Chapter 3

Design and Use of GIS-based Land Records Database Models

Abstract

This chapter is about land records database models for urban and regional environments. GIS database analysts face many choices about land records. Coordinates are needed to provide reference for land records. We draw from several published database models to describe database possibilities. Land records include information about land parcels as well as US Bureau of the Census boundary information. The US Bureau of the Census Topologically Integrated and Geographically Encoded and Referenced (TIGER) Line file information is not suitable for detailed database model development when land parcel information at the individual parcel level is needed. We differentiate database model needs among planning, improvement programming, and implementation decision problems as a way of dealing with the issue that database design depends on the context of the decision situation.

This chapter describes land records database models suitable for use in urban-regional applications of GIS. Remember that a data model language implemented in a particular context results in a database model – the (schema) model of a particular database – specified in terms of entity-object classes. The database models in this chapter focus on land records for three decision situations – planning, improvement programming, and project implementation.

3.1 Motivations for Land Records Databases

Land records are the most common type of data in urban-regional GIS because they have to do with land ownership and land use. More people work with land than any other theme, which is why the term *land information system* exists to highlight this use of GIS. Although cadastral and local property land surveys are considered basemap information, they can also be considered part of land records; it is all a matter of how a database designers perspective about GIS applications.

Land records database models contain several feature classes that focus on the spatial boundaries, e.g., lots, parcels, property boundaries, and plat maps, plus attributes for those features, e.g., land cover, land use, and zoning. The motivation for storing information on land records is that it is foundational to land related activities in all communities. Furthermore, data about human populations are also fundamental to land records. Therefore, we introduce the human population feature classes in the ArcGIS Census Data model as a way of relating land data records to population data records. We then turn to comparing/contrasting land records database model and data model examples.

3.2 Feature Classes in Land Records Database Models

There are several types of feature classes related to land. Scale is an important factor in differentiating the type of data needed for land records database models.

3.3.1 Lots, Parcels, Property Boundaries, and Plat Maps

A land (parcel) records database model often includes lots, development parcels, properties, plat maps, plus attributes like land use, land cover, and zoning. Land records are often developed from land surveys and are common features based on maps because land records (often land parcels) are geographic features used for orientation. USPLSS section corner control (with associated state plane coordinates) is used to provide location registration control for land records.

Commonly, two types of land records are part of basemaps – planimetric and cadastral. Planimetric features can be seen in a photo, e.g., streets, fences, streams, etc. Cadastral features, which cannot often be seen on airphotos include property boundaries and their legal descriptions.

Planimetric feature compilation commonly derives from aerial photos (Figure 3.1). Local control surveys establish control for feature compilation from aerial photos (Figure 3.1 step 1). Aerial photos are taken from the belly of an airplane that flies in multiple passes (Figure 3.1 step 2). Photogrammetrists capture features seen on "stereo photos" using a stereoplotter (Figure 3.1 step 3). A cartographer pulls together data layers for data analysis and map development (Figure 3.1 step 4). An example of a planimetric map as part of multipurpose cadastre is presented in Figure 3.2.

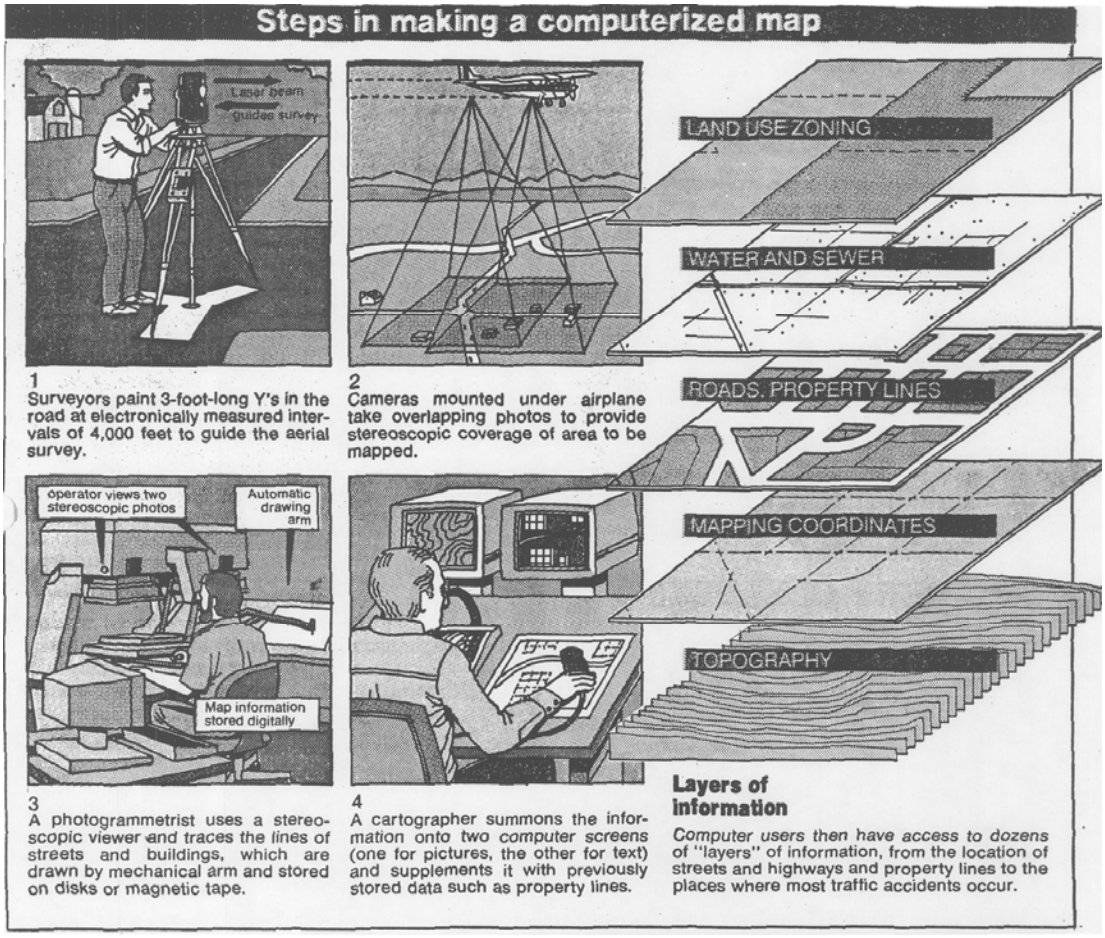


Figure 3.1 Planimetric feature compilation (Case, 1987).

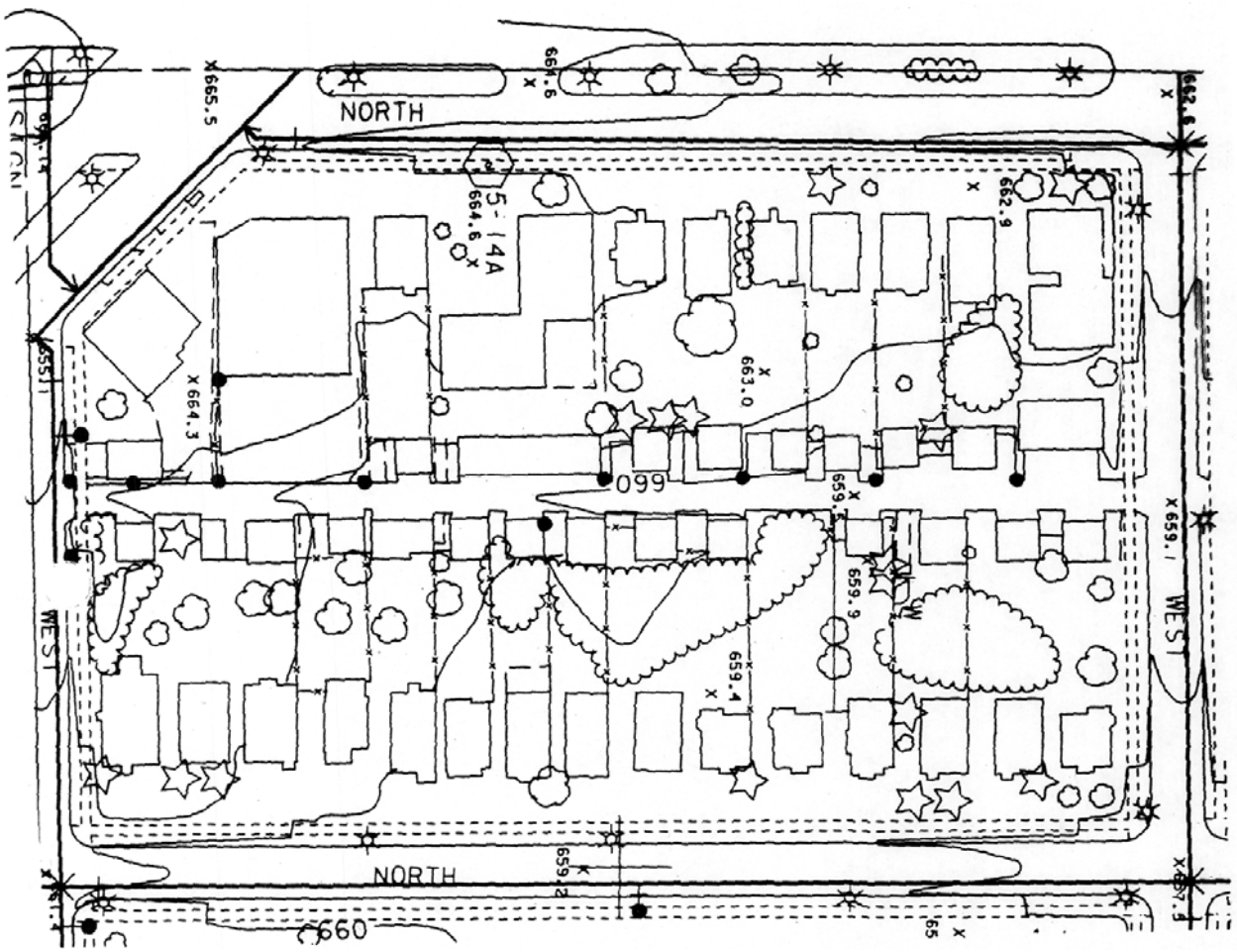


Figure 3.2 Planimetric map (from Huxold 1991 Figure 6.1).

A *cadastre* is a record of interest in land, encompassing both the interest and extent, e.g., as in the records of interest and associate rights in Figure 3.3. Interests include land ownership, zoning, rights-of-way, easements, political jurisdictions, and taxation. We can lump interests into three main types of cadastres – juridical, fiscal, and others. The *juridical* cadastre is a legal title as a record of interest. The *fiscal* cadastre is a record about taxation value of land. The *other* category includes resources, utility easements, transportation rights-of-way, etc.

One component of the record of interest is the spatial description provided in terms of a land lot. A land lot is a surveyed parcel of land designated by the spatial extent, and has ownership (a property parcel). Both public and private properties use surveyed property lines to indicate extent. Such lots could be as large as sections, 1/4 sections (in the suburban or rural areas), or they could be as small as few hundred square feet (in the urban core).

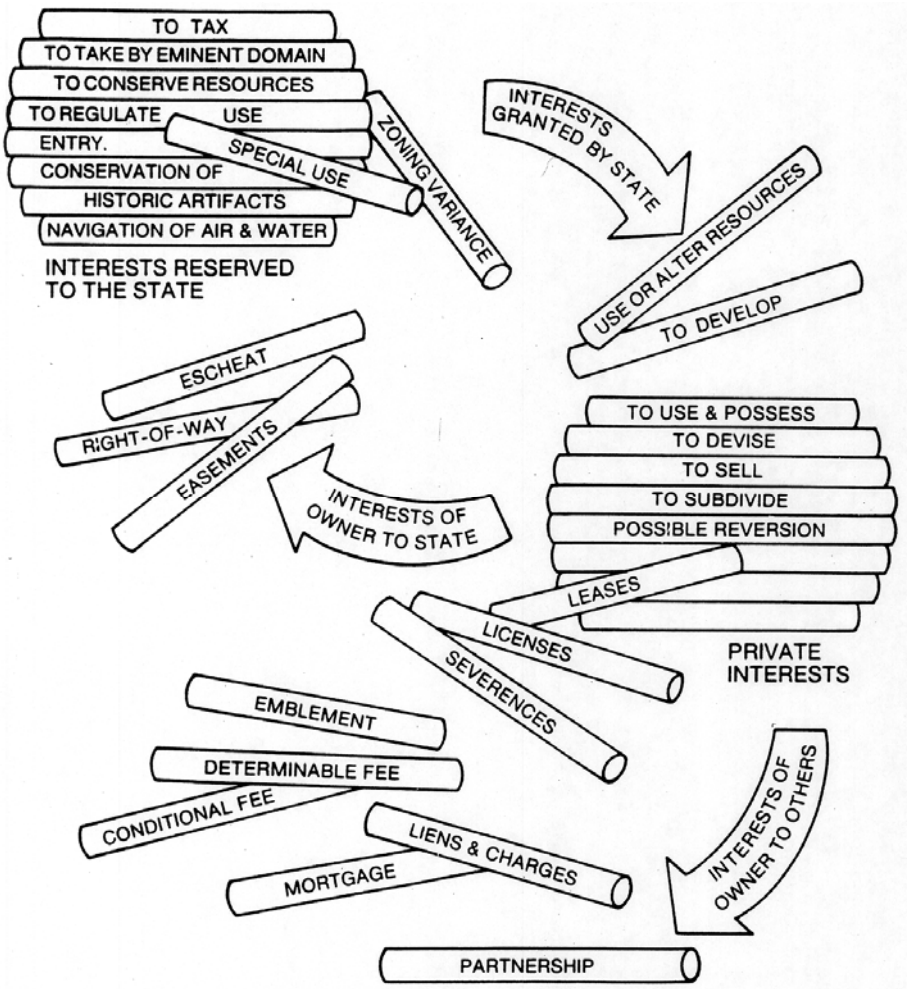


Figure 3.3 Bundle of rights as interests in land (from Epstein and Brown 1993 Figure 4-1).

Land lots are compiled onto plat maps to show the subdivisions of properties (Figure 3.4). A lot has iron pins at corners. A property identification number (PIN) identifies lot. One or more lots (two lots can be connected by "land line hooks") can act as a basis to collect property tax (Figure 3.5). Thus, a development parcel is a portion of a lot, one lot, two or more lots on which development will occur. Buildings are included as part of property tax, i.e., land value and improvement value, for a development parcel.

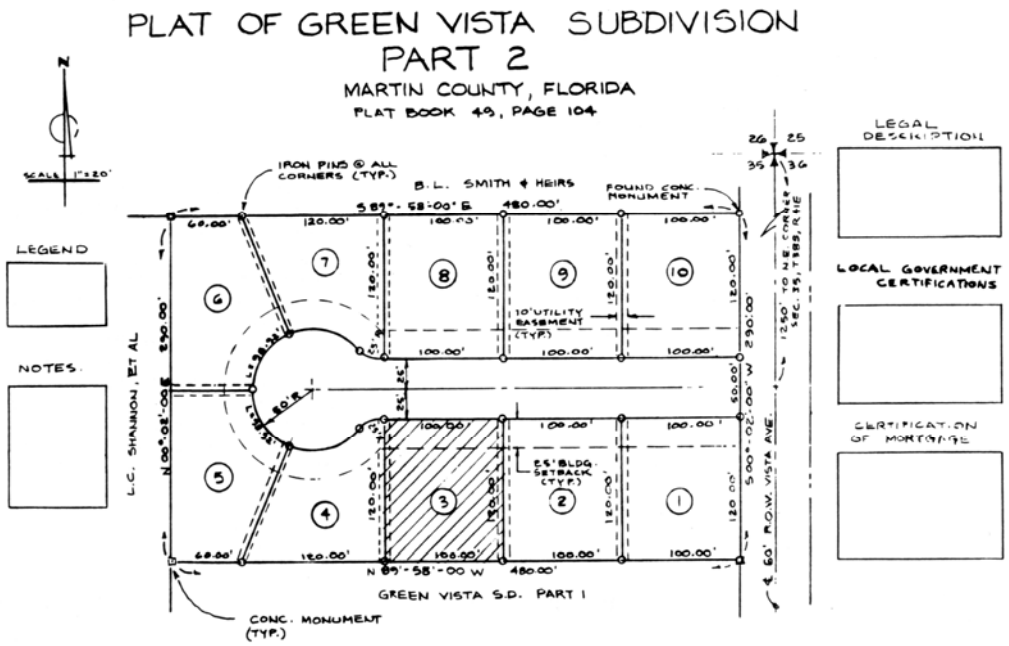


Figure 3.4. Plat map with lots (From Brown 1993 Figure 5-4).

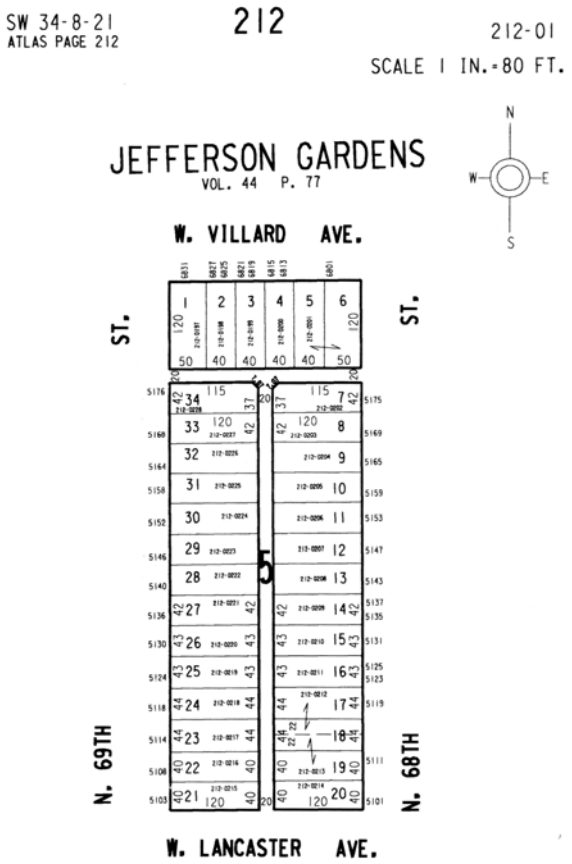
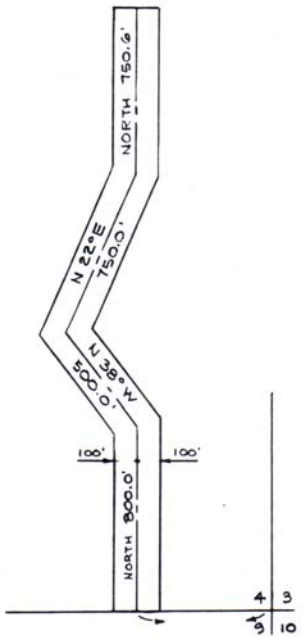


Figure 3.5 Assessor's plat map showing lots with "land line hooks" (From Huxhold 1991 Figure 3.1).

Another example of a lot is the strip description used for rights-of-way or easements (private, semi-private, and public access), as in Figure 3.6.



A strip of land 200 feet wide, 100 feet on each side of the following described centerline:

Beginning at a point on the South line of section 4, Township 35 North, Range 36 East, being 586.4 feet west of the southeast corner of said section 4; thence North 800.0 feet; thence N38°W–500.00 feet; thence N22°E 750.0 feet; thence North 750.6 feet to the north line of the southeast quarter of said section 4; the side lines of said description being shortened or elongated to meet the property lines of the Grantor.

Figure 3.6 Strip map for right-of-way (from Brown, 1993 Figure 5-5).

When boundary lines are added to a planimetric map then it is called a cadastral map (See Figure 3.7). Note also that street names have been added to the planimetric map of Figure 3.2.

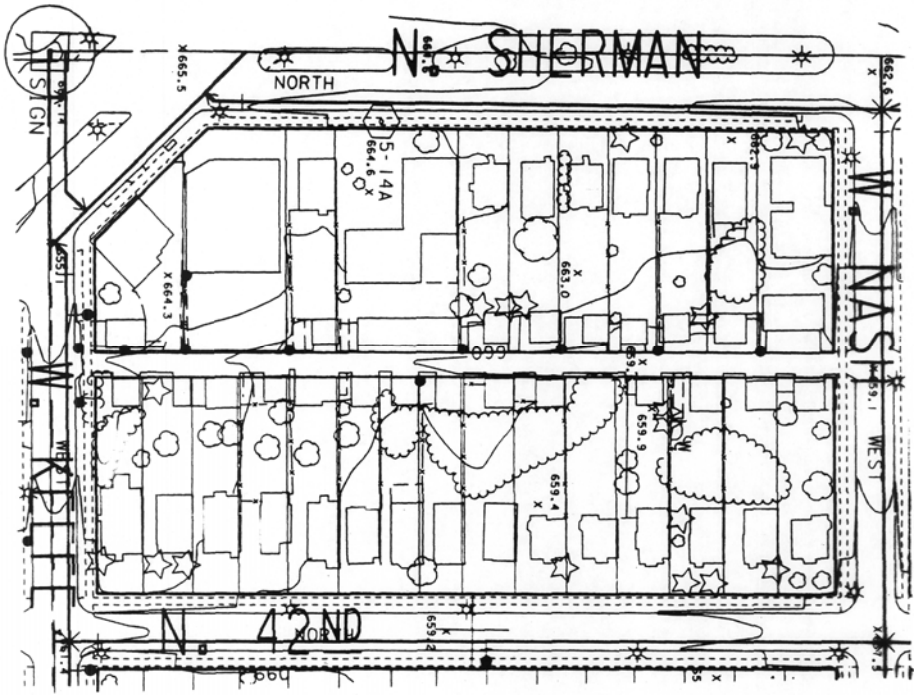


Figure 3.7 Cadastral map (From Huxhold 1991 Figure 6.4).

Different work tasks in urban environments require different cadastral accuracies in maps. This is a factor of the different interests in land, different sizes of properties, and frequency and intensity of land use. Because of these different work tasks, land parcels are often developed as a multipurpose cadastre - a record that serves multiple purposes. An urban GIS database is a multipurpose cadastre (MPC), a land records database with multiple uses (National Research Council 1982).

The parcels in a MPC are developed at various levels of cadastral accuracy (Table 3.1). Accuracy is differentiated by type of area, lot frontage to the street, basemap scale, and cadastre boundary accuracy (property lines).

Table 3.1 Accuracy Levels in MPC Parcels (after Wilcox 1984 p. 204)

Proposed Multipurpose Cadastre Map Accuracy Standards					
Multipurpose Cadastre Survey Accuracy	Type of Area	Lot Frontage	Base Map Scale	Comparable Metric Map Scale	Multipurpose Cadastre Map Accuracy*
± 0.35'	Urban Type I	15' to 40'	1:600 (1" = 50')	1:500	± 1.7'
± 0.35'	Urban Type II	50 to 90'	1:1200 (1" = 100')	1:1000	± 3.3'
± 0.35'	Suburban	100 to 180'	1:2400 (1" = 200')	1:2000 or 1:2500	± 6.7'
± 1 to 2'	Rural	200' and greater	1:4800 (1" = 400')	1:2000 or 1:5000	± 13.3'
± 40'	Resources Type I	--	1:12,000 (1" = 1000')	1:10,000	± 33.3'
± 40'	Resources Type II	--	1:24,000 (1" = 2000')	1:25,000	± 66.7'
*Accuracy is relative to map control used. This is not mean square error or standard deviation. This is at the base map publication scale.					

In summary, property boundaries are represented on plat maps, quarter-section, and section maps to develop basemaps. We start with parcel boundaries on a plat map (as described previously in Figure 3.4 and Figure 3.5). Plat maps are compiled onto a quarter-section map (Figure 3.8), e.g. quarter-section data tiles (like in City of Seattle database Figure 3.15). Four quarter-section maps compose a section map, and cover 1 square mile.

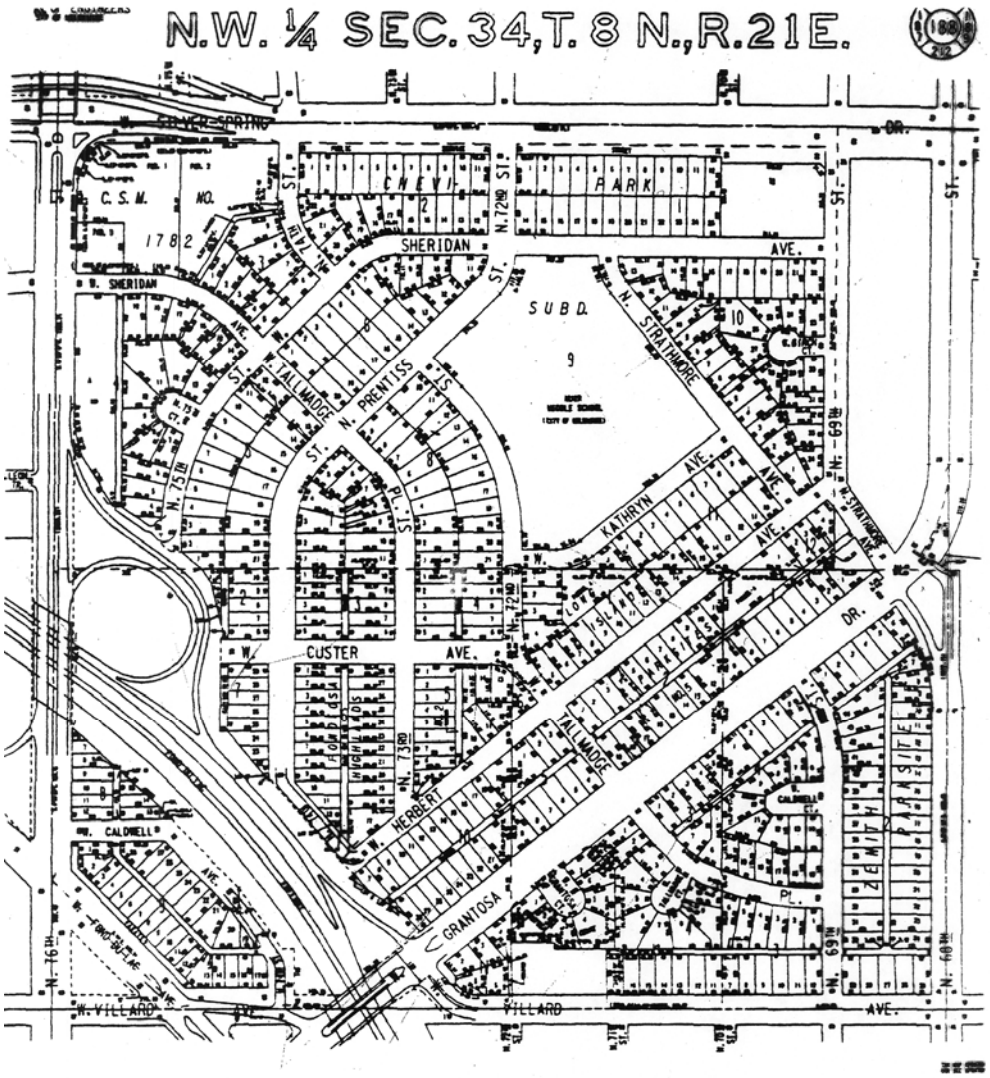


Figure 3.8 Quarter-section map (Huxhold 1991 Figure 3.2)

3.3.2 Land Cover, Land Use, and Zoning

Land cover, land use, and zoning are inter-related, but not identical. Land cover is what we see across the ground, e.g. vegetation, soil, rock, water, impervious surface (Figure 3.9). Land cover boundaries are not restricted to land parcel boundaries.

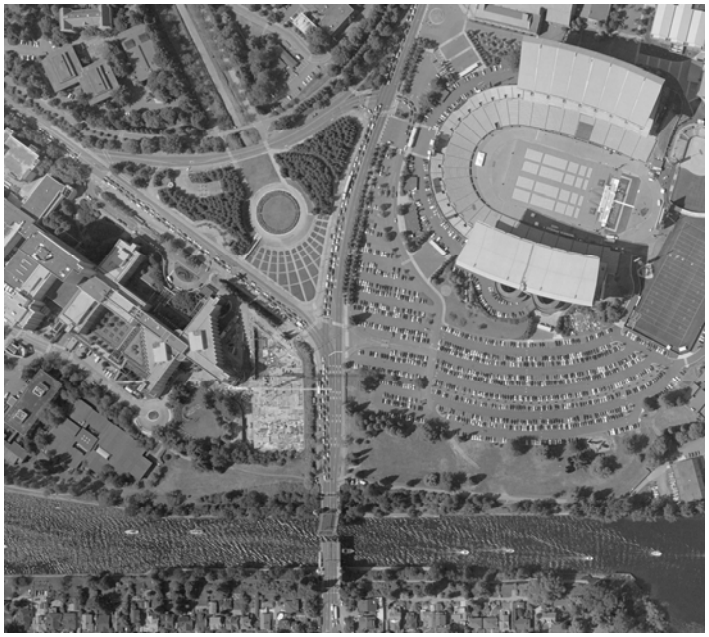


Figure 3.9 Land cover on the U of Washington campus; depicted using an image data model.

Land use refers to human activities. Land use plans are by far one of the most pervasive and fundamental of all GIS maps produced for towns and cities. We earlier presented a land use plan map from Middleton Township, WI that depicts land use areas for all thirty-sections of the township. At a more detailed quarter-section level, we can show land use on a parcel-by-parcel basis as depicted in Figure 3.10 whereby institutional land use is in dark shade and residential land use which is not shaded.

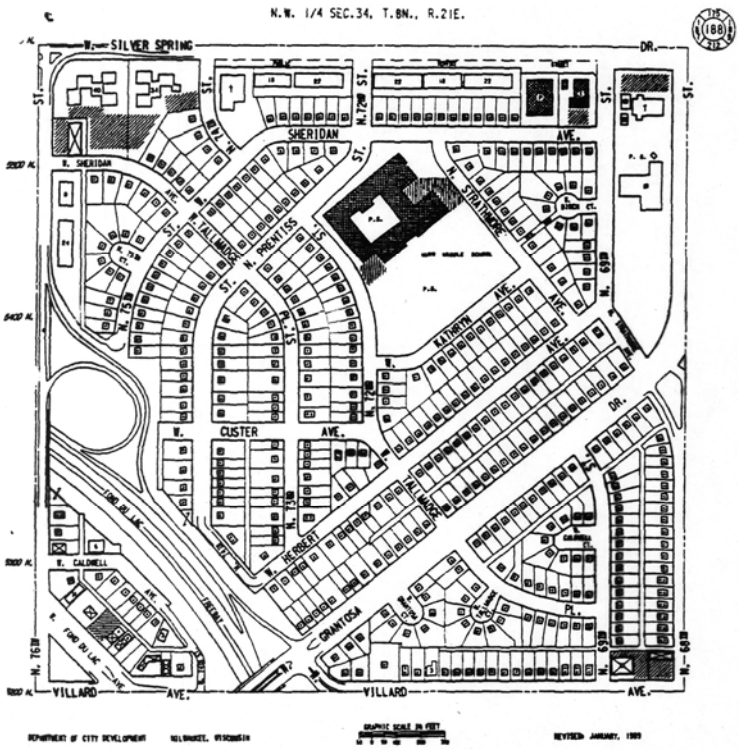


Figure 3.10 Land use map (From Huxhold 1991 Figure 3.3).

A land parcel record contains a number of attributes (See bottom of Table 3.2); particularly important is the land use code.

Table 3.2 City of Seattle and King County Parcel Data Record

FEATURE: PARCEL

FEATURE DEFINITION:

An area of land, usually contiguous which is under the same ownership. A parcel is delineated based on the segregation/merger process of the King County Department of Assessments.

COMMENTS:

Parcels are created for taxation purposes and uniquely identified by a single Parcel Identification Number assigned by the King County Department of Assessments.

Parcels are created and altered as a result of platting activities, Lot Boundary Adjustments, and the segregation/merger process of the King County Department of Assessments.

New parcels are also created when property is acquired through the City's Open Space Program.

A parcel may be coincident with all or part of one or more platted lots.
A parcel will be coincident with tax lots in unplatted areas.

GRAPHIC ELEMENT TYPE: Polygon

GRAPHIC ELEMENT DEFINITION: The polygon is defined by the parcel boundaries as delineated for taxation purposes.

EXAMPLE:

ATTRIBUTES: (examples)

Parcel ID	Excise Tax Number	Taxpayer Address
Situs Address	Area	Tax Status
Jurisdiction	Owner Name	Property Unit Type
Zvalue	Taxpayer Name	Land Use Code
Legal Description	Recording Number	Sale Price/Type

Every jurisdiction supports an array of land use codes (Table 3.3). Codes can differ from city to city and county to county. Professional associations encourage standardization, but it is up to every jurisdiction to establish their own system.

Table 3.3 City of Seattle Land Use Coding System

2	Single Family (Residential Use/Zone)
3	Duplex
4	Triplex
5	4 - Plex
6	Single Family (C/I Zone)
7	Houseboat
8	Mobile Home
9	Single Family (C/I Use)
11	Apartment
16	Apartment (Mixed Use)
17	Apartment (Co-op)
18	Apartment (Subsidized)
20	Condominium (Residential)
25	Condominium (Mixed Use)
29	Townhouse Plat
38	Mobile Home Park
48	Condominium (Mobile Home Park)
49	Retirement Facility
51	Hotel/Motel
55	Rehabilitation Center
56	Residence Hall/Dorm
57	Group Home
58	Resort/Lodge/Retreat
59	Nursing Home
60	Shopping Center (Neighborhood)
61	Shopping Center (Community)
62	Shopping Center (Regional)
63	Shopping Center (Major Retail)
64	Shopping Center (Specialty)
96	Retail (Line/Strip)
101	Retail Store
104	Retail (Big Box)
105	Retail (Discount)
106	Office Building
118	Office Park
122	Medical/Dental Office
126	Condominium (Office)
130	Farm
137	Greenhouse/Nursery/Horticulture Service
138	Mining/Quarry/Ore Processing
140	Bowling Alley
141	Campground
142	Driving Range
143	Golf Course
145	Health Club
146	Marina
147	Movie Theater
149	Park, Public (Zoo/Arbor)
150	Park, Private (Amusement Center)
152	Ski Area
153	Skating Rink (Ice/Roller)
156	Sports Facility
157	Art Gallery/Museum/Social Service
159	Parking (Associated)
160	Auditorium/Assembly Building
161	Auto Showroom and Lot
162	Bank
163	Car Wash
165	Church/Welfare/Religion Service
166	Club
167	Convenience Store without Gas
168	Convenience Store with Gas
171	Restaurant (Fast Food)
172	Government Service
173	Hospital
179	Mortuary/Cemetery/Crematory
180	Parking (Commercial Lot)
182	Parking (Garage)
183	Restaurant/Lounge
184	School (Public)
185	School (Private)
186	Service Station
188	Tavern/Lounge
189	Post Office/Post Service
190	Veterinary/Animal Control Service
191	Grocery Store
193	Daycare Center
194	Mini Lube
195	Warehouse
202	High Tech/High Flex
210	Industrial Park
216	Service Building
223	Industrial (General Purpose)
245	Industrial (Heavy)
246	Industrial (Light)
247	Air Terminal and Hangers
252	Mini Warehouse
261	Terminal (Rail)
262	Terminal (Marine/Commercial Fish)
263	Terminal (Grain)
264	Terminal (Auto/Bus/Other)
266	Public Utility
267	Private Utility (Radio/TV)
271	Terminal (Marine)
272	Historic Property (Residence)
273	Historic Property (Office)
274	Historic Property (Retail)
275	Historic Property (Eat/Drink)
276	Historic Property (Lot/Warehouse)
277	Historic Property (Park/Billboard)
278	Historic Property (Transient Facility)
279	Historic Property (Recreation/Entertainment)
280	Historic Property (Misc)
299	Historic Property (Vacant Land)
300	Vacant (Single Family)
301	Vacant (Multi-Family)
309	Vacant (Commercial)
316	Vacant (Industrial)
323	Reforestation (RCW 84.28)
324	Forest Land (Class-RCW 84.33)
325	Forest Land (Desig-RCW 84.33)
326	Open Space (Curr Use-RCW 84.34)
327	Open Space (Agric-RCW 84.34)
328	Open Space (Timber Land/Greenbelt)
330	Easement
331	Reserve/Wilderness Area
332	Right of Way/Utility, Road
333	River/Creek/Stream
334	Tideland, 1st Class
335	Tideland, 2nd Class
336	Transferable Dev Rights
337	Fresh Water Body
339	Shell Structure
340	Bed & Breakfast
341	Rooming House
342	Fraternity/Sorority House

Zoning is a procedural process to place restrictions on the use of land parcels within particular zones. Sometimes land use does not follow existing zoning rules, as in Figure 3.11 in the top left corner two zoning boundaries (R/B/60 and L/B/60) overlap .

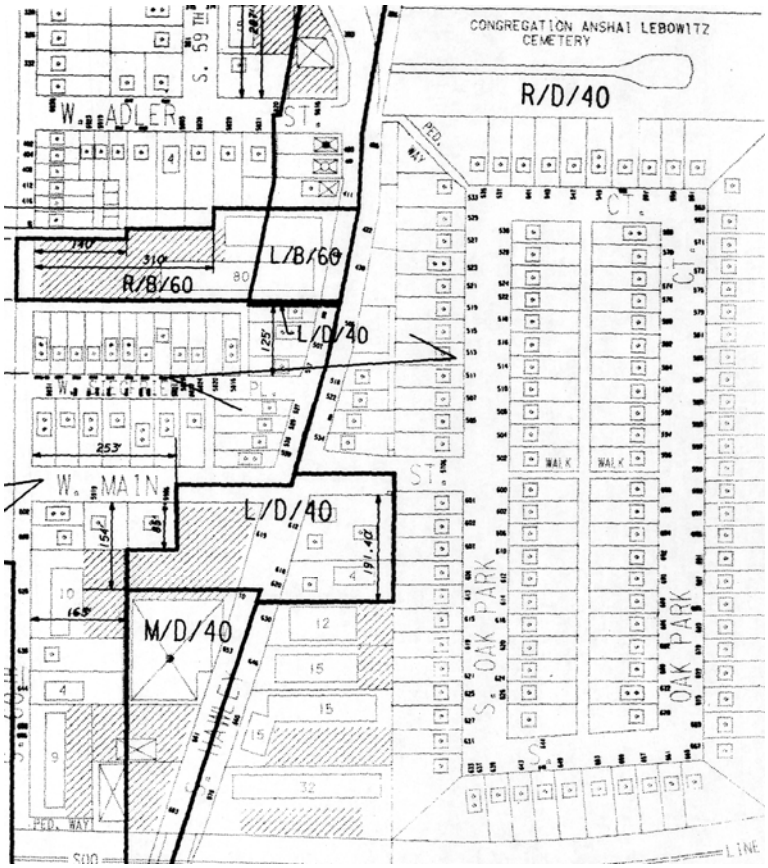


Figure 3.11 Zoning map (Huxhold 1991 Figure 3.5).

In summary land cover provides us with a description of the physical features on the land. Land use refers to the human activity occurring on a land parcel. Zoning restricts how a particular parcel of land may be used. As such, land use is very different than land cover, but both are useful in an urban database as a basemap.

3.3.3 Land Records Database Model Diagram

Details about land records data categories are provided in the parcel portion of the urban database model (Figure 3.12). Many of the concepts discussed earlier (boundaries, ownership, survey) are depicted in this database model.

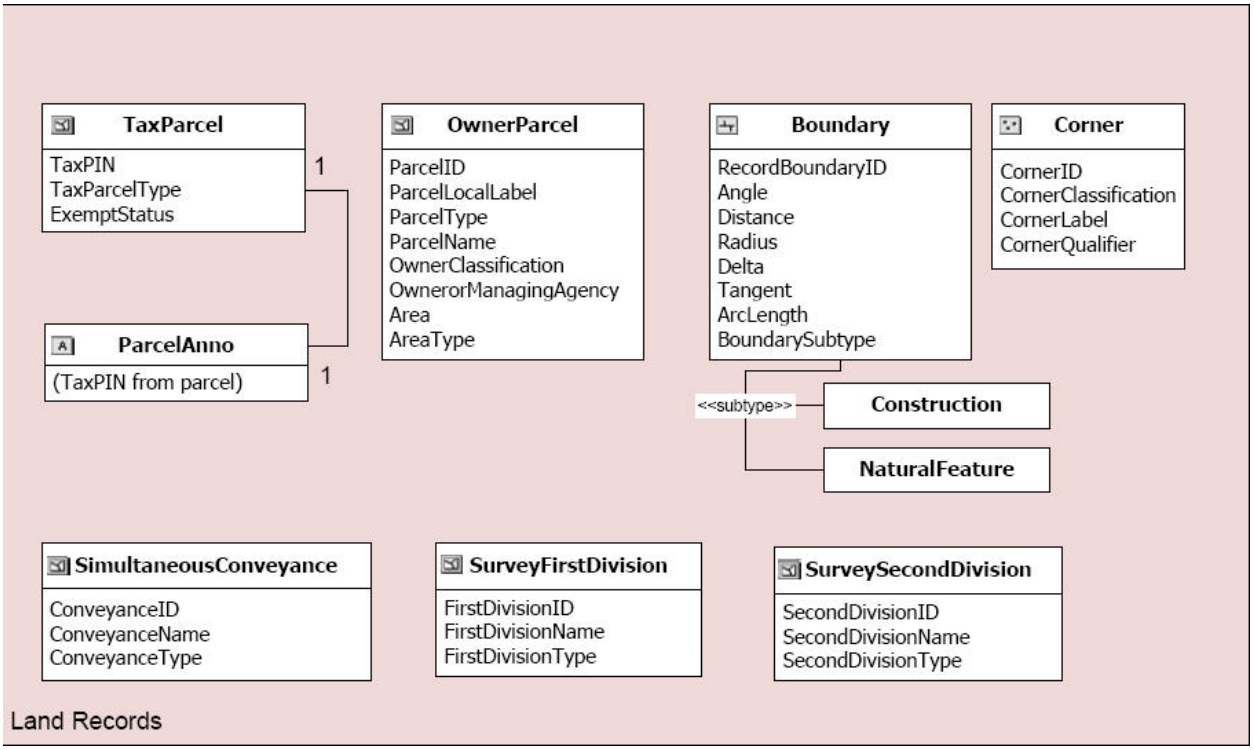


Figure 3.12 Parcel portion of urban database model (ESRI 2006b).

3.3 US Census Boundary Database Models

The next most important set of data for urban data models is Census data. This section describes census feature classes and database models. Census data is managed within land records database models through the Census' development and use of a database design that guides the delineation of boundaries.

3.3.1 Census Feature Class Base Data

Organizations at all scales (i.e., local, state, and national scales) commonly have a need for administrative boundaries. The Census Database Model contains a template set of object classes to jump start a database design typically used for administrative boundaries at those scales. The database model makes use of US Census Bureau's TIGER® – **T**opologically **I**ntegrated, **G**eographic **E**ncoded **R**eference – data object classes. TIGER data include administrative and statistical units associated with such data, plus line-oriented features including roads, hydrography, and railroads. Units such as blocks, block groups, and tracts are assembled out of those tline features. The template provides a first cut at implementation of a geodatabase data model that includes topologic rules useful for state and local agency demographic data.

Data to populate the Census database model can be developed from the TIGER Line files that are available on-line from the Census Bureau's web site. Technical documentation for the line files is available from the US Bureau of the Census (2000), as are the updated TIGER/Line files and a host of related products (US Bureau of the Census 2006). The following provides an overview

of geographic base files and enumeration for the US Bureau of Census. This material is important to understanding the composition of the "TIGER Line files".

People and businesses are counted every ten years by the US Bureau of the Census. Population is collected on the decennial (tens – "0") year and business two years after (the "2" years). Tabulation is performed using US Bureau of Census - Tabulation Geography (Figure 3.13). Location reporting of counts uses "blocks" as the finest level of resolution. Each higher level in the diagram is an aggregation of the lower level units. Enumeration units called block numbering areas are used on an ad hoc basis when no tract numbering scheme has yet been assigned. They occur in mostly rural areas, e.g., in Alaska, where the definition of tract is not met in terms of numbers of people. A census tract is defined to have approximately 3,000 – 4,000 residents. Thus, the size of the area is defined to a large degree by the need to count about 3,000 – 4,000 people in a tract. This is why tracts can vary in size significantly between the central core areas of cities and the outlying (suburban or exurban) areas surrounding cities. A geocode (identifier) links block area (i.e., not the boundary per se but the area within) with attribute data. That attribute data could be population count, median income, number of households, number of people who own cars, and many other characteristics.

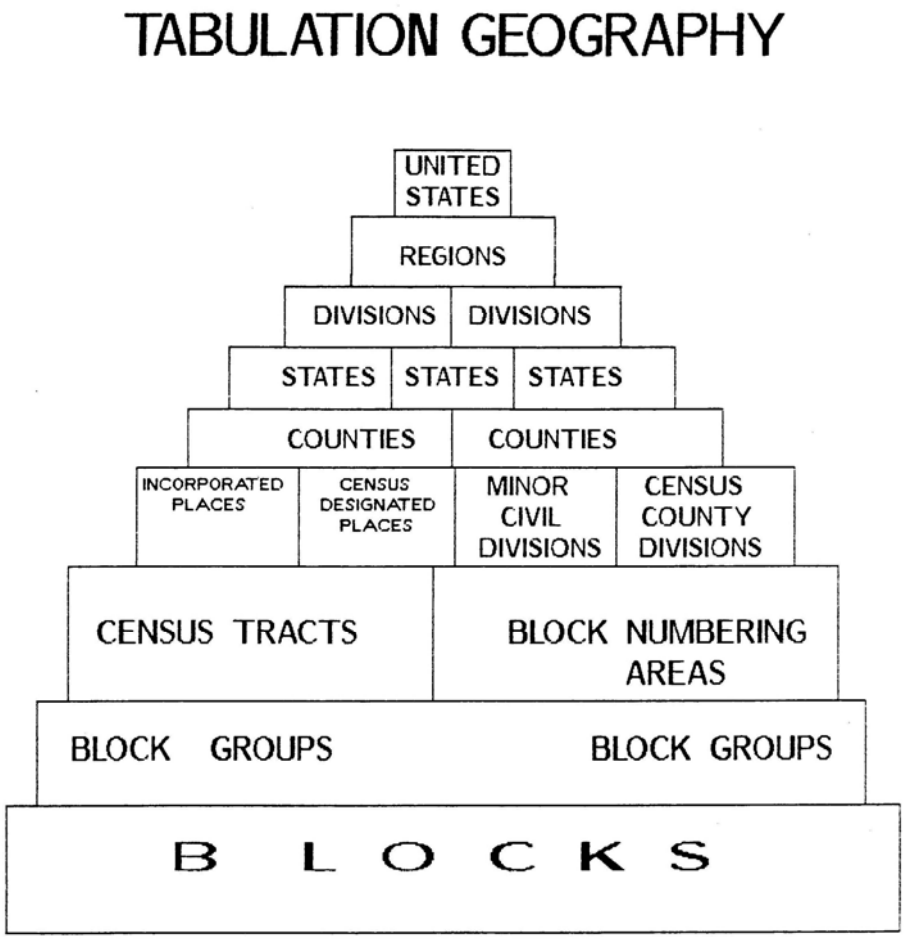


Figure 3.13 Aggregation hierarchy for U S Census Bureau enumeration areas. (US Bureau of the Census 1990a)

Geocode identifiers exist for all tabulation units in order to uniquely identify all locations and all data. The Census Bureau relies on federal information processing standard (FIPS) "geocoding" to tabulate the data (US Bureau of Census 1987, 1990b). Addresses are coded at the block level. Thus, geocodes exist for blocks, block groups, tracts, counties, and state as appear in Figure 3.14. In the example, the code 53 indicates Washington State and 033 indicates King County.

ST/COUNTY/TRACT/BLOCKGRP/BLOCK
53/033/000100/1/000
53/033/000100/1/001

Figure 3.14 Coding address scheme for Census data.

The spatial component of Census Geography is stored in GIS-readable TIGER/Line Files, e.g., block, block group, tract level administrative lines. The geometries of TIGER/Lines are structured as depicted in Figure 3.15 "Census 2000 TIGER/Line", however, remember that TIGER/Lines is a database concept, not a graphical portrayal concept. Its function as a database concept recalls earlier discussion of database elements, such as features, data fields, and data layers. TIGER/Lines are "block boundaries" (street centerline, river, pipeline, electric transmission line etc.). Features are the physical boundaries and landmarks (things you can see). The right and left side data fields require that we imagine standing on a "from node" and look toward the "to node". Thus, the left side and right side orientation are dependent on your "from and to" interpretation. The idea of planar topology means that all features are in the same data layer plane (no over or under relationships are permitted).

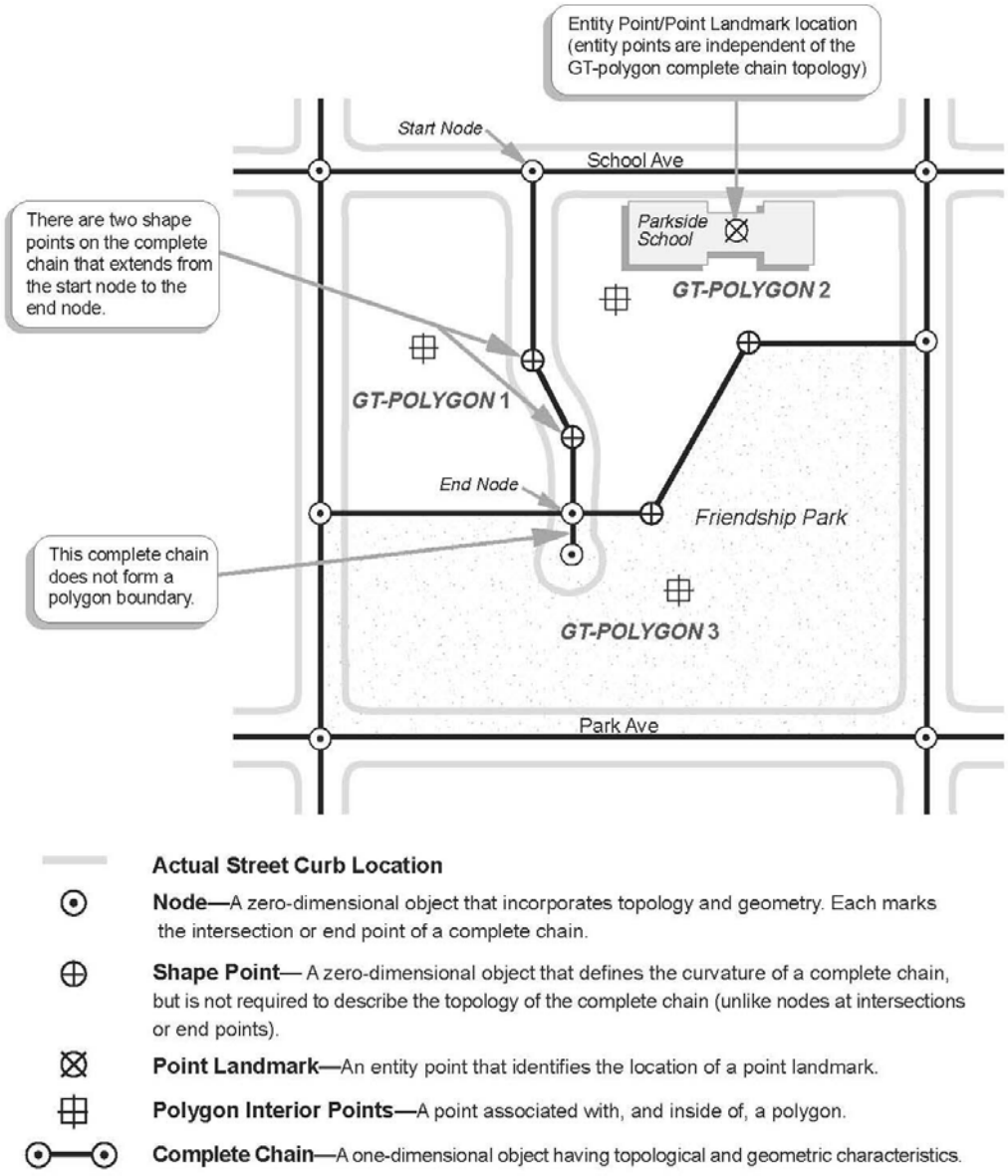


Figure 3.15 Basic spatial layout of Census 2000 TIGER/Line (US Bureau of the Census 2000).

The TIGER/Line data set consists of 20 record types (Table 3.4). A record type is a definition of a data record (schema table definition). Thus, a record type has a label name plus a set of attributes. Each record type provides data about a particular aspect of Census Geography, which is why there are so many.

Table 3.4 Record Types in the TIGER/Line Data Set; *indicates eliminated from version of December 2006 (US Bureau of Census 2006).

Record Type ID	Record Description
Record Type 1	Complete Chain Basic Data Record - topological line “from node” to a “to node”
Record Type 2	Complete Chain Shape Coordinates - shape points between the “from and to”
Record Type 3*	Complete Chain Geographic Entity Codes

Record Type 4	Index to Alternate Feature Identifiers
Record Type 5	Complete Chain Feature Identifiers
Record Type 6	Additional Address Range and ZIP Code Data
Record Type 7	Landmark Features
Record Type 8	Polygons Linked to Area Landmarks
Record Type 9*	Key Geographic Location Features
Record Type A	Polygon Geographic Entity Codes: Current Geography
Record Type B	Polygon Geographic Entity Codes: Corrections
Record Type C	Geographic Entity Names
Record Type E	Polygon Geographic Entity Codes: Economic Census
Record Type H	TIGER/Line ID History
Record Type I	Link Between Complete Chains and Polygons
Record Type M	Feature Spatial Metadata Record
Record Type P	Polygon Internal Point
Record Type R	TIGER/Line ID Record Number Range
Record Type S	Polygon Geographic Entity Codes: Census 2000
Record Type T	TIGER Zero-Cell ID
Record Type U	TIGER/Line ID Overpass/Underpass Identification
Record Type Z	ZIP+4 Codes

3.3.2 Census Administrative Boundaries from TIGER/Line

Those TIGER/Line records are useful in populating a Census database model of administrative boundaries, for example the ARCGIS Census database model. (For more information, see the link to "Administrative Boundaries Data Model Reference document" located on page provided by (ESRI 2006).

There are five groups of thematic layers in the census administrative boundaries database model: census boundaries, streets and addresses, census administrative units, other administrative units, points of interest.

Census Boundaries
Layers in this group include roads, railroads, hydrography, physical features, miscellaneous transport and landmarks, representing the underlying feature line network. Census Block features are constructed from the underlying TIGER/line features, and the rest of the features in the database model are either constructed by/or related topologically to the census blocks.

Streets and Addresses
The Streets and Addresses group is an extension of the Census Boundaries group in that it is built from the street and address information contained within the layers in the Census Boundaries group. From this layer, Address Matching analysis and the production of Cartographic street features can be performed.

Census administrative units
The Census Administrative Units group is comprised of the main census objects such as Census Blocks, Block Groups, Census Tracts, American Indian Block Groups and American Indian Census Tracts. These layers are produced from the line features in the Census Boundaries group and share a close topological relationship.

Other (statistical) administrative units
The Other Administrative Units group contains layers that can be divided into three main subgroups, County, State and Federal. Each of these sub-groups contains two main sub groups of layers; Legal and Statistical.

Points of Interest
The Points of Interest group differs from the other groups in the data model in that layers are of different feature types; point, line and polygon layers are present. These layers represent important geographic locations that are needed for typical administrative boundary data sets and maps. Included are layers such as Key Geographical Locations, Buildings and other Point, Line and Area Landmarks such as airports, airfields and bases.

3.3.3 Census Database Model Diagram
There are many feature/object classes in a full blown census database model including legal boundaries, administrative boundaries, census and statistical boundaries, census boundary hierarchy, place names, and landmarks and cartographic reference (ESRI 2006). The hierarchy from Figure 3.13 is depicted in the conceptual diagram of census area boundary hierarchy in Figure 3.16.

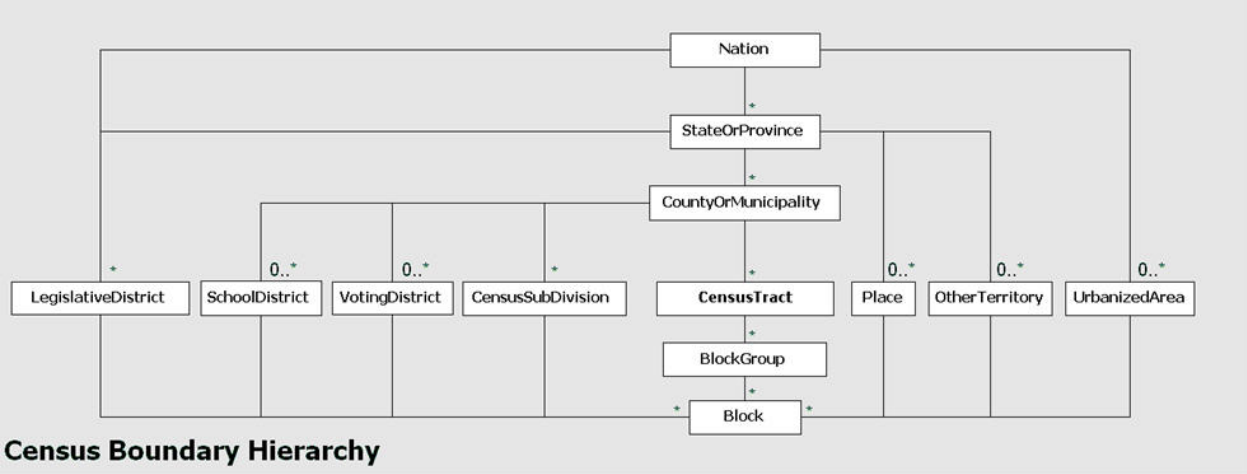


Figure 3.16 Census boundary hierarchy portion of urban database model (ESRI 2006).

The TIGER Line Files are not suitable for all applications of urban-regional GIS, as depicted by the decision tree in Figure 3.17. The Census Block is the finest area of spatial resolution for data publicly available, which means that parcel level resolution is not possible. Street network GIS applications, e.g. transportation routing of delivery vehicles that include street address matching, have been one of the most frequent uses of the data. However, data for the individual street address level (i.e., land parcel level) is not reported to the public. Therefore, street addressing applications estimate the location of a street address along the street centerline using linear interpolation.

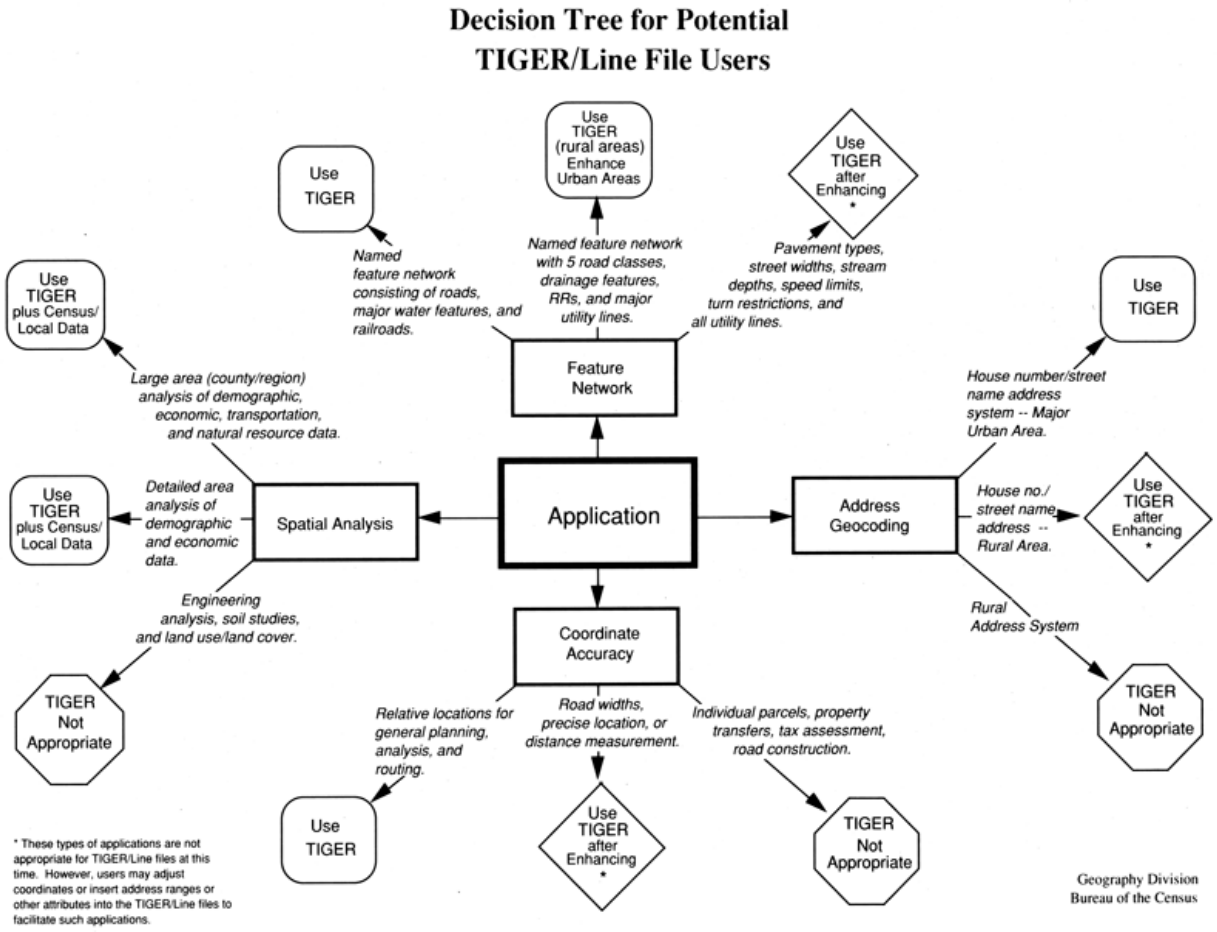


Figure 3.17 Uses of TIGER Line Files (US Bureau of Census 1990a)

3.4 Comparing and Contrasting Land Records Database Models

As a way of proceeding with database models, we introduce the concept of "practical adequacy" for determining whether we have an appropriate database model (Sayer 1984). The rule of thumb in practical adequacy in database design is "if your job might depend on the inclusion of information, then by all means include that information". By that we mean, if one creates information for a decision situation and that information does not satisfy the information need, then the information user is likely to be very disappointed. If the disappointment is at the level of "fire the person", then perhaps we could have done better. After all, someone else's livelihood or life might have depended on it. To "know what to include" simply means to be aware of the guidelines, regulations, and/or mandates (i.e., the social-institutional influences described in chapter 3) that can inform database design – put people of a level of shared understanding and expectation. Guidelines and mandates are embedded in laws, mission statements, policies, regulations, or coalition principles/ideas in an inter-organizational setting created by decision making bodies of various public, private, or non-governmental organizations. Decision makers (or interested parties) who have the need for growth management information would commonly provide such guidelines. Researchers (i.e., in part informed and motivated by decision makers and/or interested parties) could also provide such guidelines.

Little information about basemap coordinate choices appear in such guidelines/mandates – which is why we could not say much in the previous section about making choices for basemap data until we came to this section. GIS analysts need to be aware of what other data categories, e.g., land records, transportation, and/or water resources, are to be used in the planning, programming, or project-level analysis. It is those data categories that will be oriented by the basemap data (hence orienting the information user) that will provide a package of information for the information user.

Minimal detail about land records is provided in the land records portion of the urban database model. Because of the combined database model needs, fewer categories show up in the urban database model. (See Figure 3.17, which can be accessed via the ESRI website, and clicking on the "Conceptual Design-Image" download at ESRI 2006b).

The content of land parcel data classes in planning, programming, and project decision situations differ with planning level having the most general and project level having the most detailed data needs. For a planning database model, shapefile structure, i.e., non-topological data is probably fine, as it is a "broad-based" perspective about land use and land cover. For an improvement programming database model, a shapefile is of minimal need, because topological information in a coverage and geodatabase are needed for adjacency of land parcels. For a project database model, coverage or geodatabase models are needed because topology information is most likely needed. At the planning level, attribute data needs are general, and at the project level, more specific aspects of parcels data is needed.

3.5 Summary

This chapter describes several land records database models suitable for use in urban-regional GIS applications. Land records describe the boundary and financial and ownership interests that people have in land. The term *multipurpose cadastre* is used to describe those interests when they include the resource characteristics of the land. Land use, zoning as a regulation of that land use and land cover are characteristics of land parcels. Those characteristics influence the tax value of land parcels. Planimetric maps depict the physical features of land and cadastral maps depict the ownership and tax characteristics of land.

The US Bureau of the Census created the TIGER/Line files to represent boundaries for population and business counts. The line features in the TIGER/Line files are used to delineate counting areas at multiple levels of spatial scale hierarchy from blocks all the way up to counties. Census blocks are aggregated to form larger areas of block groups. Block groups are aggregated to form census tracts. Tracts exhaustively cover US counties. Thus, population data is reported by blocks, block groups, tracts, and counties. Although the TIGER/Line features are useful for characterizing some urban-wide features, those boundaries have their limitations. The TIGER/Line features are not useful for characterizing land parcel-level information, unless of course it was aggregated to the level of blocks.

3.6 References

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3.7 Review Questions

1. What is a land parcel in comparison to lot in comparison to property?

2. What is a planimetric map?

3. What are the similarities and differences between planimetric maps and cadastral maps?

4. Why do we have taxing and ownership aspects to land parcels?

5. What are the feature classes in land records database models?

6. What is the relationship between zoning and land use?

7. What is the base data used in forming Census database models?

8. What are the thematic layers of the Census Administrative Boundaries Database Model?

9. What problem topics are supported by the Census TIGER/Line database model?

10. How can we compare/contrast land records database models in regards to GIS applications for planning, programming, and implementation situations?

3.8 Glossary

cadastral – land record information constituted of fiscal or juridical categories

class – a generic term for a data category composed by bundling observations of like kinds; for example a feature class in ArcGIS

database model – A schema and data dictionary associated with the outcomes of a particular database design process.

land cover – the physical characteristics of the land surface

land use – a description of human activities that take place on land parcels

land resource records – documentation about the interest in land including is ownership, extent, and use.

parcel – a portion of land

planimetric – land record information developed from ground features than can be seen in aerial photographs.

schema – description of data categories plus data fields that characterize features (entities) about some portion of the world in a database model.

TIGER/Line File – data describing the set of urban/rural block-level boundary features in the US developed by the Bureau of the Census to geo-reference Census information such as population, housing, income and business.

topology, spatial – the study of relationships including connectedness, adjacency and containment among points, lines, polygons.

zoning – the regulatory categories for land use developed by local governments to partition community space in order to provide protection against external effects of other uses and internalize effects for a bounded area.