

CONVERTING PARCEL LAYER FROM CAD TO GEODATABASE

A presentation given at the California Cadastral Mapping Association annual conference,
Napa, 10/22/2004

THE PAGE NUMBERS HERE CORRESPOND TO THE PAGES IN THE SLIDE
SHOW

Background:

The County of Santa Cruz established its GIS in the early 1990's. The original system was based on digitized Assessor's maps, maintained in AutoCAD and housed on a mainframe platform. The system, representing almost **96,000 parcels**, consisted of about **4,500 Assessor's Map Pages**, divided between **103 Map Books** with a separate AutoCAD file for each book.

The data was distributed to other departments via mainframe applications and as countywide shape files compiled from the AutoCAD files. The mainframe platform was not able to support the relational database functionality offered by new GIS applications and therefore limited potential use of the data.

In order to take advantage of the relational database technology and ESRI's Geodatabase model, the County decided to migrate from the mainframe platform to an SDE Geodatabase, where the cadastral data could be kept in a seamless layer. The conversion process began early in 2003 and is now completed.

In this presentation I will be talking about the Cadastral Feature Dataset and focusing on the

- Migration strategy,
- Database design,
- Data maintenance procedures,
- How we make the data accessible to other departments,
- Future goals.

Data Conversion and Migration:

In converting the CAD data to the Geodatabase we had the option of migrating the CAD data directly or to use shapefiles. But since arcs are broken into tiny segments in the shapefiles we elected to import the CAD data in order to preserve true arcs that hold valuable survey information.

Prior to migrating the CAD data into the Geodatabase, there was a substantial amount of prep work that had to be done.

We needed to:

- Clean up and coordinate all the layers in the 103 AutoCAD Book drawings.
- Assemble the 103 Map Books and create seamless layers for the APNs, parcel boundaries and easement lines.
- Extract all the dimension text from the 4,500 Map Pages.
- Extract all the Lot Number and Easement text from the Map Pages.
- Assemble all the Map Books that had condominiums and create seamless layers for each of the seven condominium floors.
- Create a point file from the APNs.

The boundary layers were imported into a Geodatabase and the parcel and condominium polygons created from the boundary lines.

A point file was created from the parcel centroids and used to tie in the correct parcel numbers from the APN point file.

Two other feature classes, Blocks and Map Books were created from the parcels in a batch process.

Database Design:

In Geodatabase design, just like any other database design, you have to keep in mind what function the database will serve and how you will be using it. For us, it was important to be able to store all our data in a structure that was as similar as possible to the current structure and allow for editing practices that permitted us to maintain our current workflow.

- The first step in the design of the Cadastral Feature Dataset was to define each of the existing data layers,
- decide how to organize the layers into feature classes and
- determine the relationship between the individual feature classes.
- The Cadastral Feature Dataset we designed consists of 18 different Feature Classes and two topologies, as you see on this slide. –

This is a detail out of the Data Model diagram, that we have distributed, and lists the different feature classes in the Cadastral Feature Dataset. The feature classes are listed in the left hand column and the data type in the right hand column

| Cadastral Feature Dataset | |
|---------------------------|-----------|
| Cadastral Topology | DATA TYPE |
| AssessorsParcels | Poly |
| Boundary | Line |
| MapBooks | Poly |
| TaxCodeAreas | Poly |
| Blocks | Poly |
| Condo Topology | |
| CondoBoundary | Line |
| Condos | Poly |
| AnnoAPNCondos | Anno |
| AnnoAPNumber | Anno |
| AnnoCondoBoundary | Anno |
| AnnoDimensions | Anno |
| AnnoEasements | Anno |
| AnnoLots | Anno |
| AnnoMapPage | Anno |
| Hooks | Point |
| MiscLines | Line |
| NewDimensionLines | Line |
| SectTownRange | Poly |

FEATURE CLASSES IN THE CADASTRAL FEATURE DATASET

The Cadastral Dataset consists of 18 feature classes.

The feature classes can be line, polygon, point or annotation data types.

And

A feature class can only have one data type; for instance, you could not create a polygon feature in a line feature class or a line feature in an annotation feature class

A feature class can be further divided into Subtypes, as I will further illustrate in the next slide.

THE BOUNDARY FEATURE CLASS

| Boundary | | |
|------------|-----------|--|
| Field Name | Data Type | |
| OBJECTID | Object ID | Primary Key |
| RECBNDID | Text | Type of boundary line defined by subtype |
| RECBNDTYPE | Integer | Describes record boundary as described on deed |
| RECBNDCALL | Text | Additional information on boundary |
| RBCOMMENT | Text | Record Basis of Bearing |
| BOBEARING | Text | Map Source Agent (surveyor or firm) |
| MAPSOURCE | Text | Source of line (digitized or record information) |
| SOURCETYPE | Text | Date of record document |
| SOURCEDATA | Text | |
| SHAPE | Geometry | |
| DIRECTION | Text | Direction (meets and bounds) |
| DISTANCE | Text | Distance (meets and bounds) |
| RADIUS | Text | Radius |
| DELTA | Text | Delta |
| TANGENT | Text | Tangent |
| ARCLENGTH | Text | Arc length |
| SIDE | Text | |
| SHAPE.len | Double | Actual length of digitized lines |

| RECBNDTYPE (Subtype) | |
|-------------------------|--|
| Assessor's Parcel | |
| General Easement | |
| Road Easement | |
| Utility Easement | |
| Utility Easement | |
| Drainage Easement | |
| Well Easement | |
| Right of Way | |
| Lot Line | |
| Miscellaneous | |
| Assessors Parcel-Survey | |
| Right of Way-Survey | |

This is another detail from the **Data Model**, showing the break down of **The Boundary Feature Class** into subtypes.

- The Boundary Feature Class contains all the **parcel defining** lines, the lot lines that are abandoned parcel lines, kept for historical purposes and six different types of easements.
- The parcel defining subtypes are **Assr. Parcels** and **R/W**, but in order to be able to identify the lines that have been COGOed in from recorded documents, we have added **Assr. Parcels-Survey** and **R/W-Survey**. This is important information for the Assessor's Editors, because when we need to add new surveys into the database, they do not always fit and we need to adjust the surrounding parcel lines accordingly. But if a line has been COGOed we will know not change it.
- After editing the boundary features in the Geodatabase, we use the parcel defining lines to create the parcel polygons.

You may have noticed on the previous slide, that there were two topology boxes inside the Feature dataset. One for the parcels and another one for condos.

TOPOLOGY RULES

Cadastral Topology Rules

| | | |
|-----------------------------------|--|------------------|
| AssessorsParcels | Must Not Overlap | |
| AssessorsParcels | Must Not Have Gaps | |
| Boundary | Must Not Self Overlap | |
| Blocks | Area Boundary Must Be Covered By Boundary Of | AssessorsParcels |
| Boundary: Assessors Parcel | Must Not Have Dangles | |
| Boundary: Right of Way | Must Not Have Dangles | |
| Boundary: Assessors Parcel-Survey | Must Not Have Dangles | |
| Boundary: Right of Way-Survey | Must Not Have Dangles | |
| Boundary: Assessors Parcel | Must Be Covered By Boundary Of | AssessorsParcels |
| Boundary: Right of Way | Must Be Covered By Boundary Of | AssessorsParcels |
| Boundary: Assessors Parcel-Survey | Must Be Covered By Boundary Of | AssessorsParcels |
| Boundary: Right of Way-Survey | Must Be Covered By Boundary Of | AssessorsParcels |
| TaxCodeAreas | Must Not Overlap | |
| TaxCodeAreas | Must Not Have Gaps | |
| TaxCodeAreas | Area Boundary Must Be Covered By Boundary Of | AssessorsParcels |
| MapBooks | Must Not Have Gaps | |
| MapBooks | Must Not Overlap | |
| MapBooks | Area Boundary Must Be Covered By Boundary Of | AssessorsParcels |

- The relationship between the feature classes is defined by Topology Rules.
 - Topology validation, which is the last step in the editing process, makes sure that all the rules have been followed.
-



And here is the Topology detail out of the Data Model. It lists all the topology rules that we have applied to the parcels, to ensure **data integrity** and refers to the relationships between features with **shared geometry**.

Topology rules can be applied within or between feature classes and even between different data types. For instance, the boundaries of the **parcel polygons** need to be **coincident** with the **parcel boundary lines**, so we set the topology rule illustrated here: **Boundary must be covered by the boundary of Assessor's Parcels**. And to avoid **overlaps and gaps** between the **parcel polygons**, we set the rules: **Assessor's Parcels must not overlap** and **Assessor's Parcels must not have gaps**.


After the parcel edits are done, **Topology** in the edited area must be **validated**. If the rules have been violated, an **error report** is generated and the errors must be **fixed** or an **exception** made before the changes can be accepted into the Geodatabase.

Must not overlap

Polygons must not overlap within a feature class or subtype. Polygons can be disconnected or touch at a point or touch along an edge.

Polygon errors are created from areas where polygons overlap.

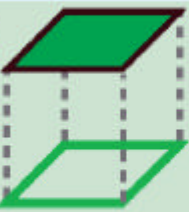



A voting district map cannot have any overlaps in its coverage.


Use this rule to make sure that no polygon overlaps another polygon in the same feature class or subtype.

Boundary must be covered by

Polygon boundaries in one feature class or subtype must be covered by the lines of another feature class or subtype.

Line errors are created where polygon boundaries are not covered by a line of another feature class or subtype.



Major road lines form part of outlines for census blocks.

Use this rule when polygon boundaries should be coincident with another line feature class or subtype.

This is the last detail out of the Data Model.

THE CONDOMINIUM FEATURE CLASS

| Condos | | | |
|------------|-----------|--|--|
| Field Name | Data Type | | |
| OBJECTID | Object ID | | |
| APN | Text | | |
| APNNODASH | Text | | |
| DEED_ID | Text | | |
| RECORDMAP | Text | | |
| SPLITCOMBO | Text | | |
| PRCLID | Text | | |
| PRCLKEY | Integer | | |
| EMISLAYR | Text | | |
| FLOOR | Integer | | |
| SHAPE | Geometry | | |
| SHAPE.area | Double | | |
| SHAPE.len | Double | | |

| Floor (Subtype) | |
|-----------------|--------------------|
| Code | Description |
| 0 | Condo Ground Floor |
| 1 | Condo First Floor |
| 2 | Condo Second Floor |
| 3 | Condo Third Floor |
| 4 | Condo Fourth Floor |
| 5 | Condo Fifth Floor |
| 6 | Condo Sixth Floor |

Being true to their nature, condominiums continued to present a special challenge in this new system and had to be dealt with separately. In order to capture the 3D aspect of the condos and distinguish between units on different floors we created subtypes to correspond to the floor levels. This was done both for the (line features) condo boundary and (polygons) the condos.

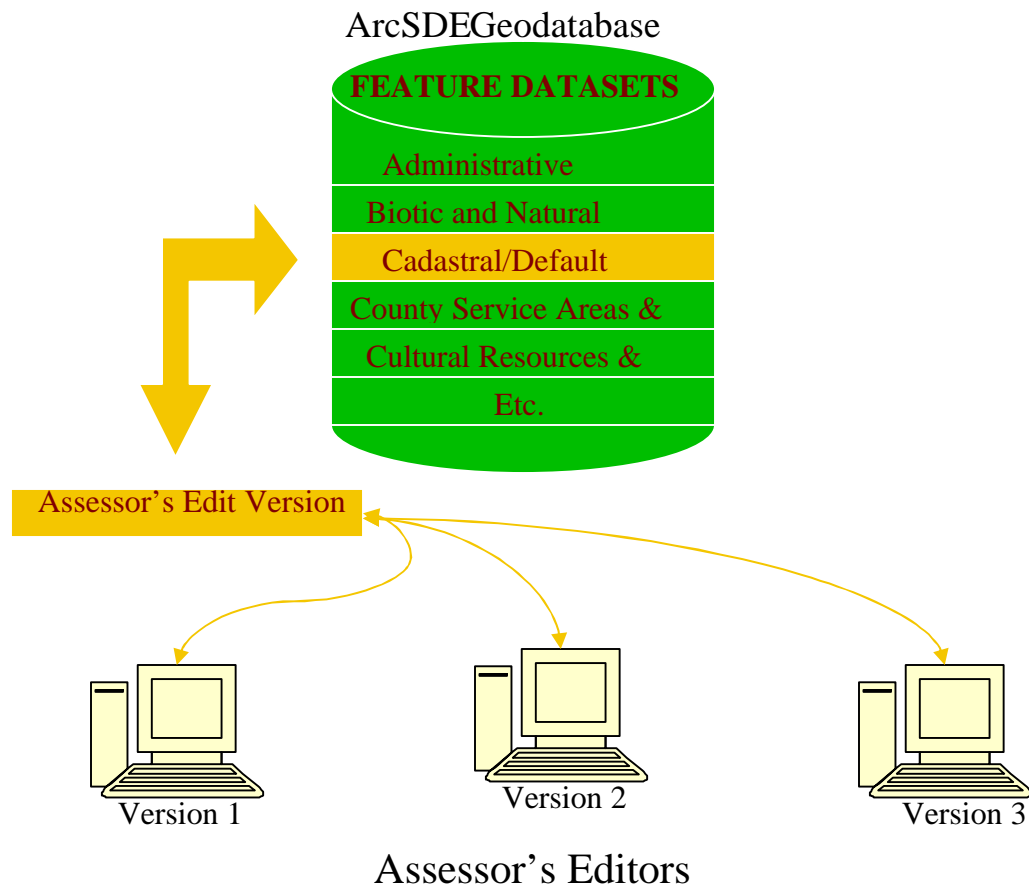
Because the condo polygons are not cut out of the base parcel and don't share its boundary lines, they **cannot** participate in the same topology so a separate topology was established for the condos, where the only rule is that the condo boundary (line feature) must be covered by the boundary of the condo polygon.

Workflow Design:

As I mentioned before, we tried to maintain our current workflow to the extent possible in the new ArcGIS system. For the most part we were able to keep the same process in place. The basic workflow for parcel updates stays the same, but our QC process is more effective now.

This flowchart represents our parcel maintenance workflow and is probably more or less the same for all of you so I will not go over it in detail.

THE PARCEL EDITING PROCESS



Now, as far as editing the parcels, we set our system up as a versioned Geodatabase. The term, versioned refers to how the data is edited.

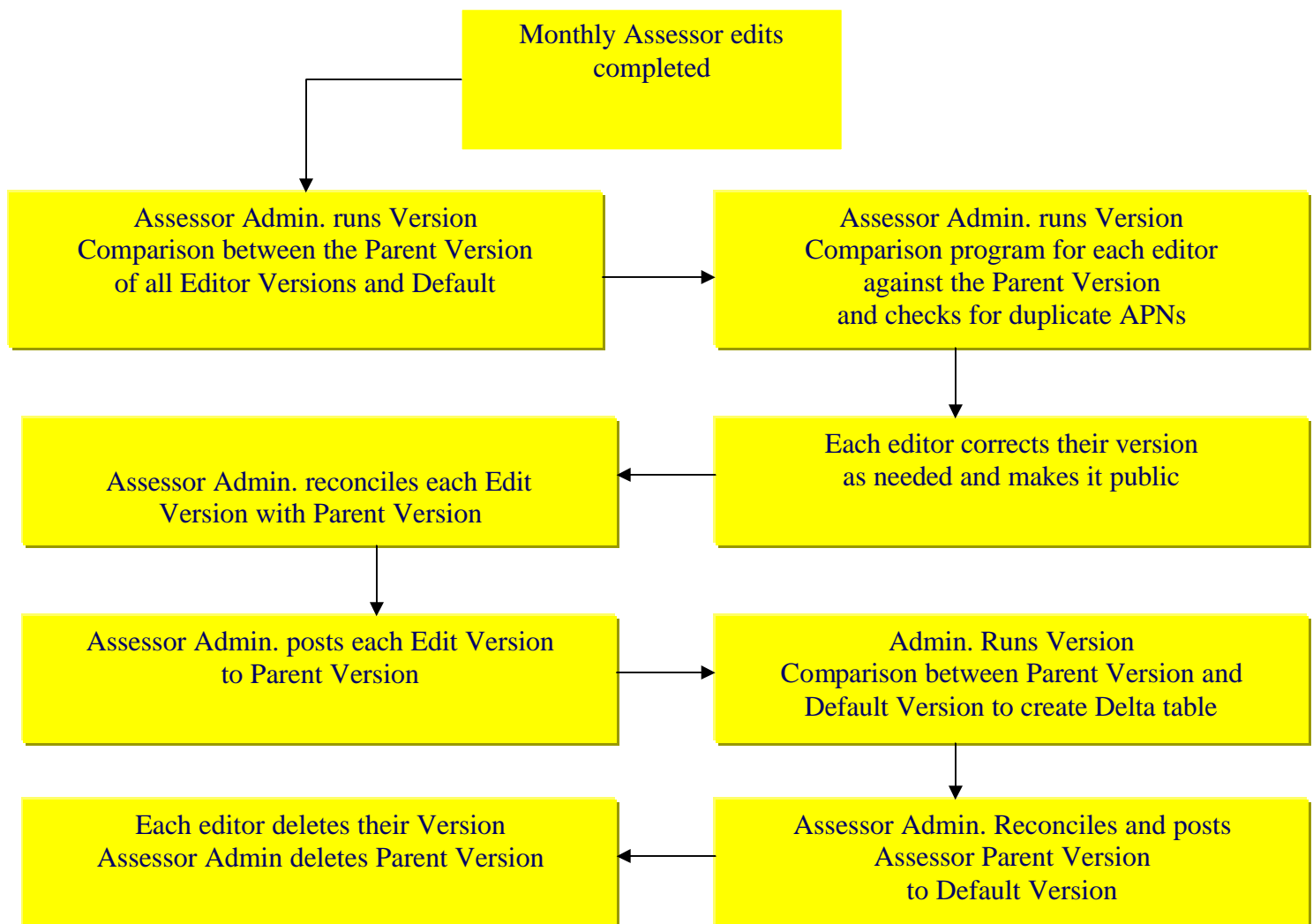
At the beginning of an edit period, an edit version is checked out from the Cadastral/Default for the Assessor Drafting staff and serves as a parent version for the individual edit versions.

Each editor logs into the Geodatabase with their edit permissions, checks out their own version from the Assessor's Edit version and works on it exclusively.

The edit permissions only allow the editor to edit his/her own version but they are able to **view** what changes the other editors have made. The edits get saved to the version instead of being saved to the Geodatabase directly.

So to recap, all the editors are editing the same data at the same time, but the changes are saved to the individual versions.

PARCEL CHANGES UPDATED TO GEODATABASE



At the end of the edit period, we run a version a comparison program that compares each edit version with the default version and produces a table for each version that lists all the changes that took place. Each editor verifies that all the edits are in the version correctly and turns the version over for reconciling and posting.

After all the edit versions have been posted, a final comparison between the parent version and the Default version is run to capture all the changes that were made during the edit period. The resulting table is used by the other departments to locate the areas where other datasets need to be aligned to the parcel base.

Now, after we have edited the Geodatabase, we need to produce map pages to show the new parcel configuration, and again - our objective was to keep the appearance of the **new map pages** consistent with the CAD pages. This proved to be a challenge, that at times left us in despair.

Assessor Map Pages

If we were to agree with Oscar Wilde when he said:
“Experience is the name everyone gives to their mistakes”
I have to say, that when it comes to making Assessor’s Map Pages in ArcMap, we in the Santa Cruz County Assessors Office are **very experienced**.

Designing and building the Geodatabase didn’t seem like much when it came to drawing the Assessor’s Map Pages in ArcMap. We encountered some major obstacles, in particular with the annotation and scale. Not to mention the frequent software crashes. This was the **single most difficult** process in this conversion.

With the help of some very knowledgeable and dedicated ESRI staff members and others, we were able to work through our difficulties and have managed to re-create the look of our AutoCAD map pages, only now they look better than before with improved fonts and better distinction between line weights and types

Page Making Procedures

As I said before, when making changes to a page, we edit the Geodatabase first and then make the new map page, utilizing data that we import from the old CAD page.

With the aid of a standard definition query, we select data from the CAD page and label it with the map page number and save it to the Geodatabase.

Using the CAD data is (at this point) easier than recreating it and enables us to draw the map faster than creating it from scratch in a standard template.

The data we import from the CAD pages is mostly non-parcel information such as record map references, adjacent map page references, right of Way lines to show both sides of streets (**flip to previous slide**) and other page notation. In addition we import the cancelled parcel numbers from the CAD pages since they are not retained as parcel attributes.

We save the map pages as .mxd, and .pdf files and use the .pdf for distribution of electronic and printed maps.

Eventually we will have all the map pages drawn in ArcMap, but at this point, 8 to 9 months later, we only have about 2% of them converted.

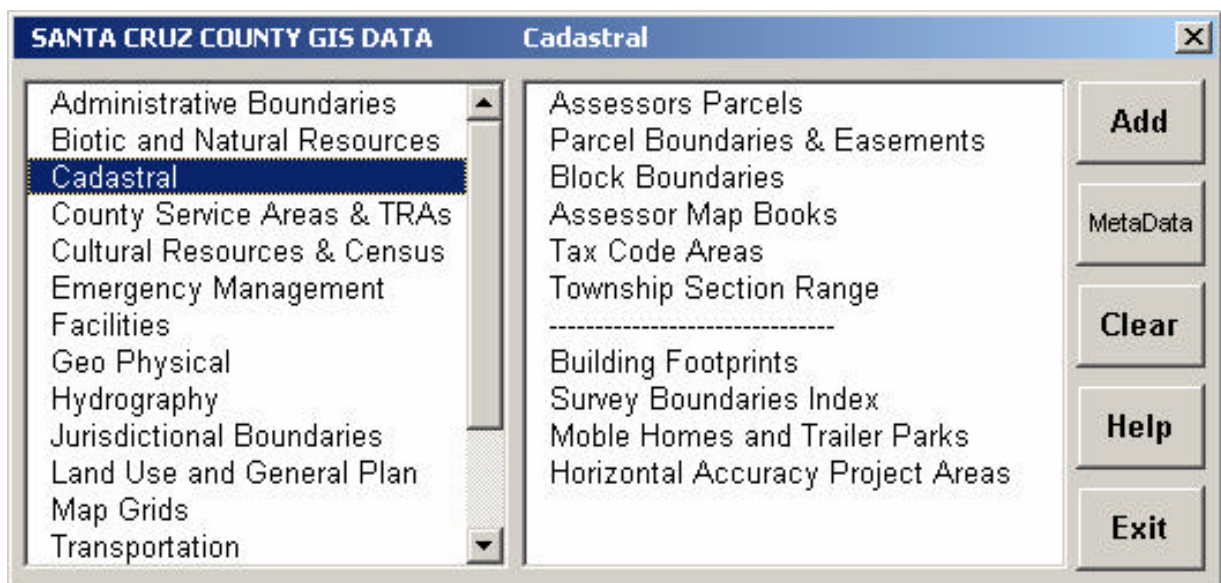
We have developed detailed step-by-step procedures on how to make the map pages and would be happy to share them with you if you are interested.

Serving Up The Data:

Now that we have an Enterprise GIS system, it's important that the data be easily accessible, so we developed a data menu application.

In addition to the Cadastral Feature dataset, the Geodatabase contains 24 other Feature Datasets, maintained by the GIS Division and the Department of Public Works. Many of the datasets are dependent on the parcel boundaries and have to be aligned monthly after the Cadastral dataset is updated

The editors access the data by going directly to the Geodatabase through their edit connections, but the other departments that use the spatial data access it through a **data menu application**. The data menu is broken down into logical groupings and is a more user-friendly interface. The Geodatabase can't be edited through the Data Menu, but the data is available for mapping projects and analysis. The metadata is also accessible through the data menu application.



More and more departments are becoming interested in updating their technology and taking advantage of this data.

Future Goals:

So this is where we are now in a nutshell, but we keep dreaming and we have set ourselves some lofty goals.

In the future we hope to be able to

- increase the accuracy of the parcel base. We have recently acquired a county wide aerial coverage that we are currently using to make determination on adjustments of the base.
- The Survey department is also starting a project to locate survey monuments using GPS technology. The information will be maintained in a Monumentation dataset and will enable us to further adjust the parcel base.
- We will also be working on increasing the automation of the parcel maintenance procedures.

The GIS division is currently conducting a county wide needs assessment for spatial data and as a result we have identified the needs for some new applications in our office. We are working on an intranet application for the Appraisers, to help them locate comparable sales for assessment appeals. Further down the road, we will also be implementing counter applications to assist the public in accessing our data.

And finally, I would like to share with you my mantra.

It has at times been severely tested through this process, but I'm happy to say that it still holds true.

People with goals succeed because they
make maps to their destination

