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Editing Vector Geodata

in

TNTmips®

and TNTedit™

Before Getting Started

This booklet introduces techniques for creating, altering, and updating vector geospatial objects in the Editor in TNTmips® and TNTedit™. Vector objects that you make or import can contain point, line, and polygon elements in strict topological relationships. Each element may have associated attributes and can be connected with complex databases. The exercises in this booklet introduce you to the basic tools used with each element type for vector objects. The Editor also has tools for editing your CAD, raster, shape, database, and TIN geodata.

Prerequisite Skills This booklet assumes that you have completed the exercises in the tutorials *Displaying Geospatial Data* and *TNT Product Concepts.* Those exercises introduce essential skills and basic techniques that are not covered again here. Please consult those booklets for any review you need.

Sample Data The exercises presented in this booklet use sample data that is 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. In particular, this booklet uses objects in the NFRESGIS Project File in the EDITVECT data collection, and STATES from the USA_STATE Project File and STATEPOP.DBF from the USA data collection. Make a read-write copy of these files on your hard drive; you may encounter problems if you work directly with the sample data on the DVD.

More Documentation This booklet is intended only as an introduction to vector editing in TNT's Editor. Consult the *Advanced Vector Editing* tutorial booklet and numerous Technical Guides available on MicroImages' web site for additional information.

TNTmips Pro, TNTmips Basic, and TNTmips Free TNTmips comes in three versions: TNTmips Pro, TNTmips Basic, and TNTmips Free. If you did not purchase the professional version (which requires a software license key), you are using TNTmips Free or TNTmips Basic, which limit the size of your project materials. All exercises in this booklet can be completed in TNTmips Free, TNTmips Basic, and TNTmips using the sample geodata provided.

Merri P. Skrdla, Ph.D., 18 August 2013
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Spatial Data Editing Overview

TNTmips' spatial data Editor (Main / Edit) offers a flexible, editing environment that can be used for simple one-object tasks or complex multi-layer, multi-object manipulations. You can have one editable object or a combination of read-only reference layers with editable layers. You can have multiple types of objects open for editing at the same time, stacked in any top-to-bottom order.

Editing operations apply to the currently "active" layer. As you switch from layer to layer, the editing tools automatically change according to the data type of the active layer (raster, vector, shape, CAD, or TIN).

Newly created objects may have independently defined map registration, or map registration derived from another layer in the editor.

A **layer** contains one geospatial object: raster, vector, shape, CAD, TIN, or database. TNT automatically reconciles the map registration and scale of all layers.
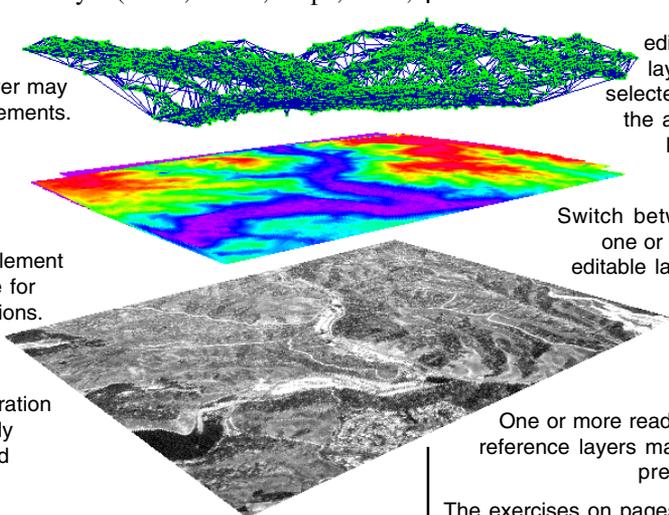
The active layer may have many elements.

One or more elements may be selected, or marked.

One marked element may be active for editing operations.

All map registration is automatically reconciled and maintained.

One editable layer is selected as the active layer.

Switch between one or more editable layers.

One or more read-only reference layers may be present.

You may see editing tools like those in TNTmips in other software products, but the important thing about the TNTmips Editor is the way you can edit *multiple geospatially related* objects easily and intuitively. You can concurrently edit project materials of all types while TNTmips automatically retains and reconciles their map registrations. This means that all the new objects you create can automatically derive their map registration from other layers, so all of your project materials have a correct geospatial relationship.

The exercises on pages 4-14 show how to create a georeferenced vector object that contains drainage line elements traced from a topographic reference map. This activity is often called "heads up digitizing." Pages 15-17 introduce techniques used in creating and editing other vector elements. Pages 18-22 deal with creating and attaching attribute tables.

Add a Reference Layer

Add Reference Objects

Edit Reference Layer

Vocabulary: a **reference layer** is a read-only layer used for visual and spatial reference. An **editable layer** is a layer to which you can add and modify elements.

STEPS
- ☑ launch the Editor
- ☑ click the Add Reference Objects icon button
- ☑ select the MAP_100 raster object from the NFRESGIS Project File in the EDITVECT sample data

The MAP_100 raster object is a 333 x 269 8-bit color-mapped section of a scanned 1:100,000 paper map of Fresno, California. It is georeferenced to Latitude / Longitude map coordinates. Each raster cell represents approximately 20 meters on the ground. Since this raster is georeferenced, any new layers you create using MAP_100 as a reference layer can automatically have the same georeference attributes.

In the first set of exercises you will create a new vector object that contains georeferenced hydrology line elements. You will use a reference layer that is a georeferenced map scan with hydrology features, and trace over the hydrology lines with the TNT editing tools.

Launch the TNT spatial data Editor by selecting Main / Edit from the TNTmips menu bar. TNTmips opens the Editor-Layer Manager and View windows. Most menus and icon buttons in the View window are the same as those you are already familiar with in the Main / Display process. You can change a reference layer into an editable layer using the Edit Reference Layer icon on the Editor Layer Manager toolbar.

Adding a reference layer first provides the georeference for the vector you are going to draw. You can choose from among the reference layers or other editable layers to provide the coordinate reference system for any new object. A new vector object will have an implied georeference, which means that the object coordinates will reflect the georeference coordinates.
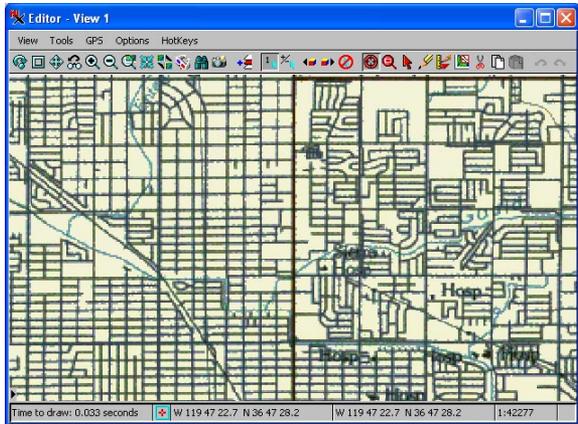
Create a Geospatial Vector Object

Use the New Object Values dialog to tell the Editor how your new vector object relates spatially to the MAP_100 reference layer. The first panel lists your choices for georeference, and by default, the selection highlight is on the Fresno Map reference layer. Choosing that item means that your new vector object will have the same initial spatial extents, orientation, and map registration as the MAP_100 reference layer. Automatic transfer of the coordinate reference system is one of the important benefits of using a reference layer when you create new spatial objects: your new object can take its coordinate reference system from existing georeference, and thus it will automatically relate correctly to all of your other georeferenced project materials.

Note that the New Object Values window also lets you choose the topology level (polygonal, planar, or network) and whether to include an extents box for the vector object. You can also specify whether the vector coordinates are 2D-XY, 3D-XY (contours with a single elevation value per line), or 3D-XYZ. For more information on vector topology, consult the *Vector Analysis Operations* booklet. Although the georeference for the object cannot later be changed in the Editor, the other parameters can be changed later by selecting Object / Properties from the Editor Layer Manager.

STEPS
☑ click the Create Object icon button and select Vector from the menu
☑ click [OK] in the New Object Values window to copy georeference information from the selected MAP_100 reference raster and create the new object

The New Object Values window by default offers to create georeference control derived from the MAP_100 reference layer. Press the OK button to accept the georeference and other parameters specified in the window.
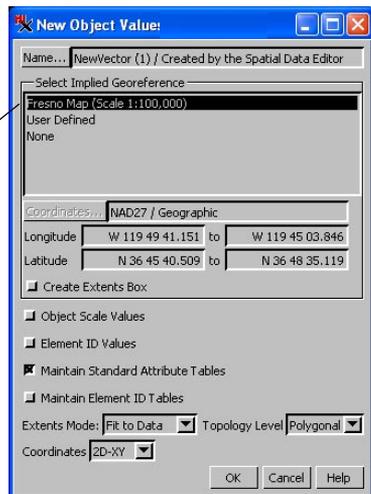
Change the Vector Line Style

Vocabulary: Line thickness, color, and pattern are defined by the current **Line Style**. A **prototype line** is a line being drawn that has not yet been added.

The Editor uses thin white lines as the default drawing style for vectors. For better visibility in this exercise, change the line color to red or some other bright color with a line thickness of 0.5 millimeters.

You can change line styles at any time during an editing session. You can save line style definitions and use a single or multiple styles again and again. Since you are creating hydrology line elements in this exercise, you will eventually want them to display in blue. But since we are tracing over blue pixels in the reference raster, the intermediate work will be easier to see in red.

When changing line thickness or any other size parameter in the TNT products, you want to change the units first. If you change the numeric value first, it will automatically change to a new value to reflect the newly selected units. The At Scale setting below the line width determines how the lines behave when you zoom in and out. A setting of None means that the line width does not change as you zoom in and out. The other two choices (User Defined and Design) make the lines wider when zoomed in beyound the set scale and narrower as you zoom out from that scale.

STEPS
- ☑ click the Layer Controls icon button for the new vector object
- ☑ select the Lines tab
- ☑ click [Edit] for Style
- ☑ select red from the color palette
- ☑ change the Width value to 0.50 millimeters
- ☑ click [OK] in the Style Editor and Vector Layer Controls windows

Select the Lines tab and click [Edit] to open the line Style Editor.
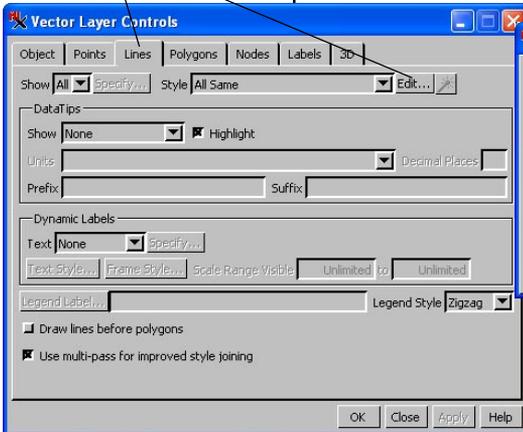
Click on a red tile in the color palette and change the Line Width to 0.50 millimeters.

Select the Add Line Tool

When an editable vector object such as your new vector is selected in the layer list, the Editor opens the Vector Tools window. The Vector Tools window presents a selection of tools for creating and editing elements in a vector object. Vector elements do not have individually assigned drawing styles as CAD Elements do. However drawing styles can be varied by script, by attribute, or by theme.

The Automatic line drawing mode lets you add to the beginning or end of the line, add new vertices, and drag existing vertices while drawing or editing the line depending on what the cursor is closest to.

When you change the drawing mode from Draw to Stretch, you see each new line segment and can drag the position of its endpoint before you place it. For the drawing operations in these exercises, this ability to move a segment as you draw to align with the reference image underneath is very helpful.
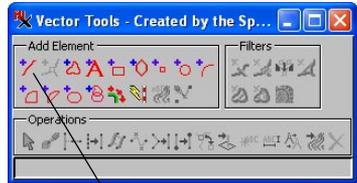
The Add Line tool opens the Add Line Parameters and Snap Options panels in the Vector Tools window.

STEPS
- ☑ click the Add Line button
- ☑ change from Draw mode to Stretch mode

The default setting is Automatic.

Change to Stretch mode.

When the cursor is the crosshairs shape, it adds to the end of the line unless it is within the snap distance of the start (in which case it adds to the start).
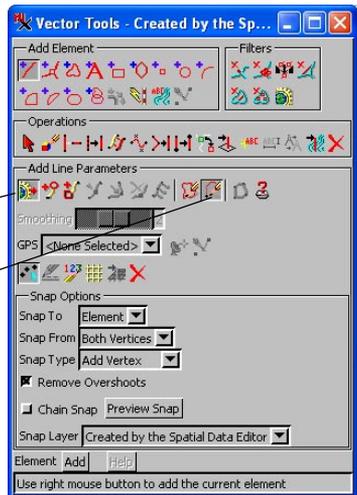
The cursor and the vertex indicator change shape as they change function.

A plus (+) symbol cursor on the line together with a hand cursor indicate that the vertex will be moved if you click and drag.

A diamond symbol cursor on the line together with a hand cursor indicate that a vertex will be inserted if you left-click.

Add Prototype Line Segments

STEPS
- ☑ zoom in on the hydrology feature at the northwest of the reference map
- ☑ click the left mouse button to extend the prototype line
- ☑ drag each new vertex to adjust the position of the new line segment

You are now ready to begin drawng hydrology features, creating new line elements as you work. With the Add Line tool active, each time you click the mouse, the editor adds a vertex to the line element. Your first click defines the starting point of the line, so choose the place where the hydrology runs off the top edge of the reference map. Then move the cursor down a short distance and click on one of the blue hydrology map pixels.
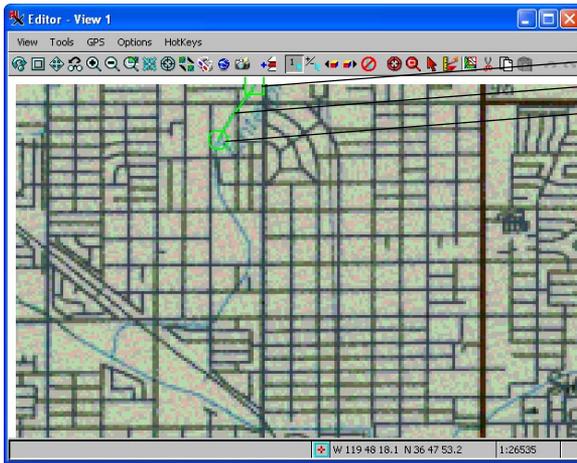
first click
second click
third click

When in the stretch drawing mode, the Editor draws a prototype segment that joins your first two click locations. Click again, a little farther along the hydrology feature to add another segment. Since you are in stretch mode, you can adjust elastic segments by dragging each new vertex to just the right spot. The prototype line does not show in the red line style we selected as long as the line remains a prototype. The prototype line color can be changed by choosing Setup/Preferences in the Editor Layer Manager and changing the Primary Tool Color on the Color tabbed panel.

The last vertex of the line is shown with a circle graphic. You can drag the last vertex by holding down the left mouse button until the vertex is where you want it.

The editor shows the starting point of a **prototype** line with a box graphic.

When you finish a prototype line, "accept" it by clicking the right mouse button.

Each click adds a new **vertex** and a prototype segment to the line.

Cancel a prototype line that you don't want by pressing the Clear button in the Add Line Parameters panel of the Vector Tools window.

Accept Line Elements

Trace the hydrology feature south to the place it joins the east-west hydrology feature. If you made mistakes and want to alter the shape of the proto-type line simply move the cursor to the place you want to move a vertex and drag it to the desired position or insert a new vertex by left-clicking when the vertex indicator is dia-mond-shaped. If satisfied with your line, click the right mouse button to ac-cept it. The editor redraws the new line element in the selected line style. (A later exercise describes tech-niques of deleting or re-shaping a line after it has been added.)
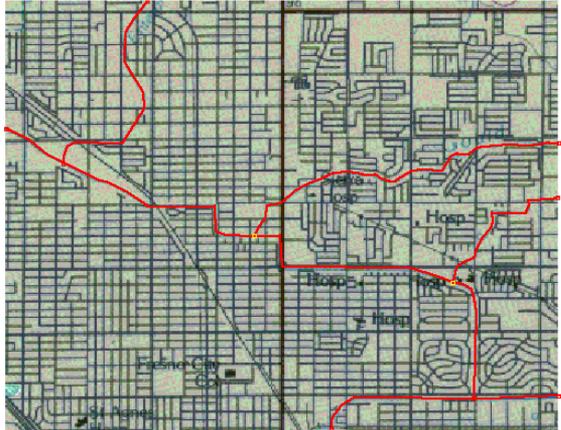
STEPS
☑ zoom and pan until you have added line elements across the entire map

Add a second line element by following the east-west hydrology feature. Continue drawing hydrol-ogy features until you are finished with the map.

At any time, you can zoom in or out using the icon buttons or the + and - hotkeys to work at a higher magnification or see more of the map. You can also use the space bar hotkey to recenter the view when working on a line that goes off the edge of the cur-rent view. All of the standard display tools are avail-able in the View window. Note that hotkeys are pro-vided in the ToolTips for adding elements, filters, and operations.

Note: using the hotkeys (shortcut keys) or the blue icons in the View window, keep the Add Line tool active. Remember that the window must have focus for the hotkeys to be active. If you use a red tool in the View window (e.g., reposition or zoom), the Add Line tool is no longer active. Your prototype line will reappear when you switch back to the Add Line tool.


Save Early, Save Often
Choose Object / Save from the main window. Use the standard select object techniques to select or create a Project File, and name your new object HY-DROLOGY. The Editor also offers an autosave feature. To use autosave, select Preferences / Save from the Setup menu in the Editor Layer Manager and specify how frequently you want a reminder to save your work. You can also enable automatic backups on the Backup tabbed panel. These backups can optionally occur in the background without you being prompted.

Select Existing Line Elements

STEPS

☑ click on the Edit Element operation

☑ click on a line element with the left mouse button to select it

Note: you can also make the editing operations available from the right mouse button menu by toggling on Edit Element on the Vector tabbed panel after you select Setup / Right Mouse Button.

After you accept a line, the Editor draws it in the currently designated line style. You can extend it or change its shape with the editing tools.
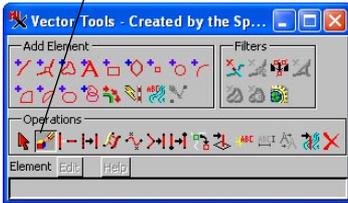
The Vector Tools window provides many editing controls, only a few of which are introduced in this booklet. Editing operations involve two steps: first, element selection, and second, element editing. Element selection can be performed in a variety of ways. Editing operations can only be performed on one element at a time. So single mouse click selection is used in this exercise. The Editor displays individually selected lines in the active element color, which can be changed using Options / Colors in the View window.

In order to select an element, selection for that element type must be turned on in the Editor Layer Manager. All element types are selectable by default. Since you have only added lines, there is no difficulty in selecting the intended element. In more complex editing cases, you may want to turn off selection of other element types to assist you in selecting the element you want to edit.


selection on
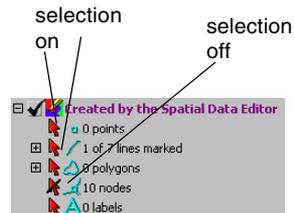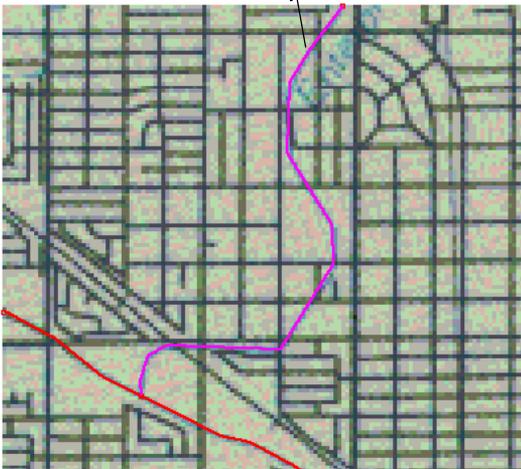
selection off

Click on the selection arrow in the Editor Layer Manager to turn selection on/off.

Line Editing Operations

When a single line is selected, you can activate it for editing operations by clicking the right mouse button. The line is then redrawn with endpoints that represent the snapping distance.

When a line element is **activated** for editing, it is drawn in the primary tool color.

You can reshape the active line by inserting, deleting, or dragging vertices. You can change quickly between these modes by paying attention to the vertex indicator or clicking the middle mouse button instead of the left mouse button (to delete a vertex) when the vertex indicator is the + shape. Sometimes you can get a better fit by simply dragging a vertex. Where the line element "cuts corners" on a curve, you need to insert one or more vertices to correct it. Editing operations are described more fully on the next page.
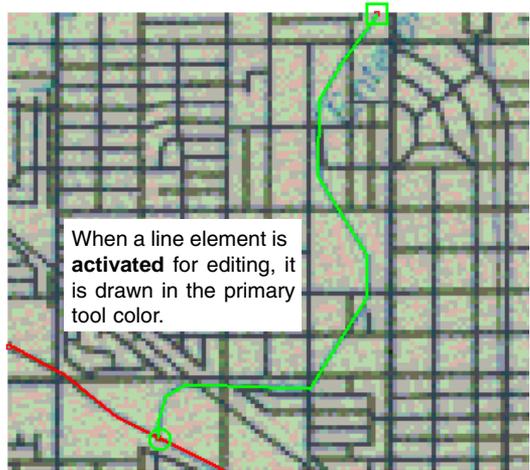
Vocabulary: When you select a single line, it becomes the **active** element. In order to edit the active element, you must first right-click. When multiple elements are selected, you still have one active element and the other selected elements are referred to as **marked** elements.
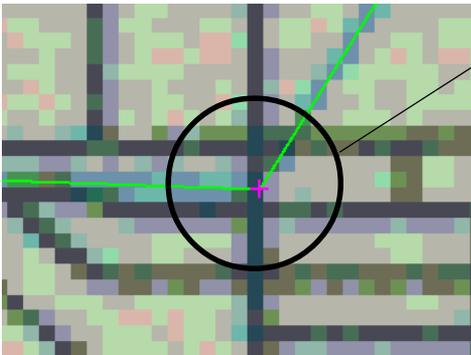
STEPS
- ☑ click the right mouse button to activate the line you selected in the previous exercise
- ☑ use the + key positioned over a line segment that does not accurately follow its reference feature to zoom in
- ☑ move the mouse to a vertex you want to reposition (vertex indicator is + shape) and/or
- ☑ position the cursor where you want to insert a new vertex (vertex indicator is diamond shaped)

Insert, Delete, and Drag Vertices

STEPS
☑ practice changing the shape of a line using the insert, delete, and drag vertex functions

The function of a mouse click changes dynamically as you move along the line. When you are near a vertex, the vertex indicator becomes a + shape. When the indicator is this shape, left-click and drag to move the vertex or click the middle mouse button to delete the vertex. When the vertex indicator is diamond-shaped, left-click to insert a vertex.
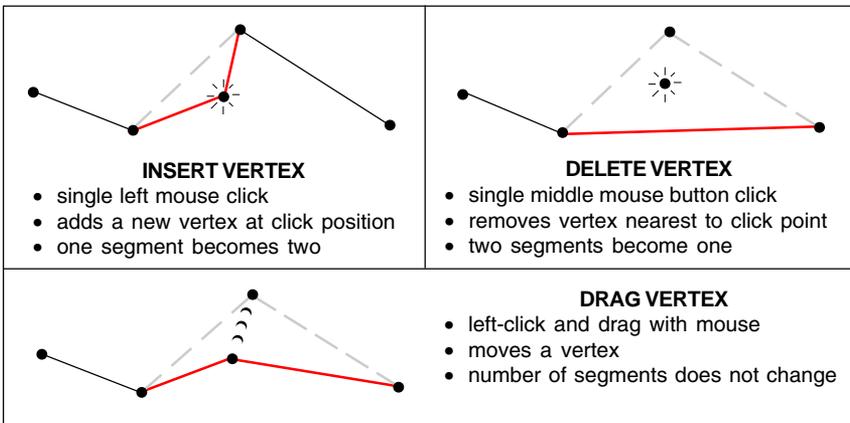
If you want to keep your changes, click the right mouse button or [Save]. To discard your changes, click the Cancel button or just switch to a different editing operation.

**Delete** vertices where too many errant mouse clicks wandered off the feature.

Insert vertices where too few mouse clicks did not conform to the complex shape of the feature.

Drag vertices where the mouse clicks missed the feature.

INSERT VERTEX
- single left mouse click
- adds a new vertex at click position
- one segment becomes two

DELETE VERTEX
- single middle mouse button click
- removes vertex nearest to click point
- two segments become one

DRAG VERTEX
- left-click and drag with mouse
- moves a vertex
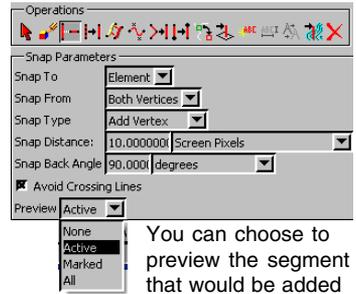- number of segments does not change

Find and Close Gaps

Line elements that you cre-
ate in TNT's Editor should
have no gaps as long as you
do not disable the automatic
snapping feature. The Edi-
tor joins the end of a new
line to an existing line auto-
matically whenever the new
line is drawn within an ad-
justable snap tolerance dis-
tance.

When you zoom in on an
intersection, it may become
apparent that the lines do
not meet.
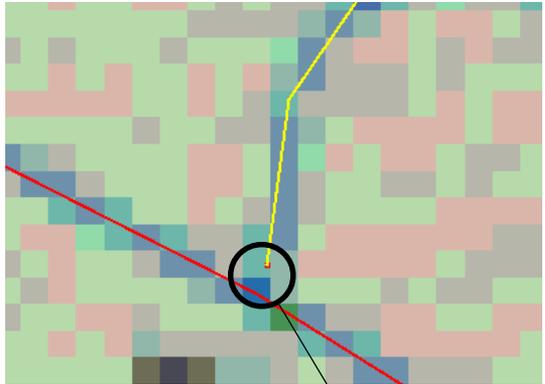
However, if you import vec-
tor line elements from external data sources, you may
have unwanted gaps between line elements that
should intersect. Gaps are often not apparent ex-
cept at high zoom levels. You should check all inter-
sections for possible gaps. Note that the node at
the line end that needs to be snapped, also
called a dangling line, are drawn in a different
color than nodes at intersections. If you are
looking for dangling lines you can open the
Vector Layer Controls, click on the Nodes tab
and increase the Dangling Node size and/or
change its color or style to something that
stands out better against the background.

You can choose to
preview the segment
that would be added
for the snap operation. Set your
choice of Preview color at Setup/
Preferences/Color.
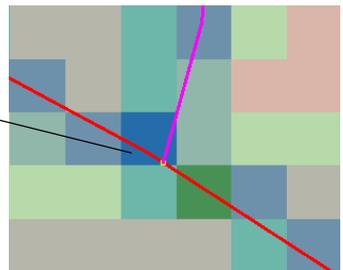
Advanced users can adjust the automatic snap
threshold, and use a selection query to find
dangling line elements automatically.
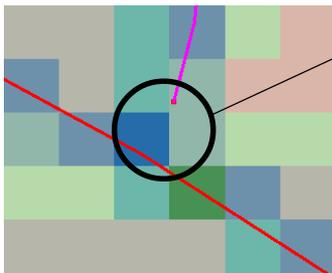
STEPS
- ☑ select the dangling line element
- ☑ set the Snap Distance to 10 screen pixels
- ☑ apply the Snap opera-tion to close the gap

Remove Overshoots

Zoom in on an intersection, to look for an **overshoot** where one line incorrectly extends past another.
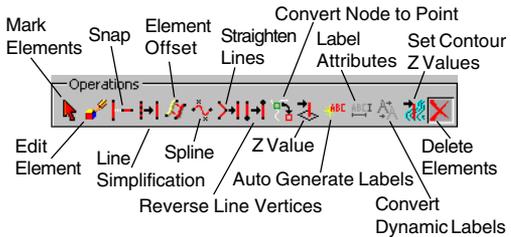
Line overshoots are short dangling lines that extend beyond the intersection with another line. In addition to using the procedure outlined in this exercise, there is a dangling lines filter that can be applied to all lines in a vector object. Line elements that you create in the Editor should have no overshoots as long as you do not turn off the Remove Overshoots checkbox in the Snap Options panel when adding lines. The Editor removes an overshoot automatically whenever a new line is drawn within the currently defined overshoot distance when this button is toggled on.

Dangling Lines Filter
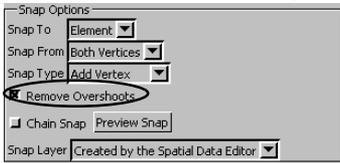
However, vectors imported from external data sources may have unwanted overshoots that extend beyond line intersections. Like undershoots, overshoots are often visible only at high zoom levels.

When the Remove Overshoots toggle is on, the Editor eliminates small overshoots in line drawing. The dangling line length to remove automatically is the same as the snap distance. The Snap Distance is set from the Setup/Preferences/Vector tabbed panel.

Advanced users can adjust the automatic overshoot threshold, and use a selection query to find overshoot line elements automatically.

Mark Elements   Snap   Element Offset   Straighten Lines   Convert Node to Point / Label Attributes   Set Contour Z Values

Operations

Edit Element   Line Simplification   Spline   Z Value   Auto Generate Labels   Delete Elements

Reverse Line Vertices   Convert Dynamic Labels

STEPS
- ☑ select an overshoot line element
- ☑ select the Delete operation
- ☑ click the right mouse button to apply the Delete operation
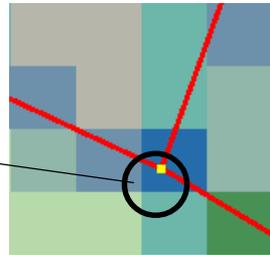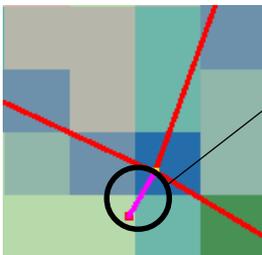
Add Points

Five hospital locations are visible on the MAP_100 reference map. In this exercise, you will create a point element for each hospital. The point tool persists after a point is added if the Clear Tool After Add toggle is off on the Vector tabbed panel of the Setup/Preferences window, so you simply need to drag from one location to the next and then right-click to place another point in the new location.

You could create a separate vector object for the hospitals (refer back to page 5), but for this exercise we will use your existing HYDROLOGY vector object. The Latitude and Longitude fields in the Manual Entry panel show the current position of the Add Point crosshair tool in the View window. You could type in map coordinates from the keyboard, but for this exercise, just manually position the tool over each hospital point.
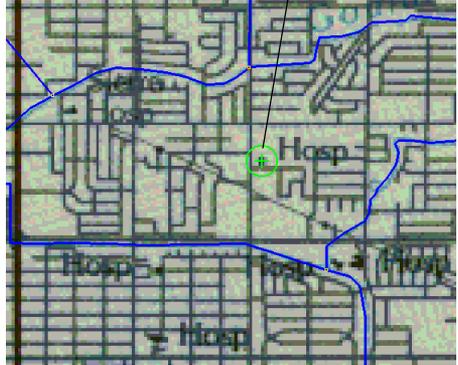
Point positions can be subsequently edited by selecting the point when the Edit Elements operation is active and dragging it to a new location. You can also change the drawing style for points by opening the Vector Layer Controls.

Add a point for each hospital location.

STEPS
- ☑ select the Add Point tool
- ☑ click the left mouse button on a hospital location
- ☑ place the point element by clicking the right mouse button
- ☑ drag the tool to the next hospital location and right-click to add
- ☑ save your changes

Click on this icon to open the Manual Entry panel.

Drag the Add Point crosshair tool with the left mouse button, then click the right mouse button to place the point.
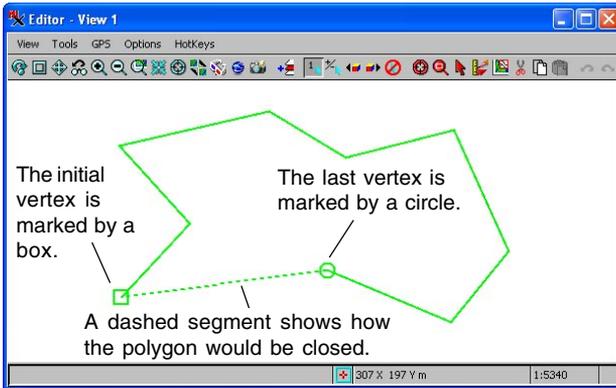
You may edit map coordinates in the Manual Entry panel of the Point Edit Controls window.

Add Polygons

The Add Polygon tool is slightly more complex than the Add Line tool, which you already know how to use. As with the line tool, a polygon's initial vertex

The initial vertex is marked by a box.

The last vertex is marked by a circle.

A dashed segment shows how the polygon would be closed.

is indicated with a box, and the last vertex is indicated with a circle. The new component you see in the polygon tool is a dashed line segment (between the initial vertex and the last vertex) which indicates how the polygon would be closed were you to complete it by clicking the right mouse button. All other aspects of the polygon tool are the same as the line tool.

You can select and edit an existing polygon element the same way you select and edit a line element. Use the insert, delete, and drag functions to reshape a polygon. You can change the drawing style for polygons on the Polygons panel of the Vector Layer Controls. Polygon filling is off by default in the Editor but can be enabled for 2D only or for 2D and 3D if desired.

STEPS
- ☑ right click on the Editor Group entry in the Editor Layer Manager and choose Remove/ Remove All Layers from the menu
- ☑ create a new vector object
- ☑ select "None" in the New Object Values dialog for Select Implied Georeference and click [OK]
- ☑ select the Add Polygon tool
- ☑ click the left mouse button to place a sequence of vertices
- ☑ click the right mouse button to complete the polygon
- ☑ when you are finished, discard this new vector object

TNT's Editor automatically maintains **topology** for all vector objects as you edit. The internal topology tables record information about things like line intersections and island polygons. Processes that work with vector objects rely on precise and dependable topology. You can update topology explicitly by selecting Validate from an object's right mouse button menu in the layer list. To learn more about vector topology, consult the *Vector Analysis Operations* booklet.
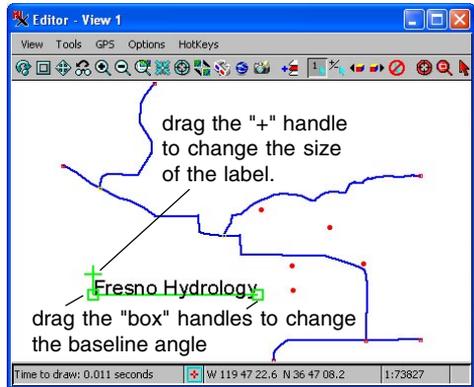
Add Labels

A label in a vector object is an element that has position and style information, just as a point element has. Just as you can change the drawing style and position of a point element, you can change the font, text, size, and color of a label.

When the text tool is active, the left mouse button moves the label baseline if the cursor is the hand shape. To make the label larger or smaller, drag the label's "+" handle or enter a value in the Height field. For georeferenced objects, this height refers to height on the ground.

When you click the right mouse button to finish the label, the Editor displays it in the selected style. You can select and edit a label with the same selection technique you use for other elements.

The label you add in this exercise is an independent label that is not associated with any other vector element. You can also add labels that are attached to elements (see the *Advanced Vector Editing* booklet). You can experiment with advanced label features such as splined baselines and adding leader lines.

The height you enter here is the height used when the Use Element Height toggle is on in the Style Editor window for the label.


drag the "+" handle to change the size of the label.

Fresno Hydrology

drag the "box" handles to change the baseline angle

STEPS
☑ open your HYDROLOGY object
☑ select the Add Label tool
☑ click the left mouse button to move the label baseline
☑ type label text (Fresno Hydrology) in the Add Label Parameters text field
☑ change text size, baseline angle, and style
☑ click the right mouse button to add the label

The MicroImages web site has several Tech Guides that describe the use of advanced labeling features.

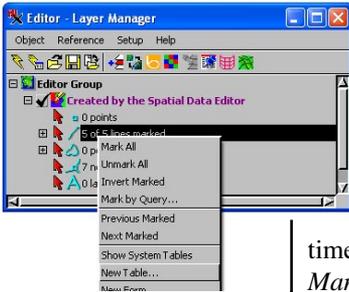Click on this icon button to edit the font and style of the text.
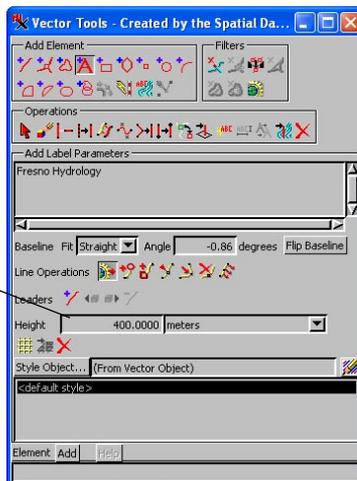
Create an Attribute Table
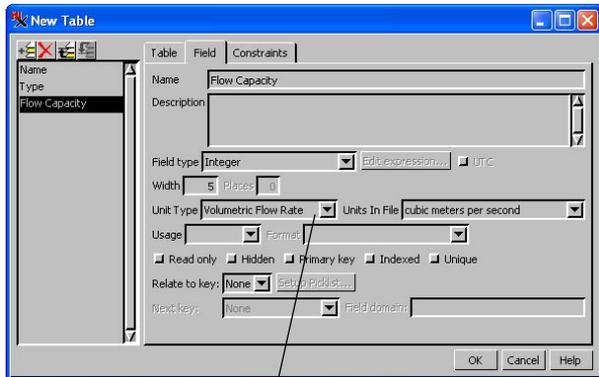
STEPS
- ☑ expand the vector layer in the layer list

- ☑ right-click on the line database entry, choose New Table from the menu, and click Next
- ☑ give the new table a name and description

- ☑ in the next panel, change the Attachment Type option to One Record Per Element, then click Next twice
- ☑ to create a field, click [Add Field]
- ☑ select and edit the field name
- ☑ choose a data type and field length in the Field Info panel
- ☑ click [OK] after you have created the fields indicated in the last paragraph above

One of the most useful features that a geospatial system can offer is the association of tabular attribute values with each element. Your HYDROLOGY object should still be open for editing from the last exercise.

The one thing about an added field that cannot be changed later is the field type. As soon as you add another field or click OK, the field type is frozen. You can change field names and widths and change or specify units at any time by opening the Properties window. Refer to the *Managing Geoattributes* and *Managing Relational Databases* booklets for more information on elements and associated attributes.

Follow the sequence illustrated below to create three fields: Name (type: *String*, width: *10*), Type (type: *String*, width: *10*), and FlowCapacity (type: *Integer*, width: *5*). Click the OK button to complete the table properties and close the properties window.
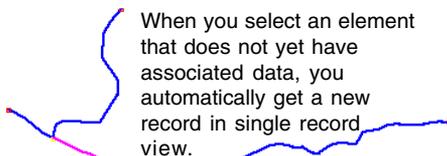

You can specify the unit type for numeric fields.
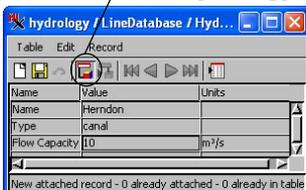
Enter Attributes

In this exercise, you will enter name, type, and flow capacity data into the attribute table that you created in the previous exercise. For each line segment of the Fresno HYDROLOGY you created, you will enter the name of the feature, its type (canal, ditch, or creek), and its flow capacity expressed in cubic meters per second. The values you enter in this case are not important, but in a real project you would of course want them to be accurate.

It is often easier to fill out new records in single record view—more fields are visible without scrolling and a new record is created automatically when you click on an element with no records attached. In tabular view, you can click on the New Record icon or choose Record/New. In either case you get a menu to choose between record attachment types: No attachment, Attached to active element, and Attached to marked elements. Single Record View has knowledge only of the active element, so the Attached to active element toggle is the only control necessary.

You can also create attribute tables for point and polygon elements. Tables are created and attributes assigned just as they are for lines.
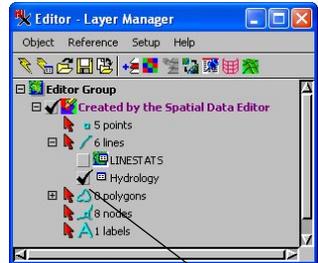
When you select an element that does not yet have associated data, you automatically get a new record in single record view.

Fresno Hydrology

STEPS
- ☑ open your new table from the database list
- ☑ select Switch to Single Record View from the Table menu in the database viewing window
- ☑ click on a line element in the view window
- ☑ type in values for each field in the database viewing window, then click on the Attached to active element toggle
- ☑ repeat steps 3 and 4 until you have supplied attributes for all line elements
- ☑ save and close the HYDROLOGY vector object when you are done

The Attached to active element toggle indicates that the new record is attached to the currently active line element. If the Attached toggle cannot be turned on and off, the table attachment type is Related Only or the table itself is not editable.

Define a Key Field

Although you can type in vector attributes from the keyboard, keyboard entry is tedious and error-prone if you are working with large existing databases. This and the next two exercises detail the steps you can follow to attach existing databases to vector elements using the attributes already assigned and/or entered. Picklists also simplify data entry. For more information on picklists and key fields, see the *Managing Relational Databases* and *Managing Geoattributes* booklets.

The STATE_CODE field makes a good key for other tables to link to, since it contains the ID number used in all the U.S. Census surveys. Using the state code also bypasses failure to match field contents because of differences in capitalization. By establishing STATE_CODE as a **primary key**, you make it possible for other tables to link to the STATES polygons through STATE_CODE values.

STEPS
- ☑ open USA_STATE / STATES from the USA data collection
- ☑ open the STATES table from the table list for polygons
- ☑ select Properties from the Table menu
- ☑ select the STATE_CODE field and depress the Primary Key toggle button on the Field panel, then click OK
- ☑ select Object / Save in the Editor Layer Manager window and save the object
- ☑ exit the Editor

You do not need to use the Editor to change database table properties and contents. It can be done in any process with a Layer Manager. In other processes, database changes are saved as you go. In the Editor, you must explicitly save the object since the changes you are making are in a temporary object.
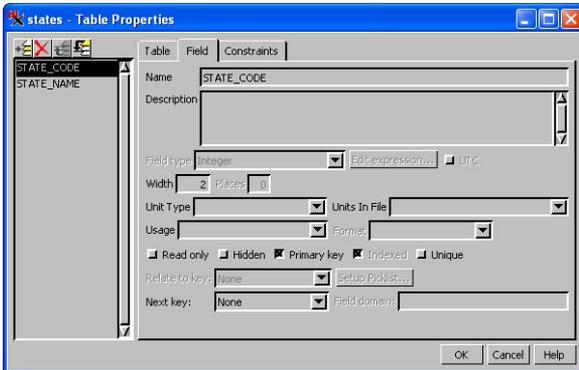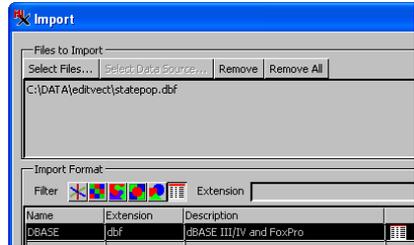

Vocabulary: a **primary key** is a field that other tables use to link to. For example, if a table attached to vector elements designates its ID field as a Primary Key, then any other table that has a field containing ID values in the same range can link to the vector elements through that Primary Key.

See the *Managing Relational Databases* and *Managing Geoattributes* booklets for additional information on key fields and picklists.
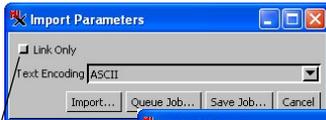
Import an Attribute Table

Now that the STATE_CODE field in the STATES table is established as a Primary Key, you can import a population table to the STATES vector object and the relationship you want to establish is ready to be made. You could also do these two exercises in the opposite order. After you import the population table, its population values can be associated with the corresponding polygon elements.

You have the option of linking to or copying a table in many database formats. If you choose to link to a table, it is available for use in TNT processes and any other application that can read that format directly. For example, shapefiles and their associated dbf files can be used directly (without copying or linking via import). If you do not import these files, they can be used and updated in the TNT products and any other products that read shapefiles and the associated dbf table. If copied to RVC format on import, any changes made in TNT are only accessible by TNT processes until exported to another format.

A copy of the table is stored with the vector object in Project File format if this toggle is not on.

Click on the desired database to navigate into it and create a new table.

STEPS
- ☑ select Main / Import from the TNT menu
- ☑ click on the Database Table filter icon
- ☑ click on [Select Files] and choose statpop.dbf from the USA data collection
- ☑ click on [Next] and then on [Import]
- ☑ navigate to the Polygon Database under the STATES object from the previous exercise
- ☑ click on [OK] (or you can rename the table before clicking OK if desired)
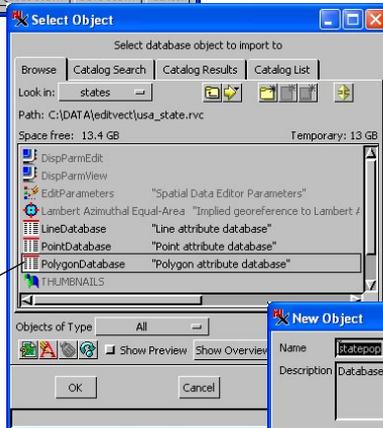
When you reach the New Object window while importing a database file to a database associated with a vector object, you are providing the name and description for a new database table.
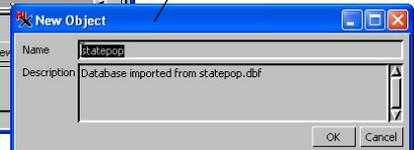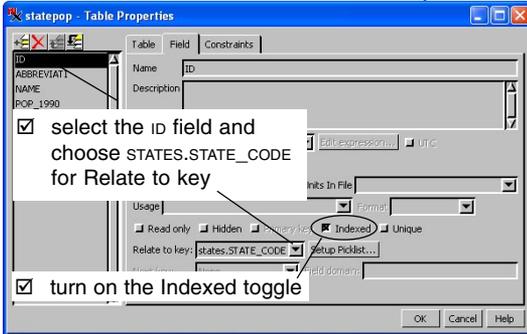
Link a Second Table by Key

STEPS
- ☑ add the STATES vector object in the Editor or in Display
- ☑ expand the layer and the polygon database, then open the STATEPOP table
- ☑ select Properties from the Table menu

Database table properties and record values are editable in TNTmips in any process that includes a Layer Manager. The layer can even be a reference layer when working in the Editor.

Element and attribute relations can be created and maintained graphically as well as through the Table Properties window. You can get to this graphical interface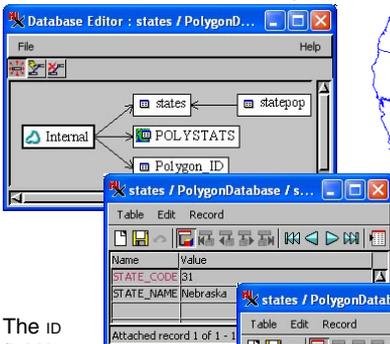 by choosing Edit Relations from the right mouse button menu for a database in any Layer Manager window or by choosing Tools / Database / Edit from the TNT menubar.

statepop - Table Properties

- ☑ select the ID field and choose STATES.STATE_CODE for Relate to key
- ☑ turn on the Indexed toggle

- ☑ click OK, then click on the Select icon in the View window and select polygons to view the related records in the newly added table

A field that points to a primary key in another table is called a **foreign key field**. Primary key fields are automatically indexed. Indexing speeds standard database operations by performing the operation in a binary rather than a linear fashion. Primary key fields are automatically indexed and it is recommended that you also index foreign key fields.
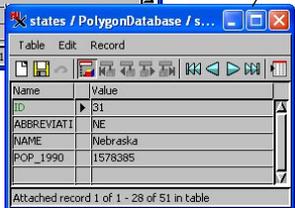
Database Editor : states / PolygonD...

File   Help

Internal → POLYSTATS
states → statepop
Polygon_ID

states / PolygonDatabase / s...

Table Edit Record

Name	Value
STATE_CODE	31
STATE_NAME	Nebraska

Attached record 1 of 1 - 1

The ID field in the STATEPOP table now links to the STATE_CODE key in the STATES table.

states / PolygonDatabase / s...

Table Edit Record

Name	Value
ID	31
ABBREVIATI	NE
NAME	Nebraska
POP_1990	1578385

Attached record 1 of 1 - 28 of 51 in table

When you select any polygon that has a record in the STATES table attached, the record with the same value in the ID field in the STATEPOP table will also be associated with that polygon and is shown as the record attached to the active element.

Undo / Redo

An Undo feature in the Editor allows you to step back through recent editing operations and recover the previous state of the object you are editing. The power of this feature is in its ability to undo the complex topological changes that the discarded edits have caused. In the same way, changes to related attribute tables are also undone. Click the Redo button to restore the last change undone.

Each time you click the Undo button, the most recent editing change is reversed. If you add elements, the Undo tool removes them. If you modify elements, Undo restores their previous shape and position. The Editor supports up to 50 levels of undo. Use the Preferences dialog (Setup / Preferences / Other) to specify the number of levels you want. The Editor maintains a separate Undo history for each object that is open for editing. Thus you can switch between multiple layers, make edits, switch to other layers, and retain the ability to Undo editing operations in each layer.

STEPS
- ☑ create a new vector object
- ☑ select the Add Polygon tool and add a number of polygon elements
- ☑ experiment with the Undo and Redo buttons to see how multiple editing operations can be reversed

You can Undo multiple steps but only Redo one step.

Undo and Redo buttons let you back up during an editing session
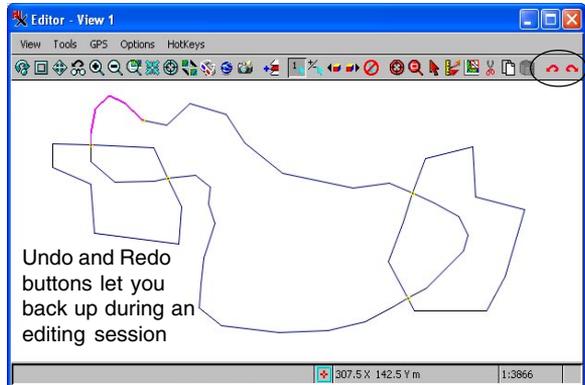
Where Next?

Refer to the the tutorial *Advanced Vector Editing* and to the Technical Guides on the MicroImages web site to learn about features not covered in this introduction.

You can use the values from any attached database table to automatically generate label elements. Labels can also be generated on-the-fly.

Easy to use but powerful **Query** tools let you create simple or complex queries so you can pan to and select elements according to their attributes. See the *Building and Using Queries* tutorial.

Point and line elements can be assigned a z-coordinate value, so you can edit the **3D attributes** of vector elements.

The MicroImages web site has several helpful Technical Guides that give more details about specific features of the TNT Editor: http://www.microimages.com/documentation/html/Categories/Editor.htm

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