GIS NEWS

Volume 1 Issue 3 Winter 2001

Geographic Information Systems (GIS) Technology at Dakota County

HIGHLIGHTS

MEETINGS & EVENTS

January 17
Dakota County GIS Users Group meeting. For more information check the GIS website at www.co.dakota.mn.us/survey.

Produced Quarterly by GIS Staff

Randy Knippel
Julie Daugherty
Mary Hagerman
Todd Lusk
Joe Sapletal
Kent Tupper

CONTACTS

If you would like to write an article for the Spotlight section of the GIS News newsletter and share how you use GIS in your department, call or email Randy or Julie.

Randy Knippel
952.891.7080
Randy.knippel@co.dakota.mn.us

Julie Daugherty
952.891.7086
Julie.daugherty@co.dakota.mn.us

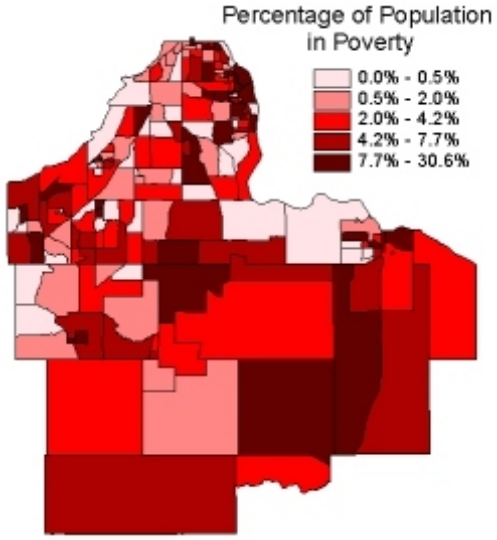
G.I.S.101

Discovering Census Data

By Julie Daugherty

Once every 10 years, in the years ending with "0", the decennial census occurs. The Census' primary purpose is to provide the population counts and housing unit totals used for the apportionment of seats in the U.S. House of Representatives. Census figures are also needed to redraw congressional and state legislative district boundaries, to allocate federal and state funds, to formulate public policy, and to assist with planning and decision-making in the private sector.

The data is provided in the form of counts for specific characteristics. These counts are associated with one of three aggregate geographic areas called 'blocks', 'block groups', and 'tracts'. Blocks are the



1990 Census Block Groups

smallest areas representing what might be considered a typical city block. Census block groups are composed of blocks while census tracts are composed of block groups. The census counts are provided in the form of digital files that need to be merged with these geographic areas for analysis.

Federal law mandates that certain census products be ready and distributed by specific dates. The first key date, December 31, 2000, is when state apportionment population totals must be delivered to the President. By April 1, 2001, block-level basic housing and population counts must be delivered to each state for use in redistricting. Also by this date, new census block and tract geography, more commonly referred to as TIGER data, must also be delivered. Following April 1 the raw census data becomes available on a flow basis, state by state. Currently, complete count data is planned to be released between June and September of 2001. Sample data is scheduled for release between August and December of 2002. A complete list of release dates is available at: http://factfinder.census.gov/home/en/releaseschedule.html.

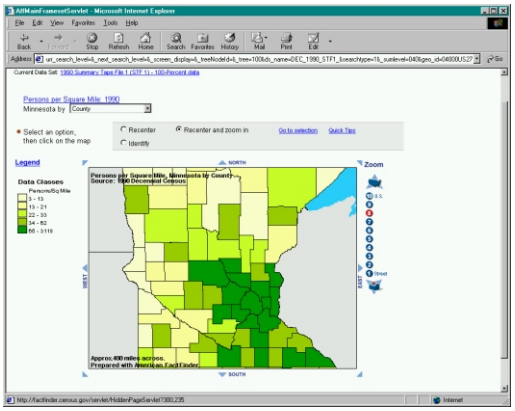
Decennial census data is divided into two major topics: population and housing. Population data is subdivided into basic, social, and economic categories. Housing data is further subdivided into basic, physical, and financial characteristics. All data is distributed in large, raw count tables which can be awkward to work with. Raw count data is not particularly useful for analysis and comparison. In order to be used effectively, and properly, the counts must be normalized to represent a percentage or density. Normalizing is the process of dividing raw counts by population, land area, or housing units to produce values for accurate comparisons. Dakota County GIS staff will be receiving the data and performing post-processing on it (including normalization) to make it available in a more useful format. The Survey and Land Information Department has already obtained Dress Rehearsal data from the U.S. Census and has begun the process of interpretation.

New for Census 2000 is the American FactFinder web site. This site gives users

G.I.S. 101
Continued on Page 2

G.I.S. 101
Continued from Page 1

access to census data tables and maps and allows them to create customized tabulations on-line. The American FactFinder provides a service which was difficult in previous censuses. The American FactFinder can be found at: http://factfinder.census.gov/servlet/BasicFactsServlet



Example of population density map on American FactFinder

A Dakota County Census Focus Group has been created and held its first meeting to talk about the data and what to expect from the 2001 Census. Discussion topics included: possible Internet applications, data that departments have used in the past, and what those departments would like to see from this census. Past census data users have also started to use the American FactFinder site to become familiar with what is available.

The Survey and Land Information Department has also met with Treasurer/Auditor staff and city clerks to demonstrate a new Redistricting extension which is available for ArcView, the County's GIS software. It appears this new ArcView Extension will make the redistricting process much smoother and more efficient than in previous years.

More information about the census and census data can be found at the U.S. Census web site: http://www.census.gov If you would like to be a part of the Census Focus Group please contact Julie Daugherty at julie.daugherty@co.dakota.mn.us

Dakota COUNTY

Department Spotlight

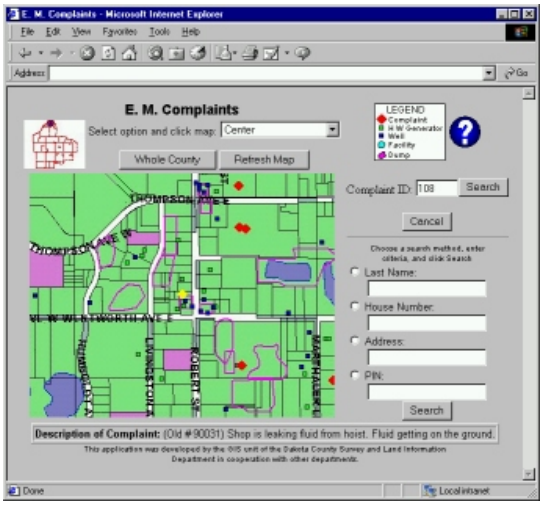
GIS and Environmental Management

By Jon Springsted

Dakota County Environmental Management regulates hazardous and solid waste management activities, well construction and abandonment, and environmental and public health nuisances. The department's authority comes from State statute requirements, State agency delegation agreements and statutory permission to develop Ordinances. As such, there are multiple administrative Sections within the Department. Each Section has collected, stored and displayed data to meet its unique needs. While this has been useful in developing each regulatory program, there is a growing need to integrate information developed by separate Sections.

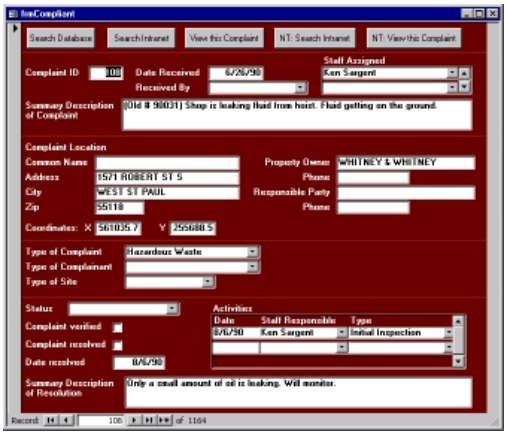
The Environmental Management Department receives approximately 200 complaints each year. Effort was being duplicated in response to public complaints because staff did not have easy access to each other's data. Occasionally, more than one Section responded to situations originating from the same complaint or inquiry only to find that it was already being investigated by other staff within the Department.

A solution was designed based on environmental data needs and the GIS capabilities of the Dakota County Internet Real Estate Inquiry. The Real Estate application, which allows parcel-based searches on owner name, address, and PIN to retrieve ownership, value, and building information, provides an easy to use interface for performing basic investigation. The application also works for generating basic site maps. These capabilities were supplemented by additional functions to display and query wells, dumpsites, and hazardous waste generators. In addition, the ability to add, modify, and delete dots representing the location of sites, which are the subject of the complaints were also added.



GIS Component in Web Browser

Data pertaining to the complaint is stored in an Access database. Appropriate forms and reports allow searches to be performed and complaint records to be viewed and manipulated. A button on the main form starts Internet Explorer and activates a link to the map server. The map server displays a map centered on the current complaint showing all complaints in the area in additon to nearby dump sites, hazardous waste generators, and wells. Any of these features can be selected to retrieve information about them.



Microsoft Access Component

Department Spotlight Continued on Page 3

Department Spotlight
Continued from Page 2

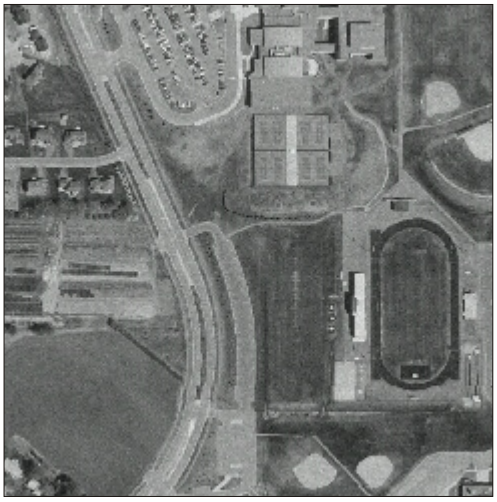
A typical scenario in response to a call might include using the map interface to find the area pertaining to the complaint while talking to the complainant on the phone. The map can be used to determine if this complaint may pertain to a previously recorded complaint based on its location and nature. The complaint can then be either updated with any additional information or recorded as a new complaint. When a new complaint is located, selected information from the underlying property information such as owner name and address is automatically copied and added to the complaint database. This procedure has streamlined the complaint process from several hours to less than 30 minutes.

Desktop G.I.S.

Aerial Imagery - Objects May Be Closer Than They Appear

By Randy Knippel

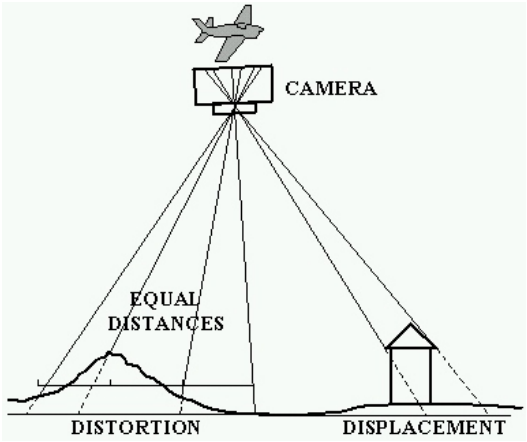
Aerial photography is a map product that is easily understood by most people. A view of the surface of the Earth from the air is easily recognizable and allows features to be readily interpreted.



This aerial photograph shows the amount of detail that can be obtained just from a simple overhead view.

As airplanes and photography developed, it didn't take long for people to begin to combine them to create images of the earth from a completely new perspective. This combination developed into a scientific process called aerial photogrammetry. This process uses a series of overlapping aerial photographs to perform precise measurements using specialized machines and software.

While easily recognizable, many people don't realize the inherent limitations of aerial photography. Cameras and film very accurately capture an image of the ground; however, tip and tilt of the aircraft and variations in surface terrain introduce distortion due to the perspective of the camera.



Perspective distortion describes slight differences in measurements and the size of features in a photo. The distortion is caused by the irregular surface of the earth being projected, via a camera lens, to a flat surface such as film. Variations in the angle of the ground relative to the center of the photo and variations in the attitude of the aircraft taking the pictures cause distortion. A feature at the edge of the photo appears to be tilted away from the center of the photo and therefore appears slightly shorter than the same feature measured at the center. Likewise, when a hill exists on the edge of the photo, features measured closer to the center of the photo appear longer than those on the far side of the hill. Perspective distortion also causes tall features to be displaced at the edges of a photo.

To compensate for these limitations, two mapping products have traditionally been created. These are called 'rectified' and 'ortho-rectified' photography. 'Rectified' photography corrects for distortion caused by the aircraft. The process determines an average fit to known locations in each photo then tips and tilts each photo to correct for the distortion. 'Ortho-rectified' photography, or simply 'orthophotos', takes this correction one step further. This process essentially flattens the surface to remove distortion caused by terrain. This rectification method was originally performed using mechanical techniques on cameras, film, and special machines. The process has been somewhat simplified with the utilization of digital images and computers.

Dakota County has traditionally had unrectified photographs, based on the Public Land Survey (PLS) half-section, which may be copied for internal use or sold to the public.

In 1997, the Metropolitan Council created a set of digital orthophotos covering the entire seven-county metropolitan area. The orthophotos are organized using the USGS 1:24,000 quarter-quadrangle format. This process was just completed again this past spring. The County also produces digital orthophotos using low altitude photography as a by-product of updating the GIS database.

As computer capacity and GIS software advance, digital aerial photography products become more commonplace and readily available. This means that an understanding of the proper use and inherent limitations of these products needs to be widely understood as well. While many people can easily interpret aerial photography, it is important to realize the significance of the terms 'unrectified', 'rectified', and 'ortho-rectified' photography.

The digital orthophoto products mentioned in this article have been processed and are available on the County network or through the Survey and Land Information department. The new imagery has also been integrated in the Real Estate Inquiry on DakotaNet at http://dakotanet/admin/main/Applications/applications.htm and will shortly be updated on the County web site.

Tech Talk

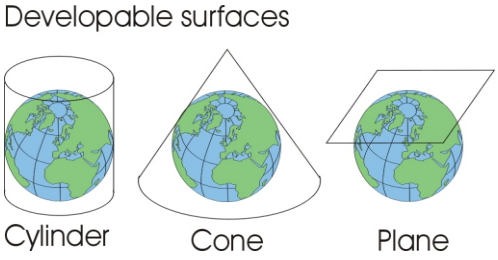
Projecting

By Mary Hagerman

What are map projections and why do we need them? A projection is the representation of the spherical, three-dimensional surface of the earth on a flat, two-dimensional plane, or map. Projections are necessary simply because the earth is not flat!

If the earth was flat, it could easily be represented on a map. You would just need to shrink it down to a usable size. But the earth is round (actually ellipsoidal -a squashed sphere), so when you shrink it down, you end up with a globe, more or less. Therefore, it is really a two step process: shrink to a scale model of the earth (i.e. a globe) and then project the globe onto a flat map. This is easier said than done. Imagine your globe is an orange. Remove the peel, preferably in one piece, and try to flatten it. Yeah. So you see, in order to portray a 3D space as a 2D map, you need to project.

Forget the orange for a minute; imagine a transparent globe, a piece of paper and a light bulb. If you put the light bulb at the center of the globe, the features on the globe are projected onto the paper, whether it is resting on the North Pole, or wrapped around the Equator. Conceptually, that's how it works, but projections are actually the results of complex mathematical formulas. Fortunately, we needn't worry about the math; the computer will do it for us. Three cheers for technology!

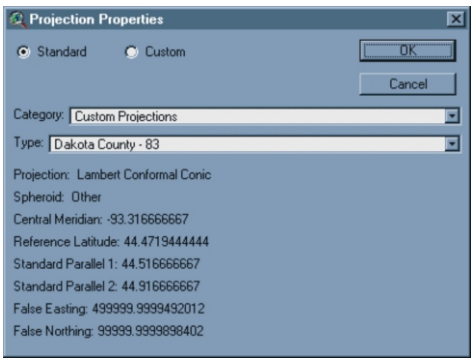


The piece of paper, or developable surface, is a flattenable surface onto which the surface of the earth can be projected. This surface can be one of three types, a cylinder, a cone, or a plane.

Back to the orange peel. Should you manage to flatten it, it will undoubtedly be severely misshapen. Only a globe (a slightly squashed globe) can be a true scale model of the earth, shrunken down to the same scale at all points. But on a flat map, some areas will be stretched and others will be compressed. Features in these areas will be distorted; some will be stretched, and some will be compressed. No map projection can eliminate distortion altogether, but they can preserve certain properties. There are four basic properties that a map projection can attempt to preserve; area, shape and angularity, distance, and true direction. Compromise projections attempt to minimally distort all of these properties, while preserving none of them.

While a projection can preserve one or more of these properties, it is always at the expense of the others. Something has got to give somewhere. Distortion is inevitable. Think back to the piece of paper and transparent globe. Where the paper touches the globe, there is no projecting of features, they are simply copied onto the paper. What is on the paper matches exactly what is on the globe, so there is no distortion. But, as you move away from the area where the paper and the globe touch, as the paper and the globe get farther and farther apart, the features need to be projected farther and farther, and distortion increases. The place where the paper touches the globe is called the standard line (or point for planar projections). There is no distortion along the standard line, and very little near it, but distortion increases as you move away from it. When choosing a projection, it is important to understand which properties (if any) are preserved, and which lines (or points) are standard lines. You can then choose a projection that minimizes distortion with respect to your map purpose and area of interest.

To use different sources of data together, all the data must be in the same projection in order to match up correctly. The Dakota County projection is based off the Lambert Conformal Conic projection, and was developed to provide the closest fit for surveying and mapping within Dakota County. To use other data with Dakota County data, that data needs to first be reprojected to the Dakota County projection (or the Dakota County data needs to be reprojected to the projection of the other data). This is easily done in ArcView with the Projector! extension.



Choosing a projection in the Projector! Extension

The Projector! extension will convert any projection to any other projection. You load the extension the same way you would any other extension, File > Extensions. The dialog will prompt you to specify the input and output projections from the dropdown lists. You will also need to specify input and output map units. It is important to specify the View's map units before reprojecting (View > Properties). If map units are not set for the View, ArcView uses display units, which are not meaningful. Map units for the Dakota County projection are feet; for UTM, units are in meters. The Dakota County Projection extension generates the necessary files for projecting to and from the Dakota County projection. Load this extension before using the Projector! extension. It executes automatically, and unloads itself. The Dakota County projection will then be available as a choice in the Projector! dropdown list.

For more information on map projections, check out these sites:
http://www.colorado.edu/geography/gcraft/notes/mapproj /mapproj_f.html *(see also related links).*
http://everest.hunter.cuny.edu/mp/mpbasics.html
http://math.rice.edu/~lanius/pres/map/mappro.html *(this one has activities!)*
http://magma.nationalgeographic.com/2000/exploration/ projections/index.cfm