

University of Arizona

THE CAMPUS
SPATIAL DATA INITIATIVE



Presentation Review

- 1. Background on Campus Mapping and Spatial Data**
- 2. The Campus Spatial Data Initiative**





Campus Spatial Data Users

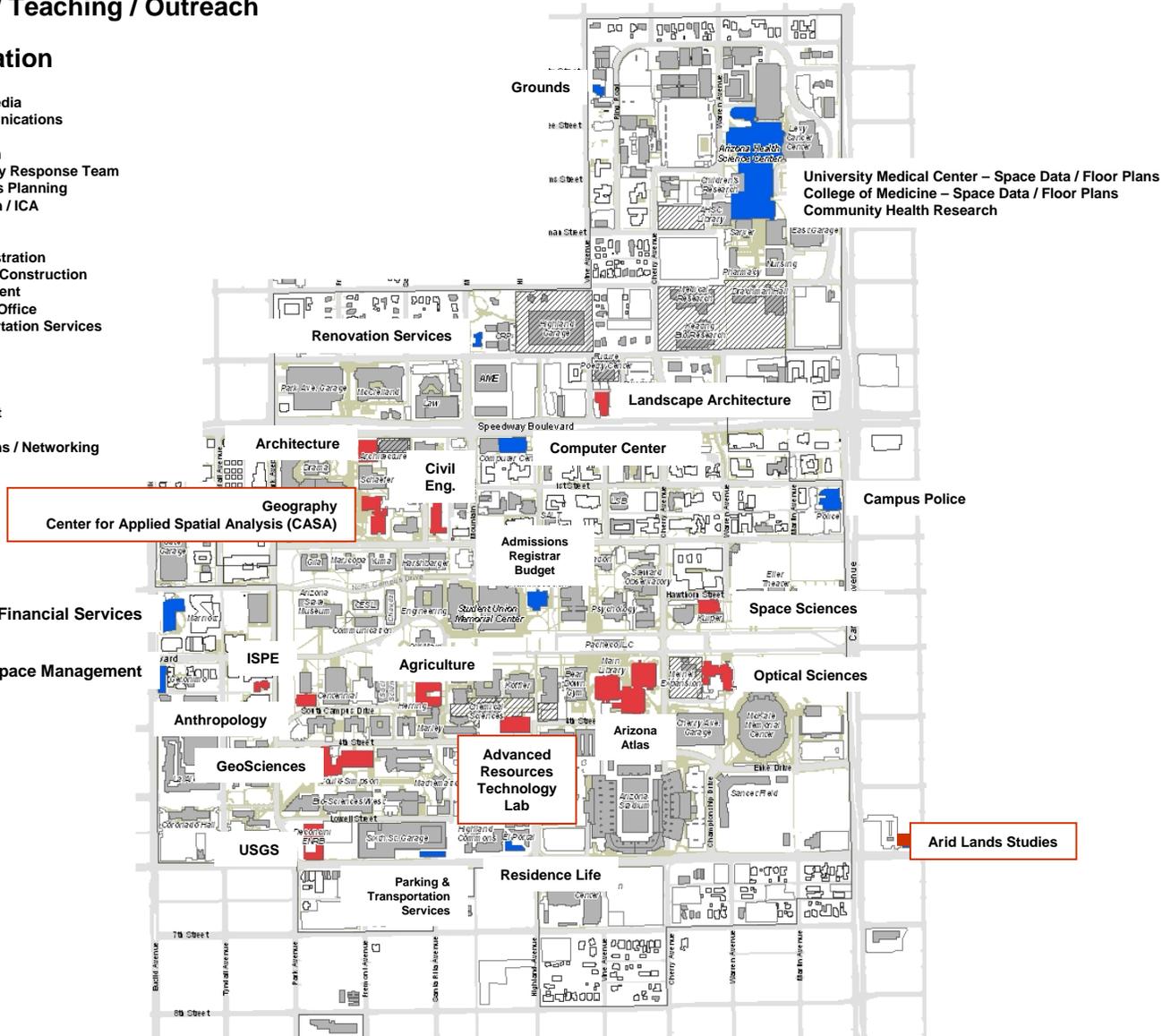


Research / Teaching / Outreach



Administration

- Admissions
- Arizona Student Media
- BioMedical Communications
- Budget Office
- Campus Arboretum
- Campus Emergency Response Team
- Campus & Facilities Planning
- Campus Recreation / ICA
- Community Affairs
- Computer Center
- Curriculum & Registration
- Facilities Design & Construction
- Facilities Management
- Financial Services Office
- Parking & Transportation Services
- Police
- Procurement
- Residence Life
- Risk Management
- Space Management
- Systems Control
- Telecommunications / Networking
- Visitor's Center



The University of Arizona



Background on Campus Mapping and Spatial Data at the UA

- Prior to 1990** Most recordkeeping related to the physical campus was in paper format.
- Late 1980's** Initiatives began to *convert data to digital formats* automation of “key plans” and creation of the space database.
- 1993** Study conducted to *assess issues and opportunities* for automation of spatial information on campus.
- 1995** Digital base mapping project began in an effort to *create a geographic framework* to integrate initiatives and address the concerns listed above.
- 1995 – 2004** Many discrete automation efforts in individual departmental operations.
- 2002** *Campus Mapping Committee* formed to coordinate graphic/publication oriented maps.
- 2003 – 2005** Presentations made on options for integrating campus spatial data. Launch of initiative in spring 2005.



Why Automate Spatial Data?

Improve ability to find information

Make data query's and analysis easier / quicker

Protect important records at risk due of decay

Have a single set of information maintained in one place

Reduce unnecessary error and effort



1996 Aerial Photos and Mapping

University Administration funded the creation of a scalable digital basemap and related digital orthophotos

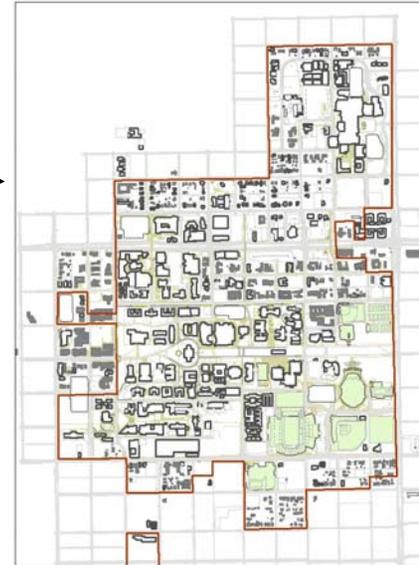
GIS “Electronic Basemap”



Highly accurate & scalable

Based on a coordinate system widely used locally

GIS formatting allows “intelligent maps” (links to data tables)



Digital Orthophoto “Photo Base”

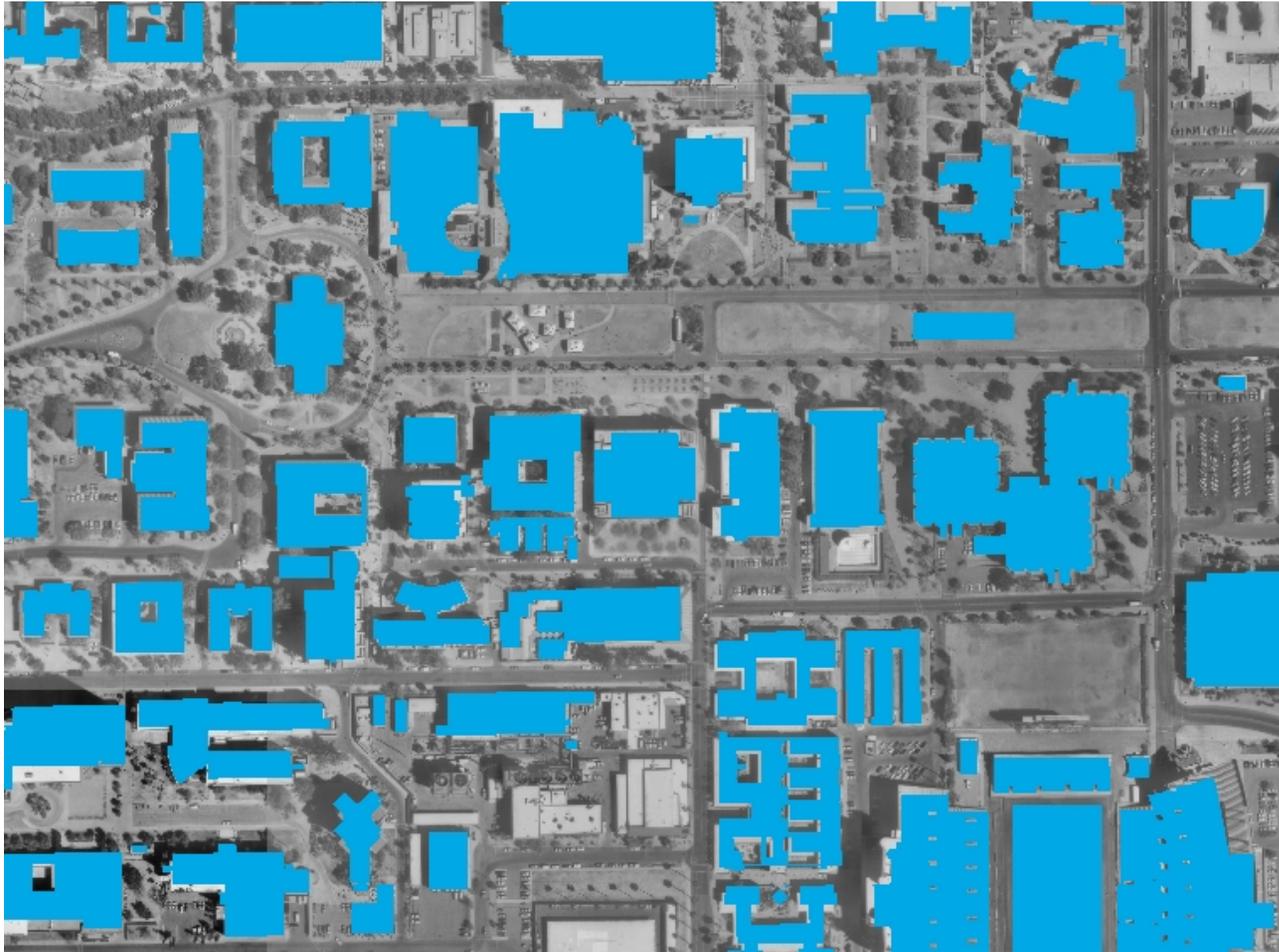


Highly accurate & scalable

Based on a coordinate system widely used locally

Provides “visual information”



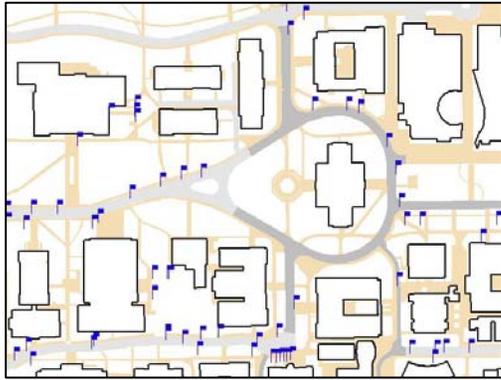


Digital Orthophoto overlaid with building map layer

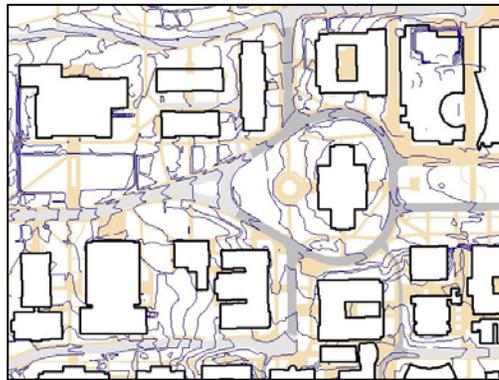


1996 Aerial Photos and Mapping

Sampling of other map layers created by the Campus Photo/Mapping project.



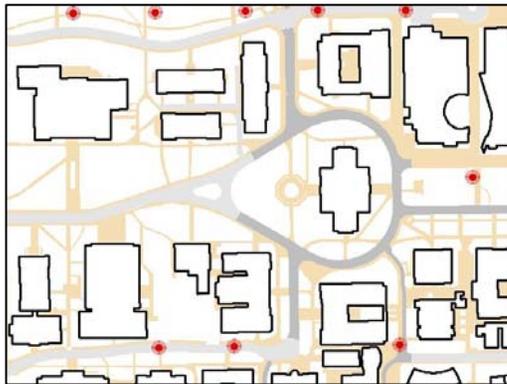
Signs



**Topographic
Contours**



Trees



Manholes



Walls



Floodplain



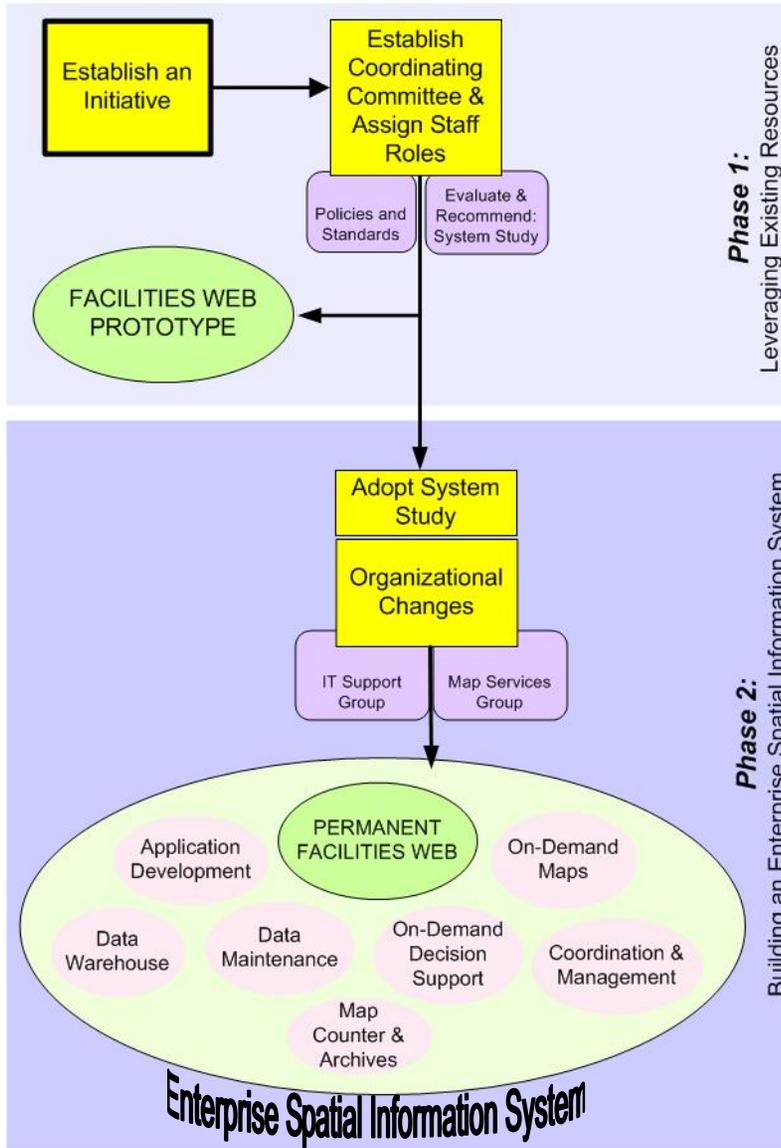


UA Spatial Data Initiative





FLOWCHART OF PROPOSED ACTIONS



PHASE ONE

1. Formally Establish an Initiative
2. Create Coordinating Committee
3. Assign Staff Roles
4. Official Basemap & Coordinate System
5. Spatial Data Standards Manual
6. Develop Prototype Projects
7. System Assessment / Specification Study

PHASE TWO

1. Adopt System Study
2. Implement "Facilities Web" Application
3. Implement Organizational Changes

Spatial Data Initiative Flowchart

What is Institutional *Spatial* Data?

It is relevant to planning, managing, or auditing a major administrative function of the University

It is referenced or required for use by more than one organizational unit

It is included in an official university administrative report; or

It is used to derive an element that meets the criteria above

AND

It is tied to a physical location related to the UA



Initiative Visions / Goals

Create a coordinating and technical framework into which departmental spatial data services / applications are plugged (with expertise and control remaining with departments).

Provide more consistent and complete spatial data services for products which are best delivered in a more consolidated fashion.

Automate paper information / processes to increase efficiency and usefulness of information (accuracy, currency, availability, etc.)

Use technology to work more intelligently and accomplish greater results with fewer resources by enabling fundamentally different approaches to defining and solving problems

Provide electronic access to all information needed by staff to do their jobs regardless of who “owns” the information, thereby increasing effectiveness and enabling a wider distribution of appropriate decision making ability.



Important Considerations

Departments don't have to give up control of their data. Appropriate access to information will be controlled.

Department are not required to change the software they use to store/update data

Much can be done with little or no new resources (e.g., a lot can be done through a clear mandate and effective coordination).



WHERE WE ARE NOW

Formed Steering and Working Committees

Assessment of external entities: Universities, local jurisdictions

Assessment of UA units



EXTERNAL ASSESSMENT

Harvard

UNIVERSITY ARCHITECT'S OFFICE

Campus Maps/Images

High-tech, interactive, more detailed maps (GIS) for all IU campuses:
<http://gis.service.indiana.edu/FIMS/html/maps.html>
 The free GIS viewer used is supported only on the java-compatible Microsoft Internet Explorer 5.01 (or higher)

Color PDF campus maps - [LINK \(new\)](#)
 Low-tech maps for IU campuses - [LINK](#)
 Campus maps in CAD-type format, aerial photos - [LINK](#)
 Other site for IU facility images - digital photo archives
<http://www.indiana.edu/~phyplant/photos.html>

web site address: <http://www.indiana.edu/~uao> Last Updated: 3/12/2003
 Copyright 1999-2003, The Trustees of Indiana University. Comments: [webmaster](#)

UNIVERSITY ARCHITECT'S OFFICE

Campus Maps

The following campus maps are currently available. [\[Campus Maps\]](#) view these interactive maps you must first have had the MapGuide Viewer installed. If you are using Microsoft Internet Explorer 4.01/Communicator 4.6 or higher a ActiveX Viewer will automatically install upon entering the campus maps. Internet Explorer is the browser that best supports this GIS mapping viewer at this time. Please refer to the [download](#) section for help with the browser and viewer requirements and installation. It is also recommended that the maps be viewed at 1024x768 screen resolution.

- [FIMS Mapping](#)
- [Getting Started](#)
- [Download](#)
- [Campus Maps](#)
- [The Team](#)

- [IU Bloomington Campus basemap](#)
[IU Bloomington GPS](#) (for Global Positioning System files/information)
- [IU East \(Richmond\) Campus basemap](#)
- [IU Kokomo Campus basemap](#)
- [IU Northwest \(Gary\) Campus basemap](#)
- [IUPUI \(Indianapolis\) Campus basemap](#)
- [IU South Bend Campus basemap](#)
- [IU Southeast \(New Albany\) Campus basemap](#)

[\[FIMS Mapping\]](#) [\[Getting Started\]](#) [\[Download\]](#) [\[Campus Maps\]](#) [\[The Team\]](#)

url: <http://gis.indiana.edu/>
 Last updated: 06/25/2002
 Copyright 2001, The Trustees of Indiana University
 Comments: [webmaster](#)

Interactive Maps of Harvard

Reference Maps
 (Adobe Acrobat format)

Interactive Maps of Harvard
 (Autodesk MapGuide format)

[Campus Map Index](#) (993Kb)

- [Harvard Yard](#) (548Kb)
- [North Yard](#) (250Kb)
- [River Houses](#) (491Kb)
- [Radcliffe Yard](#) (500Kb)
- [Business School/Stadium](#) (303Kb)
- [The Quadrangle](#) (554Kb)

[Public Interactive Map of Harvard Yard](#)

Restricted Interactive Maps of Harvard Campus
 (password protected; for access contact Jim Nelson)

[Map MetaData](#)

Other Map Information

[Search PIRC Maps and Surveys Collection](#)

[Harvard University Cambridge Campus Map](#)



INTERNAL ASSESSMENT

Currently Implemented Systems / Data Development

Space Database

On-line keyplan/data query

CMS & Fire Alarms

FM Automated Systems

Risk Management Data

911 System

Parking Management System

Campus GIS and basemap

Data Warehouse

Etc.

Related Initiatives

Lease Tracking System

PTS GIS System

Asset Management system for Telecommunication

New student information system

New financial information system



Ongoing Coordination

Ad Hoc Inter-departmental Collaborations

Risk Management

- Prototyping CAD-GIS conversion methods
- Blue light phone mapping
- Hydrant mapping



Facilities Design & Construction

- CAD Map Updates for Consultants
- Survey coordination/standards
- Map updates using “record drawings”
- Use of GIS basemap for routine mapping

Space Management

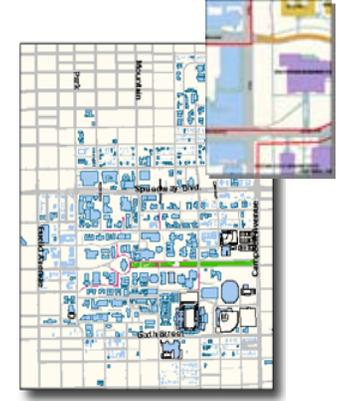
- Coordination of space data with floorplans
- Tying floorplans to GIS basemap
- Use of updated CAD Map

Parking & Transportation Services

- Providing basemap in graphic format
- Potential collaboration on spatial data warehouse

CCIT

- Maintenance of web map interface
- Exploring options for “next version” of map



Preliminary Assessments

(Prior to Formal Initiative Launch)

Uses / Users

Data Models

Services Frameworks

Organizational Models

Application Concepts

Evaluating UA



Uses of Spatial Information

Data Visualization and Spatial Analysis

Decision Support / Physical Planning Studies

Maps Conveying Technical Information

Public Oriented Communication / Information

Integrate Systems & On-line Info to Provide Better Customer Service

Answer Questions

Operate More Efficiently

Archive and Access Records more Efficiently

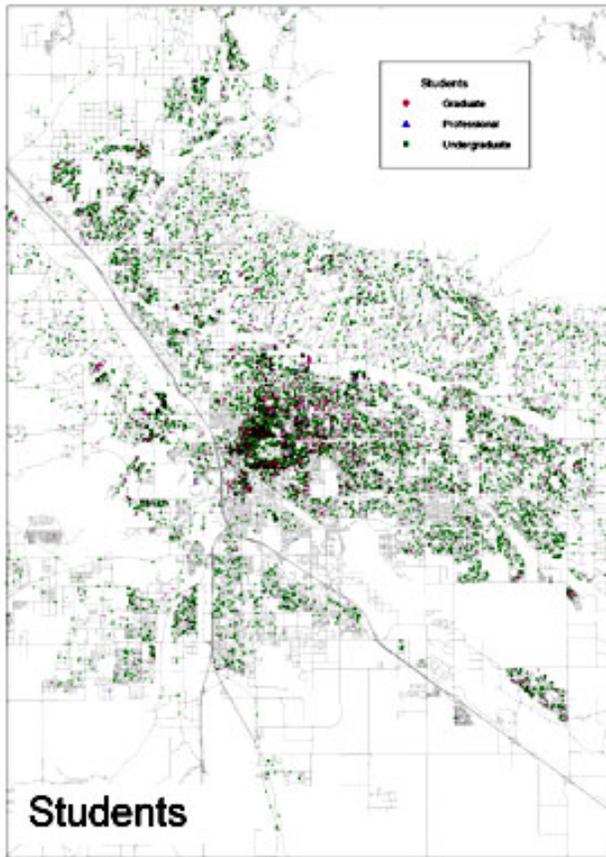
Basic Campus Maps

Base for other map layers

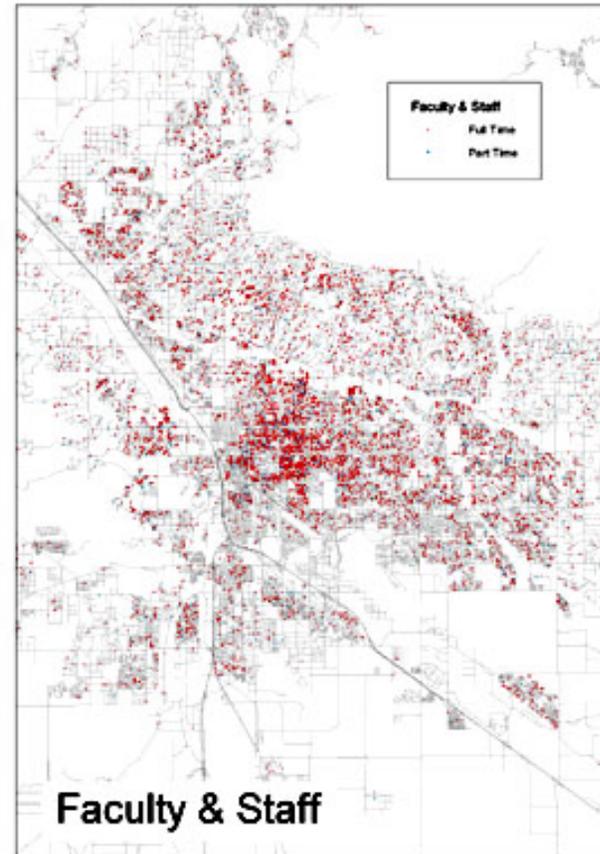
A Resource for Student Projects



Data Visualization and Spatial Analysis



Students
CAMPUS COMMUNITY RESIDENTIAL LOCATIONS
The University of Arizona

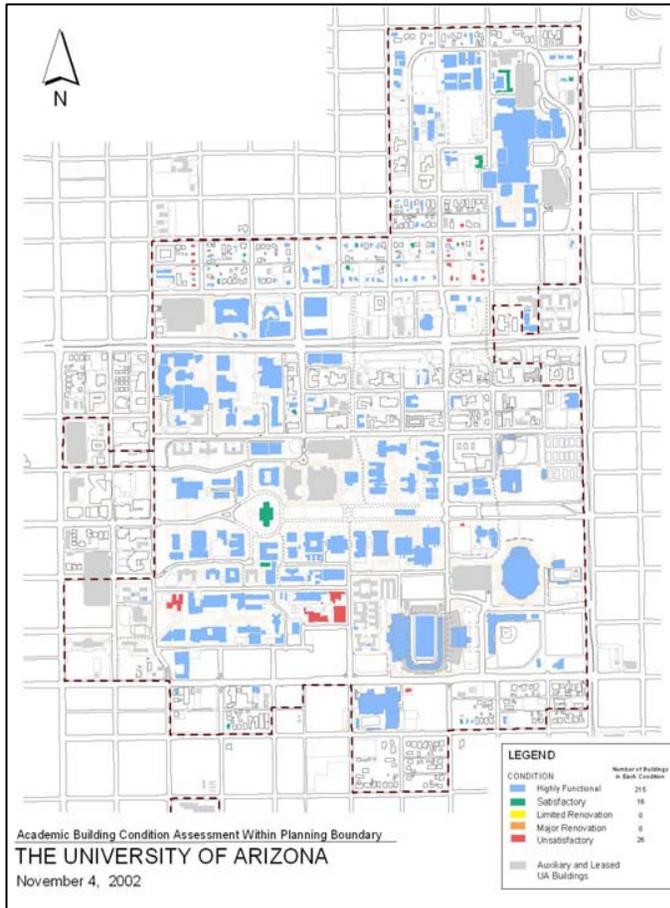


Campus and Facilities Planning
April 2003

Evaluating Spatial Distribution of Campus Population (Residential)

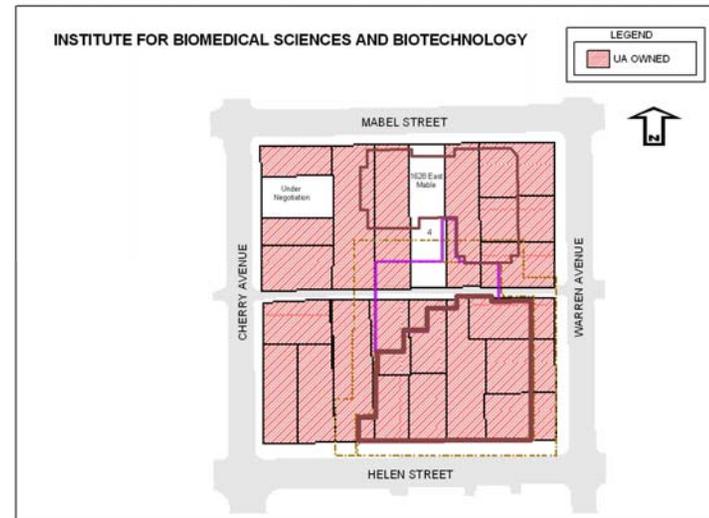
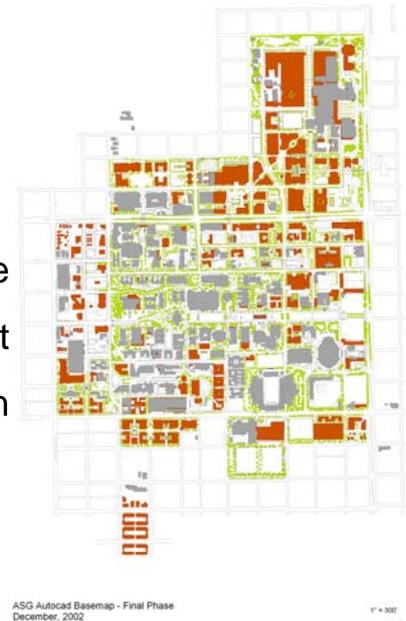


Decision Support Studies



Building Condition Assessment

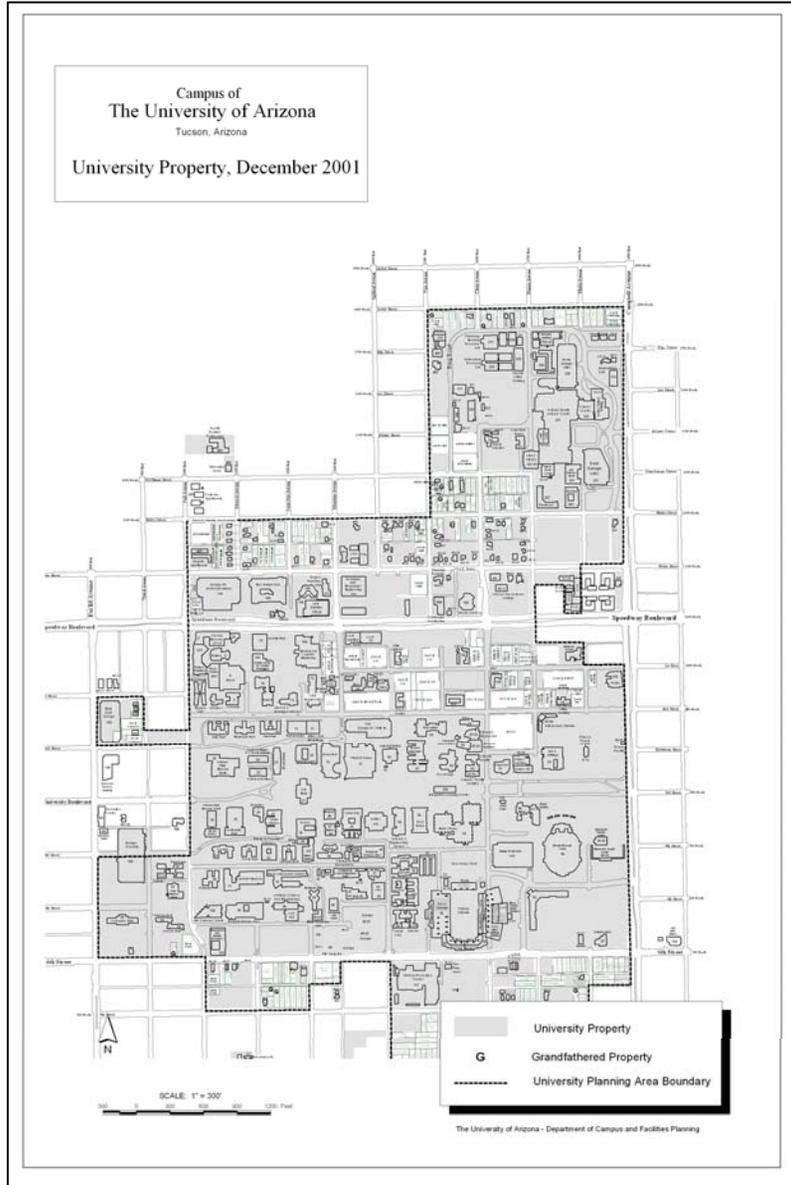
Future
Development
Pattern



Relationship between
Property ownership and a building site

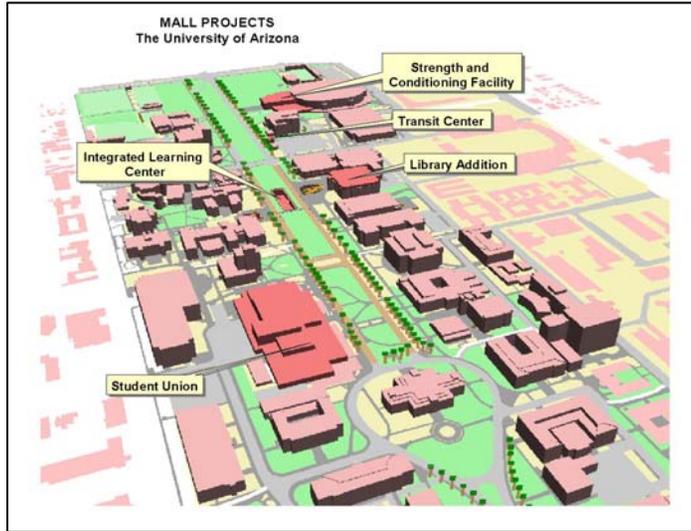


Maps Conveying Technical Information

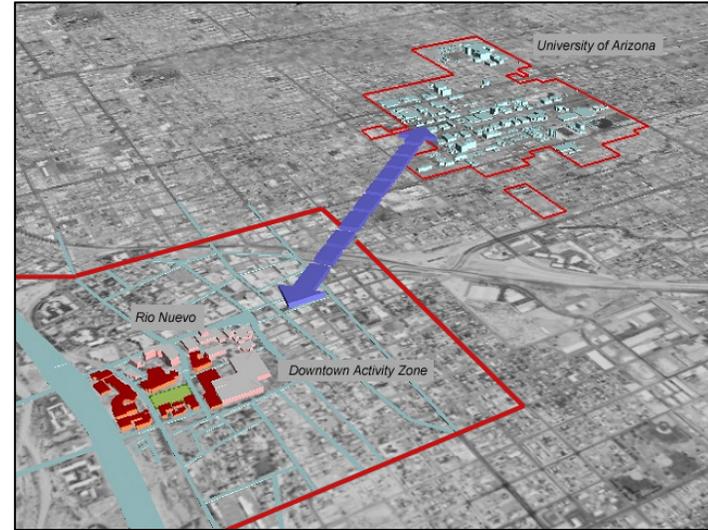


Property Ownership

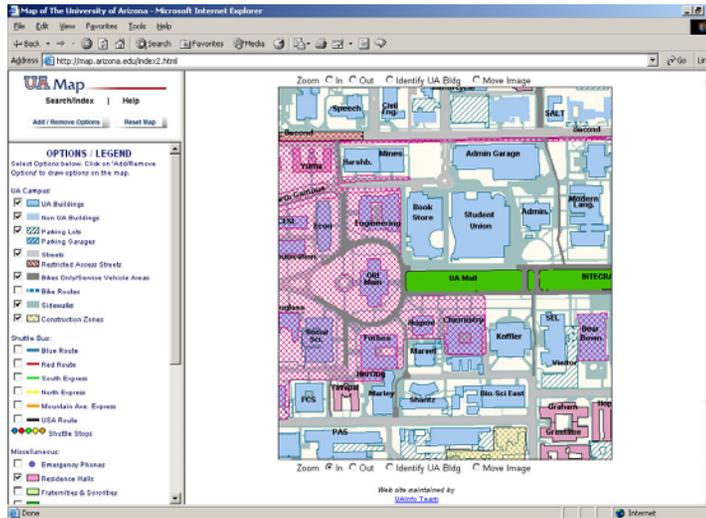
Public Oriented Communication / Information



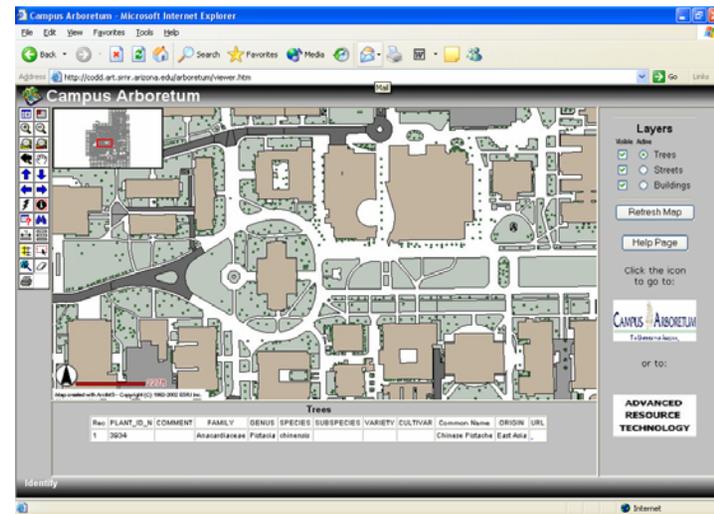
Main Mall Redevelopment



UA – Rio Nuevo Proximity



UA Online Web Map

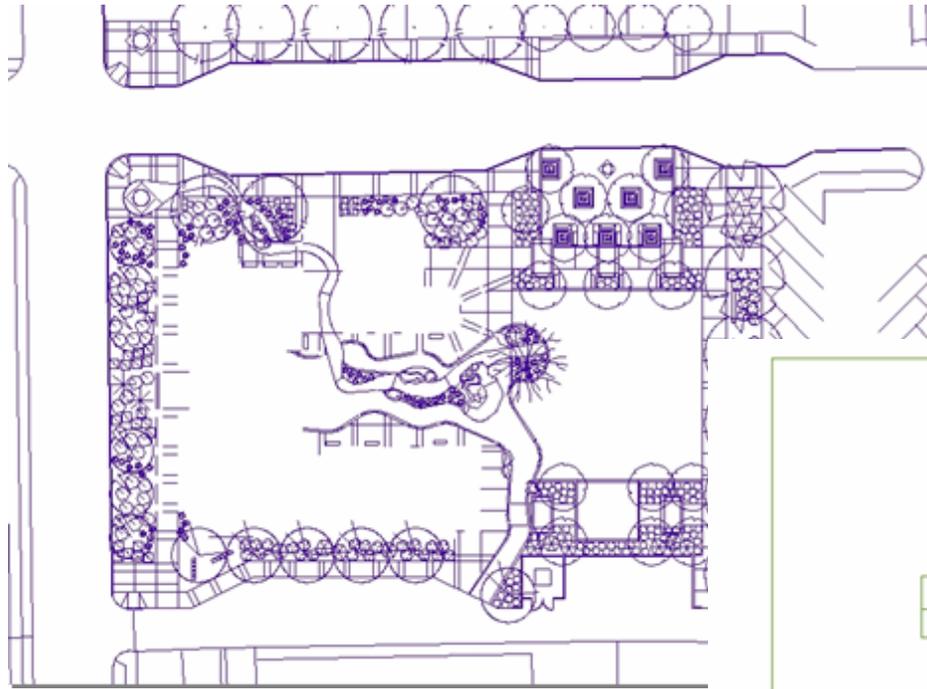


Campus Vegetation Interactive Map

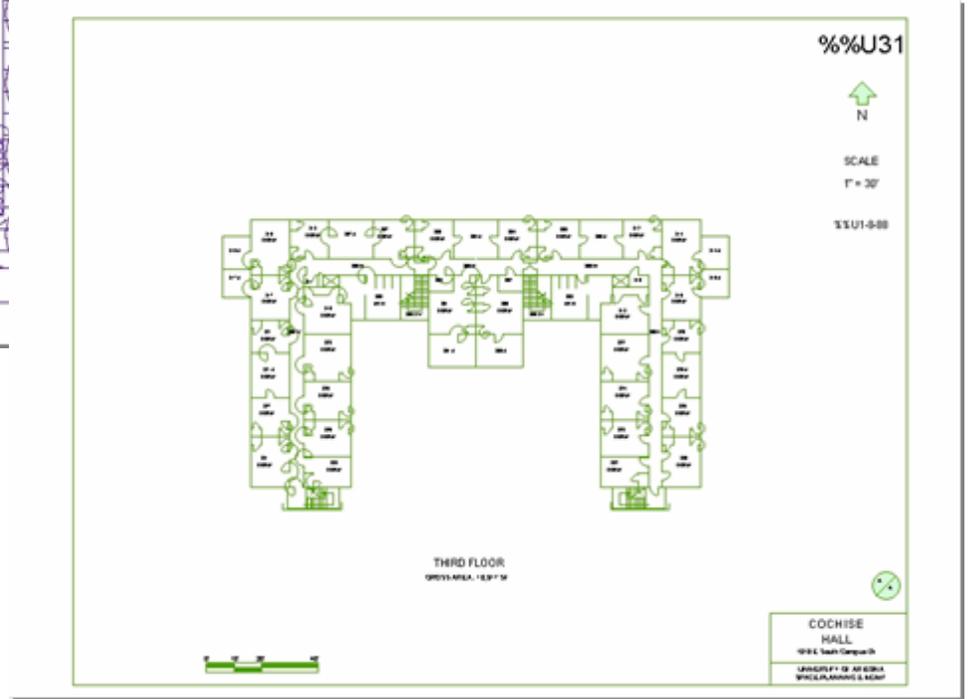


Archive & Access Information More Efficiently

Protect valuable archives & provide means for easier access to records

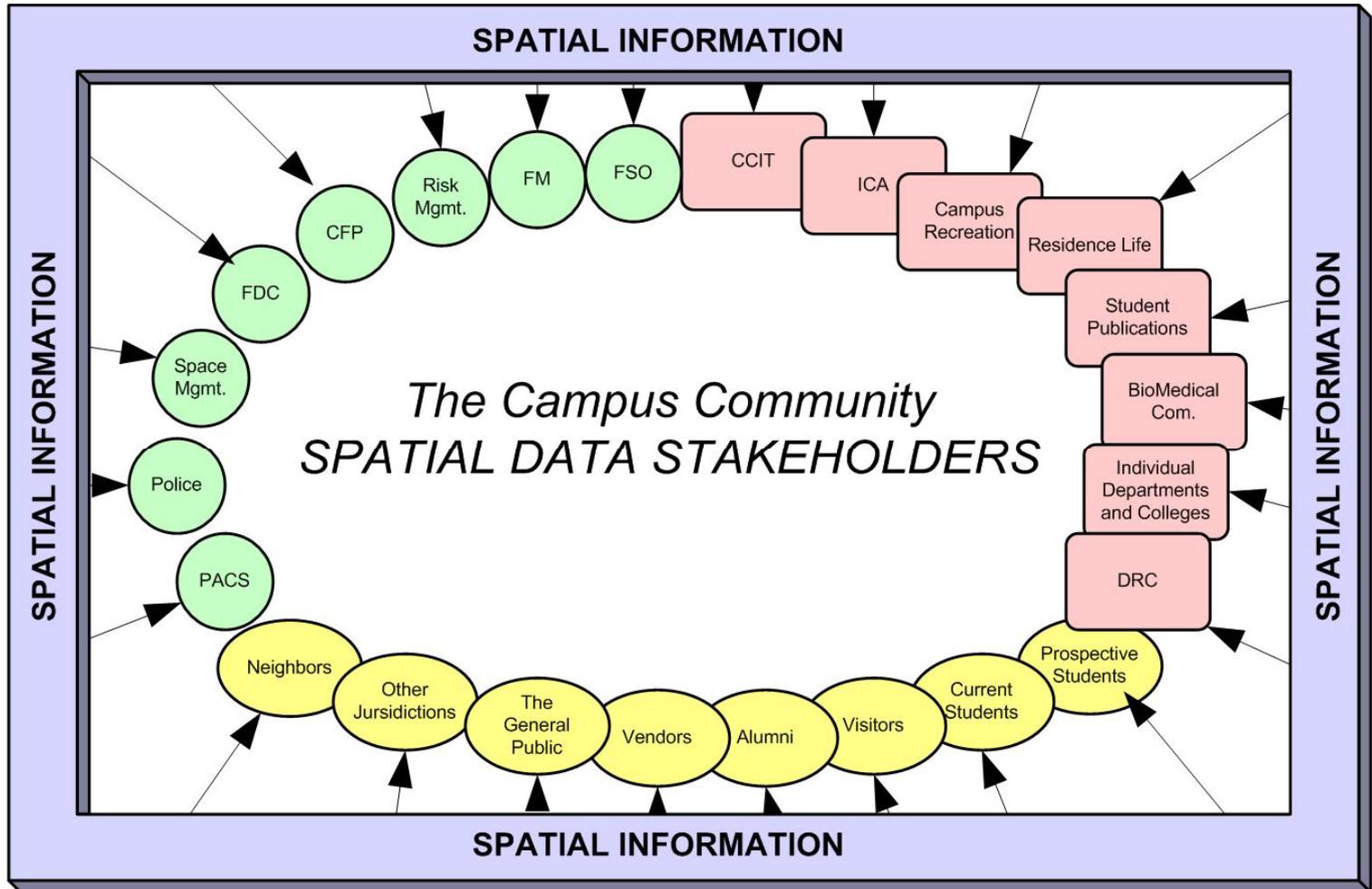


CAD record drawing for LSB landscape



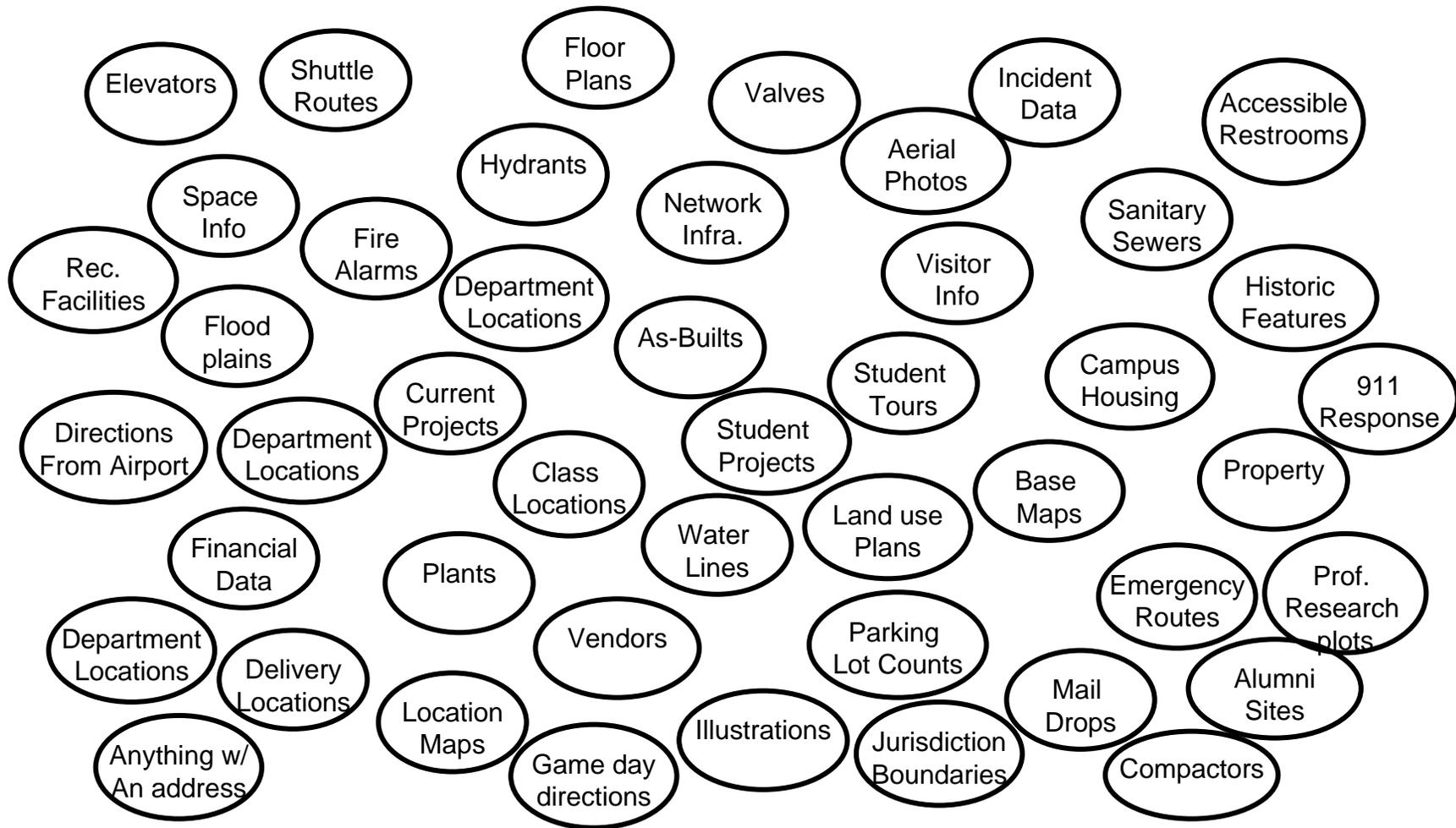
CAD Keyplan for Cochise

Many UA Users / Creators of Spatial Information



Extensive **Spatial Data** Exists Related to These Campus Stakeholders

How can it all be organized so as to be useful?



General Spatial Data Types

Graphic diagrams / Images

**CAD Drawings
Asbuilts
Floorplans
Remodel Designs**

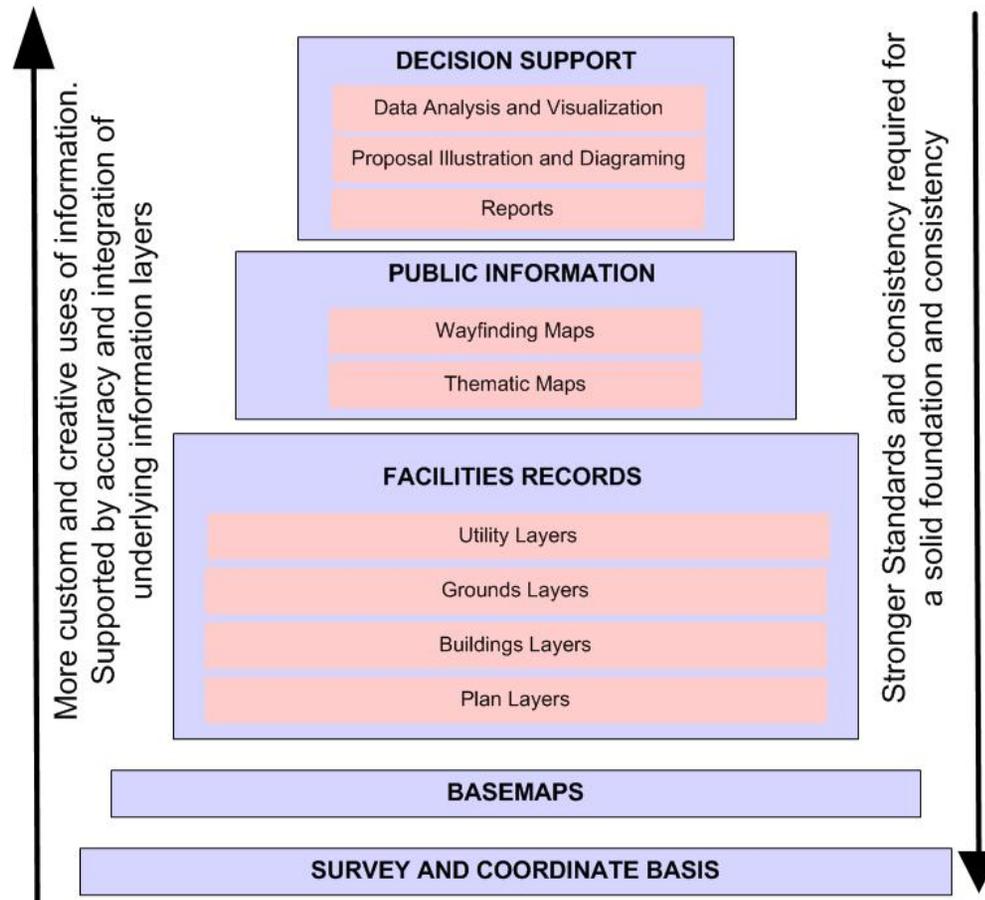
**Tabular database files with
location identifiers**

**Photographic Images
Aerials
Webcams
Etc.**

**Geographic Information System
“intelligent map” layers**



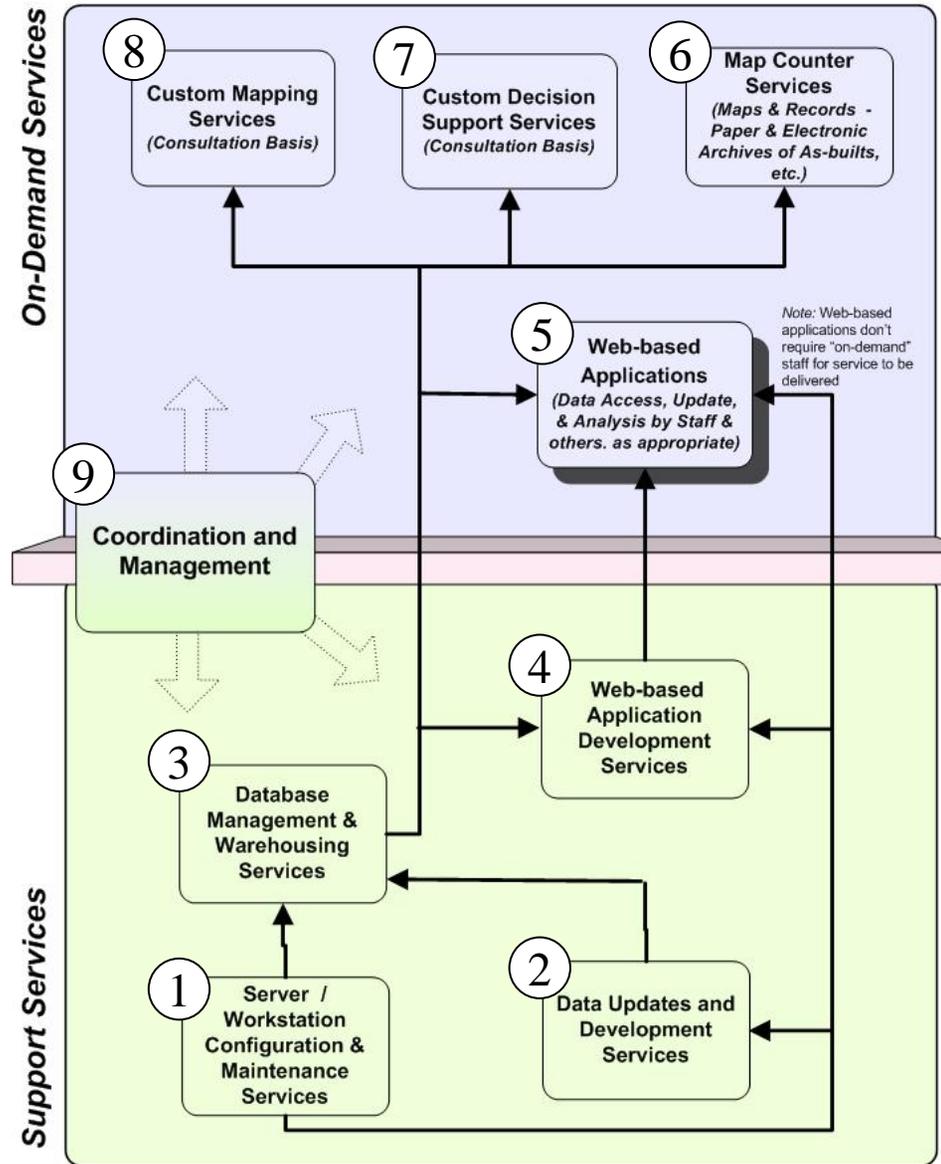
A Data Model for Organizing Diverse but Interrelated Spatial Data



Potential Spatial Data Services Framework

For
On-Demand Services
 (end user oriented)
 And
Support Services

CAMPUS SPATIAL INFORMATION SERVICES / SUPPORT Organized as "On-Demand Services" or "Support"

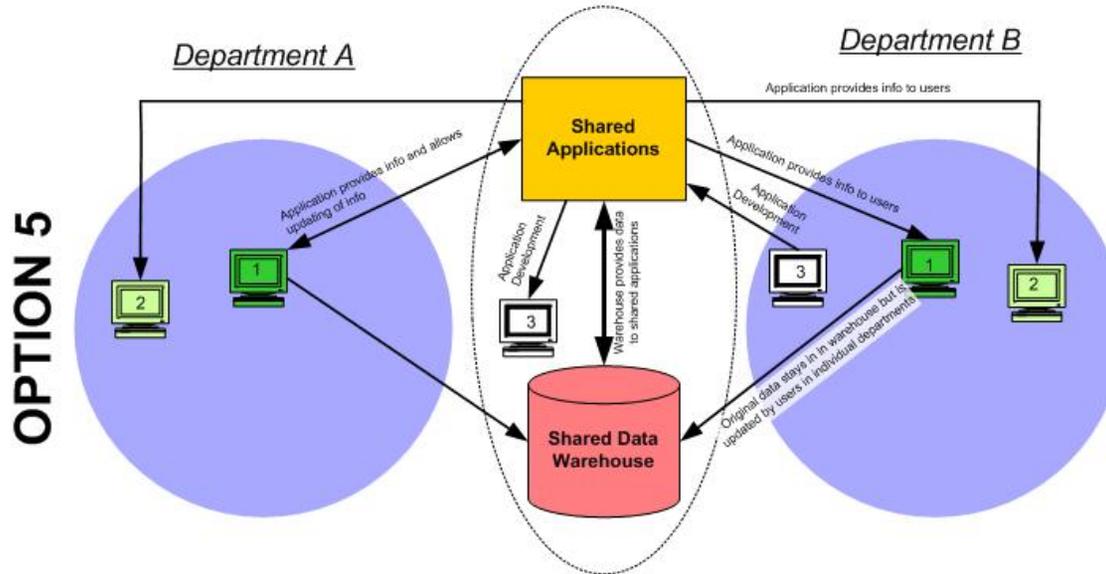


Information Technology Options

for Organizing a Spatial Data System

TECHNICAL OPTIONS FOR SYSTEM INTEGRATION (Page 3 - Continued)

“Enterprise Information System”: All data is stored in a shared data warehouse, with access and update controlled by privileges given to various departments. This data is used by shared applications, which are the main points of access to the data for most University employees



Notes:

This option involves keeping all shared data in the warehouse. One copy is stored for multiple uses: editing, downloading, serving to applications, etc.

Internal departmental applications / data may still exist, but with this model, all shared information would be maintained / accessed as a central resource.

Data is updated either by data maintainers who access the warehouse directly, or by other authorized users who access the data through the application interface. The “shared application” may actually be a series of interconnected applications for various purposes and with various levels of permission.

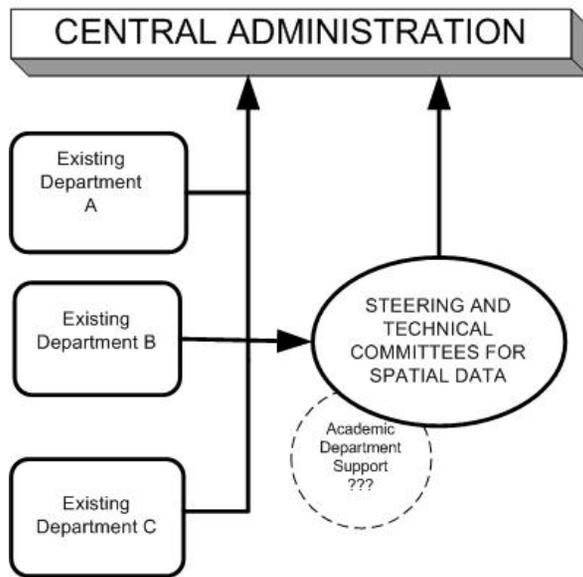
Agencies / campuses which have now or are planning such systems for some functions include: UNC Chapel Hill, Vanderbilt, Stanford, Tucson Water, and several UA Ag Extension functions.



Administrative Models for Organizing Campus Mapping / Spatial Data Services

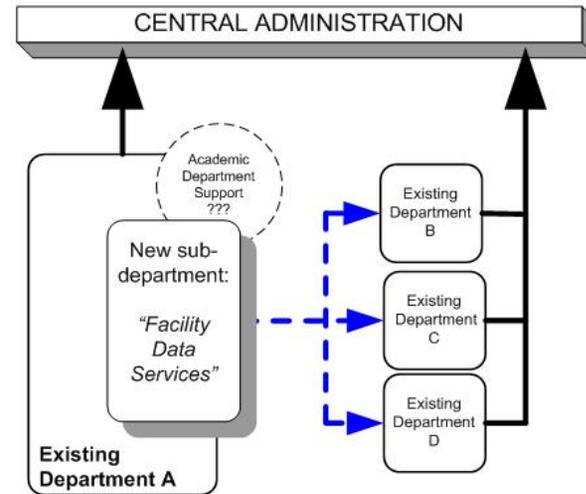
Coordinating Committee

ORGANIZATIONAL APPROACH #1

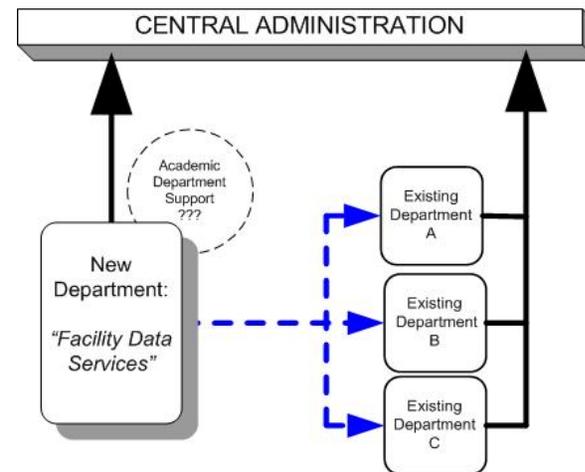


New Sub-department

ORGANIZATIONAL APPROACH #2



ORGANIZATIONAL APPROACH #3

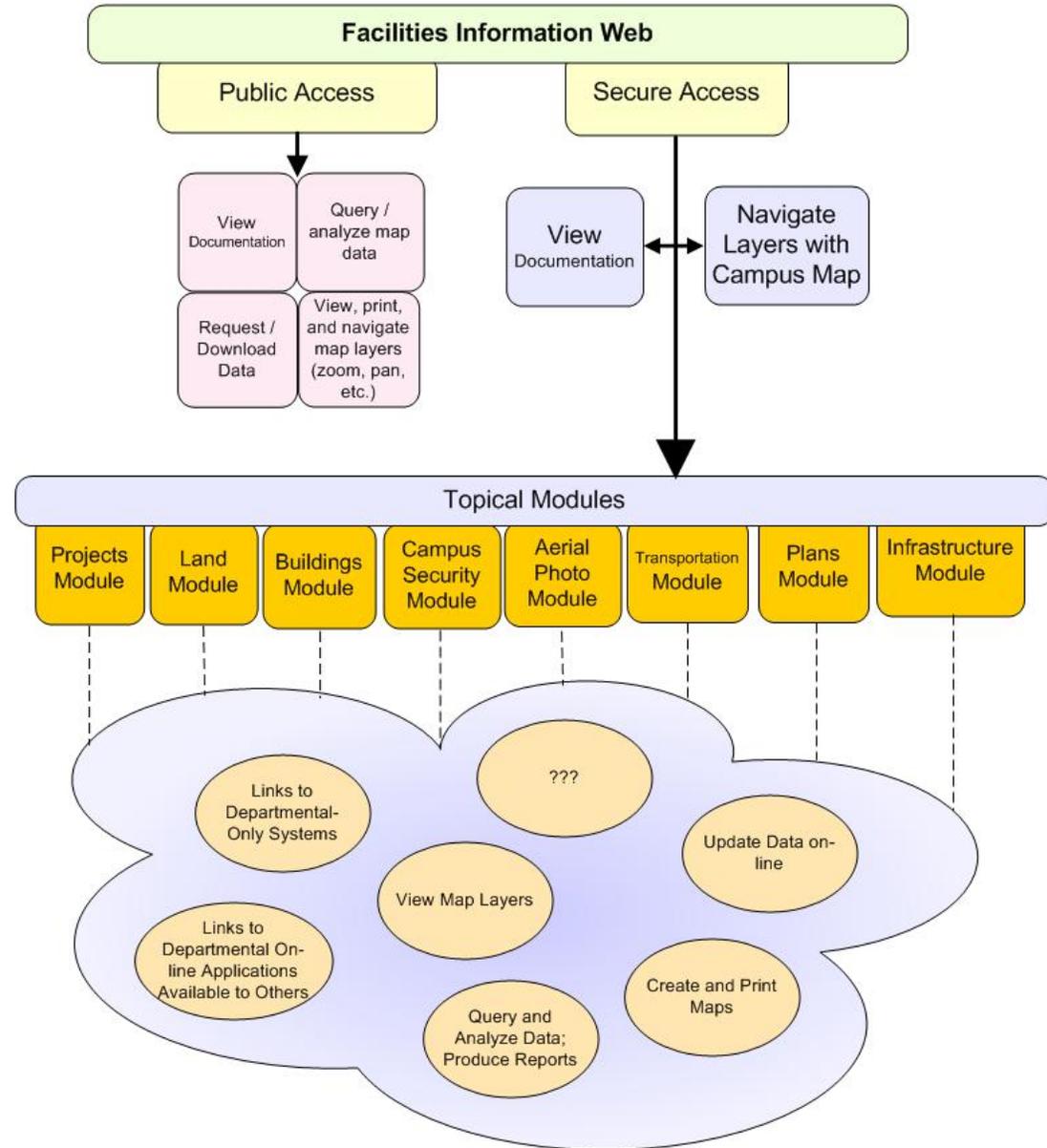


New Department



“Facilities Web” Application Concept

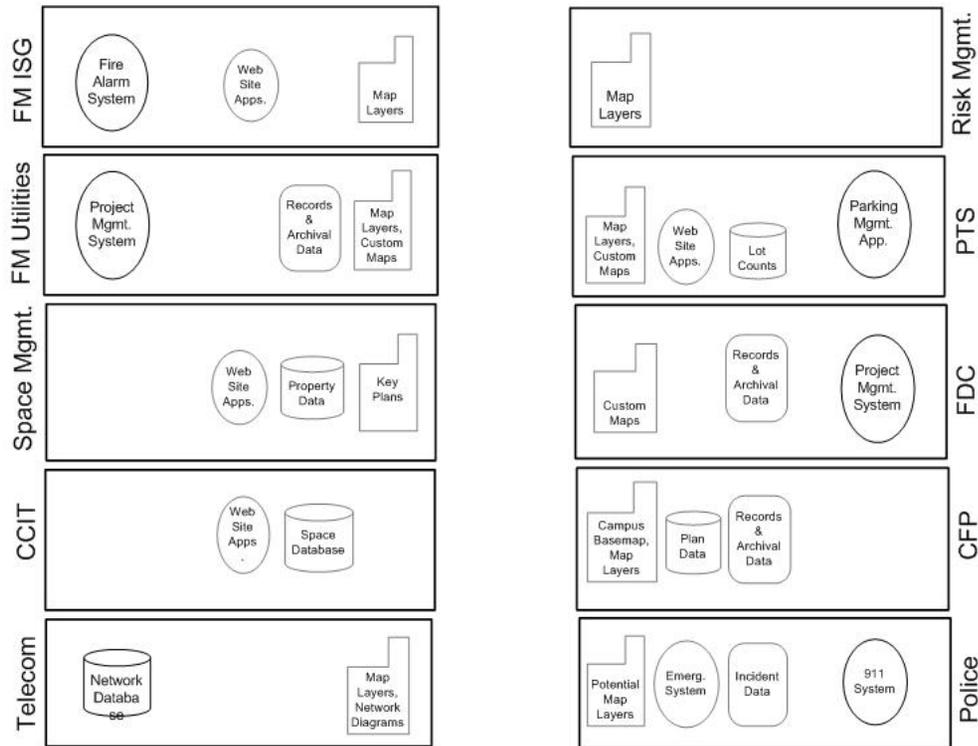
Conceptual Organization of a “Facility Web” Application



Applying Concepts to The UA

Facilities Departments Information / Systems

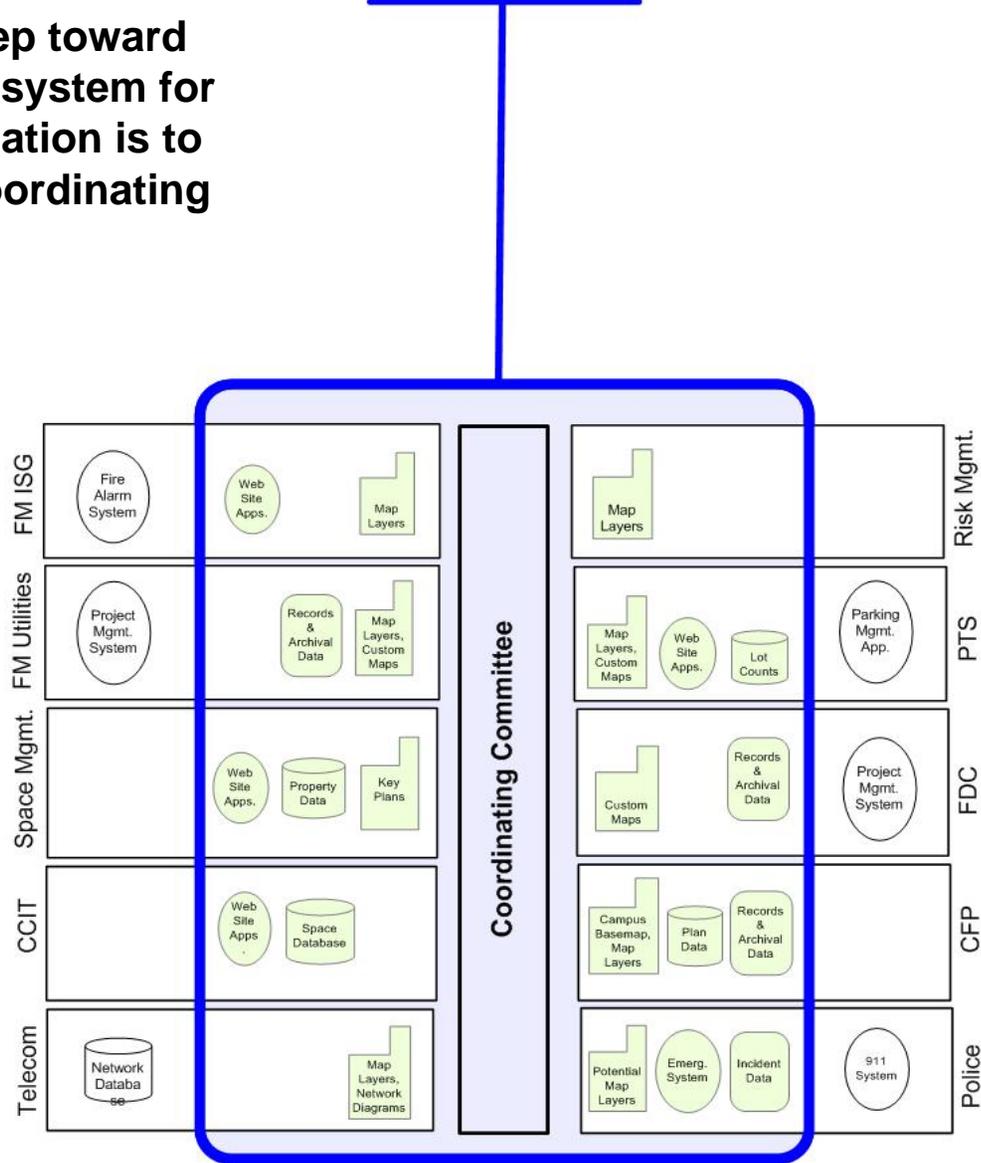
Business Affairs Departments have computer applications, maps, and databases related to a wide range of topics.



Applying Concepts to The UA

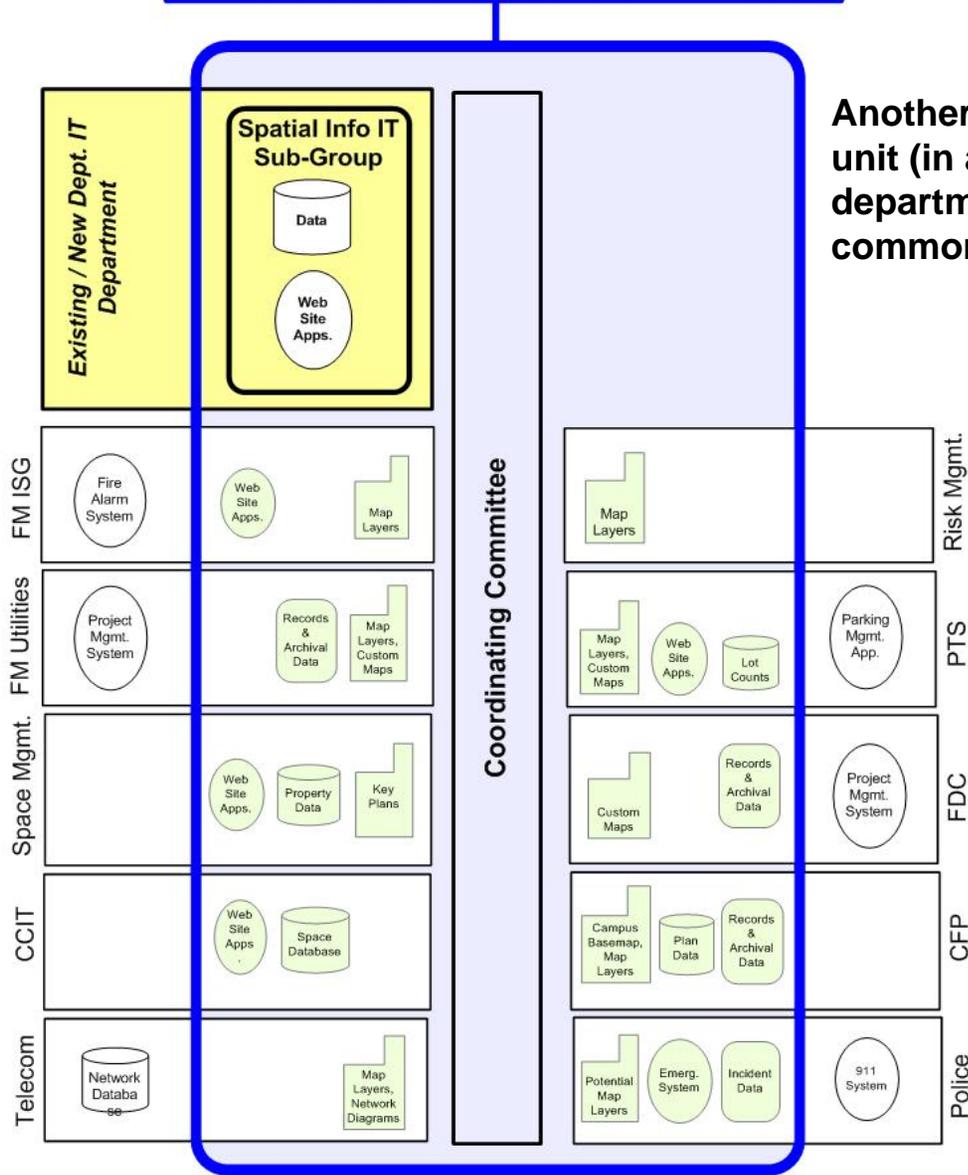
Building a *Business Affairs* Spatial Information System COORDINATION

A possible step toward an enterprise system for spatial information is to establish a coordinating committee



Applying Concepts to The UA

Building a *Business Affairs* Spatial Information System INFORMATION TECHNOLOGY SUPPORT

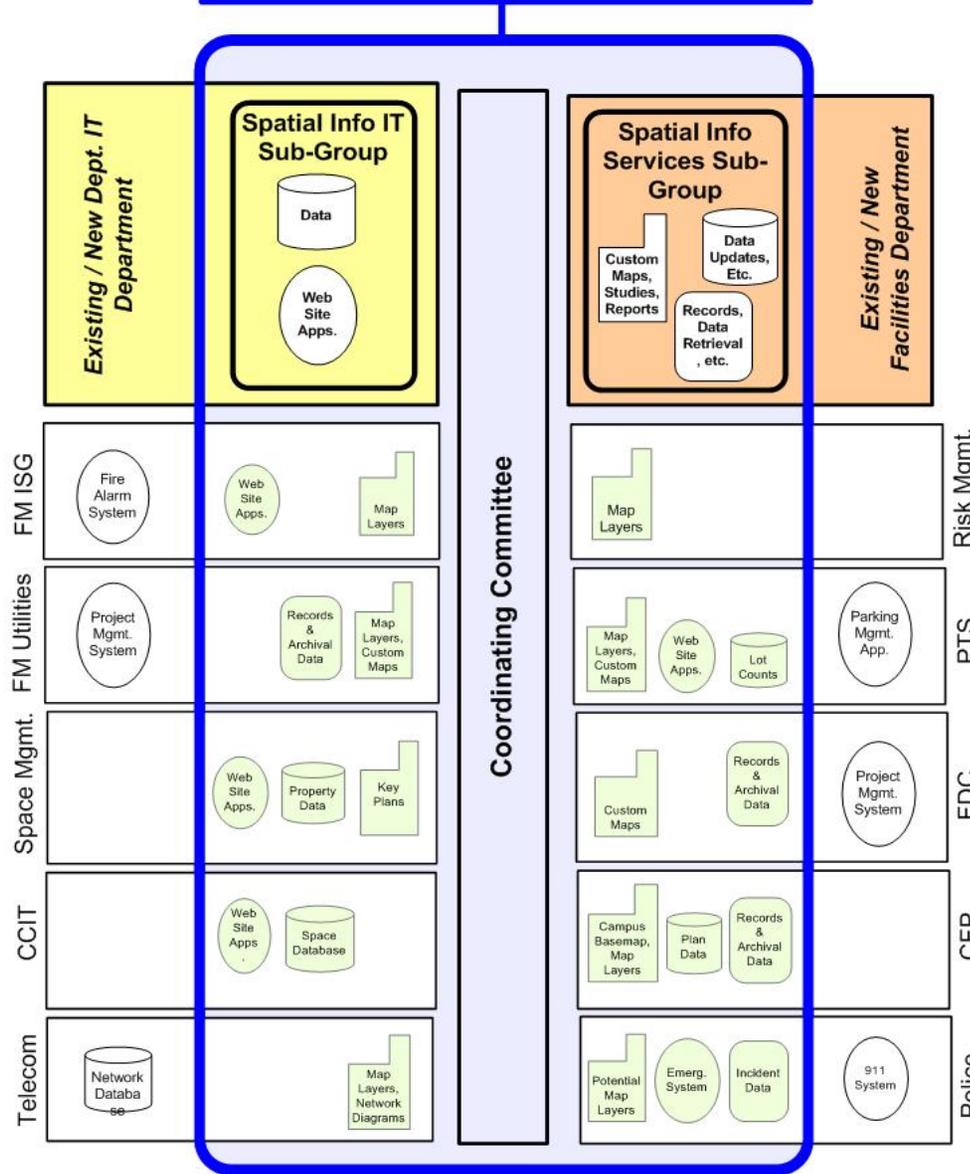


Another step is creating a new unit (in an existing or new department) to manage common IT elements which allow departmental systems and info to work together. Primary functions include database warehousing and application development



Applying Concepts to The UA

Building a *Business Affairs* Spatial Information System SPATIAL INFORMATION SERVICES

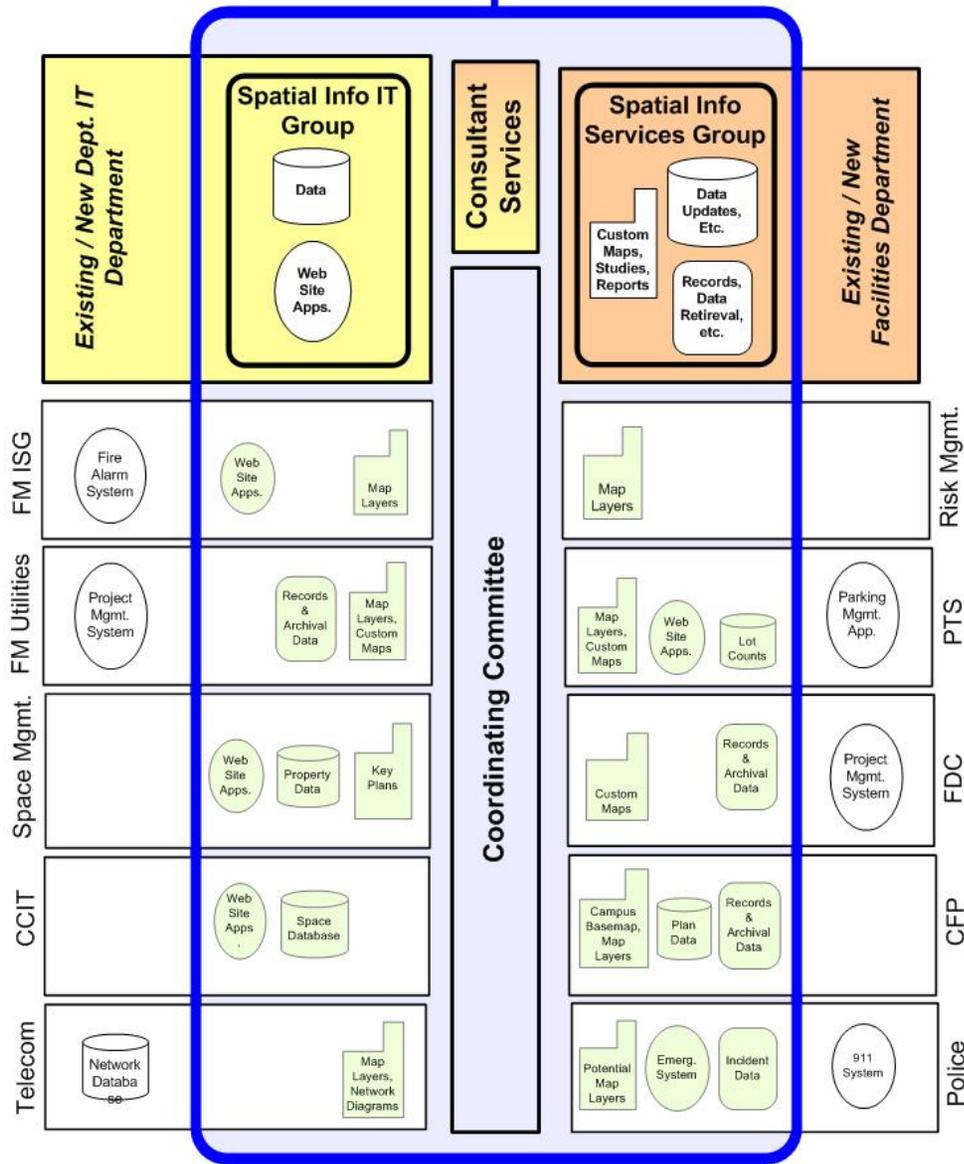


A final step is creating a new unit (in an existing or new department) to manage and use spatial info in a consolidated fashion. Functions could include on-demand mapping & reporting, data updates & development, archiving and data retrieval. Functions currently being done in departments could be moved all or in part here, or left where they are.



Applying Concepts to The UA

Building a *Business Affairs* Spatial Information System CONSULTANT SERVICES

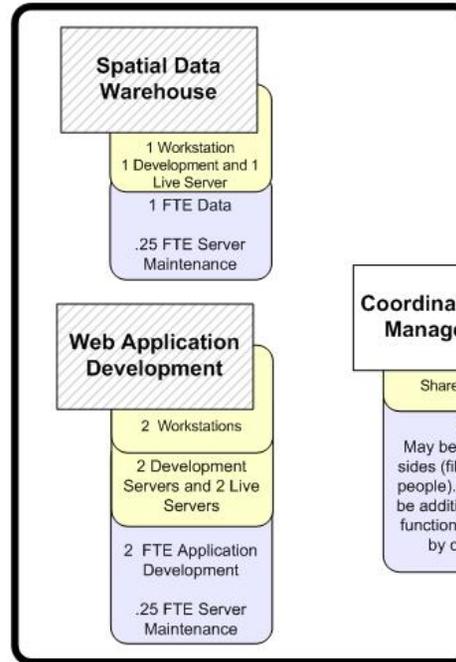


Some of the common functions could potentially be met by consultants

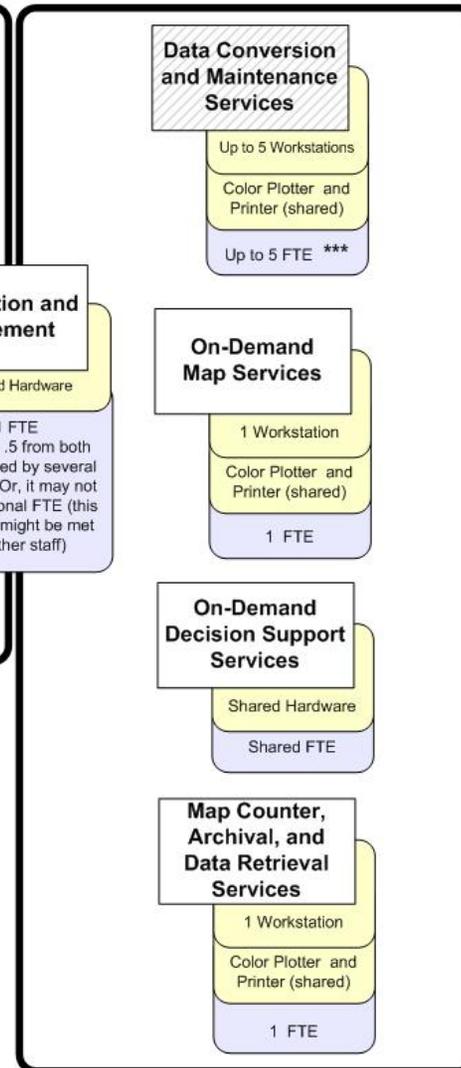


Applying Concepts to The UA

SPATIAL INFORMATION TECHNOLOGY GROUP *



SPATIAL INFORMATION SERVICES GROUP **



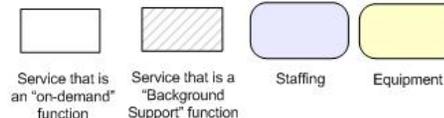
Preliminary review of **resource implications** of creating an IT Support Group and a Spatial Info Services Group

- * This IT Group could be a:
- 1) part of an existing department's IT group (e.g., FSO, PTS, etc.)
 - 2) be created as a part of a new stand-alone unit.

- ** This Services Group could be:
- 1) formed within an existing department
 - 2) affiliated with the another Department's IT group (e.g., coupled with IT option 1 above)
 - 3) created as a new stand-alone unit (or part of a new unit)
 - 4) implemented of a consortium of staff from different departments. This may be the least disruptive organizationally, but would require stringent standards for participation in order for necessary cooperation and integration to occur.

*** Staffing levels will be directly related to the data that is being maintained. Possibilities include basemaps, building data, building drawings, record drawings, archival imaging, utility maps, fire safety information, parking lot data and counts, incident records, campus plans, etc.

Note: Staffing recommendations for each service category could be augmented by student labor.



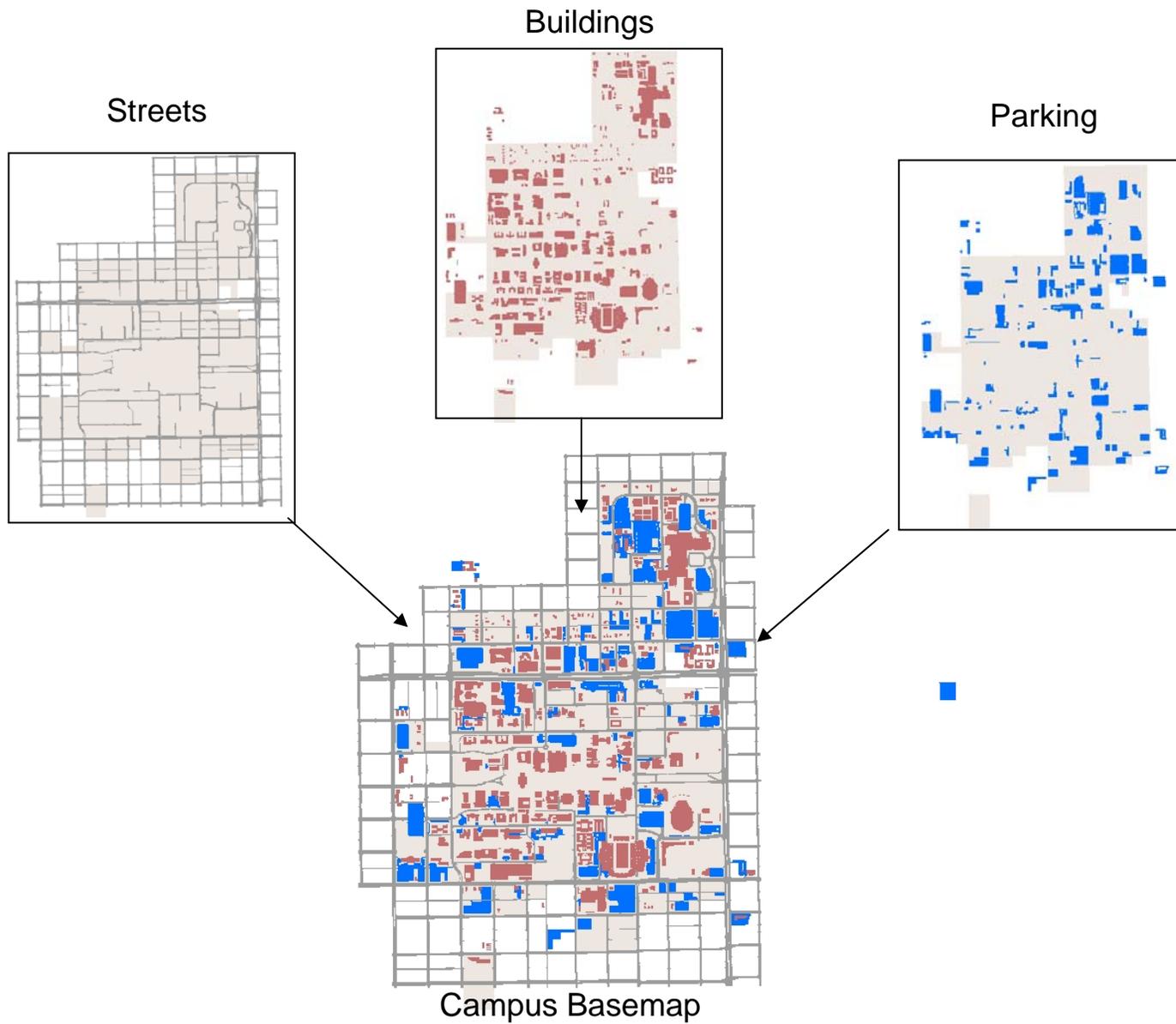


TECHNICAL MAPPING ISSUES

Communicating Key Ideas



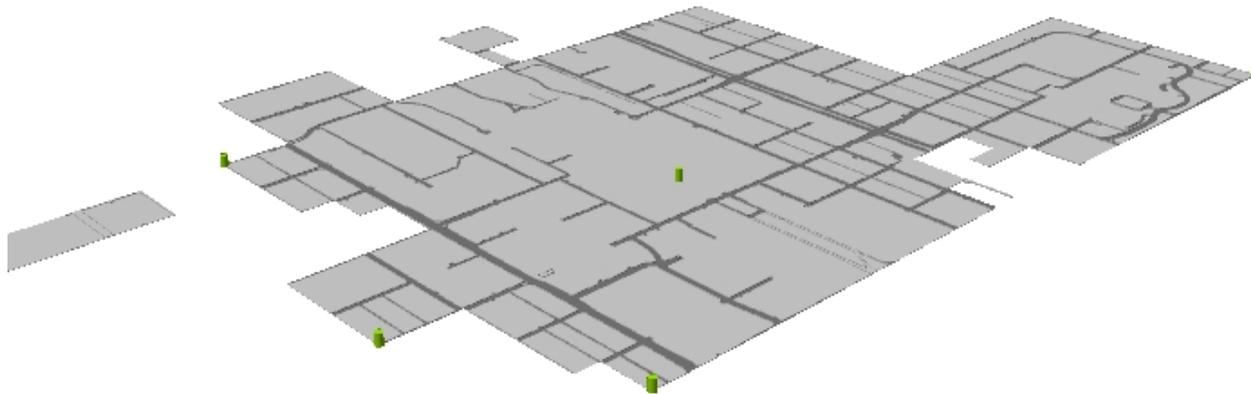
Map Layers Overlay to Create a Basemap



Using a shared *Coordinate System*

Basemaps, and other map features, are constructed as a series of layers

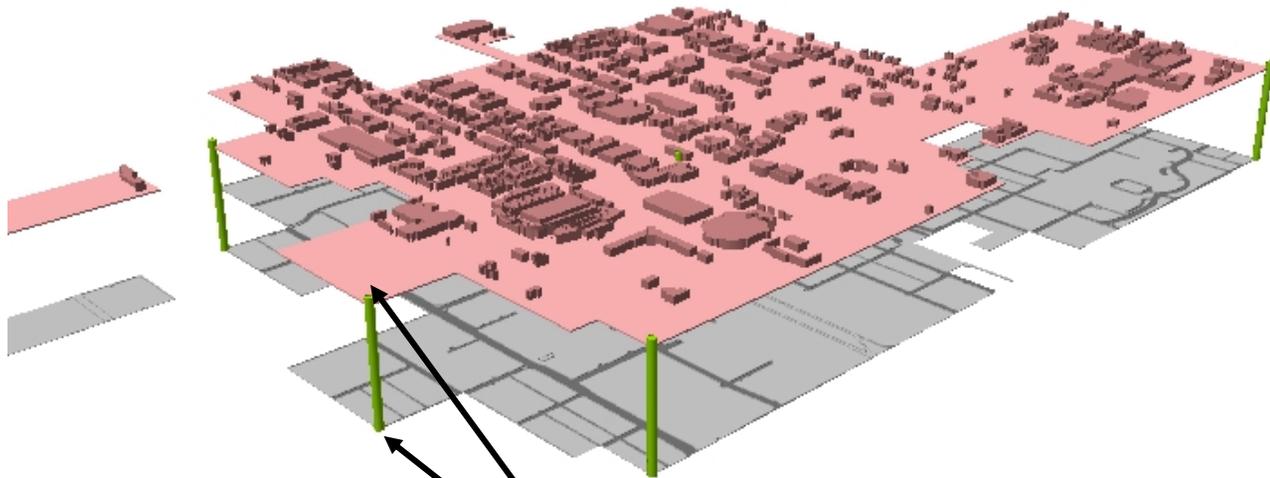
Streets “layer”



Using a shared *Coordinate System*

Proper Registration of Overlapping Layers Relies on Common Coordinates

The red buildings layer was mapped in the same coordinate system as the streets layer to insure proper registration



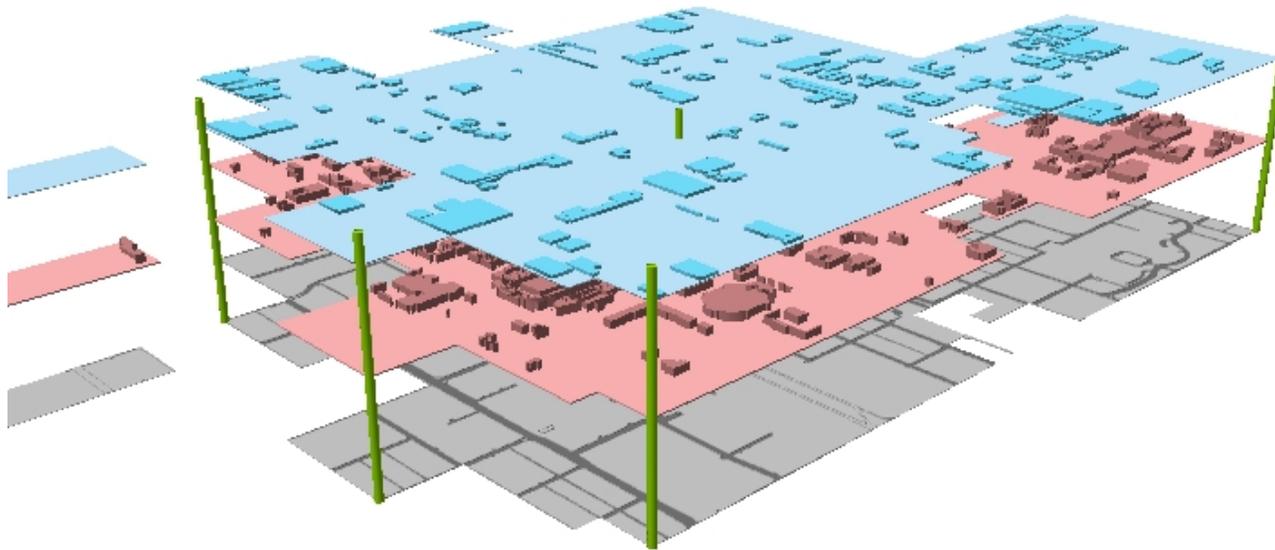
Each point occupies the same X,Y coordinates in each layer

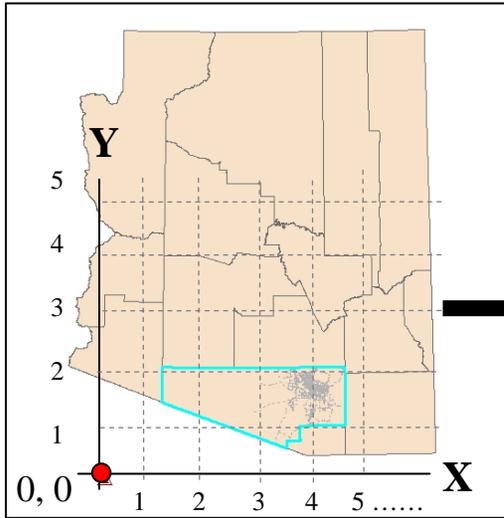


Using a shared *Coordinate System*

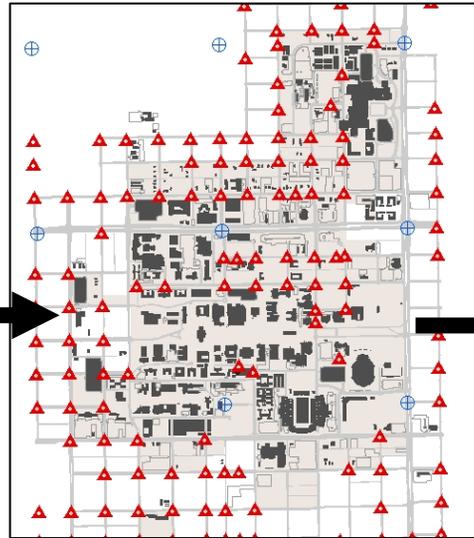
An unlimited number of layers may be built upon an appropriately constructed basemap

The blue parking lots are added as another layer. ➤

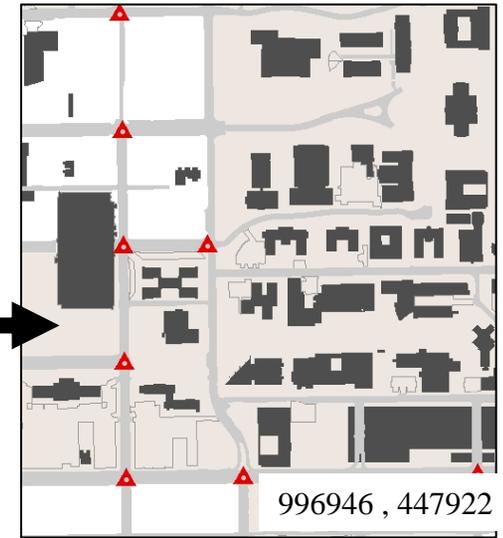




Grid defined by common points of origin / benchmarks (Arizona State Plane Coordinate System)



UA Survey Control Points, all in reference to common benchmarks.

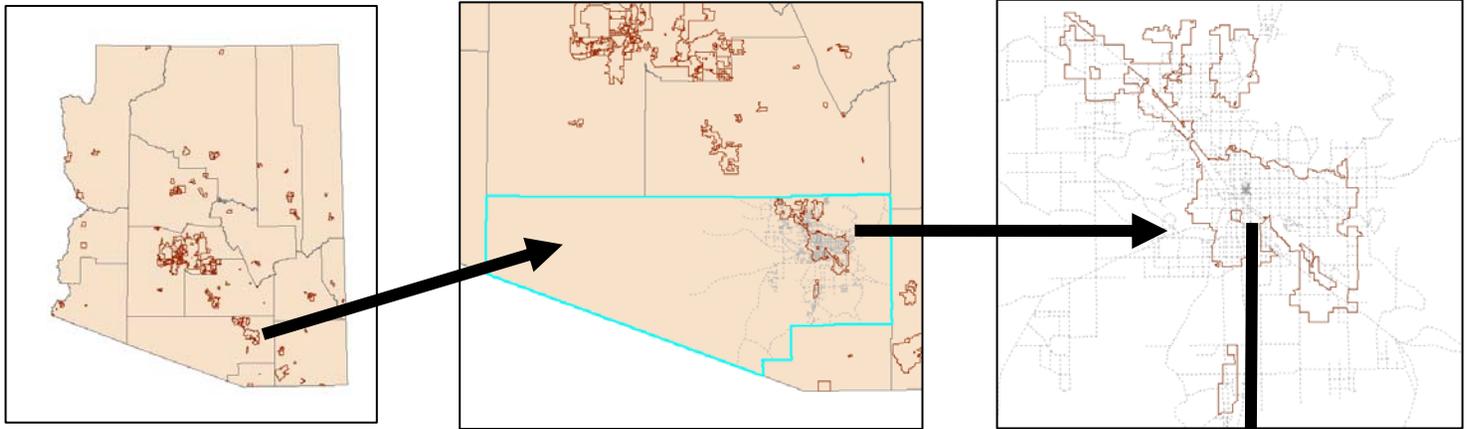


Coordinate values of monument at Park & 6th

The *Arizona State Plane Coordinate System* Provides a Framework for the UA's System of Survey Control Points



Integrating Data Across Geographic Scales.....

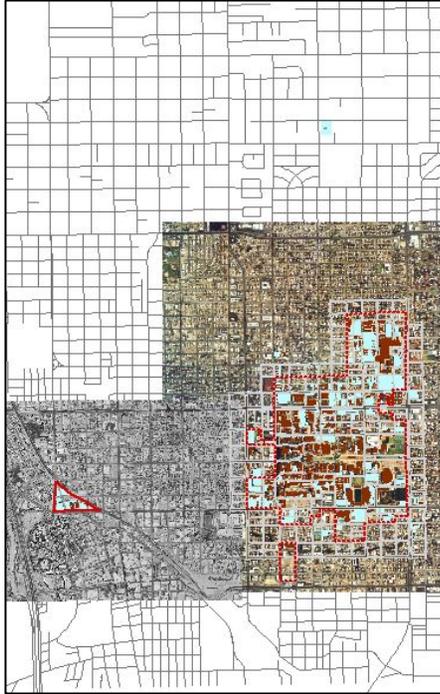


Is enabled by a common coordinate system

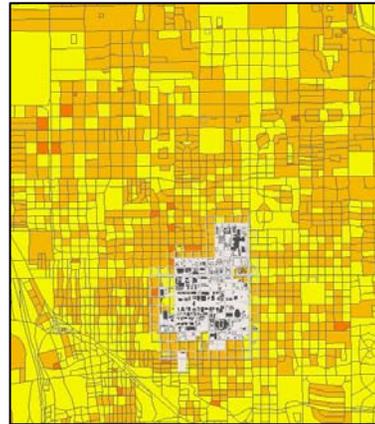


Standardized Coordinate System *Enables Data Sharing*

The State Plane Coordinate System is the “Standard” for local agencies. Collaborating with / sharing data with different jurisdictions is enabled by a common coordinate system

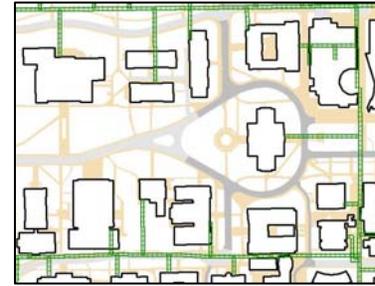


Data from four jurisdictions overlaid

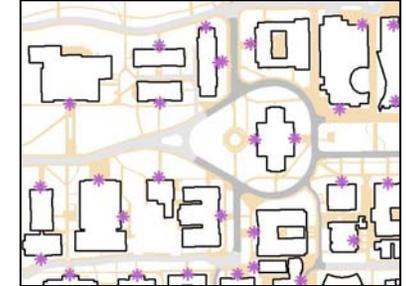


**Census data overlaid
With campus basemap**

Different layers may be reused, shared, and combined by different staff, allowing them to work more effectively and make better decisions



Tunnels



Building Entrances

Sampling of Spatial Layers: A to Z

- | | |
|-----------------------|--------------------|
| Accessible Entrances | Land Use |
| Accident Locations | Manholes |
| Attractions on Campus | Service Districts |
| Bike routes | Shuttle Routes |
| Building Expenditures | Utility Tunnels |
| Construction Zones | Park&Ride Lots |
| Contours | Project Locations |
| Crime Patterns | Property Ownership |
| Deferred Maintenance | Regional UA Sites |
| Delivery Routes | Vegetation |
| Emergency Phones | Zoning |
| Housing Distribution | |
| Hydrants | |

.... and much more

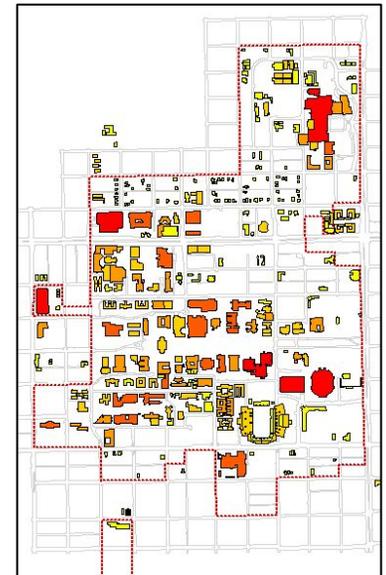


Intelligent GIS Maps: linking tabular data to graphics

The screenshot shows the ArcView GIS 3.2a interface. The main map window displays a grid of buildings colored in shades of red and orange. A black arrow points from a specific building on the map to a row in the 'Attributes of Buildings.shp' table. The table has the following columns: *Sm_gid*, *Sm_name*, *Address*, *Number*, *Blkz_cpt*, *Alpha_num*, *Alpha*, *Sign_num*, *Regist_no*, *Height1*, and *Acc_map*.

<i>Sm_gid</i>	<i>Sm_name</i>	<i>Address</i>	<i>Number</i>	<i>Blkz_cpt</i>	<i>Alpha_num</i>	<i>Alpha</i>	<i>Sign_num</i>	<i>Regist_no</i>	<i>Height1</i>	<i>Acc_map</i>
85881	02	1020 E University Blvd	29.00	29	29	29		C AUD	62.634	Accessible
20502	03	1100 E University Blvd	28.00	28	28	28			29.654	Ground floor accessible buildin
64789	02	1428 E University Blvd	56.00	56	56	56		BDWVN	47.917	Ground floor accessible buildin
83677	03	1306 E University Blvd	41.00	41	41	41		CHEM	33.801	Accessible
22487	02	1212 E University Blvd	40.00	40	40	40		NUGNT	10.614	Accessible
80346	03	1145 E South Campus	27.00	27	27	27		S SCI	44.890	Accessible
765	01	1630 E University Blvd	94.02	94	94	94B				Accessible
4952	02	715 N Park Ave	156.00	156	156	156	715 NORTH PARK AVE			
77403	03	1140 E South Campus	36.00	36	36	36		FORBES	39.091	Accessible

Each graphic object on the map (e.g., a building) relates to a record in a tabular database.



Building size symbolized by color (using Gross Square Feet data From Space Database)

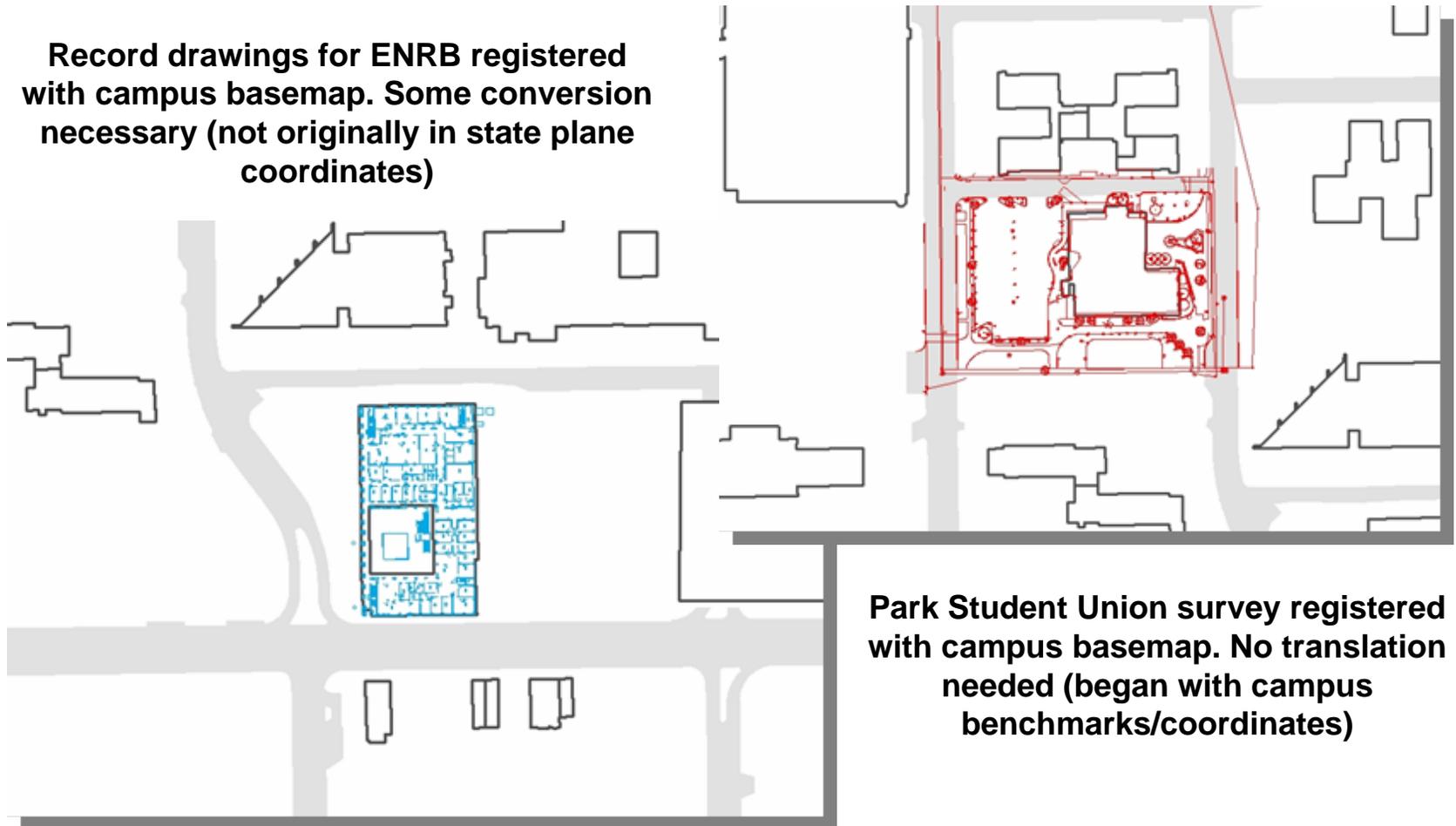
- Classify map graphics according to database values (i.e., thematic maps)
- Efficiently store and access tables of attributes about physical features
- Link maps to institutional tabular data
- Automate map labeling
- Query tabular data



Integrating

COMPUTER AIDED DESIGN AND DRAFTING (CADD)

Record drawings for ENRB registered with campus basemap. Some conversion necessary (not originally in state plane coordinates)



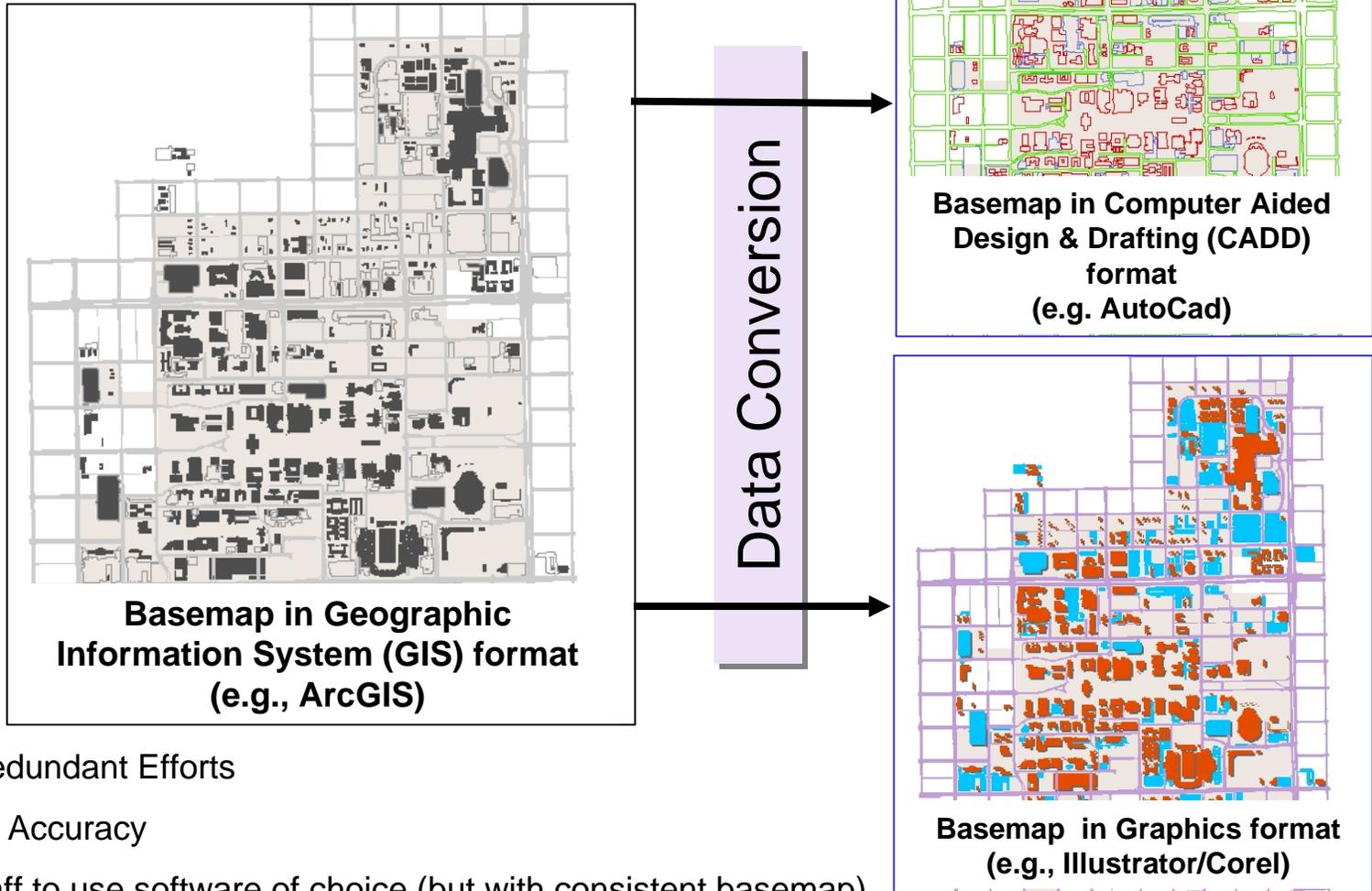
Park Student Union survey registered with campus basemap. No translation needed (began with campus benchmarks/coordinates)





Maintenance of Multiple Data Formats

Original basemap layers maintained in GIS format, then converted periodically to other formats



- Avoid Redundant Efforts
- Increase Accuracy
- Allow staff to use software of choice (but with consistent basemap)

Technical Procedures

Implementation in Progress

X-Ref procedures for CAD users

Basemap Standardization

Registering existing plans/drawings to basemap

Surveyor standards re: conversion from/to State Plane

Conversion of as-built/record drawings into State Plane

Etc.

