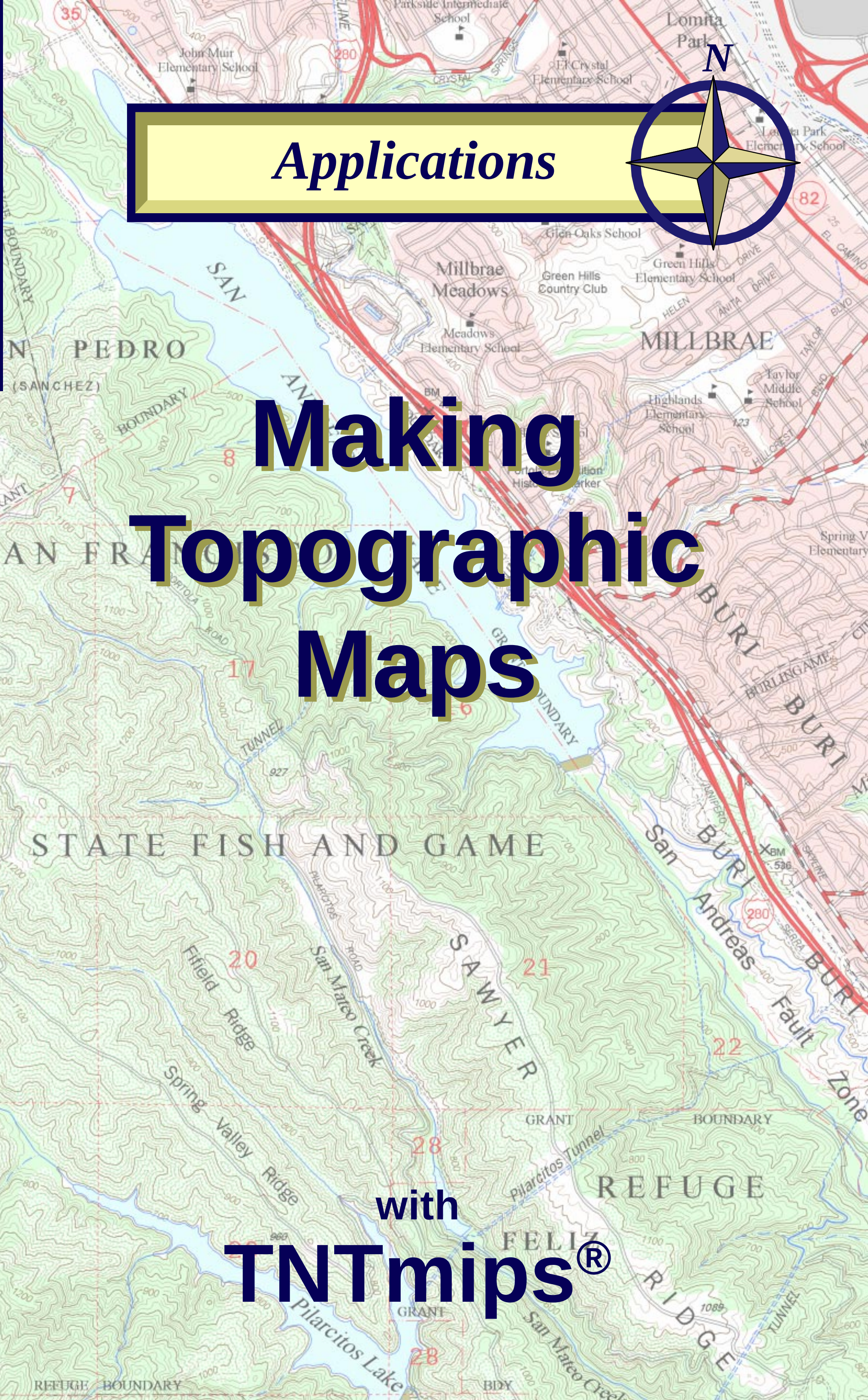
TOPO MAPS

Applications

Making Topographic Maps

with

TNTmips®



Before Getting Started

TNTmips provides a variety of tools for working with map data and making topographic maps that can be printed or distributed as an electronic atlas. This booklet is intended as a general guide to making topographic maps in TNTmips. Using a sample map layout, it discusses how the different data layers can be prepared and assembled, and illustrates the type of results you can achieve with your own data using TNTmips.

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

Sample Data The data used to prepare the map shown in this booklet are distributed as sample data with the TNT products. Although this booklet does not include exercises with step-by-step instructions on how to use this data, you may wish to view the different data layers and experiment with them before you begin working with your own map data. In particular, this booklet refers to the sample Project File MONTARA in the TOPOMAP data collection.

More Documentation This booklet is intended only as an overview of useful strategies for preparing and assembling geospatial data layers to make geologic maps. As different tasks and procedures are discussed in the text, references are provided to appropriate tutorial booklets that provide exercises introducing the tools for performing those tasks in TNTmips.

TNTmips and TNTlite® TNTmips comes in two versions: the professional version and the free TNTlite version. This booklet refers to both versions as "TNTmips." If you did not purchase the professional version (which requires a software license key), TNTmips operates in TNTlite mode, which limits object size and enables data sharing only with other copies of TNTlite.

All of the objects in the sample MONTARA Project File are useable in TNTlite.

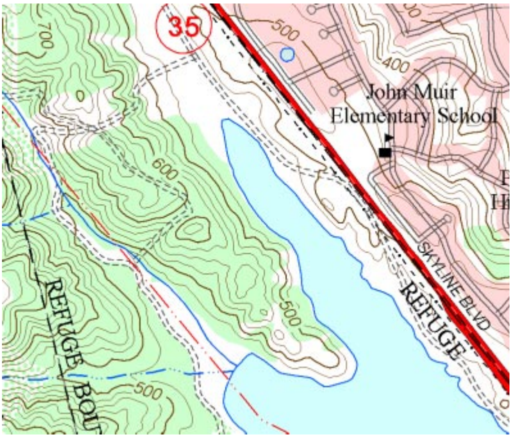
Randall B. Smith, Ph.D., 8 May 2002

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 for the newest Getting Started booklets on other topics. You can download an installation guide, sample data, and the latest version of TNTlite.

http://www.microimages.com

Welcome to Making Topographic Maps

No other type of map has wider applications in modern society than the topographic map, one that depicts the local shape of the land surface using contour lines (lines of constant surface elevation). Topographic maps produced and published by government agencies usually include both physical and cultural features, making the maps useful in municipal planning, civil engineering, watershed and other environmental studies, design of communication systems, and outdoor recreation, among others. Traditionally, topographic maps have been published in printed form, but digital forms of topographic map data are becoming widely available in some countries. In digital form, topographic map data can be combined readily with other types of digital map data to produce specialized maps that can be printed or distributed as an electronic atlas.

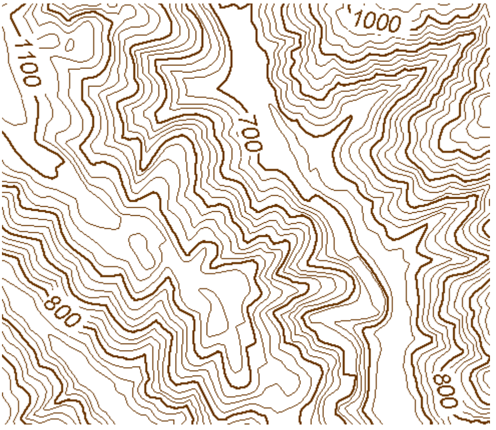


The software tools in TNTmips give you the means to create and assemble all of the necessary components of a topographic map. This booklet provides an overview of topographic map-making with TNTmips. For each map component, references are provided to exercises in other Tutorial booklets that provide provide step-by-step instructions for the relevant operations. The topographic map included with this booklet was prepared and printed entirely in TNTmips using publicly-available digital map data produced by the United States Geological Survey along with data that I digitized from a scanned map. (The map layout and all relevant data are in the MONTARA2 Project File distributed with the booklet.)

In addition to topographic contours, most topographic maps show hydrologic features (streams and rivers, lakes, and springs) and may use color patterns to indicate the distribution of vegetation and urban areas. A variety of cultural features may be included: transportation features (roads and highways, railroads, and airports); boundaries of administrative subdivisions (counties and cities); and locations of prominent public buildings, such as schools, hospitals, and government offices. All of these map elements can be represented most conveniently using the vector data format in TNTmips, which supports the use of point, line, and polygon elements to represent map features, and also incorporates text labels.

Contour Lines and Labels

Contour lines distinguish a topographic map from other types of map. Topographic contours are lines of constant ground surface elevation, and the spatial patterns of contours allow experienced map-readers to visualize the shape of the contoured surface. Contours are created with a constant elevation increment between sucessive lines, known as the *contour interval*. The contour interval varies with the scale of the map and how wide a range of elevations (relief) the map area includes. Contour lines with elevations divisible by some larger round number are designated as major contours and drawn with a wider line. For example, the sample Montara Mountain map has a contour interval of 25 feet, and contours with elevations divisible by 100 feet are shown as major contours.



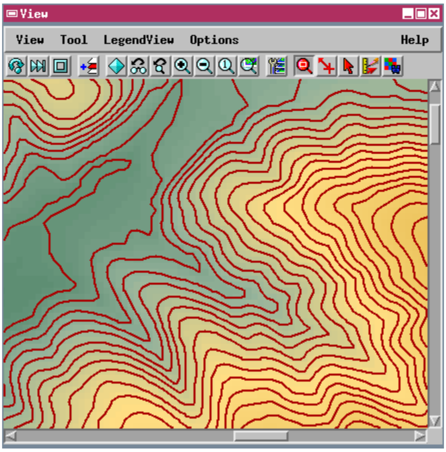
When I assembled the Montara Mountain map data, the contour data were already available in a vector file format with an elevation value associated with each line, so a simple import operation was all that was needed to create a contour vector object in the Project File. TNTmips supports import from a variety of vector and CAD data formats (see the tutorial booklet *Importing Geodata* for additional information). If you need to create contour line data, TNTmips also provides several methods that are discussed on subsequent pages.

Strategically-placed contour line labels identify the elevation for key contour lines in each subarea of the map. The Spatial Data Editor in TNTmips allows you to create text labels for contour lines automatically using the elevation values stored in an attached database table. The Editor's Auto-Generate Labels operation is a general-purpose tool for creating labels for any element type, while the the Set Line Labels tool is especially tailored for adding labels to contours. When you create the labels you can turn on a Clip Under Label option that will automatically hide the segement of contour line beneath each label. The tutorial booklet *Advanced Vector Editing* provides exercises on both of these procedures.

Separate line widths for major and minor contours can be set up by styling the lines for display using a CartoScript. The tutorial booklet *Using CartoScripts* provides several sample scripts designed for styling topographic contours.

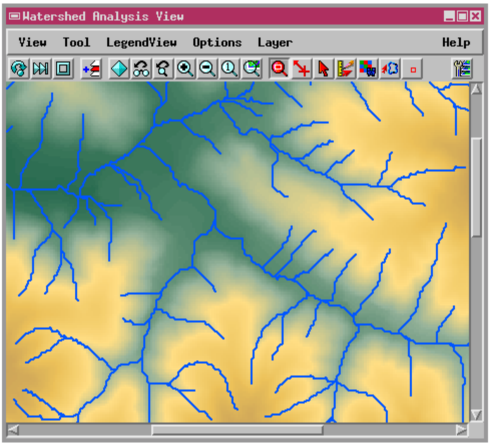
Contours and Streams from a DEM

If contour lines are not available in digital format for your area, you have several options for creating them. You may be able to obtain a digital elevation model containing gridded elevation values for the area. If so, you can then create vector contour lines from the elevation raster using the Contouring operation in the Surface Modeling process. Several contouring methods are provided that allow you to set the contour interval and starting and ending values for creating contour lines. The process creates a 3D contour vector with the elevation recorded as both the minimum and maximum Z value for each line. Additional information and sample exercises on contouring can be found in the tutorial booklet *Surface Modeling*.



Color-coded elevation raster overlaid with contours created from it in the Surface Modeling process.

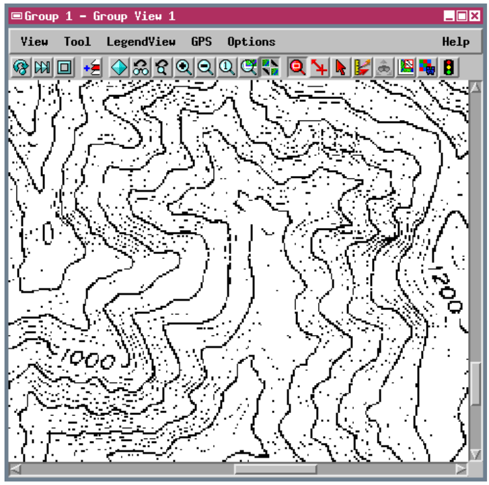
You can also extract stream lines from an elevation raster using the Watershed process. The process automatically fills spurious pits and depressions in the elevation raster, computes the patterns of downslope flow of water over the landscape, and creates a flow paths vector with lines representing potential stream lines. You can adjust several parameters to vary the density and other characteristics of the stream network. For more information and sample exercises, consult the tutorial booklet *Modeling Watershed Geomorphology*.



Vector stream lines computed by the Watershed Process from the elevation raster.

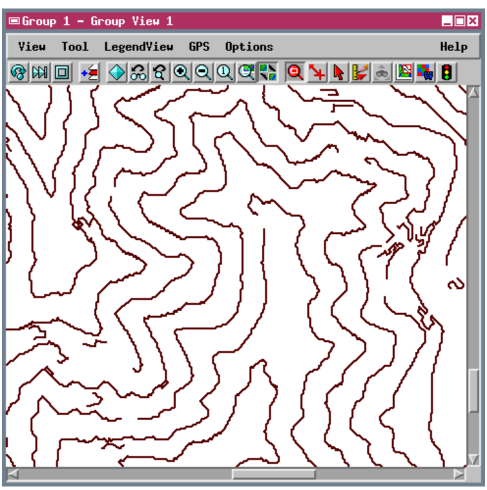
Auto-Trace Lines from a Scanned Map

If the only starting data for your project is a paper topographic map, and you have access to a scanner, you can scan the map to create a map raster. After additional processing you can automatically trace contours, hydrologic features, or any other line feature that is represented by a unique set of colors.



Binary raster (cells with value 1 in black) from brown colors of major contour lines, created by the Color Binarization process.

Begin by making a high-resolution color-composite scan of the map, then georeference the resulting raster object (see the tutorial booklet *Georeferencing*). You can then use the Color Binarization process (on the Process / Raster / Filter menu) to separate the colors representing the desired lines and output the result as a binary raster (with value 1 for cells representing the line colors).



Contours auto-traced from a binarized scanned topographic map, ready for cleanup in the Spatial Data Editor.

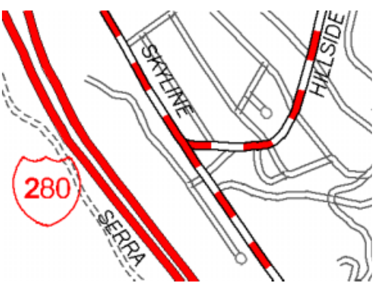
The Auto-Trace process converts the binary raster to vector lines. You can automatically apply various vector filters to reduce the number of extraneous lines and bubble polygons in the output vector (see the tutorial booklet *Digitizing Soil Maps* for exercises on Auto-Trace). You can then use the Spatial Data Editor to close remaining gaps in the contours, delete surviving extraneous lines and polygons, and assign Z-values to the final contour lines. For information on these procedures, see the tutorial booklet *Advanced Vector Editing*.

Layers, Labels, and Styles

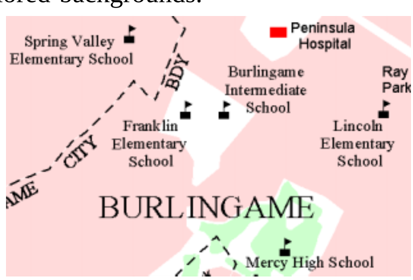
Once you have prepared the contour line vector object for your topographic map, you will need to assemble the data for hydrologic, cultural, and any other features you want to include on the map. The map data can be separated into as many different spatial objects as you want. The map group in the sample Montara map layout (Group 1) includes thirteen separate vector objects plus a map grid generated in the layout (discussed subsequently).

You can create labels for any vector objects in the Spatial Data Editor by manually adding text or from database entries using the Auto-Generate Label operation discussed previously. The layers in the Montara layout include labels for point symbols representing schools, line labels for some highways and roads, and polygon labels for cities, among others. See the tutorial booklets *Editing Vector Geodata* and *Advanced Vector Editing* for more information. The TNTmips Style Editor lets you design vector point symbols, line styles, polygon fill styles and text styles. You can use various colors and design line patterns and bitmap fill and hatch patterns for polygons. You can find more information about setting up styles in the booklet *Creating and Using Styles*.

You will need to carefully consider the layer order and style color choices to insure that proper emphasis is given to the appropriate data. In this layout the two vector layers that required solid polygon fills (objects Built and VegSurfCover) were placed on the bottom so that all other map elements were drawn on top of these colored backgrounds.



Line symbols for Highways and Roads layers and a highway point symbol. I created the Highway vector by extracting the appropriate lines from the Roads object. Eliminating highway-road intersections in the Highways object resulted in better rendering of the dashed line patterns for secondary highways.

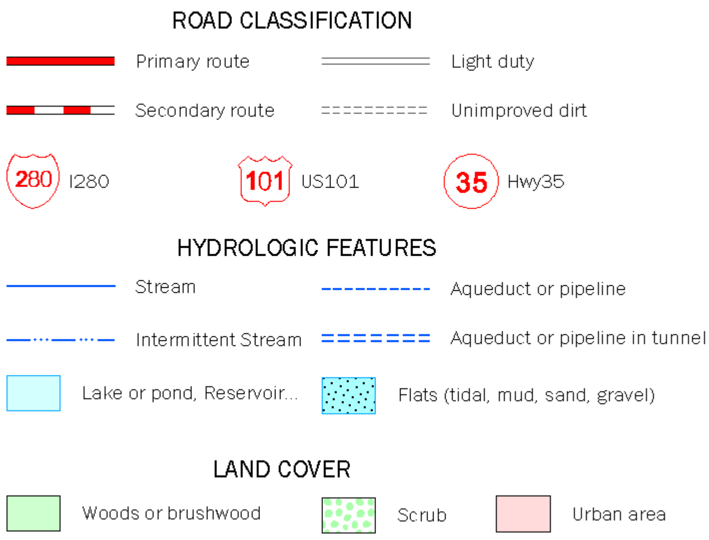


Polygon fill styles for vegetation and urban areas, point symbols for schools, and a polygon label for the city name.

Map Legends

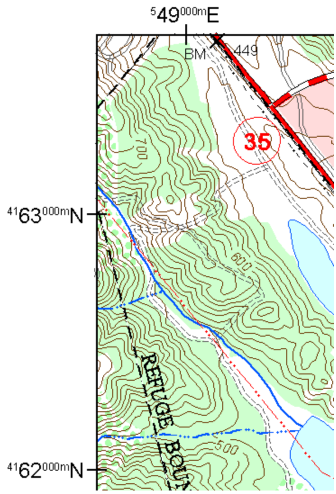
You can easily create simple or complex legends for the various data layers of your topographic maps. You can add specialized legends for rasters (color sample and color scale) or for individual element types in vector objects (points, lines, and polygons), or combine legend information for multiple layout objects in a single multi-object legend. Multi-object legends also provide a graphical editor that lets you drag legend entries to new positions and preview the results.

Legends in map layouts automatically use the sets of styles you have set up for vector elements to generate a set of corresponding legend samples. You can change the size of the legend samples, reorder them, and edit the text explanations. Multi-object legends also let you use word-wrap and text justification to provide a professional look to longer legend entries.



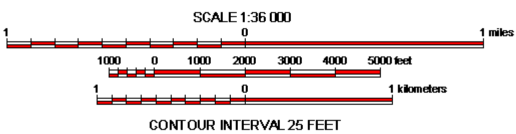
Due to space constraints, the legend on the attached Montara topographic map is confined to an explanation of the road classification and highway symbols. The illustration above shows an expanded legend that could be constructed for the map, incorporating line and polygon hydrologic features and an explanation of the land cover symbology. This sample was created as a single multi-object legend using information from three different vector objects in the layout. You can find more information about legends in the tutorial booklet *Making Map Layouts*.

Other Map Components



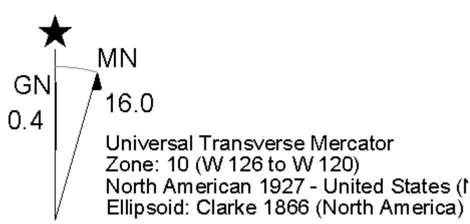
Other cartographic elements of a topographic map can be created easily in a map layout using the Layout Controls window. You should consult the tutorial booklet *Making Map Layouts* for instructions on how to create the layout elements shown here.

You can set up one or more map grids for your map using any of the many map projections supported by TNTmips. The Montara topographic map includes one UTM map grid as a layer in Group 1 (which contains all of the layers for the map itself). The Map Grid Layer Controls let you set up the extents, interval, and graphic elements for a grid. I set up the map grid to show only border tick marks and labels.



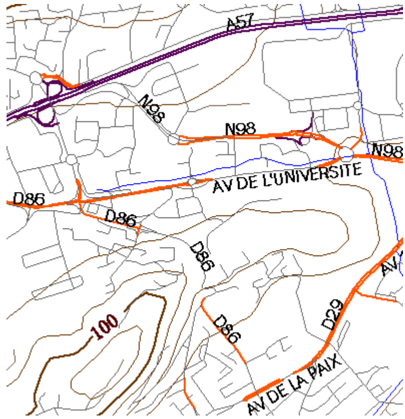
You can easily add one or more scale bars to provide graphic scales for the map. You can control the length, intervals, labeling, and bar styles. The verbal scale and contour interval annotation shown here are text elements. You can add any number of text elements to a layout to create titles and other anotations using various fonts and styles. Each element in a map layout is a group that can be positioned separately on the page and is attached to either the page or to another group. I attached the feet and kilometer scales, verbal scale text and contour interval text to the mile scalebar, so that repositioning that scalebar moves all of the attached elements as well.

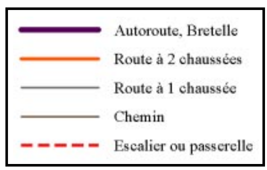
The declination graphic used in the Montara map layout is an SML (Spatial Manipulation Language) script layer. The script uses geographic information from the map group to draw the graphic with appropriate angles and to supply the relevant text labels. SML display layers are discussed in the tutorial booklet *Writing Scripts with SML*.



Use Your Language

MicroImages has clients using the TNT products in many countries around the world, working in many different languages. TNTmips has been designed so that you can create maps and other display products that have any combination of international fonts and languages.





Line labels and line legend text from database entries in French.

The TNT products support the use of 8-bit and Unicode (16-bit) character sets and standard Windows and Macintosh language entry methods and keyboard layouts. You can select any installed international font as an interface font that will then appear in text entry dialogs, and separately select fonts for styling vector labels, legend descriptions, or text annotations.

When you set up database tables you can create explicit Unicode String fields. With a Unicode interface font selected and the appropriate keyboard entry setting for your operating system, you can enter all the characters needed for text in your language into the table. When you auto-generate text labels for map elements using the database entries, the labels will appear with the same character set specified in the table. For more information on using your language, consult the tutorial booklet *Changing Languages (Localization)* and the section entitled Edit Text Files in the *Edit* volume of the *TNTmips Reference Manual*.


Ankara / LineData / Yollar

Table Edit Record Field Help

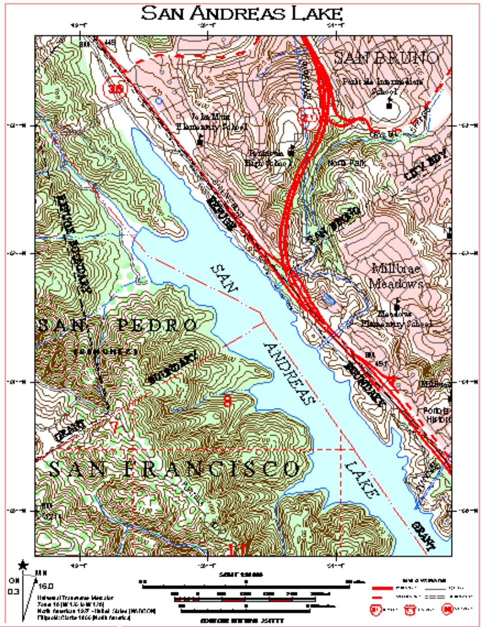
Tip	Isim
Cadde	Bursa Caddesi
Sokak	Burç Sokak
Sokak	Bu
Cadde	Bölük Caddesi
Sokak	Börüncek Sokak
Sokak	Büklüm Sokak
Sokak	Bükre
Sokak	Bükülmez Sokak
Sokak	Bükülmez Sokak

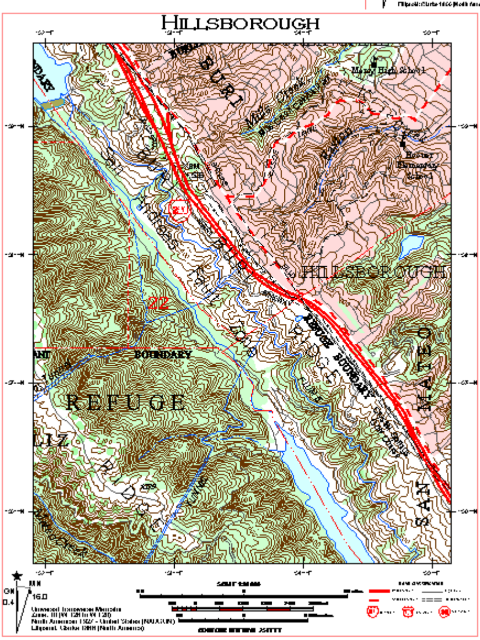
3511 of 3511 records shown

Street name labels from database entries in Turkish.

Templates for Map Production

Topographic maps are usually produced in a series of adjacent quadrangles of the same size and scale. Maps in these series share a similar layout and many invariant elements such as scale bars, legends, and various annotations. TNTmips provides an easy way for you to reuse common layout components while producing a series of similar map layouts. After setting up the layout for the first map, save it as a *template*. Before saving the template, you can designate which groups are to be used “as-is”, without change. (Scale bars and legends are automatically reused without change.) Other groups are treated as replaceable.





When you open a template, you are prompted for the new contents of any replaceable group, while the “as-is” groups are loaded directly. If a replaceable group includes a map grid, the map grid is loaded automatically and its extents are adjusted to the extents of the new group contents. You can find an extended discussion of templates in the tutorial booklet *Making Map Layouts*.

Advanced Software for Geospatial Analysis

TOPO MAPS

MicroImages, Inc. publishes a complete line of professional software for advanced geospatial data visualization, analysis, and publishing. Contact us or visit our web site for detailed product information.

TNTmips TNTmips is a professional system for fully integrated GIS, image analysis, CAD, TIN, desktop cartography, and geospatial database management.

TNTedit TNTedit provides interactive tools to create, georeference, and edit vector, image, CAD, TIN, and relational database project materials in a wide variety of formats.

TNTview TNTview has the same powerful display features as TNTmips and is perfect for those who do not need the technical processing and preparation features of TNTmips.

TNTatlas TNTatlas lets you publish and distribute your spatial project materials on CD-ROM at low cost. TNTatlas CDs can be used on any popular computing platform.

TNTserver TNTserver lets you publish TNTatlases on the Internet or on your intranet. Navigate through geodata atlases with your web browser and the TNTclient Java applet.

TNTlite TNTlite is a free version of TNTmips for students and professionals with small projects. You can download TNTlite from MicroImages' web site, or you can order TNTlite on CD-ROM.

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