CAD/GIS Interoperability

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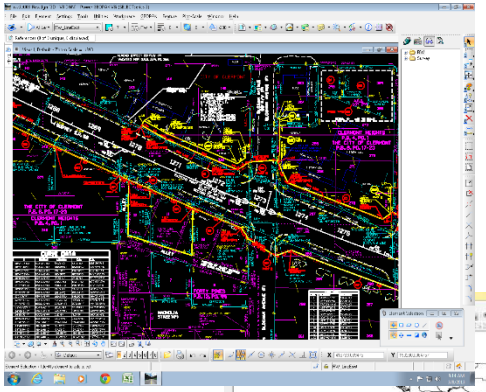
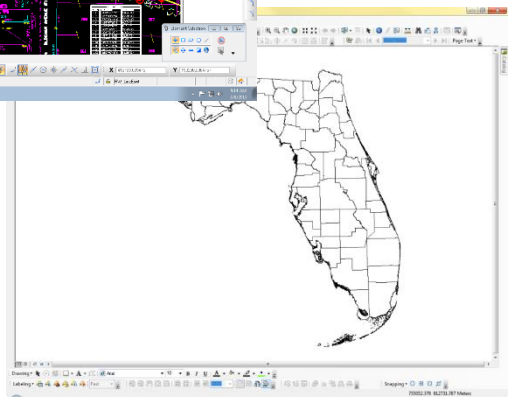
Presentation Overview

- ✓ Background
- ✓ Research
- ✓ Interoperability
- ✓ Examples
- ✓ Drafting GIS Features in MicroStation
- ✓ Processing Parcel Line Work
- ✓ Interoperability Tools
- ✓ Beta Testing
- ✓ Summary

Background

The Florida Department of Transportation (FDOT) requires standardized electronic delivery of Design Plans through CADD.





With the advancement of the GIS Enterprise View (GEV) utilizing the FDOT Enterprise GIS Framework and the technology upgrades to CADD platforms supporting the interoperability between these environments, a path for sharing data has evolved so that users in both environments can benefit.

Background

- In 2011 FDOT started looking for a way to put everything Right of Way (ROW) related into the new enterprise GIS framework looking backward to historic records
- There was some success in manipulating the CADD line work for ROW acquisitions into a GIS environment, but the work was tedious and time consuming
- Utilities (a highly desired data set) would be even more tedious

Research

- Texas A&M Transportation Institute (TTI) was brought in to examine FDOTs current system, practices and processes
- To develop a strategic implementation plan that would manage ROW parcels and utility data
- Including a process, workflow and a tool to hopefully **“automate”** bringing this historical data (CADD line work) into a GIS environment and to give it intelligence

This research project was completed in May of 2013

Research

- Overview
  - ✓ They conducted site visits and collected CADD Files and Documents. From this they developed
    - lists of levels, cells, and attributes
    - database tables, routines, and menus, to extract CADD information desirable to the GIS environment
- Recommendations:
  - ✓ Use of existing survey and GEOPAK data to generate parcel shapes
  - ✓ Use a database approach for managing design libraries and levels in MicroStation to be able to
    - link information
    - and add attribute data
  - ✓ Created steps for integrating existing parcel and utility data into FDOT's enterprise GIS framework

Research

- But, there is no true “automation” available
- There is too much drafting cleanup needed on the historical data
- So getting the historical data into a GIS environment will be mostly manual, even with the tools developed by TTI
- So where do we go from here?
  - ✓ We can began to gather new data,
  - ✓ while trying to come up with a plan for the old data

Interoperability

- What does that mean?
  - ✓ It means that you can take line work from a CADD application, give it intelligence and export it into a GIS application
  - ✓ Or take intelligent data from a GIS application and import it into a CADD application
- Since this data has intelligence you can do queries, its not just about turning off layers/levels
  - Say you only want to see roadways that have a speed limit of 55mph.....you can do that
  - Or say you only want to see parcels over/under a certain acreage...you can do that too

Interoperability

- FDOT anticipates that one day the ability to reference all or some amount of historical layers such as
  - ✓ Survey Control,
  - ✓ Parcels,
  - ✓ Aerials,
  - ✓ ROW,
  - ✓ Roadway,
  - ✓ Easements,
  - ✓ Utilities, and Permit Agreements
- In both CADD and GIS platforms
- FDOT sees this information as having great value in areas of informed decision making or maybe even those creating high amounts of public record requests
- Technology is moving in that direction with both the Bentley and AutoCAD platforms now supporting importing and exporting of GIS data

Interoperability

- So…..

- How can we integrate CADD Survey/Engineering data that's symbolized specifically to create a set of design plans for construction so that elements of that design can be visualized/attributed and thereby successfully used in a Geographic Information System?

Interoperability

Requirements

- Before we can begin to answer that question we must first have an understanding of what it is that GIS requires in order to visualize and geospatially query information
  - ✓ GIS uses relational tables of records that are geospatially aware
  - ✓ Along with linked attribute data
- In short---

Attributes Data Intelligence

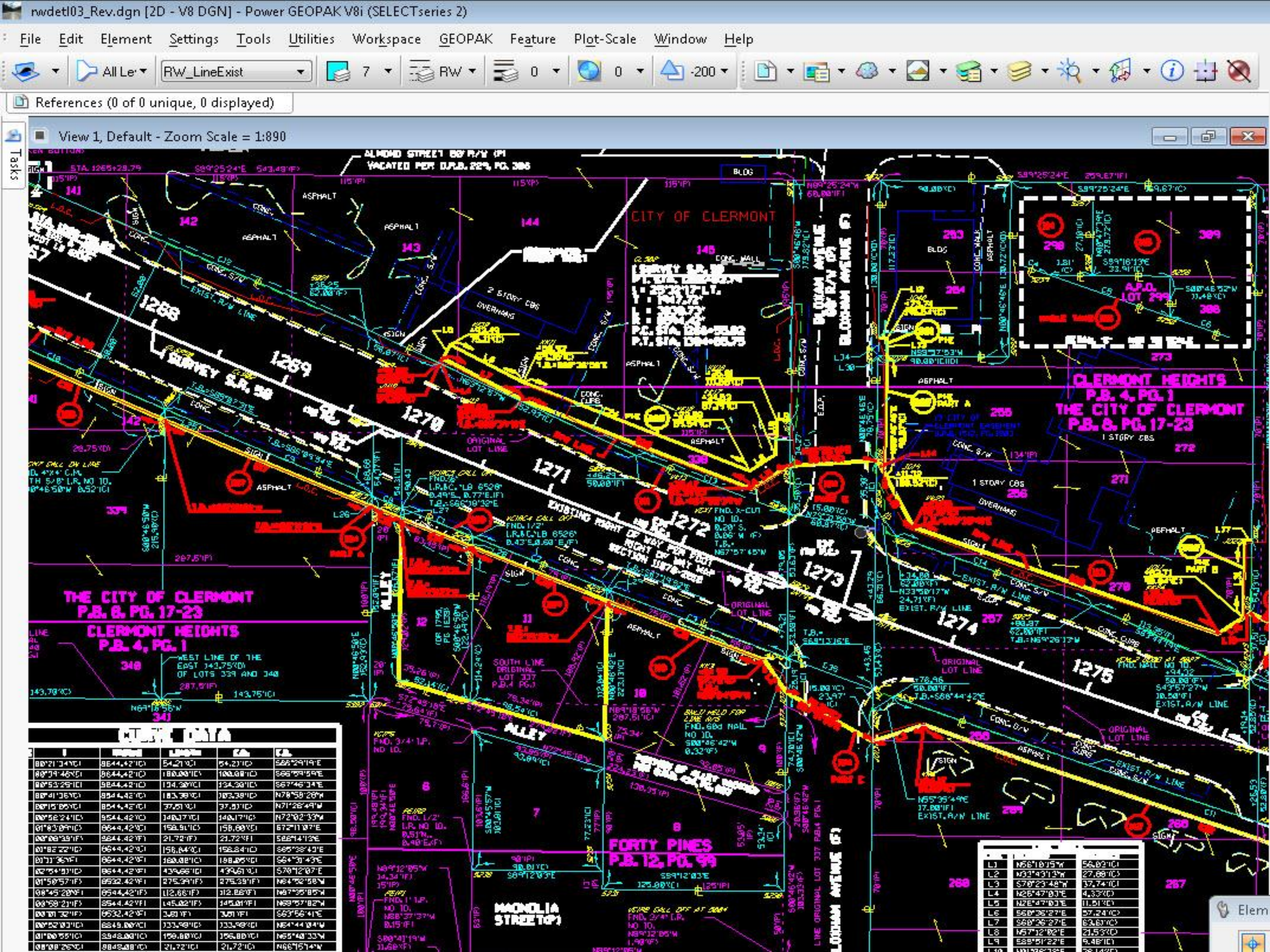
- So that means that we must somehow create outputs in the CADD environment to meet these requirements

Interoperability

- Goals
  - ✓ Use existing licensed products (both CADD and GIS)
  - ✓ Reach out and determine all potential stakeholders to data
    - There may be some who traditionally were not interested or didn't have a need to mine CADD data from design plans as they were not CADD users and the data had no intelligence
  - ✓ User assessment to identify initial need and priority of GIS features
    - Start small
      - Right of Ways
      - Parcels (both right of way and excess)
      - Alignments
  - ✓ Determine workflows, and
  - ✓ Build tools and workspaces in FDOT CADD platforms for creating these GIS features

Interoperability

- Incorporating GIS workspaces into the current FDOT workflow
- Creating intelligent data is data that is both
  - ✓ Geospatially aware, and
  - ✓ Has attributes
- Following is an example showing the FDOT tool CADD designers can use to create intelligent features in a CADD environment by either
  - ✓ Placing or
  - ✓ Promoting existing CADD elements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References (0 of 0 unique, 0 displayed)
View 1, Default - Zoom Scale = 1:890
ALMOND STREET 80' R/W (P)
VACATED PER O.R.B. 229, PG. 386
CITY OF CLERMONT
CLERMONT HEIGHTS
P.B. 4, PG. 1
THE CITY OF CLERMONT
P.B. 6, PG. 17-23
FORTY PINES
P.B. 12, PG. 99
MAGNOLIA
STREET(P)
CURVE DATA
SURVEY S.R. 50
EXISTING RIGHT OF WAY
ALLEY
ASPHALT
2 STORY CBS
1 STORY CBS
ORIGINAL LOT LINE
EXIST. R/W LINE
1268
1269
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1271
1272
1273
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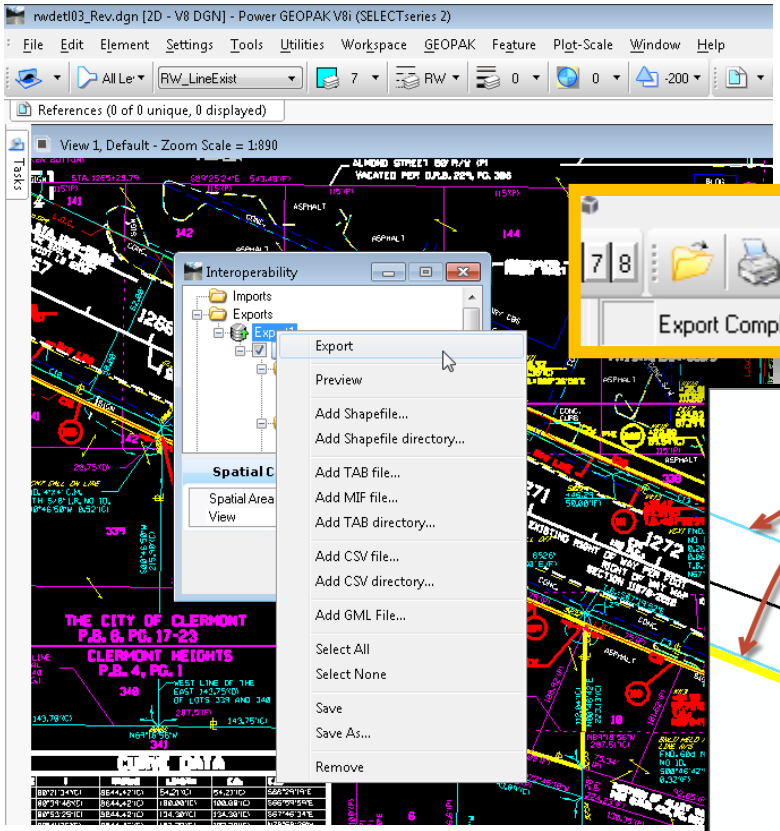
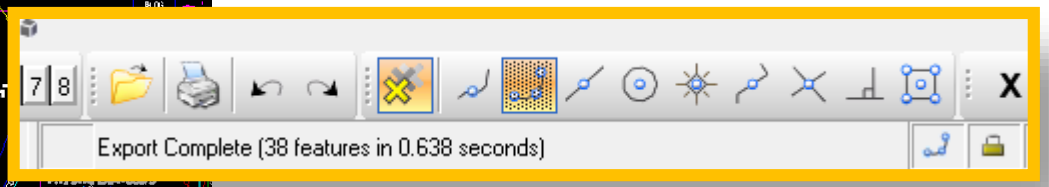
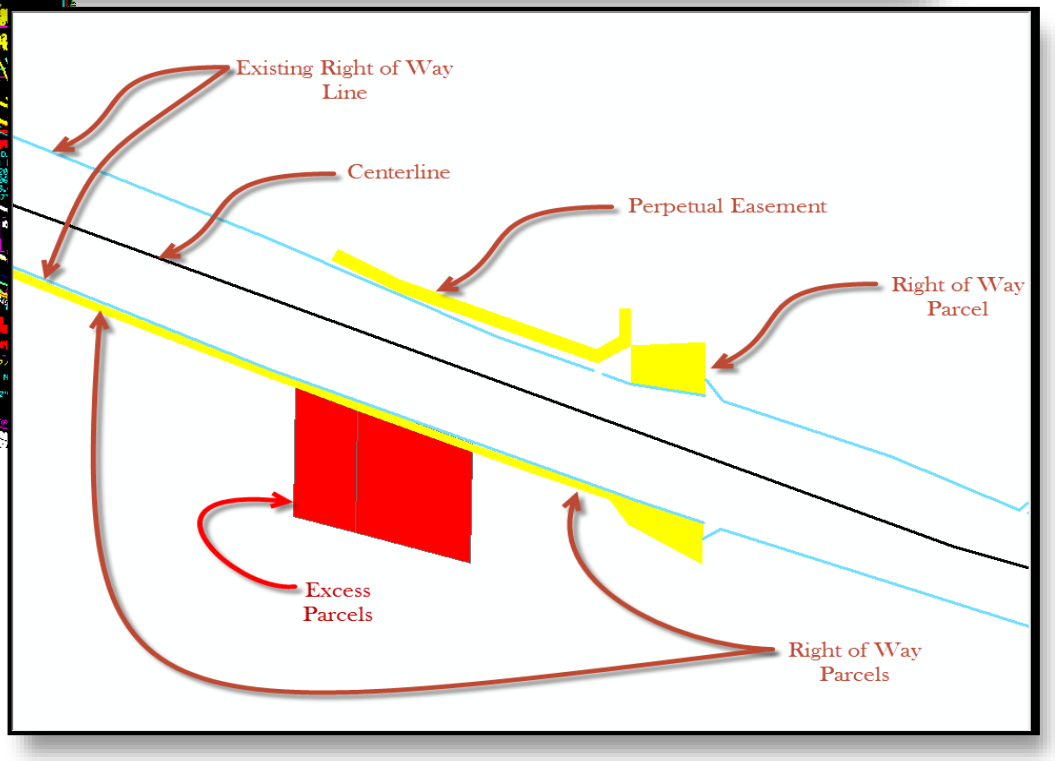
1275

Example

CADD Components Exported as GIS Features







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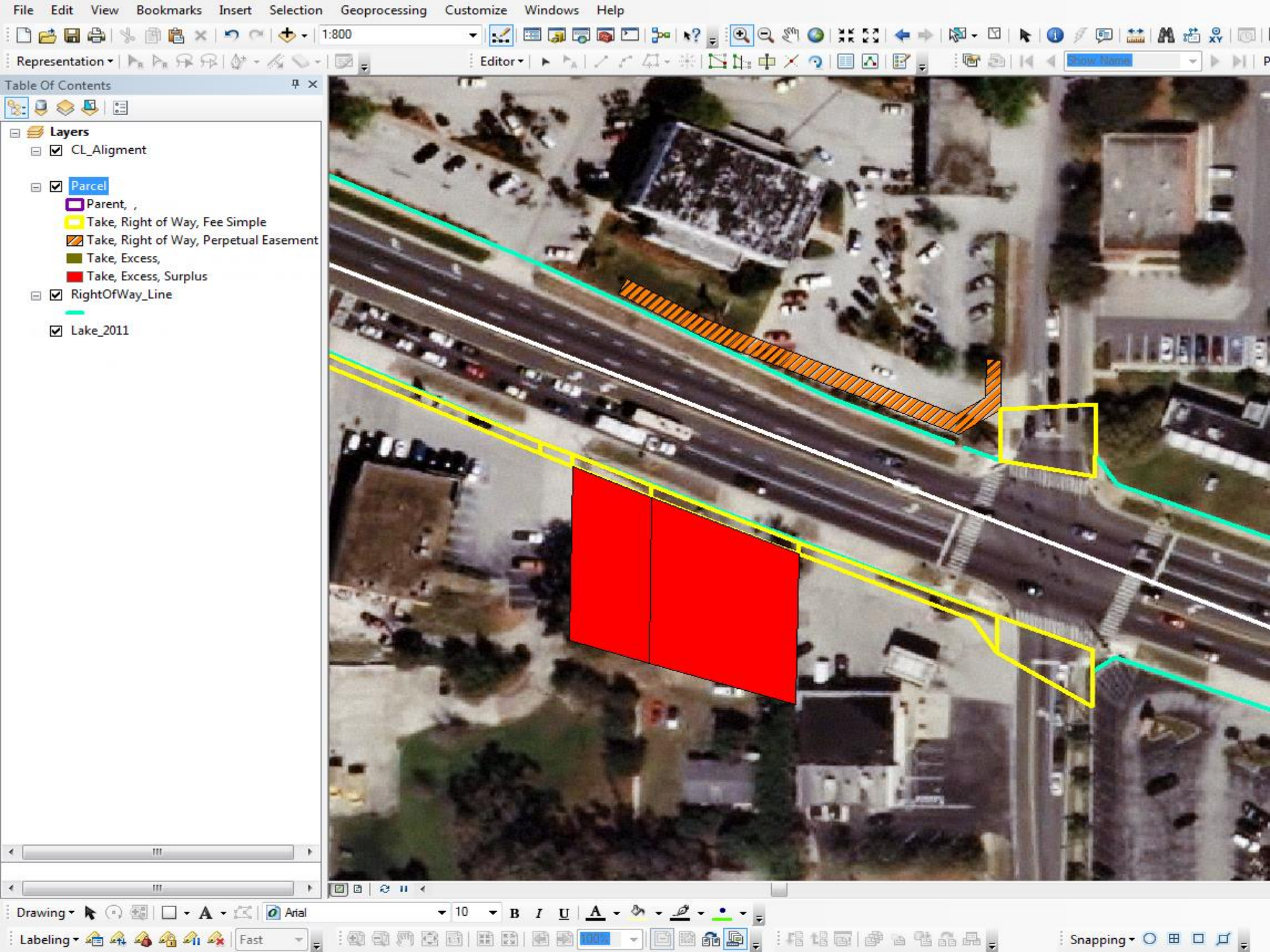
File
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Selection
Geoprocessing
Customize
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Representation
Editor
Table Of Contents
Layers
CL_Aligment
Parcel
Parent, ,
Take, Right of Way, Fee Simple
Take, Right of Way, Perpetual Easement
Take, Excess,
Take, Excess, Surplus
RightOfWay_Line
Lake_2011
Drawing
Arial
10
Labeling
Fast
Snapping

Baby Steps

- Using Bentley Geospatial Administrator
  - ✓ A FDOT GIS workspace was created and released with FDOTSS2 MR1 (Feb 14, 2014). This workspace enables the:
    - Creation of GIS Features With Attributes (intelligent data)
      - Parcels (polygons)
      - Right Of Way Lines (line)
      - Alignment (line)

Baby Steps

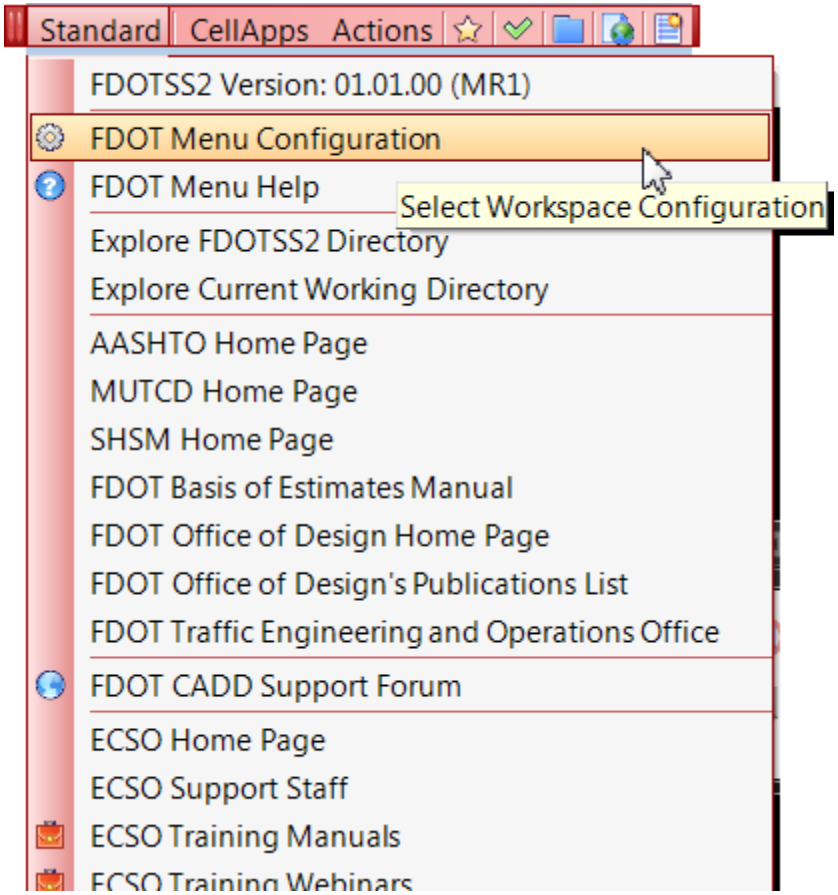
- The biggest problems are:
  - ✓ Drafting quality
    - No more sloppy drafting
      - Closed polygons
  - ✓ Data Cleanup
    - Good clean data is needed in order to Promote the line work into GIS Features
- Using the information already in the GeoPak project .gpk files and the Design & Computation Manager to visualize elements and then Promote into GIS Features
    - Polygons must be a **Complex Shape**
      - **NOT a Complex Chain**

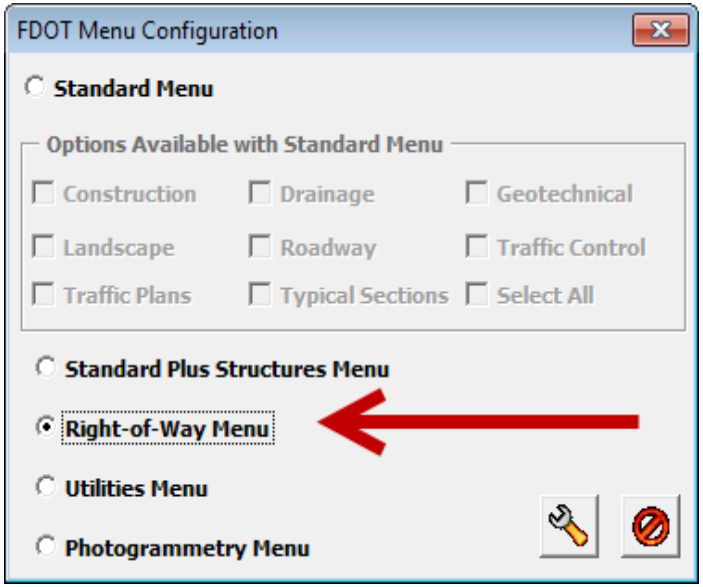
DRAFTING GIS FEATURES IN MICROSTATION

Bentley Map

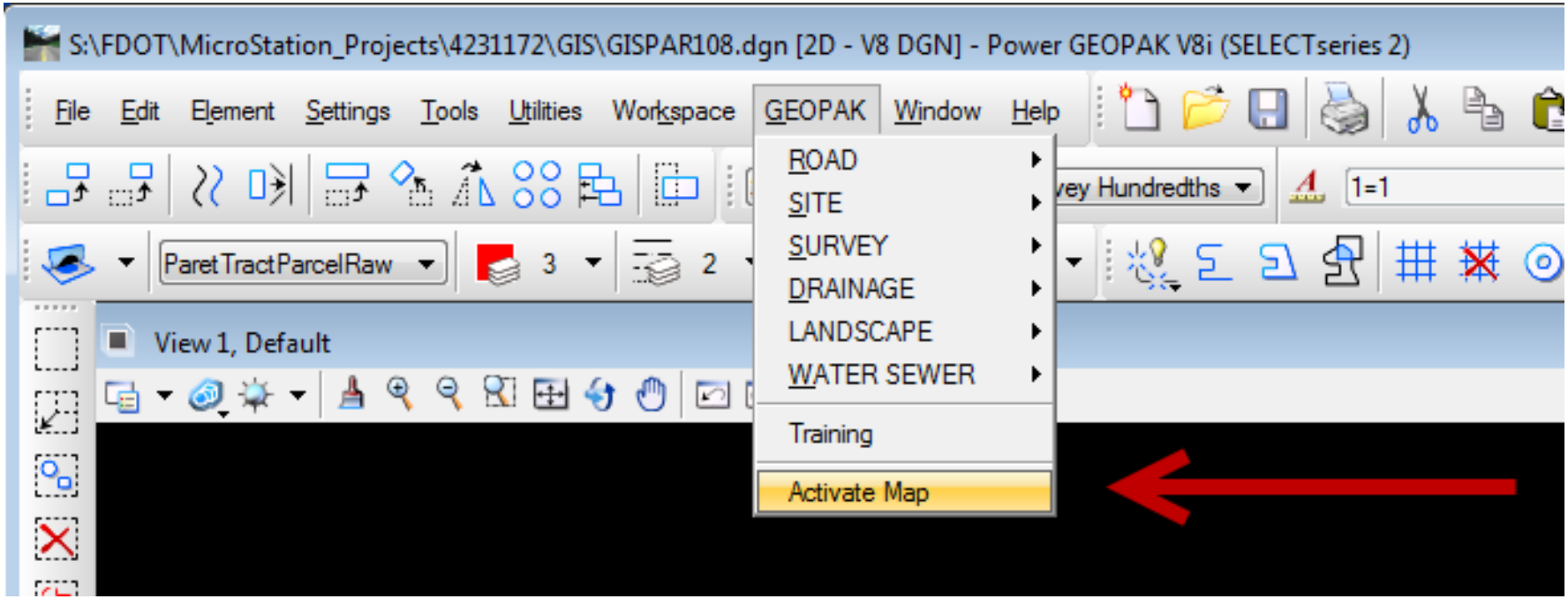
- Power GEOPAK V8i Select Series 2 with FDOTSS2 MR1 (released Feb 14, 2014)
  - ✓ Includes new geospatial tools:
    - **Interoperability tools**
      - **Map Manager**
        - Attaches files and features from any supported graphical source (such as vector maps and raster images) and manage feature display
      - **Feature Menu**
      - **Command Manager**
        - Allows for the placing, editing, promotion, analyzation and browsing of feature attributes

FDOTSS2 MR1 Workspace





Activate Map



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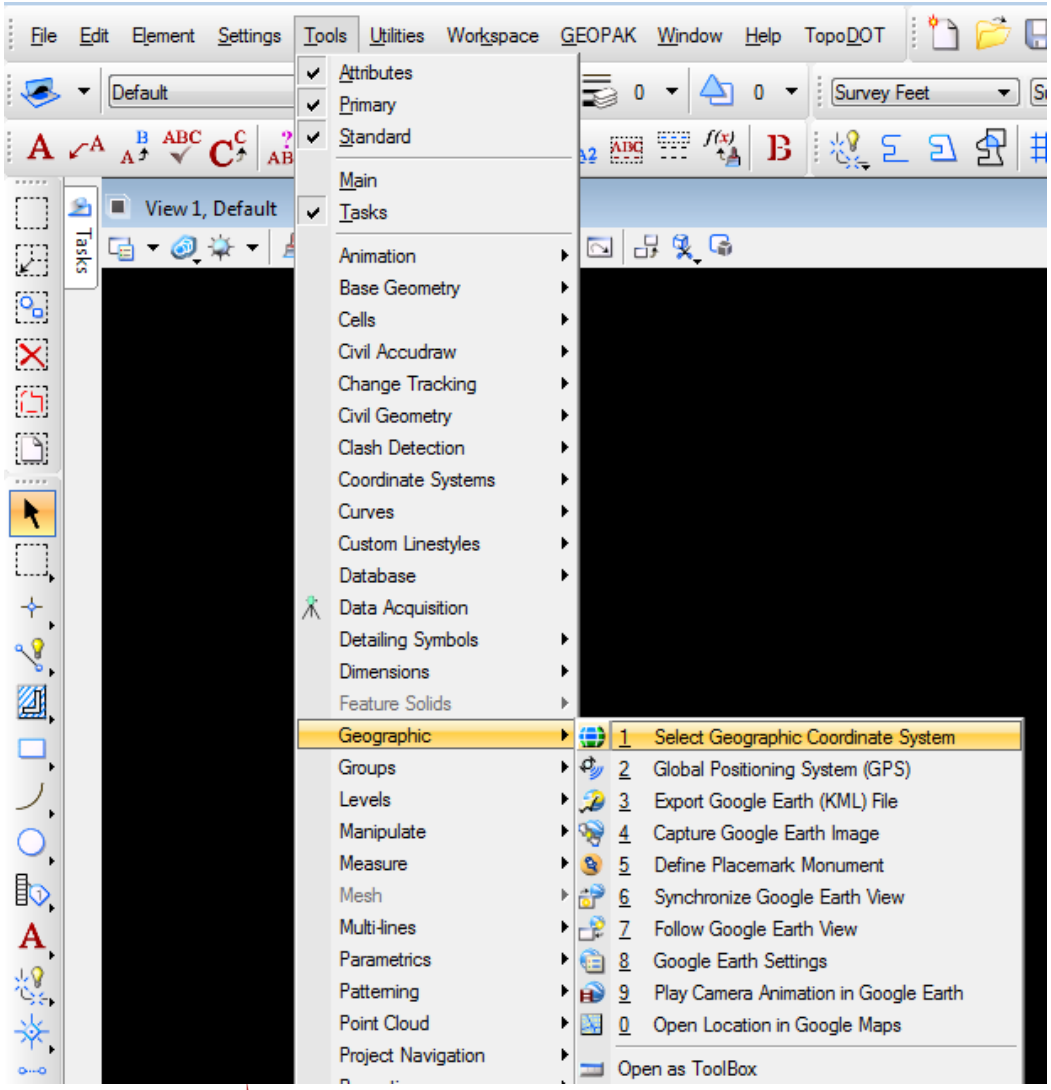

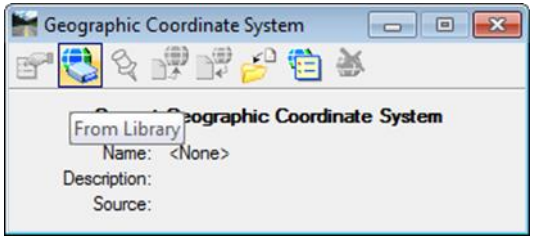

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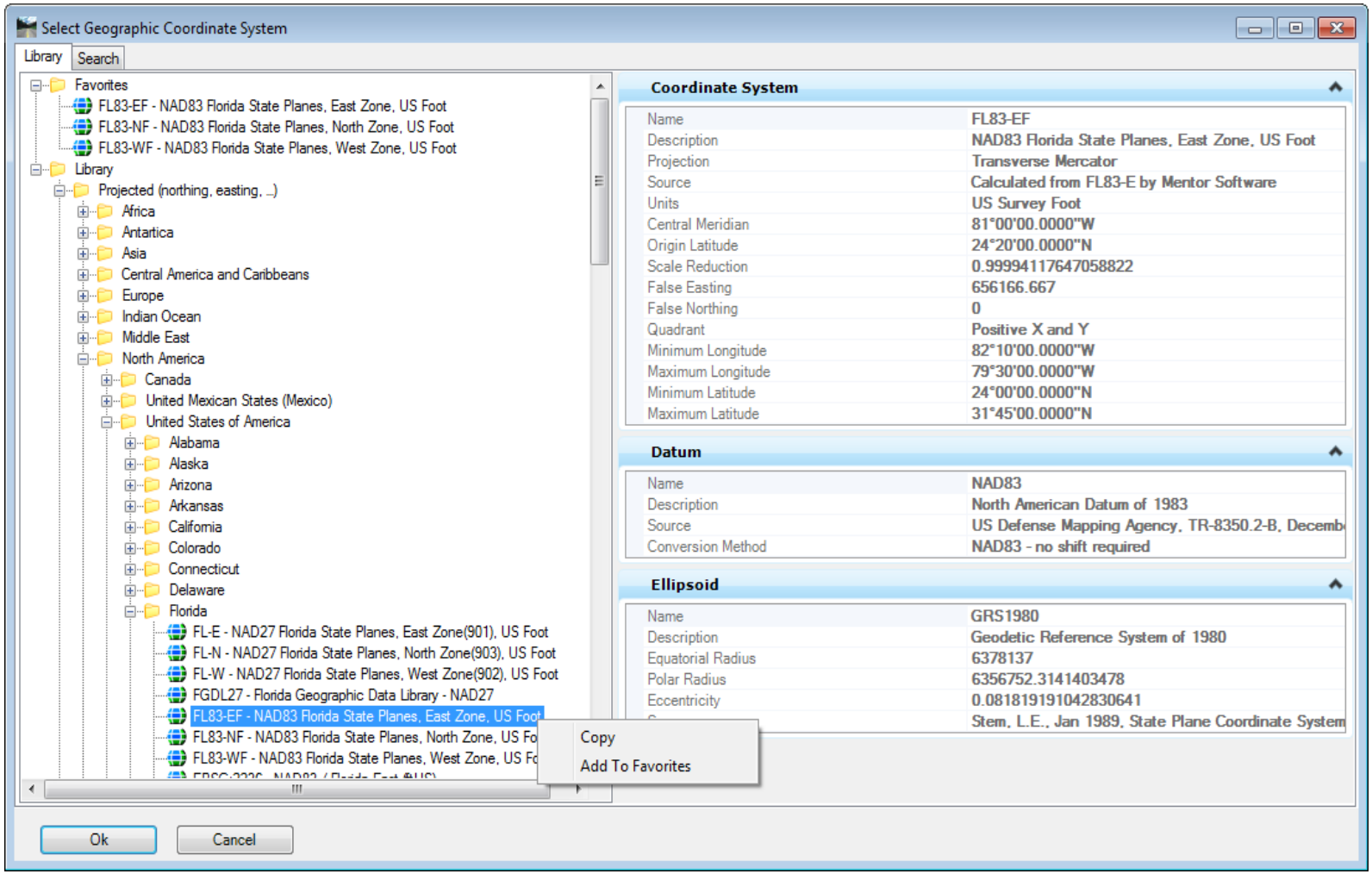

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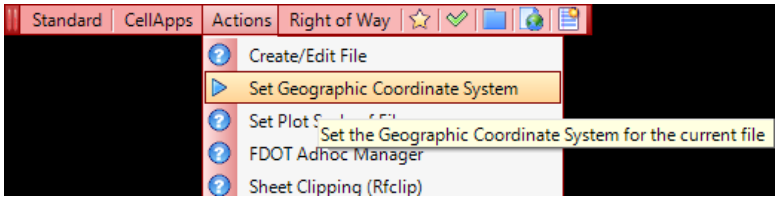
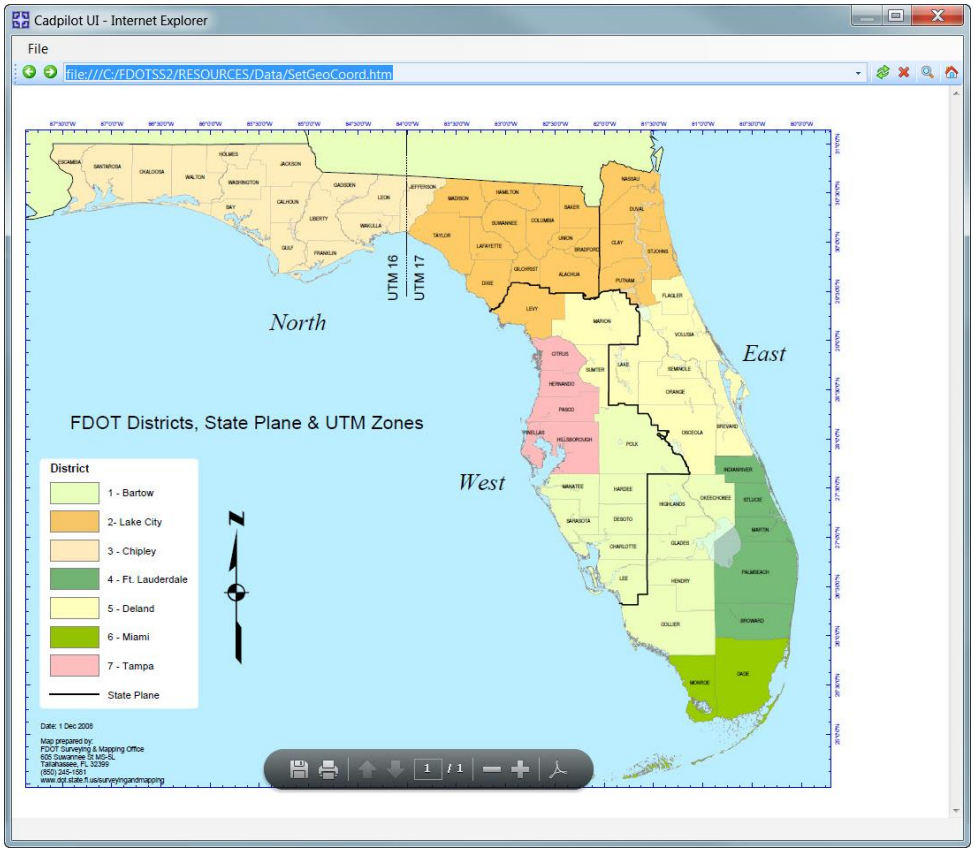
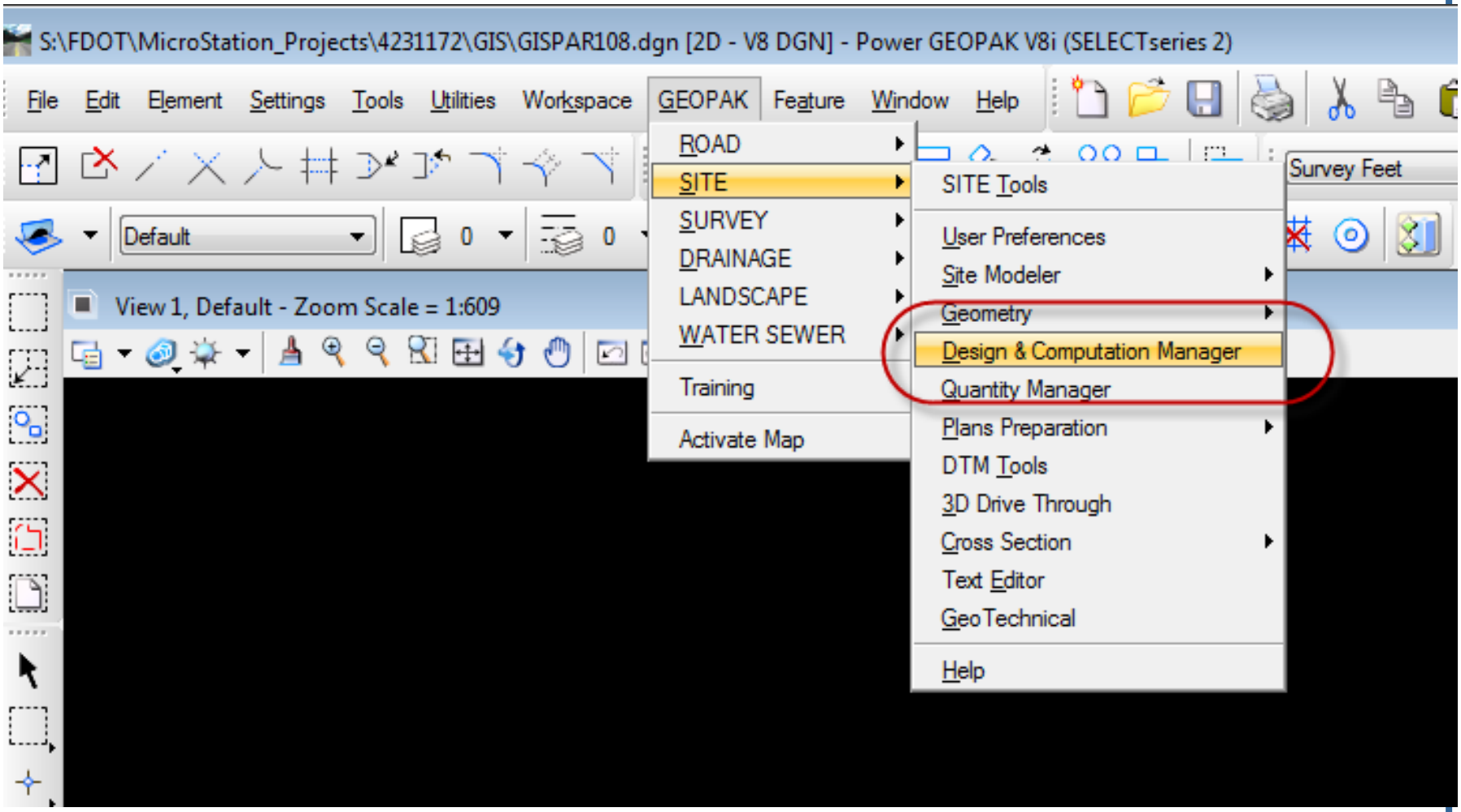




Design & Computation Manager



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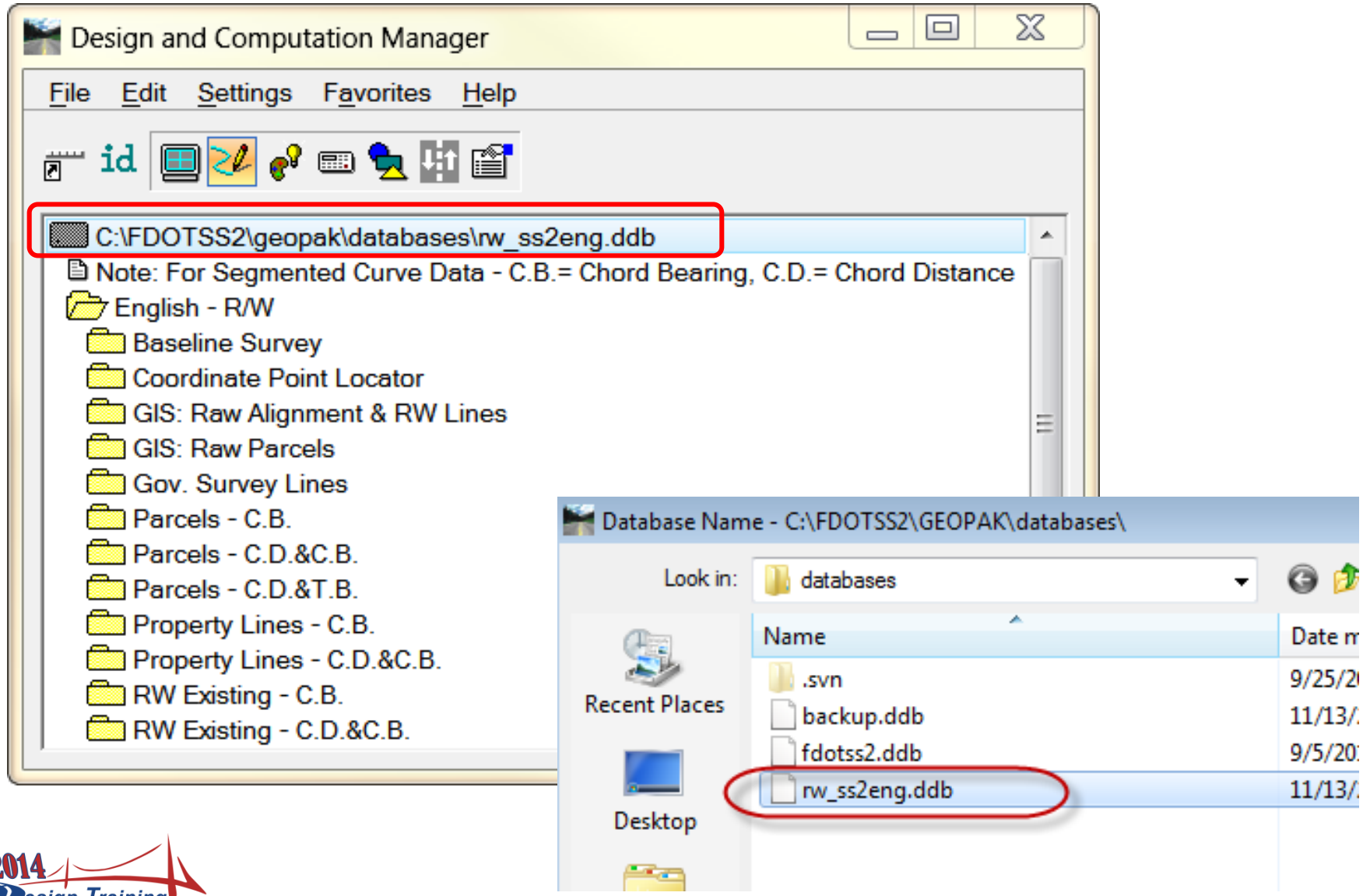
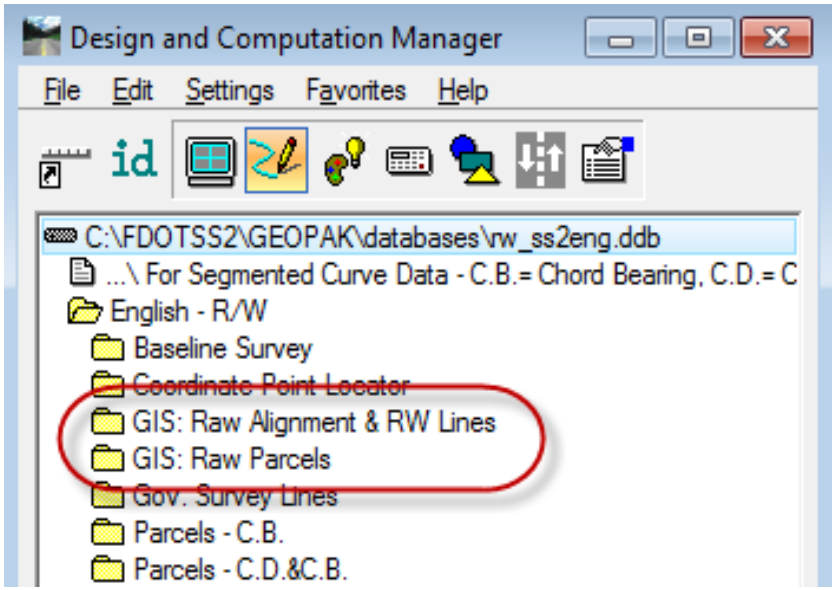
Design & Computation Manager



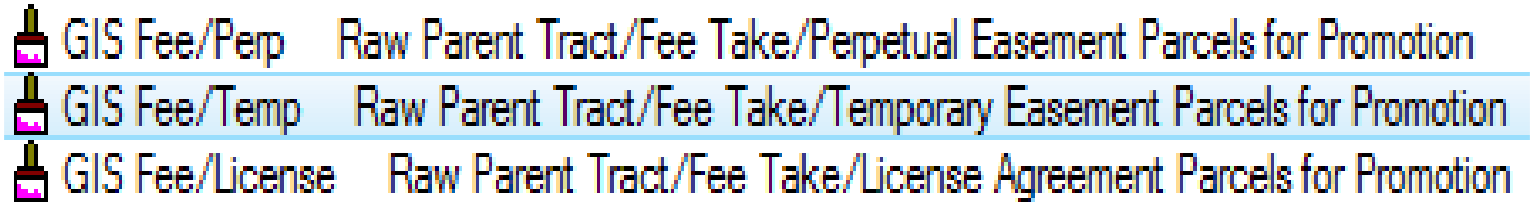
Design & Computation Manager

Two GIS Categories have been added to the Design and Computation Manager:

- Use these GIS categories to visualize "raw" line work for promotion to Bentley Map GIS features.
- Once plotted and before being promoted to a Bentley Map GIS feature, line work like:
  - ✓ **Alignments** and **Right Of Way** lines
    - Need to be turned into continuous poly-lines.
  - ✓ **Parcels**
    - Need to be turned into polygons before being promoted.



Design & Computation Manager

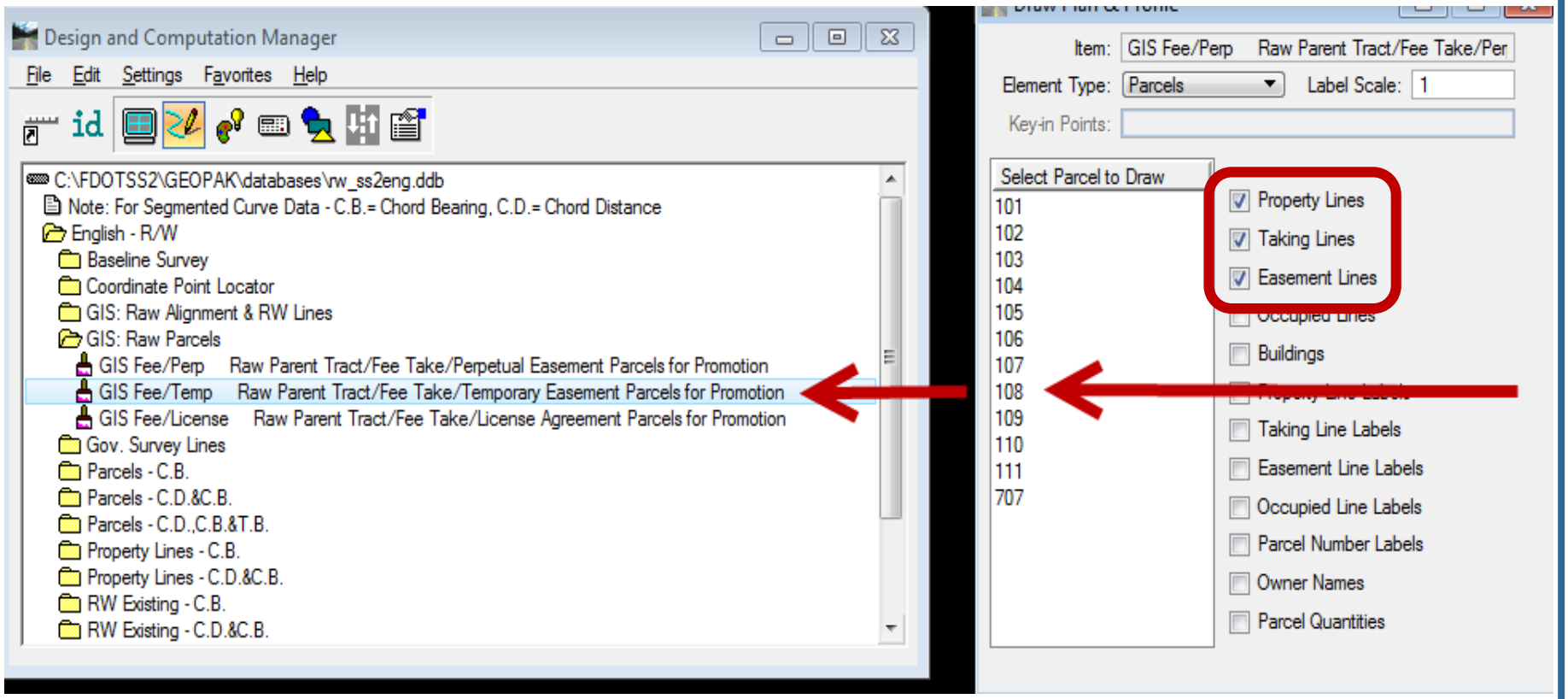


When visualizing parcels; choose the category that best fit the type of take that will be promoted. Generally choose the category based on the type of easement involved in the take.

Note: ***Do not** visualize labels. Labels are not necessary and will not be carried over to GIS when the lines and parcels are promoted.*

Design & Computation Manager

As an example here is a parcel that includes a temporary easement, parcel 708, and is used to visualize the raw parent tract, fee take (108) and the temporary easement (708) all at the same time.



GIS Levels: Raw Line Work

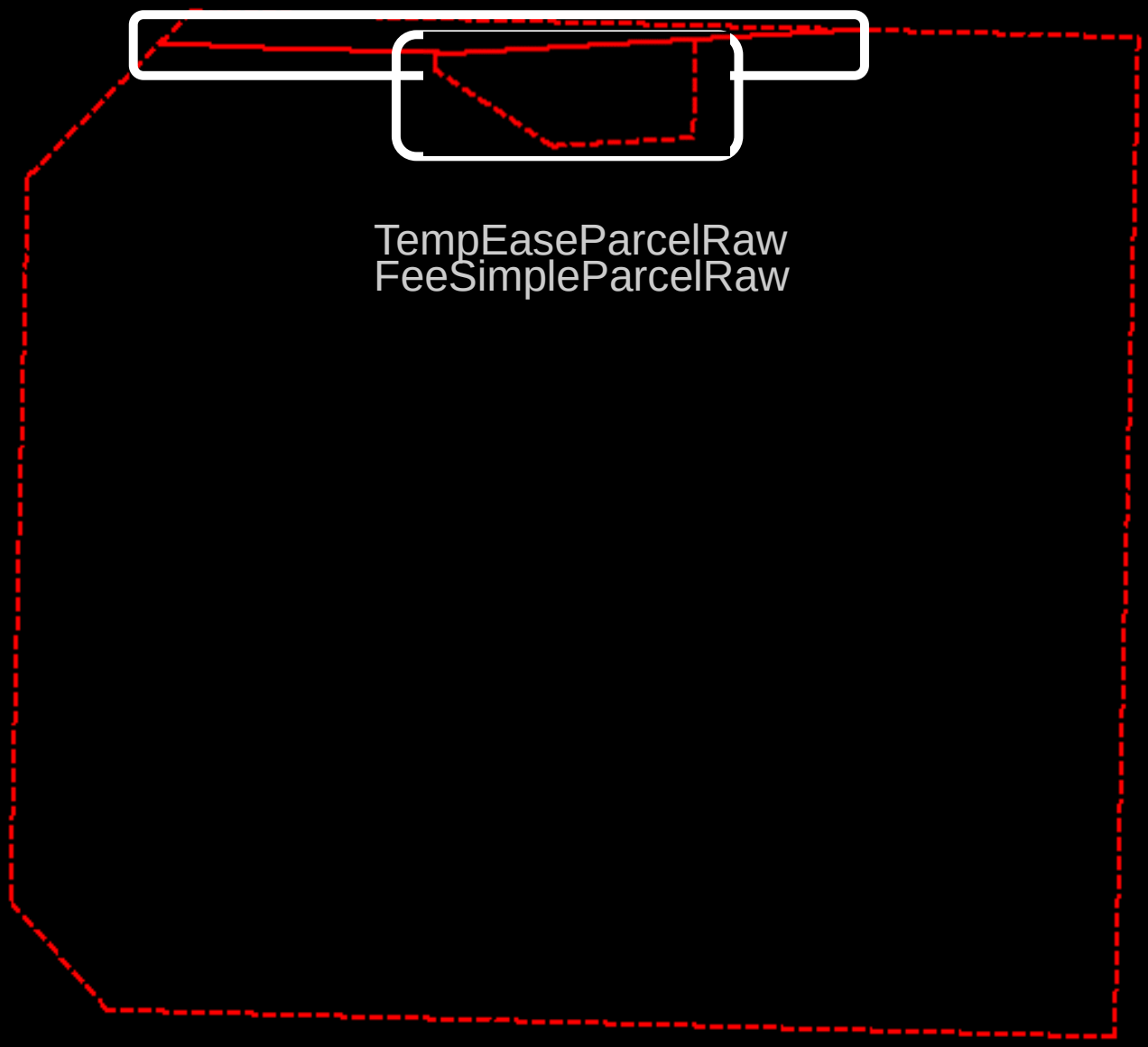
Name	Number	Description
AlignmentRaw	400	GIS: Raw Centerline/Baseline/Digitized Alignment
ExcessParcelRaw	403	GIS: Raw Excess Parcel
FeeSimpleParcelRaw	405	GIS: Raw Fee Simple Take Parcel (100s)
ParetTractParcelRaw	407	GIS: Raw Parent Track Parcel (Existing)
LiceseParcelRaw	409	GIS: Raw License Agreement Parcel (900s)
PerpEaseParcelRaw	411	GIS: Raw Perpetual Easement Parcel (800s)
TempEaseParcelRaw	413	GIS: Raw Temporary Easement Parcel (700s)
RightOfWayLineRaw	415	GIS: Raw Right of Way Lines (After Acquisition)
LARightOfWayLineRaw	417	GIS: Raw Limited Access Right of Way Lines (After Acquisition)
SurplusParcelRaw	419	GIS: Raw Surplus Property Parcel

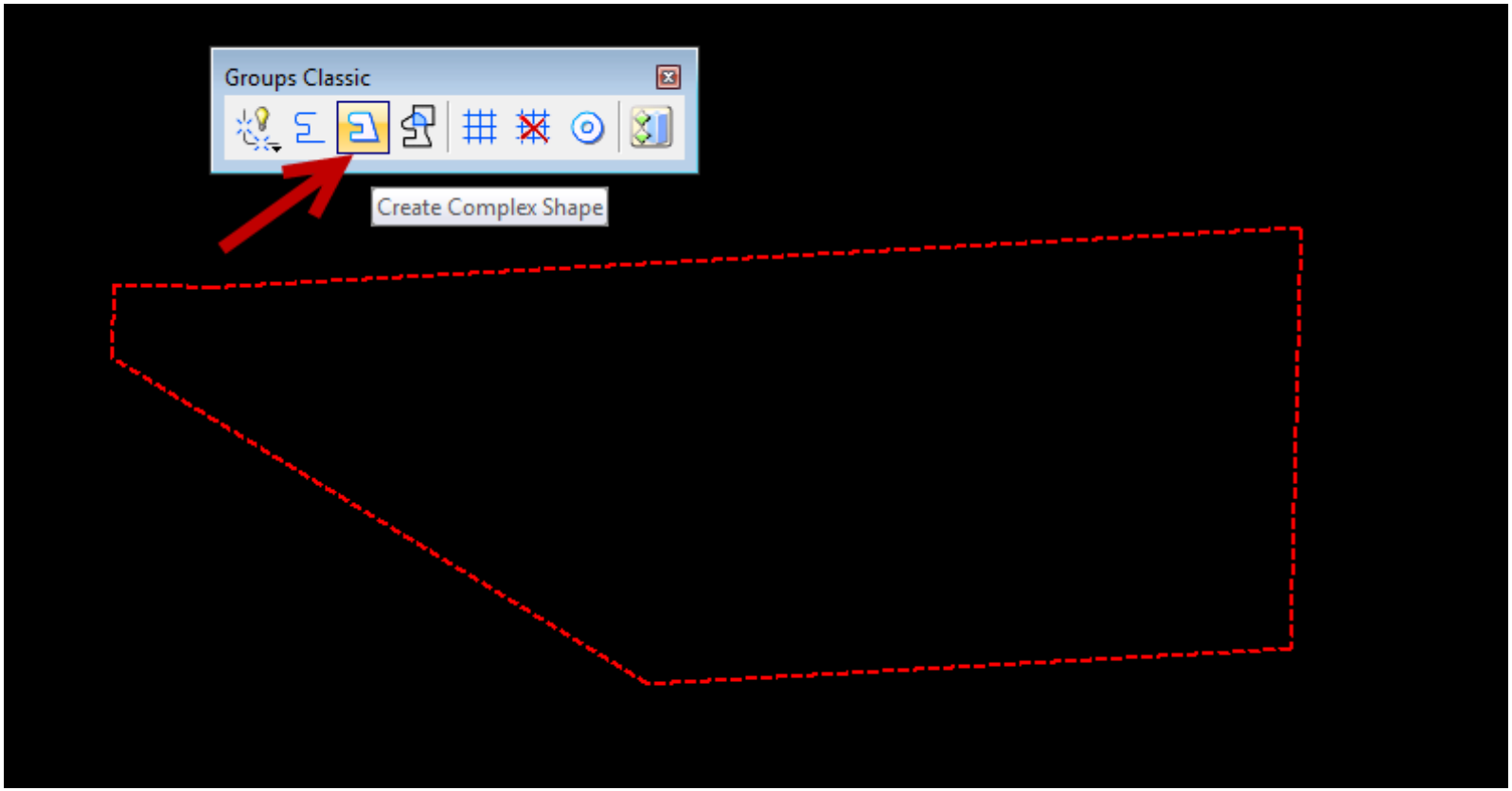
GIS Levels: Create/Promote Features

Name	Number	Description
Alignment	401	GIS: Created/Promoted Centerline/Baseline/Digitized Alignment
ExcessParcel	404	GIS: Created/Promoted Excess Parcel
FeeSimpleParcel	406	GIS: Created/Promoted Fee Simple Take Parcel (100s)
ParentTrackParcel	408	GIS: Created/Promoted Parent Track Parcel (Existing)
LicenseParcel	410	GIS: Created/Promoted License Agreement Parcel (900s)
PerpEaseParcel	412	GIS: Created/Promoted Perpetual Easement Parcel (800s)
TempEaseParcel	414	GIS: Created/Promoted Temporary Easement Parcel (700s)
RightOfWayLine	416	GIS: Created/Promoted Right of Way Lines (After Acquisition)
LARightOfWayLine	418	GIS: Created/Promoted Limited Access Right of Way Lines (After Acquisition)
SurplusParcel	420	GIS: Created/Promoted Surplus Property Parcel

After the parcels are visualized from the D & C Manager, now what?

PROCESSING PARCEL LINE WORK

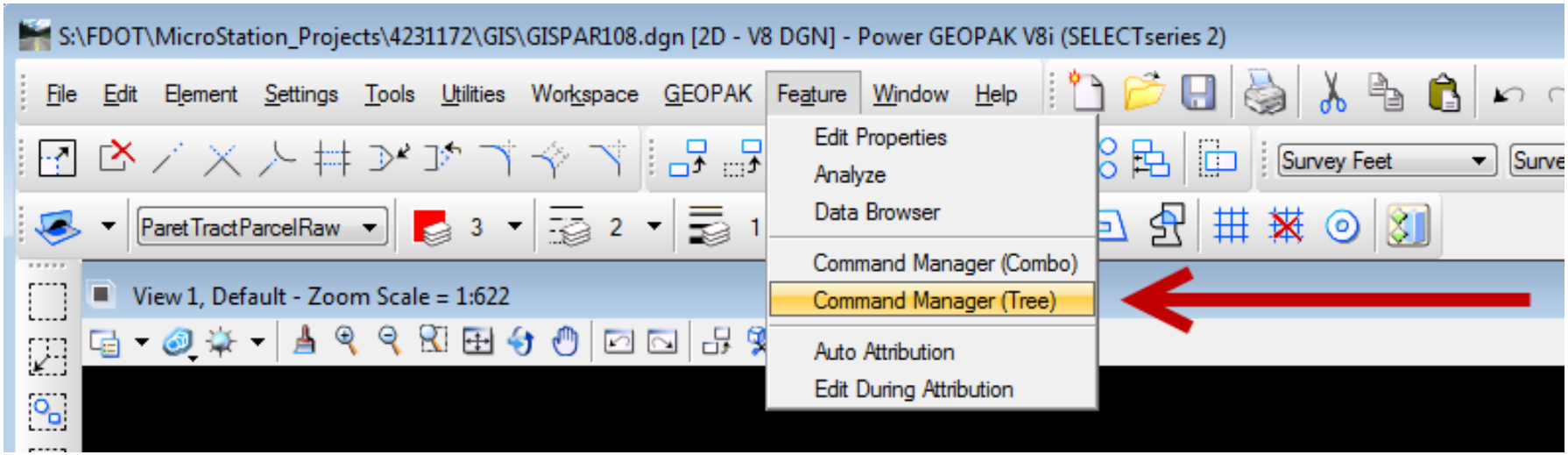

TempEaseParcelRaw
FeeSimpleParcelRaw


Groups Classic
Create Complex Shape

Command Manager

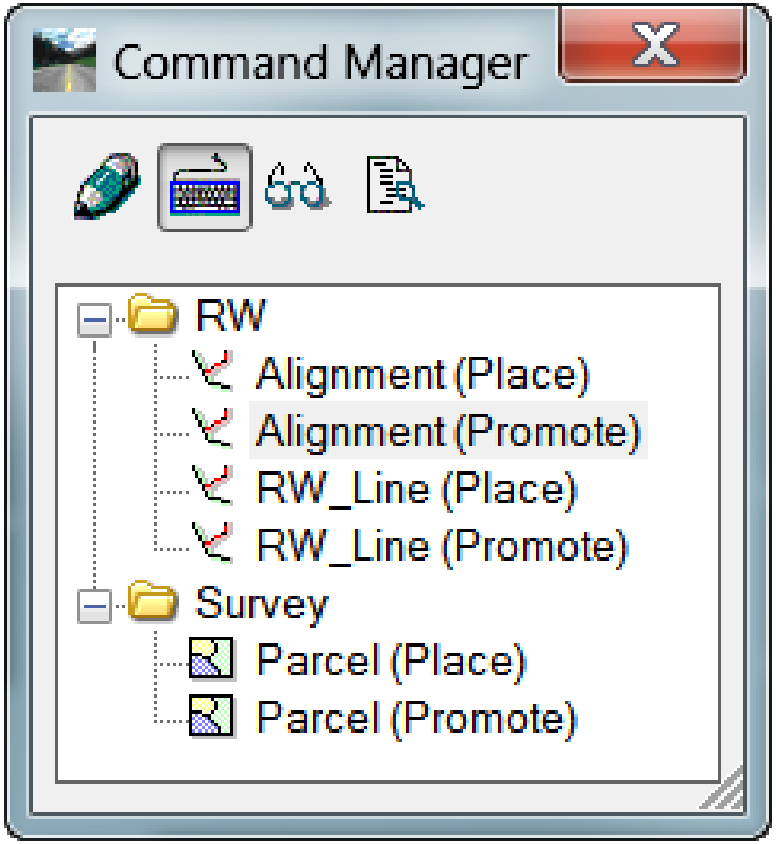
INTEROPERABILITY TOOLS

Feature Menu



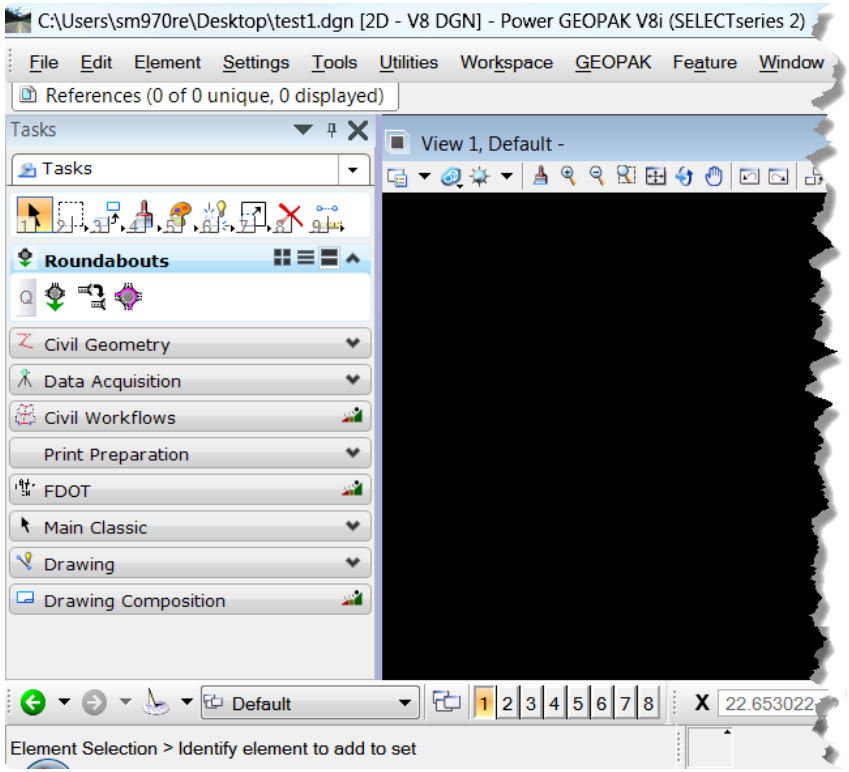
Command Manager

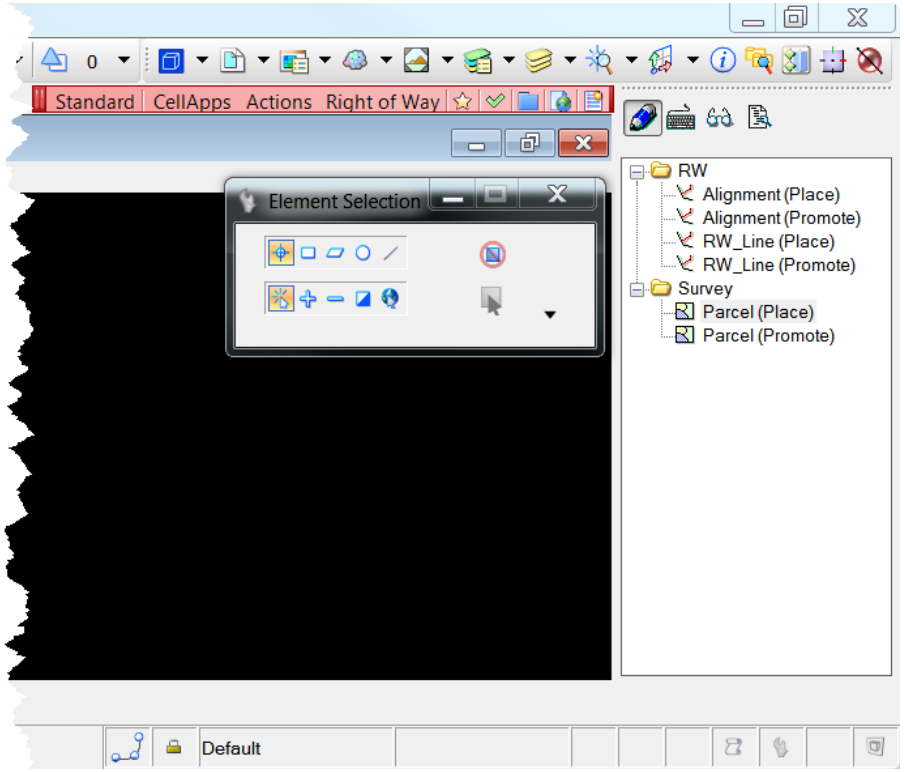
Tree



Note: Commands are categorized by discipline in this example, but could be categorized/organized in other ways.

Command Manager





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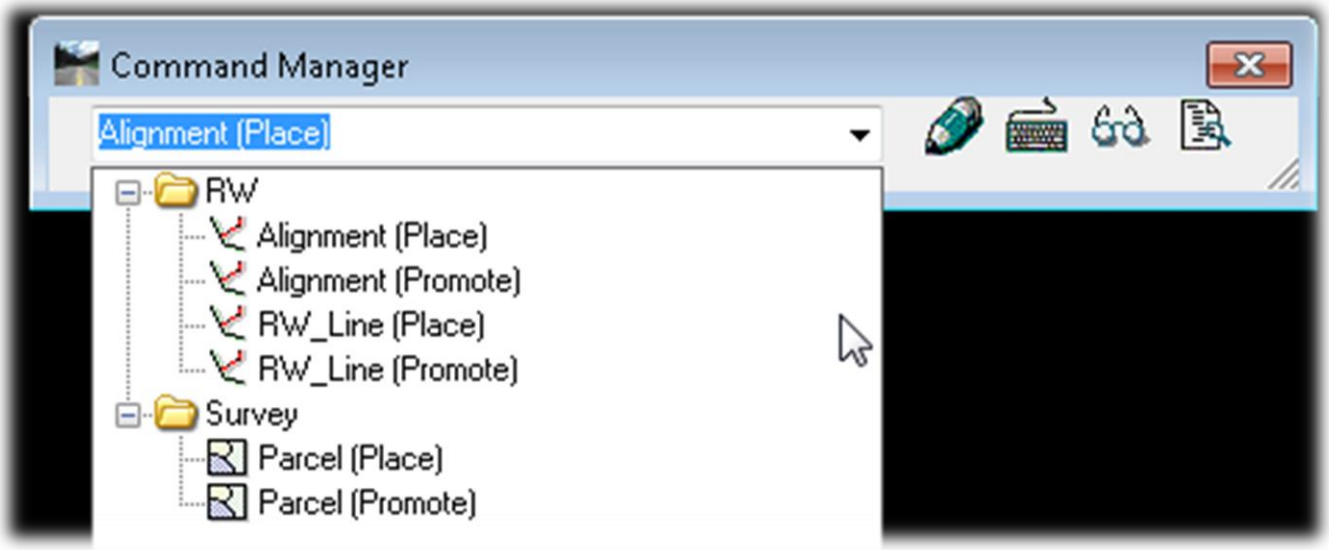
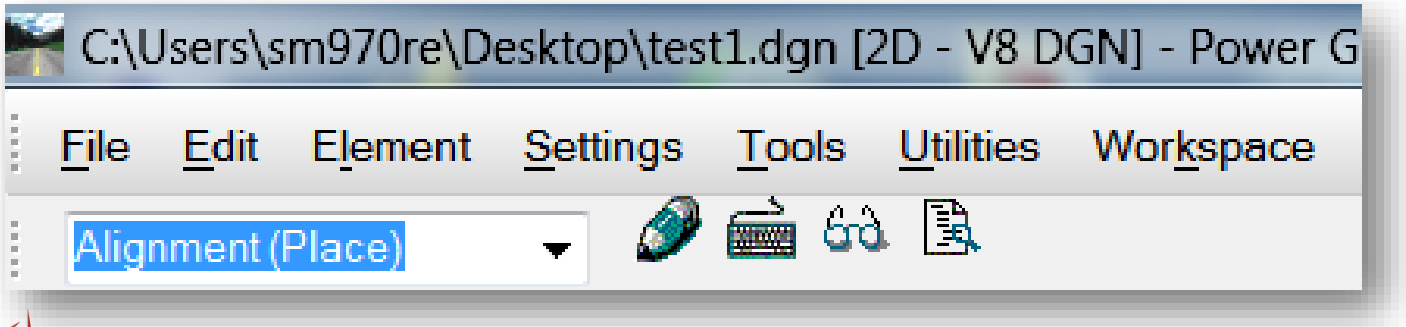
Command Manager

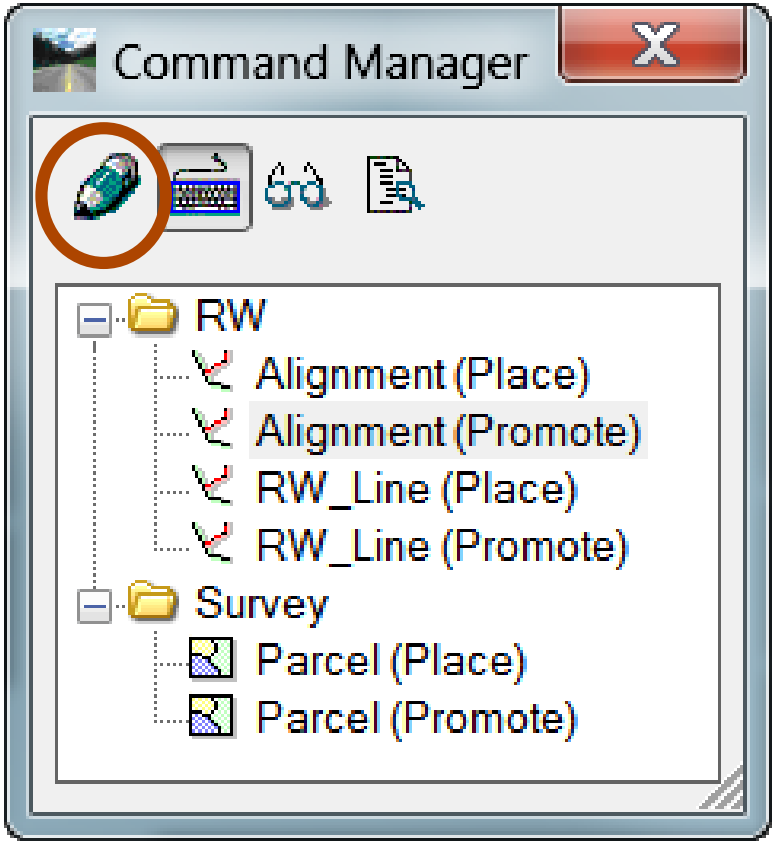
Combo Box





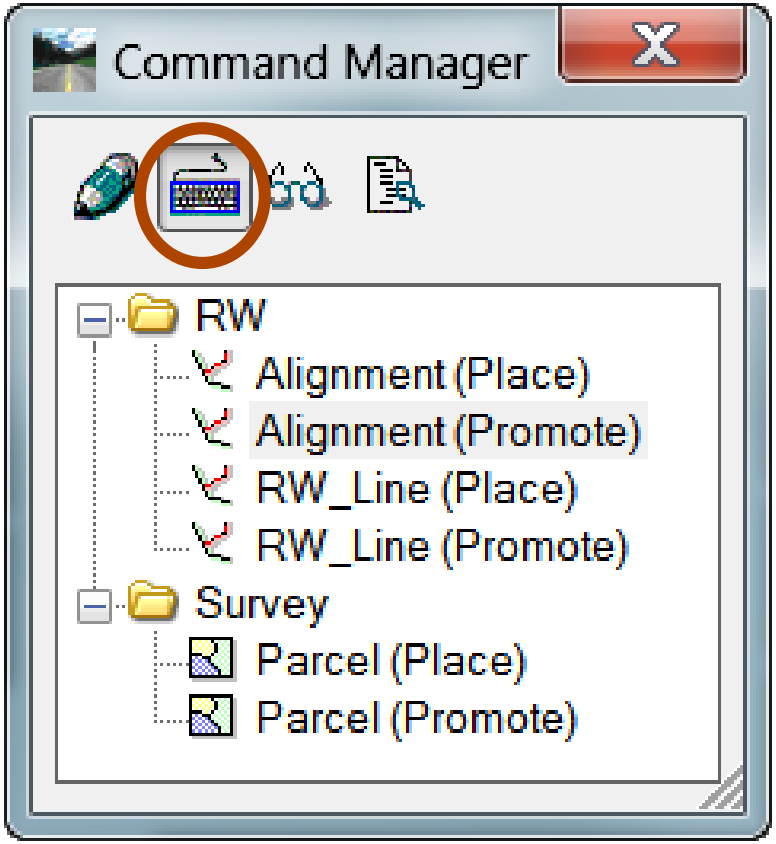
Command Manager

Place

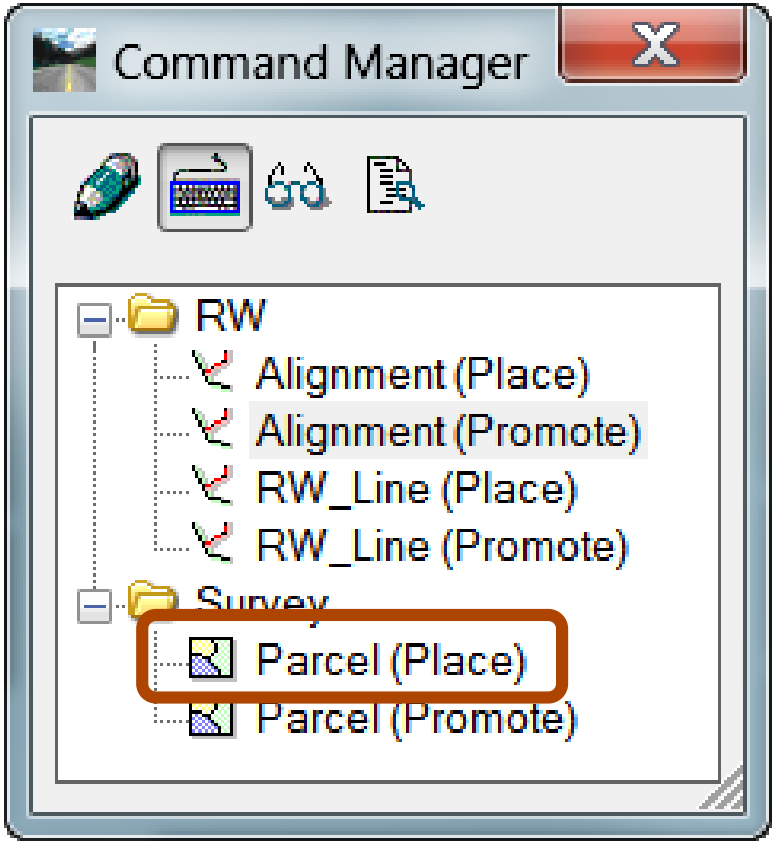


Place

Edit


Command Manager
RW
Alignment (Place)
Alignment (Promote)
RW_Line (Place)
RW_Line (Promote)
Survey
Parcel (Place)
Parcel (Promote)

Parcels


Command Manager
RW
Alignment (Place)
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RW_Line (Place)
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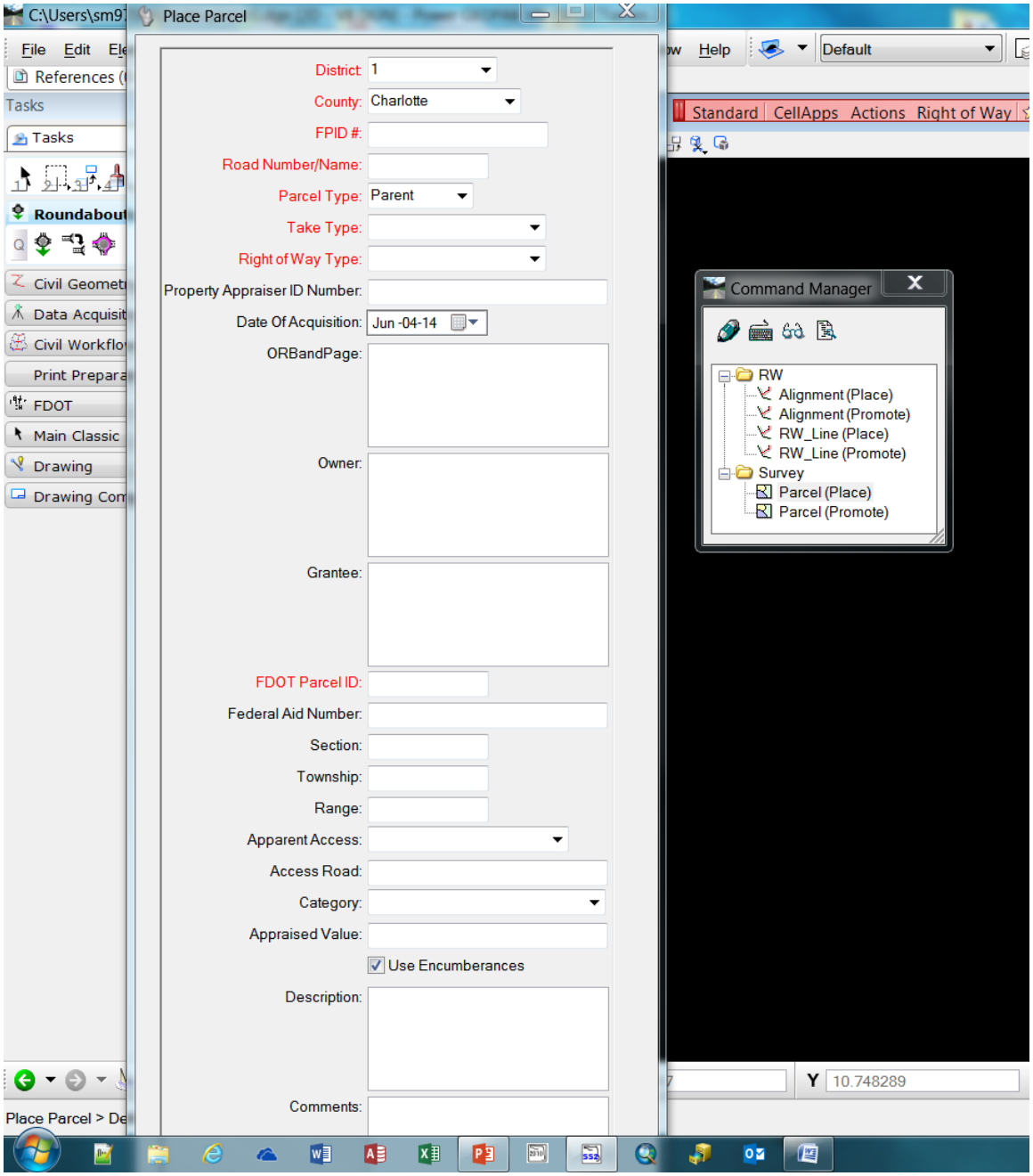
Survey
Parcel (Place)
Parcel (Promote)



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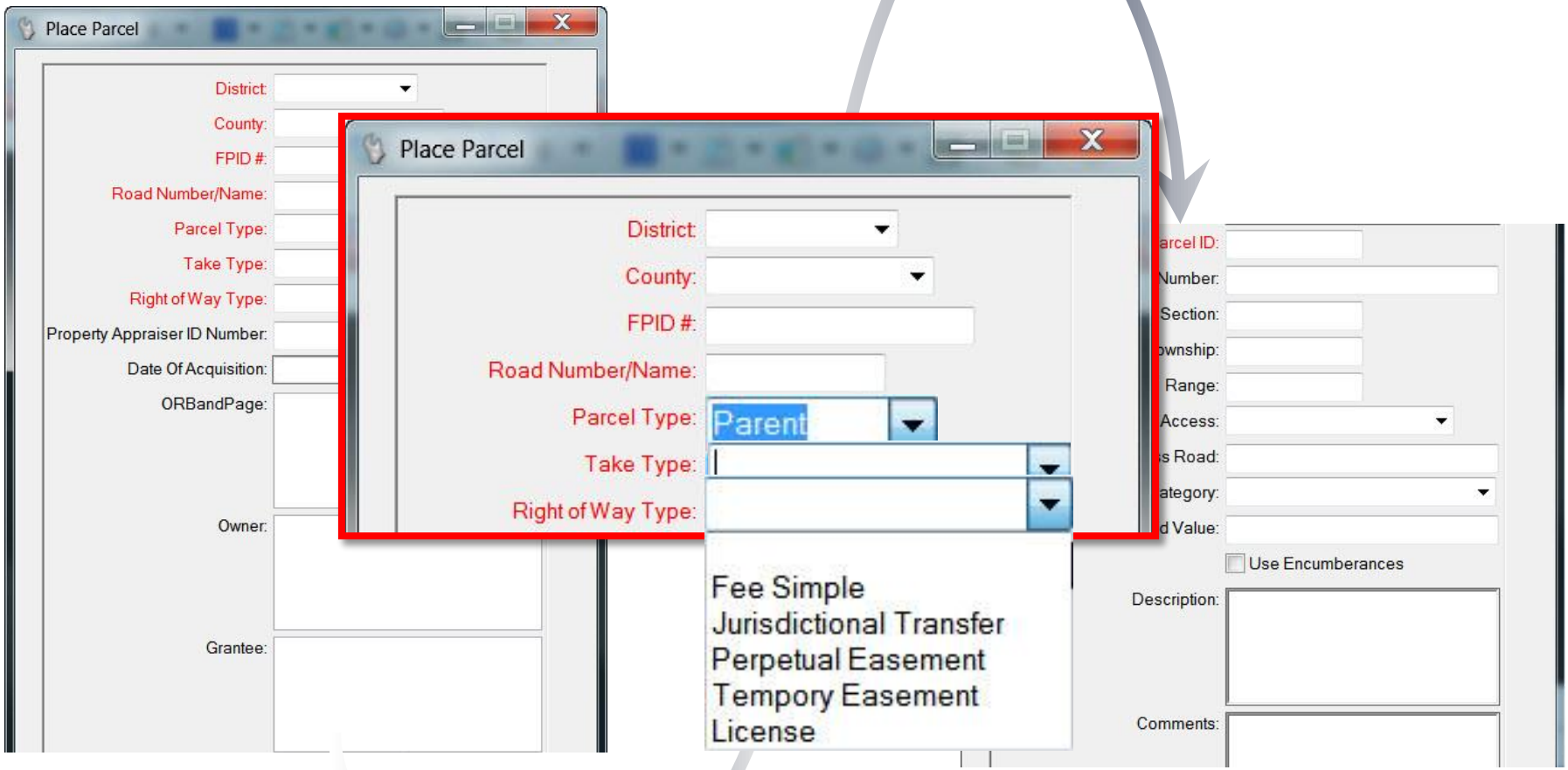
Parcels

Place/Create/Edit



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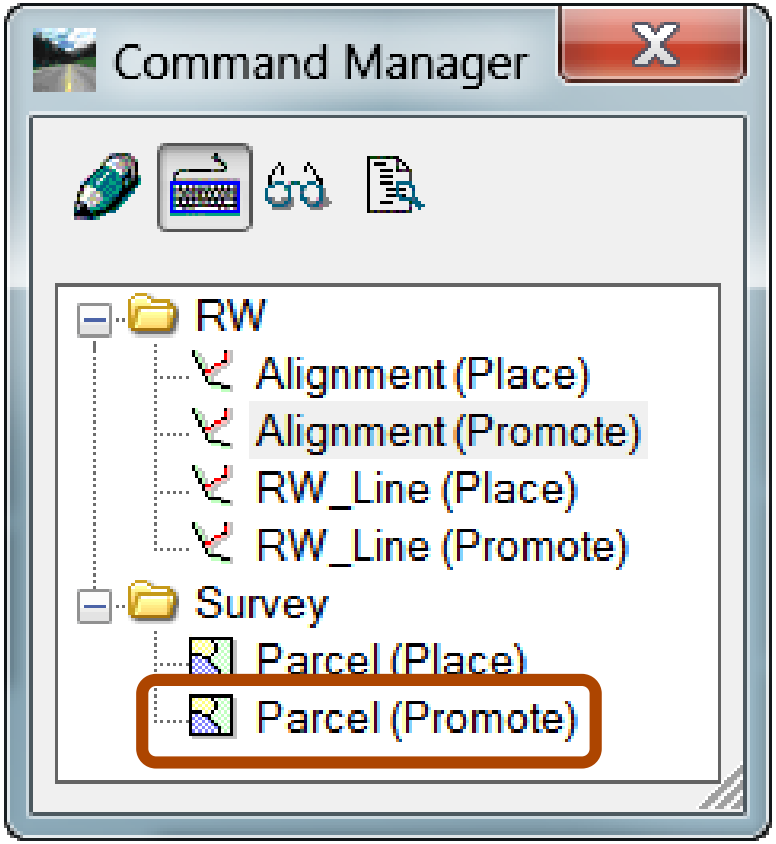
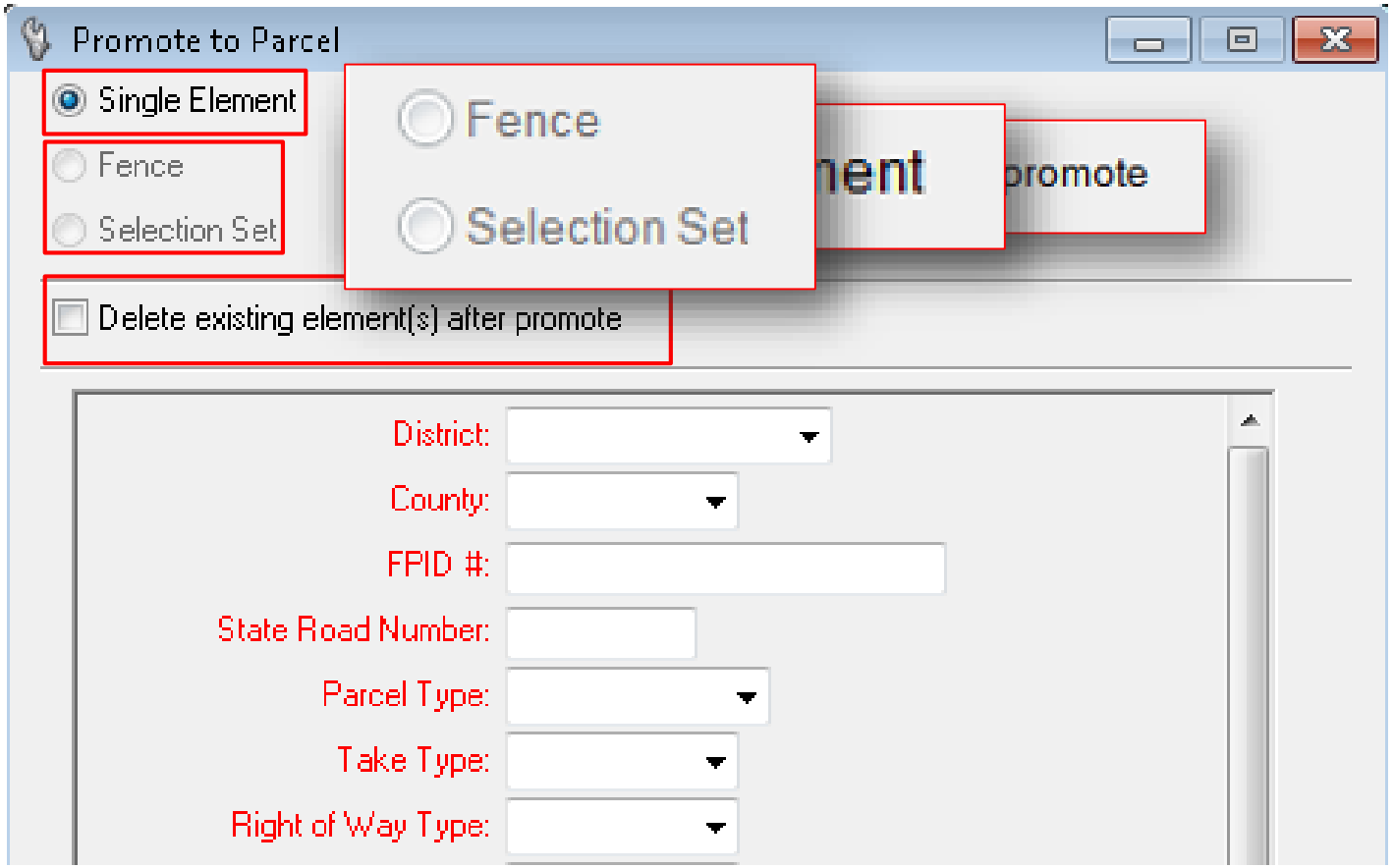
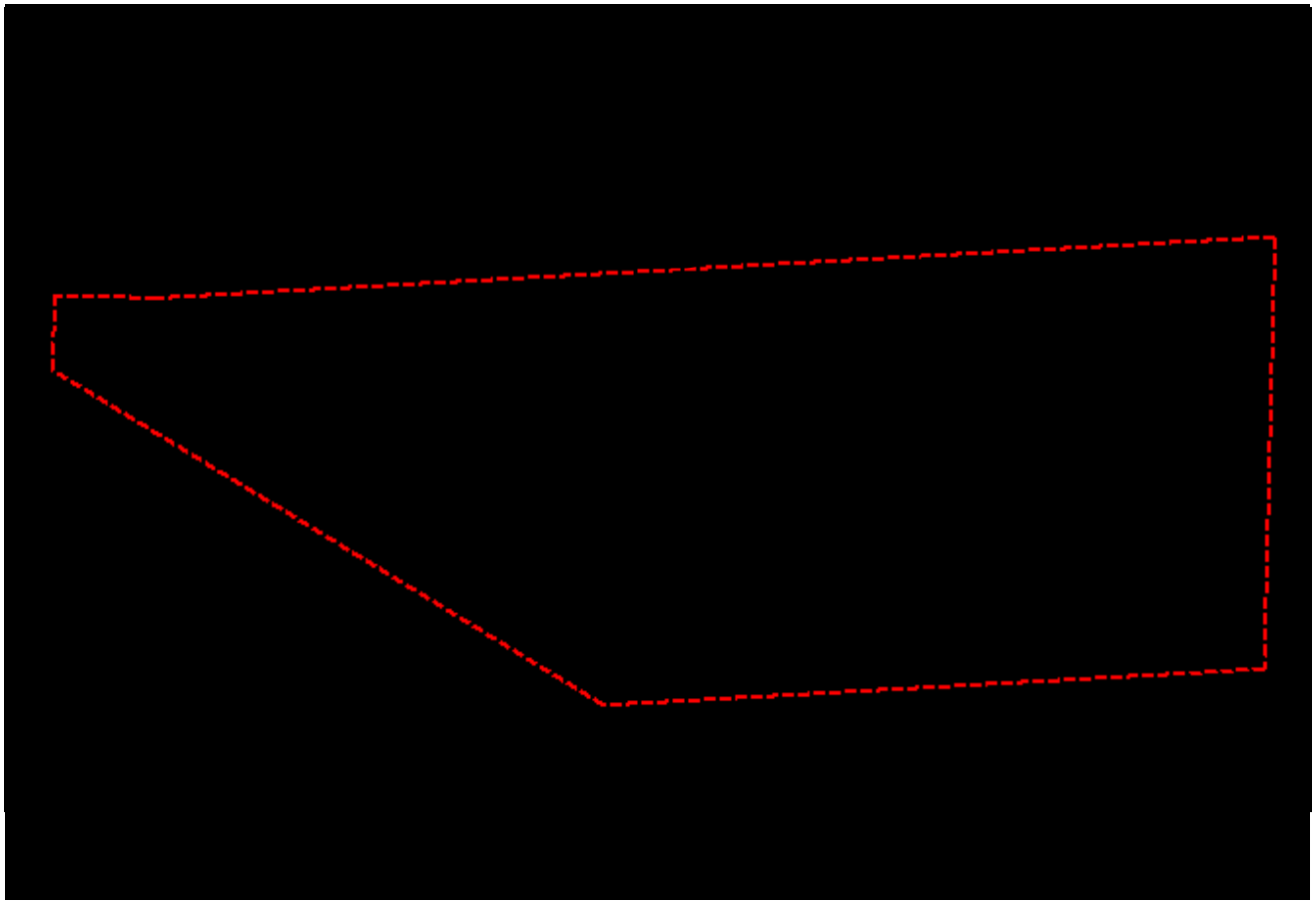
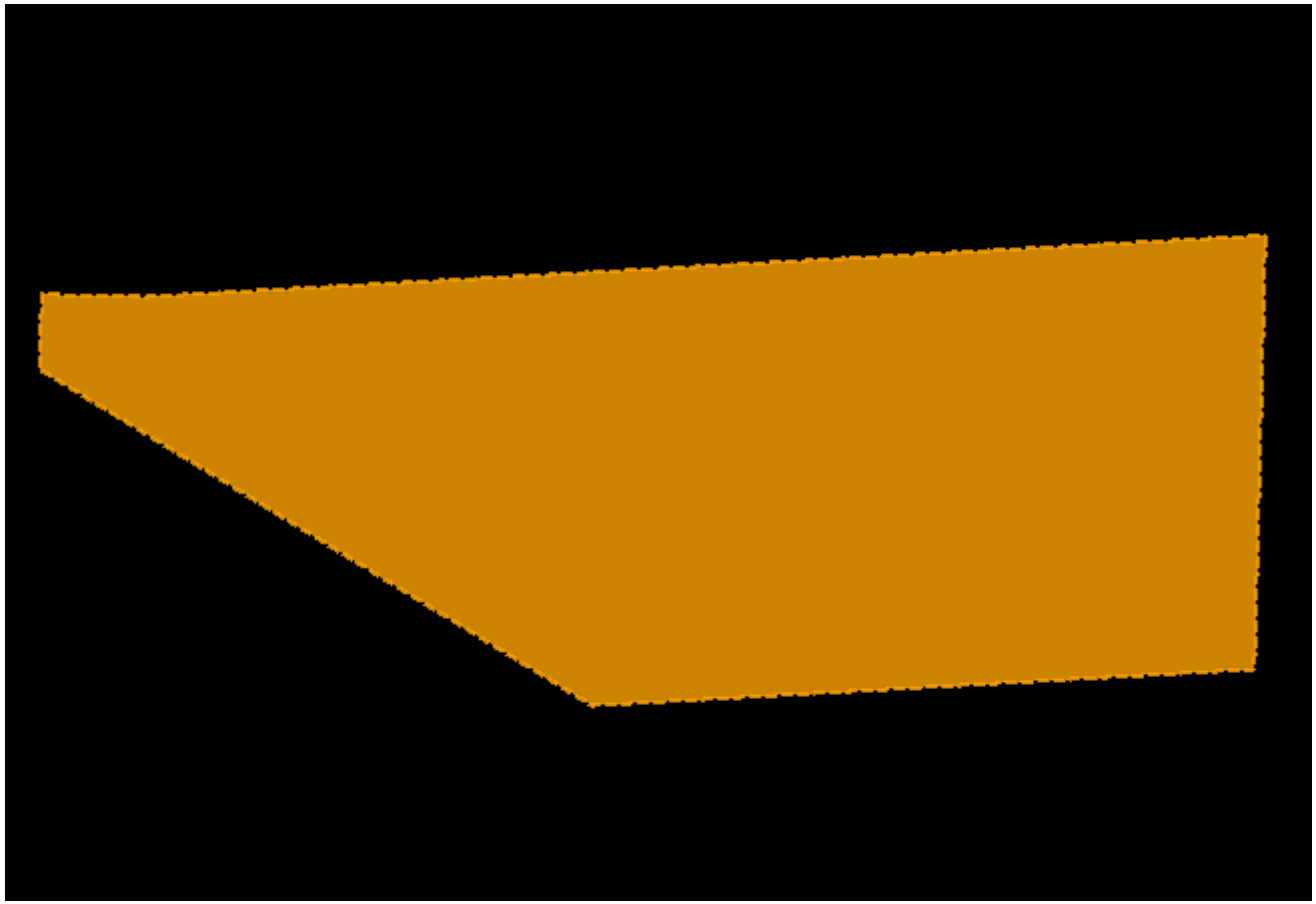

Command Manager
RW
Alignment (Place)
Alignment (Promote)
RW_Line (Place)
RW_Line (Promote)
Survey
Parcel (Place)
Parcel (Promote)

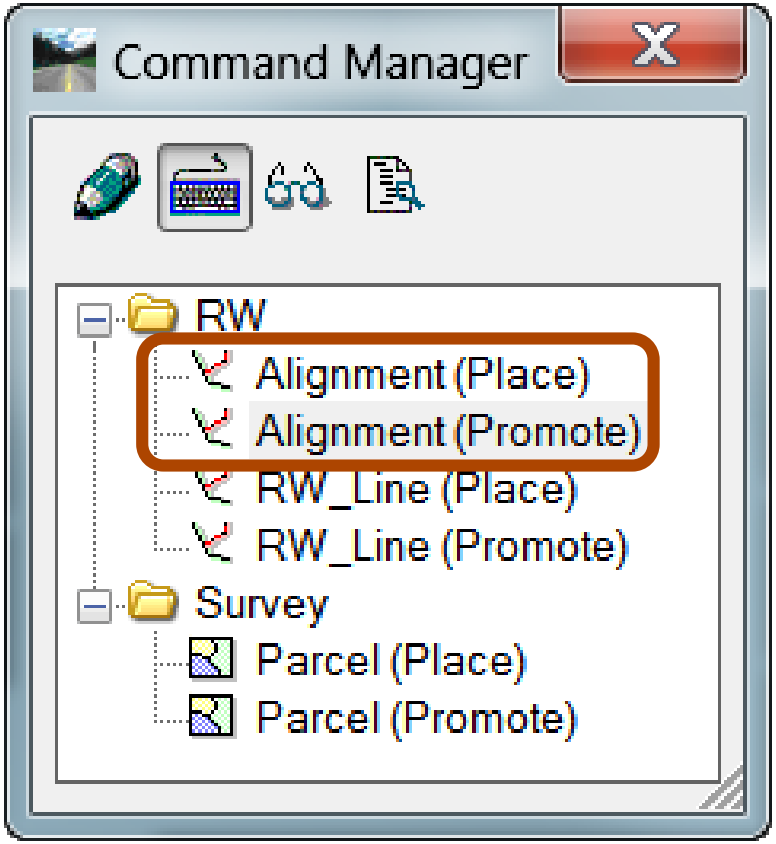
Parcels

Promote Existing to Parcel

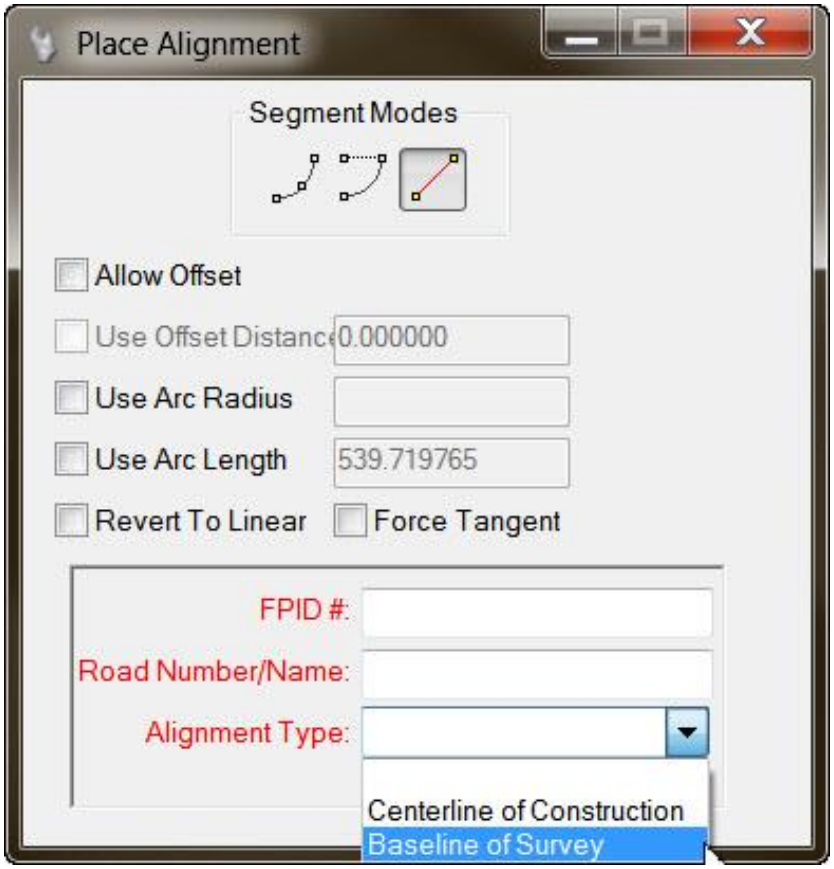


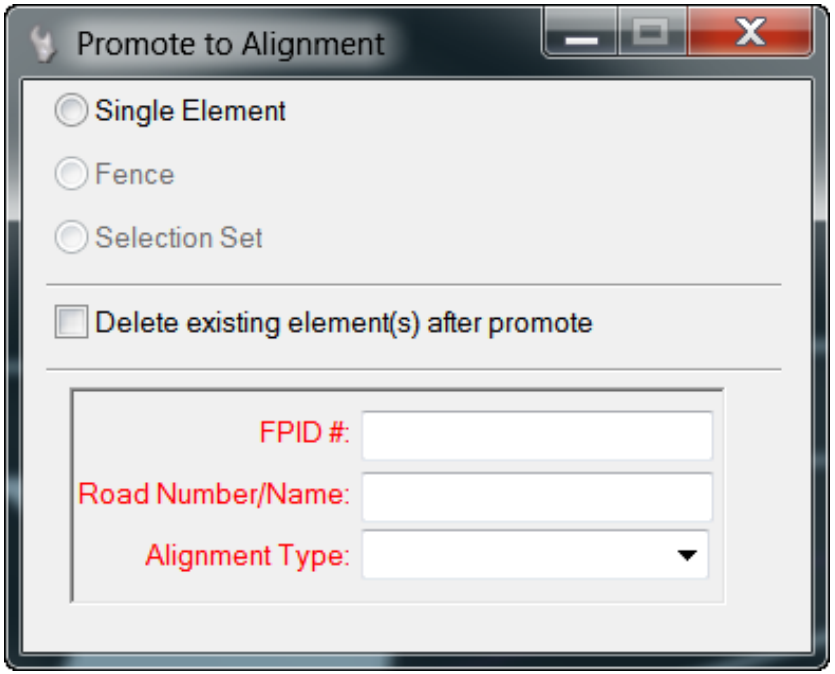


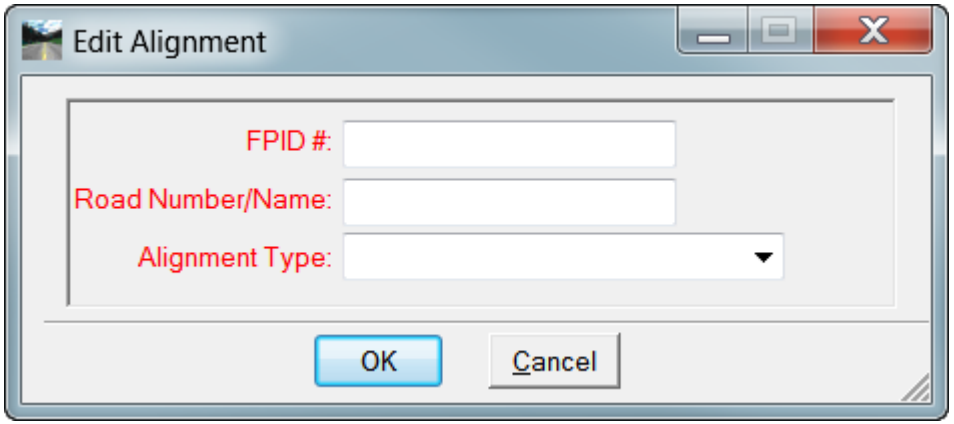



Command Manager
RW
Alignment (Place)
Alignment (Promote)
RW_Line (Place)
RW_Line (Promote)
Survey
Parcel (Place)
Parcel (Promote)

Alignment







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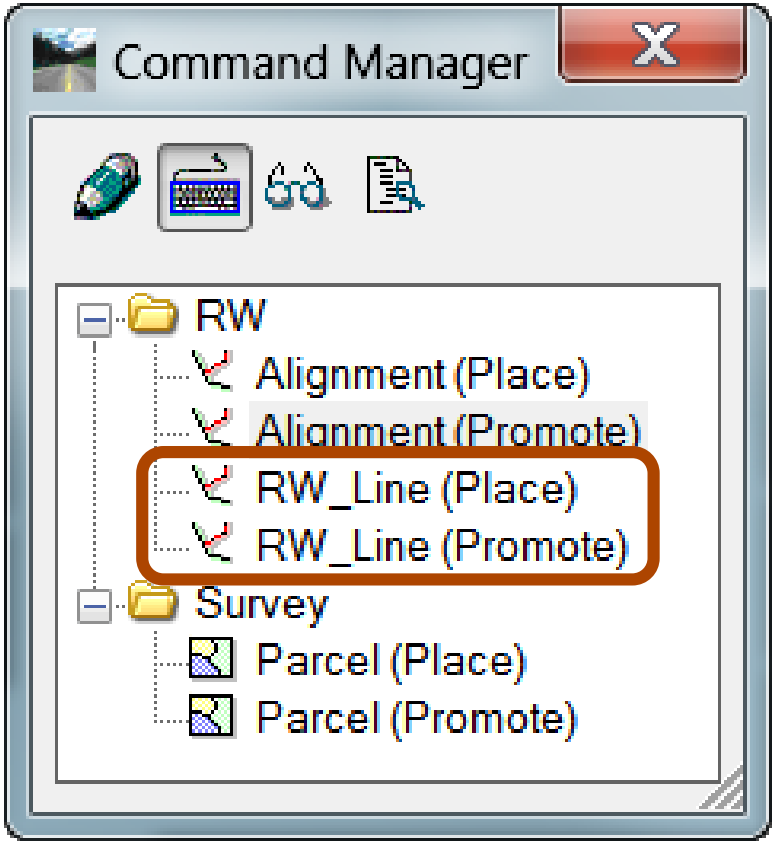
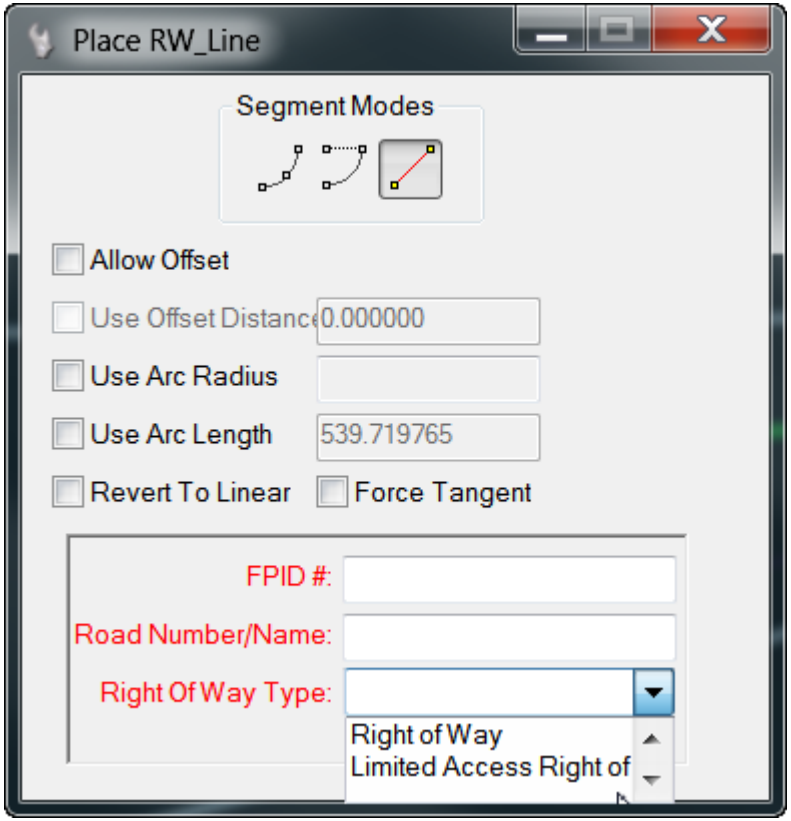
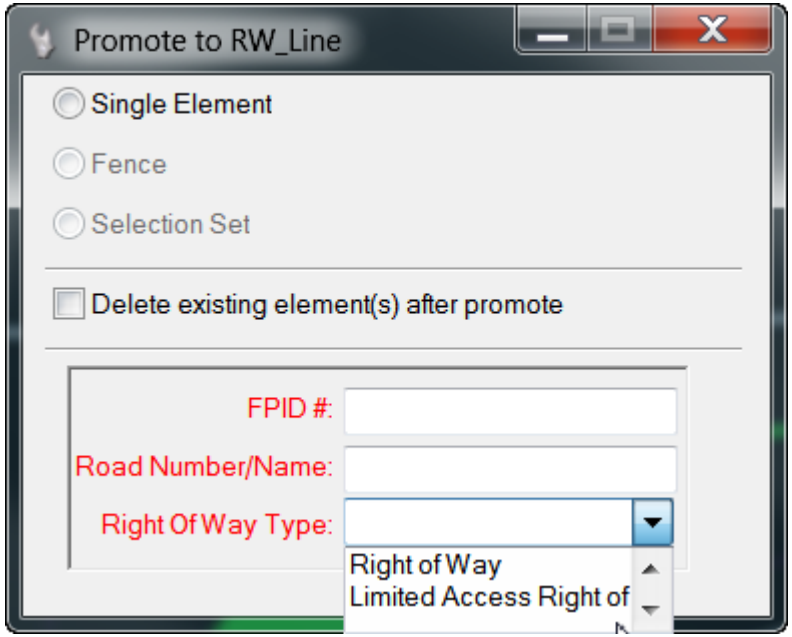
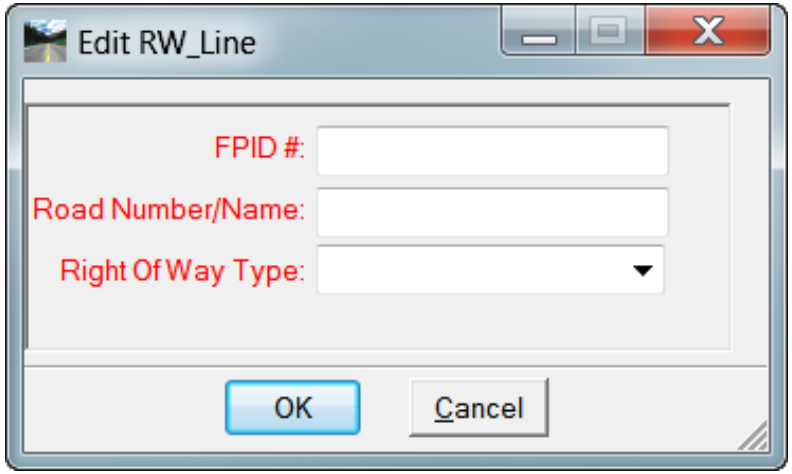

Command Manager
RW
Alignment (Place)
Alignment (Promote)
RW_Line (Place)
RW_Line (Promote)
Survey
Parcel (Place)
Parcel (Promote)

Right Of Way Lines







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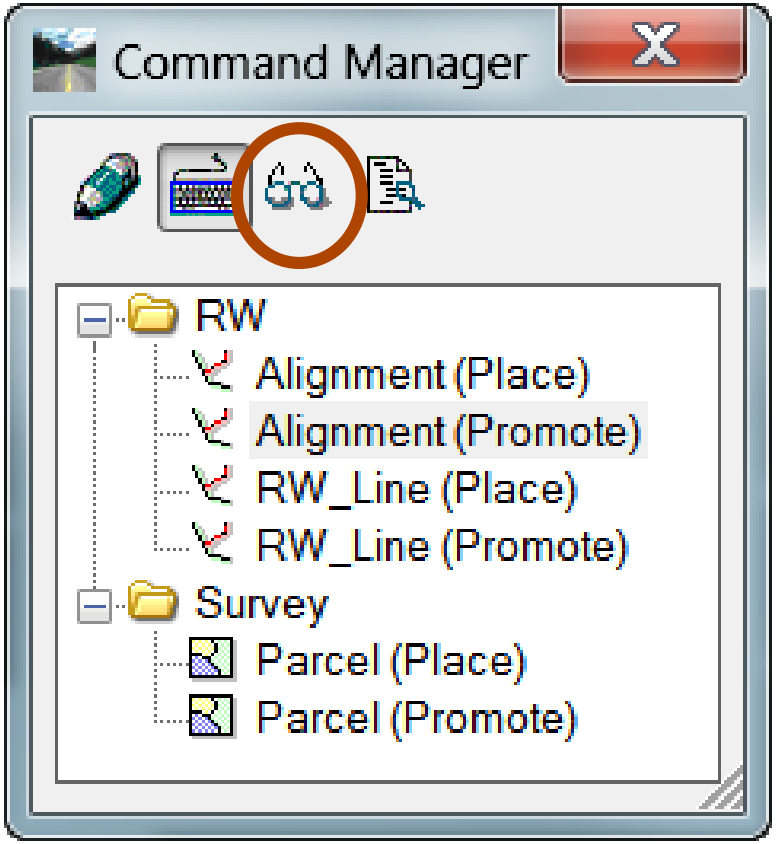
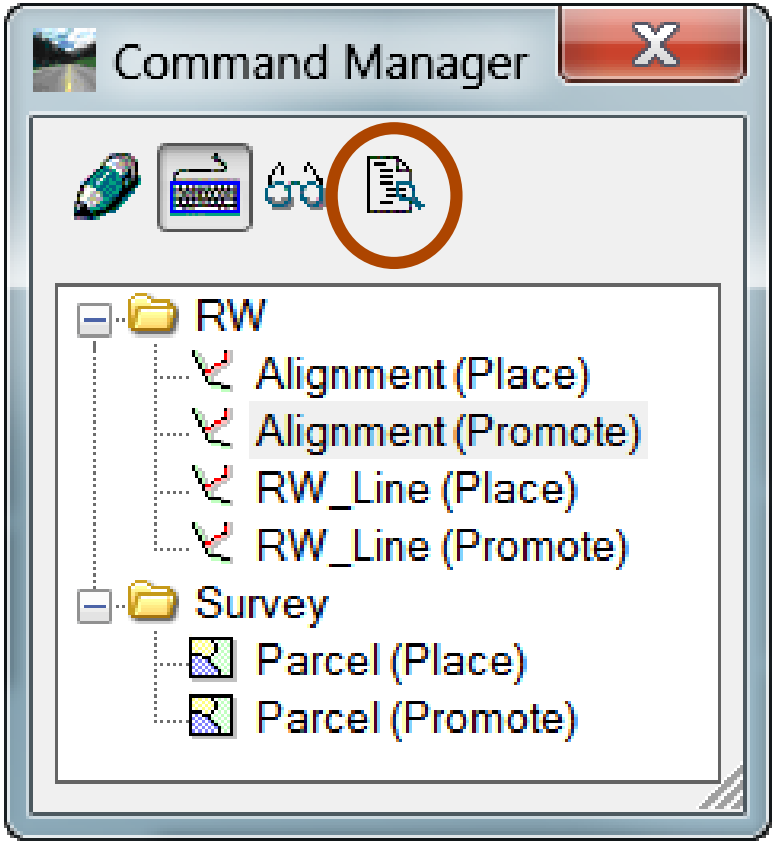
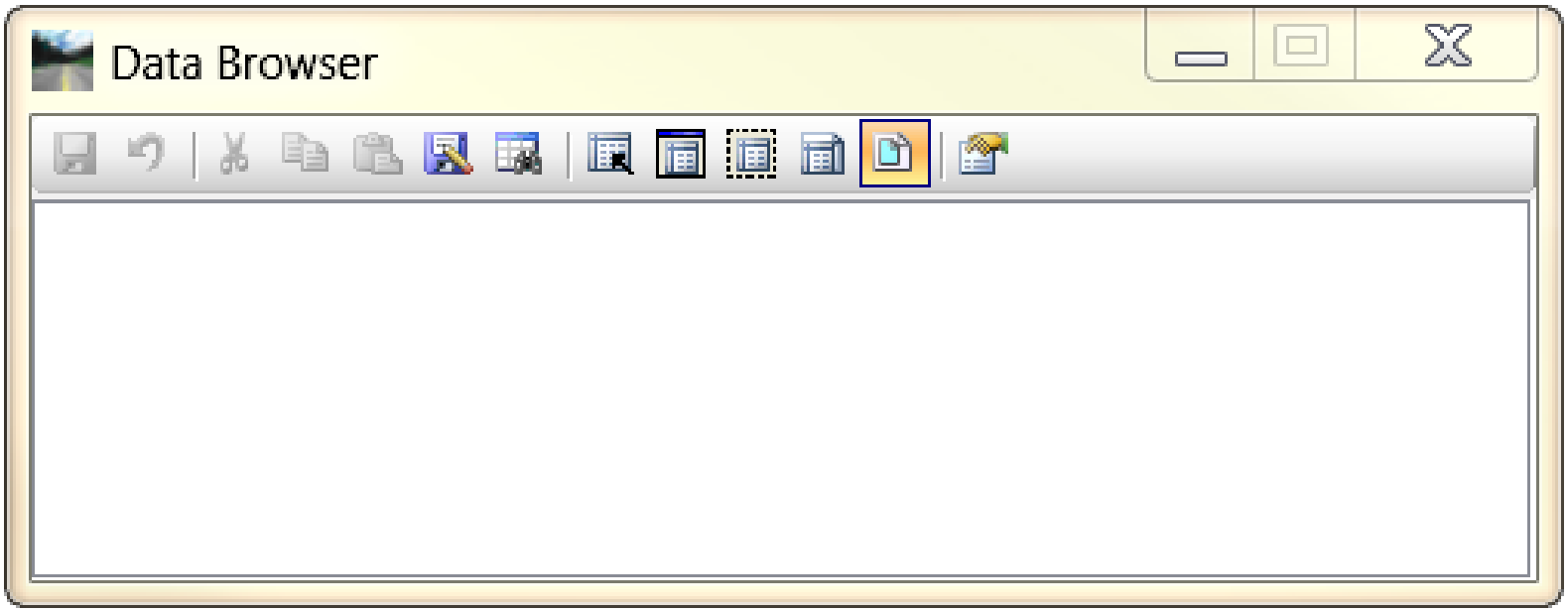
Analyze


Command Manager
RW
Alignment (Place)
Alignment (Promote)
RW_Line (Place)
RW_Line (Promote)
Survey
Parcel (Place)
Parcel (Promote)

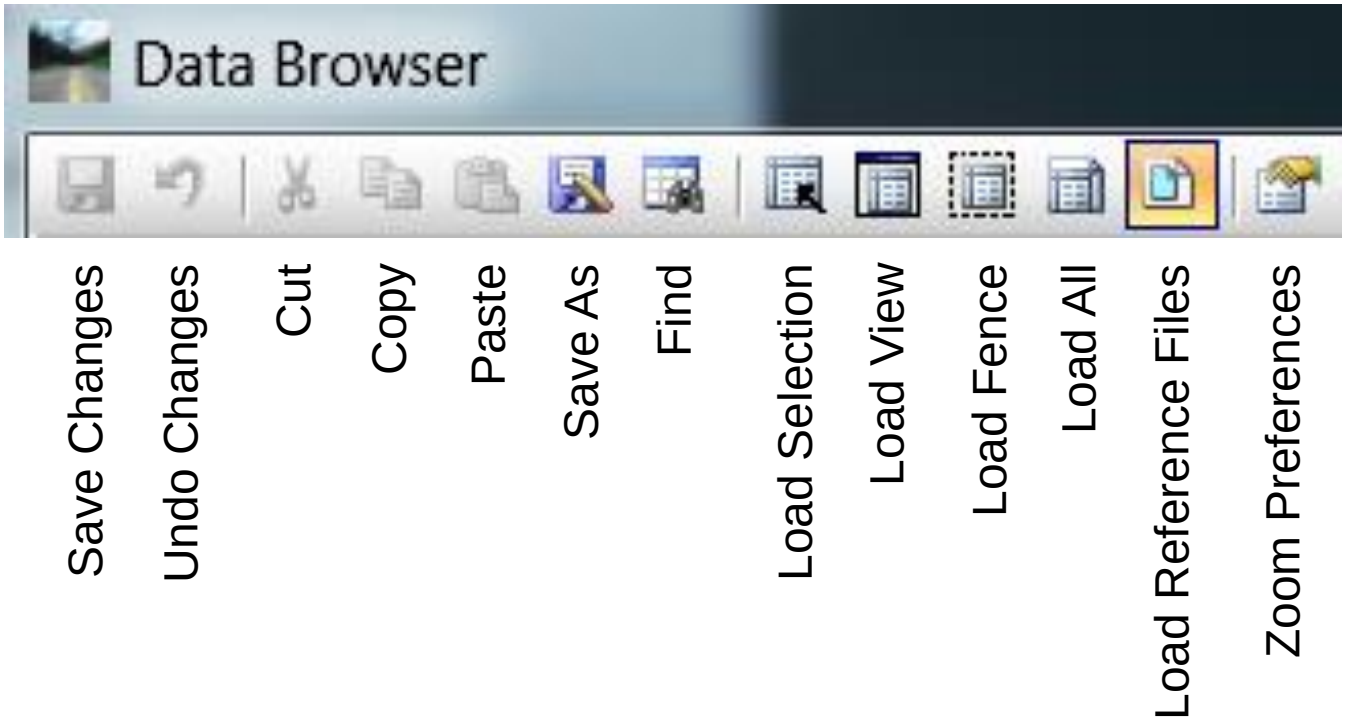
Data Browser



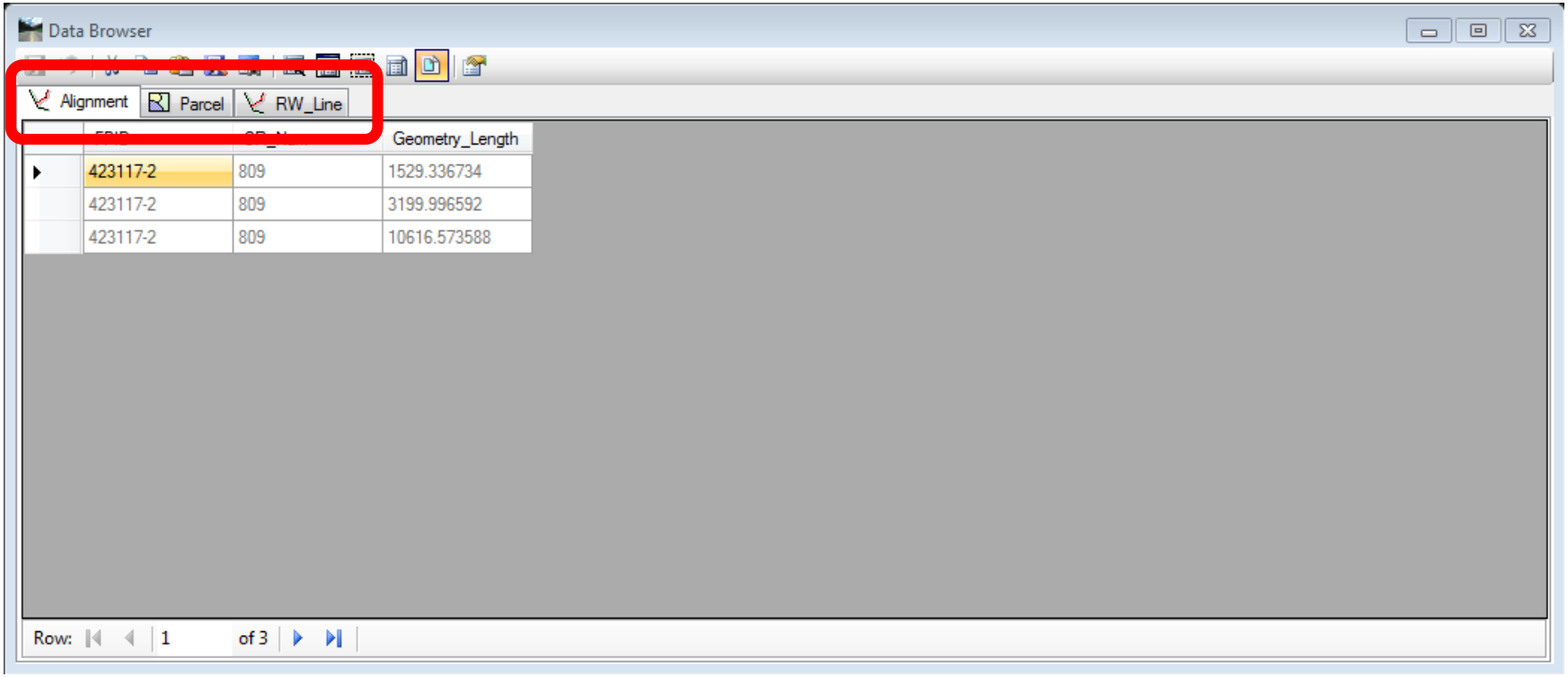
Data Browser



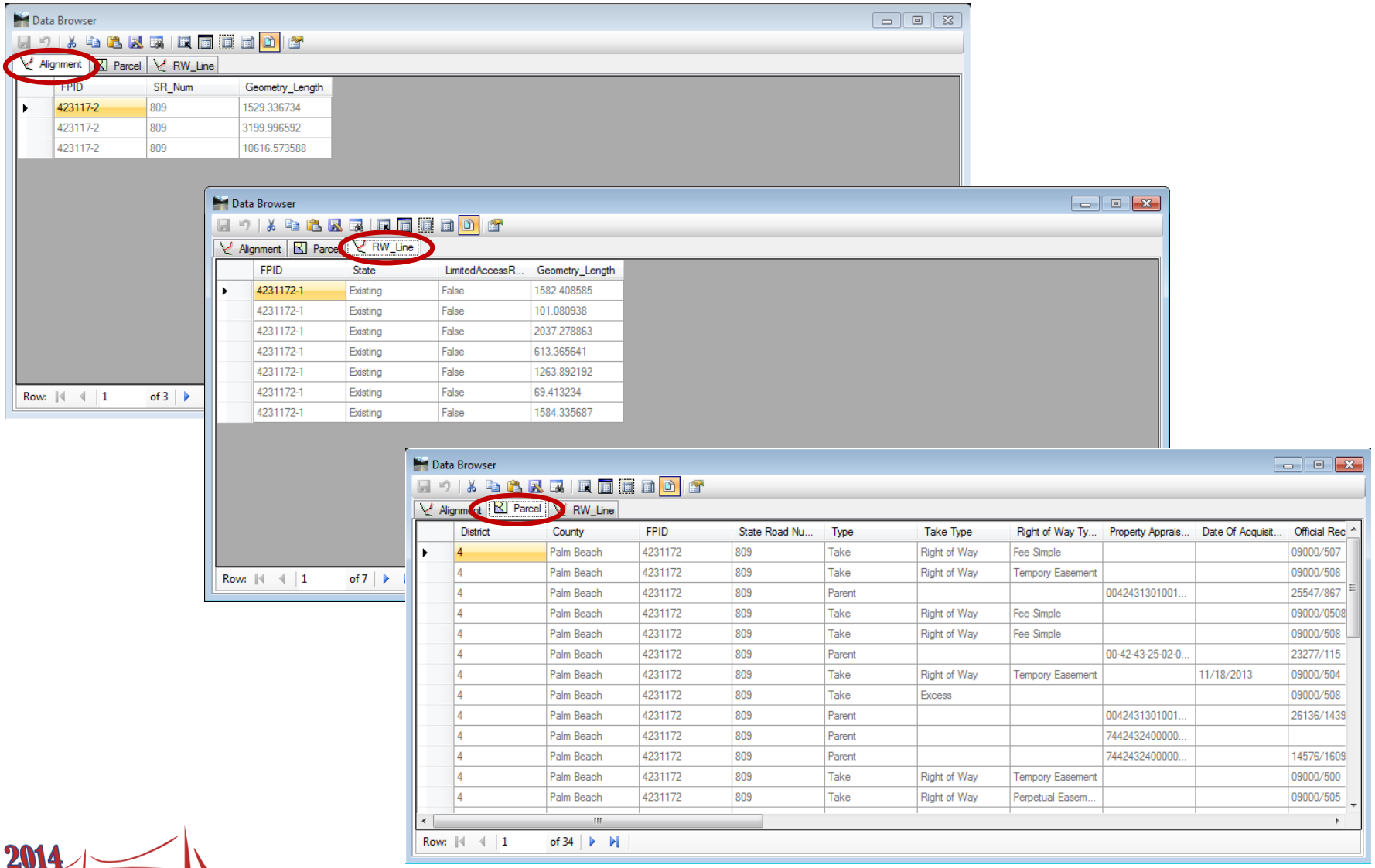
Data Browser



Data Browser

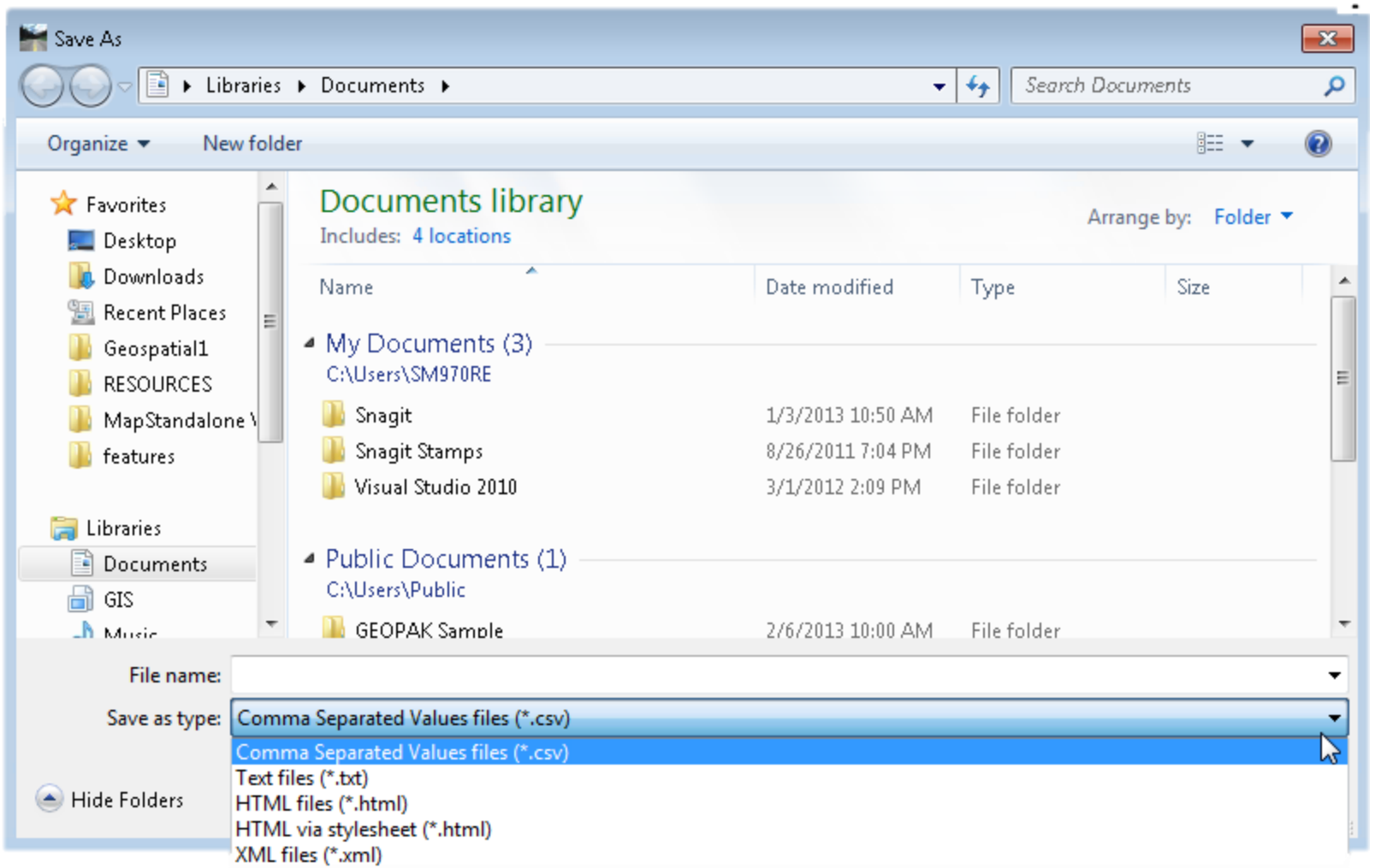


Data Browser



2014 Design Training Expo

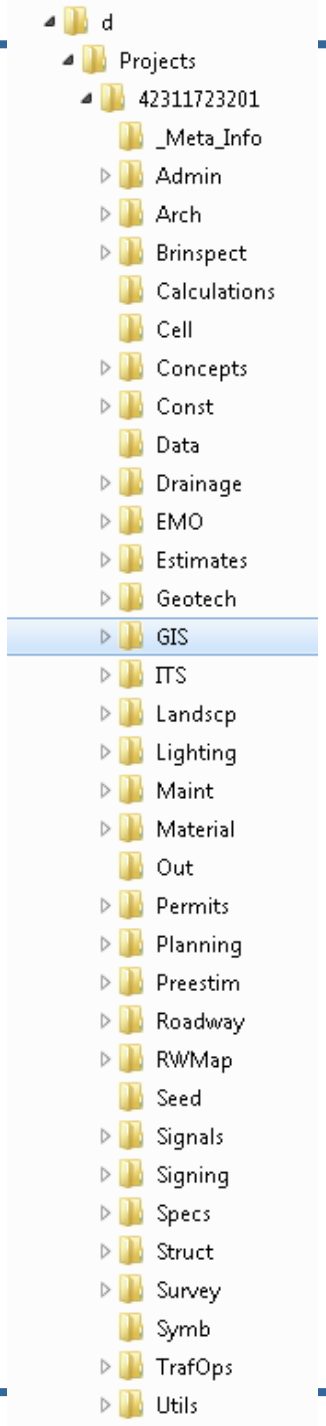
Data Browser



Where does this fit into my project?

Everything GIS no mater the discipline will go into a single GIS folder that will be added to the project template.

That way as more features are added they will all be contained in a single area.



GIS File Names

GISPAR###

Shows this is a GIS file	Shows this is a Parcel	The three digit FDOT Parcel Number

GIS File Names

GISRWDT##

Shows this is a GIS file	Shows this is a Right of Way Line	Sequence Number

GIS File Names

GISALG##

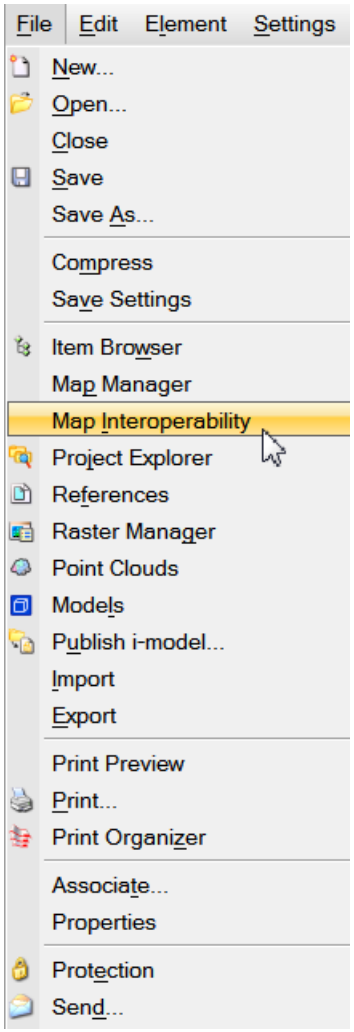
Shows this is a GIS file	Shows this is an Alignment	Sequence Number

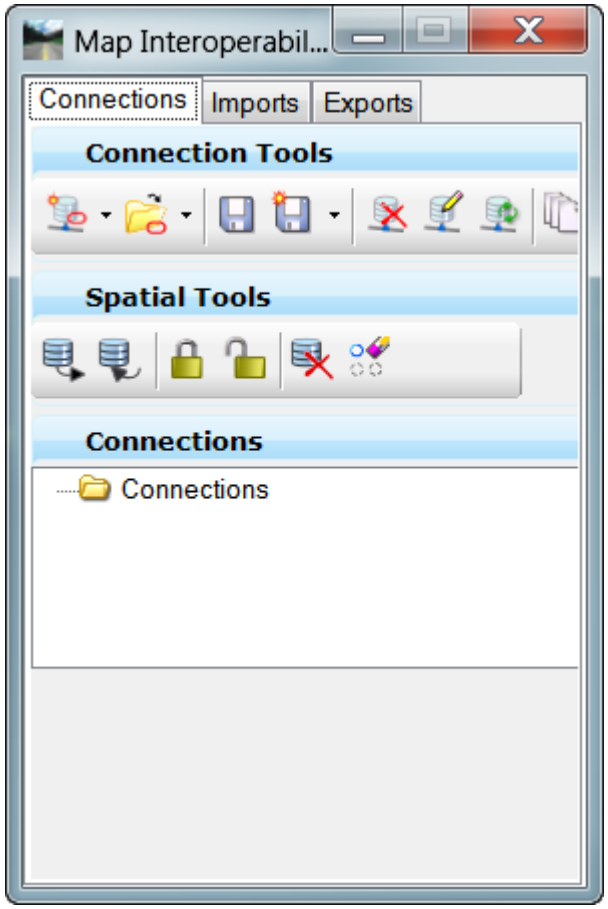
GIS File Names

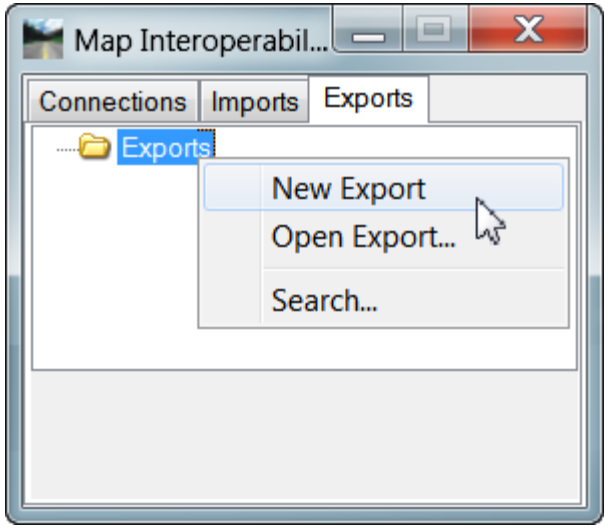
GISMASTER

Shows this is a GIS file	All parcels, Alignments and Right of Way lines referenced into a single file

Export to GIS

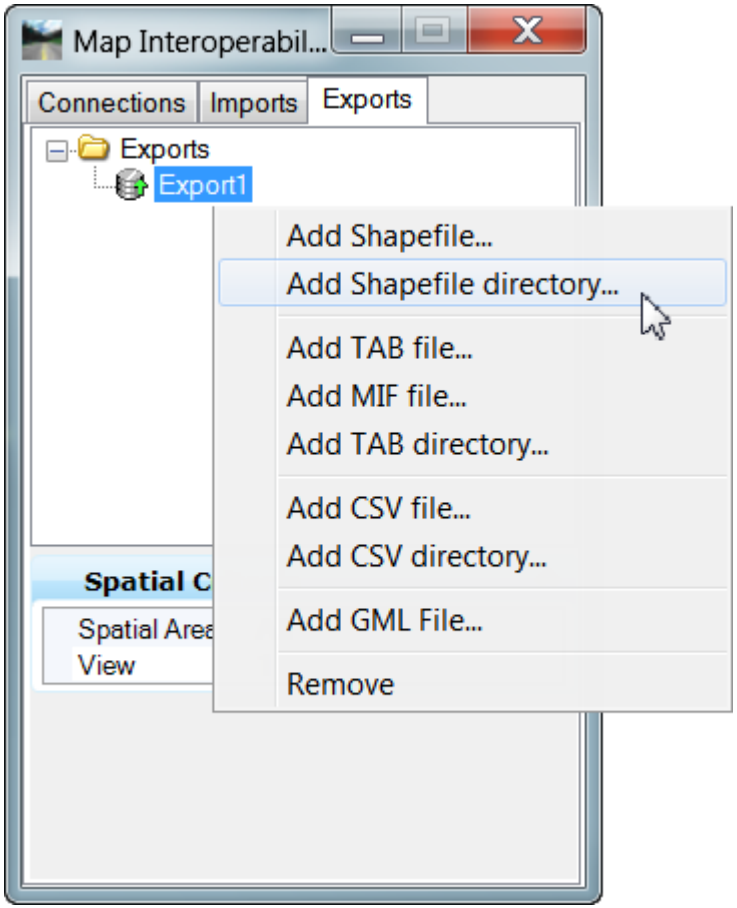




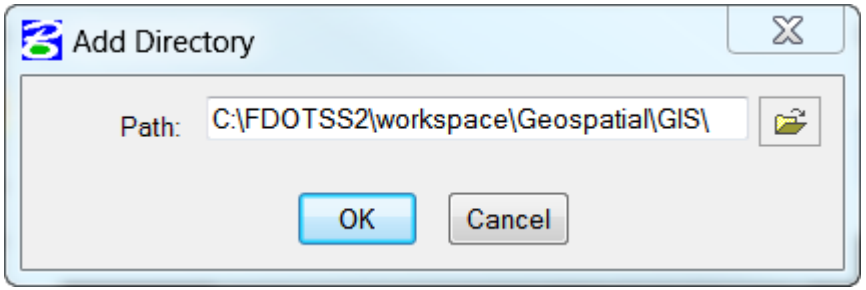


2014 Design Training Expo

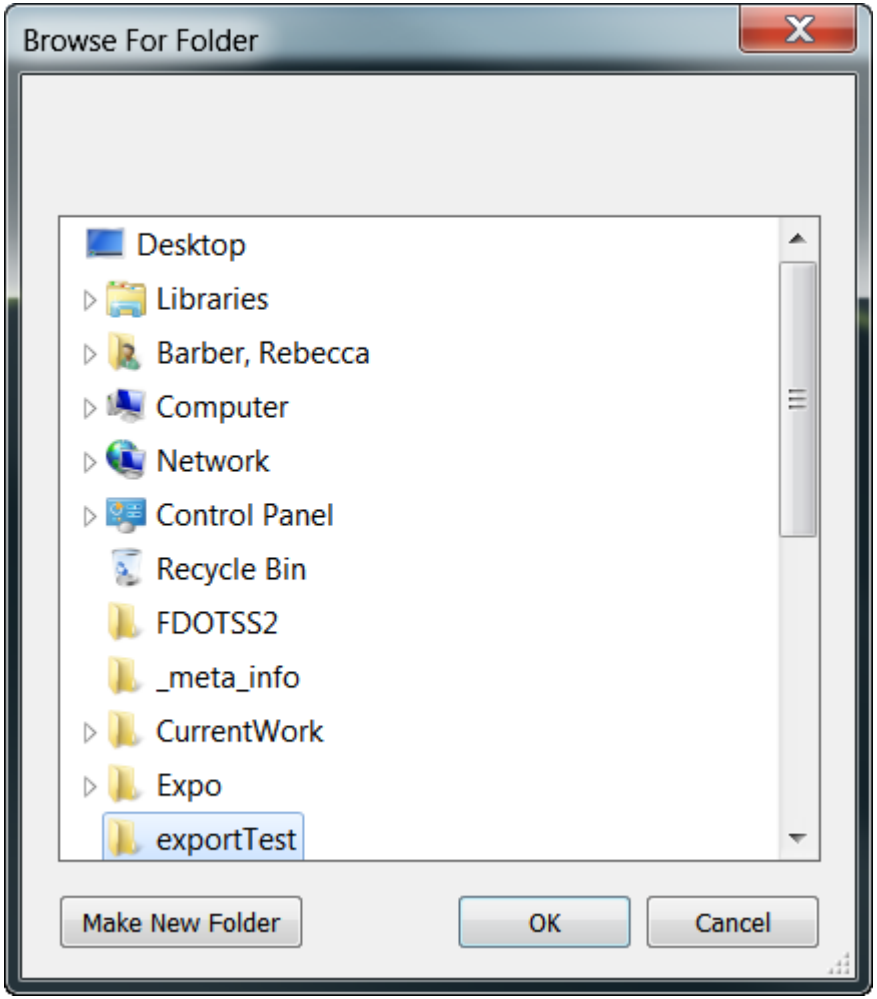
Export to GIS



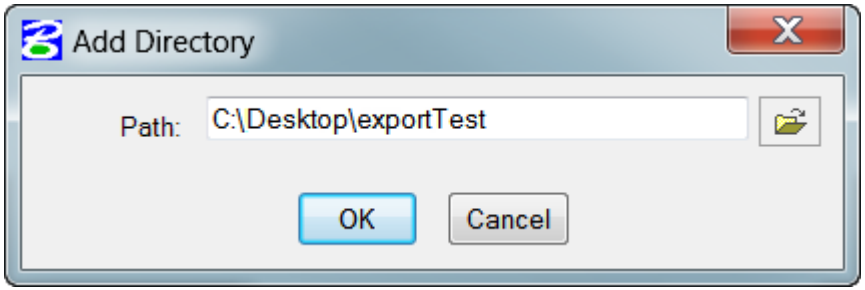
Default location:
C:\FDOTSS2\workspace\Geospatial\GIS\



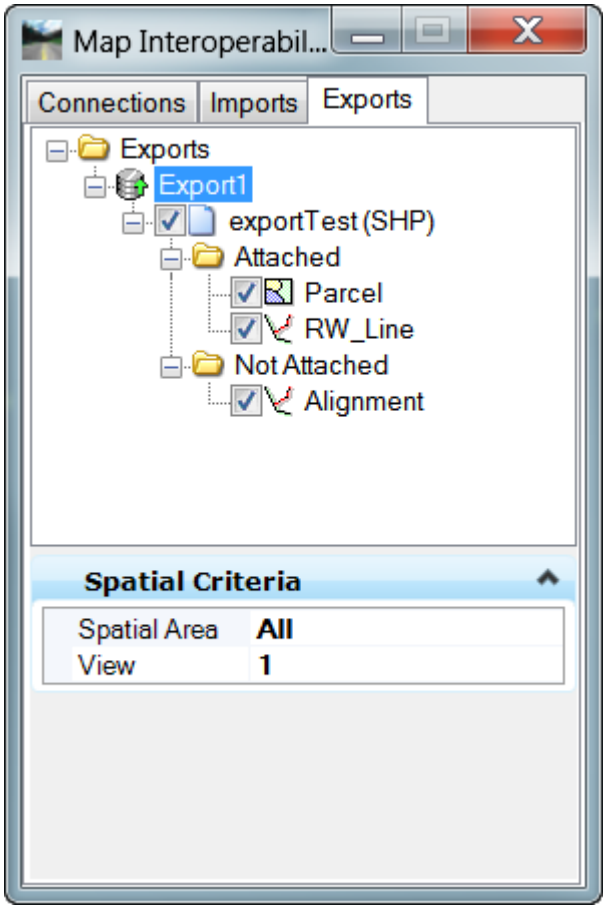
Export to GIS

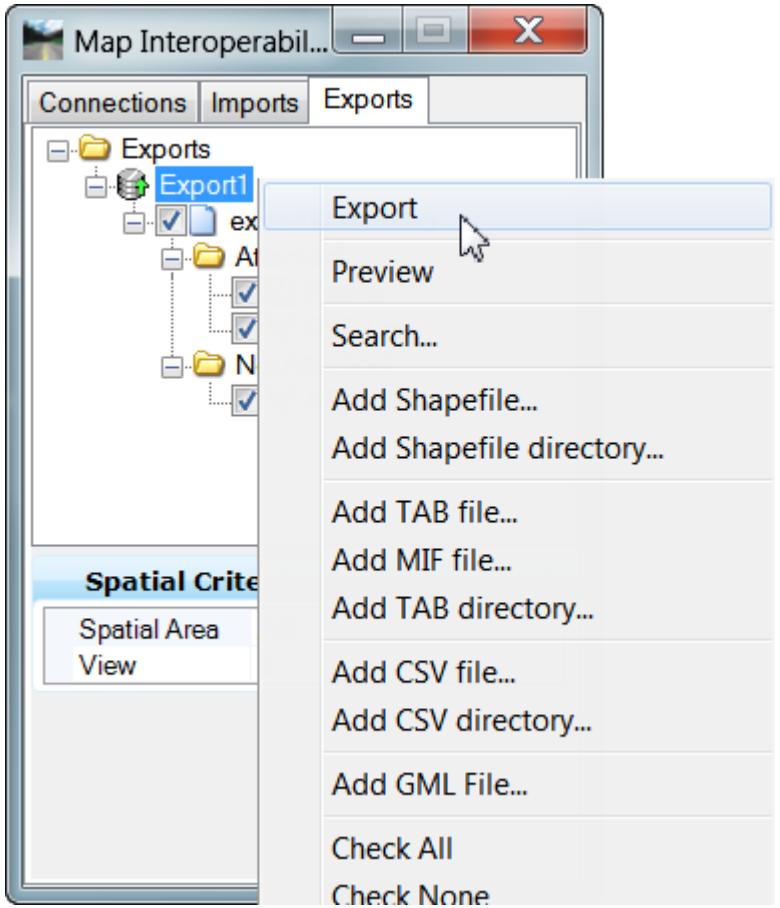


Now location is:
Desktop\exportTest



Export to GIS





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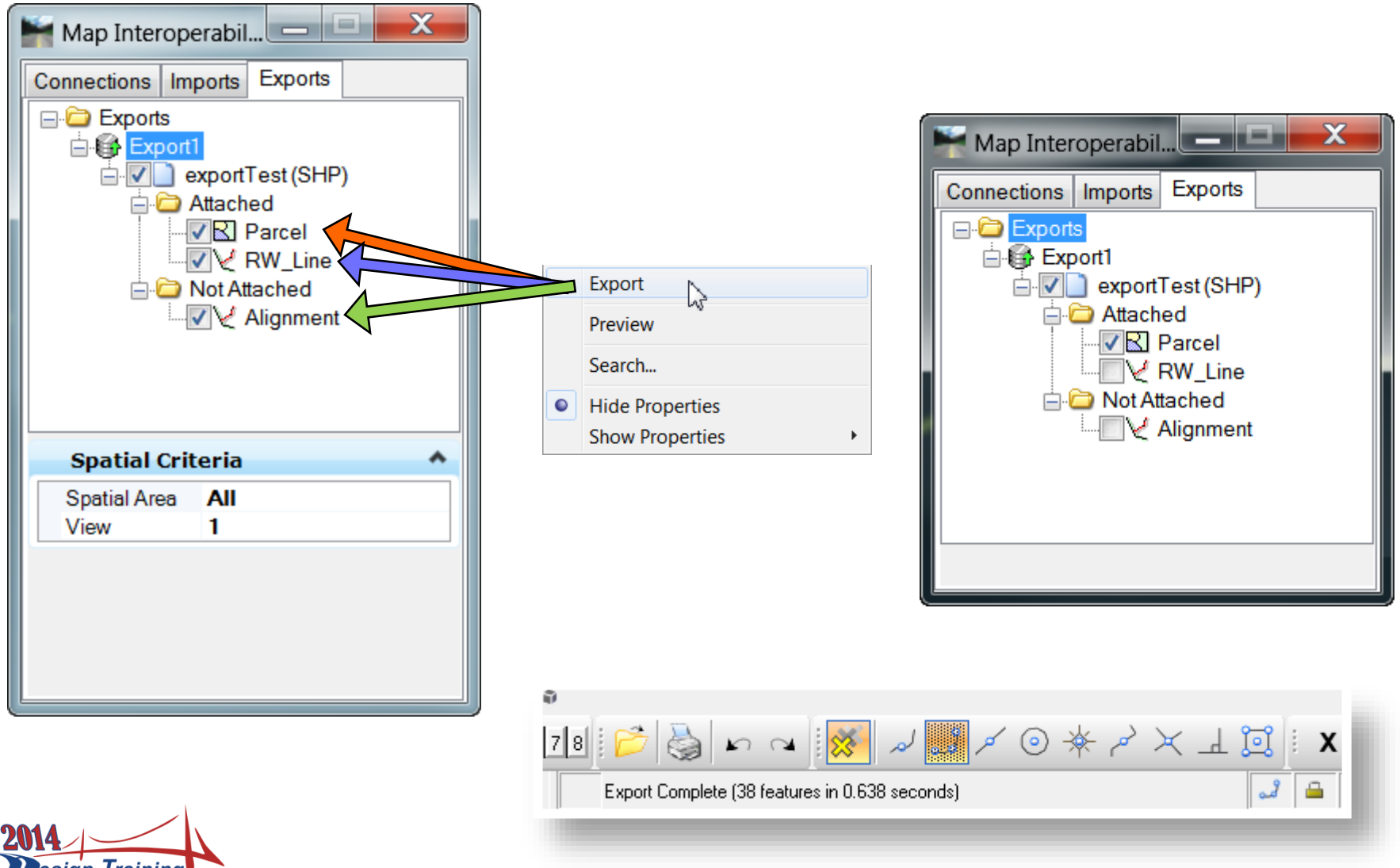
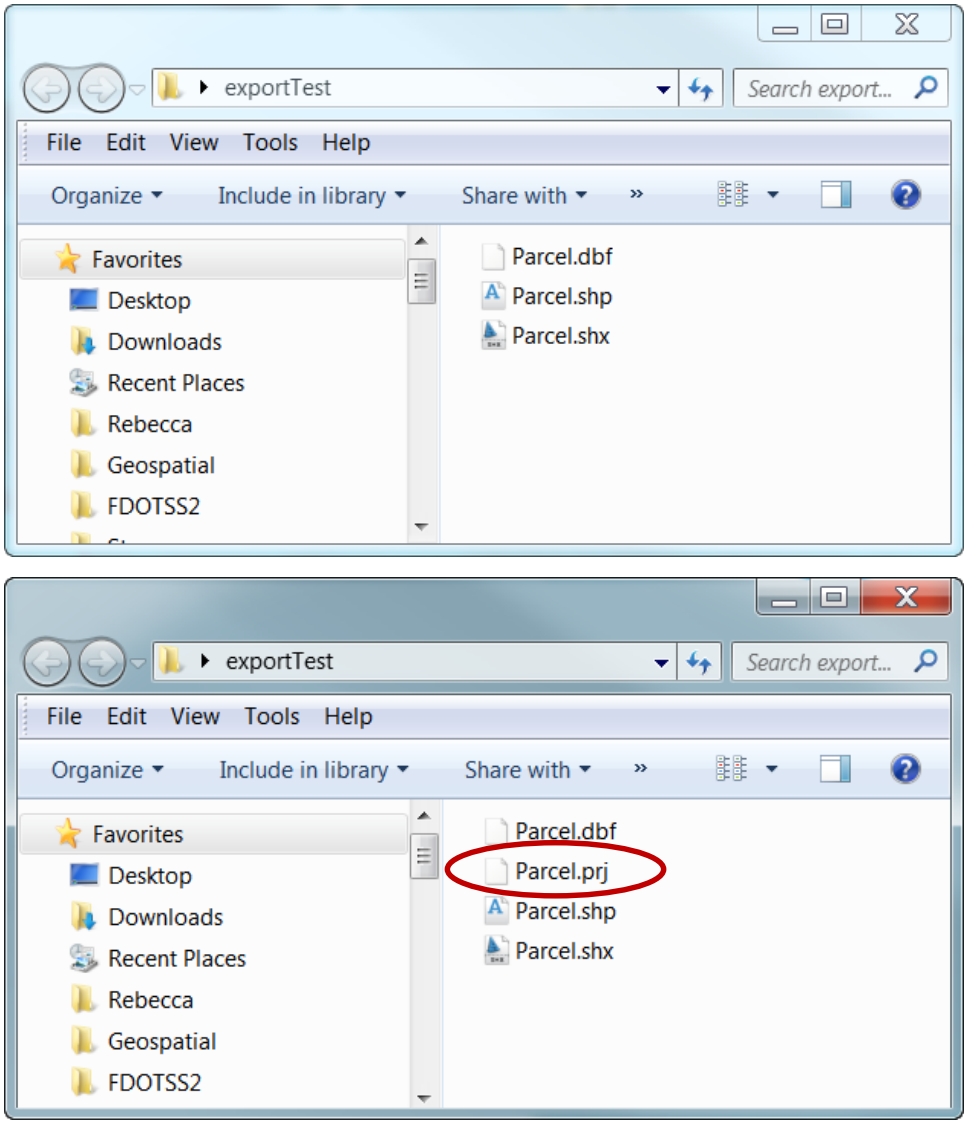
Exporting Options

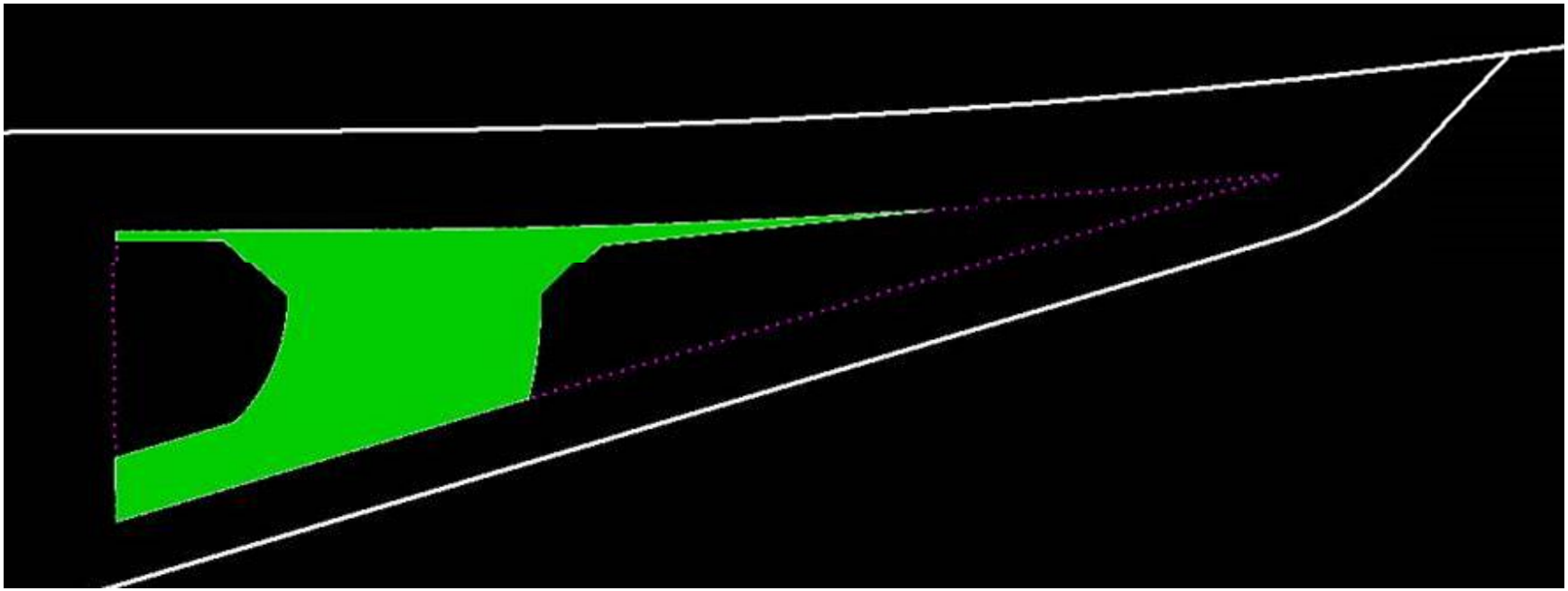


Shapefiles

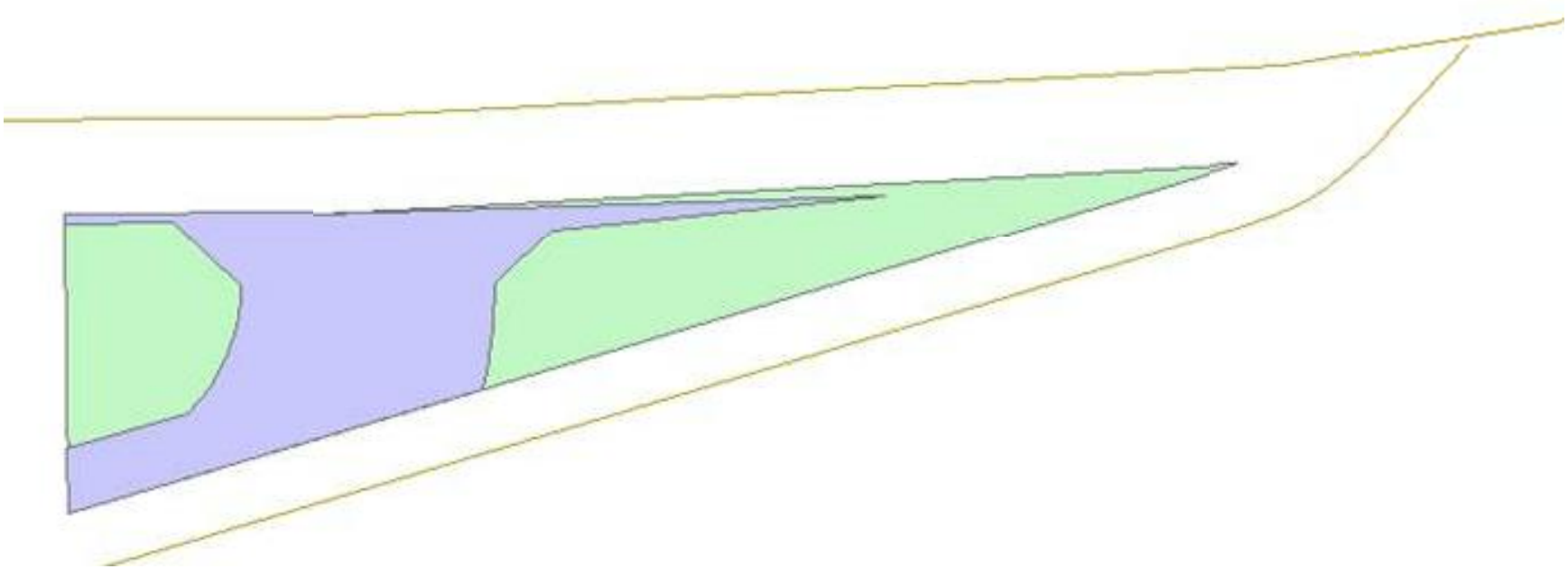

exportTest
Search export...
File Edit View Tools Help
Organize
Include in library
Share with
Favorites
Desktop
Downloads
Recent Places
Rebecca
Geospatial
FDOTSS2
Parcel.dbf
Parcel.shp
Parcel.shx
exportTest
Search export...
File Edit View Tools Help
Organize
Include in library
Share with
Favorites
Desktop
Downloads
Recent Places
Rebecca
Geospatial
FDOTSS2
Parcel.dbf
Parcel.prj
Parcel.shp
Parcel.shx

BETA TESTING

Curve Problem



Curve Problem



Curve Problem: Bentley

- Regarding the curves in GIS. This has been an issue for years and is one of the fundamental differences between CAD and GIS.
- ESRI now supports arcs but the transfer tool (SHP) does not.
- However, in the next release of Map *(Bentley release not FDOT release)* and eventually the civil tools, the ESRI file geodatabase will be supported. That format does support arcs and some level of curves so this whole process should be simplified.

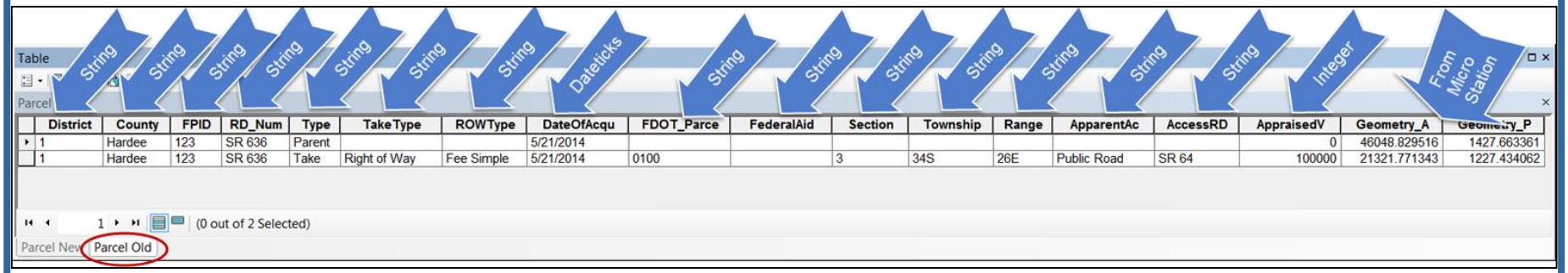
(This is referring to the exportation of the line work into shape files)

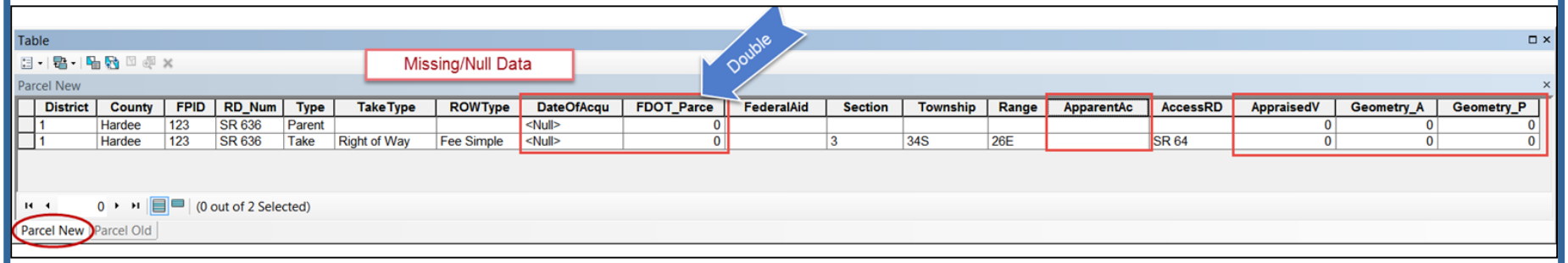
Curve Solution

- Modify the FDOT SS2 Workspace
  - ✓ Add a variable to the end of the GIS.txt
- Default value is 0.0 = no stroking = Curve Problem
- A value of 1 will produce stroking but not enough to produce a curve in GIS
- Lowering the variable means that the stroking would increase but also increases file size
- Currently not worried about the files size
- So variable is set to 0.1 (No more Curve Problem)

```
ECSDK_GEOMETRY_STROKING_TOLERANCE=0.1
```

Missing Data/Null Values



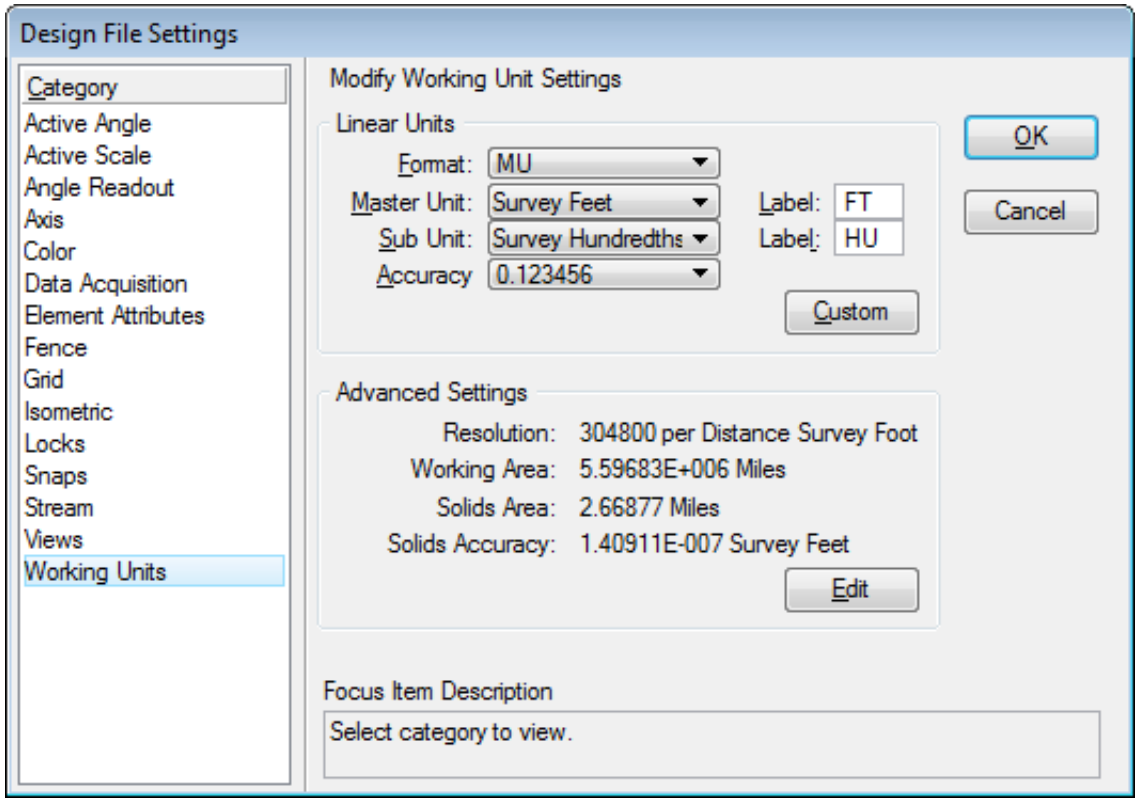


Fixed by Bentley Map SS3 V08.11.09.107

Release expected for the FDOT load is this summer

Working Units

- Do not change the Working Units in the MicroStation file that are set to Survey Feet, because it **WILL** make a difference when projecting to State Plane Coordinates.



Summary

- Process/Workflow
  - ✓ Develop a process/workflow allowing both CADD and GIS environments to interchange/share data
- This information could become:
  - ✓ A one stop shop for public records requests, and
  - ✓ Allow for better collaborative decision making tools with stakeholders,
    - whether through technical (data only in the form of tables or queries) or having a GIS/Thematic look (for display)

Summary

- Enhanced querying activities to quickly support FDOT's consultants, partners, and customers
- Knowing what is located within the ROW by going to **ONE** place, with links to:
  - ✓ maps,
  - ✓ aerials,
  - ✓ documents and
  - ✓ metadata
- Resulting in cost savings in the areas of:
  - ✓ record management,
  - ✓ staff hours, and
  - ✓ informed decision making

Questions:

Contact:

Florida Department of Transportation

Surveying and Mapping Office

Tallahassee, FL

Rebecca Barber

Geographic Mapping Specialist

rebecca.barber@dot.state.fl.us

(850) 414-4389

Copy of presentation at:
http://www.dot.state.fl.us/officeofdesign/innovation/