Right of Way Technical Training

SESSION NO. 4

MicroStation/Geopak

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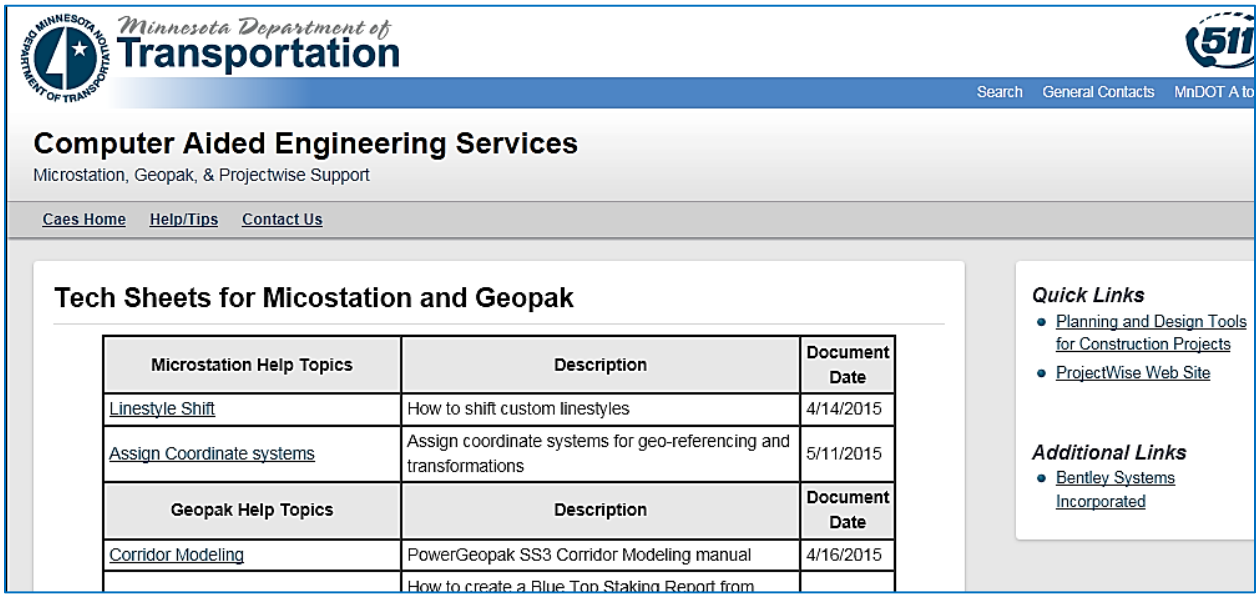
Chapter 1

MicroStation Tips and Tricks

By Jose Aguilar

According to 'MicroStation TODAY', customizing the workspace helps users comply with standards and increase production speeds. A workspace is the MicroStation environment that you are working in, similar to your desk, it should have tools that you use frequently, easily accessible. These environments are personal preference and should vary on the type of work being produced. It helps reduce errors created by using the wrong resources to complete the project and also saves on redundant mouse clicks. MnDOT has an office that provides support to users of MicroStation, Geopak and Projectwise. The CAES office or Computer Aided Engineering Services office provides training, resources and data standards. They also provide 'Tech Sheets' for Microstation and Geopak.

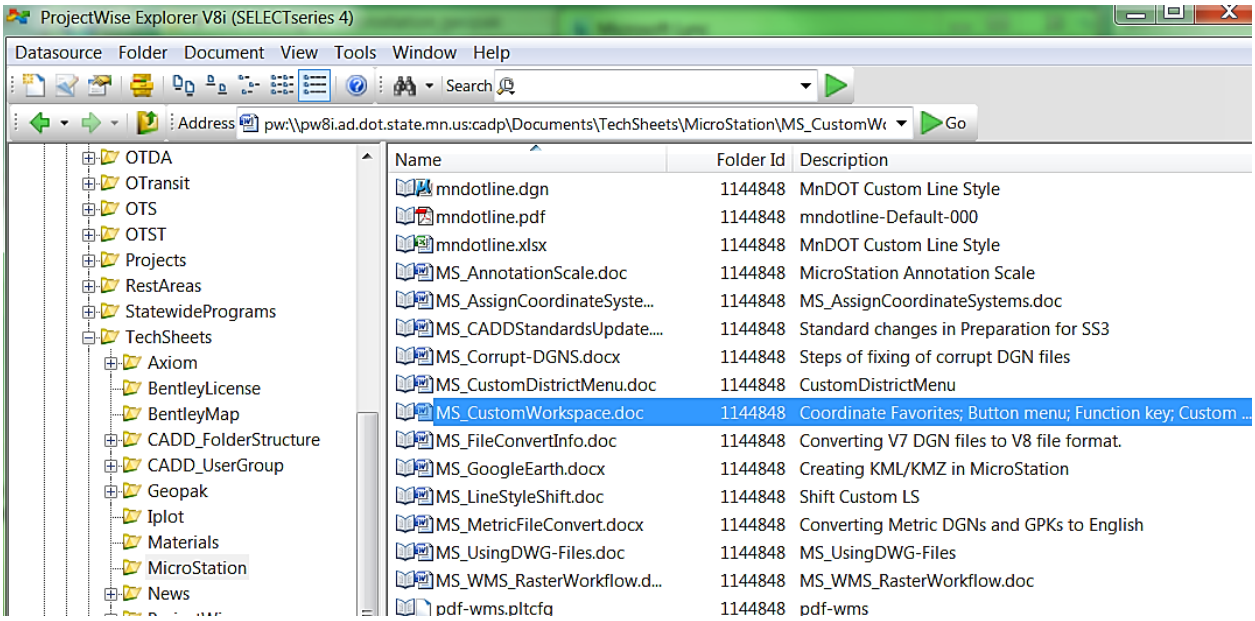


These sheets can be found externally at:
http://www.dot.state.mn.us/caes/tech.html

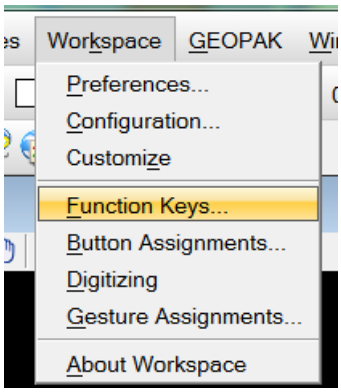
A more comprehensive selection of Tech Sheets can be found internally in Projectwise:
TechSheets

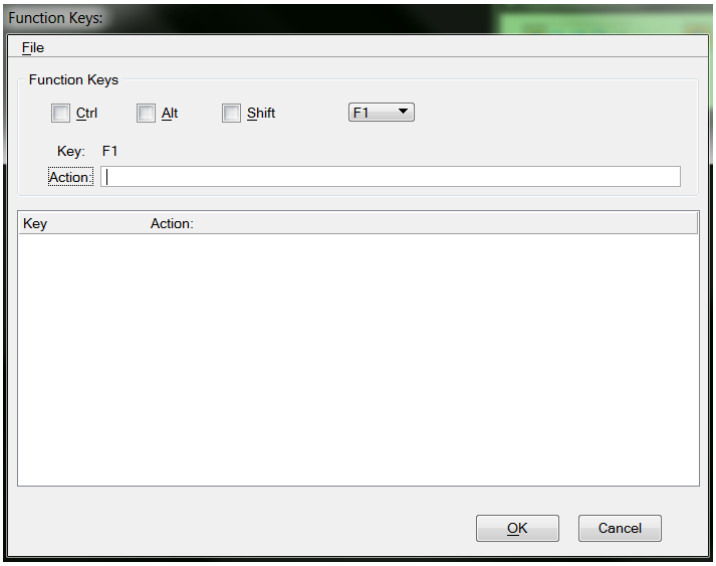
Editing the Function Key Menu

Function Keys are assigned commands created by the user for specific tasks. Under the function keys dialog box a user can setup specific actions for the available function keys. Once created the user can select the desired function key and quickly perform the wanted task. The intention is reduce the number of mouse clicks and quickly access certain commands of frequent use.

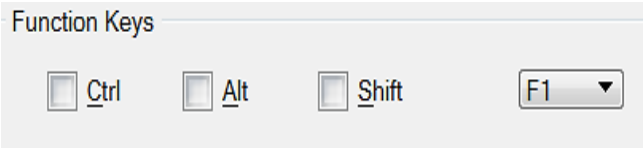


1. In MicroStation, from the Workspace menu, choose Function Keys. The Function Keys dialog box will open.

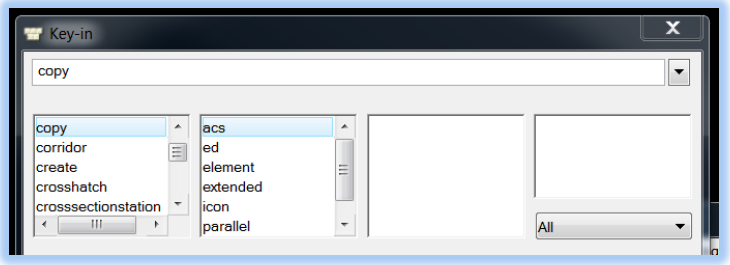


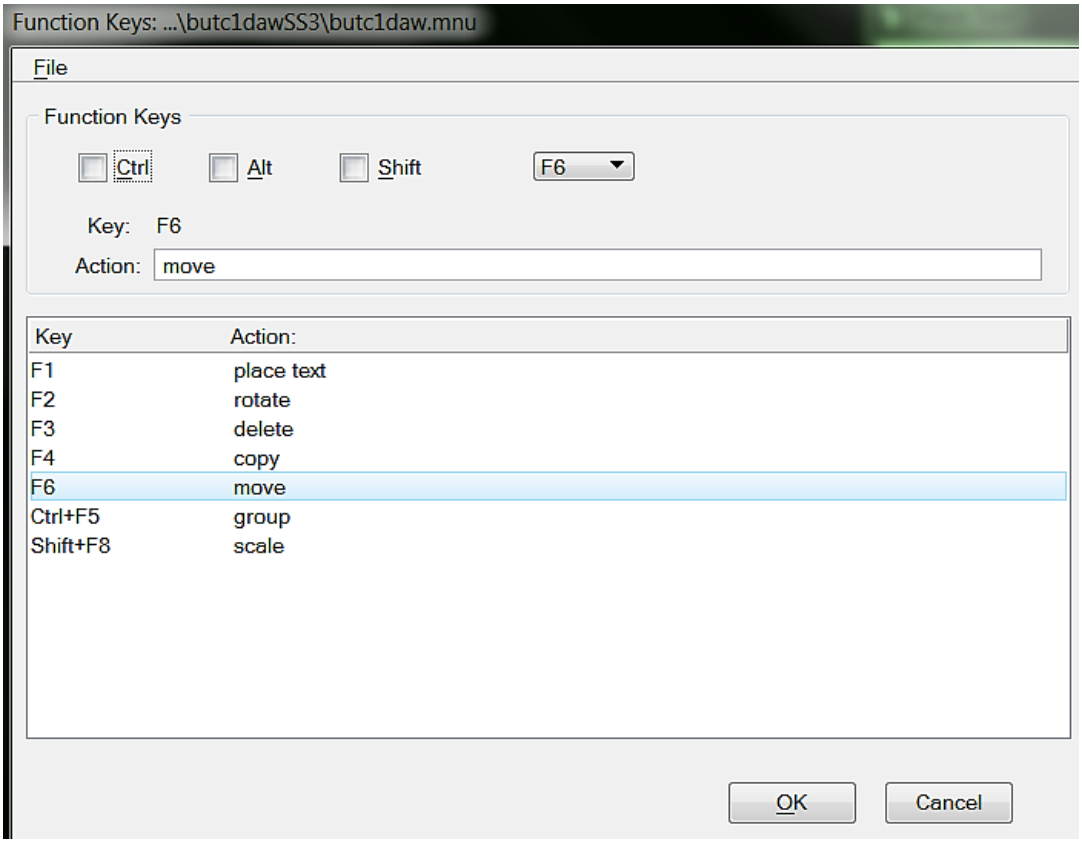


2. Select a function key from the list box showing Key & Action or in the Function Keys group box, toggle any combination of the Ctrl, Alt, and/or shift and choose the desired function key from the list box or using the keyboard, press the desired function key and the <Ctrl>, <Alt>, and/or <shift> keys.



3. In the Action text box, edit the definition or add an action. It must be a valid MicroStation key in. As a check, use the Key-in tool to verify the command.





4. Click OK when you've edited or created the function keys you need. Once these are created they are configured into your user preferences. They can be edited.

Note: Additional information can be found on the Custom Workspace Tech Sheet: Coordinate System Favorites, Function Key Menu, Creating your personal default button menu, editing the button menu, custom tools V* to V8I overview.

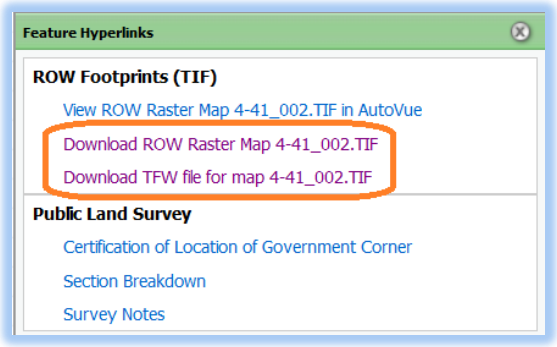
Aerial Photo and Raster Attachments

Often projects benefit or are required to overlay an aerial image. The preferred method for accessing aerial imagery is through the Web Mapping Service directory (WMS). The files cover large areas and are georeferenced. The CAES office provides a Tech Sheet for the WMS and Raster Photo Workflow. It can be located within the MicroStation folder in Projectwise (or see Appendix B).

Attaching a raster map based on the position information (TFW) of the image

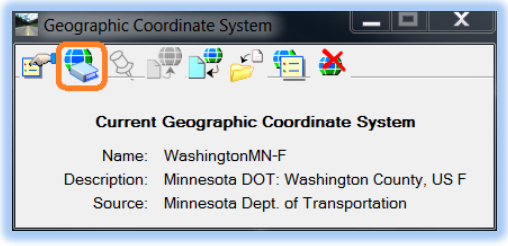
A raster image with positioning information allows the image to display relatively close to its true location. These files contain a world file (TFW) comprised of data containing the file's position and orientation. A raster map alone is just an image with no known location or orientation but the world file positions the image to display correctly. The following steps will show how to attach a raster map with a world file in MicroStation.

1. Download the TIF and TFW files from Right of Way Mapping & Monitoring for the map you want using the "Link Tool".



2. Bring both files into the same working folder in ProjectWise. The TFW and the TIF files must be stored in the same folder.

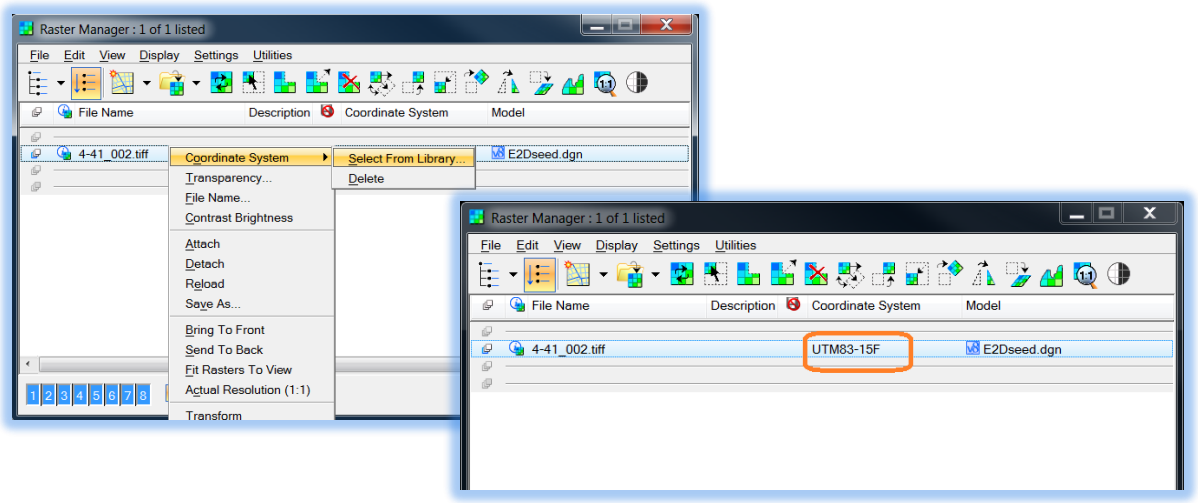
3. Open your working CAD file and select the appropriate county coordinates (if not already set) using the tool "Geographic Coordinate System".
   - *Found under **Tools** – **Geographic** – Select **Geographic Coordinate System***
   - *Using the **From Library** icon - Favorites – Minnesota Counties Survey Foot*

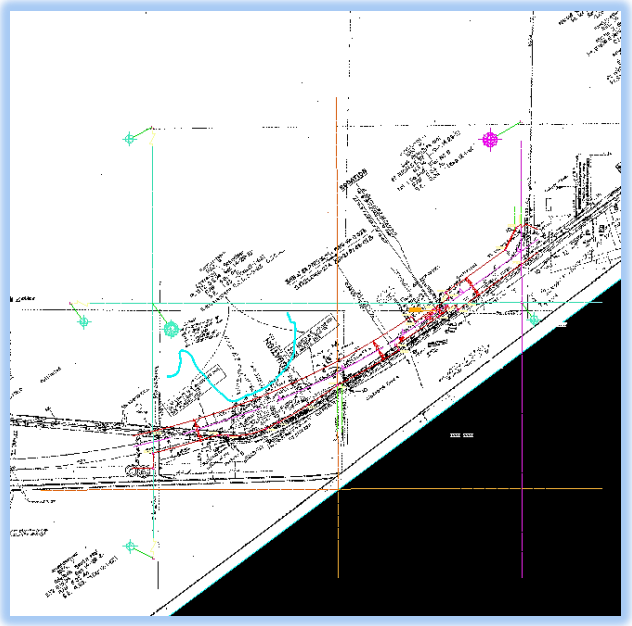


4. In Raster Manager attach the raster image. Do not attempt to include the TFW file as an attachment, it will not load (it is not a raster image).
   - When the pop-up dialog box displays be sure to turn off **Place Interactively**.

- The raster image will not display over any existing CAD work because its coordinate system has not been selected.

5. To adjust the image to its correct viewing location set the image's coordinate system to UTM83-15F (UTM83-14F depending on location). Right-click on the image and select the coordinate system.





The raster image should now display overlapping the corresponding CAD file.

Example map 4-41

Note: CAD and Raster images may never align perfectly

Warping Raster Images

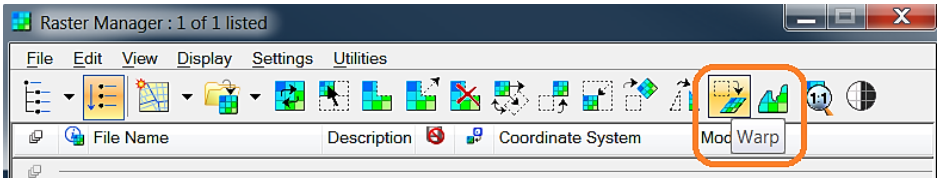
The Warp Raster tool allows you to apply a move, scale, rotate or skew transformation or a combination of all of those to a Raster image.

1. Setting up your raster image for warping

   First, determine how the raster file was brought into MicroStation. A raster without a TFW file (world file) can be altered using the warp tool to overlay existing CAD work. A raster with a TFW may require additional steps if it was brought into MicroStation from Right Way Mapping & Monitoring. ***See Raster Images with TFW*** *below for steps on deleting the coordinate system and moving the raster image.*

2. When warping a raster image it is best to have something to warp the image to, such as CAD work. The following steps assume that a CAD file has been created and that raster image is very close to overlaying the existing work area.

3. In Raster manager there is a tool called Warp.

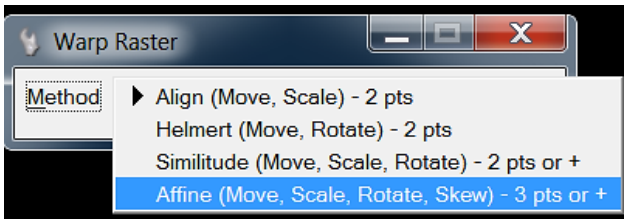


4. Identify the points that can be used for the transformation. Locate corners or intersection points found on both the CAD file and raster image

5. Select a desired method. The warp tool offers multiple options to manipulate a raster image. With this tool you can move, rotate and resize an image.

Warp Raster Methods

Align (Move, Scale) — Two points (only) are required and scaling is uniform along the x- and y-axes



Helmert — Two points (only) are required

Similitude (Move, Scale, Rotate) — Requires a minimum of two points. When two points are entered, a best fit is produced from the points. If more than two points are entered, then the source and destination points may not line up.

Affine (Move, Scale, Rotate, Skew) — Requires a minimum of three points and then produces a best fit. If more than three points are entered, the source and destination points may not line up.

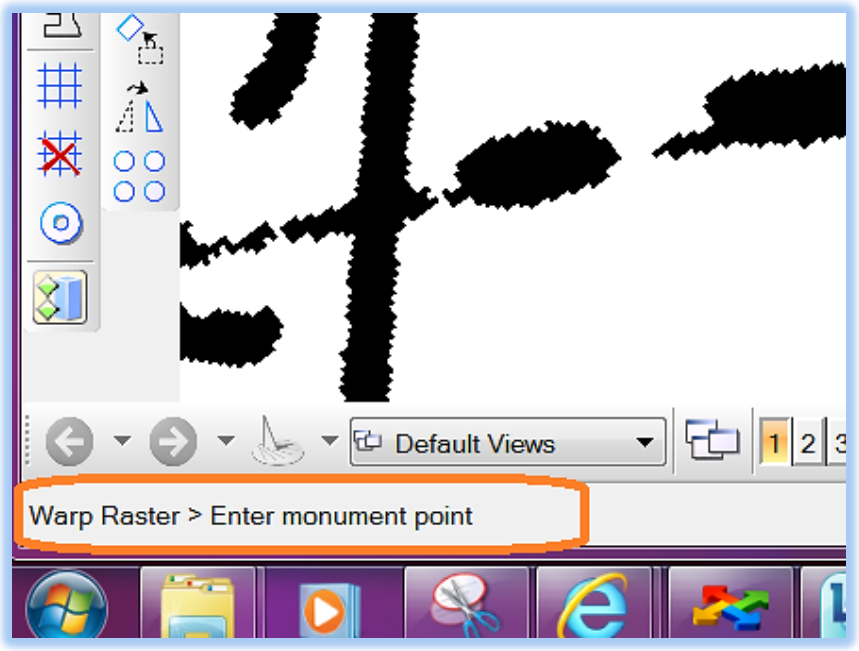
(definitions from MicroStation Help V8i)

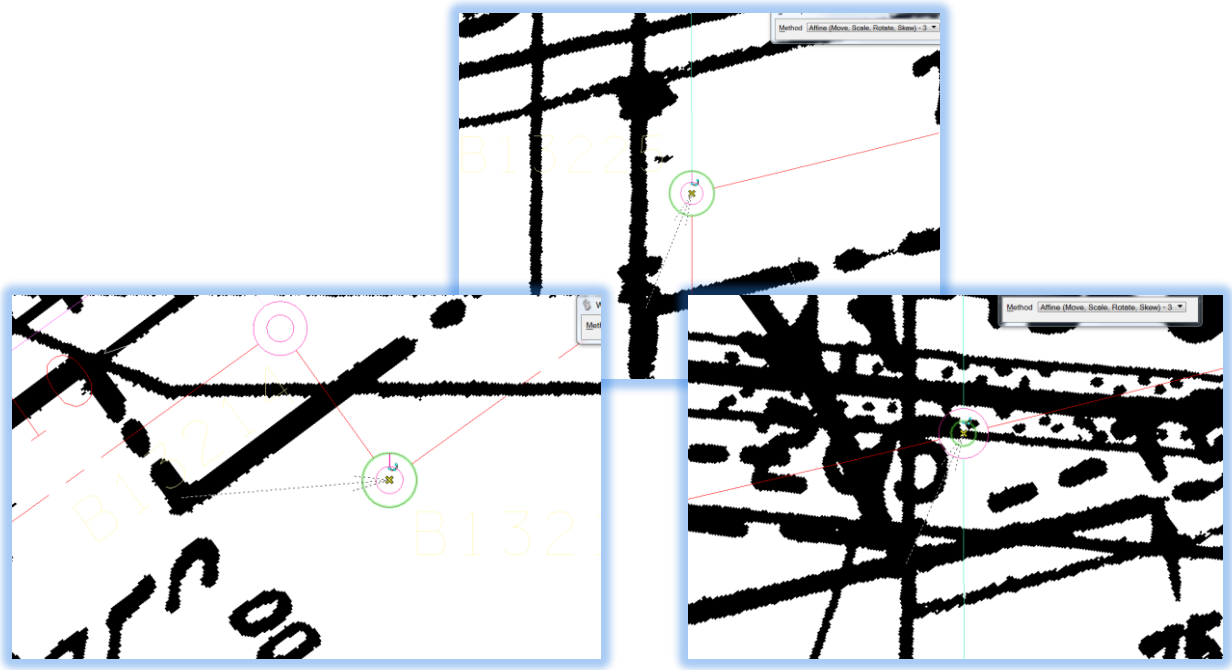
Terms:

Enter Image Point – refers to a point on the raster image you want to use to warp

Enter Monument Point – refers to the CAD point to which you want the raster point to move to.

6. Click on the appropriate image and monument point. The command line will indicate what needs to be selected. *The command line is found on the lower left side of the screen.*

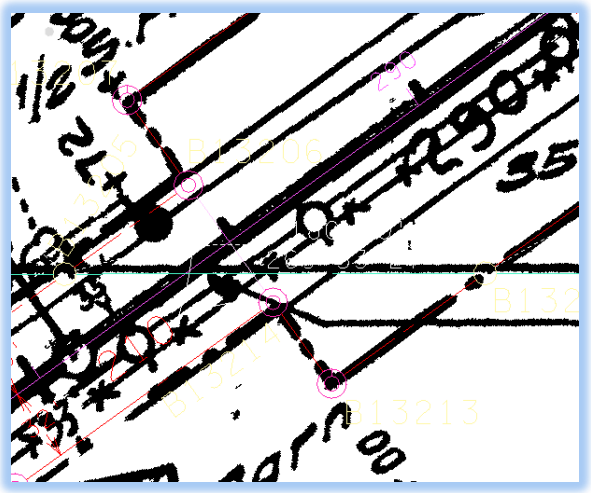




Each image shows an image point (raster image) being moved to a monument point (CAD) using Affine-3 points

7. Continue with additional points as necessary depending on the method selected. Once complete, the raster image should overlap the existing CAD work. It is important to note that CAD and raster images may never align perfectly.

The raster image aligns better with existing CAD lines after warping

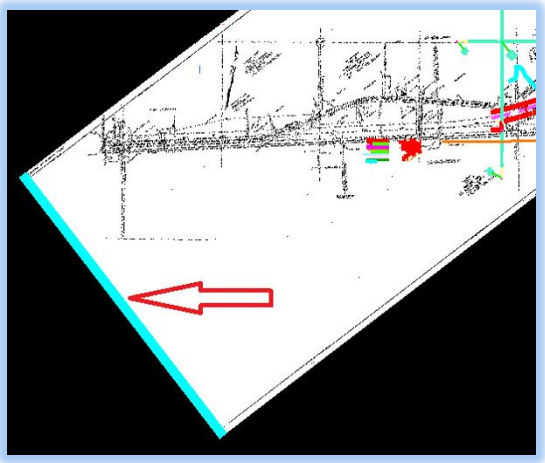


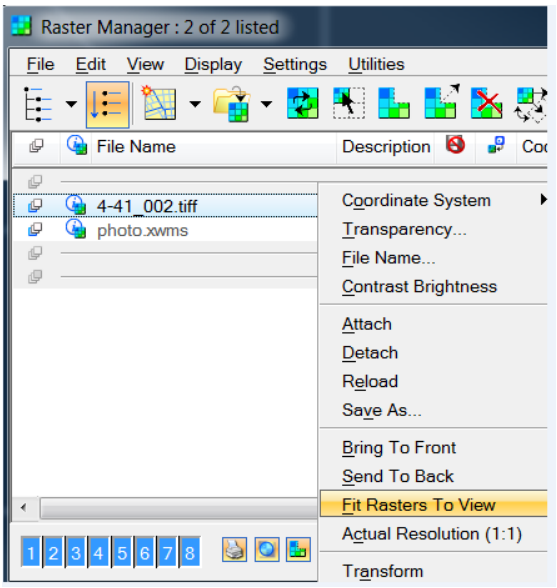
Free a Raster Image from its World File (TFW)

Maps downloaded from Right of Way Mapping and Monitoring with a TFW file are referenced to the UTM Geographic Coordinate System. If the raster image needs to be manipulated, then the associated coordinate system needs to be removed. This allows the file to be manipulated and better fit the existing line work. Deleting the coordinate system will result in the raster image appearing distant from the work area. If you are having trouble finding the image try using the 'Fit Rasters to View' tool.

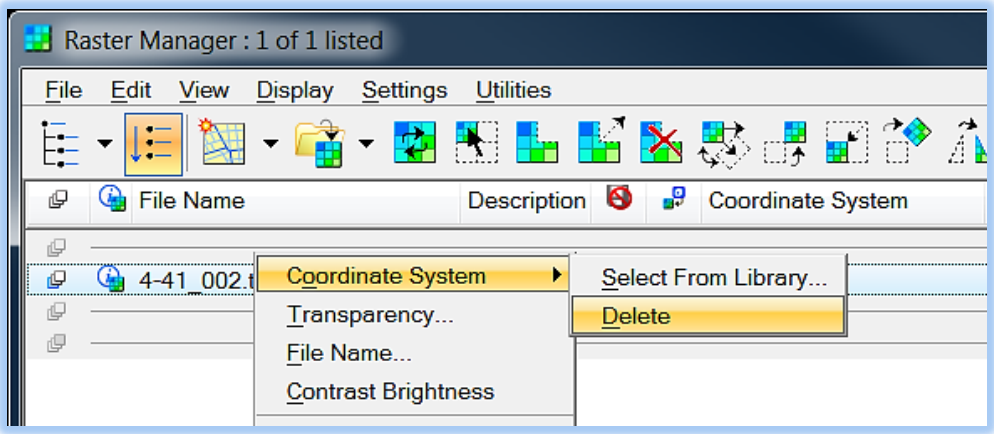
1. To retain the general location of the file, set a box or line to which the raster can be moved back to.

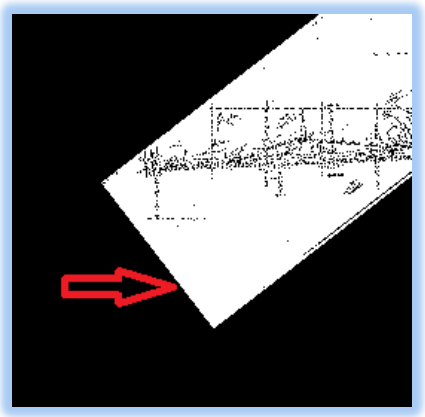
   Example of using a line



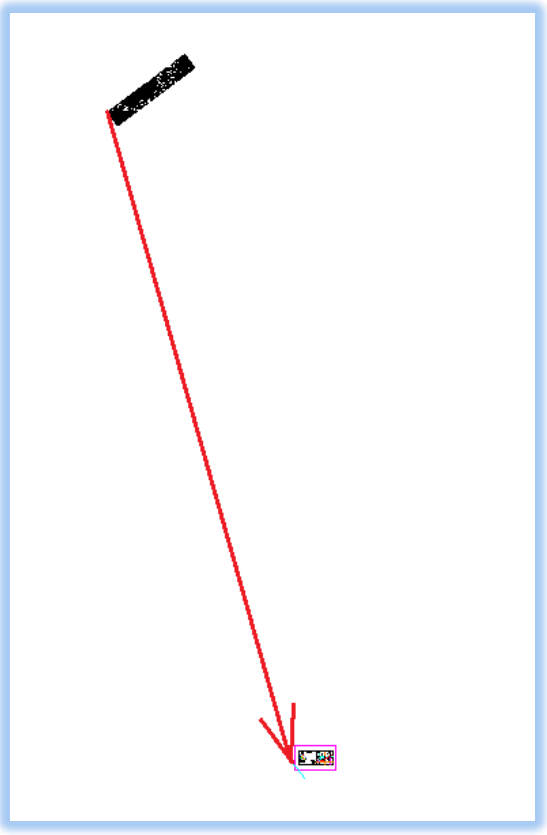


2. Next proceed with removing the UTM Coordinate System by right-clicking on the raster name –**Coordinate System** and selecting **Delete**. The raster file will appear distant from the working area.





Example of a raster image far from the working area



3. Manually move the raster file using the same location and orientation as the previously created box or line. This step returns the file back into the work and appears very close in orientation to how it was prior to deleting the coordinate system.

4. Once the file is returned to the work area it can be warped to fit the existing CAD work. *(Refer to Steps for Warping Raster Images)*

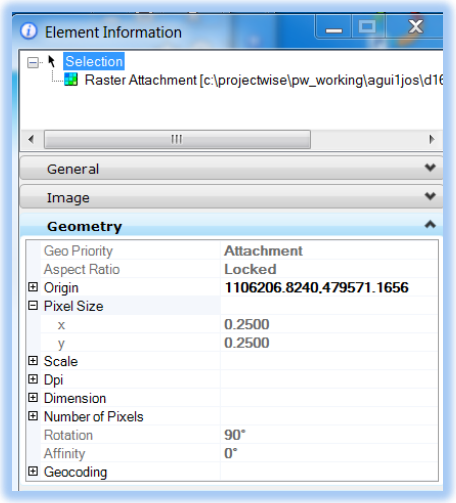
<u>Scaling a Raster Image (Files without a TFW file)</u>

The following table shows how a raster map without a world file can be manually set to scale.

Map Scale	Pixel Size (400 dpi)	Pixel Size (200 dpi)
1:50	0.125	0.25
1:100	0.25	0.50
1:200	0.50	1.00

Note: 400 dpi raster maps will typically display long portions of a map with individual sheets ending at match lines were as the 200 dpi maps display short, often standard length portions of a map containing numerous map sheets and each sheet ending at a random location.

If the scale of the map is unknown, then one could guess. Verify the correct scale measure between tick marks or any labeled distance using the Measure tool. The raster image distance should be very close to the CAD distance.



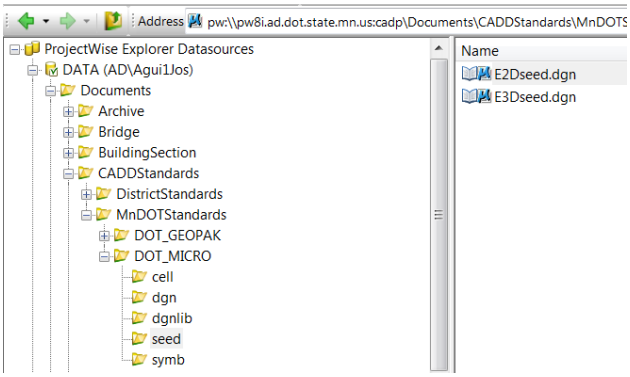
This example shows the pixel size at 0.25 for a 400 dpi file

Line Style Annotation Fixer

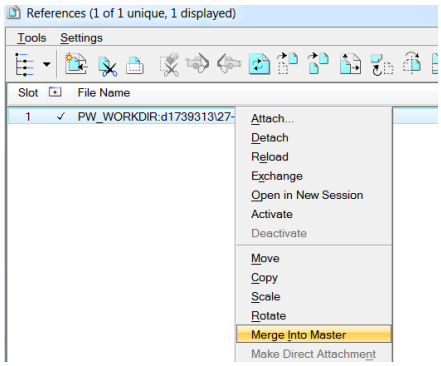
Software enhancements and updates to the custom line styles resource file were performed to accommodate for Annotation scale. A new seed file was created by the CAES Office to scale line styles at a Drawing Scale of 1:100 (back in 2013). Older files containing custom line styles will appear out of scale because of how they were originally placed. This will often occur when working with older files imported into a new seed file.

The following are a set of steps to identify if your file is having this problem.

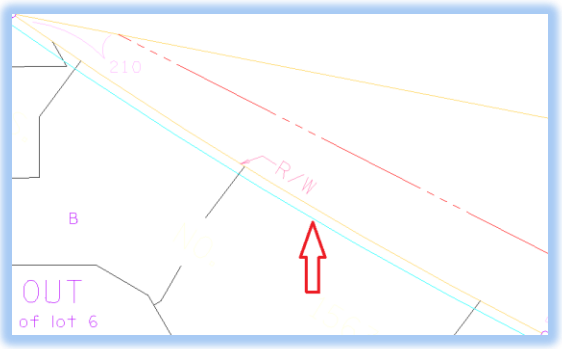
- Obtain a copy of a new seed file



- Reference the old file into the new seed file.

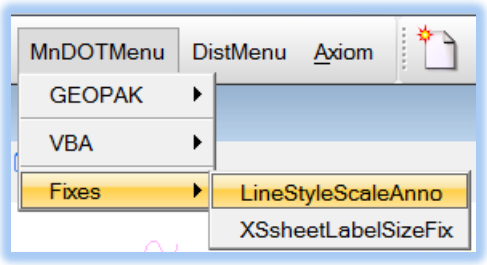


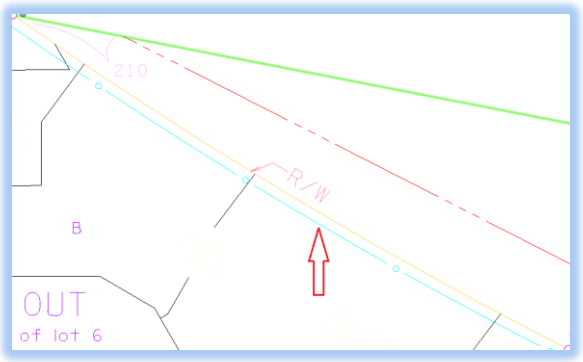
- Merge your old file into the new seed file.
- If the line styles or text display out of scale then the fix will need to be performed on the file. If the line styles are displaying correctly then no further action is required.



Prior to performing the fix, the access control symbols are not visible at this scale.

- To update the DGN to use annotation scale for imported line styles use **LineStyleScaleAnno**. This will scale the line styles to view correctly.

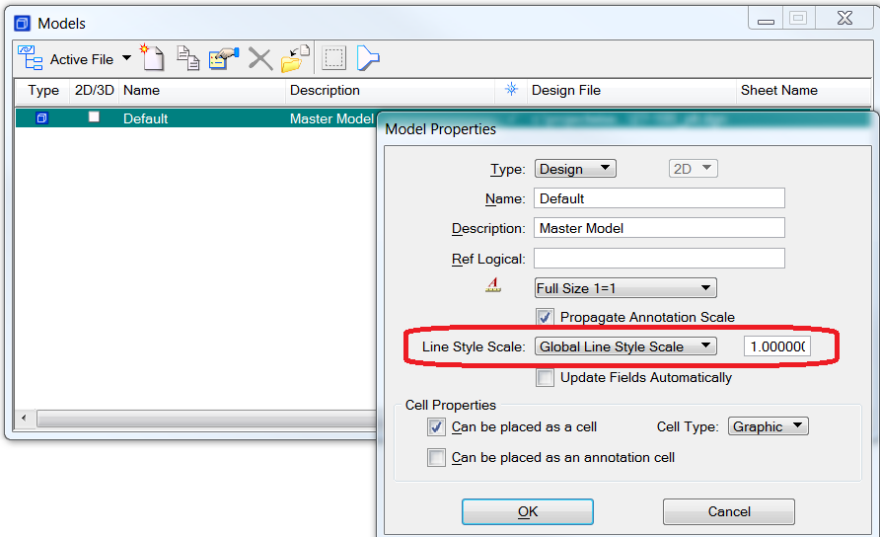




This image shows the access control displaying to scale after using the fix.

Another method that <u>may</u> provide some clues as to whether the lines will scale correctly is by identifying the type of Line Style Scale set for the DGN model. This can be found within Model Properties.

- A new seed file displays Annotation Scale, 1=100
- An Old seed files displays Global Line Style Scale, Full Size 1=1



Terms

Annotation Scale – Scale factor of the drawing, drives the scale of the elements depending on the Drawing Scale selection.

See the Tech Sheet MS_CADDStandardsUpdate for additional information regarding level libraries, text and dimension styles, custom line styles, seed files, cell libraries, GEOPAK

Using Google Earth in MicroStation

Overview

MicroStation has the ability to interface with Google Earth. It requires no additional CAD software. Google Earth must be loaded, either the free or professional version.

MnDOT can utilize the free Google Earth software for internal use only! If you have any questions, see your district / office IT staff.

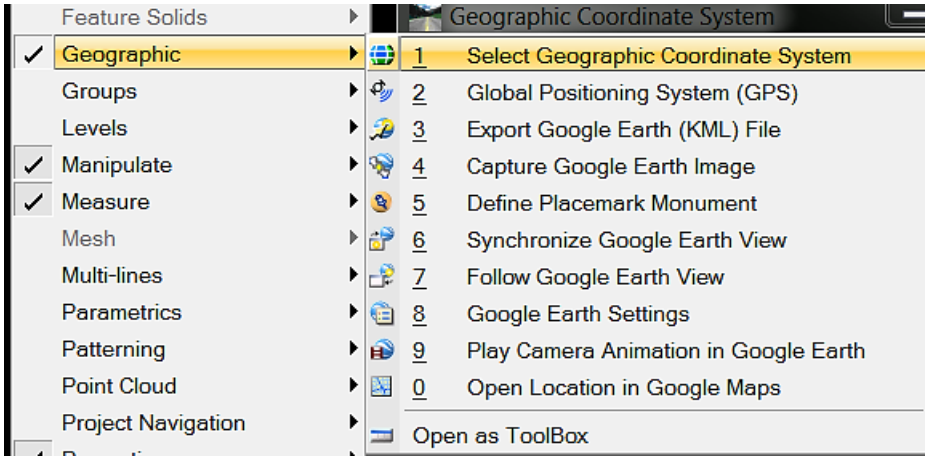
The basic steps are:

1. Open MicroStation file from within ProjectWise and assign a county coordinate system. Set levels on / off as you want to view them in Google Earth.
2. Create a KML/KMZ file, which automatically opens Google if installed to the correct location.
3. View as desired.
4. Export image (optional).

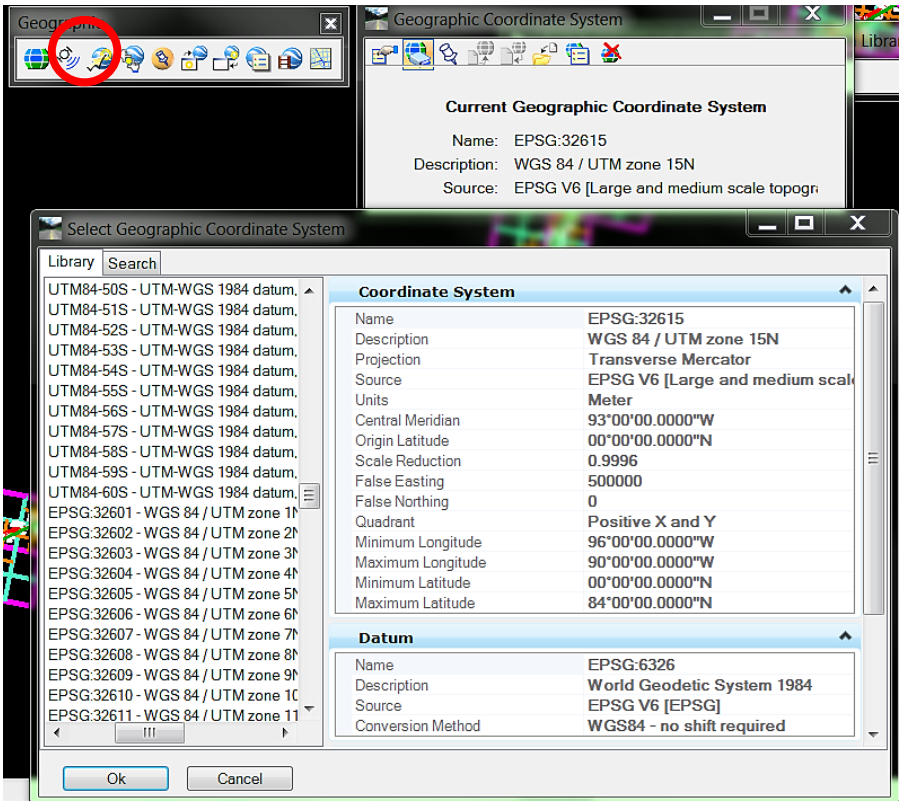
MicroStation File Setup and Creation

Open the MicroStation file either 2D or 3D from within ProjectWise and perform the following steps as needed:

1. Assign the coordinate system for the file.
   Use the Geographic Coordinate System dialog found under Tools



Click on ‘Select Geographic Coordinate System’ and then the ‘from library’ button and select the appropriate coordinate system from the library. The CAES office provides a Tech Sheet on how to do this: MS_AssignCoordinateSystems.doc .



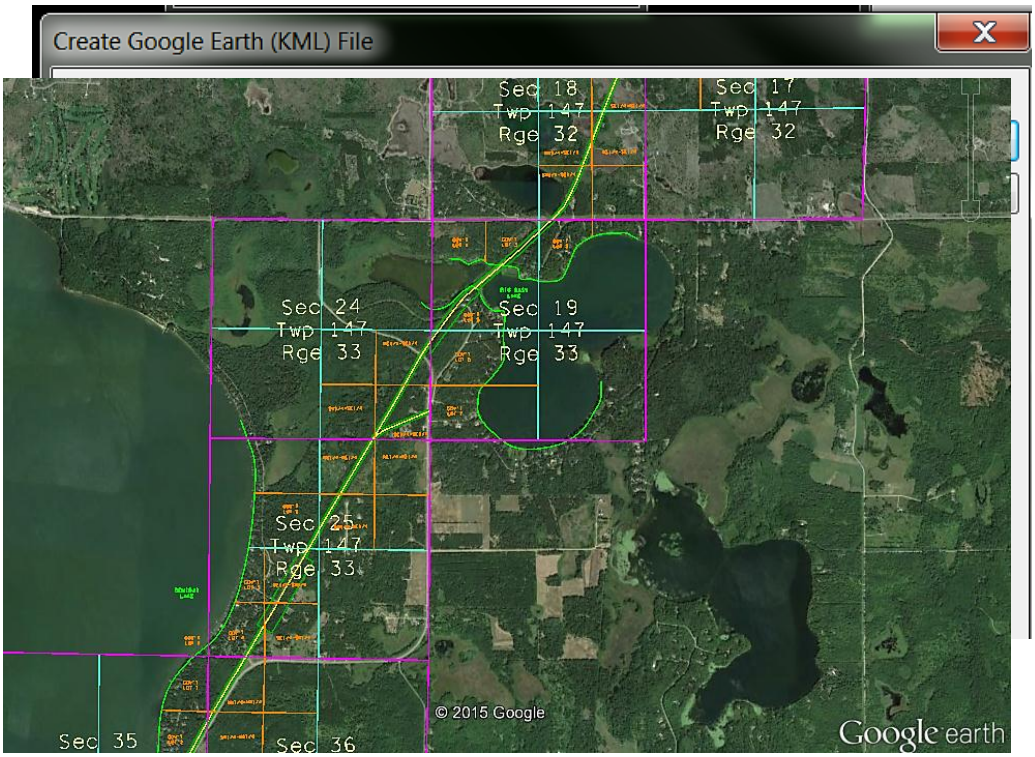
2. Turn off the weights, which are normally too heavy within Google Earth.
3. Turn off any levels that are not needed, in order to have the most basic drawing as possible that will fulfill your project requirements.
4. Set your view to the area of interest. Keep in mind the larger the area, the fuzzier Google Earth is when you zoom in.
5. Select **Tools > Geographic > Export Google Earth (KML)** File from the main MicroStation menu.

6. A ProjectWise dialog opens where you can name the Google Earth file. Note that it's creating a KMZ file, not KML as seen in the tool tip. If you have not created a KMZ file from this MicroStation file, you can use the default name. Otherwise, change the name in order to save it in ProjectWise.

   Note: KML is an uncompressed Google Earth file – KMZ is a compressed Google Earth file

7. Click Save.

Synchronizing With Google Earth



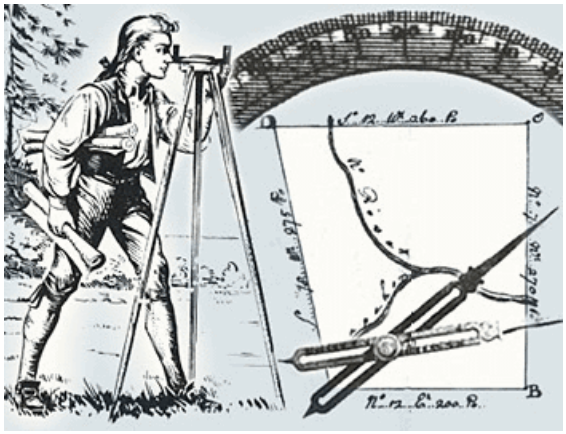
Open the file with Google Earth, if it has not done so automatically. You will see the Google Earth background, with the MicroStation drawing on top.

Chapter 2

Azimuths and Bearings

By Josh DeLeeuw

One of the first practical guides for the field surveyor was, GEOSAESIA, written by John Love with the first edition published in 1687. Thirteen editions of the book were published and many notable Colonial surveyors studied it, including George Washington.



In this book, Love defines a point, line and angle:
"A point is that which has not parts; consequently of itself no magnitude, and may be considered as invisible."
"A line has only length, but neither breadth or thickness, and may be conceived as generated by the continual motion of a point."
"An angle is the meeting of two lines in a point."

The most common unit for measuring an angle is with the Sexagesimal System of dividing a circle into 360 degrees with each degree measured by 60 minutes and each minute measured by 60 seconds. Common surveying practices used a compass to navigate and measure horizontal angles to determine the location and orientation of points. One of the early instruments was a circumferentor.

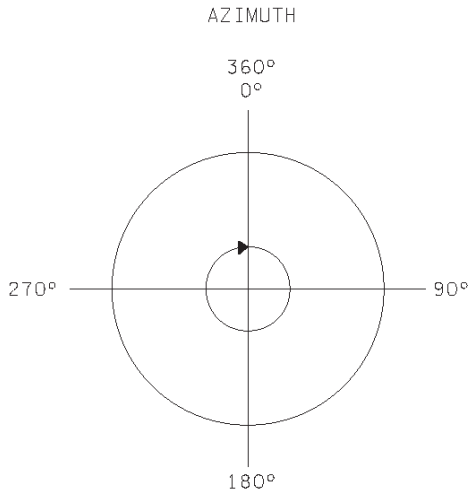
This instrument is a compass with sights. The reference meridian would be magnetic north. To measure an angle between two known lines, one would set the instrument over the point of intersection. Then sight to one known point, note the degree pointed at by the south end of the needle, then turn the instrument to a point on the other line. The angle would be found by calculating the difference.

This same concept is used today. There are two styles of annotating the direction of a line; either by azimuth or by bearing.

What is an Azimuth?

- Definition: Horizontal angle observed clockwise from any reference meridian. *(Elementary Surveying 12th Edition p. 168)*

  The angle measured clockwise from the meridian (usually from a north or south reference line) to the line being described. *(Brown's Boundary Control and Legal Principles)*
  - Generally 0° is Grid North, also known as the zero base line. Grid North is dependent upon which datum you are using.



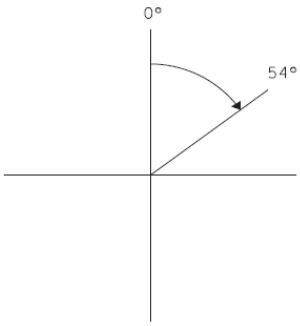
- The azimuth is MnDOT's standard method for identifying the direction of a line. For Right of Way Acquisition Plats, the course and direction are located in a boundary tabulation box.
- Azimuths allow for simpler computations. You are able to determine the angular relationship between the two lines by subtraction.

Example: Line 1az = 180° Line 2az = 90°

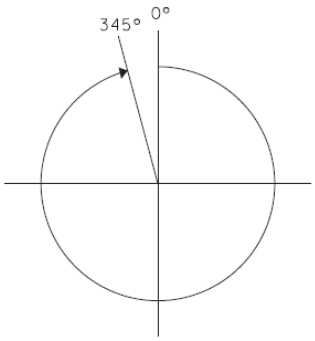
PLAT BOUNDARY DATA		
POINT	DISTANCE	AZIMUTH
B26-B27	Δ 30°09'09" R	2779.79'
C	1446.07' CAZ 238°45'23" ARC	1462.89'
B27-B28	192.38'	223°40'48"
B28-B29	142.72'	177°34'59"
B29-B30	Δ 40°05'54" R	522.96'
C	358.57' CAZ 110°01'27" ARC	365.99'
B30-B118	50.39'	179°58'29"
B118-B120	243.50'	269°57'50"
B120-B31	Δ 18°11'22" R	622.96'
C	196.94' CAZ 302°04'43" ARC	197.77'
B31-B32	139.87'	267°41'23"
B32-B121	137.18'	223°40'49"
B121-NE 17	458.31'	269°57'50"
NE 17-B117	634.47	270°14'11"

180° - 90° = 90° ~ angular relationship

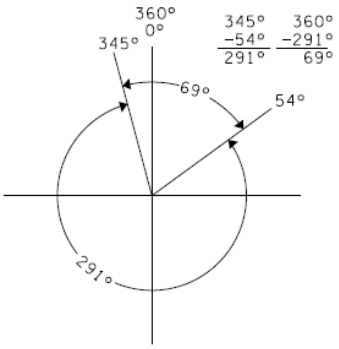
- Examples of azimuths and computing the angle between them.

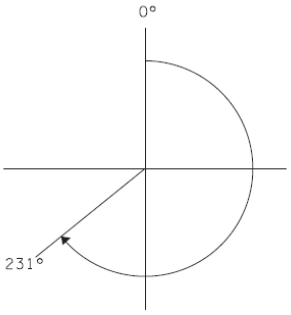


az = 54°00’00”

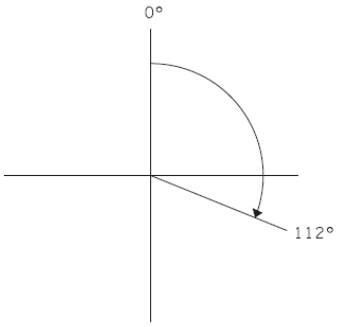


az = 345°00’00”

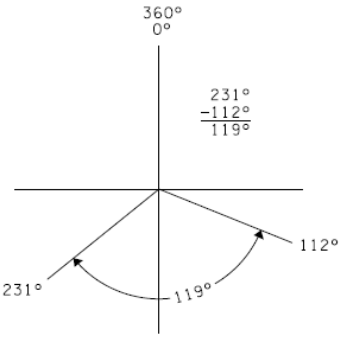




az = 231° 00’00”

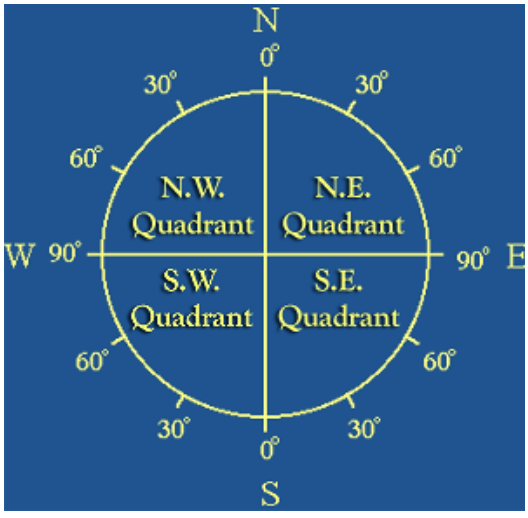


az = 112°00’00”



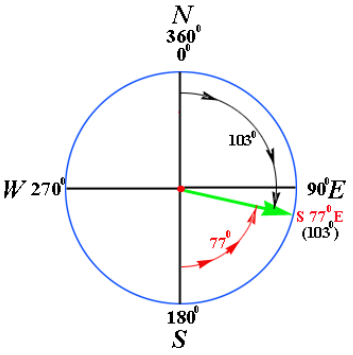
What is a Bearing?

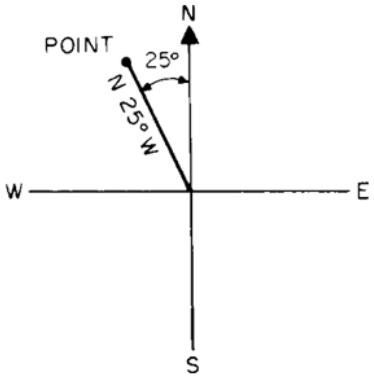
- Definition: The acute horizontal angle between a reference meridian and the line. *(Elementary Surveying 12th Edition p. 169)*
  - The reference meridian is usually the north-south line that divides the quadrants of a circle.
  - Quadrant bearings are not generally used on MnDOT mapping or Acquisition Plats. Although Minnesota State Statute 505.021 allows for the



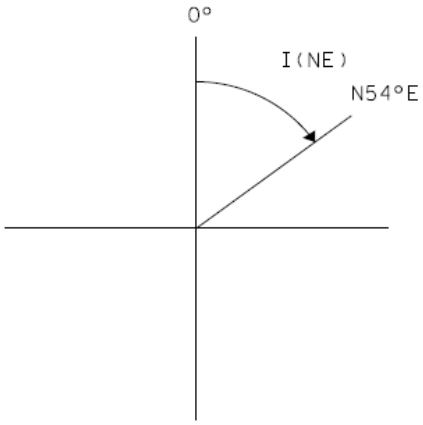
use of azimuths or bearings on plats; bearings are more common. (https://www.revisor.mn.gov/statutes/?id=505.021)

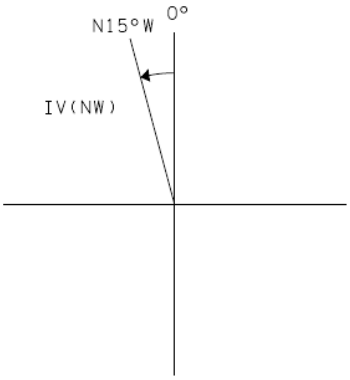
- Quadrant bearings allow for directional qualifiers so that the reader of a legal description or plat will know what direction the line is headed based on 90° as opposed to an azimuth that gives a direction based on 360°. The azimuth requires the readers to know which quadrant they are in to determine the direction of a given line.

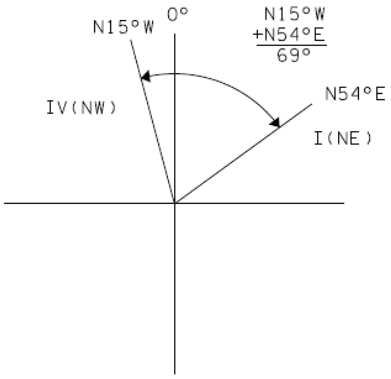


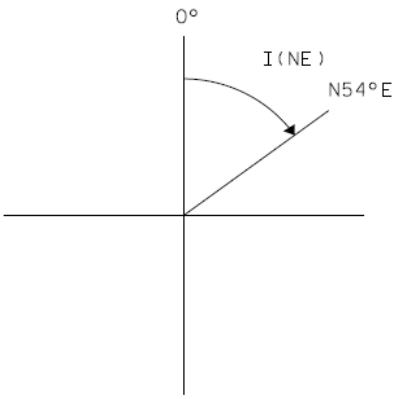


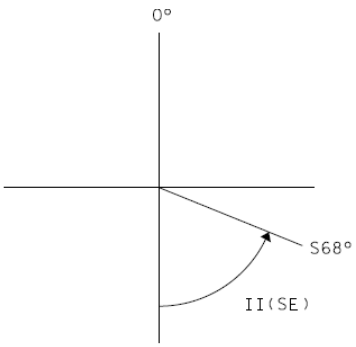
- Angular relationships can be figured out, but some simple steps need to be followed to ensure the proper calculation of an angle between two bearings.
- Examples of computing an angle between bearings

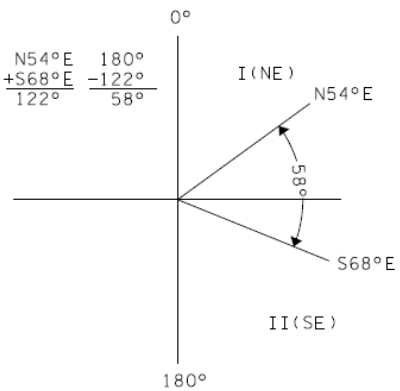








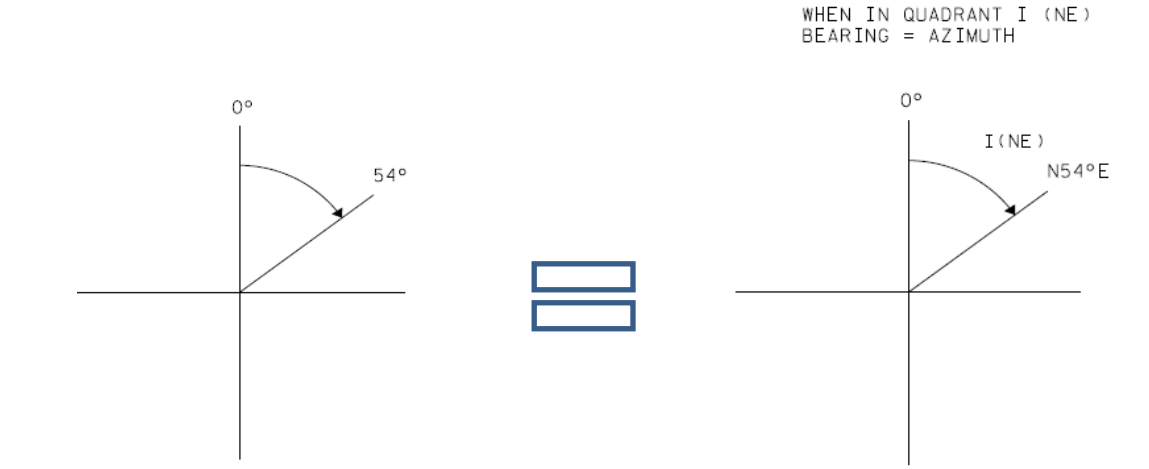


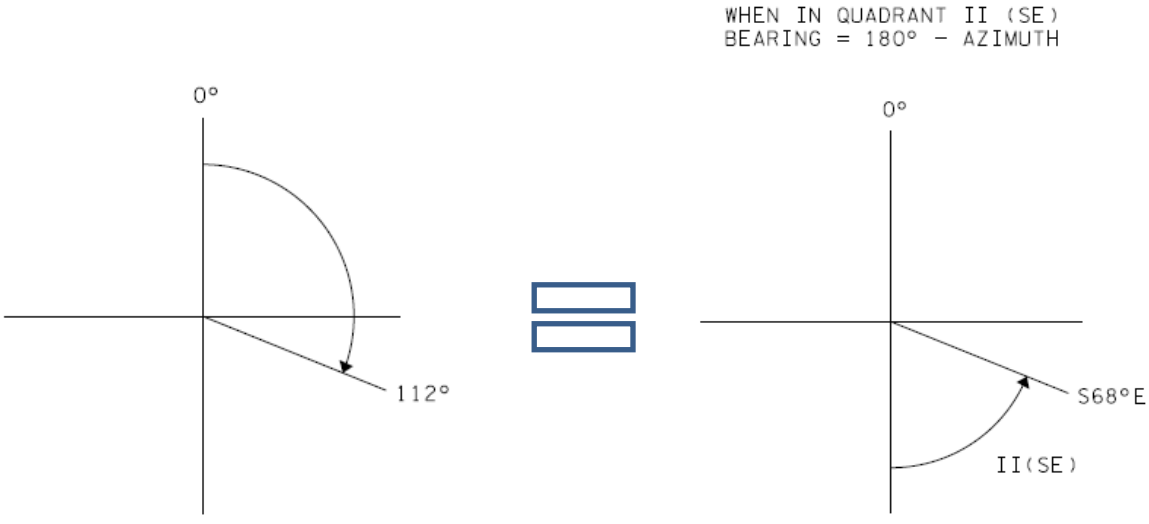


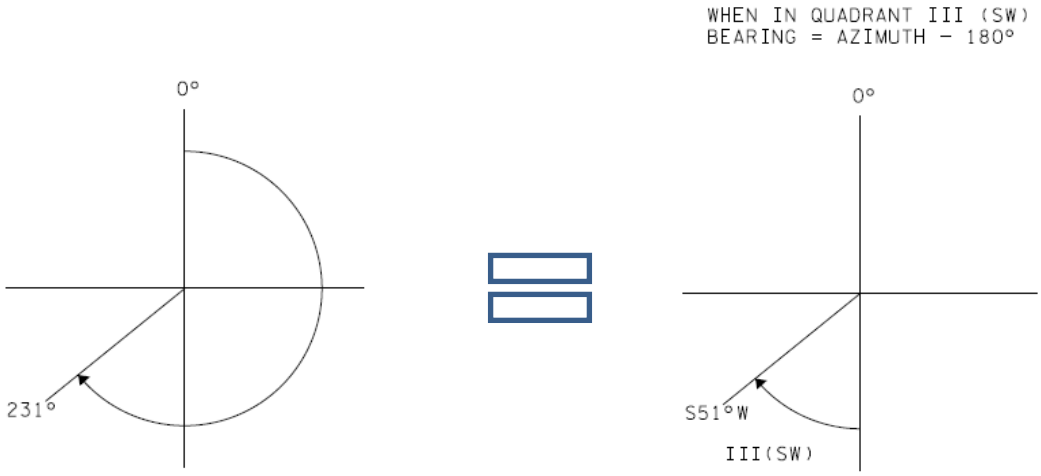
How do they relate to each other?

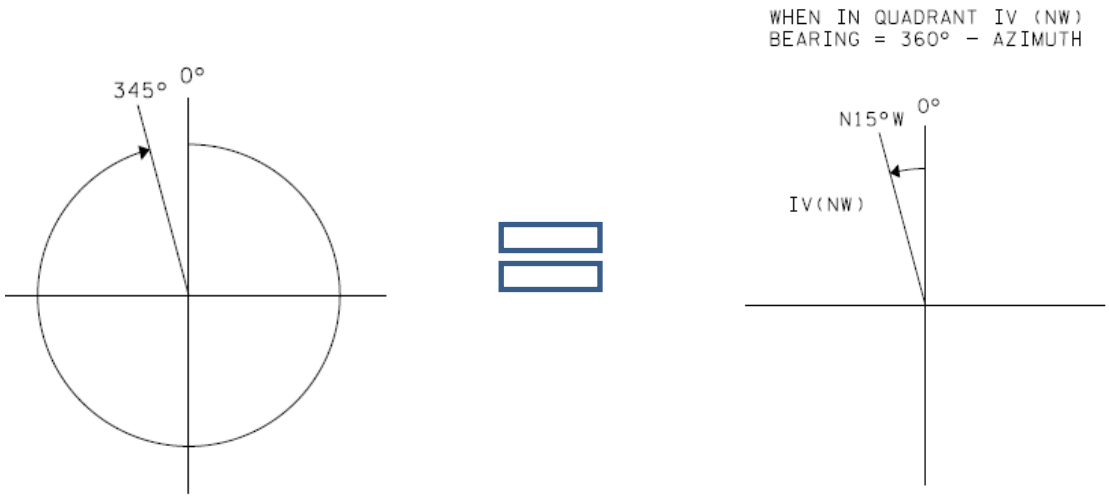
- They are both based upon a definition of north.
- Azimuths utilize a full 360° circle. The directions are based off of north, being 0° and considered the base line or reference. Measurements are made clockwise from the base line.
- Bearings are limited to on one fourth of a circle or 90°. They are based off of 0° being north and 0° being south.
    - They are measured as follows:
        i. East of North (NE quadrant)
        ii. East of South (SE quadrant)
        iii. West of South (SW quadrant)
        iv. West of North (NW quadrant)

- Converting from azimuth to bearing

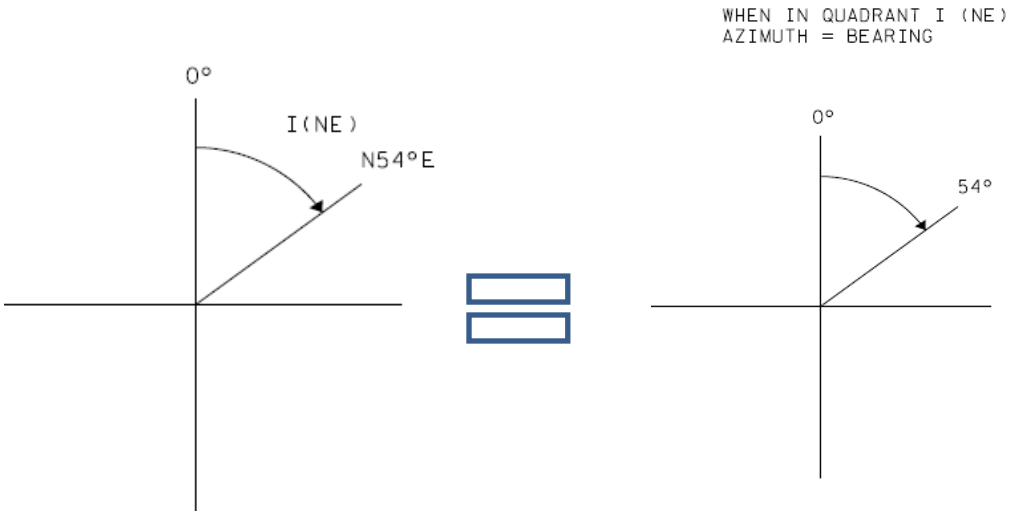


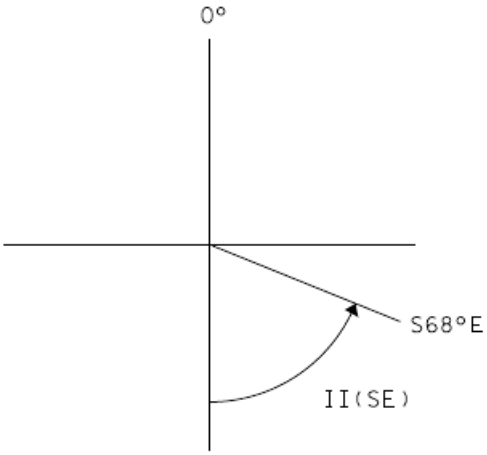




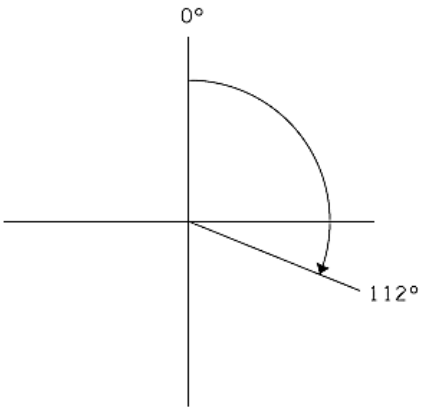


- Converting from bearing to azimuth

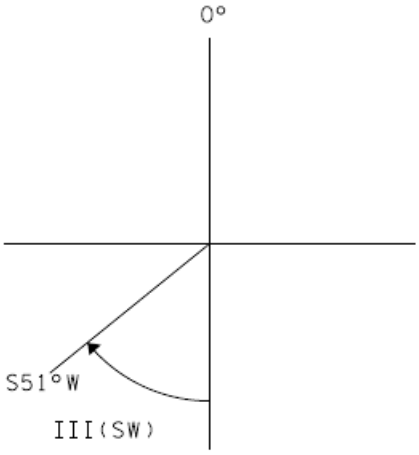


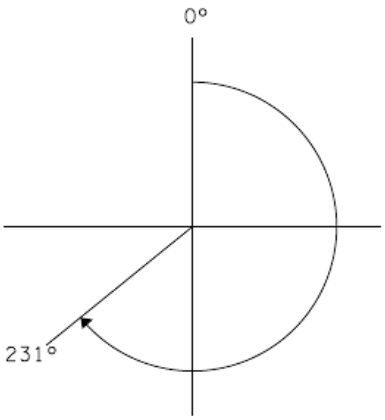


WHEN IN QUADRANT II (SE)
AZIMUTH = 180° - BEARING



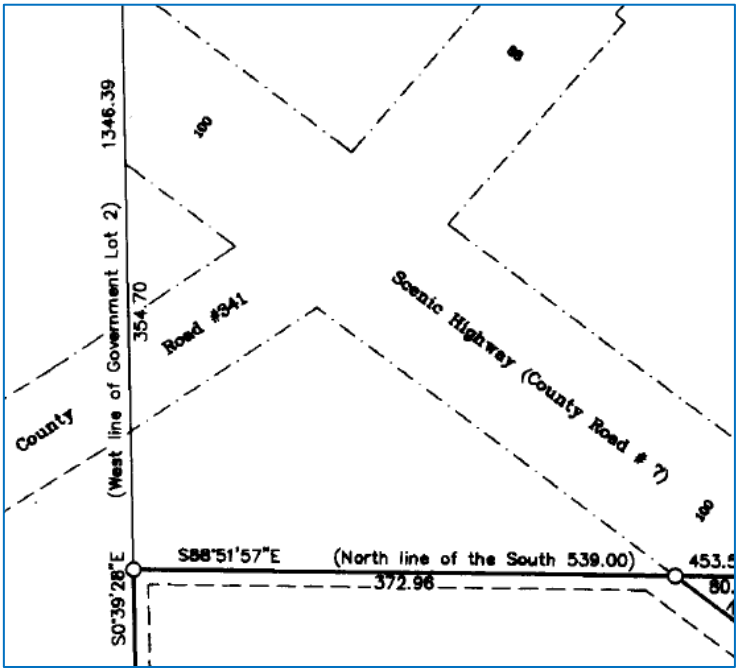
WHEN IN QUADRANT III (SW)
AZIMUTH = BEARING + 180°





How to relate a Subdivision Plat to the .fip file or MnDOT Survey Information

- Find a common section line and compare the azimuth in the .fip file to the bearing on the subdivision plat.
- Compare the .fip file direction and the plat direction for the common line.
    - If they are not the same, calculate the difference. All the subsequent lines on the plat can be adjusted by the found difference.
    - For example: MnDOT .fip file azimuth for the west line of Government Lot 2 is 179°40’52”
        i. Bearing to Azimuth: 180° - 00°39’28” = 179°20’32
        ii. .fip – plat: 179°40’52” - 179°20’32” = 00°20’20”
        iii. Adjust or rotate the north line of the south 539.00 feet, S88°51’57”E - 00°20’20” = S88°31’37”E
        180° - 88°31’37” = az 91°28’23”



- Another method is to compute each angle between the given lines on the subdivision plat and use that angle when entering the data into the .fip file.
    - For example the angular difference between the west line of Government Lot 2 and the north line of the south 539.00 feet is:
        S88°51’57”E – S00°39’28”E = 88°31’37”
        i. Subtract the difference from the .fip file:
        az 179°40’52” - 88°31’37” = az 91°28’23”
- The subdivision plat may not match the .fip file. This may be due to accuracy differences and data collection techniques. Different coordinate systems may also be the source of differences in measurements. There is software available to compare coordinate systems:

http://www.dot.state.mn.us/surveying/toolstech/survsoft.html

Contact Cory Arlt for assistance: corwyn.arlt@state.mn.us

Converting to decimal degrees

- Converting degrees minutes and seconds to decimal degrees may simplify your computations. Similar to the measure of time, an hour is divided into 60 minutes; a degree is also divided into 60 minutes. The same concept is applied to seconds. 1 minute is 60 seconds; multiply that by 60 for 60 degrees and the result is 3600 seconds in a degree.

  For example we will use 54°33’27”

  Degrees = 54

  Divide minutes by 60: 33/60 = 55

  Divide seconds by 3600: 27/3600 = 75

  The decimal degree = 54.5575°

- To convert decimal degrees to degrees minutes seconds, simply do the above procedure in reverse:

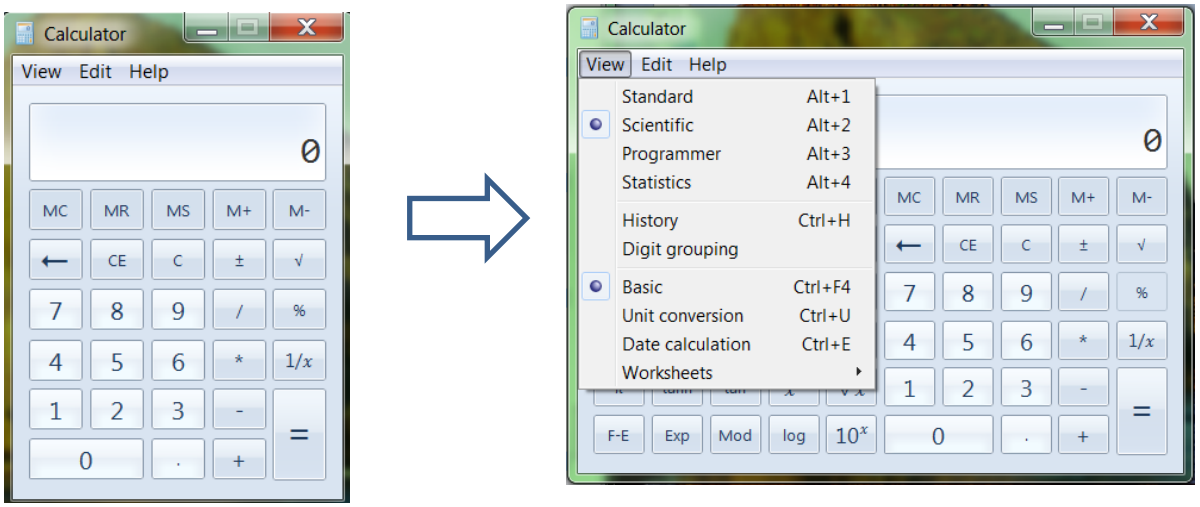
  Multiply .0075 by 3600: .0075x3600=27

  Multiply .55 by 60: .55x60=33

  The Degree Minutes and Seconds = 54°33’27”

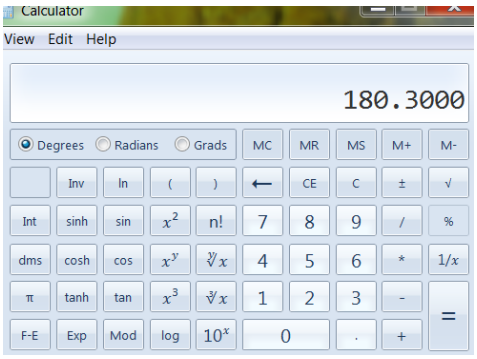
How to use the scientific calculator to add or subtract azimuths and bearings

- This procedure is by using the calculator in Windows 7



- Switch to scientific mode under the view menu.
- Type in the degrees minutes seconds of the first line.
  - For example: 180°30’00”

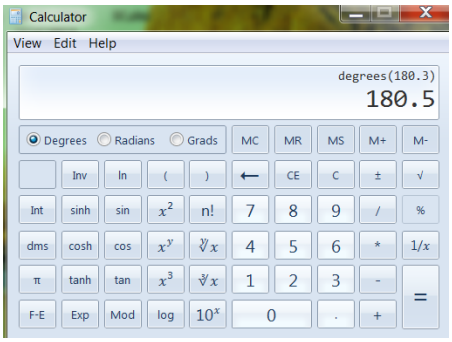
  Enter it as 180.3000. This calculator does not think in degrees minutes seconds



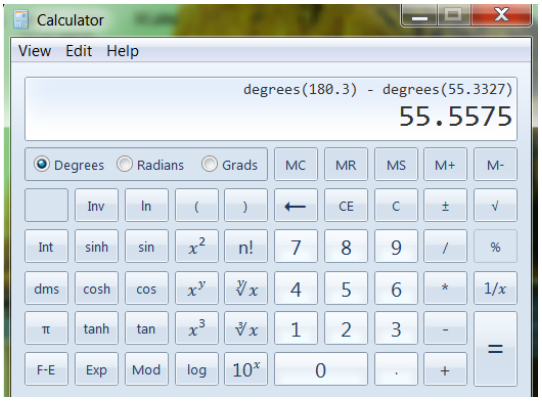
- decimal degrees are units of 1/10/100
- degrees minutes seconds are in units of 1° = 60’ = 3600”

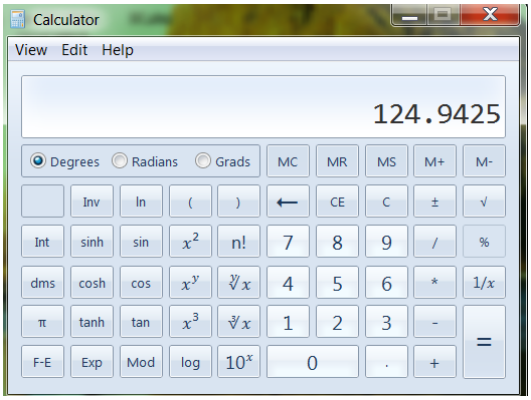
- Press the 

key
- Press the 



- To subtract angles, press the – key and enter the value of the next line. We will use 54°33’27”. Again, type 54.3327 => inv key => deg ke





- If you want that in degrees minutes seconds format, select the inv key and then the dms key

Practice Problems:

1. Convert Degrees Minutes Seconds to Decimal Degrees
    a. 11°25’33”

2. Convert Decimal Degrees to Degrees Minutes Seconds
    a. 245.7650°

3. Convert from azimuth to bearing
    a. 127°25’37”
    b. 345°13’26”
    c. 138°59’01”
    d. 26°01’33”

4. Convert from bearing to azimuth
    a. N15°27’02”E
    b. S56°13’59”E
    c. S79°58’16”W
    d. N86°01’56”W

5. Compute interior angles
    a. Az1= 349°25’13” Az2=2°01’47”
    b. Az1= 156°55’00” Az2 = 149°04’47”
    c. N89°05’56”E S54°01’45”E
    d. N45°12’50”W N54°21’05”E

Practice Problems (Answers)

1. Convert Degrees Minutes Seconds to Decimal Degrees
    a. Convert 11°25’33” to Decimal Degrees
        a. 11.4258
    b. Convert 245.7650 to Degrees, Minutes, Seconds
        a. 245°45’54”
2. Azimuth to Bearing Conversions
    a. Convert the azimuth 127°25’37” to a bearing
        a. S52°34’23”E
    b. Convert the azimuth 345°13’26” to a bearing
        a. N14°46’34”W
    c. Convert the azimuth 138°59’01” to a bearing
        a. S41°00’59”E
    d. Convert the azimuth 26°01’33” to a bearing
        a. N26°01’33”E
3. Bearing to Azimuth Conversions
    a. Convert the bearing N15°27’02”E to an azimuth
        a. 15°27’02”
    b. Convert the bearing S56°13’59”E to an azimuth
        a. 123°46’01”
    c. Convert the bearing S79°58’16”W to an azimuth
        a. 259°58’16”
    d. Convert the bearing N86°01’56”W to an azimuth
        a. 273°58’04”
4. Computing Angles
    a. What is the smaller angle between the azimuths 349°25’13” and 2°01’47”
        a. 12°36’34”
    b. What is the smaller angle between the azimuths 156°55’00” and 149°04’47”
        a. 7°50’13”

Chapter 3

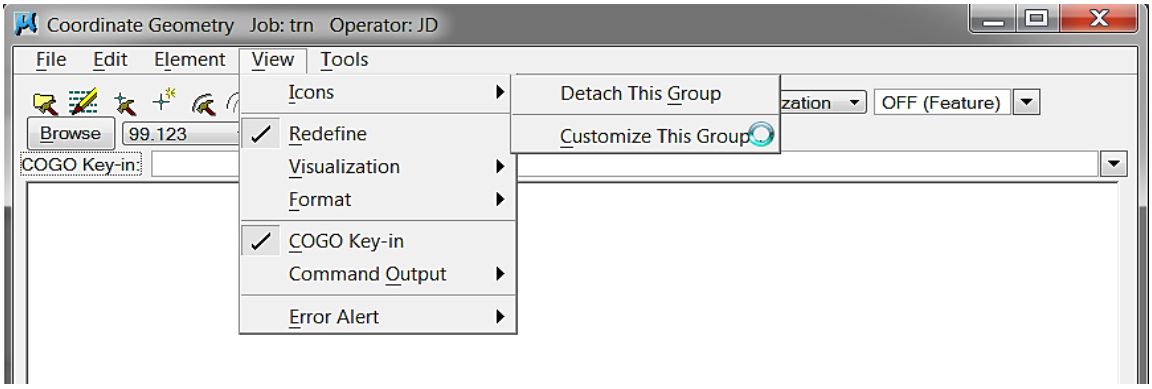
Computations in Geopak

By Josh DeLeeuw

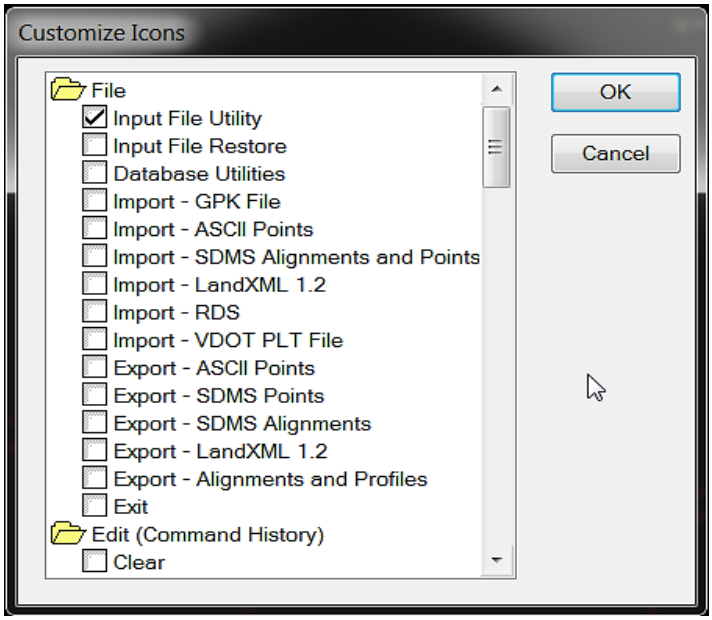
GEOPAK CUSTOMIZATION

When using GEOPAK it is important to make it familiar each time it's used. By customizing the tool bar with the tools used most often the user can become much more efficient. There are several tools that can be used to create points, lines, curves, chains, etc. It's up to the user to decide which tools he/she will put on their toolbar. To customize the toolbar use the following steps:

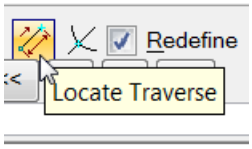
1. Select Customize This Group from the View/Icons menu.

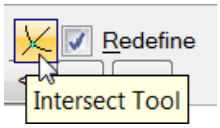


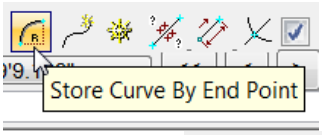
2. Select the tools to be displayed on the toolbar and then click OK.

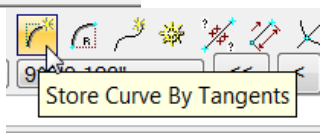


TOOLS USED MOST WHEN COMPUTING

1. Locate Traverse (Points) 

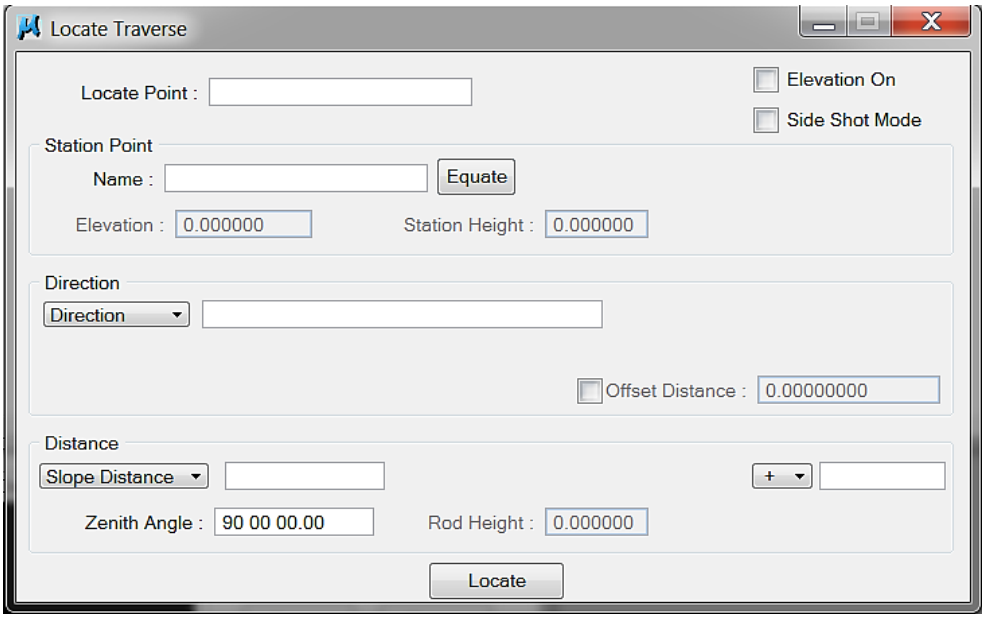
2. Intersect Tool (Points) 

3. Store Curve By End Point (Curves) 

4. Store Curve By Tangents (Curves) 

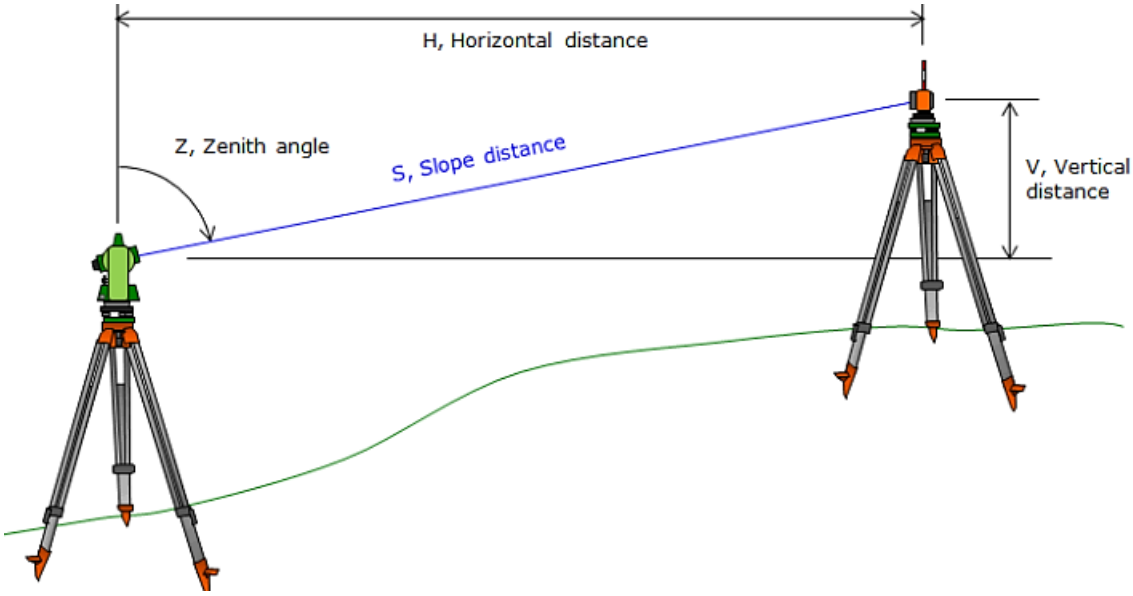
These are the four commonly used and basic tools for computing. The following pages will take the user through some of the basic functions of each. Please keep in mind that there are several different ways for the user to create points, lines, curves, etc. The use of these four computation tools will give the user the basic understanding of how a point, line, curve, etc. is created thus giving the user the background to use the many other tools available in geopak.

LOCATE TRAVERSE TOOL



This tool allows the user to create points by means of a virtual traverse. The default dialog box calculates the slope distance; be sure to change the Slope Distance

to Distance using the drop down menu. This will eliminate the possibility of adding an elevation to points that is unnecessary for the computing that is done in right of way. By leaving the slope distance on, the user runs the risk of accidentally changing the zenith angle which would result in a computation of a slope distance rather than the grid (horizontal) distance.



The Locate Traverse tool is ideal for the following:

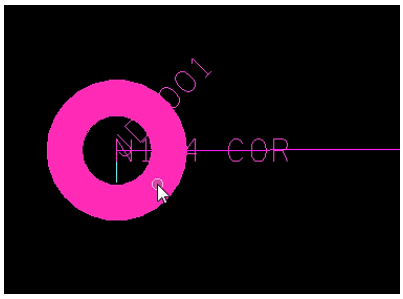
- Set a point on a line between two known points.
- Set a point at a specific offset distance between two points.
- Set a point on deflection angle from a line between two known points. Commonly this would be called for in a property description or shown on a subdivision plat.
- Set a point from a known point using a distance and direction.

The following steps will show how to perform each of these four functions using the Locate Traverse Tool. Remember to visualize the points to be used for computations before using this tool. It will make the computing process easier and minimize data entry errors. It is strongly suggested to make sure the Redefine box is ***not*** checked on. This will eliminate the chance that the user would overwrite a previously stored point/element.

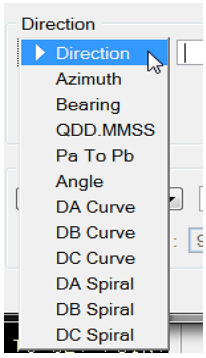
➢ Set a point on a line between two known points

1. Type in the point you wish to store first in the ***Locate Point Box***. Metro numbering standards ask the user to type their initials in followed by a number,

for example JD3001. (Ask the District Surveyor for the appropriate naming convention used, or see Appendix A for metro's)



2. Click inside the Station Name box to move the cursor there. Then select the point you wish to calculate a new point from by clicking on the visualized point in your MicroStation file.

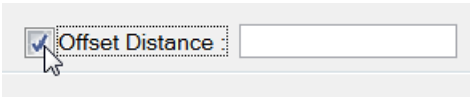


3. Then select the Direction you would like to use. For setting a point between two known points, the Pa to Pb is the best option. When using the Pa to Pb option, simply click inside the box on the left to move the cursor into that box, this is Pa, then click the visualized point you wish to be Pa. After this point is selected the cursor will move to the Pb box and you will do the same to select that point. Keep in mind which point you selected to be 'a' and which point you selected to be 'b'. It matters significantly in most cases because the direction of the line is important. The direction of the line will be from Pa to Pb.

4. Click inside the Distance box (not slope distance). Enter in the distance you wish to set the point at and click ok. This will store your point at a specified distance from the point the user determined to be 'a' on a line to the point the user determined to be 'b'.

➢ Set a point at a specific offset distance between two points

1. Perform this process just the same as you would set a point on a line between two points. The only difference is that you will need to add a few extra pieces of information to the tool.
2. Determine the point number you wish to store, the point to start from and the direction. (Pa and Pb) Refer to the Plat Computations Standards when deciding the name.
3. Check the Offset Distance box and type in the distance you wish to be offset from the line Pa to Pb. Remember that if you wish to be on the left side of the line your value must be negative and if you wish to be on the right side of the line your value must be positive.



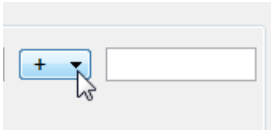
4. Type in the distance in the distance box that you wish to travel from your starting point along the Pa to Pb line and then click ok. This will compute a point at a specified offset distance from a line at a specified distance along that line.

- Set a point on a deflection angle from a line between two known points

1. Perform this process just the same as you would set a point on a line between two points. The only difference is that you will need to add one extra piece of information to the tool, a deflection angle.

2. Determine the point number you wish to store, the point to start from and the direction. (Pa and Pb) Refer to the Plat Computations Standards when deciding the name.

3. Click on the deflection angle box and specify if it will be a right (+) or a left (-) deflection.



4. Type in the angle you will be deflecting in the following syntax DDD MM SS. Example, 180 00 00 or 95 27 35. In some cases you may need to figure out the angle between two lines. Please refer to the chapter on Azimuths and Bearings if needed.

5. Type in the distance desired and click ok. This will compute a point on a deflection angle between two different lines. In most cases the starting point will be Pb, but again this will be dependent upon the type of computation the user is wishing to perform.

- Set a point from a known point using a distance and direction

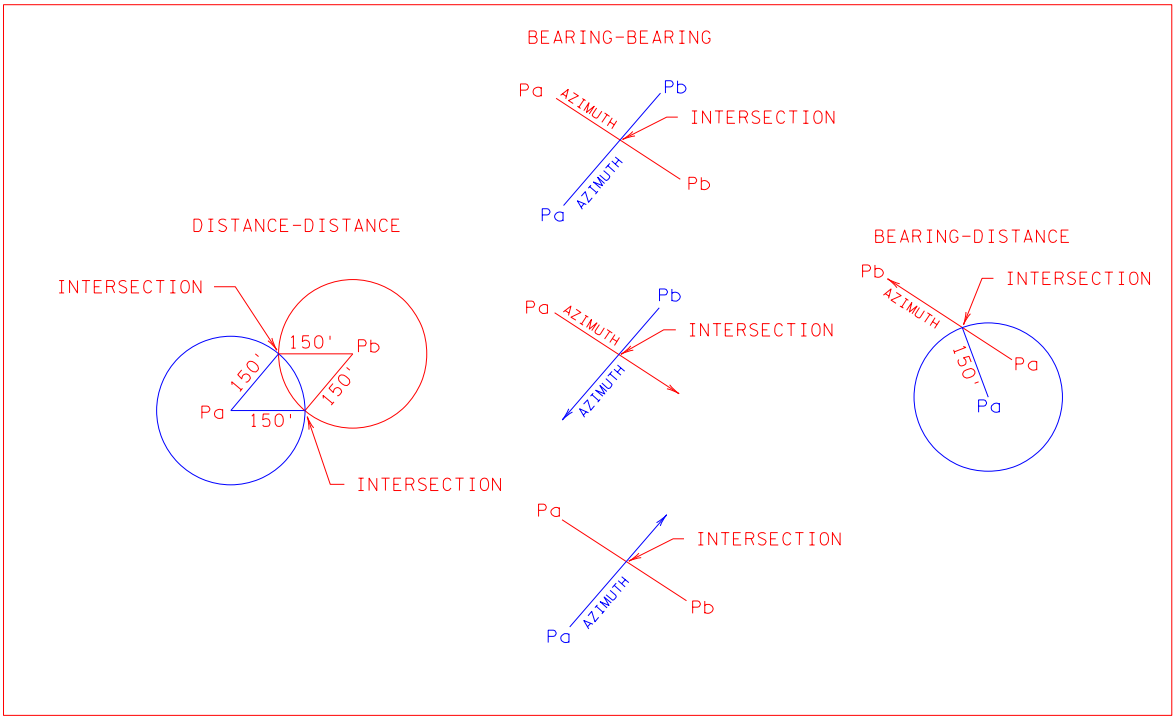
1. Determine the point number you wish to store and the point to start from. Refer to the Plat Computations Standards when deciding this name.

2. Specify the direction type you wish to use. Example Azimuth or Bearings and use the proper syntax for entering an angle, as shown above, to enter the desired direction.

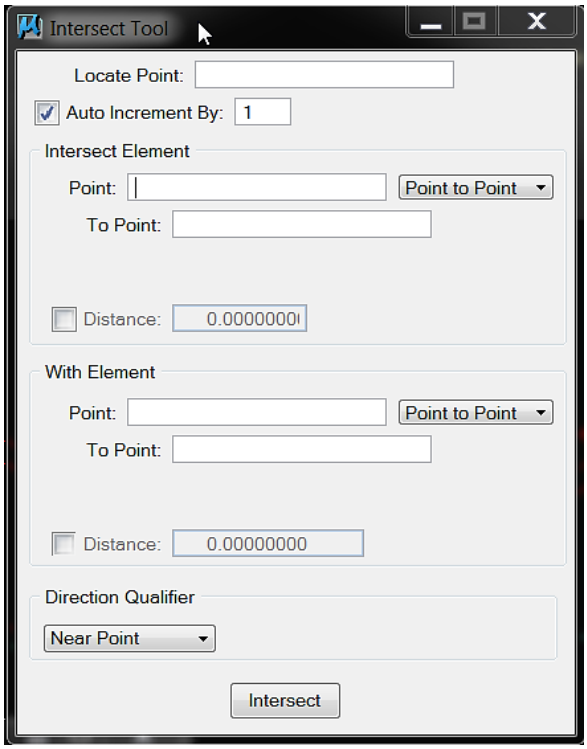
3. Specify the distance needed and click ok. This will compute a point from a known point at a specified direction and distance.

INTERSECT TOOL

The intersect tool is used when the user needs to determine the intersection between two elements. An element can be defined in several different ways. It could be an intersection of two lines (Bearing-Bearing) or a distance from two points (Distance-Distance). Several types of intersections are illustrated below.



A few variations of how to compute some of the most basic intersections shown above are described on the following pages and should supply enough knowledge of the intersection tool to use it in many different ways.



- Basic Intersection between two lines using four known points (bearing-bearing)

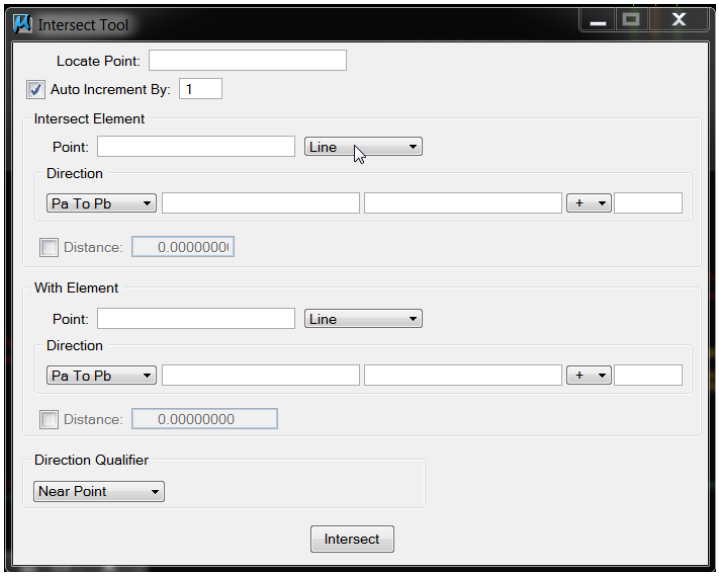
1. Open the intersection tool and type in the point number you wish to store in the Locate Point Box. Make sure Point to Point is selected in the element drop down boxes.

2. In the with Element area click in the Point box and then select your desired visualized points in Microstation for both ends of the first element and do the same for the next element.

3. Click the intersect button and a point will be created at the specified intersection between four known points.

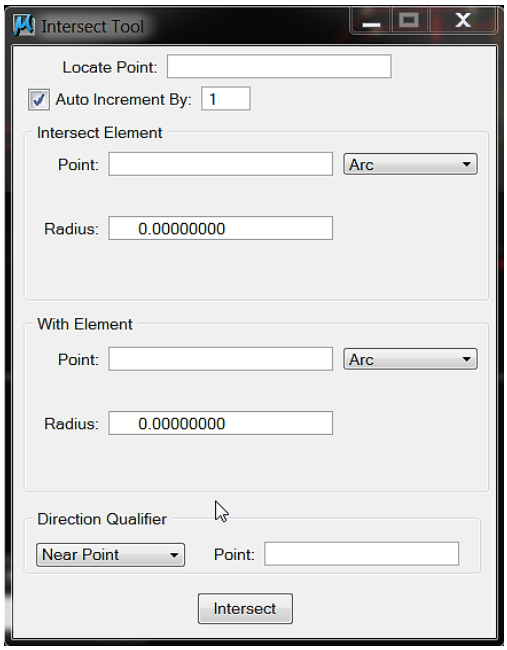
➢ Intersection using two known points and a direction from each (bearing-bearing)

1. Open the intersection tool and set both types of elements to Line. Also type in the point number you wish to store.



2. For the first element determine the point from which you wish to start your intersection from. Then determine the direction (Pa To Pb). This is the same principal as what was used in the Locate Traverse section of this manual.

3. Do the same for the second element and then click ok. This will create an intersection at the specified direction from each point. Make sure that you use the proper direction of the line so that the lines will intersect.



➢ Intersection between two known points at a specified distance (distant-distance)

1. Open the intersection tool and set both types of elements to Arc. Also type in the point number you wish to store.

2. Select the points you wish to use by clicking on the desired visualized points in your Microstation file and type in the distance from each that you wish for them to intersect at. Keep in mind the distances specified need to create an intersection. For example, if the two points are 1000' apart don't type in 200' from one and 200' from another because they will not intersect, there will be a minimum of a 600' gap.

3. Click on the direction qualifier box and determine the direction. There will be three options to choose from, Near Point, Right, or Left. The Near Point refers to a point that the intersection is close to, the Right and Left options need to be thought of in the following manner. If a line were to be drawn from the first point to the second point which side of that line is the desired intersection on? When creating a distance-distance intersection there will be two possible intersections created so you need to be mindful of which point you want.

CURVE TOOL

In order to use the curve tools in geopak, the user should have a basic knowledge of the different parts of a curve. Below is a sheet from the 1973 technical manual showing the different elements of a curve. Refer to this sketch with any questions on the various parts of a curve.

CIRCULAR CURVES (Arc Definition)

The following notations and formulas are consistent with Figure CC at right.

PI = point of intersection of tangents.
PC = beginning of curve.
PT = end of curve.
R = radius of curve.
D = degree of curve.
Δ = central angle of curve.
L = arc length from PC to PT.
C = long chord from PC to PT.
T = tangent from PC to PI or from PT to PI.
E = external distance from PI to midpoint of circular arc, L.
M = middle ordinate connecting midpoints of circular arc, L, and long chord, C.

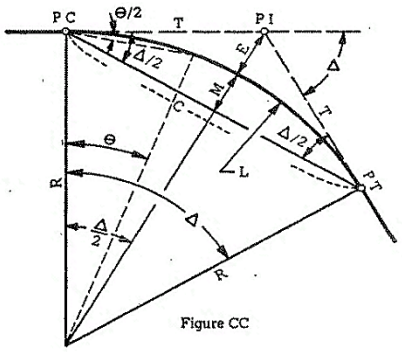


Figure CC

The degree of curve (arc definition)* is defined to be that central angle which subtends an arc length of 100 feet. See Figure DC at right.

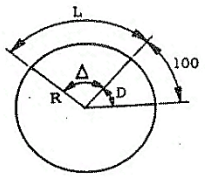


Figure DC

CIRCULAR CURVE FORMULAS (Arc Definition)

From Figure DC at right,

$2\pi R'$ is to 360^{o} as 100' is to D^{o} as L' is to Δ^{o},

or $\frac{2\pi R}{360} = \frac{100}{D} = \frac{L}{\Delta}$. $\pi = 3.1415926536$

Therefore, $RD = 18{,}000/\pi$; where R is in feet and D is in degrees,
and $LD = 100\Delta$; where L is in feet and D and Δ are in degrees.

From Figure CC above,

$\tan(\Delta/2) = \frac{T}{R} \longrightarrow T = R\tan(\Delta/2)$

$\sin(\Delta/2) = \frac{C/2}{R} \longrightarrow C = 2R\sin(\Delta/2)$

$\cos(\Delta/2) = \frac{R}{R+E} \longrightarrow E = R(\sec(\Delta/2)-1)$

also, $E = T\tan(\Delta/4)$

$\cos(\Delta/2) = \frac{R-M}{R} \longrightarrow M = R(1-\cos(\Delta/2))$

$D = \frac{18000}{\pi R}$

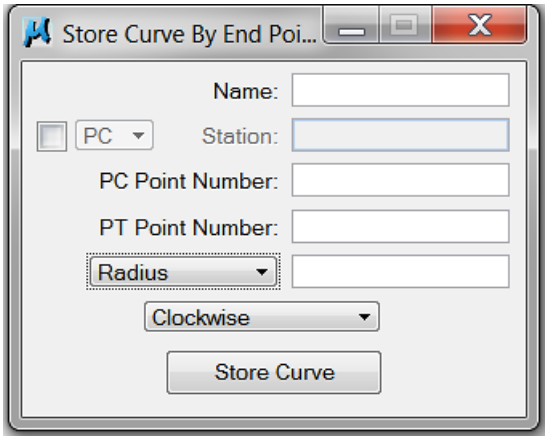
$R = \frac{18000}{\pi D}$

$L = \frac{100\Delta}{D}$

$D = \frac{100\Delta}{L}$

➢ Store Curve by Endpoints tool

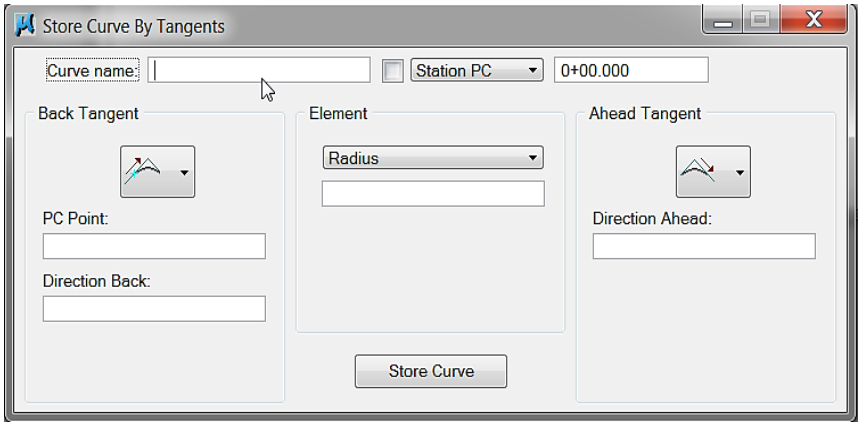
This curve tool is commonly used when a curve needs to be computed and only the endpoints of the curve and one other piece of information about the curve are known. The endpoints are also known as the PC and PT of the curve. In many cases this curve tool is used when a curve is non-tangential. This just means that the direction of the line into and out of the curve does not match the direction of the tangents of the curve itself.



1. Open the tool and enter the curve name you wish to store in the 'Name' box.
2. Click in the PC Point Number box and then click on the visualized point in your Microstation file that you wish to have as the PC of your curve. Do the same for the PT Point Number. Keep in mind that if the user will be using this curve as an element in a chain the points that are identified as the PC and PT are very important because this will establish the direction of the curve.
3. Make sure the box under PT Point Number is set to the appropriate curve part. In most cases the user will select Radius. Enter that information into the box.
4. Select the direction of the curve whether it is clockwise or counterclockwise. This will set which side of the chord the arc will appear on.
5. Click on Store Curve to complete creating your curve.

➢ Store Curve by Tangents tool

To create a tangential curve the user will want to use the Store Curve by Tangents Tool. This tool will use the information surrounding the curve and also information about the curve to be created in order to create a curve that flows smoothly between line segments.



1. Open the tool and enter the curve name you wish to store in the Curve Name box.

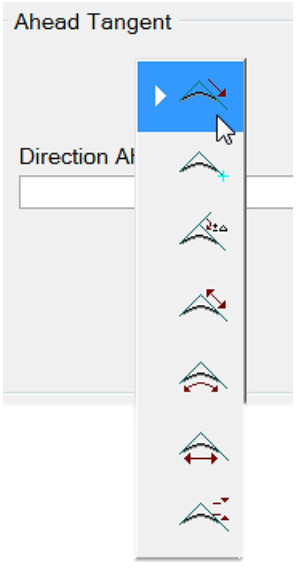
2. Under the Back Tangent area select the PC point by clicking in the box under PC Point to move the cursor to the box and then click on the desired visualized point to make it the PC Point.

3. The Direction Back is another way of saying Back Tangent Direction. To select this direction the user can either type in an azimuth/bearing or they can select the two points leading into the curve. The user will need to be mindful of the direction in which the curve is to travel to understand what the Direction Back is. This direction back is the azimuth/bearing from the point before the PC of the curve to the PC of the curve.

4. Under the Element area of this tool select the information about the curve you would like to use. This is where you will take a piece of information about the curve and enter it here. In most cases the radius is what is used as this is a very important part of a curve. There are other pieces of information the user can enter, but the Radius is most common. It all depends on what information is available about the curve.

5. The Ahead Tangent is the direction of the line that will be coming out of the curve at its PT. There are several options to choose from. Again, the user will need to be mindful of what information is available and what is important when creating the curve.

Options for Ahead Tangent



- If perfect tangency is required using the Deflection Angle (Same as Delta or Central Angle) is best. This is the third option from the top of the selection set shown to the right. To enter the deflection angle the syntax of DDD MM SS should be used. Enter your angle and then click Store Curve.

- The Length of the curve is also a common option that is used. This is the fifth option from the top of the selection list. If this option is selected it's important to remember that because of how the software does its computing and rounding of numbers tangency could be affected. Enter the length of the curve and click Store Curve.

- The Chord Length is the other commonly used option. This is the sixth option from the top of the selection list. If this option is selected it's also important to remember that because of how the software does its computing and rounding of numbers tangency could be affected. Enter the length of the chord and click Store Curve.

Summary

It's important to remember that there are several ways to compute a point, line, offset point, curve, etc... The above described tools are ones to help a user of geopak compute any of these. Geopak offers other tools in the Graphical COGO toolbox. Once a user is familiar with these basic tools and has an understanding of the basic drafting tools in Microstation he/she will be able to use the Graphical COGO tools with much more ease and proficiency.

Chapter 4

LIDAR to DTM

By Jordan Kurth

Light Detection and Ranging (LIDAR) is a remote sensing technology, like the aerial photos, the data can be used to assist with construction projects. Instead of taking photos, LIDAR uses a laser to scan the surface of the Earth and measures the reflected light. The data gathered is useful for many different groups, ranging from agriculture, archaeology, biology/conservation, etc. For right of way, the data can be transformed into contours.

MNDOT DISTRICT 6

LIDAR to DTM

Illustrated Edition

Prepared by Jordan Kurth

9/21/2015

This guide details how to migrate LIDAR Data, provided per the MnDNR's "MnTOPO" Web Application, from an ArcGIS Application to a MicroStation DTM Environment for use in a planning or otherwise reference purposes.

- *As part of the Minnesota Clean Water and Legacy Amendment the Department of Natural Resources has commissioned multiple LIDAR flights around the State. This data is public: http://arcgis.dnr.state.mn.us/maps/mntopo/*

- *This data is a huge resource and can have potential applications for MnDOT Program Delivery staff. Including:*
  - *Preliminary Planning*
  - *Rough Site Design*
  - *Augmenting Existing or non-existent survey data*
  - *Pre-project Condemnation Exhibits*

- *The purpose of this guide is to migrate this data from a relatively unfamiliar ArcGIS Application to a more common MicroStation Environment*

- *The MnTOPO Help Manual is available here: http://files.dnr.state.mn.us/aboutdnr/gis/mntopo/mntopo_help_document.pdf*

- *For details of the Clean Water Fund : http://www.legacy.leg.mn/funds/clean-water-fund*

- *This guide is made with limited experience. Other extraction and application methods certainly exist.*

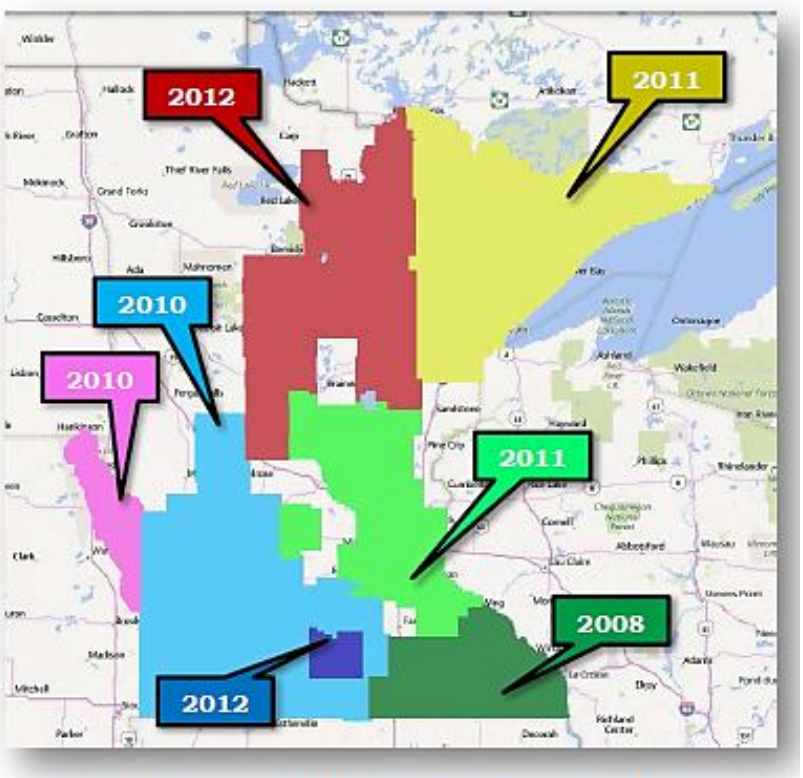
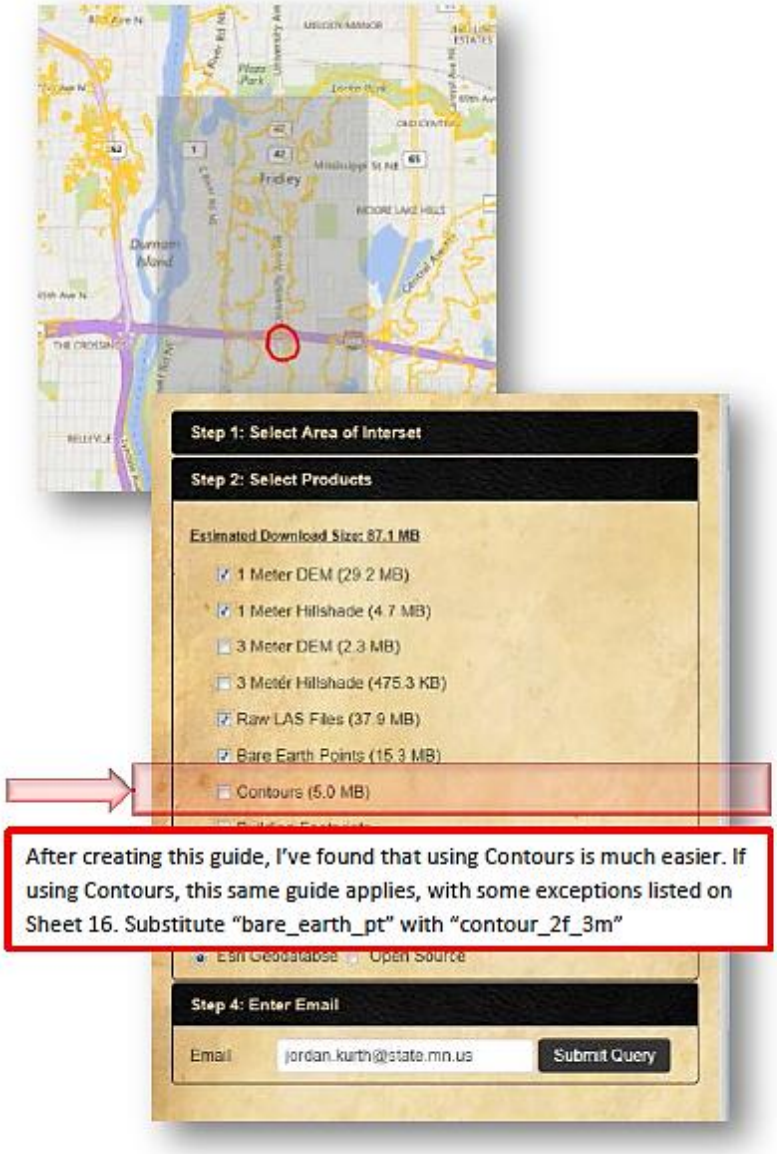


Figure 1 ~ Illustrates the Flight Line Dates for the DNR's LIDAR Project.

Figure 2 ~ Additional LIDAR data sets (Red River 2008-2010) are Available through the ND LIDAR Dissemination Map Service http://lidar.swc.nd.gov/. This guide will not cover how to download and manipulate this data.



1) *Within the MnTOPO Viewer, zoom to your area of interest and Select the "Download Data" Icon.*

2) *Use the "Freehand Polygon" option to circle your area on the map.*

3) *For this instance we'll choose:*
   a. *1 Meter DEM*
   b. *1 Meter Hillshade*
   c. *Raw LAS Files*
   d. *Bare Earth Points*

   The Bare Earth Points are all that are really necessary but we'll take the others just for fun as points of further interest, not to be discussed in this process

4) *Select the Esri Geodatabase as the Product Type*

5) *Enter your E-Mail Address for delivery*

6) *Agree to the Disclaimer. Don't read it – you don't want to know that you are agreeing to….*

Figure 3 ~ Use the tools on the right side of the viewer once you've determined your area of interest.

Figure 4 ~ WOOOOO – Now you're a Stylin', Profilin', Limousine Ridin', Jet Flyin', Kiss-Stealing, Wheelin' N' Dealing' Son of A Gun!! (Ric Flair… get it? Figure 4?)

On a Serious Note, If you've done all the steps correctly you will see this appear. If not, go to Page 1 of this guide, open the MnTOPO Help file and review the official directions.

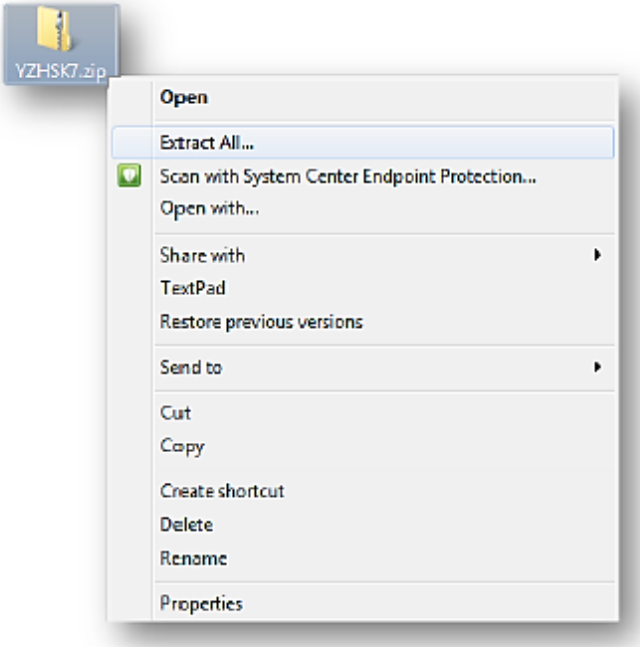


Figure 5 ~ A simple "right click" will allow the files to be uncompressed, or extracted.

Figure 6 ~ When the files are Extracted, the directory structure looks as above

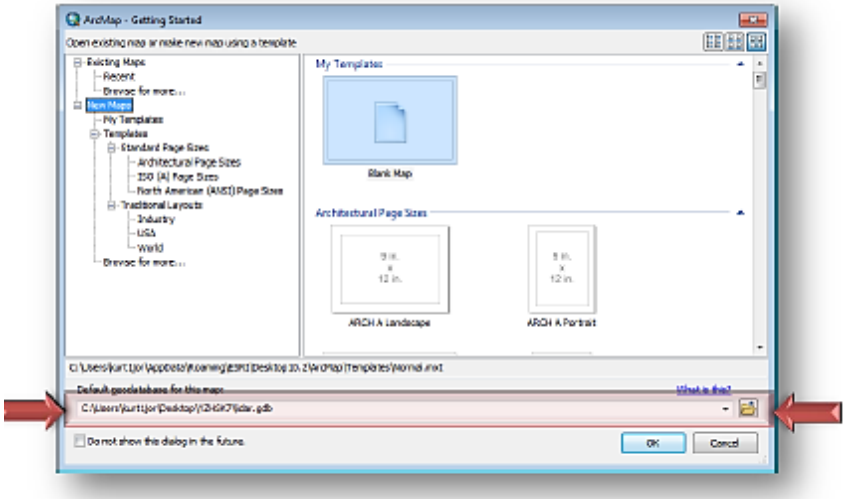


Figure 7 ~ ArcMap Startup Options

7) *In due time, an e-mail message will arrive stating something to the effect of…*

Greetings,
Your request has been processed. You may download your data here:

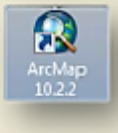
ftp://ftp.gisdata.mn.gov/outgoing/lidar/YZHSK7.zip

A Copy of this file will be included in the training files provided.

8) *Once this compressed file is downloaded it can be extracted. See Figure 5.*

9) *The result is an oddly named folder containing another "folder" called "lidar.gdb". This really is not a folder, rather an ArcGIS Geodatabase*

10) *Launch ArcMap*



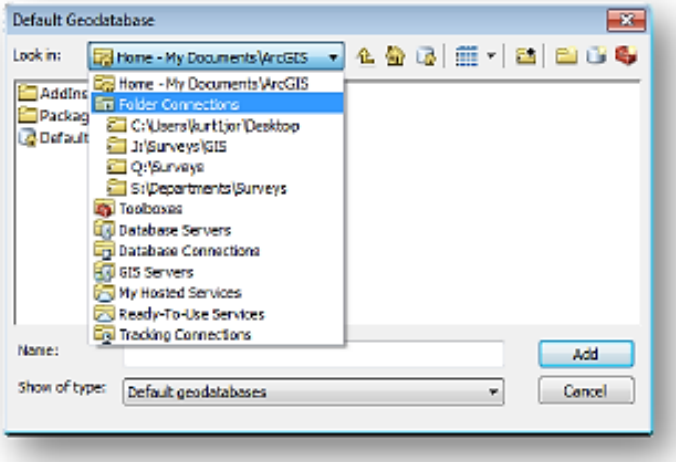
11) *Reference Figure 7 at left for startup options*

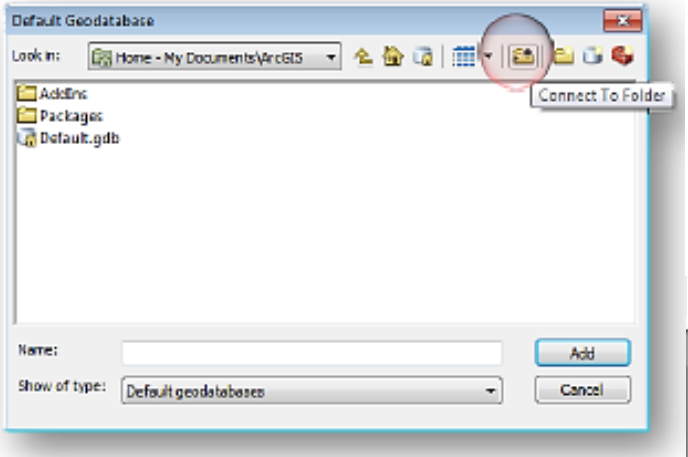
12) *Be sure to map the "Default geodatabase for the map" to the lidar.gdb file we've acquired (see the following page for "Connect To Folder instructions"*

13) *Mirror the options at left and select OK to proceed*

SUPPLEMENTAL INSTRUCTIONS

"CONNECT TO FOLDER"



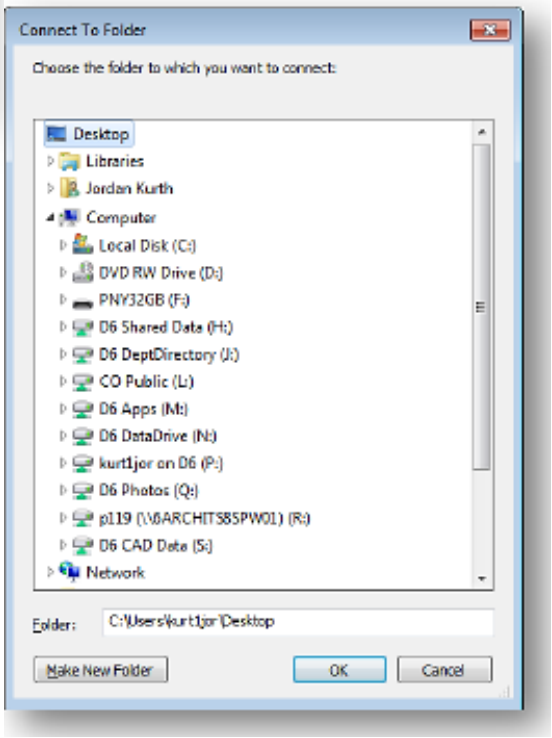


ArcMap uses what is calls "Folder Connections", or pre-defined location to browse for data.

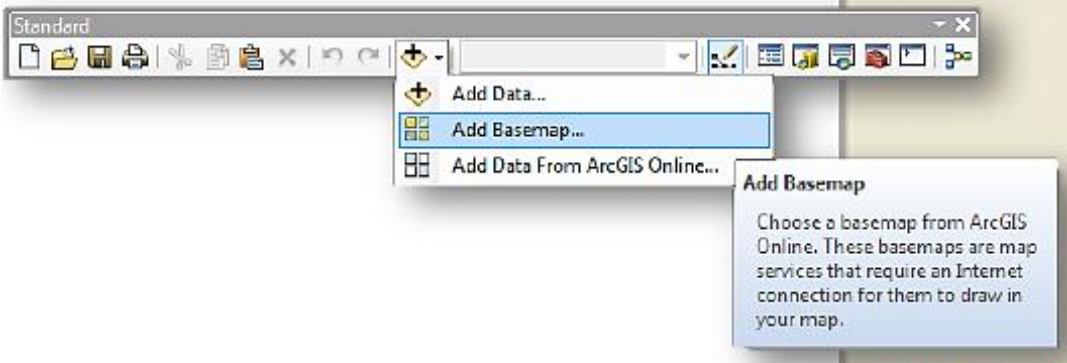
While Browsing for the default geodatabase you may not see your directories available, frustrating, through simple to remedy.

Click on the "Connect to Folder" Icon and in the following window the familiar directories will be available to choose from. Choose whatever directory in needed.

Notice my already chosen "Folder Connections" at top left, for examples.



14) Add a Basemap for reference purposes. Choose whichever meets your fancy on the following prompt



15) Add your LIDAR Ground Points Shapefile using "Add Data..."

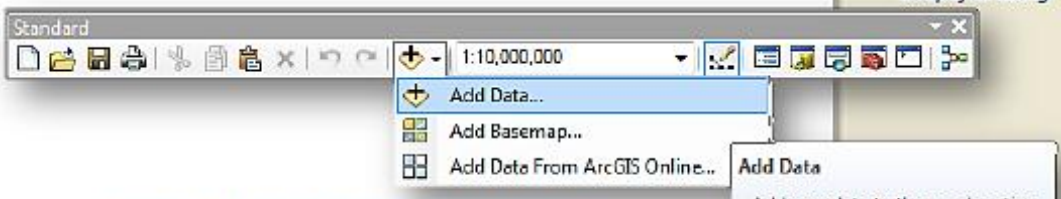
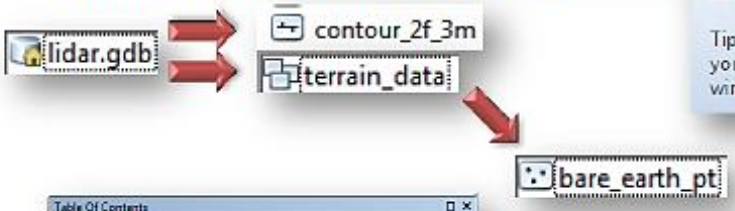


Figure 8 ~ (Below) Browse to the Bare Earth Shape File



16) Browse into the "lidar.gdb"

17) Open the "terrain_data" feature class and choose the bare_earth_pt. (Figure 8)

18) From the Table of Contents Window in ArcMap "right click" the feature "bare_earth_pt" and select "Zoom to Layer" (Figure 9)

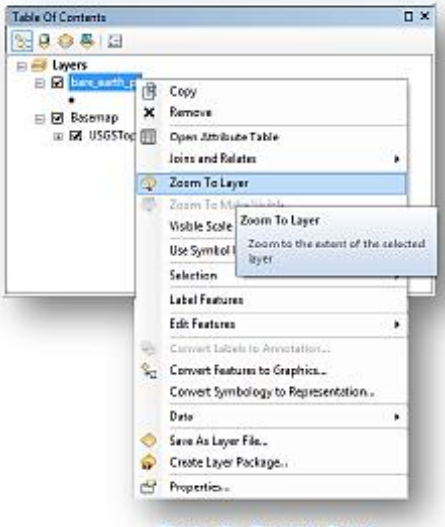
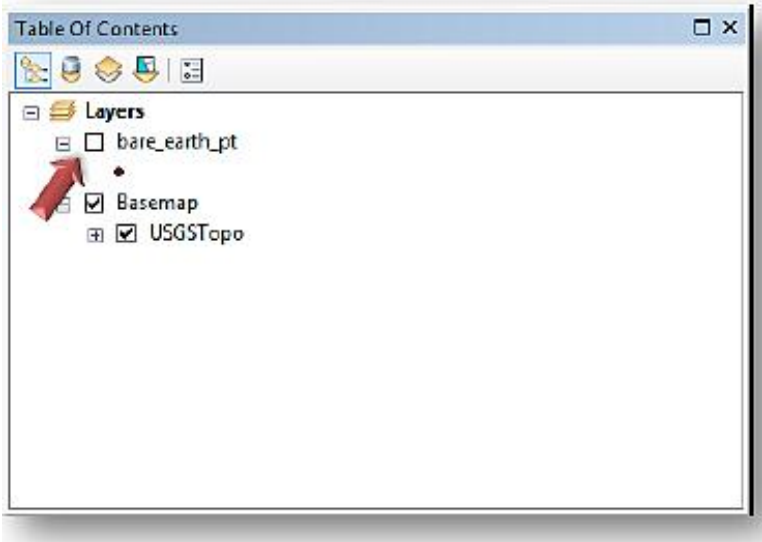


Figure 9 ~ Zoom to Layer

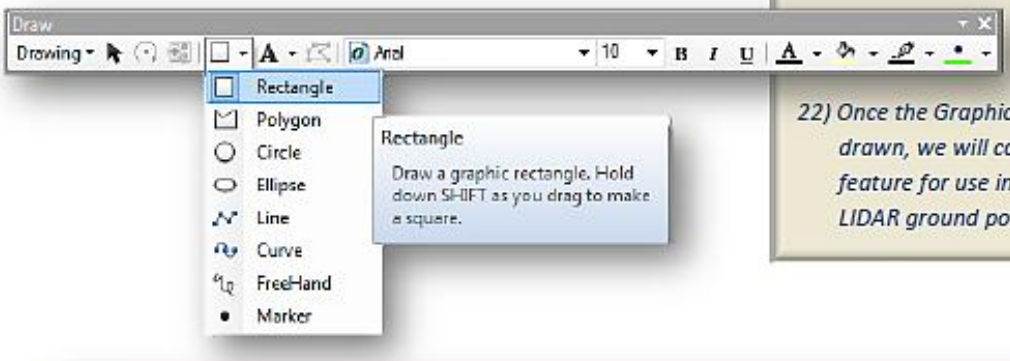


You can see that this is a very large dataset. We'll want to reduce it down to something useable for your area of particular interest.

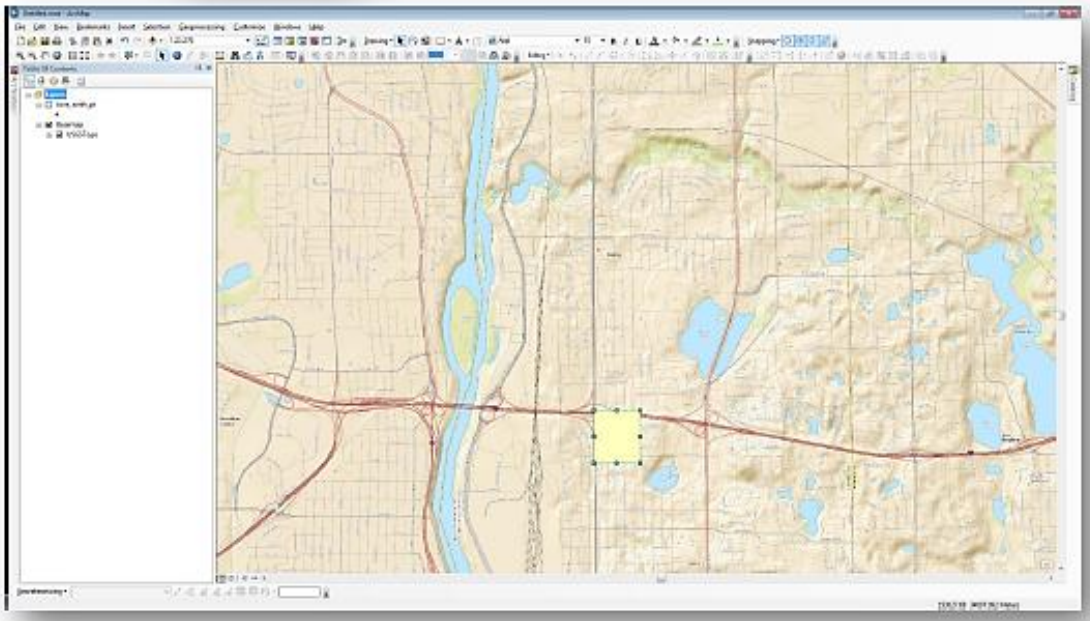
19) Turn off the "bare_earth_pt" display by un-checking the selection box.

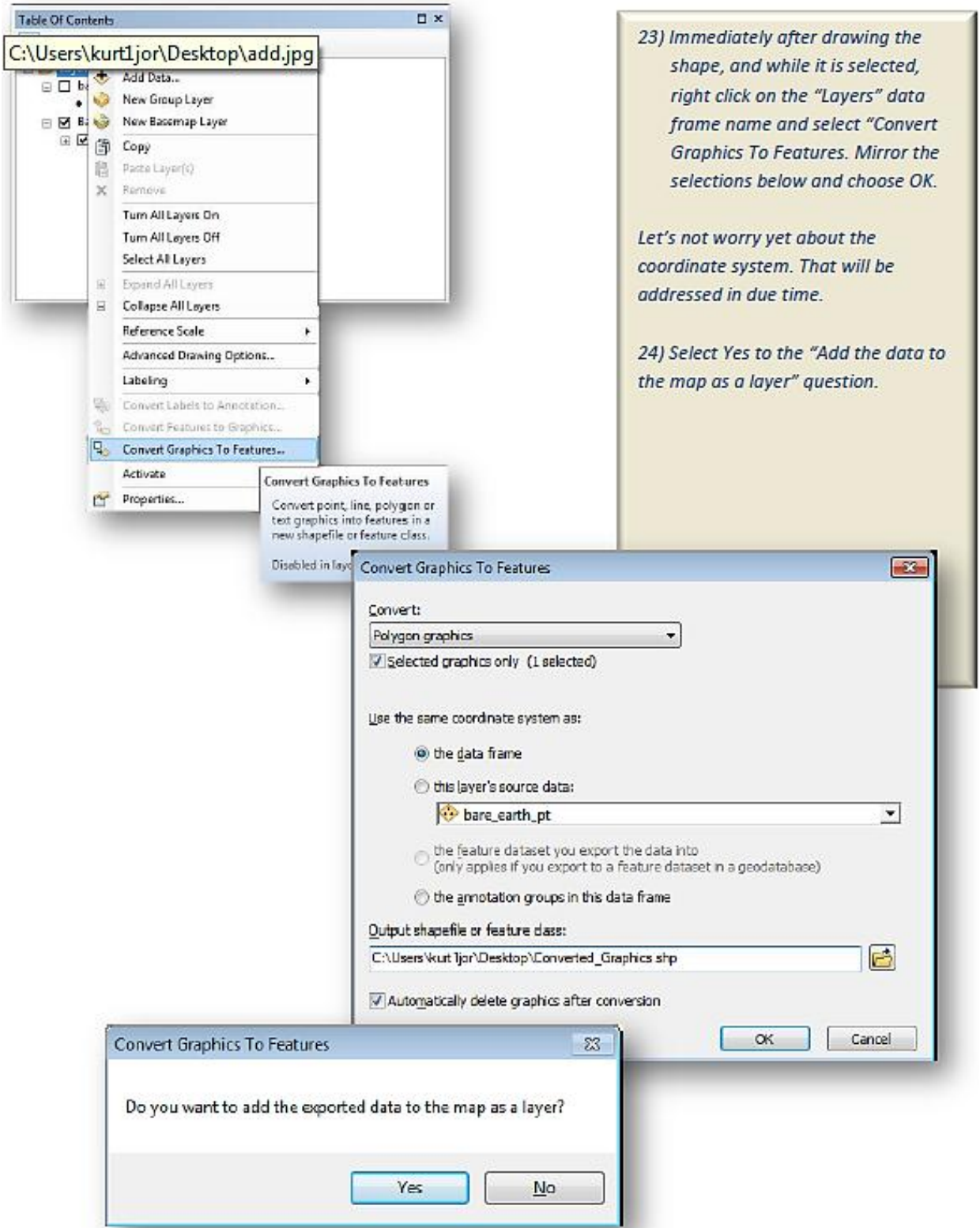
20) Right Click anywhere on the grey margin of the toolbar area and turn on the "Draw" toolbar.

21) With the draw toolbar activated choose the rectangle or polygon option and draw a shape around your site



22) Once the Graphics have been drawn, we will convert them to a feature for use in clipping our LIDAR ground points.





23) Immediately after drawing the shape, and while it is selected, right click on the "Layers" data frame name and select "Convert Graphics To Features. Mirror the selections below and choose OK.

Let's not worry yet about the coordinate system. That will be addressed in due time.

24) Select Yes to the "Add the data to the map as a layer" question.

The view may look the same, but the graphics are now actually recognized as a Polygon Shapefile.

25) Open the "ArcToolbox"

26) From the "Analysis Tools" and "Extract" choose "Clip"

27) Designate the Input Features and Clip Features as shown on Figure 10. The new feature will be created in the default lidar.gdb

The new features will be added to the map automatically.

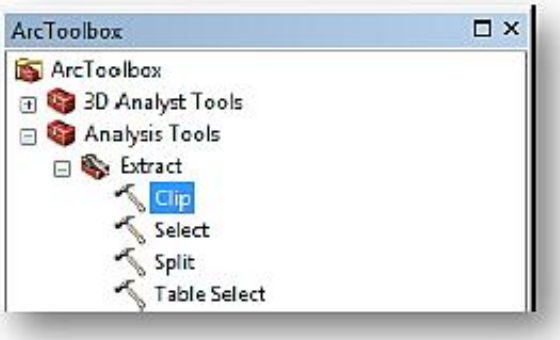
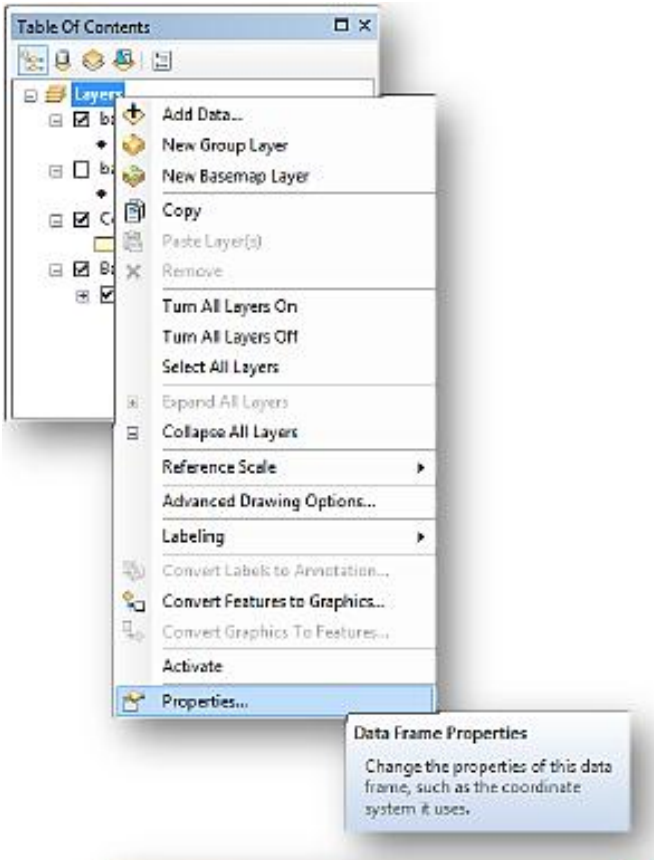
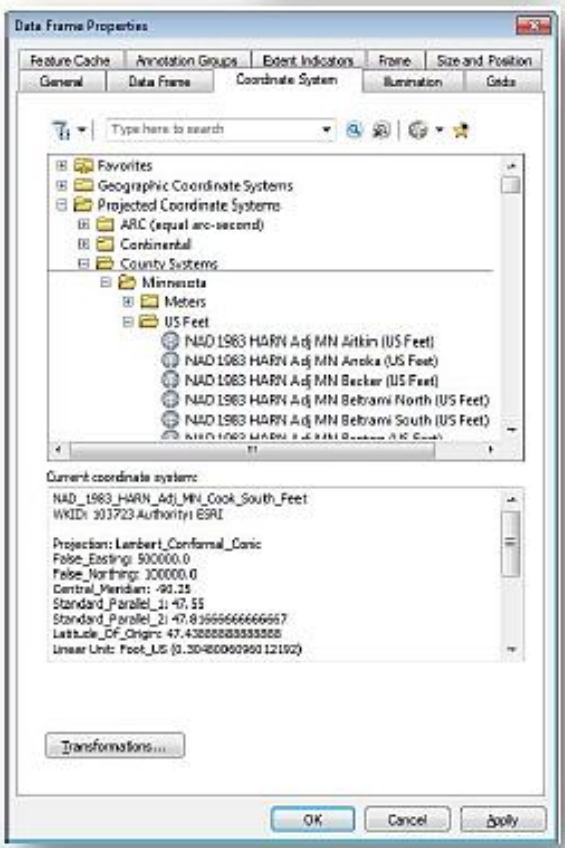


Figure 10 ~ Clip the LIDAR Points down to the Site Polygon

In the following steps we will re-project the data into a local coordinate system and export it as a shapefile the MicroStation can read.





29) In the "Table of Contents" right click the Data Frame name "Layers" and choose "Properties"

30) Under the Coordinate System Tab, browse to and select your local coordinate system. In this example use NAD83 HARN Adj. MN Anoka (US Feet)

31) Acknowledge the warning that a transformation is being applied.

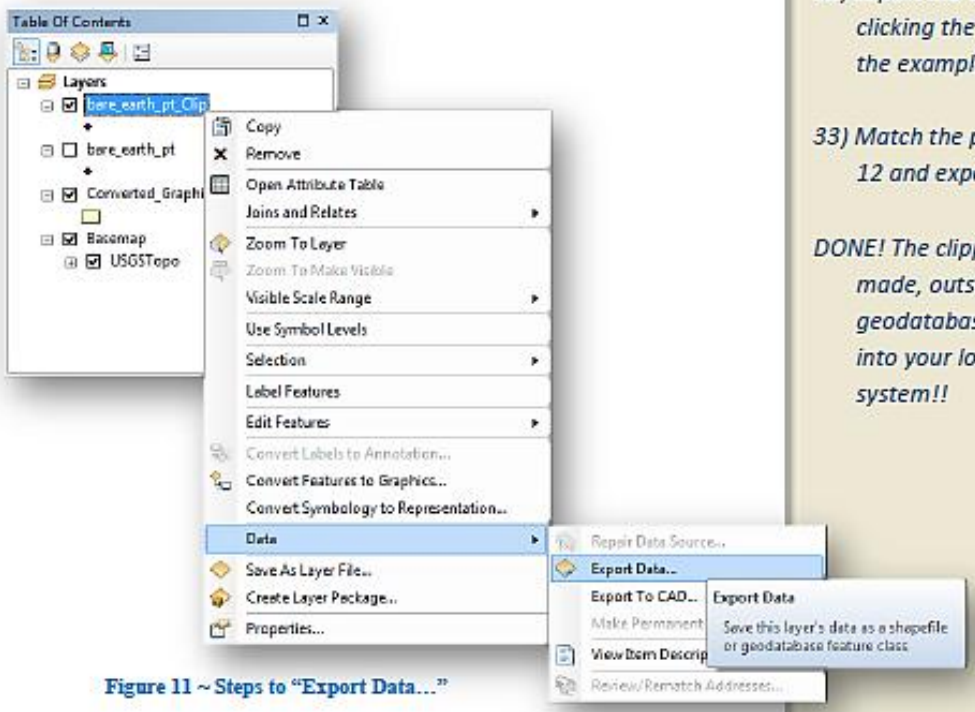


Figure 11 ~ Steps to "Export Data…"

32) Export the clipped points by right clicking the feature and following the example of Figure 11.

33) Match the parameters of figure 12 and export the shapefile.

DONE! The clipped shapefiles is made, outside of the geodatabase, and is projected into your local coordinate system!!

The Next Steps will take this file and manipulate it in MicroStation

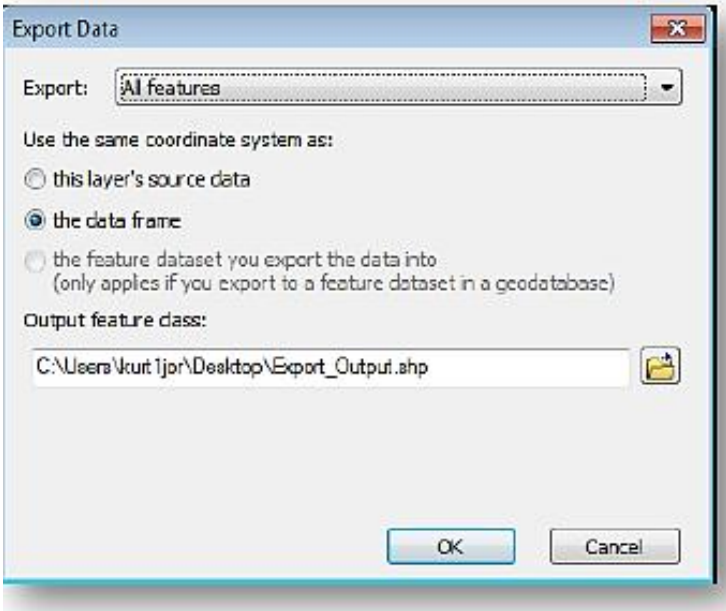
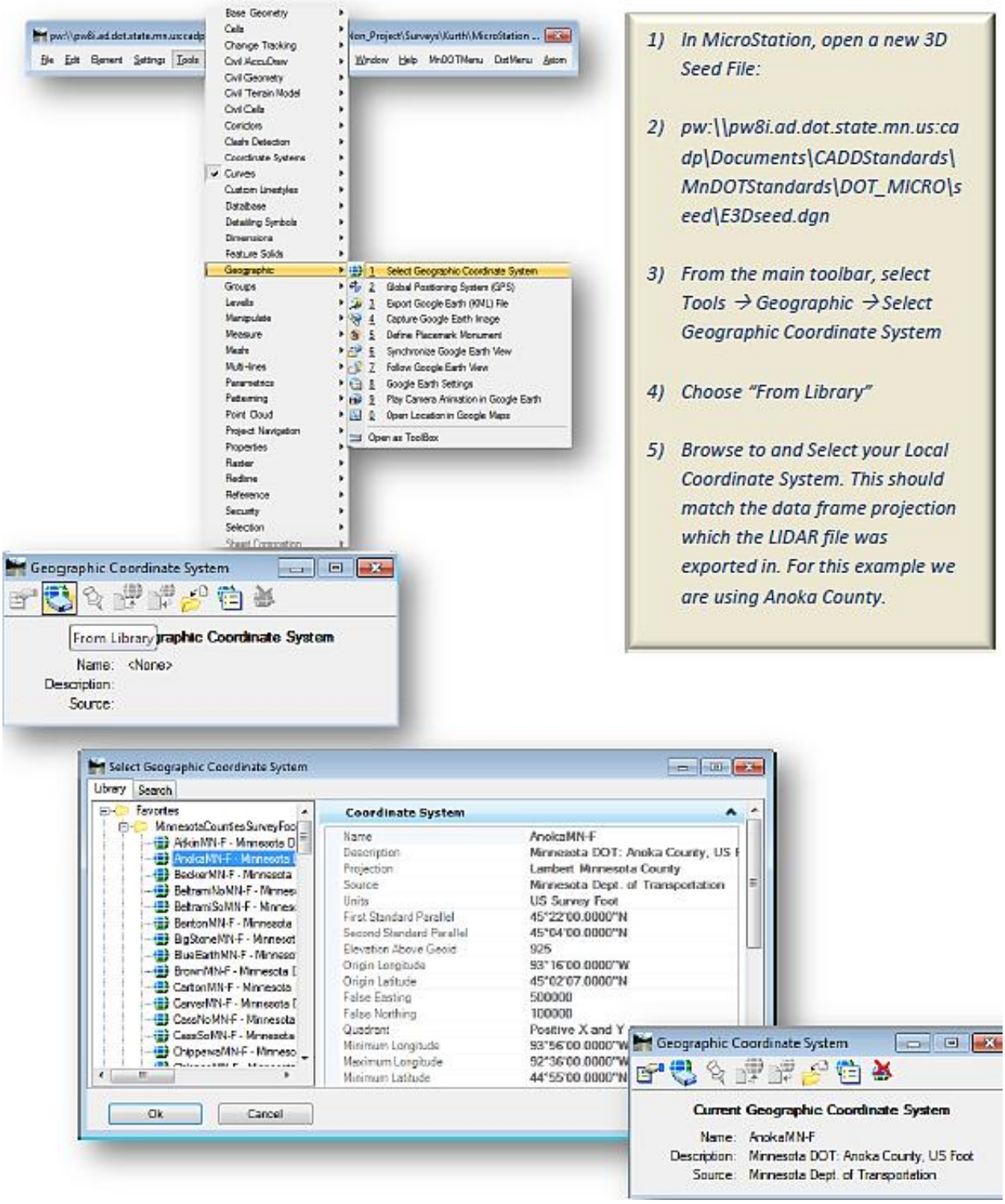


Figure 12 ~ "Export Data" Parameters

~~This concludes the ArcMap involvement in the Process ~~

~~At this point begins the MicroStation Process ~~



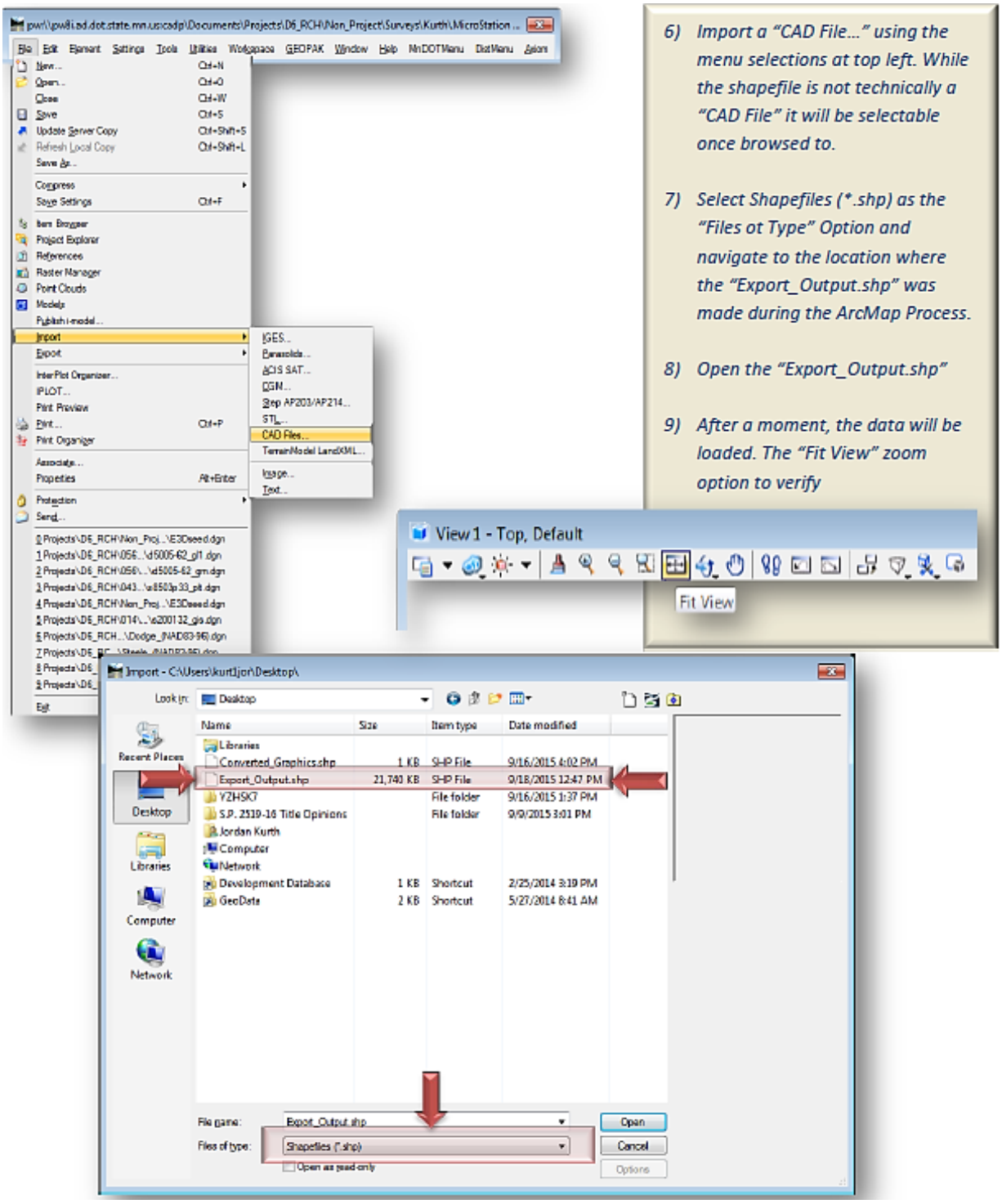
1) *In MicroStation, open a new 3D Seed File:*

2) *pw:\\pw8i.ad.dot.state.mn.us:cadp\Documents\CADDStandards\MnDOTStandards\DOT_MICRO\seed\E3Dseed.dgn*

3) *From the main toolbar, select Tools → Geographic → Select Geographic Coordinate System*

4) *Choose "From Library"*

5) *Browse to and Select your Local Coordinate System. This should match the data frame projection which the LIDAR file was exported in. For this example we are using Anoka County.*



6) *Import a "CAD File…" using the menu selections at top left. While the shapefile is not technically a "CAD File" it will be selectable once browsed to.*

7) *Select Shapefiles (*.shp) as the "Files ot Type" Option and navigate to the location where the "Export_Output.shp" was made during the ArcMap Process.*

8) *Open the "Export_Output.shp"*

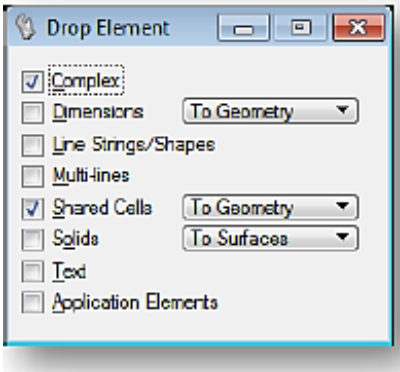
9) *After a moment, the data will be loaded. The "Fit View" zoom option to verify*

This Data may look useable, but there are a few more steps to take to ensure its proper use.

10) Add all elements to your selection set.

11) Using the "Drop Element" drop all complex elements.

If you investigate any of these elements you will see that they are still holding metric elevations. These will need to be scaled up to US Foot Elevations.

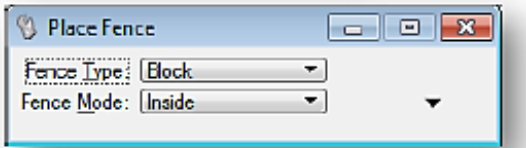


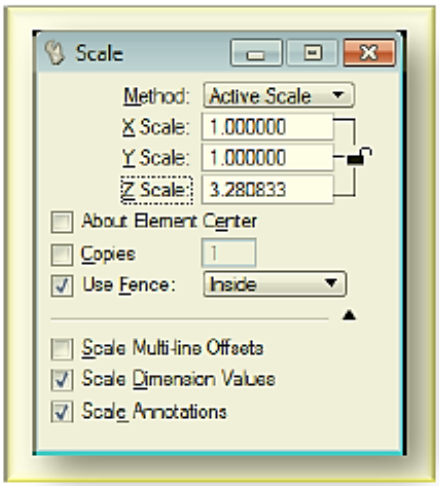
12) Place a Fence around all elements

13) Choose the "Scale" command

14) Using the parameters as shown on Figure 13 at lower left, scale the Z values up by a value of 3.280833333 (the metric conversion to US Survey Feet). Pick an arbitrary location as the "origin"

This process may take a moment, as the computer is scaling a huge number of elements





If Using Contours, these steps are unnecessary as the elevation data is already in U.S. Feet.

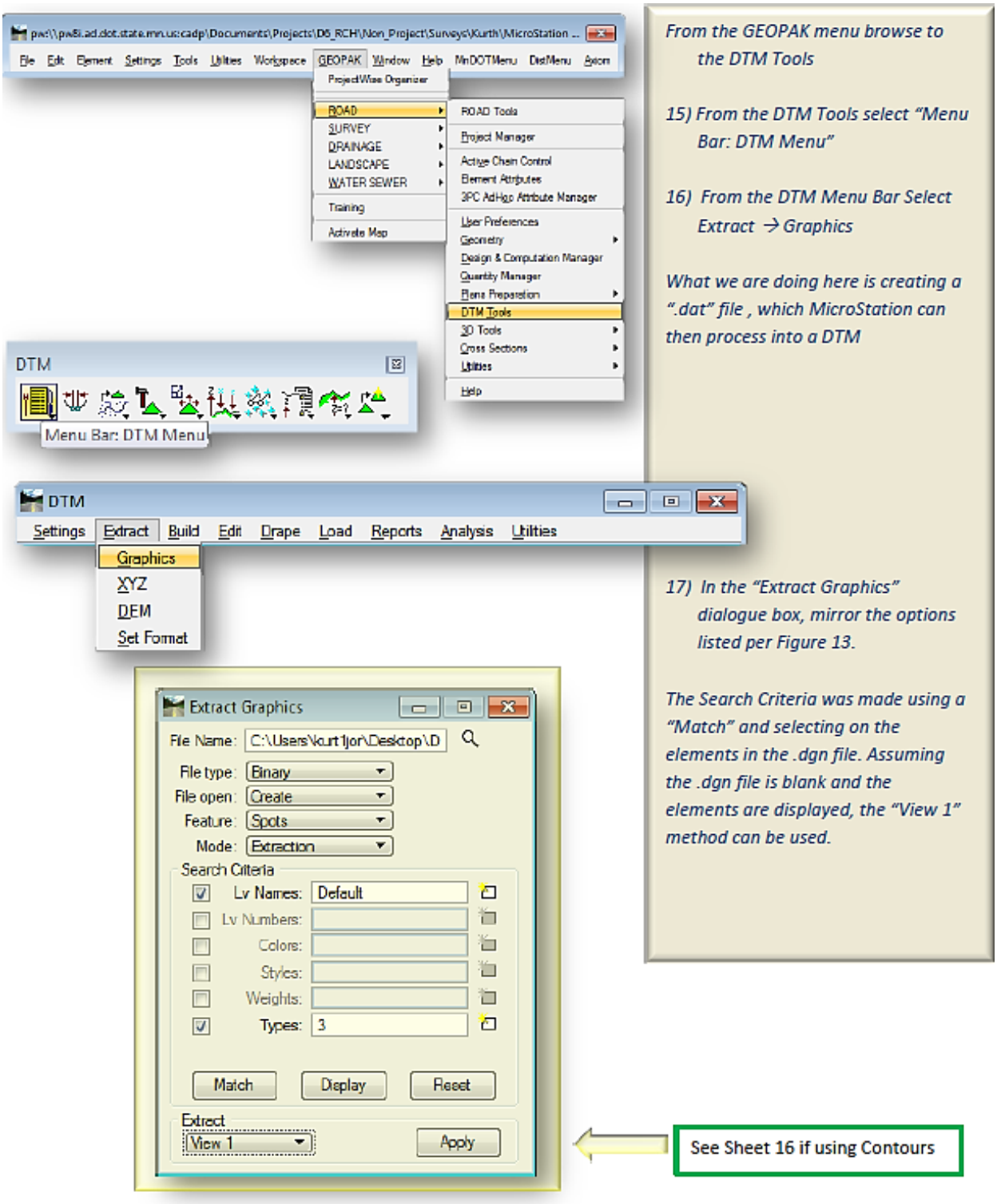


Figure 13 ~ Extract Graphics to .dat file

From the GEOPAK menu browse to the DTM Tools

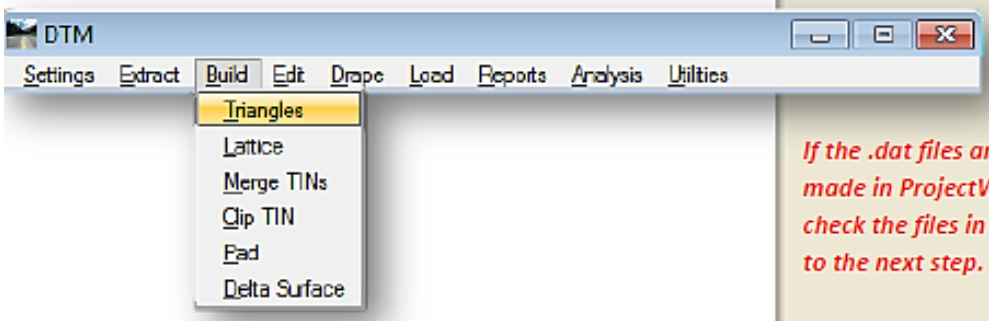
15) From the DTM Tools select "Menu Bar: DTM Menu"

16) From the DTM Menu Bar Select Extract → Graphics

What we are doing here is creating a ".dat" file , which MicroStation can then process into a DTM

17) In the "Extract Graphics" dialogue box, mirror the options listed per Figure 13.

The Search Criteria was made using a "Match" and selecting on the elements in the .dgn file. Assuming the .dgn file is blank and the elements are displayed, the "View 1" method can be used.



If the .dat files and .tin files are made in ProjectWise always always check the files in before moving on to the next step.

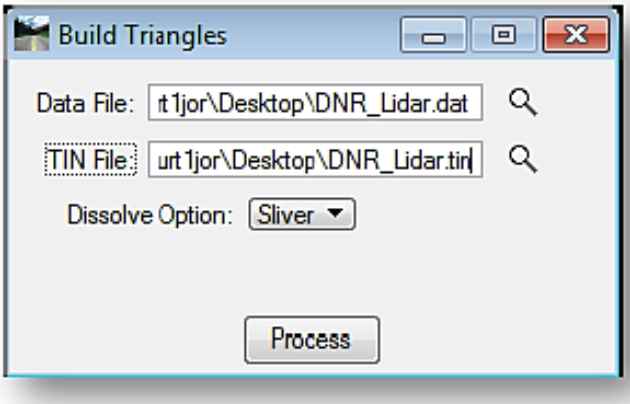
18) Using the DRM Menu Bar, build Traingles from the newly created .dat file.

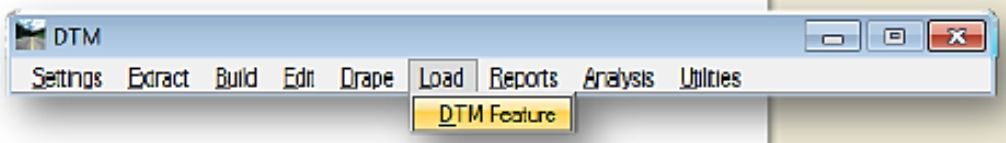
19) Create the .tin file.

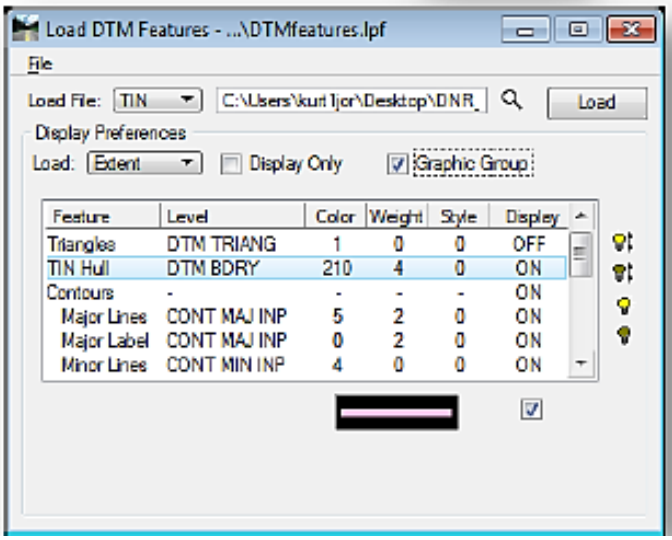
20) Load the DTM Features (Triangles, Contours, etc.) from, the .tin file created.

~~***The End***~~

See Next Page for Additional Instructions







Not quite the end… I've found that instead of using points, a greater area can be computed by using contours instead. The process is the same, with a few exceptions:

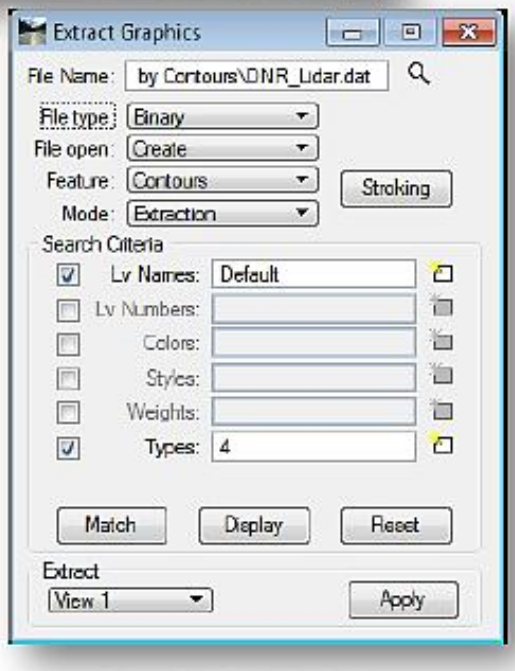


Figure 14 ~ Extracting Contours

1) *At the "Select Products" Screen choose Contours.*

2) *On Sheet 13, omit steps 13-15. The Elevation of this product is correct, meaning there is no need to scale from Meters to U.S. Feet.*

3) *On Sheet 14, Step 17, use Figure 14 as a guide.*

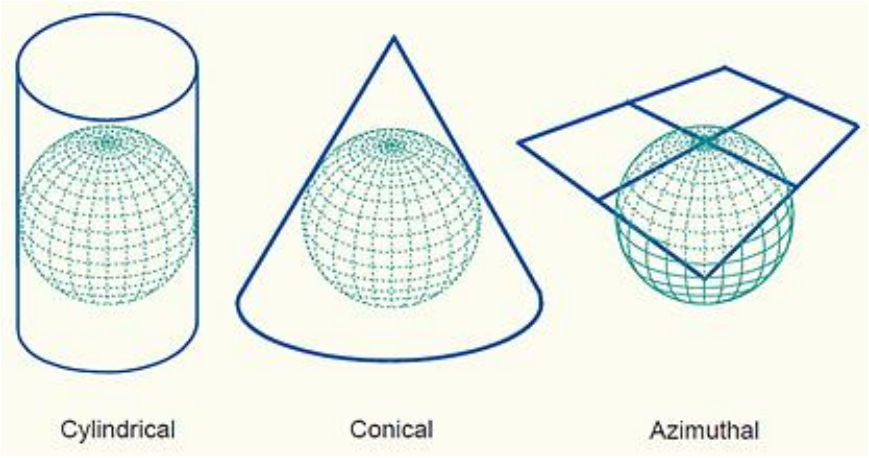
4) *That's it! All the general concepts are the same, just the process of using Contours uses less computing resources and generates a somewhat smoother product.*

Chapter 5
Map Projections

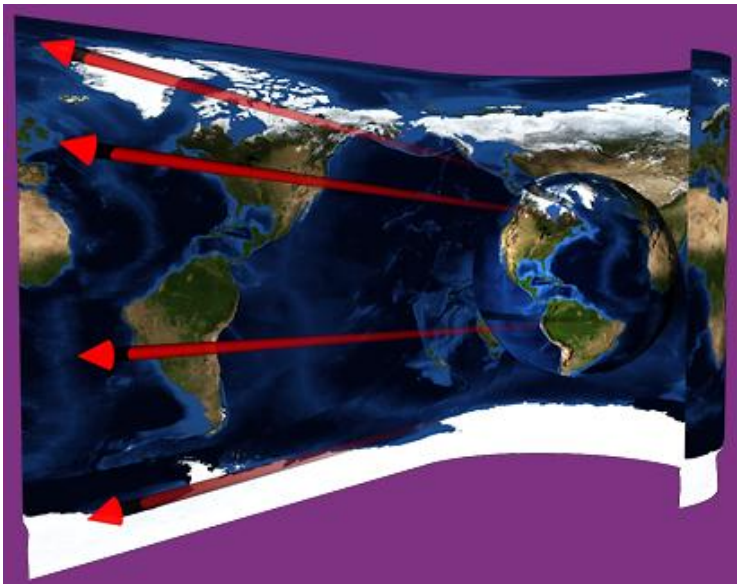
A map is a graphic representation or scale model of the Earth. The globe is a three dimensional spherical scale model of terrestrial bodies, like the Earth. Unfortunately carrying a globe around to convey geographic information is impractical. This has been a dilemma for map makers, or cartographers, for many years, maybe even 8,000 years.

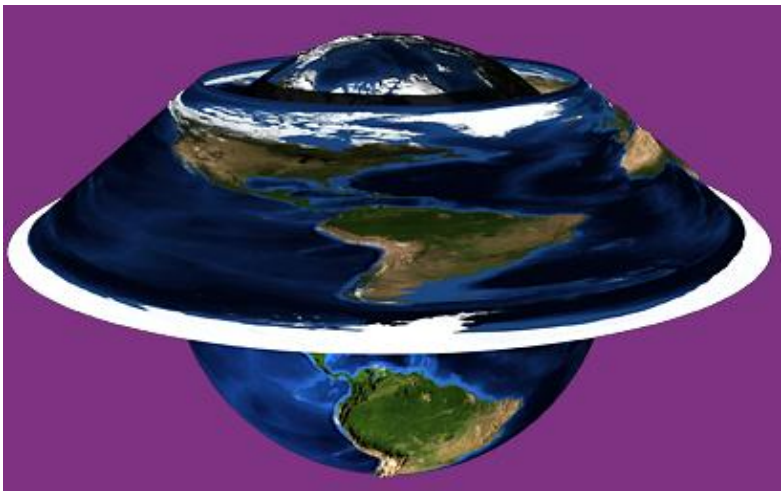
The Fra Mauro map:
Made around 1450 by the Venetian Monk Fra Mauro

Map projection is the attempt to portray the surface of the Earth. Imagine gift wrapping a rubber ball. It takes many folds, cuts, wrinkles to cover the round object with a flat piece of paper. There are three classes of projections: cylindrical, conical and azimuthal.



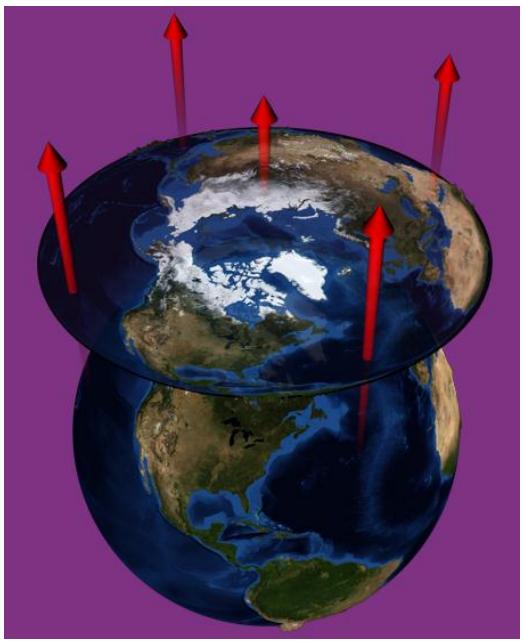
Cylindrical – The most common type of projection. Imagine placing the movie screen around the globe in a cylinder shape. The areas close to the equator have little distortion but as you travel closer to the poles, the more distorted the map gets.



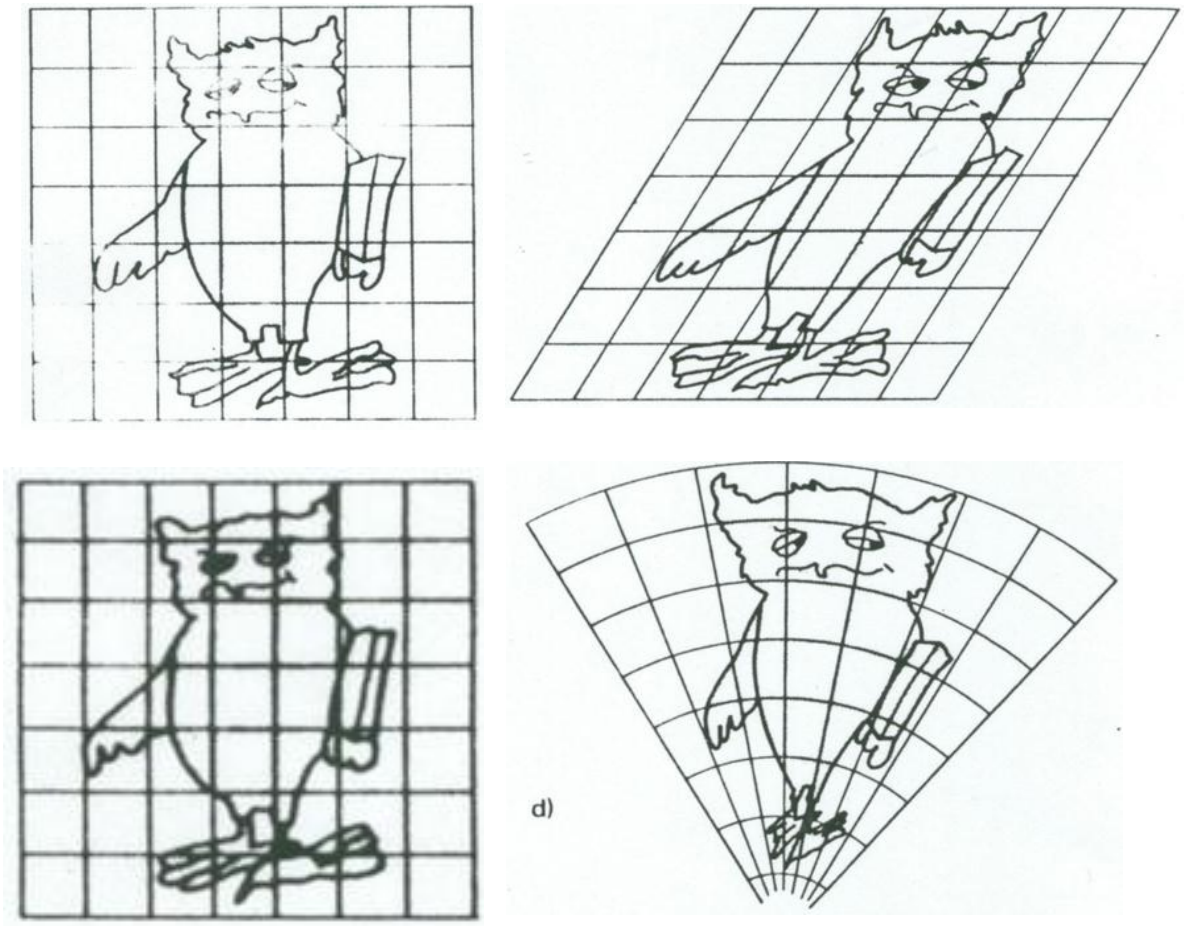


Conic – It is created by placing a cone on a globe. It's more accurate than the cylindrical.

Azimuthal or plane -



Distortions occur with all projections.



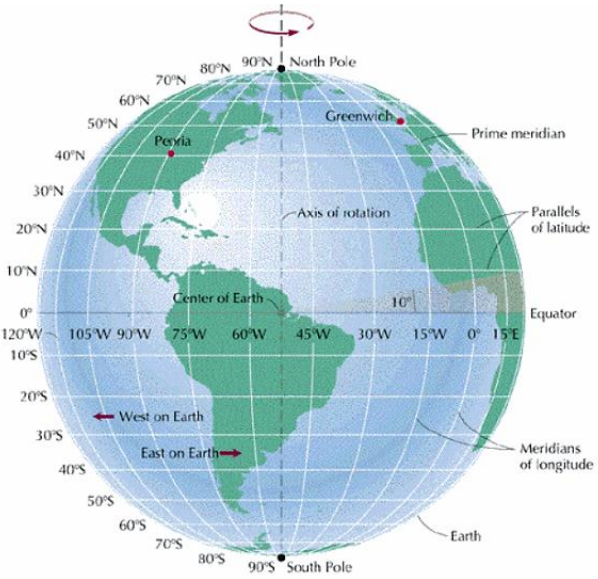
Video on map projections of the earth:

https://www.youtube.com/watch?v=X4wgFSHZXBg

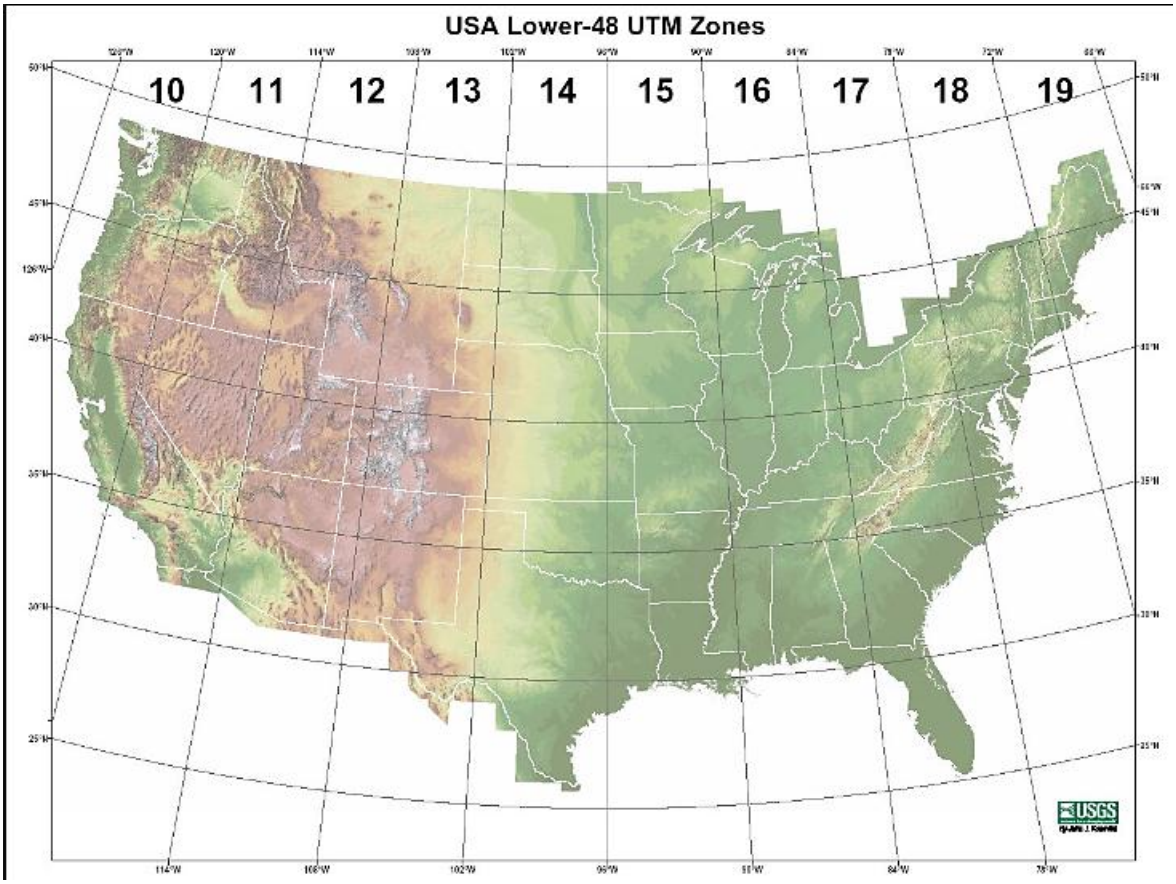
Grid Systems or Coordinate Systems

A grid system allows the location of a point on a map to be described in a way that is meaningful and universally understood. There are several types of grids used to divide the Earth's surface in the United States: Geographic, UTM, State Plane and County.

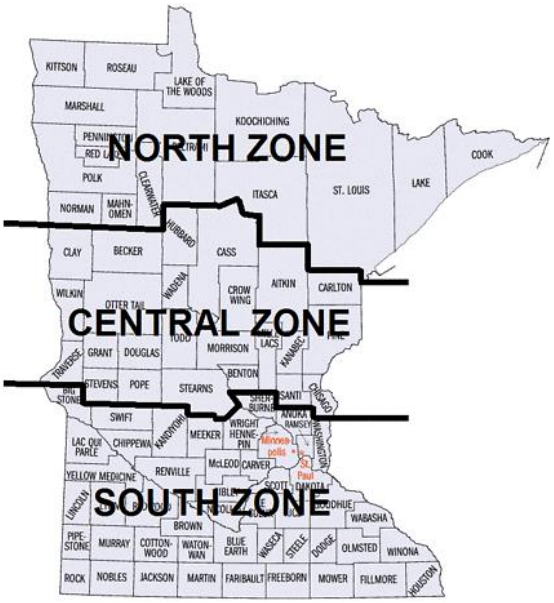
The Geographic Coordinate System uses latitudes and longitudes to describe a location.

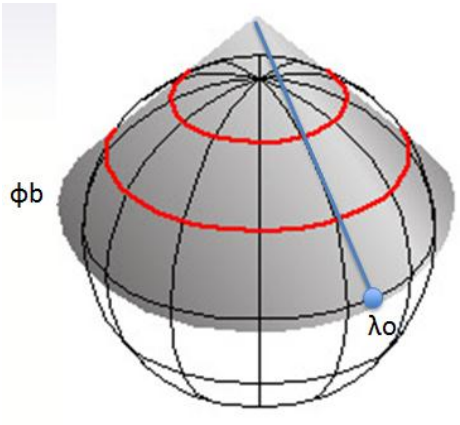


Universal Transverse Mercator Geographic Coordinate System (UTM) divides the Earth into swaths six degrees in longitude wide. The first zone begins at the International Date Line and numbered from west to east. Minnesota falls mostly within zone 15.



The State Plane Coordinate System (SPCS) was developed by the U.S. Coast and Geodetic Survey to provide a common reference system. Each state was divided into zones and assigned a projection with parameters suited to the state's unique shape. Minnesota has three zones, north, central and south and uses the Lambert Conformal Projection.





The County Coordinate System is just that; each county has their own coordinate system.

NAD27 Minnesota Project Coordinate System:

In order to achieve a coordinate system in which map distances closely matched ground distances, the Minnesota Department of Highways developed the Minnesota Project Coordinate System. In it, the State of Minnesota was divided into a grid of rectangles measuring 15 minutes of latitude by one degree of longitude. The name for each zone was XX-YYYY where XX is the line of longitude marking the east edge of the rectangle and YYYY is the line of latitude forming the south edge of the rectangle. For example zone 93-4445 is bounded by 94 degrees longitude to the west, 45 degrees latitude to the north, 93 degrees longitude to the east and 44 degrees, 45 minutes latitude to the south. Parameters consisting of a combined factor, X constant and Y constant were established for each project coordinate system zone that was defined by one of these rectangles. More information about this was written by Robert B. Roscoe, P.E., in a paper titled ***Project Coordinate System--A Ground Coordinate System for Surveyors and Engineers***.

For more information about map projection and parameter for MnDOT:

http://www.dot.state.mn.us/surveying/toolstech/mapproj.html#27MPCS

Datums:

The NGS and NOAA have provided some educational videos that explain datums:

https://www.youtube.com/watch?v=kXTHaMY3cVk

The conversions between Datums (from MnDOT surveying tech sheet)

Converting data between the North American Datum of 1927 and the North American Datum of 1983 is not a simple task, since no direct mathematic relationship exists between them. There are, however, several ways to convert data. The appropriate method for any situation depends mostly on accuracy requirements. If a high degree of accuracy is required, additional information is necessary. For example, the coordinates of some points in a data set from both datums will be needed. In addition, best results can be achieved if surveying measurements between data set points are available.

The most accurate way to convert data from one datum to the other is not always feasible. It is the case where coordinates are known from both datums for one or more control points that are part of the data set and measurements from those control points(s) are available to all the other points in the data set. In this situation, the way to convert the data set to the other datum is by starting with the other datum's coordinates on the control point (s) and recomputing the coordinates of all the other points based on the measurements from the control points. This method will definitely provide data that is sufficiently accurate for engineering or surveying uses.

The next most accurate method is for the case where coordinates are known from both datums for three or more points in a data set, but measurements are not available. In this situation, a transformation algorithm can be used to compute the relationship between the two datums and apply it to the other points in the data set. This method may provide data that is sufficiently accurate for engineering or surveying uses, depending on the geographic extent of the data set being converted and the statistical results of the transformation.

If accuracy is not as important, there are several tools that can be used to convert between datums. The most famous is the National Geodetic Survey's NADCON, which can convert between NAD27 latitude/longitude and NAD83 latitude/longitude. MnDOT's **MnCon** program contains the NADCON functionality. The U.S. Army Corps of Engineers has a similar program called CORPSCON that extends the ability to state plane and Universal Transverse Mercator coordinates. Both of these programs are available from the National Geodetic Survey. ARC/INFO includes the NADCON algorithm in its PROJECT command, which can compute conversions within or between datums.

Appendix A

Metro Plat Computation Standards
Created by David Streitz, 2004

- Create 1 gpk file per job using the number to the right of the dash in the S.P. as the job # (ex. 2776-31 → gpk name would be 031). Store file in *Plats* directory above the individual plat folders.
- Gpk element naming conventions:

	Element name	Feature
Points		
B-Points	DSxxxx	B
TE-Points	DSTExx	TE
Comp Points	DS1	COMP

  - Equate B-Point numbers to existing R/W points created by surveys for visualization purposes but use original survey numbers for the report and comp map.

Curves		
New Curves	DSxx01	PLAT
Curve Segments	DSxxxx-1	PLAT
Chains		
Plat Boundary	DSxxxB,B1,B2,IB,E	PLAT

  - Use original survey element names when they exist
  -

Land Ties	DSxxxLT1	COMP
TE	DSxxxTE1	TE

- Plat Computations Report
  - Use the *insert → file* command to bring all pertanent gpk output files into 1 Word document. These include all inverses, land ties and closures.
  - File name → Plat Comps Report xx-xxx
- Plat Computations Map
  - pdf format
  - See graphical standard
  - File name → Plat Comp Map xx-xxx
  - If comps include curve segments, include a label for the original curve that the segements were created from
- Plat Review File
  - Create 1 pdf file from the following individual files:
    1. Scan of the final redlined plat review
    2. Scan of the plat checklist
    3. Scan or electronic version of the areas checklist
    4. Any important correspondence

- File name → Plat Review xx-xxx

- When plat complete create a *Finals* folder within each plat folder and transfer the following files: comps.pdf, comps.doc, .plt, review.pdf, geopak input files.
- EDMS

Documents	EDMS Doc. Type
Plat Comps Report xx-xxx	PLATBNDY
Plat Comps Map xx-xxx	PLATBNDY
Plat Review xx-xxx	PLATRPT
xx-xxx Breakdown	PLATRPT

  - Section Corner Certs.

N1/4 1-25-43	CERT_LOC
SE 1-25-43	
MC E Line	
WC N1/4 1-25-43	
RM N1/4 1-25-43	

- Gpk plat boundary closures
  - Create boundary parcel → make input file → import to a new gpk named *cls.*

A. Run closure and save parcel for future changes

Appendix B

WMS and Raster Photo Workflow

CAES Office Tech Sheet 7/30/2015

General

In general, it is desirable to attach any raster imagery or WMS services (XWMS) imagery files to an empty DGN file. Then use this DGN file as a reference to other files on a project on an as needed basis. In addition a user may want to create a Geospatial PDF to be retained with the project.

Benefits:

- Uniform imagery across a project.
- Eliminates rework in setting up or modifying the imagery.
- Avoids nested imagery attachments, where multiple copies of the same imagery are loaded on top of each other.
- Avoids inadvertently copying out ProjectWise raster references.
- Easier manipulation of clipping boundaries from reference dialog.
- Lessens the need to assign the coordinate system to each project file.

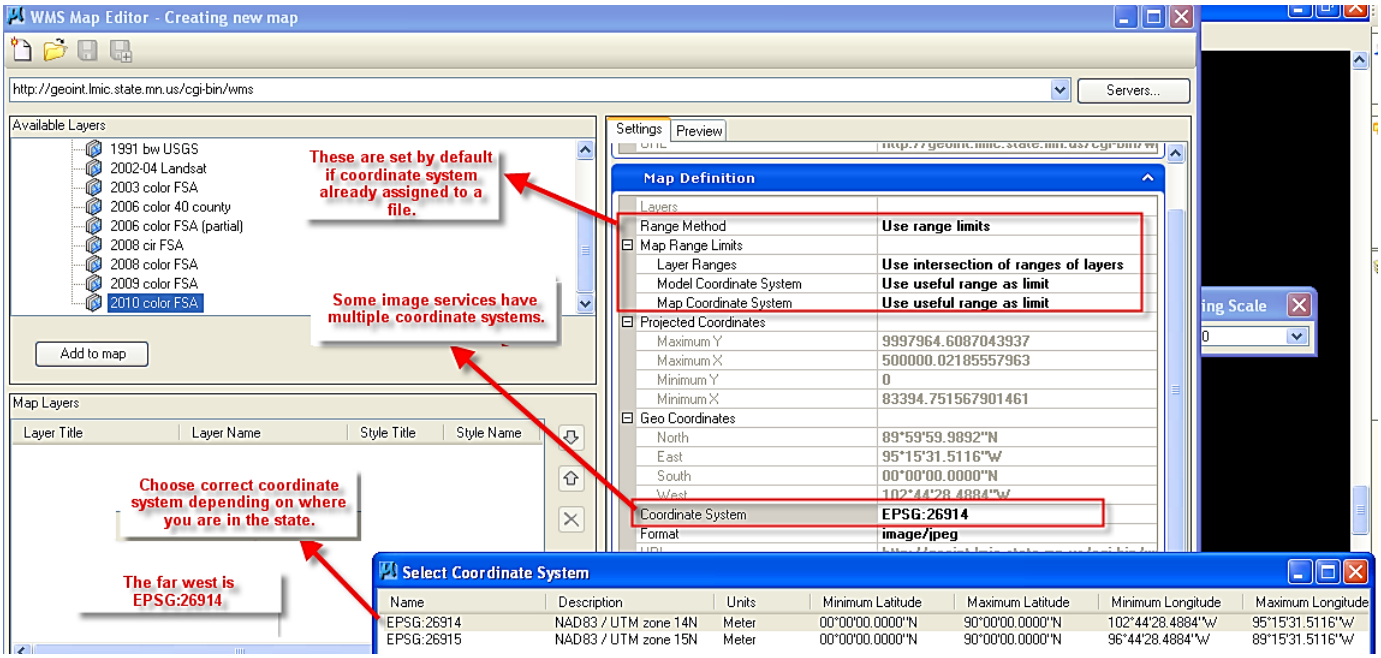
Raster Workflow

1. Copy a 2D seed DGN file.
2. Rename the file according to project information (d340814_raster.dgn).
3. Open the file.
4. In Raster Manager, attach the imagery file/files.
5. Save and exit the file/files.

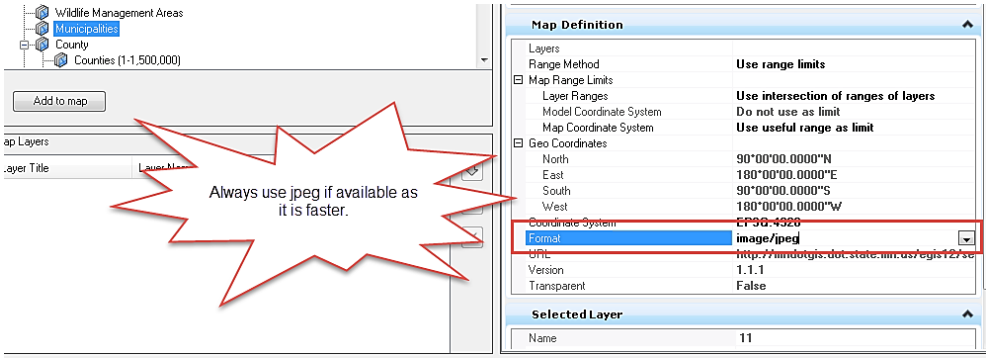
Use this file as a reference to other project files where needed. You will be able to use the reference tools to Clip and Mask the imagery as needed.

WMS Workflow

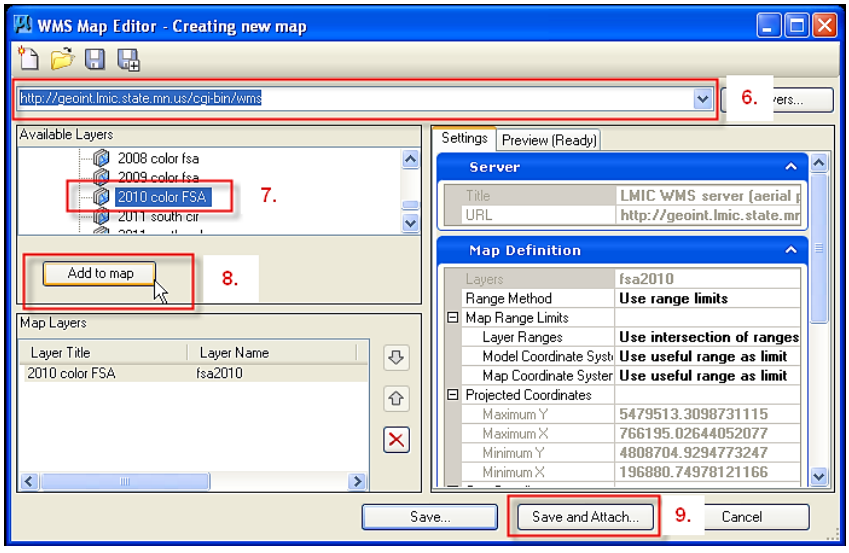
1. Copy a 2D seed DGN file.
2. Rename the file according to project information (d340814_raster.dgn).
3. Open the file.
4. Assign the appropriate county coordinate system to the file. For more information see: MS_AssignCoordinateSystems.doc
5. In Raster Manager, click **File > New > WMS…**
6. Select or add the path to the image service.
7. Select the layer/layers you want to add.
8. Use the appropriate coordinate system for the imagery depending on where you are in the state. The far Western part of the state is EPSG:26914 and the rest of the state is EPSG:26915.



9. Set the image format as **image/jpeg** for the fastest display if available.



10. Click **Add to Map**.
11. Click **Save and Attach…**

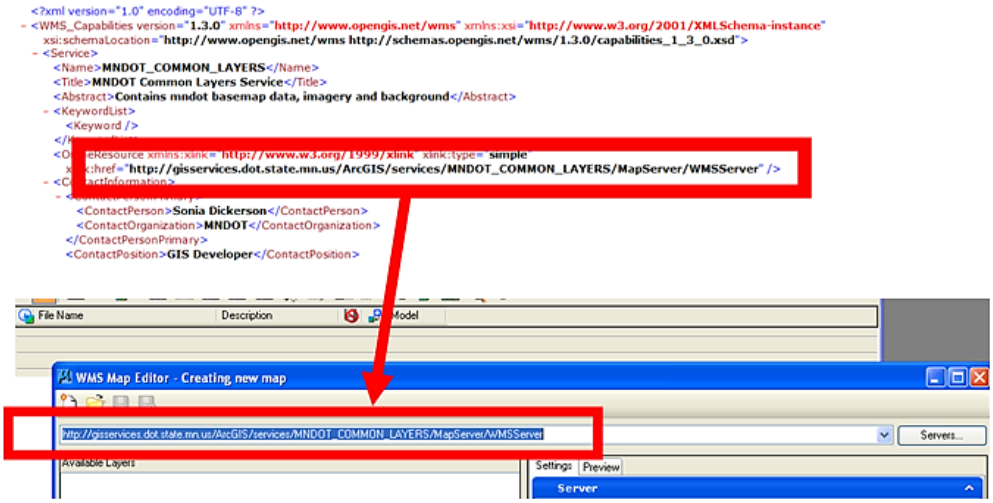


12. Save the file to ProjectWise.
13. Make sure the setting for “Inherit GeoCS from Model” is toggled off. This will reproject the imagery into the county coordinate system.
14. Save and exit the file/files.

Use this file as a reference to other project files where needed. You will be able to use the reference tools to Clip and Mask the imagery as needed.

Additional Services

- Some basic WMS services are preloaded in the Microstation WMS directory
- The address of additional services can typically be found on the web if the information exists.
- Additional WMS services are available here - http://mndotgis.dot.state.mn.us/egis12/rest/services/
- Click on the service you wish to use, and then select “WMS” at the top of the page. Some of these are not in WMS format.
- Copy and paste the website link into the Microstation WMS window



Optional – Create Static PDF Image from WMS service

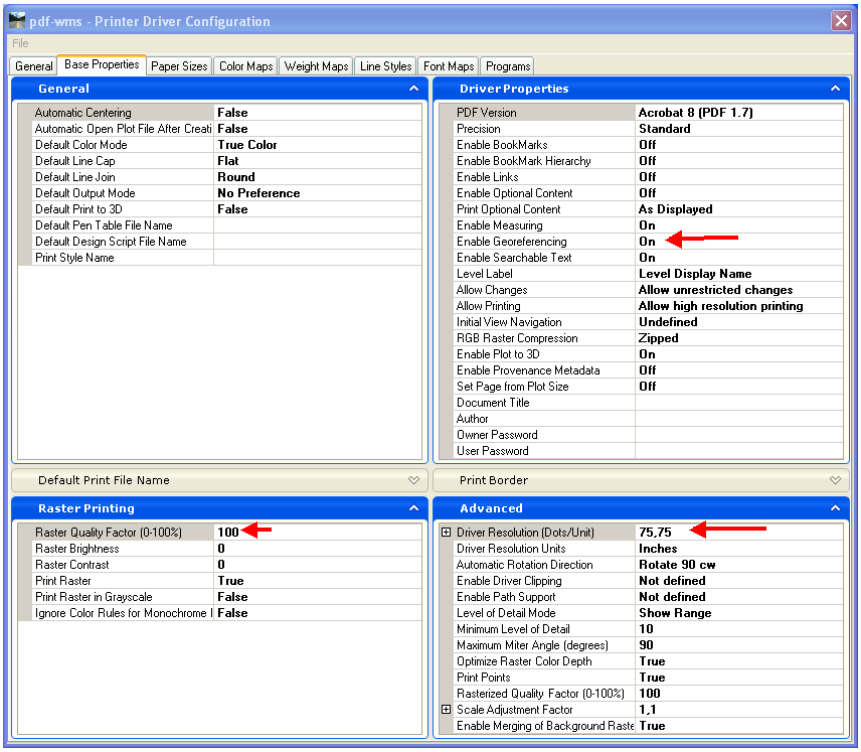
Often times a user may want to create a static image of the WMS to be used as a reference and retain with the project or because of performance issues. With WMS imagery the speed of the raster display depends on a multitude of parameters; network traffic, image quality, service speed, etc... Every time a new print is created the information from the WMS must be pulled down in the creation of the plot.

The following steps are an outline of how to create such imagery in a Geospatial PDF for reference.

A Geospatial PDF is one in which the coordinate system is embedded in the file. One obstacle is that Geospatial PDF files do not work with county coordinates so the coordinate system of the file would have to the same as the WMS service.

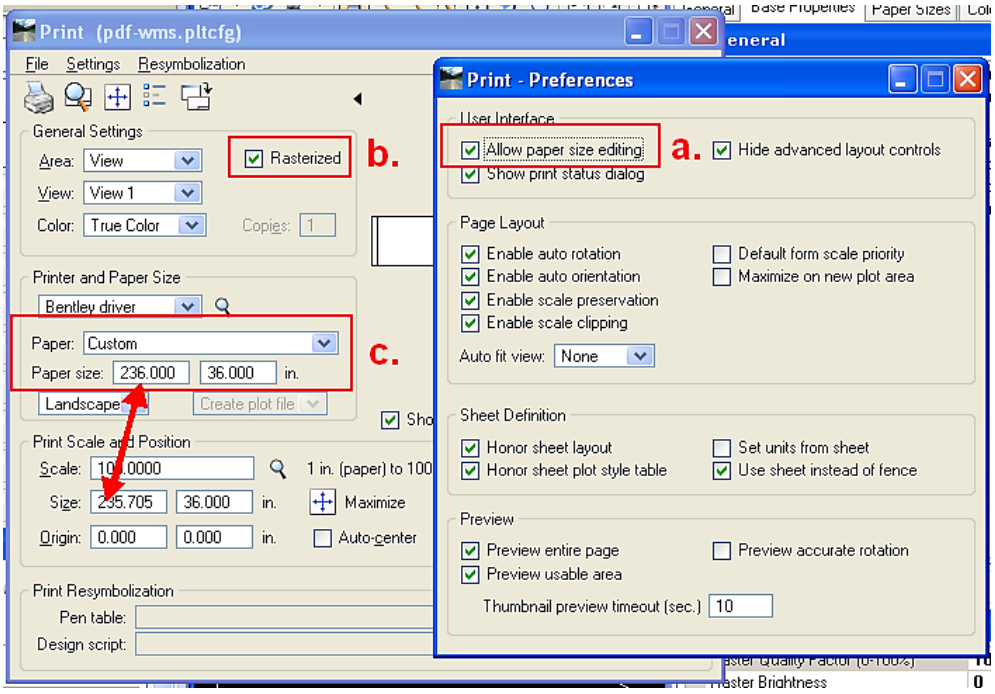
1. Create a dgn file with coordinate system of WMS Service (d340814_raster.dgn).
2. Create/Attach WMS service.
3. Fence area for desired image. Only use an area for the project limits. Do not encompass a entire county.
4. Use MicroStation Print (File> Print) with a pdf.pltcfg driver file that has geospatial enabled. (Example: [pw:\\PW8i.ad.dot.state.mn.us:cadp\Documents\TechSheets\MicroStationTS\pdf-wms.pltcfg](pw:\\PW8i.ad.dot.state.mn.us:cadp\Documents\TechSheets\MicroStationTS\pdf-wms.pltcfg))
    A. File> Select Bentley Driver – Choose the pdf.pltcfg

    Fine tuning of the pltcfg config file would be needed also, such as resolution and dpi depending on the imagery.

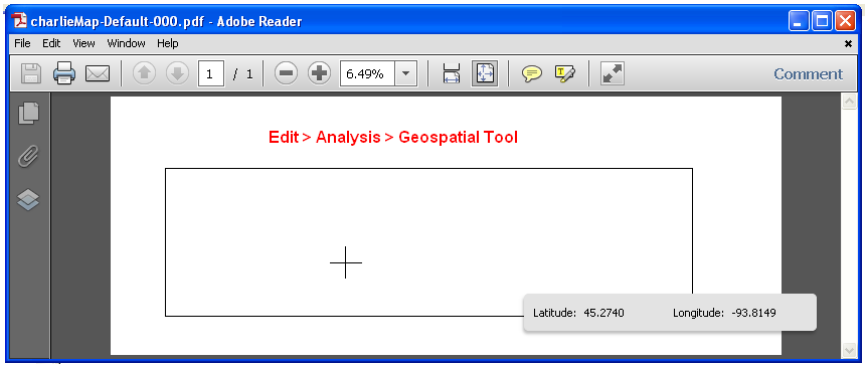


5. Change Settings for print.
    a. Change the MicroStation print **Setting > Preferences** to allow paper size editing if not already enabled.
    b. Set the Print to Rasterized – You will want to Change this back afterwards otherwise it may slow your typical print.
    c. Set the scale and the paper size to eliminate any “White space.”

6. Click Print.



7. Once PDF created, verify that Lat/ Long display by opening the PDF
   A. Use the Edit > Analysis > Geospatial to verify the Lat/Long.
   B. Verify the quality.



8. Attach via raster manager to DGN file.

Note: The time it takes to create the pdf is directly related to the resolution settings of the pdf.pltcfg. Do not set it too high!