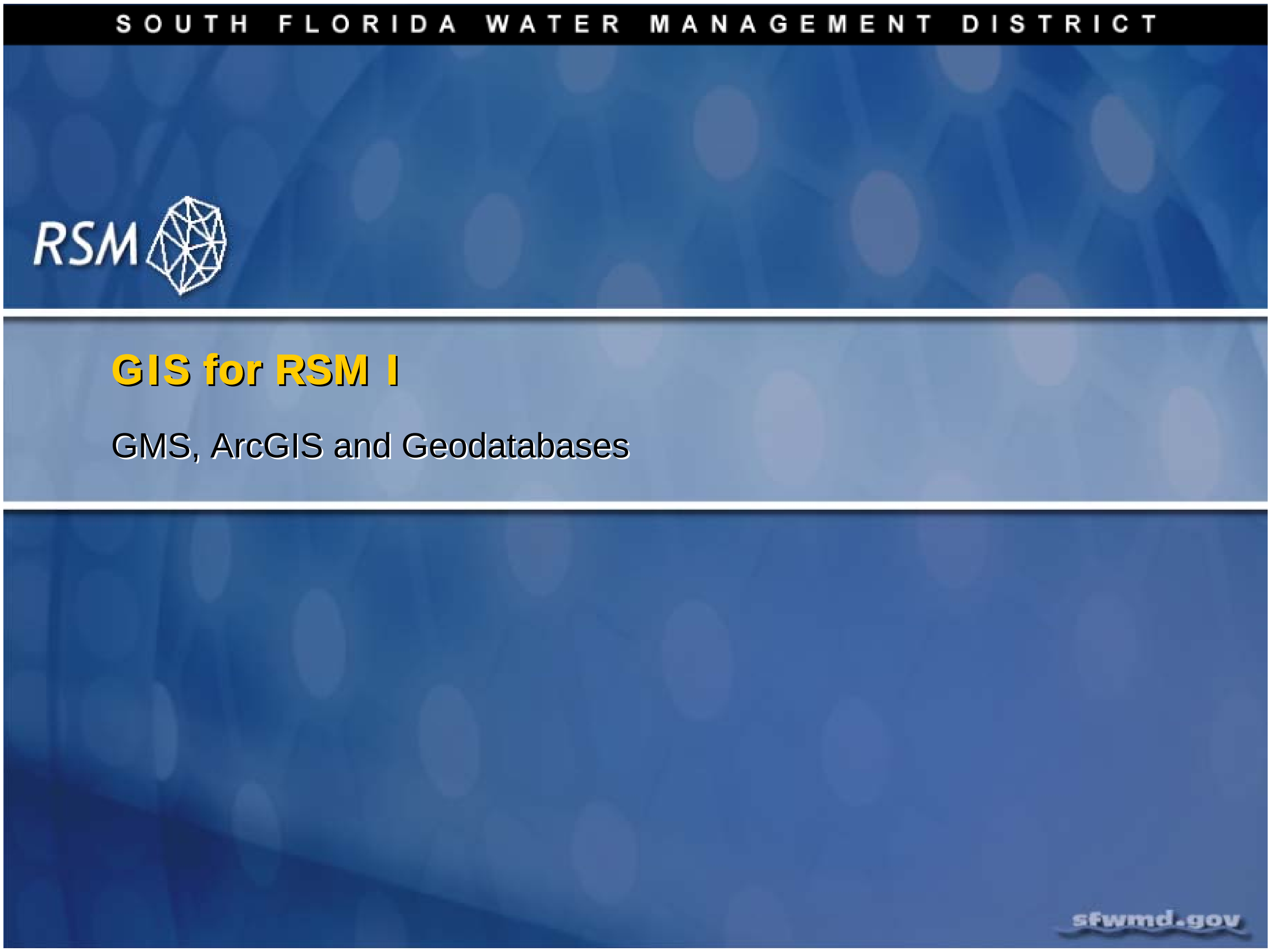


Lecture 5: GIS for RSM I—GMS, ArcGIS and Geodatabases

This lecture reviews:

- Use of the Groundwater Modeling System (GMS) for mesh creation
- Basic Geographic Information System (GIS) skills needed to create and modify features in the Regional Simulation Model (RSM) geodatabase using ESRI ArcGIS 9.2
- A brief introduction to geodatabases

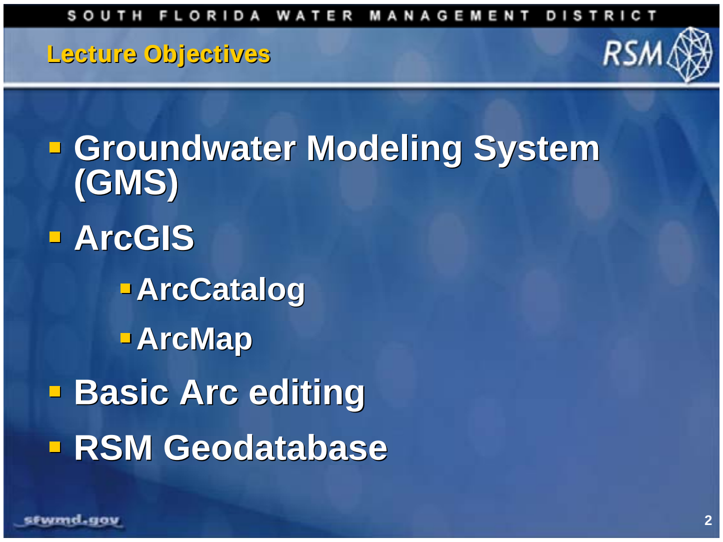
NOTE:

Additional Resources

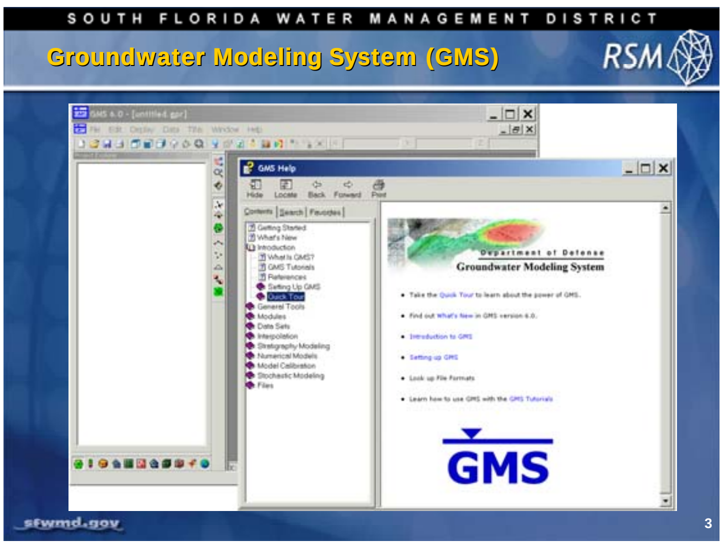
A video is provided for those modelers who do not have access to ArcInfo GIS Software.

RSM GUI Manual

GMS Manual (2007)

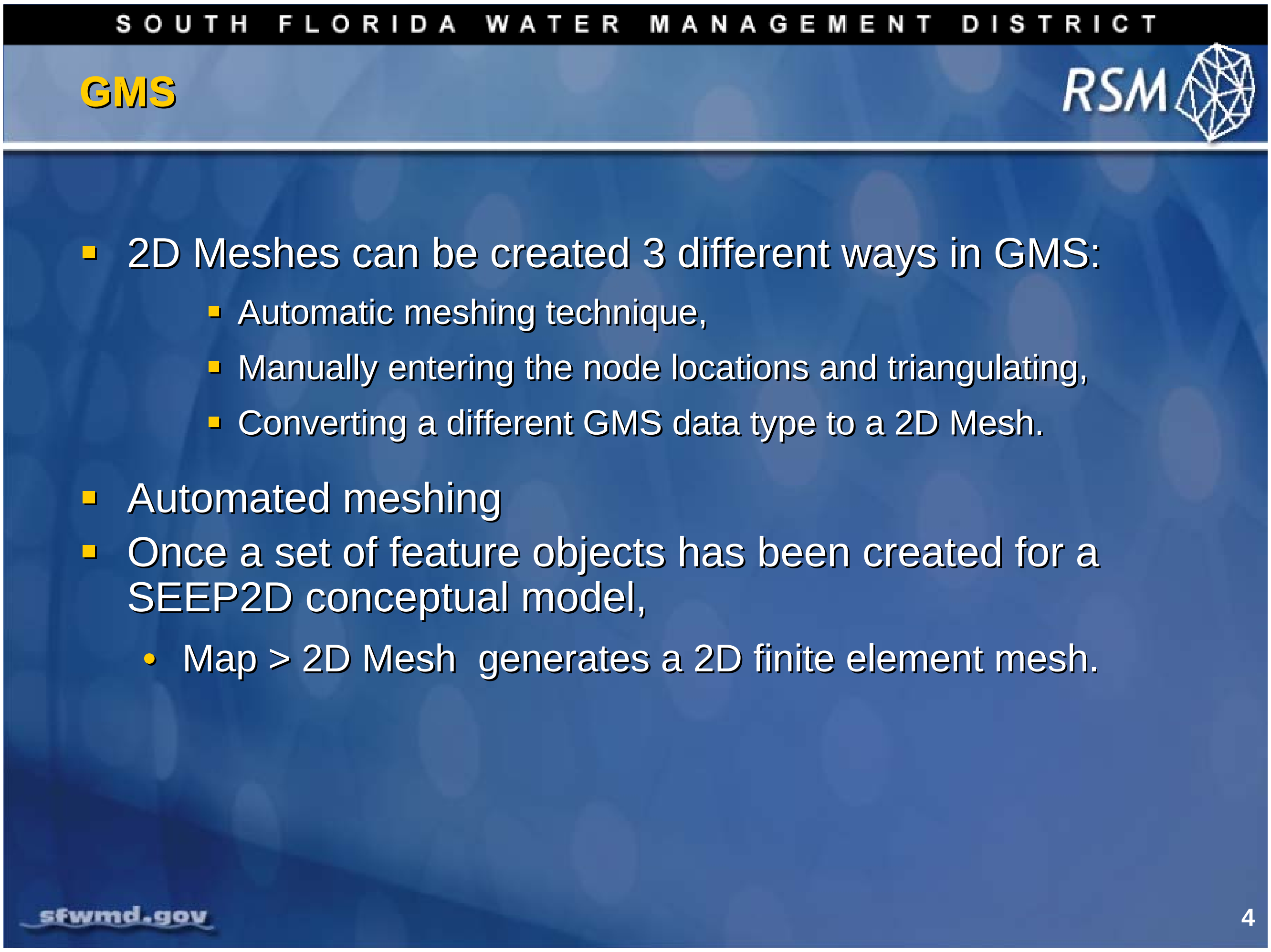


Exploring use of the Groundwater Modeling System (GMS) for mesh creation and ArcGIS for the RSM, requires a few fundamental GIS manipulations and editing basic line work. Geodatabases are closely linked to the use of ArcGIS.



The GMS creates competent 2-dimensional (2D) meshes using the Seep2D model option. The GMS software was developed by the U.S. Army Corps of Engineers to create meshes for the RSM. The software is designed to create the input datasets for several models.

This proprietary software is available to federal agencies and their partners. The South Florida Water Management District Hydrologic and Environmental Systems Modeling team has adapted the method for creating a mesh used for the Seep2D model for use with the RSM.



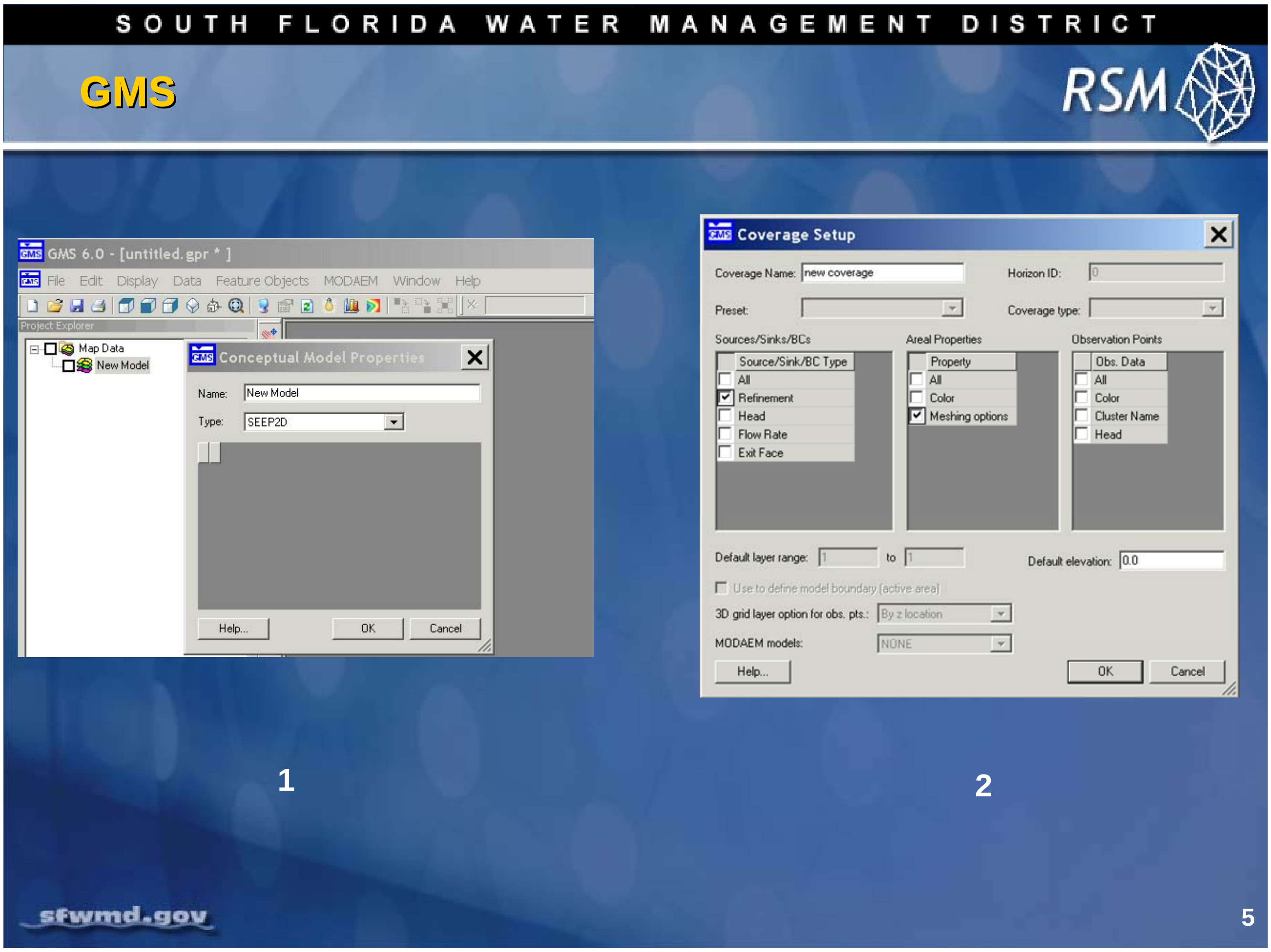
"**Adaptive tessellation**" is a mesh generation technique used to fill the interior of a polygon.

A polygon is assigned to be adaptive tessellation in the **Polygon Attributes** dialog. And, the polygon is filled using the **Map to 2D Mesh** command.

Adaptive tessellation uses the existing spacing on the polygons to determine the element sizes on the interior. Any interior arcs and refine points are forced into the new mesh. If the input polygon has varying node densities along its perimeter, the GMS attempts to create a smooth element size transition between these areas of differing densities.

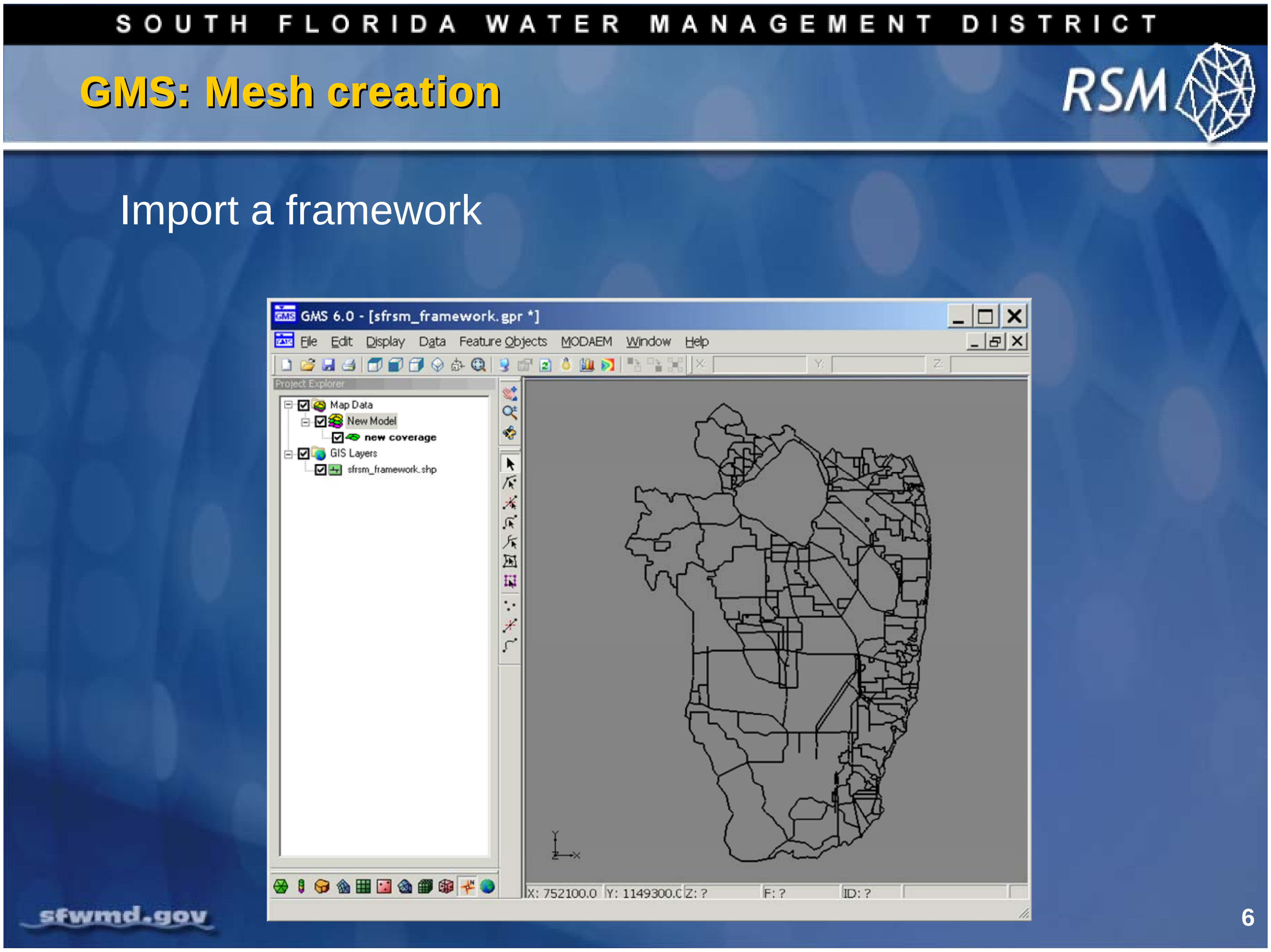
By altering the size bias, the user can indicate whether the GMS should favor the creation of large or small elements. Decreasing the bias will result in smaller elements; increasing the bias will result in larger elements. In either case, the elements in the interior of the mesh will honor the arc edges and the element sizes specified at nodes. The bias simply controls the element sizes in the transition region.

[Source: *GMS Manual (2007)*]

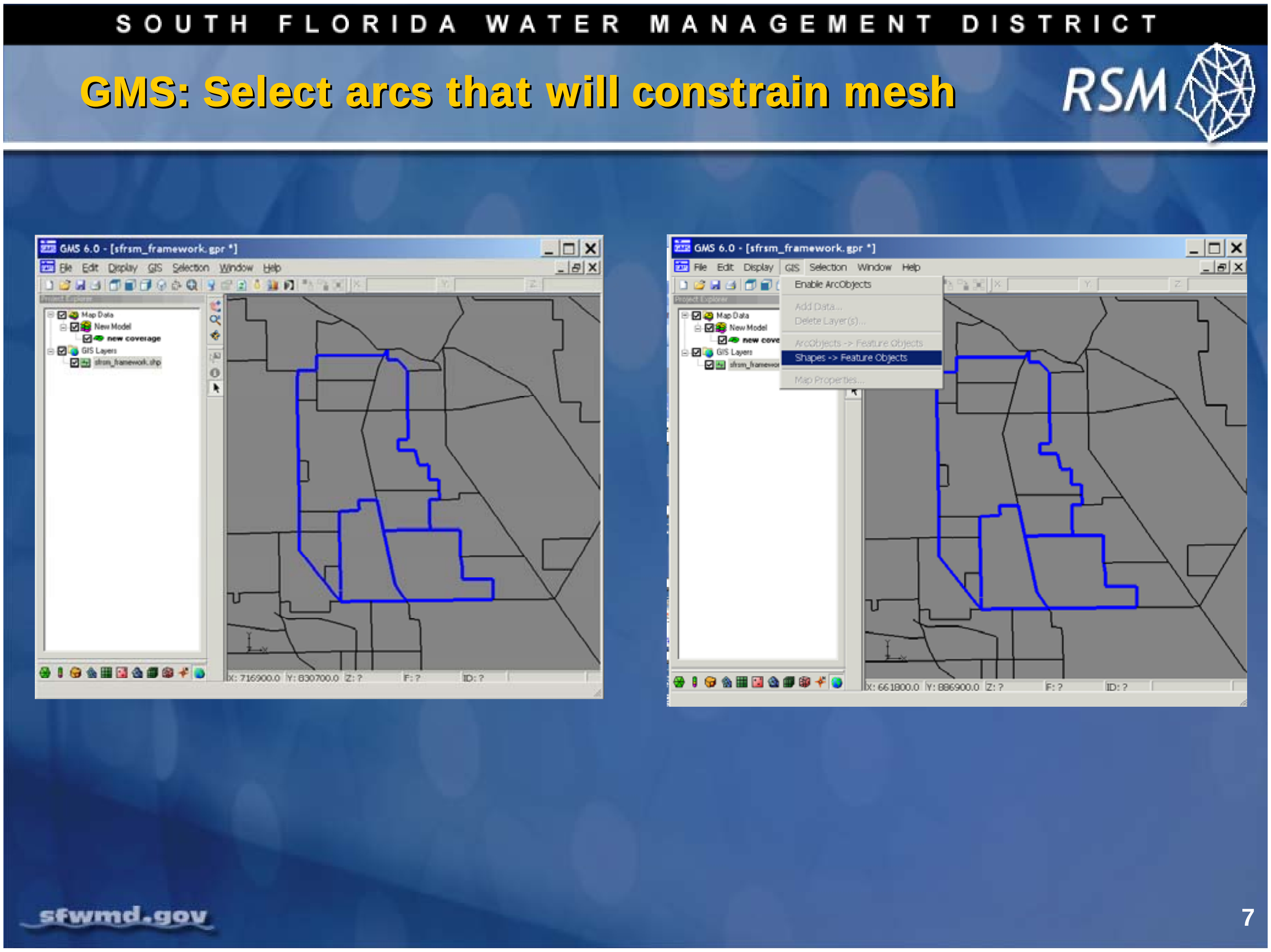


The process for making a mesh is relatively straightforward.

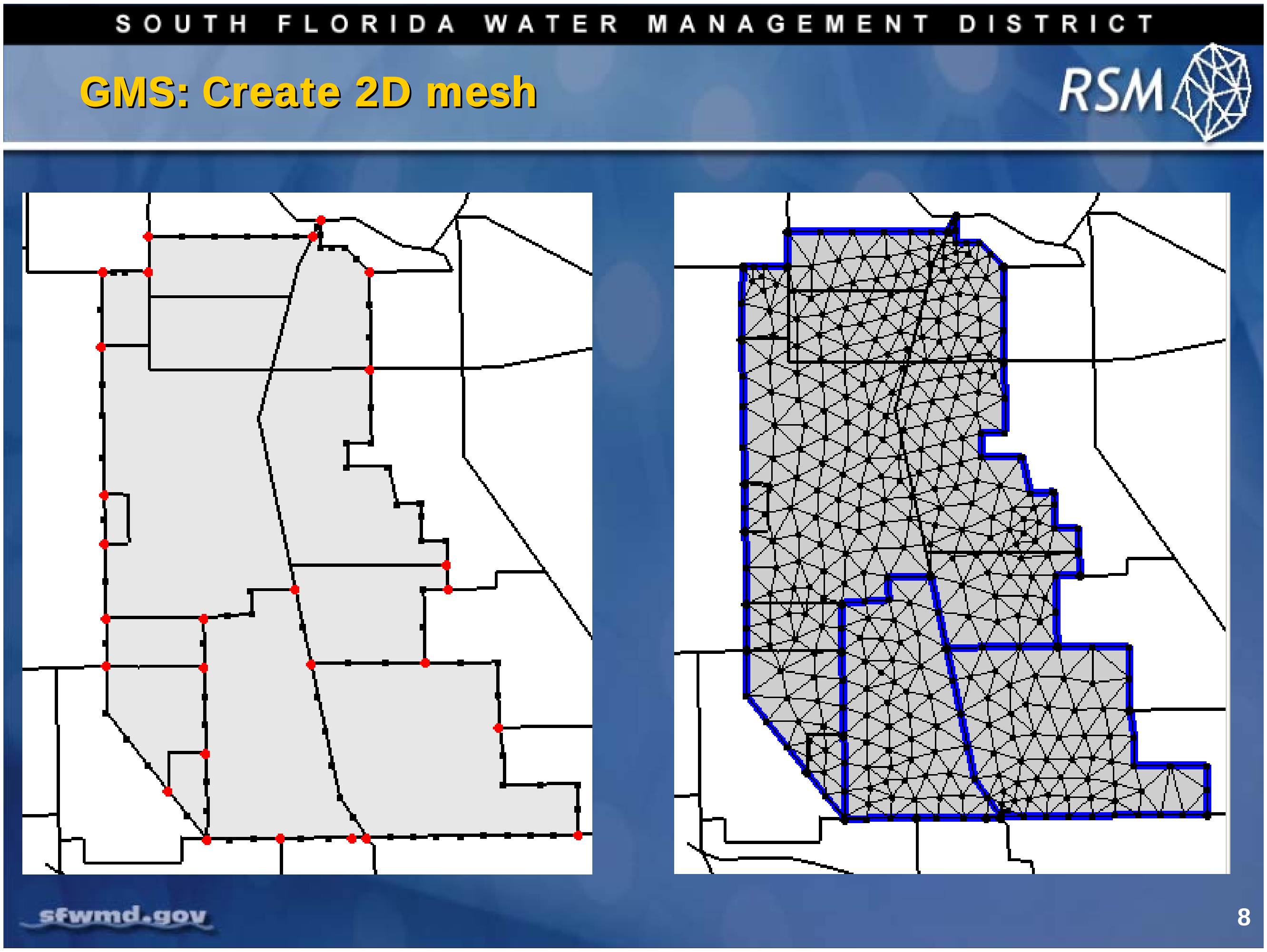
1. Create a new SEEP2D model in the GMS environment (as illustrated in the dialog box above).
2. Then, create a new **Coverage Setup** within the new model.



The next step in the mesh creation requires importing a shape file that has polygons or arcs to serve as a framework.

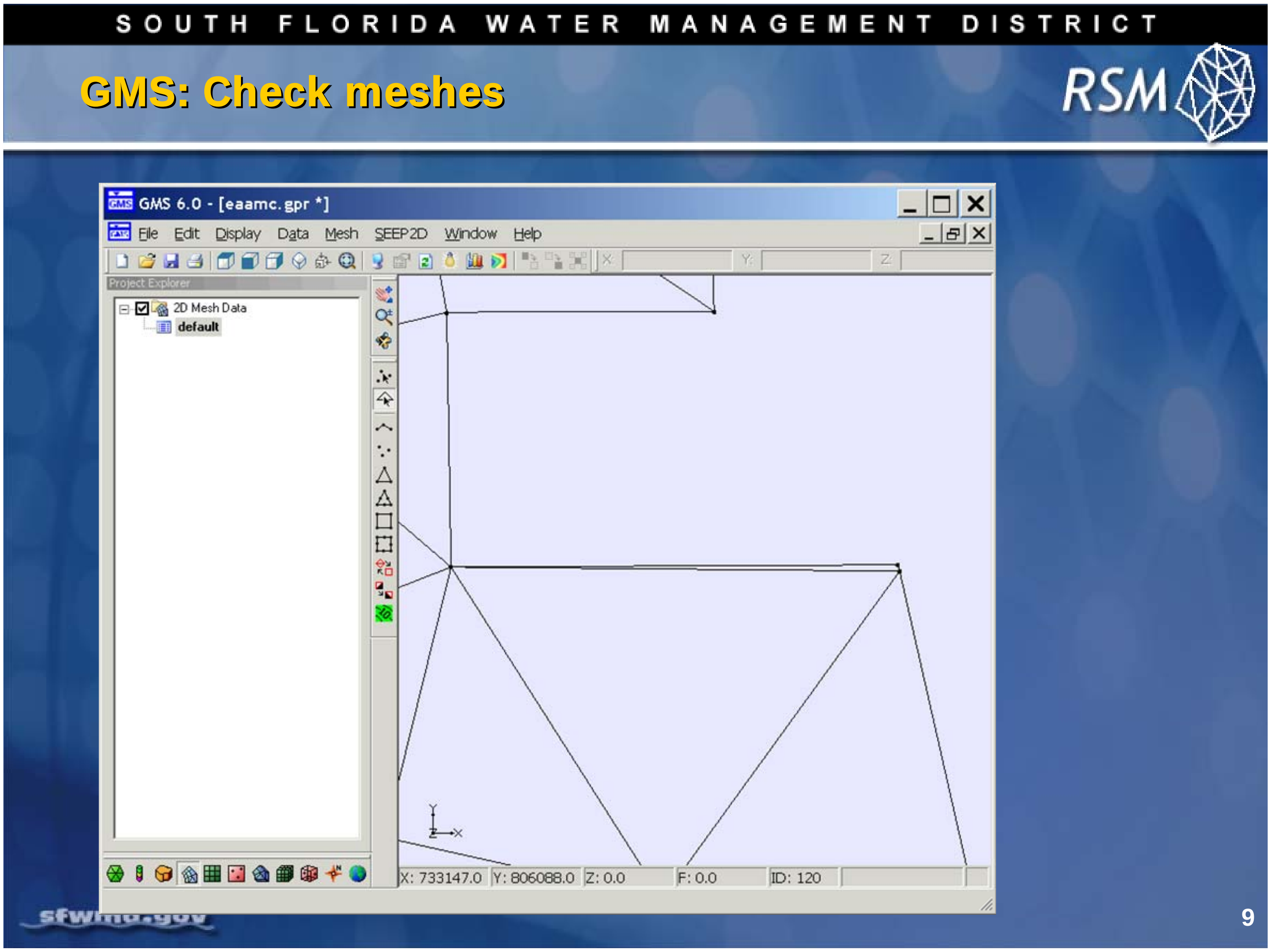


Select the components, arcs and polygons of the framework shape that will be used for constraining the mesh. The components are used to create feature objects.



The vertices along the framework control the density and location of the mesh triangular cells. There are tools to redistribute the vertices along the framework.

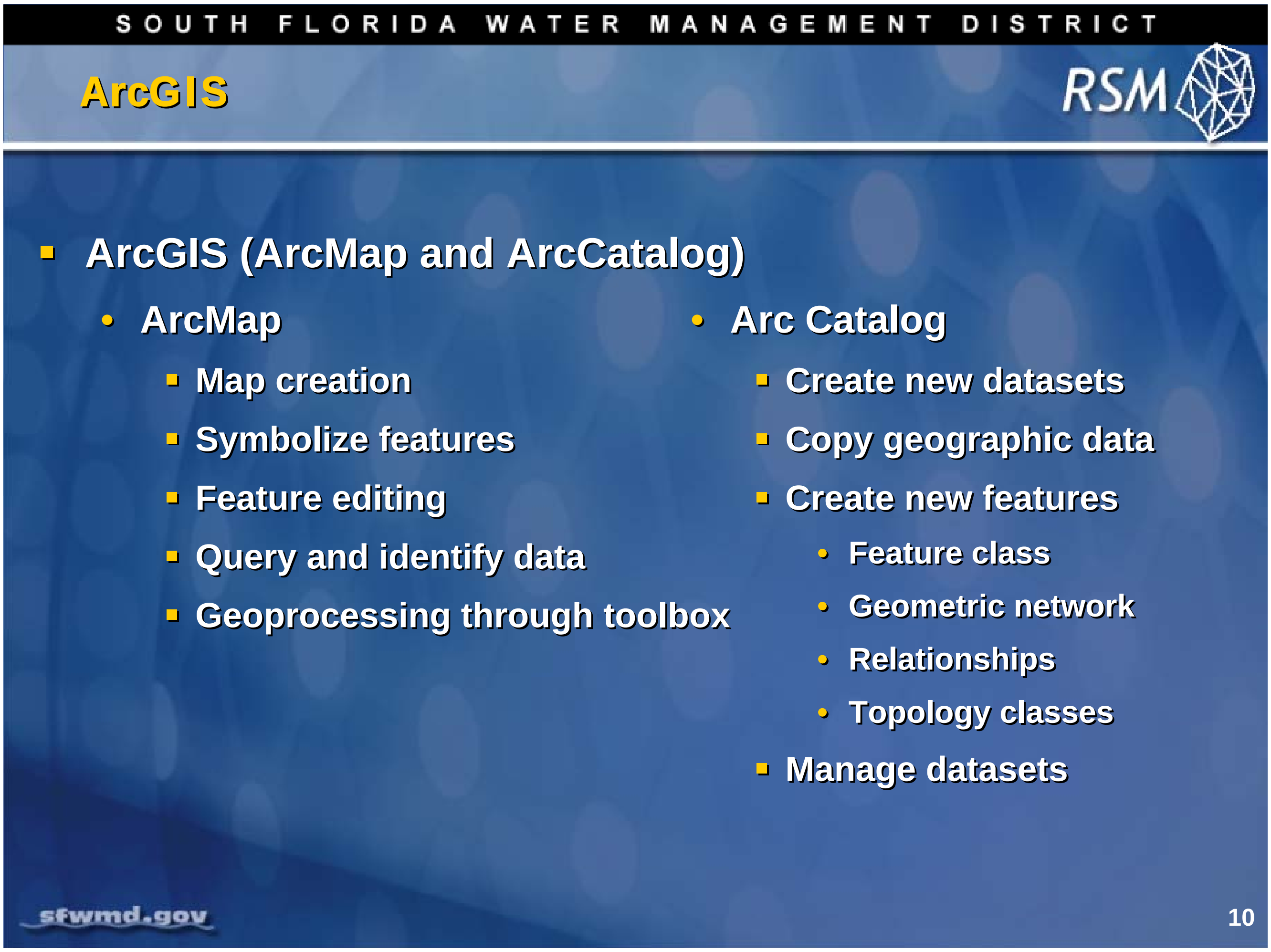
Once a good set of vertices is obtained, it can be used to create a mesh. The mesh is then saved as an ASCII *.2dm file that is used by the RSM to create the mesh geometry used in the model.



You can use the GMS to check that a mesh is sound and to check for cell connectivity.

In this case, a *.2dm file is imported into the GMS where you can look for thin triangles.

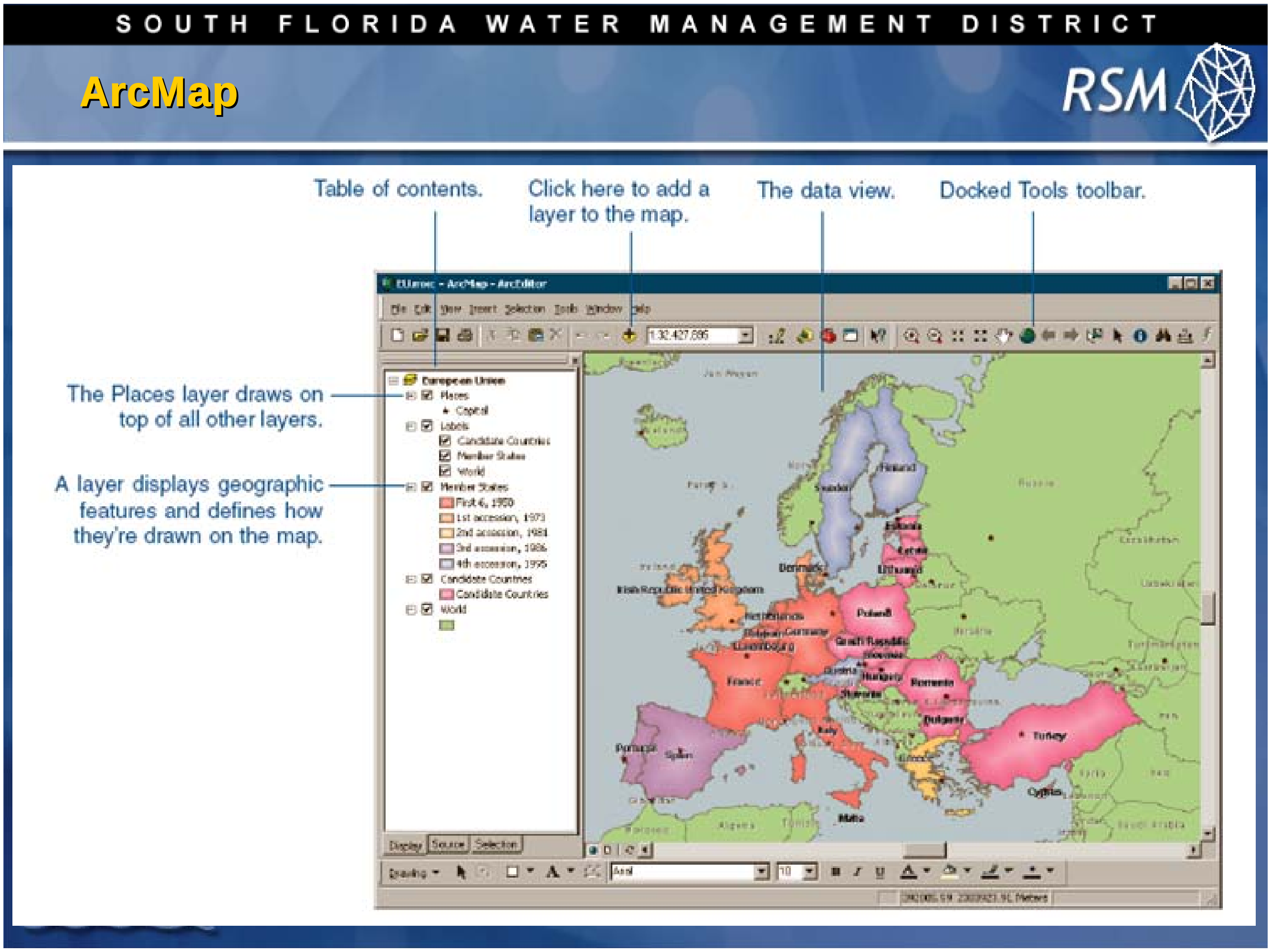
This completes the mesh creation. The next part of this lecture examines ArcGIS and the RSM geodatabase.



ArcMap is the primary GIS application used at the South Florida Water Management District for viewing and displaying spatial data.

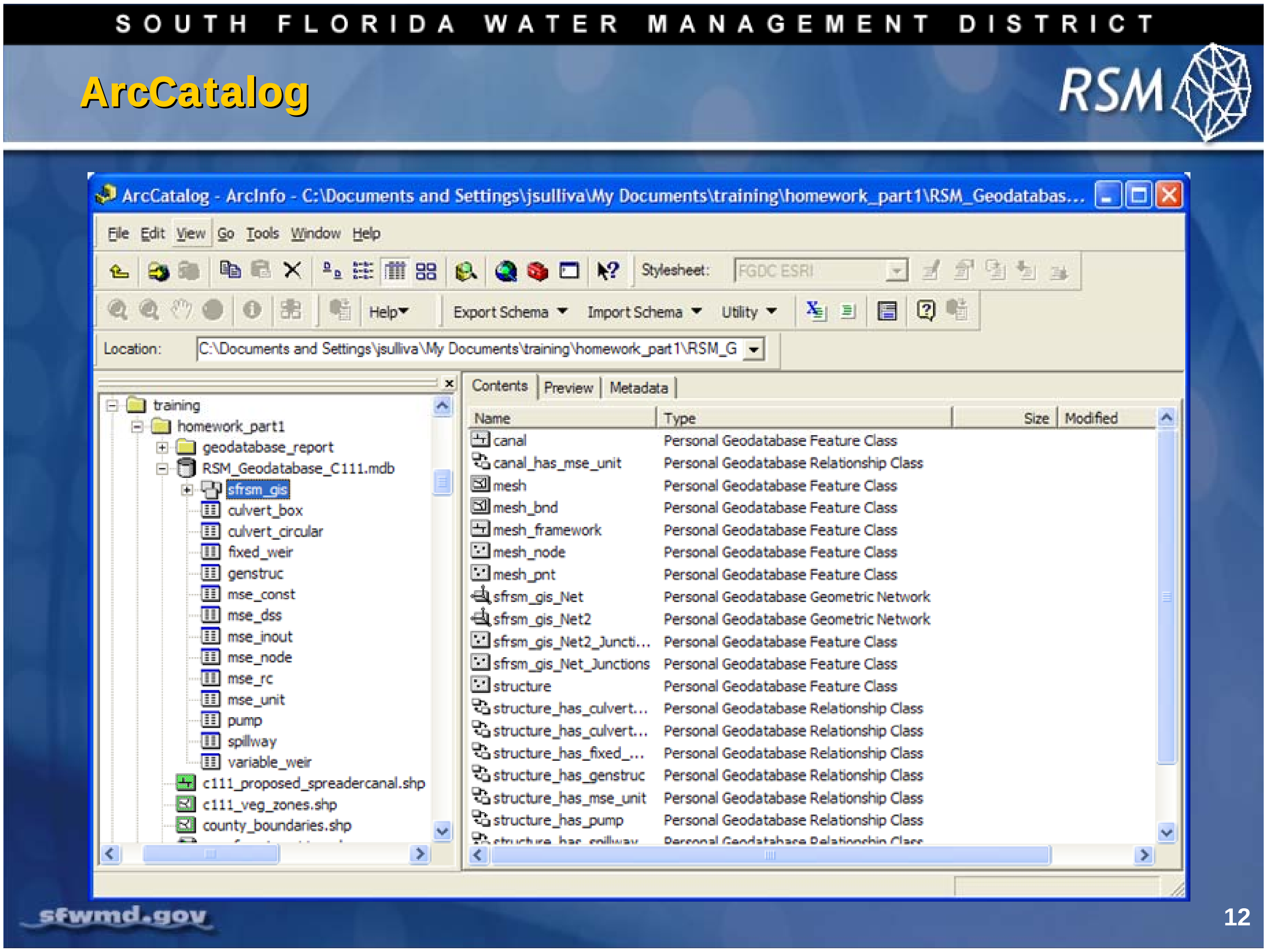
ArcGIS also provides a platform from which data layers can be edited and attributes can be modified.

The RSM GIS tools are available as a custom toolbar in ArcGIS.



ArcMap is used to present and manipulate spatial data from the RSM geodatabase for use in the RSM. The RSMGIS toolbar, which is presented in Module 7, provides tools for extracting spatial data and placing it in files to be used by the RSM. It is useful to have a working knowledge of ArcMap.

The order, by which data layers are displayed, controls how the data is displayed on the screen. One layer can cover another layer.

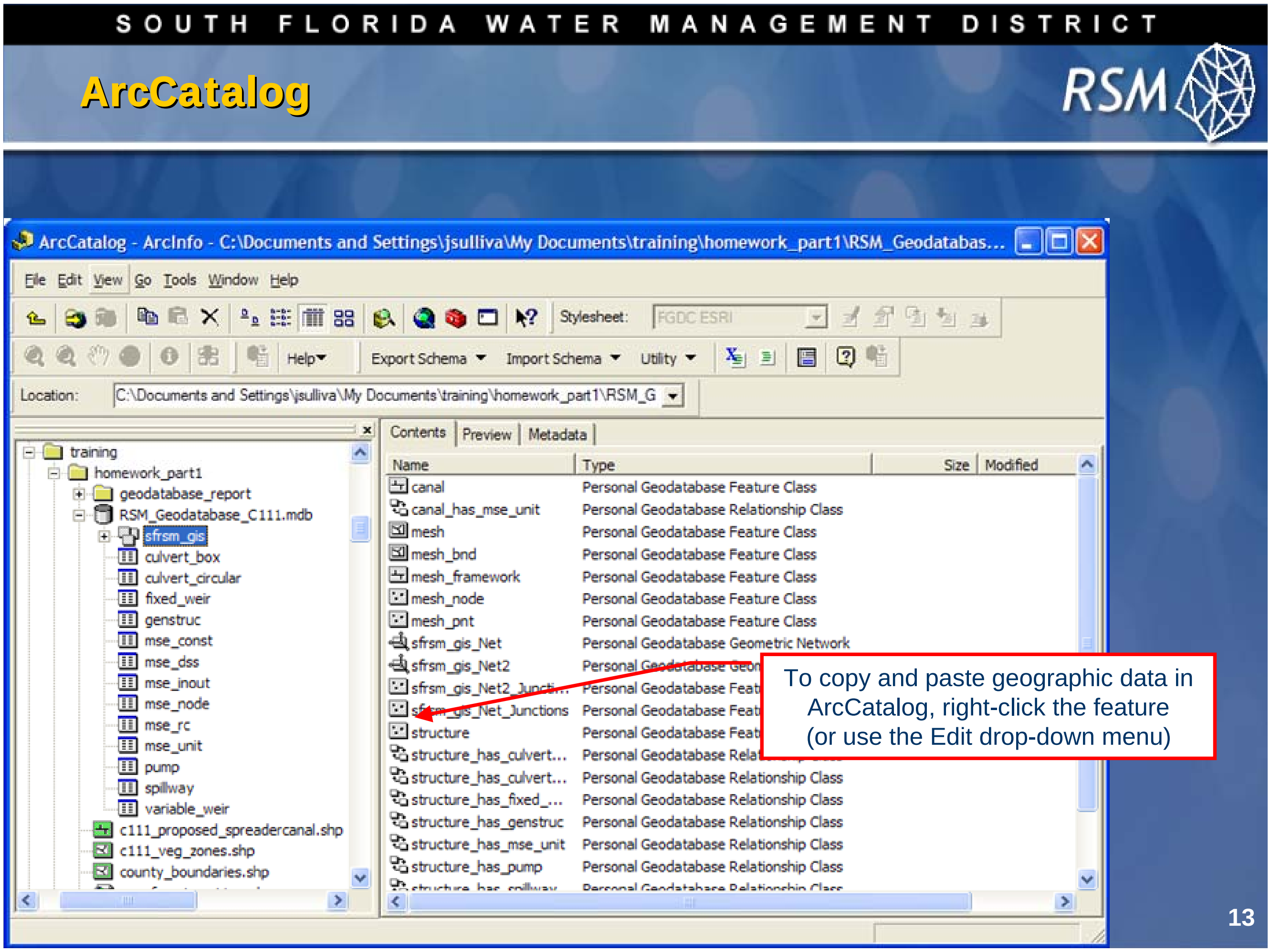


The browser window in the slide above provides a snapshot of the content of the RSM geodatabase in ArcCatalog.

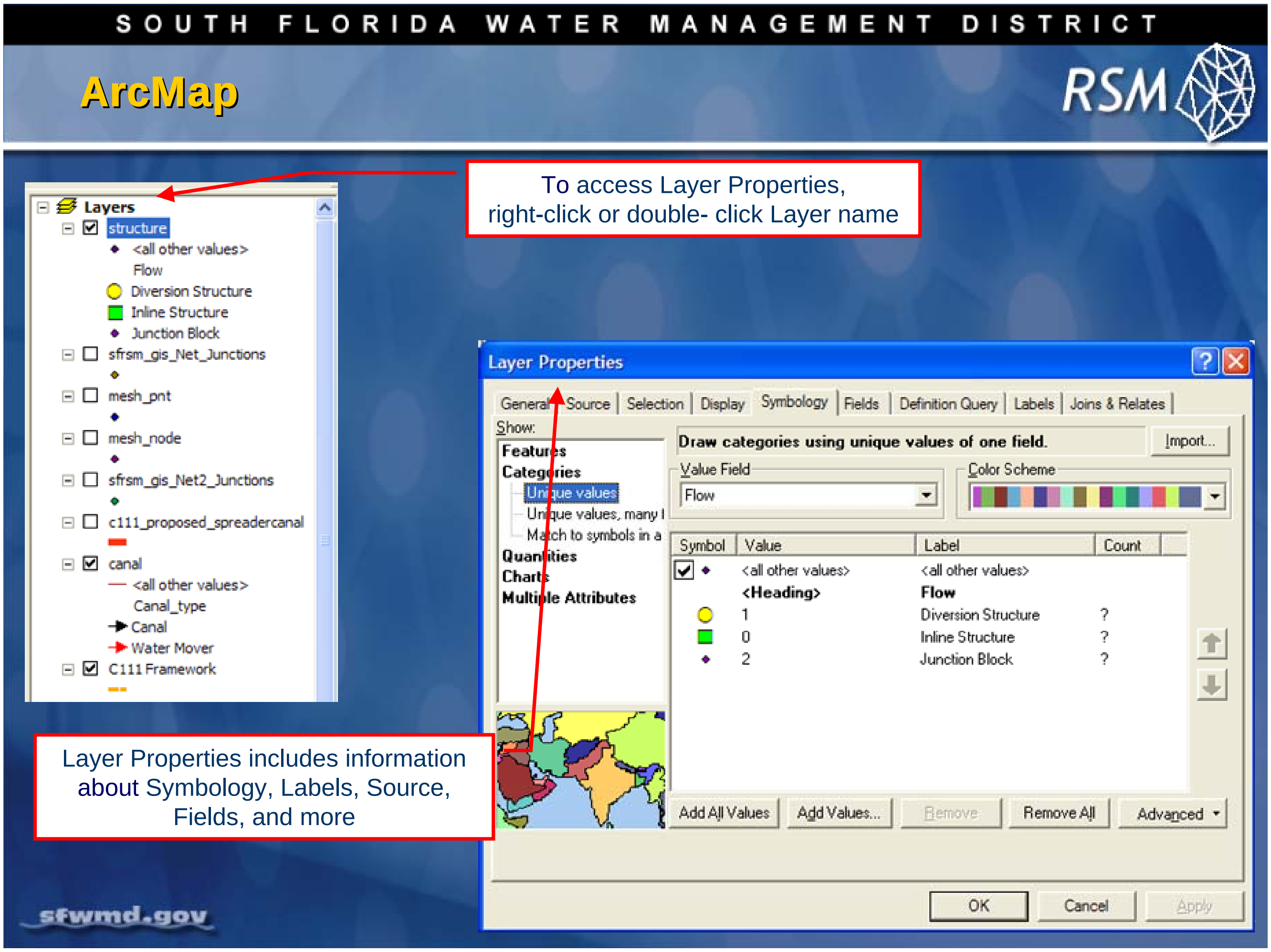
ArcCatalog is a shared ArcGIS application that allows you to organize and access all GIS information such as maps, globes, datasets, models, metadata, and services. It includes tools to:

- Browse and find geographic information.
- Define, export, and import geodatabase schemas and designs.
- Search and browse GIS data on local networks and the Web.

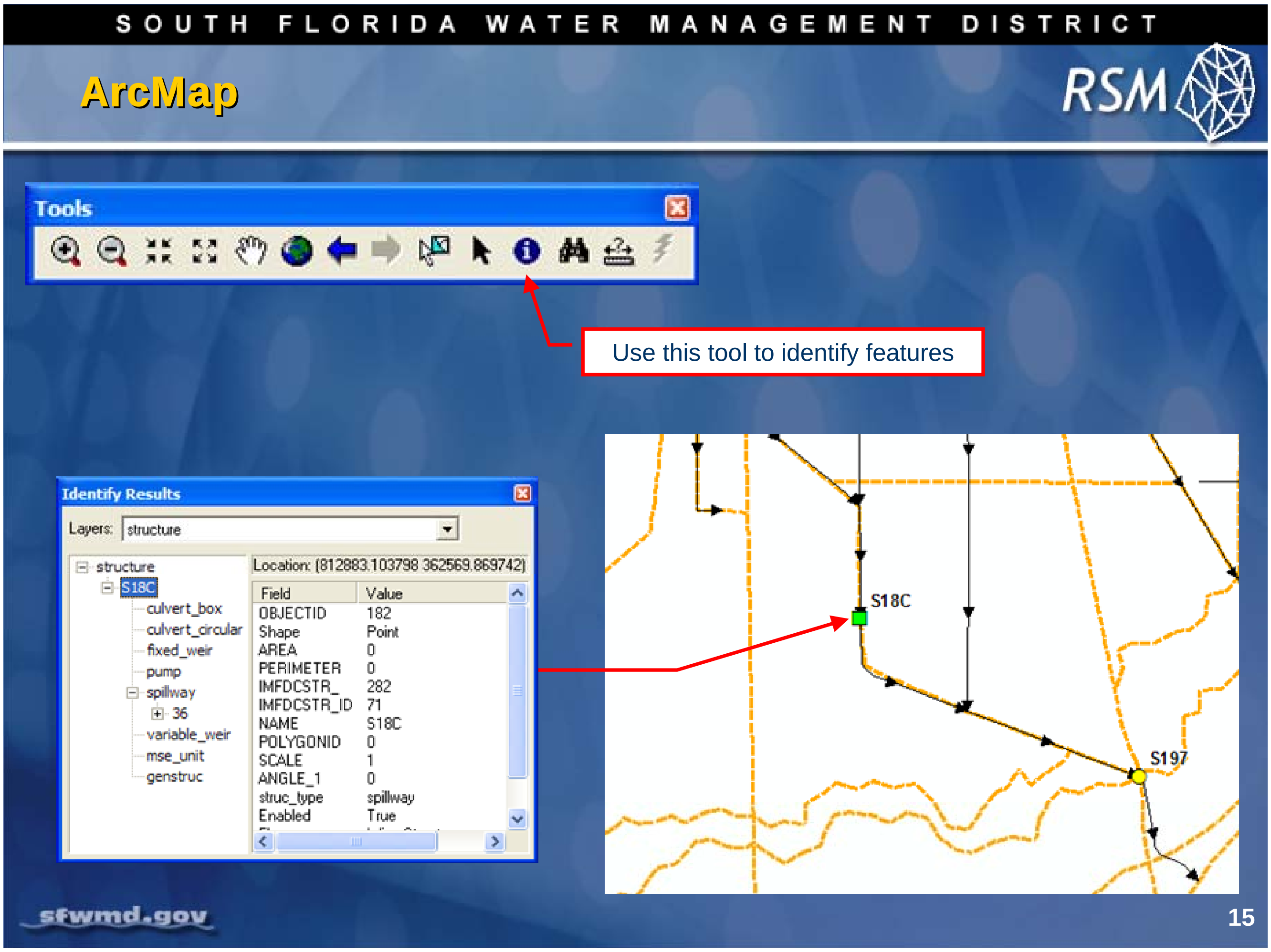
[Reference: http://www.esri.com/software/arcgis/about/arccatalog.html]



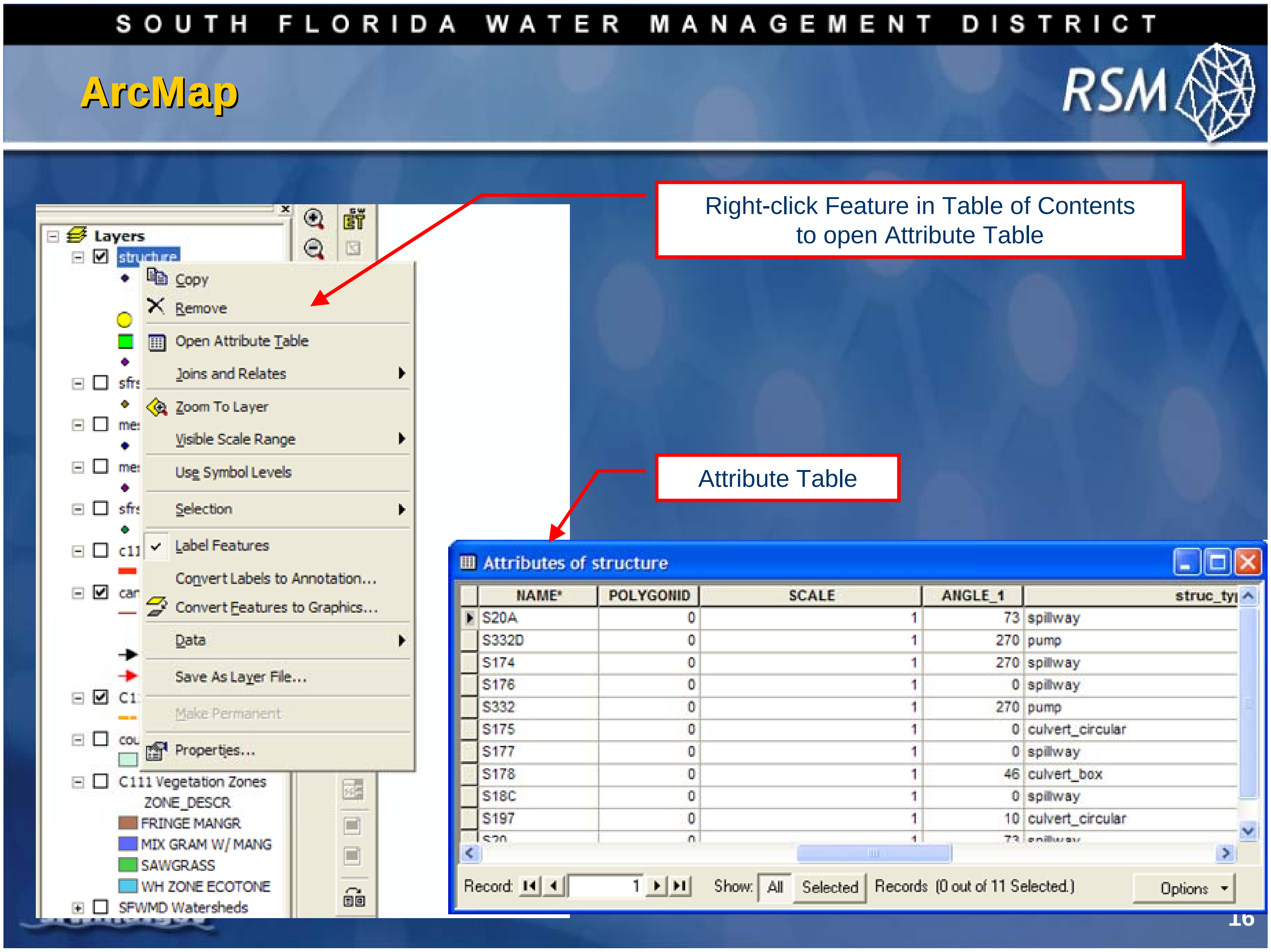
ArcCatalog is used to build the geodatabase that contains the spatial data used in the RSM. The spatial feature classes can be copied from the catalog and pasted in an ArcMap for processing.



Each data layer in the Table of Contents is controlled by properties which dictate how the data is displayed. You can change properties of the data layer by right-clicking the data layer name or the symbol.

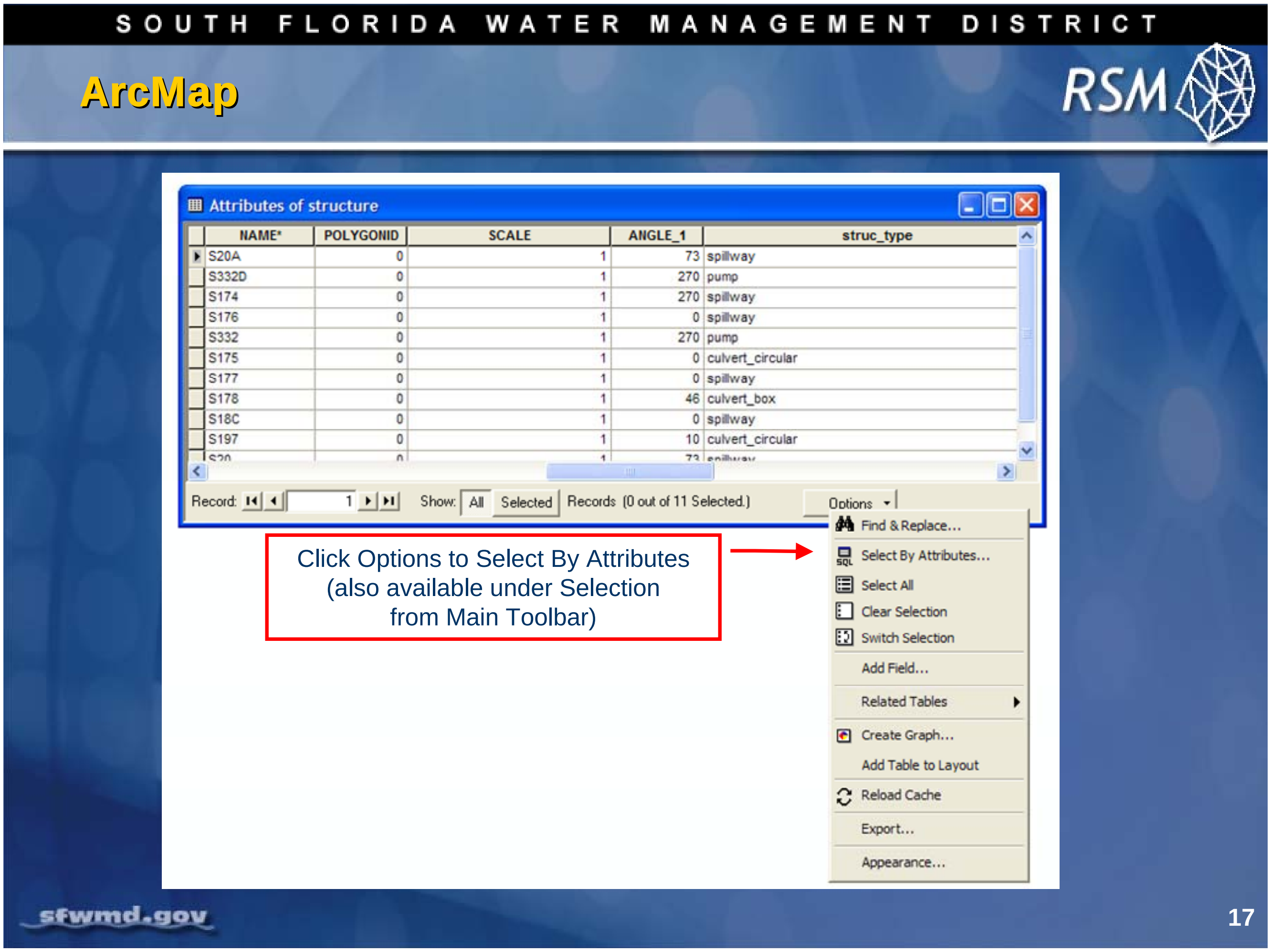


The necessary attributes for the RSM are built into the attribute files. You can use the **Identify** tool to select a data element in the display window and view its attributes.

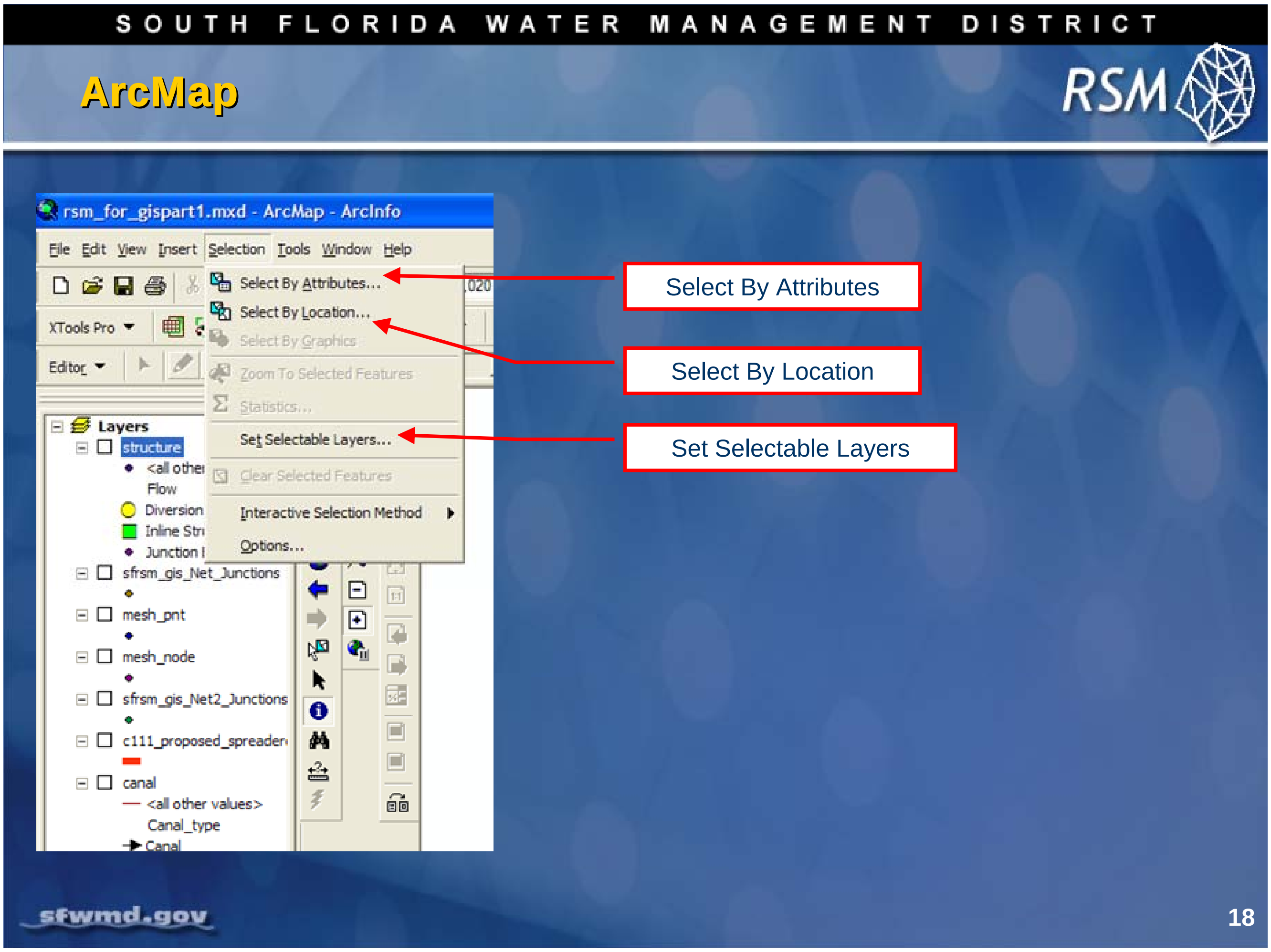


You may also view the **Attributes of a structure** by right clicking a data layer in the Table of Contents and selecting **Open Attribute Table** for that layer.

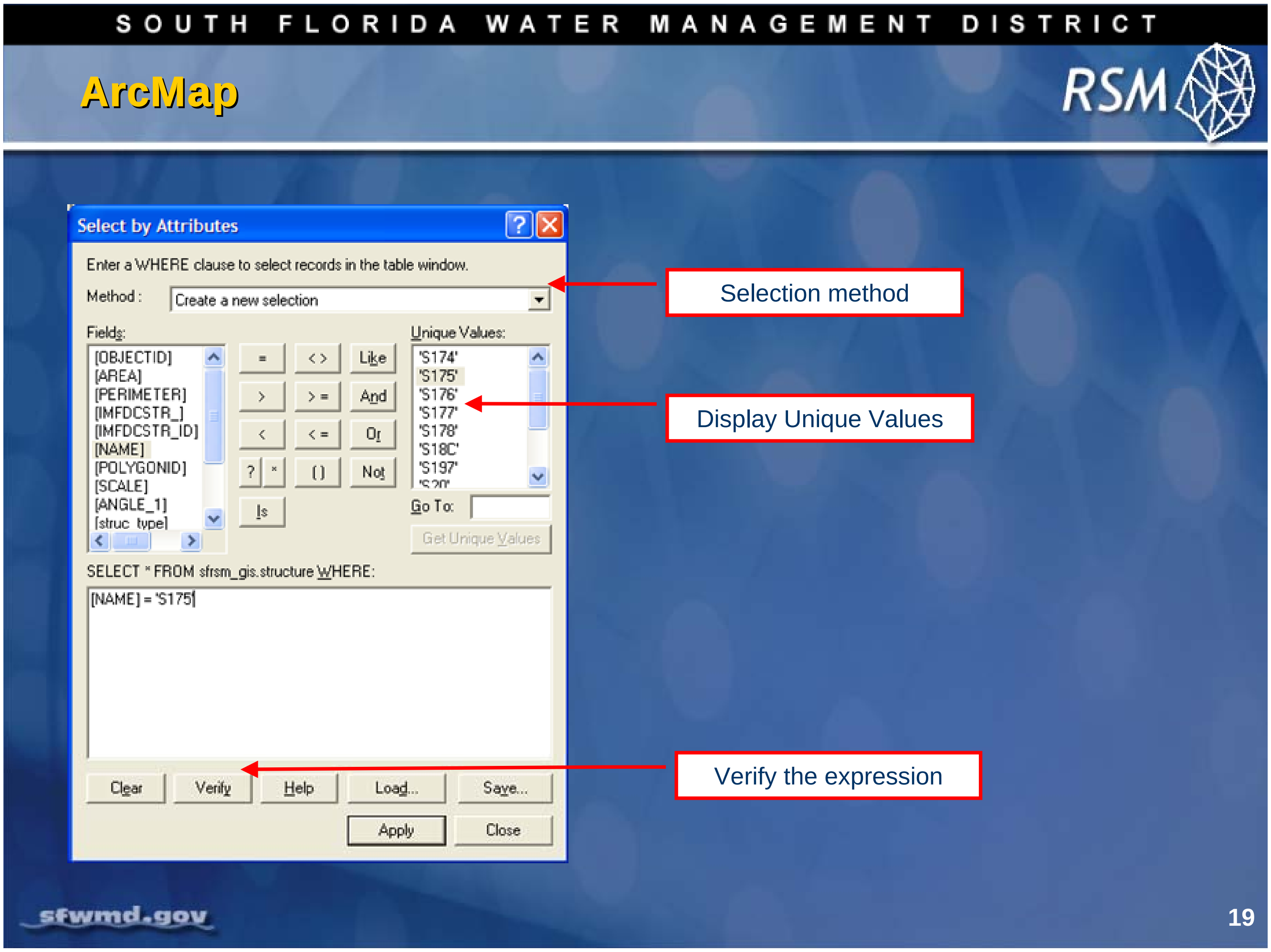
At the bottom of the attribute table you can view the entire table or only the selected data elements. Right-click on the heading over any attribute in the table and sort the table.



While viewing the attribute table, data records can be selected by clicking the individual data records at the far left side of the table. The selected data records will appear on the screen as highlighted features.



It is possible to select for a specific feature or features by location, attributes or layer.

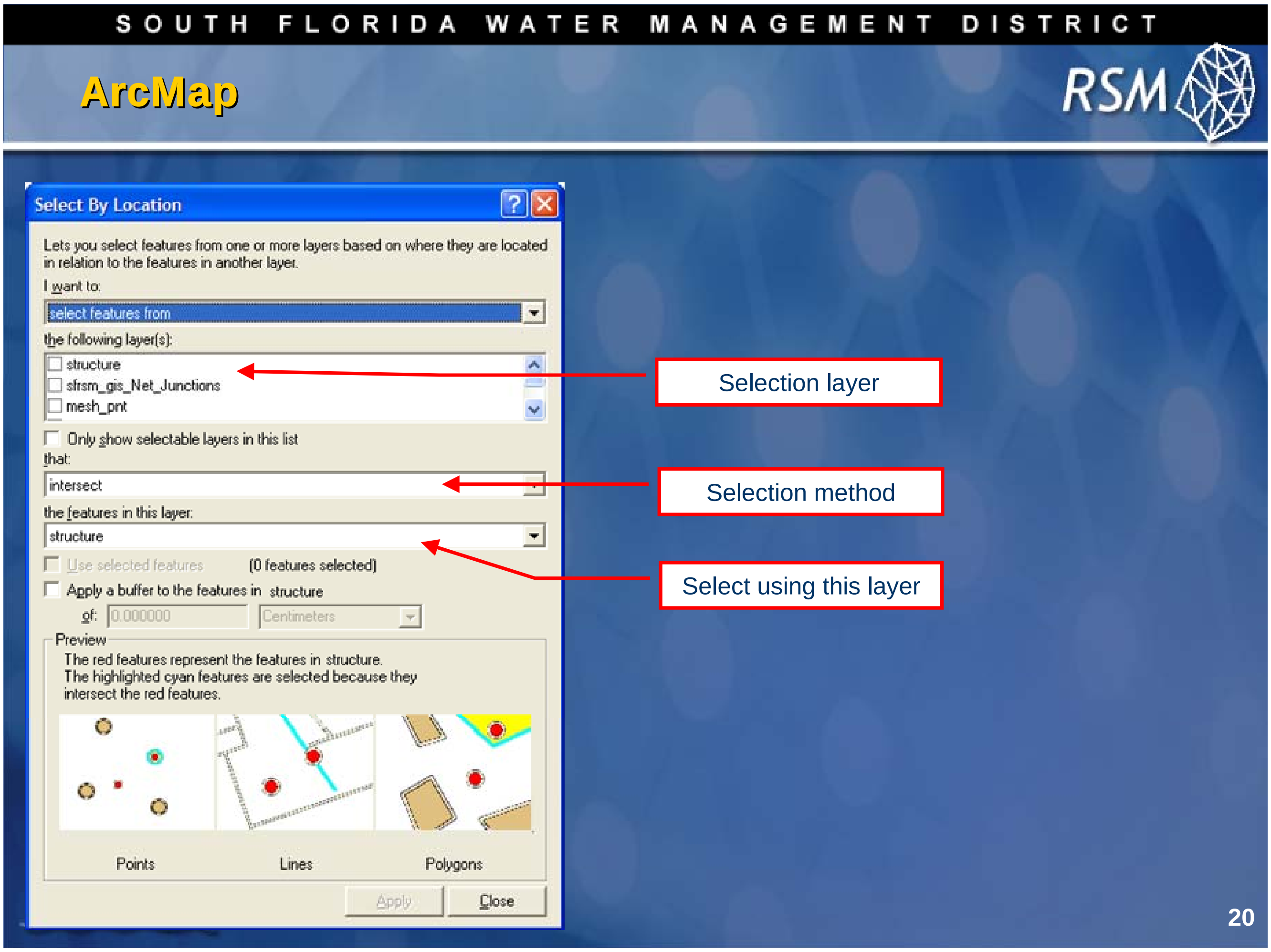


The **Query** tool allows you to construct a SQL-type query to make specific data selections from a data layer.

For example:

SELECT 'Structure' WHERE Name = 'S175'

When you return to the map, you will see that feature is highlighted. (This capability is particularly useful for finding small features.)



The **Select By Location** dialog box lets you select features based on their location relative to other features.

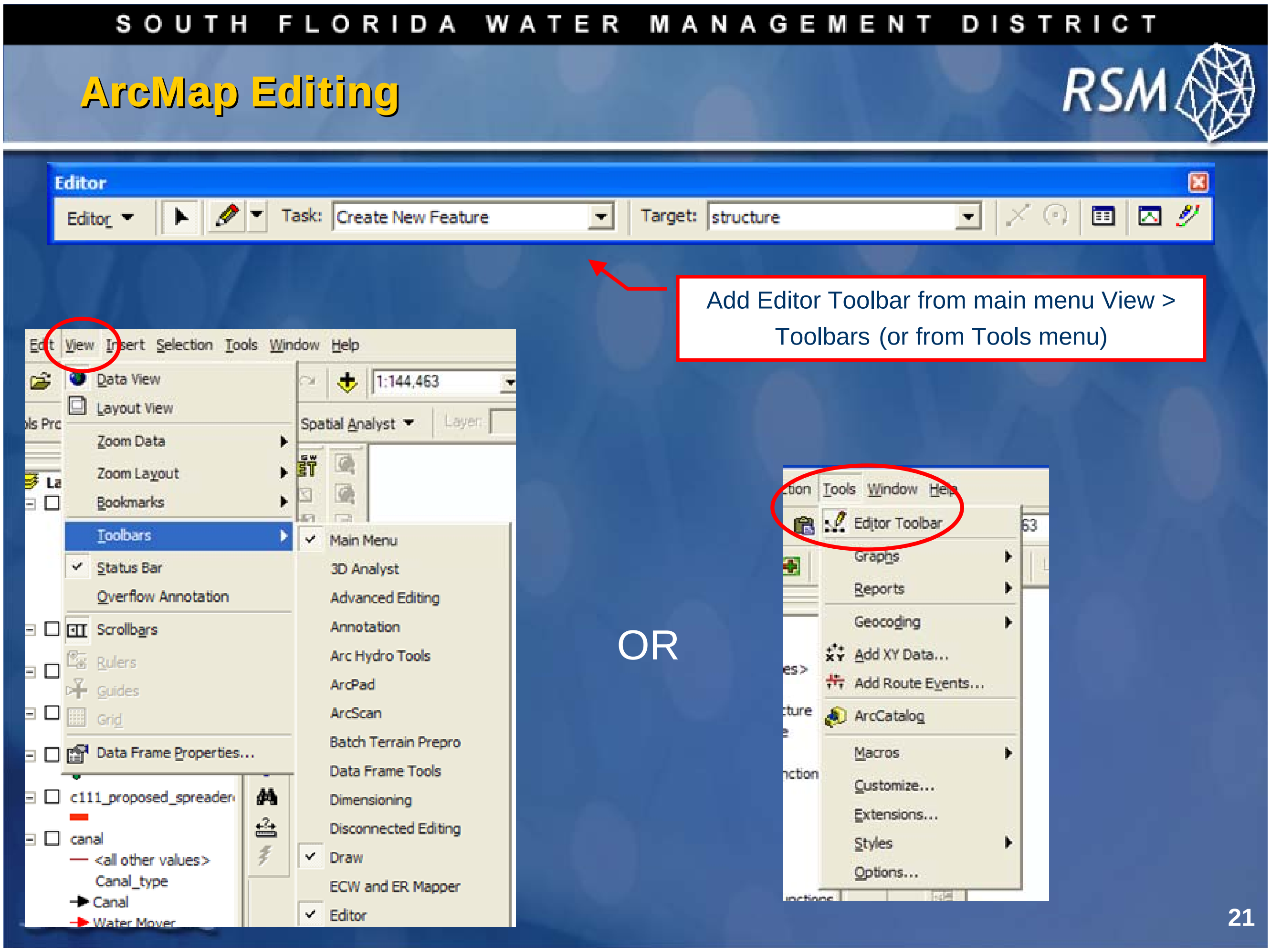
For example, if you want to know how many homes were affected by a recent flood and you mapped the flood boundary, you could select all the homes that are within this area. Answering this type of question is known as a spatial query.

By combining queries, you can perform more complex searches. Suppose you want to find all the customers who live within a 20-mile radius of your store, and who made a recent purchase, so you can send them a promotional mailing.

You would first select the customers within this radius (Select By Location), then refine the selection by finding those customers who have made a purchase within the last six months according to a date-of-last-purchase attribute (Select By Attribute).

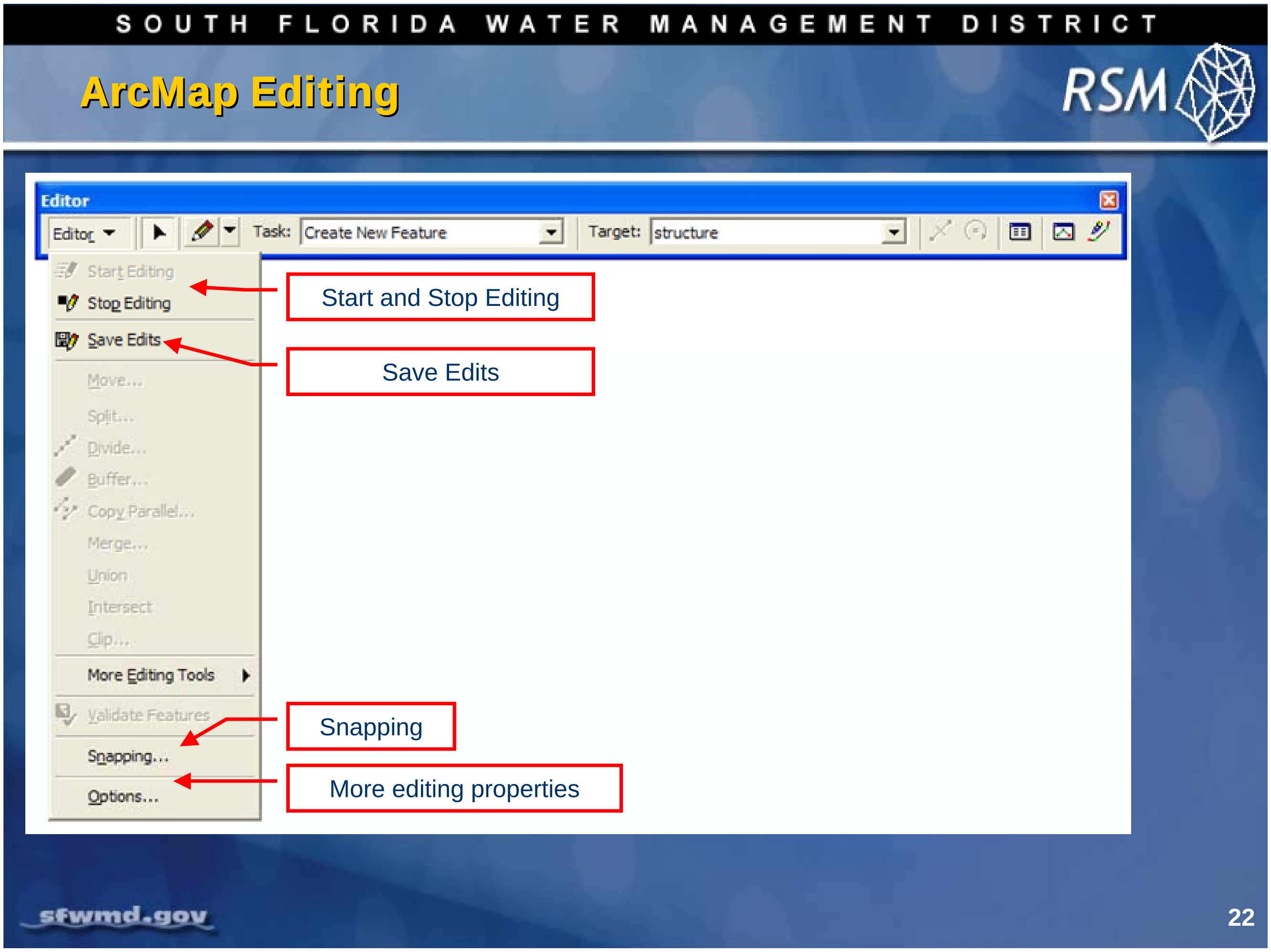
You can use a variety of selection methods to select the point, line or polygon features in one layer that are near, or overlap the features in the same or another layer.

[Source: *ArcGIS 9.2 Desktop Help*]



The ArcGIS **Editor** toolbar contains several editing tools and options.

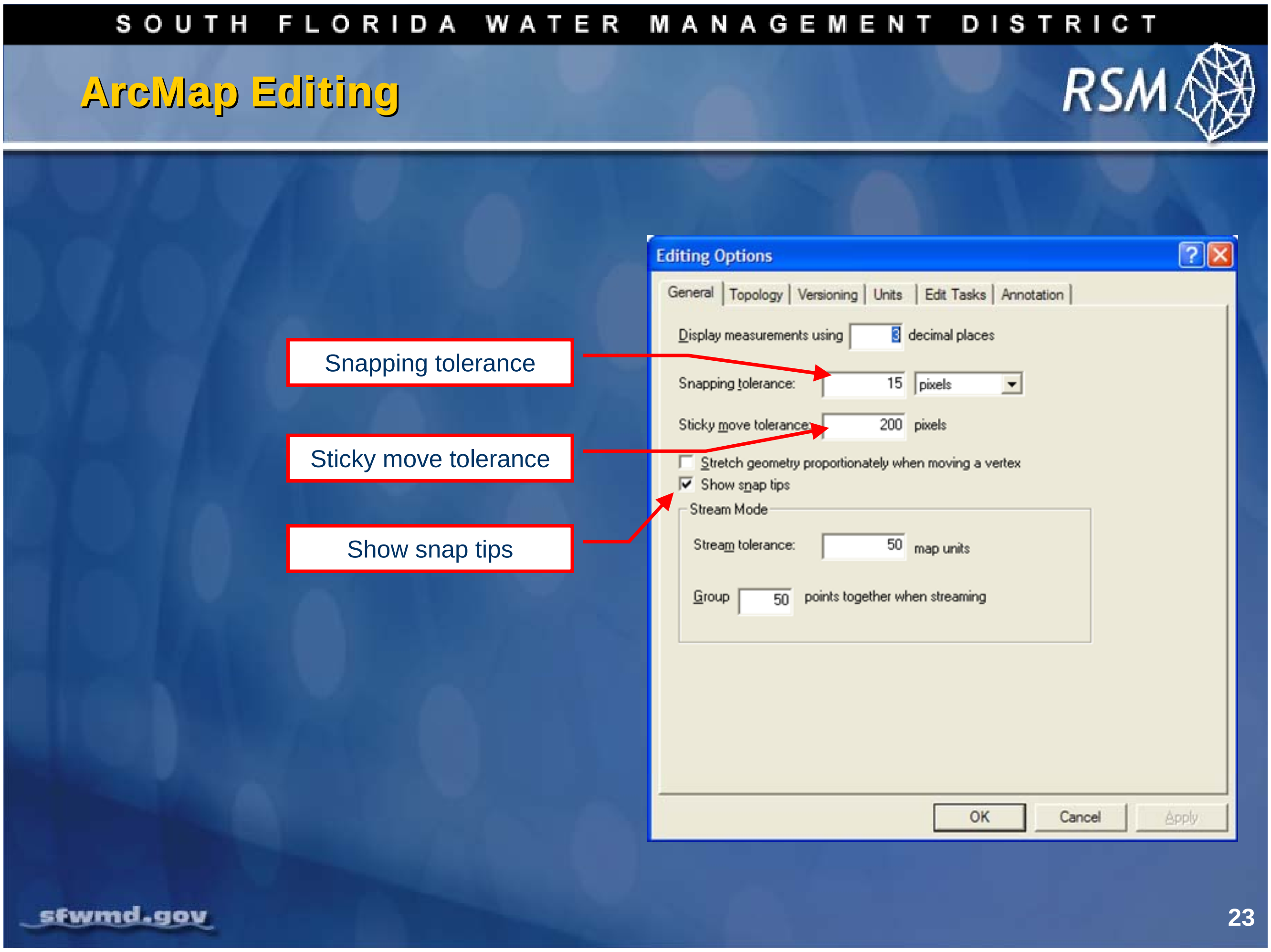
When it is necessary to edit canal segments, structures or other feature classes, ArcMap provides an interface for editing those features, as well as spatial extents or attributes.



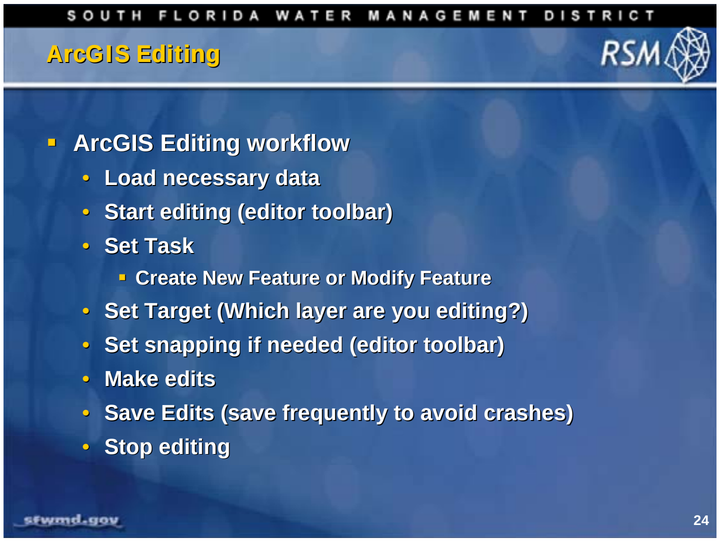
To begin an editing session in ArcMap:

1. Click the **Editor** drop-down menu in the **Editor** Toolbar.
2. Select the **Start Editing** option.

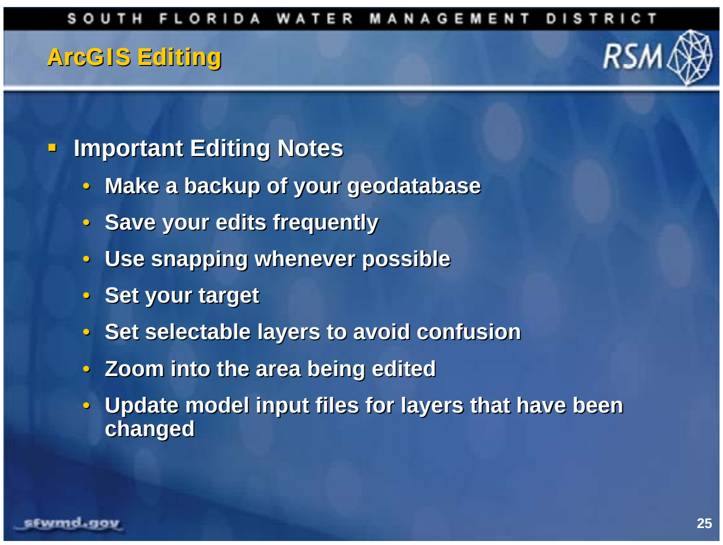
Subsequently, there are choices to **Save Edits** and **Stop Editing**. Additionally, the snapping feature is very useful for making sure the edits are attached to coverage features.



Before adding new data to the geodatabase, set up tolerances to ensure points and lines are placed appropriately in relation to the existing data.



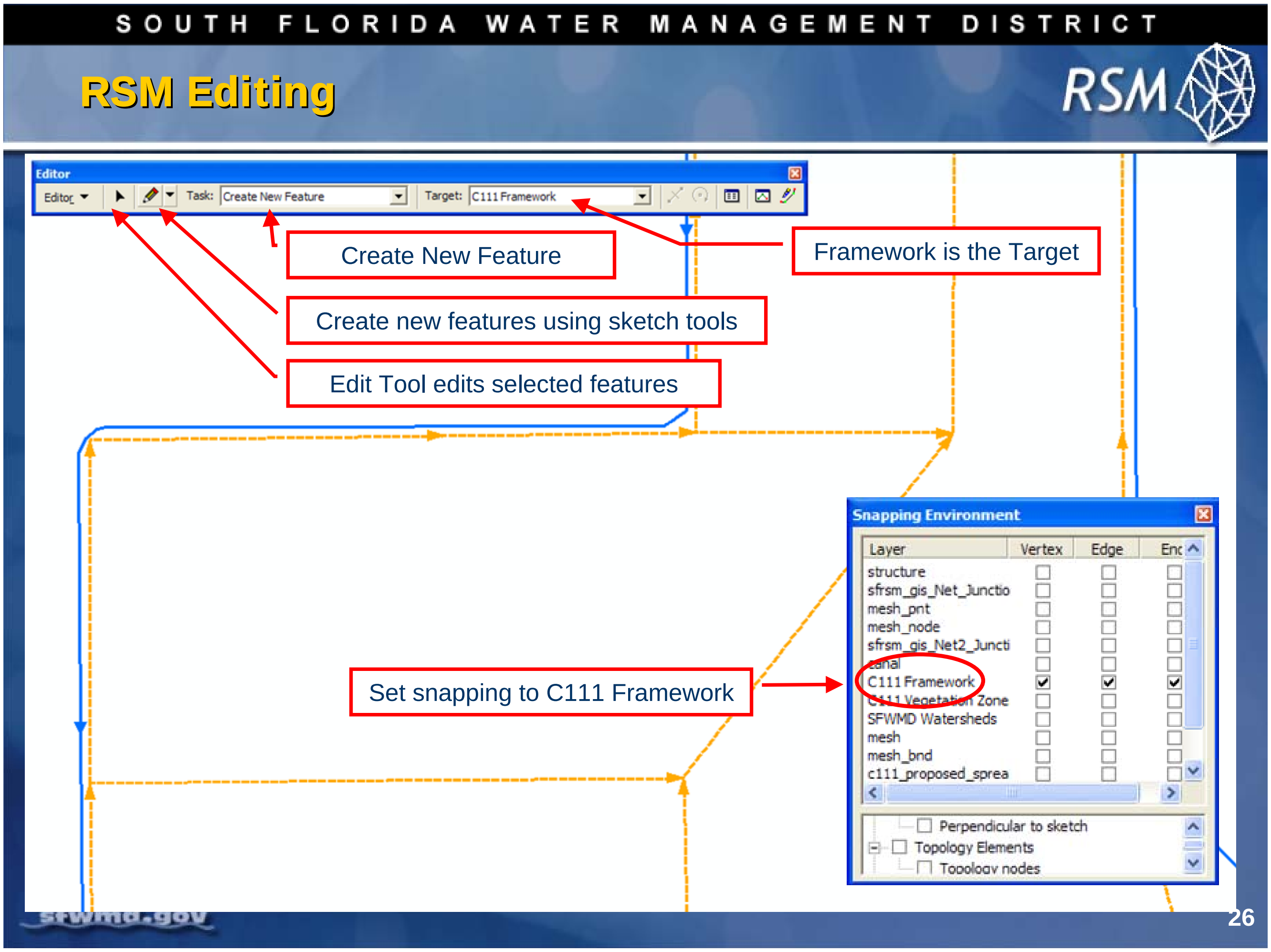
To edit a feature class in ArcMap, follow the process outlined on the accompanying slide, ArcGIS Editing.



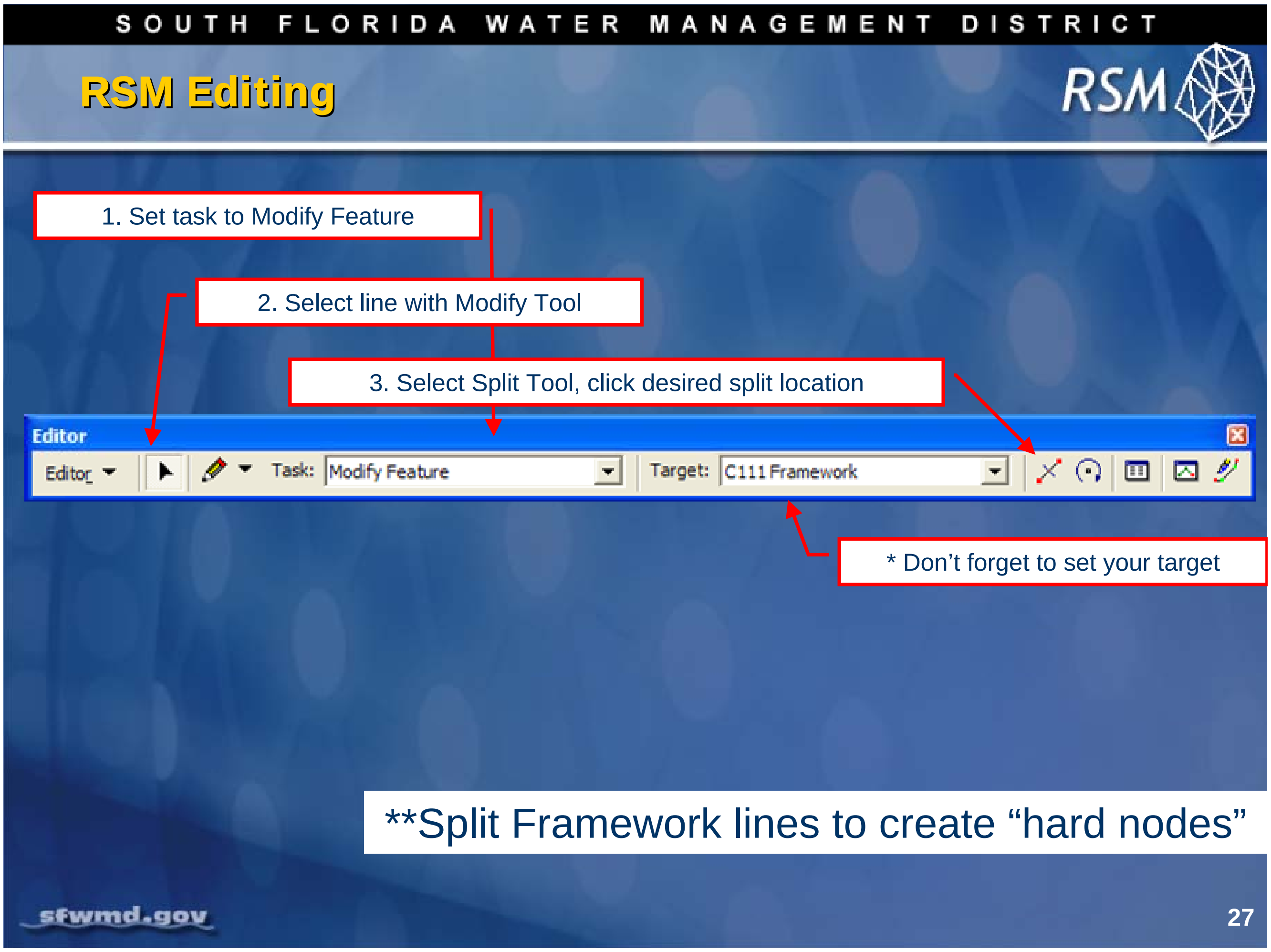
Before starting an edit session:

1. Always make a backup of your personal geodatabase.
   - Save your edits frequently to avoid loss of data and to preserve successful edits at key points.
2. Check tolerances to ensure proper placement of new data, connectivity of lines and closure of polygons.
3. Turn off layers that do not aid in the editing process to avoid confusion.
4. Zoom in on areas where edits are being made.

After completing edits, regenerate all RSM XML files.

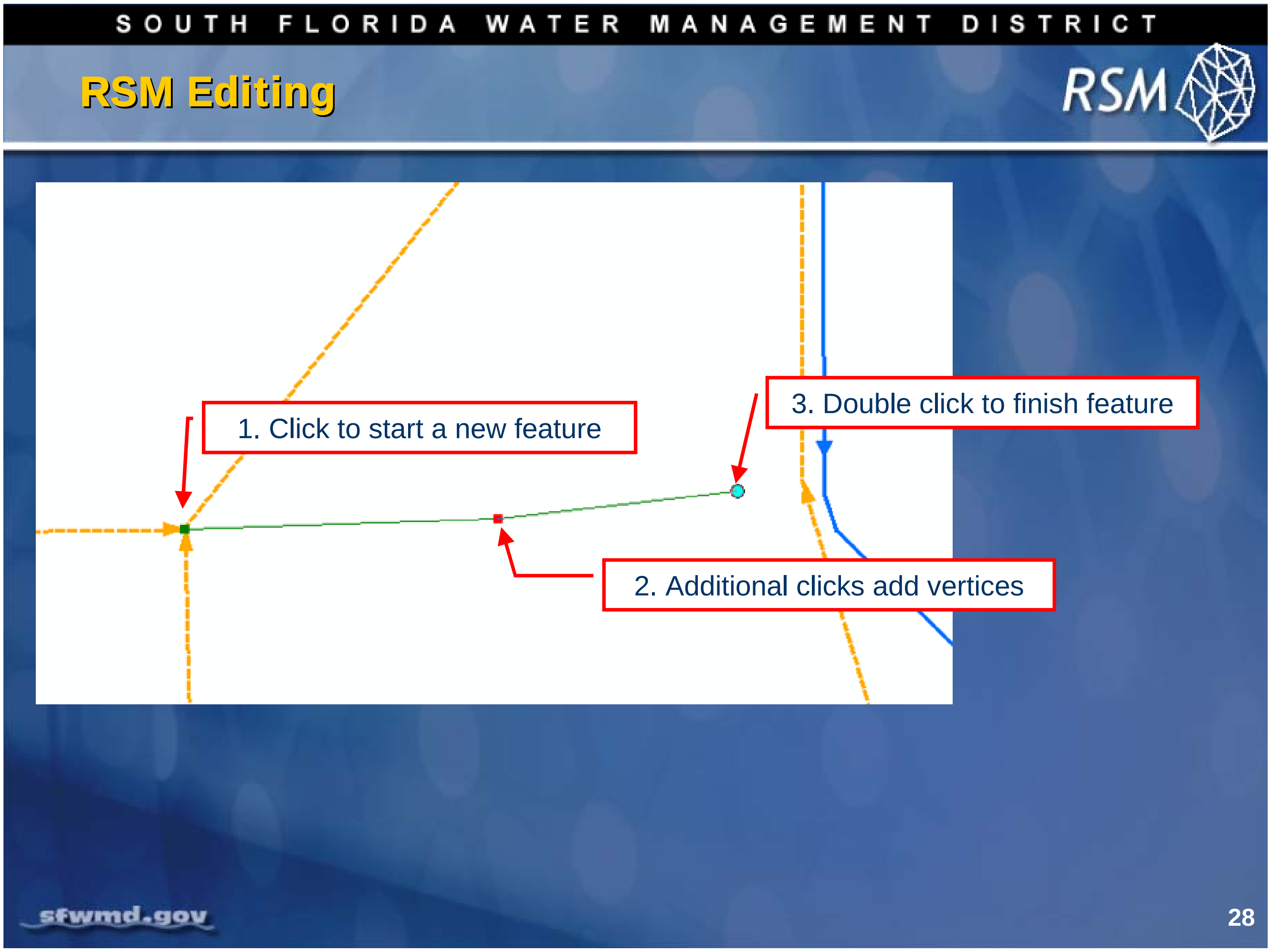


This slide highlights key tools and capabilities which are helpful for editing a feature class in the RSM.



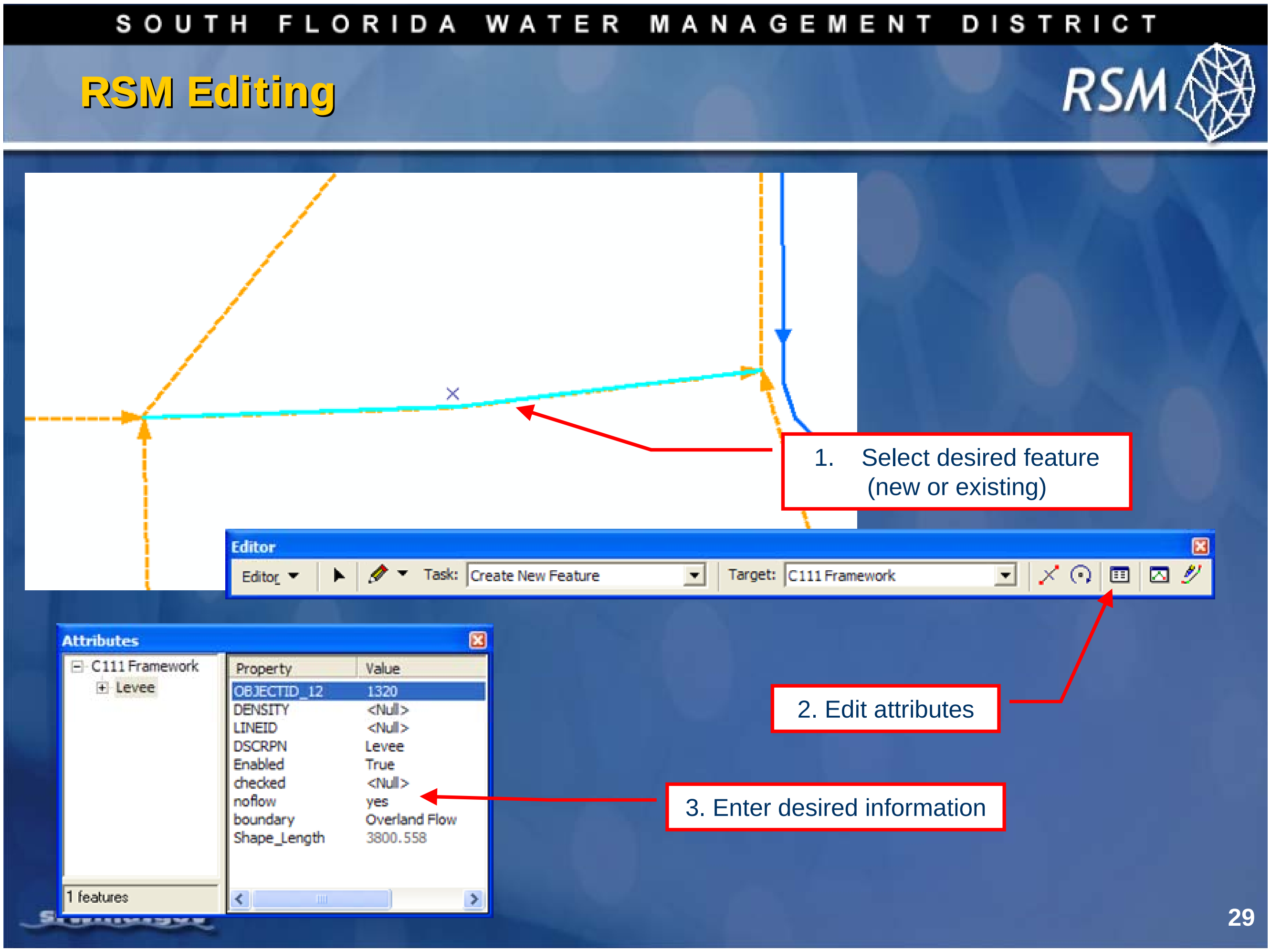
The **Split** Tool gives you the ability to divide selected framework lines at a desired location and to create "hard nodes" or line endpoints.

1. Select the Modify Feature option in the task dropdown list
2. Click on the Modify tool
3. Select the canal segment to be split
4. Choose the target layer
5. Select the split tool
6. Click on the desired location where the split is to be placed



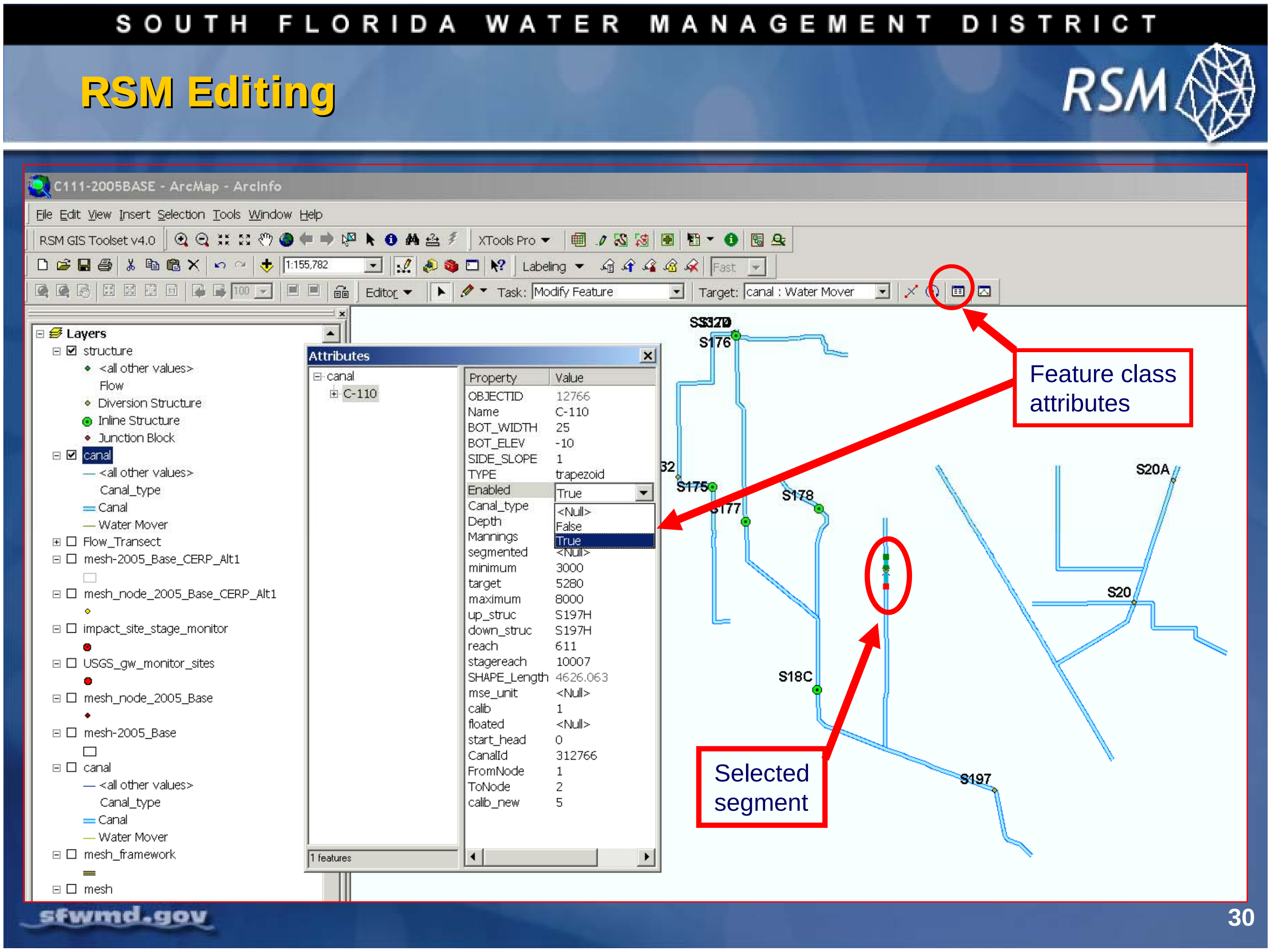
Process for adding a canal:

1. Start at a node on a current canal
2. Add the necessary vertices
3. Double click to end the segment

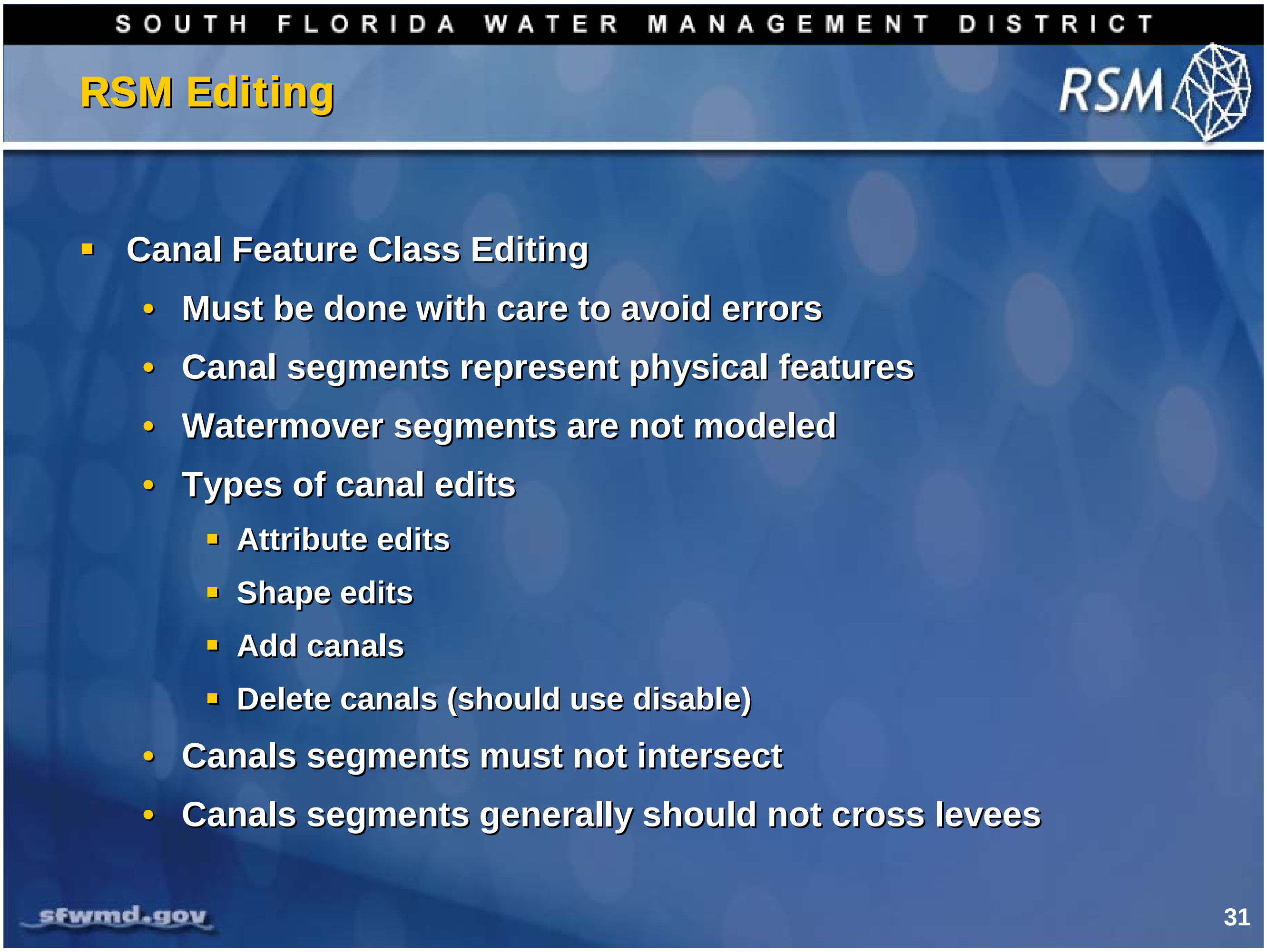


To add database attributes for the new canal segment:

1. Select the line to be modified using the modify tool on the editor toolbar
2. Select the **Edit Attributes** button from the Editor menu
3. Click on the attribute value to be changed and add the desired information to the attribute table for the new feature



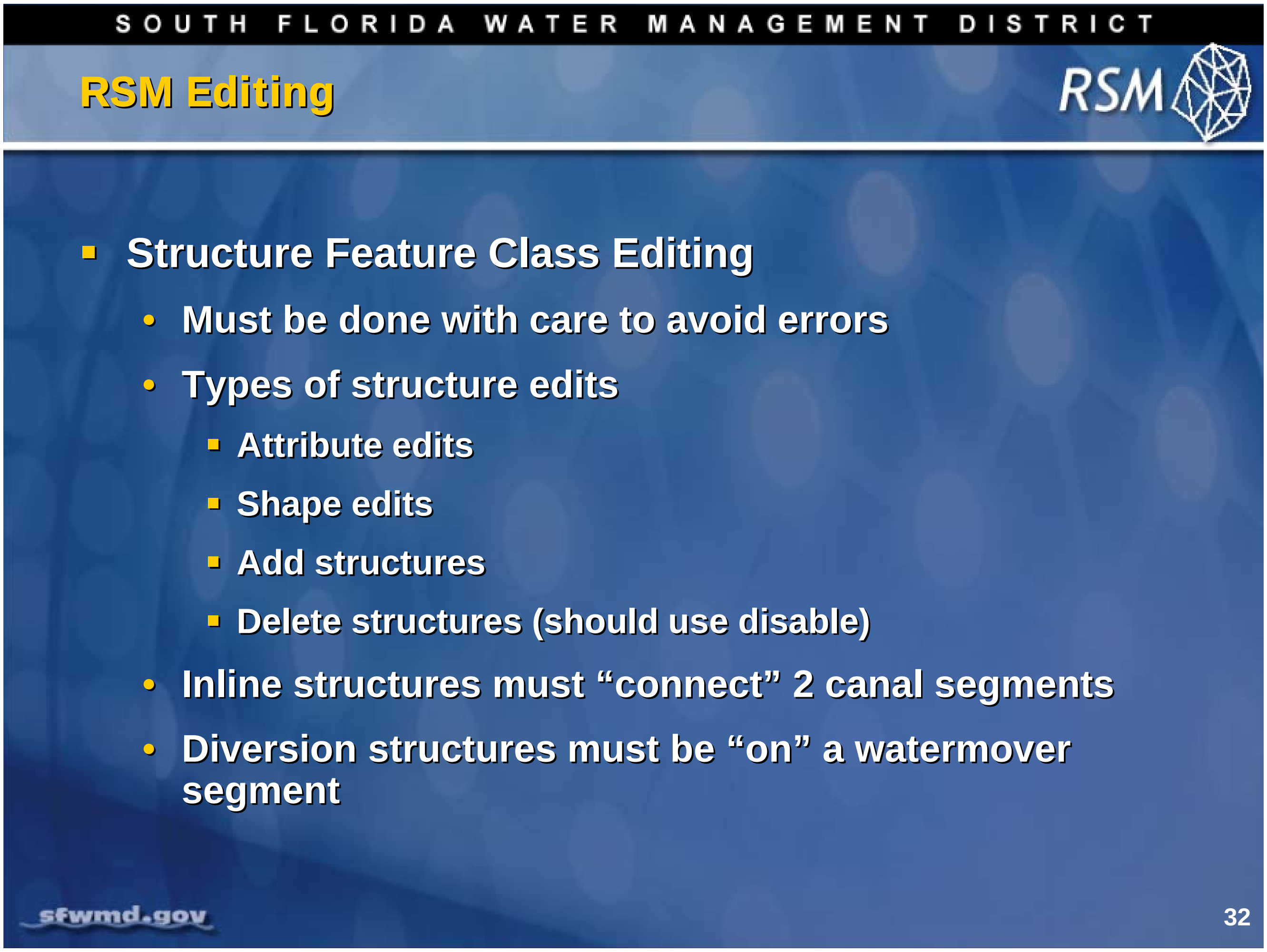
When editing the line work, it is possible to edit the attributes directly in the geodatabase. This will be discussed in Module 7.



Geodatabase schema* rules and guidelines for the RSM:

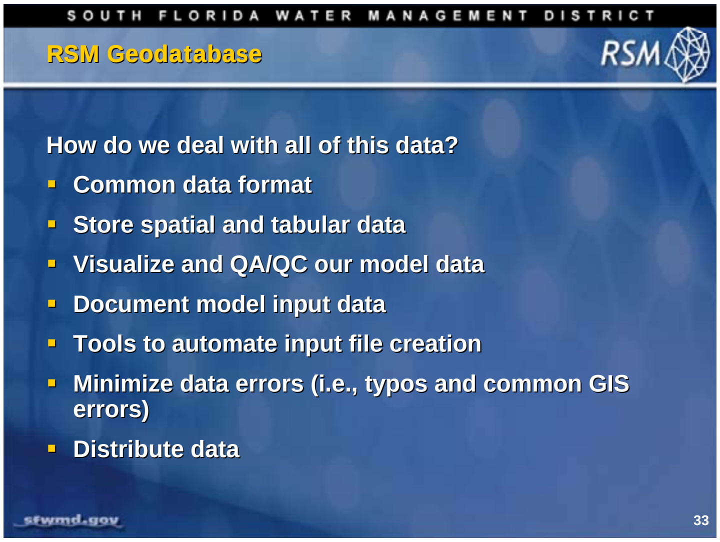
- Canal segments are waterbodies.
- Canal segments represent physical canals which are modeled. (Rather than a conceptualization of the canal, the RSM models the physical location of the canals.)
- Canal segments join to create canal reaches that are bounded by junctions.
- Canal reaches span multiple junctions to form stage-reaches bounded by an upstream and downstream structure.
- Canal segments do not intersect. Canals can only connect through structures.
- Care must be taken that canals do not cross levees or domain boundaries. This will cause a “leak” in the model, which will be difficult to detect. The SFRSM geodatabase has been carefully checked to ensure that canals and levees are correctly located.
- Watermover segments are used to symbolize and visualize connections between canal segment waterbodies but they are not modeled.

* Note: A schema is a data model that represents the relationships between the entities; a structured set of relationships.



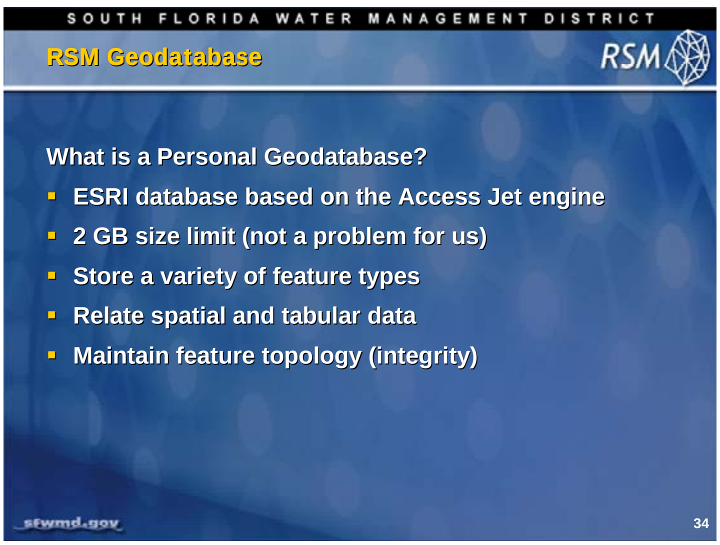
RSM Geodatabase schema rules and guidelines:

- Feature classes are added through a change control process to ensure new layers are added to the RSM GIS tools and to ensure they do not break existing tools.
- All RSM canals are trapezoidal.
- All canals and structures can be enabled and disabled. Rather than delete a canal for a selected alternative, just disable the unnecessary canals and structures.
- Inline structures must be connected to one source and one destination segment.
- Diversion structures must be "on" a watermover segment.
- All structures are junctions, but not all junctions are structures.
- Domains help control the data expected to be present in each attribute.



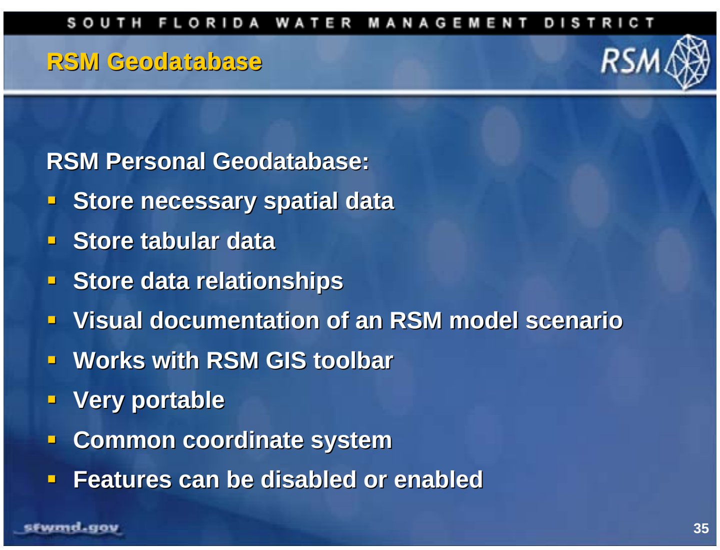
The geodatabase was created to organize and store the data required for the RSM.

With different RSM implementations it is possible to have data errors and inconsistent data sets. The common geodatabase resolves many data input issues.

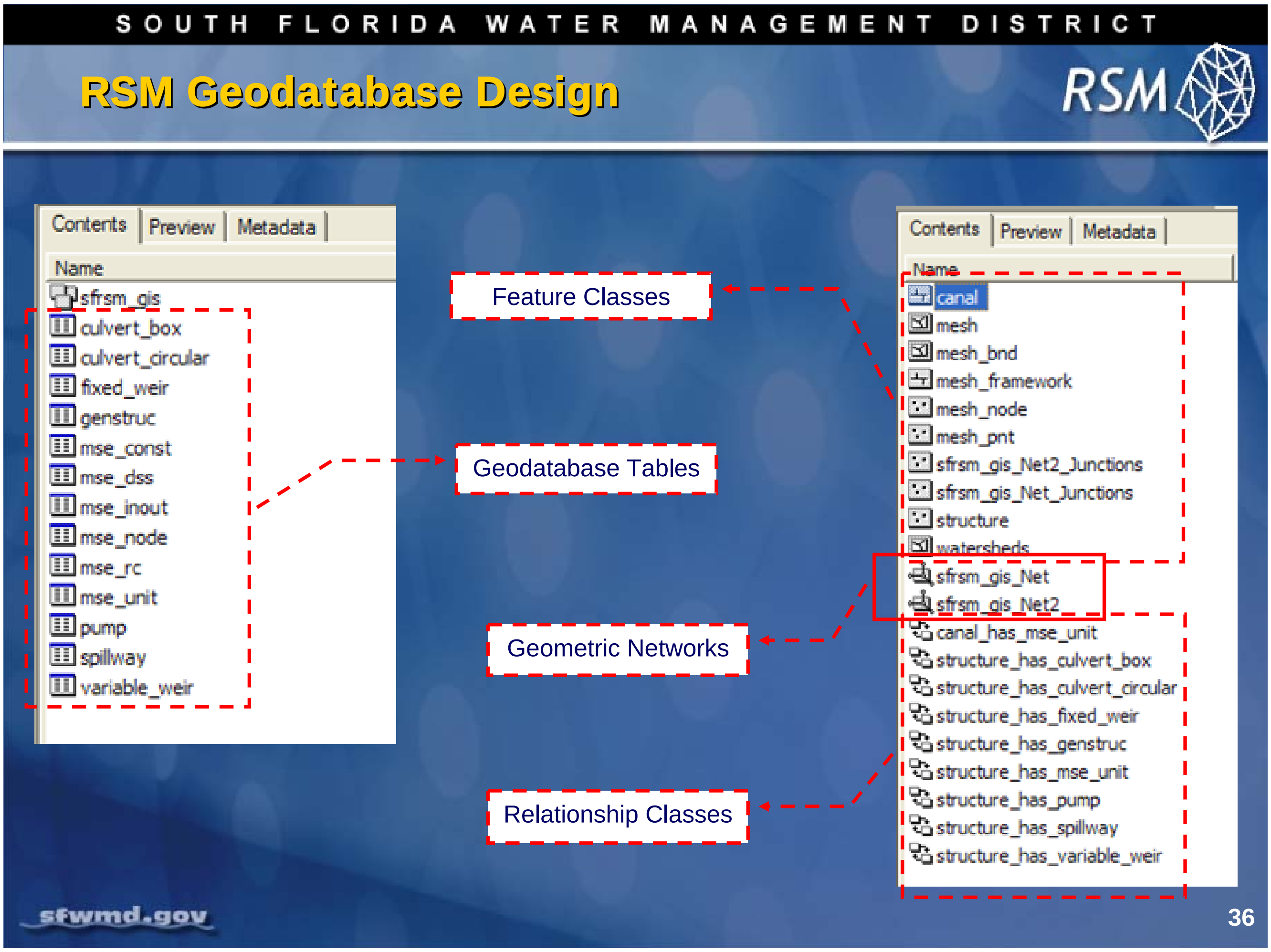


The South Florida Water Management District selected the ESRI database as the agency's standard for the geodatabase.

Each application has a personal geodatabase that can be used with the RSM GIS ToolBar preprocessor to develop the RSM input datasets.

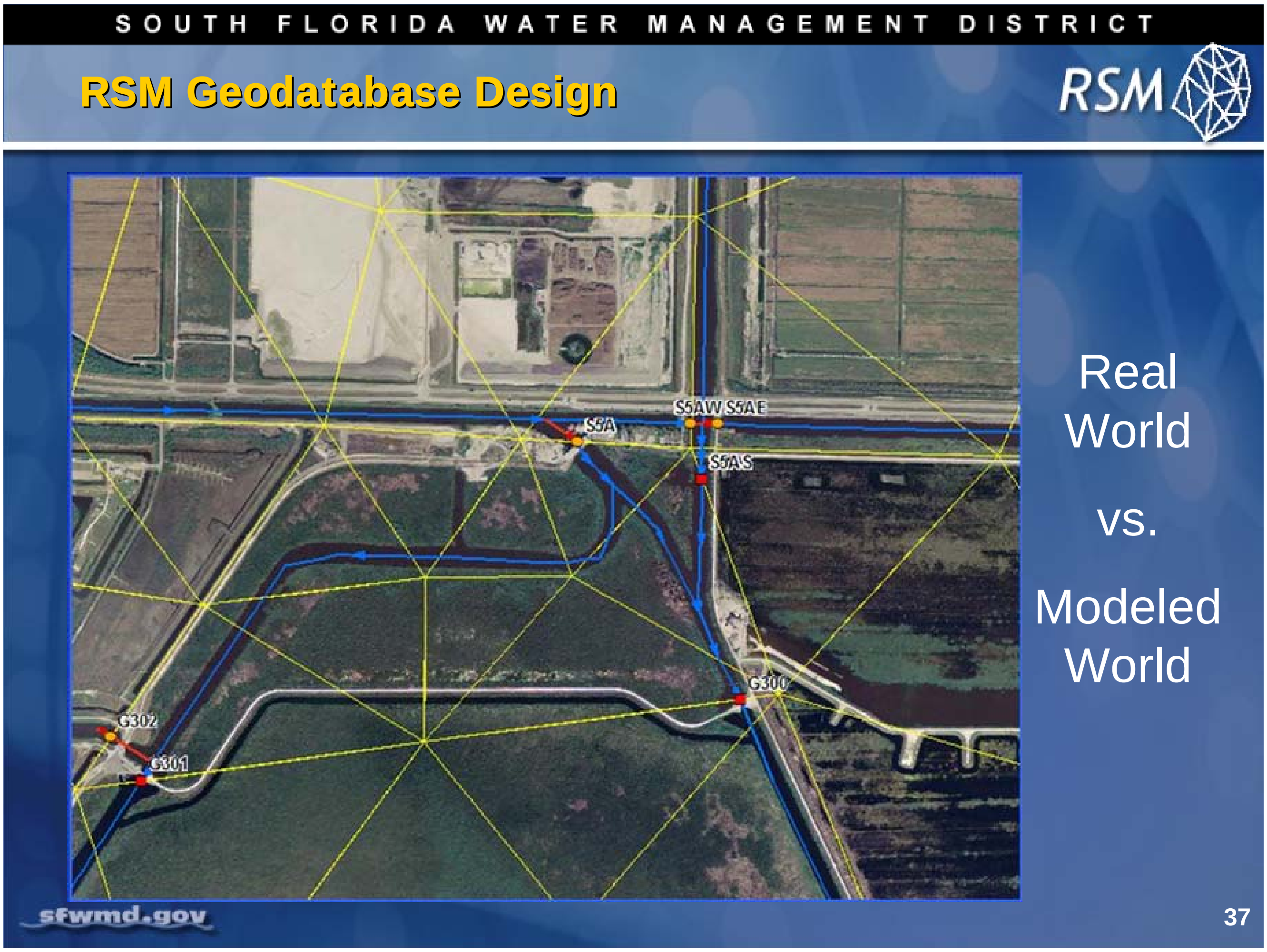


The project-specific geodatabase encapsulates the spatial and attribute data used in the model run and becomes a useful archive.

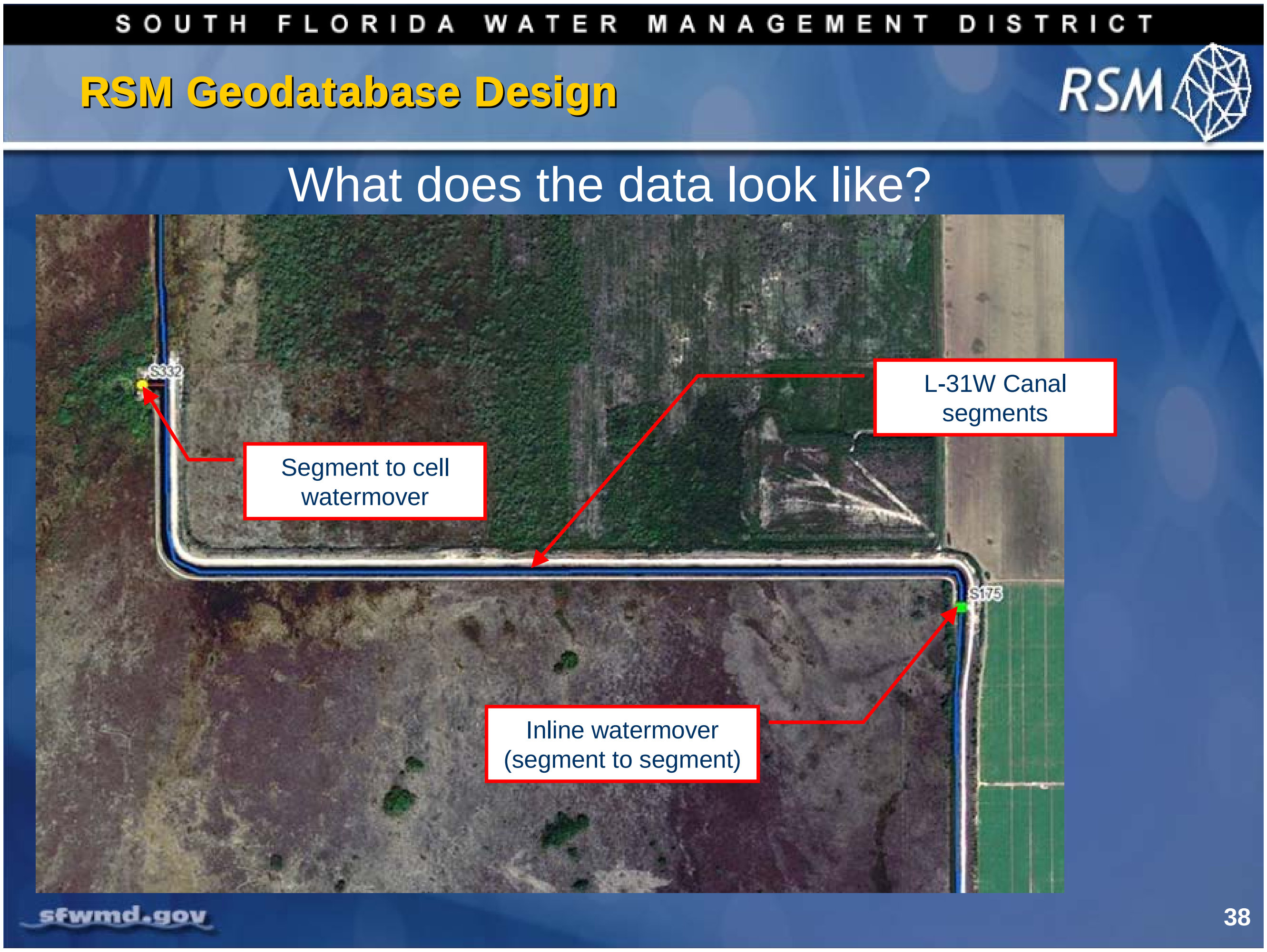


The RSM Personal Geodatabase contains:

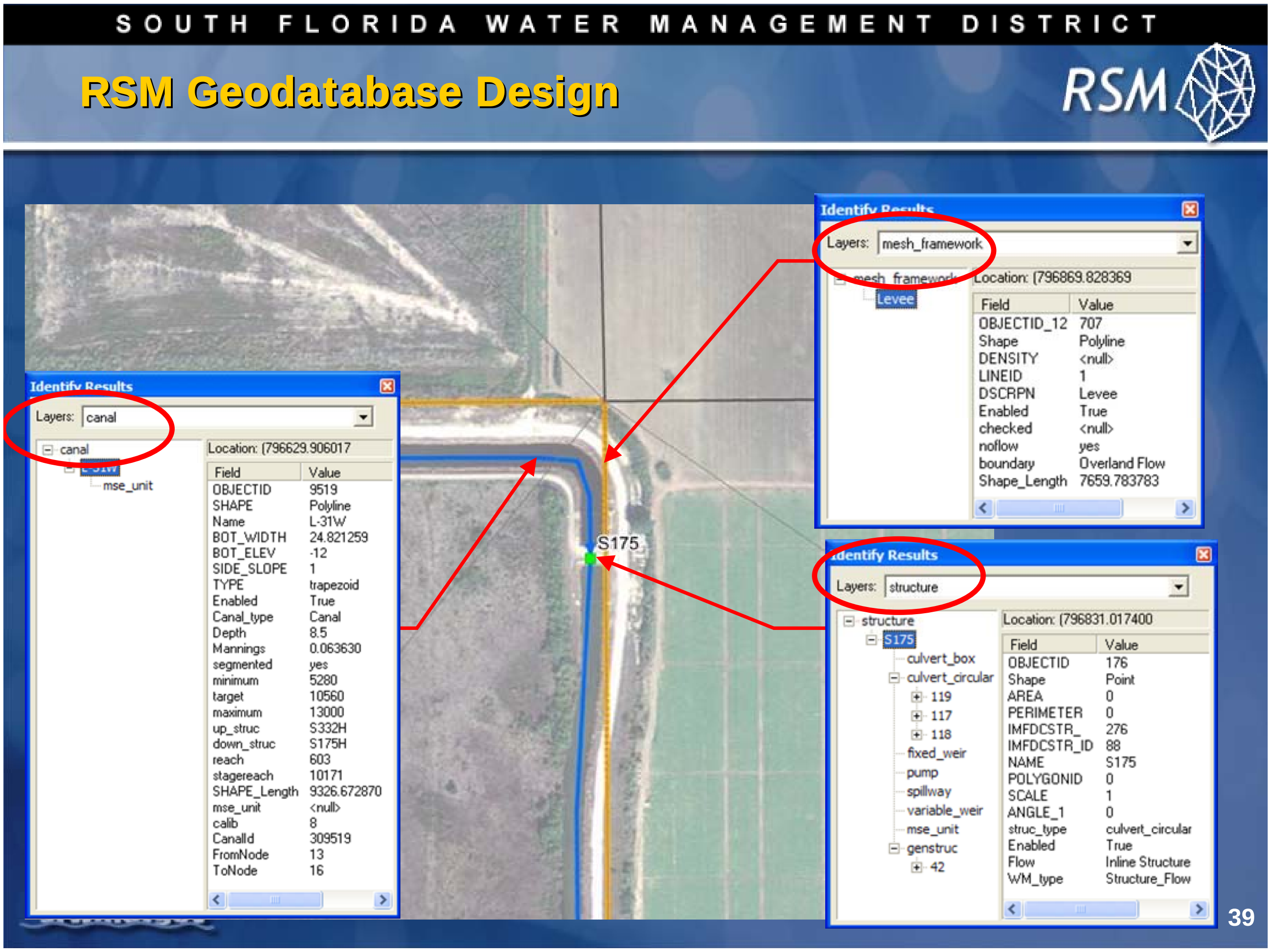
- **Feature classes**: The canals, mesh and structures
- **Geodatabase tables**: The attribute tables for each feature class
- **Relationship classes**: The storage of the relationships between the different features (e.g., a canal has a structure and the structure has culverts)
- **Geometric networks**: Maintain the geometry of the canal networks
- **Subtypes**: Groupings of similar objects (e.g., pumps, weirs, wells, cells)
- **Domains**: Overall grouping of the feature classes into one geographic area



The real world has a complex distribution of canals and structures. The modeled world captures the canals, structures and landscape features and maintains the correct juxtaposition and connectivity among the features.



This slide features an aerial photograph of an area within the C-111 RSM model domain. In this example, the L-31W canal boundary is adjacent to a levee and includes two structures: an in-line structure (S175) and a diversion structure (S332).

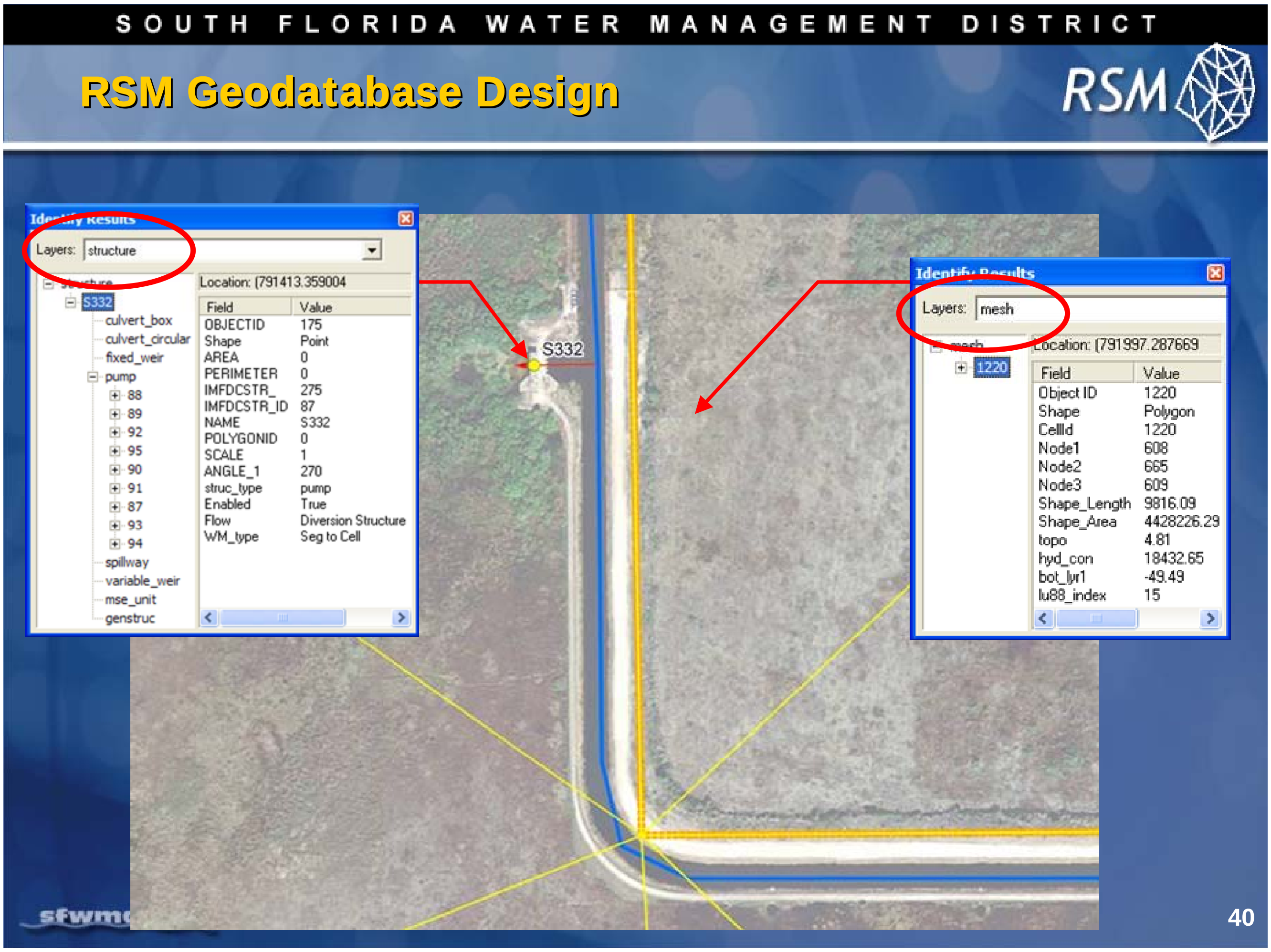


This slide shows data maintained in the geodatabase for the levee (mesh_framework), canal and structure.

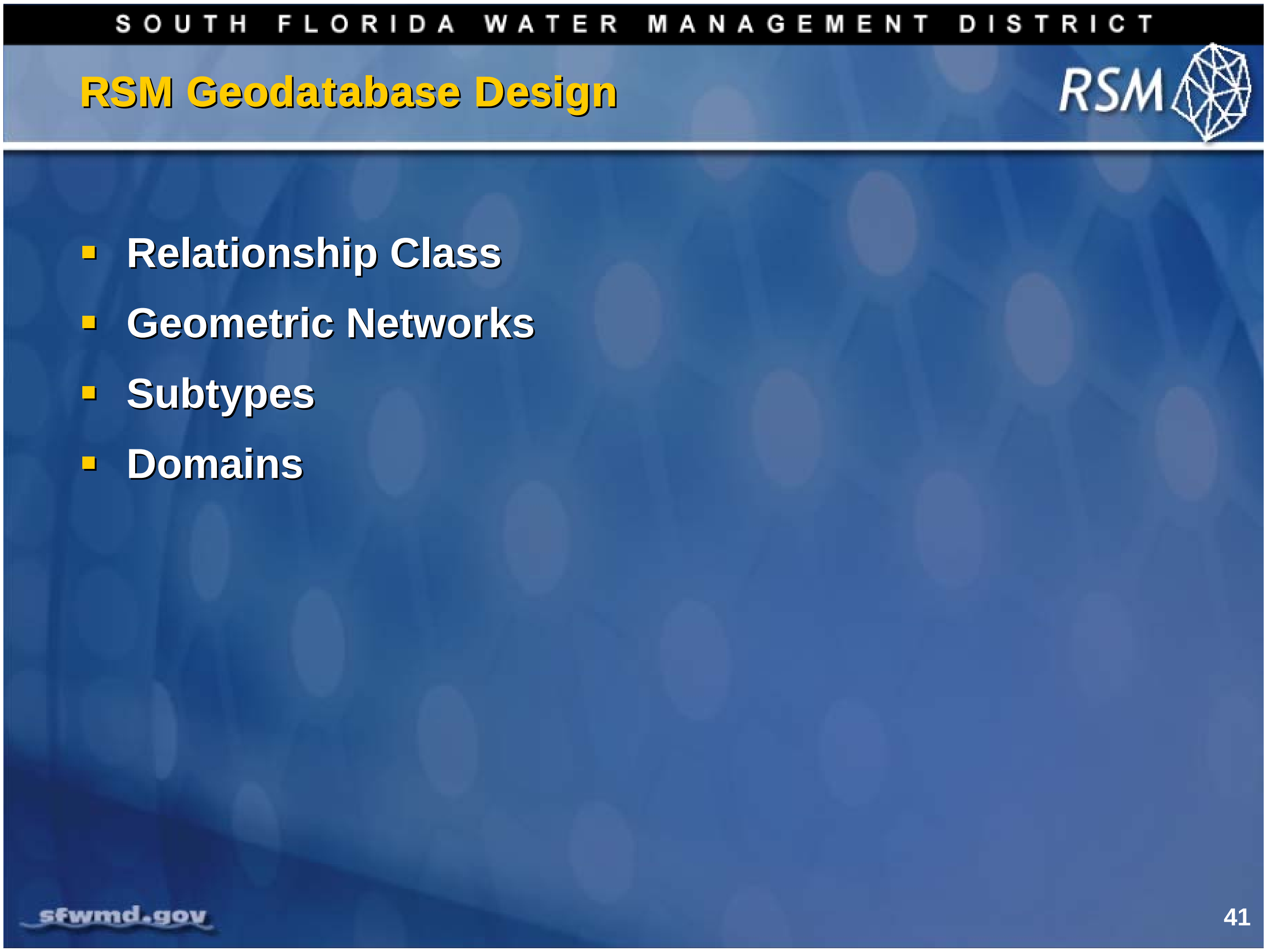
Levee attributes include whether it is enabled and type of boundary.

Canal attributes include properties, names, upstream/downstream structures, IDs and connectivity.

Structure attributes include type, name and other properties. Structure attributes include the fields for all of the various types of structures, but only attributes relevant for each structure are populated.

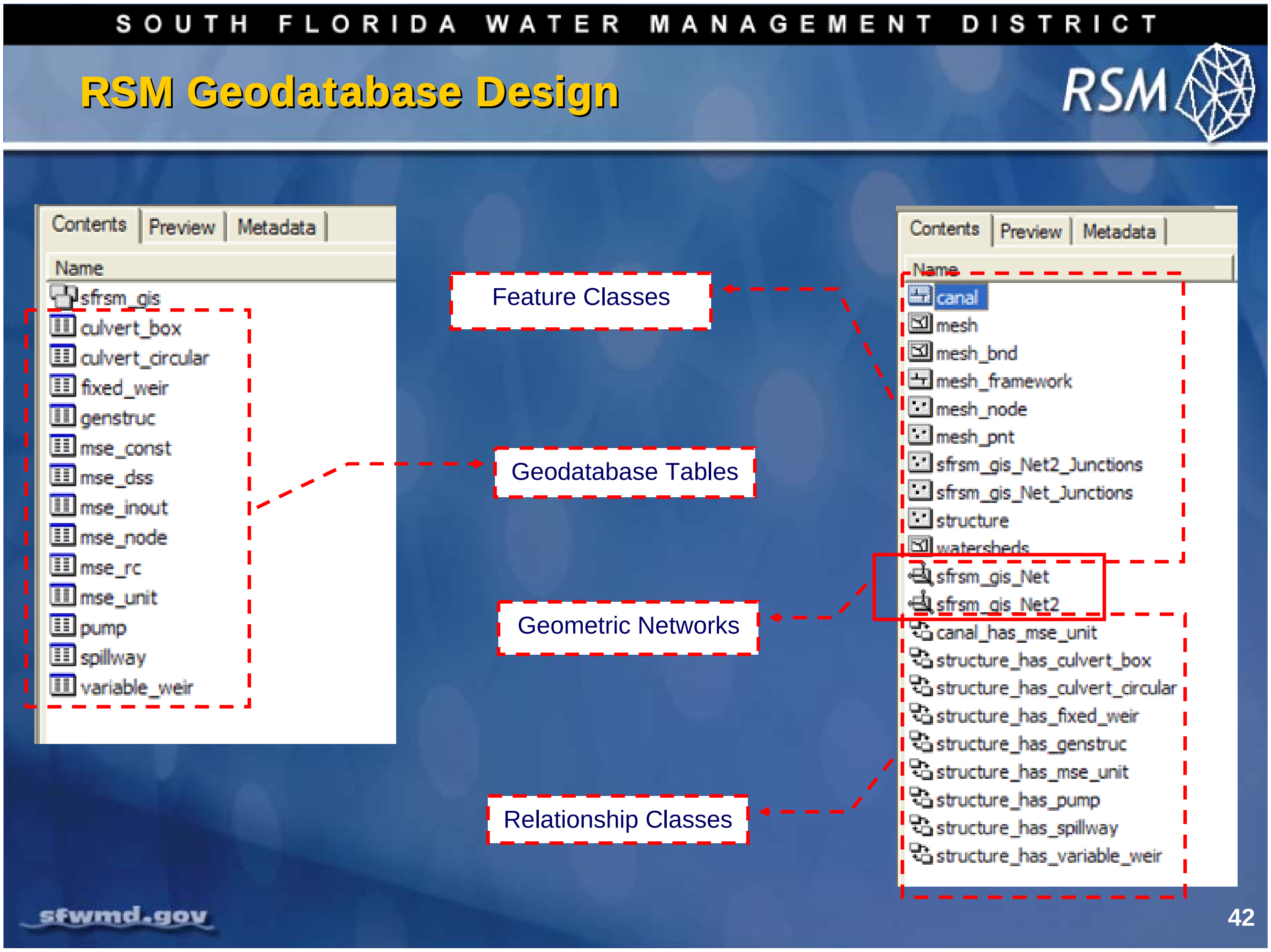


The geodatabase contains the mesh attributes (ID, connectivity and properties). Where a location has a structure with multiple components, such as more than one culvert, each component's individual properties can be modeled separately.

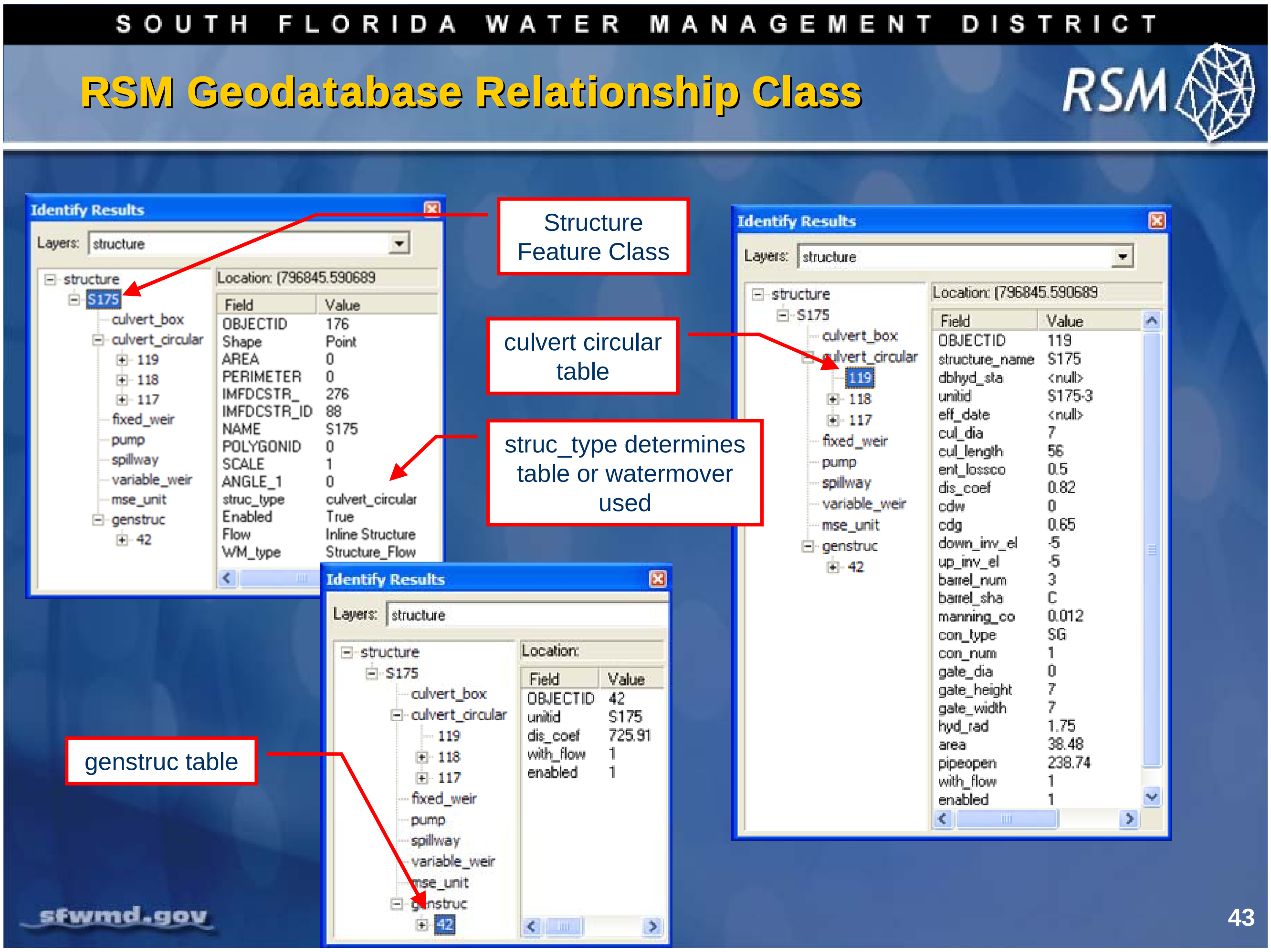


The RSM geodatabase design includes components that provide for data maintenance and connectivity.

- Relationship classes link the appropriate feature classes
- Geometric networks maintain the appropriate connectivity
- Subtypes maintain certain attributes
- Domains define the allowable input values

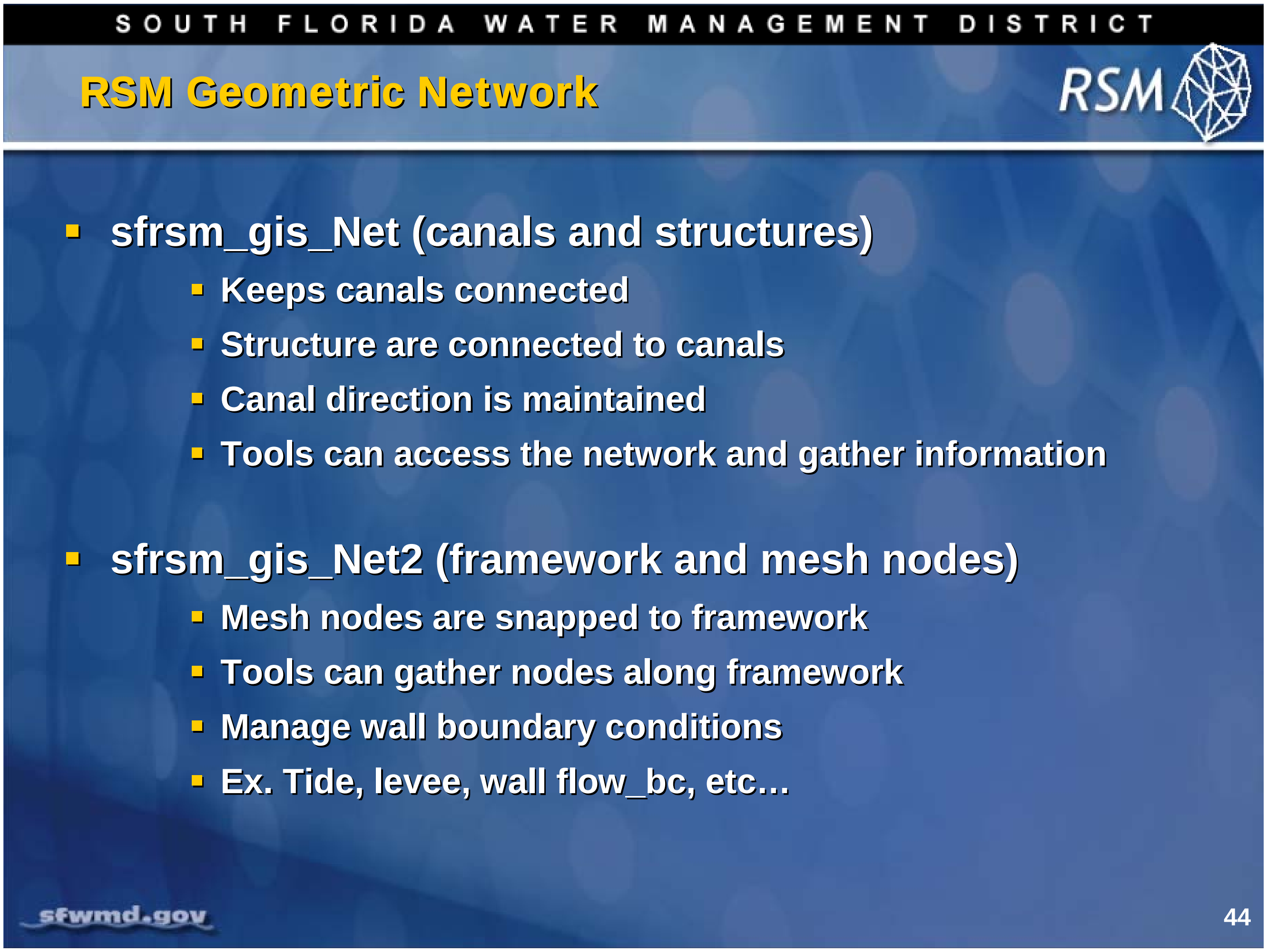


Components of the RSM geodatabase, accessible through ArcCatalog, are shown above.



The Relationship Class component provides for decentralized data. The table can be edited independent of data. There are different types of relationships:

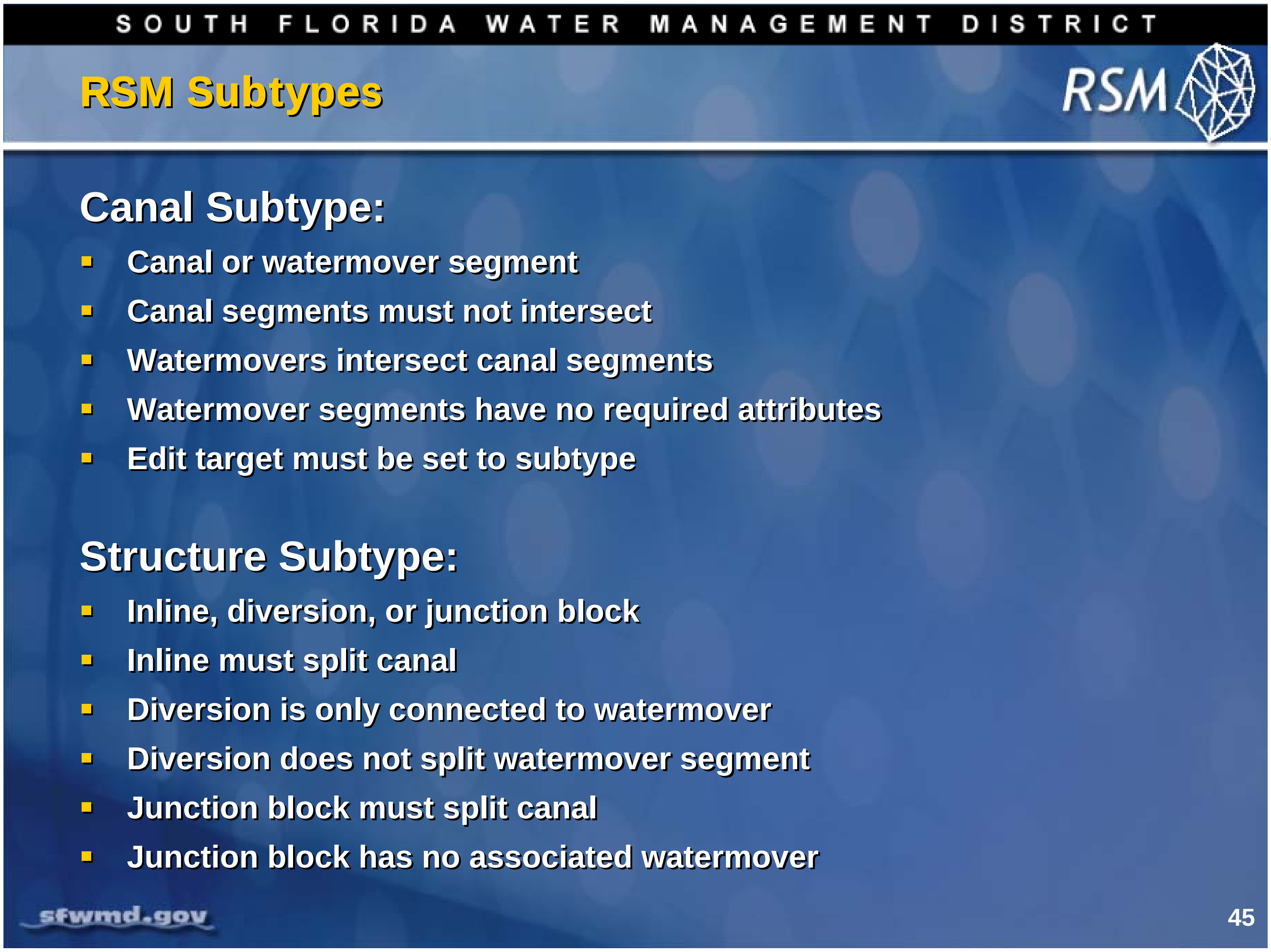
- One-to-one (structure has genstruc)
- One-to-many (structure has culvert_circular)
- Many-to-one (canal has mse_unit)



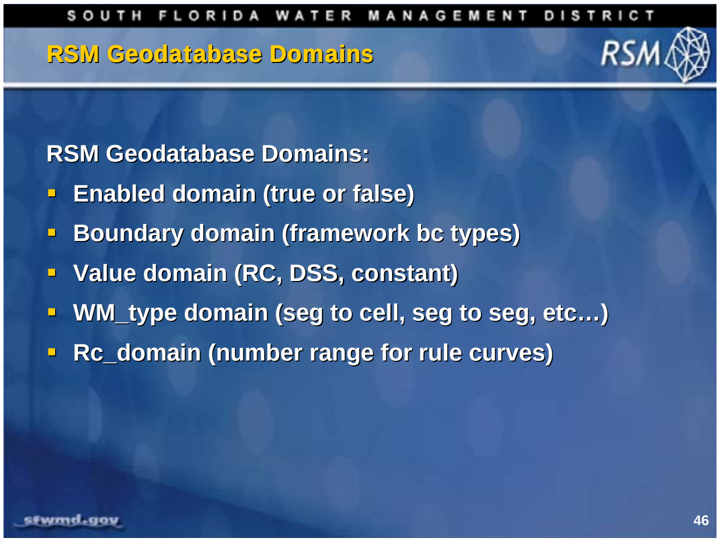
There are two networks maintained in the geodatabase, one for the canals and one for the mesh nodes. These networks allow you to use the GIS tools to produce input datasets (XML files) and post-process the RSM output efficiently.

The networks also enable you to manage spatial relationships between points and lines, maintain connectivity rules, and snap points to lines, when editing.

The canal network allows us to maintain the appropriate flow direction by using the “as digitized” direction to represent the direction of flow in the canal.

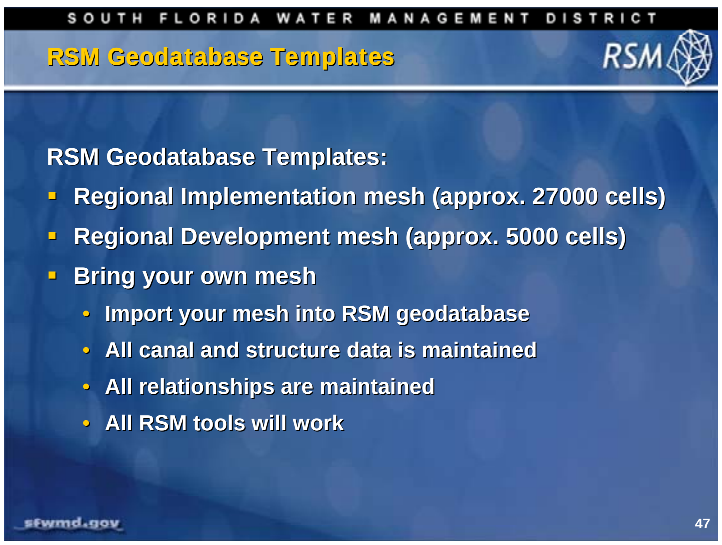


Subtypes are used for canals and structures. Subtypes are useful for Symbology creating maps showing the unique components of the model. Additonally, they maintain certain rules for network connectivity. The subtypes provide a basic framework for editing and data validation.



Domains are used in the RSM geodatabase to:

- Avoid data input errors
- Maintain available attribute values
- Establish ranges for input variables



All of the necessary spatial and attribute components for an RSM implementation have been combined into an RSM geodatabase template.

When a new mesh is created for a subregional RSM implementation, it can be imported into the geodatabase template and the subregional geodatabase will have all of the available data and necessary relationships. (The relationships provide a fixed framework for adding the required attribute data.)

The RSM GIS ToolBar utilities work with the standard geodatabase to extract the spatial and attribute information and create input data files for the Regional Simulation Model.

Knowledge Assessment

(pre- and post-lecture quiz to assess efficacy of training materials)

1. What are the possible methods for creating a mesh for RSM?
2. What is the format of the mesh file used by RSM?
3. What are the input requirements to create a mesh in GMS?
4. How do we use GMS for RSM?
5. What information is contained in the ArcCatalog RSM geodatabase?
6. What is the difference in the mesh and network creation within RSM?
7. What is contained in the geodatabase network?
8. What are four advantages to maintaining the RSM Geodatabase?
9. Why is the RSM personal Geodatabase critical?
10. What does the enabling feature allow?

Answers

1. There are several methods for creating an RSM mesh: create by hand (small meshes), USACE GMS mesh generator, import a mesh.

2. The accepted mesh format is an ASCII file following the GMS SEEP2D format.

3. GMS requires a framework shape file that contains the linework for constraining the mesh and the required density of vertices for each framework line.

4. GMS provides a tool for checking modified meshes and meshes built using other methods.

5. The RSM geodatabase contains feature classes, canal network, relationships and topology classes.

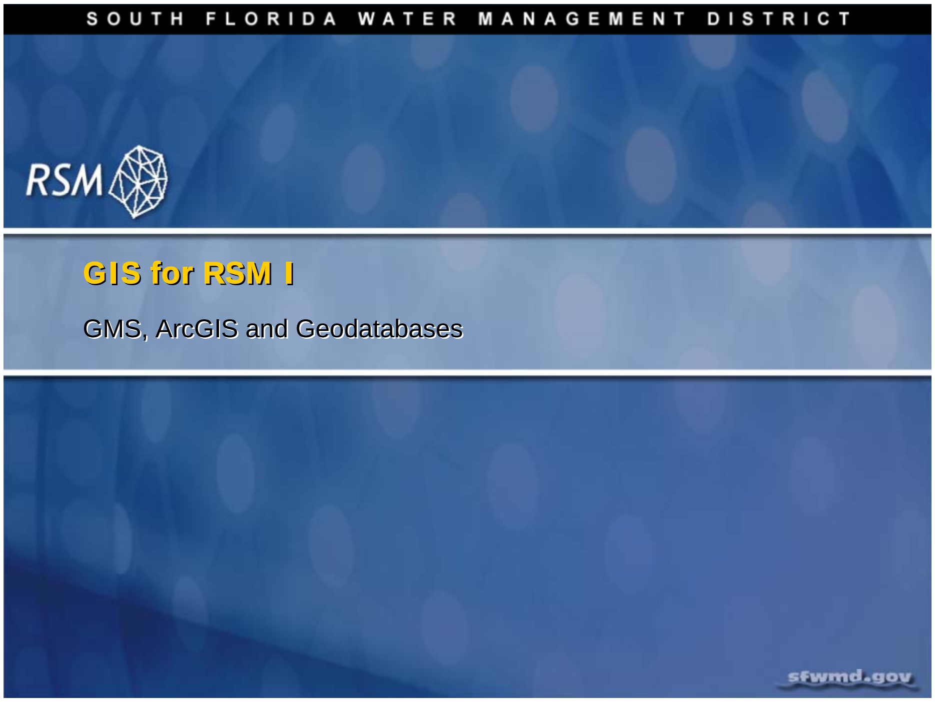
6. Alternative meshes can be created for RSM but the canal network for south Florida is part of the RSM geodatabase and is selected when the user-defined mesh is intersected with the RSM template geodatabase.

7. The RSM geodatabase network contains the canal and water control structure topology and attributes.

8. There are several advantages for maintaining the RSM geodatabase including:
   - Common data format,
   - Documentation of model input data sets,
   - Automated input data creation,
   - Minimize input data errors,
   - Easy distribution of data,
   - Enable/disable features,
   - Data is connected to RSMGUI pre-processing tools

9. The geodatabase is critical for maintaining the exact location of the levees, canals and structures because they are located near each other and the RSM uses the exact locations for determining cell and segment connectivity.

10. The enabling feature allows the user to disable any canal or structure feature in an RSM implementation without deleting the feature from the geodatabase. This provides considerable flexibility in building alternative project models.



Lab 5: Editing RSM Features

Time Estimate: 2 hours

Training Objective: Gain familiarity with ArcGIS personal geodatabases

This lab is designed to provide you with an opportunity to investigate the Regional Simulation Model (RSM) geodatabase.

The information necessary to create the parameters for RSM XML input files is obtained from the geographic data. Diagnosing problems with an RSM implementation frequently requires observing the spatial distribution of model features. Therefore, you must be able to navigate among the feature classes and attribute tables used to construct the input files.

This lab requires a general ability to understand and run ArcGIS.

NOTE:

For ease of navigation, you may wish to set an environment variable to the directory where you install the RSM code using the syntax

```
setenv RSM <path>
```

For SFWMD modelers, the path you should use for the NAS is:

```
/nw/oomdata_ws/nw/oom/sfrsm/workdirs/<username>/trunk

setenv RSM
/nw/oomdata_ws/nw/oom/sfrsm/workdirs/<username>/trunk
```

Once you have set the RSM environment variable to your trunk path, you can use $RSM in any path statement, such as:

```
cd $RSM/benchmarks
```

Training files are currently located in the following directories:

```
INTERNAL_TRAINING
|
|____sfrsm_geodata
|____data
|        |__geographic
|        |__C111
|        |__rain+et
|        |__glades_lecsa
|        |__losa_eaa
|        |__BBCW
|
|____trunk
|        |___benchmarks
|        |___hpmbud
|
|____labs
```

Files for this lab are located in the **labs/lab5** directory. Additional materials in the directory include:

lab5.wmv

RSMLU.doc

supercodes_4-digit_1988_1999_SFWMM.xls

Activity 5.1: Investigate the Regional Simulation Model

Overview

Activity 5.1 includes two exercises:

- **Exercise 5.1.1** Explore a geodatabase
- **Exercise 5.1.2** Explore geospatial data sources

You will examine some of the key features of the C111 geodatabase and the geospatial datasets used to support it.

Exercise 5.1.1 Explore a geodatabase

1. Open ArcMap. Add canal; mesh; mesh_framework; structure; and watersheds feature classes from the C111 geodatabase (**`$RSM/../labs/lab5/c111.mdb`**).

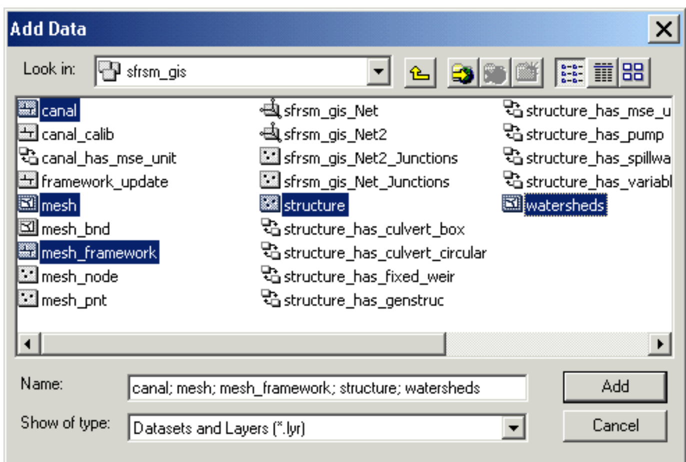


Figure 5.1 ArcMap Add Data Dialog box

2. Save as C111 map file.
3. Zoom to extent of C111 mesh.
4. Define the layers in the ArcMap project that went into the creation of the framework.
   - Select the **`Symbology`** tab, then select **`Categories`** and **`Unique Values`** in the **`Show`** box.
   - Double click on **`mesh_framework`** feature class
   - Select **`DSCRPN`** in Value Field
   - Select “Add All Values,” click “Apply” then “OK”
   - Turn **`on`** the layers
   - Compare the mesh to the framework lines

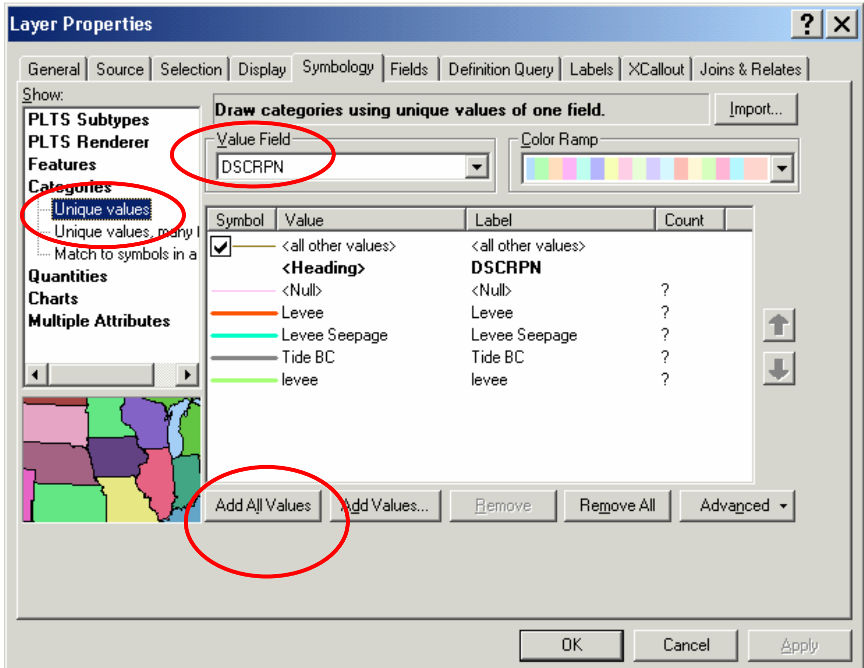


Figure 5.2 Selection of mesh_framework attributes

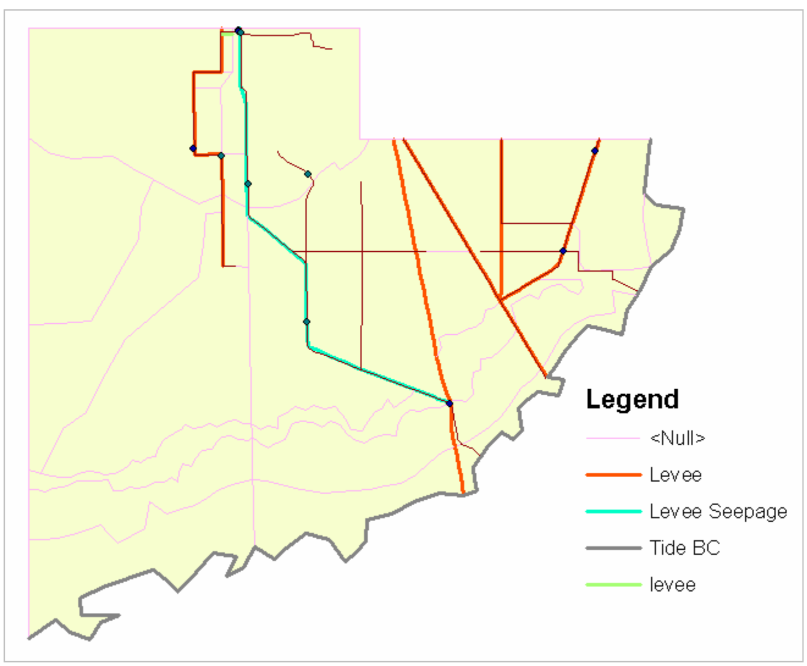


Figure 5.3 Physical features used to constrain the mesh

5. Show that the mesh is also constrained by the landuse types.
   - Double-click to select the **`mesh`** feature class. Make sure the **`Symbology`** button is selected.
   - Click on **`Categories`** then in **`Layer Properties`** select **`LU2000_index`** in **`Value`** Field
   - Turn **`on`** the layers
   - Compare the mesh to the framework lines (see **Fig 5.4**)

The mesh does not conform exactly to the landuse distribution, but follows the general configuration.

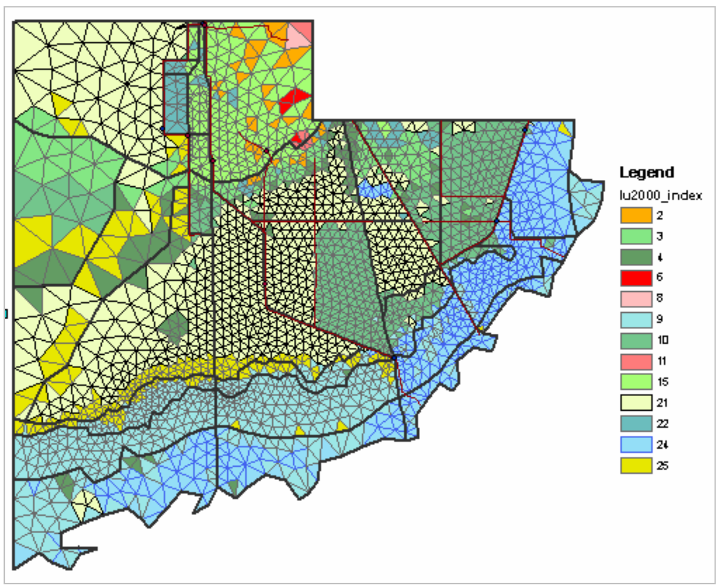


Figure 5.4 Mesh_framework components related to 2000-base landuse type

6. Identify structure properties of S18C from the C111 project.
   - Select and display the mesh, canals and structures

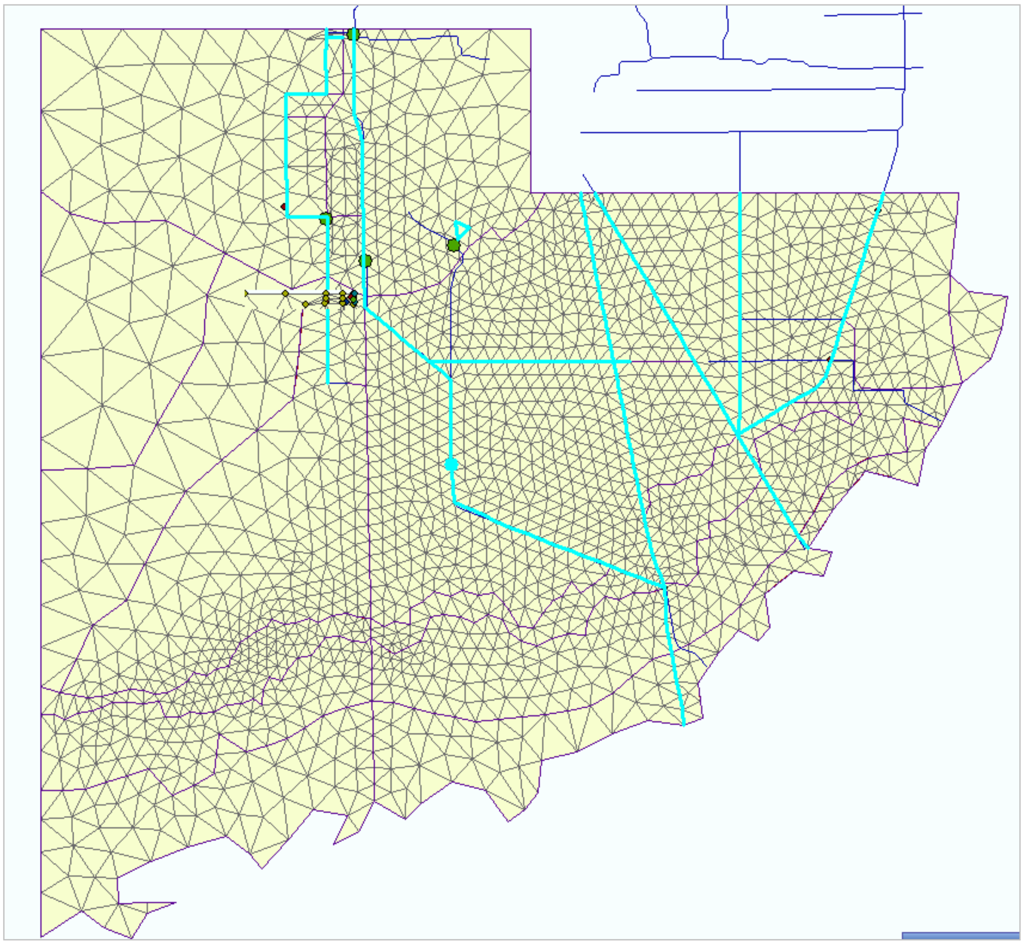


Figure 5.5. Mesh, canals and structures for the C111 project.

7. From the ArcMap drop-down menu, choose the Selection Menu and click Select by Attribute.
   - Type **`[NAME] = "S18C"`** in the bottom text box.

Alternatively, you can Double-click on **`[NAME],`** click on "**=**", and type "**S18C**" in the text box. Click **`Apply`**, and then **OK**. S-18C will be highlighted.

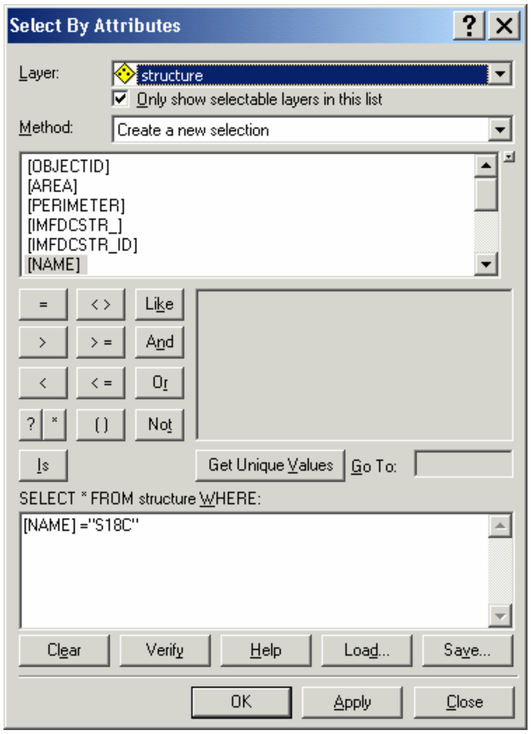
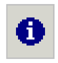


Figure 5.6 Select By Attributes Dialog box

8. Use the ArcMap Identify tool  and select **S18C**.

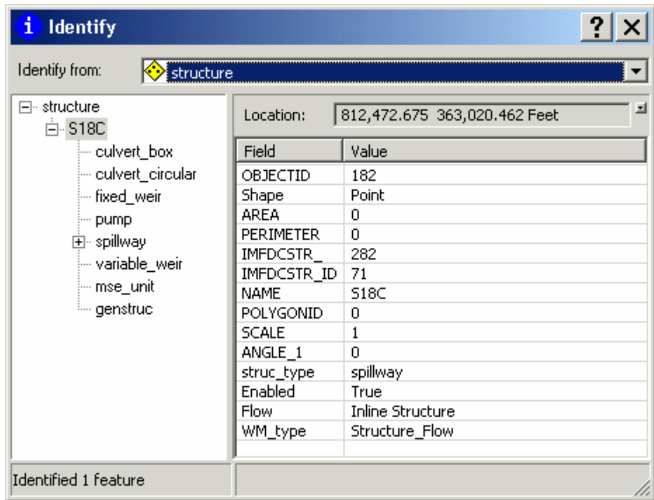
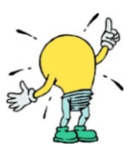


Figure 5.7 ArcMap Identify Menu

- What is the **struc_type**, **Flow**, and **WM_type** indicated for S18C in the geodatabase?
- Is structure S18C enabled?
- Open the related table named **has_spillway**. What is this structure's discharge coefficient (**dis_coef**)?



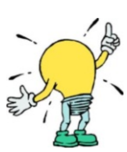
HINT Select 

on the left side of the window and click 

.

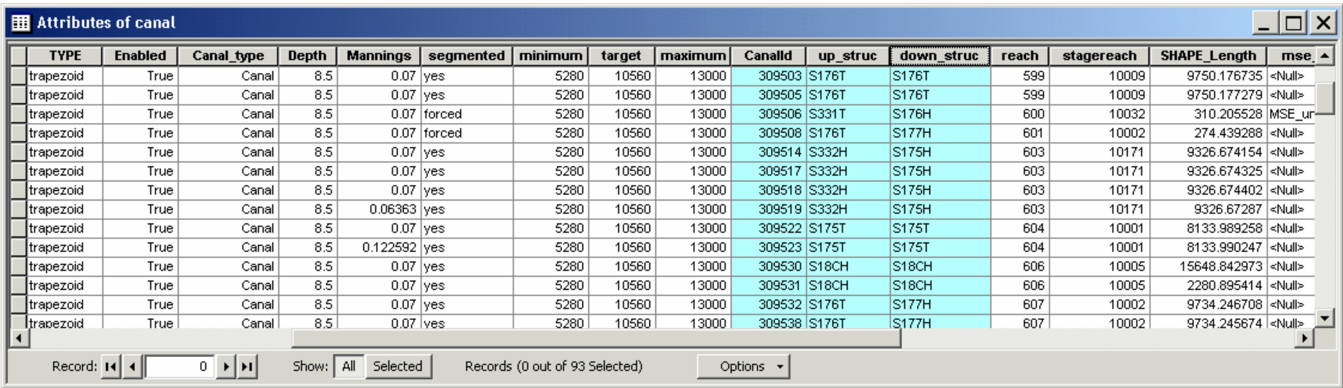
9. Examine the Attributes table for canal. Click on Selection, Select by Attributes. Change layer to "**Canal**." Double-click on **Canal Type**. Click on "**=**" and type "**1**". Click on **Apply** and **OK**. Repeat selection for Enabled.

- How many canal segments are being modeled in the C111 model?



HINT Watermover segments and disabled canals are not used by the model. Select By Attribute using [Canal_type] = 1 and [Enabled] = 1

10. Find the upstream structure (**`up_struc`**) and downstream structures (**`down_struc`**) on canal segment **`309514`**. Search the Attributes table for canal for the appropriate canal segment.



Attributes of canal

TYPE	Enabled	Canal_type	Depth	Mannings	segmented	minimum	target	maximum	CanalId	up_struc	down_struc	reach	stagereach	SHAPE_Length	mse_
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309503	S176T	S176T	599	10009	9750.176735	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309505	S176T	S176T	599	10009	9750.177279	<Null>
trapezoid	True	Canal	8.5	0.07	forced	5280	10560	13000	309506	S331T	S176H	600	10032	310.205528	MSE_ur
trapezoid	True	Canal	8.5	0.07	forced	5280	10560	13000	309508	S176T	S177H	601	10002	274.439288	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309514	S332H	S175H	603	10171	9326.674154	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309517	S332H	S175H	603	10171	9326.674325	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309518	S332H	S175H	603	10171	9326.674402	<Null>
trapezoid	True	Canal	8.5	0.06363	yes	5280	10560	13000	309519	S332H	S175H	603	10171	9326.67287	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309522	S175T	S175T	604	10001	8133.989258	<Null>
trapezoid	True	Canal	8.5	0.122592	yes	5280	10560	13000	309523	S175T	S175T	604	10001	8133.990247	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309530	S18CH	S18CH	606	10005	15648.842973	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309531	S18CH	S18CH	606	10005	2280.895414	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309532	S176T	S177H	607	10002	9734.246708	<Null>
trapezoid	True	Canal	8.5	0.07	yes	5280	10560	13000	309538	S176T	S177H	607	10002	9734.245674	<Null>

Record: 0 Show: All Selected Records (0 out of 93 Selected) Options

Figure 5.8 Attributes table for canal

11. Examine the **`mesh_framework`** attribute table.
   - Of the 217 framework lines, how many are assigned as levees?
   - Open **`Select By Attributes`** Dialog box
   - Select **`[boundary]`**
   - Select **`Get Unique Values`**
   - Look at the boundary attribute: **`[boundary] = 'ol' OR [boundary] = 'ol/gw'`**

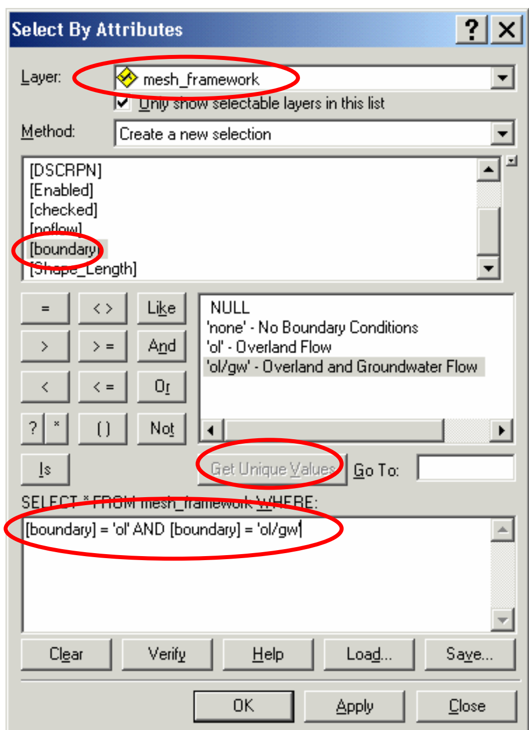


Figure 5.9 Building a query to select levees in the mesh_framework

12. Examine the **`Attributes`** table of the mesh file.

- What is the **`Cellid`**, **`area`** and **`topo`** of the smallest cell in the C111 model?

HINT Sort the table using the `Shape_Area` attribute

- What structure is closest to cell **`2022`**?

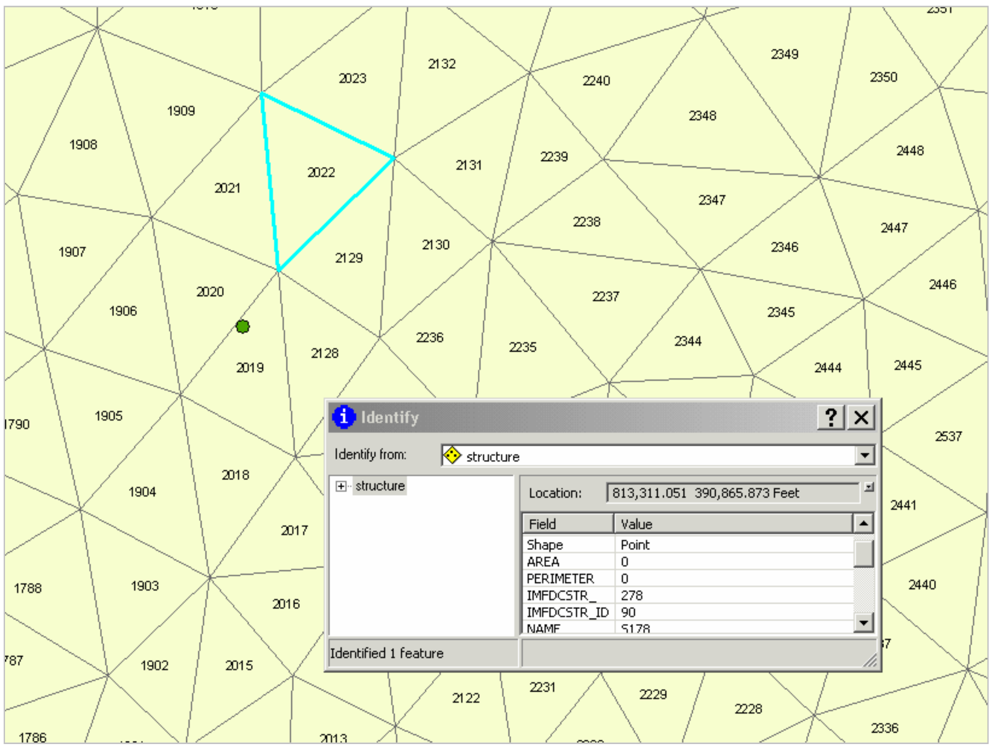


Figure 5.10 Mesh cell 2022 and a nearby structure

Exercise 5.1.2 Explore geospatial data sources

The South Florida Water Management District has developed several geospatial datasets to support the Regional Simulation Model. These data are used to provide necessary attributes for RSM implementations. It is important to explore these datasets to understand their content.

13. Open ArcMap
14. Open the SFRSM geodatabase:

    `$RSM/../sfrsm_geodata/sfrsm_geodata.mxd`

15. Save the map in the **`labs/lab5`** directory.
16. Add the Public Water Supply wells (PWS) to the map.

    `$RSM/../data/geographic/pws/pws_CalibVerif_v2`

17. Add topographic data to the map:

    `$RSM/../data/geographic/topography/rsm_topo_v2`

18. Add 1995 and 1988 land use/land cover data to the map:

    `$RSM/../data/geographic/landuse/lu95c`
    `$RSM/../data/geographic/landuse/RSM_Landuse.mdb/lu1988_v1`

    The values for the SFWMM landuse codes are available in a crosswalk table (**`supercodes_4-digit_1988_1999_SFWMM.xls`**). The conversion table for the landuse codes used in the RSM are provided in **`RSMLU.doc`**. Both files are available in the **`labs/lab5 directory`**.

19. Add hydraulic conductivity data to the map:

    `$RSM/../data/geographic/geology/hyd_con_v2`

    - What is the range in values?
    - Modify the **`hydraulic conductivity`** dataset to provide additional visual information.
    - Highlight the **`hyd_con_v2`** feature class and double click.
    - From the **`Symbology`** tab, select **`Classified`**.

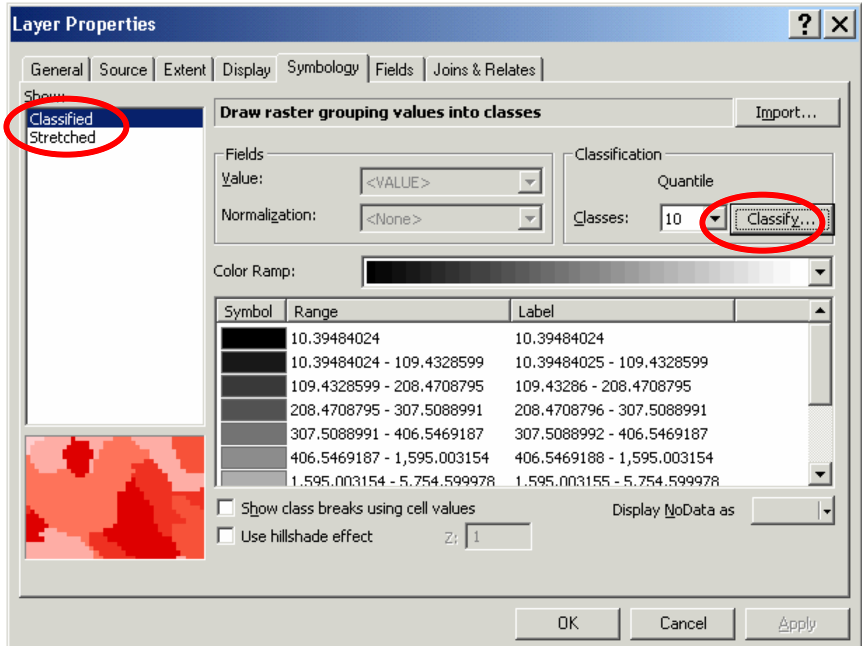


Figure 5.11 **`Layer Properties`** Dialog box

- From the **`Classification`** window, select **`Method=Quantile`** and **`Classes=10.`** This will provide reasonable display of the values.

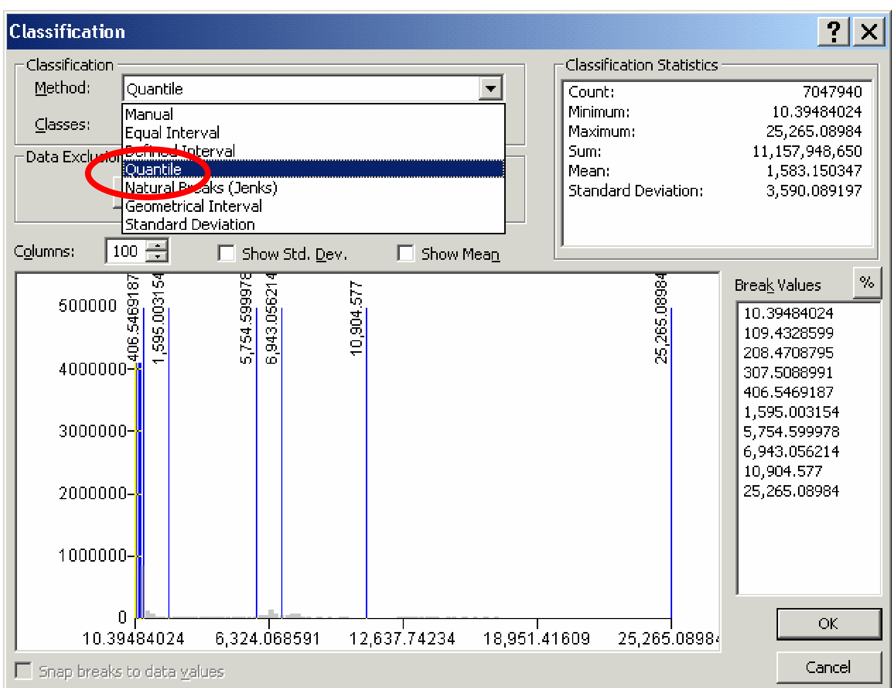


Figure 5.12 Classification options

20. Select the **`identify`** tool button and select a value in the EAA-Miami Canal basin. The value should be ~26

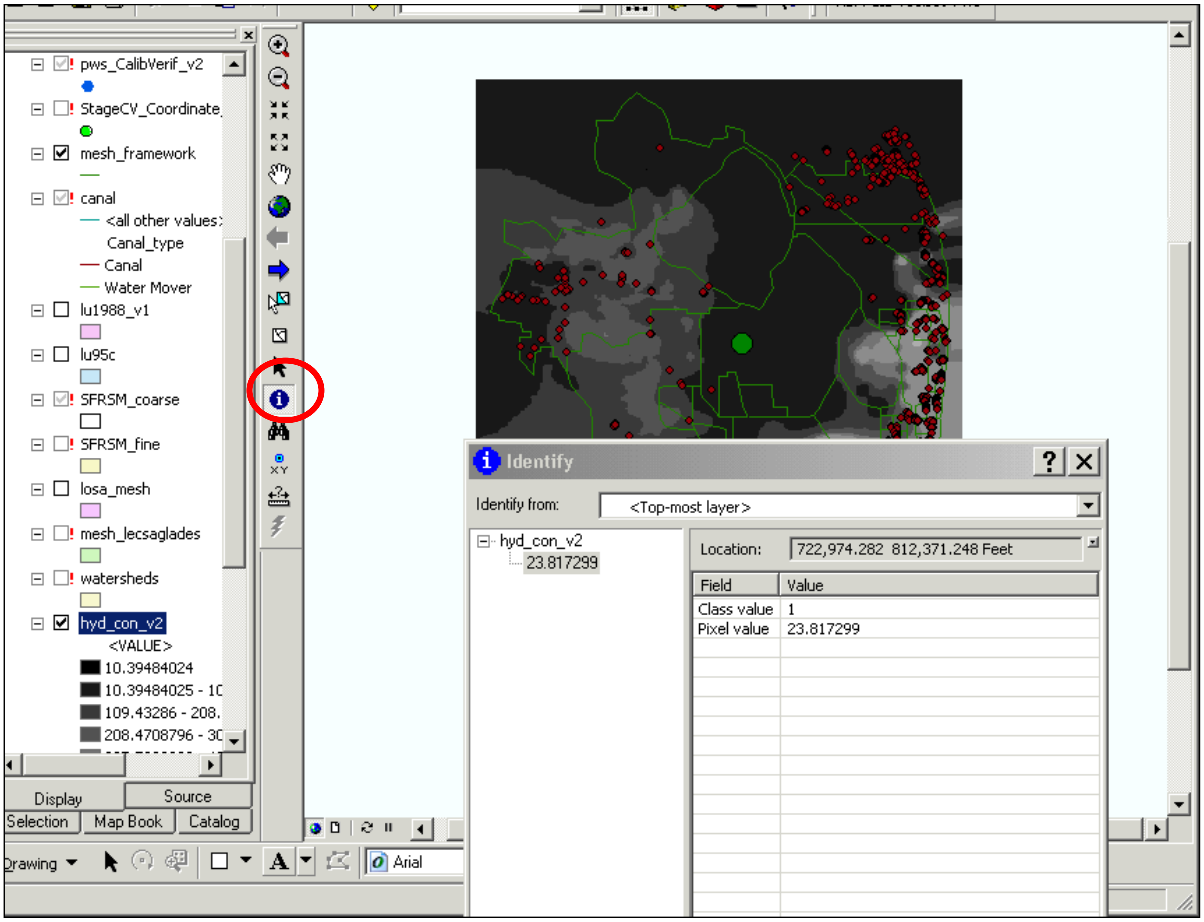


Figure 5.13 Identify tool

21. Add the aquifer bottom elevation data to the map:

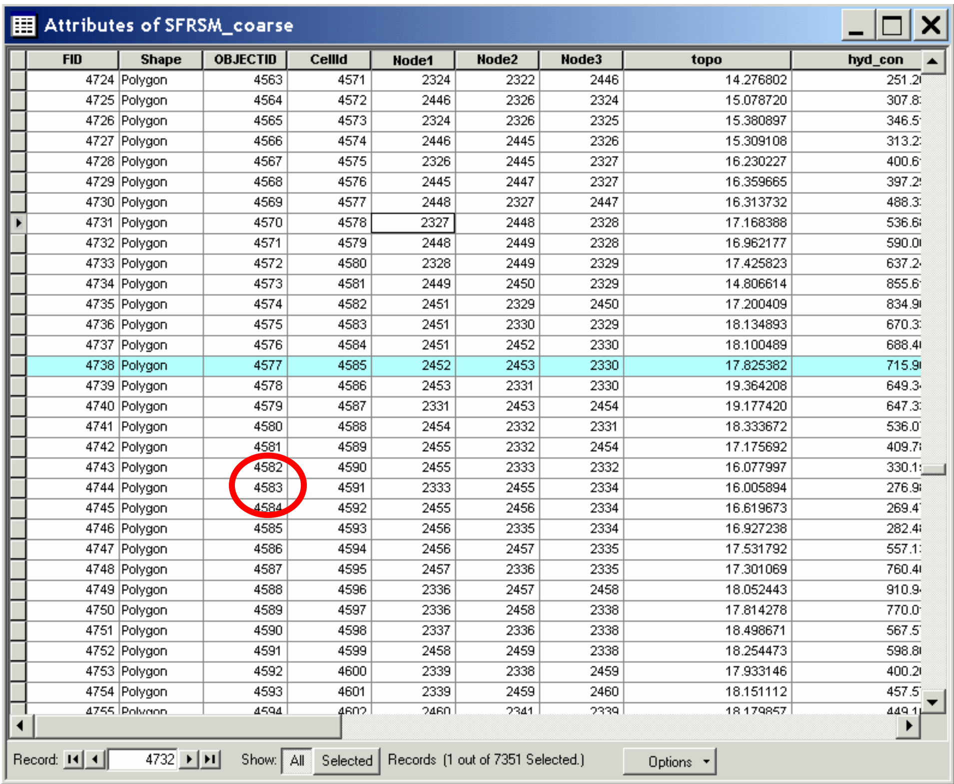
    `$RSM/../data/geographic/geology/base_wt_v1`

22. Add coarse and fine SFRSM meshes to the map.

    These meshes contain the **`geology`**, **`landuse`** and **`topographic`** attributes. The coarse mesh has 7351 cells and contains 1988 landuse data (LU88) and other mesh attributes. The fine mesh has 27604 cells and contains both 1988 and 1995 landuse data (LU88 and LU95).

    `$RSM/../data/geographic/meshes/SFRSM_coarse`
    `$RSM/../data/geographic/meshes/SFRSM_fine`

23. Select **SFRSM_coarse mesh**.
24. Right-click **SFRSM_coarse** , then select **Open Attribute File**.
    - How many cells are in the coarse mesh?
25. Goto **Cellid = 4583**.
    - Highlight the row.



FID	Shape	OBJECTID	CellId	Node1	Node2	Node3	topo	hyd_con
4724	Polygon	4563	4571	2324	2322	2446	14.276802	251.2
4725	Polygon	4564	4572	2446	2326	2324	15.078720	307.8
4726	Polygon	4565	4573	2324	2326	2325	15.380897	346.5
4727	Polygon	4566	4574	2446	2445	2326	15.309108	313.2
4728	Polygon	4567	4575	2326	2445	2327	16.230227	400.6
4729	Polygon	4568	4576	2445	2447	2327	16.359665	397.2
4730	Polygon	4569	4577	2448	2327	2447	16.313732	488.3
4731	Polygon	4570	4578	2327	2448	2328	17.168388	536.6
4732	Polygon	4571	4579	2448	2449	2328	16.962177	590.0
4733	Polygon	4572	4580	2328	2449	2329	17.425823	637.2
4734	Polygon	4573	4581	2449	2450	2329	14.806614	855.6
4735	Polygon	4574	4582	2451	2329	2450	17.200409	834.9
4736	Polygon	4575	4583	2451	2330	2329	18.134893	670.3
4737	Polygon	4576	4584	2451	2452	2330	18.100489	688.4
4738	Polygon	4577	4585	2452	2453	2330	17.825382	715.9
4739	Polygon	4578	4586	2453	2331	2330	19.364208	649.3
4740	Polygon	4579	4587	2331	2453	2454	19.177420	647.3
4741	Polygon	4580	4588	2454	2332	2331	18.333672	536.0
4742	Polygon	4581	4589	2455	2332	2454	17.175692	409.7
4743	Polygon	4582	4590	2455	2333	2332	16.077997	330.1
4744	Polygon	4583	4591	2333	2455	2334	16.005894	276.9
4745	Polygon	4584	4592	2455	2456	2334	16.619673	269.4
4746	Polygon	4585	4593	2456	2335	2334	16.927238	282.4
4747	Polygon	4586	4594	2456	2457	2335	17.531792	557.1
4748	Polygon	4587	4595	2457	2336	2335	17.301069	760.4
4749	Polygon	4588	4596	2336	2457	2458	18.052443	910.9
4750	Polygon	4589	4597	2336	2458	2338	17.814278	770.0
4751	Polygon	4590	4598	2337	2336	2338	18.498671	567.5
4752	Polygon	4591	4599	2458	2459	2338	18.254473	598.8
4753	Polygon	4592	4600	2339	2338	2459	17.933146	400.2
4754	Polygon	4593	4601	2339	2459	2460	18.151112	457.5
4755	Polygon	4594	4602	2460	2341	2339	18.179857	449.1

Figure 5.14 Attributes of **SFRSM_coarse** mesh

26. Select **View**, **Zoom Data**, and zoom to **Selected Features**.
27. Zoom into cell **4583**.
28. Look at the attributes
    - What is the 1988 landuse type (LU88) for that cell?
    - What is the range in elevation in that cell?
    - Observe other attributes at that location.
29. Select **Identify** icon and **feature class**.
30. Add the observation monitoring stations used for calibration:
    - The verified stage monitoring sites are located at:

      $RSM/../data/geographic/monitor/stage/StageCV_Coordinate_v3_12_13
    - The verified tide measurement sites are located at:

      $RSM/../data/geographic/monitor/tide/tidal_station_coordinate

31. Add SFRSM canal network and structures:

- Open **`ArcCatalog`** on the **`ArcMap`** toolbar.
- Open **`geodatabase_template`**:

  `$RSM/../data/geographic/geodatabase_templates/mesh_import_template.mdb`
- Select **`canal`** and drag icon into ArcMap.
- Select **`watersheds`** and drag icon into ArcMap.
- Select **`mesh_framework_template`** and drag icon into ArcMap.

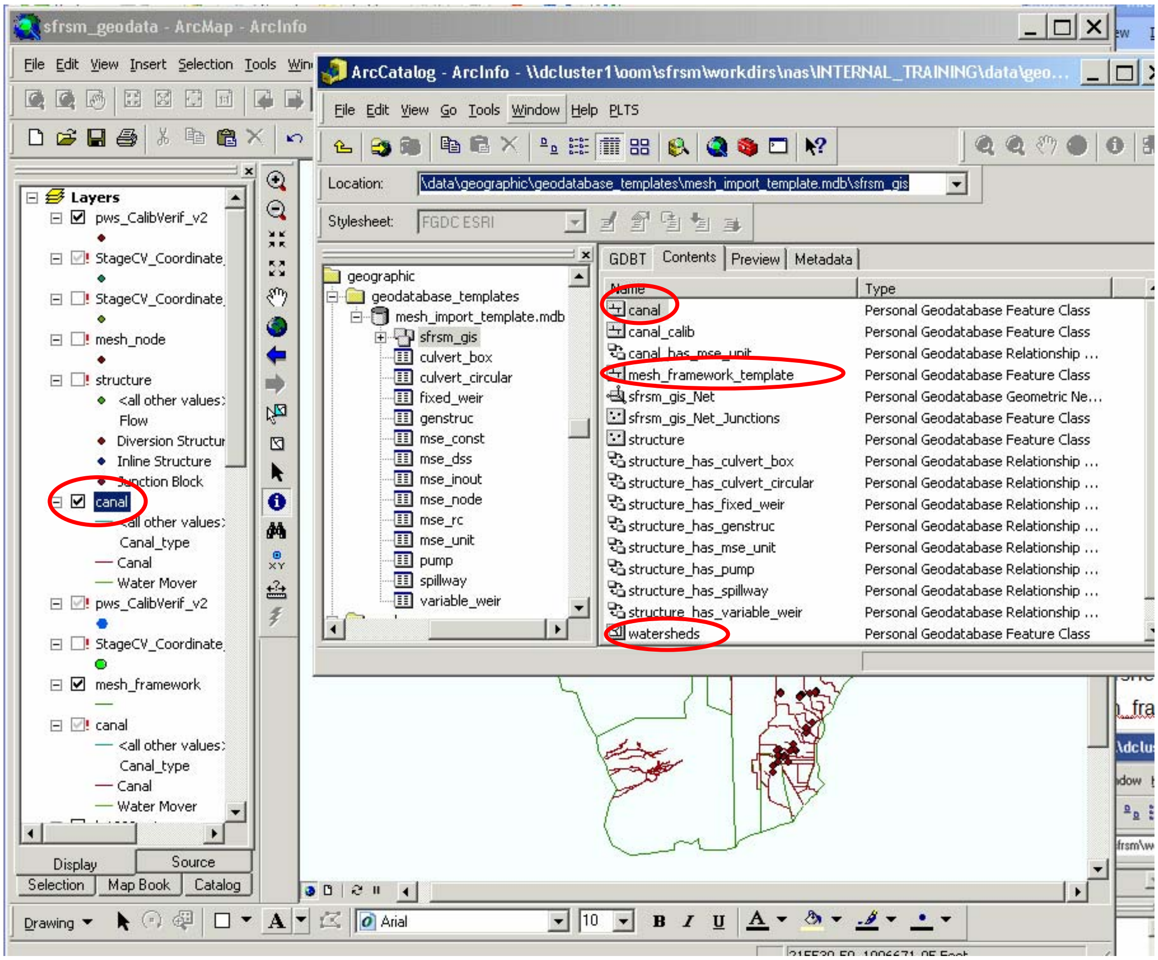


Figure 5.15 ArcCatalog

32. Save the ArcMap file in the **`labs/lab5`** directory for future reference.

This is a quick review of the standard geodatabase data available for the Regional Simulation Model.

Answers for Lab 5

Exercise 5.1.1

8. struc_type = *Spillway*
Flow = *Inline Structure*
WM_type = *Structure_flow*
Structure S18C enabled/disabled = *True (Enabled) + 5 watermover segments*
Discharge coefficient = *2912*

9. # canal segments = *88*

11. # framework lines assigned as levees = *32*

12. Cellid of smallest cell = *1947*
area of smallest cell = *162618.630842*
topo of smallest cell = *1.058204*
closest structure to cell 2022 = *5178*

Exercise 5.1.2

7. Range in hydraulic conductivity values = *10.3948 – 25,265.1*

12. # cells in the coarse mesh = *7351*

16. Land use type in 1988 for cell 4583 = *6*

    Range in elevation in cell 4583 = *16.1-19.0 ft*

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