

GY/GEO 461 Flooding Damage Modeling Exercise

Introduction

In this exercise you will calculate the potential flood damage in a local subdivision caused by various hurricane storm intensities. The raw data provided will include:

1. A polygon topology coverage in ArcGIS® geodatabase format containing the subdivision property parcels and tagged with the current market value. The ArcGIS system keeps track of the area of each parcel automatically. The parcel map coordinate system is UTM grid zone 16, NAD27 map datum.
2. A DEM in ASCII format for the Springhill 7.5 minute quadrangle in NAD27 format.
3. The Springhill 7.5 minute topographic quadrangle in NAD27 DRG format (GeoTIFF). This file is used for reference only.

Concept

You will use the polygon “intersect” feature of the ArcGIS to tabulate where rising flood levels would affect the property parcels. Because the GIS can keep track of the amount of flooding on each parcel, a very accurate assessment of property loss is possible. You will be given a complete polygon topology of the affected subdivision (**Figure 1**) derived from the Mobile County Tax Assessor’s Office. Each parcel will have several data items on the object data fields, including market value of the property, and whether the property is residential or commercial. You will generate a 2nd polygon topology of the flood levels affecting the subdivision area based on historical flood records. Weather experts have calculated that a category 1 hurricane that moved slowly over Mobile county could potentially cause a flood event 15 feet above the Langham Park Lake north of 12 Mile Creek. Assuming that the mean lake elevation is 85 feet elevation, the 100 foot topographic contour line should indicate the extent of flooding during the category 1 flood event. You will also consider the effects of category 2 and 3 storms that generate flood levels up to 110 and 120 respectively.

The generated flood levels polygon topology should each polygon containing attribute data field that stores the category level (Field name = Category [Integer]). To create this topology you need only trace the 100, 110, and 120 foot contour lines as “cutting edges” of a polygon feature that covers the same extent as the tax parcels. You will then “intersect” the two polygon topologies to form a 3rd polygon topology that would contain the storm category along with the market value of the flooded portion of the parcel. This data will then be exported in “report” format so that you can import the results into Excel. Excel will be used to calculate the property damage caused by each storm category.

Step 1: Download Data Files

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Create a folder under the “C:\ArcGIS_Data\XXX\” folder named “FloodingProject” where “XXX” represent your initials.. Copy the Project 6 files (Project6.zip) downloaded from:

http://www.usouthal.edu/geography/allison/gy461_project_resources.htm

to this folder. Use” WinZIP” to unpack the files.

Step 2: Add data layers to ArcGIS project

Start ArcCatalog from the desktop and navigate to your project folder. Under the “File” menu select “New”. Create a new geodatabase file named “FloodingProject”. Your folder should appear as in **Figure 1** under ArcCatalog. Now start the ArcToolbox application. Under “Import to Geodatabase” find and start the “Shape file to Geodatabase” utility. Select the “TaxParcels” shape file in your folder. Select the “FloodingProject” geodatabase as the output database. Make sure the settings match **Figure 2** and select “OK” to import the shape files into the geodatabase.

Start the ArcMap application and indicate a new blank project file. Use the “Add data” button to navigate to and add from the “FloodingProject” geodatabase. The layer “TaxParcels” should appear as a subfolder under the geodatabase name (double-click on the name).

Now add the SpringHill quadrangle for reference. Using the “Add data” button again, select the “o30088f2.tif” file. The tax parcel features should fit into the SW quarter of section 15 on the quadrangle. To enhance the topographic features add the DEM and construct a hillshade. The downloaded data includes an ASCII grid file - Use the Toolbox “Conversion Tools > To Raster > ASCII to Raster” to convert “sh_dem.asc” to an ESRI grid. **Figure 3** contains the setup.

Your display should appear as in **Figure 4**. Save the ArcMap project as “FloodingProject”.

Step 3: Create the Flood Levels Polygon Feature

Using ArcCatalog create a new feature class named “FloodLevels” that is a polygon topology with one attribute field named “Category”. This attribute should be a short integer because it will hold the storm category class (1, 2, or 3). After creating the feature, add it to the ArcMap project, and then select “Edit mode”. Add the initial polygon by setting a snap mode and following the corners of the tax parcels feature. Then use “Cut Polygon Features” and trace the 100, 110, and 120 foot topographic contours on the DRG as cutting edges to define the respective category 1, 2, and 3 areas. Remember to label each new polygon with the correct category number.

Use the information icon to verify that you can access the classification and value of the tax parcels, and the storm category in the flood levels polygon topology.

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The proper processing of later calculations requires that the original area of each flooded tax parcel be preserved so a new field named “Orig_Area” will be created and filled with the area in the “TaxParcels” layer. Right-click on the “TaxParcels” layer name and then select “Open Attribute Table”. Next, select the “Options” button in the lower left part of the dialog, and then “Add Field”. Create a new field named “Orig_Area” with a precision of 12 and a scale of 2. You now need to fill in this new field with the area value in “Shape_Area” with a calculation. From the editor button bar select “Start Editing” to put ArcMap in edit mode. Right-click on the “Orig_Area” field name in the attribute table, and then select “Calculate Values”. Fill in the dialog as indicated in **Figure 5**. Select the “OK” button- this will copy the area values in “Shape_Area” to “Orig_Area”. Verify that this is the case by browsing the attribute table. If all appears well, select “Stop Editing” and then “Save Edits” from the Editor button bar.

Step 4: Creating the “Intersect” Polygon Topology

The next step will “intersect” the two polygon topologies created so far to produce a third topology that contains the data of the initial two topologies. In this manner we can determine how much of a given tax parcel is covered by a specific flood level.

Make sure that your project file is loaded into the ArcMap application. Select the “Toolbox” icon and then expand the folder “Analysis Tools > Overlay” from the toolbox window. Select the “Intersect” option and continue to the next dialog. Use “TaxParcels” as the first layer and then “FloodLevels”. Before selecting the “OK” button make sure the dialog is setup as in **Figure 6**. Name the resulting polygon topology as “StormCat” in your project folder. With the identity tool verify that this new topology contains the storm category and value attributes.

Step 5: Composing the Hard Copy Map

In this step you will design a map layout to better display the relationship between flood levels and the affected property parcels. In ArcMap right-click on the “StormCat” layer. Select “properties” and then the “Symbology” tab. Setup the dialog as in **Figure 7**.

Now setup the page layout with “File” and then “Page Setup” from the main menu in ArcMap. Set the options to match **Figure 8**, and then select the “OK” button. Next select “View” and then “Layout View” from the main menu. When the display adjusts to this new setting you should see a map data frame containing the map elements on top of a rectangle that represents the media margins. Right-click on the map data frame and select “properties”. Then choose the “Data Frame” tab, and set an fixed scale of 1:6000. This will set the scale of the printed map. Re-size the data frame window to approximately match the layout of **Figure 9**.

To complete the map you need to add:

1. Scale bar and relational fraction (scale text)

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2. North arrow
3. Title
4. Legend

Choose the “Insert” and then “Scale bar” option from the main menu. Select the “Alternating scale bar 1” type, and place it centered and below the map frame. Use the same menu to insert the relational fraction (“scale text”), north arrow and title.

Next choose the “Insert” and then “Legend” option. Allow only the “Tax Parcels” and “Storm Flooding Potential” layers to be added to the legend. Select an outline for the legend but otherwise let the defaults control the format of the legend frame. Your final layout should appear as in **Figure 10**. Print a hard copy of the map to the printer specified by your instructor.

Step 6: Calculating Property Damage

In this step you will use Excel to determine the amount of property damage caused by a category 1,2, or 3 hurricane. First you need to export the “StormCat” table to Excel format. Start the Access database application and load the “FloodingProject.mdb” file. In the “tables” tab highlight the “StormCat” table. Select “File” and then “Export”. Change to export file type to “Excel 97-2002 (xls)” and save to your folder “\ArcGIS_Data\XXX\FloodingProject”. Close Access and then start Excel and load this new file. The file name will be “StormCat.xls”.

With the Excel spreadsheet sort the data based on “Category” and property “Type”. Calculate the property damage in the right-most column under the heading “Property_Damage”. Use the equation:

$$\text{Damage} = \text{Shape_Area} / \text{Orig_Area} * \text{Prop_Value}$$

You will have to re-cast the above equation in terms of the cell addresses. Copy the values down the column. Subtotal the damages whenever the category or property type changes. Accumulate the values in a table below the main spreadsheet data arranged as below:

Storm Category	Residential Damage	Commercial Damage
1	\$	\$
2	\$	\$
3	\$	\$

Print the spreadsheet report to turn in with your map. The spreadsheet should appear similar to **Figure 11**.

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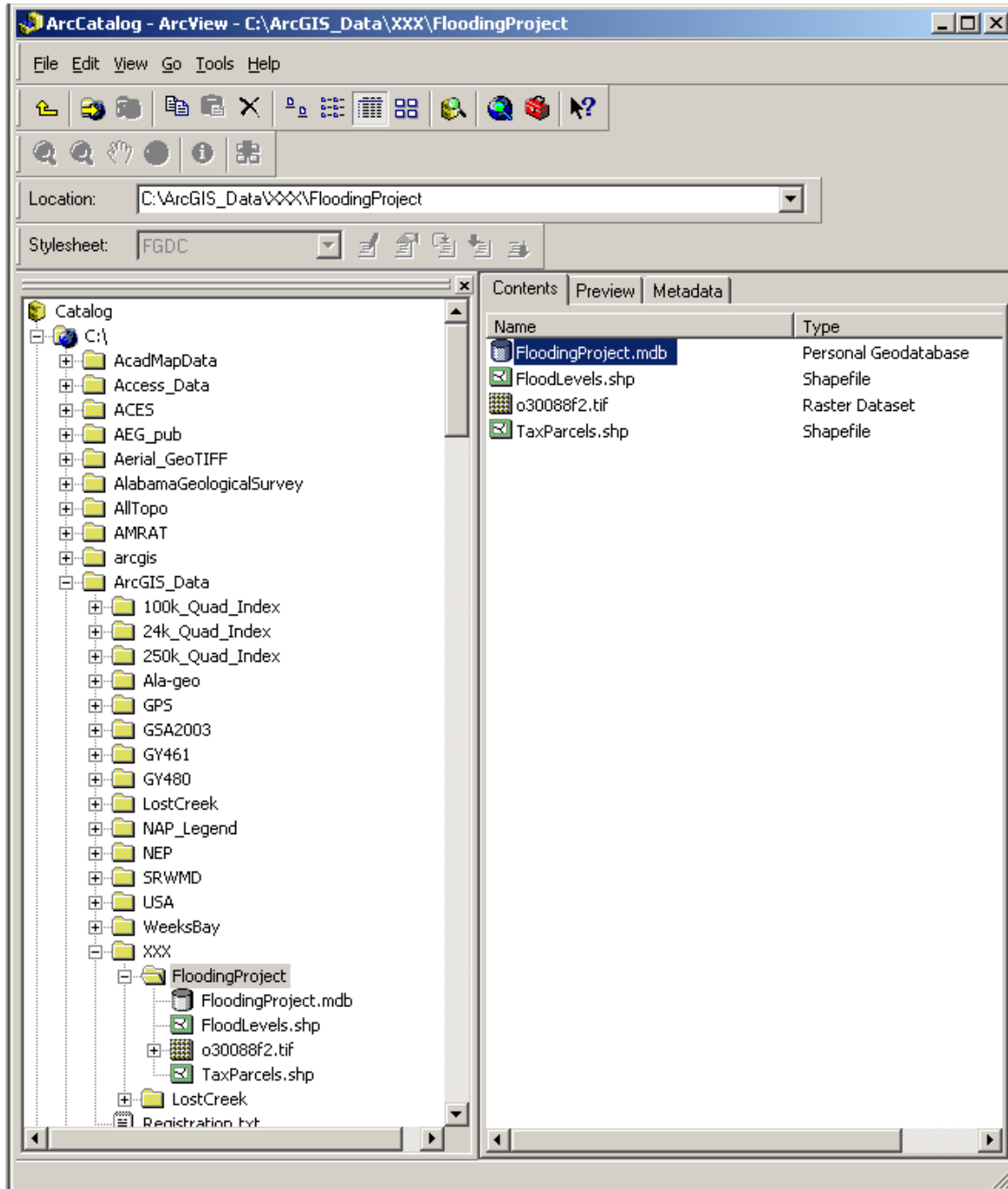


Figure 1: ArcCatalog view during creation of geodatabase file.

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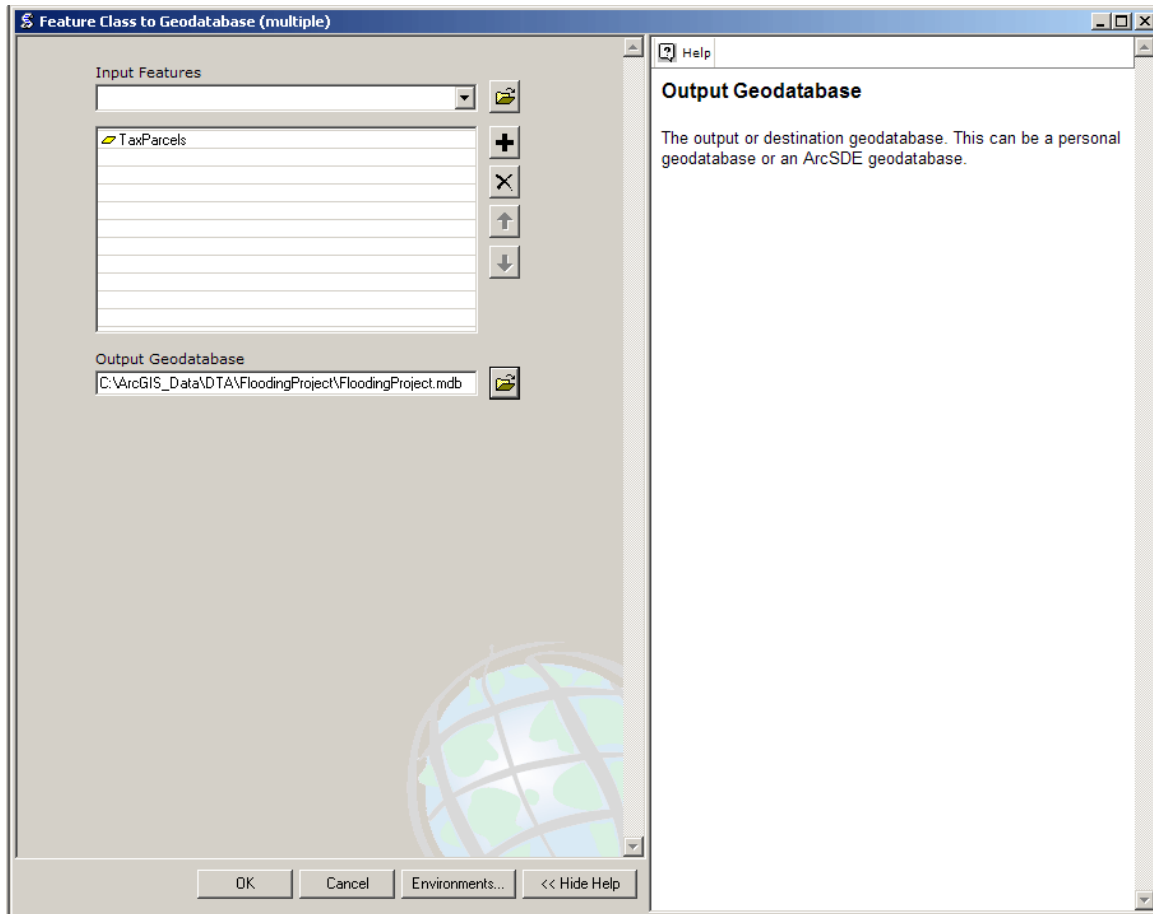


Figure 2: ArcToolbox utility for importing tax parcel shape file into the Flooding Project geodatabase.

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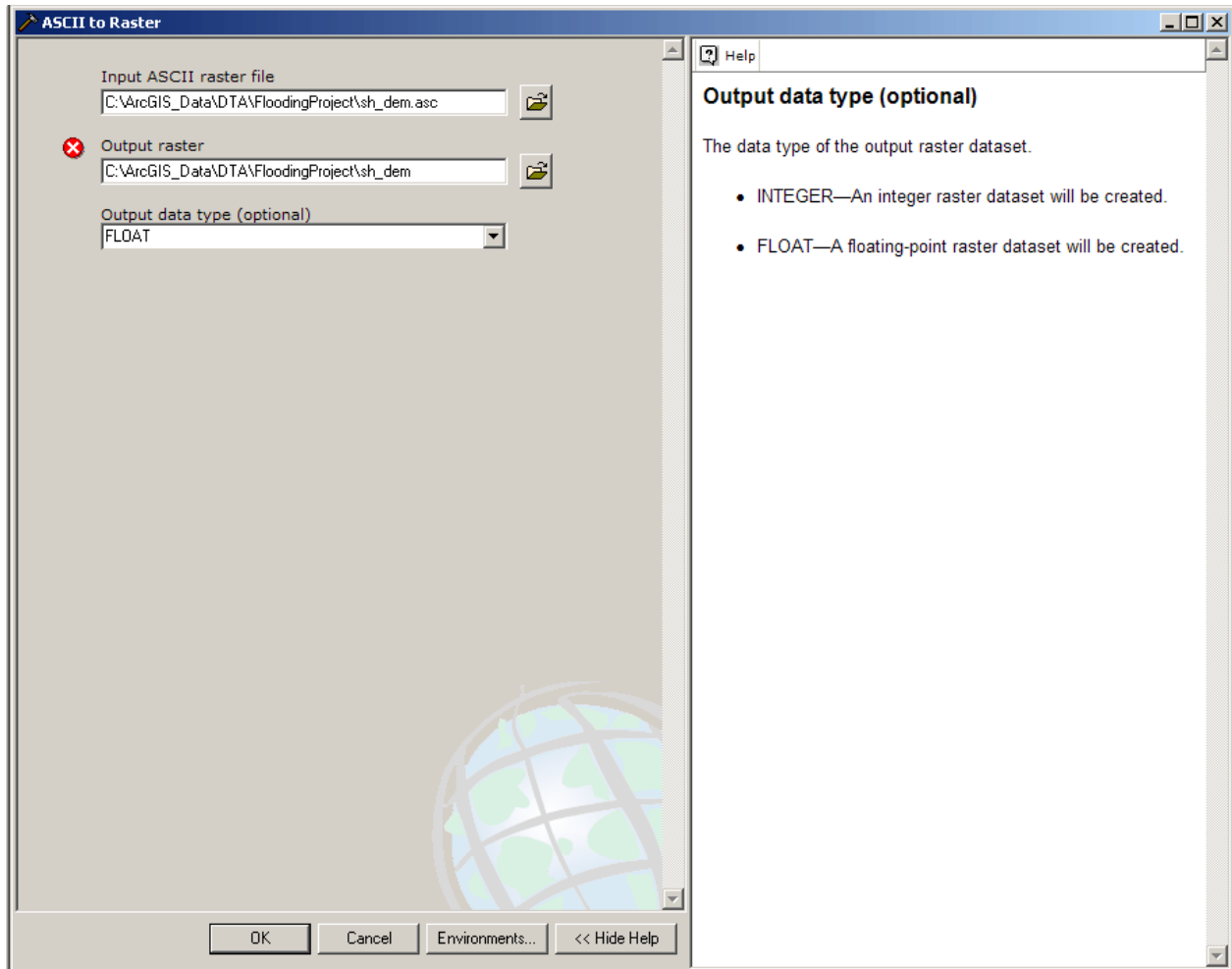


Figure 3: Conversion of ASCII Springhill Quadrangle DEM file to ESRI grid.

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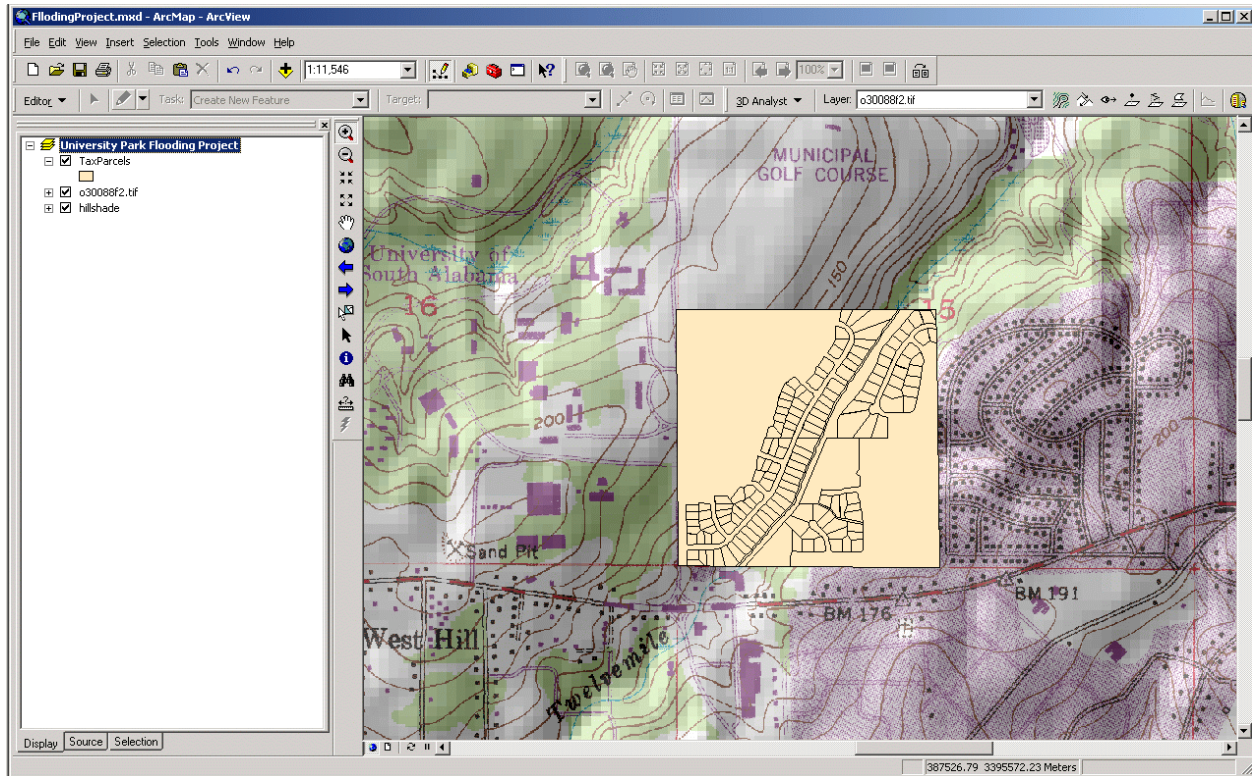


Figure 4: View of feature layers after adding DRG in ArcMap project file.

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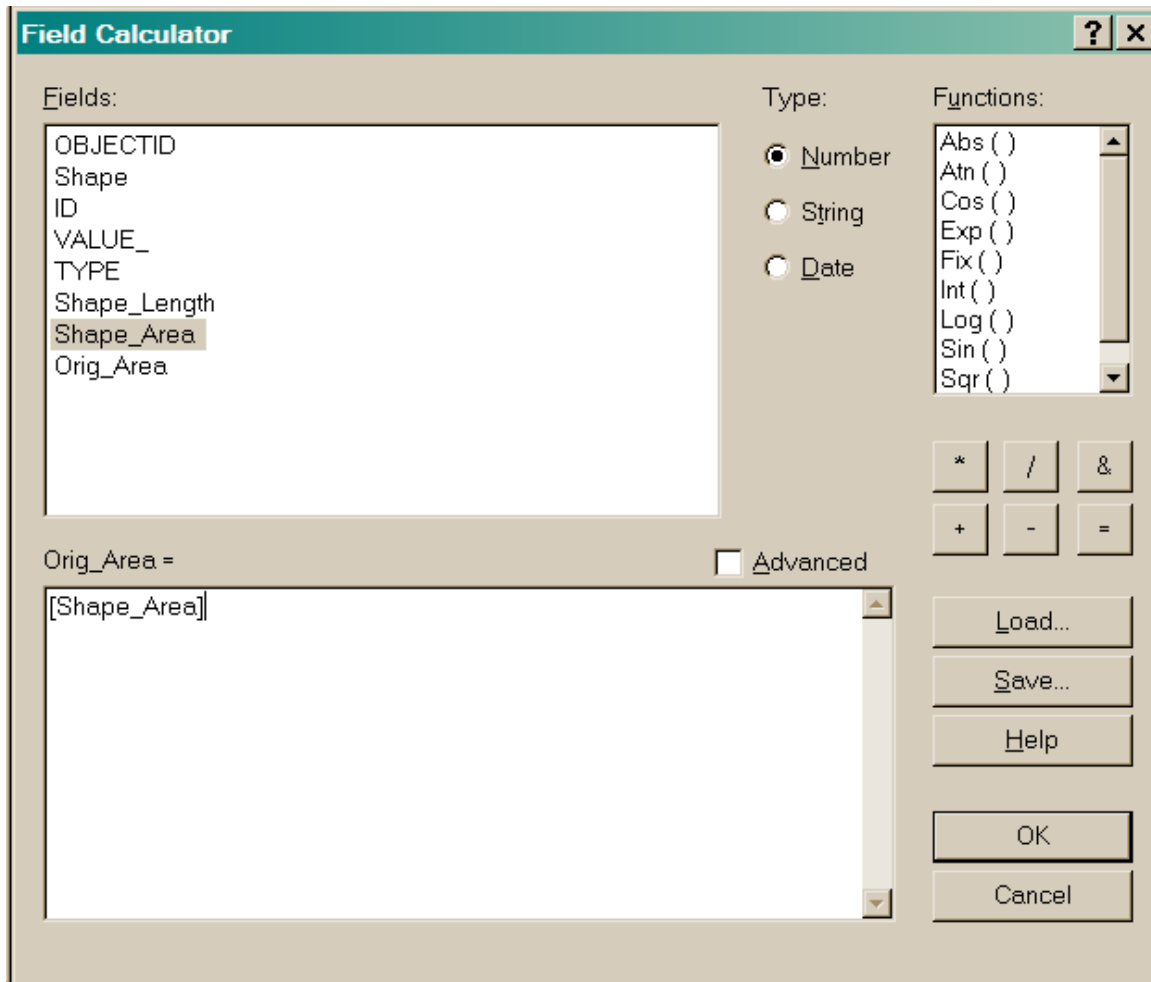


Figure 5: Calculation to copy polygon area to “Orig_Area”..

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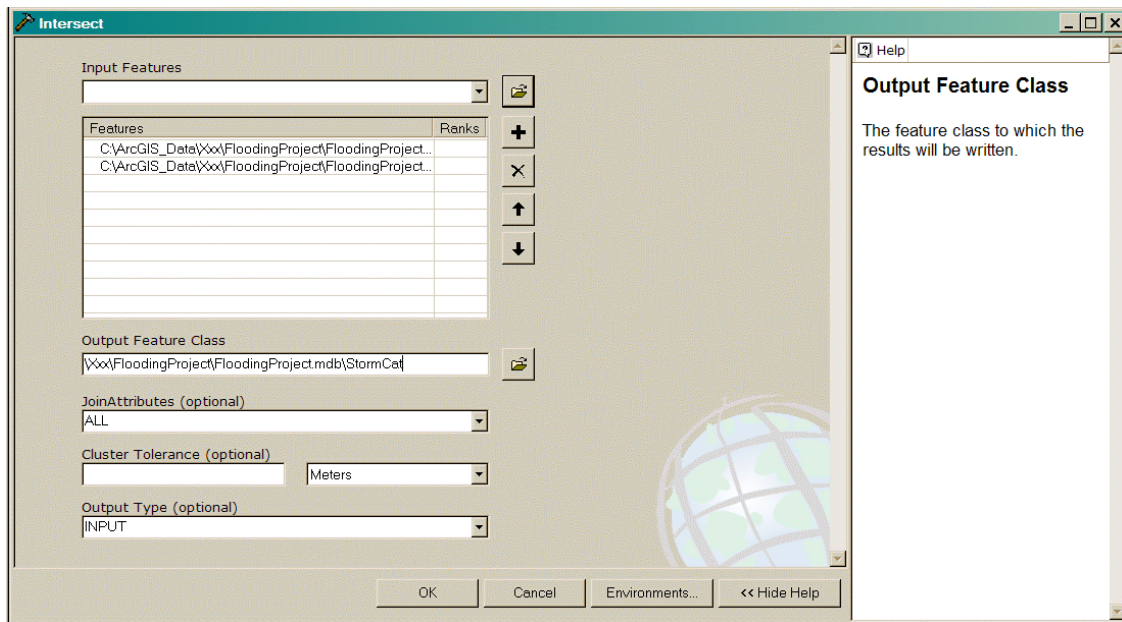


Figure 6: Creating “StromCat” layer using “Intersection ” of polygon topologies “Taxparcels” and “FloodLevels”.

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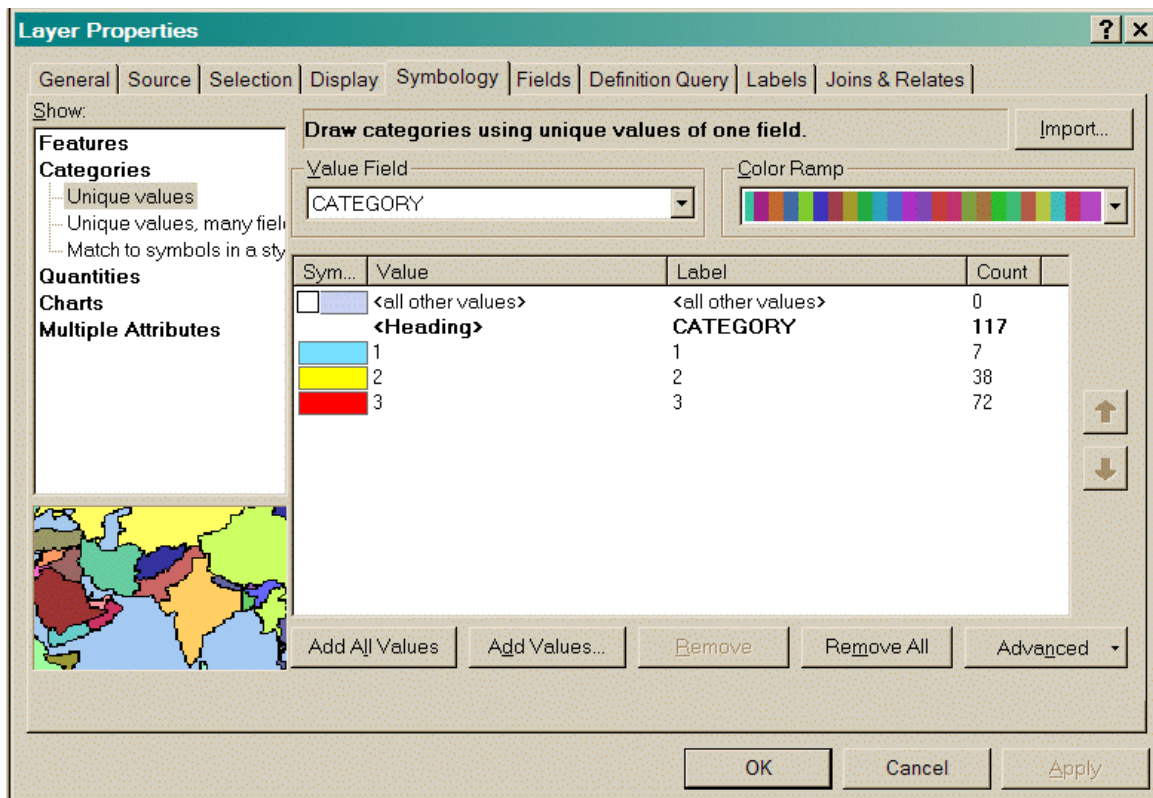


Figure 7: Symbology setup for the “StormCat” polygon topology.

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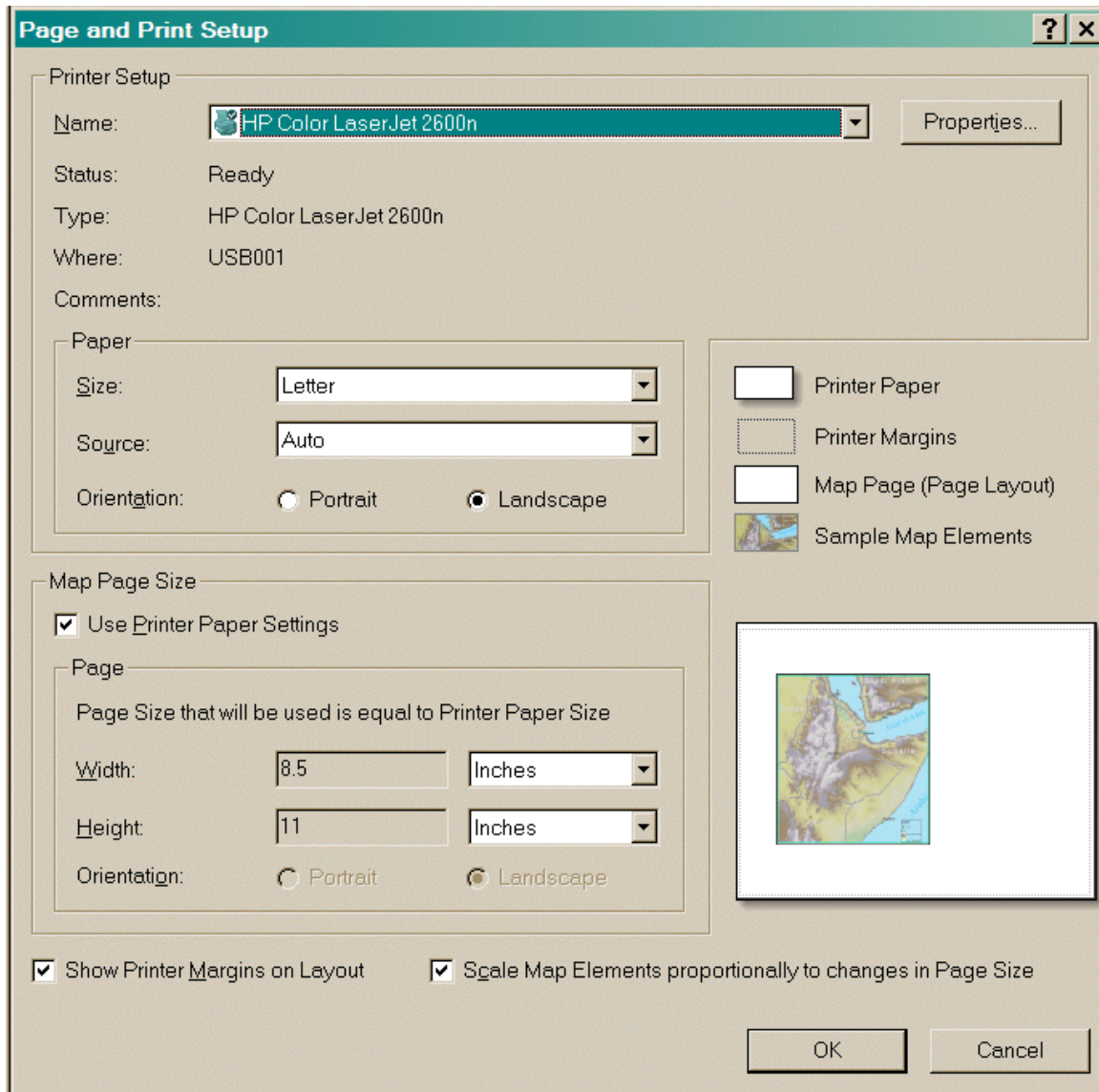


Figure 8: Page setup to prepare for layout view.

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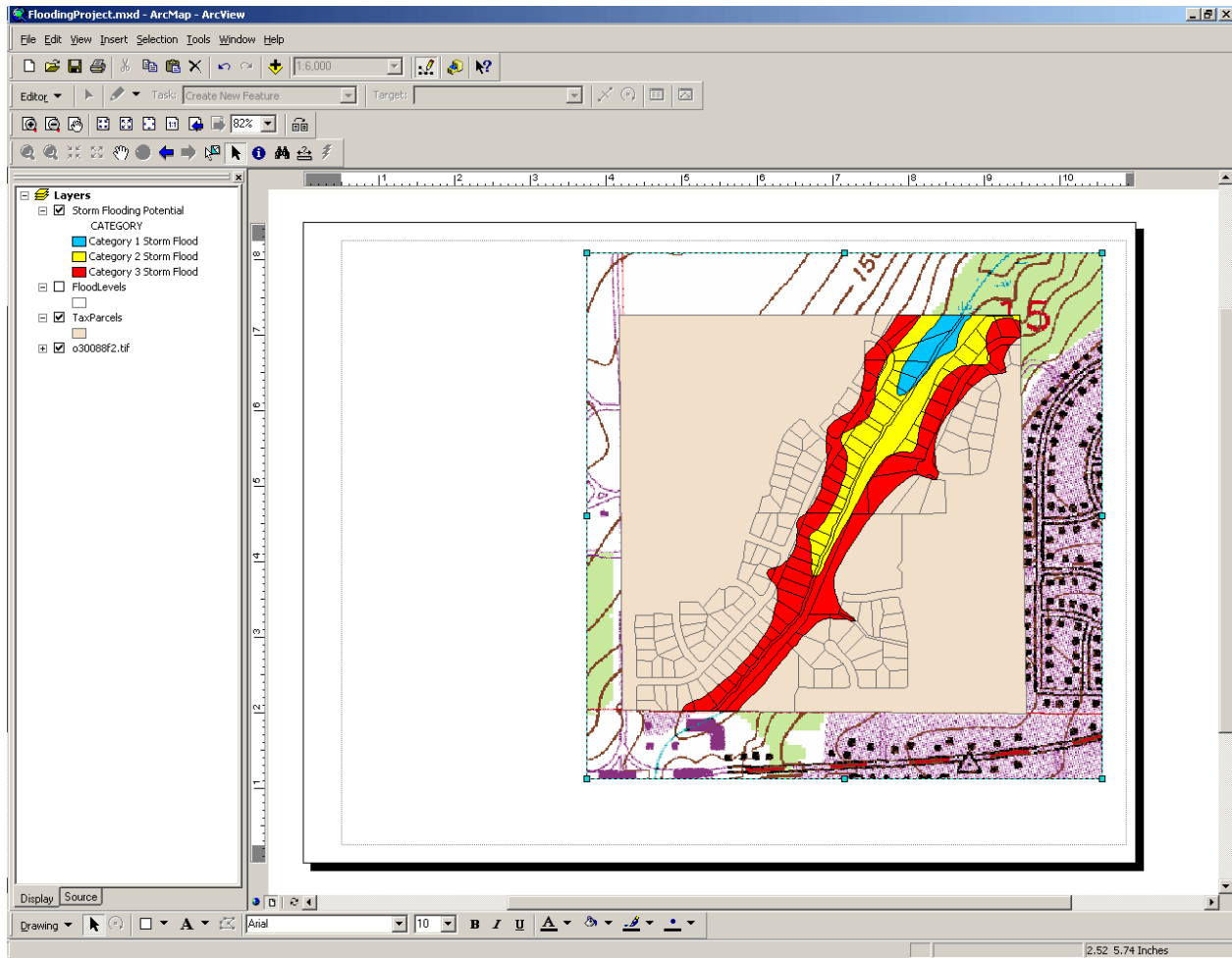


Figure 9: Layout view of project with scale set to 1:6,000.

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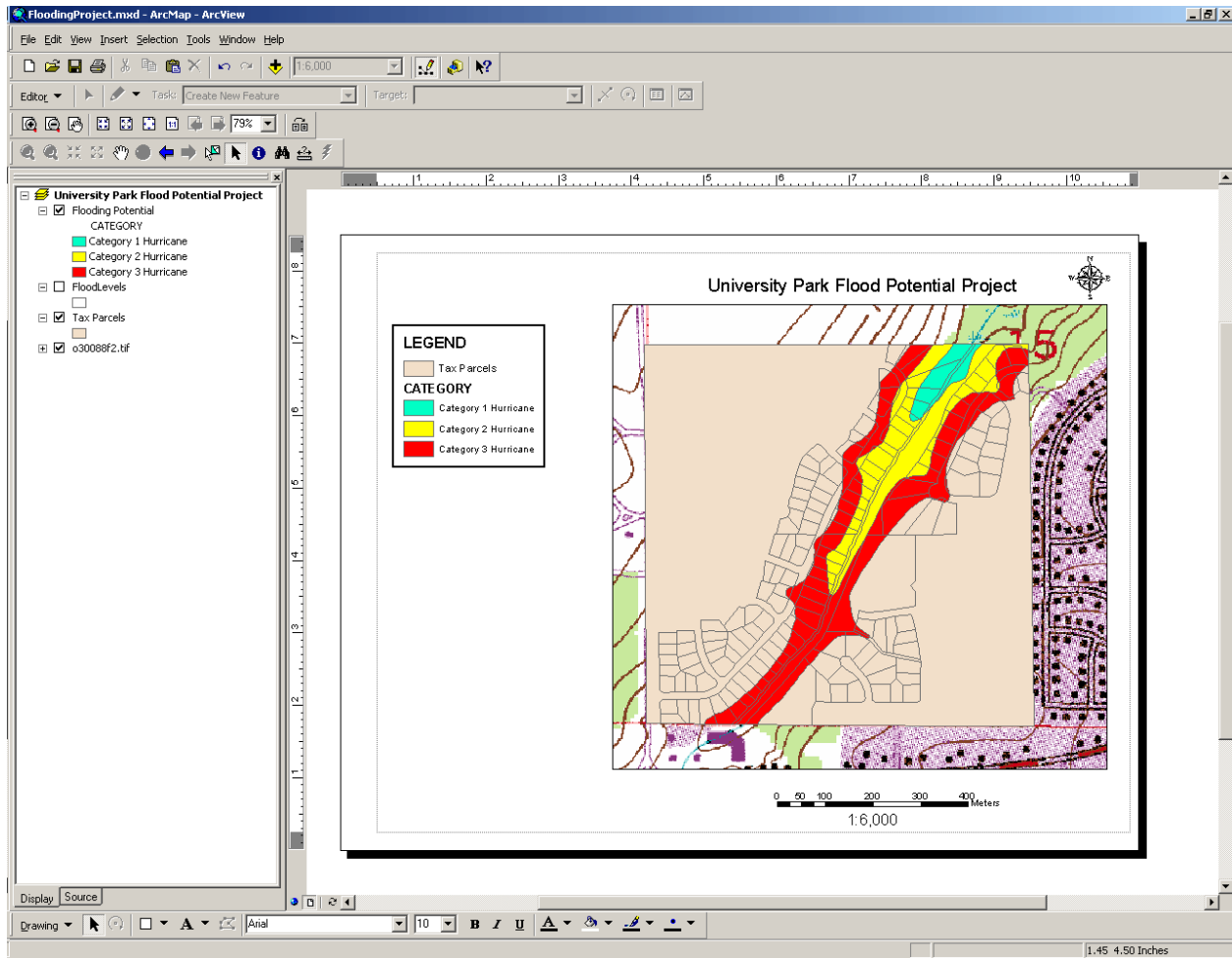


Figure 10: Final layout view of hard copy project map.

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OBJECTID	ELEVATION	CATEGORY	FID_TaxParcels	ID	Value	Type	Orig_Area	Shape_Length	Shape_Area	Property Damage
2	39	100	1	R022805153003041	\$500	Commercial	23206.50	334.84	1638.59	\$35.30
3	40	100	1	3 unknown	\$0	Residential	5613.06	378.67	1006.84	\$0.00
4	41	100	1	4 R022805153001096	\$75,900	Residential	1657.93	145.65	1225.92	\$56,122.69
5	42	100	1	5 R022805153001096.001	\$103,700	Residential	3295.86	235.76	2298.12	\$72,307.51
6	43	100	1	6 R022805153001096	\$19,500	Residential	5440.30	215.92	1783.73	\$6,393.53
7	44	100	1	9 R022805153001094	\$65,500	Residential	1574.05	125.18	978.50	\$41,339.30
8	45	100	1	10 R022805153001093	\$64,100	Residential	1081.58	57.48	186.62	\$11,060.13
9										
10										
11	1	110	2	1 R022805153003041	\$500	Commercial	23206.50	1448.19	13954.10	\$298.50
12	95	110	2	92 R022805153003105.009	\$45,000	Commercial	1772.18	141.51	950.79	\$24,142.83
13	2	110	2	3 unknown	\$0	Residential	5613.06	928.50	2571.09	\$0.00
14	3	110	2	4 R022805153001095	\$75,900	Residential	1657.93	87.19	432.01	\$19,777.32
15	4	110	2	4 R022805153001096.001	\$103,700	Residential	3295.86	148.26	997.74	\$31,392.69
16	5	110	2	6 R022805153001096	\$19,500	Residential	5440.30	266.23	2559.53	\$9,174.27
17	6	110	2	7 unknown	\$0	Residential	232354.67	419.98	2215.27	\$0.00
18	7	110	2	9 R022805153001094	\$65,500	Residential	1574.05	122.22	695.55	\$25,160.70
19	8	110	2	10 R022805153001093	\$64,100	Residential	1081.58	155.96	894.96	\$53,039.87
20	9	110	2	11 R022805153001092	\$78,200	Residential	1192.25	147.06	1190.98	\$78,116.40
21	10	110	2	12 R022805153001091	\$88,700	Residential	1814.92	160.73	1542.59	\$75,390.68
22	11	110	2	13 R022805153002144	\$70,800	Residential	1190.82	146.96	1190.82	\$70,800.00
23	12	110	2	14 R022805153002145	\$83,900	Residential	1771.89	164.78	1710.85	\$81,009.60
24	13	110	2	15 R022805153002143	\$71,900	Residential	1216.83	139.10	930.30	\$54,998.98
25	14	110	2	16 R022805153002142	\$68,600	Residential	1263.37	100.03	579.42	\$31,452.05
26	15	110	2	17 R022805153002141	\$72,300	Residential	1339.42	87.26	453.40	\$24,473.90
27	16	110	2	18 R022805153002140	\$76,800	Residential	1410.97	86.18	454.29	\$24,727.29
28	17	110	2	19 R022805153002139	\$69,800	Residential	1521.84	87.26	464.66	\$21,311.76
29	18	110	2	20 R022805153002138	\$12,500	Residential	1331.62	71.14	269.74	\$2,532.04
30	19	110	2	21 R022805153002136	\$95,700	Residential	1405.48	116.38	628.78	\$56,432.04
31	20	110	2	22 R022805153002137	\$82,900	Residential	2211.08	147.77	1057.56	\$39,650.89
32	21	110	2	23 unknown	\$98,600	Residential	1372.93	109.12	677.59	\$43,733.58
33	22	110	2	24 R022805153002134	\$75,200	Residential	1343.27	82.07	376.76	\$21,022.26
34	23	110	2	25 R022805153002133	\$65,000	Residential	1331.28	54.78	138.59	\$6,766.91
35	24	110	2	45 unknown	\$0	Residential	143666.08	126.99	728.81	\$0.00
36	25	110	2	73 R022805153003105.041	\$270,200	Residential	1786.47	129.16	812.61	\$124,296.74
37	26	110	2	74 R022805153003105.001	\$272,800	Residential	1692.39	111.04	694.31	\$112,582.44
38	27	110	2	75 R022805153003105.002	\$45,000	Residential	1410.49	85.69	367.26	\$11,717.03
39	28	110	2	76 R022805153003105.003	\$45,000	Residential	1315.52	74.84	200.94	\$5,873.62
40	29	110	2	77 R022805153003105.004	\$236,400	Residential	1315.49	79.81	262.14	\$47,108.33
41	30	110	2	84 R022805153003105.005	\$273,600	Residential	1454.60	105.06	556.47	\$104,667.17
42	31	110	2	85 R022805153003105.006	\$45,000	Residential	1277.11	122.85	784.30	\$27,635.25
43	32	110	2	86 R022805153003105.007	\$45,000	Residential	1151.20	133.56	1136.60	\$44,429.38
44	33	110	2	87 R022805153003105.008	\$45,000	Residential	1368.65	146.08	1348.82	\$44,347.81
45	34	110	2	89 R022805153003105.012	\$50,000	Residential	1695.32	35.94	66.90	\$2,351.73
46	35	110	2	93 R022805153003105.010	\$345,300	Residential	1638.11	91.20	186.50	\$39,313.68

Figure 11: Spreadsheet layout for report.