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OTHER DATA LAYERS

Previous sections of this Guidebook have outlined the importance of referencing a GIS/LIS to a local geodetic reference framework, which is connected to the National Spatial Reference System. In the Base Map section, we noted that a Public Land Survey System base map and a surface features base map, tied to the geodetic reference framework, provide a solid foundation upon which additional data layers, including the cadastral data layer, can be developed and spatially anchored. The Cadastral Data section highlighted the critical role that a cadastral data layer and its associated attribute data plays in almost all local government multipurpose land information systems. This section discusses some of the other data layers that local governments might want to consider as they formulate an overall plan for the development of a multipurpose land information system.

Data Layers Common to Many Local Government Multipurpose GIS/LIS

Cadastral Boundary Related Data Layers

- PLSS Corners Base Map
- Cadastral (Legal Lot Subdivision and Parcels)
- Zoning
- Municipal Boundaries
- Rights-of-Way and Easements
- Census Tracts
- School District Boundary
- Other Governmental Unit Boundaries
- Street Address - Phone

Infrastructure Related Data Layers

- Street and Road Centerlines
- Sewer Lines
- Water Lines
- Water Wells
- Septic & Hazardous Waste Sites
- Railroads
- Elect. & Gas Distrib. Systems

Natural Boundary Related Data Layers

- Surface Features Base Map
- Floodplains
- Topographical/Elevation
- Soils

Fig 17.) Some of the data layers common to many multipurpose local government GIS/LIS.

Phased Development of Other Data Layers. It is not the intent of this section to provide a comprehensive list of all the geospatial data layers that might be needed for a multipurpose land information system. Rather, the intent is to provide a limited amount of information on some of the more common data layers that are developed and used in many local government multipurpose GIS/LIS operations. Likewise, the outlining of a data layer in this section does not imply that it is a bottom line necessity for the operation of a particular local government GIS/LIS. Whether, and when, a specific data layer is needed for a given GIS/LIS operation depends primarily upon the nature and timing of the applications planned for the system.

It is a common practice to develop many of these other data layers in the later phases of an overall GIS/LIS development and implementation process. Such a phased development approach allows for an initial investment in the necessary development of the base maps and the cadastral data layer(s) and a demonstration of the merits of the GIS/LIS, prior to making investments in these other data layers. However, even in the context of such a phased development approach, it is important to consider these other data layers in the early planning stages of GIS/LIS

development. It is important to consider which data layers will be needed for the planned early applications and demonstrations of the merits of the GIS/LIS and to make sure that those data layers are on a development timeline consistent with the timelines for those early applications. In most cases, it is important that policy makers are aware of the likely need to make additional investments, down the road, in these other data layers. It is also politically prudent to insure that the various partners in any joint GIS/LIS development effort understand and support the strategic decisions made in a plan for phased data development, as this may affect some of the applications they wish to pursue.

Another reason to initiate consideration of these other data layers early in the planning process, is the frequent need for interagency dialogue, and planning prior to initiating development. In many cases attribute data that will be associated with these graphical layers already exist in two or more agencies. Interagency planning will be needed to determine how to best integrate and supplement these existing attribute databases and how to link them to the spatial/graphic data in a manner that meets the multiple needs of the various users. Likewise dialogue and planning will be needed to determine the optimum spatial accuracy for the elements of each mapped data layer and to determine the source(s) for this spatial data. To determine the optimum spatial accuracy for a given data layer the partners must balance several factors: the spatial accuracy needs of anticipated applications, the availability of source data, the initial development costs for the different levels of spatial accuracy, and the potential costs to enhance the spatial accuracy later.

Mapping the Infrastructure - Other Cultural Data Layers. In the Cadastral Data section the concept of a natural LIS and a cultural LIS was discussed. They were described as two alternative ways of dividing the Earth's surface and it was noted that information about both was useful within the context of a multipurpose GIS/LIS. Cadastral (property parcels) data was highlighted as a critical component of cultural information needed for most local government multipurpose GIS/LIS. Another type of cultural information that is also commonly used within a multipurpose GIS/LIS, is the information related to the various types of physical infrastructure that local governments have developed and are involved in maintaining.

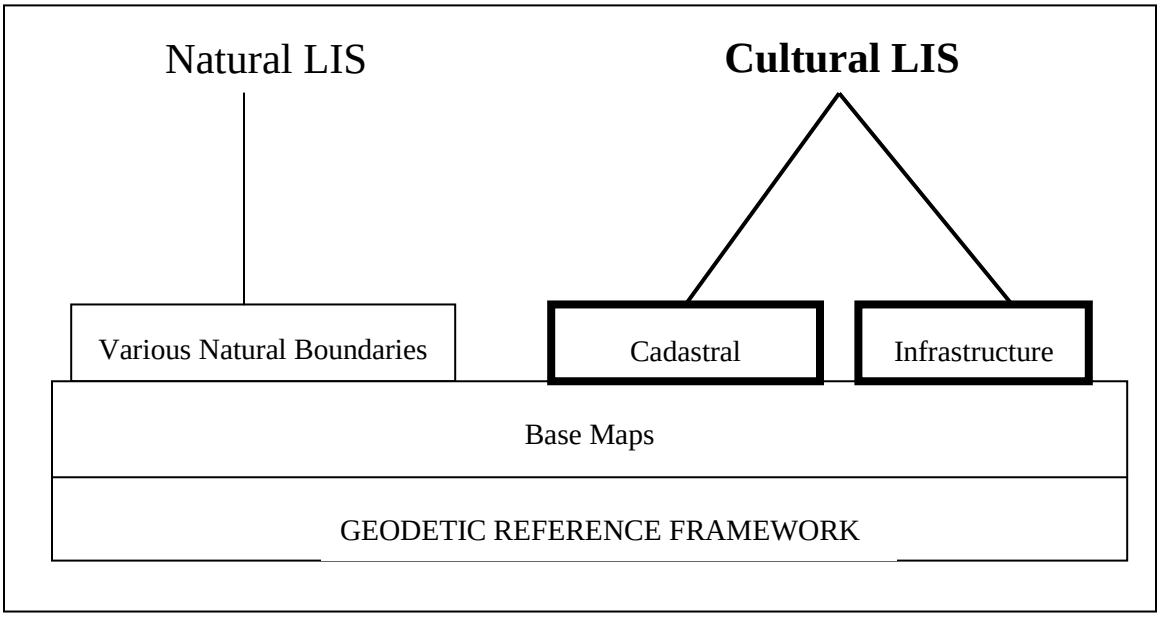

Fig 18.) Information related to our physical infrastructure (streets, water and sewer systems, etc.) is another important component of our cultural and organizational impact on our world and as such infrastructure-related data layers are important for many local government multipurpose GIS/LIS.

Many local governments are charged with developing, managing, and maintaining a wide variety of physical infrastructures such as: streets and roads, sewer and water systems, public buildings, and electricity and gas distribution systems. Mapping the spatial characteristics of these infrastructure facilities and using the GIS/LIS to relate this data, and its associated attribute data, with other data layers provides powerful information management tools to assist with the planning, management, and maintenance associated with these systems. Because of this, the geospatial data layers that capture the information related to these infrastructure systems are another primary category of geospatial data layers that are frequently developed and used within a local government multipurpose land information system.

In outlining the other data layers that a local government might wish to consider in developing a multipurpose GIS/LIS, it is useful to group them into three general types of data layers – those related to infrastructure, natural, and cadastral features. These groupings are useful because each type of data layer shares similar features and attributes and relies on similar map source material.

Other Data Layers Related to Infrastructure. The data layers outlined below are closely related to community developed infrastructure. For most of these data layers engineering drawings, in conjunction with surface feature base maps and the legal lots/PLSS data layer, will provide the primary data source for their development.

Street and Road Centerlines. Street and road centerline databases are key geospatial databases for numerous GIS/LIS applications at the local government level. Typically these databases consist of a mapping of the street and road centerlines with related attribute information that characterize the various street and road segments. This related attribute information may include information about the width of the street and/or the right-of-way, the road surface material (paved or unpaved), the condition of the road surface, the direction of travel, the legal speed, the number of lanes, volume of traffic, street address range, etc. Among the applications for which this type of data is very useful are the following: transportation planning; maintenance management; emergency response; economic development; comprehensive planning and zoning; public safety and law enforcement. The spatial accuracy requirements for this type of database are dependent upon the anticipated needs of the applications. However, the *Base Map Scale and Positional Accuracy Recommendations* outlined in the Base Map section of these guidelines provides a good starting point. Potential data sources include the Nebraska Department of Roads; local surface features base map; U.S. Bureau of the Census (TIGER files); property parcel maps; and local engineering (CAD) drawings. All of these data sources will vary in terms of their completeness, currency, and level of spatial accuracy and as such must be evaluated for each specific geographic area.

Sewer Lines. Underneath the pavement of all cities and communities lies an extensive array of storm and sanitary sewer lines. Through the years many sewer lines have deteriorated to the point where seepage occurs. In some cases, the location of sewer lines have been lost or forgotten. Maintaining a sewer layer(s) as a line map(s) in the GIS/LIS provides officials with a resource to assist in monitoring the effectiveness of the sewer networks and to aid in the processes of problem solving, expansion and remediation. Each line segment can be referenced to attribute information about trunk size, volume capacity, flow rates, year built and so on. Manhole cover locations can also be included as part of this layer. A sewer layer(s) could aid decision-makers in determining the capacity for a city to grow. It could show the necessity for larger trunk lines to support a proposed subdivision or reveal an aging sewer line that needs attention. The sewer layer can help a community maintain and protect its utility investments. As with other data layers the required spatial accuracy is directly related to the anticipated applications, but recommended base

map accuracy standards provide a good starting point for further consideration. In selecting the optimum spatial accuracy standard for a sewer data layer, the fact that this infrastructure is buried and largely invisible on the surface should be considered. If this data layer is to be used as a primary guide for future excavation, then higher levels of spatial accuracy are necessary. The primary source materials for the development of a sewer line data layer are the engineering "as-built" drawings (commonly known as "sewer quarter sections") and the above ground location of associated manhole covers. The local public works department is probably the best source for locating these "as built" drawings. However another potential source is the Nebraska Department of Environmental Quality, which maintains microfilm of these drawings back to 1914.

Water Lines. Almost all houses have water lines leading to them. These lines represent another underground utility that we rely upon, yet often ignore until a problem occurs. The location of the main feeder lines and the valves would be an important layer in a multipurpose GIS/LIS. Armed with this information, a field technician could start at the valve and use a locator to trace the line to the house. In many jurisdictions, this type of information is kept on old hand-drawn paper maps. These maps are subject to being lost or destroyed and many are out of date. A maintained digital water line in a GIS/LIS can save time and money for water service staff when they respond to problems. It can be an important tool in monitoring water loss and usage and present decision-makers with another valuable layer to base decisions upon. Attribute information that can be associated with and accessed through this type of geospatial database include the size and/or volume of lines, age, size and types of values, approximate depth, etc. As with the other data layers, the optimum spatial accuracy of this data layer depends upon the anticipated applications, the available source data, and the available resources, with an added premium for spatial accuracy because it is a buried infrastructure. The primary data sources will be existing paper, engineering drawings (water quarter sections) showing "as-built" features and approximate locations.

Water Wells. Nebraska is very fortunate to have excellent ground water. It is often taken for granted and because of this, pollution sometimes finds its way into the groundwater. Maintaining a water well layer in a GIS/LIS is a good way to help monitor the use and proliferation of wells. Data has been collected for a number of years on well flow rates and depth, the permit process and test results. When well data in a GIS is examined graphically, patterns become more evident. Aquifer boundaries may be able to be more easily defined as well as recharge rates and aquifer levels. By maintaining an up-to-date well data layer, decision-makers can have an important piece of information to aid them in the decision making process. If a given local jurisdiction does not track and/or regulate water wells, then the best source of this data is probably the State of Nebraska or the local Natural Resources District. The Nebraska Department of Natural Resources maintains a Registered Wells database that can be downloaded into a GIS/LIS and a point map can represent the spatial location of all the registered wells. It is, however, important to note that there is considerable variation in the spatial accuracy of the well locations in this database.

Septic and Hazardous Waste Sites. When an industry wants to locate in an area, it is important to be aware of any environmental hazards that may exist. Local health departments are also concerned about tracking and controlling hazardous waste and other potential pollutants. Chemical compounds can seep into the water table and spread many miles from the source. Septic sites represent one source of pollution. Septic tanks or old sewer lagoons can seep into the groundwater contaminating the drinking water for a community. A septic and/or hazardous waste layer could be a valuable data tool for these types of applications and to monitor potential problems before they become serious problems. Some local jurisdictions track this information through permitting processes and therefore this data may be available in a tabular format that could be converted to a geospatial database. At the state level, the Department of Environmental

Quality (DEQ) maintains extensive data on a variety of regulated facilities, including businesses housing hazardous materials and hazardous water sites. DEQ also maintains a limited amount of data on septic sites. The Nebraska Health and Human Services System (HHS), Regulation and Licensure Department also collects data on home septic systems. However these inspection reports are maintained in a paper format, filed by the owners name, and is therefore not very accessible for the development of an area database. For different geographic and program areas, this type of data will vary in terms of its format, its completeness, and its spatial accuracy. Local governments interested in this type of data layer should contact these agencies to research the type and amount of data they have available and, if need be, the feasibility of working with them to convert this data to a geospatial format and/or to enhance its spatial accuracy.

Railroads. For many local governments, existing railroad lines have a significant impact on their communities. Examples of these impacts include public safety and maintenance concerns related to street and track crossings; transportation and property access implications for economic development; and potential emergency response problems related to temporarily blocked railroad crossings. These and other impacts illustrate some of the potential applications of a GIS data layer that maps and provides related attribute data on railroad networks in a given area. There are several potential sources for this data. The most obvious are the railroad companies themselves, although corporate policies and bureaucracies may make accessing this data difficult. The Nebraska Department of Roads maintains a statewide data layer of railroad lines, but in some areas the data may not be current or complete, relative to all the spurs, new tracks, and/or double tracks. An alternative data source would be to collect this data from digital orthophotographs that are available at 1:12,000 scale from the Nebraska Department of Natural Resources.

Electric and Gas Distribution Systems. Many local governments have a role in the distribution of electricity and/or natural gas. For these local governments, GIS data layers that map and provide related attribute data on these distributions systems would provide valuable tools to assist in the maintenance, planning and administrative activities associated with these systems. This data would also be useful for economic development, one-call digging response, and public safety applications. As with other data layers, the spatial accuracy requirements for this type of database are dependent upon the anticipated needs of the applications. However, the *Base Map Scale and Positional Accuracy Recommendations* outlined in the Base Map section of these guidelines provides a good starting point. Potential data sources include the original engineering and/or "as built" CAD drawings that will hopefully be available through the local utilities or the original contracting firms. In situations where the distribution networks are owned by private firms or regional distribution entities, those entities will need to be contacted to explore the potential availability of this data. All of these data sources will vary in terms of their completeness, currency, and level of spatial accuracy and as such must be evaluated for each specific geographic area.

Data Layers Related to Natural Features. The data layers outlined below are closely related to natural features. For most, the surface features base map will provide a primary data source for the development of the following data layers.

Topographical/Elevation. The topographic layer consists of contour lines that model the “lay of the land”. The contour lines connect lines of equal elevation. Contour lines are constructed either by surveying, or more commonly by photogrammetric techniques. In a digital environment, the “lay of the land” or elevation data is commonly presented in one of two formats: a digital version of the topographic contours lines, known as "tagged vector contours", or a Digital Elevation Model (DEM). DEMs consists of a regularly spaced grid of points, each of which has its particular locational coordinates and a value for the elevation earth's surface at that

point. With the availability of DEM data, many GIS software packages can generate contour lines. Elevation data in a GIS/LIS allows the user to add to the analytical mix the issues of relative surface elevation and slope. With elevation data, most GIS/LIS are capable of draping other data layers over a virtual model of the earth's surface, to bring a 3-D perspective to problem solving efforts. Elevation data also allows for water run-off calculations and view analysis. With the addition of elevation data, another dimension of spatial accuracy (vertical in addition to horizontal) must be considered. Elevation data that has a very high degree of vertical accuracy is quite expensive to develop for anything beyond a relatively small project area for engineering purposes. The Base Map section of these guidelines offers suggestions for what are considered "typical combinations" of horizontal and vertical accuracy standards. For example for a 1:12,000 scale map a "typical combination" of vertical accuracy might be from 5 - 20 foot contours, but for a 1:600 scale map one might expect 1 - 2 foot contours.

The development of DEM data is a standard step in the process most commonly used today to develop orthophotographs. Therefore, DEM data is likely to be available, for a given area, if an orthophotograph has been prepared for that area. In Nebraska, the Department of Natural Resources have available both tagged vector contours and DEMs derived from the 1:24:000 USGS 7.5-minute topographical maps. Before a local government invests additional resources in the development of more detailed topographical information a review should be conducted to identify the particular GIS/LIS applications that would warrant this investment.

Floodplains. This layer consists of the delineation of the 100-year floodplain along rivers and streams. Additional information might also include the 500-year floodplain delineation and the floodway delineation. This data layer is very useful in assessment, planning and zoning applications. The most common source of information for this data layer is the Flood Insurance Rate Maps (FIRMs) provided by the National Flood Insurance Program (NFIP). The NFIP has digitized the FIRMs for a few communities in Nebraska and there are vendors that sell digitized floodplain data. Many communities that have developed this layer have digitized the information from their community FIRMs. If a local government plans to digitize the information for the floodplain layer they should first contact the Floodplain Management Division of the Nebraska Department of Natural Resources for possible data availability and technical guidance.

Soils. The soils layer shows the distribution of soil mapping units over the landscape. The associated attribute data describes the chemical and physical properties of these mapping units and their predicted behavior for selected land uses. This data layer is very useful for assessment and planning applications. The best available source for this data is the USDA Natural Resources Conservation Service's Soil Survey Geographic (SSURGO) Database. The SSURGO database is the most detailed and precise spatial soil information available from NRCS. The SSURGO coverage was created by digitizing analog soil maps (county soil surveys) and "terrain correcting" the data using orthophotographs. The SSURGO soil maps for Nebraska have a spatial accuracy corresponding to a 1:20,000 to 1:24,000 scale map. SSURGO development is a national priority for Natural Resources Conservation Service and is currently available for many areas in Nebraska and efforts are currently underway to develop this data statewide.

Data Layers Related to Cadastral Features. The data layers outlined below are closely related to cadastral features. For most, either the property parcel data layer or the legal lots/PLSS data layer will provide a primary data source for their development.

Zoning. This data layer consists of delineations showing various types of zoning either parcel by parcel or by looking at an overall geographic area. This information is usually maintained by a City Planning Department or a County Planning Department depending on jurisdiction. Zoning

information is used to determine what type of structure is allowed to be built on a certain parcel or parcels of land and helps a city or county maintain an orderly level of development. In addition to planning applications, this data is also useful for economic development and assessment applications. These zoning data layers are usually developed from the legal lot maps and so they have a similar spatial accuracy as those lot maps. This data layer can be developed by digitizing the boundaries, based on legal lot maps, of contiguous areas with common zoning classifications, or one can use the GIS itself to select and define these areas of common zoning by deriving this data from the zoning attribute information associated with each legal lot.

Municipal Boundaries. This layer shows where a municipality's corporate limits begin and where they end. This layer may also show where their zoning limits. This layer may also contain the boundaries of area sanitary improvement districts and/or rural water districts. This layer is very important for identifying where services such as road maintenance, snow removal and emergency response should come from and also for determining if you are inside or outside of the city limits. Most City Planning departments maintain a set of maps and have information on what areas have been annexed and when these areas were annexed. This data layer can be developed by using a combination of these planning department maps and the cadastral legal lot map to provide accurate spatial information for legal lot boundaries.

Rights of Way & Easements. Defined areas of legally binding "Rights of Way" and "Easements", for public access, is another useful local government data layer. This data layer typically consists of a network of lines, whose intersection with parcel boundaries create polygons that define the areas of dedicated “Rights of Way “ and “Easements”. These polygons define tracts of land that are dedicated for public use. The most noticeable of these are the rights of way for public roadways, but other buried and above ground utilities, such as water, sewer, gas and electric power lines also have deeded rights of way or easements. Many attributes related to these components of the public infrastructure must be continuously maintained. GIS provides the most accurate and economical means of managing this task. One of the problems typically encountered in developing and maintaining this data layer is data availability, because in many jurisdictions, these "Right of Way" and "Easement" agreements are not consistently filed with the Register of Deeds.

Census Tracts. A geospatial database outlining the boundaries of the various Census Tracts, in a given geographic area, is another useful data layer for multipurpose local government GIS/LIS. Census tract boundaries generally follow visible physical features and county boundaries (many of these are directly related to cadastral boundaries). In a few rare instances, a census tract may consist of discontinuous areas. According to the U. S. Bureau of the Census, the Census Tracts are geographic statistical entities within a county (or statistical equivalent of a county). When first established, census tracts should have relatively homogeneous demographic characteristics. Generally, census tracts have a population size between 2,500 and 8,000 people, and average about 4,000 people. These Census Tracts are the basis upon which the demographic data of the U.S. Census is collected, compiled, analyzed and accessed. Census tracts were last defined in preparation for the 2000 census, and will next be defined for the 2010 census. The Census Tract geospatial database is available as part of the U. S. Bureau of the Census TIGER/Line files for any given area of the United States.

School Districts. A data layer outlining the boundaries of the various school districts, within a given geographic area, is also a useful data layer for local government GIS/LIS. Such a data layer is useful in assessment, taxation, planning, economic development, as well as school administration and planning. In most cases, the boundaries in such a data layer will closely follow legal lot or section boundaries and as such can be derived from legal lot/PLSS geospatial

databases. The spatial accuracy requirements of such a data layer closely parallels those of a legal lot cadastral database for the same area. The Nebraska Department of Education maintains geospatial databases for school districts, educational service units, and community colleges for the state of Nebraska. This information is collected on an annual basis and is updated on or about June 1 each year. The local information is collected and verified by the county clerks and forwarded with corrections to the Department of Education. Every effort is made to assure the information is accurate including compiling information regarding dissolution and mergers of existing districts.

Other Governmental Unit Boundaries. As with the school districts, the boundaries of several other governmental units are useful data layers for multipurpose GIS/LIS. Among these are the following: natural resources districts, community college districts, county boundaries, fire districts, election districts and voting precincts. The first place to check for these data layers is with the particular governmental unit to see if they have developed the data layer or know where the layer is maintained. If it is not available, most of these boundaries are related to legal lot or property parcel boundaries and as such can be derived from those cadastral data layers. These cadastral data layers can be used as the bases for determining the shape and location of these boundaries by "digitally plotting" the boundaries from descriptive source material in statutes or ordinances. Another method of deriving many of these governmental unit data layers is to utilize the ability of the GIS/LIS to select map features based on their attributes. In Nebraska, many of these governmental units receive property tax support with specific mill levies attached to each property parcel in their district. If attributes related to these unique tax districts or mill levies are associated with the property parcel data layer, a query can be used to select out the property parcel in each school or fire district and then the boundaries of that district can be derived from this query result.

Street Address-Phone Geospatial Database. A data layer that provides locational coordinates for specific street addresses (residential or business) and any associated phone numbers is a valuable data layer of multipurpose local government GIS/LIS. Such a data layer provides a means for converting and integrating existing databases, which include street addresses, into geospatial databases appropriate for use within a GIS/LIS. Such a data layer is also invaluable as part of emergency response applications. Within a GIS/LIS, such a data layer, used in conjunction with a street centerline data layer, allows an E911 operator to rapidly convert an incoming emergency call to a street address and its locational coordinates and to plot the quickest response route. Cooperative efforts with the local phone company are a key to developing and maintaining such a data layer, as phone numbers are very dynamic data. In planning for such a database it is also important to consider privacy issues and how you will respect unlisted phone numbers. In most cases, a surface features base map that shows the general outlines of buildings can be used as a data source for determining the locational coordinates for specific street addresses.

Other Data Layers to be Developed as Needed and as Resources Allow. As was noted at the beginning of this section, it was not the intention of this section to provide a comprehensive list of all the geospatial data layers that might be needed for a multipurpose land information system. Rather, the intent was to provide a limited amount of information on some of the more common data layers that are developed and used in many local government multipurpose GIS/LIS operations. Also, because a data layer was outlined in this section is not to imply that it is a bottom line necessity for the operation of a particular local government GIS/LIS. A local government, or the partners in a multipurpose local government GIS/LIS, should determine whether, and when, a specific data layer is needed for a given GIS/LIS operation based primarily upon the nature and timing of the applications planned for the system.