Geographic Information Framework for Texas

RESOLUTIONS FOR ACTION

Texas Geographic Information Council
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Austin, Texas

Comments or inquiries concerning this document or geographic information coordination in Texas are welcome and may be sent to the address given below.

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Preface

This is the first in a series of six documents to be published by the Texas Geographic Information Council (TGIC). The series can be collectively considered a Geographic Information Plan for Texas. This document expresses TGIC s vision of a common framework for building and sharing Texas geographic information. This vision is expressed in five Council resolutions that contain high-level goals and objectives. TGIC will publish five strategic plans detailing how TGIC and its members intend to implement the goals and objectives under each resolution.

This document and the five strategic plans represent ongoing efforts begun by TGIC s predecessor organizations, the Texas GIS Planning Council and the Texas Natural Resources Information System Task Force. As such, these documents update and supersede previous documents released by those organizations, including the Task Force s report Developing a Digital Base of Map Information for the Texas Natural Resource Agencies (1983) and the Planning Council s Statewide GIS Implementation Plan (November 1997).

EXECUTIVE SUMMARY

This document contains the collective vision of 44 member organizations of the Texas Geographic Information Council (TGIC) for the evolution of a proven program for governmental cooperation and collaboration that will benefit every citizen of Texas.

In amendments made to the Water Code in June 1997, the Texas Legislature authorized the merger of the Texas Natural Resources Information System (TNRIS) Task Force and the Texas GIS Planning Council to form TGIC. TGIC serves as an advisory body to the Executive Director of the Texas Water Development Board on matters related to operating TNRIS, the state s geographic information clearinghouse and referral center. TGIC also serves as an advisory body to the Executive Director of the Texas Department of Information Resources on matters related to data and information technology standards and strategies. TGIC s charter states, in part, that TGIC

> *is created to provide cost-effective and useful exchange and retrieval of geospatial information both within and among the various agencies and branches of government, and from the agencies and branches of state government to the people of Texas and their elected representatives.*

Geographic information is a strategic resource in the operation of all levels of government. In combination with modern computerized analysis and communication technologies, geographic information provides a means to address the very complex issues that face governmental organizations, both individually and collectively. For government to make intelligent decisions it must have good information. The significant cost of good information can be mitigated through cost sharing and other collaborative approaches.

This document presents a vision for coordinated planning and collaborative use of geographic information and related technologies in Texas. This vision is embodied in five resolutions that represent a framework designed to propel the state into increased efficiency and effectiveness. The five resolutions, summarized on the following page, were unanimously approved by TGIC in November 1998. Each resolution includes a goal statement and several objectives. Over the course of 1999, TGIC will develop strategic action plans that detail steps to achieve these goals and objectives.

The framework described here will strategically advance the use and management of geographic information in Texas. The resulting system will help maximize the effectiveness and minimize the cost of government. There are few endeavors in government that provide the promise inherent in the strategic application of these technologies.

Partnership Resolution

Goal The Texas Geographic Information Council resolves to establish and maintain strategic partnerships with public and private sector entities to improve government efficiency and service delivery through coordinated acquisition and sharing of geographic information and collaborative use of related technologies.

Objectives
- ❑ Build a multi-channel network of TGIC partners.
- ❑ Document Resources and Needs of TGIC Members and Partners.
- ❑ Design and Build a Sustainable Program for Meeting Member and Partner Needs.

Base Mapping Resolution

Goal The Texas Geographic Information Council resolves to lead cooperative efforts for acquisition of geographic information that contributes to the National Framework of digital data, builds upon previous successes, and results in cost saving and cost avoidance while providing the best base maps feasible to the broadest possible constituency.

Objectives
- ❑ Complete the Strategic Mapping Program.
- ❑ Identify and plan acquisition of additional Texas Framework layers.
- ❑ Encourage cooperative development of other base map layers by member organizations.

Data Sharing Resolution

Goal The Texas Geographic Information Council resolves to share the benefits of public investments in geographic information and related technologies through policies, services, and technologies that maintain and promote the broadest feasible public access to the best geographic information available.

Objectives
- ❑ Support application of the Texas Public Information Act for geographic information.
- ❑ Support high-speed data access and exchange, including the TGIN Initiative.
- ❑ Develop and adopt a comprehensive set of spatial data standards.

Field Data Collection Resolution

Goal The Texas Geographic Information Council resolves to develop and promote the use of cost effective systems that provide the most accurate locational information feasible for field data collection and navigation needs statewide.

Objectives
- ❑ Support creation of the Texas Geodetic Advisor Program.
- ❑ Support statewide real-time broadcast of GPS correction information.

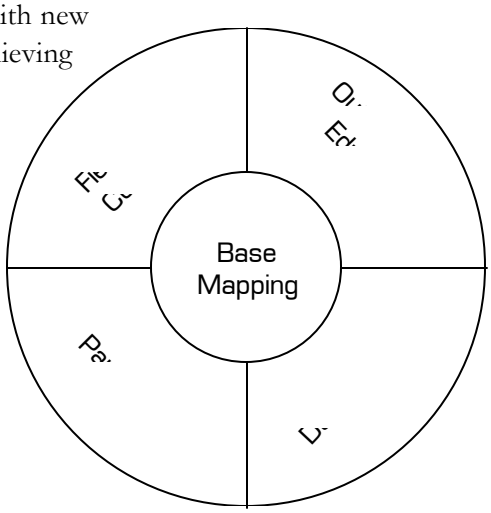
Outreach and Education Resolution

Goal The Texas Geographic Information Council resolves to develop and maintain effective mechanisms for outreach and education to inform interested parties of geographic information technologies, and of TGIC initiatives, services, and resources aimed at developing the skills and capabilities of state agency customers, clients, and employees.

Objectives
- ❑ Establish a statewide learning program for geographic information technologies.
- ❑ Expand the scope of TGIC s web resources.
- ❑ Research and develop a geographic information technologies curriculum.
- ❑ Develop career paths for geographic information technology professionals.

The Texas Geographic Information Council (TGIC) was created through amendments to the Water Code (Texas Water Code Ann. §16.021 (Vernon 1998)) passed by the 75th Texas Legislature. That legislation directed that two organizations, the Texas Natural Resources Information System Task Force and the Texas Geographic Information Systems Planning Council, be merged to form TGIC. Both of these organizations had ongoing initiatives and action items. This document lays out the initiatives of the new, united TGIC.

This document expresses TGIC s vision of a common framework for building and sharing Texas geographic information. This vision is expressed in the form of five resolutions. Each resolution was passed unanimously by TGIC in November 1998. TGIC will use each resolution as a guide for a corresponding initiative. The purpose of publishing this vision at this time is to provide direction and focus to TGIC activities and to indicate which elements of the precursor organizations activities will be carried forward. During calendar year 1999, TGIC will develop strategic action plans for each initiative. These strategic plans will integrate activities already in progress with new efforts to produce a consolidated approach to achieving the vision described here.



The five initiative areas contained in TGIC s vision are Partnership, Base Mapping, Data Sharing, Field Data Collection, and Outreach and Education.

Each of these initiatives is discussed in a separate chapter. The overarching goal of these activities is to improve government access to strategic geographic information, and at the same time, improve the efficiency and effectiveness of government in Texas.

The Value of Geographic Information

In recent years, Texas state agencies have become increasingly aware of the value of state geographic information in performing many of their routine functions. State information systems already contain a wealth of data that is geographic in nature. Enhancing these systems to allow improved queries and map displays will improve decision-making for the highly complex tasks Texas government faces every day. Geography can be a great unifying factor that makes it possible to link data from disparate databases maintained by various agencies, often resulting in the discovery of new information.

Improvements in Geographic Information System (GIS) technology have made it practical for state agencies to use GIS to unlock the geographic nature of their databases. GIS

technology is being used successfully today in such diverse areas as emergency response, facility management, drought planning, industrial permitting, and demographic analysis. However, GIS implementation is a massive undertaking. Agencies must take care to maximize the gains through coordination and collaboration.

Because we all share a common geography, state agencies cooperate closely in GIS planning and implementation. Because of the expense associated with GIS implementation, such cooperation is essential. The spirit of cooperation shown in this decade by those Texas agencies planning and implementing GIS-based applications has been outstanding. The primary vehicle for this cooperation has been the Texas Geographic Information Council and its predecessor organizations.

A representative sample of the ways in which GIS technology is being used today to improve government decision-making is shown below..

Representative GIS Applications

Abandoned Mines/Wells Inventory
Agricultural Crop Monitoring/Modeling
Air Pollution Emissions Inventory/Modeling
Archeology Surveys
Census Data Analysis
Client Analysis
Coastal Fisheries Assessment
Construction Project Tracking
Contamination Source Analysis
Crime Analysis
Disaster Relief Assistance
Disease Mapping
Drought Planning
Emergency Response, including 9-1-1
Endangered Species Management
Environmental Compliance Studies
Environmental Justice Studies
Environmentally Sensitive Areas Monitoring
Erosion Studies
Flood Analysis/Modeling
Future Water Demand Modeling
Groundwater Modeling
Groundwater Pollution Potential Analysis
Habitat Analysis/Planning
Hazardous Materials Spill Response
Highway Performance Tracking/Modeling
Industrial/Hazardous Waste Facility Permitting
Land Ownership Mapping
Legislative District Delineation/Redistricting
Mineral Resource Tracking/Leasing
Municipal Solid Waste Facility Permitting
NAFTA Policy Analysis
Nonpoint Source Pollution Analysis
Oil and Gas Well Permitting/Tracking
Oil Spill Response, Deployment/Management
Pavement Management
Petroleum Storage Tank Facility Permitting
Pipeline Routing, Permitting and Tracking
Population Projections
Precision Agriculture
Property Tax Appraisal
Public Lands and Facilities Management
Public Water Supply Tracking
State Park Planning
Surface Water Modeling
Timber Tracking/Permitting
Transportation Modeling/Analysis
Utility Facility Management
Utility Service Area Delineation
Watershed Delineation/Analysis
Wellhead Protection
Wetlands Resources Monitoring/Mitigation
Wildlife Tracking

Texas Geographic Information Council

TGIC (the Council) was formed on September 1, 1997. Membership consists primarily of state agencies and universities involved in geospatial data development and use. Each member agency appoints a member of its executive staff to represent the agency on the Council. Approximately 44 organizations currently participate in TGIC. The Council holds quarterly meetings which are posted in the Texas Register. These regular meetings are open to the public.

The purpose of the Council is to direct interagency coordination. The Council establishes goals and objectives for developing a mutually supportive environment for the use of geospatial systems in Texas. TGIC is assisted by a Managers Committee, which consists of management personnel from the same organizations represented on the Council.

TGIC provides guidance to the Department of Information Resources (DIR) for the promulgation of geospatial data standards, and to the Texas Water Development Board (TWDB) on the direction and long-term planning for the Texas Natural Resources Information System (TNRIS). TGIC maintains a strategic plan for development of coordinated, cost-efficient, and nonredundant GIS systems in the state. This vision is one component of that plan.

For news on geographic data development efforts in Texas, visit the TNRIS web site:

www.tnris.state.tx.us

For the latest news on geographic information coordination in Texas, visit the TGIC web site:

www.tgic.state.tx.us

TGIC Accomplishments

TGIC and its predecessor organizations have been highly successful at interagency coordination. The Federal Geographic Data Committee recognized TGIC as the first state Cooperating Partner in the development of the National Spatial Data Infrastructure. The Council demonstrates the willingness of Texas agencies to cooperate with each other to improve the efficiency and effectiveness of state government in Texas.

One of the most visible outcomes of the Council s effort has been in the area of common base map development. The support of TGIC led to the creation of the Texas Orthoimagery Program (TOP) in 1995 and the Texas Strategic Mapping Program (StratMap) in 1997. These programs are building new digital base maps for Texas that will be more current, more detailed, and more accurate than any existing base map. Through coordination provided by TGIC, Texas has been able to leverage state and local government investments with significant federal cost sharing. All data produced through these programs is in the public domain and available to the public for the cost of duplication.

The Council has determined that adoption of common base maps is the most critical factor in the development of a coordinated, cost-efficient and non-redundant GIS system. Common base maps constitute a framework with which state agencies will be able to gain full advantage of GIS technology.

The Framework effort in Texas mirrors and complements a larger effort at the national level. The stated goal of the Framework component of the National Spatial Data Initiative (NSDI) is just as applicable to us in Texas:

> *The goal of the Framework is to improve everyone s operations, reduce costs, and facilitate new analyses and joint decision making by providing a readily available set of basic digital geographic data. The Framework consists of commonly needed, used, and produced data brought into a common standard and made widely accessible.*
>
> Framework Introduction and Guide,
> Federal Geographic Data Committee, 1997

Authority

This document has been developed under the authority of the Texas Geographic Information Council, in fulfillment of its charter and the goal of planning for the most cost-effective means of acquiring and distributing geographic information to the state as a whole and ensuring that agency programs are in concert with other state, federal, and local programs. It is important to note that TGIC is an advisory council with no staff or budget. The goals identified in this vision can only be accomplished through coordinated actions taken by TGIC member organizations.

TGIC Participants

State Agencies

Adjutant General s Department

Advisory Commission on State Emergency Communications

Comptroller of Public Accounts

Department of Information Resources

General Land Office

General Services Commission

Health and Human Services Commission

Legislative Council of Texas

Office of Court Administration

Office of State-Federal Relations

Office of the Attorney General

Office of the Governor

Office of the Lieutenant Governor

Office of the Secretary of State

Public Utility Commission of Texas

Railroad Commission of Texas

Texas Department of Agriculture

Texas Department of Criminal Justice

Texas Department of Economic Development

Texas Department of Health

Texas Department of Housing and Community Affairs

Texas Department of Human Services

Texas Department of Insurance

Texas Department of Transportation

Texas Education Agency

Texas Forest Service

Texas Historical Commission

Texas Natural Resource Conservation Commission

Texas Natural Resources Information System

Texas Parks and Wildlife Department

Texas Rehabilitation Commission

Texas State Soil and Water Conservation Board

Texas Water Development Board

State Universities

The University of Texas, Bureau of Economic Geology

Stephen F. Austin State University, Forest Research Institute

Sam Houston State University

Southwest Texas State University

Texas A&M University

Texas Tech University

Statewide Associations

Texas Association of Appraisal Districts

Texas Association of Counties

Texas Association of Regional Councils

Texas Mapping Advisory Committee

Federal Representative

United States Geological Survey

RESOLUTION

Goal

The Texas Geographic Information Council resolves to establish and maintain strategic partnerships with public and private sector entities to improve government efficiency and service delivery through coordinated acquisition and sharing of geographic information and collaborative use of related technologies.

Objectives

Objective 1. Build a Multi-channel Network of TGIC Partners

TGIC will sponsor formal recognition of local, regional, state, federal, and private sector organizations through a multi-channel network to take advantage of available synergies and economies of scale for geographic information acquisition, sharing, and use of related technologies.

Objective 2. Document Resources and Needs of TGIC Members and Partners

TGIC will develop and maintain information describing the geographic information resources and needs of members and partners through ongoing communications regarding items of mutual interest.

Objective 3. Design and Build a Sustainable Program for Meeting Member and Partner Needs

TGIC will develop and sponsor various mechanisms (including cost-sharing arrangements, Cooperative Research and Development Agreements (CRADAs), standards development and adoption processes, and other mechanisms) to improve government efficiency and service delivery and to maximize benefits among TGIC members and partners.

Resolution passed unanimously by the Texas Geographic Information Council on November 18, 1998.

Introduction

It is widely understood that goals are more easily reached when group resources are combined to achieve them. For example, multiple groups often need access to identical geographic data regarding a site of common interest. These common interests and common goals can be the basis of partnerships whereby that combine resources and efforts lead to better results.

There are many ways in which cooperative arrangements between groups interested in geographic data can lead to better results. One of the most common examples is using partnerships to collect geographic data. Obtaining data is the most expensive component of geographic analysis costing even more than computer equipment and professional salaries. Partnerships can be used in pooling resources to purchase or create data. Directly related to this, partnerships can also be used to lower data and equipment costs due to the economy of scale associated with larger projects. On a similar note, partnerships can be used to attract funds from outside sources by bringing more resources to the bargaining table. In short, partnerships enable a group of smaller entities to work together and get the attention and service reserved for larger groups. As the number of partners in a data acquisition project increases, the cost per partner decreases significantly.

By determining who may have common interests in mapping a region, a listing of potential partners can be generated. This can be further refined by finding the mapping interests, plans, and priorities of these groups. Resulting partnership arrangements can save all parties money and provide better products than a single entity could afford alone.

What groups would want to form a partnership in dealing with geographic information?

Opportunities for partnerships exist everywhere and are relatively easy to identify. Every parcel of land in Texas, regardless of its owner, falls within the jurisdiction of many governmental and nongovernmental groups. These groups may share common interests in partnership.

The following entities may have an interest in simple land parcels.

City of Hurst Texas, North Parcel Base Map

Local County government, 9-1-1 district, municipality, appraisal district, law enforcement.
Regional River authorities, councils of government, municipal utility districts, water districts.
State TNRCC, Railroad Commission, TxDOT, law enforcement, TWDB.
Federal EPA, FEMA, USACE, DOT, law enforcement.
Private Land owners, utilities, developers, etc.

Background and Examples

Partnerships help agencies avoid the costs of duplicate data acquisition. As more Texas agencies implement GIS, the chance for data duplication increases. One of the first aims of the original GIS Planning Council was to provide the most efficient planning for GIS in Texas, thus reducing data duplication and fostering increased communication. These are the roots of the Partnership Resolution.

What are the benefits of partnerships?

Three benefits found in virtually all geographic information partnerships are:

- ❑ Funds are leveraged to allow significantly more product produced per individual partner-dollar invested.
- ❑ Data duplication is avoided by planning present and future needs with partners. Data updates are more easily established among groups that have already worked together as partners.
- ❑ Ongoing coordination results in improved operations and enhanced decision-making.

What are the types of partnerships?

Partnership benefits go beyond data development. The many examples of partnerships that have been used in Texas can be broken into two types based on their primary goals. Partnerships can provide **cost savings** in creating and using geographic data and they can improve **organization** with regard to planning and data applications. Cost-saving partnerships generally minimize data creation, equipment purchases, and distribution costs. Organizational partnerships assist with planning, data exchange, and funding solicitations.

What are some partnership examples?

Several examples of partnerships used in Texas are listed below. The type of partnership (cost savings or organizational) is noted.

Data Creation (cost savings) The Texas Strategic Mapping Program (StratMap) is providing mutually compatible statewide base map data layers. These include digital orthophotos, digital elevation models, topographic contours, roads, water features, boundaries, and soil surveys. Of the estimated $30 million total program cost, approximately 25% is being contributed by local/regional groups, 28% by the State of Texas, and 47% by federal agencies.

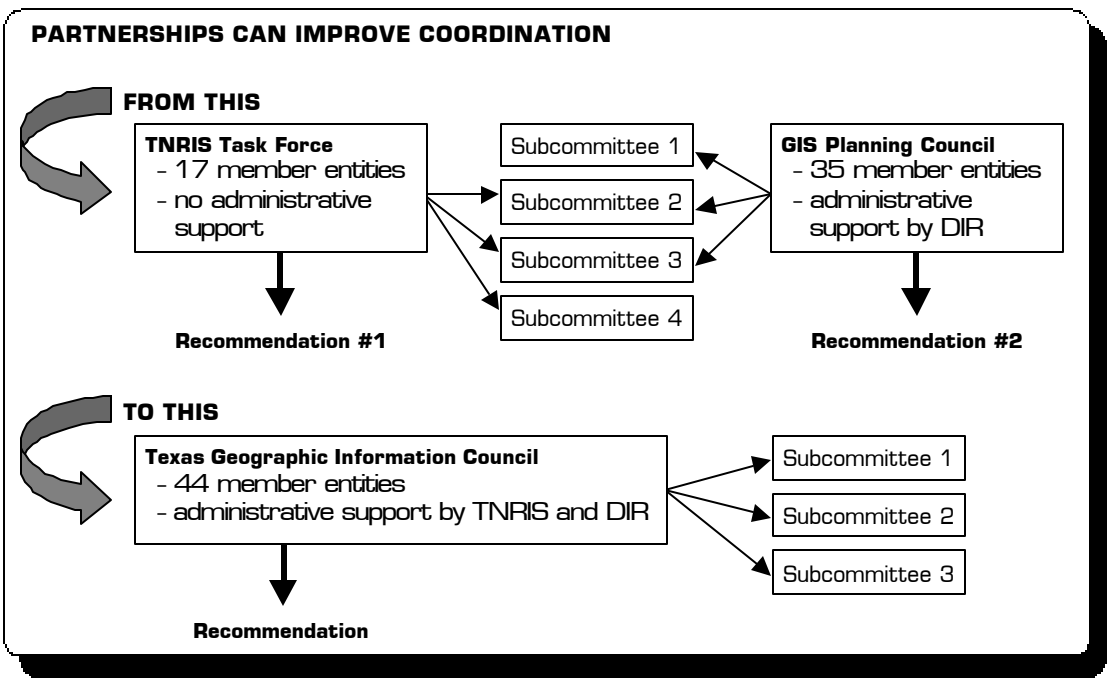
Applications (organizational) The Houston-Galveston Area Council (HGAC) integrated transportation data for the Houston metropolitan area created by various local and regional governments. HGAC manages the combined database. Application partnerships are invaluable for improving access to data and data exchange between different groups. These arrangements often pool data from many groups and allow access by all for a

specific application. Prime application examples include 9-1-1 emergency coordination, transportation routing, and land use management.

Coordination (organizational) The Texas GIS Planning Council and the TNRIS Task Force, both working in geographic data planning, merged in 1997 to become TGIC. This is an organizational partnership formed between two similar groups to improve efficiency and communication while reducing organizational overhead. The figure below shows how this partnership streamlined interagency communications and leads to more efficient planning.

Cooperative Purchasing (cost saving) The Texas Department of Information Resources has cooperative agreements with software companies that allow the state to purchase products at reduced cost. Why? Because state agencies are acting in concert (as partners) to allow one agency to be their representative in purchases. Cooperative purchasing partnerships let owners of small projects put them together to create one large project that provides lower per-unit costs. Larger projects generally allow vendors to provide a lower unit cost.

Grant Applications (organizational) A significant number of TGIC member agencies teamed with private companies, universities, and local government to apply for a NASA data distribution grant. Grant application partnerships are useful in seeking outside funding because many granting entities want their funds to benefit as many potential users of their product as possible.



Partnership Objectives

Below, the objectives of the TGIC partnership resolution are described individually. The TGIC Strategic Action Plan for Partnerships, to be developed over calendar year 1999, will provide greater detail and specific actions to be taken by TGIC and its members in support of this initiative.

Objective 1. Build a Multi-Channel Network of TGIC Partners

> *TGIC will sponsor formal recognition of local, regional, state, federal and private sector organizations through a multi-channel network to take advantage of available synergies and economies of scale for geographic information acquisition, sharing and use of related technologies.*

Developing high-quality geographic data for the entire state requires the involvement of more than just organizations with statewide jurisdiction. Regional and local partners can help determine what data best serves an area, can champion the value of geographic data, and can organize local interest in support of statewide and regional cooperative mapping systems.

TGIC should support regional champions of its efforts through regular communication, notice of available funding, contact assistance, and formal partnerships. This process should be modeled after procedures used by the Federal Geographic Data Committee (FGDC). FGDC coordinates geographic data policy and strategy among federal agencies and has long supported partnership formation. One of TGIC s predecessors, the GIS Planning Council, was the first nonfederal entity named as a partner with FGDC and has since worked with several FGDC agencies to address common mapping needs in Texas. TGIC is now the formal Texas partner of FGDC and will maintain that relationship. FGDC continues this practice and has established partnerships with many other states and national groups. By using the same basic practice, TGIC can recognize local and regional groups. This recognition will help TGIC by providing improved communications with new groups and help the local or regional group by providing them the opportunity to participate in major policy and cost-sharing initiatives.

Objective 2. Document Resources and Needs of TGIC Members and Partners

> *TGIC will develop and maintain information describing the geographic information resources and needs of members and partners through ongoing communications regarding items of mutual interest.*

The number of potential partnering groups within Texas (among local, regional, state, and federal entities) is huge. Opportunities for partnership exist when common goals are identified for any group of interested entities, regardless of individual purpose (education,

private, government, etc.). Surveys and contact information will be used to determine essentially who wants what where? These needs will be organized to show the potential partners for different regions. Although this information cannot be gathered from all possible groups and kept current, surveys and other means will provide at least a general knowledge of who partnership potentials.

The importance of good communication cannot be overstated. Effective and frequent communication must go on between all potential partners before, during, and after any cooperative activity. Good communication starts with good organization bringing potential partners together through some type of umbrella group such as TGIC, the Texas Association of Regional Councils (TARC), the Texas Association of Counties (TAC), or the Texas Association of Appraisal Districts (TAAD) will help ensure open lines of communication.

DIR and TNRIS are providing administrative support for TGIC by assisting with communications and establishing an Internet home page. TGIC can serve (through DIR and TNRIS) as the point of contact for this information. TGIC should maintain links for geographic data and GIS advice, Texas events, GIS jobs in Texas, mailing lists, and lists of contacts. As TGIC becomes more visible, attempts to form partnerships will likely become more successful.

Objective 3. Design and Build a Sustainable Program for Meeting Member and Partner Needs

TGIC will develop and sponsor various mechanisms (including cost-sharing arrangements, Cooperative Research and Development agreements, standards development and adoption processes, and other mechanisms) to improve government efficiency and service delivery and to maximize benefits among TGIC members and partners.

As potential partnering entities are identified and their needs described, TGIC will assist in providing the mechanisms needed for these partnerships to succeed. TGIC will support Cooperative Research and Development Agreements (CRADAs). CRADAs are an excellent mechanism for fostering partnerships between public and private entities. Each partner gets access to something it does not have.

TGIC will also use the inherent partnership of it membership to seek outside funding. This includes public and private grants and federal funding. TGIC is currently addressing common goals of its membership and has begun work to seek funds to meet these needs. The Texas Geographic Information Network (TGIN) is an example of this (see Data Sharing Initiative). Also, many partnerships are formed to build and share data. Beyond just agreeing to exchange data, partners must agree on data standards.

RESOLUTION

Goal

The Texas Geographic Information Council resolves to lead cooperative efforts for acquisition of geographic information that contributes to the National Framework of digital data, builds upon previous successes, and results in cost saving and cost avoidance while providing the best base maps feasible to the broadest possible constituency.

Objectives

Objective 1. Complete the Strategic Mapping Program

TGIC supports StratMap, including the Texas Orthoimagery Program. Completion of the seven common base map layers covered by StratMap is essential to the utilization of geographic information technologies in Texas. Members will use the StratMap data products where feasible and will develop cooperative mechanisms for maintaining and improving StratMap data layers.

Objective 2. Identify and Plan Acquisition of Additional Texas Framework Layers

TGIC will analyze agency requirements for additional common digital base map data, develop acquisition cost estimates, evaluate the feasibility of projects, and develop plans for acquisition and distribution of layers that are deemed feasible (updated georeferenced imagery, land use/land cover, and high-resolution digital elevation models will likely be included).

Objective 3. Encourage Cooperative Development of Other Base Map Layers by Member Organizations

TGIC encourages member organizations that produce additional base map layers to make them available to other members and the public in formats consistent with the Texas Framework model.

Resolution passed unanimously by the Texas Geographic Information Council on November 18, 1998.

Introduction

The history of digital base mapping in Texas can be traced over the course of twenty-five years, beginning in 1973 with the Texas Water Oriented Data Bank (a precursor to TNRIS) and the first statewide GIS data layer locating water wells in relation to county boundaries. State agencies have long sought to expand the high-resolution base mapping available for Texas. Interagency reports prepared in the 1970s and 1980s advocated a coordinated effort to produce digital versions of the base mapping layers in common use.

In its 1994 report, *Building Texas GIS Infrastructure,* the Texas GIS Planning Council promoted the idea of creating a series of high-resolution datasets, including 1:12,000-scale color infrared digital orthophoto quarter-quads (DOQs), 1:24,000-scale digital elevation models (DEMs), and 1:24,000-scale digital line graphs (DLGs). The recommendations followed a comprehensive survey of the mapping needs of state agencies and the general public.

These resulted in the funding of the Texas Orthoimagery Program (TOP) drawing upon $1.4 million from the State Match Pool beginning in August 1995. The funds were augmented by the U.S. Geological Survey through an Innovative Partnership that provided a significant federal share in the cost of orthoimage production. TOP products are created to exceed the national standards for 1:12,000-scale orthoimagery, so that they can serve as the source for extracting information necessary to update other base map layers. Through 1998, more than 5,500 quarter-quadrangle TOP orthoimages have been delivered to the state with several thousand more in production. Each one-meter DOQ is available in 24-bit color in GeoTIFF format for easy use with standard GIS software packages.

Base Mapping Objectives

Below, the objectives of the TGIC base mapping resolution are described individually. The TGIC Strategic Action Plan for Base Mapping, to be developed over calendar year 1999, will provide greater detail and specific actions to be taken by TGIC and its members in support of this initiative.

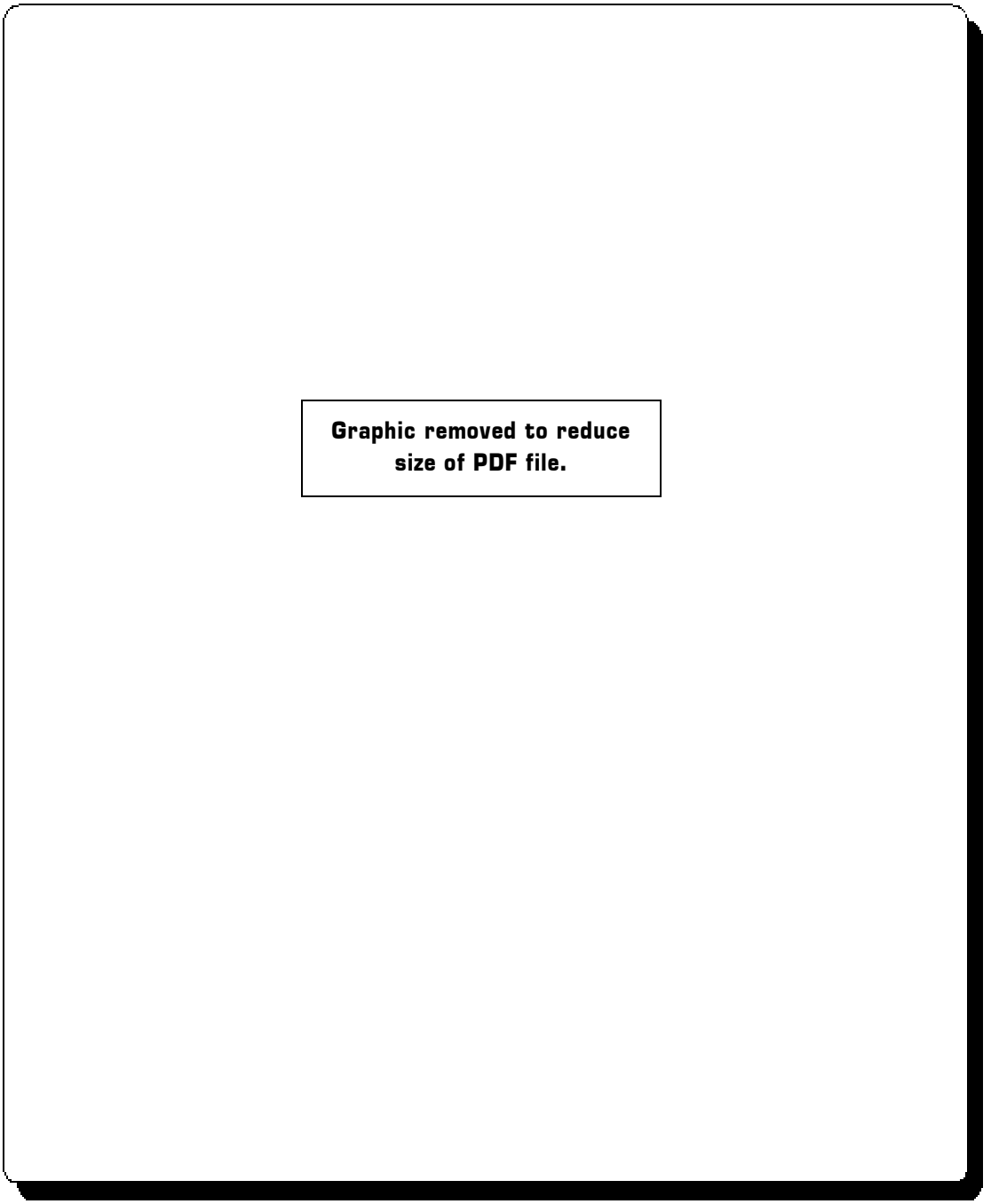
Objective 1. Complete the Strategic Mapping Program

> *TGIC supports StratMap, including the Texas Orthoimagery Program. Completion of the seven common base map layers covered by StratMap is essential to the utilization of geographic information technologies in Texas. Members will use the StratMap data products where feasible and will develop cooperative mechanisms for maintaining and improving StratMap data layers.*

The success of TOP confirmed the feasibility of pursuing an even larger project to create statewide data layers. The Texas Strategic Mapping Program (StratMap), funded by the

75th Legislature in June 1997, will produce datasets for digital orthoimagery, digital elevation models, hypsography (elevation contours and spot elevations), hydrography, soils, transportation, and political boundaries for each of the 7.5-minute quadrangles within or along the boundaries of Texas.

Texas Point at Sabine Pass, an example of a TOP digital orthoimage.



StratMap is being conducted as another Innovative Partnership with the U.S. Geological Survey and will serve to build the National Framework of base mapping data in Texas according to the Federal Geographic Data Committee s National Spatial Data Infrastructure (NSDI) model. Under this model, the best available data for an area the most current, complete, and accurate data are to be utilized. To meet this goal, StratMap works with regional and local GIS organizations to incorporate their datasets wherever these offer greater spatial accuracy or more current information.

The first StratMap data layer to be completed is the series of 30-meter profile digital elevation models. Another product scheduled for release in 1999 will be a seamless 30-meter profile DEM of Texas created by the U.S. Geological Survey EROS Data Center. The availability of 1:24,000-scale DEMs for Texas has already generated benefits in the form of improved surface representations for hydrologic modeling. Computer modeling experiments conducted by Dr. David Maidment of the University of Texas Center for Research in Water Resources have led to refinements in flood prediction based upon the more accurate elevation data obtained from the new DEMs.

You can view maps showing the status of the StratMap data layers at the TNRIS web site:

www.tnris.state.tx.us

Additional elevation data are becoming available through the StratMap hypsography data layer, which will create digital line graphs for elevation contours and supplementary spot elevations. As with the other base mapping DLGs, the hypsography files will be projected in UTM using an NAD83 datum. In addition to supplying a digital version of contours found on standard 1:24,000-scale topographic quadrangle maps, the hypsography DLGs can serve as the source for higher resolution DEMs that represent more detailed terrain.

Production of hydrography DLG datasets for Texas is occurring in several areas of the state. Each hydrography DLG file will record the location of all flowing water, water bodies, and wetlands and will be produced in accordance with the standards of the new National Hydrography Dataset (NHD) to include stream centerlines, the direction of flow, and unique identifiers located at stream confluences. The U.S. Geological Survey will use the StratMap hydrography layer to produce a high resolution NHD model for Texas that will update the stream reach codes for hydrological networks. The resulting 1:24,000-scale NHD hydrography files will be an excellent tool for use with hydrologic models tracing runoff, sediment loads, and nonpoint source pollution.

Under an agreement signed with the U.S. Department of Agriculture Natural Resources Conservation Service, more than 40 Texas counties now have digital versions of their county soil surveys. The Soil Survey Geographic (SSURGO) datasets will be produced for at least 150 counties during the course of the StratMap program. The SSURGO files are produced in the same UTM projection and NAD83 datum as other StratMap data layers

and will contain information for more than 25 different physical and chemical soil properties.

The final two StratMap data layers covering transportation and political boundaries will enter production in 1999 in coordination with the Texas Department of Transportation and will incorporate road centerline data for federal, state, county, and many municipal roads. The excellent transportation and boundary data available from regional GIS organizations, such as the Houston-Galveston Area Council, North Central Texas Council of Governments, and Capital Area Planning Council, will be integrated into production of these data layers. The completed transportation and boundary data layers will benefit from systematic updates of information received from regional GIS groups working in the most densely populated areas of the state. In this manner, these dynamic StratMap base layers will become living digital archives of the state s transportation and political boundaries.

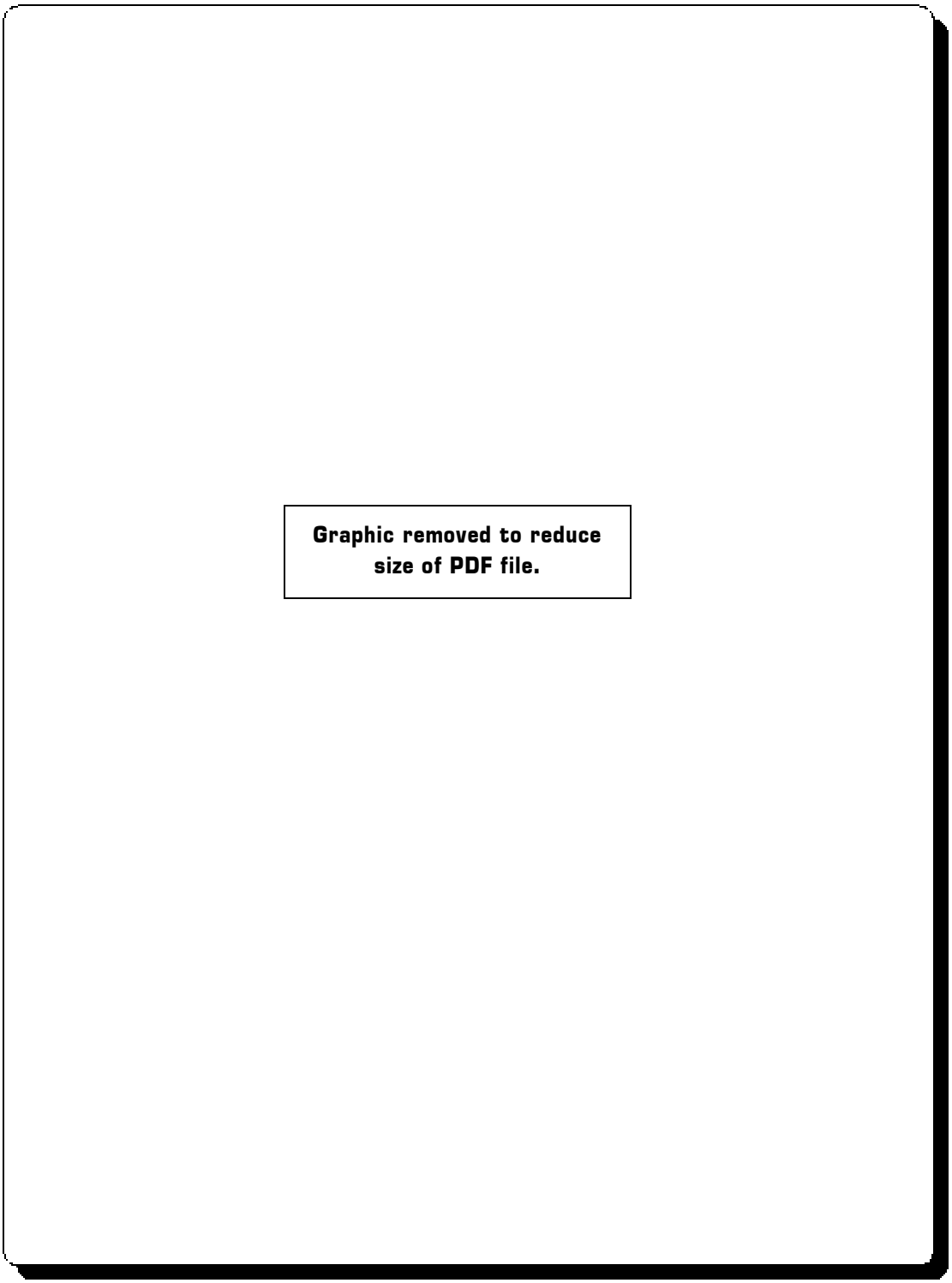
Objective 2. Identify and Plan Acquisition of Additional Texas Framework Layers

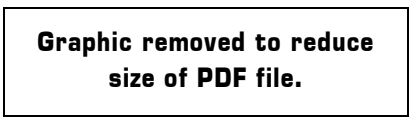
TGIC will analyze agency requirements for additional common digital base map data, develop acquisition cost estimates, evaluate the feasibility of projects, and develop plans for acquisition and distribution of layers that are deemed feasible (updated georeferenced imagery, land use/land cover, and high-resolution digital elevation models will likely be included).

In coming years, it will be advantageous to update existing StratMap data layers and to create additional Framework base mapping layers that meet the requirements of state agencies. Planning for this effort must begin immediately to address the needs for the revision of current GIS layers, to establish the priorities for production of new layers, and to make the most efficient use of state funds.

Orthoimagery represents the most costly single element in base mapping, but it is essential to the development of other data layers and many value-added applications, such as resource management and tax appraisal. In the near future, new production techniques may dramatically reduce the cost of georeferenced imagery. Commercial remote sensing companies will soon begin operating high resolution (one-meter ground-cell) imaging systems using satellite technology. Both NASA and private firms will also begin flying more advanced versions of digital cameras on board aircraft. These techniques should be evaluated to determine the possible advantages and cost savings over conventional orthoimagery production. Another potentially effective method to update orthoimagery is to use the existing TOP data and DEMs in conjunction with newly acquired aerial photography to construct resampled, georeferenced images from scanned photos. Initial experiments have shown that 1:12,000-scale horizontal accuracy can be achieved in areas of low and moderate relief using this relatively inexpensive production technique.

Six decades of change. A precision imagemap (below) of central Austin in 1937, rectified and georeferenced using ground control points selected from a 1996 TOP orthoimage (opposite).

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size of PDF file.

With expanding uses of DEMs for hydrologic modeling, viewshed determination, slope/aspect analyses and 3-D surface visualization, there will be a growing need for higher resolution DEMs than the currently available 30-meter profile datasets. Enhanced DEMs having a 10-meter grid posting interval provide much more accurate representations of landforms and can be created using the StratMap hypsography DLG datasets. For some low-lying areas, there may not be sufficient elevation data to construct useful DEMs. For these regions of the coastal plain, southern High Plains and river flood plains, experiments should be conducted using data generated by airborne lidar and radar altimeters to determine the production cost and effectiveness of DEMs created from these new sources of elevation data.

Careful consideration should be given to future statewide production of additional commonly needed 1:24,000-scale (or larger) base mapping layers. The original seven StratMap layers plus these additional layers will be known as the Texas Framework. Candidate data layers include survey control to provide assistance to professional surveyors and TOP aerotriangulation control to encourage the development of orthoimagery and imagemaps by commercial satellite and aerial imagery firms. The requirements for several new data layers dealing with the state s water resources should be studied for coastal and reservoir bathymetry, watershed delineation, wetlands inventory and flood hazard delineation. Future elements within a miscellaneous transportation/communication layer might contain electrical transmission networks maintained by utilities and by radio mast and microwave tower localities within the state. Knowledge of the geology of Texas would be advanced by the production of 1:24,000-scale digital maps of the most important areas of the state s surface geology. Additionally, several agencies and organizations have expressed strong interest in a statewide assessment of land use/land cover. Such a survey could be conducted using TOP orthoimagery together with satellite multispectral data to inventory categories of land use and vegetation cover across the Texas landscape.

In each case, the proposed Texas Framework base mapping layers should be assessed by TGIC members to determine the importance to agency needs, the best methods for production, and the most cost-effective means to secure statewide coverage.

Objective 3. Encourage Cooperative Development of Other Base Map Layers by Member Organizations

TGIC encourages member organizations that produce additional base map layers to make them available to other members and the public in formats consistent with the Texas Framework model.

The member organizations of TGIC develop and maintain a broad range of GIS data for use by state government as well as by the public at large. Whenever feasible, these datasets

should be made available in the public domain in the UTM projection and NAD83 datum compatible with the Texas Framework model. Fully descriptive metadata should accompany each dataset to ensure that the accuracy, date, and method of production are well documented.

Of all the GIS and remote sensing resources archived by state agencies, the aerial photography collection housed at TNRIS may be the most valuable. Constant use of the collection by the public threatens to damage important holdings, especially the photographic prints from aerial surveys conducted during the 1930s and 1940s. Preservation of this essential archive should be pursued through the digital scanning of rare aerial photographs and development of an automated index system permitting Internet access to an electronic version of the TNRIS aerial photography collection.

Coincident with digital scanning of photographs in the TNRIS archive, tests should be made to ascertain the feasibility of using photographs from federal and private aerial surveys completed during the 1930s to produce historical retrospective imagemaps at a scale of 1:24,000. A series of historical imagemaps would display the condition of the land surface prior to the boom of economic expansion and development following the Second World War. A Texas Framework layer consisting of digital 1:24,000-scale historical imagemaps would provide important information concerning the impact of urban and suburban growth, conversion of farmland, woodland, and wetlands, and other significant changes to the Texas landscape.

RESOLUTION

Goal

The Texas Geographic Information Council resolves to share the benefits of public investments in geographic information and related technologies through policies, services, and technologies that maintain and promote the broadest feasible public access to the best geographic information available.

Objectives

Objective 1. Support Application of Texas Public Information Act for Geographic Information

TGIC acknowledges that geospatial data acquired by public entities is public information as defined in the Public Information Act and that charges to the public for this data should be limited to justifiable costs of providing the copy. TGIC sees this policy as fundamental to the effort to improve government through improved information exchange.

Objective 2. Support High-speed Data Access and Exchange, Including the TGIN Initiative

TGIC supports the use of broadband Internet and client/server technologies to provide nonduplicative data storage and retrieval systems that will help maximize the benefits of public investments in computer technology. Specifically, TGIC supports TWDB s efforts to improve data access and exchange capabilities through the Texas Geographic Information Network and increases in TNRIS s server speed and capacity. These efforts will improve data access and reduce data costs statewide.

Objective 3. Develop and Adopt a Comprehensive Set of Spatial Data Standards

TGIC will develop a new set of cartographic and documentation standards and guidelines for use in the development of geospatial data and applications in local, regional, and state government, and submit these to DIR to update existing, outdated rules.

Resolution passed unanimously by the Texas Geographic Information Council on November 18, 1998.

Introduction

Since its inception, the Texas Geographic Information Council has been committed to sharing the benefits of public investments in geographic information and related technologies through policies, services, and technologies that maintain and promote the broadest feasible public access to the best geographic information available.

> *Since data acquisition typically represents 80% of the cost of a GIS system, development of reliable systems for data access and exchange combined with the development of base maps represents a tremendous opportunity to reduce the overall costs of GIS implementation.*
>
> Texas GIS Implementation Plan, 1997

Data Sharing Objectives

Below, the objectives of the TGIC data sharing resolution are described individually. The TGIC Strategic Action Plan for Data Sharing, to be developed over calendar year 1999, will provide greater detail and specific actions to be taken by TGIC and its members in support of this initiative.

Objective 1. Support Application of Texas Public Information Act for Geographic Information

> *TGIC acknowledges that geospatial data acquired by public entities is public information as defined in the Public Information Act and that charges to the public for this data should be limited to justifiable costs of providing the copy. TGIC sees this policy as fundamental to the effort to improve government through improved information exchange.*

The Texas Public Information Act allows the public to access information that is collected, assembled, or maintained by or for a government body, with some exceptions as noted below. This act states that government entities must provide copies of requested information and that charges for this information cannot exceed the cost of reproducing the data. It is important to note that there is no charge for the data itself.

Some government organizations are seeking the ability to recoup the cost of geographic information systems through mechanisms that will allow them to market the information used to populate their GIS databases. A fundamental problem with treating GIS information differently than other public information is the inherent limitation that such changes would place on the distribution of this information among governmental bodies. The resulting increased isolation will increase duplication of effort, prevent government from taking advantage of economies of scale available through cooperation, and reduce the overall efficiency of government in Texas. These negative impacts are potentially very

significant, both in terms of restricting citizen access to the information being used to make decisions on their behalf, and to the overall efficiencies of government. There is an opportunity for improving government through coordinated GIS development across the state and there is a corresponding loss of opportunity through isolated development.

As noted above, data acquisition typically represents 80% of the cost of a GIS project or system. Cross-jurisdictional exchange of data will help reduce this cost. Data developed on top of common base map layers, such as those developed through the StratMap program, uses a standard reference and is more readily integrated with other data sets than data developed independently. Readily available data will also reduce the long project start-up times necessary when data must be created from scratch.

The General Services Commission (GSC) was mandated by the Legislature to conduct a study to determine reasonable charges for GIS data. The Texas GIS Planning Council participated in the study along with other state, regional and local public entities and several private companies. In its resulting report, GSC concluded that although the issues involved in determining reasonable charges for GIS data are numerous and complex, the provisions of the Public Information Act are adequate to cover all costs associated with providing data to the requestor. TGIC supports this conclusion.

Objective 2. Support High-Speed Data Access and Exchange, Including the TGIN Initiative

TGIC supports the use of broadband Internet and client/server technologies to provide nonduplicative data storage and retrieval systems that will help maximize the benefits of public investments in computer technology. Specifically, TGIC supports TWDB s efforts to improve data access and exchange capabilities through the Texas Geographic Information Network and increases in TNRIS s server speed and capacity. These efforts will improve data access and reduce data costs statewide.

In the past, data access and data exchange between agencies were accomplished by copying the data onto a tape, diskette, or more recently, a CD. While these methods will continue to play a role in providing access, the explosion in the use of the Internet is providing faster, easier data exchange alternatives. Internet technology provides the ability to download data from a remote site and, increasingly, the ability to view and manipulate data from that remote site without GIS software.

As the manager and distributor of the StratMap data layers, TNRIS requires funding for ongoing operation of the program, not just for data acquisition. TGIC recommends that state funding be allocated to meet the hardware, software, and staffing needs for expanded data distribution efforts.

TGIC has recently proposed creating high-speed access to digital data by taking advantage of existing state investments in fiber-optic communications technology. Sharing digital geographic information provides a common frame of reference and leads to quicker and more efficient problem solving. The Texas Geographic Information Network (TGIN) calls for a fundamental upgrade in the ability of agencies to share information electronically.

TGIN will allow very fast data transfer speeds by tying into the existing Greater Austin Area Telecommunications Network (GAATN). GAATN is a fiber-optic system that operates at a speed sufficient to allow transfer of large GIS datasets between connected agencies.

A key element of this proposal is providing TNRIS with a connection to GAATN. This connection will bring immediate benefit to everyone accessing data available through TNRIS by decreasing the time needed to access and download files. Additional benefits will be realized as other entities connect to the network. High-speed connectivity means that important datasets such as Digital Orthophotos and satellite imagery will be available over the Internet for real-time use in oil spill response, drought and flood analysis, forest management, fire fighting efforts, and the like. TGIN will make this infrastructure available without the delay and costs associated with developing or duplicating data.

As a first step in the realization of TGIN, the Texas Water Development Board, which houses TNRIS, has submitted an exceptional item in its Legislative Appropriation Request to the 76th Legislature. If approved, TNRIS will be connected to GAATN and will acquire additional hardware, software, and staff resources to begin expanding its data distribution services. TGIC strongly supports this appropriation request, and suggests that further opportunities be explored to fund expansion of TNRIS s data server speed, capacity, and ease of use, as well as the general connectivity at state agencies to high-speed Internet communications.

Objective 3. Develop and Adopt a Comprehensive Set of Spatial Data Standards

TGIC will develop a new set of cartographic and documentation standards and guidelines for use in the development of geospatial data and applications in local, regional, and state government and submit these to DIR to update existing, outdated rules.

Standards are necessary to allow integration of data from various sources. While Texas does have a set of standards that were established in 1992 (see the standards at www.tgic.state.tx.us), they are out of date and in need of revision. New standards will

cover the following topics: map projections and coordinate systems, data exchange formats, spatial accuracy, data attributes, data update, distribution, and documentation.

Data standards allow work produced by one organization to be used by many others. Standards also preserve a dataset s utility as those who created the data leave the organization. Open data sharing requires that data be thoughtfully documented.

The Federal Geographic Data Committee (FGDC) coordinates policies, standards, and procedures for organizations to cooperatively produce and share geographic data. An example of a standard defined by the FGDC is the Content Standards for Digital Geospatial Metadata. The FGDC metadata standard covers information relating to the creation, processing, storage, and distribution of data. This standard was created so that governmental, nonprofit, and commercial participants worldwide can make their collections of spatial information searchable and accessible on the Internet using free software developed by the FGDC.

Standards proposed or defined by the FGDC will be examined by TGIC for adoption in Texas. Many states have standards that cover all or some of the above topics these will be examined for possible use.

RESOLUTION

Goal

The Texas Geographic Information Council resolves to develop and promote the use of cost-effective systems that provide the most accurate locational information feasible for field data collection and navigation needs statewide.

Objectives

Objective 1. Support Creation of the Texas Geodetic Advisor Program

TGIC supports creation of a Texas Geodetic Advisor function through a cost-sharing partnership with the National Geodetic Survey. This partnership will benefit public and private organizations requiring an accurate geodetic control network for engineering, surveying, and mapping applications within the state.

Objective 2. Support Statewide Real-time Broadcast of GPS Correction Information

TGIC endorses rapid statewide deployment of real-time broadcast of Global Positioning System (GPS) correction data. This federally funded program will lower the costs and increase the accuracy of real-time locational information available with GPS. Beneficiaries will include all government and private sector entities needing accurate real-time location information in Texas, such as emergency response agencies and the agriculture and transportation industries.

Resolution passed unanimously by the Texas Geographic Information Council on November 18, 1998.

Introduction

Agencies, private sector organizations, and citizens need tools to capture geospatial information in the field. State agencies require accurate locational information about regulated facilities, biological resources, environmentally sensitive areas, and state-owned lands. The traditional method for capturing this data is to send field teams out with various types of maps to try and determine where these things are, or to send survey teams out to verify the locations.

Some agencies are adding a new method of data capture which is often quicker, less expensive, and more accurate. This method, Global Positioning Systems (GPS), is a satellite-based technology developed during the 1980s by the Department of Defense and now being used by many federal and state agencies, businesses, and the public.

Whether using GPS or traditional surveying techniques for field data collection, a certain level of coordination is needed to ensure that all users (and taxpayers) receive the maximum benefit for their technology investment. The two objectives stated in TGIC s Field Data Collection Resolution relate to the establishment of a coordination program and to supporting an effort that will improve GPS data collection in Texas.

Field Data Collection Objectives

Below, the objectives of the TGIC field data collection resolution are described individually. The TGIC Strategic Action Plan for Field Data Collection, to be developed over calendar year 1999, will provide greater detail and specific actions to be taken by TGIC and its members in support of this initiative.

Objective 1. Support Creation of the Texas Geodetic Advisor Program

> *TGIC supports creation of a Texas Geodetic Advisor function through a cost-sharing partnership with the National Geodetic Survey. This partnership will benefit public and private organizations requiring an accurate geodetic control network for engineering, surveying, and mapping applications within the state.*

This objective calls for the creation of a Geodetic Advisor Program to serve all state agencies and other local and regional governmental agencies, and to have an ongoing, proactive relationship with the private sector. The National Geodetic Survey (NGS, a division of the National Oceanic and Atmospheric Administration, or NOAA) has approached the state through the Texas Mapping Advisory Committee (TMAC), offering to assist in the immediate creation of a Texas Geodetic Advisor position. Recovery of existing monuments and creation of new monuments are critical to public and private surveyors across the state. Both of these programs have been neglected. There is no one agency working on these important initiatives. The program proposed by NGS for Texas,

similar to programs they helped set up in other states, including Louisiana and New Mexico, will address these needs.

NGS has proposed a five-year plan by which it would fund half of a State Geodetic Advisor s salary, as well as expenses for computer, automobile, and related tools. The remaining salary, office, and administrative costs would be funded by the state. NGS has requested the State of Texas, through the Texas Mapping Advisory Committee (TMAC) and TGIC, to outline a modern program emphasizing an approach combining GPS coordination and survey monument identification, maintenance, and retrieval.

TGIC supports the creation of a Texas Geodetic Advisor Program based on the NGS proposal, but optimized to suit the needs of Texas. This program must be supported by at least two full-time positions. One position, the **State Geodetic Advisor,** should be housed in a general support entity such as TNRIS or DIR. The other position, **State Geodetic Coordinator,** should be housed in the Texas Department of Transportation (TxDOT), since it performs a majority of the state s routine GPS and surveying work. The Geodetic Coordinator position would be created simultaneously or soon after the Geodetic Advisor and fall under the same funding partnership plan.

These positions will focus on the development of real-time GPS and monument maintenance throughout the state. The Geodetic Coordinator will act closely with TxDOT and TPWD (for whom they do survey work) and will be active in day-to-day state-based operations. The Geodetic Advisor will work with the Geodetic Coordinator and operate as an outreach and program manager.

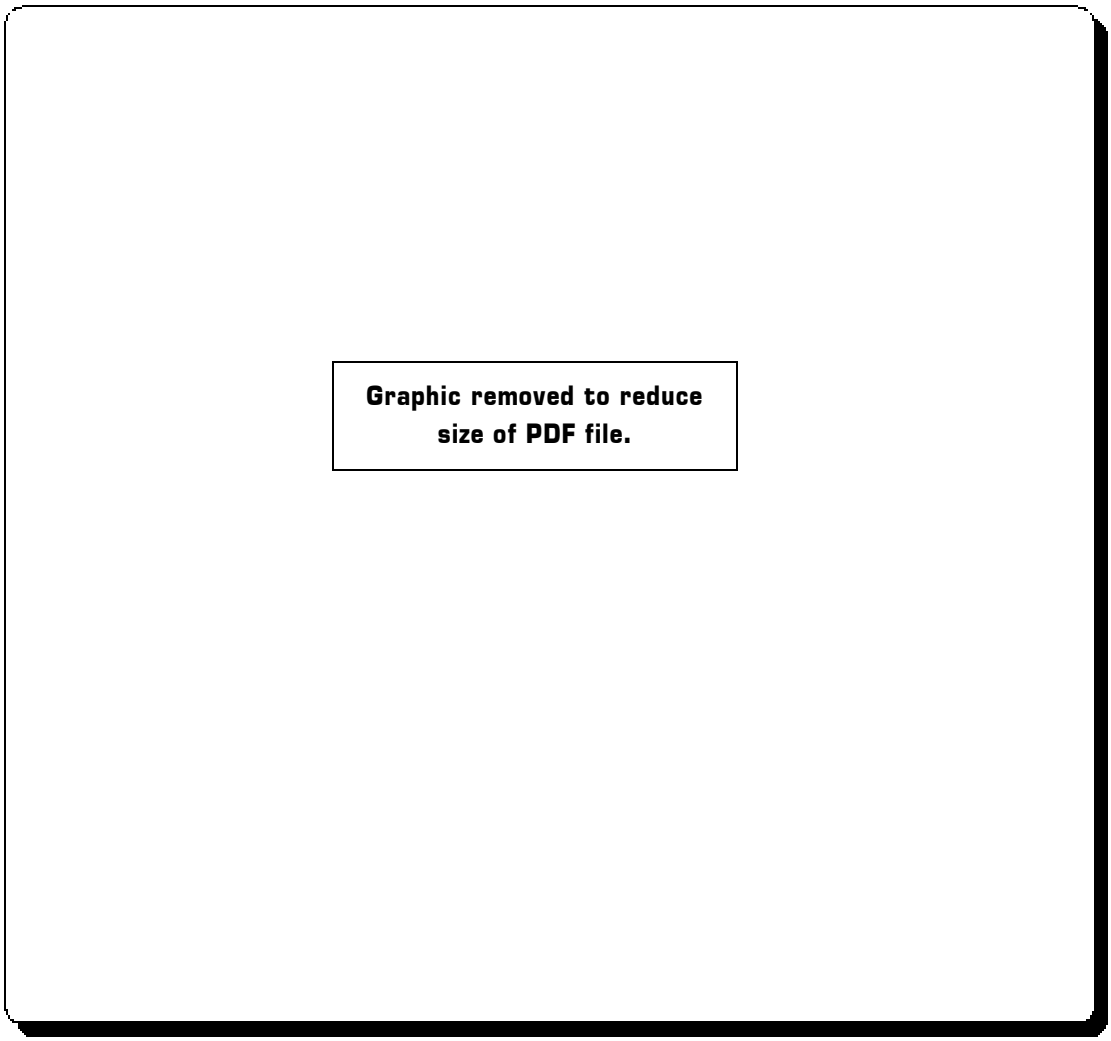
The Geodetic Advisor Program. The Texas Geodetic Advisor s job will address GPS and a program replacing lost monuments. This initiative marks a change in federal thinking that parallels the Texas program. NGS sees the need for a combined program of traditional surveying efforts, intertwined with emerging GPS tools. Key to this initiative is the merging of GPS and traditional geodetic advisor programs based on the mutual needs of these activities. Traditional surveying utilizes GPS on a daily basis. In fact, many surveying jobs are perfect for GPS technology, yet as much or more surveying must still be done in the traditional manner. Traditional surveying methods are the most effective means to obtain a legal lot description that can be publicly filed.

The Texas Geodetic Advisor will coordinate all GPS activity within the state, including the creation or certification of GPS training classes, standards, rating systems, and information updates on technology and other related matters. The Texas Geodetic Advisor will oversee the Monument Maintenance Program through efforts to spatially identify all known points within the state, establish confidence ratings and NGS acceptance status, and propose a systematic program to increase the network of known points for surveyors and GPS users. Through coordination with the TxDOT Geodetic

Coordinator, known points in public rights of way and within public lands will be established. These will be accessible to all GPS users and surveyors.

GPS requires known points to effectively record and verify the accuracy of the GPS unit and surveyor. Often, a surveyor or technician will set upon a known point to establish the accuracy of the GPS unit and then be able to collect data within that area with a relatively high level of confidence. The use of precise GPS surveys requires a GPS unit to set upon a known point to allow triangulation with a secondary unit that records the perimeter survey. These known points, essential to surveyors and all GPS users, are found in varying levels of accuracy throughout the state. Yet to find, publicize, and verify these locations is frequently difficult due to a lack of communication among agencies creating known points.

Model of Web Site to Access Texas Geodetic Control Points



The Texas Geodetic Advisor will administer a web site to identify, document, and publicize all known geodetic control points throughout Texas. Useful and highly accurate known points are constantly established throughout the state by federal, state, regional, county, and municipal governments. This web site would publicize all known points with accompanying data and attributes. Certified surveyors could use this site to register verified points. Working closely with the Geodetic Coordinator, the Geodetic Advisor would verify, replace, and maintain the state s network of known points and monuments.

A state the size of Texas that has seen field data collection neglected for decades requires the services of two geodetic professionals to properly restore the accuracy, safety, and quality of Texas GPS and surveying.

Objective 2. Support Statewide Real-Time Broadcast of GPS Correction Information

TGIC endorses rapid statewide deployment of real-time broadcast of Global Positioning System (GPS) correction data. This federally funded program will lower the costs and increase the accuracy of real-time locational information available with GPS. Beneficiaries will include all government and private sector entities needing accurate real-time location information in Texas, such as emergency response agencies and the agriculture and transortation industries.

In 1998, the federal government announced a plan to create a real-time broadcast system over the entire United States that would provide for positive train control and monitoring. This initiative was originated by the Federal Railroad Administration (FRA) and was partially created out of the precursor to this document, the 1996 *GIS Implementation Plan.* The current program does not have a set timetable to construct the network nationwide, yet some states have been announced for the initial phase of the system. Texas is scheduled to have one of four real-time broadcast stations established in 1999 at the Summerfield site near Lubbock. This initiative seeks a concerted effort to establish the remainder of the Texas real-time GPS broadcast stations as soon as possible.

Background. GPS technology utilizes hand-held receivers to interpret satellite signals and calculate a latitude/longitude location on the ground. The locational accuracy of raw GPS data ranges from 30 to 100 meters. This data can be corrected by a variety of methods to sharpen the accuracy to 2 meters or better. This normally takes place **in the office** after field data has been collected. TGIC supports a standards-based implementation of GPS technology that utilizes a correction method known as real-time broadcast of differential correction information. Development of a real-time broadcast network will aid in correcting GPS data **in the field** and ensure that the most cost-effective use of this technology is available to state and local government agencies and the private sector.

National Trends. Several federal agencies have shown great interest in implementing GPS technology for a variety of purposes. The Department of Defense is the largest current user in the federal government, but agencies within the Department of Commerce (DOC) and the Department of Transportation (DOT) have also initiated efforts to implement GPS. Two of the primary uses seen by these agencies are for aviation support and for traffic control. The Federal Aviation Administration (FAA) has conducted pilot studies and has begun localized implementations of GPS technology for assisted navigation during takeoffs and landings. The Department of Transportation has studied several aspects of GPS technology to support an Intelligent Vehicle Highway System (IVHS). An IVHS would rely on GPS to help monitor the nation s most congested freeways and provide input to a new traffic control system.

The U.S. Coast Guard has established a successful GPS navigation system in conjunction with the U.S. Army Corp of Engineers that is used for maritime traffic and navigation on the nation s coasts and navigable waterways. This system is based on the real-time broadcast of Differential GPS (DGPS) data via radio beacons and provides corrections to GPS data, making it possible to capture locations as accurate as two meters. Surveyors, the land transportation industry, geoscientists, and meteorologists are taking advantage of these signals in inland areas where possible. The Department of Transportation is the agency charged with representing the nation s civilian interests in the use of DGPS, and has begun studies to determine the interest and feasibility of extending the Coast Guard s DGPS system.

Two marine beacon transmission stations have been established in Texas at Aransas Pass and Galveston. These represent a free resource for use by state agencies and the public. The range of the low-frequency DGPS signal varies, but is generally being received within 200 to 250 miles of the beacon sites. The expansion of this system, using the same or similar technology will provide a consistent means of capturing accurate data for a variety of purposes. State cooperation with the federal government in the establishment of a GPS infrastructure will serve to benefit both the public sector and the private sector. Cooperative programs and standardized implementations of GPS technology, which allow the various government entities to share costs and methodologies, will serve to improve the efficient acquisition of geospatial data.

Two examples of the benefits to the private sector of this expansion are detailed below.

Positive Train Control and Transportation Uses. FRA s June 1995 report, *Differential GPS: An Aid to Positive Train Control,* submitted to the Committees on Appropriations, supports the use of Differential GPS as a means of promoting the accuracy and utility of positive train control systems. Positive train control systems are technologies that aid in preventing collisions between trains, deter the possibility of high-speed derailments, and can provide additional safety and economic benefits. Not only will this expanded

technology represent a major aid in the prevention of accidents and casualties (avoiding approximately $35 million per year in losses), but it also will provide better quality service, more efficient utilization of existing track, and reduced fuel consumption through better pacing of trains.

The transportation industry also utilizes real-time GPS in automobiles, public transportation, insurance companies, and enhanced 9-1-1 emergency communications. The uses of such technology are growing daily, yet no person, division, or agency is nurturing this essential technology.

Precision Agriculture. The U.S. Department of Agriculture has been actively supporting a revolution in farming operations that provides the ability to plant, fertilize, apply pesticide, and harvest in such a way to provide economic benefits, while at the same time protecting the environment. The potential benefit of applying exact amounts of chemicals for the highest productivity, and minimization of the chemical effect and cost, could represent the greatest technological change to impact farming in 100 years. Most of the states with significant farming interests, such as Illinois, Kansas, Indiana, Missouri, Oklahoma, Minnesota, Michigan, Wisconsin, Nebraska, Iowa, and the U.S. shoreline states, all have adequate DGPS signal availability. This capability speeds their ability to take advantage of precision farming and realize the economical and ecological benefits of these new techniques. However, the lack of Differential GPS capability is a problem for other grain-crop-producing states such as Texas, which has less than one-third of its area covered by DGPS correction signals. It is feared that without expanded coverage of DGPS, states without access will fall behind in technology and profitability.

RESOLUTION

Goal

The Texas Geographic Information Council resolves to develop and maintain effective mechanisms for outreach and education to inform interested parties of geographic information technologies, and of TGIC initiatives, services, and resources aimed at developing the skills and capabilities of state agency customers, clients, and employees.

Objectives

Objective 1. Establish a Statewide Learning Program for Geographic Information Technologies

TGIC will lead a statewide outreach effort to inform and educate geographic information professionals and the public on geographic information technologies and TGIC initiatives, services, and resources.

Objective 2. Expand the Scope of TGIC s Web Resources

TGIC will coordinate presentation of materials describing geographic information technologies and TGIC initiatives, services, and resources through implementing a set of web pages providing easy access from a home page housed at DIR to other pages housed at appropriate member or partner locations.

Objective 3. Research and Develop a Geographic Information Technologies Curriculum

TGIC will conduct a survey of members and partners to determine the types, levels, and amounts of GIS- and GPS-related training needed, and preferred delivery methods. Based on assessment of training and education resources available, TGIC will propose ways to make needed training more accessible to the agencies at reduced cost.

Objective 4. Develop Career Paths for Geographic Information Technology Professionals

Based on a survey of professional GIS career path models, TGIC will recommend a set of GIS professional career paths.

Resolution passed unanimously by the Texas Geographic Information Council on November 18, 1998.

Introduction

The Outreach and Education Initiative arose out of the recognition of needs for GIS education, the dissemination of information to facilitate data and other resource sharing, and for outreach to assist those who may be just starting to use GIS. Key objectives include promoting communication, facilitating interagency coordination of GIS efforts, and expanding the users knowledge base to maximize the benefits of GIS for the community at large.

The rapid growth of technology and the GIS community has made it difficult to keep pace with theoretical and practical issues in the field. Time and logistic demands have made sharing of knowledge and potential resources difficult. The effort to coordinate and promote information communication for the state GIS community as a whole remains in its infancy. Most efforts have been largely informal and/or in-house as needed by the agency.

Significant infrastructure for sharing geographic data is in place. The Texas Natural Resources Information System (TNRIS), the state s clearinghouse and referral center for natural resources data, serves the GIS community well. The expanding availability of data, along with increasingly user-friendly software, has increased awareness of the value of GIS analysis and attracted many new users. The Internet has also played a major role by improving data accessibility. In addition, there are now sites being developed that utilize web-based map-making tools. This emerging technology brings GIS to an audience who may not even be aware that they are using GIS.

Broadly speaking, two general classes of GIS constituents technical and nontechnical can be identified. Technical users generate GIS data and output. Their level of expertise can vary from beginner and simple mapmaker to the full time GIS professional with a substantial educational background in GIS. The nontechnical user generally only deals with the final GIS products. These users may know little or nothing of the technical side of GIS, but have a need for the analyses and maps. They may be upper-level managers, advisors, or policy makers. Though they may not need to know how the software works, a general knowledge of GIS would enhance their utilization of GIS output.

With the growing recognition of the power of this tool, GIS specialists will increasingly find themselves communicating and interpreting results to nontechnical audiences. These may include managers and decision-makers, regulators, other professionals, or the general public. It is essential that GIS specialists develop the skills to meaningfully communicate technical information and analytic results to audiences unfamiliar with GIS.

Outreach and Education Objectives

Below, the objectives of the TGIC outreach and education resolution are described individually. The TGIC Strategic Action Plan for Outreach and Education, to be developed over calendar year 1999, will provide greater detail and specific actions to be taken by TGIC and its members in support of this initiative.

Objective 1. Establish a Statewide Learning Program for Geographic Information Technologies

TGIC will lead a statewide outreach effort to inform and educate geographic information professionals and the public on geographic information technologies and TGIC initiatives, services, and resources.

Numerous GIS educational and training resources are available. These include university courses, commercial vendor training courses and seminars, Internet courses, books, and other Internet resources. A number of state government departments hold in-house training sessions. TNRIS offers limited special training sessions, and DIR offers access to training through competitive contracts. However, information on these activities is scattered and often hard to find, especially for those just initiating GIS work. There is a need to organize and evaluate the training tools that are available so that beginners and more advanced GIS users can efficiently access and tailor a training program for themselves or their agencies.

TNRIS and DIR have hosted the Texas GIS Forum in Austin each year for the past ten years. This event has been highly successful in bringing together a wide range of GIS professionals and users from state and local governments and the private sector to learn about each other s activities, attend workshops, and keep up with technological advances. Due to the popularity of this training opportunity, more workshops have been added. The sponsoring agencies are looking into ways to keep this forum useful and up to date in the face of rapidly changing technology and the maturing of GIS implementations in Texas. A key factor in the success of the Texas GIS Forum has been the philosophy of keeping registration fees to a minimum. Additional workshops and innovative options for information exchange presented at the forum will further enhance its role in outreach and education.

Excellent GIS training courses are offered by many GIS and GPS vendors, and many state agencies have sent staff to these courses. However, high registration fees and remote locations often render this option unavailable for agencies with tight training and travel budgets. TGIC and DIR are exploring additional opportunities for cooperative contracts that would include training discounts with other GIS and GPS vendors. TGIC will also explore opportunities to reach other parts of the state, possibly through co-sponsoring events with local or regional organizations.

Objective 2. Expand the Scope of TGIC s Web Resources

TGIC will coordinate presentation of materials describing geographic information technologies and TGIC initiatives, services, and resources through implementing a set of web pages providing easy access from a home page housed at DIR to other pages housed at appropriate member or partner locations.

TGIC currently maintains a web site, and the expansion of this site is a vital component of TGIC s plan to advance its outreach and education goal. All TGIC activities, initiatives, and resources will be described on this site. Links to GIS-related content at appropriate partner and member locations will be maintained. In addition, links to sites for federal and other government agencies, educational institutions, and vendors will provide easy access to data, information, and educational resources. TGIC will consider adding discussion threads that allow anyone to participate in discussions on current issues involving geographic information in Texas. Information at this site about who is doing what with geographic information may provide leads that result in new partnerships. Tutorials on various aspects of GIS and GPS implementation may be developed and published on this site.

Visit the TNRIS web site:
www.tnris.state.tx.us

Visit the TGIC web site:
www.tgic.state.tx.us

TNRIS s web site is the business end of GIS in Texas. This site provides easy access to the state s shared, nonconfidential GIS datasets. The offerings on this site are continually being updated and expanded. TNRIS will continue to be the primary clearinghouse for geospatial data in Texas.

Objective 3. Research and Develop a Geographic Information Technologies Curriculum

TGIC will conduct a survey of members and partners to determine the types, levels and amounts of GIS and GPS related training needed, and preferred delivery methods. Based on assessment of training and education resources available, TGIC will propose ways to make needed training more accessible to the agencies at reduced cost.

Some efforts have been made to assess the needs of the GIS user community. Two recent efforts to increase knowledge of resources and needs include a User Needs Assessment survey conducted by the Texas Water Development Board and the Federal Geographic Data Committee s Framework Data Survey aimed at the collection of state-level information. However, these state and federal efforts have mainly been concerned with data issues.

Visit the National Center for Geographic Information Analysis web site:

www.ncgia.ucsb.edu/education/ed.html

The National Center for Geographic Information Analysis web site contains national examples of core curricula, encompassing both technical and nontechnical approaches. These curricula have been widely accepted in U.S. colleges and universities. However, while certain components may be directly usable, the format of the material may not lend itself to meeting the specific needs of GIS users with limited time or more specialized interests. In particular, the diverse experience level of the GIS user client base has already been noted. A simple curriculum will not fit the needs and various demands of every GIS workplace. Therefore, TGIC will develop a survey of the GIS community in Texas to assess the scope and needs of the audience for GIS-related education and training (including GPS). This survey would seek to determine the character of the audience (for example, the current level of expertise and size of demand) as well as the appropriate content and format for educational outreach activities.

Objective 4. Develop Career Paths for Geographic Information Technology Professionals

Based on a survey of professional GIS career path models, TGIC will recommend a set of GIS professional career paths.

State agencies currently have no formal guidelines that recognize geographic information technology or GIS as a professional specialization with appropriate career path and level designations. This lack creates problems at several junctures: wording of job listings for hiring, requirements for training, criteria for advancement and promotion, and appropriate compensation. In the absence of such officially recognized career paths and levels for GIS professionals, criteria frequently vary between and even within agencies. With its wide membership of state agencies employing geographic information technology, TGIC is in a good position to evaluate and make recommendations on potential career paths, titles, and levels.

In many professions, academic and professional organizations provide a venue for judging or recognizing levels in the career path for those working in the field. As GIS is still a relatively new profession, such bodies have yet to develop specific professional standards. Most universities and colleges offer a variety of programs ranging from minor or major specializations, to certification in GIS. However, curricula are not standard. The Bachelor of Science in Geographic Information Science offered at Texas A&M University, Corpus Christi, remains one of the few instances where GIS is offered as a specific degree or diploma. More frequently, GIS coursework is offered as a sub-field within another discipline, so that judging relative content and expertise remains somewhat subjective.

Other aspects of the GIS field make it difficult to establish one definition or model for a career path. GIS professionals may have different types of responsibilities (data development, application development, data analysis, management, etc.) and work in many

diverse disciplines, so that the additional skills required may be different for each discipline using GIS technology. The number of advancement levels for any particular career path, the foundation for these, and the appropriate compensation for each may vary by application area. Additionally, on-the-job and nonformal training is becoming increasingly common. Evaluation of skills obtained through these means must be taken into account.

Given the dynamic nature of the field and the demand both in the public and private sectors for skilled individuals, a system should be developed that provides sufficient flexibility for retention incentives. The system should also provide clear and accepted standards that reflect skills and provide uniformity and equity from one organization to another.

TGIC will gather information from its member agencies about the job titles, minimum requirements, and duties associated with current GIS professional positions. TGIC will explore the different career paths and certification/evaluation models being discussed by such organizations as the University Consortium for Geographic Information Science and the Urban and Regional Information Systems Association, as well as those provided by other states and by related professions such as surveying and remote sensing. Further, TGIC will compare this information with current trends in Texas state employee compensation. By analyzing this internal and external information, TGIC may be able to recommend a set of GIS professional career paths for use by the state agencies. Career paths would improve the state s hiring, development, and retention of GIS professionals.

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Accuracy the closeness of observations to true values or values accepted to be true. Accuracy relates to the quality of a result and is distinguished from precision, which relates to the quality of the operation by which the result is obtained. In common GIS practice, accuracy frequently refers to positional accuracy (plus or minus X meters).

Aerotriangulation the analytical process involving an aerial photographic image and surveyed ground control points within the image that generates the mathematical model used in the production of an orthoimage.

Attribute descriptive characteristic or quality of a feature that can be assigned to one or more discrete values in a GIS. Data about geographic features usually stored as text in a database format.

Base data set of information that provides a baseline orientation for another layer of primary focus, e.g., roads, streams, and other data typically found on USGS topographic and/or planimetric maps.

CIR Color Infra-Red. Infra-red refers to nonvisible light with wavelengths above 700 nanometers. Most infra-red data are collected from reflected infra-red light, not emitted infra-red energy (heat). Infra-red light provides information on vegetative mass and health, as well as information on soil moisture and geology. CIR film shows infra-red data typically by coloring the infra-red data red, resulting in a false color image.

COG Council of Government

Contour a line connecting points of equal elevation.

Control point any station in a horizontal or vertical control network that is identified in a data set or photograph and used for correlating the data shown in that data set or photograph.

Coordinate systems reference frame or system, such as plane rectangular coordinates or spherical coordinates, that uses linear or angular quantities to designate the position of points within that particular reference frame or system. Coordinates are used to represent locations on the earth s surface relative to other locations or fixed references. In planimetric mapping (two-dimensional coordinate system), locations are represented by X, Y coordinate pairs, while in topographic mapping (three-dimensional coordinate system), locations are represented by X, Y, and Z values.

CRADA Cooperative Research and Development Agreement

Datum a mathematical reference framework for geodetic coordinates defined by the latitude and longitude of an initial point, the azimuth of a line from this point, and the parameters of the ellipsoid upon which the initial point is located.

Database consists of one or more data sets related by a common fact or purpose.

Data capture series of operations required to encode data in a computer-readable digital form (digitizing, scanning, etc.).

Data quality refers to the degree of excellence exhibited by the data in relation to the portrayal of the actual phenomena.

Data set collection of similar and related information recorded in a common format.

DEM see Digital Elevation Model

DGPS Differential Global Positioning System (see Differential Correction)

Differential correction a process used to increase the accuracy of geographic positions measured with Global Positioning System (GPS) technology. This process requires, in addition to the GPS receiver operating at the position being measured, a second GPS receiver operating simultaneously at a precisely known location within a few hundred miles. Data sent from both receivers can be processed to yield a position measurement that is significantly more accurate than a measurement made with a single receiver.

Digital data of or relating to data presented in the form of digits-data displayed, recorded, or stored in binary notation.

Digital Elevation Model (DEM) a file with terrain elevations recorded at the intersections of a fine grid and organized by quadrangle to be the digital equivalent of the elevation data on a topographic base map.

Digital Line Graph (DLG) USGS product that includes digital information from the USGS map base categories, such as transportation, hydrography, contours, and public land survey boundaries.

Digital Orthophoto Quarter-quad (DOQ) a 3.75 minute square distortion-free image of the surface of the earth. The imagery has been geographically and photographically rectified to remove all distortion and meet requirements of the USGS.

DIR Texas Department of Information Resources

DLG see Digital Line Graph

DoD United States Department of Defense

DOQ or DOQQ see Digital Orthophoto Quarter-quad

Feature objects that have a geographic location that can be represented by one or more points, lines, or polygons.

Federal Geographic Data Committee (FGDC) established by the Federal Office of Management and Budget, is responsible for the coordination of development, use, sharing, and dissemination of surveying, mapping, and related spatial data.

FAA Federal Aviation Administration

FRA Federal Railroad Administration

FGDC see Federal Geographic Data Committee

GAATN Greater Austin Area Telecommunications Network

Geographic Information System a computer system for the input, editing, storage, maintenance, management, retrieval, analysis, synthesis, and output of geographic, or location-based, information. In the most restrictive usage, GIS refers only to hardware and software. In common usage, it includes hardware, software, and data. When organizations refer to their GIS, this latter usage is usually what they mean. For some, GIS also implies the people and procedures involved in GIS operation. In this document, the common usage hardware, software, and data is intended.

Geospatial data information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth. The information may be derived from among other things remote sensing, mapping, and surveying techniques.

GeoTiff Recent extension of the raster TIFF format which recognizes geospatial coordinates.

GIS see Geographic Information System

GLO Texas General Land Office

Global Positioning System (GPS) a satellite-based navigation system developed by the U.S. Department of Defense. Inexpensive GPS receivers can accurately determine one s position on the earth s surface.

GPS see Global Positioning System

GSC Texas General Services Commission

Hydrography a representation of surface water features including all flowing water, water bodies, marshlands, and water-related, man-made features such as canals, locks, and dams.

Hypsography a representation of the elevation features of surface topography, such as lines of equal elevation (contours) and point elevations.

Imagemap a digital image that has been resampled and georeferenced to a map projection and coordinate system. Note: all orthoimages are imagemaps, but not all imagemaps are necessarily orthoimages.

Imagery a two-dimensional digital representation of the earth s surface. Examples are a digital aerial photograph, a satellite scene, or an airborne radar scan.

IVHS Intelligent Vehicle Highway System

Latitude angular distance measured in degrees, minutes, and seconds, of a point north or south of the equator on the earth s surface.

Layers refers to the various overlays of data, each of which normally deals with one thematic topic. These overlays are registered to each other by the common coordinate system of the database.

Lidar laser-based distance measurement technology used to generate extremely precise surface elevation data.

Longitude angular distance measured in degrees, minutes, and seconds, of a point east or west of the Greenwich Meridian on the earth s surface.

Map projection mathematical model that transforms the locations of features on the earth s surface to locations on a two-dimensional surface.

Metadata data about the content, quality, condition, and other characteristics of data.

NAD83 (27) North American Datum of 1983 (1927)

NGS National Geodetic Survey

NHD National Hydrography Dataset

NOAA National Oceanic and Atmospheric Administration

NRCS Natural Resource Conservation Service

NSDI National Spatial Data Infrastructure. The technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data.

Orthoimage an aerial photograph or satellite image from which displacements caused by terrain relief and sensor tilt have been removed. The result combines the image characteristics of a photograph with the geometric qualities of a map.

Orthophoto see Orthoimage

Point data level of spatial definition referring to an object that has no dimension, e.g., well or weather station.

Positional accuracy term used in evaluating the overall reliability of the positions of cartographic features relative to their true position.

Precision refers to the quality of the operation by which the result is obtained, as distinguished from accuracy.

Quality control process of taking steps to ensure the quality of data or operations is in keeping with standards set for the system.

Radar altimetry radar-based distance measurement technology used to create more precise surface elevation data.

Raster data a uniform array or grid of cells defined in row/column sequences with each cell containing a single value. Every location in the data area corresponds to a raster cell.

Real-time differential correction in GPS, the application of **differential correction** in real time through the use of radio broadcast of the reference GPS signal.

RRC Railroad Commission of Texas

SA or S/A see Selective Availability

Selective Availability (S/A) method for artificially creating a significant clock error in the GPS satellites. The DoD uses this in the GPS satellite system.

Scale ratio or fraction between the distance on a map, chart, or photograph and the corresponding distance on the surface of the earth.

Scanning an automated means of inputting data. When used in remote sensing applications, it refers to the imaging of the earth s surface.

Spatial data see Geospatial Data

SSURGO Soil Survey Geographic datasets produced by NRCS.

Standards exact value, a physical entity, or an abstract concept, established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures, or evaluating results.

StratMap Texas Strategic Mapping Program

TGIC Texas Geographic Information Council

TGIN Texas Geographic Information Network

TMAC Texas Mapping Advisory Council

TNRCC Texas Natural Resource Conservation Commission

TNRIS Texas Natural Resources Information System

TOP Texas Orthoimagery Program

Topographic map a map that represents the horizontal and vertical positions of features on the face of the earth. Vertical positions are defined by contours or other symbology.

Topology branch of geometrical mathematics concerned with order, contiguity, and relative position, rather than actual linear dimensions.

TPWD Texas Parks and Wildlife Department

TWDB Texas Water Development Board

TxDOT Texas Department of Transportation

UCGIS University Consortium for Geographic Information Science

URISA Urban and Regional Information Systems Association

USGS U.S. Geological Survey

UTM Universal Transverse Mercator coordinate system