METROPOLITAN
TRANSPORTATION
COMMISSION

BAY AREA AUTOMATED
MAPPING ASSOCIATION

BAY AREA GIS SURVEY:
Summary Report

June 2002

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Special thanks to Eric Zhang and Anders Flodmark of the GIS Center at U.C. Berkeley for creating and maintaining the on-line survey and database for this project.

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Sponsors

The Bay Area GIS Survey is a collaborative effort of the Metropolitan Transportation Commission (MTC), and the Bay Area Automated Mapping Association (BAAMA). It also supported by the GIS Center (GISC) at U.C. Berkeley, the Association of Bay Area Governments (ABAG), and the District 4 office of the California Department of Transportation (CalTrans). Most of the funding for the project came from in-kind staff time of MTC and the GISC. Additional funding was provided by a National Spatial Data Infrastructure (NSDI) Cooperative Agreements Program (CAP) grant from the Federal Geographic Data Committee (FGDC).

MTC is the transportation planning, coordinating and financing agency for the nine-county San Francisco Bay Area. More information is available at www.mtc.ca.gov.

BAAMA is a non-profit, professional organization that strives to serve the educational, networking, data exchange/sharing and related needs of Geographic Information System (GIS) professionals in the Bay Area. More information is available at www.baama.org.

NOTE: the information in this report is intended to foster regional GIS coordination and data sharing/exchange in the Bay Area. It is not intended to be a resource for GIS consultants, vendors or other organizations to conduct unsolicited marketing campaigns and related activities. Any use of this information for unsolicited "for-profit" activities is expressly forbidden.

Table of Contents

Introduction

The Metropolitan Transportation Commission (MTC) and the Bay Area Automated Mapping Association (BAAMA), in cooperation with other organizations, conducted a Bay Area GIS Survey in order to build the foundation for GIS data sharing/exchange and metadata awareness/usage in the San Francisco Bay Area. This document is one of three deliverable products resulting from the survey. These products include:

> Bay Area GIS Survey: Summary Report *(this document)* - presents detailed background information about the project, a statistical analysis of the information gathered on all surveys, and a summary of the GIS data documented by all survey respondents. To provide context, this report includes a brief history of GIS and an explanation of metadata.
>
> Bay Area GIS Survey: Detailed Results - presents all of the raw, detailed information that was gathered on all of the surveys. This information is presented in individual tables that were created for each survey respondent. The tables contain respondents' answers to all survey questions and describe the GIS data they documented. The tables are sorted by organization and department name.
>
> Bay Area GIS Survey: GIS Contacts - presents only the contact information (i.e. phone, fax, e-mail, etc.) for all survey respondents. This information is sorted by type of organization to make it easy to locate a GIS contact for a specific organization.

In addition to these products, the brief metadata descriptors and GIS contact information from the surveys are being uploaded to the state's Environmental Information Catalog (http://ceres.ca.gov/catalog/), which is part of the California Environmental Resources Evaluation System (CERES). This will create a "starter metadata catalog entry" for survey respondents who are encouraged to maintain this metadata over time.

Workshops are being planned to promote the use and maintenance of the metadata.

Acknowledgements

The Principal Analyst/Author for the Bay Area GIS Survey was Amy Lee (MTC). Mike Skowronek (MTC) served as Project Manager/Editor, with assistance provided by Bruce Joffe (GIS Consultants). In addition, many other individuals provided substantial contributions to make this project possible. We want to acknowledge the dedicated efforts, patience and perseverance of everyone who contributed.

- Eric Zhang and Anders Flodmark (GIS Center at U.C. Berkeley) created and maintained the on-line survey form and back-end database.

- Michael Porter created an application to edit and convert the project database into a format that could easily be uploaded into the CERES database - the state's on-line metadata catalog.

- Roger Kunkel (CA Resources Agency) provided support for importing and testing the uploading of the project database to the CERES database.

- The 2001-2002 BAAMA Board of Directors, who strongly supported and encouraged this effort, include Phil Beilin, Ken Blankinship, Patrick DeTemple, Bruce Joffe, Van Johnson, Jeff Kapellas, Dennis Klein, Elizabeth (Lis) Klute, Lysee Moyaert, Mike Skowronek, and George White.

- Others who contributed to this project include Kearey Smith (ABAG), and Dick Fahey (Caltrans, District 4).

- Financial support was provided by a National Spatial Data Infrastructure (NSDI) Cooperative Agreements Program (CAP) grant from the Federal Geographic Data Committee (FGDC).

Most importantly, we want to acknowledge and thank the individuals listed below who completed the survey, or designated someone to complete the survey on their behalf - this project would have been meaningless without their participation:

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- Billy Gross, City of Albany
- Chris Alvarez, City of Antioch
- Kevin DeRouen, City of Belmont
- Bob Branz, City of Belvedere
- John Bunch, City of Benicia
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- Nikki Nowack, City of Cupertino
- John Sanchez, City of Daly City
- Andy Timko, City of Dixon
- Kevin VanKatwye, City of Dublin
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- Suparna Robertson, City of San Leandro
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- Tom Harais, ECCTA, Tri Delta Transit
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- Greg Bazhaw, Santa Clara County
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- Bill Tucker, Santa Clara Valley Water District,
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Background & Purpose

What is GIS?

A Geographic Information System (GIS) is a computer mapping and analysis system that combines or overlays layers of geographically referenced information, which allows assembling, storing, manipulating, analyzing and displaying geo-referenced data according to their locations. It's ability to perform geographic queries, search databases and conduct complex spatially-related analyses has become an invaluable and necessary function for government agencies, research/educational institutions, non-profits, private companies and other organizations.

There are five required components for a fully-functioning GIS: *Hardware, Software, Data, Analysis* and *Community* (Appendix A provides more details on these GIS components, as well as an historical timeline of GIS). Of these five components, data is the most important and, unfortunately, most demanding component. Amongst GIS professionals, it is commonly accepted that 80% of the cost of a quality, functioning GIS is the cost of accurate, current and meaningful data. This makes a strong argument for government agencies and other organizations to share or exchange data they have developed with other organizations to the mutual benefit of all parties involved.

But before GIS data sharing and exchanging can share or exchange data, GIS users must inventory their data and create metadata.

What is Metadata?

Metadata, often described as "data about data," is structured information that describes the content, quality, condition, and other characteristics of data. Metadata standards provide consistent terminology and format of data, and facilitate information sharing among various organizations and agencies.

Appendix B of this report provides more details on Metadata.

Status of Bay Area Metadata and Data Sharing

Many organizations and agencies in the Bay Area have organized and compiled digital maps and databases. The formats, scale, and currency of these data are often very diverse and few agencies have maintained or organized their data with the same system or format. Because of the very heterogeneous sources of data, a variety of integration problems occur when sharing data. Thus data sharing/ exchanging is difficult to achieve.

The following issues must be taken into consideration in order to build the foundation for metadata creation and maintenance. As data documentation becomes a standard sustainable business process, data sharing becomes easier.

- Acknowledge how frequently and regularly metadata is being created and/or maintained in an organization.
- Recognize the common obstacles that people have encountered when creating and/or maintaining metadata.
- Be familiar with data distribution policies within organizations if they exist.
- Provide appropriate metadata training and further investigation to encourage metadata use.

Taking into consideration all of the issues above, the ***Bay Area GIS Survey*** was prepared and distributed to gather metadata from different organizations throughout the Bay Area region.

Purpose of the Bay Area GIS Survey

The purpose of the Bay Area GIS Survey is to build the foundation for GIS data sharing/exchange and metadata awareness/usage in the San Francisco Bay Area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma Counties). Neighboring jurisdictions were also welcome and encouraged to participate, as did the City of Santa Cruz.

Questions that the survey addressed include:

- How many Bay Area agencies have, create, or maintain GIS map/data?
- How many create GIS metadata?
- How many maintain GIS metadata?
- How many have uploaded GIS metadata into the CERES metadata catalog (An NSDI metadata node)?
  - Why Not?
  - How Can We Improve This Situation?

Major goals that were established at the beginning of the project include:

- Report on the "state of GIS metadata and data sharing" in the Bay Area.
- Create "starter" metadata catalog records for Bay Area GIS professionals.
- Upload "starter" records into CERES metadata catalog.
- Encourage continued maintenance and use of the CERES metadata catalog.

It is worth noting that the GIS Survey project did not entail gathering or compiling actual GIS data, rather only metadata information was collected so that it could be uploaded to the state metadata catalog (CERES).

Methodology

The Survey Form

The foundation of the project was a comprehensive GIS survey that was made available in both a hard-copy and online version. The survey asked respondents to tell us who the primary GIS contact person is within their organization and document a few, basic metadata descriptors for the GIS data they create, maintain or are responsible for. The survey also asked if they create metadata and under what conditions they are able to share or exchange the data. Finally, the survey asked respondents to briefly identify the major GIS applications and GIS-related technology that they utilize. A copy of the survey is presented in Appendix F of this report.

The online version of the survey was created by Eric Zhang and Anders Flodmark of the GIS Center at U.C. Berkeley. The survey, which was located at http://warntz.gisc.berkeley.edu/survey/part.asp, utilized active server pages (ASP) scripting and a back-end Microsoft Access database. Survey respondent's answers were saved in "cookie" files on their local computers to enable them to review and change their answers until they completed the entire survey and clicked the "All Done" button at the conclusion of the survey.

Project Schedule/Phasing

The table below summarizes the major tasks and phases with this project.

Phase 1 Task (Data Collection)	Schedule	Comments
Apply for FGDC "Don't Duck Metadata" CAP grant	March, 2001	Received grant acceptance notification in late May, 2001
Decide upon survey questions for GIS Data table	July – August, 2001	Project was formally initiated when MTC hired summer intern to work on project
Create hard-copy survey	July – August, 2001	(see Appendix F)
Create on-line version of survey and back-end database	September, 2001	Created by Eric Zhang and Anders Flodmark of GIS Center at U.C. Berkeley
Create database with contact information for ~300 potential respondents	August-September, 2001	
Mailed outreach letters and hard-copy survey	September 24, 2001	
Promote survey via BAAMA meetings, newsletter and web site	Continuous	
Round 1 deadline for completing surveys	October 15, 2001	As of the initial deadline, approximately 40 survey responses were received
Conduct second round of more focused outreach and promotion	November, 2001 to January, 2002	
Round 2 (final) deadline for completing survey	February 15, 2002	As of the final deadline approximately 100 individuals completed the survey
Phase 2 Task (Analysis)	**Schedule**	**Comments**
Create individual summary report for each respondent and provide each respondent with a copy of this report so they could make edits as necessary	January, 2001 (for Round1 deadline respondents); February, 2002 (for Round 2 deadline respondents)	
Conduct preliminary analysis of results	February, 2002	Preliminary analysis conducted to report findings at CalGIS
Report on preliminary results at California GIS Conference (CalGIS 2002)	March 7, 2002	
Create script to reformat and clean up database so that it could be automatically uploaded to CERES metadata catalog	March – April, 2002	Created by Michael Porter
Reformat and clean up database to prepare to upload data to CERES metadata catalog	May, 2002	
Upload metadata descriptors (i.e. "starter metadata records") into CERES metadata catalog	June, 2002	Survey respondents will be notified when their metadata is uploaded to CERES. They will also be provided a user-name and password, so they can update and maintain the metadata.
Create "GIS Contacts" report	March-April, 2002	Posted on BAAMA web site late April, 2002
Create "Detailed Results" report	March-April, 2002	Posted on BAAMA web site late April, 2002

Create "Summary Report" (this document)	April-May, 2002	
Report on findings and results at BAAMA meeting	June 20, 2002	

Target Audience

The target audience for the survey was all organizations in the Bay Area that create or maintain GIS data. To avoid duplicate information, we asked that only one individual from each organization (i.e. the key GIS contact) complete the survey. The distribution of the types of organizations that the survey was mailed to is listed below.

Organizations that were mailed the Survey

Type of Organization	Count
Cities	136
Counties *	33
Regional Agencies	20
State Agencies	23
Federal Agencies	7
Utilities	26
Colleges & Universities	15
Transportation/Transit Agencies	28
TOTAL	**288**

* Although the formal outreach efforts involved only the nine Bay Area counties, several individuals and organizations within these counties were contacted to encourage as much participation as possible.

Upload to CERES Metadata Catalog

To make the metadata (i.e. data documentation) captured on all of the surveys useful to a wide audience, the brief metadata descriptors and GIS contact information from the surveys are being uploaded to the state's Environmental Information Catalog (http://ceres.ca.gov/catalog/), which is part of the California Environmental Resources Evaluation System (CERES). This will create a "starter metadata catalog entry" for survey respondents who are encouraged to maintain this metadata over time.

As survey respondents' metadata are uploaded to the CERES metadata catalog, they are given a user name and password so that they can edit, add to and maintain the information online in the CERES metadata catalog over time.

CERES is an information system developed by the California Resources Agency (http://ceres.ca.gov/) to facilitate access to a variety of electronic data describing California's rich and diverse environments. The goal of CERES is to improve environmental analysis and planning by integrating natural and cultural resource information from multiple contributors and by making it available and useful to a wide variety of users.

CERES' Environmental Information Catalog serves as an online directory for reporting and discovery of information resources for California. It also functions as a

clearinghouse node of the National Spatial Data Infrastructure (NSDI). It has been developed through a collaborative effort with the California Geographic Information Association, California Environmental Resources Evaluation System, and the Federal Geographic Data Committee.

Survey Respondents

Due to an extensive outreach and promotion effort, over 100 individuals completed the survey. The majority of the respondents are employed by municipal governments. Other responses were received from counties, regional government agencies, transportation agencies (i.e. transit operators and congestion management agencies), state governments, federal governments, non-profit organizations, educational institutions, and consultants.

We formally contacted a total of 288 individuals within the Bay Area. The total number of organizations contacted was 178 (note: in many cases, several letters were sent to more than one individual within an organization). Of these 178 organizations, 110 (61%) completed the survey and 68 (39%) did not complete the survey *(see **Figure 1**)*. The categories and survey respondents included:

- Cities
- Counties
- Regional Agencies (includes regional transportation agencies)
- State Agencies
- Federal Agencies
- Transportation/Transit Agencies (public transit and congestion management/sales tax agencies only)
- Non-Profit Organizations
- Education/Research Institutions
- Utilities
- Private Organizations

See Figure 3 for the results of respondents by category.

Out of the 75 Bay Area cities that we formally contacted, 48 cities (65%) responded to the survey and 26 cities (35%) did not respond to the survey *(see Figure 2)*. The cities that were not formally contacted were the ones in which it was known that they do no use GIS or are very small in size.

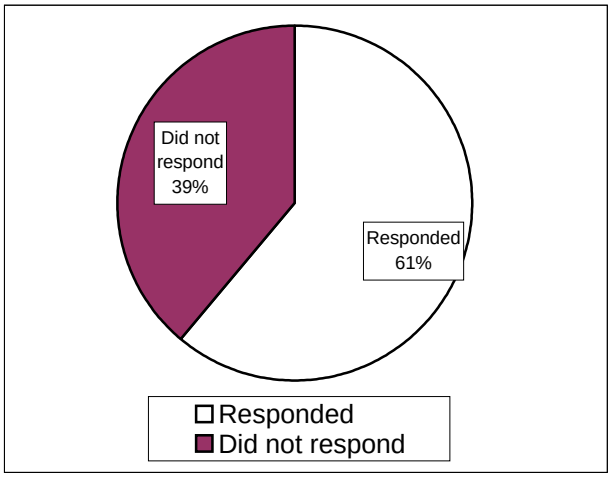


Figure 1

Out of the 178 organizations that we contacted, 110 (61%) completed the survey and 68 (39%) did not complete the survey.

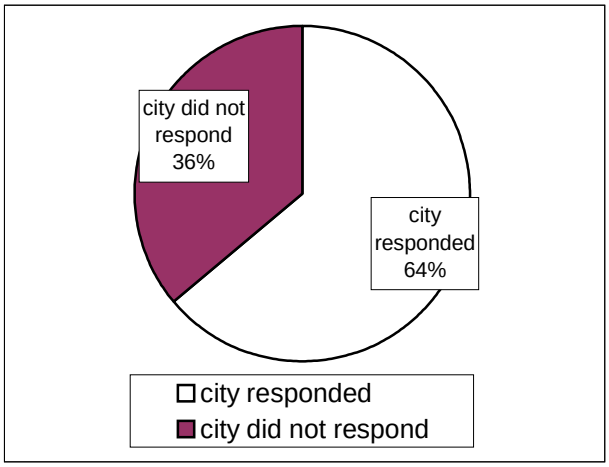
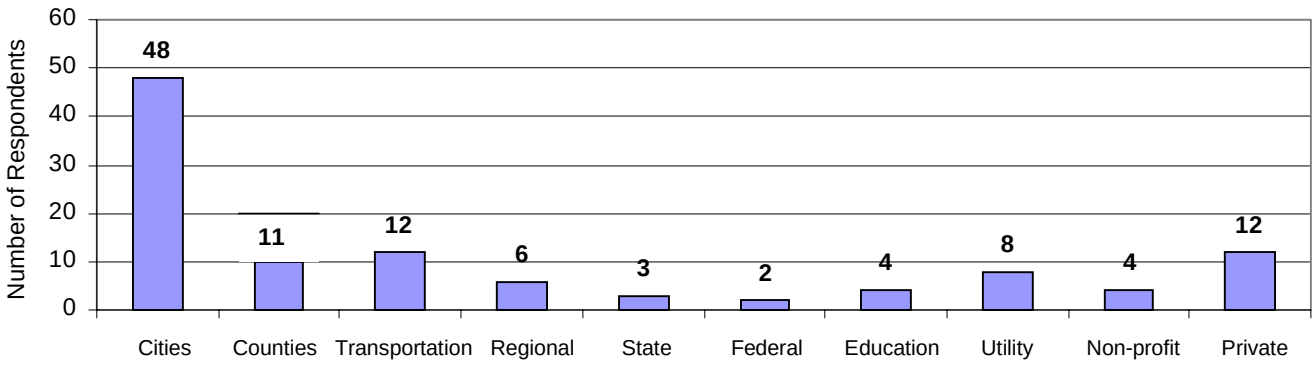


Figure 2

Out of the 75 Bay Area cities that we formally contacted, 48 cities (65%) responded to the survey and 26 cities (35%) did not respond to the survey

Figure 3: Respondents by category



Summary Results

This section provides an overall summary of all survey responses.

- *A separate report titled "Bay Area GIS Survey: Detailed Results" presents all of the raw, detailed information that was gathered on all of the surveys. This information is presented in individual tables that were created for each survey respondent. The tables contain respondents' answers to all survey questions and describe the GIS data they documented. The tables are sorted by organization and department name.*
- *A separate report titled "Bay Area GIS Survey: GIS Contacts" presents only the contact information (i.e. phone, fax, e-mail, etc.) for all survey respondents. This information is sorted by type of organization to make it easy to locate a GIS contact for a specific organization.*

The GIS Survey was broken into the following five sections:

- Background Information
- Metadata Awareness & Use
- GIS Data
- Data Distribution, Sharing and Exchange
- Miscellaneous Information

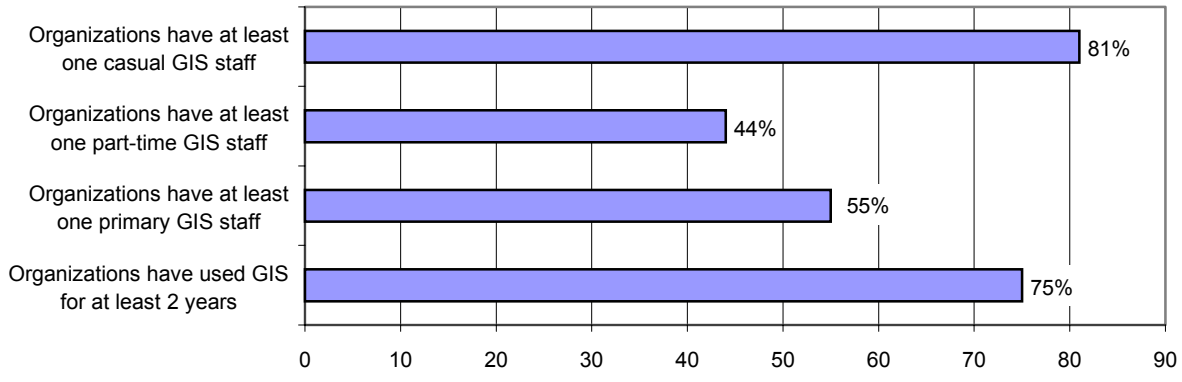
The summary results from each of these sections are presented below.

Background Information Results

The *Background Information* section asked for contact information of the primary GIS contact person within the organization and/or departments. We also ask respondents to specify number of dedicated GIS staff employed the organizations and the primary GIS software that organizations are currently using.

75% of the respondents stated that their organizations have used GIS for at least two years. Over half of the respondents (55%) indicated that they have at least one primary GIS staff within the organization. 44% of the organizations have part-time GIS staff and 81% have causal GIS users. See Figure 4 below.

Figure 4: GIS Applications



The table below summarizes the GIS software that survey respondents use.

NOTE: The table below does not represent a complete or thorough market analysis of GIS software usage in the Bay Area; the actual market share of GIS vendors may vary significantly from these data. The table simply tabulates the results of the survey question "What primary GIS software does your organization use?" Neither MTC nor BAAMA advocate or promote the use of any specific software product.

GIS Vendor	Use by Respondents	Software Products Listed on Surveys
ESRI	64%	ArcView 3x, ArcInfo, ArcGIS, Spatial, ArcIMS, SDE
Autodesk	10%	Autodesk, AutoCAD Map, MapGuide,
Intergraph/Bentley	6%	Intergraph MGE, GeoMedia, Microstation Geographics
MapInfo	1%	MapInfo
SmallWorld	1%	GE SmallWorld
Other	4%	GENTRY Sytems "GENMAP", Encompass, Tp+/Viper, Relational database
No Response	14%	

Metadata Awareness & Use Results

In the *Metadata Awareness & Use* section we asked respondents whether or not their organizations create and/or maintain metadata. We also asked what are the major obstacles that make it difficult to create and maintain metadata.

~70% of the respondents stated that they are either very familiar or somewhat familiar with metadata, *(see Figure 5)* yet only around one-third of the respondents (36%) indicated that they create and/or maintain some metadata *(see Figure 6)*.

Figure 7 identifies the hurdles that survey respondents cited that make it difficult to create or maintain metadata.

Figure 5: Familiar with Metadata?

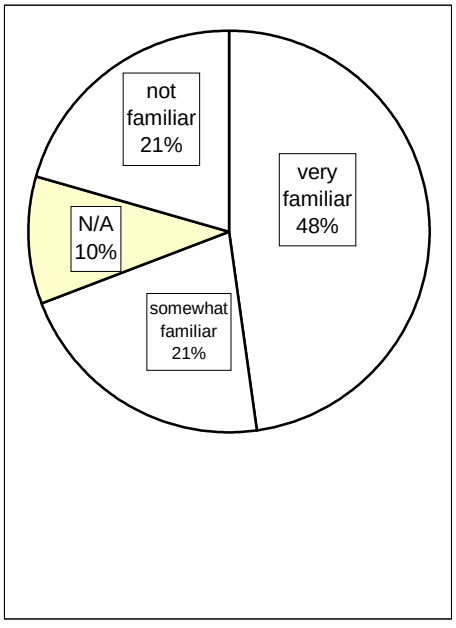


Figure 6: Create/maintain Metadata?

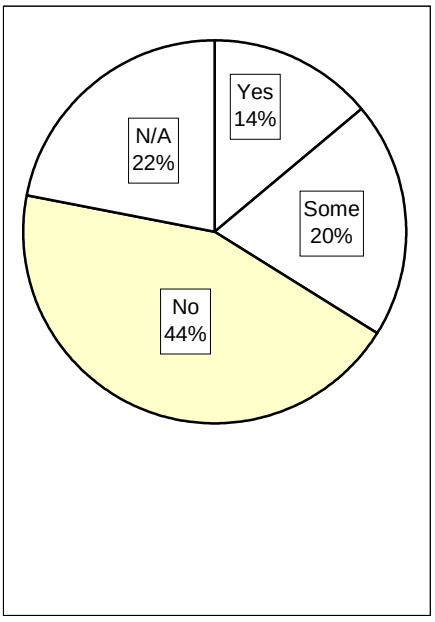
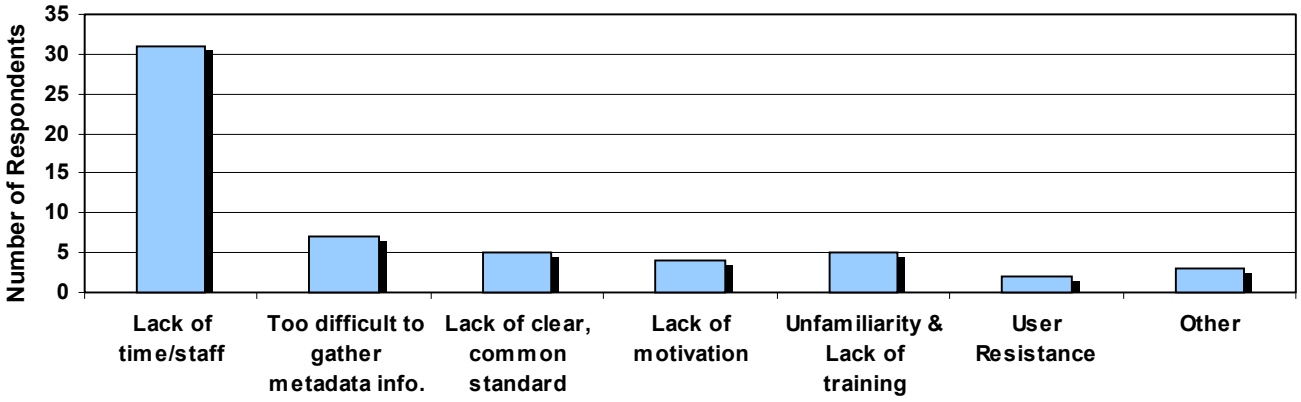


Figure 7: Obstacles Cited Re: Metadata Creation/Maintenance



GIS Data Results

In the *GIS Data* section we asked respondents to describe major categories of digital GIS data that they create, maintain and/or are responsible for. This section allows us to collect details about GIS data (partial metadata) from different organizations throughout the nine-county Bay Area region. The partial metadata are being uploaded to the state's CERES metadata catalogue. The key GIS contact person within an organization will be given a user-name and password so they can update and modify the metadata.

The total number of data layers documented on all surveys was 583. The distribution of data into categories is summarized in the chart below.

Data Category	Count	%
Transportation	86	15%
Government/Political Boundaries	75	13%
Other	71	12%
Utilities	62	11%
Land use/zoning	52	9%
Cadastral Information	44	8%
Environmental	40	6%
Orthoimagery	41	7%
Hydrography	38	7%
Public Safety	33	5%
Elevation	31	5%
Geodetic Control	10	2%

A list of additional data layers that agencies/organizations mentioned they would like would like to have is presented in Appendix C.

The maps on the following pages illustrate the data that **cities** and **counties** indicated (by category) that they have created or are responsible for. Other organizations may have these data, but this is not shown on these maps.

City/county maps on pages 15 through 19 are not included in the ESRI version of the report due to file size limitations.

Data Distribution, Sharing and Exchange Results

In the *Data Distribution, Sharing and Exchange* section we asked respondents whether or not they participate in GIS user groups or other organizations to coordinate data development, data sharing/exchanging or application development activities. We also asked respondents under what conditions they are able to share or exchange the data.

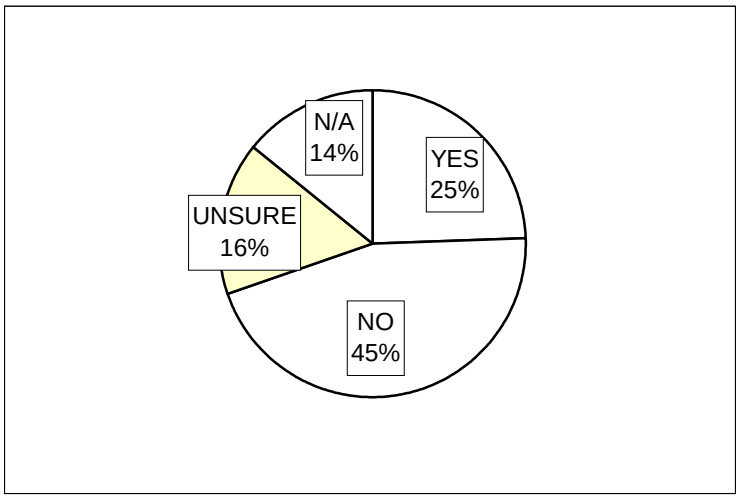
Out of 109 respondents, 56% stated that they do participate in GIS user groups; 17% do not and 17% did not respond to the question.

A list of GIS users groups name provided by the respondents is list below:

- BAAMA
- Contra Costs County users group
- URISA
- Central Coast Joint Data Committee
- Bay Area Open Space Council
- County of San Mateo
- County of Sonoma GIS
- FGDC
- NSDI
- GIS Policy committee
- Techical Advisory Committee Chair (Contra Costa County)
- Countywide partners Coordination Group (Contra Costa County)
- State OES Disaster Resources
- HAZUS User Group, www.hazus.org
- Sonoma County Law Enforcement Consortium
- University of California
- California Sata University
- Sonoma County Community District GIS users group
- State of California
- United States Government
- SVGISA
- CALGIS
- MapGuide Users Group
- MarinMap-marinmap.org
- MTC GIS Users Group
- CCSF Enterprise GIS working group
- SF Bay Area ArcGIS users group
- Napa County GIS Group
- National Park Service GIS Group
- NPS conferences
- Bay Area Mesonet
- Silion Valley GIS Association
- Earth Science Enterprise group of NASA
- Earth Science Information Partners Federation (ESIP)
- Southern Alamed County Geographic Informational Systems Authority (SACGISA)
- Santa Rosa ArcView users group
- California Mapping Coordinating Committee (CMCC)

For data distribution policy, 25% stated their organizations have a data distribution policy; 45% do not have a data distribution policy; 14% responded 'unsure' and 16% did not respond to the question. See Figure 8 below.

Figure 8: Data Distribution Policy



Individual comments or suggestions related to regional GIS coordination, data sharing/exchange or metadata uses in the Bay Area are listed in Appendix D of this report.

Miscellaneous Information Results

The *Miscellaneous* section asked respondents to briefly identify their major GIS applications, as well as GIS-related technology that they utilize. A list of GIS-related technologies that they utilize is presented in Appendix E.

County-Level Results

This section summarizes current county-wide GIS activities within the Bay Area. The counties include San Francisco and San Mateo on the peninsula, Santa Clara in the south bay, Alameda and Contra Costa in the east bay and Marin, Sonoma, Napa & Solano in the north bay.

Status of County-Wide Framework Data

The table on the following page summarizes the current status of "framework data" that have been created or are under development for Bay Area counties. The table also lists a few key metadata descriptors for some of the framework data themes.

Framework data is defined by the Federal Geographic Data Committee (FGDC) as the seven themes of digital geographic data that are most commonly used:

- Geodetic control provides a common reference system for establishing the coordinate positions of all geographic data and a means for tying all geographic features to common coordinate systems.
- Orthoimagery is a geo-referenced image prepared from an aerial photograph or other remotely sensed data from which displacements of images caused by sensor orientation and terrain relief have been removed.
- Elevation data provide information about terrain (i.e. spatially referenced vertical position above or below a surface)
- Transportation data include road centerlines, trail centerlines, railroad centerlines, waterway centerlines, airports/ports, and bridges/tunnels.
- Hydrography data include surface water features such as lakes and ponds, streams and rivers, canals, oceans, and shorelines.
- Governmental units include boundaries of counties, incorporated places and consolidated cities.
- Cadastral data represent the geographic extent of the rights and interests in real property (i.e. parcel boundaries and ownership attributes).

Appendix G of this report defines the framework data themes in more detail.

The information in this report is intended to foster regional GIS coordination and data sharing/exchange in the Bay Area. It is not intended to be a resource for GIS consultants, vendors or other organizations to conduct unsolicited marketing campaigns and related activities. Any use of this information for unsolicited "for-profit" activities is expressly forbidden.

Notes:

- This table only identifies county-wide framework data - municipal-level framework data that has not been compiled for the entire county is not documented below.
- This table may list information about county-wide data that was not documented on the survey form - additional research was conducted to ensure that this table is as complete as possible.

Bay Area County	**Status of County-Wide Framework Data** *(with key metadata descriptors)*						
	Geodetic Control *(Date)*	**Orthoimagery** *(Scale) (Accuracy) (Date)*	**Elevation** *(Contour Interval)*	**Transportation** *(Scale) (Accuracy) (Date)*	**Hydro-graphy**	**Gov. Units**	**Cadastral** *(Scale) (Accuracy) (Date)*
Alameda	X	√ *(200') (2.5') (1992-1995)*	√ (200') (2.5') (2001)	√ *(200') (2.5') (2001)*	√ *200') (2 ½') (2001)*	X	√ *(200') (3') (2002)*
Contra Costa	√ *(2002)*	√ *(200' & 400') (5' & 10') (2000)*	√ *(10')*	√ *(200') (5') (2002)*	√	√	√ *(100') (2') (2002)*
Marin	√ *(2002)*	√ *(200' & 400') (2.5' & 5') (1997)*	√ *(5' & 10')*	√-TIGER *(200')*	√-TIGER *(200')*	√	√ *(200' & 400) (2.5' & 5') (2002)*
Napa	X	√ - USGS DOQQs *(2,000') (NMAS @ 1:24,000) (1993)*	√ *(10 meter &30 meter)*	UD	√-USGS	√	√ *(Varies) (Varies) (June 2002)*
San Francisco	√ (2001)	√ *(100') (2 ½') (2002)*	√ *(5')*	√ *(100') (2 ½') (2002)*	√ *(100') (2 ½') (2001)*	√	√ *(100') (2 ½') (2001)*
San Mateo	√ *(1-3ft) (1970)*	√ *(200') (10') (April 2001)*	√ (400') (20') (1970)	√ *(200') (10') (April 2001)*	√ (400') (40') (1970)	√ (200') (10') (2001)	√ *(200) (10') (2001)*
Santa Clara	?	?	?	√ *(500') (5') (Oct. 2001)*	?	√	√ *(500') (5') (Oct. 2001)*
Solano	X	X	X	√-TIGER *(2000') (40') (2000)*	√-TIGER	√-TIGER	√ - Unincorp. Area Only *(2000') (40') (2000)*
Sonoma	?	√ *(100', 200', 400') (1' to 8') (2000)*	?	√ *(2000') (100') (2001)*	?	√	√ *(?) (50') (2001)*

LEGEND:

√ County-wide data exist
X County-wide data do not exist
UD Data is **under development** within County.
? Unknown – this information was not provided to the authors of this report

County GIS Fact Sheets

The following pages present one-page summaries of the status of GIS within the nine Bay Area counties. The information on the "GIS fact sheets" was pulled from the GIS survey form, as well as additional research conducted to ensure that they are as complete as possible.

For detailed information about the GIS data listed on these "GIS fact sheets", see the individual tables for each county in the "Bay Area GIS Survey: *Detailed Results*" document.

Alameda County – GIS Fact Sheet

GIS Contact:
Rohin Saleh, Assoc. Engineer
County of Alameda, Public Works Dpt.
399 Elmhurst Street, Hayward, CA 94544
phone: 510-670-5487, fax: 510-782-1939
rohin@acpwa.mail.co.alameda.ca.us

Annual GIS Budget: ?

Primary GIS Software Used: ESRI: ArcGIS, ArcInfo, ArcView. Autodesk: AutoCAD MAP, MapGuide

How is GIS Used within County?:
Overlay applications, County-wide parcel and street centerline layer & county-wide digital orthophotos.

GIS-Related Technology & Software:
SQL Server

County GIS Staff:
Number of full-time GIS staff: 0
Number of part-time GIS staff: 2
Number of casual GIS users: ~80

County GIS Coordination Groups:
URISA, BAAMA, ABAG, ESRI

County GIS Resources: ?

Standard County Base-Map Used:
Modified TIGER, ETAK, Aerial digital Orthophotos, USGS Quad, Field observation, County surveyor

Data Gathering/Creation Activities:
County-wide parcel and street centerline layer & county-wide digital orthophotos

Metadata:
Customized standard

Data Distribution Policy:
See Appendix H

Data Listed on GIS Survey:
Governmental/Political boundaries: Board of Supervisors Districts, State Assembly Districts, State Senate Districts, Census Block/Census Tract, Ashland/Cherryland/Castro Valley Bopper, United States Congressional Districts. **Hydrography:** Flood Control, Drainage Basins. **Elevation:** Contours, Contours – digiair. **Public Health/Safety:** Floodplain ACPWA, Floodplain – Firm. **Transportation:** Face of curb, Pavement centerline, Road Projects. **Utilities:** manholes. **Cadastral Information:**monuments, parcels. **Orthoimagery:** Black &white digital orthophotos, Color digital orthophotos. **Environmental:** Soils – NRCS. **Others:** Grid index, Drainage inlets, Street sweeping Ashland, Rain gages, Zip Codes.

Cities within Alameda County:

City	Completed Survey?	Uses GIS?
Alameda	YES	YES
Albany	YES	YES
Berkeley	no	YES
Dublin	YES	YES
Emeryville	no	?
Fremont	no	YES
Hayward	no	?

City	Completed Survey?	Uses GIS?
Livermore	YES	YES
Newark	YES	YES
Oakland	YES	YES
Piedmont	no	?
Pleasanton	no	?
San Leandro	YES	YES
Union City	no	?

Notes:
? Unknown – this information was not provided to the authors of this report.

Contra Costa County - GIS Fact Sheet

GIS Contact:
Elizabeth (Lis) Klute, GIS Coordinator
Contra Costa County Public Works Dpt.
255 Glacier Drive, Martinez, CA 92553
phone: 925-313-2174, fax: 925-313-2333
eklute@pw.co.contra-costa.ca.us, Tti10@aol.com

Note: The County will hire a GIO in July 2002

Annual GIS Budget: $900K – 1.2M

Primary GIS Software Used:
ESRI Product Line

How is GIS Used within County?:
Local government, parcels, surveying, flood control, dispatch, area designation analysis, community development analysis, web based public information system, flood plain management, geofile maintenance, in-vehicle response, emergency management.

GIS-Related Technology & Software:
FireView, CATS, EIS, MicroStation, AutoCAD Map (1 copy), Hitachi Raster, all ESRI products

County GIS Staff:
Number of full-time GIS staff: 20
Number of part-time GIS staff: 30
Number of casual GIS users: 100

County GIS Coordination Groups:
GIS Policy Comm., Technical Advisory Comm., Countywide Partners Coordination Group

County GIS Resources:
http://contra-costa.gatekeeper.com/

Standard County Base-Map Used:
Cadastral, Centerline, Right of way, city/county bound

Data Gathering/Creation Activities:
In process of countywide drainage inventory. Fire hydrants, watershed boundaries, tax rate areas, stream inventory, census mapped to county parcels.

Metadata:
The County uses ESRI simple and custom metadata formats

Data Distribution Policy:
For parcels/attributes the County has a Computer Mapping Systems - parties apply for and sign agreements for the use of the data for a per parcel cost. Until the Policy Committee was formed, the Public Works Department also charged other departments to use the data.
See Appendix H

Data Listed on GIS Survey:
Geodetic control: survey control networks. **Orthoimagery**: 200'& 400' b/w, county mosaic. **Elevation:** contour lines, mass points. **Transportation:** BART stations & rail, container routes, freeways/ramps, rail, street cline & ROW, trails/paths. **Hydrograhy:** streams, water bodies, watersheds. **Gov. Units**: census blocks/tracts, county, fire districts, special districts, supervisor districts, uni-community bdy., urban limit line. **Cadastral Information:** parcels. **Environmental:** habitat, soil composition, vegetation, wetlands. **Land use/zoning:** General Plan areas, open space designations, zoning unincorp areas. **Utilities:** Aerial locations. **Public Safety/Public Health:** meterorological stations, flood plains, fire hydrants/stations, hazmat, hospital/medical sites, liquefaction zones, retirement homes, shelters, sheriff districts, undergr. storage tanks, wildland fire jurisd. **Other:** areas of benefits, base map grid, culverts, dams & levee, orthophoto grid, EBMUD jurisd. EBParks jurisd., education-child care centers, harbors, catch basins, inlets, manhole locations, parks, public buildings, school districts, schools, sign inventory, storm sewer lines, street lights, zip codes

Cities within Contra Costa County:

City	Completed Survey?	Uses GIS?
Antioch	YES	YES
Brentwood	YES	YES
Clayton	YES	YES
Concord	YES	YES
Danville	YES	YES
El Cerrito	no	Via consultants
Hercules	no	Via Pinole
Lafayette	no	YES
Martinez	YES	YES
Moraga	no	Via consultants

City	Completed Survey?	Uses GIS?
Oakley	YES	YES
Orinda	no	Via consultants
Pinole	YES	YES
Pittsburg	no	YES
Pleasant Hill	no	Via consultants
Richmond	YES	YES
San Pablo	YES	YES
San Ramon	no	YES
Walnut Creek	YES	YES

Marin County - GIS Fact Sheet

GIS Contact:
Fred Vogler, Principal GIS Analyst
Marin County, Community Development Dpt.
3501 Civic Center Drive #308, San Rafael
phone: 415-499-6286, fax: 415-499-7880
http://www.co.marin.ca.us

Annual GIS Budget: ?

Primary GIS Software Used:
ESRI Product Line

How is GIS Used within County:
Assessor parcel boundaries, cities, communities, administrative districts, voting precincts, 5 feet and 10 feet contours, attributes of parcel polygons, six-inch pixels orthimagergy.

GIS-Related Technology & Software:
SQL-Server database, AutoCAD & Map

County GIS Staff:
Number of full-time GIS staff: 4
Number of part-time GIS staff: 1
Number of casual GIS users: 0

County GIS Coordination Groups:
MarinMap-a consortium of public agencies organized to create data and GIS applications

County GIS Resources:
MarinMap (ArcIMS applications on the web):
http://marinmap.org/

MarinMap is a Consortium of public agencies (local governments, special districts) and the Marin Community Foundation organized under the auspices of the Marin Telecommunications Agency.

MarinMap is dedicated to building and sharing a geographic information system (GIS) and cooperating to improve each agency's business processes and public service. It was originally formed in 1996 to create the successful aerial photographing of the Marin County (completed in 1997). Since then, MarinMap has built a World Wide Web accessible GIS. Members are cooperating to bring the best available information to the web.

MarinMap **public** links provide unrestricted access to geographic information in the form of an online parcel viewer located at http://199.88.75.164/parcelviewer/

MarinMap **member** links are user/password protected access to geographic information, with online help available. The member links contain a Parcel Notification/Mailing List application (http://marinmap.org/notification.html) and a Capital Improvement Projects application (http://marinmap.org/cip.html).

Standard County Base-Map Used:
Both roads and hydrology came from TIGER files. (rectified to 200 scale orthos) Same for hydrology

Data Gathering/Creation Activities:
Mapping administrative districts improving road network, improving hydrology.

Metadata:
The County uses FGDC standard

Data Distribution Policy:
See Appendix H

Data Listed on GIS Survey:
Geodetic control: monuments. **Orthoimagery**: 6 inch pixels. **Elevation:** 5 and 10 foot contours. **Gov. Units**: cities, communities, administrative districts, voting precincts. **Cadastral Information:** assessor parcels boundaries. **Land use/zoning:** attributes of parcel polygons.

Cities within Marin County:

City	Completed Survey?	Uses GIS?
Belvedere	YES	YES
Corte Madera	no	?
Fairfax	no	?
Larkspur	no	?
Mill Valley	no	?
Novato	no	?
Ross	no	?

City	Completed Survey?	Uses GIS?
San Anselmo	no	?
San Rafael	YES	YES
Sausalito	no	?
Tiburon	no	?

Napa County - GIS Fact Sheet

GIS Contact:
Patrick Kowta, GIS Coordinator
Napa County, Information Technology Services
650 Imperial Way, Suite 201
phone: 707-259-8141, fax: 707-253-4824
pkowta@co.napa.ca.us

Annual GIS Budget: (1)

Primary GIS Software Used:
ESRI Product Line

How is GIS Used within County?:
Governmental/Political boundaries – parcels, 10 and 30 meter contours elevation.

GIS-Related Technology & Software:
ESRI products, SQL Server

County GIS Staff:
Number of full-time GIS staff: 2
Number of part-time GIS staff: 0
Number of casual GIS users: 50

County GIS Coordination Groups:
Napa County GIS Group

County GIS Resources:
GIS Web server, online metadata

Standard County Base-Map Used:
1993 DOQQ's

Data Gathering/Creation Activities:
There are numerous data creation activities taking place. Records of survey, roads, environmental sensitivity maps, zoning, hazardous sites, wineries, & special district boundaries.

Metadata:
Custom format, GIS Web server - online metadata

Data Distribution Policy:
http://gis.napa.ca.gov
See Appendix H

Data Listed on GIS Survey:
Elevation: 10 and 30 meter contours. **Gov. Units**: Parcel

Cities within Napa County:

City	Completed Survey?	Uses GIS?
American Canyon	no	no
Calistoga	no	no
Napa	YES	YES
Saint Helena	no	no
Yountville	no	no

Notes:
(1) This information was not provided to the authors of this report.

San Francisco County - GIS Fact Sheet

GIS Contact:
Erich Seamon, GIS Manager
San Francisco DTIS Dpt.
875 Stevenson Street, 5th Floor, San Francisco
phone: 415-554-0808
erich.seamon@sfgov.org

Annual GIS Budget: $1.1 Million

Primary GIS Software Used:
ESRI Product Line

How is GIS Used within County?:
Fire Batallion Districts, Subdivision Lots, BlueZones, Street lights, Street structures, Seismic Hazard Zones, Supervisor Districts, Street Centerline Network, Contours (5-foot), Orthorectified Aerial Photographs.

GIS-Related Technology & Software:
DB2, SQL Server, AutoCAD, et al.

County GIS Staff:

Number of full-time GIS staff:	2
Number of part-time GIS staff:	1
Number of casual GIS users:	200

Cities within San Francisco County:

City	Completed Survey?	Uses GIS?
San Francscio	YES	YES

County GIS Coordination Groups:
Within the city, DTIS has the lead role in coordinating data sharing and exchange.

County GIS Resources:
Via ArcIMS and ArcGIS clients

Standard County Base-Map Used:
Ortho-photos, Street centerlines, Edge of pavement (EOP) & Parcels

Data Gathering/Creation Activities:
New photography this year

Metadata:
Custom format, moving to FGDC standard via ArcCatalog

Data Distribution Policy:
Under review

Data Listed on GIS Survey:
Orthoimagery: Orthorectified Aerial Photographs. **Elevation:** Contours (5-foot). **Transportation:** Street Centerline Network, Street structures, BuleZones. **Gov. Units**: Supervisor districts. **Cadastral Information:** Subdivision lots. **Environmental:** Seismic Hazard Zones. **Utilities:** Street lights. **Public Safety/Public Health:** fire Batallion Districts.

San Mateo County - GIS Fact Sheet

GIS Contact:
Bob Maher, Project Manager
San Mateo County Information Services Dpt.
455 County Center, ISD120, Redwood City
phone: 650-363-4463, fax: 650-363-7800
rjmaher@co.sanmateo.ca.us

Annual GIS Budget: (1)

Primary GIS Software Used:
GeoMedia

How is GIS Used within County?:
Government census blocks, supervisorial district, orthophotos for San Mateo County, parcels, street centerline.

GIS-Related Technology & Software:
Oracle 8i Spatial DB, Orthophotos

County GIS Staff:
Number of full-time GIS staff: 0
Number of part-time GIS staff: 4
Number of casual GIS users: 2

County GIS Coordination Groups:
Intermal, multi-departmental committees

County GIS Resources:
Under development

Standard County Base-Map Used:
Derived from 1" = 200' scale DPW and individual city parcel basemap

Data Gathering/Creation Activities:
Address Reconcilation, Precinct to Street Address cross-reference; on-going parcel basemap maintenance

Metadata:
Included with map conversion

Data Distribution Policy:
See Appendix H

Data Listed on GIS Survey:
Orthoimagery: Orthophotos for San Mateo.
Gov. Units: Census blocks, supervisorial district.
Cadastral Information: parcels
Transportation: street centerline with address ranges

Cities within San Mateo County:

City	Completed Survey?	Uses GIS?
Atherton	no	?
Belmont	YES	YES
Brisbane	no	?
Burlingame	YES	YES
Colma	YES	YES
Daly City	YES	YES
East Palo Al to	no	?
Foster City	YES	YES
Half Moon Bay	no	?
Hillsborough	YES	YES
Menlo Park	YES	YES
Millbrae	YES	YES
Pacifica	no	?
Portola Valley	no	?
Redwood City	no	?
San Bruno	no	?
San Carlos	YES	YES
San Mateo	no	?
South San Francisco	no	?
Woodside	no	?

Notes:
(1) This information was not provided to the authors of this report.
? Unknown – this information was not provided to the authors of this report.

Santa Clara County - GIS Fact Sheet

GIS Contact:

Priya Tallam, GIS manager
Santa Clara County Information Services Dpt.
1555 Berger Dr. 2nd Fl, Bldg#2, San Jose
phone: 408-918-7002, fax: 408-297-7484
priya.tallam@isd.co.santa-clara.ca.us

Annual GIS Budget:

At ISD (Information Services Department), the budget is approx. $1.1 million. This includes one time funds from Tech Committees for GIS use for entire County + revenue from Barclay. Have not yet figured out what it costs the entire County for GIS efforts in all departments.

Primary GIS Software Used:

ESRI Product Line

How is GIS Used within County?:

GIS is used to maintain and update County's base-map in GIS format. Depending on customers' requests, spatial analysis and map production are sometimes performed. The County Planning Department uses GIS for Environmental Review, property notification, customer service, and ad hoc mapping.

GIS-Related Technology & Software:

ArcInfo/ArcView, ArStorm Library, AutoCAD (to display/export Assessor's maps which are in .dwg format), ArcIMS (to create and modify internet map files/services for ISD clients).

County GIS Staff:

Information Service Department
Number of full-time GIS staff: 3
Number of part-time GIS staff: 0
Number of casual GIS users: 0

Planning Department
Number of full-time GIS staff: 2
Number of part-time GIS staff: 1
Number of casual GIS users: 15

County GIS Coordination Groups:

ISD GIS team is active in SVGISA & BAAMA, and work actively with various County departments (i.e. Planning Dpt.) as well as County external agencies (i.e. City of San Jose).

County GIS Resources:

ISD GIS team distribute County's GIS base-map on CDs to County departments on a regular basis. The process is not yet on-line but we would like to more this direction.

Standard County Base-Map Used:

Planning Department uses standard DEM from USGS, both 10 meter and 30 meter resolutions. Have made contours from the DEMS.

Data Gathering/Creation Activities:

County-wide GIS Strategic Plan

Metadata:

ISD: FGDC, minimal requirement. Planning Dpt.: text files, and ArcGIS Metadata forms.

Data Distribution Policy:

The county is presently reviewing its data sharing policy through the County-wide GIS Strategic Planning process.

Data Listed on GIS Survey:

Cadastral Information: air parcel – condominiums, townhouse, etc, street centerlines, right of way, parcel annontation, parcels, city political boundary. **Gov. Units**: supervisor districts. **Land use/zoning:** zoning layers, general plan, development activity layer. **Public Safety/Public Health:** geologic hazards. **Hydrology:** from SCVWD and other sources, including USGS

Cities within Santa Clara County:

City	Completed Survey?	Uses GIS?
Campbell	YES	YES
Cupertino	YES	YES
Gilroy	YES	YES
Los Altos	YES	YES
Los Altos Hills	No	?
Los Gatos	YES	YES
Milpitas	YES	YES
Monte Sereno	No	?
Morgan Hill	No	?
Mountain View	YES	YES
Palo Alto	YES	YES
San Jose	YES	YES
Santa Clara	YES	YES
Saratoga	YES	YES
Sunnyvale	no	?

Solano County - GIS Fact Sheet

GIS Contact:
Cliff Covey, System Analyst
Solano County Environment Management Dpt.
601 Texas Street, Fairfield
phone: 707-421-6765, fax: 707-421-4805
ccovey@solanocounty.com

Annual GIS Budget: (1)

Primary GIS Software Used:
ESRI Product Line

How is GIS Used within County?:
Internal use only for Planning division

GIS-Related Technology & Software:
No other GIS-Related technology and software

County GIS Staff:
Number of full-time GIS staff: 0
Number of part-time GIS staff: 0
Number of casual GIS users: 3

County GIS Coordination Groups:
County-wide GIS planning team

County GIS Resources:
none

Standard County Base-Map Used:
USGS 7.5 min quad sheet base

Data Gathering/Creation Activities:
No major data gathering/creation activities

Metadata:
Varies – most in a doc format.

Data Distribution Policy:
No data distribution policy

Data Listed on GIS Survey:
Gov. Units: County Boundary theme, city limits theme. **Cadastral Information:**Solano County (unincorporated area) Parcels theme. **Environmental:** habitat, soil composition, vegetation, wetlands. **Land use/zoning:** county zoning theme, county general plan theme.

Cities within Solano County:

City	Completed Survey?	Uses GIS?
Benicia	YES	no
Dixon	YES	YES
Fairfield	no	?
Rio Vista	no	?
Suisun City	no	?
Vacaville	YES	YES
Vallejo	no	YES

Notes:
(1) This information was not provided to the authors of this report.
? Unknown – this information was not provided to the authors of this report.

Sonoma County - GIS Fact Sheet

GIS Contact:
Tim Pudoff, GIS Coordinator
Sonoma County Information Systems Dpt.
2615 Paulin Drive, Santa Rosa
phone: 707-565-1941, fax: 707-565-2817
tpudoff@sonoma-county.org

Annual GIS Budget: (1)

Primary GIS Software Used:
ESRI Product Line

How is GIS Used within County?:
Support of law enforcement; Board of Supervisors; land use and environmental planning; in future, tax assessment and appraisal.

GIS-Related Technology & Software:
Several flavors of RDBMS and ERDAS image processing software; will be implementing an ArcSDE/IBM DB2 enterprise GIS database.

County GIS Staff:
Number of full-time GIS staff: 9
Number of part-time GIS staff: 6
Number of casual GIS users: 15

County GIS Coordination Groups:
In development; Sonoma County Law Enforcement Consortium; University of California, California State University, Sonoma County Community College District; State of California, United States Government; Share for internal use ONLY.

County GIS Resources:
GIS Data Request Line: 707-565-3819 or gis@sonoma-county.org. County also has an internal GIS help desk phone number.

Currently, county does not serve GIS data/map on-line, but this is being considered for the future.

Standard County Base-Map Used:
(1)

Data Gathering/Creation Activities:
Correction of parcel data to orthophotography; conversion of Assessor parcels to digital process.

Metadata:
Short version of FGDC

Data Distribution Policy:
In development. Data are provided to consultants who work on County-approved projects. Client pays the cost of time and materials to reproduce. Data are NOT intended for resale.
See Appendix H

Data Listed on GIS Survey:
Orthoimagery: balck and white orthophotography. **Transportation:** street centerline. **Gov. Units**: city, fire, law and toher boundaries. **Cadastral Information:** planning parcels. **Environmental:** Open space acquisition. **Land use/zoning:** General Plan land use.

Cities within Sonoma County:

City	Completed Survey?	Uses GIS?
Cloverdale	no	?
Cotati	no	?
Healdsburg	YES	YES
Petaluma	no	?
Rohnert Park	YES	YES

City	Completed Survey?	Uses GIS?
Santa Rosa	YES	YES
Sebastopol	no	?
Sonoma	no	?
Windsor	no	?

Notes:
(1) This information was not provided to the authors of this report.
? Unknown – this information was not provided to the authors of this report.

Appendix A: Overview of GIS

What is GIS?

A Geographic Information System (GIS) is an integration of five components: *Hardware, Software, Data, Analysis and Community.*

Hardware

Hardware is the computer or a computing system on which a GIS operates. It is a device that accepts data, and processes the data in accordance with a stored program. GIS is compatible with a wide range of hardware types, from an individual workstation up to centralized computer servers.

Software

GIS software provides intelligent data functions and models for storing, analyzing, representing and displaying geographic information, spatial information as features, rasters (i.e. grid-cell data), and other data types. It also provides all the tools necessary for creating and working with the geographic data. GIS can as well be expanded through database base management system (DBMS) to a multi-user system, which is a practical means for sharing/ exchanging and protecting data.

Data

A functional geographic information system (GIS) encompasses two key elements: spatial and non-spatial data. Spatial data refers to geographic features such as points, lines or areas; these features occupy a position or location. Non-spatial data describes a position or location in space; it is linked to a geographic component.

Analysis

Traditional GIS-analysis could be anything from traffic analysis to environmental analysis. Some of the basic GIS analyses include: overlay, buffer, proximity, nearest neighbor, and networking. More complex GIS analyses involve attribute queries, spatial queries, 3D analysis, spatial analysis, and use of geo-location for coincidence tabulation and complex modeling.

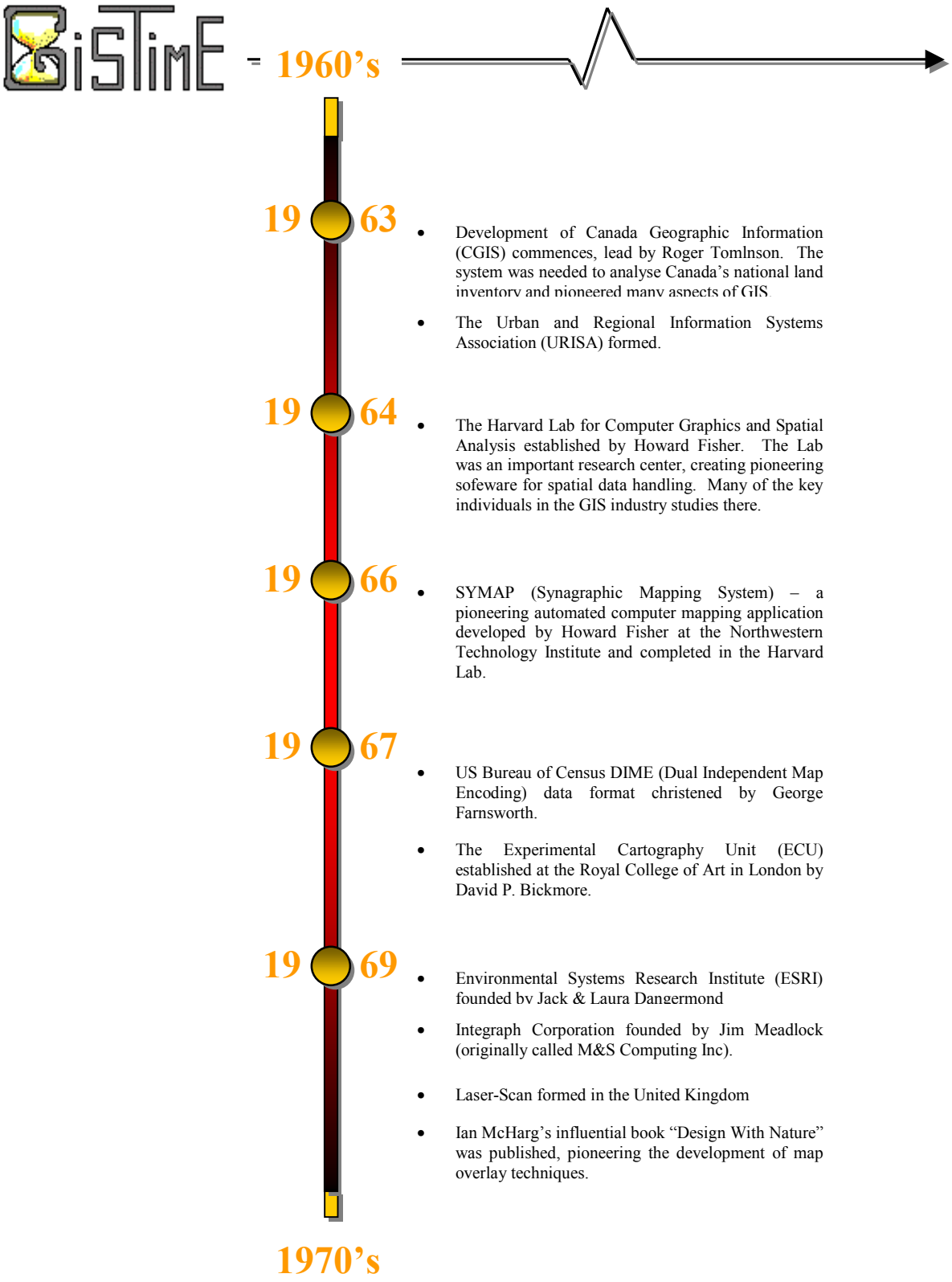
Community

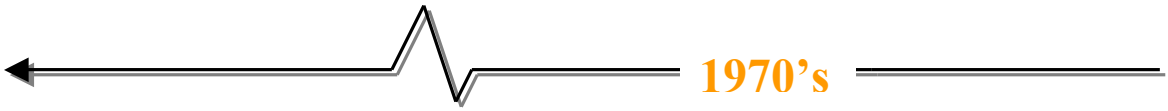
GIS data and information resources are generated and used by diverse user communities. GIS technology has unlimited value with the people who implement analysis and plans with the system.

The next few pages illustrate a brief history of GIS in the past 40 years. It is a timeline of historical events in the development and growth of GIS from their conception in the 1960's to the present day.

GIS Time Line

The timeline below was excerpted from the GiS TiMELiNE developed by Martin Dodge (m.dodge@ucl.ac.uk) and Simon Doyle (s.doyle-walsh@ucl.ac.uk) at the Center for Advanced Spatial Analysis (CASA), University College London.





1970's

1971

- The Canada Geographic Information (CGIS) became fully operational.

1972

- The first Landsat satellite launched (originally known as ERIS-1)
- IBM/s GFIS launched

- General Information System for Planning (GISP) developed by the UK Department of the Environment.

1973

- The USGS began development of Geographical Information Retrieval and Analysis System (GIRAS) to management and analyze large land resources databases being created

- Maryland Automatic Geographic Information

1974

- The first AUTOCARTO conference held in September 1974, in Reston, Virginia, (Although the AUTOCARTO series really started the year before as the International Symposium on Computer-Assisted Cartography).

- Experimental Cartography Unit (ECU) established at the Royal College of Art in London.

1976

- Minnesota Land Management Information System (MLMIS), another significant state-wide GIS, began in 1976 as a research project at the Center for Urban and Regional Analysis

1977

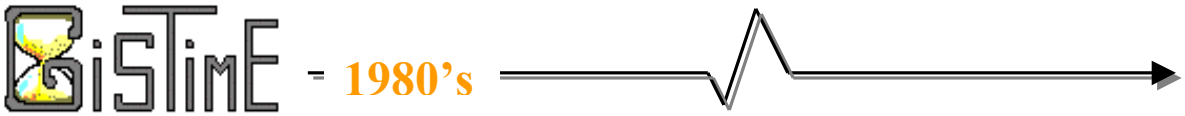
- USGS developed the Digital Line Graph (DLG) spatial data format

1978

- ERDAS founded

1979

- The ODYSSEY GIS developed at the Harvard Lab. The first modem vector GIS



19 81

- ESRI launched ARC/ INFO GIS

19 83

- ETAK digital mapping company formed

19 84

- Marble, Calkins & Peuquet "Basic Readings in Geographic Information Systems" published
- The First International Spatial Data Handling Symposia held.

19 85

- GPS (Global Positioning System) becomes operational
- GRASS – Geographic Resources Analysis Support System development begins in the US Army Construction Engineering Research Laboratories.

19 86

- A first SPOT satellite launched
- MapInfo founded
- Peter Burrough "Principles of Geographic Information Systems for Land Resources Assessment" published

19 87

- The International Journal of Geographical Information Systems is published.
- IDRISI Project started by Ron Eastman at Clark University
- SPANS GIS produced by Tydac was released
- Handling Geographic Information: the report of the Committee of inquiry" (The Chorley Report). An important report that did much to faster the development of GIS in the United Kingdom

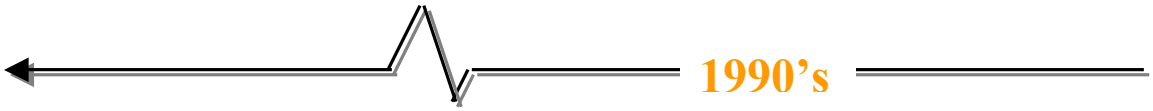
19 88

- The First GIS/LIS Conference held
- Smallworld founded
- The GIS-L Internet list-server started by Ezra Zubrow, State University of New York at Buffalo
- UK's Regional Research Loaboratory (RRL) Initiative
- The National Center for Geographic Information and Analysis NCGIS established in the USA
- The first public release of the US Bureau of Census TIGER (Topologically Integrated Geographic Encoding and Referencing) digital data product

19 89

- Stan Aronoff. "Geographic Information Systems: a Management Perspective" published
- The Association of Geographic Information (AGI) formed in the UK

1990's



1990's

- Maguire, Goodchild, and Rhind "Geographical Information Systems: Principles and Applications" (The GIS "Big Book") is published
- ESRI released ArcView, a desktop mapping system with a graphical user interface that marked a major improvement
- MapInfo Professional launched for Windows 95
- Autodesk - Autodesk MapGUide, AutoCAD Map 2000i, Autodesk Powerline, VISION Enterprise, VISION Objects, VISION Framework
- Intergraph Corporation – GeoMedia, GeoMedia Professional, GeoMedia Web Map
- Northwood Technologies Inc. – Vertical Mapper
- NovaLIS Technologies Inc. – Parcel Editor, GATE
- PCI Geomatics – Geomatica
- PenMetrics – FieldNotes
- Smallworld Systems Inc. – Smallworld GIS
- Tripod Data Systems – SOLO CE

- MAPublisher for Macromedia Freehand
- MAPublisher for Adobe Illustrator
- Bently Systems Inc. - MicroStation GeoGraphics, MicroStation GeoOutlook, ModelServer Continuum
- Blue Marble Geographics - GeoView, GeoViewLT, GeoObjects, Geographic Calculator, Geographic Transformer, Geographic Translator, Geographic Tracker
- Caliper Corporation – Maptitude, GIS+, TransCAD
- CARIS – CARIS GIS
- CarteGraph Inc. – MAP director 5
- CEDRA Corporation – CEDRA Avcad, CEDRA Avcogo, CEDRA Avparcel, CEDRA Avsand, CEDRA Avwater
- Clark Labs – Idris32, CartaLinx
- EPPL7 – LMIC – EPPL7, EPPL2000,
- ERDAS Inc. – ERDAS IMAGINE 8.4, Stereo Analyst [116], ERDAS MapSheets 1.2a, MapSheets Express1.2a
- ESRI – ArcView GIS 3.2a, MapObjects, ArcIMS,
- Golden Software Incm – Didger, DRAGON/ips Professional

The original source of the GIS timeline is Martin Dodge (m.dodge@ucl.ac.uk) and Simon Doyle (s.doyle-walsh@ucl.ac.uk) at the Center for Advanced Spatial Analysis (CASA), University College London. Updated information was added to the timeline for this report.

http://www.geocities.com/SiliconValley/Lakes/2160/gis/gistimeline/gistimeline.html

2001's

Appendix B: Overview of Metadata

What is Metadata?

Metadata is very often described as "data about data." Metadata is basically information and documentation of a dataset. It is important for users to be able to answer the following questions regarding the dataset before any application proceed:

What does the data describe?

- When were the data created?
- How were the data created?
- Who created the data?
- How current and accurate are the data?

Why is Metadata Important?

Metadata is important and valuable in several ways:

- Metadata maintains the value of the data set by describing the origins of and tracks the changes to geospatial data, which enables its continued use over time
- Metadata helps users find and use geospatial data that they need for designated purposes
- Metadata supports easier spatial data access and management
- Metadata makes updates of geospatial data more easily
- Metadata helps facilitate data transfer and interpretation by new users
- Metadata increases overall GIS application

Why Use Standards?

Metadata standards are simply a common set of expressions and definitions that describe geo-spatial data. Data and information resources are produced by and for various interest groups for various purposes and hence metadata requires descriptions of these resources to communicate with diverse user communities in an appropriate and understandable form. Metadata standards provide consistent terminology and elements of data, and facilitate information sharing among various organizations and agencies.

Metadata Tools

Today a great number of software, templates and tutorials is available to help with metadata creation and maintenance. The following is a breakdown of metadata tools by GIS/platform/OS:

UNIX with Arc/Info
blmdoc (aml), data dictionary (aml), document (aml), fgdcmeta (aml) 1.1, metalite (aml) Beta 1.8, findarc

UNIX (and possibly Linux)
cns, mp, mdc, Oklahoma metadata creator, xtme

MS-Windows
NOAA FGDC Metadata Toolkit 1.0 Beta, Metamaker 2.10, DataLogr 1.0, The MDC (Metadata Collector), KMDD (Klamath Metadata Dictionary), Corpsmet95, Dataset Cataloger 4.0, Metadata Manager Professional 2.0, Metadata Management System, Metagen32

MS-DOS
cns, mp, Corpsmet, Oklahoma metadata creator

Any platform with a Web browser
Metamorph, BIC Metadata Form, Metadata Lite Entry Form, Metadata Validation Service, ESRI, Integraph, Autodesk, MapInfo metadata tools

Any platform with a text editor or a word processor
ASCII templates

Categories of Metadata Tools

Metadata tools may be separated into categories based on their operating characteristics and functions. The following four categories of metadata tools seem distinct:

Intelligent Metadata Tools

These tools extract some information from spatial data sets without the user having to determine it and then separately record it. Examples in this category are data dictionary (aml), document (aml), fgdcmeta (aml), blmdoc (aml), metalite (aml), and findarc. The sort of information automatically determined from Arc/Info coverages are bounds, projection information, attributes, and vector feature count. None of these tools perform all documentation - the user will need to supply descriptive information such as the abstract, contact and distribution information, and explanation of attributes, although the ability to do this may be built into the editing functions of the tool.

Forms-Based

These tools provide a user interface which helps guide the user throughout the documentation process. Typically a series of forms with fill-in boxes or pick lists is central to the tool. Some of these tools indicate which are the optional and mandatory elements and have on-line help. Several of these are built on the framework of a database which makes it easy to recycle portions of metadata which may repeat between data sets. This category has the most representatives and includes: NOAA FGDC Metadata Toolkit, Metamaker 2.10, xtme, Corpsmet 1.02, Oklahoma Metadata Creator, The MDC (Metadata Collector), DataLogr 1.0, Metamorph, BIC Metadata Form, Corpsmet95, Dataset Cataloger 4.0, Metadata Lite Entry Form, Metadata Management System, Meta

Data Manager Professional 2.0, Metagen32, NOAA FGDC Metadata Toolkit 1.0 Beta, and KMDD (Klamath Metadata Dictionary)

ASCII and Word Processor Templates

These are not metadata tools per se; instead an existing text editor and word processor is used to edit these template documents which contain all or most of the possible metadata elements and to add text to those elements that are appropriate. Unneeded or empty elements are deleted, repeating elements must be copied and pasted repeatedly. ASCII templates are simple to use, require no GIS software or other specialized software, and may be cloned for parts of the metadata which are common to several data sets. A major drawback for templates is that there is no built in control of the structure; in the process of cutting and pasting it is easy to damage the structure of the template so it is no longer CSDGM compliant. There are a number of representative templates around in various word processor and ASCII forms.

Utilities

This category includes tools and services which are not used for the primary production of metadata, but rather are used to process it in some form. In that category there are tools to find data sets (findarc), to pre-process metadata into consistent format (cns), and to validate metadata (mp and the Metadata Validation Service, mp's on-line counterpart).

The source of the Metadata Tool and Categories of metadata tools are excerpted from the Metadata Primer -- A "How To" Guide on Metadata Implementation developed by David Hart, University of Wisconsin-Madison, Land Information and Computer Graphics Facility and Hugh Phillips, formerly with Wisconsin State Cartographer's Office http://www.lic.wisc.edu/metadata/metaprim.htm#MP_1_3

Appendix C: Comments on Additional GIS Data

The table below lists all responses to the survey question: "Are there any other GIS data layers that you do not currently have that you would like to have

- accurate adjacent jurisdiction and regional information
- accurate road centerlines
- aerial photos, street centerline files, parcels
- Base system is proposed to have aerials, elevation, and other basic info. Would like to have all layers included.
- bike + ped volumes, transit on/off loading
- Building Footprints
- Census
- census, voter precincts, zoning, FEMA, geo-hazard, any derivative layers from the County's GIS basemap, any GIS data layer useful to County departments
- centerline data
- City boundaries for SF Bay Area, watershed boundaries, subwatershed boundaries, vegetations...
- Color aerial photography
- Color Orthos, point addresses
- Crime statistics, season ticket holders, business licenses, building permits
- current 1 meter aerial imagery for all 9 counties in the Bay Area. Parcel data for all 9 counties.
- Current color airphotos
- Current high-res satellite data
- Digital County Parcel Map data
- Economic Development
- Geologic Hazards, Soils, Utility Easements
- high resolution DOQ
- if we move to a fully-fledged GIS then zoning and demographic information would be useful. as would high-resolution aerial photography
- land use (detailed), creek bath.
- Level of Service by street intersection
- Mars and Moon planetary GIS, All EB Parks watershed -ortho, elevation
- More utility information
- New Travel Analysis Zones, Bus routes, light rail routes, parcels/landuse
- other adjacent cities zoning + landuse designations, new seismic hazards map, flood zone maps
- PAC Bell, PGE, Pipelines, cable etc.
- Parcel boundaries for the entire region; aerial photography at < 1 meter accuracy for the entire region
- private utilities - P.G&E, cable street tress, street signs, striping
- Region-wide parcels, region-wide land use, more complete and accurate aerial photography, stops for all Bay Area bus routes and light rail routes
- Right of way, jurisdictions, contours, lakes and streams, easements, principal buildings, landmarks, subdivisions, corner record, LLS, zoning
- Satellite imagery
- soil types, flood zones
- soils, parcels, color orthos
- Sonoma County Soils, Zoning
- street centerline
- topography, city parks, aerial photography, utilities
- updated orthos
- USDA Soils Survey; Geology and hazards.
- Utilities that cross the CalTrain corridor, property lines along corridor
- Vegetation coverages, storm drainage culverts & lines, Water Quality, Source Pollution, Stream Channel conditions, building footprints, parking lots, parcel-level existing land use, agriculture data, geocoded streets layer, Habitat
- vegetation, more accurate soils,
- We will eventually use categories #2,5,8 and 11
- yes - storm drains, community centers
- Yes - various Planning information, locations of curb and gutter, location of sidewalks, location of traffic lights, location of city owned streets, topographic elevations, etc.
- Yes, once the base is complete and staff is trainined we'll be adding public safety, planning, building and finance function/layers
- Yes, our next layers to add include a zoning layer, general plan layer, landscape and lighting districts
- yes. Considering purchase of BARCLAY's Santa Clara County Data

Appendix D: Comments on GIS Coordination, Data Sharing/Exchanging or Metadata

The table below lists all responses to the survey question: "Do you have any other comments or suggestions related to regional GIS coordination, data sharing/exchange or metadata use in the Bay Area?"

- A regional data library would be wonderful
- Coordinate regional data sharing efforts with the CA GIS Council (CGC)
- Do It!
- Ensure that any standards developed are compliant and useful for regional ITS standards
- Form Data Sharing Alliances/Agreements
- Good idea to try to coordinate, very hard to do. Decentralized network of information about information is best.
- I encourage it.
- I support it completely...
- I would support regional cooperation in GIS data sharing. I would be very interested in seeing the development of a regional repository for GIS data.
- Increased regional data sharing would be great esp. for model consistency (MTC TAZ data in GIS capable format)
- ISD GIS team currently undertakes a GIS Strategic Plan/Tactical Plan Project. One of the goals is to identify GIS needs and trends at a regional focus to help determine GIS vision in Santa Clara County. Also, the aerial ortho-photography project, partner
- Keep it simple and it there funding to make it worthwhile to the city
- Not at this time. SACGISA may develop a policy over the next year regarding data sharing/exchange.
- One stop shopping
- Set up a website with info. & Updates
- There should be more cooperative measures to foster private/public ventures
- This survey is a good step and hopefully the results will be publicized so GIS users are aware of what exists. The data sharing policy is also good to attach.
- Add a GIS /community sharing component to the Chabot Space & Science Center, for Alameda GIS sharing
- We are exploring the creation of a consortium for our region.
- We share data sets in connection with projects we support. Mainly we supply RS data sets
- We want agencies to coordinate data gathering; I don't like public agencies or non-profits getting a grant and then "doing their own thing"
- We would be very much interested in new layers/updates for GIS base maps at no or low cost
- Yes - interested in developing a Consortium

Appendix E: Comments on GIS-Related Technology

The table below lists all responses to the survey question: "Besides the Gis Software identified earlier, does your organization utilize GIS-related technology & software such as a relational database management system, CAD, image processing, etc. If yes, please briefly specify & describe."

- Accella Permitting (Building Permits)
- Access
- ArcIMS
- ArcSDE
- ArcStorm Library (Store GIS data)
- Arcview
- AutoCAD
- BMI ImageVu (Document Imaging)
- CAD relational database management-Accela Permits Plus
- CATS
- CIMAGE documentation management system
- custom C++ GIS application
- DB2
- Desktop publishing (Photoshop & Quark)
- EIS
- emergency Dispatch
- ER Mapper
- ERDAS image processing software
- ERDAS IMAGIN
- ESRI Products
- Excel
- Filemaker pro database
- FireView
- GenEDA
- GenMap
- GeoMedia
- GPS Data Collection
- GPS: Trimble Pathfinder Office software
- Hansen for utility systems
- Hitachi Raster
- Informix/Oracle
- Intergraph MGE
- Land Development
- LaserFiche
- Mapguide
- M-Color from Motive Systems
- MicroScan
- MicroStation
- Mr. Sidd
- Oracle 8i Spatial DB
- Printrak-(dispatch)
- RF Coverage planning
- SQL server
- Thomas Guide emaps
- Travel demand modeling software (TP+, Viper)

Appendix F: GIS Survey Form

The hard-copy version of the survey form that was mailed to potential survey respondents is attached.

Bay Area GIS Survey

http://warntz.gisc.berkeley.edu/survey/part.asp

The Bay Area GIS Survey is a collaborative effort of the Bay Area Automated Mapping Association, the Metropolitan Transportation Commission, the Association of Bay Area Governments, the GIS Center at U.C. Berkeley, the California Department of Transportation and others. It is also partially funded by the Federal Geographic Data Committee.

Introduction

The purpose of the survey is to build the foundation for Geographic Information System (GIS) data sharing/exchange, as well as metadata awareness & usage in our region.

We are asking you to tell us who the primary GIS contact person is within your organization and document a few, basic metadata descriptors for GIS data that your organization **creates, maintains or is responsible for**. The survey also asks if your organization creates metadata and under what conditions you are able to share or exchange your GIS data with others. At the conclusion of the survey, we also ask you to briefly identify your major GIS applications, as well as GIS-related technology (i.e. CAD, RDBMS, image processing, etc) that your organization utilizes.

The survey results will be a compendium of the contact information and listing of data layers, as well as statistical analysis on the usage of metadata and data sharing. A comprehensive report will be distributed to all respondents.

We also plan to assemble the brief metadata descriptors into a regional NSDI metadata catalog so that others looking for geographic data will know about your data.

For background information about the survey, go to http://warntz.gisc.berkeley.edu/survey

Who Should Complete the Survey?

The survey is being distributed to a wide variety of organizations that create and maintain GIS data for the Bay Area.

Within your organization (i.e. county government, city government, state or federal agency, utility company, transit operator, non-profit organization, college/university, private business or other organization), we're asking you to self-select the most appropriate person to complete the survey.

Our intended survey respondent is the key GIS contact person within an organization who is knowledgeable about all GIS data and activities within that organization. If a single GIS contact person doesn't exist within an organization, survey respondents should include the key GIS contact person within each department or unit that creates or maintains GIS data.

To help us reach the appropriate people, please forward this survey to whoever you feel is the appropriate person within your organization or within other organizations that you interact with. If you forward this to others, please let us know so that we may follow up with them.

How to Complete the Survey

The survey can be completed using one of three methods:

1. Complete this printed survey, or
2. Download a PDF copy of this survey from http://warntz.gisc.berkeley.edu/survey and complete it, or
3. Complete an on-line* version of the survey at http://warntz.gisc.berkeley.edu/survey/part.asp

**Note: The on-line version of the survey contains the same questions as this version, but the questions are in a different order. The on-line questions have been re-ordered to optimize the display for on-screen viewing.*

If you complete a printed version of the survey, you should attach additional pages as necessary and mail or fax the completed survey to:

Amy Lee, GIS Intern
Metropolitan Transportation Commission
101 Eighth St, Oakland, CA, 94607-4700
Fax: 510-464-7848

All surveys should be submitted by October 15, 2001

For more information, contact:

Mike Skowronek
510-464-7808
mskowronek@mtc.ca.gov
Metropolitan Transportation Commission

or

Bruce Joffe
510-238-9771
gis.consultants@joffes.com
GIS Consultants

Bay Area GIS Survey

http://warntz.gisc.berkeley.edu/survey/part.asp

Part 1 – Background Information

Does your organization currently utilize GIS?

☐ Yes ☐ No

If no, is your organization planning to use GIS?

☐ Yes ☐ No ☐ N/A

If yes, please specify when:

Who is the primary GIS contact person within your organization and/or department? (See "Who Should Complete the Survey" instructions).

Name Title

Organization Department

Organization URL (Web Address)

E-Mail

Phone Fax

Physical Address:

Address

City State Zip Code

Mailing Address (if different):

Address

City State Zip Code

How many dedicated GIS staff are employed within your organization?

Number of full-time GIS staff: _____

Number of part-time GIS staff: _____

Besides your dedicated GIS staff, how many other staff within your organization use GIS on a casual, periodic basis?

Number of casual GIS users: _____

How long has your organization been using GIS?

What primary GIS software does your organization use?

Part 2– Metadata Awareness & Use

Are you familiar with metadata (i.e. what it is; what it is used for; why it is important)?

☐ I'm very familiar with metadata
☐ I only know a little about metadata
☐ I'm unfamiliar with metadata

Does your organization create and/ or maintain metadata?

☐ Yes, for a majority of our data
☐ For some, but not all of our data
☐ No, not at all

If your organization creates metadata, what metadata format/standard do you use?

What are the biggest hurdles that make it difficult to create and maintain metadata?

Part 3 – GIS Data

Please complete the following table for the major categories of digital GIS data that your organization creates, maintains and/or is responsible for. It is not necessary to document common data layers that you have acquired from other sources, such as Census TIGER/Line files.

If using the printed version, attach additional pages as necessary

Category (1 - 12)*	Brief Description	Data Source (a)	Geographic Extent of Data	Data Format (b)	Data Currency (c)	Does Metadata Exist?	Access Policy (d)	Use Policy (e)	Scale (f)	Accuracy (g)

If using the printed version, attach additional pages as necessary

*** Categories include:**

1. Geodetic control
2. Orthoimagery (aerial photography, satellite images, etc)
3. Elevation (topography)
4. Transportation (street center lines or ROWs, rail/transit lines, airports, etc)
5. Hydrography (rivers, streams, lakes, wetlands, watersheds, etc)
6. Governmental boundaries/political units (cities, counties, election districts, etc)
7. Cadastral information (parcels, property lines, etc)
8. Environmental (soils, habitats, etc)
9. Land use/ zoning
10. Utilities (water, gas, telecom)
11. Public safety/public health
12. Other

Notes:

(a) Specify source, such as field observation, aerial photography, existing map, etc.
(b) Specify file format, such as shape file, coverage, Autocad dwg file, Microstation design file, tiff image, jpeg image, or other format
(c) Specify either date of last update or update frequency
(d) Specify any restrictions & legal prerequisites for accessing the data set
(e) Specify any restrictions & legal prerequisites for using the data set once access is granted
(f) Specify scale of source data (1"=200', 1"=1000', 1:24000, 1:100000, etc.)
(g) Specify degree to which a measured value is correct (+/- 2 feet, +/- 10 feet, +/- 100 feet, etc)

If you use something other than any of the above data layers as your standard GIS base-map, please describe.

Are there any other GIS data layers that you do not currently have that you would like to have?

Are you currently conducting any major data gathering or data creation activities, or will you be doing so within a year? Please describe.

Part 4 –Data Distribution, Data Sharing, & Data Exchange

Do you participate in GIS user groups or other organizations to coordinate data development, data sharing/exchanging or application development activities? Please describe.

Does your organization serve, share, or provide GIS data or maps on-line? If so, how (GIS web server, FTP site, on-line metadata, etc)?

Does your organization have a data distribution policy?

☐ Yes ☐ No ☐ Unsure

If yes, briefly describe your policy, or provide URL link to your policy, or transmit an electronic copy of your policy to mskowronek@mtc.ca.gov

Do you have any other comments or suggestions related to regional GIS coordination, data sharing/exchange or metadata use in the Bay Area?

Part 5 – Miscellaneous

How is GIS used within your organization (i.e. what are your major GIS applications)?

Besides the GIS softward identified earlier, does your organization utilize GIS-related technology & software, such as a relational database management system, CAD, image processing, etc. If yes, please briefly specify & describe.

Thank You Very Much for Completing this Survey

Appendix G: Definition of FGDC Framework Data

The Federal Geographic Data Committee (FGDC) has defined "framework data" as seven themes of digital geographic data that are commonly used. These seven framework data themes include geodetic control, orthoimagery, elevation, transportation, hydrography, governmental units, and cadastral information.

The following information was reproduced from a Federal Geographic Data Committee (FGDC) web page subtitled "What the framework's data, technology, operational, and business elements are, and how they work". Source: http://www.fgdc.gov/framework/frameworkintroguide/chapter3.html

Geodetic Control

Geodetic control provides a common reference system for establishing the coordinate positions of all geographic data. It provides the means for tying all geographic features to common, nationally used horizontal and vertical coordinate systems. The main features of geodetic control information are geodetic control stations. These monumented points (or in some cases active Global Positioning System control stations) have precisely measured horizontal or vertical locations and are used as a basis for determining the positions of other points. The geodetic control component of the framework consists of geodetic control stations and related information -- the name, feature identification code, latitude and longitude, orthometric height, and ellipsoid height, and metadata for each station. The metadata for each geodetic control point contains descriptive data, positional accuracy, condition, and other pertinent characteristics for that point.

Geodetic control information plays a crucial role in developing all framework data and users' applications data, because it provides the spatial reference source to register all other spatial data. In addition, geodetic control information may be used to plan surveys, assess data quality, plan data collection and conversion, and fit new areas of data into existing coverages.

Orthoimagery

Orthoimagery provides a positionally correct image of the earth. An orthoimage is a georeferenced image prepared from an aerial photograph or other remotely sensed data from which displacements of images caused by sensor orientation and terrain relief have been removed. An orthoimage has the same metric properties as a map and has a uniform scale. Digital orthoimages are composed of an array of georeferenced pixels that encode ground reflectance as a discrete digital value. Many geographic features, including those that are part of the framework, can be interpreted and compiled from an orthoimage. Orthoimages can also serve as a backdrop to reference the results of an application to the landscape.

The framework may include imagery that varies in resolution from submeter to tens of meters. Accurately positioned, high-resolution data (pixels of 1 meter or finer) are

presumed to be the most useful for supporting the compilation of framework features, particularly those that support local data needs. In some areas, lower-resolution imagery may be sufficient to support the framework and applications.

Orthoimagery provides a useful tool for a variety of applications. Because many land features can be seen on an orthoimage, it can serve as a backdrop for visual reference purposes, saving the expense of creating vector files of features that are needed only for reference. Orthoimagery can be used to compile vector themes photogrammetrically.

Elevation

Elevation data provide information about terrain. Elevation refers to a spatially referenced vertical position above or below a datum surface. The framework includes the elevations of land surfaces and the depths below water surfaces (bathymetry).
For land surfaces, the framework employs an elevation matrix. Elevation values will be collected at a post-spacing of 2 arc-seconds (approximately 47.4 meters at 40° latitude) or finer. In areas of low relief, a spacing of 1/2 arc-second (approximately 11.8 meters at 40° latitude) or finer will be sought.

For depths, the framework consists of soundings and a gridded bottom model. Water depth is determined relative to a specific vertical reference surface, usually derived from tidal observations. In the future, this vertical reference may be based on a global model of the geoid or the ellipsoid, which is the reference for expressing height measurements in the Global Positioning System.

Elevation data are used in many different applications. Users may want a representation of the terrain, such as a contour map, spot elevations, or a three-dimensional perspective view. Elevation data are also used to build models and perform applications, ranging from line-of-sight calculations, to road planning, to water runoff. Elevation data are often combined with other data themes in applications and mapping.

Transportation

The framework's transportation data include the following major common features of transportation networks and facilities:

- roads -- centerlines, feature identification code (using linear referencing systems where available), functional class, name (including route numbers), and street address ranges;
- trails -- centerlines, feature identification code (using linear referencing systems where available), name, and type;
- railroads -- centerlines, feature identification code (using linear referencing systems where available), and type;
- waterways -- centerlines, feature identification code (using linear referencing systems where available), and name;
- airports and ports -- feature identification code and name; and
- bridges and tunnels -- feature identification code and name.

Transportation information is used in many applications. Some use it only for reference purposes, as an element of base mapping, while many others use it to attach other types of information, such as address-related information or street characteristics. Transportation features and related data are important elements of many planning applications. Geocoding applications use road and related address data for uses ranging from marketing analysis to site identification. Routing applications use street network data for operations such as vehicle dispatch and fleet management.

Hydrography

Framework hydrography data include surface water features such as lakes and ponds, streams and rivers, canals, oceans, and shorelines. Each of these features has the attributes of a name and feature identification code. Centerlines and polygons encode the positions of these features. For feature identification code, many federal and state agencies use the Reach scheme developed by the U.S. Environmental Protection Agency. Many hydrography data users need complete information about connectivity of the hydrography network and the direction in which the water flows encoded in the data. To meet these needs, additional elements representing the flow of water and connections between features may be included in framework data.

A shoreline is the intersection of the water's surface with land. It usually is referenced to some analytically determined stage of the tide for coastal water, or other water level for lakes and rivers. Several shorelines, referenced to different stages of the water such as "mean high water" and "mean lower low water," are included in the framework. These shorelines are included because different users require different shorelines and the complex, nonlinear relationships between various shorelines make it difficult to determine them analytically. Attributes include the description of the tidal reference for the shoreline.

Hydrography is important to many applications. As with other data themes, many users need hydrographic features as reference or base map data. Other applications, particularly environmentally oriented analyses, need the information for analysis and modeling of water supply, pollution, flood hazard, wildlife, development, and land suitability.

Governmental Units

The framework includes the geographic areas of units of government. These units include

- the nation,
- states and statistically equivalent areas,
- counties and statistically equivalent areas,
- incorporated places and consolidated cities,
- functioning and legal minor civil divisions,
- federal- or state-recognized American Indian reservations and trustlands, and
- Alaska Native regional corporations.

Each of these features includes the attributes of name and the applicable Federal Information Processing Standard (FIPS) code. Features boundaries include information about other features (such as roads, railroads, or streams) with which the boundaries are associated and a description of the association (such as coincidence, offset, or corridor). Governmental unit boundaries are used for a wide variety of applications. Some need the boundaries only for information and orientation; others require the polygons to determine inclusion related to a number of other features. Business GIS is a very active field that uses these boundaries for statistical analysis and decision making.

Cadastral Information

Cadastral information refers to property interests. Cadastral data represent the geographic extent of the past, current, and future rights and interests in real property. The spatial information necessary to describe the geographic extent and the rights and interests includes surveys, legal description reference systems, and parcel-by-parcel surveys and descriptions.

Two aspects of cadastral information are included in the framework:

- cadastral reference systems, such as the Public Land Survey System (PLSS) and similar systems for areas not covered by the PLSS (for example, the Connecticut Western Reserve in Ohio), and
- publicly administered parcels, such as military reservations, national forests, and state parks.

Features include the survey corner, survey boundary, and parcel. Each instance of a feature has the attributes of name (or other common identifier) and information about data quality. Each instance also should have a permanent feature identification code. For the PLSS, the minimum content is the boundaries of sections, including deflection points and the positions for quarter corners along section boundaries. Boundaries that have been surveyed are the preferred content for cadastral reference systems. Cadastral information is the basis of many analysis, decision-making, and operational applications, such as site selection, land use administration, and transportation planning. The reference system can be used to register locally produced information into the framework. Information about publicly owned lands serves both those who administer the lands and those who have interests in them. Framework representation of these lands provides useful information about their location, boundaries, extent, and relationships to other geographic features and phenomena. Because parcels play an important role in many public and private sector activities, and parcel information is a basic ingredient of many applications, there is interest in providing multiple levels of cadastral data. These levels would be based on available data and customer requirements. The framework provides a means to link existing parcel data into the larger cadastral network.

Appendix H: Sample GIS Disclaimers and Data Distribution Policies

Note: the information in this report is intended to foster regional GIS coordination and data sharing/exchange in the Bay Area. It is not intended to be a resource for GIS consultants, vendors or other organizations to conduct unsolicited marketing campaigns and related activities. Any use of this information for unsolicited "for-profit" activities is expressly forbidden.

Sample Data Disclaimers and Data Distribution Policies are not included in the ESRI version of the report due to file size limitations.

The Metropolitan Transportation Commission (MTC) is the transportation planning, coordinating and financing agency for the nine-county San Francisco Bay Area. More information is available at www.mtc.ca.gov.

The Bay Area Automated Mapping Association (BAAMA) is a non-profit, professional organization that strives to serve the educational, networking, data exchange/sharing and related needs of Geographic Information System (GIS) professionals in the Bay Area. More information is available at www.baama.org.

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