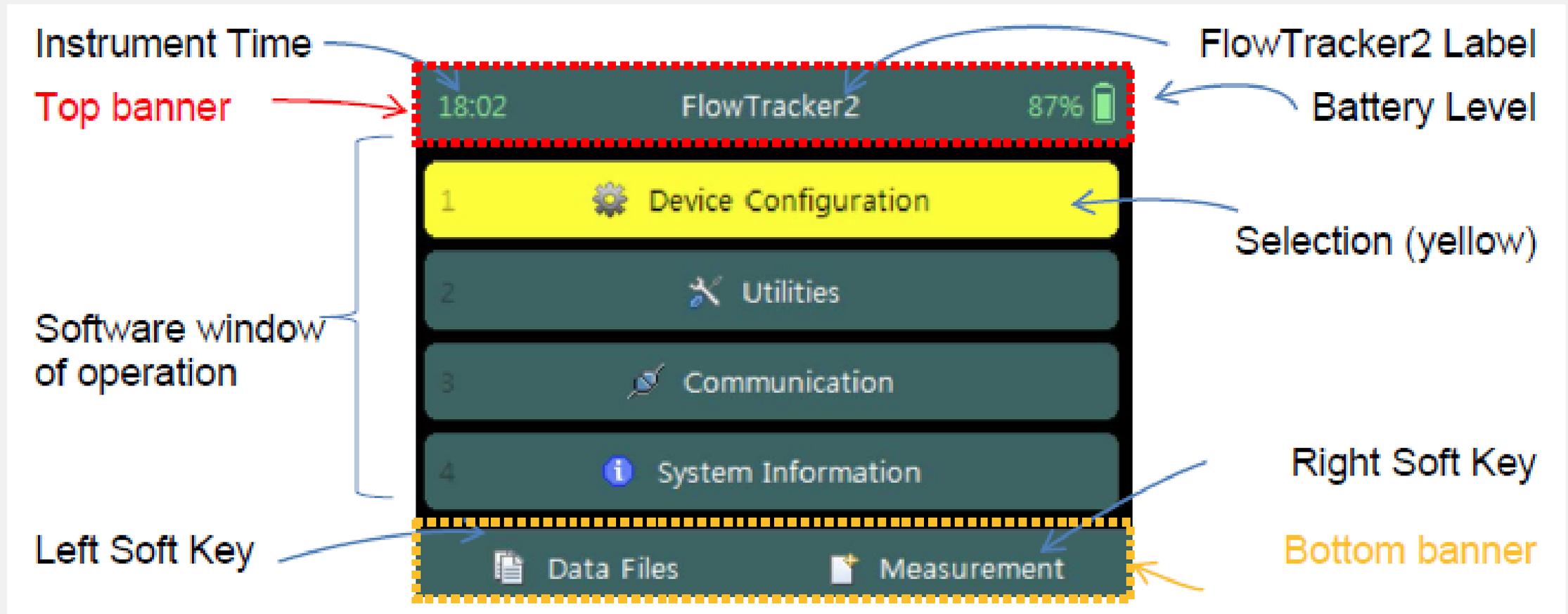


# Handheld Interface

- Soft keys on top left and right with arrow buttons for navigating
- Left soft key
  - Return to previous menu
  - Restart/cancel
  - Select action
- Right soft key
  - Start new measurement
  - Accept /new
  - Quality control menu
- Enter – key in middle of arrows
  - Select

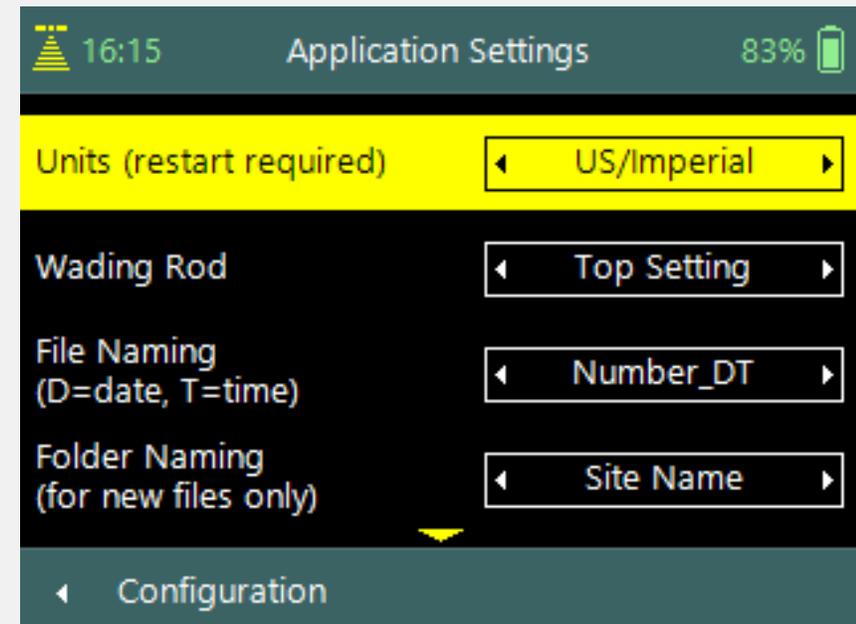
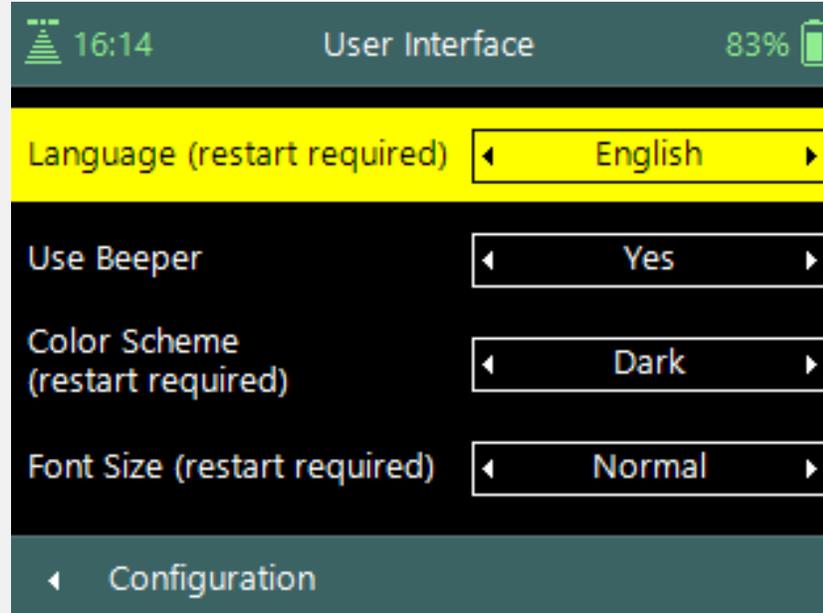


# Handheld Screen Layout



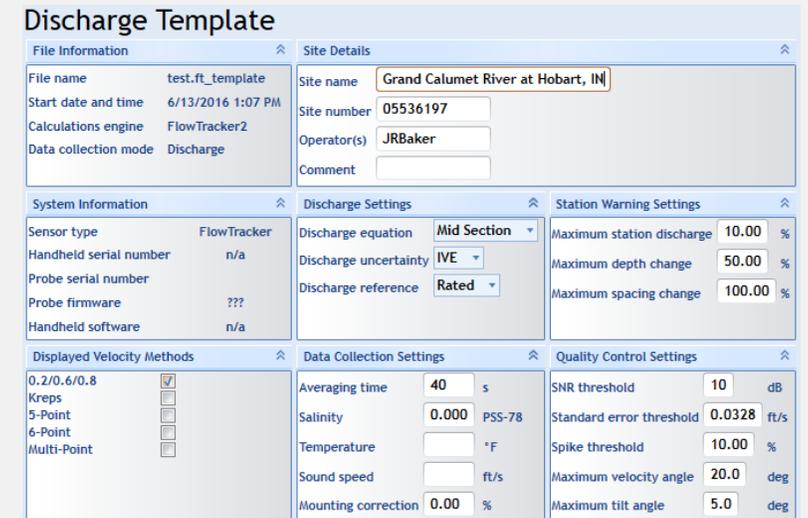
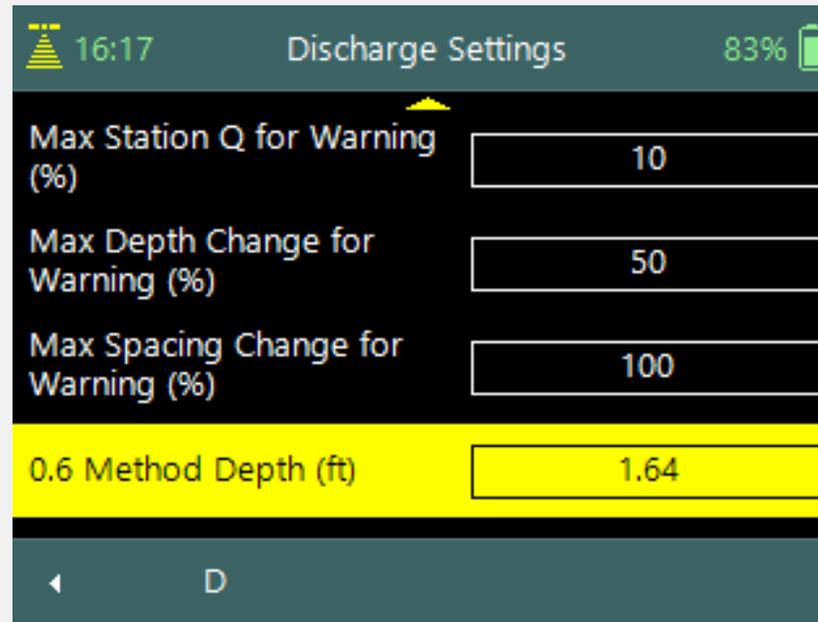
# Device Configuration

- User Interface
- Applications Settings
- Discharge Templates

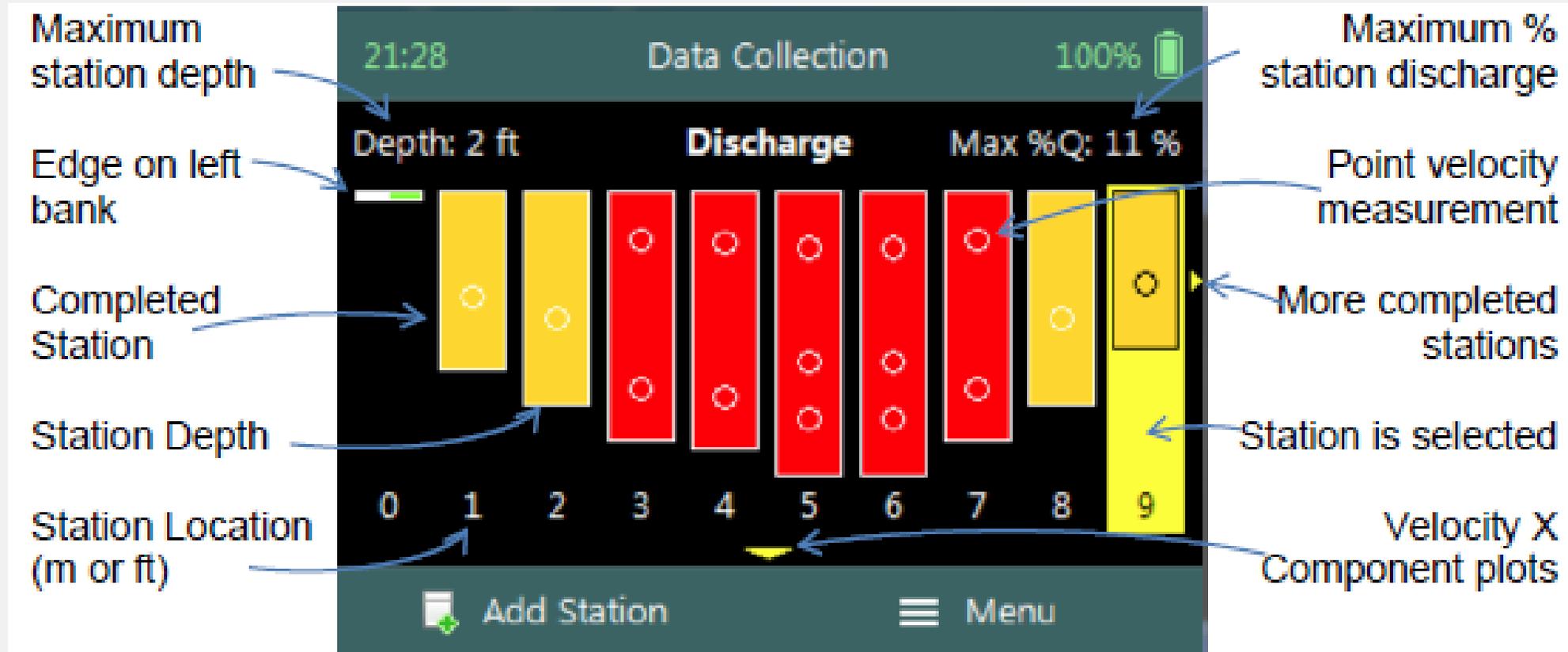


# Discharge Templates

- Saves settings for a measurement
- Example: can create a template for each station that populates the station name and number.
- Can be created on handheld or in PC software and uploaded to handheld



# Handheld Data Collection Screen



# Adding a Station

- At each vertical
  - Enter location
  - Depth
  - Station type
  - Velocity method
- Press measure (right soft key)

14:05 Add Station 83%

Location (ft) 1

Depth (ft) 0.3

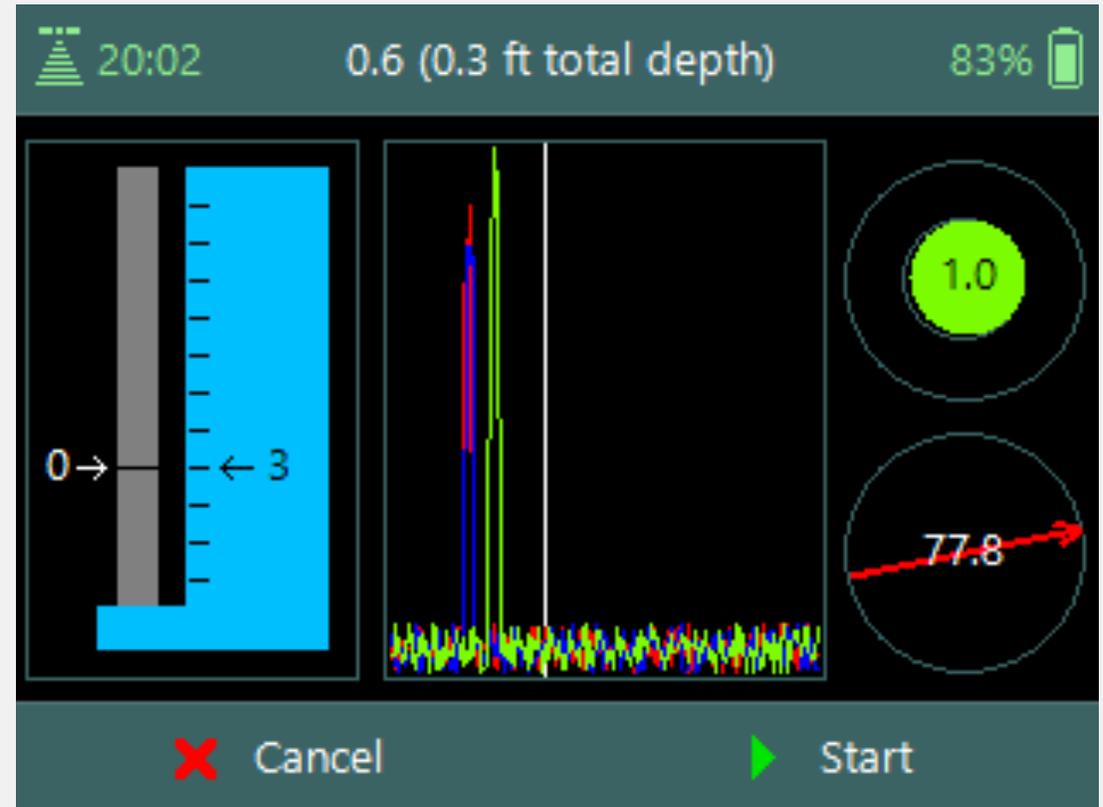
Station Type Open Water

Velocity Method (push for options) 0.6

Cancel Measure

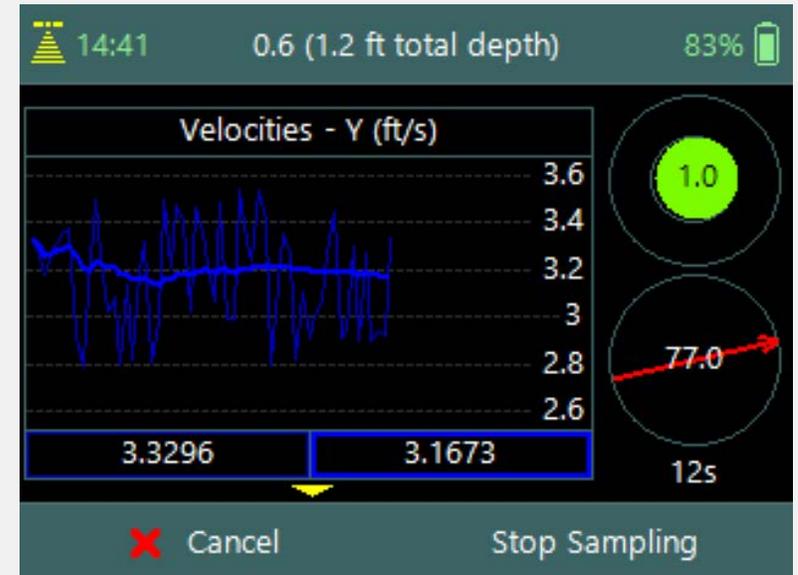
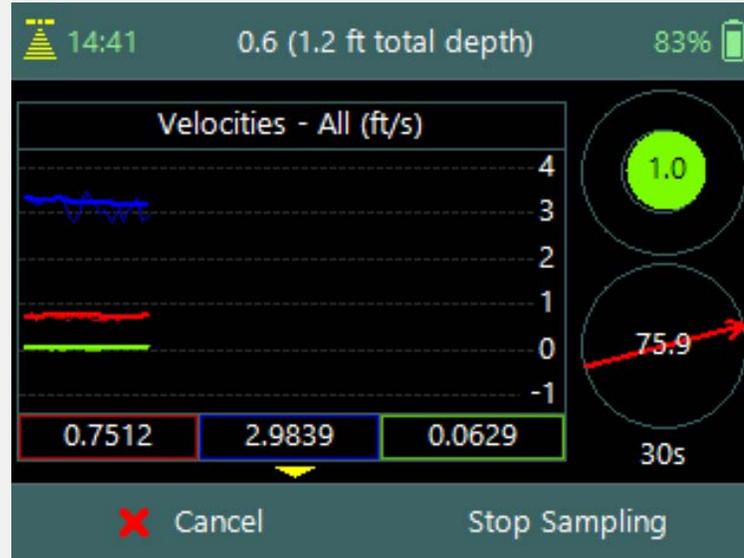
# Prior to Starting Each Point Measurement

- Graphic indicates top setting rod location
- Level indicator to insure probe is level
- Angle displays flow direction. Not used for aligning FlowTracker
- Live beam SNR information prior to starting measurement



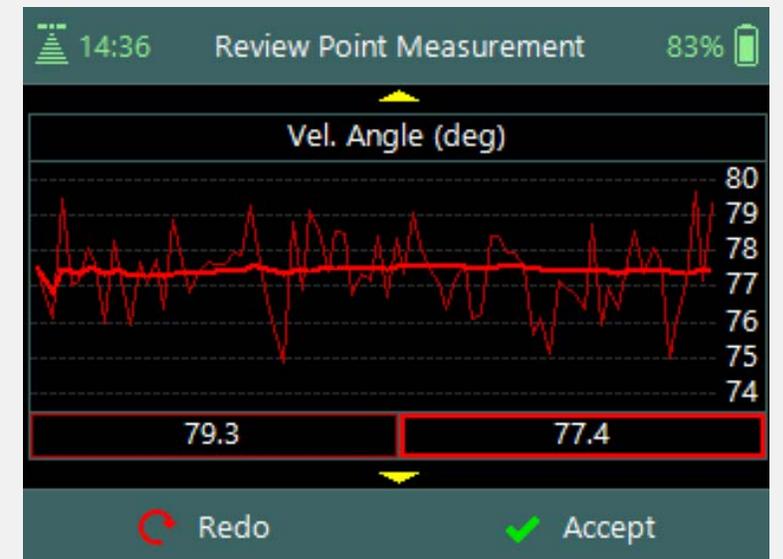
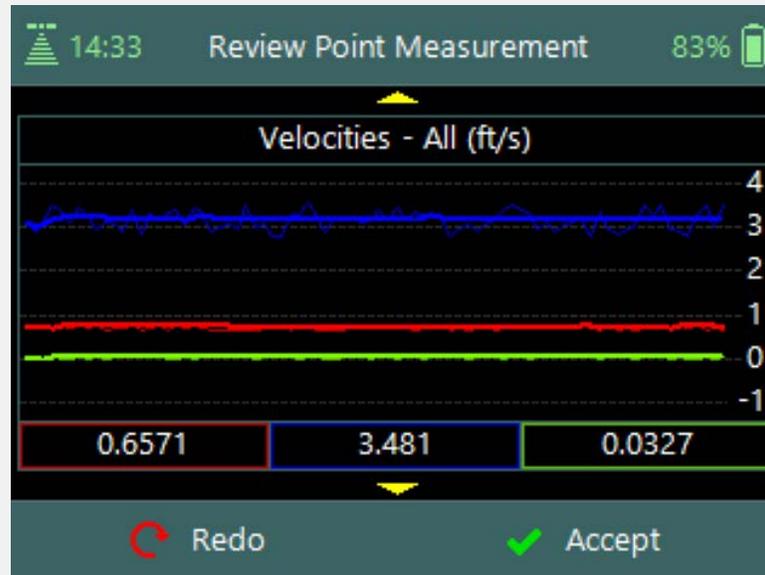
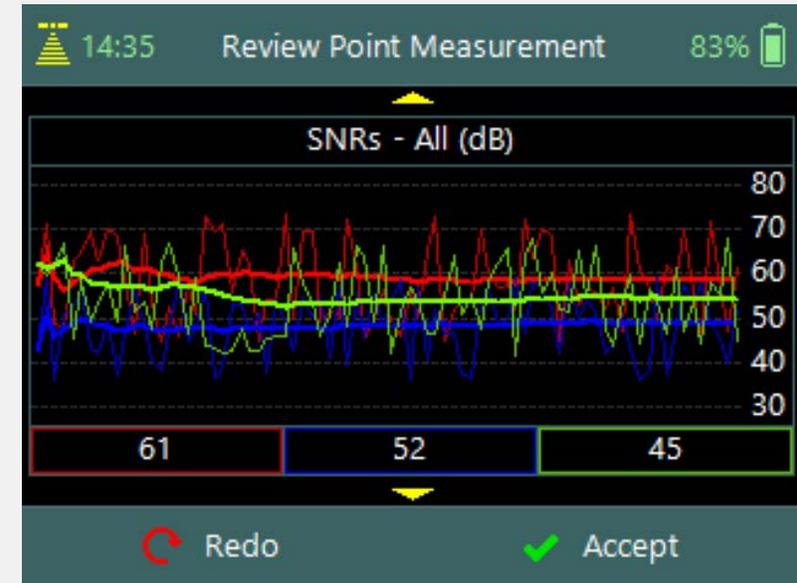
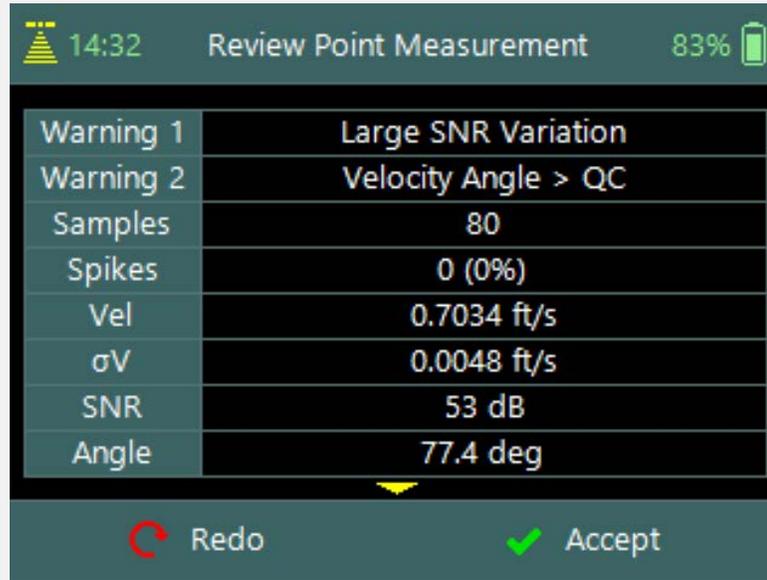
# Graphs

- Number buttons (1, 2,3, 4) toggle what is displayed (velocity on graphs X,Y, all)
- Moving average vs individual samples



# Point Review

- Displays QC warnings at end of point measurement
- Can review graphs
  - Velocity
  - SNR
  - Temperature
  - Tilt
  - Vel angle



# FlowTracker2 Software

FlowTracker2

View Data Device Export Settings Utilities Manual About

Dysart0216\_20160217-112836

Measurement Summary

Section Stations Area Sensors Supplemental data Diagnostics Summary

Settings

Site Details

Site name: Dysart0216  
 Site number:   
 Operator(s): Aji  
 Comment:

Station Warning Settings

Maximum station discharge: 10.00 %  
 Maximum depth change: 50.00 %  
 Maximum spacing change: 100.00 %

Discharge Settings

Discharge equation: Mid Section  
 Discharge uncertainty: IVE  
 Discharge reference: Rated

Data Collection Settings

Salinity: 0.000 PSS-78  
 Temperature:  °F  
 Sound speed:  ft/s  
 Mounting correction: 0.00 %

File Information

File name: Dysart0216\_20160217-112836.ft  
 Start date and time: 2/17/2016 10:23 AM  
 Calculations engine: FlowTracker2  
 Data collection mode: Discharge

System Information

Sensor type: Top Setting  
 Handheld serial number: FT2H1542013  
 Probe serial number: FT2P1538001  
 Probe firmware: 1.17  
 Handheld software: 1.0.9

Discharge Summary

# Stations	28	Avg interval	40
Mean depth	1.522 ft	Total width	108.000 ft
Mean velocity	1.1229 ft/s	Total area	164.3500 ft <sup>2</sup>
Mean SNR	35 dB	Total discharge	184.5448 ft <sup>3</sup> /s
Mean temp	33.399 °F		

Discharge Uncertainty

Category	ISO	IVE
Accuracy	1.0 %	1.0 %
Depth	0.1 %	1.3 %
Velocity	0.3 %	1.6 %
Width	0.1 %	0.1 %
Method	1.0 %	

Discharge chart

Velocity chart

Depth chart

# Measurement Summary Window

- File Information
- System Information
- Discharge Summary
- Discharge Uncertainty

Dysart0216\_20160217-112836

### Measurement Summary

#### File Information

File name	Dysart0216_20160217-112836.ft		
Start date and time	2/17/2016 10:23 AM		
Calculations engine	FlowTracker2		
Data collection mode	Discharge		

#### System Information

Sensor type	Top Setting		
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#### Discharge Summary

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Mean temp	33.399 °F	Total discharge	184.5448 ft <sup>3</sup> /s

#### Discharge Uncertainty

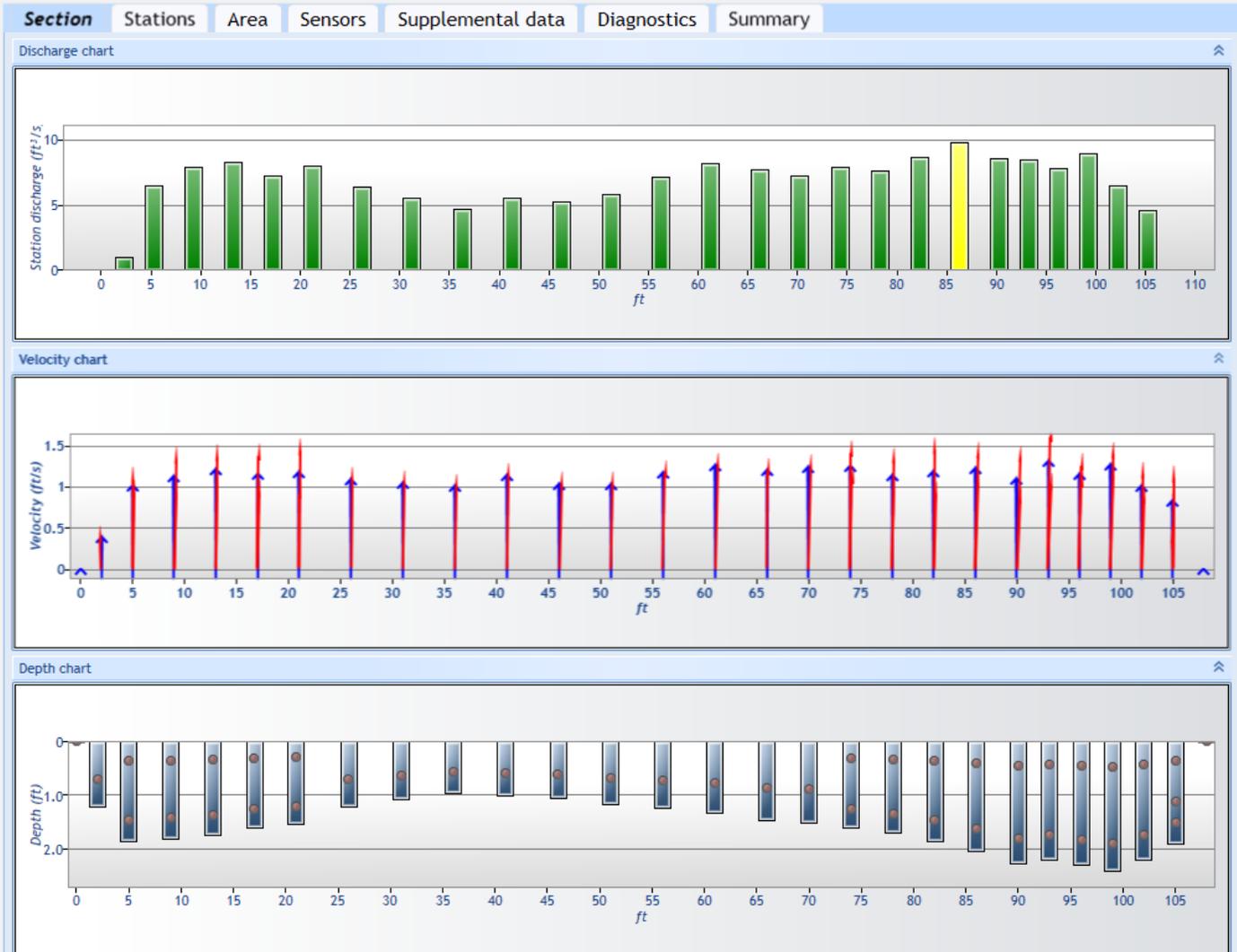
Category	ISO	IVE
Accuracy	1.0 %	1.0 %
Depth	0.1 %	1.3 %
Velocity	0.3 %	1.6 %
Width	0.1 %	0.1 %
Method	1.0 %	
# Stations	1.8 %	
Overall	2.3 %	2.3 %

#### Viewer Controls

Chart size +      Chart size -

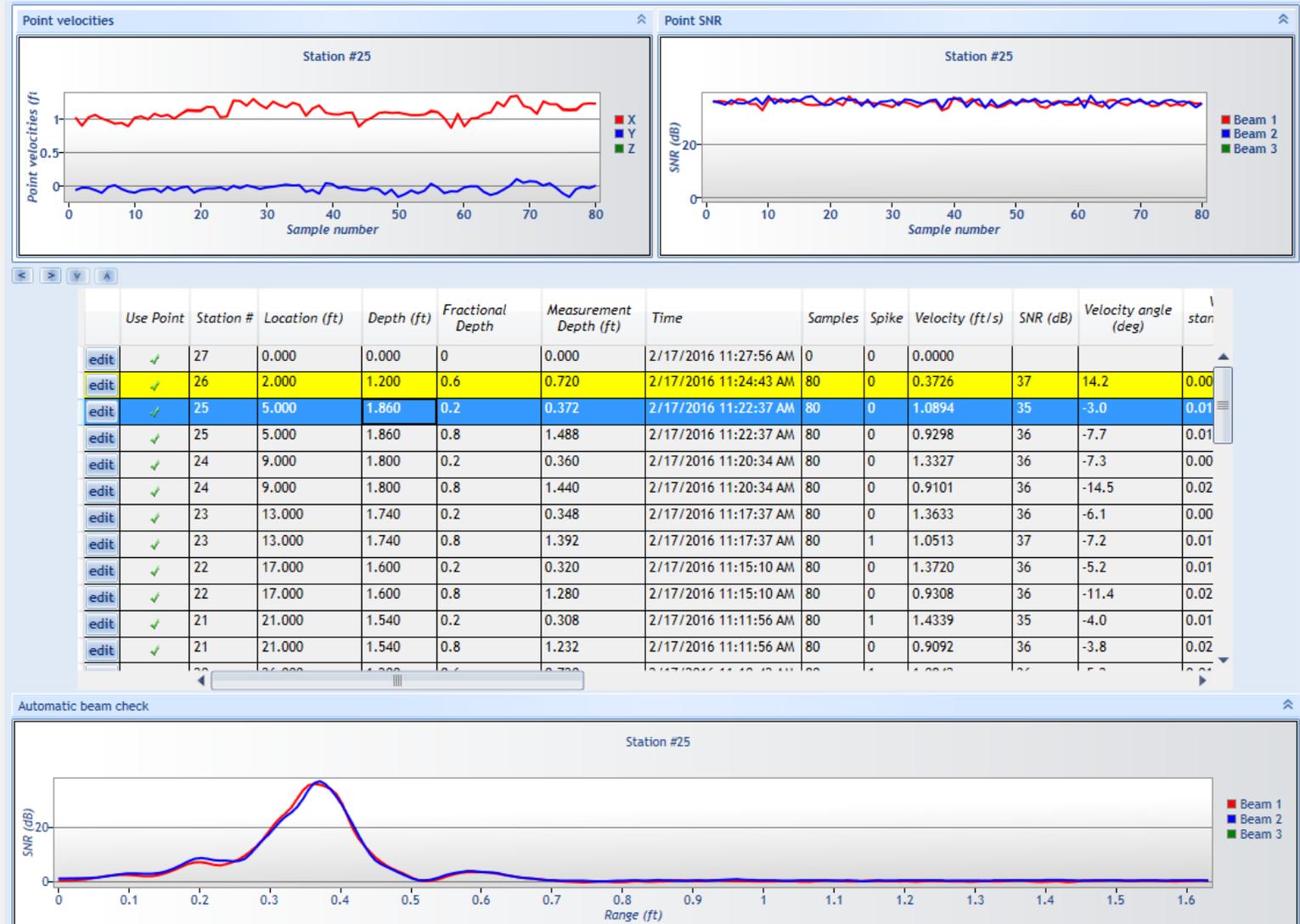
# Section Tab

- Discharge
- Velocity
- Depth with sample locations



# Stations Tab

- Unit value velocity and SNR plots for selected sample
- Table of samples
- Beam check of sample
  - From single ping collected prior to each sample



## Stations Tab – Cont.

- Can change erroneous locations, depths or correction factors
- Can mark section with erroneous velocity as not used

The screenshot displays the 'Stations' tab in a software interface. At the top, there are navigation tabs: Section, Stations, Area, Sensors, Supplemental data, Diagnostics, and Summary. Below these, the 'Station point measurement details' section is visible, featuring a 'Point velocities' graph and a table of data points. An 'Edit point measurement data' dialog box is open, showing details for Station # 26, including Time, GPS coordinates, Station type, Velocity method, Location, Depth, and Correction factor. The dialog box has buttons for 'Remove measurement', 'Revert to original', 'Accept', and 'Cancel'.

Station point measurement details

Point velocities

Point SNR

Currently editing data point at Station # 26

Time 2/17/2016 11:24:43 AM

GPS Latitude 42.251

GPS Longitude -92.300

Station type **Open Water**

Velocity method **0.6**

Location 2.000 ft

Depth 1.200 ft

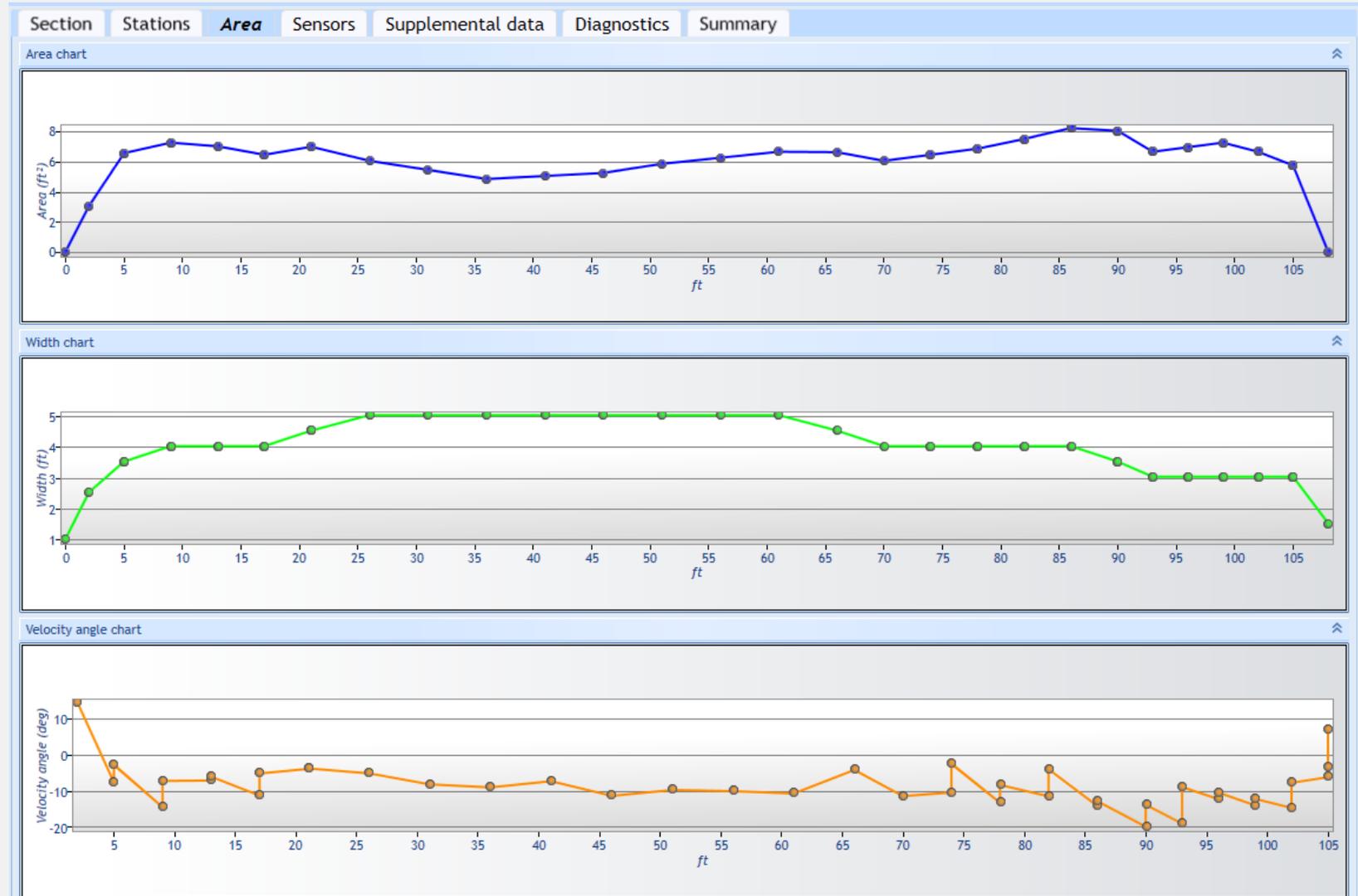
Correction factor 1

Comment

	Use Point	Station						
<input type="button" value="edit"/>	✓	27						
<input type="button" value="edit"/>	✓	26						
<input type="button" value="edit"/>	✓	25						
<input type="button" value="edit"/>	✓	25						
<input type="button" value="edit"/>	✓	24						
<input type="button" value="edit"/>	✓	24						
<input type="button" value="edit"/>	✓	23						
<input type="button" value="edit"/>	✓	23						
<input type="button" value="edit"/>	✓	22	17.000	1.600	0.2	0.320	2/17/2016 11:15:10 AM	80
<input type="button" value="edit"/>	✓	22	17.000	1.600	0.8	1.280	2/17/2016 11:15:10 AM	80
<input type="button" value="edit"/>	✓	21	21.000	1.540	0.2	0.308	2/17/2016 11:11:56 AM	80

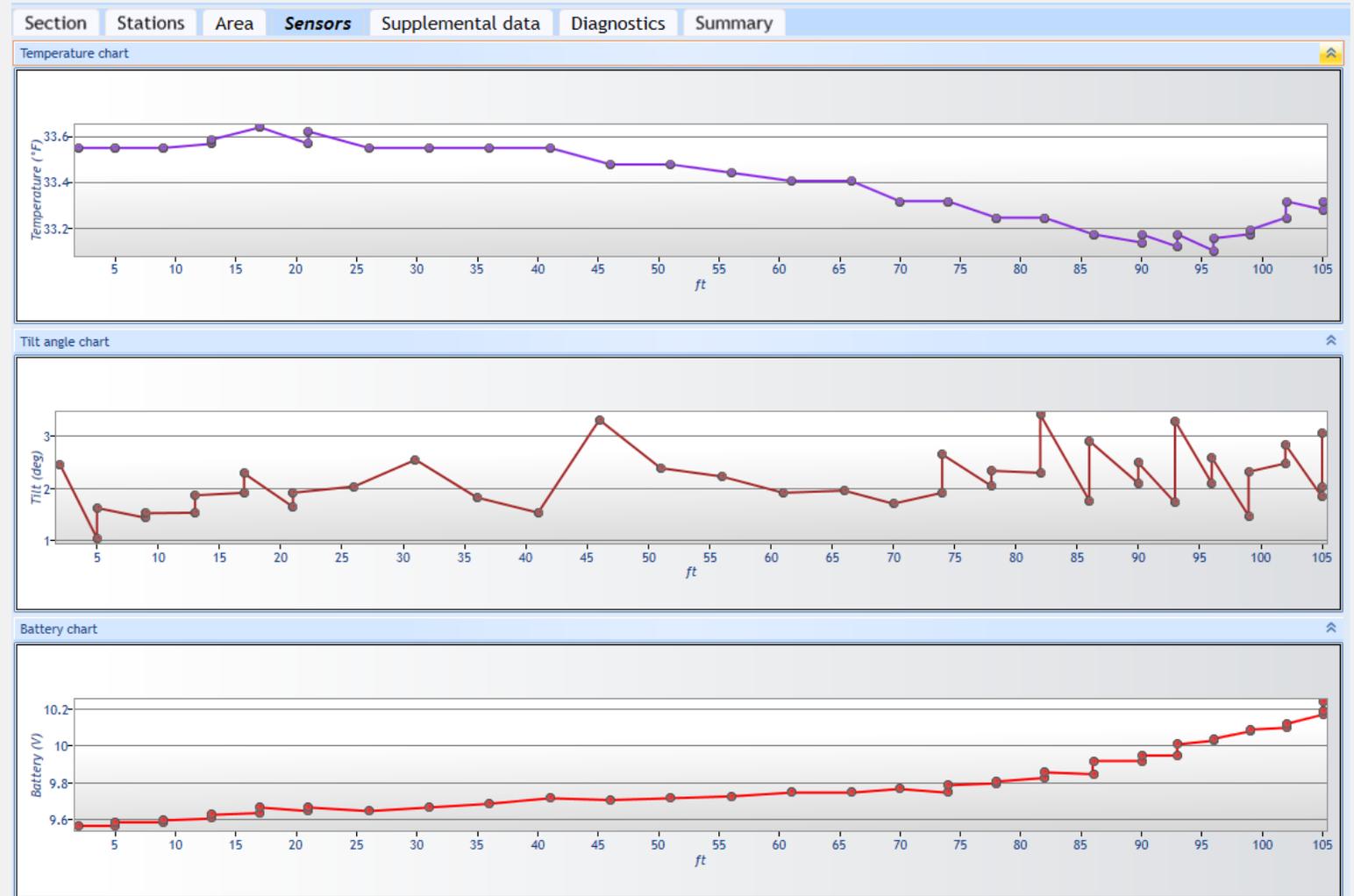
# Area Tab

- Area
- Width
- Velocity



# Sensors Tab

- Temperature
- Tilt
- Battery



# Supplemental Data Tab

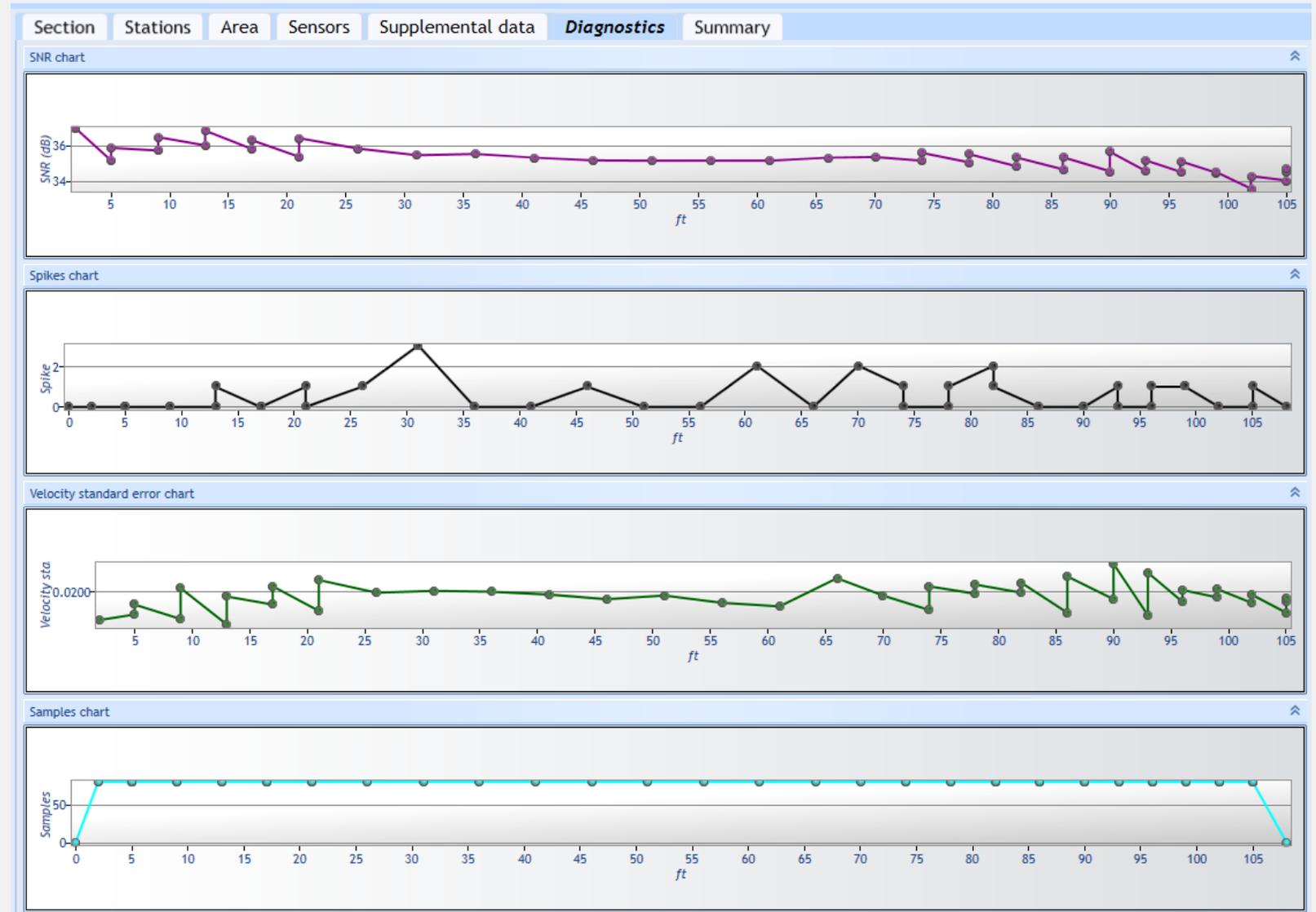
- Gage heights
- Rated Discharge
- Gage height comments

The screenshot shows a web interface with a navigation bar at the top containing tabs: Section, Stations, Area, Sensors, **Supplemental data**, Diagnostics, and Summary. Below the navigation bar is a button labeled "Add supplemental data". Underneath the button is a table with the following columns:

		Gauge height time	Gauge height (ft)	Rated discharge (ft <sup>3</sup> /s)	Gauge height comments

# Diagnostics Tab

- Mean SNRs
- Spikes
- Velocity Std Errors
- # Samples



# Summary Tab

Section Stations Area Sensors Supplemental data Diagnostics **Summary**

## Discharge Measurement Summary

**File Information**

File name: Dysart0216\_20160217-112836.ft  
 Start date and time: 2/17/2016 10:23 AM  
 Calculations engine: FlowTracker2  
 Data collection mode: Discharge

**System Information**

Sensor type: Top Setting  
 Handheld serial number: FT2H1542013  
 Probe serial number: FT2P1538001  
 Probe firmware: 1.17  
 Handheld software: 1.0.9

**Discharge Uncertainty**

Category	ISO	IVE
Accuracy	1.0 %	1.0 %
Depth	0.1 %	1.3 %
Velocity	0.3 %	1.6 %
Width	0.1 %	0.1 %
Method	1.0 %	
# Stations	1.8 %	
Overall	2.3 %	2.3 %

**Summary overview**

No changes were made to this file  
 Quality control warnings

**Discharge Summary**

# Stations: 28      Avg interval: 40  
 Mean depth: 1.522 ft  
 Mean velocity: 1.1229 ft/s      Total width: 108.000 ft  
 Mean SNR: 35 dB      Total area: 164.3500 ft<sup>2</sup>  
 Mean temp: 33.399 °F      Total discharge: 184.5448 ft<sup>3</sup>/s

**Site Details**

Site name: Dysart0216  
 Site number:   
 Operator(s): Ajl  
 Comment:

**Discharge Settings**

Discharge equation: Mid Section  
 Discharge uncertainty: IVE  
 Discharge reference: Rated

**Station Warning Settings**

Maximum station discharge: 10.00 %  
 Maximum depth change: 50.00 %  
 Maximum spacing change: 100.00 %

**Data Collection Settings**

Salinity: 0.000 PSS-78  
 Temperature:  °F  
 Sound speed:  ft/s

**Quality Control Settings**

SNR threshold: 10 dB  
 Standard error threshold: 0.0328 ft/s  
 Spike threshold: 10.00 %

Measurement results

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measure d Depth (ft)	Samples	Velocity (ft/s)	Correct ion	Mean Velocity (ft/s)	Area (ft <sup>2</sup> )	Flow (ft <sup>3</sup> /s)	%Q
27	11:27 AM	0.000	None	0.000	0	0.000	0	0.0000	1	0.3726	0.0000	0.0000	0.00
26	11:24 AM	2.000	0.6	1.200	0.6	0.720	80	0.3726	1	0.3726	3.0000	1.1177	0.61
25	11:22 AM	5.000	0.2/0.8	1.860	0.2	0.372	80	1.0894	1	1.0096	6.5100	6.5724	3.56
25	11:22 AM	5.000	0.2/0.8	1.860	0.8	1.488	80	0.9298	1	1.0096	6.5100	6.5724	3.56
24	11:20 AM	9.000	0.2/0.8	1.800	0.2	0.360	80	1.3327	1	1.1214	7.2000	8.0741	4.38
24	11:20 AM	9.000	0.2/0.8	1.800	0.8	1.440	80	0.9101	1	1.1214	7.2000	8.0741	4.38
23	11:17 AM	13.000	0.2/0.8	1.740	0.2	0.348	80	1.3633	1	1.2073	6.9600	8.4026	4.55
23	11:17 AM	13.000	0.2/0.8	1.740	0.8	1.392	80	1.0513	1	1.2073	6.9600	8.4026	4.55
22	11:15 AM	17.000	0.2/0.8	1.600	0.2	0.320	80	1.3720	1	1.1514	6.4000	7.3688	3.99
22	11:15 AM	17.000	0.2/0.8	1.600	0.8	1.280	80	0.9308	1	1.1514	6.4000	7.3688	3.99
21	11:11 AM	21.000	0.2/0.8	1.540	0.2	0.308	80	1.4339	1	1.1715	6.9300	8.1187	4.40
21	11:11 AM	21.000	0.2/0.8	1.540	0.8	1.232	80	0.9092	1	1.1715	6.9300	8.1187	4.40
20	11:10 AM	26.000	0.6	1.200	0.6	0.720	80	1.0842	1	1.0842	6.0000	6.5050	3.52
19	11:09 AM	31.000	0.6	1.080	0.6	0.648	80	1.0412	1	1.0412	5.4000	5.6223	3.05
18	11:08 AM	36.000	0.6	0.960	0.6	0.576	80	1.0059	1	1.0059	4.8000	4.8285	2.62
17	11:06 AM	41.000	0.6	1.000	0.6	0.600	80	1.1361	1	1.1361	5.0000	5.6805	3.08
16	11:04 AM	46.000	0.6	1.040	0.6	0.624	80	1.0270	1	1.0270	5.2000	5.3402	2.89
15	11:03 AM	51.000	0.6	1.160	0.6	0.696	80	1.0253	1	1.0253	5.8000	5.9466	3.22
14	11:01 AM	56.000	0.6	1.240	0.6	0.744	80	1.1670	1	1.1670	6.2000	7.2356	3.92
13	11:00 AM	61.000	0.6	1.320	0.6	0.792	80	1.2555	1	1.2555	6.6000	8.2860	4.49
12	10:58 AM	66.000	0.6	1.460	0.6	0.876	80	1.1979	1	1.1979	6.5700	7.8705	4.26
11	10:57 AM	70.000	0.6	1.500	0.6	0.900	80	1.2338	1	1.2338	6.0000	7.4031	4.01
10	10:54 AM	74.000	0.2/0.8	1.600	0.2	0.320	80	1.4093	1	1.2472	6.4000	7.9819	4.33
10	10:54 AM	74.000	0.2/0.8	1.600	0.8	1.280	80	1.0850	1	1.2472	6.4000	7.9819	4.33
9	10:52 AM	78.000	0.2/0.8	1.700	0.2	0.340	80	1.3212	1	1.1350	6.8000	7.7178	4.18
9	10:52 AM	78.000	0.2/0.8	1.700	0.8	1.360	80	0.9488	1	1.1350	6.8000	7.7178	4.18
8	10:49 AM	82.000	0.2/0.8	1.860	0.2	0.372	80	1.4474	1	1.1815	7.4400	8.7900	4.76
8	10:49 AM	82.000	0.2/0.8	1.860	0.8	1.488	80	0.9155	1	1.1815	7.4400	8.7900	4.76
7	10:44 AM	86.000	0.2/0.8	2.040	0.2	0.408	80	1.3949	1	1.2208	8.1600	9.9616	5.40
7	10:44 AM	86.000	0.2/0.8	2.040	0.8	1.632	80	1.0467	1	1.2208	8.1600	9.9616	5.40
6	10:42 AM	90.000	0.2/0.8	2.280	0.2	0.456	80	1.3390	1	1.0924	7.9800	8.7175	4.72
6	10:42 AM	90.000	0.2/0.8	2.280	0.8	1.824	80	0.8458	1	1.0924	7.9800	8.7175	4.72
5	10:39 AM	93.000	0.2/0.8	2.200	0.2	0.440	80	1.6055	1	1.3080	6.6000	8.6326	4.68
5	10:39 AM	93.000	0.2/0.8	2.200	0.8	1.760	80	1.0104	1	1.3080	6.6000	8.6326	4.68
4	10:36 AM	96.000	0.2/0.8	2.300	0.2	0.460	80	1.2530	1	1.1499	6.9000	7.9341	4.30
4	10:36 AM	96.000	0.2/0.8	2.300	0.8	1.840	80	1.0467	1	1.1499	6.9000	7.9341	4.30
3	10:34 AM	99.000	0.2/0.8	2.400	0.2	0.480	80	1.3916	1	1.2645	7.2000	9.1044	4.93
3	10:34 AM	99.000	0.2/0.8	2.400	0.8	1.920	80	1.1374	1	1.2645	7.2000	9.1044	4.93
2	10:32 AM	102.000	0.2/0.8	2.200	0.2	0.440	80	1.1515	1	1.0048	6.6000	6.6315	3.59
2	10:32 AM	102.000	0.2/0.8	2.200	0.8	1.760	80	0.8580	1	1.0048	6.6000	6.6315	3.59
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.2	0.380	80	1.1027	1	0.8247	5.7000	4.7009	2.55
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.6	1.140	80	0.9171	1	0.8247	5.7000	4.7009	2.55
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.8	1.520	80	0.3619	1	0.8247	5.7000	4.7009	2.55
0	10:24 AM	108.000	None	0.000	0	0.000	0	0.0000	1	0.8247	0.0000	0.0000	0.00

# Summary Tab – cont.

1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.6	1.140	80	0.9171	1	0.8247	5.7000	4.7009	2.55
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.8	1.520	80	0.3619	1	0.8247	5.7000	4.7009	2.55
0	10:24 AM	108.000	None	0.000	0	0.000	0	0.0000	1	0.8247	0.0000	0.0000	0.00

Quality control warnings ⤴

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
26	11:24 AM	2.000	0.6	1.200	0.6	0.720	Boundary Interference
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.2	0.380	Water Depth > QC
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.6	1.140	Water Depth > QC
1	10:25 AM	105.000	0.2/0.6/0.8	1.900	0.8	1.520	Water Depth > QC
0	10:24 AM	108.000	None	0.000	0	0.000	Water Depth > QC

# Settings

- Edit Measurements Settings
- Save changes to file
- Reload last saved changes
- Revert to original data
- FlowTracker1 files also have “unlock” option

A full screenshot of the Settings window. The window has a title bar 'Settings' and a toolbar with icons for refresh, save, revert, and undo. The main content is organized into several sections:

- Site Details:** Site name: Pelm; Site number: 02160326; Operator(s): Jms; Comment: (empty).
- Station Warning Settings:** Maximum station discharge: 5.00 %; Maximum depth change: 50.00 %; Maximum spacing change: 100.00 %.
- Discharge Settings:** Discharge equation: Mid Section; Discharge uncertainty: IVE; Discharge reference: Rated.
- Data Collection Settings:** Salinity: 0.000 PSS-78; Temperature: (empty) °F; Sound speed: (empty) ft/s; Mounting correction: 0.00 %.
- Quality Control Settings:** SNR threshold: 10 dB; Standard error threshold: 0.0328 ft/s; Spike threshold: 10.00 %; Maximum velocity angle: 20.0 deg; Maximum tilt angle: 5.0 deg.

## New File formats (not yet supported by SVMobile)

- The FlowTracker2 and FlowTracker2 software stores in JSON format
- FT2 software can export in format similar, but with some differences, to .dis, .sum, ctl, .dat exported by original FT1 software
- Have requested FCIS implement import of JSON and/or new FT2 export format
- For now, summarize discharge measurement info in SVMobile until FT2 support is implemented



# Loading files from original FlowTracker Software

- Converts original FlowTracker files into FT2 format that will load into FT2 software
- Must have .wad and exported .dis, .dat, .ctl, and .sum with original software
- Select Utilities.. FlowTracker1 Import... select original .wad
- Will create a FT2 .ft file that can be loaded in FT2 software



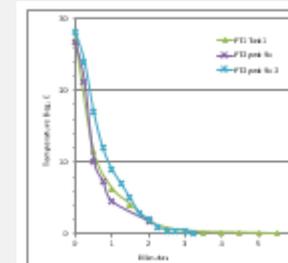
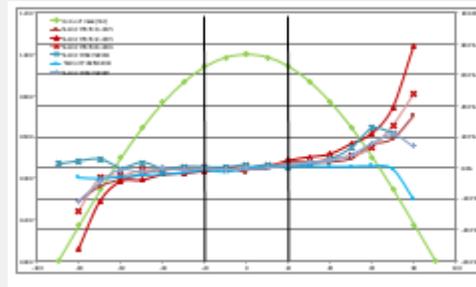
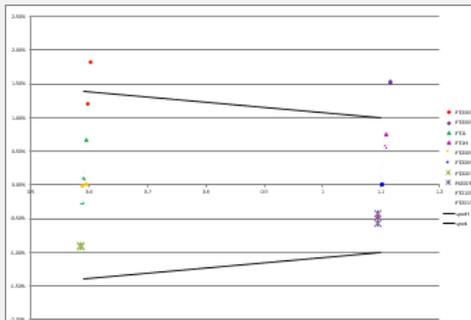
# Field Testing Completed

- 4 Prototype FlowTracker2's tested by USGS
- 40+ comparison measurements collected by
  - Iowa WSC
  - New England WSC
  - South Atlantic WSC
- Tested multiple handheld, probe, and software beta versions and provided feedback to SonTEK
- FlowTracker2 discharges compared favorably with original
- Special thanks to Philip Habermehl and Alex Laffoon – who made many of the comparisons



# HIF Hydraulics Lab Testing

- Rotated All 4 prototype FlowTracker2's through the Hydraulics Lab
  - Velocity
  - Flow angle
  - Temperature response
  - Worked on developing QA procedures for FT2



# HIF

- All FlowTrackers are required to be quality assured at HIF prior to use
- HIF can now test FlowTracker2's in the small acoustic tow tank
- Recently shipped first 10 FlowTracker2's purchased

# Comparison Needs

- Will be contacting WSC's directly who are getting first batches of FlowTracker2s to provide test plan and place on [hydroacoustics.usgs.gov](http://hydroacoustics.usgs.gov)
- All units purchase through the HIF will have been velocity and other QA checks
- USGS still needs to compile comparisons for production FlowTracker2 measurements made over wide range of conditions
- Water Science Centers please submit any comparison data

# Questions?



**FlowTracker2**<sup>®</sup>  
USER'S MANUAL 1.1  
SOFTWARE VERSION 1.1  
FIRMWARE VERSION 1.17



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