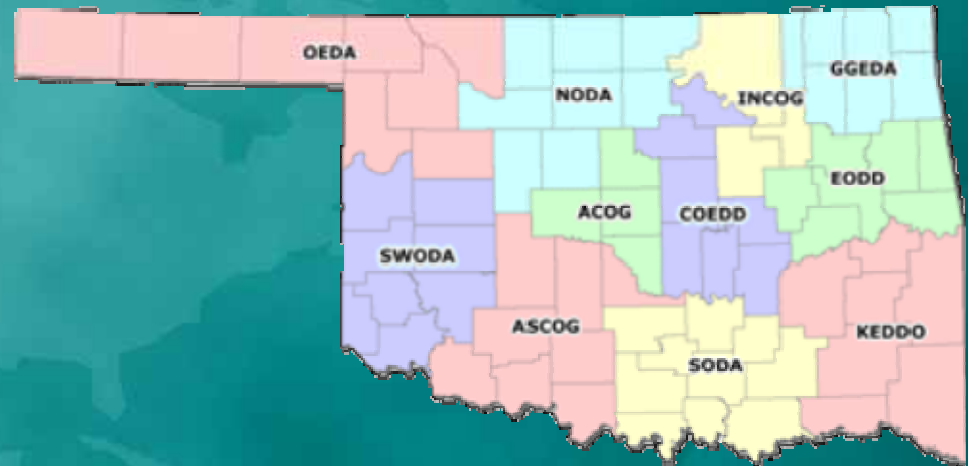




## GeoCIP© Program Partners



# Oklahoma GIS for GeoCIP

A Center for Spatial Analysis Report to  
Oklahoma GI Council  
6 November 2009

# The CSA team



Kathy Hines



Tran Trung



Semiha Caliskan



Scott March



May Yuan



Peter Camili

# The Vision and Goals

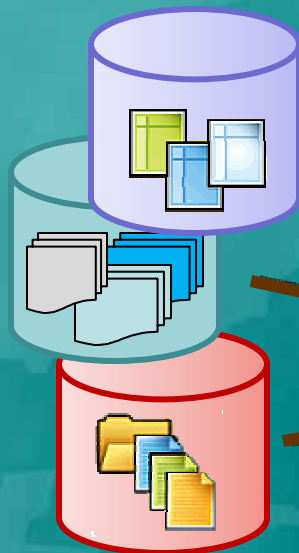


- Vision: A GeoCIP GIS to support asset inventory and management for local governments across the state of Oklahoma over the web through collaboration with ODOC, COG, and CSA.
- Goals to support the Vision
  - A standardized database system for all communities
  - Automation of cost estimates for asset management at different geographies
  - Web-based data browsing and mapping
  - Training and planning for sustainability

# Need data standardization



communities



## Standardized GIS Database

- Administration
- Electricity
- Gas
- Parks
- Structures
- Transportation
- Water
- Waste Water

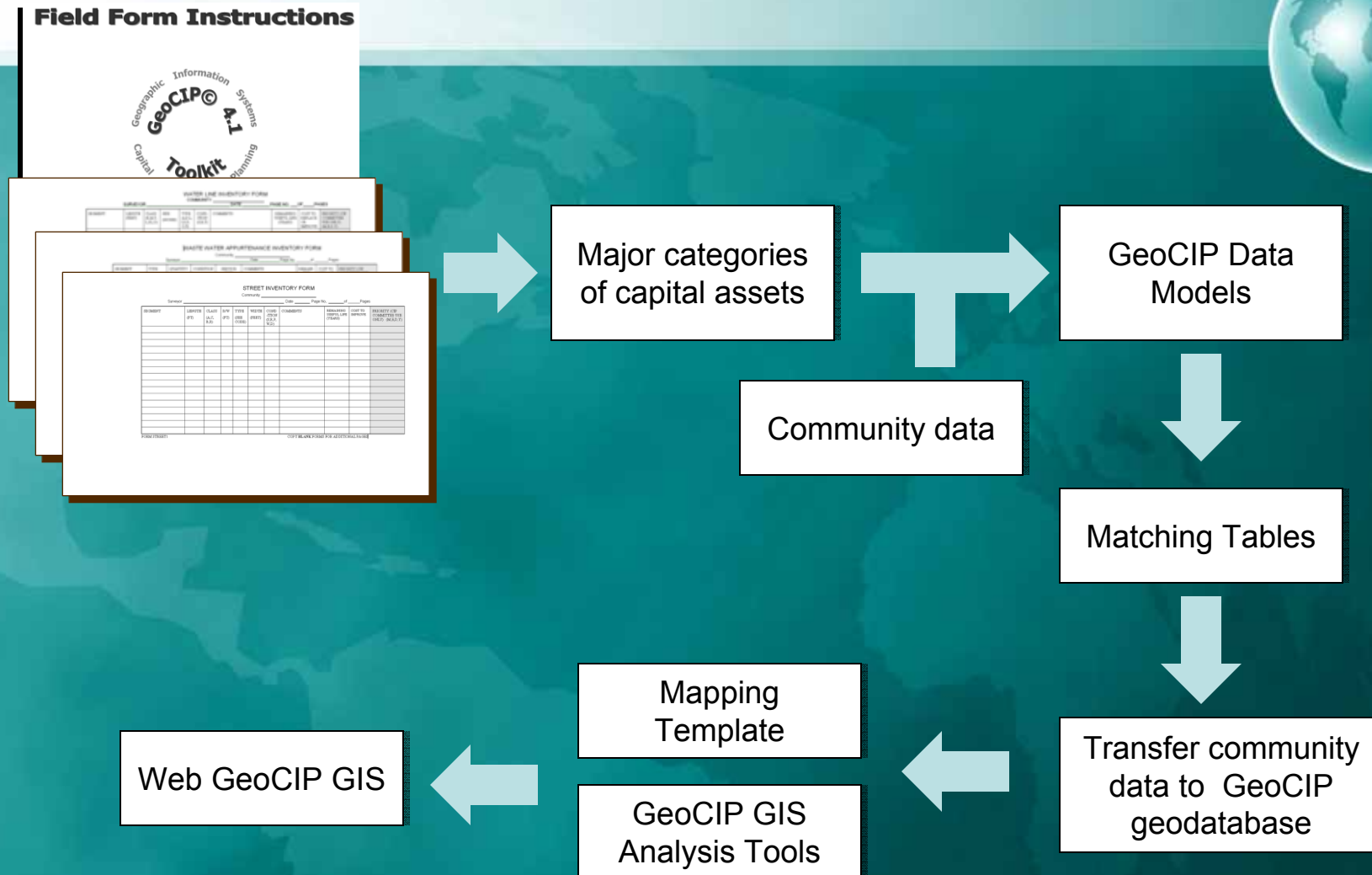


CIP  
reporting

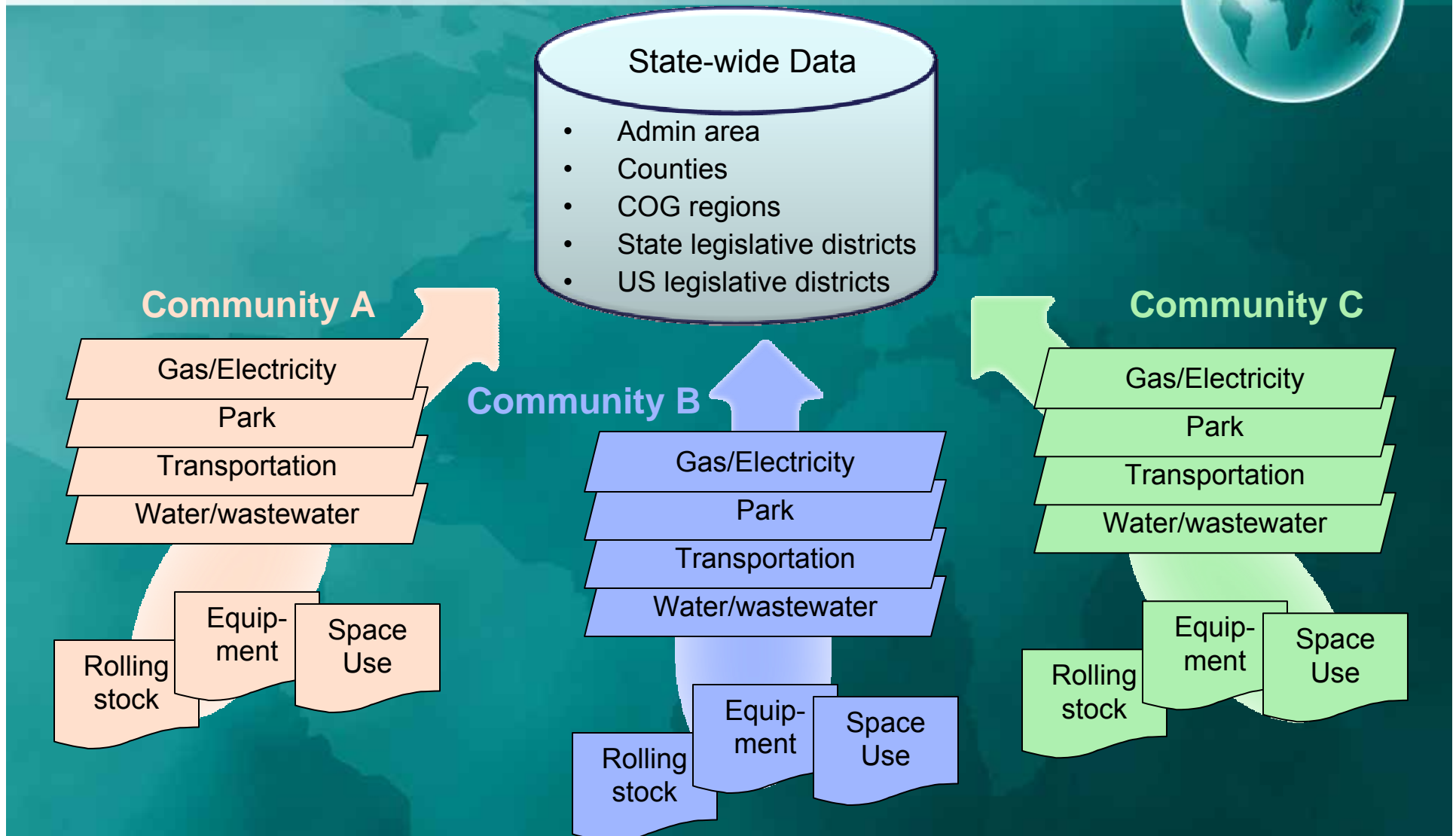
Data  
sharing  
and  
integration

Common  
analysis  
tools

Web GIS  
applications



# GeoCIP GIS data organization



# Standardization Process



- Identify applicable data models nation-wide and modify the data models to meet GeoCIP needs
- Determine what needs to be included in a data model (such as what features need to be in water utilities)
- Determine geometry for each feature
- Determine attributes for each feature
- Determine feature subtypes, data types, data domains (e.g. valid data values), and data description
- Determine matching tables from community data to the standardized data
- Edit meta data for each feature class and attribute
- Transfer community data to GeoCIP geodatabase
- Provide training to geotechs on database management

# Example: Water Data Models



- ESRI Water Utilities Data Model
- GeoCIP Water
- GeoCIP Wastewater
- GeoCIP StormDrainage

Water Utilities Data Model - ESRI Support - Mozilla Firefox

File Edit View History Delicious Bookmarks Tools Help

http://support.esri.com/index.cfm?fa=downloads.dataModels.filteredGateway&dmdid=16

Most Visited Getting Started Latest Headlines Customize Links Free Hotmail Windows Marketplace Windows Media Windows

ESRI Support Center Your online technical resource

Customer Service | Training | Contact Us

Welcome, May.

Support Home Software Knowledge Base Downloads User Forums

Search the Support Center for data models Go

Open my search options (default) Need help?

You are here: [Support Home](#) > [Data Models](#) > Water Utilities

## Water Utilities Data Model

Date Submitted: July 9, 2001  
Last Modified: April 1, 2009

The ArcGIS Water Utilities Data Model provides the foundation for a complete GIS solution geared to the needs of Water/Sewer Stormwater utility end users. The Water/Sewer Stormwater Data Model is a collection of objects, feature classes and attributes defined for water and wastewater distribution networks. The model can be tailored to meet project requirements for data management and integration with other systems.

For more information contact [Lori Armstrong](#). And for a link to the downloadable ArcScript developer samples click [Team Water](#).

### User Forums

**Data Model User Group**

Join the [data model user group](#) if you are an existing ArcGIS customer and want to learn more about design and architecture of personal or enterprise Geodatabase and become a part of ESRI's growing data model community.

We invite user group members to participate in a

# Need to recognize distinctive attributes



- Example: Open drainage line (Ditch) vs. Close drainage line (Main)
  - depth of a ditch  $\neq$  depth of a main line
  - ditch has width, main has diameter
- Solution
  - Represent both ditch and main as one line feature class
  - Merge attributes of the two
- Example: Appurtenance and Hydrant/Meter/Valve
  - Appear similar
  - May have distinctive attributes and functions
- Solution
  - Each is represented as a separate feature class

# Hydrant, Meter, and Valve



## Water Network Feature Class::CommunityName\_wHydrant

- HydrantID : esriFieldTypeString
- BarrelDiameter : wDomainDiameter = 10
- MainValveType : esriFieldTypeString
- NozzleDiameter1 : wDomainDiameter = 4
- NozzleDiameter2 : wDomainDiameter = 4
- NozzleDiameter3 : wDomainDiameter
- NozzleDiameter4 : wDomainDiameter
- OutletConfiguration : esriFieldTypeString
- SeatDiameter : esriFieldTypeInteger

## Water Network Feature Class::CommunityName\_wMeter

- MeterID : esriFieldTypeString
- Type : wDomainMeterType
- Diameter : wDomainDiameter
- FlowRange : esriFieldTypeString

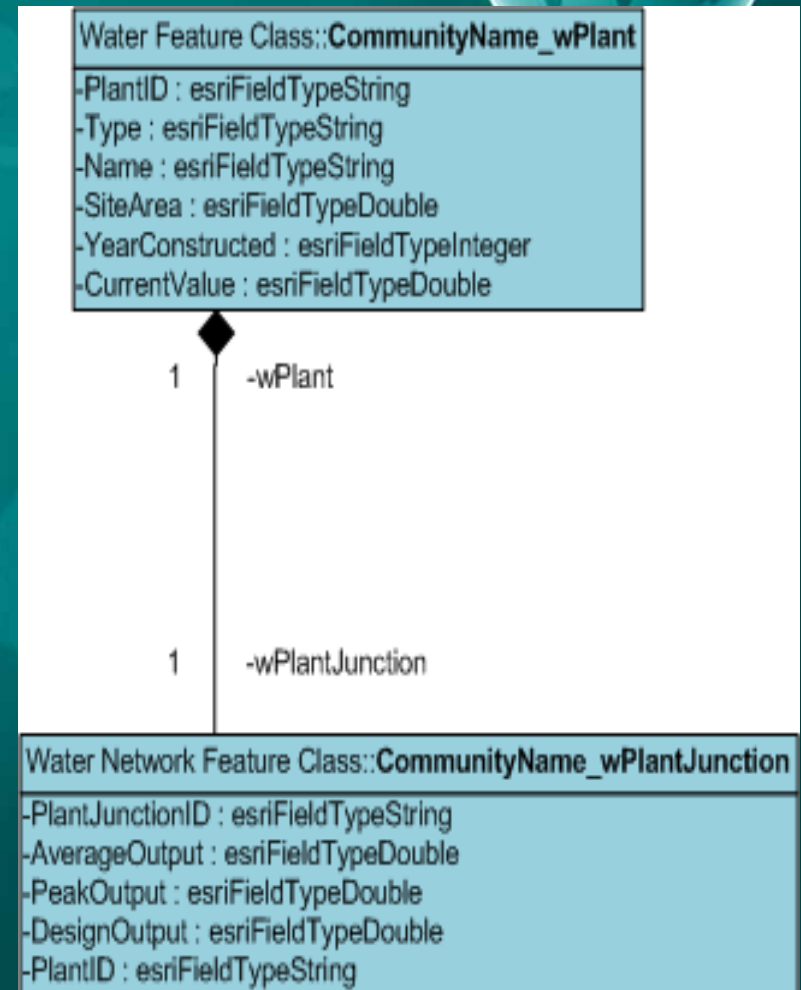
## Water Network Feature Class::CommunityName\_wValve

- ValveID : esriFieldTypeString
- Diameter : wDomainDiameter
- BypassValve : DomainBoolean = 0
- RegulationType : wDomainWHSysValveRegulationType
- TurnsToClose : esriFieldTypeInteger
- SystemValveType : wDomainSystemValveType
- ControlValveType : wDomainControlValveType

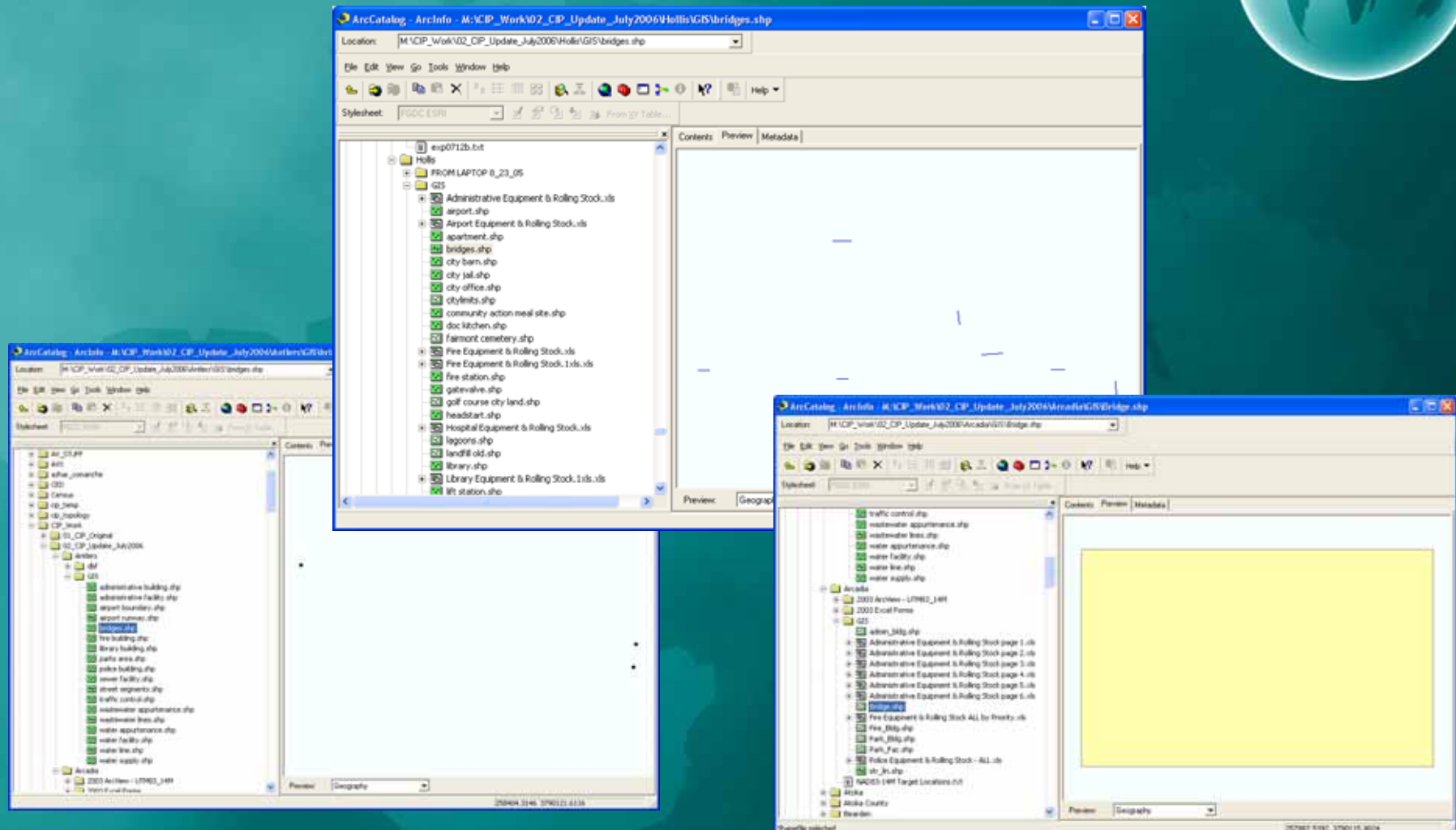
# Need to Recognize Proper Spatial Representation



- Plant as Point vs. Plant as Polygon
- Example
  - A plant is the end (sink) of a water/wastewater network
  - A plant has shape and area
- Solution
  - Represent a plant as both polygon (Plant feature class) and point (PlantJunction feature class)
  - One Plant, one PlantJunction
  - PlantJunction has attributes regarding network flow (e.g. average output, peak output, and design output)
  - Plant has descriptive attributes (e.g. name, site area, current value, ...)



# Example of geometry issues: Bridge



# Example of attribute issues



Community A

CONDITION
R
S
R
R
R
R
R
S
S
R
R
R
S
R
S
R
S
R
R
R
R
R
R
R
R

Community B

CONDITION
SATISFACTORY
SATISFACTORY
SATISFACTORY
SATISFACTORY
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**Database Properties**

General Domains

Domain Name	Description
DomainCondition	Condition of the asset
DomainCounty	Name of County
DomainInitialPriority	Initial Priority
tDomainAirportClass	Type of the Airport Class
tDomainBridgeDesignCon	Type of design of the the bridge
tDomainBridgeMaterialDe	Kind of Material used for the bridge
tDomainCommercialServic	Type of the Commercial Service Primary Airports
tDomainCurbs	Number of the curbs
tDomainDirectional	Directions

Coded Values:

Code	Description
Satisfactory	Satisfactory
Not Satisfactory	Not Satisfactory

OK Cancel Apply

# Example: standardize attribute values



**Database Properties**

General Domains

Domain Name	Description
DomainCondition	Condition of the asset
DomainCounty	Name of County
DomainInitialPriority	Initial Priority
tDomainAirportClass	Type of the Airport Class
tDomainBridgeDesignCon	Type of design of the the bridge
tDomainBridgeMaterialDe	Kind of Material used for the bridge
tDomainCommerci	
tDomainCurbs	
ItDomainDirectiona	

Coded Values:

Code	Description
Mandatory	Mandatory
Essential	Essential
Desirable	Desirable
Deferrable	Deferrable

OK Cancel Apply

# Reorganize the Attributes



## Type of street, type of surface & number of sidewalks for street segment

U	Platted or dedicated but unopened for public use
D	Opened but unimproved
G	Gravel
OCR	Oil & Chip
A	Asphalt without curb & gutter
AC	Asphalt with curb & gutter
B	Brick without curb & gutter
BC	Brick with curb & gutter
C	Concrete without curb & gutter
CC	Concrete with curb & gutter

**Note:** Add a 0,1 or 2 to Type code for none, one or two sidewalks along street segment

## Existence of Sidewalk

0	No Sidewalk
1	Sidewalk one side
2	Sidewalk both sides

## Number of Curbs

0	No Curbs
1	One Curb
2	Two Curbs

## Street Surface Material

Gravel
Oil and Chip
Asphalt
Brick
Concrete

# Reorganizing the Domain Values



Street Classification	
A	Arterial
C	Collector
B	Commercial/industrial
R	Residential

GeoCIP Street Classification	
H	Highway
C/I	Commercial/Industrial
C	Collector
A	Arterial
RE	Residential
SR	Scenic Route
P	Private
PR O	Proposed
EA	Emergency Access
AL	Alley
R	Ramp
L	Local
U	Unknown

# Matching Tables



- Match community data with GeoCIP geodatabase
- Determine matches for the following items
  - Feature classes
  - Attribute fields
- Developed a matching tool to match community data to GeoCIP geodatabase definitions
- Develop data transfer tool to transfer community data to GeoCIP geodatabase

# Matching and standardization



## Community A “Streets” attributes

Field 1 – Distance  
Field 2 – Type  
Field 3 – Surface type  
Field 4 – Curbs, number  
Field 5 - Condition

## Community A matching table

Input “Streets” attributes	Output “Roads” attributes
Field 1 – Distance	Field 1 – Length
Field 2 – Type	Field 2 – Type
Field 3 – Surface type	Field 3 – Surface
Field 4 – Curbs, number	Field 4 – (Empty)
Field 5 – Condition	Field 5 – Condition

## GeoCIP geodatabase

### Community A: Roads

Field 1 – Length  
Field 2 – Width  
Field 3 – Surface  
Field 4 – Type  
Field 5 – Class  
Field 6 – Condition  
Field 7 – Comments  
Field 8 – Cost

## Community B “Roads” attributes

Field 1 – Sidewalk  
Field 2 – Cost to fix  
Field 3 – Condition  
Field 4 – Wide  
Field 5 – Length  
Field 6 - comment

## Community B matching table

Input “Roads” attributes	Output “Roads” attributes
Field 1 – Sidewalk	Field 1 – (Empty)#
Field 2 – Cost to fix	Field 2 – Cost
Field 3 – Condition	Field 3 – Condition
Field 4 – Wide %	Field 4 – Width
Field 5 – Length	Field 5 – Length
Field 6 - comment	Field 6 - Comments

### Community B: Roads

Field 1 – Length  
Field 2 – Width  
Field 3 – Surface  
Field 4 – Type  
Field 5 – Class  
Field 6 – Condition  
Field 7 – Comments  
Field 8 – Cost

# Attribute Matching Table



Matching table (MatchingTab.txt).				
This table has 5 columns: Identifier, CIP_Shapefile, ESRI_FeatureClass, SQL_Condition, and Default Value.				
- <b>Identifier:</b> (required) This field is used to identify whether a line in this table is for layer matching or for field matching. The values can be:				
----- {} : for community				
----- [] : for shapefile				
----- * : for fields				
----- ? : to specify a default value of a particular field of a ESRI feature class				
----- Note: Usually field matching follows right after layer matching.				
- <b>CIP_Shapefile:</b> (required) This field can be a shapefile name or a field name of a CIP shapefile.				
- <b>ESRI_FeatureClass:</b> (required) This field can be a feature class name or a field name of an ESRI feature class.				
- <b>SQL_Condition:</b> (optional) This field is used if the CIP shapefile has to be split out into many ESRI feature classes. It has to follow the SQL structure accepted by ArcGIS. E.g. <b>Type = 'FH'</b> . In this case, <b>Type</b> is a field name in the shapefile (NOT the ESRI feature class). If there is no need to split, leave this field blank.				
- <b>Default Value:</b> (optional) This field is used if it is necessary to assign a default value to a particular field of the ESRI feature class. In this case, the default value can be either a constant or an SQL expression to get data from variety of fields of the original shapefiles. E.g. Comments = "FAC_SQ_FT=" & [FAC_SQ_FT] → Value of the Comments field of this feature class is a combination of a text "FAC_SQ_FT=" and the value taken from the field FAC_SQ_FT of the matching shapefile.				
After finishing this table, please Save As this table to Tab Delimited Text (*.txt) with the filename: MatchingTab.txt. Click Yes or OK when prompted.				
Required means the column cannot have null or blank value.				
Optional means the column can have null or blank value.				
** Please do not change the following example.				
Identifier	CIP_Shapefile	ESRI_FeatureClass	SQL_condition	Default Value
{}	Martha_			
[]	firehydrantsmerged	Hydrant	Type = 'Fire Hydrant'	
*	APPURTENAN	FacilityID		
*	REM_LIFE	RemainingUsefulLife		
[]	gatevalvesmerged	ControlValve	Type = 'Gate Valve'	
*	APPURTENAN	facilityID		
*	REM_LIFE	RemainingUsefulLife		
{}	Arapaho_			
[]	Appurtenance	SystemValve	App_Type = 'HY'	
*	App_ID	Utility_ID		
*	Appurtenance	Hydrant	App_Type = 'FH'	
{}	Ravia			
[]	Ravia Wastewater Apps	Ravia_wwAccess	App_Type = 'Manhole'	
	Community			
	Date_			
	Surveyor			
*	App_ID	AccessID		
	App_Type			
*	Seg_ID	SegmentID		
*	Condition	Condition		
*	Comments	Comments		
*	REM_LIFE	RemainingUsefulLife		
*	Cost_IP_RE	Cost		
*	S_Priority	InitialPriority		
I	Priority	IPACPriority		

# Domain Matching Table



2	Identifier	Original Value	New Value	Field used
3	[ ]	wDomainCondition		<i>This is example.</i>
4	*	S	Standard	<i>This is example.</i>
5	*	I	Improvement	<i>This is example.</i>
6	[ ]	<b>DomainCondition</b>		<b>Condition, StructureCondition, ...</b>
7	*	S	S	
8	*	R	N	
9	*	I	N	
10	*	T	N	
11	*	Satisfactory	S	
12	*	Needs Improvement	N	
13	*	Should Be Replaced	N	
14	[ ]	<b>DomainInitialPriority</b>		<b>InitialPriority, StructureInitialPriority, ...</b>
15	*	Y	Deferrable	
16	*	E	Essential	
17	*	M	Mandatory	
18	*	D	Desirable	
19	*	Deferrable	Deferrable	
20	*	Essential	Essential	
21	[ ]	<b>wDomainWaterLineMaterial</b>		<b>Material (usually for water/wastewater line)</b>
22	*	I	CI	
23	*	C	CL	
24	*	P	PVC	
25	*	O	Other	
26	*	D	DI	
27	*	S	Steel	
28	*	U	Unknown	
29	*	Clay	CL	

# Metadata editing

The screenshot displays the ArcGIS Desktop environment with the following components:

- File Explorer:** Shows the project structure under 'GeoCIP' > 'CommunityName', listing various feature classes like 'CommunityName\_dAccess', 'CommunityName\_dBasin', etc.
- Metadata Editor:** The main window showing details for 'CommunityName\_wLine'. It includes tabs for Description, Spatial, and Attributes. The 'Description' tab is active, showing the object type as 'Feature Class' and the number of records as 0. It lists attributes: OBJECTID, Shape, Enabled, and Condition. The 'Condition' attribute is detailed with its alias, data type (String), width (20), precision (0), scale (0), and definition: 'Condition of the asset when surveyed. Domain Values are "Standard" and "Improvement/Repair". Definition Source: GeoCIP project team with input from local GIS communities.'
- Editing Dialog:** A secondary window titled 'Editing "CommunityName\_wLine"' is open, showing various metadata fields. The 'Description' tab is active, showing fields like Abstract, Purpose, Language, and Supplemental Information. The 'Purpose' field is highlighted with a red border and contains the text: 'REQUIRED: A summary of the intentions with which the data set was developed.'

**Sources of metadata:**

- Input from local GIS communities.
- GeoCIP toolkit version 4.1.
- Revised from existing data models

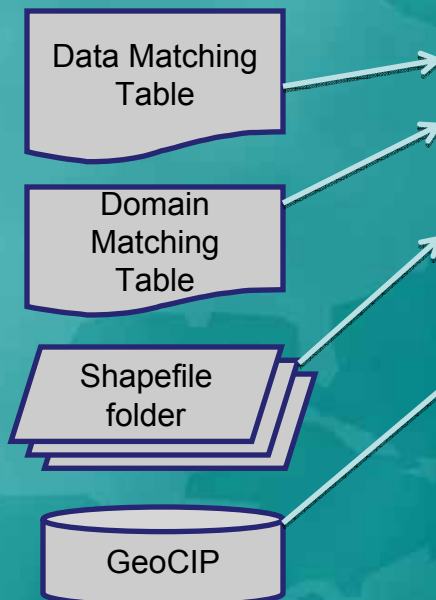
# GeoCIP Data Transferring Tool



# How it works



# Version 4.0



23

**GeoCIP - Data Transferring - Version 4.0**

Matching table: D:\MyProjs\CIP\Phase3\MatchingTables\Haileyville\_MatchingTable.txt ...

Domain matching table: D:\MyProjs\CIP\Phase3\MatchingTables\DomainMatchingTable-2.0.txt ...

Community: Haileyville ▼

Shapefile folder: M:\CIP\_Work\cip\_temp\Haileyville\GIS ...

GeoCIP folder: D:\MyProjs\CIP\GeoCIP ...

☒ Clearing ESRI feature classes before copying Cancel Go >>

**Report:**

- Checking if selected community Haileyville exists in GeoCIP...Passed
- Reading textfile for community Haileyville...Passed
- Reading domain-matching-table textfile...Passed
- Checking if shapefiles/tables exist...
  - Shapefile/tab: sewer\_facility...Passed
- Checking if ESRI feature classes/tables Detailed report of the data transferring progress ▼

Save report

Detailed report of the data transferring progress



# What are we doing now...



- Finalize data models
  - Electricity and Gas
  - Transportation
  - Equipment
  - Rolling stock
- Compile matching tables
- Transfer data to the GeoCIP state-wide geodatabase
- Prepare documentation
- Design map template and symbology
- Plan the next training workshop
  - Coordinate Systems & Projections ✓
  - Editing in ArcMap ✓
  - Creating and Editing Topology ✓
  - Georeferencing CAD Data ✓
  - Editing and Maintaing GeoCIP® Database Models

# Workshops



A series of workshops have been developed by the Center for Spatial Analysis to provide training for GeoCIP® geotechs and coordinators. These workshops have focused on building up a basic framework of GIS knowledge enabling COG geotechs to maintain the CIP infrastructure data models developed for each community.

## Topics Covered

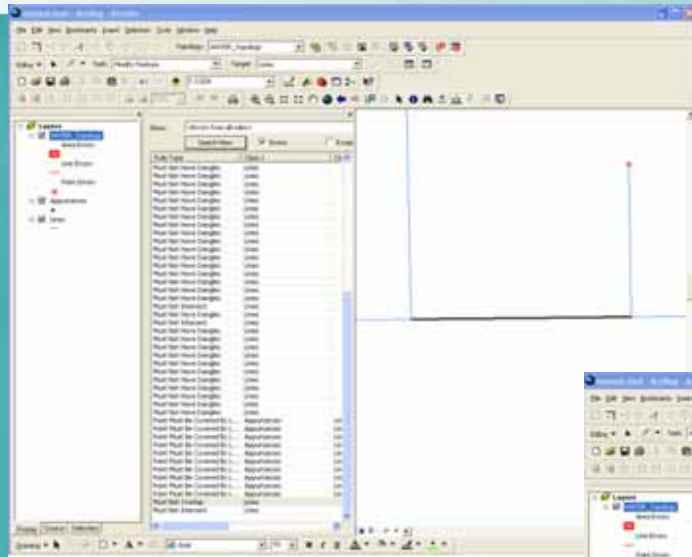
- Coordinate Systems & Projections
- Editing in ArcMap
- Topology
- Georeferencing CAD data
- Editing and Maintaining GeoCIP® Database Models

# Topology

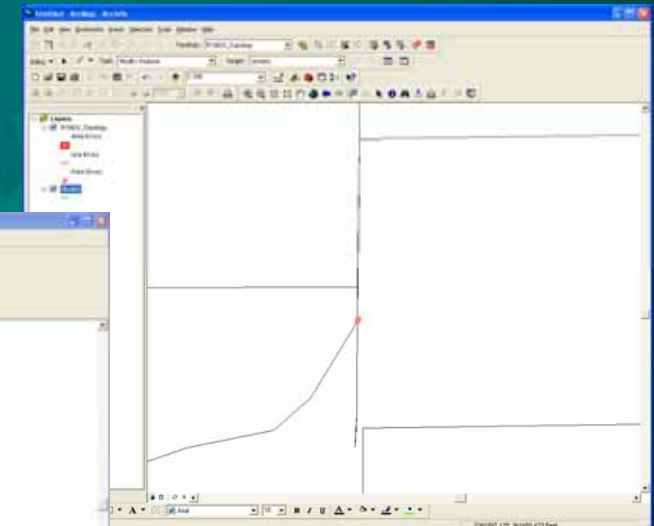
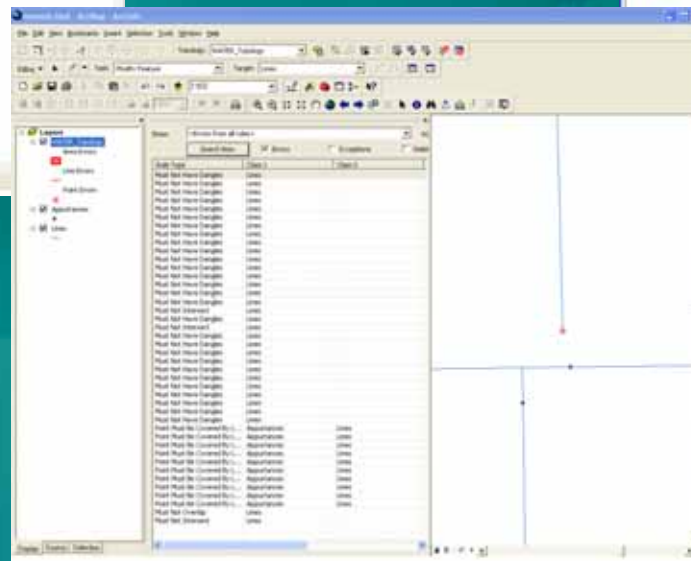


- Much of the line and point data submitted to CIP are georeferenced but lack the connectivity to other features to develop accurate spatial relationships that model the real world.
- Lines are not snapped to the endpoints of other lines.
- Intersections between lines overlap and are not connected.
- Appurtenances do not split line segments and in many cases are not lying on the line.
- Many duplicate line segments and points have been digitized.
- These potential digitizing errors create problems when trying to develop a GIS for the CIP that will accurately model real world relationships.

# Topological errors



A duplicate water line

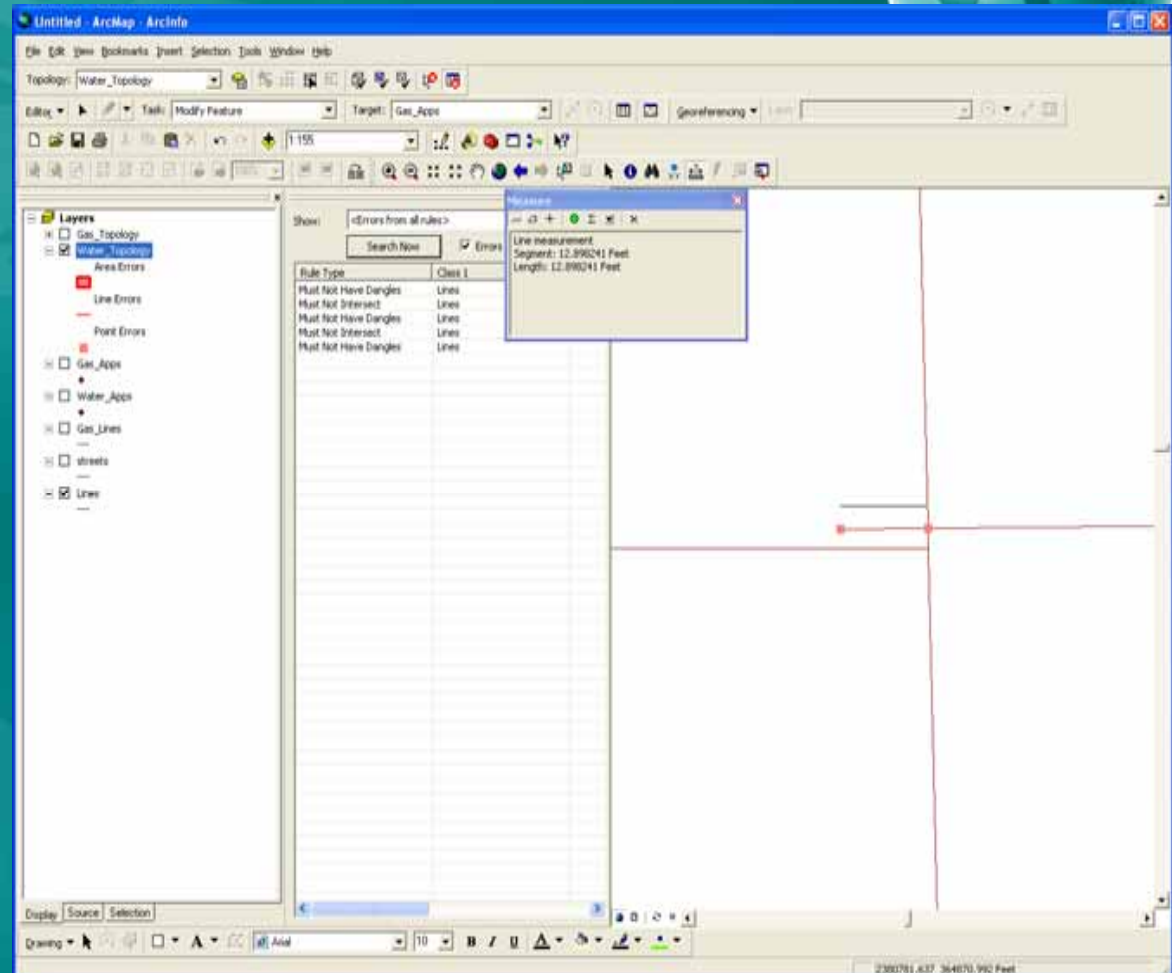


duplicate road segments  
and dangle roads

A water line should have been snapped to the water valve appurtenance.

# Topology issues

- Should that water line connect at the intersection?
- Does the water line inventory match the geometry?
- Do those lines intersect or do they overlap?
- Is that really a 12ft water line or should it terminate at the intersection?



# The next steps



- Web GIS: enable data browsing and query over the web  
<http://geospace.csa.ou.edu/GeoCIP>
- Analyze functional needs for reporting and planning
- Develop tools to support asset analysis for communities, regions, and state
- Distribute the data and tools over the web GeoCIP® GIS
- Expand the GeoCIP® GIS to include social and economic assets, such as demographics, schools, social or cultural groups, business establishments, land parcels, sales or tax records, workforce, etc. for comprehensive asset mapping and economic development planning