

DIGITAL MAPPING TECHNIQUES 2016

The following was presented at DMT'16
(May 22-25, 2016 - Florida Geological Survey,
Tallahassee, FL)

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2016)

<http://ngmdb.usgs.gov/info/dmt/>

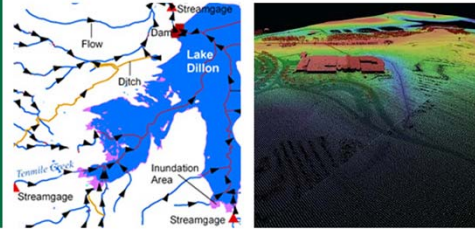
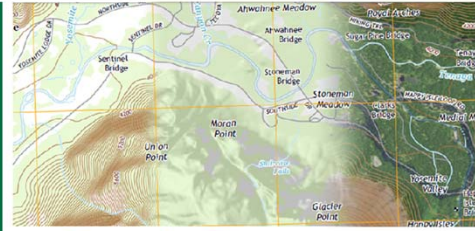
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Title: The Flexibility of the Topo TNM Style Template: A series of extended-use demonstrations

Abstract:

The U.S. Geological Survey's (USGS) National Geospatial Technical Operations Center (NGTOC) is enabling users to easily obtain The National Map (TNM) data and quickly configure it to resemble a US Topo-like design within a GIS platform. In order to achieve these goals, two objectives must be met. The first is to provide a method to configure data to US Topo layout and cartographic specifications. The second is to provide an efficient approach to obtain all the data layers used within US Topo maps. The NGTOC has created and released a new, versatile template to contain all symbol design, label rules, and map marginalia of US Topo maps. The template is realized as an Esri ArcMap Document and can be used anywhere TNM data is available. In addition, the NGTOC is producing a new vector data product called Topo Map Vector Data. This Esri File Geodatabase product contains a standard extent, 7.5-minute, extract of all TNM data used in US Topo map production. This presentation will provide an overview of how to obtain the Topo TNM Style Template and Topo Map Vector Data products. A Topo TNM Style Template will be set up and configured to one of the ~65,000 Topo Map Vector Data products. The presentation will conclude with how the map extent and data content can be customized to meet user-specific needs.

The flexibility of the Topo
TNM Style Template:
A series of extended-use
demonstrations



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Digital Mapping Techniques Workshop
May 22-25, 2016

+ Agenda

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- Topo TNM Style Template
 - Objective and current status
 - Overview of customizing the Topo TNM Style Template

- Topo Map Vector Data product
 - Product content and intended purposes
 - Production Status

- 'Advanced' Topo TNM Style Template Demo (group vote – as time permits)
 - Altering map content, scale, and page size
 - Improving template drawing performance
 - Exporting alternative formats
 - Performing analysis using TNM and 'local' data

- Download website: Download the template and data from TNM
Download Client to try it yourself



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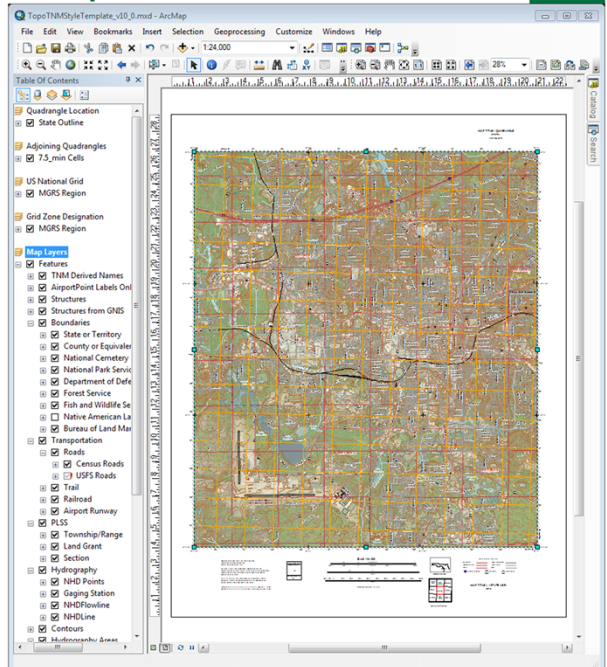
The intent of the presentation is to discuss how to use, customize, and extend the Topo TNM Style Template to meet your organization's needs. As such, some of the demos may not be 'academically correct' or all that sophisticated. They are intended to get you thinking about what you could do to enhance your experience and get the most out of the template.

Included is a brief overview of the template and Topo Map Vector Data product and demonstration of the flexibility of the Topo TNM Style Template through 'advanced' examples.

The focus will be on 'extended use' demonstrations. These demos are not intended to provide absolute answers or ways to use the template but are intended to inspire new ways for end users to consider using the template. As a template, this product is capable of much more than just creating a US Topo-like design. The four demos will cover topics such as building and developing a custom map design and extent, improving template performance when working with large datasets, exporting various formats from the template, and performing on-the-fly analysis using The National Map data.

+ Topo TNM Style Template: Objective

- Requirement derived from Geologic Mapping and Hazards Community of Use
- “Provide an efficient, ‘one-stop shopping’ approach to secure GIS-ready map data configured to US Topo layout and cartographic specification”



The U.S. Geological Survey (USGS) National Geospatial Technical Operations Center (NGTOC) continues to evaluate methodologies to produce and deliver a map template product that is based upon US Topo Map specifications and can be easily used with data available for download from The National Map (TNM) (<http://nationalmap.gov/>). The requirement for this format was originally reported to the National Geospatial Program (NGP) by the Geologic Mapping and Geologic Hazards Communities of Use (COUs) in 2012. Since then, additional COUs and scientists within the USGS and in state and local organizations have shown interest as well. GIS-ready data layers provided in conjunction with a map template that uses the layout, symbology, and labeling specifications of the published US Topo Maps would be an invaluable tool for customers to create their own tailored maps.

+ Topo TNM Style Template: Objective

- ArcMap (.mxd) file
 - Layout, labeling rules, symbology specifications
 - Service links to imagery and shaded relief
 - *Fulfills US Topo cartographic specifications requirement*
- Topo Map Vector Data
 - *(formally combined vector product)*
 - Esri file geodatabase format
 - Contains US Topo-related datasets
 - *Note: template can also be used with individually-downloaded datasets from TNM*
 - *Fulfills one-stop shop for GIS ready data*

VECTOR_44226_Tallahassee_7_5_Min.gdb

- Cells
 - CellGrid_7_5Minute
- Foundation
 - Elev_Contour
 - GU_CountyOrEquivalent
 - GU_NativeAmericanArea
 - GU_PLSSFirstDivision
 - GU_PLSSSpecialSurvey
 - GU_PLSSTownship
 - GU_Reserve
 - GU_StateOrTerritory
 - LANDCOVER_WOODLAND
 - Struct_Point
 - Trans_AirportPoint
 - Trans_AirportRunway
 - Trans_RailFeature
 - Trans_RoadSegment
 - Trans_RoadSegment_USFS
 - Trans_TrailSegment
- GazVector
 - TNMDerivedNames
- Hydrography
 - NHDArea
 - NHDFlowline
 - NHDLine
 - NHDPoint
 - NHDWaterbody
- BPFeatureToMetadata
- Meta_DatasetDetail
- Meta_ProcessDetail

VECTOR_44226_Tallahassee_7_5_Min.jpg

VECTOR_44226_Tallahassee_7_5_Min.xml

The Topo TNM Style Template has been developed according to the 1:24,000-scale, 7.5-minute layout and cartographic design of published US Topo maps and is intended for use in any geographic location where data is available for download from TNM. The template is provided as an Esri-specific solution (ArcGIS v10.0 ArcMap document) for the benefit of USGS earth scientists and other science professionals who have a requirement for symbolized and annotated topographic base map layers to support advanced GIS analysis and mapping. Symbolized map layers, links to Web Map Services, labeling rules, grids, standard map layout, and marginalia information are included in the template. The USGS recognizes that this solution only meets the needs of end users dependent upon Esri products. Research continues into alternative formats.

Symbolized layers within the template can be linked to data downloaded from TNM and include layers from TNM vector data themes of Transportation, Hydrography, Elevation Contours, Geographic Names, Governmental Units (Boundaries), Structures, and Woodland polygons. Web Map Service layers in the template include orthoimagery and shaded relief services produced by the USGS, as well as a National Wetlands Inventory (NWI) Web Map Service produced by the U.S. Fish and Wildlife Service (USFWS). An ancillary file geodatabase, provided along with the template, contains a Military Grid Reference System (MGRS) feature class and a data table created by the National Geospatial Technical Operations Center (NGTOC)

containing 7.5-minute map cell names, UTM zones, and other information for use in tailoring the template to a specific 7.5-minute map. Instructional Documentation is available to help with tailoring the template.

+ Topo TNM Style Template: Customization

- One template to be used in any geographic area where TNM data is available
- Necessary map customizations provided through an ancillary file geodatabase and table.



CELL_ID	MapName	State	UTMZone	MapRotation	DFWidth	DFHeight
2026	Azure Ridge	Nevada	11N	-1.73797628	18.49	22.81
2027	Azurite Peak	Washington	10N	-1.641851	15.17	22.85
2028	Azusa	California	11N	0.52597059	18.96	22.79
2029	B K Ranch	Montana	12N	0.41055492	15.68	22.84
2030	B Pond	Maine	19N	1.36128887	16.32	22.83
2031	B T Ranch	New Mexico	13N	0.36560363	19.39	22.78
2032	Babb	Montana	12N	1.83309529	15.13	22.85
2033	Babb Canyon	Texas	13N	0.03265613	19.52	22.78
2034	Babb	Mississippi	15N	0.78466277	15.46	22.84

This template may be used with any TNM data source available from the TNM Download Client and can easily be extended with data layers supported by ArcGIS according to end user needs. For best results in symbolization and labeling, it is recommended to be used with the Topo Map Vector Data products, and at scales between 1:18,000- and 1:36,000.

Topo TNM Style Template Disclaimer: Initial styling of this Map Template is provided by the U.S. Geological Survey (USGS). The USGS does not endorse any products created from the template.

+ Topo Map Vector Data Overview

- Extracts at 7.5' cell extent
- Currently in production (~20,000/65,000 produced)
- Package of 8 data themes used on US Topo Products
 - Map Indices, Elevation, Governmental Units, Landcover, Structures, Transportation, GeoNames, Hydrography
 - Up to 23 features classes
 - Only includes a dataset if data exists in 7.5' extent

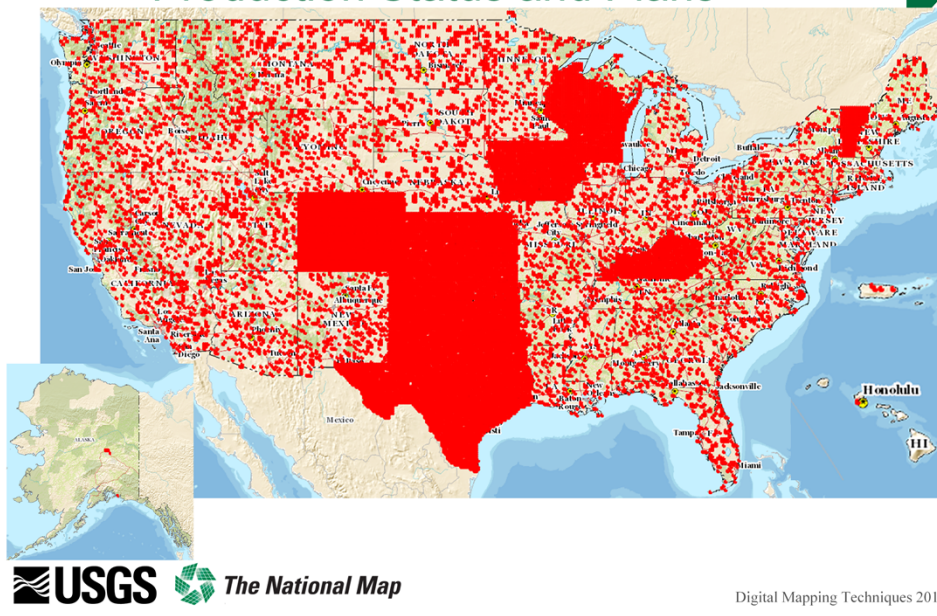
- TNM Derived Names
 - Derived from Geographic Names Information System (GNIS)
 - Multipoint and exploded multi-point features
 - Filtered and enriched content to drive better labeling
 - Content filtered – only includes features shown on US Topo
 - Enrichment – Populations to drive Populated Place Hierarchy



The Topo Map Vector Data products are one specific type of staged product available from TNM. They are intended for a variety of GIS and cartographic applications. These products are staged at a 7.5-minute footprint to correspond with the US Topo map 7.5-minute extent. They contain feature classes from all TNM vector data themes, including Elevation Contours, Governmental Units (Boundaries), Woodland polygons, Structures, Transportation, Hydrography, TNM Derived Names, and 7.5-minute map cells.

+ Topo Map Vector Data Production Status and Plans

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The production schedule for the Topo Map Vector Data products does not directly coincide with the published US Topo map production schedule. Topo Map Vector Data products will be produced for the entire nation in 2016. Beginning in Fiscal Year (FY) 2017 (October 2016 through September 2017), updates to the Topo Map Vector Data products will follow the US Topo map production schedule.

The National Map (TNM) Derived Names data are provided only in conjunction with Topo Map Vector Data products. TNM Derived Names dataset is a feature class derived from the Geographic Names Information System (GNIS). The GNIS is the official repository of domestic geographic names data; the official vehicle for geographic names used by all departments of the Federal Government; and the source for applying geographic names to Federal electronic and printed products of all types. See <http://geonames.usgs.gov> for additional information. TNM Derived Names is a filtered and enriched dataset intended to be used in the Topo TNM Style Template for symbolizing and labeling named features.

The status graphic is current as of May 22, 2016. Updated status is available from TNM Downloader (<http://viewer.nationalmap.gov/basic/>).

data is appended together. By first performing an out of the box spatial selection operation on the datasets (NHD and GU) with features that overlap the 7.5-minute extent, duplicate features can be deleted. Note that the 'Map Indices' used in this selection process must only be the 7.5-minute extent that defines the target geodatabase for the append operation. The 'Features to Delete' are the feature classes in the geodatabases that will be appended to the target. Otherwise non-duplicated features are likely to be deleted accidentally.

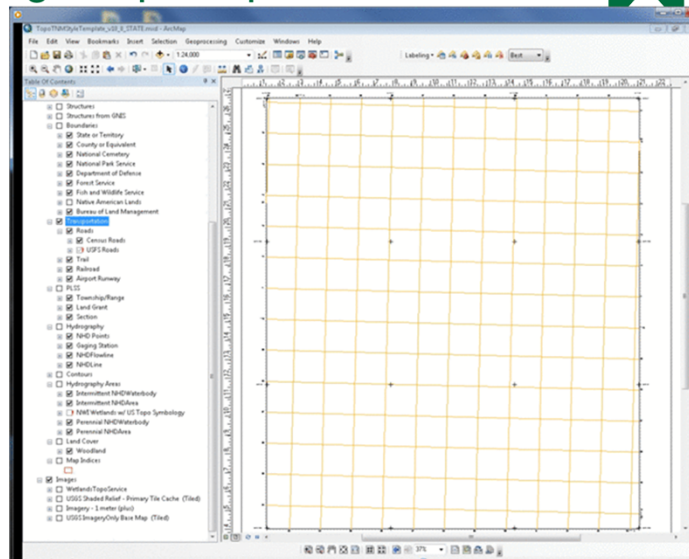
In some cases, graphical inconsistencies can exist between contour features across neighboring cells. Contour intervals are defined for the US Topo program by 7.5-minute extent based on the relief characteristics within each extent. When multiple contour intervals are present, a simple definition query can be placed on the Contours layer within the template:

$$\text{MOD}(\text{ContourElevation}, 40) = 0$$

This query will only show contours that have an elevation that is perfectly divisible by 40 feet. The '40' should be substituted for the maximum contour interval across neighboring 7.5-minute extents.

+ Demo Option 2: Improving template performance

- Label management
- Spatial Indexes
- Creating basemaps from TNM data



USGS  **The National Map**

Digital Mapping Techniques 2016

When using complex, multi-layered symbology, detailed label rules, or large extents of data in ArcMap, the graphics engine has to work overtime. This can frequently lead to frustration waiting for the map to render. Luckily, some of these problems can be averted. This demo will overview three methods that address template performance: preventing label placement, altering data with large extents, and map symbology caching.

The first, and simplest, method to reduce map rendering time is to evaluate the map labeling. Every time the map is refreshed (adding/removing data, panning, zooming, repositioning the map frame, etc.), the Maplex Labeling Engine runs through all of the labeling rules and re-evaluates the optimal place for each label. While this is useful before a ‘final’ map export is conducted, it may become a distraction to the user while analysis is conducted or map customizations are done. The following tips are all done from the [Labeling Toolbar](http://desktop.arcgis.com/en/arcmap/10.3/map/working-with-text/a-quick-tour-of-the-labeling-toolbar.htm) (<http://desktop.arcgis.com/en/arcmap/10.3/map/working-with-text/a-quick-tour-of-the-labeling-toolbar.htm>).

The first option is to “Pause Labeling”. This will temporarily stop ArcMap from placing and rendering all labels. As no labels will be displayed while labeling is paused, there will be no time delay from rendering the map caused by label placement. The second option is to “Lock Labels”. This will freeze any rendered

labels in position. As the map is moved around, no new labels will be placed but all existing labels will still be rendered. Since the labeling is locked, the labeling engine will not have to recalculate the label placement and simply redraw them where they originally were. It is recommended to Pause Labeling until the desired map extent is identified in the Map Layout view. Unpausing the labeling will then place all labels in the map extent. After letting all labels place, locking the labels will freeze all labels in the map frame, allowing the user to pan and zoom around the map without having the label engine replace all labels in the current map extent.

The second option is to manipulate the data itself to support map rendering and export improvements. By recreating the spatial index, ArcMap is more informed to the data that is in the current map extent and can therefore render the data in a more efficient way. Rebuilding spatial indexes can reduce the rendering time of large and complex data as well as improve the functionality of multi-layered symbology. This tactic is especially useful when state-wide TNM data themes are being used in conjunction with the Topo TNM Style Template opposed to a single Topo Map Vector Data Product.

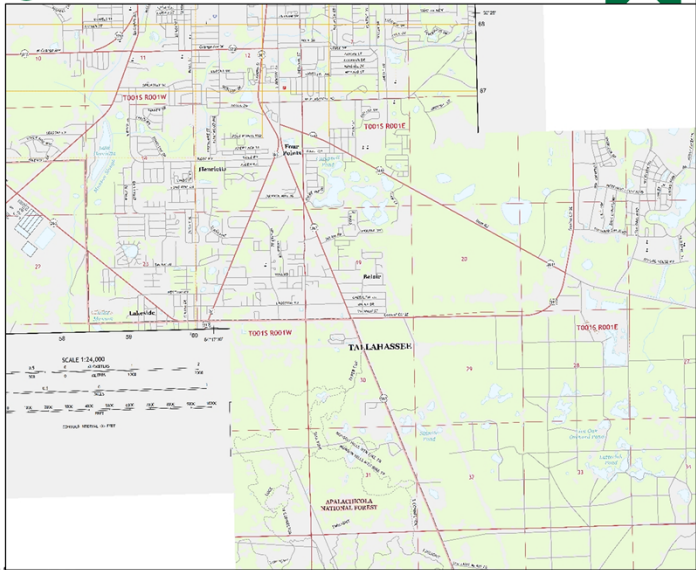
A GIS user can first remove any spatial index that already exists on the feature class. Once the feature class has no spatial index associated with it, the 'Calculate Default Spatial Grid Index' will re-compute the ideal index for the data. This information is normally returned in the results window and will be three numbers (to define the spatial grid). Finally, the Add Spatial Index tool is run with the three index definition values from the previous step.

The final option to improve map rendering performance is to create a [Basemap Layer](http://help.arcgis.com/En/Arcgisdesktop/10.0/Help/index.html#//00s500000017000000) (<http://help.arcgis.com/En/Arcgisdesktop/10.0/Help/index.html#//00s500000017000000>). Basemap layers were introduced in ArcGIS 10.0, behave like a Group Layer, and utilize a different drawing engine that improves rendering speeds. The dynamic content within a basemap layer behaves as a cached dataset where content loads the first time an area is displayed and quickly returned on subsequent display refreshes.

In order to create a basemap layer, simply right click on a data frame and select "New Basemap Layer". This will add the basemap layer to the Table of Contents at the bottom of the data frame. Simply drag and drop layers from the Table of Contents into the new basemap layer, which will contain the data in the same manner as a Group Layer. Upon adding content to the basemap layer, several icons may appear next to a layer name indicating errors or potential problems with that specific layer. To see the best results of the basemap layer, these problems should be resolved by the GIS user.

+ Demo Option 3: Exporting GeoTIFFs

- Exporting collared AND collarless GeoTIFFs
- Adding and manipulating GeoTIFFs in ArcMap
- Addressing the “Black Smudge” problem



Some users like to convert a map to a GeoTIFF file format to be re-inserted into other GIS systems. While it is possible to convert a [US Topo to a GeoTIFF](http://nationalmap.gov/ustopo/documents/ustopo2gtif_current.pdf) (http://nationalmap.gov/ustopo/documents/ustopo2gtif_current.pdf), some users may wish to alter the map symbology prior to TIFF creation. This demo defines how a GIS user can setup the Topo TNM Style Template and generate custom GeoTIFFs as an export format. Note that the recommended process demonstrated here uses the Layout GeoTIFF export, which is currently only available with the Production Mapping extension to ArcGIS.

The first example outputs a GeoTIFF that contains the map frame, grids, and map marginalia. When exporting the map (File > Export Map), choose “Layout GeoTIFF” as the save as type. Set the resolution as needed. [Dr. Kimerling wrote an Esri blog post](https://blogs.esri.com/esri/arcgis/2011/02/28/dem-resolution-output-map-pixel-density-and-largest-appropriate-map-scale/) (<https://blogs.esri.com/esri/arcgis/2011/02/28/dem-resolution-output-map-pixel-density-and-largest-appropriate-map-scale/>) about relating raster resolution to map resolution where the equation can be rewritten to define the dpi for a specific ground resolution:

$$\text{output resolution (DPI)} = \frac{\text{scale denominator}}{\text{raster resolution (inches / cell)}}$$

Therefore, if a 1-foot TIFF resolution is desired for a 1:24,000 scale map out, the

filled in equation would be:

$$\text{output resolution (DPI)} = \frac{24000}{12 \text{ inches}}$$

By solving the equation, a GIS user would need to define the resolution as 2,000 dpi.

The most important change to the output settings is to define the Page Layout reference on the Production Tab. This option defaults to using the projection and reference information of the first data frame in the Table of Contents. In order to appropriately reference the output GeoTIFF, change the Page Layout option to use the projection information of the Map Layers data frame.

In order to generate a collarless GeoTIFF, all excess map marginalia must be removed. The Grids (LatLong and UTM) must be either unchecked or removed from the Grids Tab of the Map Layers data frame. Assuming the template was fully tailored prior to GeoTIFF export, the Width and Height on the Size and Position Tab of the Map Layers data frame should reflect the actual size of the Map Layers Data frame. Note these values as they will be used to adjust the page size. In Page and Print Setup (under the File Menu), change the Map Page Size to a custom size and enter the width and height that was noted from the Map Layers data frame. Upon clicking OK, the page size will change and it is likely to be displaced from the Map Layers data frame. As the page size is identical to the data frame size, simply right click on the data frame and select Distribute > Fit to Margins. The GeoTIFF is now ready to be exported as described above.

Some final tweaks may need to be completed prior to GeoTIFF export. At some resolutions, a large black streak may run through the TIFF. This is caused by transparency within the template. During export, the map is 'flattened' which causes some graphical issues. This can be remedied by removing transparency from the following layers:

- Fish and Wildlife Service boundaries
- Native American Lands boundaries
- Bureau of Land Management boundaries
- Perennial NHDWaterbody
- Perennial NHDArea
- Woodland

Simply removing transparency (setting to 0% on the Display Tab of each Layer Properties) may not always generate an ideal color scheme. It is recommended to use

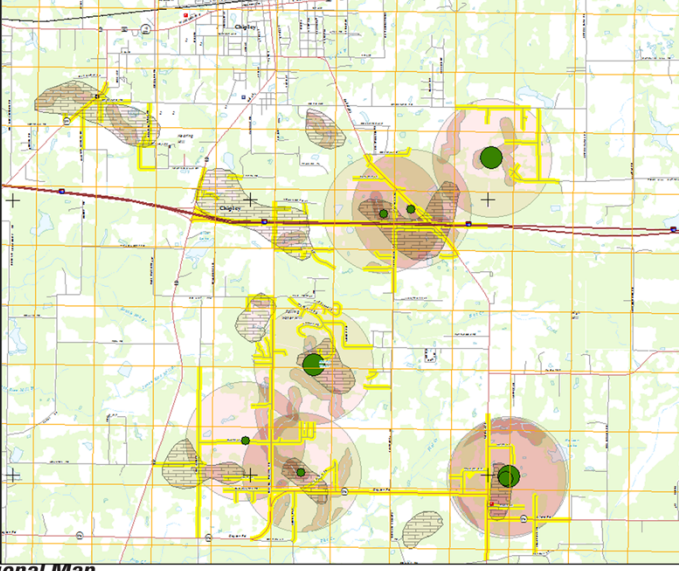
the Eye Drop Tool to collect the RGB colors of each layer with transparency. When transparency is removed and the layer symbologies change to reflect the sampled colors, a non-transparent, identical color will be displayed.


Upon Adding a GeoTIFF to an ArcMap document, the colors may appear distorted. This can be easily resolved in the GeoTIFF's layer properties. On the Symbology Tab, change the Stretch Type to None and uncheck the option to "Apply Gamma Stretch". The colors of the GeoTIFF should now properly reflect the GeoTIFF that was exported.

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+ Demo Option 4: On the fly analysis within the template

- Use GP tools that consume local and TNM data inputs
- Query map data on-the-fly with spatial selections
- Integrate results into map layout



USGS  *The National Map*

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The final demonstration overviews how to use the Topo TNM Style Template and TNM data within an analytical workflow. The original purpose of the template was to integrate TNM data as a basemap for other geographic or geologic information. However, TNM data can be used with 'local' data to perform detailed analysis and develop an integrated map design. This demo exemplifies how 'local' datasets of Florida swallets and lithology (http://geodata.dep.state.fl.us/datasets?q=*&keyword=geology) can be combined with TNM Hydrography data to predict what TNM roads may be at risk for newly forming sinkholes. The example here may overgeneralize some processes and may not be the most scientifically accurate or rigorous. Despite this, the example is intended to demonstrate how local and TNM data can be used together within an analytical framework.

The first step is to add the swallet and lithology data to the Topo TNM Style Template. It can be symbolized however desired. In this case, the depth of a swallet will be related to its geographical significance so graduated symbols are used. As limestone is characteristic to karst topography and the formation of sinkholes, a definition query is applied to the Lithology to only show a subset of data that contains limestone.

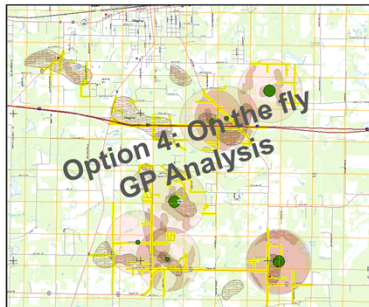
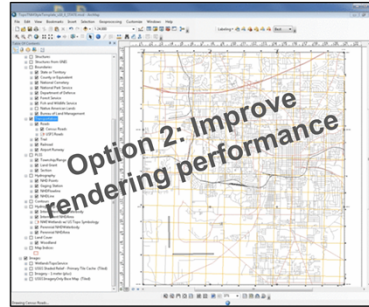
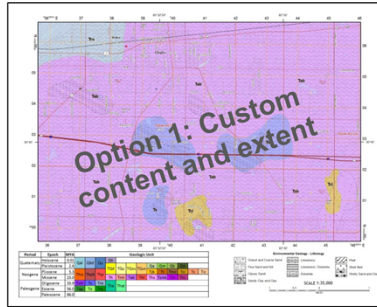
A series of geoprocessing steps are then executed on both the TNM and local data

to mimic an analytical workflow to assess risk areas. The Florida Swallet and TNM Flowlines datasets are buffered. The buffered extents of the swallets represent a higher likelihood of new swallets forming. A buffered stream represents how groundwater may interact with the underlying soil and bedrock. It can be assumed that where the buffered streams intersect the buffered swallets, a yet higher risk of new sinkhole formation could be expected. If the buffered swallets and streams as well as the limestone datasets are combined using the Union geoprocessing tool and spatially joined with itself, a count of overlapping swallets, streams, and limestone can be generated. This dataset is considered to be the final result of the risk assessment. Higher join counts, or overlaps, represent higher degrees of modeled risk or sinkhole formation. This will be used again later to create a meaningful map design.

In addition, on-the-fly analysis can be conducted within the Topo TNM Style Template. In this case, the roads that are at risk of damage due to a new sinkhole can be predicted. A selection is done in ArcMap to identify any TNM Roads that intersect the created risk assessment layer. The selected roads are converted to a separate layer used to enhance the map display.

In a traditional base map, data layers can only be placed above or below the base map content. Since the Topo TNM Style Template exposes the TNM layers in a GIS, custom layers can be interlaced with basemap layers. This is especially useful for developing a strong visual hierarchy. The road segments that intersect the risk layer are moved to be just below the transportation data group in the template. By symbolizing the selected roads with a wide, yellow symbol, the TNM roads that are 'at risk' are highlighted or haloed with a yellow symbol. In addition, the risk assessment layer can be inserted below point and label features but above all other TNM data content. By applying a light transparency to the layer, it is retained at the top of the visual hierarchy, exposes all TNM base map content that could be at risk, and doesn't impede the clarity of map labels.

+ Which demo?



+ Topo TNM Style Template website: viewer.nationalmap.gov/tools/topotemplate

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Topo TNM Style Template

A NEW GIS-READY TOPOGRAPHIC MAP STYLE TEMPLATE!

The Topo TNM Style Template can be readily used with the Topo Combined Vector Product (recently renamed "Topo Map Vector Data products") and other data available for download from *The National Map* (TNM). The template and TNM data are intended to be used together to quickly provide the GIS user with a fully customizable map in the style of US Topo maps using the most current TNM data.

The Topo TNM Style Template is provided by the U.S. Geological Survey (USGS) National Geospatial Technical Operations Center (NGTOC). It has been developed according to the 24,000-scale, 7.5-minute layout and cartographic design of published US Topo Maps and is intended for use in any geographic location where data is available for download from TNM. The template is provided as an Esri-specific solution (ArcGIS v10.0 map document (.mxd)) for the benefit of USGS earth scientists and other scientific professionals who have a requirement for symbolized and annotated topographic base map layers to support advanced Geographic Information System (GIS) analysis and mapping. Symbolized map layers, links to Web Map Services, labeling rules, grids, standard map layout, and marginalia information are included in the template. Ancillary data for tailoring the template is provided along with the template in an Esri file geodatabase (v10.x). The USGS recognizes that this solution only meets the needs of end users dependent upon Esri products. Research continues into alternative formats.

This template may be used with any TNM datasource available for download and can easily be extended with any data layers according to end user needs. For best results in symbolization and labeling, it is recommended to be used with Topo Map Vector Data products. These products are currently under production and many are now available for download from TNM [Downloader](#).

The Topo Map Vector Data products are staged at a 7.5-minute footprint that corresponds with a single US Topo Map extent. They will contain four feature datasets that include feature classes from all TNM Vector data themes, including Elevation Contours, Government Units (Boundaries), Woodland Tint polygons, Structures, Transportation, Hydrography, TNM Derived Names, and 7.5-minute map cells.

The following items are available for download:

1. [Zip file](#) containing the template, tailoring data contained in a file geodatabase, and tailoring instructions in PDF.
2. [Frequently Asked Questions document](#) in PDF.
3. Topo TNM Style Template [Metadata](#), [FAQ](#), [Text](#), and [XML](#).

Questions/comments are welcome and should be referred to Kristin Fishburn (kfishburn@usgs.gov).

The template is available for download from the template homepage. Links for the zip file containing the ArcMap document, ancillary file geodatabase, and User Guide are near the bottom of the web page, as well as links to the FAQ document and metadata for the template.

