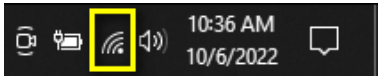


MSPS Fall Conference - Accuracy Course

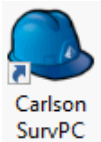
Before beginning, establish an Internet connection via the WiFi indicator on the tablet:



NOTE: If you plan to use a network rover for this exercise, obtain proper credentials as available at <https://gpsweb3.modot.mo.gov/>. It may take an hour or longer for the credentials to be generated.

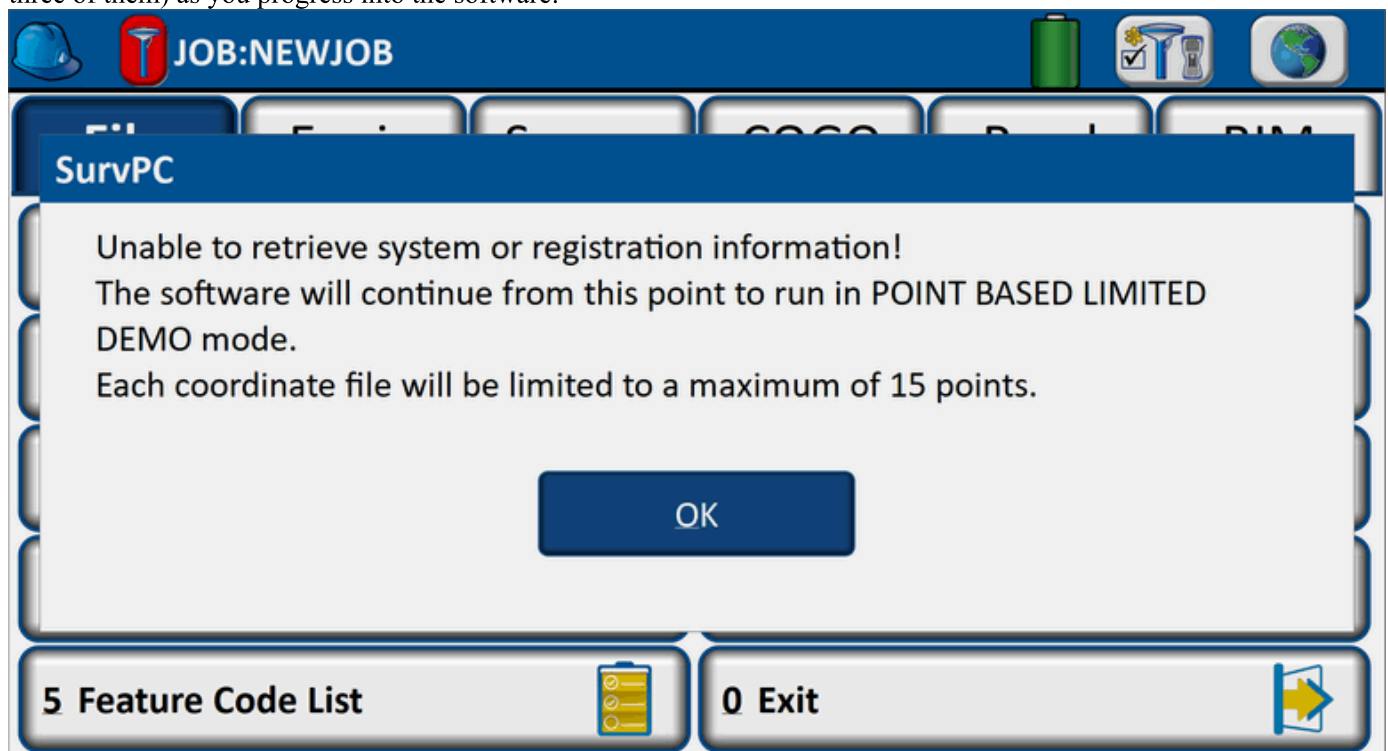
Startup/Control File Creation

1. Locate the Carlson SurvPC icon on the tablet desktop and double-tap to launch the application:

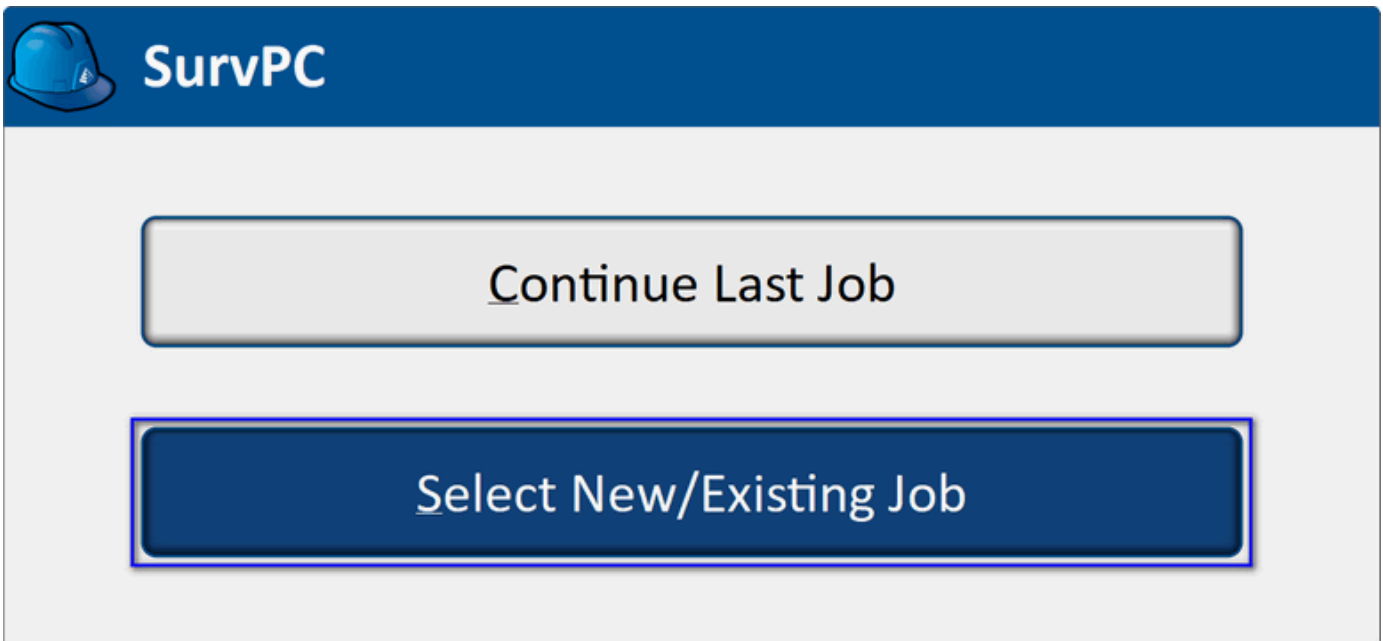


NOTE: Throughout this guide, the *SurvPC 7* interface will be shown with variants as found in SurvPC 6 cited where necessary.

2. Presuming you have the 15-point evaluation version of SurvPC installed, accept any alerts or indications (there may be three of them) as you progress into the software:



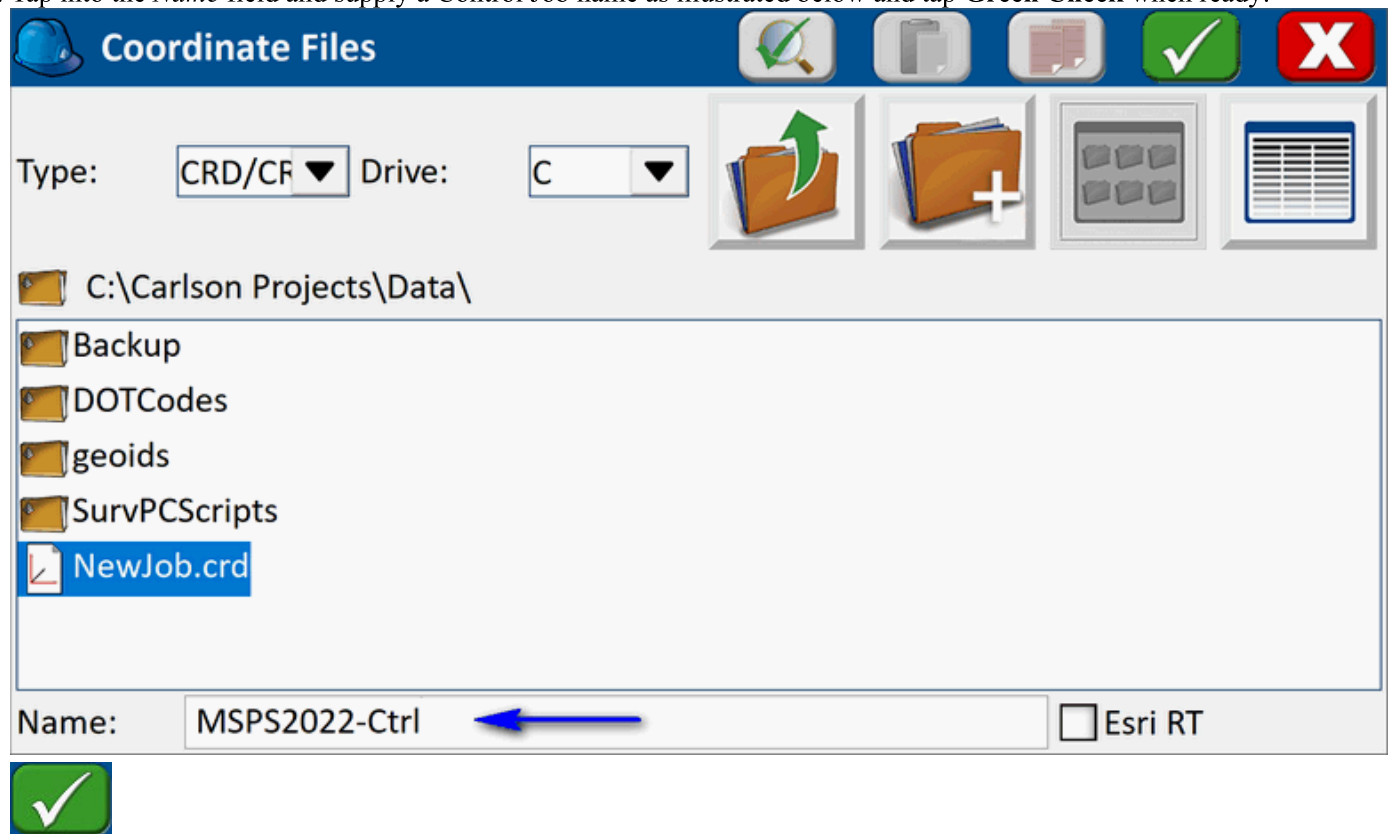
3. Our first main task will be to create what will become a "control" ("CTRL" for short) job file. Tap **Select New/Existing Job**:



NOTE: If time-constraints are an issue, the *Control* file we're about to create below can be downloaded from the Internet by visiting:

<https://web.carlsonsw.com/owncloud/index.php/s/cMNjk3bXhAg2vlq> (password **mmps2022**). Upon downloading and specifying this file as the file to open, you may skip to the [List Points](#) discussion below.

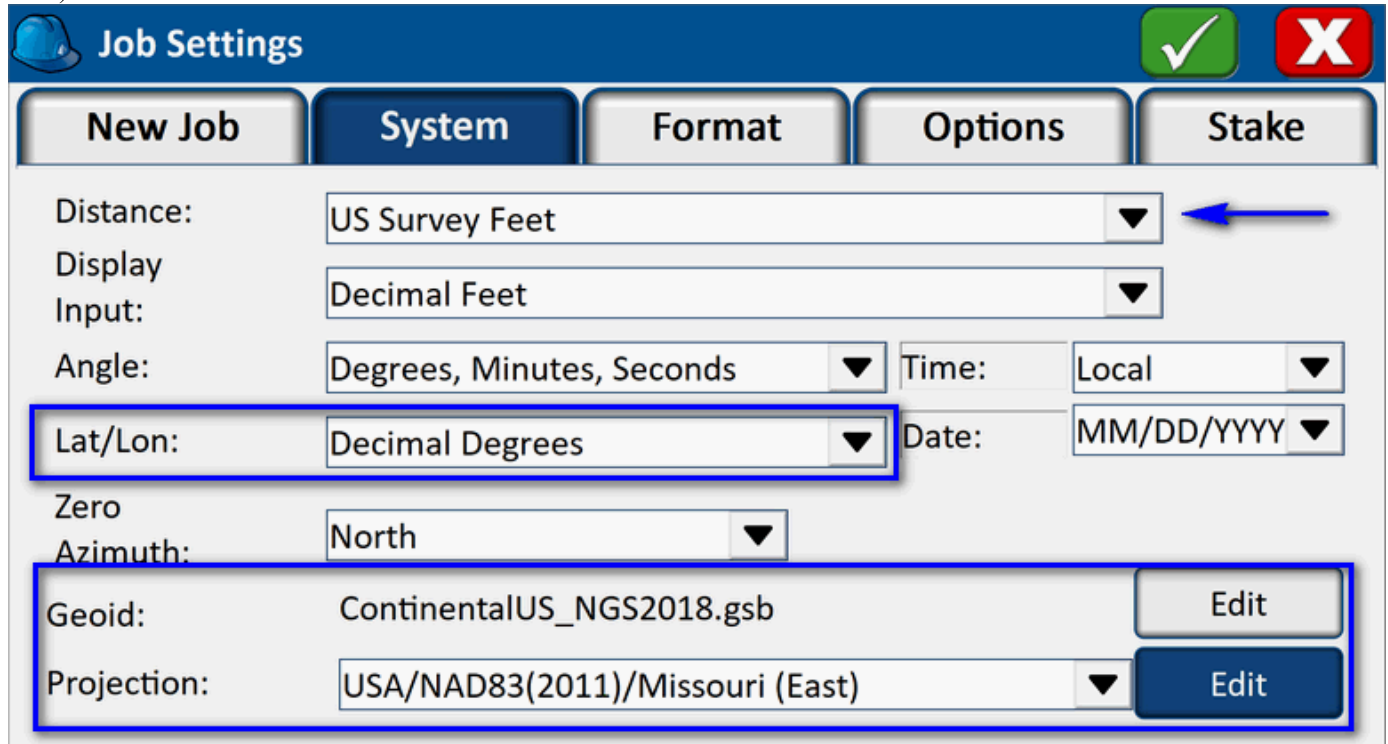
4. Tap into the *Name* field and supply a Control Job name as illustrated below and tap **Green Check** when ready:



NOTE: "Green Check" is used throughout the application as the OK/Accept button. For commands below that have a *Green Check* button, tap this button to implement the instructions unless otherwise noted.

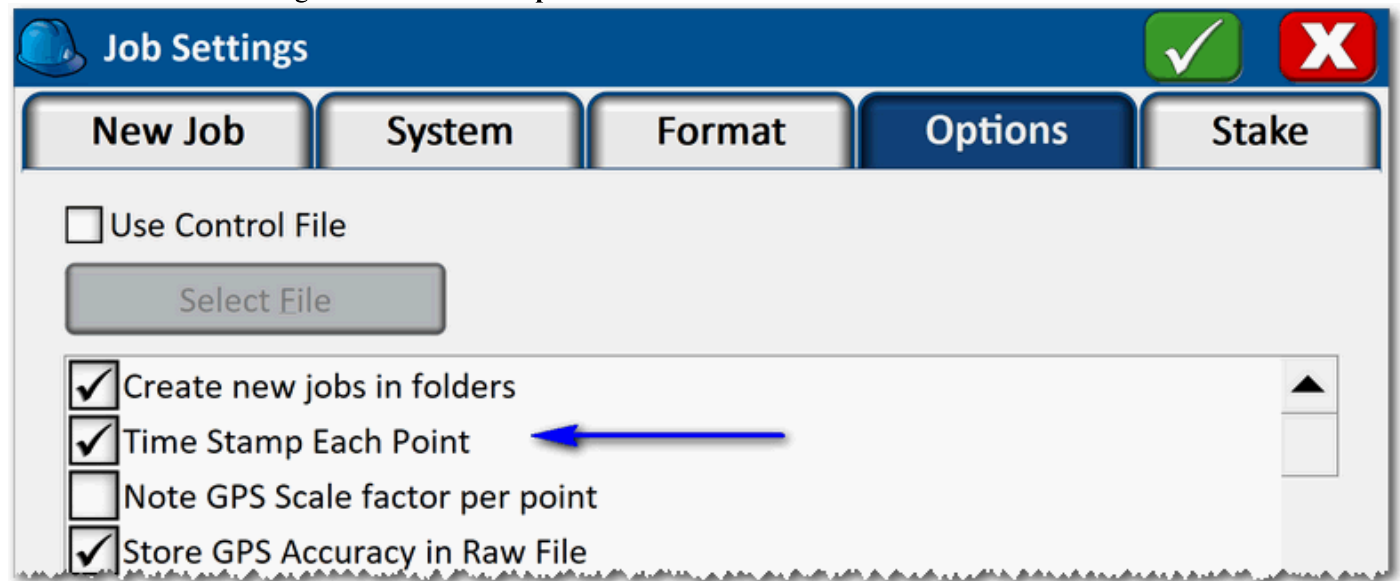
5. Approximate positions of the "ground control" points have been provided in Lat/Long positions in Decimal degree (d.ddddd) format and we ultimately want State Plane coordinates as indicated below (but do not tap *Green Check* at this

time):



The image shows the 'Job Settings' dialog box with the 'System' tab selected. The dialog has a blue header with a hard hat icon, a title bar, and a green checkmark and red X button. Below the header are five tabs: 'New Job', 'System' (selected), 'Format', 'Options', and 'Stake'. The 'System' tab contains several settings: 'Distance' is set to 'US Survey Feet' (indicated by a blue arrow), 'Display Input' is 'Decimal Feet', 'Angle' is 'Degrees, Minutes, Seconds', 'Time' is 'Local', 'Lat/Lon' is 'Decimal Degrees' (highlighted with a blue box), 'Date' is 'MM/DD/YYYY', 'Zero Azimuth' is 'North', 'Geoid' is 'ContinentalUS_NGS2018.gsb' with an 'Edit' button, and 'Projection' is 'USA/NAD83(2011)/Missouri (East)' with an 'Edit' button.

6. Continue to review settings and activate the **Options** tab as shown below:



The image shows the 'Job Settings' dialog box with the 'Options' tab selected. The dialog has the same header and tabs as the previous image. The 'Options' tab contains a list of settings: 'Use Control File' (unchecked), 'Select File' button, 'Create new jobs in folders' (checked), 'Time Stamp Each Point' (checked, indicated by a blue arrow), 'Note GPS Scale factor per point' (unchecked), and 'Store GPS Accuracy in Raw File' (checked).

7. When applicable Job Settings have been established, tap *Green Check*.

NOTE: You can always return to these settings via the File tab of the SurvPC main menu and tapping button #2 - *Job Settings*.

8. Our next task will be to convert the approximate Lat/Long values of the Ground Control "course" targets into approximate State Plane coordinates so we can use those coordinates to locate the targets. Locate the **Calculator** routine

as shown below:



9. Activate the *Conversion* tab and set the values as suggested below:

The screenshot shows the "Calculator" dialog box with the "Conversion" tab selected. The dialog has a blue header bar with a hard hat icon and a red "X" button. Below the header are four tabs: "Standard", "Scientific", "Conversion", and "Generic". The "Conversion" tab is active. It contains several radio buttons for unit selection: "M-Ft", "Deg", "SD-HD", "LLH-Grid", and "Az-Br". The "LLH-Grid" radio button is selected and highlighted with a blue box. Below these are input fields for "Lat DD:" and "Lon DD:". The "Lat DD:" field contains the value "38.70174167" and has a blue arrow pointing to it. The "Lon DD:" field contains the value "90.44721111" and has a blue arrow pointing to it. There are also input fields for "Hgt:" and "Pt ID:". The "Hgt:" field contains the value "553.93". Below these fields are two buttons: "Solve Lat/Lon" and "Solve N/E". The "Solve N/E" button is highlighted with a blue box. At the bottom, there are two checkboxes: "Apply Localization" and "Apply Geoid".

NOTE: [Course data](#) is summarized below. Refer to the official data at <https://stlsurveyor.org/accuracy-course/> for official values.

10. Upon inputting the specified values (approximate elevation shown), calculate the coordinate and save as the designated point number as illustrated below:

Calculator

Standard

Scientific

Conversion

Generic

☐ M-Ft
 ☐ Deg
 ☐ SD-HD

☒ LLH-Grid
 ☐ Az-Br

Lat DD:

☒ N
 ☐ S

Northing

Lon DD:

☒ W
 ☐ E

Easting

Hgt:
 Pt ID:

☐ Apply Localization
 ☐ Apply Geoid

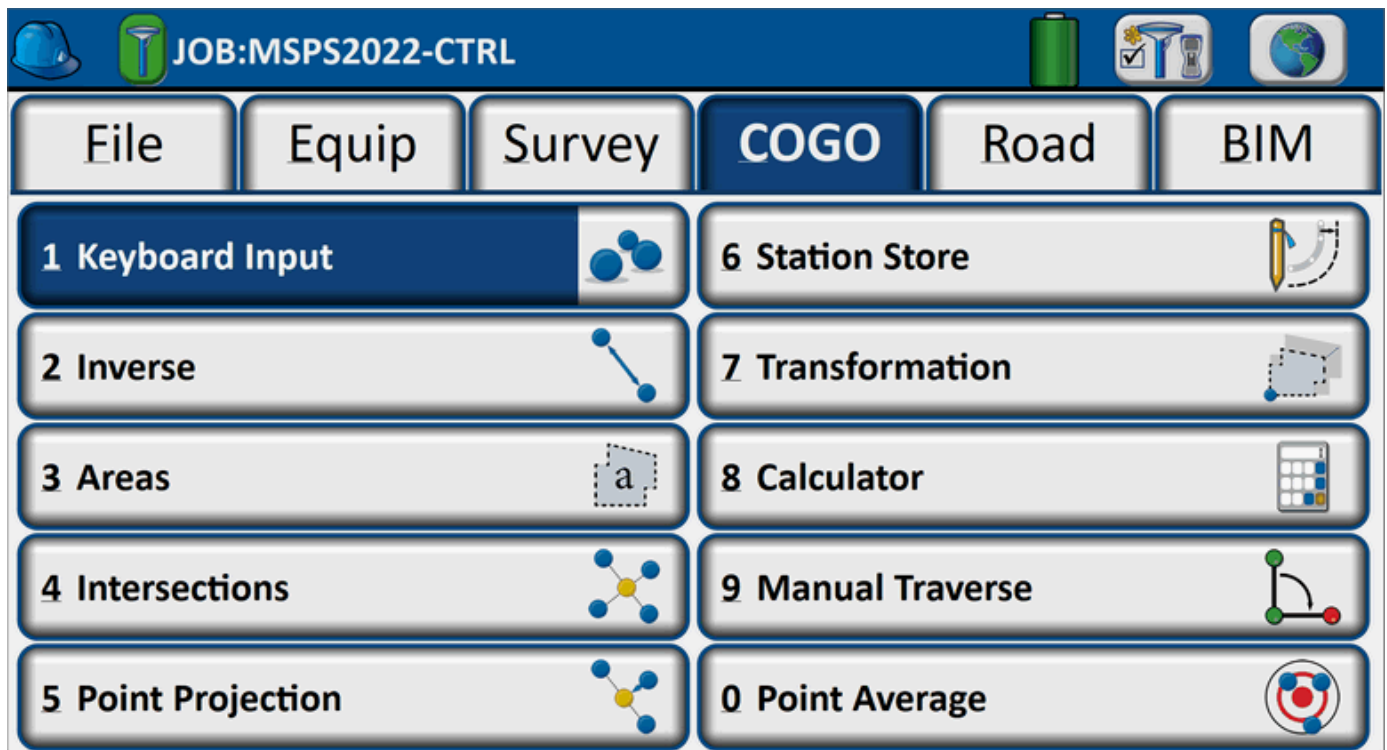
11. Repeat for each of the course locations making sure to specify the designated point number prior to storing the point:

Show entries

	Title	Category	Address
	PT#1 CARLSON		38.70174167, -90.44721111
	PT# 2 CLAYTON		38.70166667, -90.44644722
	PT# 3 SEILER		38.70077778, -90.44721389
	PT# 4 SURDEX		38.70173611, -90.44818611
	PT# 5 SAM		38.70229444, -90.44923889
	PT# 6 BFA		38.70279167, -90.44782222
	PT# 7 STL TITLE		38.70220278, -90.44694444

NOTE: Upon completion of all values, tap **Red X** to dismiss the Calculator routine.

12. Our next task will be to input the exact values of the Ground Control "control" targets as given State Plane coordinates so we can use those coordinates to locate the targets. Locate the **Keyboard Input** routine as shown below:



NOTE: [Control data](#) is summarized below. Refer to the official data at <https://stlsurveyor.org/accuracy-course/> for official values.

13. Upon inputting the specified values (suggested description shown), save the designated point number as illustrated below:

Enter and Edit Coordinates
←

Type CRD: Alphanumeric

Point ID:

8

Northing:

1044906.4760

ft

Easting:

834710.5580

ft

Elevation:

533.9980

ft

Description:

GCP /TWM

A
B
C

Prev

Next

Store

Utilities

NOTE: Tap the *Next* button to establish a new point.

14. Repeat for each of the control locations making sure to specify the designated point description prior to storing the point:

	CP# 8 TWM	38.70322222, -90.44918056	CLICK FOR OPUS SOLUTION - CP 8 OPUS-RS MO-SP FT: 1,044,906.476 N, 834,710.558 E, 533.998 EL
	CP# 10 SEILER	38.70209167, -90.44751389	CLICK HERE FOR OPUS SOLUTION - CP 10 OPUS-RS MO-SP FT: 1,044,495.404 N, 835,189.064 E, 553.929 EL
	CP# 9 SURVEYORS MATERIALS	38.70120833, -90.44758611	CLICK HERE FOR OPUS SOLUTION - CP 9 OPUS-RS MO-SP FT: 1,044,173.135 N, 835,165.862 E, 555.563 EL

Please consult with
<https://stlsurveyor.org/accuracy-course/>
for latest and official
control coordinates!

15. Let's review what we've established thus far. Locate the **Points** routine as shown below:



16. Note the different designator(s) of the points. Tap **Orange Arrow** to dismiss the Points routine.

Point ID	Northing(ft)	Easting(ft)	Elevation(ft)	Description	Rod Ht(ft)
+/- 1	1044367.60	835273.07	553.930	GCP /Carlson	
+/- 2	1044340.41	835491.09	553.930	GCP	
+/- 3	1044016.57	835272.48	553.930	GCP	
+/- 4	1044365.41	834994.83	553.930	GCP	
+/- 5	1044568.58	834694.28	553.930	GCP	
+/- 6	1044749.88	835098.46	553.930	GCP	
+/- 7	1044535.57	835349.08	553.930	GCP	
8	1044906.48	834710.56	533.998	GCP /TWM	

Working Job Creation/Equipment Initialization

1. From the **File** tab, tap button *1 Job* to create a new Job (this one to contain the locations you are measuring. Set a job name as indicated by the course instructions:

Coordinate Files

Type: CRD/CF Drive: C

C:\Carlson Projects\Data\

Backup NewJob.crd

DOTCodes

geoids

MSPS2022-Ctrl

SurvPCScripts

Name: MSPS2022-xxx.crd

xxx = Three-digit Observer ID number

Esri RT

2. Continue with the review and establishment of any other settings making note to reference the previously created *Control* file:

Job Settings

New Job System Format Options Stake

☒ Use Control File

Select File C:\Car.. Projects\Data\MSPS2022-Ctrl\MSPS2022-Ctrl.crd

☒ Create new jobs in folders

☒ Time Stamp Each Point

☐ Note GPS Scale factor per point

☒ Store GPS Accuracy in Raw File

☒ Auto Append Suffix to Base ID in Raw File

☒ Use Feature Codes for Descriptions

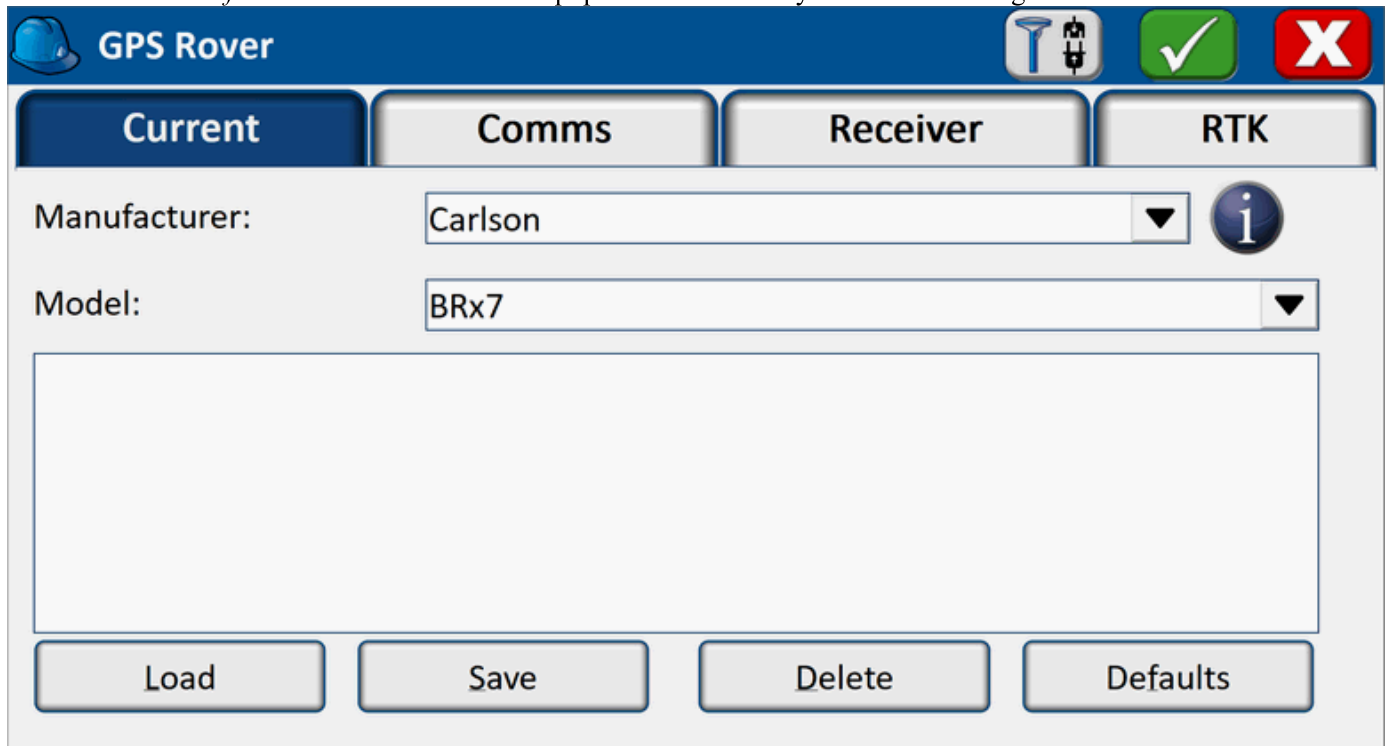
☒ Read Job Read File

3. Our next task will be to establish communications with our desired field equipment. Locate the **GPS Rover** routine as shown below:



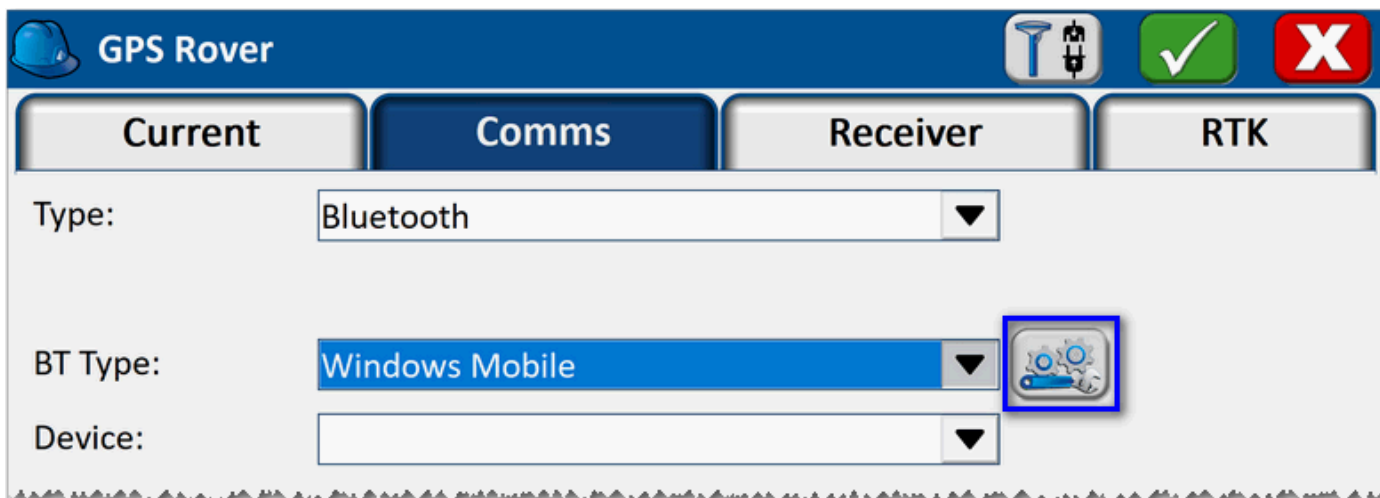
NOTE: If working with a traditional base/rover setup, you'll want to first use the **GPS Base** (similar setup instructions as GPS Rover).

4. Establish the *Manufacturer* and *Model* for the equipment with which you will be working:



Activate the *Comms* (Communications) tab.

5. If this is the initial setup for the equipment, establish the desired communication type (generally, Bluetooth) and tap the "Wrenches" button as illustrated:



GPS Rover

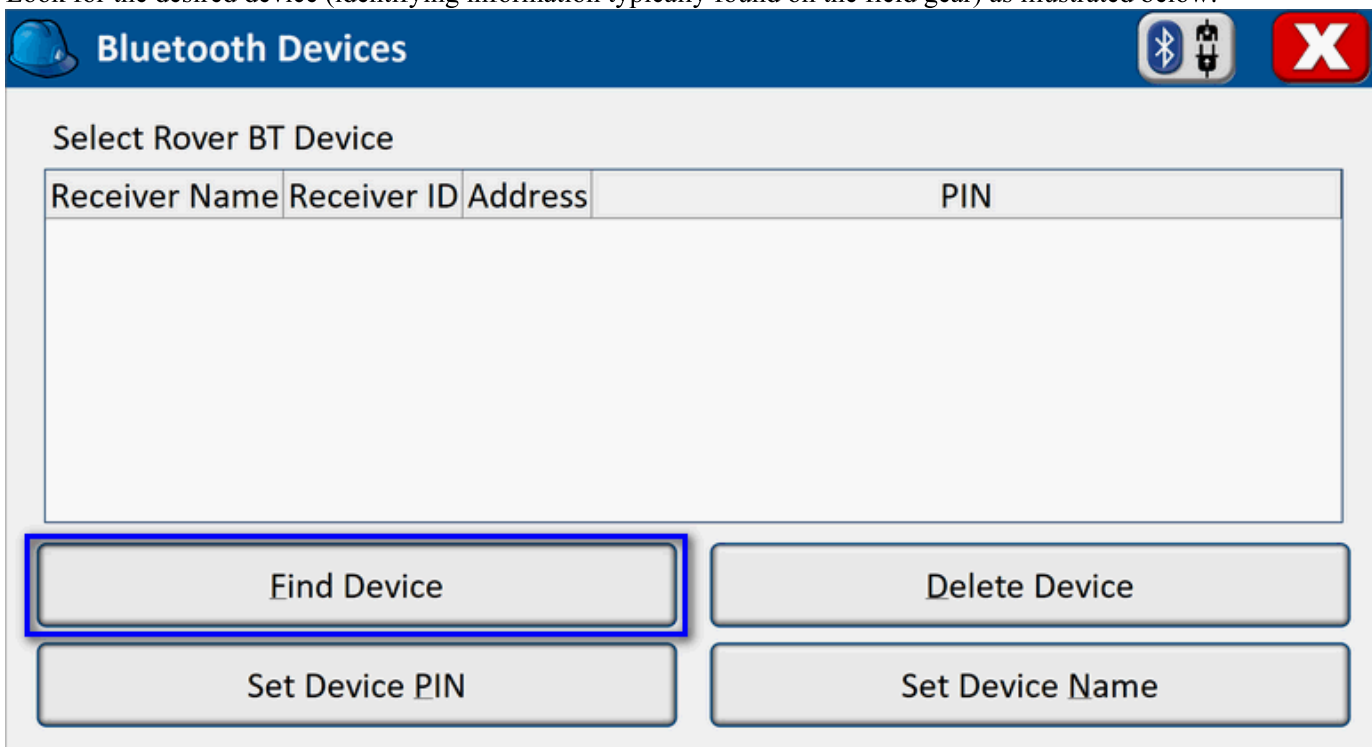
Current Comms Receiver RTK

Type: Bluetooth

BT Type: Windows Mobile

Device:

6. Look for the desired device (identifying information typically found on the field gear) as illustrated below:



Bluetooth Devices

Select Rover BT Device

Receiver Name	Receiver ID	Address	PIN

Find Device Delete Device

Set Device PIN Set Device Name

7. Once the desired field gear item has been found (the *Find Device* may need to be run a second time in "noisy" Bluetooth areas), select/highlight the device and tap **Green Check**:



Bluetooth Devices

Please select from these available devices:

DL12193

D2220710801230

Green Check X

8. The device will be added to the list of desired devices. Select/highlight the device and tap **Bluetooth Connect**: button to pair the controller to the field equipment:

Bluetooth Devices

Select Rover BT Device

Receiver Name	Receiver ID	Address	PIN
D2220710801230	D2220710801230	9c:50:d1:e1:d1:65	

Upon a successful pairing, activate the *Receiver* tab.

9. Verify and set the desired values. **NOTE:** If using a metric-based pole height (typically as measured from the pole tip to the bottom side of the receiver), you can indicate the metric value and apply a label (e.g. m = meters, mm = millimeters, " = inches, ft = feet, etc) and even equations (e.g. 2m + 40mm) if additional items (e.g. quick-disconnects) are part of the pole height. Switching focus from the field will compute the value in the customary units for the current job. Tap the *Advanced* button for additional options available to your field gear:

GPS Rover

Current

Comms

Receiver

RTK

Antenna Type: [BRX7 Internal] L1/L2/L5 In

Antenna Height: ft Abs. 70.1mm

Elevation Mask: °

Position Rate:

14 Parameter Datum

Advanced

10. Based on the field gear you're using, you may have options for additional accuracy checks as illustrated below:

Advanced

☐ Log Raw Data to Receiver

Readings Per Point:

☒ Enable SureFix

Audio Mode:

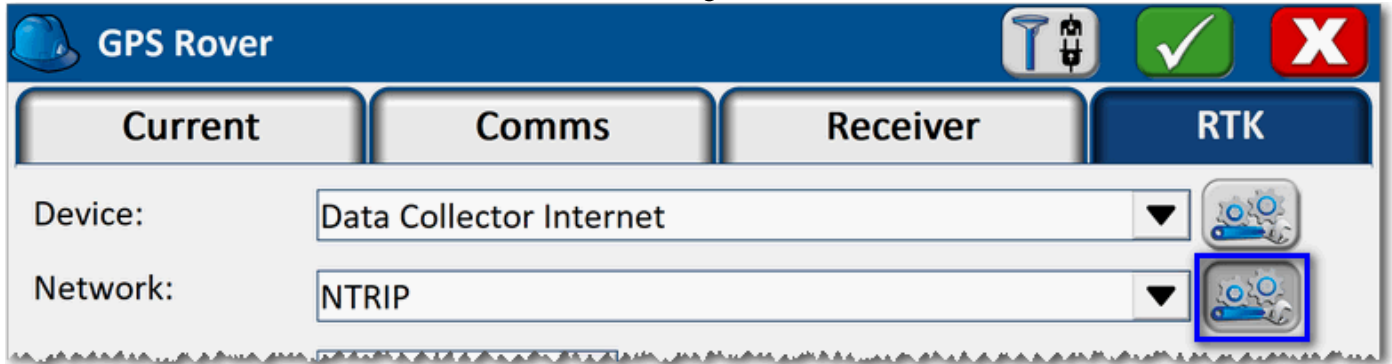
☐ Send file after config

No File Selected!

Configure NMEA Output

Configure Constellations

11. Establish the *RTK* characteristics that the receiver will use to get its corrections:



GPS Rover

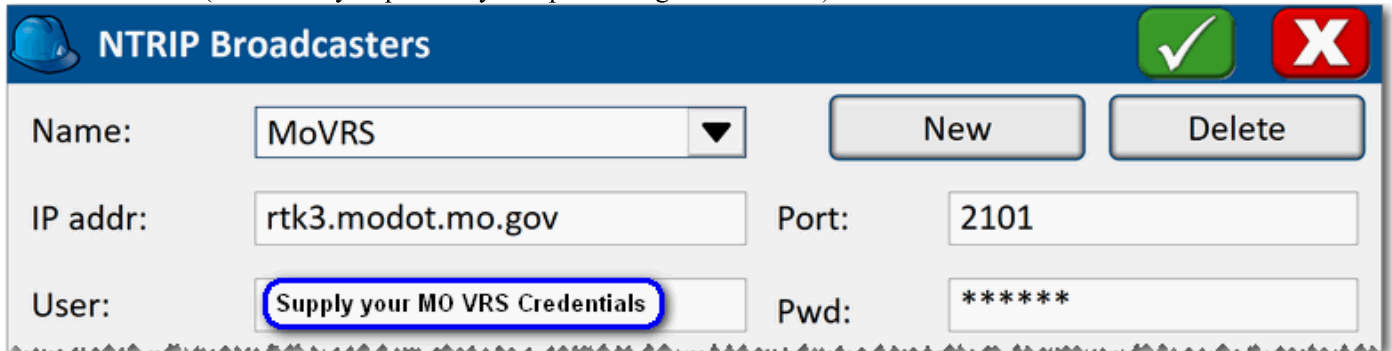
Current Comms Receiver **RTK**

Device: Data Collector Internet

Network: NTRIP

NOTE: The following section presumes MoDOT VRS credentials have been established (you may register for the service at <https://gpsweb3.modot.mo.gov/>).

12. If a desired NTRIP provider has not already been established, create a *New* set of NTRIP Broadcaster credentials as illustrated below (make sure you provide your specific login credentials):



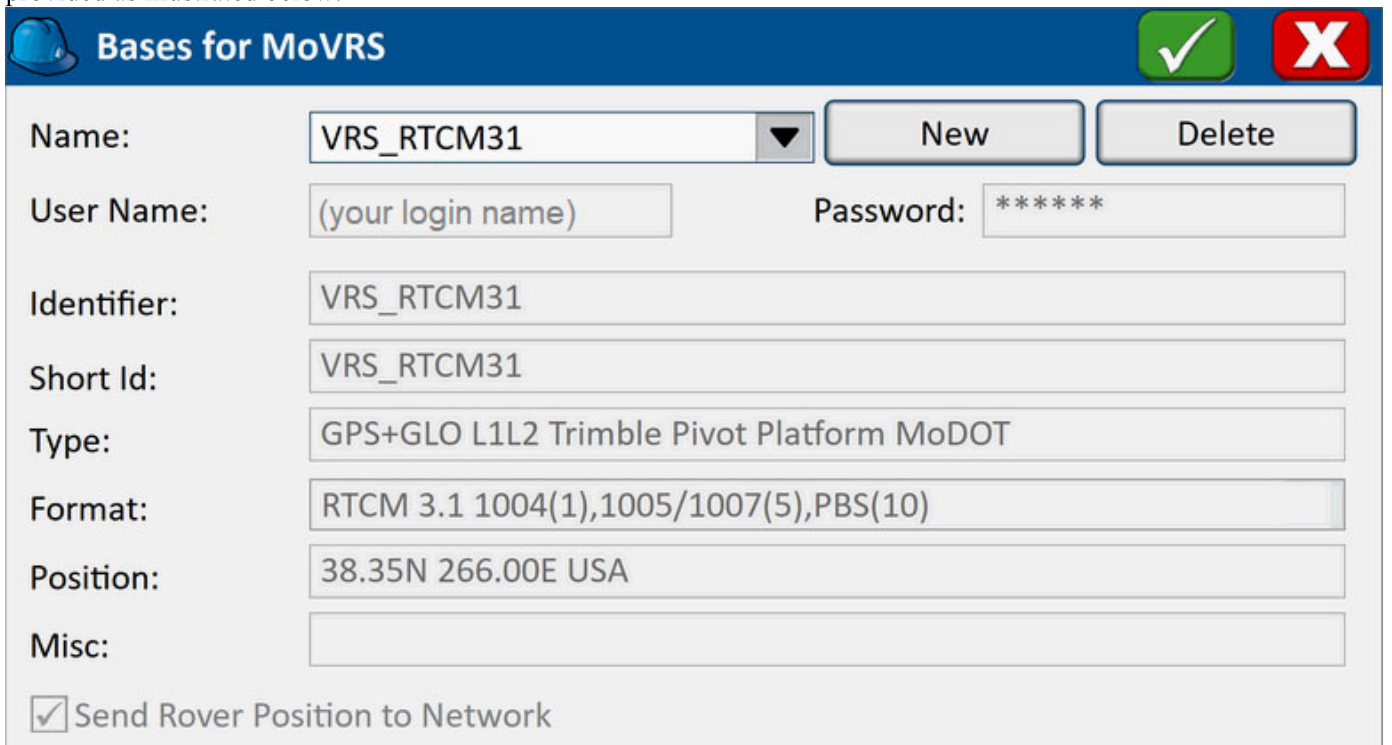
NTRIP Broadcasters

Name: MoVRS New Delete

IP addr: rtk3.modot.mo.gov Port: 2101

User: Supply your MO VRS Credentials Pwd: *****

13. Upon successful creation, authentication and accessing of the NTRIP Broadcaster, an available list of *Bases* will be provided as illustrated below:



Bases for MoVRS

Name: VRS_RTCM31 New Delete

User Name: (your login name) Password: *****

Identifier: VRS_RTCM31

Short Id: VRS_RTCM31

Type: GPS+GLO L1L2 Trimble Pivot Platform MoDOT

Format: RTCM 3.1 1004(1),1005/1007(5),PBS(10)

Position: 38.35N 266.00E USA

Misc:

☒ Send Rover Position to Network

NOTE: It is generally advisable to utilize a Base in the following preferred order of availability:

1. **RTCM 3.2:** GPS (including L5)+GLO+GAL+BDS
2. **RTCM 3.1:** GPS+GLO
3. **RTCM 2.3:** GPS Only

14. Upon proper specification of the desired Base, review your applicable settings and accept the configuration:

NOTE: Once set, these values will be retained as default values for subsequent uses of the equipment.

Equipment Configuration

1. Once complete, it is a recommended practice to ensure the receiver is able to obtain at least a **Fixed** GNSS solution prior to performing any work. Tap the *Monitor/Skyplot* button as illustrated below to check the current GNSS status:

2. Within *Monitor/Skyplot*, common items of interest include:
 - **Status:** The accuracy solution of the receiver (should be **Fixed** or **SureFixed**)
 - **Latency:** The age of the RTK correction (latency values greater than 5 seconds may indicate Internet connectivity problems or radio interference issues)
 - **HRMS:** Horizontal Root Mean Squared accuracy, 1-sigma (68%); essentially, expected horizontal error
 - **VRMS:** Vertical Root Mean Squared accuracy, 1-sigma (68%); essentially, expected vertical error

Monitor/Skyplot

Quality		Position	SATView	SATInfo	Ref
Status:	FIXED		Satellites:	23/25	
Latency:	0.4s		Local Elev:	650.1080ft	
Base Selection:	VRS_RTCM31				
Local Northing:	1044368.5001ft				
Local Easting:	835273.0707ft				
HDOP:	1.10	VDOP:	2.10		
X-Tilt:	-0.02	PDOP:	2.37	<input type="button" value="Reset RTK"/>	
Y-Tilt:	-0.00	<input type="button" value="Disconnect"/>		<input type="button" value="Connect"/>	
Hrms:	0.043ft				
Vrms:	0.104ft				

3. Once a **Fixed** GNSS solution has been attained, let's set some other useful values. From the Main menu, tap *Configure* as illustrated below:

JOB:MSPS2022-XXX

File	Equip	Survey	COGO	Road	BIM
1 Total Station		6 Localization			
2 GPS Base		7 Monitor/Skyplot			
3 GPS Rover		8 Tolerances			
4 GPS Raw Only		9 Peripherals			
5 Configure		0 GPS Utilities			

4. For the gathering of data to come, we'd like to record multiple measurements for a given point as illustrated below:

The 'Configure' dialog box is shown with the 'General' tab selected. The 'Coding Style' is set to 'Classic'. The 'Prompt for Total Station Setup' checkbox is unchecked. The 'Prompt for Height & Description' checkbox is checked. The 'Prompt for Point Notes' checkbox is unchecked. The 'Prompt If Duplicate of Backsight or Last Reading (TS)' checkbox is unchecked. The 'No. of Readings to Avg -' is set to 1. The 'TS:' is set to 1. The 'GPS:' is set to 60. The 'Enter/Store Icon - TS:' is set to 'Read & Store'. The 'Enter/Store Icon - RTS/GPS:' is set to 'Read & Store'.




5. (Optional) Based on your desired use of correction for tilted-pole, indicate your preferred *IMU* (Inertial Measurement Unit) settings (based on your field equipment):

The 'Configure' dialog box is shown with the 'IMU' tab selected. The 'View GNSS Level' checkbox is checked. The 'Sensor Mode:' is set to 'Correct for tilt'. The 'Incline Tolerance:' is set to 15.0.

NOTE: In SurvPC 6.x and earlier, locate this feature under Equip → GPS Rover → Receiver tab:

The 'GPS Rover' dialog box is shown with the 'Receiver' tab selected. The 'Antenna Type:' is set to '[BRX7 Internal] L1/L2/L5 In'. The 'Antenna Height:' is set to 25 ft. The 'Elevation Mask:' is set to 10. The 'Position Rate:' is set to 5 Hz. The 'Tilt Features(IMU)' checkbox is checked. The 'aRTK' checkbox is unchecked. The '14 Parameter Datum' and 'Advanced' buttons are visible at the bottom.

6. As you are likely going to be averaging your measurements to obtain a coordinate, set/review the *Average GNSS* settings:


Configure



General

View

IMU

Average GNSS

Point Averaging Mode: From Raw Data ▼

☐ Beep on rejected measurements
☐ Log Average Observations
☐ Automatically accept average results
☐ SurvNet duplicate point tag

Coordinate Match Tolerance (3D) = 0.098 ft

7. (Optional) Based on your desired use of correction for tilted-pole, you may want to perform an IMU Pole Calibration. If so, tap on *GPS Utilities* as illustrated below:



JOB:MSPS2022-XXX




File

Equip

Survey

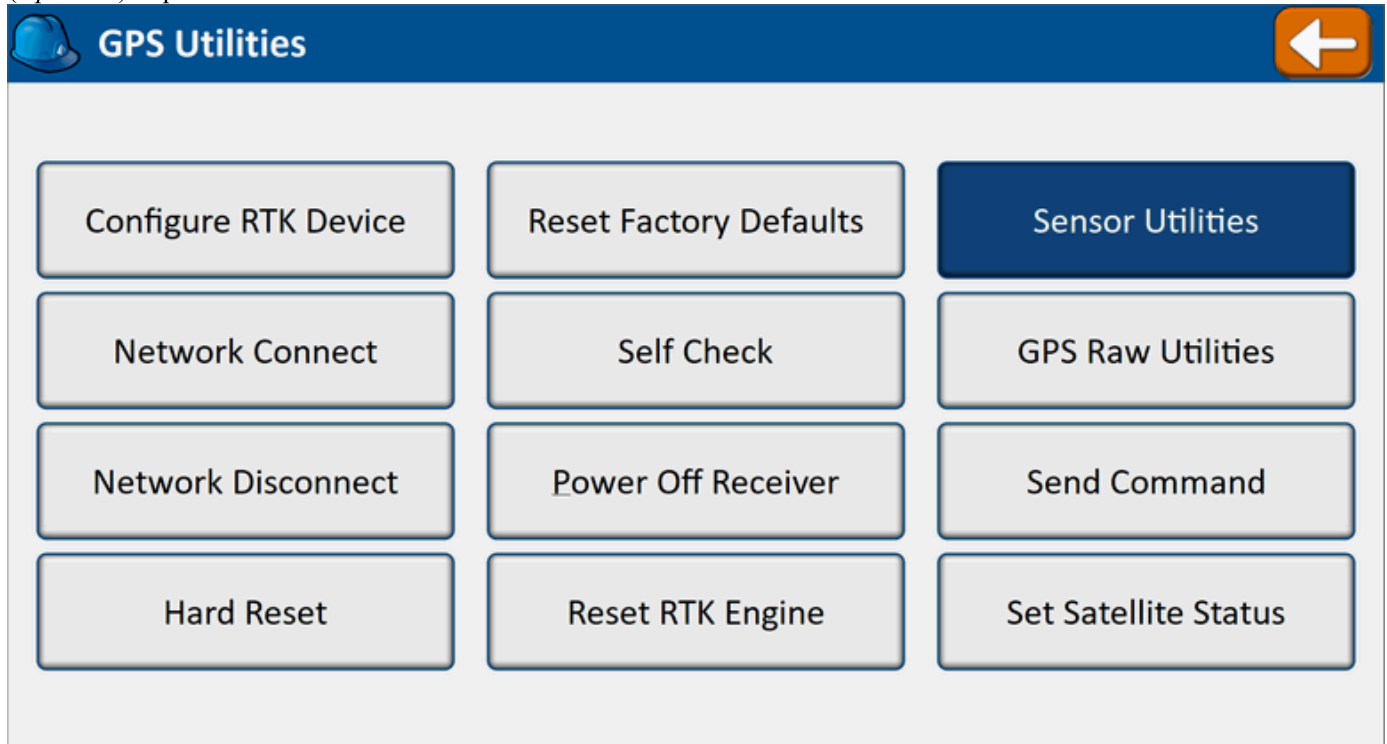
COGO

Road

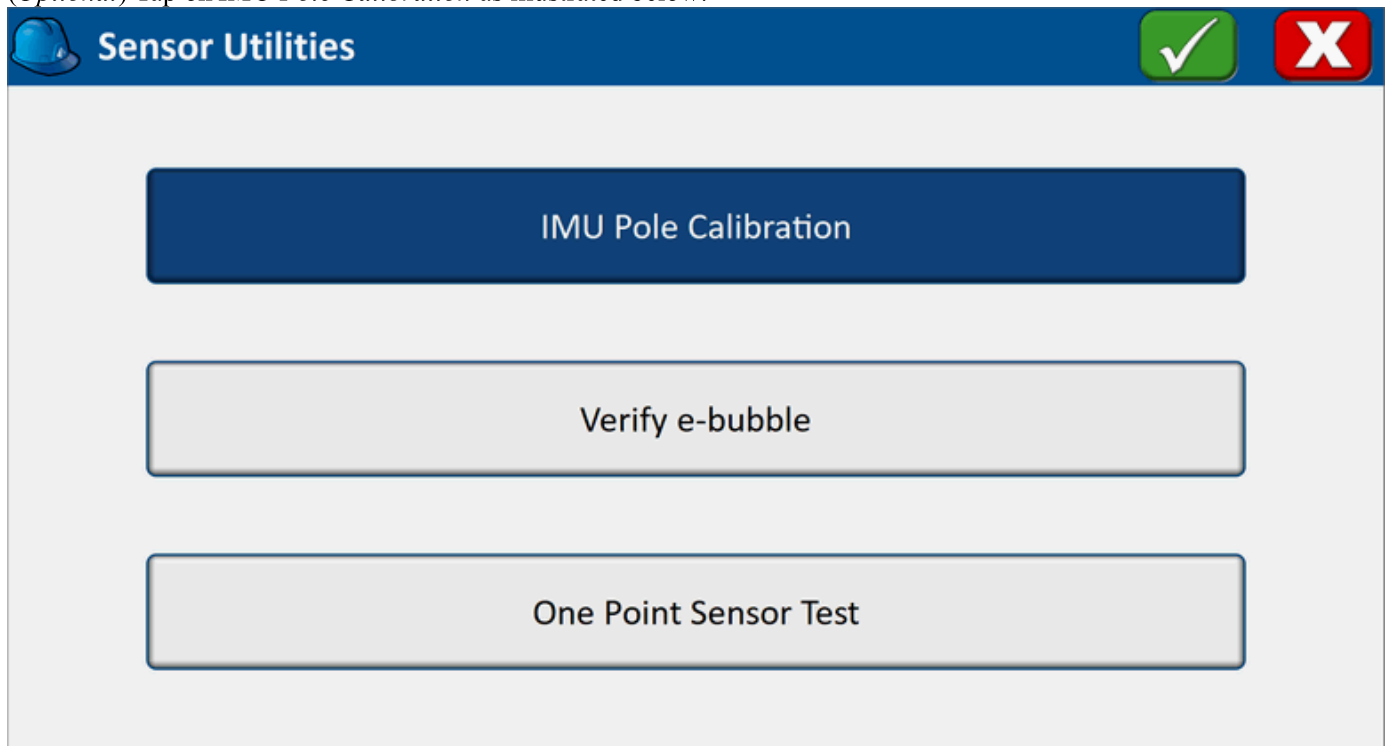
BIM

1 Total Station 	6 Localization 
2 GPS Base 	7 Monitor/Skyplot 
3 GPS Rover 	8 Tolerances 
4 GPS Raw Only 	9 Peripherals 
5 Configure 	0 GPS Utilities 

8. (Optional) Tap on *Sensor Utilities* as illustrated below:



9. (Optional) Tap on *IMU Pole Calibration* as illustrated below:



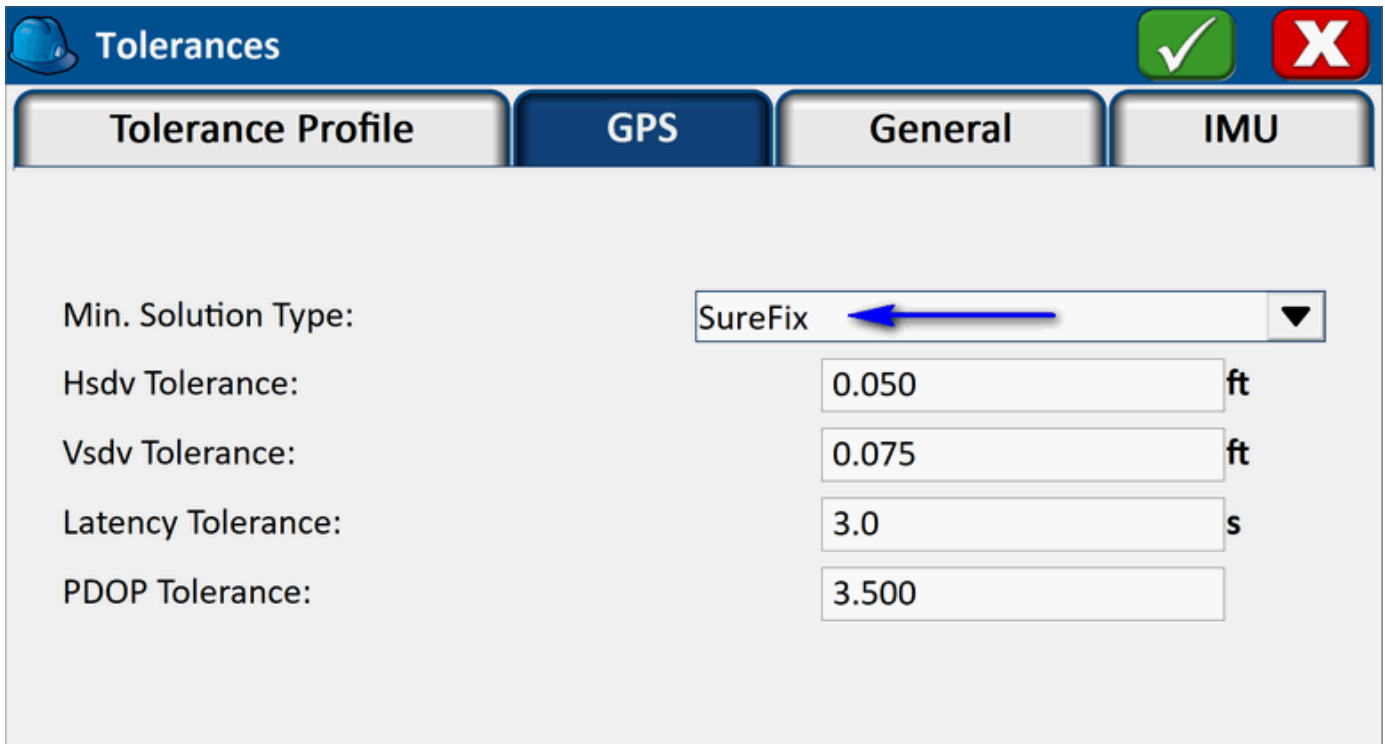
NOTE: Refer to https://web.carlsonsw.com/files/knowledgebase/kbase05.php?action=display_topic&topic_id=1198 for additional information regarding IMU calibration.

Measurement Tolerances and Aides

1. Our next task will be to review and set applicable *Tolerances* as accessed below:



2. Based on the brand/model of equipment, you will typically want to employ the highest *Solution Type* (aka Fix Quality) as illustrated below:



Set other desired maximum tolerances as suggested above.

3. For the "locate" work to follow, the following *General* tolerance values can be set:

The screenshot shows the 'Tolerances' dialog box with the 'General' tab selected. The dialog has a blue header with a hard hat icon, the title 'Tolerances', and two buttons: a green checkmark and a red 'X'. Below the header are four tabs: 'Tolerance Profile', 'GPS', 'General' (selected), and 'IMU'. The main area contains three rows of settings:

Setting	Value	Unit
Stakeout Tolerance:	1.000	ft
"Navigate To" Tolerance:	16.404	ft
Proximity Radius:	1.000	ft

A blue callout box points to the '1.000' value in the 'Stakeout Tolerance' row, containing the text: 'Not suggested for "regular" work!'.

4. (Optional) Review/set any desired *IMU* tolerances:

The screenshot shows the 'Tolerances' dialog box with the 'IMU' tab selected. The dialog has the same blue header and buttons as the previous screenshot. Below the header are four tabs: 'Tolerance Profile', 'GPS', 'General', and 'IMU' (selected). The main area contains two rows of settings:

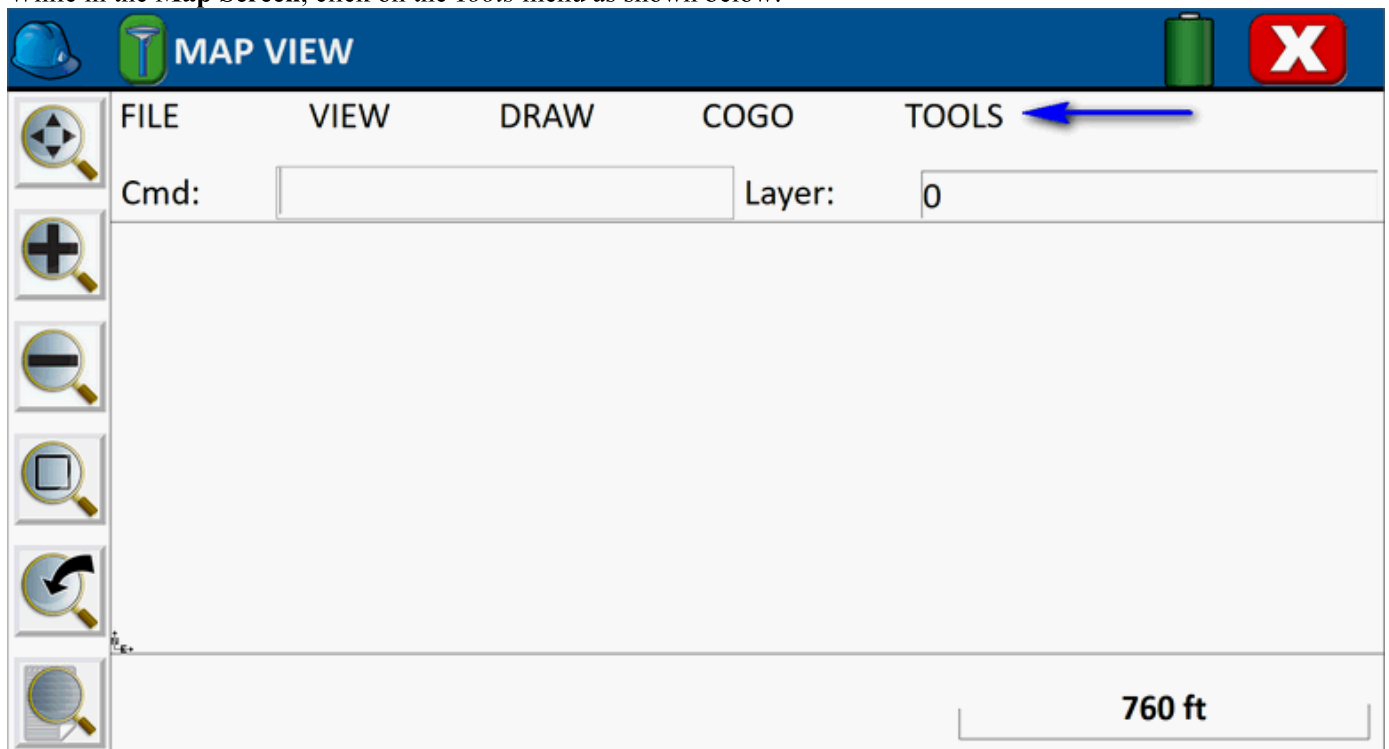
Setting	Value	Unit
Level Tolerance:	0.049	ft
Incline Tolerance:	15.0	°

NOTE: Upon completion of these desired tolerances, they can be saved into a named **Tolerance Profile** for quick re-use in other similar projects.

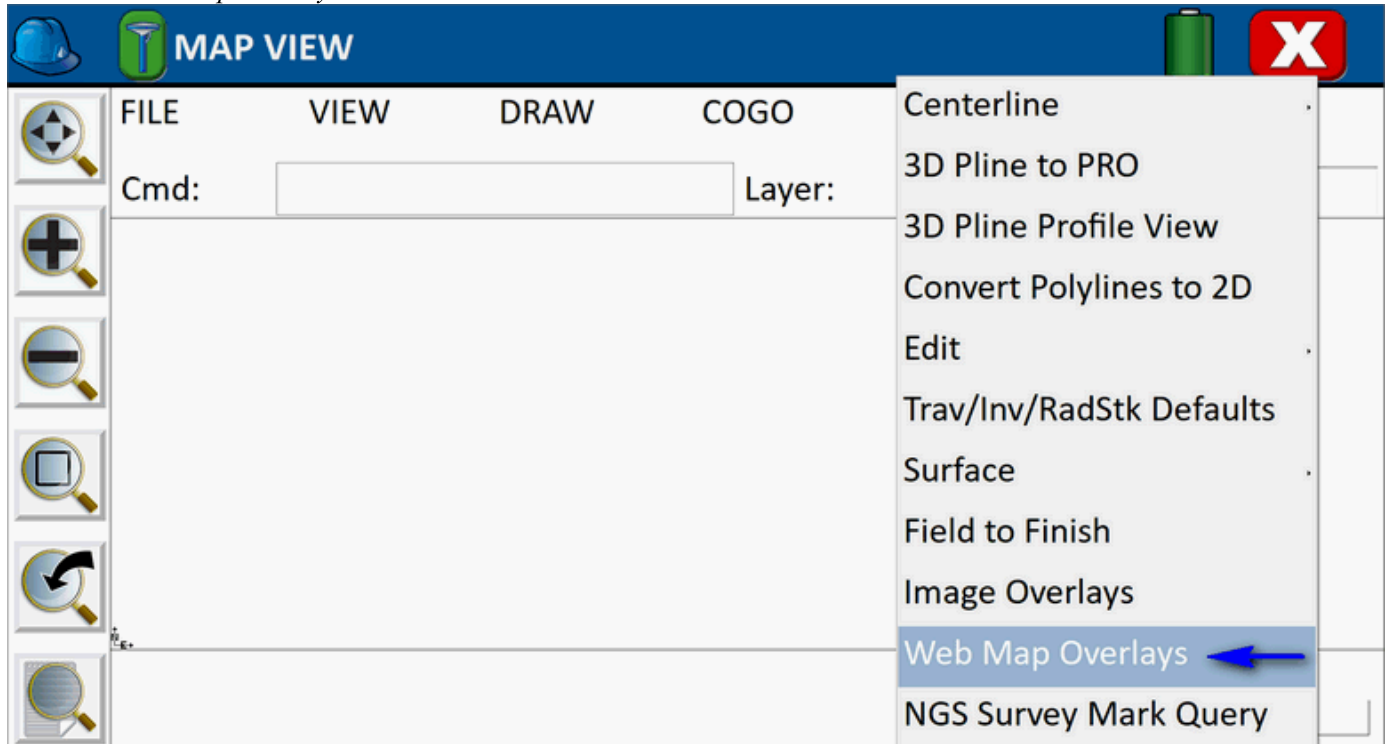
5. (Optional) In the event you'd like to see background imagery (*e.g.* from on-line source such as Google to aid with navigation), you might consider enabling the option through the use of the *Map* screen as illustrated below:



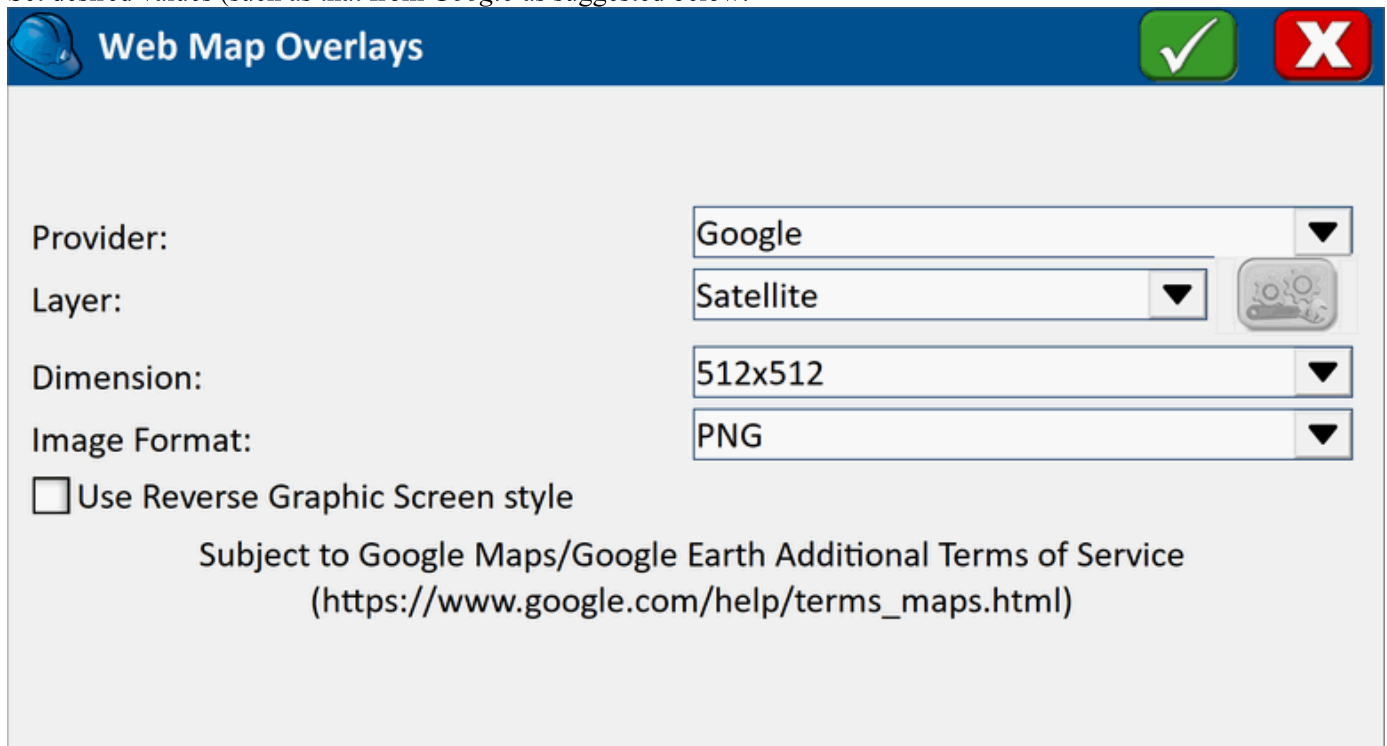
6. While in the **Map Screen**, click on the *Tools* menu as shown below:



7. Select the *Web Map Overlays* command as illustrated below:



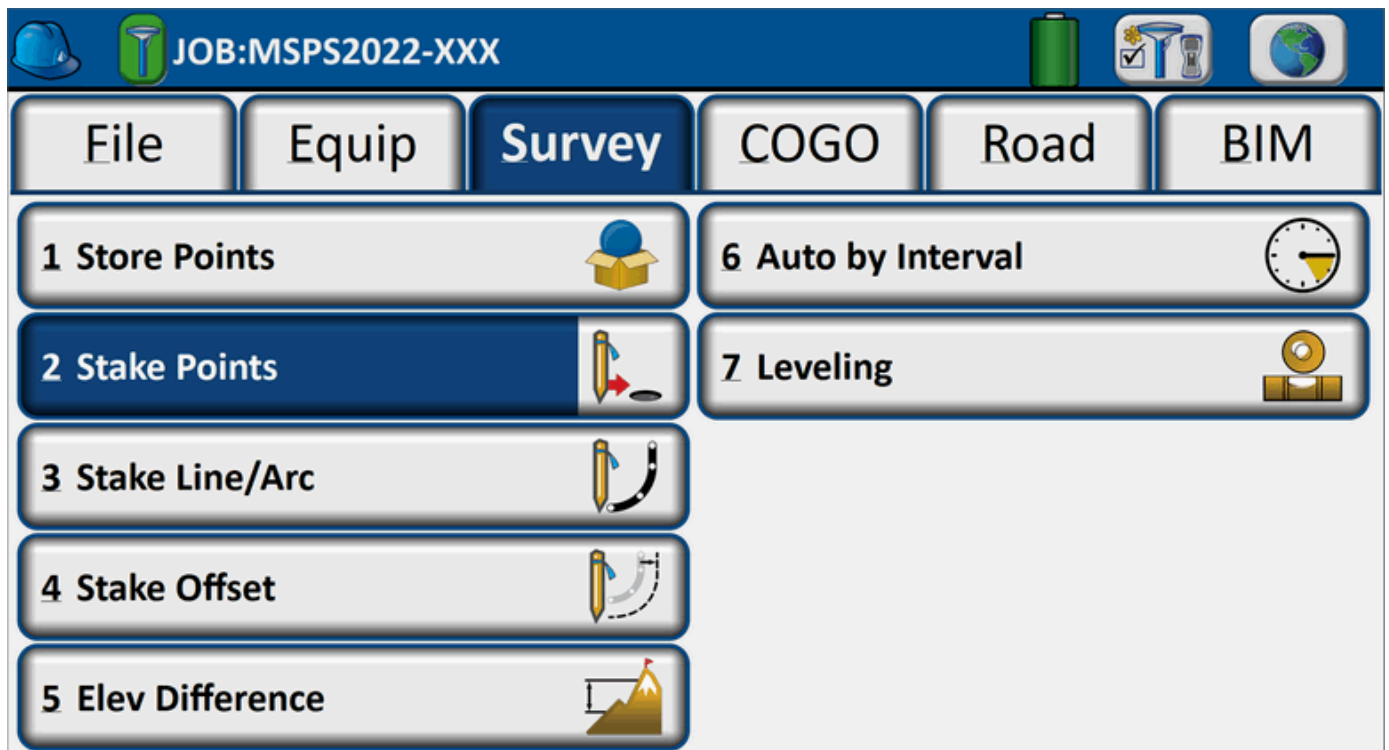
8. Set desired values (such as that from *Google* as suggested below:



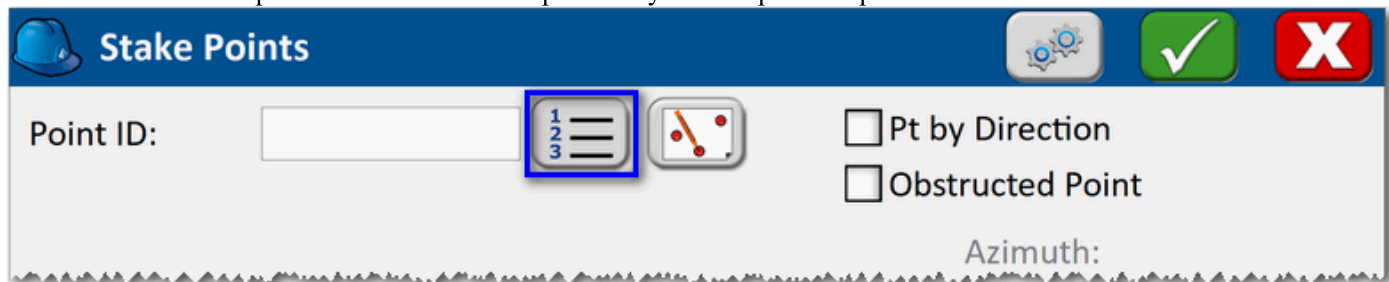
NOTE: For large coverage areas (being excessively "zoomed" out) or for slow/poor internet connection speeds, it may take several seconds or minutes for the imagery to appear.

Locating Points

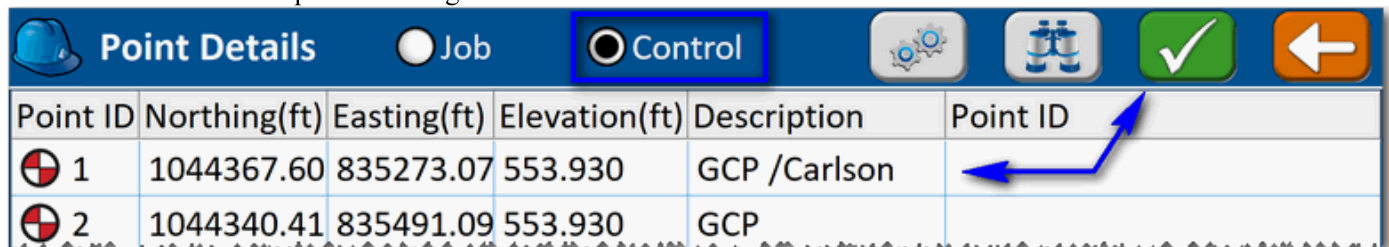
1. We should now have the basics established for the gathering of our data. Let's locate our course points and take readings where we find them to be. Issue the *Stake Points* command as shown below:



2. We'd like to fetch the position of a desired and previously created point. Tap the *Point List* button as illustrated below:

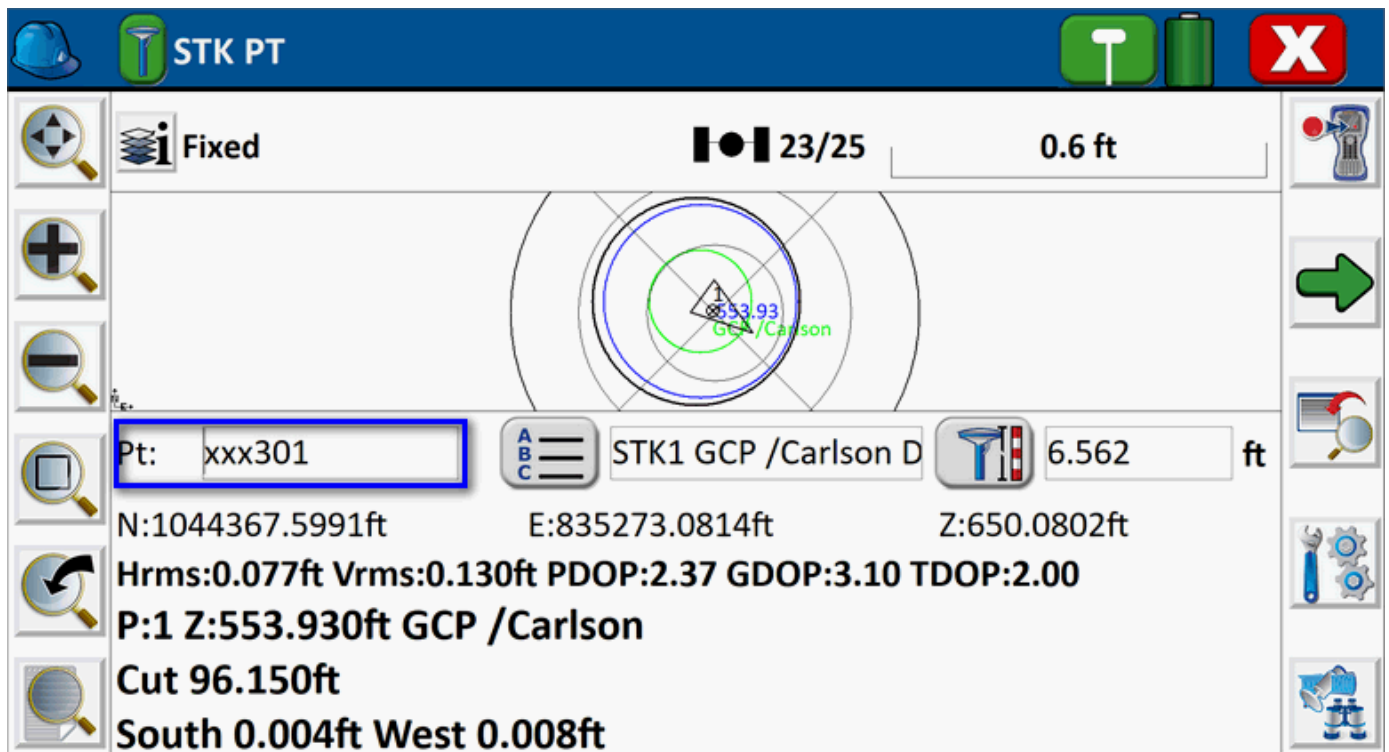


3. Since our desired point is housed within an external and referenced *Control* file, set the applicable **Control** source "radio button" as found at the top of the dialog box as shown below:



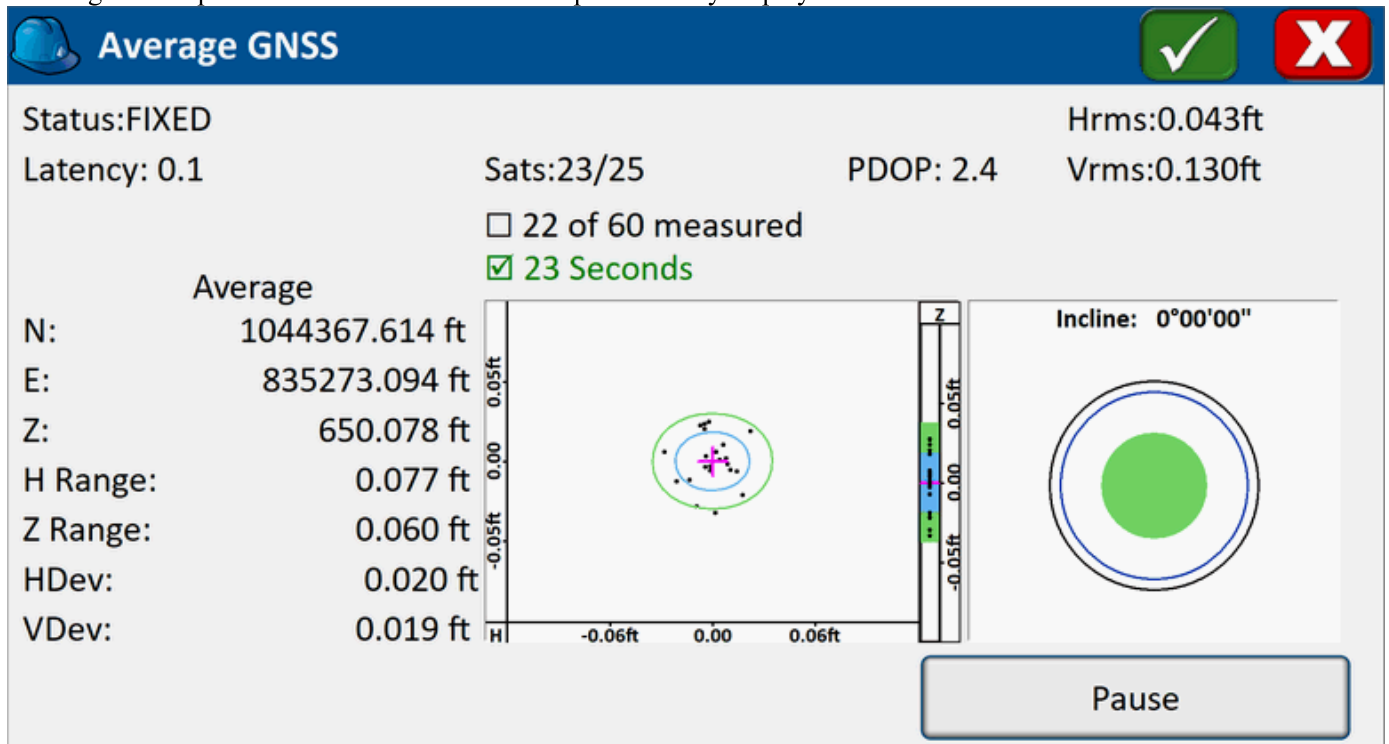
Highlight/select the desired point from the list and tap *Green Check*.

4. You will be provided with relative directions on where the desired point is in relation to where the receiver is. Navigate to the point and establish the GNSS receiver over the point when located:



NOTE: Make sure to override the default **Point Number** with the pertinent point number syntax as provided for the course. When ready, initiate readings with the "Store Point" button (data collector with red dot toward the upper right of the interface).

- Readings on the point will commence and results preliminarily displayed:



6. A summary of the results will be displayed. When comfortable, accept the result.

Stakeout Report

✓
✕

Pt: 1 Desc: GCP /Carlson

	Northing(ft)	Easting(ft)	Elevation(ft)
Staked:	1044367.617	835273.067	650.082
Design:	1044367.595	835273.073	553.930

Move: South:0.022ft East:0.006ft Cut 96.152ft

Simulated position, your results will vary!

VOff 1: ft Elev: ft

VOff 2: ft Elev: ft

Hrms:0.061ft Vrms:0.108ft PDOP:2.371

☒ Store Point Point ID: XXX301

Point Description: STK1 GCP /Carlson Dist: 0.023ft ABC

7. Repeat the process by tapping the *Green Arrow* and establishing the next desired point.

Exporting Data

1. When all measurements have been completed, tap the *Export* button as shown below:

JOB:MSPS2022-XXX

File

Equip

Survey

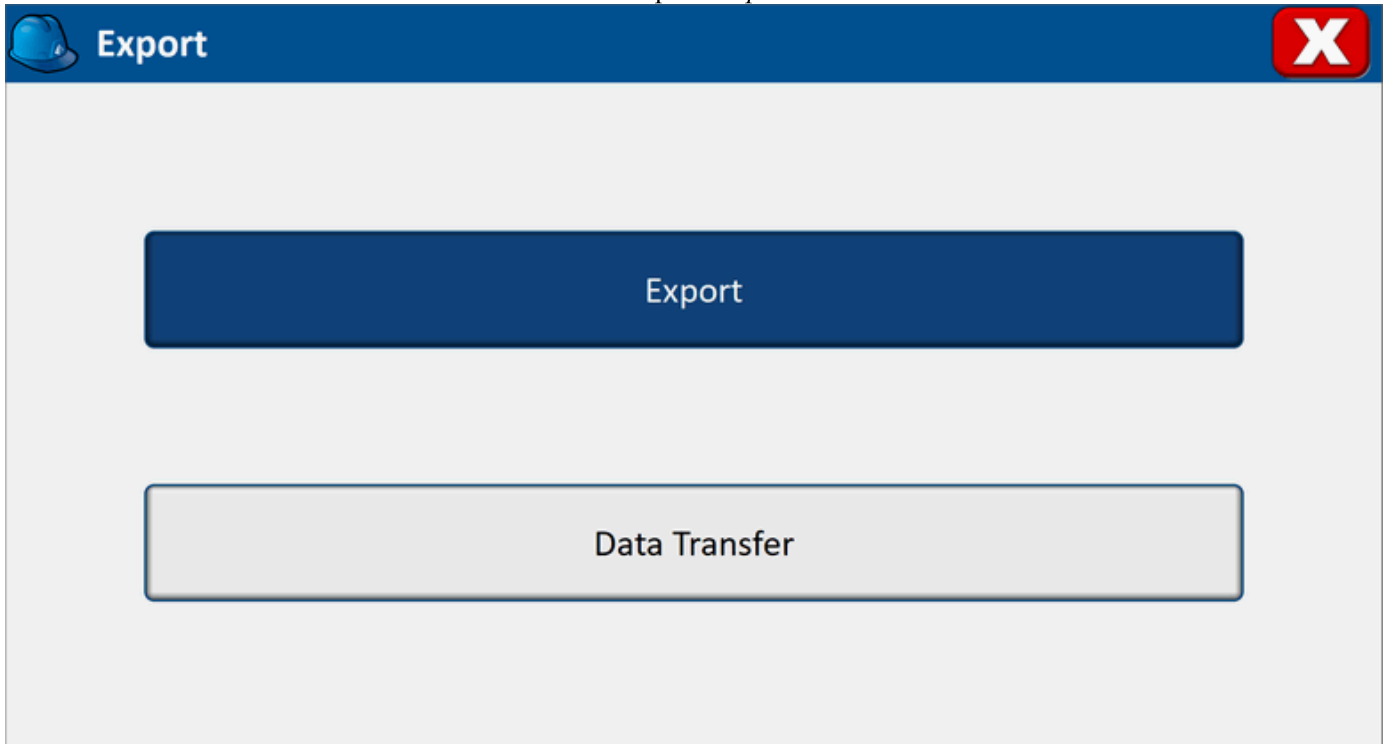
COGO

Road

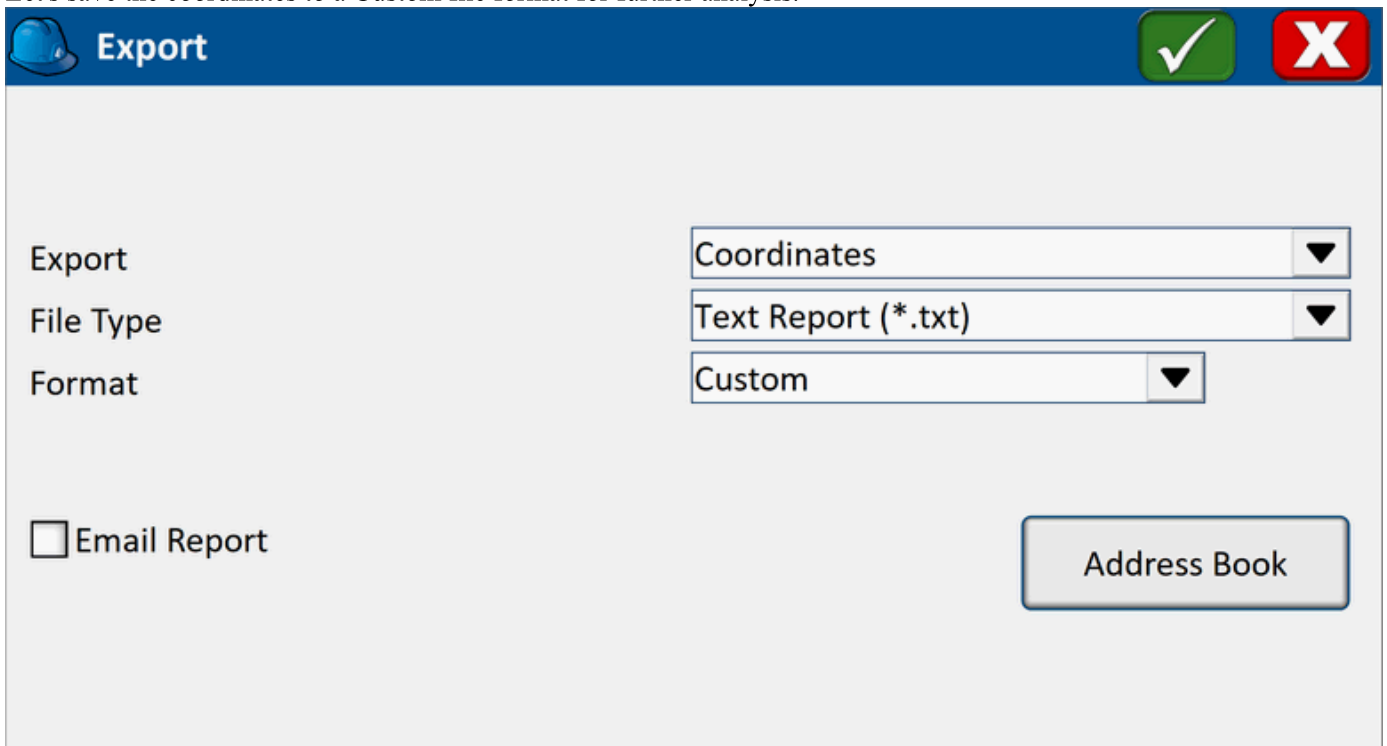
BIM

1 Job	6 Import
2 Job Settings	7 Export
3 Points	8 Delete Job
4 Raw Data	9 About Carlson SurvPC x64
5 Feature Code List	0 Exit

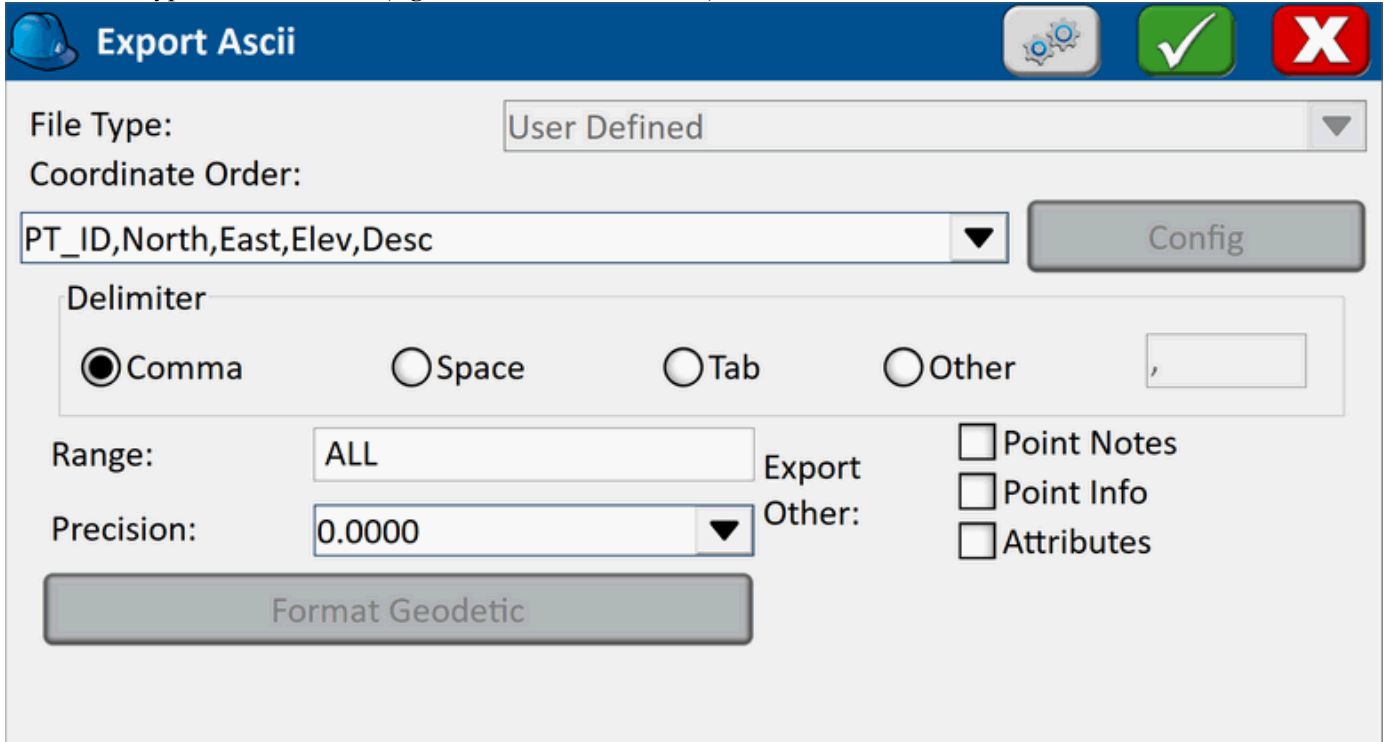
2. Let's externalize our measurements to an external file. Tap the *Export* button as shown below:



3. Let's save the coordinates to a Custom file format for further analysis.



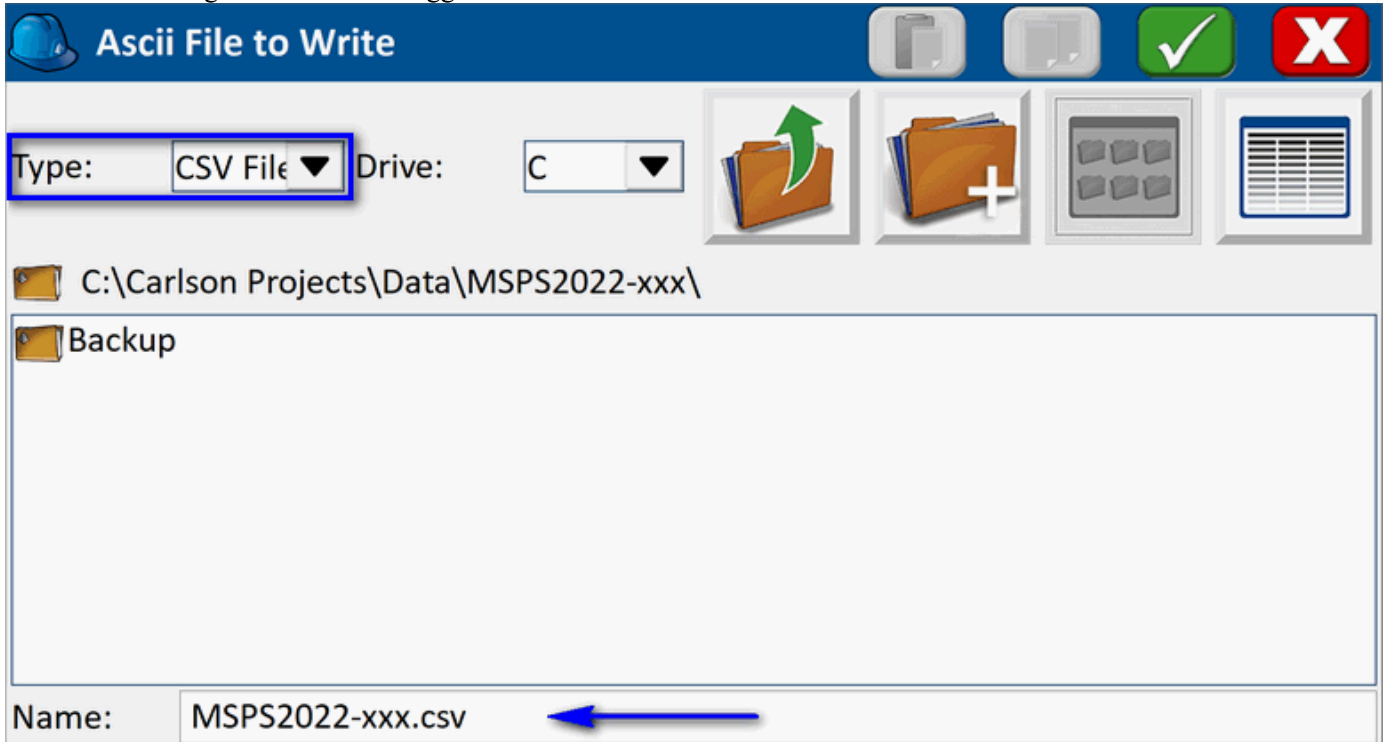
4. Indicate the type of file to create (e.g. P,N,E,Z,D file structure):



The "Export Ascii" dialog box has a blue header with a hard hat icon, the title "Export Ascii", and three buttons: a settings icon, a green checkmark, and a red X. The main area contains the following controls:

- File Type:** A dropdown menu set to "User Defined".
- Coordinate Order:** A dropdown menu set to "PT_ID,North,East,Elev,Desc" with a "Config" button to its right.
- Delimiter:** Four radio buttons labeled "Comma", "Space", "Tab", and "Other". The "Comma" button is selected. To the right of the "Other" button is a small text input field containing a comma.
- Range:** A text input field containing "ALL".
- Precision:** A text input field containing "0.0000" with a small dropdown arrow to its right.
- Export Other:** Three checkboxes labeled "Point Notes", "Point Info", and "Attributes", all of which are currently unchecked.
- Format Geodetic:** A large grey button at the bottom.

5. Provide a meaningful file name as suggested below:



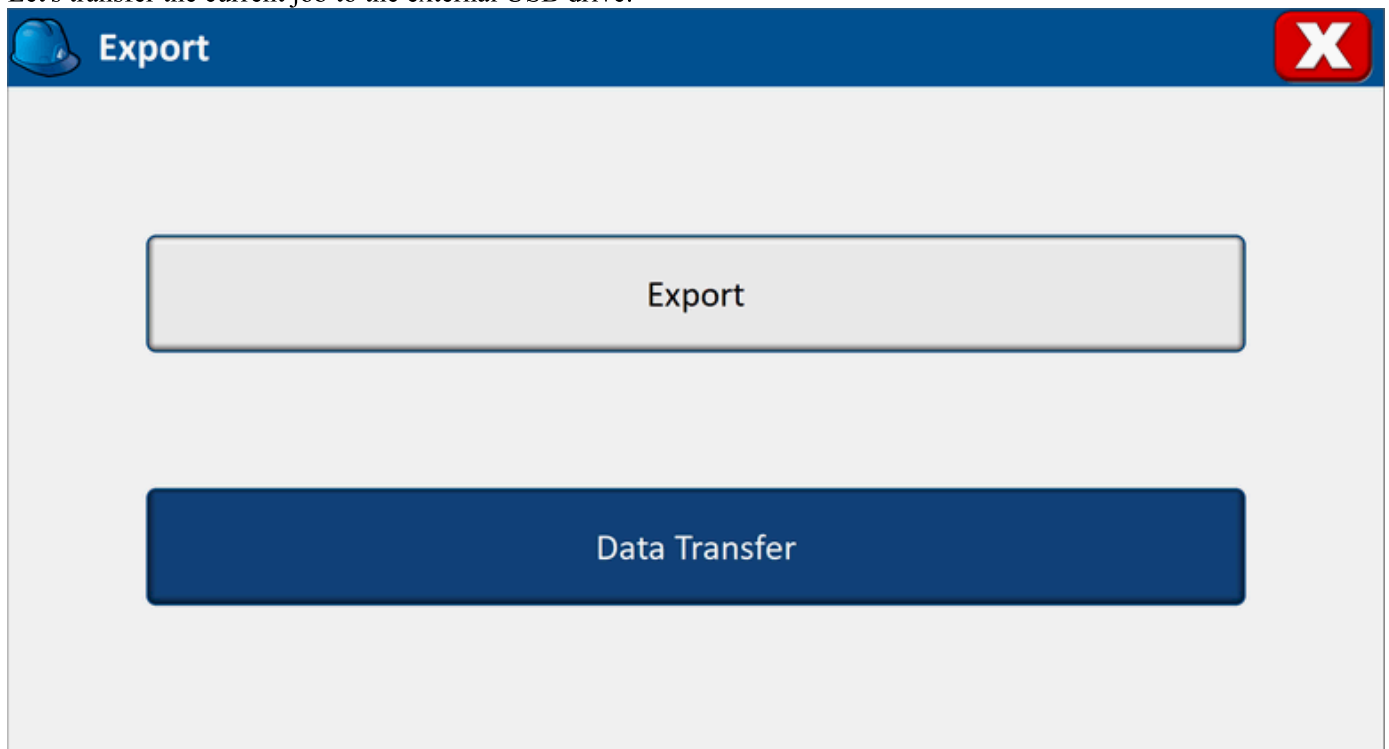
The "Ascii File to Write" dialog box has a blue header with a hard hat icon, the title "Ascii File to Write", and three buttons: a folder icon, a document icon, a green checkmark, and a red X. The main area contains the following controls:

- Type:** A dropdown menu set to "CSV File", which is highlighted with a blue border.
- Drive:** A dropdown menu set to "C".
- File Explorer:** A section showing a tree view of the file system. The path "C:\Carlson Projects\Data\MSPS2022-xxx\" is selected. Below it is a "Backup" folder.
- Name:** A text input field containing "MSPS2022-xxx.csv". A blue arrow points to this field from the right.

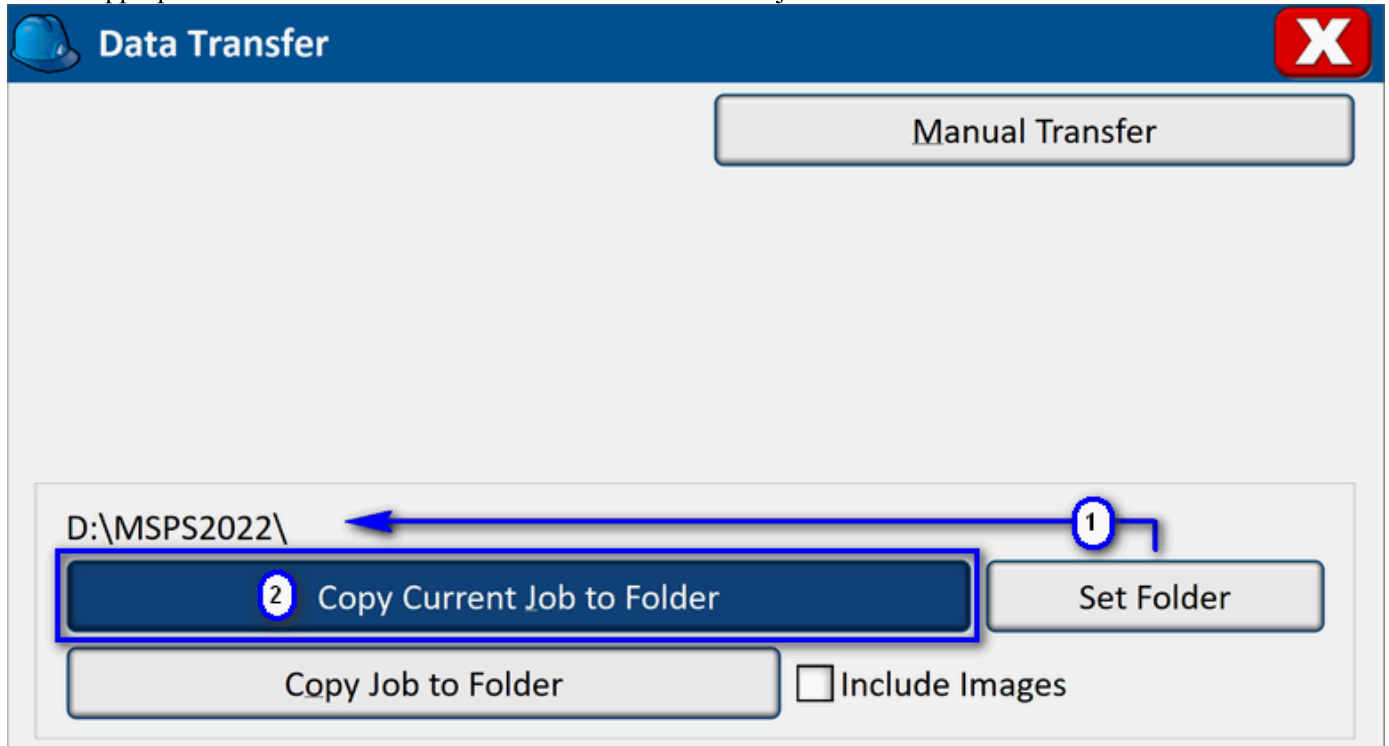
6. Attach a removable USB "jump" (or "thumb") drive to the data collector/controller (the operating system will likely assign it a "D:" logical drive letter). Return to the *Export* button as shown below:



7. Let's transfer the current job to the external USB drive:



8. Set the appropriate destination folder and initiate the transfer of the job to the external drive/folder:



This completes the suggested exercise. As desired, exit from SurvPC via the File → Exit SurvPC button.