L

Land Information Systems

A specific use of GIS technology to manage and service the records of individual land parcels is often referred to in the United States, Australia, and Canada as *land information systems (LIS)*. LIS are concerned with managing all types of data associated with ownership of individual land parcels and reflects the cadastral map and associated streets and rights-of-way that allow access and carry utilities to each land parcel. It has been suggested that 90% of all the processes involved with the running of local governments require spatial data and information. The majority of these processes relate to services provided to individual land parcels lying within the local government jurisdiction and to the streets used to carry services and to access land parcels.

European countries, having a longer history of development with denser populations, have paid more attention to mapping and managing information about land parcels. High land values have driven the need for accurate cadastral mapping. The long-term application of precise mapping technologies has led to the ongoing refinement of precise, very detailed cadastral maps in most of Europe. This entry, however, describes the situation more common in the United States, Canada, and Australia.

To manage land-parcel-related services, local governments have traditionally used large collections of paper base maps, which depict parcel, road, and rights-of-way boundaries. Originally, land parcel base maps were small scale, covering large areas. These maps were produced by roughly piecing together sketches of each land parcel obtained from the precise, large-scale parcel maps (plats in the U.S.) prepared from precise survey data. Figure 1 shows a section of such a survey plat for the City of Corpus Christi, Texas.

Before digital mapping became efficient, cities were faced with the large cost of manually updating these paper-based parcel maps using aerial photography, which captures data on the date of the flight and then quickly goes out-of-date. In the mid-1980s, many cities began using GIS to create ever-evolving, up-to-date digital maps based on existing survey plat data. The end result is a digital cadastral base map that uses a large number of precisely located GPS points to mathematically tie together original surveyed bearings and distances from the survey plats. Figures 2 and 3 show portions of the Corpus Christi LIS base map.

By using accurate parcel dimensions from survey plats and accurate mapping control coordinates from GPS, the resulting GIS digital cadastral base map becomes very useful for many different kinds of planning purposes: from general land use and zoning activities to the detailed work required for precise engineering design. The digital cadastral base map can also be used as control for plotting or mapping other layers of data such as utility lines or street infrastructure. Given the accuracy of the base maps, such utility features can be located using simple offsets from parcel boundaries to point features or to linear features running parallel to parcel boundaries along a street frontage.

It is important to note that the creation of a digital cadastral base map for LIS is generally a mapping exercise and not an exercise in precise boundary

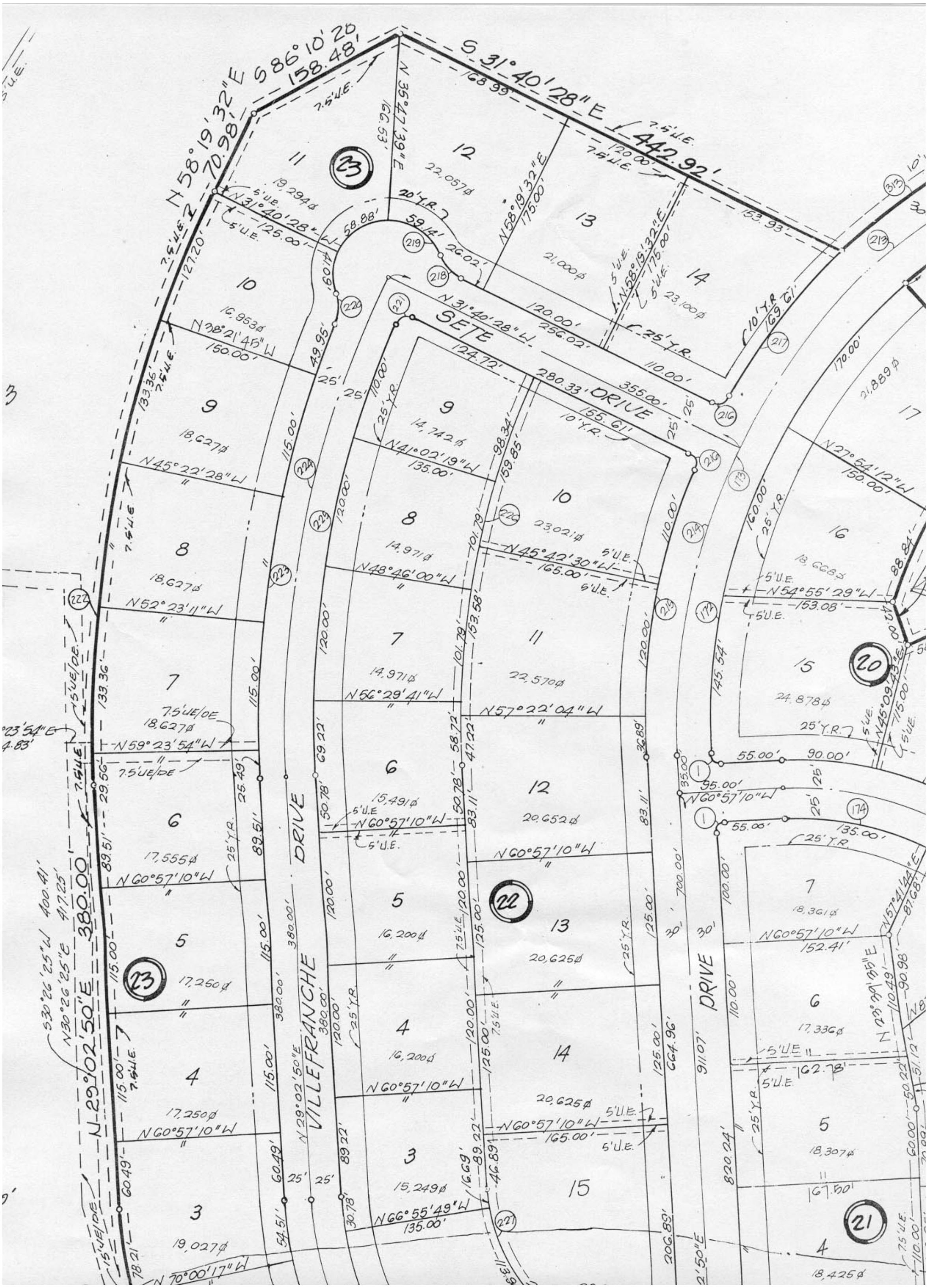

Figure 1 Section of a Survey Plat of the Lots Shown in Figure 2

Source: City of Corpus Christi GIS Group.

The bearings and distances from the plat were used to precisely construct the Corpus Christi GIS/LIS Digital Cadastral Base Map.

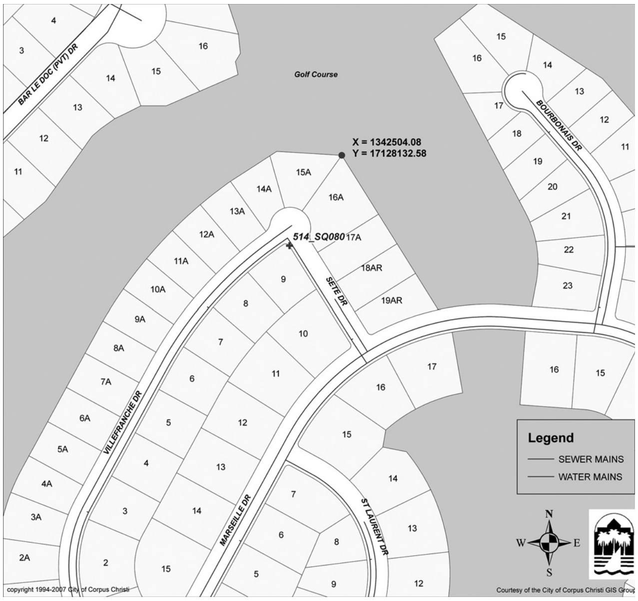

Figure 2 Detail of Corpus Christi Digital GIS/LIS Cadastral Base Map Showing Lot Boundaries and Coordinates in NAD 83 State Plane

Source: City of Corpus Christi GIS Group.

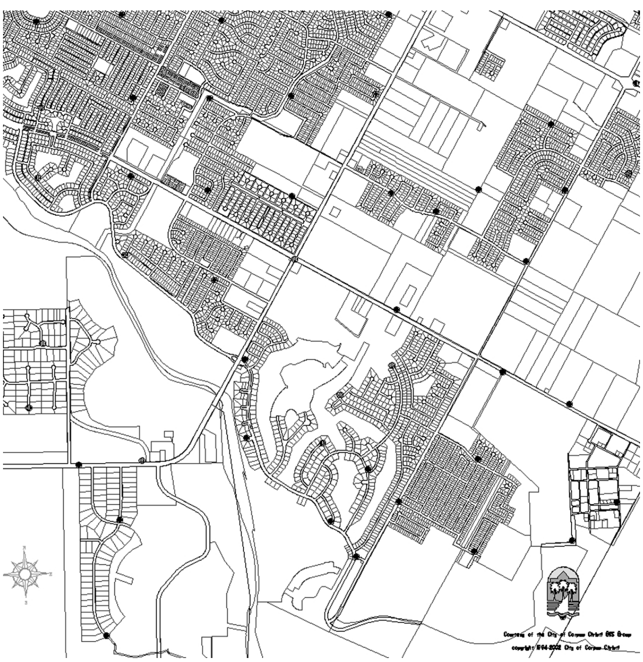

Figure 3 A Sample of the Corpus Christi GIS/LIS Digital Cadastral Base Map Showing GPS Control Points

Source: City of Corpus Christi GIS Group.

definition for land title purposes. For example, the City of Corpus Christi set out to achieve a goal of having the parcel base map locations within 1.5 feet of their true position in Texas State Plane Coordinates based on the North American Datum of 1983. While this goal was achieved over the majority of the city, there are still areas of the city that do not meet this goal, due to the age of the original land surveys that created the land parcels. These areas can be accurately depicted only in the GIS cadastral base map once the true title boundaries have been established by resurvey and replatting. Over time, as property values increase, these areas will be resurveyed, and precise locations will be transferred to the digital base map.

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See also Cadastre; Global Positioning Systems; (GPS); State Plane Coordinate System

Layer

A *layer* is a GIS data set that represents geographic features organized according to subject matter and geometry type that is overlayed with other layers through georeferencing. Layers help to organize a GIS database by grouping features by subject matter (e.g., wells, roads, soils, or elevation). Data within a GIS layer are of a consistent geometry type: that is, point, line, polygon, triangulated irregular networks (TIN), raster, and so on.

All layers in a GIS database are georeferenced, which allows them to be used in overlay operations. *Georeferencing* is the procedure used to bring data layers into alignment via known ground location or the procedure of bringing a map or data layers into alignment with the earth's surface via a common coordinate system. The result is that for all georeferenced layers, every location on one layer is precisely matched to its corresponding locations in all the other layers. Once the layers are georeferenced, they can be used in overlay operations. *Overlay* is the process of superimposing two or more maps to better understand the relationships between the geographic features of interest and their attributes. Overlay can be either visual or analytical.

In visual overlay, layers are displayed on top of each other in a map view. This allows the user to visualize information selectively and collectively and is facilitated by turning layers on and off. Analytical overlay includes point-in-polygon, line-in-polygon, and polygon-on-polygon overlay, which use GIS