

Tutorial:
Locating Elevation Data from USGS
National Map Viewer and Importing
into APCD

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Overview

- This tutorial covers the process for finding and downloading DEM (Digital Elevation Model) data for the United States from the Internet, converting it to a format required by the APCD, and importing it into APCD, resulting in a CRZ file.
- This tutorial does not cover the process of aligning an aerial image of the course over the terrain in the resulting CRZ file.
- Disclaimer: This tutorial is developed from my limited experience finding and importing DEM data into APCD, and is an attempt to consolidate pieces of information gathered from various Links Corner threads and posts into one place for convenience. Corrections or suggested improvements to the process are welcome!
- There are three primary tasks involved:
 - Locate & Download Files from USGS National Map Viewer
 - Use 3DEM Software to Reformat DEM for APCD Import
 - Import the DEM into APCD

Task 1

Locate & Download Files from USGS National Map Viewer

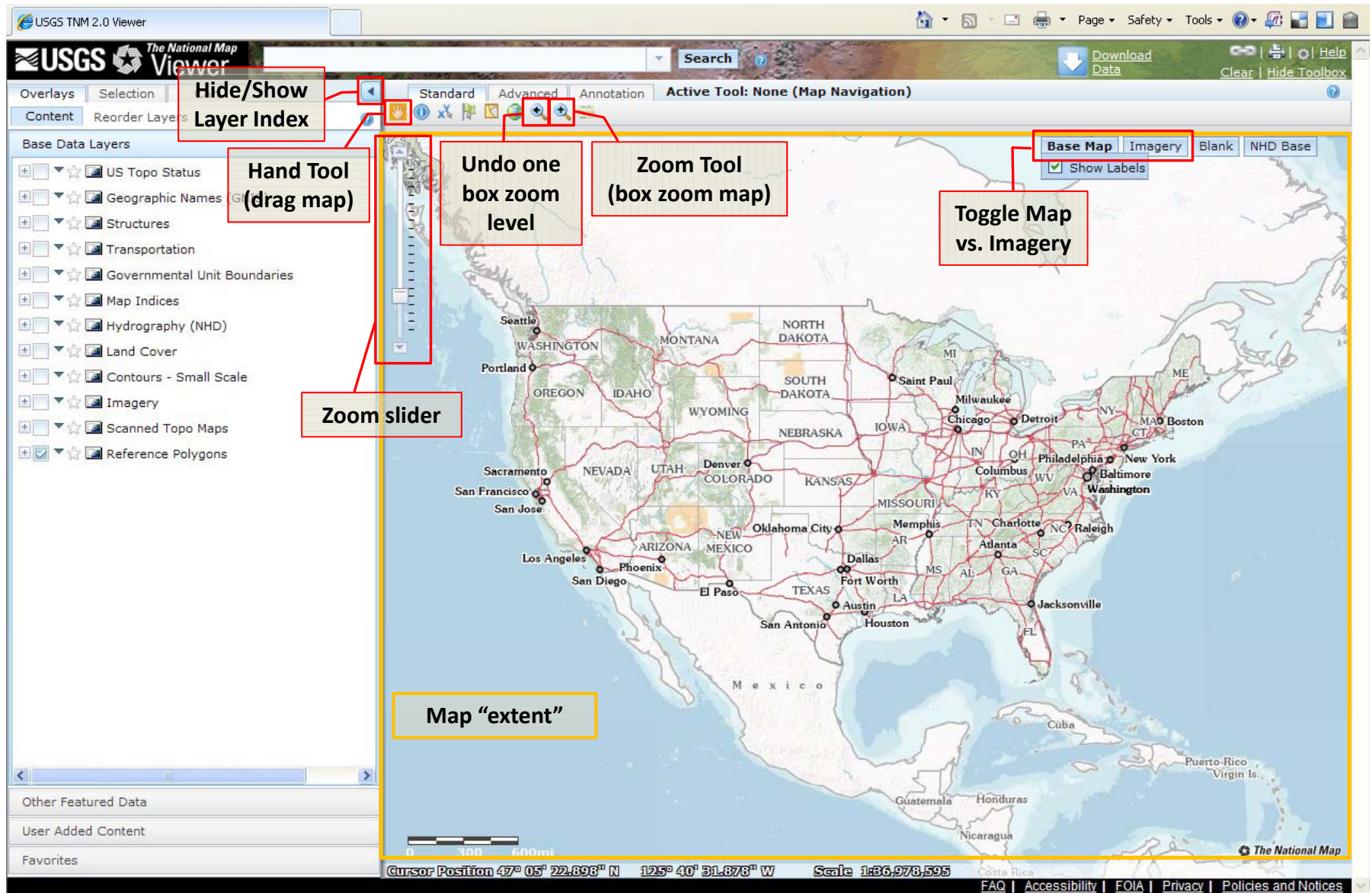
National Map Viewer Links

- The USGS Seamless Server was replaced by the National Map Viewer (NMV) in July 2012.
- The home page for the NMV provides background info about NMV and basic information about the process to download elevation data.
<http://nationalmap.gov/viewer.html>
- The Viewer application, linked from the NMV homepage, is used to identify the desired geographic location for capturing DEM data. This is the primary interface tool you will use to locate and download data.
<http://viewer.nationalmap.gov/viewer/>

Navigating the NMV Viewer

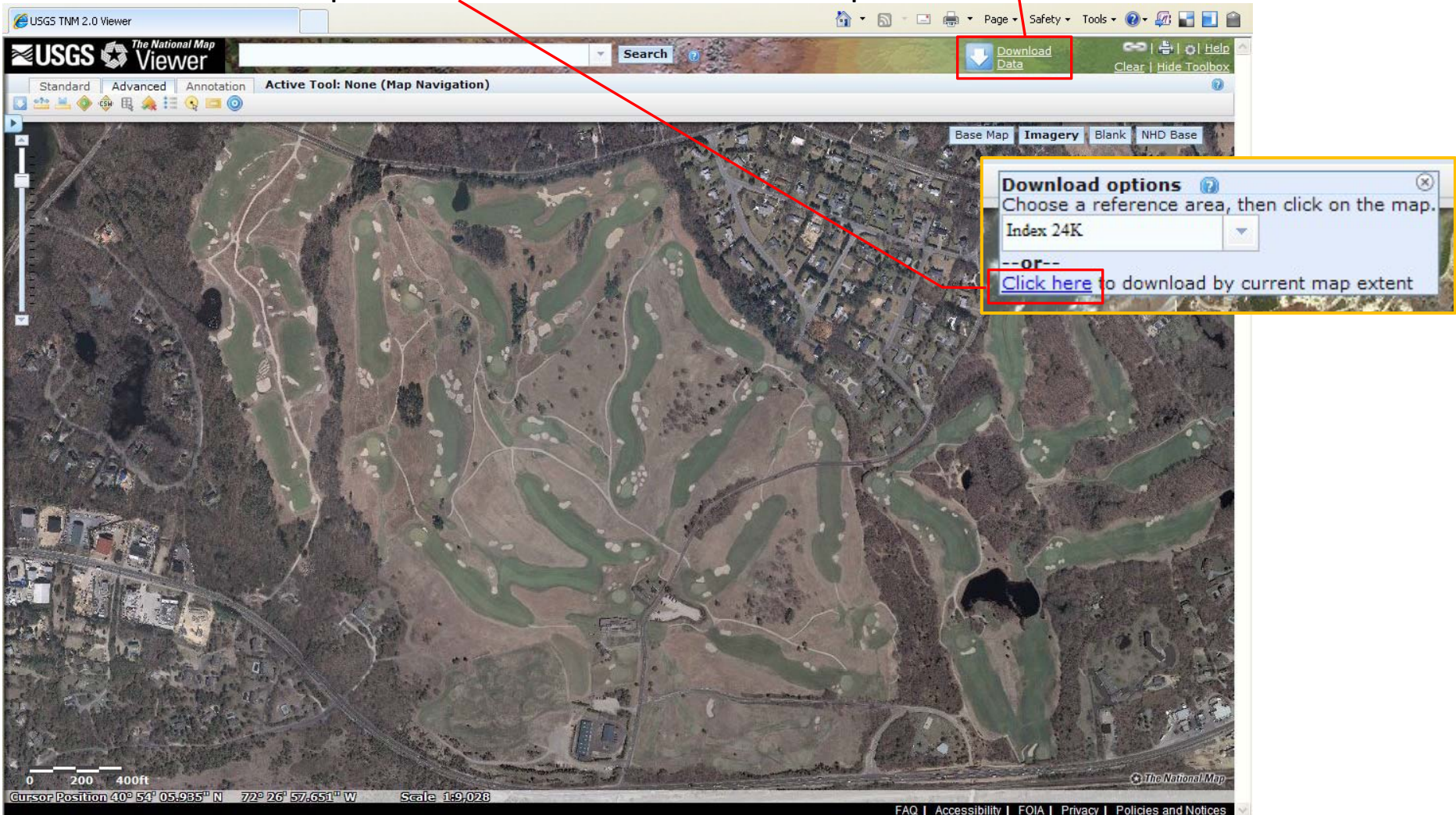
- The simplest option for navigating the map to the desired location is by repeated box zoom with the mouse – use the Box Zoom In tool (magnifying glass icon with “+” sign) in the “Standard” toolbar at the top of the map window. The Zoom tool seems to work better if the Viewer window is maximized on your monitor.
- The map can be dragged/repositioned using the Map Navigation tool (hand icon).
- The displayed area of the map within the window is called the map “extent.” It is recommended to hide the Layer Index box on the left side of the screen to maximize the map extent size.
- Default map view is a road map without aerial imagery, but imagery can be added to the view to assist in finding the golf course area of interest. At the top right of the map window, toggle between “Base Map” and “Imagery” for ease in zooming in to the desired location.
- See next page for illustration of these tool locations.

Viewer Navigation Tools



Select Area for Data Download

1. Center the golf course area comfortably in the map extent window.
2. Click “Download Data” link at top right of window.
3. Click on subsequent link to download current map extent.



Select Basic Data Products

- Another dialog box will appear entitled “USGS Available Data” that lists a menu of the type of data available for the selected area.
- Select “US Topo,” “Elevation,” and “Orthoimagery” by ticking the boxes.
- Select the desired format for each data product from the pulldowns.
 - For US Topo, select GeoPDF
 - For Elevation, select GeoTIFF
 - For Orthoimagery, select GeoTIFF as it should be high resolution and can be imported into PhotoShop or GIMP for conversion to a .tga texture
- Click Next at the bottom of the dialog box.

USGS Available Data

The following themes and products are available in various formats for download in the reference area polygon you selected. Check one or more and click 'Next.' Products will be added to the Cart on the left side of the screen.

Selected item type: **Current Extent**
 Selected item name: **(-72.453, 40.891), (-72.426, 40.902)**

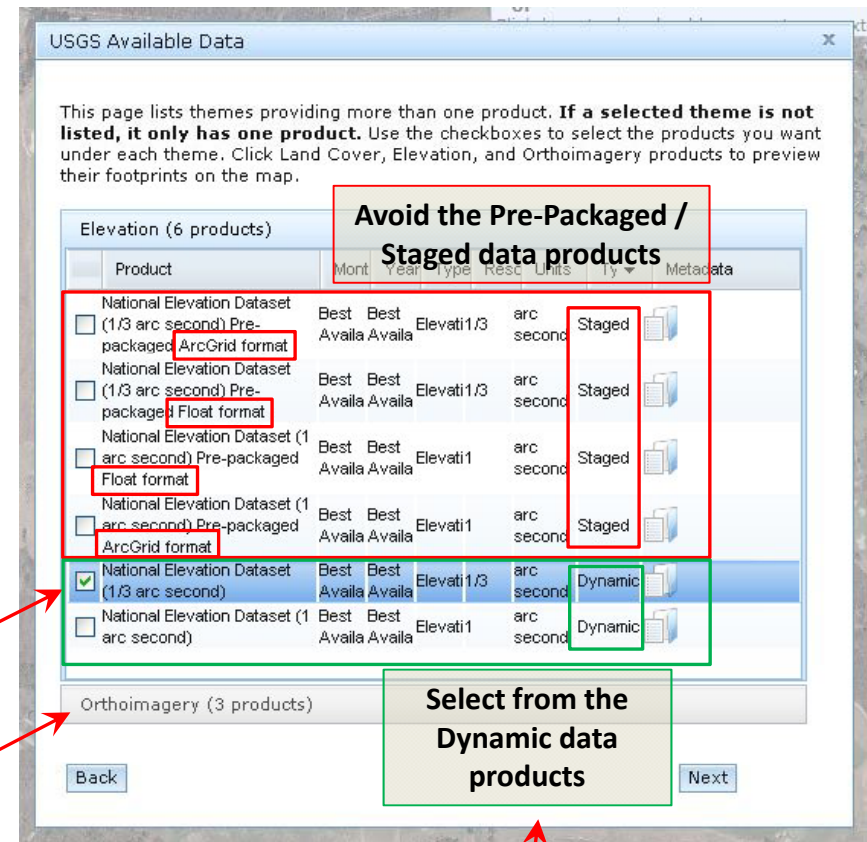
Theme	Format
<input checked="" type="checkbox"/> US Topo	GeoPDF
<input type="checkbox"/> Historical Topo Maps	GeoPDF
<input type="checkbox"/> Structures	File GDB 9.3.1
<input type="checkbox"/> Transportation	File GDB 9.3.1
<input type="checkbox"/> Boundaries	File GDB 9.3.1
<input type="checkbox"/> Geographic Names	Text
<input type="checkbox"/> USGS Map Indices	File GDB 9.2
<input type="checkbox"/> Hydrography	File GDB 9.3.1
<input type="checkbox"/> Land Cover	GeoTIFF
<input checked="" type="checkbox"/> Elevation	GeoTIFF
<input checked="" type="checkbox"/> Orthoimagery	GeoTIFF

If a checkbox is disabled, the area you selected is too large.
 Click theme names to see theme descriptions.

Next

Select from Elevation Products

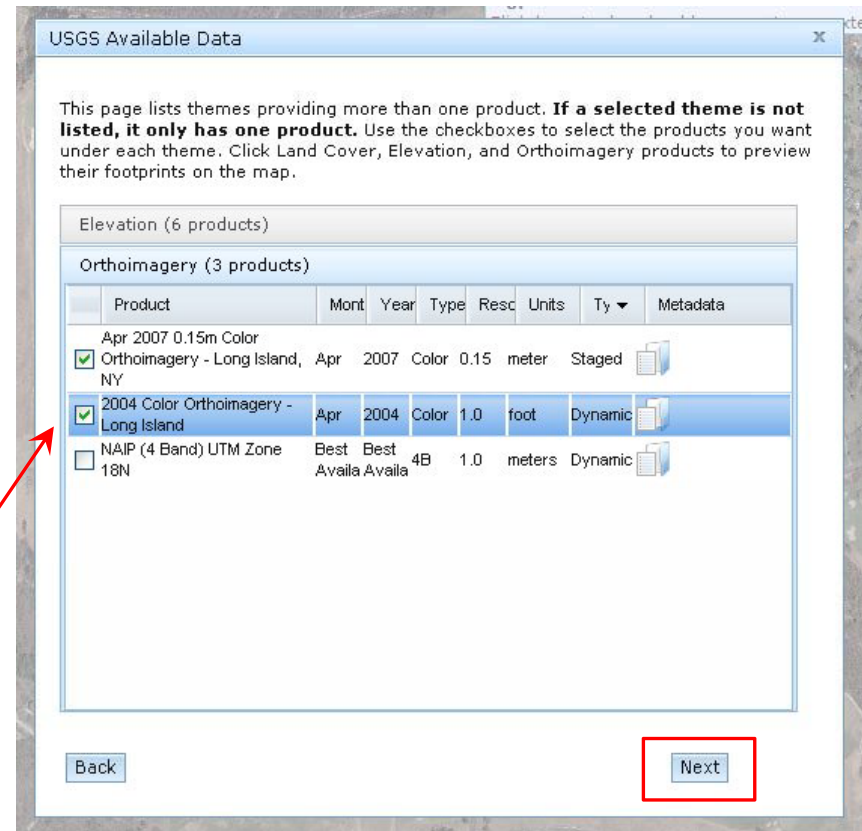
- National Elevation Dataset (NED) - different areas of the United States have different NED resolutions available, listed below from coarse to fine:
 - 1 arc-second: ~30 meter resolution (1 vert every 30m) – very coarse, will require much manual elevation work
 - 1/3 arc-second: ~10 meter resolution (1 vert every 10m) – decent but will still require manual elevation of smaller features
 - 1/9 arc-second: ~3 meter resolution (1 vert every 3m) – high resolution; small features will be visible, but high vert count may need to be simplified in places to make it easier to use in APCD, and total vert count could exceed standard APCD import limit (more on that later)
- Tick the box next to the desired product(s) – you may wish to download multiple resolutions and experiment.
- Then click on the Orthoimagery bar.



Upon closer inspection, you will notice that there are multiple format options for each resolution. It is recommended to select the "Dynamic" type data which will be customized to the map extent you selected. It is not recommended to select the ArcGrid and Float formats which are "Staged" type data, which means you would receive a much larger pre-packaged data file of which the map extent you selected would be a very small part; you would end up with much more data than you need or could likely import into APCD.

Select from Orthoimagery Products

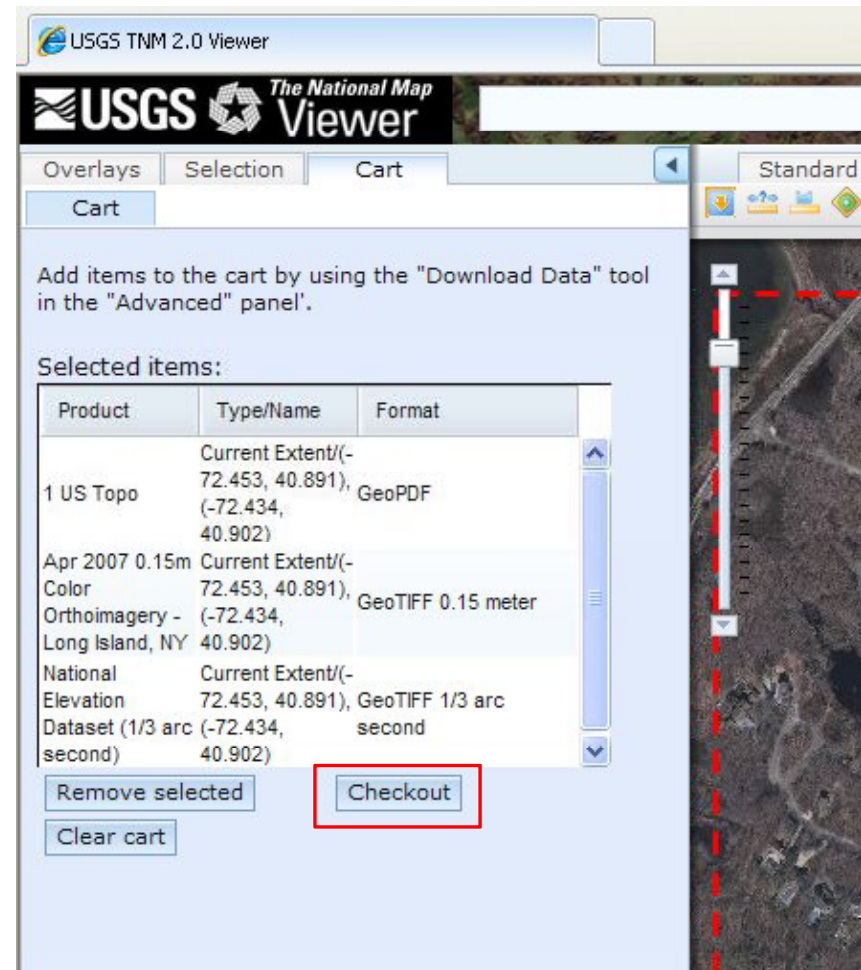
- An orthoimage is one that has been corrected so that it has a uniform scale like a map; in other words, it is an image that looks straight down on the surface of the Earth (no error due to lens distortion, camera tilt, etc).
- You will need orthoimagery to provide the aerial image to overlay as a texture within APCD. You should be looking for the highest resolution imagery available (generally look for the smallest distance quoted like 0.15m or 1.0ft) but also pay attention to date and color options of the imagery. You may wish to select a few different options for later inspection; you can keep the best and discard the others.
- Tick the box(es) of the imagery you want
- Click Next



It is possible/likely that the orthoimagery products will be very large in size (>300MB), and the selected map extent may span across multiple “chunks” of orthoimagery that you will need to edit & stitch in PhotoShop or GIMP.

Confirming Products for Checkout

- NMV will add the selected / available products to your cart for checkout.
- Note that the US Topo product will be added to the cart by default if you selected it earlier.
 - The US Topo GeoPDF contains various layers of information, including orthoimagery and contour line data which may be helpful to align the mesh and orthoimagery. The orthoimagery within the GeoPDF may not be sufficient resolution for APCD work, so it is recommended to download the separate orthoimagery products.
- Review the cart contents and click Checkout

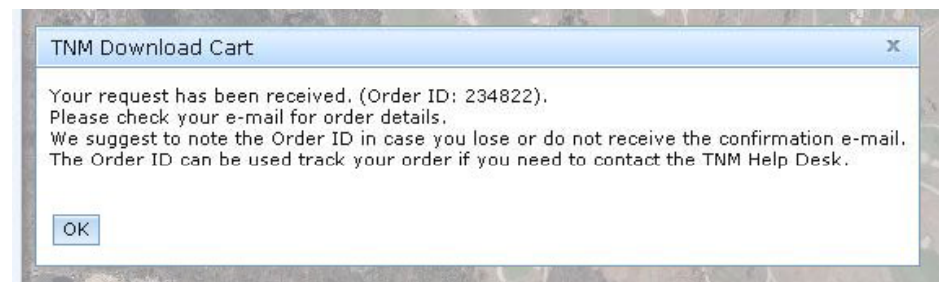


Enter Email Address

- You will be prompted to enter an email address; download links for the data products will be provided via email.
- Enter an email address (twice), and click “Place Order”
- NMV will confirm the order. Check your email!

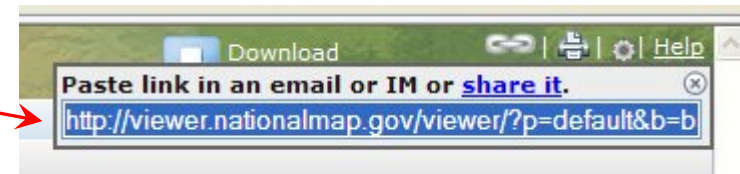
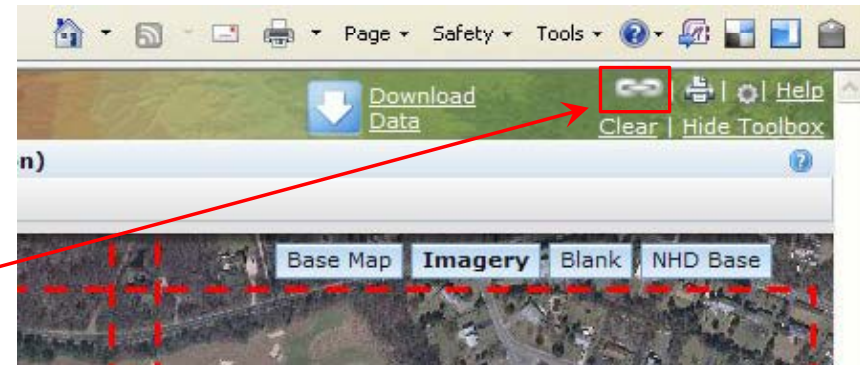


The screenshot shows the 'USGS TNM 2.0 Viewer' interface. The 'Cart' tab is selected, displaying a form for entering an email address. The form includes a text box for 'E-mail address:' and another for 'Re-enter e-mail address:'. A red box highlights the 'Place Order' button at the bottom right. Two red arrows point from the text 'Enter an email address (twice)' in the list to the two email input fields.



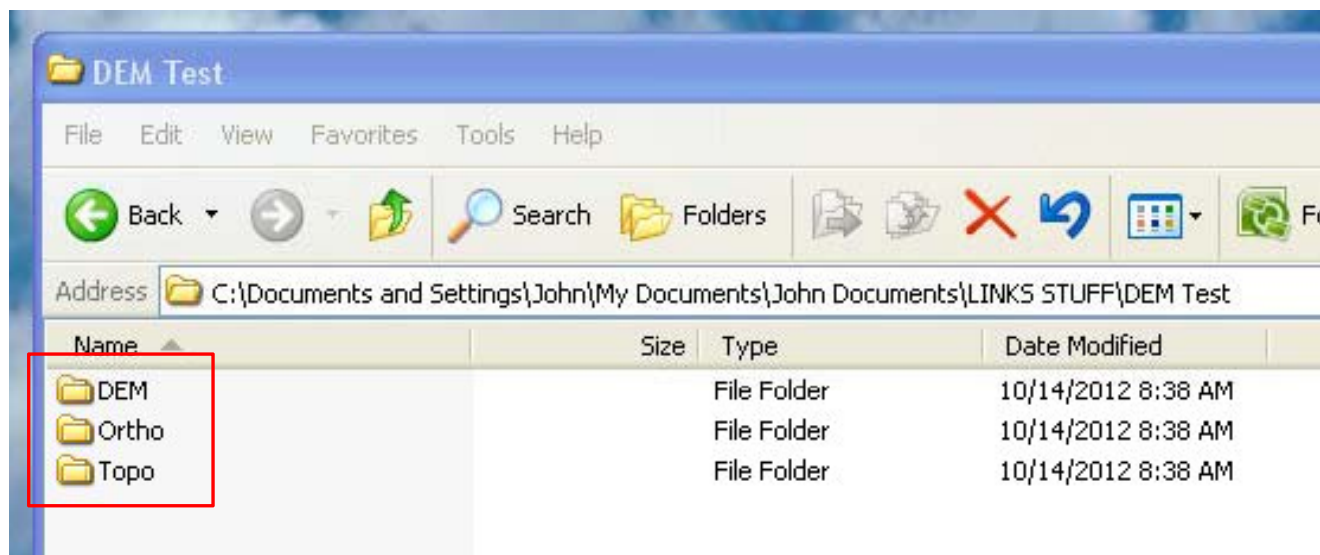
Save NMV Location Link for Reference

- It is recommended to save the NMV link location of the map extent for future reference. If you forgot to select a dataset, or got an error and need to try again later, you can easily return to the same location/extent in the National Map Viewer.
- Click on the Link icon (image of a chain link) at the very upper right of the viewer window.
- You can copy and paste the URL into a simple text file and save it, or paste it into an email and send it to yourself.
- You can now close the NMV web browser windows.



Preparing for Download

- Before downloading the files from the email links, I recommend setting up named folders where you can save the separate products. The download zip filenames will be alphabet soup, so it may be easier to have them in separate folders to keep them straight.
- I recommend something simple like “DEM”, “Ortho”, and “Topo” where you can save the files and then extract them using WinZip or an equivalent unzip program.



Downloading the Data Products

- Open the email and click the embedded links to download (“Save”) the products to the desired folder(s).
- The US Topo and Orthoimagery products should download directly
 - As previously mentioned, the Orthoimagery products will likely be large and in multiple chunks that you may need to edit & stitch in PhotoShop or GIMP
- The Elevation data will open a web browser and provide an additional link to click, and then show status as it processes the download (adding to queue, extracting), and then provides a final download link.
- Unzip the files

From: The National Map Viewer [tnm_help@usgs.gov] Sent: Sat
To:
Cc:
Subject: The National Map Viewer Order 234822 (Do Not Reply)

USGS The National Map

Thank you for your recent data order placed with The National Map Viewer. Below are the details of your order with specific instructions.

Order ID: 234822

US Topo - Below are the links to download the data you requested.

Product	Extracted by	Format	Download Link
Southampton, New York	Current Extent/(-72.453, 40.891), (-72.434, 40.902)	GeoPDF	Click here to download

Elevation - Below are the links to download the data you requested. Due to the size of raster data, your request may have been broken into chunks. The chunks are listed below, and in the near future, this message will include a map to locate the chunks.

Product	Extracted by	Format	Download Link
National Elevation Dataset (1/3 arc second) Chunk 1/1	Current Extent/(-72.453, 40.891), (-72.434, 40.902)	GeoTIFF	Click here to download

Orthoimagery - Below are the links to download the data you requested. Due to the size of raster data, your request may have been broken into chunks. The chunks are listed below, and in the near future, this message will include a map to locate the chunks.

Product	Extracted by	Format	Download Link
Apr 2007 0.15m Color Orthoimagery - Long Island, NY Chunk 1/4	Current Extent/(-72.453, 40.891), (-72.434, 40.902)	GeoTIFF	Click here to download
Apr 2007 0.15m Color Orthoimagery - Long Island, NY Chunk 2/4	Current Extent/(-72.453, 40.891), (-72.434, 40.902)	GeoTIFF	Click here to download
Apr 2007 0.15m Color Orthoimagery - Long Island, NY Chunk 3/4	Current Extent/(-72.453, 40.891), (-72.434, 40.902)	GeoTIFF	Click here to download
Apr 2007 0.15m Color Orthoimagery - Long Island, NY Chunk 4/4	Current Extent/(-72.453, 40.891), (-72.434, 40.902)	GeoTIFF	Click here to download

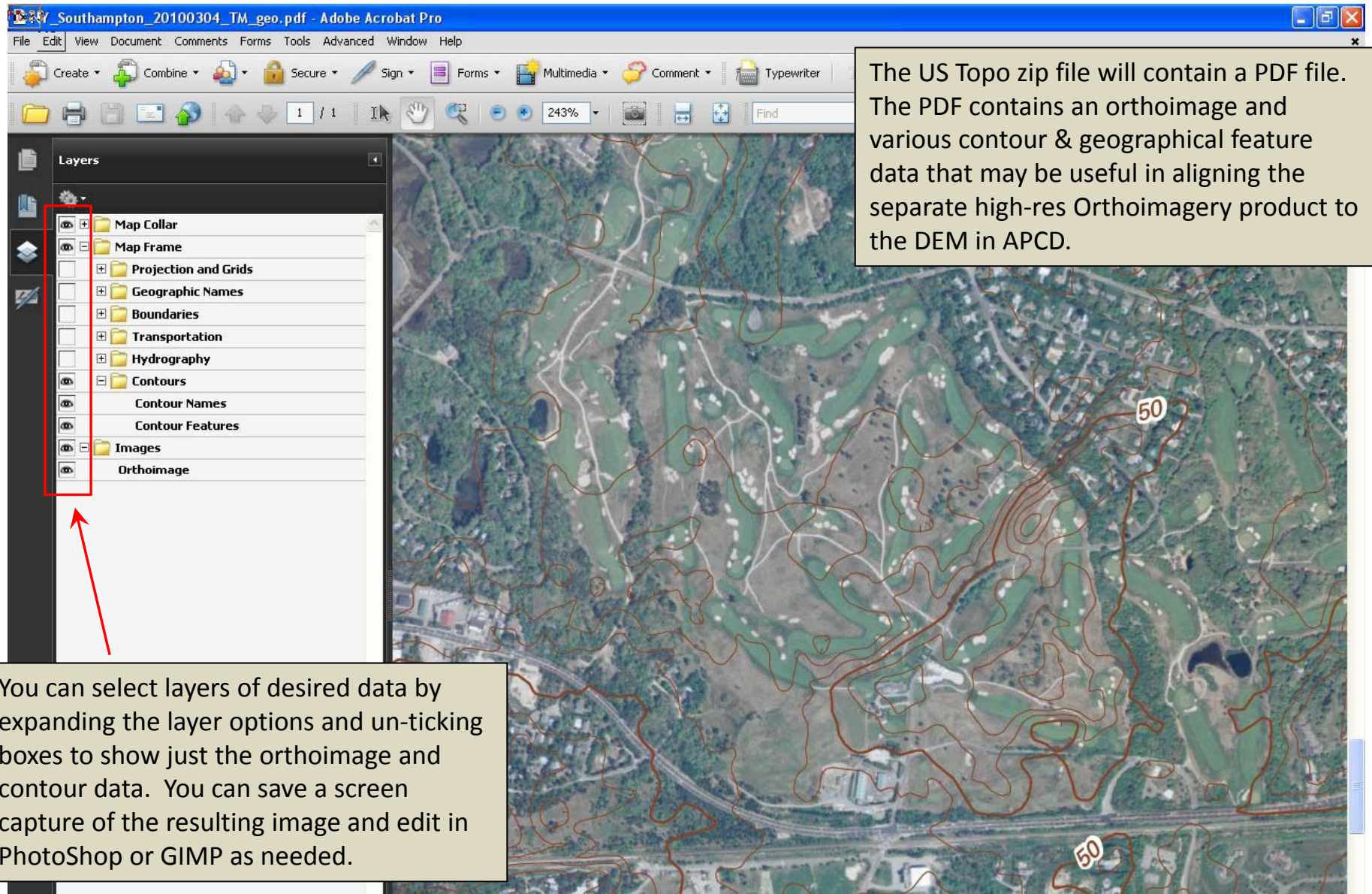
The National Map Viewer

The data extraction has completed.

If an error occurs during download, click [here](#) to retrieve the download bundle.

After one hour, the download bundle will be automatically deleted from our server.

Zip File Contents – US Topo



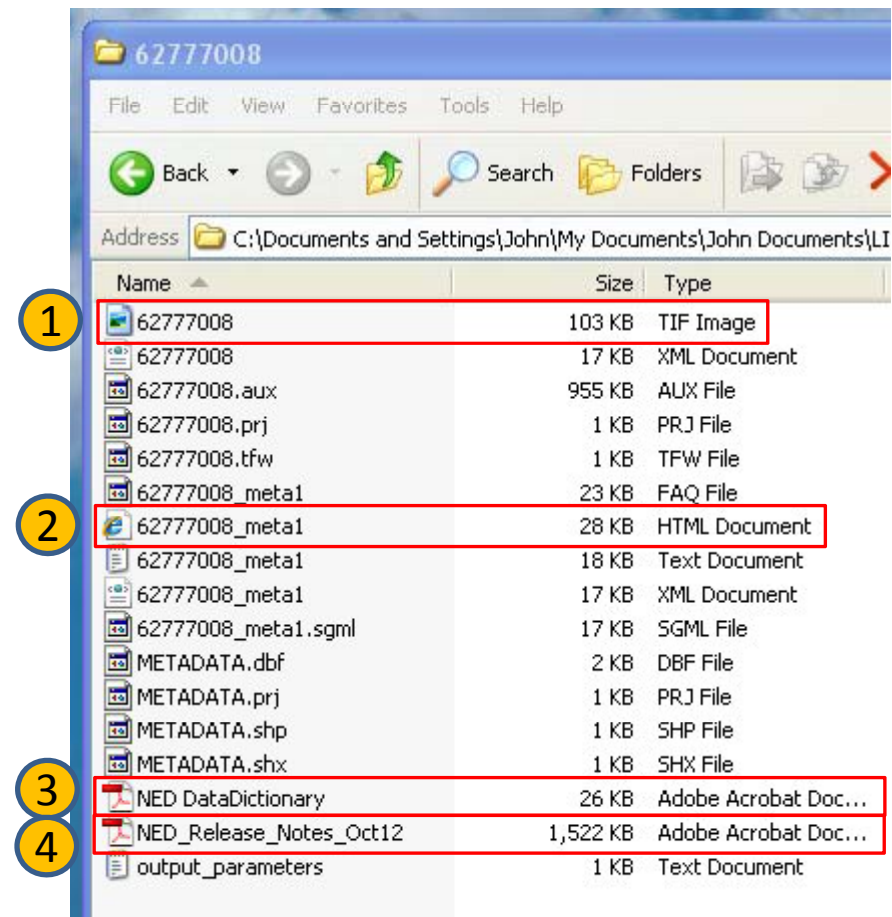
The screenshot shows the Adobe Acrobat Pro interface with a PDF file titled "Southampton_20100304_TM_geo.pdf". The Layers panel on the left lists several layers, including "Map Collar", "Map Frame", "Projection and Grids", "Geographic Names", "Boundaries", "Transportation", "Hydrography", "Contours", "Contour Names", "Contour Features", "Images", and "Orthoimage". A red box highlights the "Contours" and "Orthoimage" layers, and a red arrow points to the "Orthoimage" layer. The main content area displays a map of Southamptton with contour lines and an orthoimage. A text box in the top right corner explains that the US Topo zip file contains a PDF file with an orthoimage and contour & geographical feature data. A text box in the bottom left corner explains that users can select layers of desired data by expanding the layer options and un-ticking boxes to show just the orthoimage and contour data, and that they can save a screen capture of the resulting image and edit it in PhotoShop or GIMP as needed.

The US Topo zip file will contain a PDF file. The PDF contains an orthoimage and various contour & geographical feature data that may be useful in aligning the separate high-res Orthoimagery product to the DEM in APCD.

You can select layers of desired data by expanding the layer options and un-ticking boxes to show just the orthoimage and contour data. You can save a screen capture of the resulting image and edit in PhotoShop or GIMP as needed.

Zip File Contents – Elevation Data

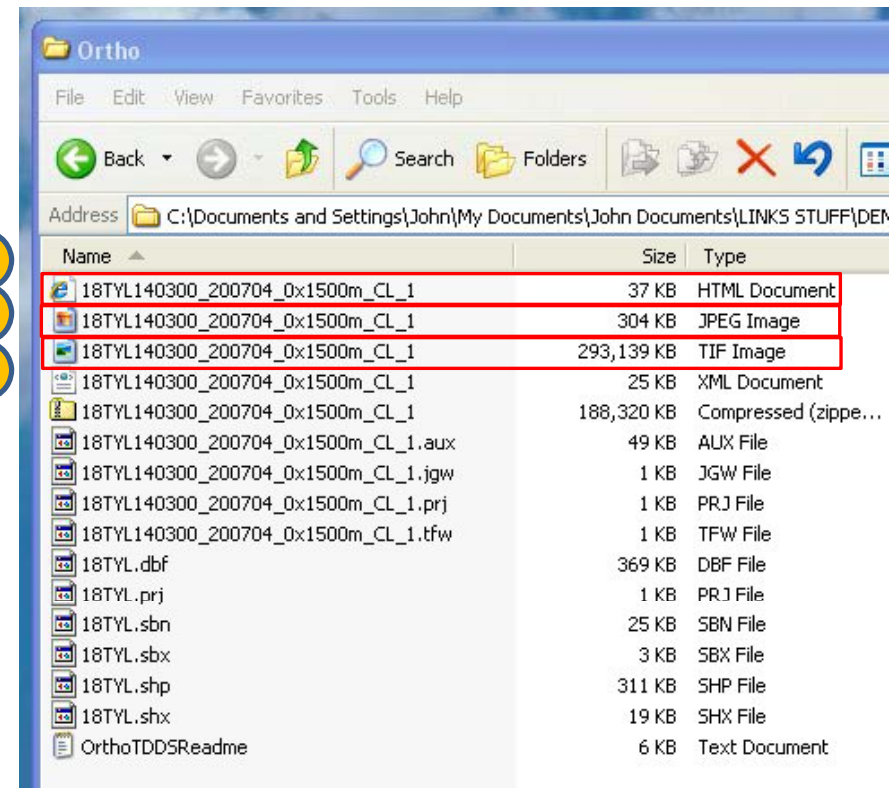
- The Elevation zip file contains multiple files, although we really just need one:
1. TIF = GeoTIFF file that contains the elevation data. This will be used in the next Task.
-
- Other files that may be of minor interest:
2. A Metadata file that lists details about this specific set of elevation data. Double-click to open in a web browser.
 3. Glossary that explains the information in the Metadata file.
 4. NED Release Notes – some interesting background on the current status of National Elevation Data



Zip File Contents – Orthoimagery

- The Orthoimagery file contains multiple files, but we need just two:
 - The high-res GeoTIFF image that will likely be the best source for the aerial image texture. This can be opened in PhotoShop or GIMP.
 - The Metadata file will list the projection method used for the orthoimage. We can use this information in the next Task (see box below for more info).
- You will note that the package also contains a JPEG image, but it is significantly compressed (lower-res) compared to the GeoTIFF and will probably be insufficient for APCD purposes:
- A lower-res JPEG orthoimage file

2
3
1



The Metadata file contains projection method information. Double-click on the .html file to open in a web browser and search for "Horizontal_Datum_Name". Make a note of the date; in this example, 1983. This info can be used in Task 2.

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983
 Ellipsoid_Name: Geodetic Reference System 80
 Semi-major_Axis: 6378137.000000
 Denominator_of_Flattening_Ratio: 298.257222

Task 2

Use 3DEM Software to Reformat DEM for APCD Import

3DEM overview

- 3DEM is a free utility that works great to take the DEM data and reformat it for APCD import. It is available for download here:

<http://freegeographytools.com/2009/3dem-website-is-gone-but-3dem-still-available-here>

- Note: the 3DEM download link is below the topographic map image

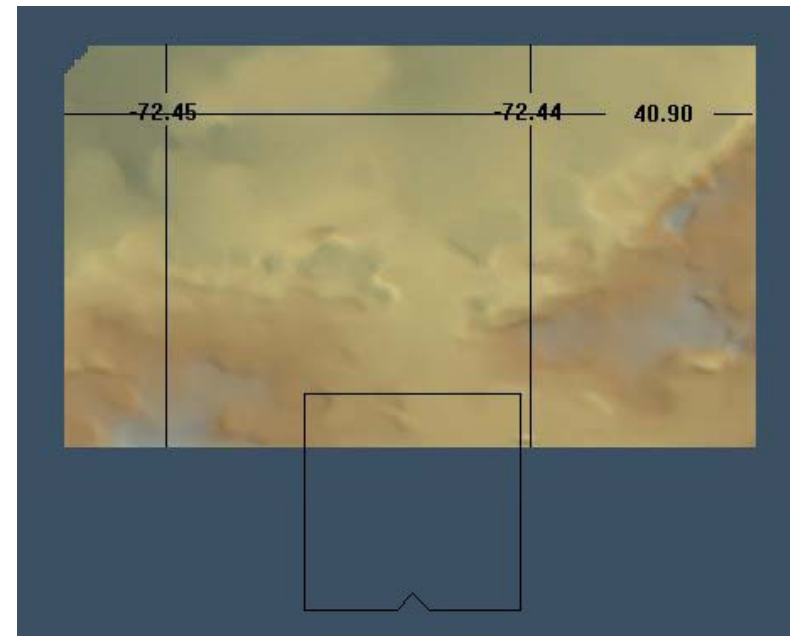
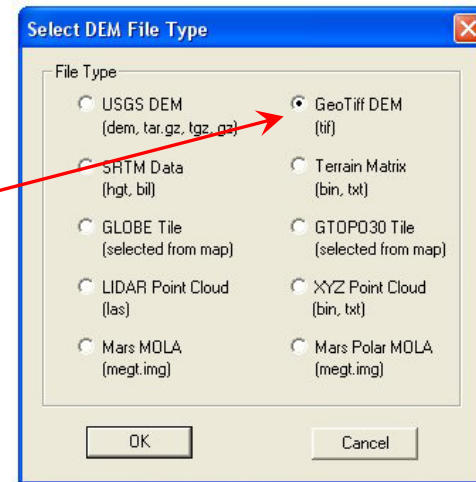


Unfortunately, the author, Richard Horne
he's graciously given me permission to l
[download it here.](#) It comes with a full PD
help if you run into problems, but any bu

- It is not the prominent “Start Download” link near the top of the webpage!
- Install 3DEM, run it, and proceed to the next steps

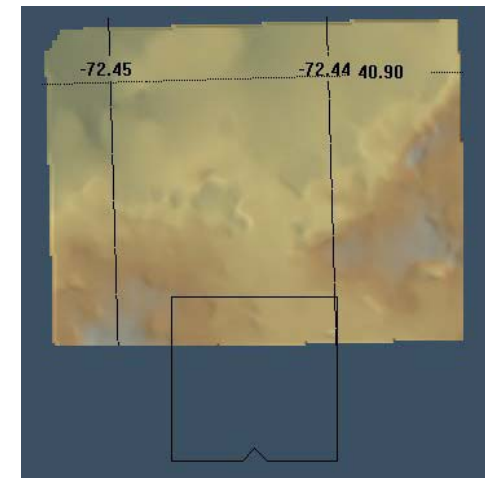
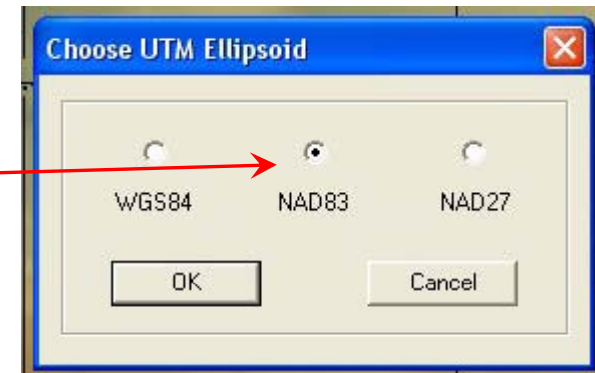
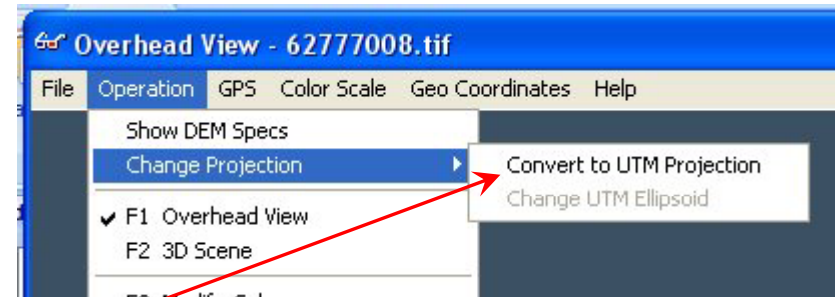
Import the DEM Data into 3DEM

- 3DEM will automatically prompt: “Select DEM File Type”
- Click GeoTIFF DEM and click OK.
- Browse to the unzipped DEM folder and select the GeoTIFF DEM file and click Open. The DEM should be displayed in a color contour image.



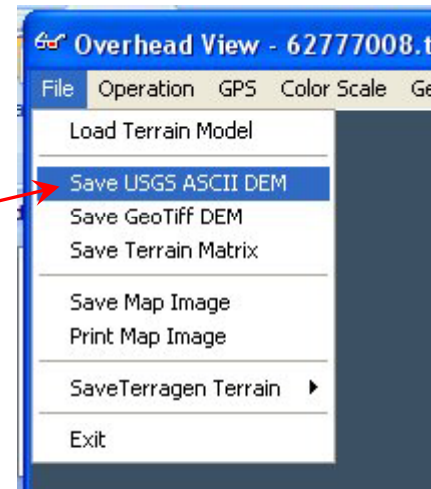
Convert the DEM to Proper UTM Projection

- The DEM must be converted to one of two Projection formats: NAD27 or NAD83.
 - NAD = North American Datum, either 1927 or 1983, which are slightly different methods to account for the fact that the Earth is not a perfect sphere or ellipsoid
- In 3DEM, click “Operation” then “Change Projection” and “Convert to UTM Projection”
- Select either NAD83 or NAD27 in the subsequent popup box and click OK.
 - Use the method matching the Metadata datum description of the orthoimagery found in the last Task
 - If the NAD method is unknown, it is most likely NAD83.
 - I’m not even sure if the method really matters for APCD purposes.
- 3DEM will recalculate the DEM and update the contour image.



Save the DEM in USGS ASCII Format

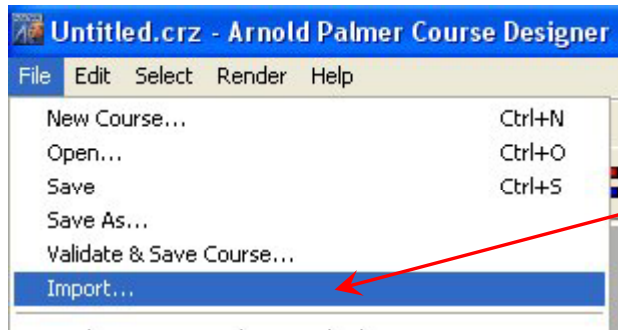
- Once the projection has been changed, save the DEM in the proper format for APCD.
- Click “File” then “Save USGS ASCII DEM”
- Browse to a desired folder, type desired filename, and click Save.
- Exit 3DEM



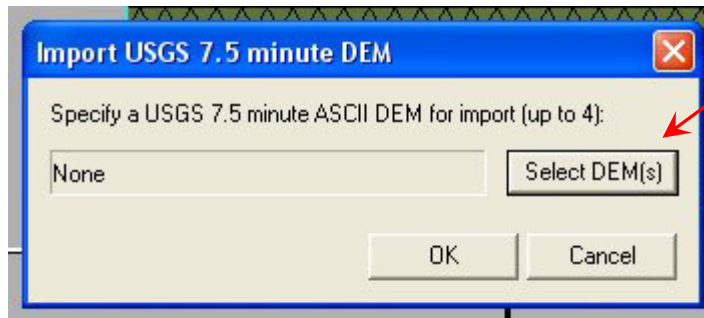
Task 3

Import the DEM into APCD

Open the DEM in APCD

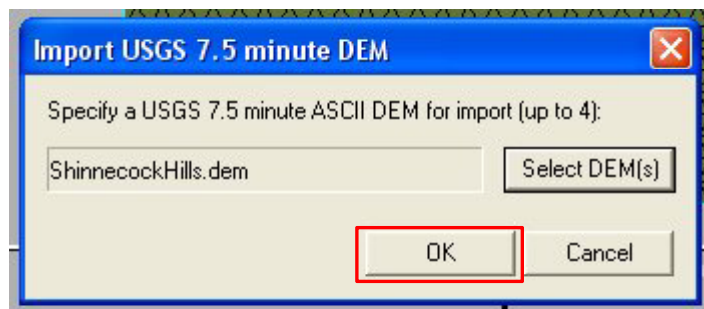


- Open APCD, and click File, then Import...



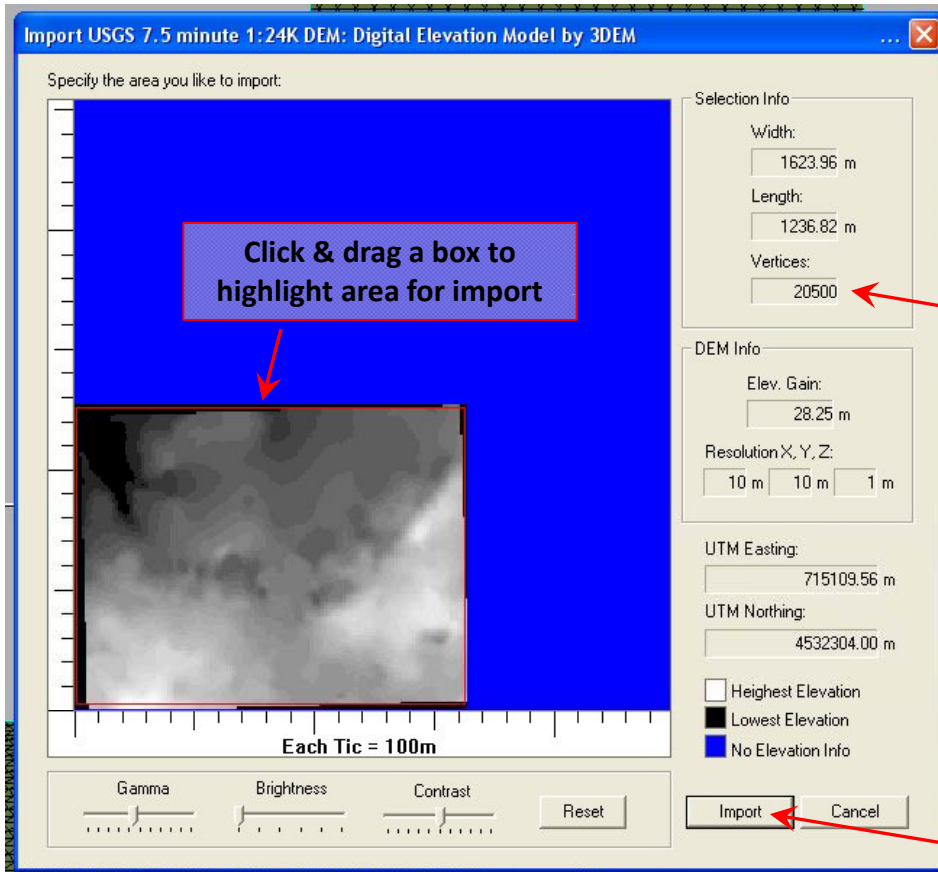
- Click on “Select DEM(s)” and browse to the location of the USGS ASCII DEM file.

- You may select up to four DEMs if necessary, just hold the “Ctrl” key while clicking on each DEM filename. Click Open.



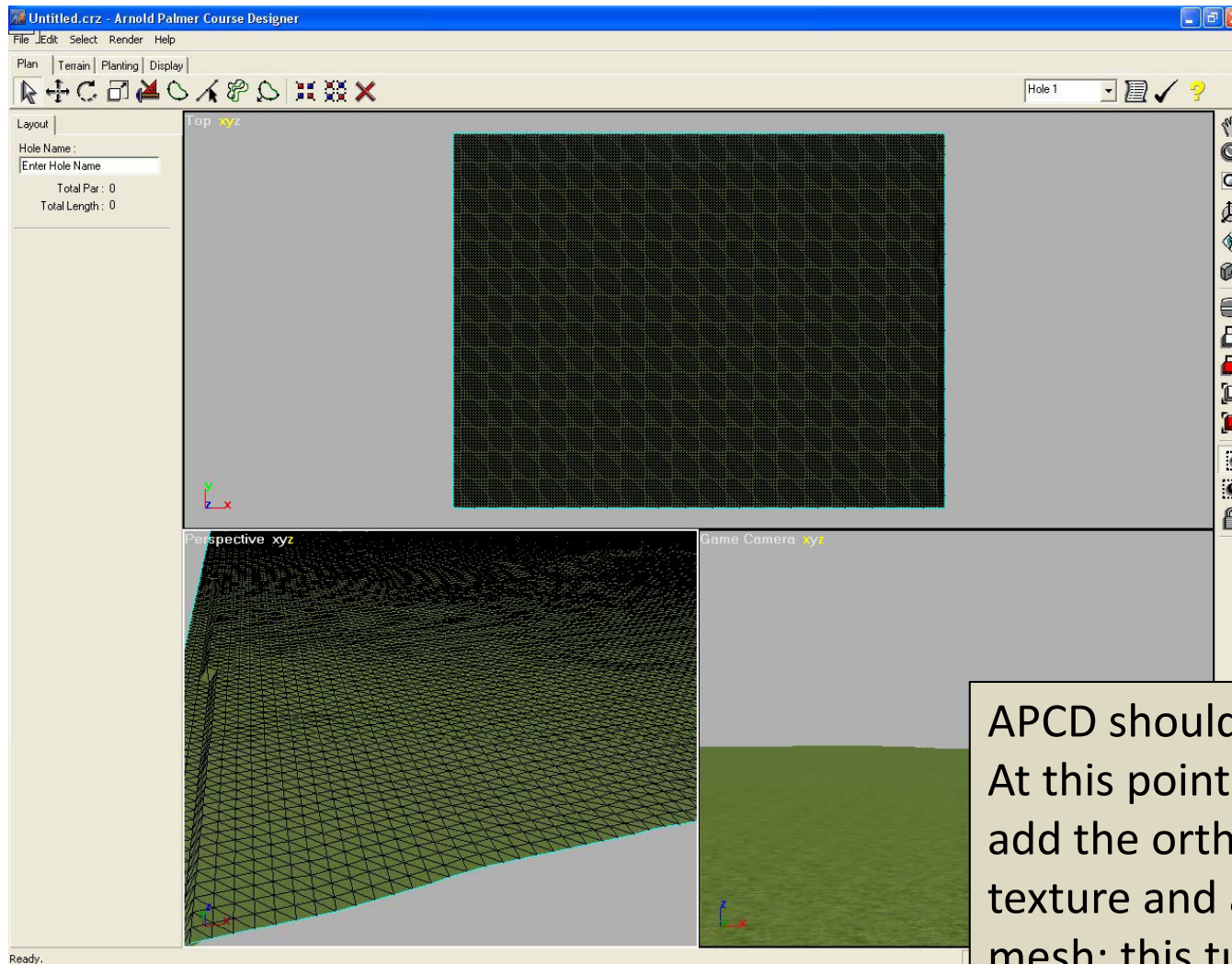
- Click OK

Select Area for Import



- A window will open showing a similar contour image of the plot as we saw in 3DEM.
- Click and drag on the image to draw a box around the desired import area.
 - You will be able to see the number of verts that would result in the imported file in the upper right box labeled “Selection Info”.
 - The import limit for standard APCD is 100,000 verts. If your desired area exceeds that number – which may be very likely if using 1/9 arc-second (3m) resolution DEM – then you will need to solicit help from APCD experts who have the capability to import files with much higher vert counts
- Click Import to finish the import process.

Final Import as APCD Mesh



APCD should import the DEM. At this point you will need to add the orthoimagery as a texture and align it with the mesh; this tutorial does not cover that process.

References

- I found the following threads on Links Corner forums to be helpful.

<http://linkscorner.org/forum/viewtopic.php?t=25655>

<http://www.linkscorner.org/forum/viewtopic.php?t=18147>

<http://www.linkscorner.org/forum/viewtopic.php?t=15409>

- There are older tutorials in Tutorial Corner that contain extensive detail, but most of the information and processes appear to be obsolete or unnecessary with the more recent availability of DEM data and orthoimages through the National Map Viewer.

<http://www.linkscorner.org/forum/viewtopic.php?t=480>

<http://www.linkscorner.org/forum/viewtopic.php?t=687>