Trimble R8 VRS Survey to ArcGIS Import

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This tutorial is for use with a Trimble TSC3 controller running Trimble Access Software version 2013.10 and Trimble R8 GPS Receiver and VRS style differential correction. ArcGIS version 10.2.2 is the desktop computer software used here. Other models and versions may be similar but be aware you may need to make adjustments for differences.

1. Setting up and turning on the equipment
    a. Order of operations is important to reduce errors.
    b. Turn on the mifi jetpack or other wifi hotspot device
        i. Make sure it has a signal.
        ii. If low signal or no signal you may be able to extend the range with an external antenna.
        iii. The jetpack has a range of up to 1,000ft in clear areas so it can be placed in a central high point for your survey if you do not get sufficient signal carrying it with you.
        iv. Any error messages relating to the "base" is a problem with your internet connection.
    c. Turn on the R8 GPS and attach it to the survey pole or other mounting bracket you are using
        i. The antenna in the case that screws to the bottom of the R8 is NOT used for VRS type surveys. It is only used if you use a RTK base station which is not covered here.
        ii. The controller doesn't have to be directly next to the receiver but should be within about 100ft. Thus you can have an assistant operating the survey rod with the GPS while you run the controller if needed.


    d. Turn on the controller by pressing the green button.
        i. It is always best to start from a clean boot on the TSC3. i.e. if you press the power button and it immediately comes on then that was not a full restart. If you run into errors start by shutting the controller all the way off. Hold the green power button down for 3-5 seconds until a screen appears giving you the option to shutdown. Then restart from there.


    e. Connect to the internet
        i. If the controller has been used with the jetpack in the past it should connect on it's own during startup as long as the jetpack has signal and is in range thus you don't need to do anything.
        ii. If you have a problem in later steps with connecting to internet/something like "requested address not found" you may have to manually connect to the hotspot.
            1. Press the windows button (top left black key)
            2. Tap settings

3. Tap connections
4. Tap WiFi
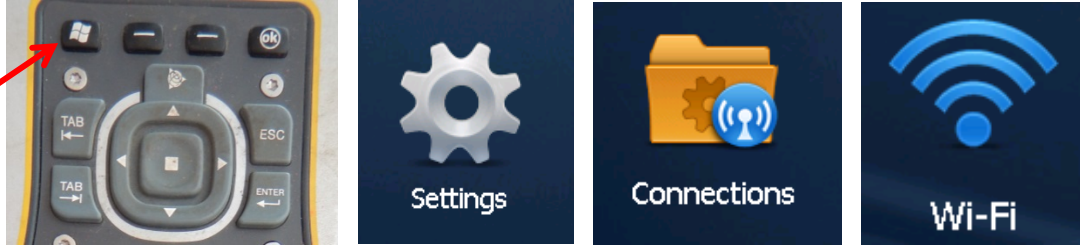
5. Your jetpack should be in the list and hopefully says connected.
6. If it is not connected you may need to select it and hit connect in which case it may prompt you for the security key. The security key can be found in the display menus of the mifi jetpack.
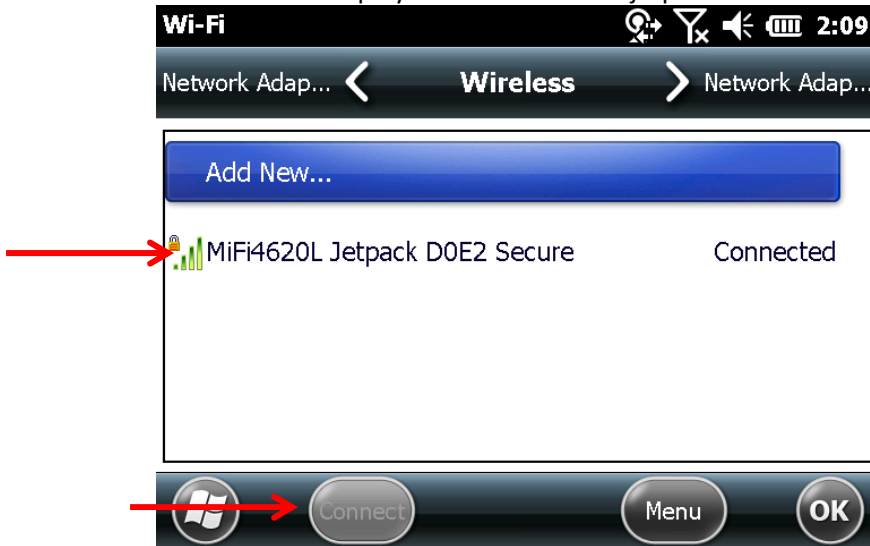

f. From a full startup Trimble access will load itself. If not press the top center grey key with the globe and triangle icon.

2. Starting a new Trimble access job
   a. This tutorial assumes you already have the basic settings on your controller set up. If you are starting fresh, consult your Trimble dealer or other experienced user for initial GPS settings.
   b. With Trimble Access open, tap General Survey
   c. Tap Jobs

   d. Tap New job to create a new file
      i. Give it a name
      ii. Choose a template if you already have one made or go with default settings
      iii. Choose a coordinate system or use the default but just know what it is. This will be important later when you export your final data in a shapefile to ArcGIS

iv. Units Distance should be in Meters if you are using UTM coordinate systems or you may run into display problems if you are overlaying map data like shapefiles.
v. Active map is if you are importing and displaying any other files such as a shapefile of features overlaid on your survey map.
vi. Press Accept to create the new job
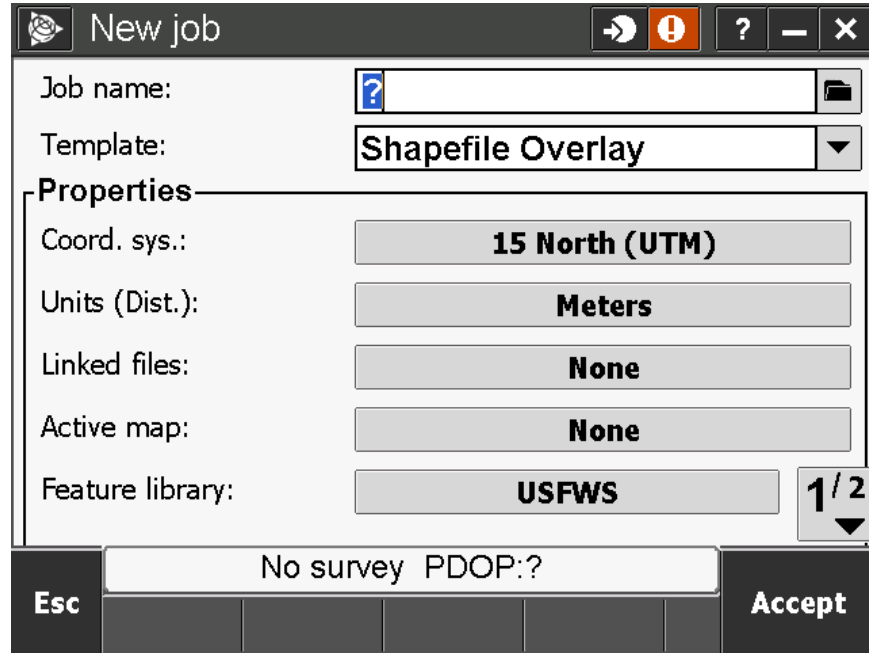
e. Press Measure
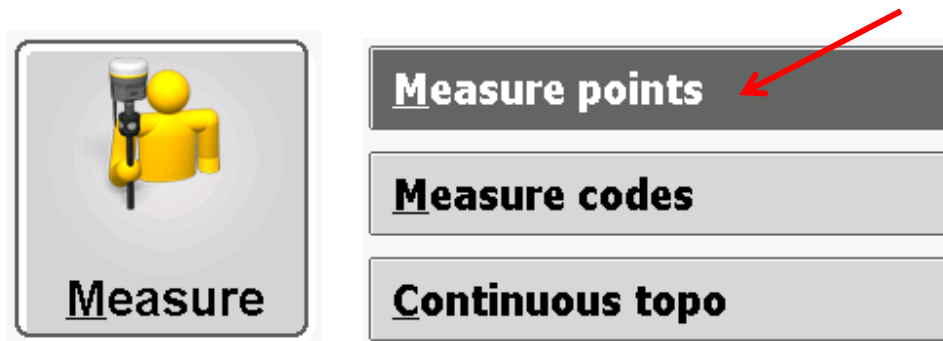
f. Press Measure Points
i. This is where it will now try to connect to the GPS and to the internet. The GPS unit will very rarely have problems connecting as long as it is turned on and initial setup was done right. If there are problems with the internet refer to section 1.e. above
ii. A list will be displayed of mount points. Unless you have other specific directions use the one with CMRx_NAD83(1996)_ HARN. If you can't read all the options drag the column separator at the top to the right of the Mount Point Cell

4
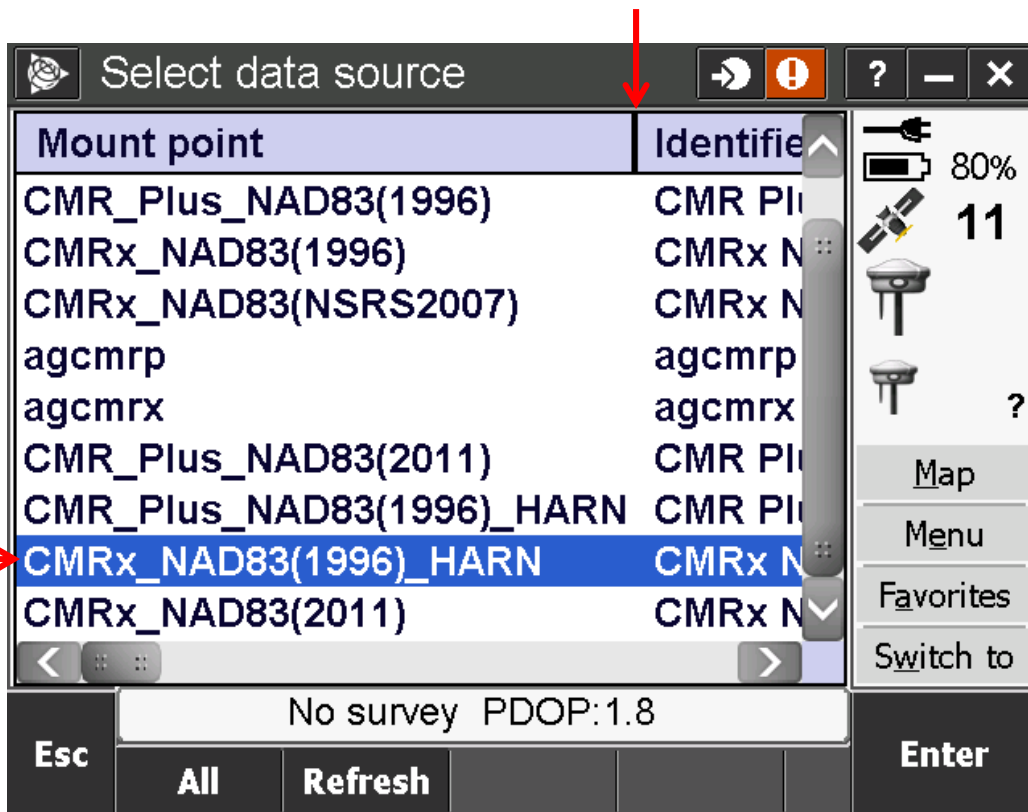
iii. It should now connect and you will hear it say waiting for corrections and waiting for satellites. If you have a clear signal you will then here it say initialization has been gained. Once that is heard you are ready to start surveying.

iv.

v. GPS status is displayed on the bottom and once initialized it will say RTK fixed and show horizontal and vertical accuracy

vi. VERY IMPORTANT make sure the Antenna height is correct for whatever mount you are using. Standard 2 meter pole is 6.562sft, Measured from the bottom of the antenna mount

3. Measuring points (From the job screen go to Measure > Measure Points)
    a. Point name is whatever you want. Generally start with 1 for your fist point
    b. Depending on your initial setup you may have different fields but you should have some type of field for notes or description to type in a description of what you are recording such as 24in CMP culvert invert. Be descriptive so you can understand what was recorded once back in the office
    c. Trimble access has the option of using code values if you create a definition library first. HOWEVER the code definitions do not transfer when exporting to a shapefile as we will do in this tutorial so for now we do not recommend this option.
    d. Choose your method
        i. Rapid point is recording one quick shot with whatever accuracy the GPS has at that moment and is fine for most standard ground shots.
        ii. Topo point is used for higher degree of accuracy and is configured in initial setup. It will take a predetermined number of shots while you hold the unit stationary and average them to get the recorded position. It takes longer as you have to wait at that position without moving the unit until it is done. Average may be 10-15 seconds.
    e. Press the Measure button on the bottom right corner of the screen to take the shot. You can also hit either of the two enter buttons on the top or bottom of the key pad.
        i. If you are using topo mode it will count down until the point is ready to be stored. Hold the GPS still during this time and when it reaches 0 press Store in the bottom corner of the screen.
    f. You will here a sound "Observation Stored"

4. Continuous Topo – For taking a lot of ground shots quickly you should use the continuous topo mode with the GPS mounted on an ATV.
   a. Follow the steps in the previous section for getting connected and GPS initialized
   b. Press the ESC key to get out to the main job screen
   c. Press Measure
   d. Press Continuous Topo
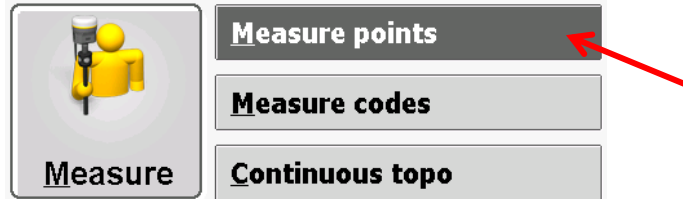
   e. Check your antenna height and update it on the screen. It is likely different than the survey pole. If you are not sure then using the standard survey rod, shoot the elevation under the ATV GPS mount then put the GPS on the mount and shoot the same spot again. Go into the Points manager menu (under Jobs Menu) and subtract the difference in the two readings and add or subtract that difference from the survey rod height to get the GPS mount height.
   f. For method generally use fixed distance
   g. For distance enter how often you want to take a point such as 1 meter
   h. Page down with the (1/2) button to get to the next screen
   i. Enter and description or notes in the correct field if desired
   j. Give a starting point name such as CT1
   k. Hit Start or the Enter key on the key pad to start your survey.
   l. Drive wherever you want to survey and you should hear the controller click as it takes a reading every meter. For better accuracy keep speeds down to 5-10 mph.
   m. Press Stop on screen or the enter key to stop recording.
   n. At any point you can exit and go to standard measure points menu if you want to take a single more specific shot using rapid point or topo point methods.
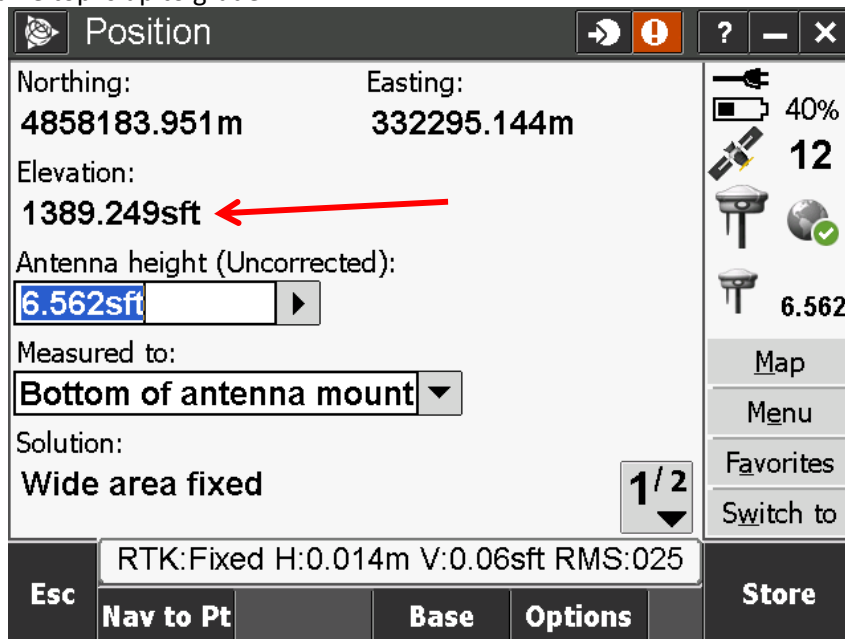

7
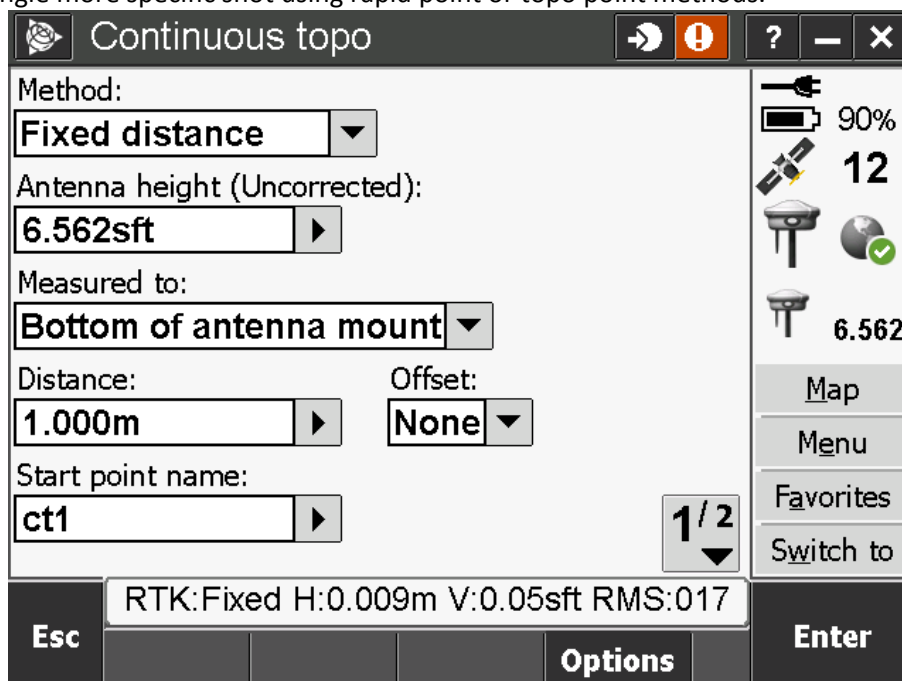
5. Display position without taking points
   a. If you are in a different screen hit escape until you get to the job screen with the options of Job, Key In, Cogo etc.
   b. Hit the Instrument option
   c. Hit Position
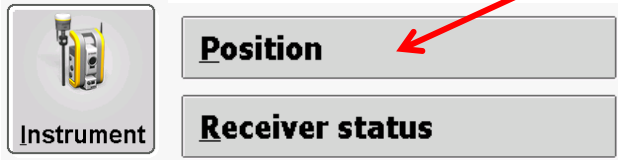
   d. This screen will show real time position which is useful for checking elevation of features like if a dike top is up to grade


6. View The Map
   a. Sometimes it is useful to visually display your points or if you are using a shapefile on-screen for navigation you can view it on the map. Any of the measuring screens have a "Map" option on the right side of the window.
   b. To navigate to where you are you can use the pan/hand tool and the + or – buttons OR hit the large up arrow, then choose "Pan to" then choose "Here" to center your location on screen.
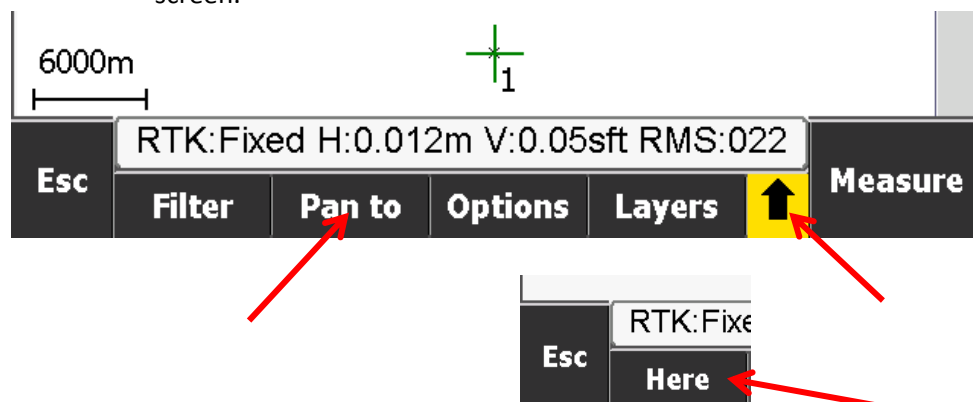
7. Working around trees or cover, Ensuring Accuracy – RTK Initialization
   a. Trees or other canopy cover scatters and fragments the GPS signal so it does not retain a positive lock and has a higher degree of error. You may get errors such as initialization has been lost at which time you can not take a point.
   b. BEFORE entering a canopy area or even do this with the start of any survey you can do a RTK Initialization, which basically locks on to a fixed satellite signal and will hold a little better in trees.
   c. First you need a solid position, likely from a tripod/bipod and take a topo point. Remember the point name or number you gave it.
   d. Do not move the GPS after you take that topo point!
   e. Press the Escape key to get back out to the Measure options screen
   f. Press RTK Initialization
   g. In the bottom right corner press Init
   h. You will get a warning about discarding the current initialization. Press Yes
   i. On the Initialization screen use Known Point for the method
   j. Enter the Point name for the location you are at which you just took a topo point of
   k. Press Start in the bottom right corner and wait a few seconds
   l. A screen will appear showing initialization has been gained and hit "Accept" in the bottom right corner
   m. Escape back to your measurement screen
   n. Your GPS fix will now hold slightly better in canopy cover as well as ensure a little better accuracy. When working in trees where you could loose signal at any time I recommend using rapid point method. Surveys in the fall, winter or early spring where leaf cover is absent also helps.
   o. Even with RTK initialization in tree cover you still might loose satellites and loose the RTK initialization. If this happens you can move back out to open space and let it get another on-the-fly initialization or repeat the steps above to get another RTK initialization.
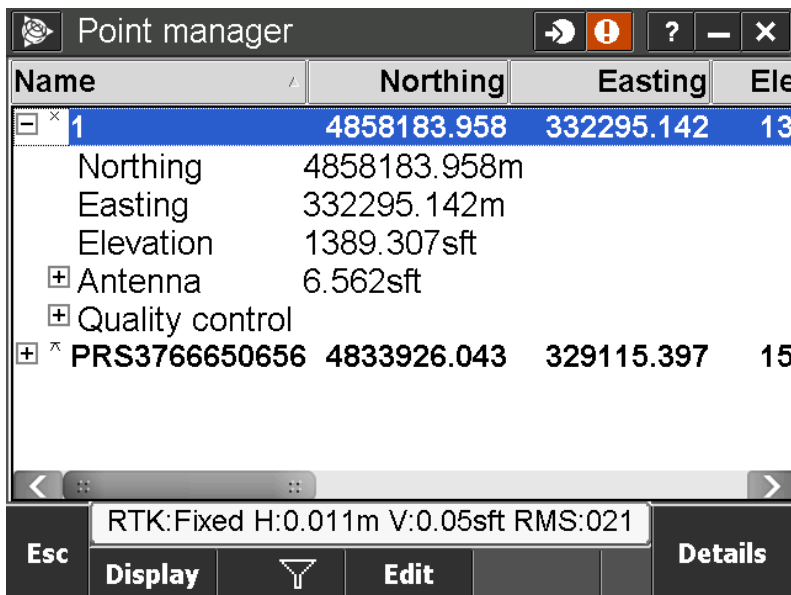

9
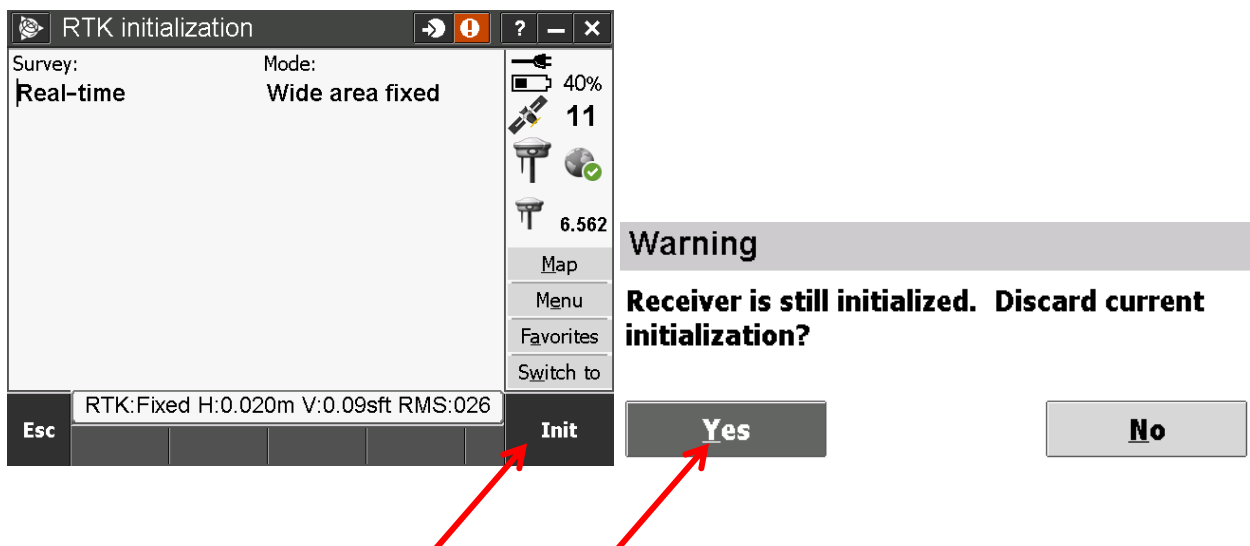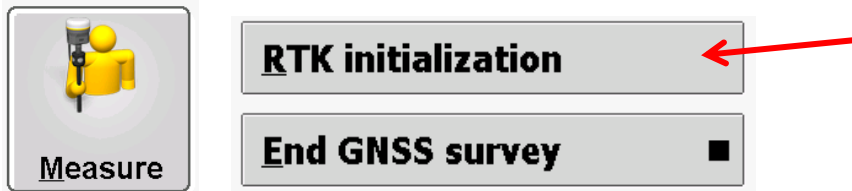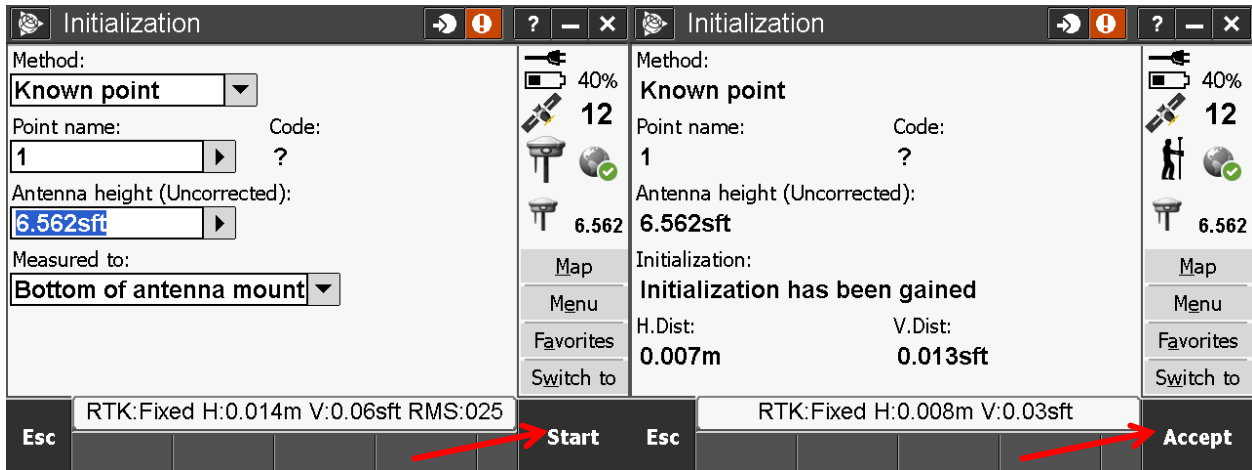
8. Reviewing a point
   a. To view a point you took including the option to delete it, go to the jobs screen, then point manager

   b. You can scroll down through your list of point names and hit the + icon next to it to expand the details. Tap the point name to edit it

9. Finishing Survey – Hit the Escape key until it asks to stop the survey and you say yes to the option to power down receiver. If you are finished with field work power off the controller by holding down the green power key until the power menu screen comes up which you choose shut down.
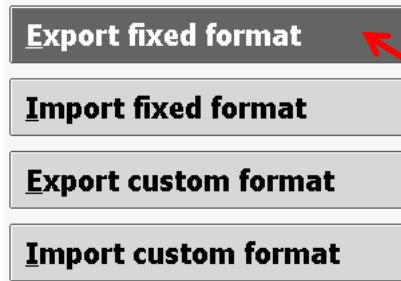
10. Exporting data to AcrGIS
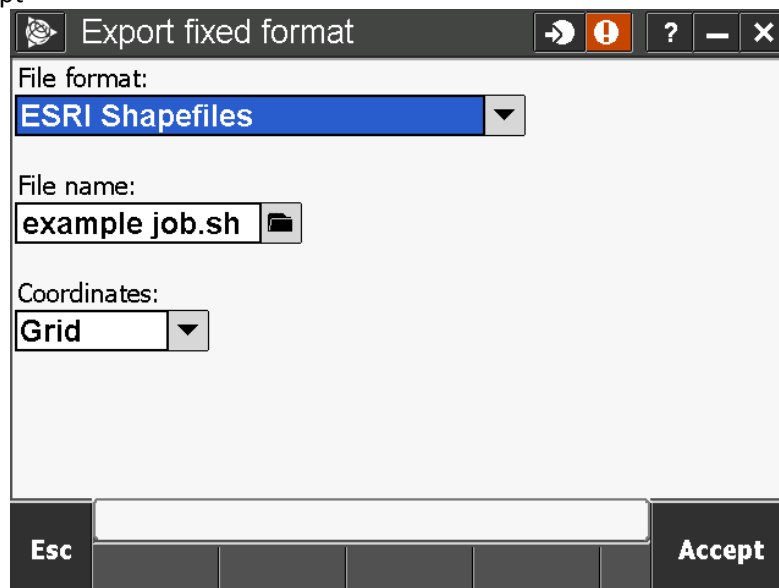   a. Power on the TSC3 controller
    b. Open Trimble Access
    c. Hit General Survey
    d. Hit Jobs
    e. If Your desired job file is not already open then open it

    f. Hit Import/Export
    g. Hit Export fixed format


    h. File Format choose ESRI Shapefile
    i. Filename is whatever you want to call it or the job name by default
    j. Coordinates choose Grid
    k. Press Accept

      l.   Record what coordinate system you were using. If not sure go to Jobs Menu and Properties of Job

11. Import data to desktop computer
    a.   Plug in your TSC3 Controller to your computer with the USB cord
    b.   Open windows Explorer
    c.   The TSC3 should show up in your list of disk drives
    d.   Within the TSC3 there are probably 2 drives listed. Open the blank one not the Storage Card
    e.   Click on Trimble Data
    f.   Open the sub folder for your user
    g.   Open the Export Folder
    h.   There should be 3 files with the name you gave when you exported. Select and copy all 3 (.dbf, .shp, .shx)
   i.   Paste them to your hard drive or server wherever you store your project files
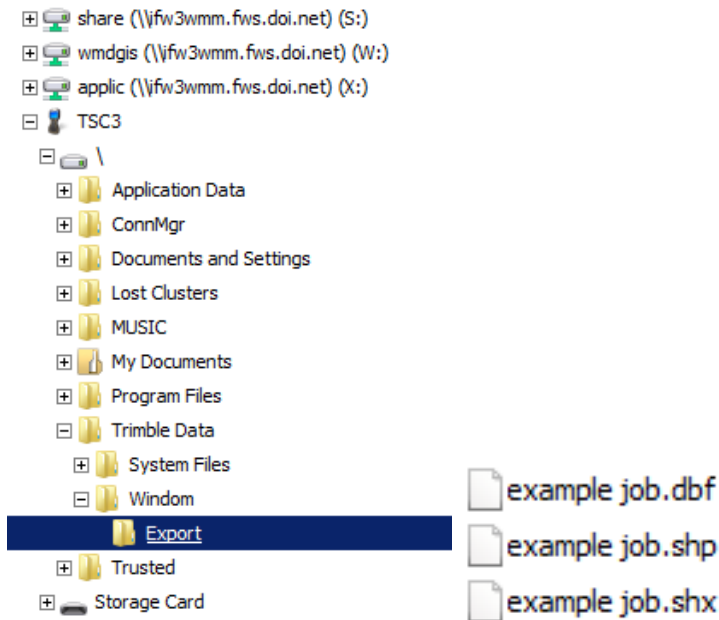
12. Importing Survey Shapefiles in ArcGIS
    a.   Open ArcMap
    b.   Click on the ArcCatalog button. White square with yellow file cabinet icon on top toolbar.
    c.   Navigate to where your survey shapefile is stored. If you don't see your disk drive hit the connect to folder button (folder icon with a + sign), Highlight your drive you want to add and hit OK and it will add a shortcut to that drive in your Catalog window
    d.   Once you see your shapefile in the list right click on it and choose properties
    e.   Define the coordinate system
         i.   When it is exported from trimble, for some reason they do not export the coordinate system which is needed for proper use of shapefiles.
        ii.   In the properties window go to the XY Coordinate System Tab and define your Coordinate System in the list
       iii.   For common UTM NAD 83 Zone 15N it is under Projected-UTM- NAD 1983
    f.   Rename the shapefile if you want to something intuitive like Jobname_Survey_points.shp
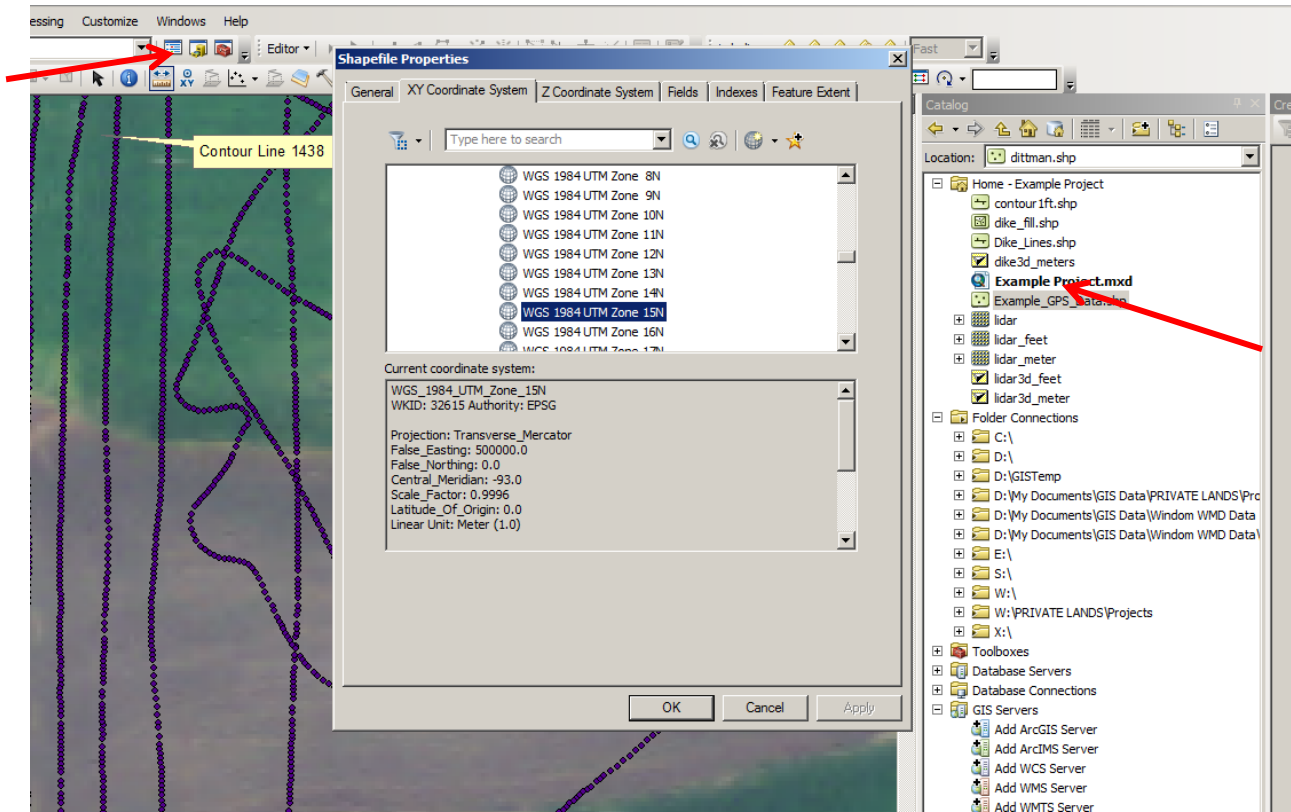
g. Add the shapefile to your map by either dragging and dropping or use the add data button
h. Open the attribute table and notice what has been imported. It should have your point name, notes or descriptions and the Lat, Long and elevations. If you used code values then only the code is imported but not the code definition.
i. Notice the first point in the list is something like PRS###. This is the VRS base station used for GPS corrections. I recommend starting editing and deleting this point so it does not confuse later steps.
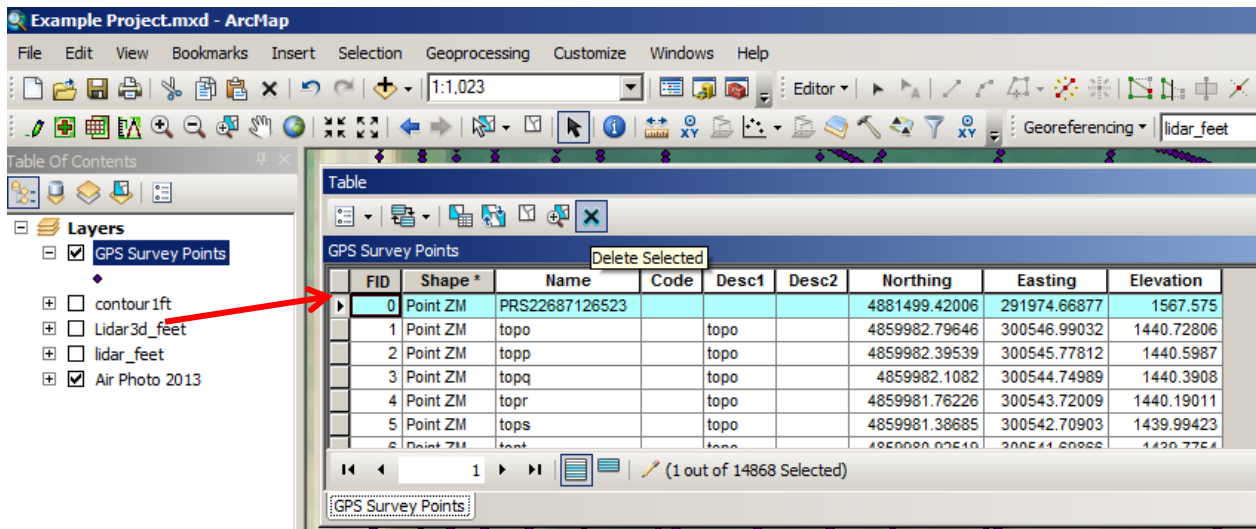
13. Creating a 3d terrain surface from your survey.
    a. If your survey is complete enough coverage to represent topography of the area it will be easier to view as a continuous surface instead of a series of points. You can then also create contour liens and in later steps design restoration features like dikes and spillways.
    b. If all your points are ground shots you can continue as is. If some points are not ground elevation such as water surface, top of culverts etc., you may want to exclude those from your 3d surface since those points don't actually represent your terrain.
        i. Select all points that will make up your terrain surface
        ii. Right click on the layer in the table of contents
        iii. Under Selection, choose "Create Layer from Selected Features"
        iv. You now have a subset layer from those selected points
    c. Open ArcToolbox – Red toolbox icon on the top menu bar
    d. Open 3D Analyst Tools > Data Management > TIN > Create TIN
    e. Output TIN is what you want to name it and where to save it. Use something intuitive like "Survey3d"
    f. Define the Coordinate system which should be the same as the input data
    g. Input data is your survey points layer which you can drag and drop from the table of contents, choose from the dropdown menu or browse to the file
    h. Change both height field and tab field to Elevation
    i. Hit OK
    j. You now have a 3d layer of your survey
    k. You can change the display color ramp if needed by double clicking on the layer or right click and choose properties and go to the symbology tab. I recommend sticking with the default color ramp but increase the number of classes to the maximum of 32.
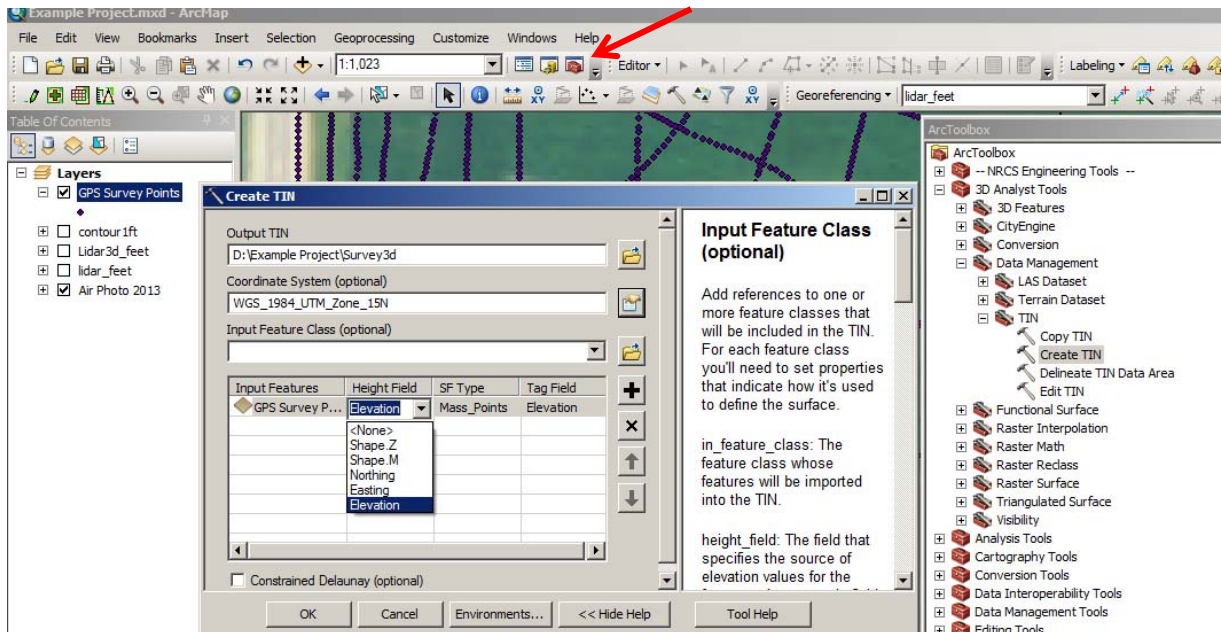

14. Supplementing Survey data with LIDAR
    a. Often LIDAR data is good for general landscape features but survey data fills in gaps with more accurate information such as wetland bottoms in heavy vegetation where LIDAR is not as good. You can combine datasets to get a good full picture.

15

b. See the supplemental tutorial for working Uning LIDAR to Design Embankments in ArcGIS for more information about LIDAR.
c. From the LIDAR tutorial (steps 1, 2 & 3) obtain LIDAR data, clip it to the work area and convert units to feet (assuming your survey is also in feet elevation units)
d. You should now have a clipped lidar Raster/DEM layer in feet units
e. Open ArcToolbox and go to Conversion Tools > From Raster > Raster to Point
f. Input Raster is your clipped lidar
g. Field by default should be the elevation values of the raster
h. Output point features is where you want to store it and what you want to name it. Something intuitive like Lidar_points.shp
i. Hit ok
j. Now you have a point layer with a elevation point every square meter from the lidar
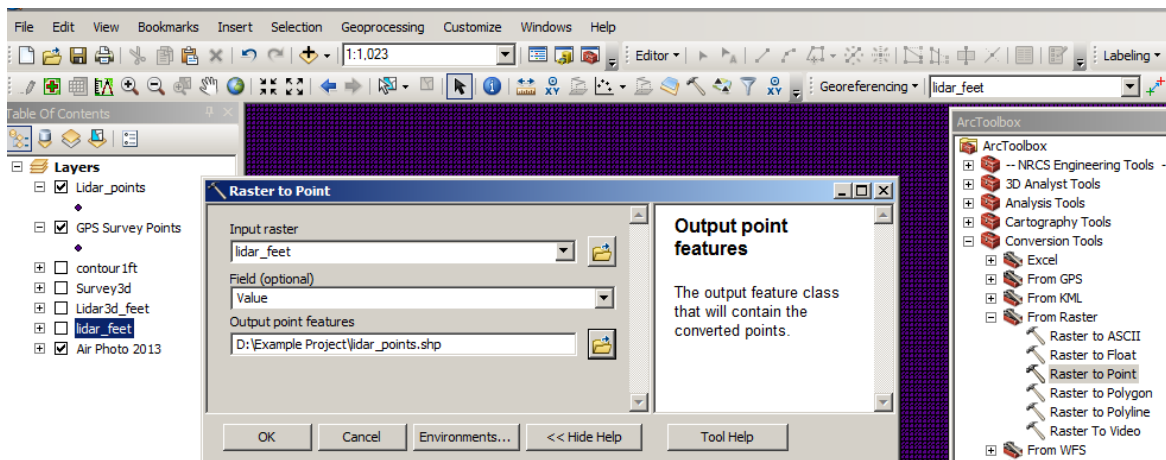

k. Next we will remove the LIDAR points where we have quality survey data
l. From the file menu at the top of the screen go to Selection and select by location
m. Use select features from and choose the Lidar_points layer you created
n. Source layer is the survey points layer (or sub-selection layer of survey points representing ground shots)
o. Spatial Selection method is by default "intersect the source layer feature"
p. Check the box for apply a search distance. Choose a distance that you feel comfortable where the survey point at that location will override the lidar data such as 10ft.
q. Hit OK and now all lidar points within that buffer distance of the survey points will be selected.
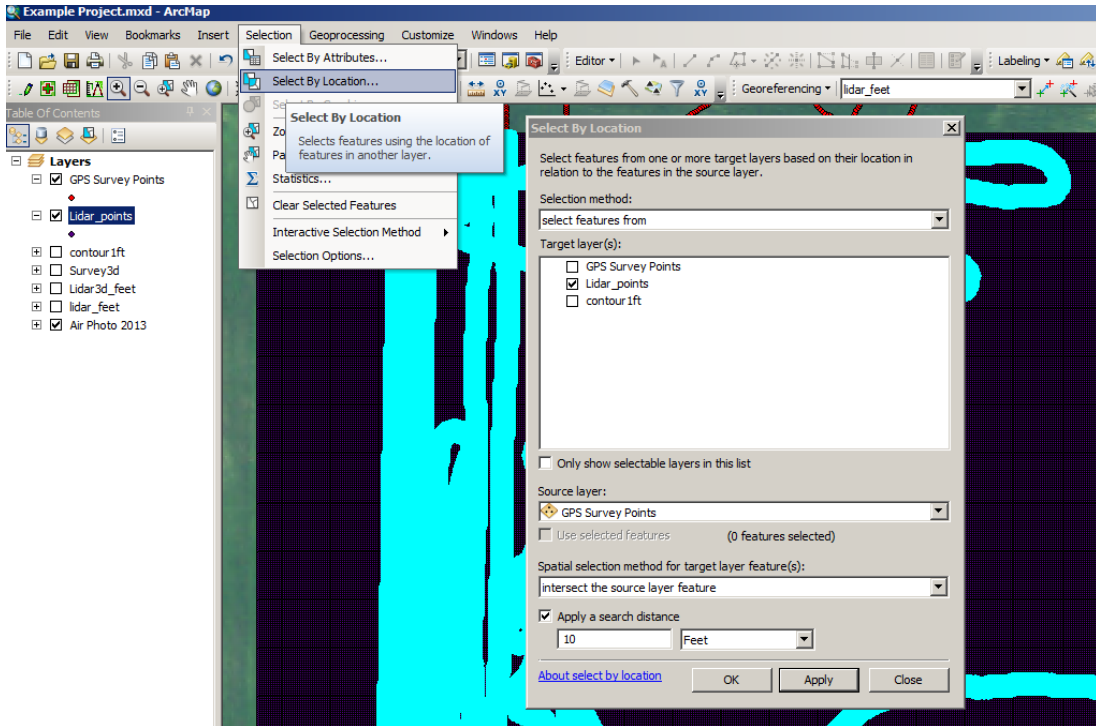
r. However we actually want the inverse selected so right click on the lidar_points layer in the table of contents and go to selection the "switch selection" and the selection will now reverse

s. Create a new layer from the selection by right clicking again on the lidar points layer in the table of contents, go down to selection, hit Create Layer from Selected features
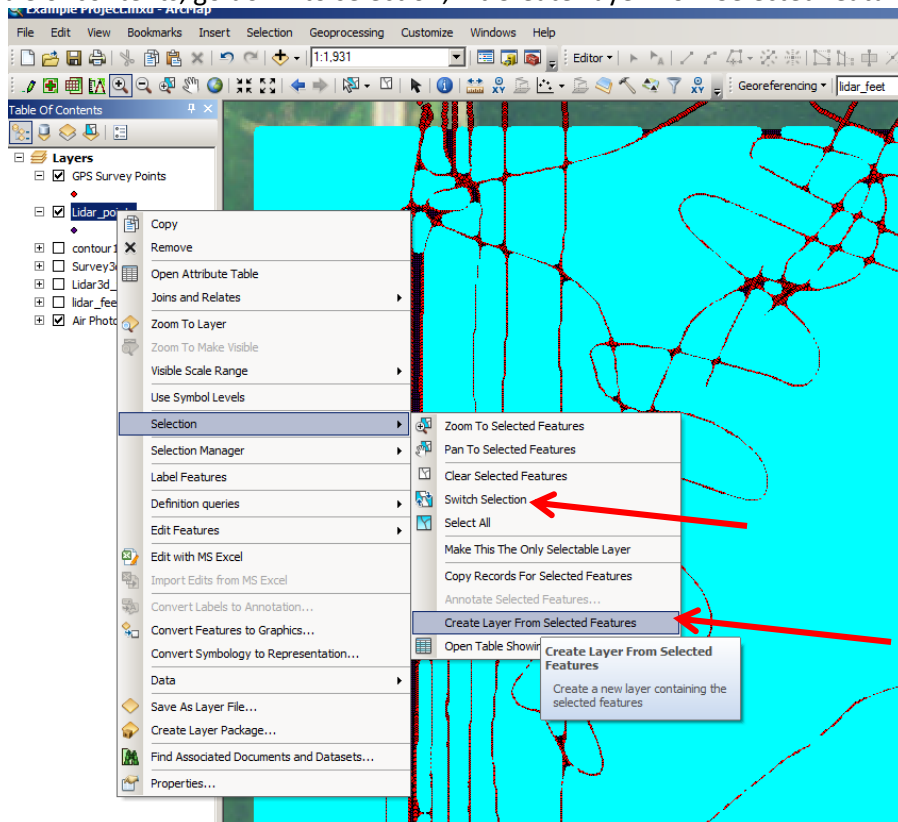
t. Rename this new layer if needed in the table of contents such as LIDAR Buffer
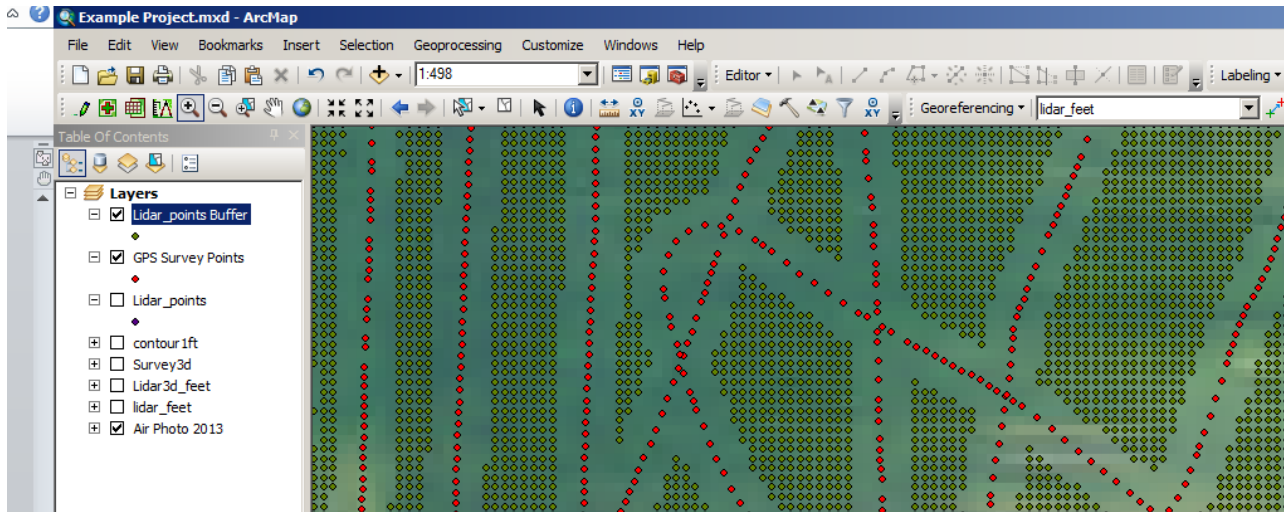
u. Now you can again create a 3d Terrain model as outlined in section 13 above. However in step 13g include both the survey point data AND the LIDAR buffer point data in the input. Be sure to again change the height field and tag field to the elevation values. Name it something intuitive like Survey_Lidar_Merge3d

v. You will now have a 3d terrain surface that merges the survey data with the LIDAR data to fill in survey gaps.
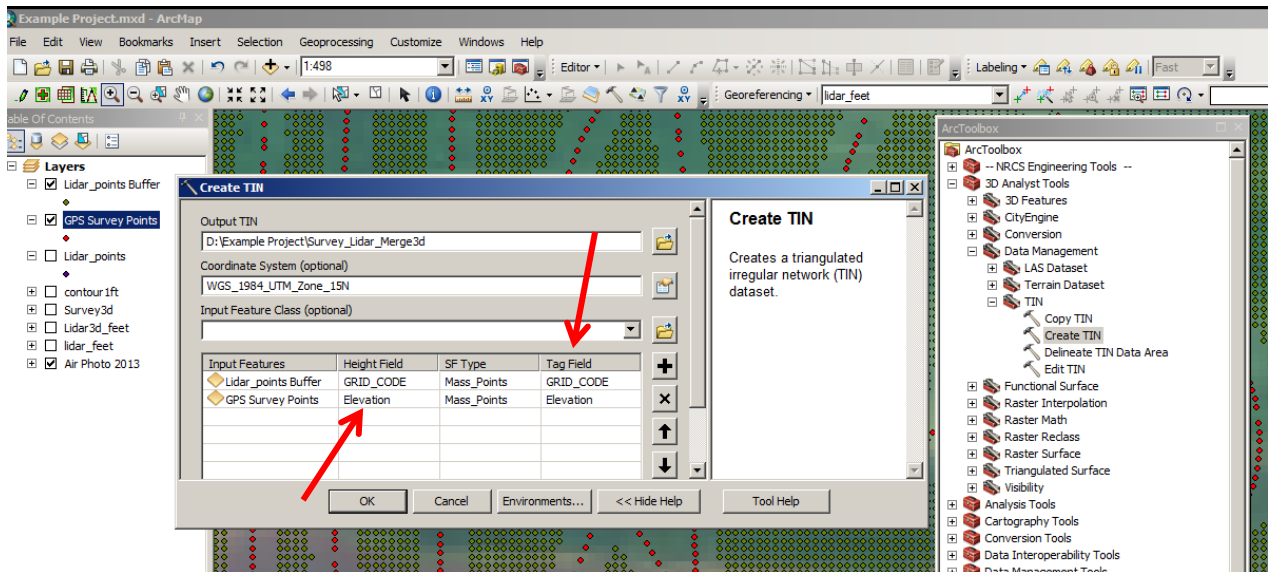
w. Contour lines can be made from the new TIN layer, Open ArcToolbox, go to 3D Analysis Tools > Terrain and TIN Surface > Surface Contour
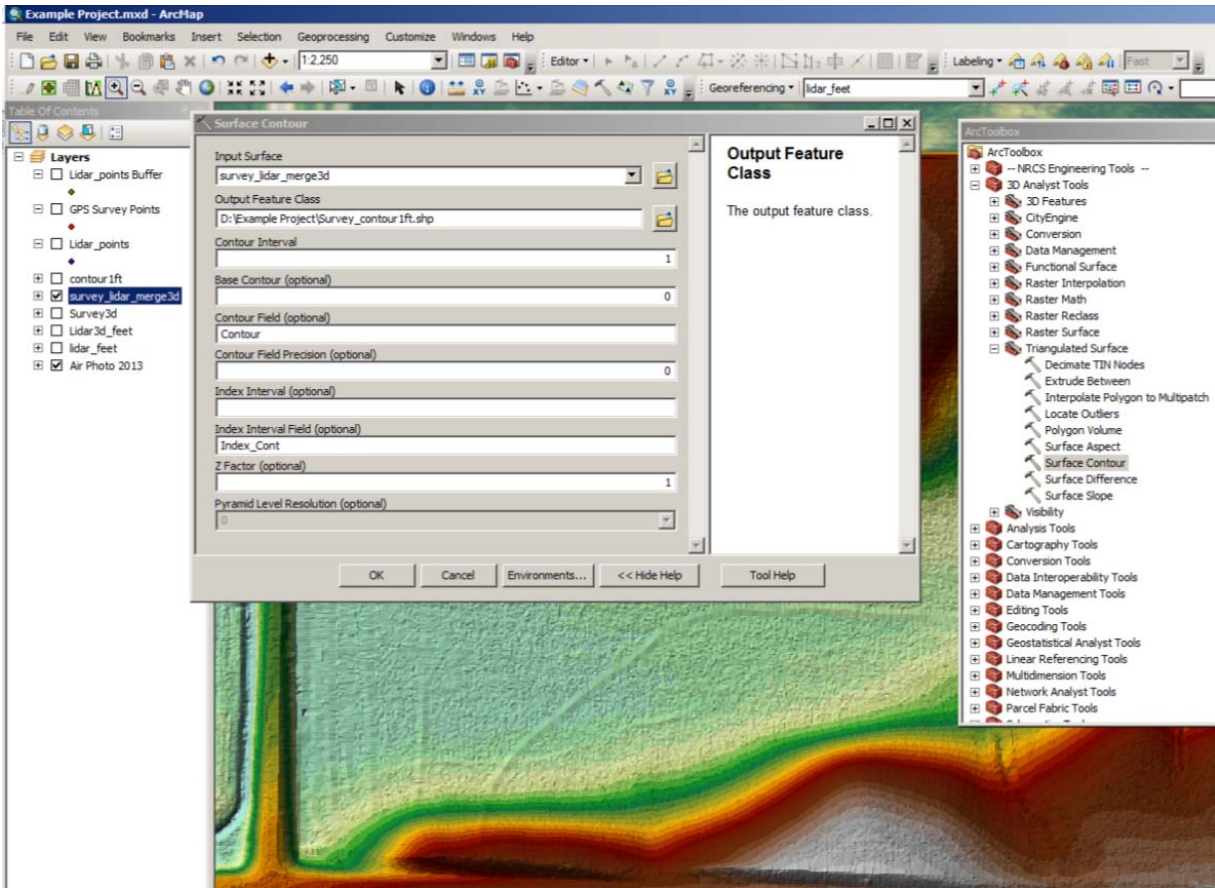
x.   This merged TIN layer can be supplemented and used in the dike building tutorial instead of pure LIDAR data. In the dike building exercise you need a TIN in Meters units so add a step of creating a new field in the attribute table for both the lidar points layer as well as the survey points layer and do a conversion calculation to meters. Then continue with the rest of the steps to create the TIN with the **meters** as the **height** and **tag** value field.
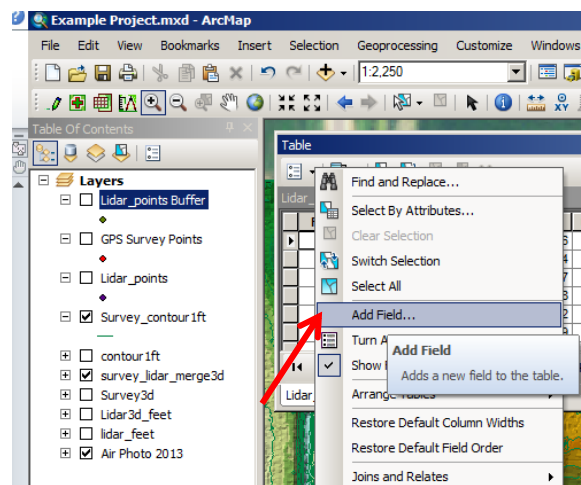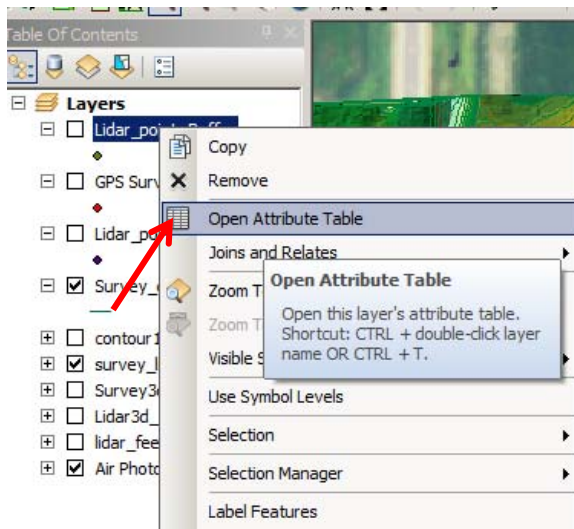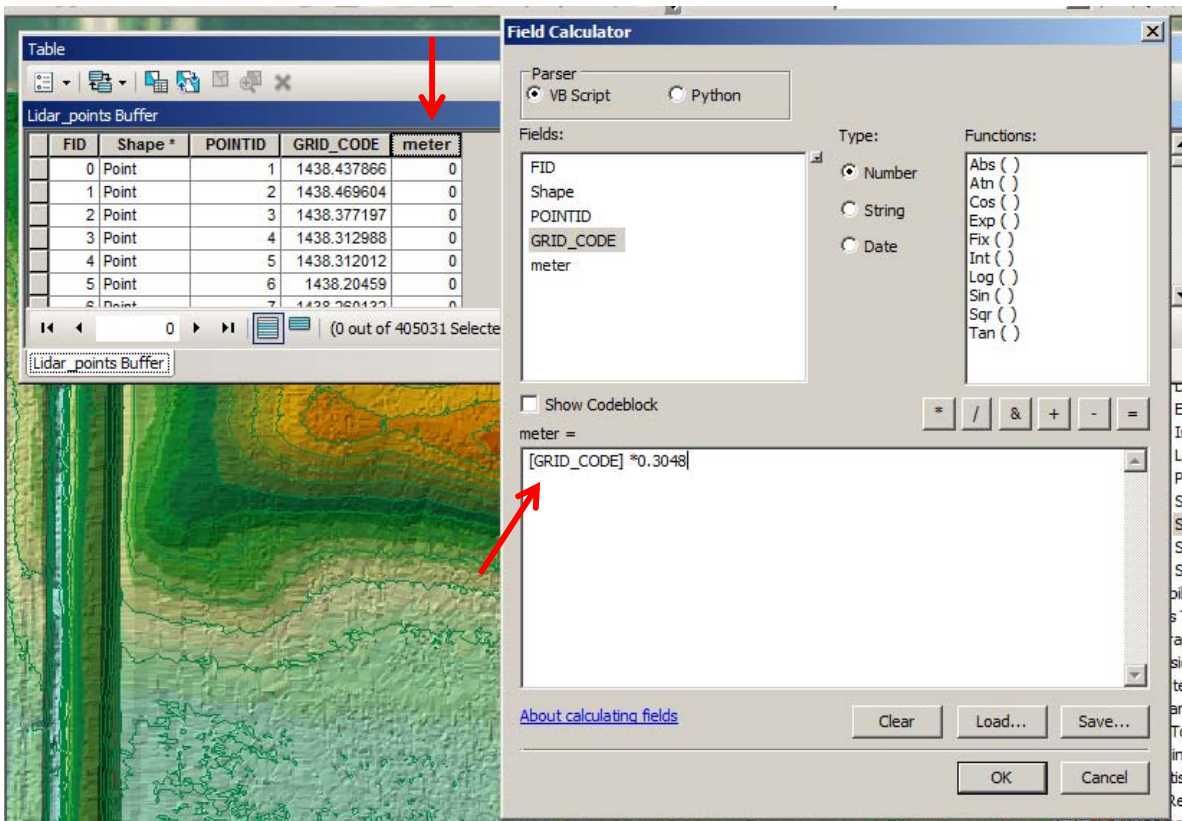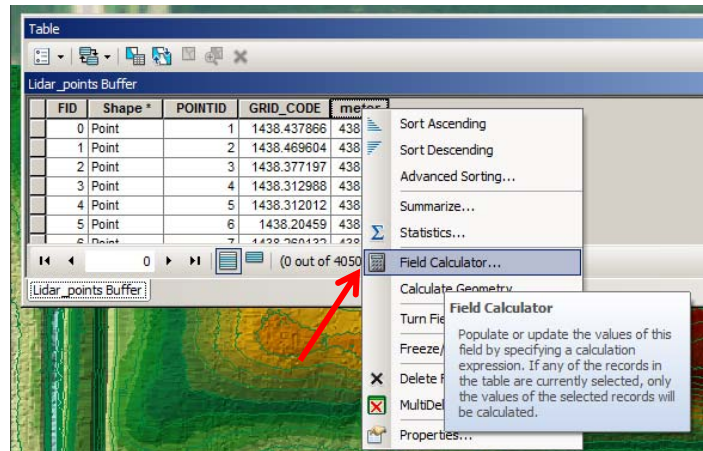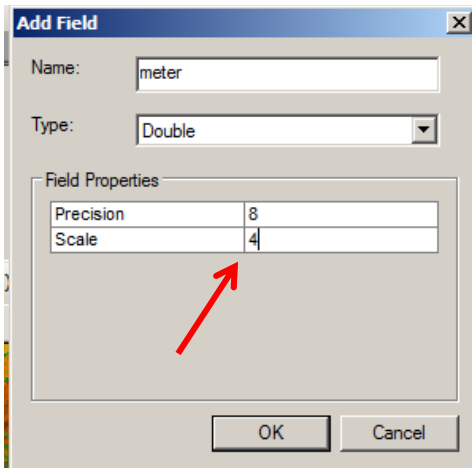
Repeat for Elevation values in GPS Survey Points
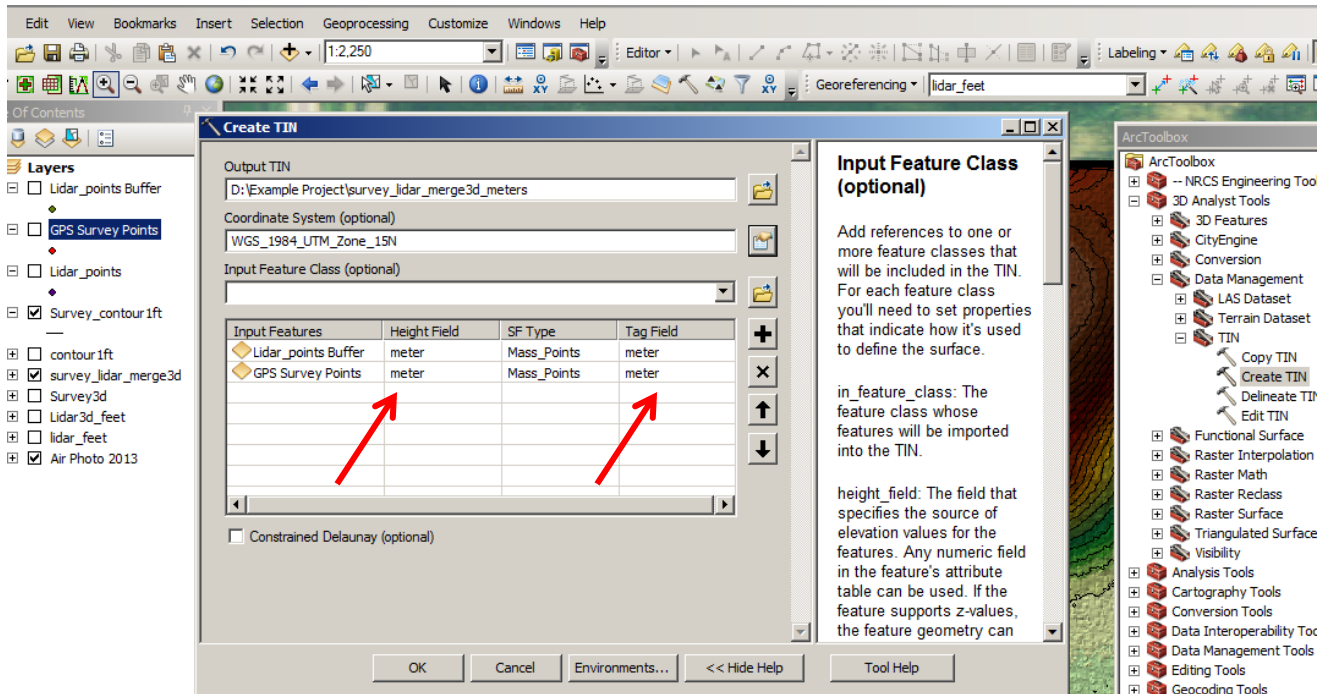
Refer to the Diking Building Tutorial for more information on designing dikes in ArcGIS from digital elevation data. If you have gotten to this step of making a hybrid Survey and Lidar TIN layer you will resume on step 7 of the Dike building tutorial.