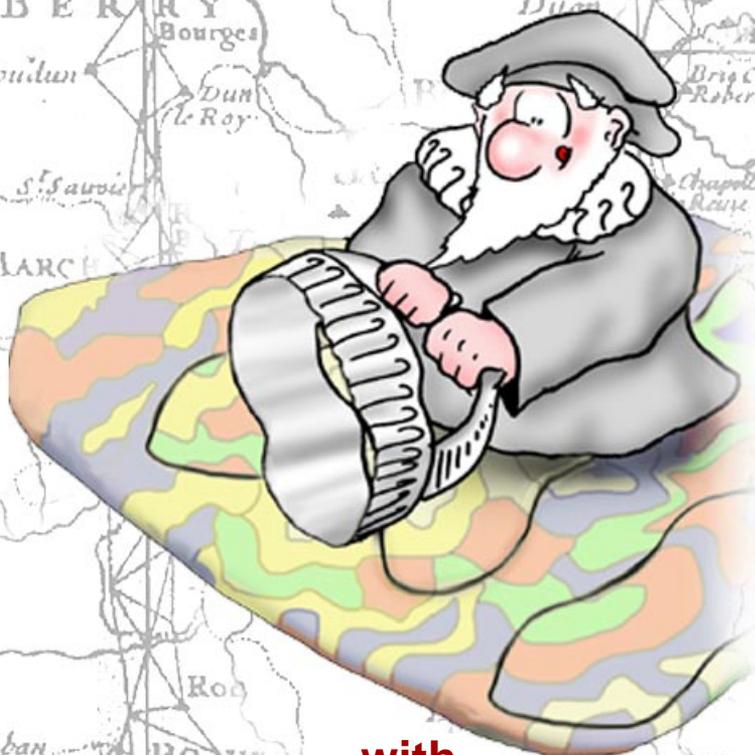


Tutorial



REGIONS

Using Regions



with

TNTmips®

TNTedit™

TNTview®

Before Getting Started

A region is an area used for selection or extraction. “Region” seems to be a pretty vague term. Perhaps that’s because regions can be used for so much and generated in so many different ways. So rather than vague, think of region as an all inclusive term. Through a series of exercises, this booklet familiarizes you with the powerful functions that generate regions and uses them for selection and extraction. These functions are found throughout TNTmips® as well as in TNTedit™ and TNTview®.

Prerequisite Skills This booklet assumes you have completed the exercises in the *Displaying Geospatial Data* and *TNT Product Concepts* tutorial booklets. The exercises in those booklets provide basic knowledge on how to use the TNT products including how to select and view raster, geometric, and database objects stored in Project Files. You should know how to zoom, pan, and enhance display objects. Please be sure you remember how to add and remove layers from a multilayer view. This booklet does not present these basic skills again.

Sample Data The exercises presented in this booklet use sample data distributed with the TNT products. If you do not have access to a TNT products DVD, you can download the data from MicroImages’ web site. The first exercises use objects in the CB_DATA data collection in the DATA directory. Additional objects and Project Files are found in the REGIONS and BERA data collections.

More Documentation This booklet is intended only as an introduction to the functions associated with creating and using regions. For more information, search the documentation, which includes discussion of these topics in conjunction with Spatial Display and the Spatial Editor.

TNTmips® Pro and TNTmips Free TNTmips (the Map and Image Processing System) comes in three versions: the professional version of TNTmips (TNTmips Pro), the low cost TNTmips Basic version, and the TNTmips Free version. All versions run exactly the same code from the TNT products DVD. If you did not purchase the professional version (which requires a software license key) or TNTmips Basic, then TNTmips operates in TNTmips Free mode. This booklet refers to TNTmips, TNTedit, TNTmips Free, and TNTview as “TNT.”

Merri P. Skrdla, Ph.D., 16 November 2010

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It may be difficult to identify the important points in some illustrations without a color copy of this booklet. You can print or read this booklet in color from MicroImages’ web site. The web site is also your source of the newest tutorial booklets on other topics. You can download an installation guide, sample data, and the latest version of TNTmips.

<http://www.microimages.com>

Introducing Regions

A region is a simple object used to define what may be a complex geographic area of interest. There are no separate element types in a region object. Nor do regions have associated databases with attached attributes. Regions have rudimentary topology in that alternating nested polygons are inside then outside the region. For all their simplicity, however, regions provide very sophisticated and powerful selection capabilities for analytical tasks that use the attributes of one object to determine the elements selected in another object. For example, if you have a contour map of the distance from the surface to the groundwater, a soil map with attributes such as permeability attached to soil type polygons, and point locations for hazardous materials storage, you can identify areas most in need of monitoring for groundwater contamination. You can identify target marketing areas from demographic point data and political boundaries, such as counties or ZIP codes. You can identify areas in greatest need of public health information for a variety of diseases. In short, regions let you relate the previously disjoint information you have available in a number of new and innovative ways.

A region is a geographic area, which means regions are made up of one or more polygons but may also contain points or lines. Region generation is embedded in TNTmips' powerful GeoToolbox and right mouse button operations found in processes throughout TNTmips.

TNTmips supplies additional means for interactive GIS by providing methods for region combination to generate new regions. Intersection, union, exclusive union, and subtract operations are supported for region combinations. Thus you can generate a region that is more than 200 but less than 400 meters from a stream or that has a specified soil type and is within 100 feet of a road.



Vocabulary: A **region** is a scalable mask generated from selected vector points, lines, or polygons; selected CAD elements; or raster cell values. The elements for region generation can also be drawn directly.

STEPS

- launch TNT
- copy the files in the REGIONS data collection, as well as CB_DLG and CB_ELEV in the CB_DATA data collection, to your local drive

Pages 4–7 introduce the element selection tools that are an integral part of region generation. Pages 8–12 introduce region generation techniques that work directly on selected elements. Pages 13–17 describe region generation methods that require a reference raster. Pages 18–19 introduce the Extract Via Region operation and associated database features that can be applied to vector layers. Pages 20–23 describe the advanced options, region combinations, and adding regions to vector objects.

Before Regions: Element Selection

STEPS

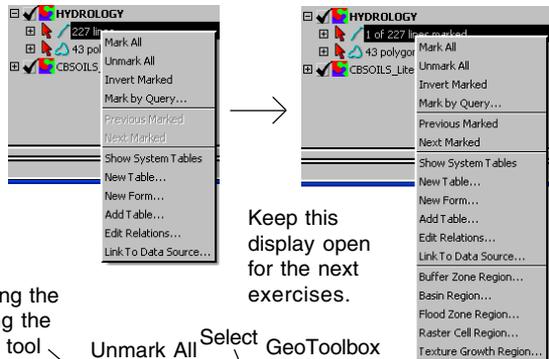
- ☑ select Main / Display from the TNTmips menu
- ☑ choose Options / View Options in the Display Manager, and turn on *Default to redraw primary views after any change* on the View panel
- ☑ choose Display / New / 2D Display and select CBSOILS_LITE from the REGIONS Project File, then select HYDROLOGY from the CB_DLG Project File (both in the REGIONS data collection)
- ☑ expand the HYDROLOGY layer  → 
- ☑ click on the Select tool icon in the View window 
- ☑ click on one of the lines in the HYDROLOGY object
- ☑ note that the Select icons for HYDROLOGY lines and polygons are now turned on and the region creation options have been added to the right mouse button menu for lines

When you select a vector element, the region creation options for that element type are added to its right mouse button menu in the Display Manager.

The TNT products offer two tools for element selection: the Select tool for simple selection and the GeoToolbox for more complex selection. The Select tool lets you select just one element at a time. You can, however, create a selection set with either of the selection modes (Mark Exclusive or Toggle Marked) or by starting with selection by query (or select all) and directly using or modifying that selection set.

In order to create regions from selected vector or CAD elements or from rasters, you need to show the details for the layer. Regions cannot be generated from TIN elements and regions generated from CAD elements are limited to regions generated from selected elements.

When you click on the plus icon for a layer, the information for that layer is exposed. Vector and TIN layers have a row for each element type. Raster layers have a row for each component of the layer (one for single, three for RGB, four for RGBA, and so on). CAD layers have a single element row. When you expand an element row, the database tables for that element type are shown. The available right mouse button menu choices change with the level in the object hierarchy you click on.



Keep this display open for the next exercises.

mode for modifying the selected set using the current selection tool

Unmark All Select GeoToolbox



Element Selection Tools and Modes

Two selection-related icons are in the View window by default: Mark Exclusive and Toggle Marked. These control the mode for the Select tool's operation. If you prefer separate icons for adding to and removing from the selected set, you can add them to your toolbar using Options/Hidden Features in the View window (Mark Additional and Unmark, respectively). The View window also has an Unmark All icon and icons for the Select and GeoToolbox tools. The GeoToolbox icon opens another window that contains the selection and region drawing tools (also used for measuring and sketching).

The tool icon selected in the GeoToolbox determines which drawing tool is active for identifying elements for selection. Elements clicked on are immediately highlighted when the single select tool is active. The other tools require a right mouse click (perhaps accompanied by a menu choice) or a click on the Select Elements button on the Select panel in the GeoToolbox window to select elements. A right mouse click and menu choice is also necessary to generate a region from the current tool.

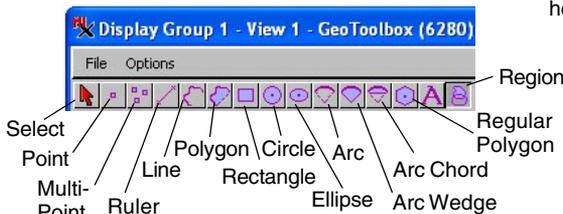
Vocabulary: The **selectable set** is the set of element types chosen for display that also have their Select icon turned on in the Display Manager. When an element type is not part of the selectable set, none are selected even though they fall within the area defined by a selection tool. If none of the Select icons are on when you use the Select tool, the Select icons for all drawn element types in the active layer are turned on. (The first table that has a primary key or for the first displayed element type if no primary key is also opened.) The **selected, or marked, set** is those elements that have been marked with the mouse, by query, or using a region.



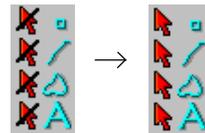
See the Displaying Geospatial Data booklet for identification of all icons.

Mark Exclusive

The Mark Additional and Unmark icons are inserted here if you choose to add them.



In the GeoToolbox, the Select tool or an area drawing tool is required for selection to be active (point, line, segment, and arc tools cannot be used for element selection). Any of the drawing tools can be used for region generation. The type of regions that can be generated depends on the drawing tool selected.

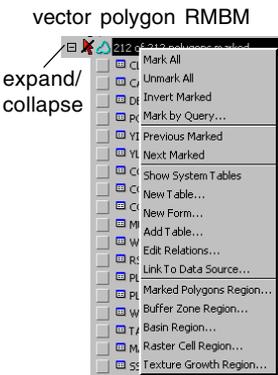


If no element types are turned on for marking and you use a selection tool, all element types in the active layer are turned on for marking and the first table with a primary key is opened.

Other View Tools and Manager Options

Vocabulary: A **form** is an alternative layout for a database table in single record view. It draws its fields from an existing table, but need not include all fields and can incorporate headings or other labels not associated with an individual field (see the *Managing Relational Databases* booklet for more information).

 These two icons found on the View window toolbar let you step through all elements in a selected set, highlighting the element and associated records in open tables as you go. The RMBM also provides these functions.

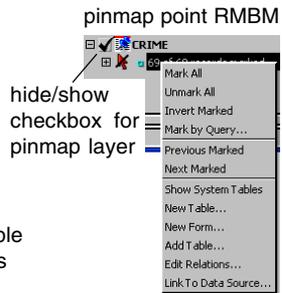
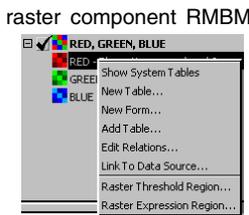
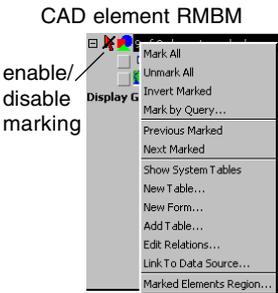


The element/component row in the Display Manager lets you activate selection for an object (CAD, raster, pinmap) or individual element type (vector, TIN). Use the expand/collapse icon to list database tables and forms. Raster layer components do not have a select icon or expand/collapse icon unless associated database tables are present.

The element/component row has a right mouse button menu (RMBM) that varies with layer and element type. Composite raster layers do not have a right mouse button menu. Many marking and database functions are found on the RMBM, such as creating new tables and forms, and electing to mark by query. You can also create regions from selected elements and step through database information about the elements in the selected set while automatically repositioning the view to show the element if zoomed in. You cannot create regions from pin map, TIN, or composite color raster layers or from non-geospatial layers, such as legends and text.

An element must be in the selectable set to be selected by mouse action in the View window. You need not turn on the Select icon to select elements using the choices on the RMBM, such as Mark by Query or Mark All.

Each layer row in the Display Manager also has a check box to hide/show the layer and an RMBM appropriate to the layer type that includes zooming and other options.



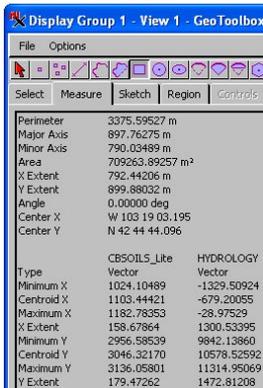
Each component of a multiple component raster layer has its own RMBM.

GeoToolbox Options and Features

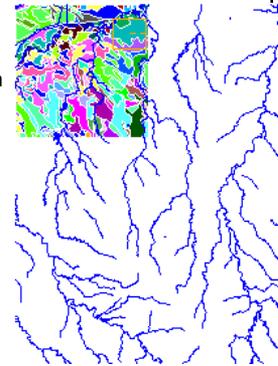
Selecting elements and generating regions are only two of the GeoToolbox's functions, which also include sketching and measuring. The right mouse button function can be set to decrease the effort needed when the GeoToolbox is used repeatedly for only one of its tasks. For example, if the tools are in repeated use for selection only, you can elect to make a right mouse click select elements by applying the region test chosen (partially inside, completely inside, partially outside, or completely outside). Generating regions from graphic tools requires that the Right Mouse Button option be set to Choose from Menu*.

Including region management in the GeoToolbox means that measurements are immediately available for any region created. You can also know the ground dimensions of the graphic tools before using them for selection.

Measurements are for the current graphic tool, which in this case is the rectangle. When the Region tool is active, the measurements apply to the region selected on the Regions panel.



File		Options	
Perimeter	3375.59527 m		
Major Axis	897.76275 m		
Minor Axis	790.03489 m		
Area	709263.89257 m ²		
X Extent	792.44206 m		
Y Extent	899.88032 m		
Angle	0.00000 deg		
Center X	W 103.19.03.1.95		
Center Y	N 42.44.44.096		
CBSOILS_Lite		HYDROLOGY	
Type	Vector	Vector	
Minimum X	1024.10489	-1329.50924	
Centroid X	1103.44421	-679.20055	
Maximum X	1182.78353	-28.97529	
X Extent	158.67864	1300.53395	
Minimum Y	2956.58539	9842.13860	
Centroid Y	3046.32170	10578.52592	
Maximum Y	3136.05801	11314.95069	
Y Extent	179.47262	1472.81208	



* Use Current Panel also works if the Region panel is active.

The measurements provided at the top of the Measure panel are in the units selected from the Options menu. The object specific measurements are in object coordinates. For more information on other aspects of the GeoToolbox, refer to the *Sketching and Measuring* booklet.

STEPS

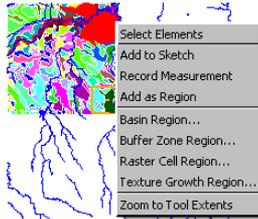
- ✓ click on the Geo-Toolbox icon 
- ✓ select Options / Right Mouse Button / Choose from Menu and Options/ Measure/Layer Information/All Layers in the GeoToolbox window
- ✓ click on the Rectangle icon 
- ✓ use the mouse to draw a rectangle near the upper right of CBSOILS_LITE
- ✓ click on the Measure tab and note the measurement details you have about the rectangle
- ✓ check that the Select Elements option on the Select tabbed panel is set to Partially Inside
- ✓ click on the Unmark All icon in the View window 
- ✓ expand the CBSOILS_LITE layer
- ✓ turn on the  polygon Enable for Marking icon
- ✓ right-click over the canvas area of the View window and choose Select Elements from the menu

The exercise on the following page starts where this one leaves off.

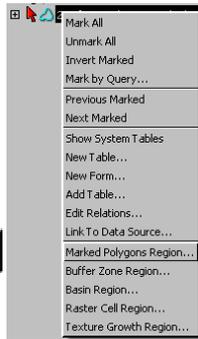
Selected Polygon Regions

STEPS

- ☑ click on the Toggle Marked icon in the View window
- ☑ drag the Rectangle tool to the lower right of CBSOILS_LITE
- ☑ right-click over the canvas area of the View window and choose Select Elements from the menu
- ☑ choose Marked Polygons Region from the polygon RMBM
- ☑ click [OK] in the Marked Element Region Generation window that opens
- ☑ click on the Region icon in the GeoToolbox to see the newly created region outline and on the Region tab to view the list of region management tools

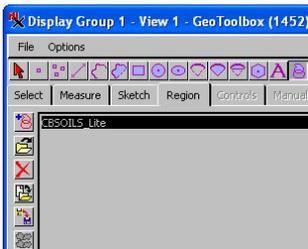


The point of dwelling on element selection is that elements must be selected to create regions. The region drawing tools let you directly draw the selected elements (a feature that will be described later), but for the most part regions are generated from selected elements in existing objects. Because regions are areas, polygons are the only element type that can be converted directly to a region.

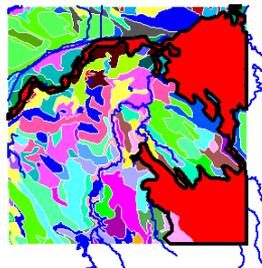


You can select polygons to define a region using any selection method, such as the mouse, a query, or with another region. Lines between adjacent selected polygons are dissolved when a region is created. A region generated from selected polygons can include spatially separated polygons, each referred to as a subregion. They can also contain islands. The Marked Polygons Region option appears on the RMBM as soon as at least one polygon is selected.

A region is added to the list on the Region panel of the GeoToolbox window as soon as you click on [OK] in any Region Generation window. We will use this region to select line elements for buffering in the next exercise.



All region manipulations are handled from the Region tabbed panel.



Keep this region open for use in the next exercise.

Using a Region to Select

You can use an existing region to select elements in any displayed object whenever the Region selection tool is active and a region is selected on the Region panel. Let's use the region we created on the previous page to select elements from another object, specifically the HYDROLOGY object already chosen for display.

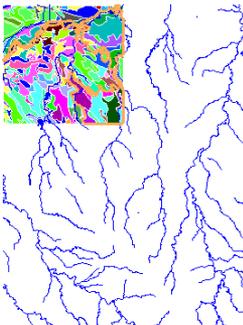
The polygons used to create the region in the previous exercise remain selected after the region is created. It is not necessary to deselect these elements to proceed, especially since we are switching the selection mode to exclusive, but deselection makes the results of each step clearer to the novice. Turn off selection of lines and polygons in the CBSOILS_LITE object, then turn line selection on in the HYDROLOGY object. It wouldn't hurt to leave the CBSOILS_LITE object active for selection, but the selected hydrology lines are much easier to see when selection of soil map elements is disabled.

Once you have created a region or opened a saved region, using that region to select is as simple as clicking on the Region icon then right-clicking over the View window and choosing Select Elements.

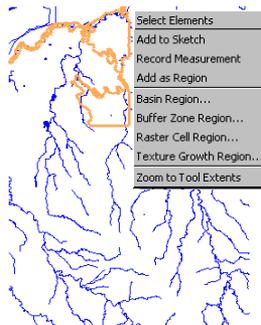
STEPS

- click on the Unmark All icon 
- turn on line selection for the HYDROLOGY layer 
- change the selection mode from Toggle Marked to Mark Exclusive 
- click on the Select tab in the GeoToolbox window and check that the Test option is set to Partially Inside
- click on the Region icon 
- right-click in the View window and choose Select Elements

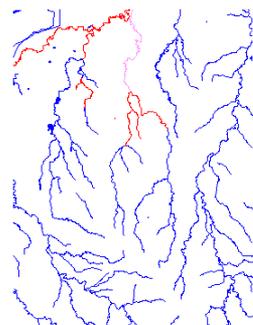
CBSOILS_LITE and CB_DLG /
HYDROLOGY in overlay with
selected polygon region



selected polygon region with
CBSOILS_LITE layer hidden



elements selected



Buffer Zone Regions

STEPS

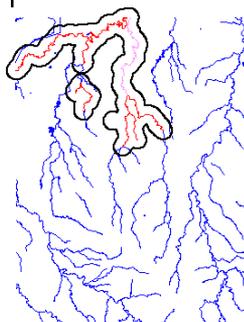
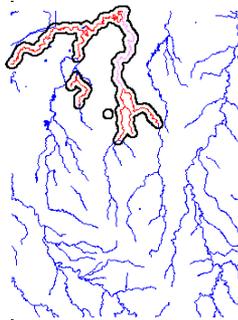
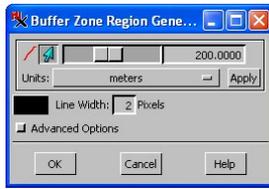
- right-click on the HYDROLOGY lines in the Display Manager and select Buffer Zone Region from the drop down menu
- set the buffer (line setback) distance to 200 meters and the Line Width to 2 pixels
- click on [Apply]
- click on [OK]
- right-click on the HYDROLOGY lines again, and select Buffer Zone Region from the menu
- set the buffer distance to 400 meters then click on [Apply]
- click on [OK]
- click on the Save icon on the Region panel
- save HYDROLOGY1 as HYDROLOGY400 then highlight HYDROLOGY, click on Save and name it HYDROLOGY200

Now that you have selected lines, you can use them to generate a region (in this case, a buffer zone region). Buffer zone regions can also be generated from selected points and polygons. Generating buffer zones around polygons results in setback lines around the outside of the polygons only. Generating buffer zones around lines that form polygons results in setbacks on both the interior and

exterior of the polygons if the polygon dimensions are more than twice the buffer distance.

Once a region is generated, it is a temporary object for use only in the current display session unless you explicitly save it. You can save a region in the same Project File with the same name as the object it was generated from because it is a different object type (two objects of the same type cannot have the same name in the same file, but different object types, for example a vector and region, can have the same name in a single Project File). The default region name is the name of the object it was generated from, but you may want to add more information to the name or description, such as the region generation method.

You can make a set of buffer zones with different setback distances around the same selected lines by choosing Buffer Zone Region from the RBMB again, changing the setback distance, and accepting the new prototype region.



The Region Panel

When you click on the OK button in any of the Region Generation windows, the Region is automatically added to the list on the Region panel and highlighted. A region is created as a temporary object with a default name that is the same as the object from which region generation was initiated. If you create multiple regions based on the same object, the new region names will be appended with a 1, then a 2, and so on. Click on the Edit icon if you want to change the default name without creating a permanent region object. Click on the Save icon if you want to save the region as a permanent object for use in later display sessions or other processes. The current region name is offered as the default in the New Object window when you save. You can change the name and edit the description if desired.

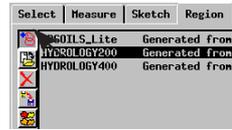
You can also open previously saved region objects or any vector object to serve as a region by clicking on the Add icon. When you open a vector object as a region, all polygon boundaries are dissolved and you are left with the object outline.

You can use the Region tool without first generating any regions in the current display session by clicking on the Add button to select an existing region or vector object, which will then be drawn in position if it falls within the area currently shown in the View window. The drawn region changes as you change the region selected in the list.

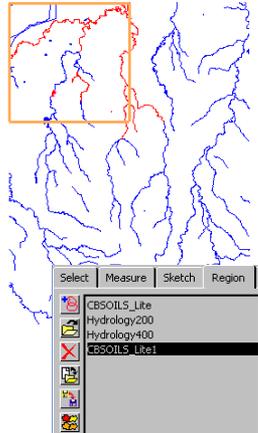
There is also a Delete icon so that you can remove regions you no longer need from the list. Remember that a newly generated region is a temporary object; if you haven't used the Save button, you cannot select this region in a subsequent display session. The last icon at the left of the region list is the Combine icon, which is active when there are two or more regions in the list. Region combinations are discussed at the end of this booklet.

STEPS

- click on the Add icon  on the Region panel



- select the CBSOILS_LITE vector object and click [OK] in the Select Objects window
- hide the CBSOILS_LITE vector layer



Note: The CBSOILS_LITE vector object you added as a region was renamed CBSOILS_LITE1 to distinguish it from the region generated from selected soil polygons in the exercise on page 8.

- highlight each entry in the region list in turn and note the changes in the objects drawn
- when done with this exercise, choose Display / Close in the Display Manager window

Cluster and Polygon Fitting Regions

STEPS

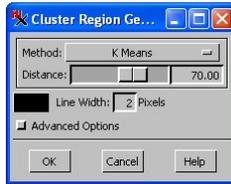
- ☑ click on the Add Objects icon in the Display Manager and select the POINTS object in the REGIONS Project File
- ☑ expand the layer listing in the Display Manager
- ☑ right-click on the point element row and choose Mark All
- ☑ right-click on the point element row again and choose Cluster Region
- ☑ set the Method to K Means and Distance to 70.00, then click [OK] in the Cluster Region Generation window
- ☑ right-click on the point element row, choose Mark By Query, and enter the query below

Internal.ElemNum <= 54 or
Internal.ElemNum >= 144

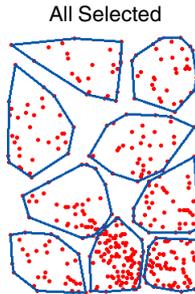
- ☑ click on [Apply]
- ☑ right-click on the point element row, choose Cluster Region, then click [OK] in the Cluster Region Generation window
- ☑ right-click on the point element row and choose Polygon Fit Region, then select Tessellation and set the Percentage to 95, then click [OK]
- ☑ right-click on the point element row and choose Voronoi Region, then click [OK]
- ☑ click on the GeoToolbox icon and highlight each of the regions in turn



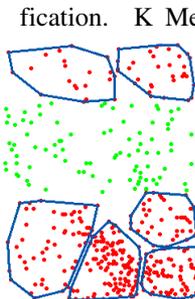
Region generation methods that use points as input without also requiring a reference raster include Buffer Zones, Polygon Fitting, Clustering, and Voronoi Regions. Buffer Zones for points work just as they do for lines; you specify a setback distance,



and any overlap of the buffers around individual points is resolved to form a single polygon. The polygon fitting algorithms were derived originally to define an animal's home range based on swarms of observation points.



The Minimum Polygon, Harmonic Mean, Fourier, Tessellation, Minimum Convex, and Kernel algorithms for Polygon Fitting are available for regions. The Clustering algorithms for points are adaptations of those used for automatic raster classification. K Means, Fuzzy C Means, Minimum Distribution Angle, Self Organization, Adaptive Resonance, and ISODATA Classification methods are available.

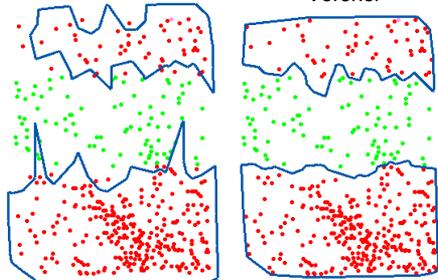


Changes in parameters while generating these regions are immediately applied to the displayed regions.

Query Selected

Polygon Fitting (Tessellation)

Voronoi

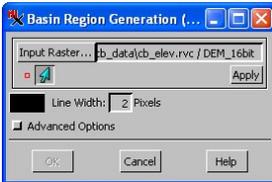


Basin Region Generation and Histogram

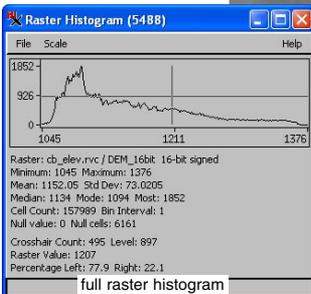
A basin region identifies the watershed basin for one or more selected points using an elevation raster to determine the cells that contribute to water flow through the selected points. Points can be selected from any existing vector object or drawn directly over a reference object as you do in this exercise. When the Region tool is active, you can update the histogram for any raster that has an open Raster Histogram window so that it includes only the histogram of those cells that fall within the selected region.



Your display will appear with a rainbow color map instead of in gray-scale as shown here. If you would rather view the raster in grayscale, set the Color Palette option to None. You select the color map again for the exercise on page 15.



Keep this elevation raster open in the View window for the next two exercises.



STEPS

- click on the New icon, choose 2D Display, and select the DEM_16BIT object in the CB_ELEV Project File
- click on the Geo-Toolbox icon
- click on the Point drawing tool
- position the cursor approximately as shown and click the left mouse button to place the tool
- right-click and select Basin Region from the dropdown menu
- click on [Input Raster] and select DEM_16BIT if not selected
- click on [Apply]
- click on [OK] (results will vary with point position)
- right-click on the row for the DEM_16BIT layer and select View Histogram from the menu
- view the Histogram Display then click on the Update Histograms icon in the GeoToolbox window and note the difference

Viewshed Region Generation

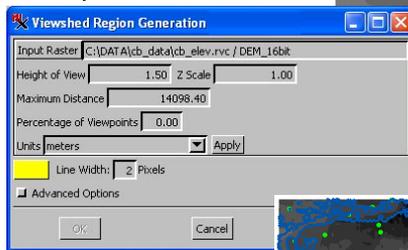
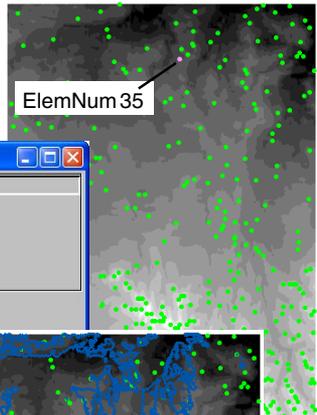
STEPS

- click on the Add Objects icon, and select the POINTS object in the REGIONS Project File
- expand the POINTS layer, right-click on the point select row, and choose Mark by Query
- choose Internal for the Table and ElemNum for the Field
- choose Number from the second [Choose Type/ Table] option menu, enter 35 in the field that appears to the right, and click [OK]
- right-click on the point selection row and choose Viewshed Region from the menu
- click on [Input Raster] and select DEM_16BIT from the CB_ELEV Project File
- set the Height of View to 1.5 (meters), then click on [Apply]
- click on [OK]
- click on the Edit icon in the Region panel and change the name to Viewshed



A viewshed is the area that can be seen from one or more selected points, and thus requires elevation information (both terrain information and the height of the viewer above the surface at the selected point). Because of the ups and downs in elevation surfaces, a viewshed is generally made up of many discrete polygons some of which may be very small.

The viewshed functions allow you to pick multiple viewpoints and designate the percentage of the selected points that must be able to see a particular location for it to be included in the viewshed. A percentage of 0.00 means that the location must be visible from at least one of the selected points. A maximum distance to search for components of the viewshed can also be entered. The default value is somewhat larger than the largest dimension of the elevation raster.



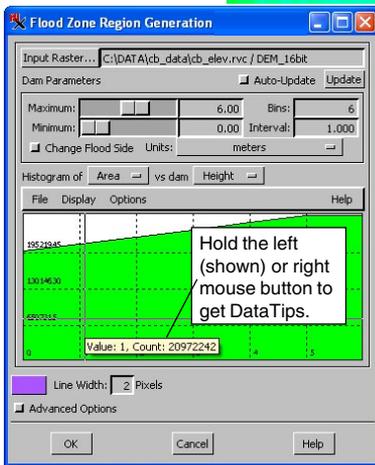
This region outline indicates which areas can be seen from 1.5 meters above the surface at point 35.

Note that the regions on these two facing pages are drawn in the same color even though the color shown for the prototype region differs. The final regions are drawn with the Graphic Tools color set from the Options menu in the GeoToolbox window.

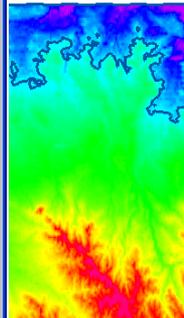
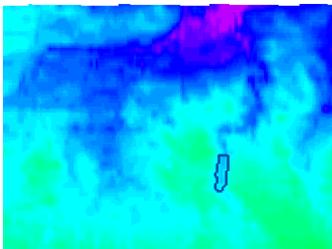
Flood Zone Region Generation

Flood zone regions enable you to determine the area that would be flooded if a dam represented by a selected location and a specified height happened to break and, alternatively, to determine the area that would be covered by the lake behind the dam. You may have a vector object with designated potential sites or you may be looking for a suitable site. The “dam” line you draw or select must cross a valley or you will receive the message that the element is improperly positioned.

Use the Line tool to evaluate a potential dam site.



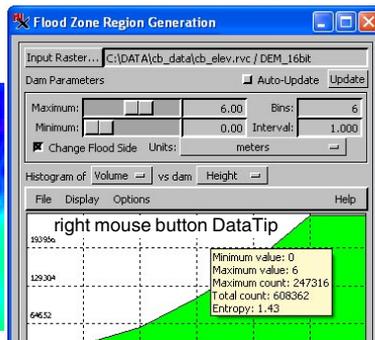
The histogram shows either the area covered by or the volume of water with increasing dam height.



STEPS

- ✓ remove the POINTS layer
- ✓ open the Layer Controls for the DEM_16BIT layer and choose ColorMap on the Color Palette option menu
- ✓ with the cursor over the View window canvas, type a 1 (to zoom one-to-one) and check that a position report on the Options menu (View window) is toggled on with the Projection set to Lat / Lon
- ✓ position the cursor near N 42° 44' W 103° 19' and press the + key
- ✓ click on the Geo-Toolbox icon then on the Line tool
- ✓ draw a line across the narrow, darker blue “finger” near the center of the view, then right-click and select Flood Zone
- ✓ click on [Input Raster] and select the DEM_16BIT object from the CB_ELEV Project File
- ✓ enter 6.0 meters for the Maximum height and click [Update]
- ✓ after observing the

region that would flood if the dam broke, change the Histogram option menu to Volume, click on the Change Flood Side toggle, and [Update]



Raster Area-Trace Regions

STEPS

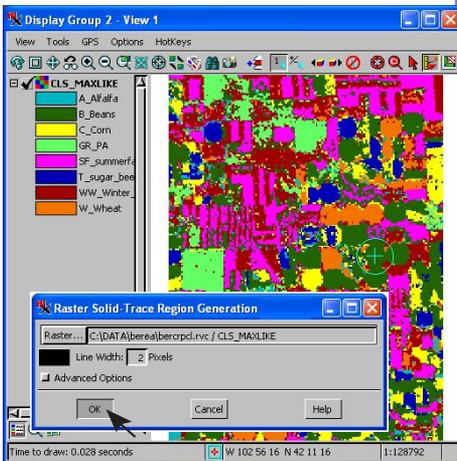
- choose New / 2D Display, and select the object in the BERCPCL Project File in the BERE data collection
 
- click on the Geo-Toolbox icon, then on the Point tool
 

- position the cursor over one of the several connected bean fields (dark green, cell value = 5) at the center right of the raster and left-click
 
- right-click and choose Raster Area-Trace Region from the menu
 
- click on [Raster] and again select CLS_MAXLIKE, then click [OK]
 
- click on the Region tool and the Measure tab to see both the region outline and the measurements for the rather rambling bean field
 

Raster Area-Trace region generation creates a region that encloses an area of uniform cell value defined by the position of the point tool. This type of region is best generated from categorical data, such as automatic classification or feature map rasters. The position of the point tool defines both the origin and the cell value for the region. The region is generated by searching from the origin in all directions until any different cell value is found, which defines the region boundary.

You can use the Multi-Point tool on the Controls panel of the GeoToolbox to define multiple origin and cell value pairs. The region polygons generated from multiple points still enclose just one cell value (unless you happen to place points so that region polygons would share a common boundary, which is dissolved), but that cell value can be different for each polygon.

Another region generation method, Raster Boundary-Trace, uses the point tool to define an origin and one or more boundary cell values. Such regions include the origin and extend until the boundary values are encountered.



raster set to 50% transparency to make region visible (black outline)

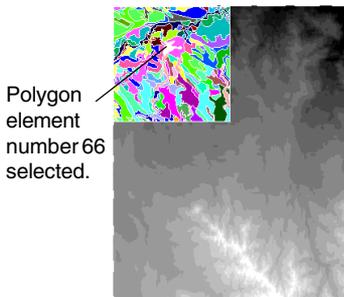


Raster Cell Region Generation

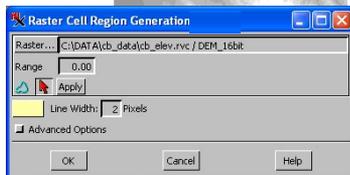
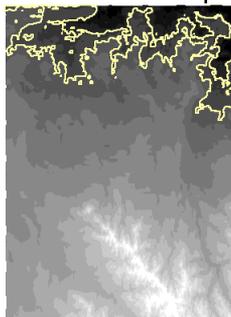
A Raster Cell Region is generated by first selecting one or more points, lines, or polygons. The cell values that fall within the selected polygons, along the selected lines, or at the selected points define the cell values to find throughout the raster. (You can also use the GeoToolbox to draw the points, lines, or areas for cell value identification.) The resulting region outlines the cells that match those initially identified by selected elements.

You can set a range around the identified cell values to expand the raster values matched when generating the region. We leave the range at zero in this exercise so that only the values `Internal.ElemNum==66` that fall within the selected polygon are matched throughout the raster.

We use an elevation raster as input so the resulting region includes the cells with the same elevations as those enclosed by a specific polygon. A more sophisticated usage might involve a classification raster, say clustering of a multitemperal, multispectral image, and a vegetation map or surface geology vector object. Then the raster cell region would represent the image classes that were associated with a particular vegetation type or surface geology.



You will use this region in the exercises on the next two pages.



STEPS

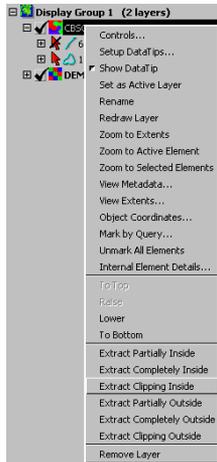
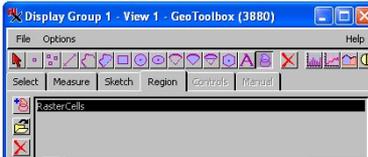
- choose New / 2D Group, select DEM_16BIT from the CB_ELEV Project File, CBSOILS_LITE from the REGIONS Project File
- set the Color Palette option menu to None for DEM_16BIT
- expand the CBSOILS_LITE layer in the Display Manager
- right-click on the polygon row, choose Mark By Query, and enter the query at the left
- click [Apply] in the Mark Polygons By Query window
- right-click on the polygons row and choose Raster Cell Region
- click [Raster] and select DEM_16BIT
- click [Apply]
- click [OK]
- click on the Geo-Toolbox icon, the Region tab, then the Save icon, and save the region to your REGIONS Project File naming it RasterCells

A Raster Cell region identifies those cells with the same elevation values as enclosed by the selected polygon(s).

Extract via Region

STEPS

- check that the Region tool is active and the RasterCells region is selected on the Region panel
- right-click on the CBSOILS_LITE layer in the Display Manager and select Extract Clipping Inside from the lower panel of the menu
- change to some tool in the GeoToolbox or in the View window so the drawn region doesn't obscure your view of the extracted elements



When you start this exercise, the Region tool and Region tab are selected if you have just completed the previous exercise. This tool may be automati-

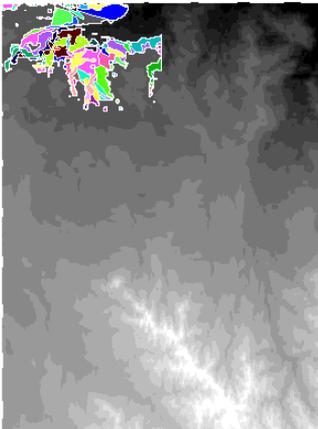
cally selected after generating a region, but it depends on the options used to generate the region. Making the Region

tool active does not necessarily activate the Region panel, which lets you open, save, delete, and rename regions, as well as initiate region combinations.

Note that the vector object you are extracting from becomes a hidden layer and the extracted layer is drawn when the extract function is completed. If the original layer was not hidden, you wouldn't be able to tell the extracted layer was also there.

This extracted layer is only a temporary object; when you exit the display process, it is gone (so be sure not to exit the display process before completing the next exercise). If the extraction is done in TNT's Editor, you can paste the extracted elements into a new or existing vector object. You can also use the Copy function in the Editor to extract only selected elements within a region. The extract functions in display extract all elements within the region whether or not they are selected. A later exercise in this booklet tells you how to add regions to vector objects using the TNT's Editor.

Although temporary, the extracted layer has all the element selection features and database viewing capabilities of any permanent object. The database information is adjusted when you extract so that only the records attached to the extracted elements remain in the tables.



New Tables from Extracted Elements

The extracted layer is identified by DataTip and in the Layer Controls window as located in a file named TEMP0001.TMP (or a higher number if you have other temporary files on your machine) with the original object name. You will note that all the display controls are available for this temporary layer. You can click on the Layer Controls icon and change the display parameters. You can expand the layer in the Display Manager and view all the associated database information, which is the same as for the original object except only those records related to the elements in the extracted object are present. You can use the Save As feature found in tabular database viewing to create a new and permanent table that will continue to identify the attributes of the elements that were part of this extraction. The elements themselves can also be identified using either the selection tools or by selecting from database records.

The tables associated with extracted elements, or any tables, can be saved in TNTmips' internal format (RVC), in dBASE III/IV format, in a predefined ODBC format, as comma separated values, as tab delimited text, as a CAD snapshot, or as HTML. You need not save all records in a table; you can save only those records attached to the active element or all marked elements or only records that are selected in the tabular view. You also have the option of whether or not to save any fields hidden at the time and whether to save with the units as currently shown or as stored.

STEPS

- expand the extracted vector layer and its polygon row
- open the DESCRIPTN table and switch to tabular view
- choose Save As from the Table menu
- check that Format is set to RVC, Records to All Records, and Values is set to Data, then click [OK]
- select CBSOILS_LITE as the destination vector object, click [OK] in the Select database object window, set the element type to Polygon, and click [OK] again in the Edit Name and Description window
- note the new table at the end of the CBSOILS_LITE (not the extracted version) polygon list
- close this group and delete the region

Style	SYMBOL	NAME	ACRES
Bc		Bankard loamy fine sand, 0 to 2 percent slopes	3500
Bd		Bankard loamy fine sand, wet variant, 0 to 2 percent slopes	2600
Bg		Bridget silt loam, 0 to 1 percent slopes	5000
BgB		Bridget silt loam, 1 to 3 percent slopes	11400
BgD		Bridget silt loam, 3 to 9 percent slopes	10000
BgF		Bridget silt loam, 9 to 20 percent slopes	5900
BnB		Buften silty clay loam, 1 to 3 percent slopes	4400
BnD		Buften silty clay loam, 3 to 9 percent slopes	9000
BoD		Buften-Slickspots complex, 0 to 9 percent slopes	6200
DuB		Duroc very fine sandy loam, 1 to 3 percent slopes	6800
FnF		Finnish silt loam, 3 to 30 percent slopes	2300

37 of 37 records shown

The number of records in the extracted and saved database table is fewer than in the original.

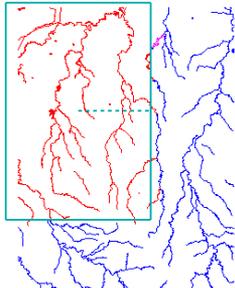


Advanced Options

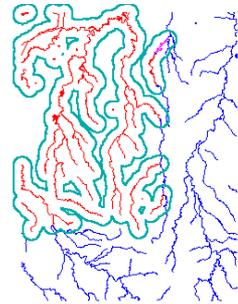
STEPS

- click on New, choose 2D Display, and select the HYDROLOGY object in the CB_DLG Project File
 
- expand the HYDROLOGY layer, and turn on selection for lines
 
- click on the Geo-Toolbox icon in the View window
 
- click on the Rectangle icon, draw a box that inscribes the upper left of the vector, right-click, and choose Select Elements
 
- right-click on the lines selection row and choose Buffer Zone Region
 
- set the line buffer distance to 400 m
 
- click on [Apply] then on the Advanced Options button
 
- toggle on the Remove All Islands button, click [Apply] and note how the region changes
 
- toggle off the Remove All Islands button, click once in the trough to the right of the Minimum Island Size slider, click [Apply], and note the changes
 
- click once in the trough to the right of the Minimum Subregion Size slider, click [Apply], and note the changes
 
- click [OK] in the Region Generation window
 
- click on Save and save this region as ADVANCEDOPTIONS
 

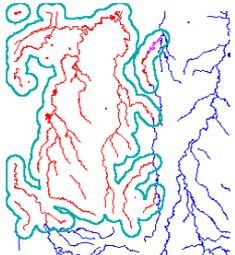
The advanced options, which are available for all region types, let you remove islands and subregions less than a specified size from a prototype region. The advanced options are only active while this drop down panel is active, so you must click on [OK] with the panel open for the settings to become part of the actual region.



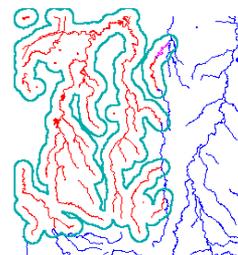
area selected



400m buffer zones
advanced options off



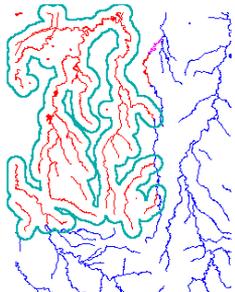
all islands removed



only smaller islands removed

Advanced Options	
Minimum subregion size:	0.0000
Minimum island size:	0.0000
Units: square meters	<input checked="" type="checkbox"/> Remove All Islands

Advanced Options	
Minimum subregion size:	0.0000
Minimum island size:	514968.41
Units: square meters	<input checked="" type="checkbox"/> Remove All Islands



small islands and small
subregions removed

Advanced Options	
Minimum subregion size:	822659.81
Minimum island size:	514968.41
Units: square meters	<input checked="" type="checkbox"/> Remove All Islands

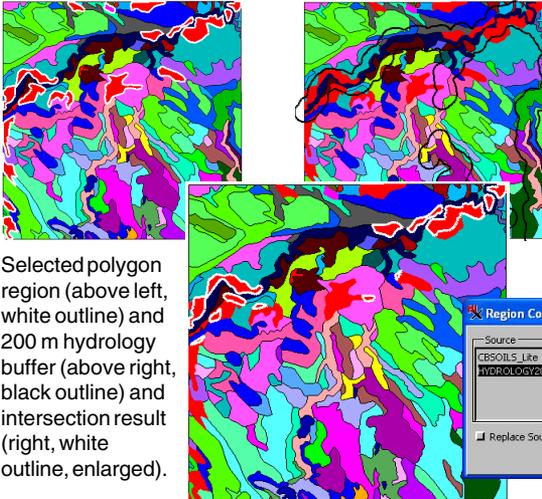
Be sure you've turned this toggle off when you want to remove only some of the islands.

Region Combinations: Intersect

The Combine icon on the Region panel of the GeoToolbox becomes active as soon as two regions are listed. These regions can be newly created or added from a previous display session.

The four combination choices are Intersect (AND), Union (OR), Exclusive Union (XOR), and Subtract. Intersect results include areas found in both regions. Union results include areas found in either region. Exclusive Union results include the areas present in one or the other, but not both, regions. Subtract results remove all areas in the operator region from the source. For more information on these operations see the *Vector Analysis Operations* booklet.

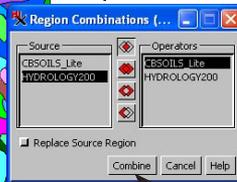
Many questions can be answered using region combinations. You can identify areas that are more than one mile but less than five miles from features of interest, areas that have a slope > 5% and face north, areas of specified soil types within potential development sites, and so on. In this exercise, you identify areas within 200 meters of water features that also have one of two specified soil types.



Selected polygon region (above left, white outline) and 200 m hydrology buffer (above right, black outline) and intersection result (right, white outline, enlarged).

STEPS

- click on New, choose 2D Display, and select the CBSOILS_LITE object from the REGIONS Project File
- expand the layer in the Display Manager and turn on polygon selection
- open the CLASS table
- click on the Show All Records icon in tabular view, scroll and click in the Select Record box for GoB and JmC polygons
- click on the Exclusive icon in tabular view
- right-click on the polygon selection row, choose Marked Polygons Region, and click OK
- click on the GeoToolbox icon, then on the Region tab, and on the Add icon
- select the hydrology200 region you made on p. 10
- click on the Combine icon on the Region panel
- with the operation set to Intersect and HYDROLOGY200 as the Source and CBSOILS_LITE (selected polygons) as the Operator, click on [Combine]



Region Combinations: Subtract

STEPS

- ☑ in a new 2D Display, select the **CACOUNTIES** and **CALCITIES** objects in the **REGIONS** Project File
- ☑ expand the **CALCITIES*** layer, right-click on the point selection row, choose **Mark By Query**, enter the query at the right on the **Script** panel, and click on **[Apply]** in the **Mark Points by Query** window
- ☑ right-click on the point selection row and choose **Buffer Zone Region**
- ☑ set the distance to 10 miles, click **[Apply]**, then **[OK]**
- ☑ click on the **Unmark All** icon in the **View** window, change the selection query for the points to match that at the right, and click on **[Apply]**
- ☑ right-click on the point selection row, select **Buffer Zone Region**, set the distance to 100 miles, click **[Apply]**, then **[OK]**
- ☑ click on the **Geo-Toolbox** icon, on the **Region** tab, then on the **Combine** icon
- ☑ choose **CalifCities** as the **Source** and **CalifCities1** as the **Operator**, click on the **Subtract** icon, then on **[Combine]**
- ☑ click on the **Region** icon to see the results

Population.POP > 20000 and
Population.POP < 90000



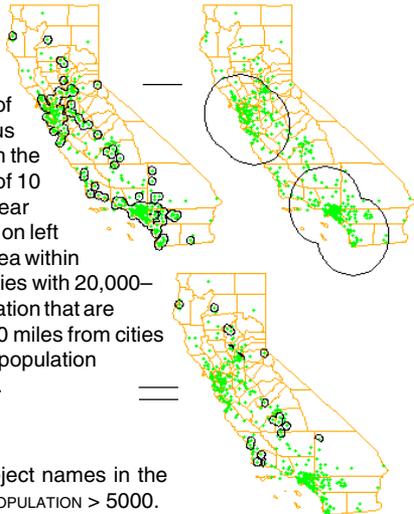
Population.POP > 50000



Subtract is the only region combination in which it matters which region is the source and which is the operator. (The source / operator assignment in vector combinations does matter for vector combinations for the other operations because of element selection and attribute transfer considerations.) The purpose of this exercise is to locate areas to live in California within 10 miles of a city with a population between 20,000 and 90,000 but at least 100 miles from a city with a population > 500,000.

Such areas can be identified by subtraction of two buffer zones (intersection would find areas within 10 miles of moderately sized cities that were also within 100 miles of large cities). The importance of which region is the source and which the operator is apparent in this example. If the 100 mile buffer zone is the source, the result identifies areas that are within 100 miles of a large city but not within 10 miles of a city with population between 20,000 and 90,000. For this example, the 10 mile buffer zone is the source and the 100 mile buffer zone is the operator.

When you subtract the buffer zones of 100 mile radius (far right) from the buffer zones of 10 mile radius (near right), the region left represents area within 10 miles of cities with 20,000–90,000 population that are more than 100 miles from cities over 500,000 population (bottom right).



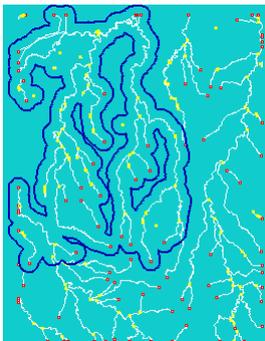
* If showing descriptions rather than object names in the **Group Controls** window, **CALCITIES** IS **POPULATION > 5000**.

Adding Regions to Vector Objects

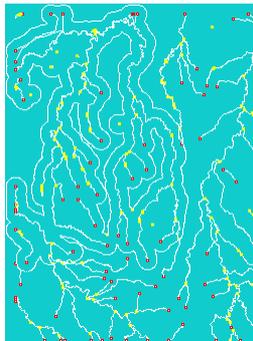
This is the only exercise in this booklet that cannot be completed in TNTview, as well as in TNTmips and TNTedit. The features of TNT's spatial Editor are required. Most illustrations in this booklet use a white background in the View window, which is the default color for lines in the Editor. It appears as though nothing has been drawn if you open an object for editing over a white background. Also note that after you add the region, you need to change to some tool other than the Add Region tool in order to see the changed appearance of the vector object.

In this example we add the region without assigning any attributes. Attribute assignment is the topic of another Getting Started booklet (*Managing Geoattributes*). It is up to you whether you save or discard this object when exiting the Editor (the original is not affected in any way).

region and vector
before adding

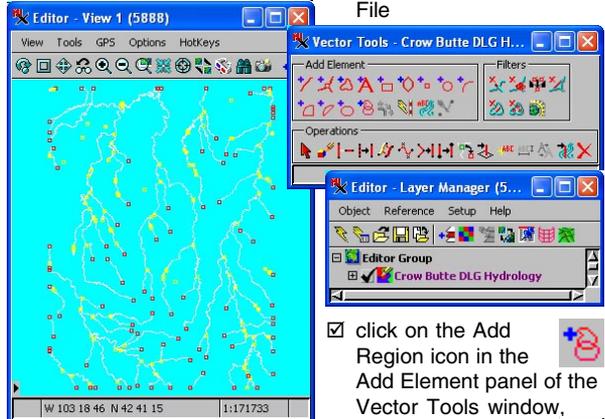


vector after
adding region



STEPS

- choose Main / Edit from the TNTmips menu
- click on the Open Object for Editing icon and select HYDROLOGY from the CB_DLG Project File



- click on the Add Region icon in the Add Element panel of the Vector Tools window, then click on the Add Region icon in the Add Region Parameters panel that opens



- select the ADVANCEDOPTIONS object you saved on page 20
- click on Element [Add] below the Add Region Parameters panel
- change the tool selected in the Add Element panel to see the added elements

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