Understanding our world.

CAD: Introduction to using CAD Data in ArcGIS

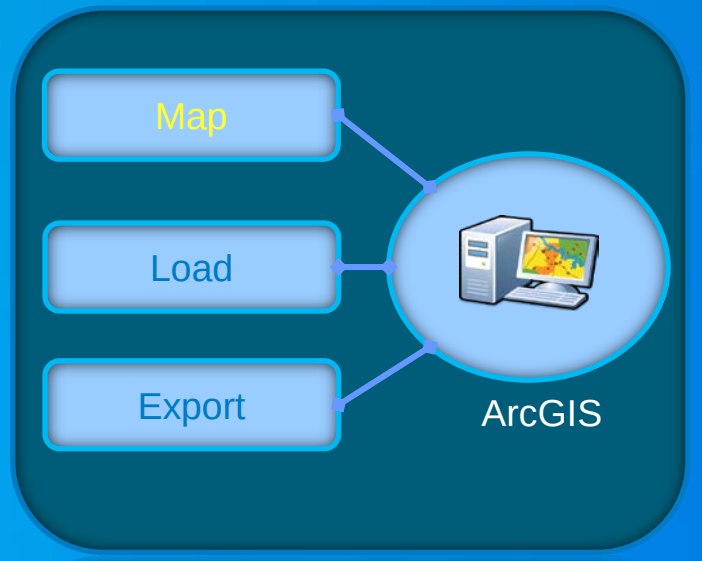
Kyle Williams & Jeff Reinhart

What we will accomplish today

- Overview of ArcGIS CAD Support
- Georeferencing CAD data for ArcGIS
- How Mapping Specification for CAD can help
- Loading CAD features into a Geodatabase
- Creating CAD Data (Export to CAD)
- CAD data support in ArcGIS Pro 1.1

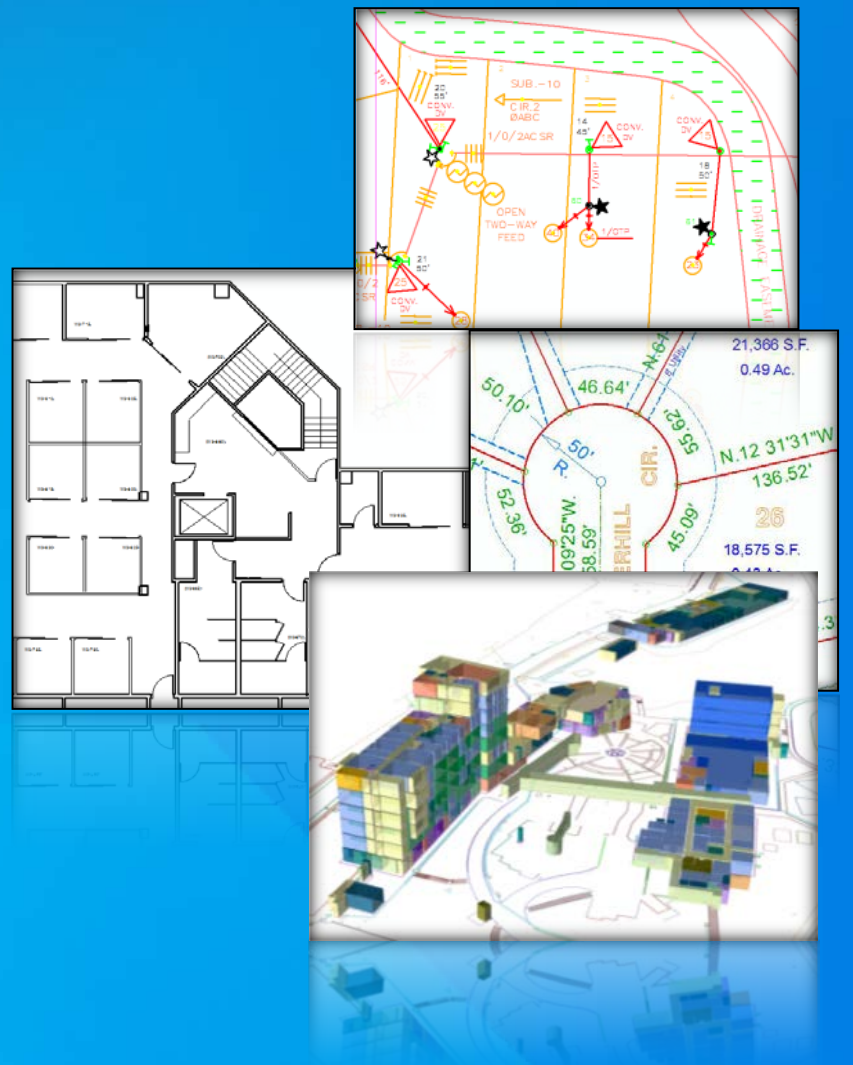
CAD/GIS Interoperability Scenarios

- ArcGIS user who needs to…
  - Display CAD data in maps
  - Load CAD data into their Geodatabase
  - Deliver GIS data in a CAD format



CAD in the Geospatial context

- CAD drawings are a large source of GIS data
  - Surveying
  - Cadastre
  - Civil engineering
  - Architecture
  - Landscape Architecture
  - Planning
  - Geodesign

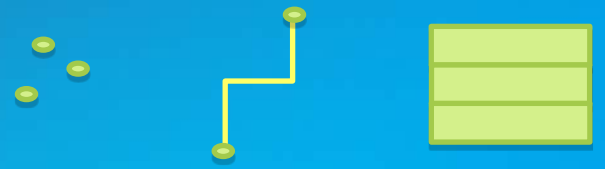


CAD Drawings

- Geometry, text, and symbols
  - comprise CAD entities/elements
- Organized into layers or levels
- Symbology represents information
- Can have data attached to entities

CAD Datasets in ArcGIS

Geometry



CAD entity geometry organized into feature classes

Attributes

CAD properties, tags, and database links are stored in attribute tables

Coordinate System

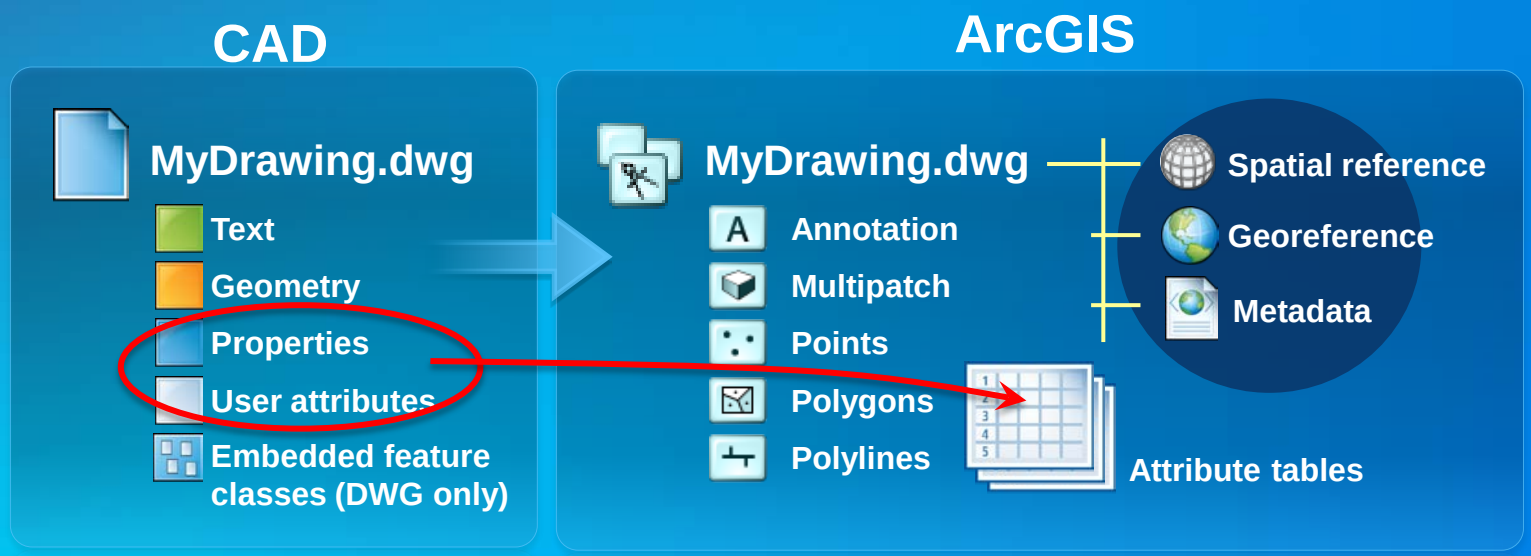
CAD data can be reprojected to overlay with other GIS layers

World File

CAD drawings can be transformed from local coordinates to projected coordinates

Direct-read CAD datasets in ArcGIS

Translated on the fly as a virtual feature class



Contents of a CAD Dataset

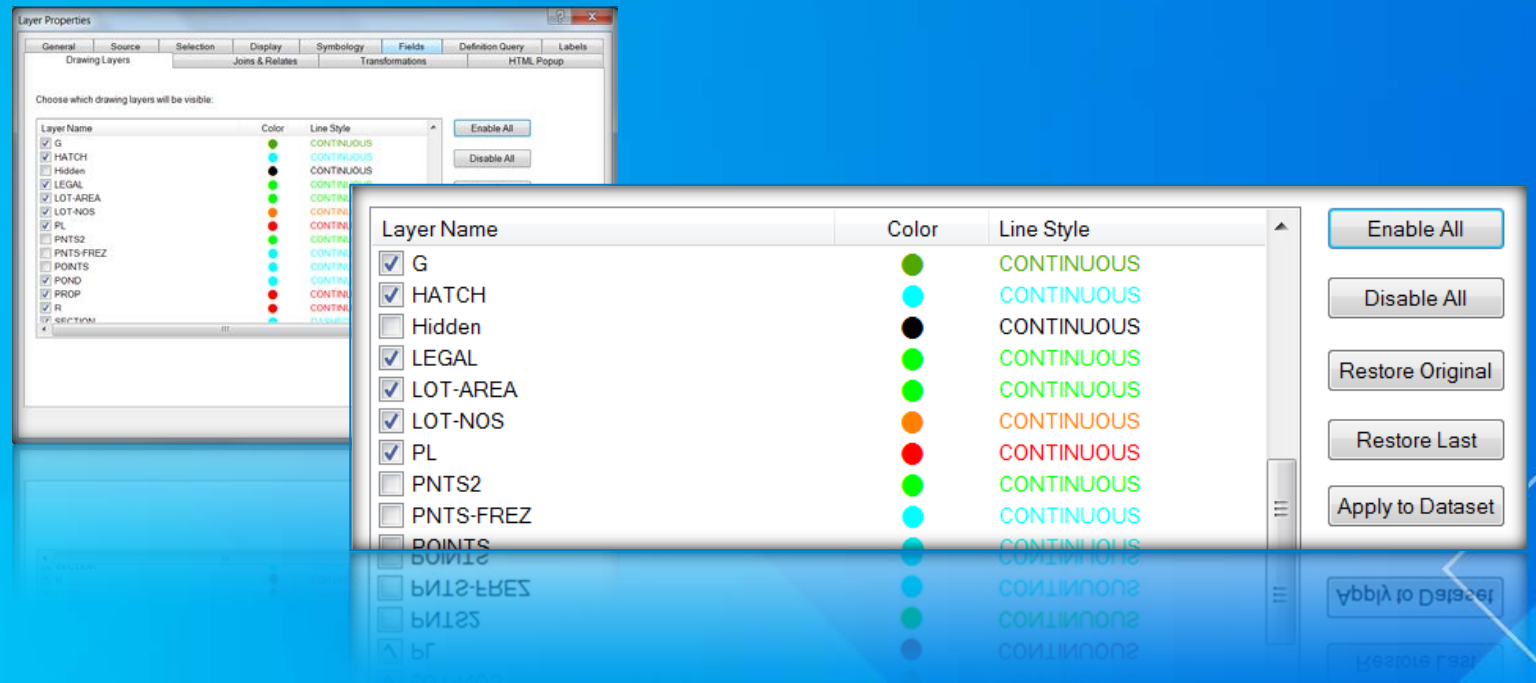
City.dgn

Annotation	Text, tags, and attribute definitions
Multipatch	Polygons and is useful for 3D representation
Point	Points, blocks, and cells
Polygon	Closed areas such as polygons, ellipses, and circles
Polyline	Lines, polylines, and arcs

City.prj	Projection files define a coordinate system for a CAD dataset. They are recommended but not required.

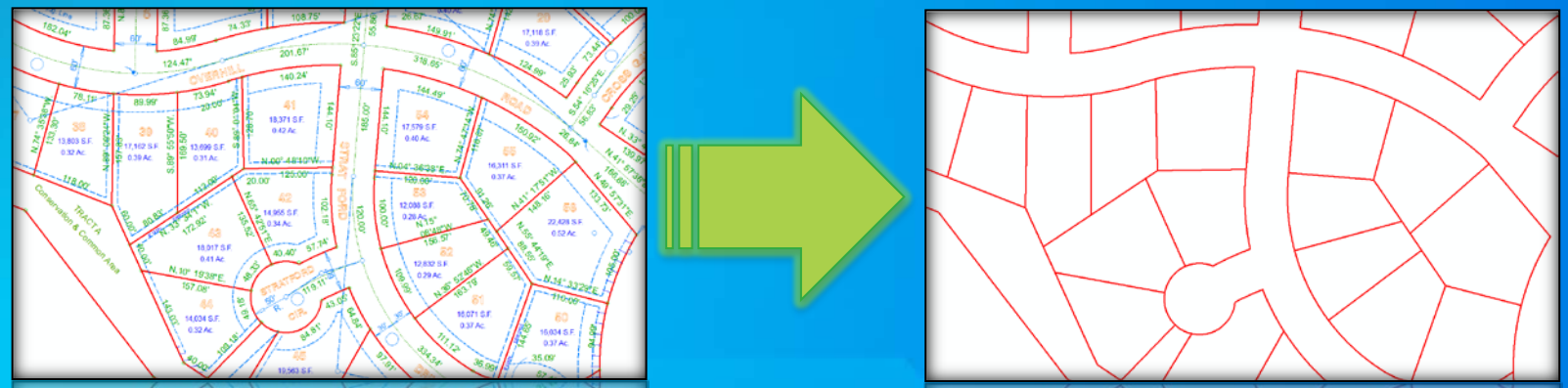
Display Control

- Turn layers off and on to control feature display
  - Saved in the .MXD or .LYR
  - Apply to the entire dataset
  - Restore back to original rendering



Filter CAD Features

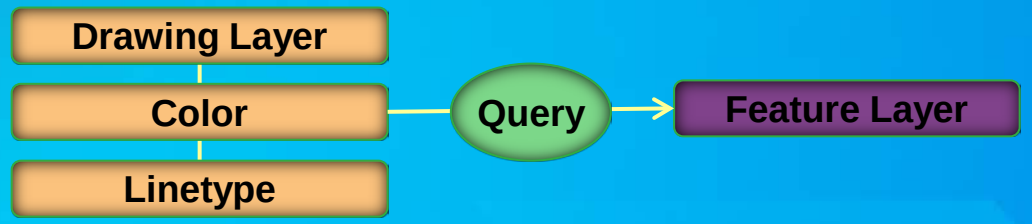
- **Isolate the CAD data you need to work with using…**
  - **Specific CAD Feature Classes**
  - **Drawing layer visibility**
  - **Definition Query**

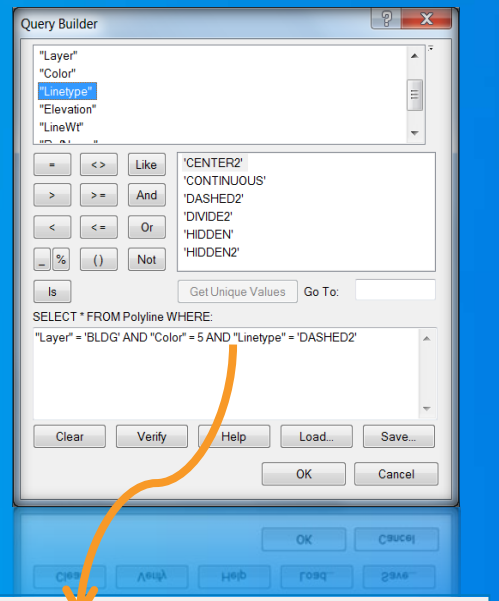


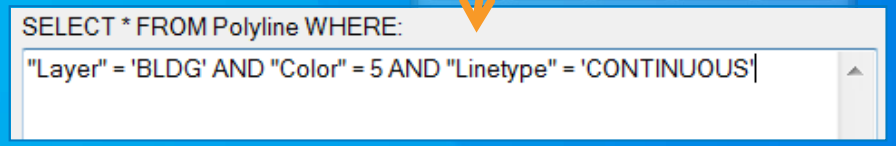
- **https://desktop.arcgis.com/en/desktop/latest/manage-data/cad/using-query-builder-with-cad-layers.htm**

Filter CAD Features

- Use Definition Queries to create subsets
  - Saved in the .MXD or .LYR
  - Expressions can be saved to .EXP files for re-use





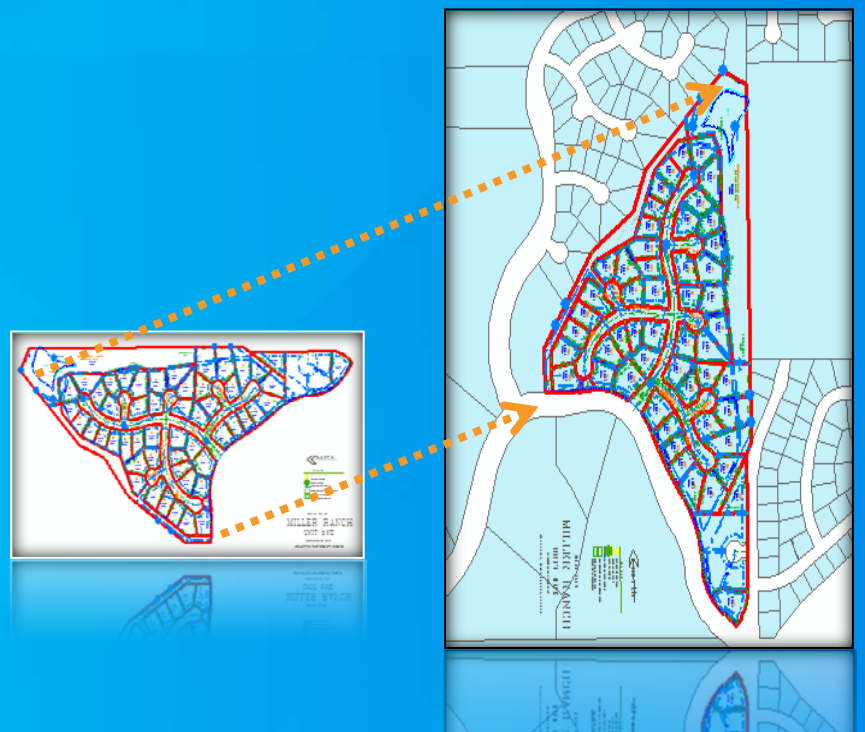


CAD Data Support in ArcGIS 10.3.1

- ESRI has long provided CAD support and integration tools

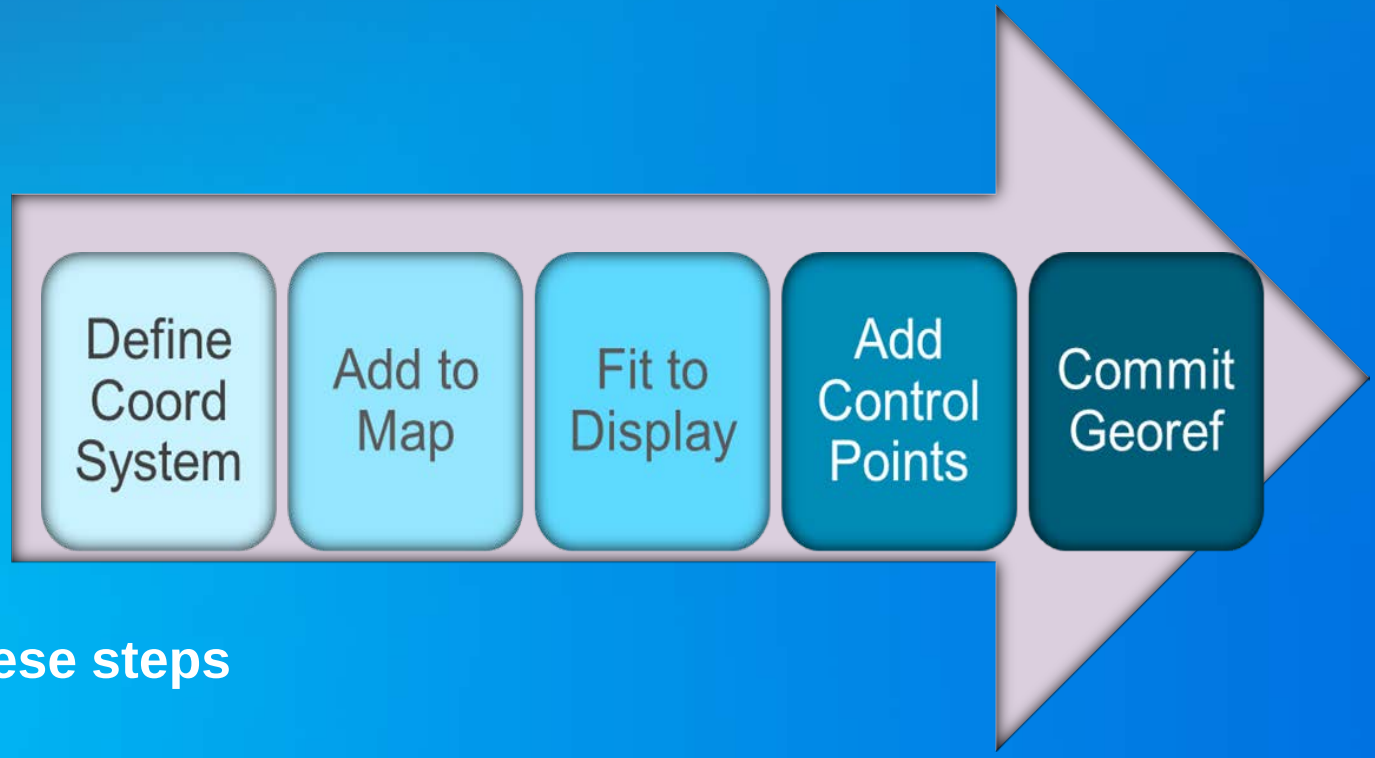
- Out of the box
  - No extension required
- Direct read
  - Conversion not required
- Current version support:
  - AutoCAD DWG/DXF: Up to 2016 (read/write)
  - MicroStation DGN: Up to V8i SELECT series 3

DEMO: Assigning coordinate systems and Georeferencing CAD in ArcGIS



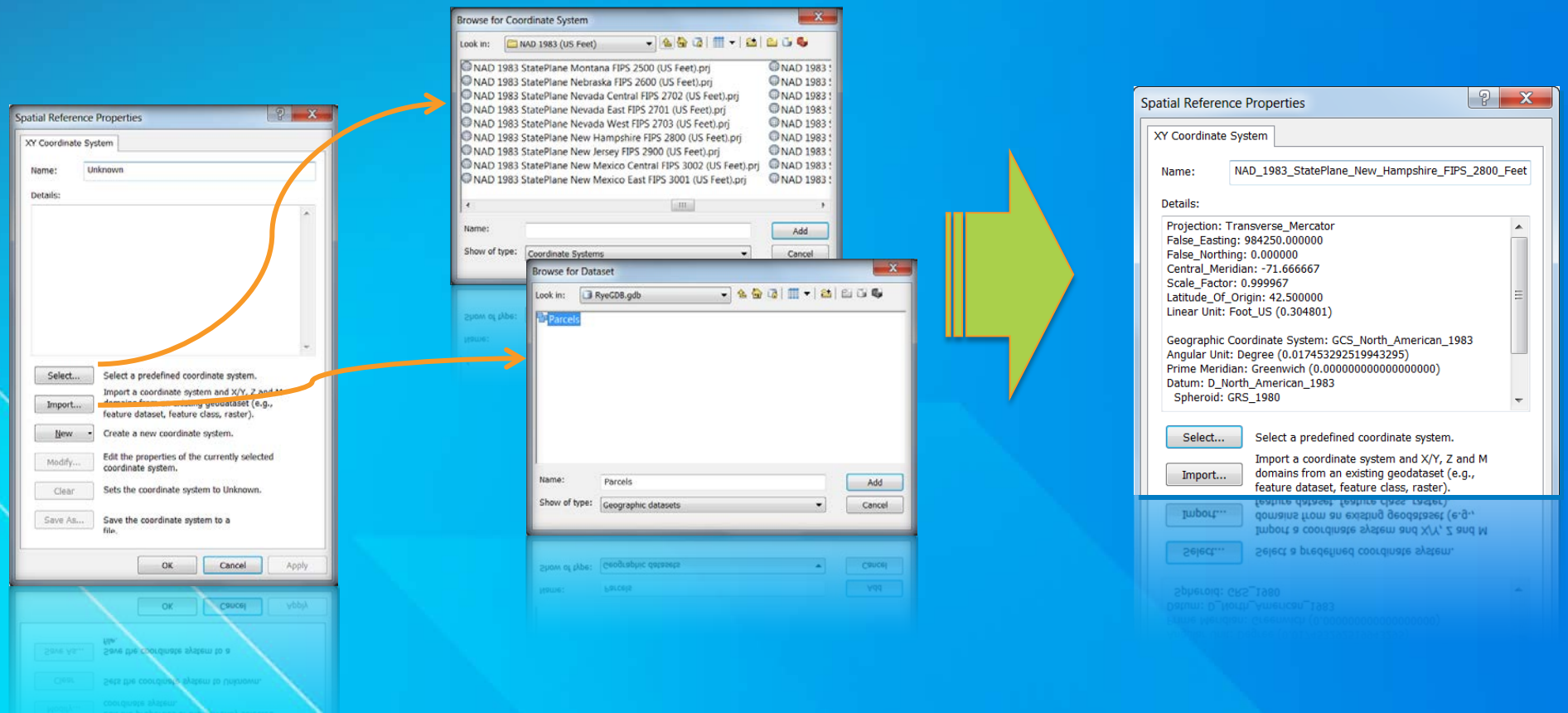
Georeferencing Process

- Assigning a coordinate system
- Applying a transformation
- Stop Tracing
- Not all CAD datasets require these steps



Assigning Coordinate Systems

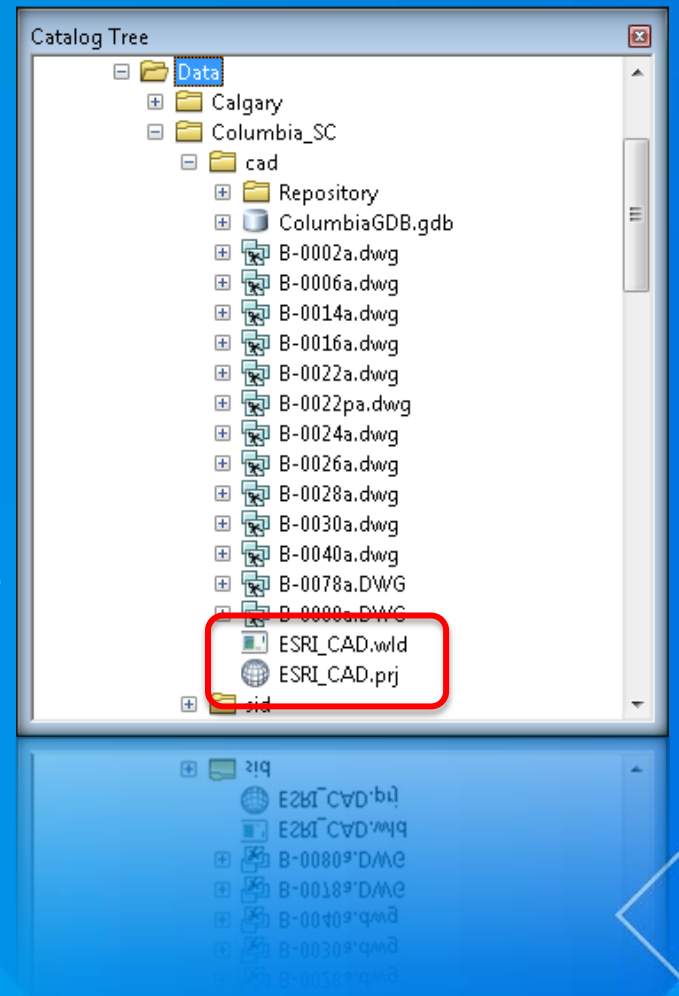
- Defined at the CAD Dataset level
- Catalog window's Spatial Reference Properties dialog



Universal Projection and World Files

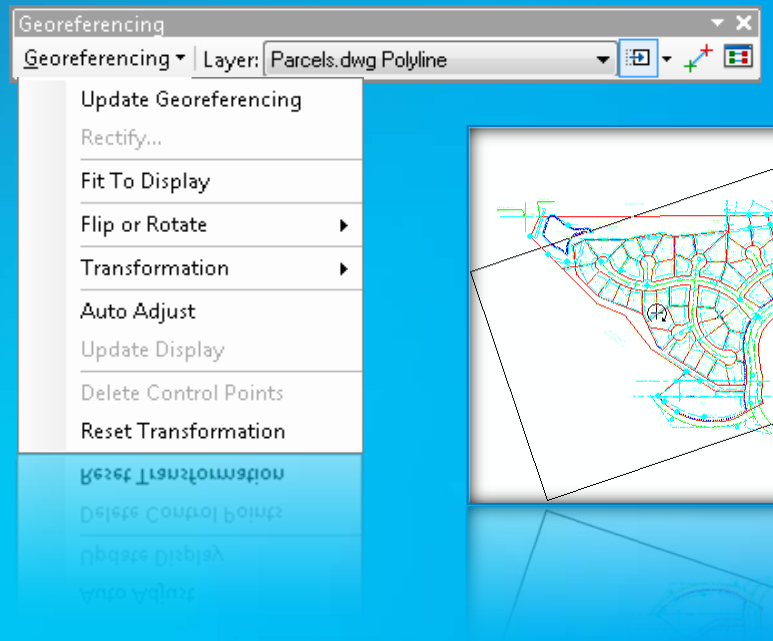
- **Universal World File**
  - ESRI_CAD.WLD
  - Applies identical transformation to all CAD files in workspace
  - Useful for set of tiled CAD drawings

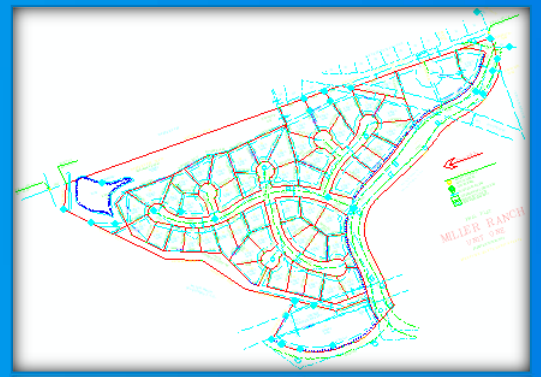
- **Universal Projection File**
  - ESRI_CAD.PRJ
  - Applies same coordinate system to all CAD files in workspace



Georeferencing Toolbar

- **Georeferencing toolbar – use mouse pointer to move layer and create control points in map**
  - **Rotate, Scale, and Shift tools**





Georeferencing

- **Two-point Similarity transformation method**
  - **Move, Rotate, and Scale**
  - **Aspect ratio always maintained**
  - **Cannot skew or ‘rubber sheet’ CAD drawing**

- **Transformation managed by World Files**
  - **ArcGIS is not modifying the CAD drawing**

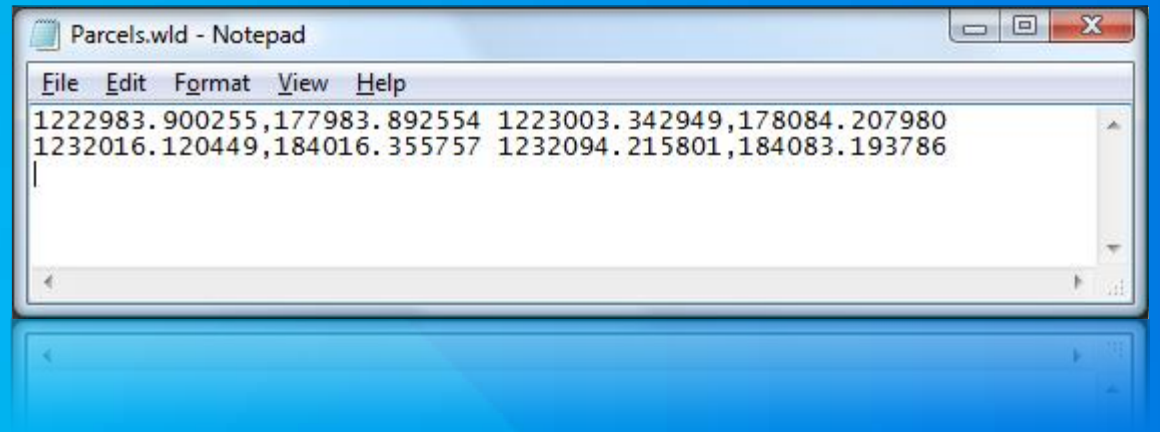
- ***NOT required for drawings that are drawn in real-world coordinate location.**

Georeferencing: World Files

- File based, two point transformation for CAD data
- Uses the .wld file extension
- Simple text file containing two lines with two pairs of coordinate values:

  <From X1, From Y1> <To X1, To Y1>

  <From X2, From Y2> <To X2, To Y2>



ArcGIS for AutoCAD 350 - Free Download from Esri

- **Access to GIS content**
  - **Basemaps**
  - **Image services, Map Services**
  - **Location Services**
  - **LISP API**
- **Access to Feature Services**
  - **Direct editing GIS data**
  - **Subtype, domains**
- **Mapping Specification for CAD**

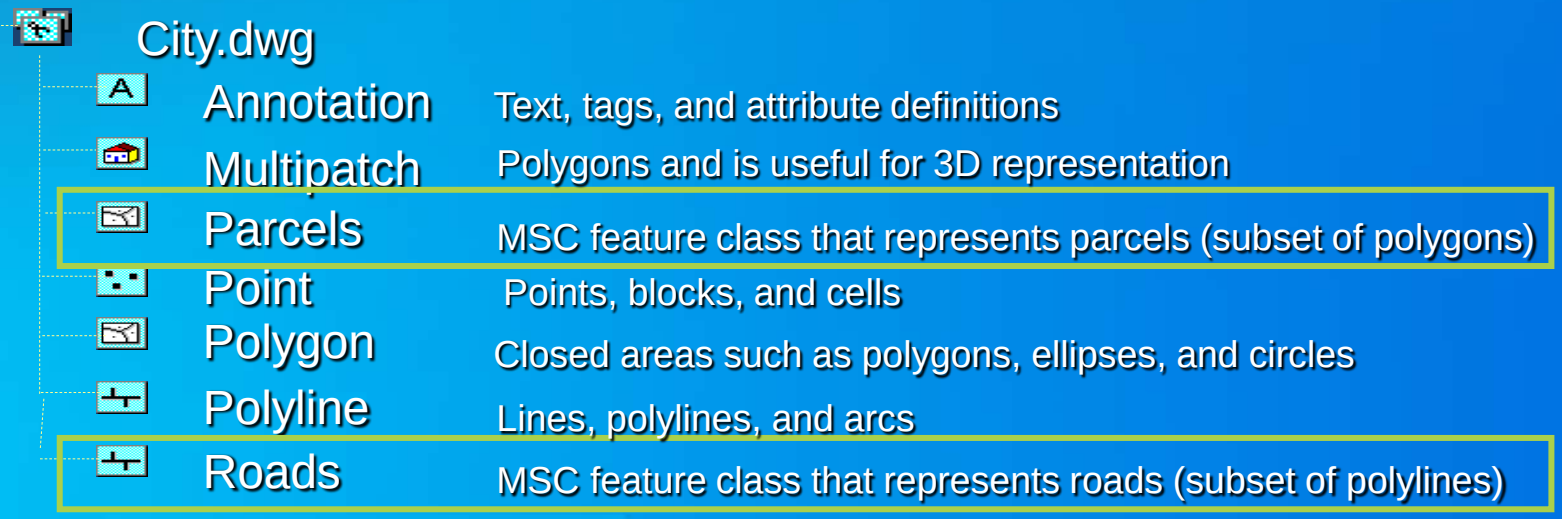
Mapping Specification for CAD (MSC)

Provides improved interoperability between CAD and GIS

- **Open source framework developed by ESRI**
  - GIS feature classes + attributes
  - Coordinate systems
- **Utilizes CAD data structures to define schema and store data**
- **Leveraged by ArcGIS Desktop CAD tools**
  - CAD direct read/import tools
  - Export to CAD

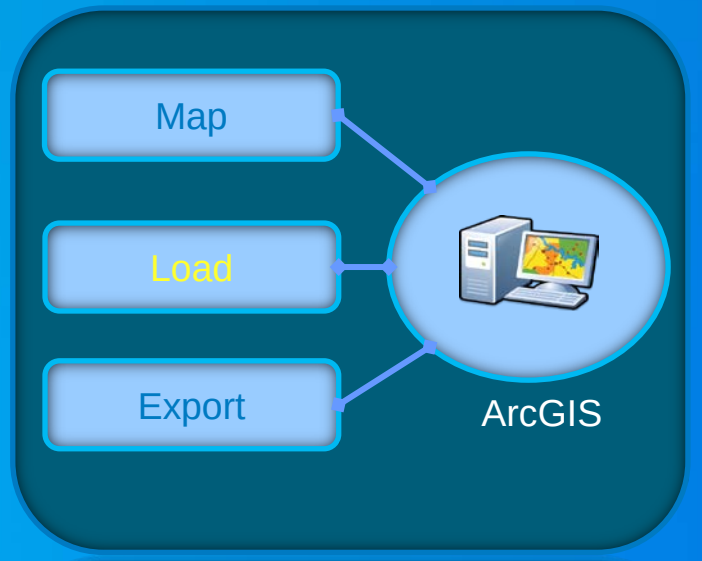
CAD data structure in ArcGIS

- **Subset feature class**
- **AutoCAD Query**
  - **Layer, color, linestyle**
  - **Etc**
- **Invisible in AutoCAD**
- **Better than a SHP file**



CAD/GIS Interoperability Scenarios

- ArcGIS user who needs to…
  - Display CAD data in maps
  - Load CAD data into their Geodatabase
  - Deliver GIS data in a CAD format

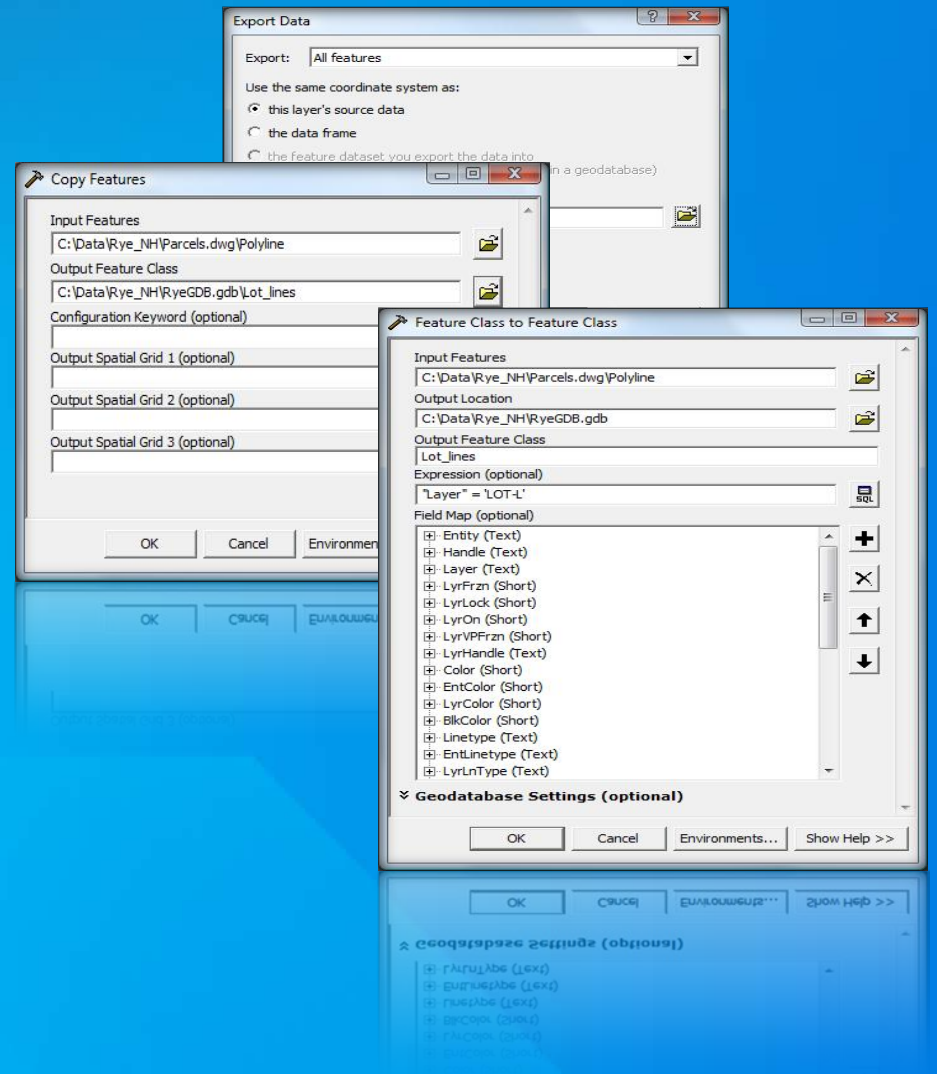


Loading CAD data in ArcGIS

- Add to Geodatabase feature classes or create new Geodatabase from CAD
  - As-built updates
  - Editing requirements
  - Advanced Geodatabase tasks (i.e., Geometric Networks, Topology, etc.)
- Conversion supported by the Geoprocessing framework and ArcMap tools
- Can be combined with other Geoprocessing functions
  - Spatial Joins
  - Geometry manipulation

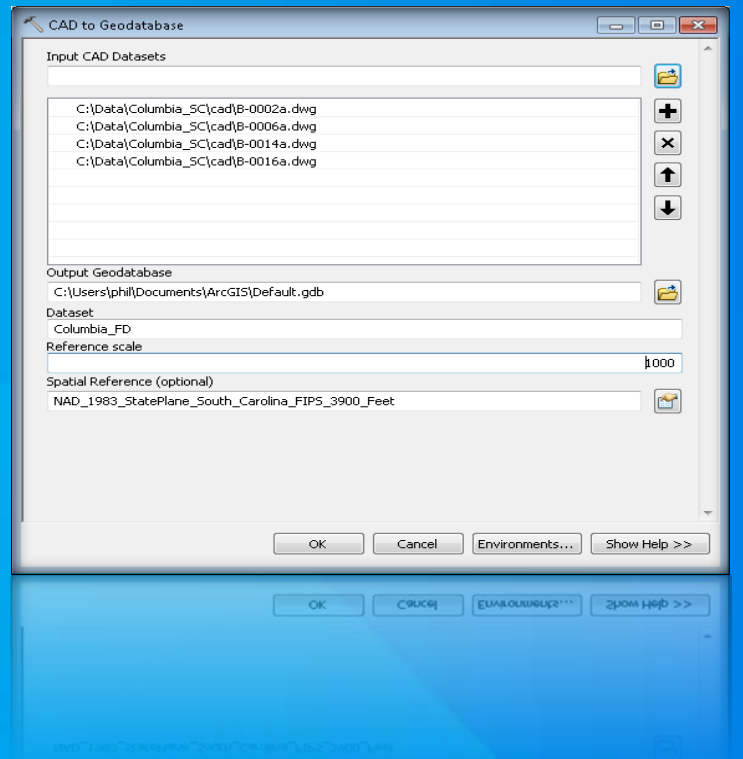
CAD Conversion Tools

- ArcMap
  - Export Data
  - Copy & Paste (Edit session)
- ArcToolbox – Geoprocessing
  - Feature Class to Feature Class
  - Copy Features
  - Import CAD Annotation

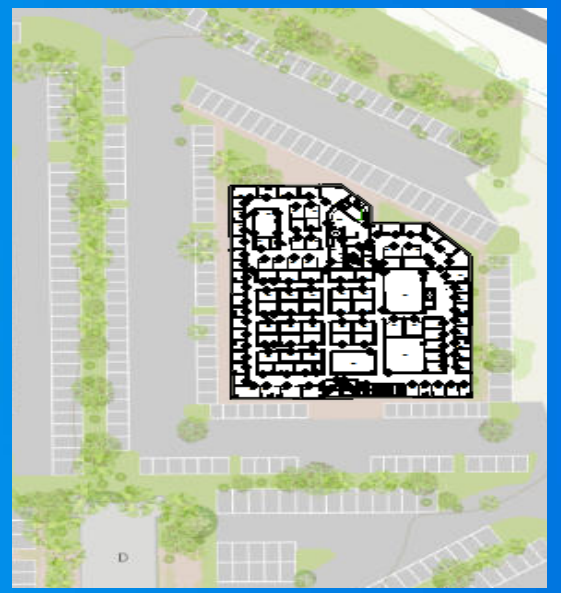


CAD to Geodatabase

- **Designed for bulk loading CAD datasets into a Geodatabase**
  - **Combines Copy Features, Merge and Import CAD Annotation into single tool**
  - **Works at the dataset level**

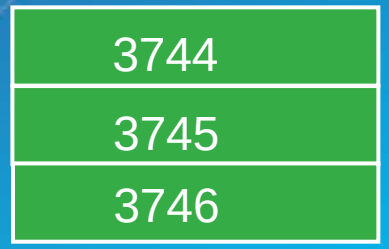


Loading CAD data Demo: Campus example



Geoprocessing Scenarios

- CAD text inside polygons



- CAD text near lines

- Line segments to polygons

- CAD to Geodatabase

- Append to existing Geodatabase

- Merge with other layers

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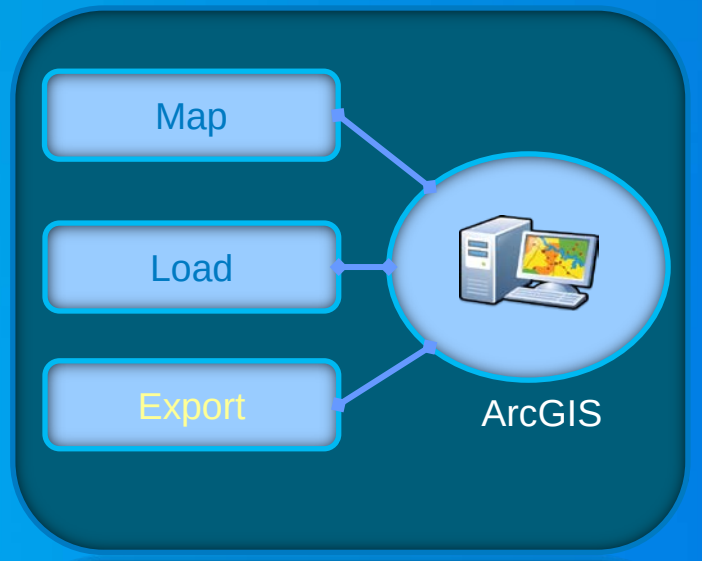
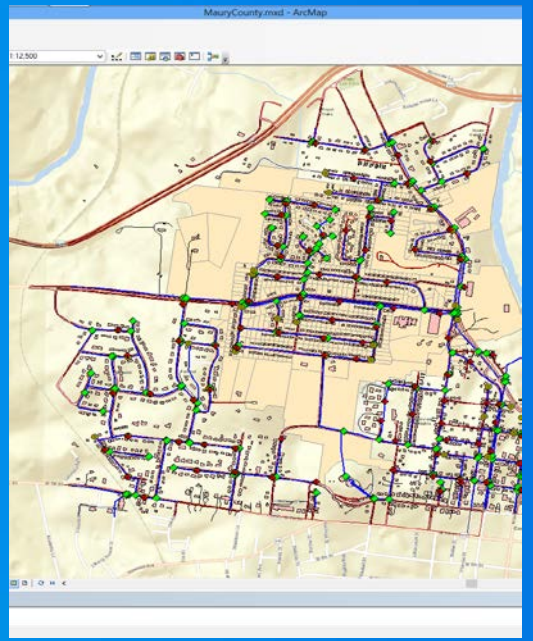
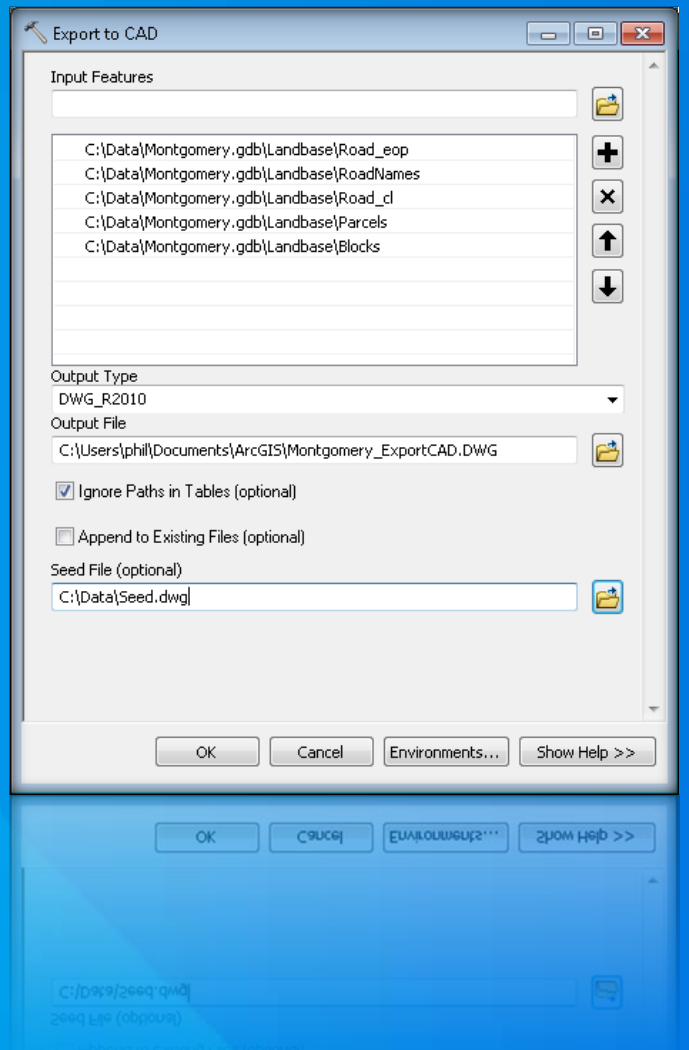


Data Submittal Demo



Export to CAD

- Output features to native CAD format
  - DGN V8
  - DWG/DXF Release 14 to 2016 (ArcGIS 10.3.1)
- Supports appending to existing CAD drawings
- Creates Seed files
  - CAD feature Classes (MSC)
  - Fields and default values, layers color, linestyles…
- *Available at all license levels



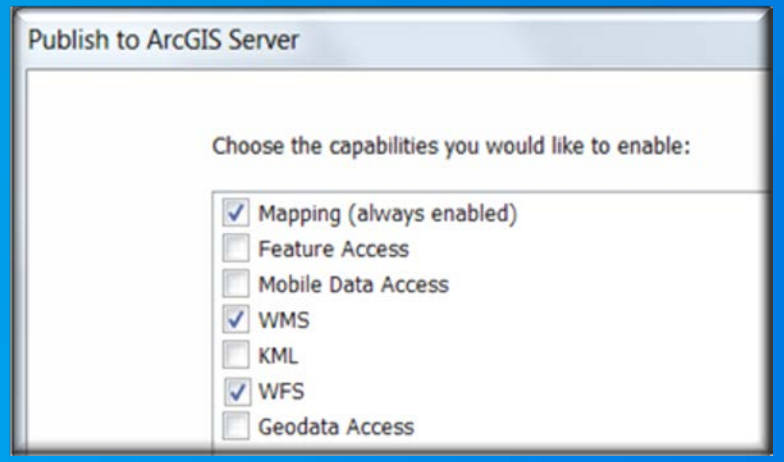
Reserved CAD Fields

- Reserved CAD fields
  - Fields understood by Export to CAD
  - Creates shared cells, blocks, layers, colors
  - Creates MSC feature classes, fields, field values.

- Resources in help system
  - https://desktop.arcgis.com/en/desktop/latest/manage-data/cad/reserved-cad-fields-for-dwg-and-dxf-files.htm
  - https://desktop.arcgis.com/en/desktop/latest/manage-data/cad/reserved-cad-fields-for-dgn-files.htm

Accessing Services in Microstation

- MicroStation V8i has built-in WMS capabilities
- Web Mapping Services Imagery
- Web Feature Services



- Bentley Map works with Esri File Geodatabase?

Best Practices

- Tips and best practices for CAD & GIS
  - Seed/template file
  - Layer standards (Plan ahead)
  - Coordinate systems
  - Drawing in proper locations
  - Only use Model Space

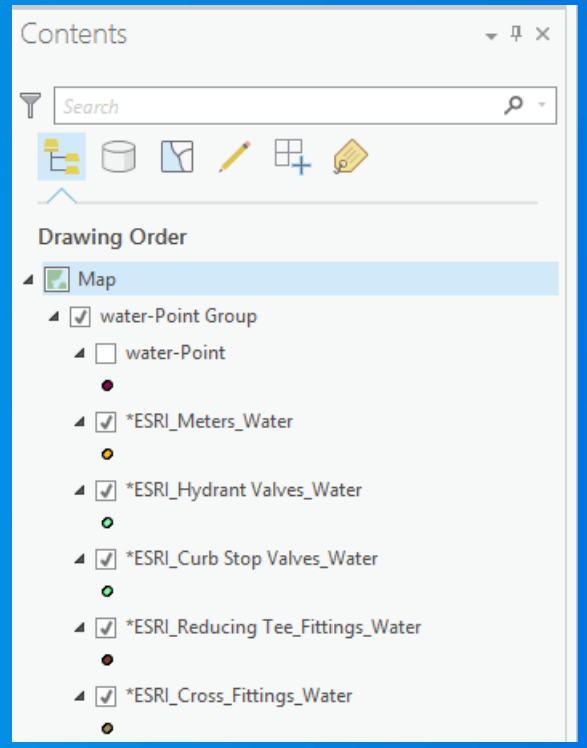
- Export to CAD
  - template
  - Coffee and donuts

Demo: CAD support in ArcGIS PRO 1.1

ArcGIS Pro 1.1 CAD improvements

Feature Layers organized by Level/layer

- Group layer created with the feature class name and a suffix "Group"
- Feature layers based on CAD layer/Level names
  - Feature Class will be included with layer visibility turned off
  - Feature Layers for each Level/layer geometric type
- Feature Layers can be used as input to GP tools
  - Maintains Layer color with conversion
  - Honor CAD layer level visibility



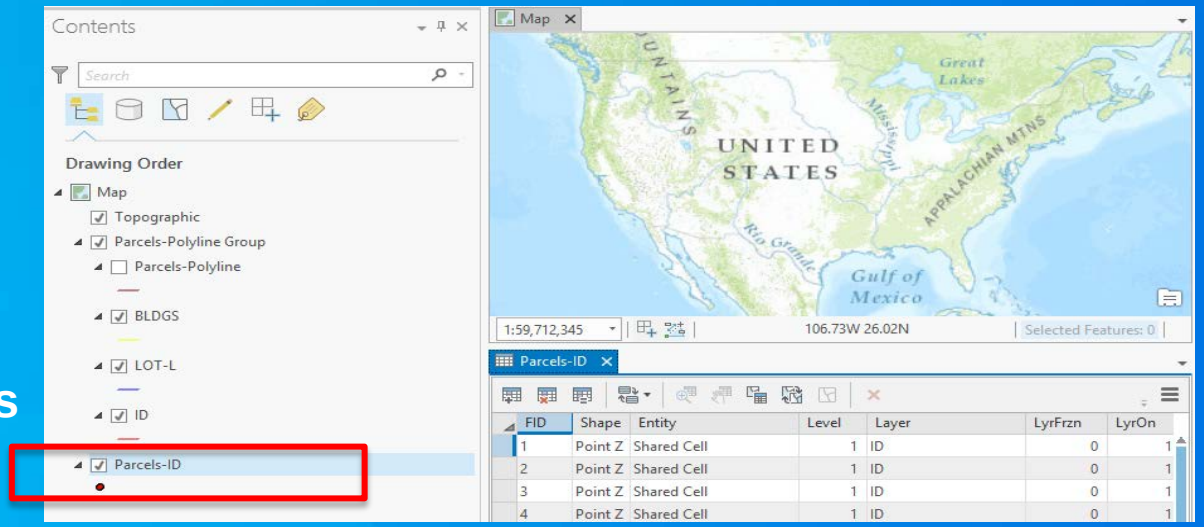
ArcGIS Pro 1.1 CAD improvements

Separate Feature Layers for Blocks and Shared Cells

- Group layer created with the feature class name and a suffix "Group"

- Feature layers based Shared Cells and Blocks
  - Microstations Shared Cells
  - AutoCAD Blocks

- Attributes values
  - schema of Shared Cell and Block only
  - Removed from CAD point feature class

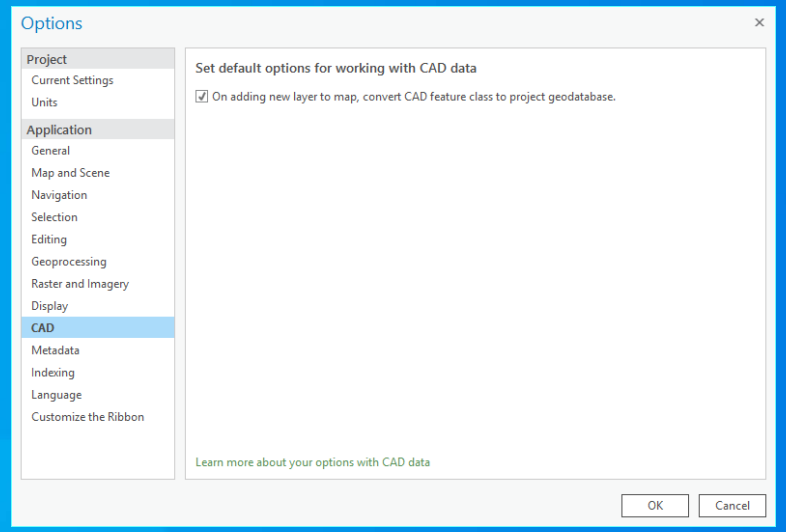


ArcGIS Pro 1.1 CAD improvements

Automatic Labeling of Annotation Points and Convert on Add

- CAD file support is simple feature classes
  - ANNOTATION features are currently added as a POINTS
  - Labeling of CAD POINT
  - Standard with other data sources

- Convert on Add Option (off by default)
  - Automatically converts CAD data to GDB
  - Simplifies data migration of conversion



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More CAD at UC

Session Title	Date/Time	Room
CAD: Introduction to using CAD Data in ArcGIS	Tue 7/21/2015 08:30 AM - 09:45 AM	Room 03
CAD: The ArcGIS for AutoCAD CAD Plug in	Tue 7/21/2015 01:30 PM - 02:45 PM	Room 03
CAD: The ArcGIS for AutoCAD CAD Plug in	Wed 7/22/2015 03:15 PM - 04:30 PM	Room 31 B
CAD: Introduction to using CAD Data in ArcGIS	Thu 7/23/2015 08:30 AM - 09:45 AM	Room 15 A

Session Title	Date/Time	Room
CAD: Lining Up CAD Data in ArcGIS	Wed 7/22/2015 10:00 AM - 10:30 AM	Tech Theater 16 Exhibit Hall A
CAD: Lining Up CAD Data in ArcGIS	Thu 7/23/2015 10:00 AM - 10:30 AM	Tech Theater 16 Exhibit Hall A

Want to learn more?

- **Documentation**
  - http://resources.arcgis.com/en/communities/cad-integration/
- **Related Esri Training and Tutorials**
  - **CAD in ArcGIS:**
  - **http://training.esri.com/gateway/index.cfm?fa=catalog.coursedetail&courseid=50120390_10.x**

  ArcGIS FOR AUTOCAD training video's:

  http://training.esri.com/Gateway/index.cfm?fa=seminars.viewDetails&course_id=182

  http://video.arcgis.com/watch/3901/arcgis-for-autocad-350-training-series-how-to-create-gis-data-in-cad-session-3-export-from-arcmap
- **Additional Resources**
  - **Margaret Maher's book "Lining up Data in ArcGIS"**

Thank you…

- Please fill out the session survey in your mobile app
- Select [CAD: Introduction to using CAD Data in ArcGIS]
- in the Mobile App
  - Use the Search Feature to quickly find this title
- Click “Technical Workshop Survey”
- Answer a few short questions and enter any comments