

# Cell Tower Kernel Density Comparer Help File

Prepared as part of the CE594R course taught by Dr. Dan Ames at BYU  
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## Purpose

The purpose of the Cell Tower Kernel Density Comparer tool is to provide an easy to use function that allows ArcMap users to generate several maps of possible cell phone tower locations within a spatial area. This tool can be used by communication companies and planners in determining options for best placement of new cellular tower within a region.

Efforts were made to include parameters that would best determine locations for cell tower placement. These parameters include:

- Slope of terrain (towers cannot be placed on excessively steep hillsides)
- Proximity to access roads
- Distance from other towers (ensuring operational and cost efficiency in placement)

The tool generates a collection of maps (an atlas). The user load any number of spatial areas of interest and the tool returns four maps of possible tower placements for each area. Each of the four maps returned to the user represent a different kernel density. The maps can then be compared and a best scenario is selected by the user.

This software was created at Brigham Young University for the CE 594R “GIS Programming” class under the direction of Dr. Daniel Ames.

Thank you for using this tool. We hope you enjoy it

## How to get the code

This script along with its documentation can be obtained by emailing the authors directly or any other person that has these files. You may email the following authors to obtain a copy of the script:

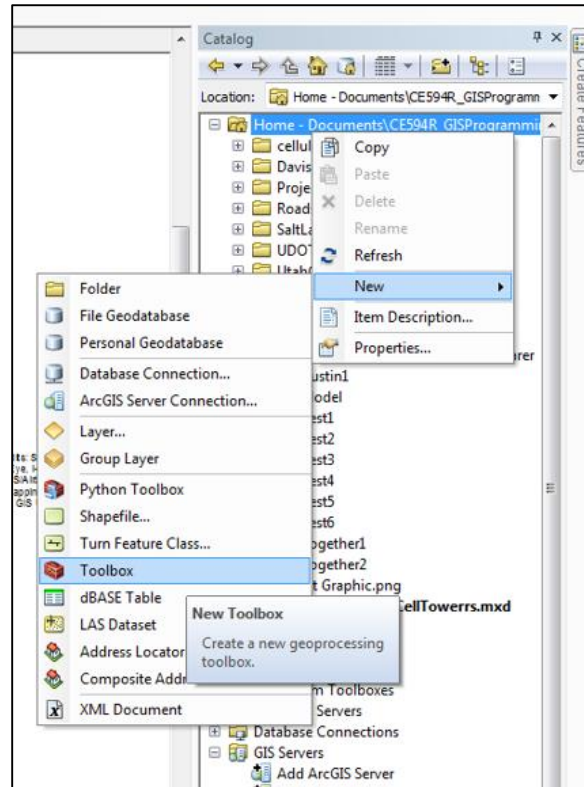
- Dustin Woodbury: [dustinhwoodbury@gmail.com](mailto:dustinhwoodbury@gmail.com)
- Stephen Duncan: [stephenduncan64@gmail.com](mailto:stephenduncan64@gmail.com)

Alternatively the code and its documentation are available on the web by visiting the corresponding github site. To download the Python script simply click on the link entitled `Python-Program.py` and it will download to your computer and then installed. The URL for the tool's github site is:

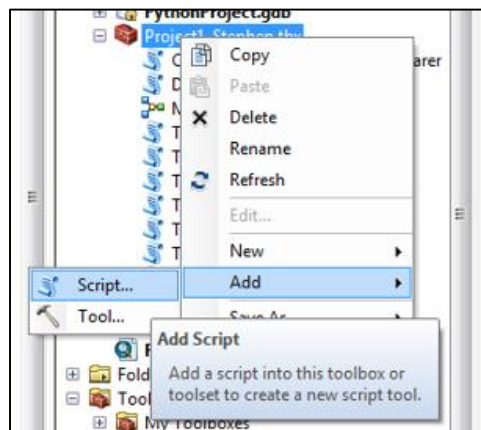
<https://github.com/sduncan4/Cell-Tower-Kernel-Density-Comparing-Tool>

## Installation of This Python Script in ArcMap

Inside the ArcMap Catalog, this software needs to be installed as a new “Script.” First, inside the “Home” folder (or any connected folder inside ArcMap) a new “Toolbox” needs to be created. This can be done by right clicking on the desired folder you want it to be in and select “New” → “Toolbox” (as shown below).




A similar process can be used to add this script to the Map Document. This can be done by right clicking the desired Toolbox, and select “Add” → “Script” (as shown below).

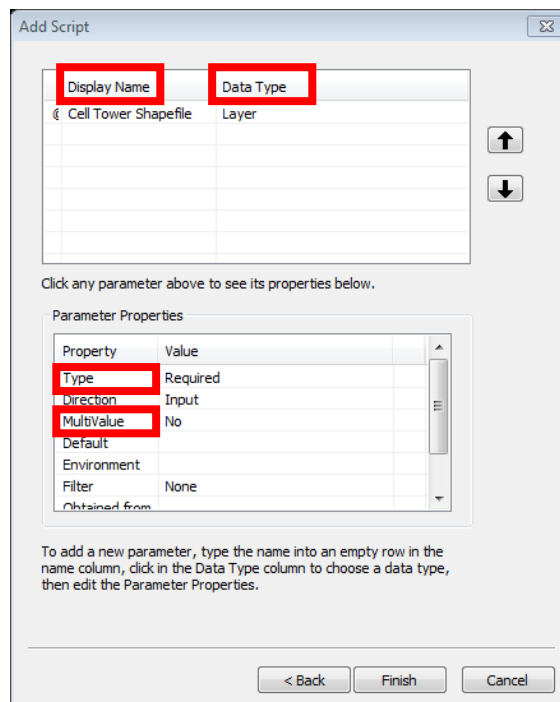


The next step is to fill out the required information about this script. It is recommended to use the following descriptions in each field. However, any description the user desires to use is also fine. It is also recommended to turn on the “Store relative path names (instead of absolute paths)” and “Always run in foreground” options on this page. After filling this page out, select the “Next >” button.

Field Name	Suggested Description
Name:	CellTowerKernelDensityComparer
Label:	Cell Tower Kernel Density Comparer
Description:	This script compares different kernel densities of Cell Towers for the different Polygons in a shapefile, suggest possible locations (if any), and produce an Atlas with the final results. This was used to compare the different densities of cell towers in Utah County, although it could be used for any shapefile.
Stylesheet:	<leave blank>

The next page should ask you for the location of the script file. This can be found by either typing in the path and name of the script (wherever you downloaded and saved it too) or by clicking the  button next to the text box. After searching for this script, click add in the window browser and the path and script name should appear in the textbox. If you are satisfied with your connection to the script’s location, then select the “Next >” button.

The last page should look like the figure shown below. The three required fields that need to be checked for each parameter in the script are the “Display Name” and “Data Type,” and in the properties field “Type” and “MultiValue.”



The screenshot shows the 'Add Script' dialog box. At the top, there is a table with two columns: 'Display Name' and 'Data Type'. The first row contains 'Cell Tower Shapefile' and 'Layer'. Below this table are up and down arrow buttons. A text prompt says 'Click any parameter above to see its properties below.' Below this is the 'Parameter Properties' section, which contains a table with 'Property' and 'Value' columns. The 'Type' property is set to 'Required', 'Direction' is 'Input', 'MultiValue' is 'No', 'Default' is empty, 'Environment' is empty, and 'Filter' is 'None'. At the bottom, there is a text prompt: 'To add a new parameter, type the name into an empty row in the name column, click in the Data Type column to choose a data type, then edit the Parameter Properties.' At the very bottom are three buttons: '< Back', 'Finish', and 'Cancel'.

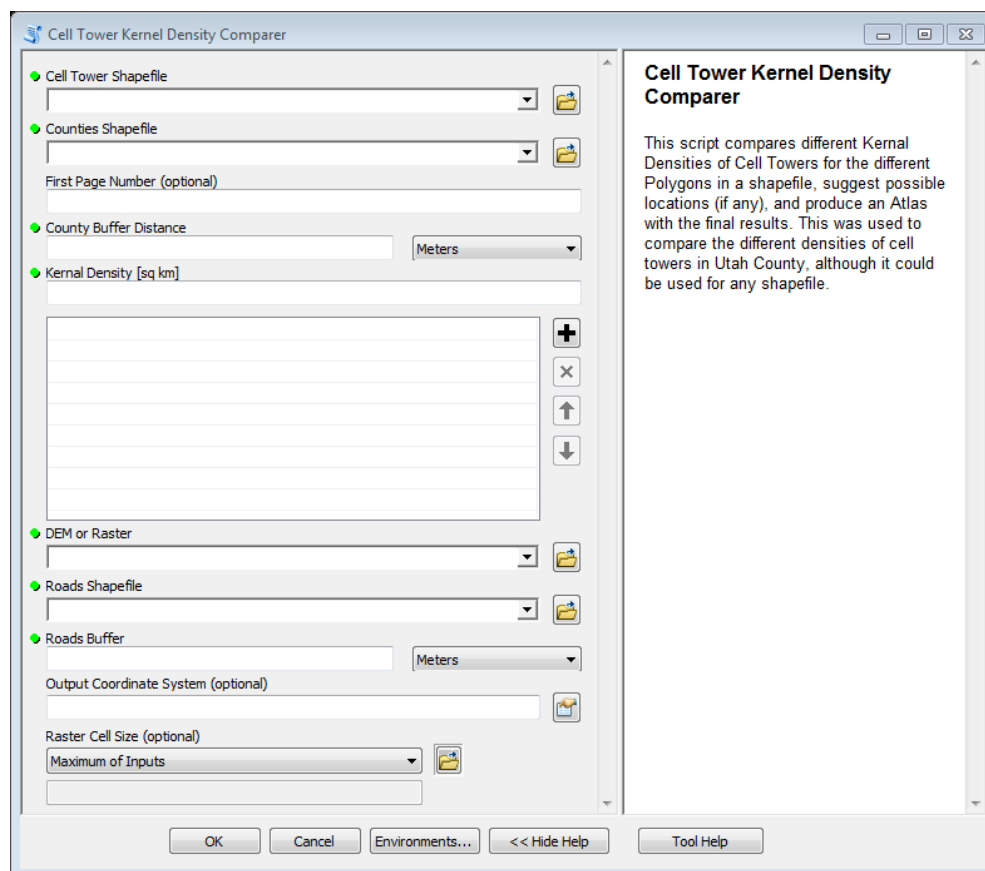
Property	Value
Type	Required
Direction	Input
MultiValue	No
Default	
Environment	
Filter	None
Obtained from	

The order of the parameters is requisite for this script to work. The order of the following table should be followed, with the appropriate properties associated with it.

Display Name	Data Type	Type	MultiValue
Cell Tower Shapefile	Layer	Required	No
Counties Shapefile	Layer	Required	No
First Page Number	Double	Optional	No
County Buffer Distance	Linear Unit	Required	No
Kernel Density [sq km]	Double	Required	Yes
DEM or Raster	Layer	Required	No
Roads Shapefile	Layer	Required	No
Roads Buffer Distance	Linear Unit	Required	No
Output Coordinate System	Coordinate System	Optional	No
Raster Cell Size	Cell Size	Optional	No

*\*NOTE: The order of these parameters is VERY important, or else the script will not work.*

If set up correctly, when double clicking the newly imported script it should look like any other toolbox tool. The following figure is an example if the instructions were followed in this document.



If you have a final prompt looking like the example above, your installation is complete.

## Required Files

The tool requires several files to run and are provided by the users. These input files include several types of shapefiles and a raster. The types of input files required as well as example sources where some might be obtained are given below:

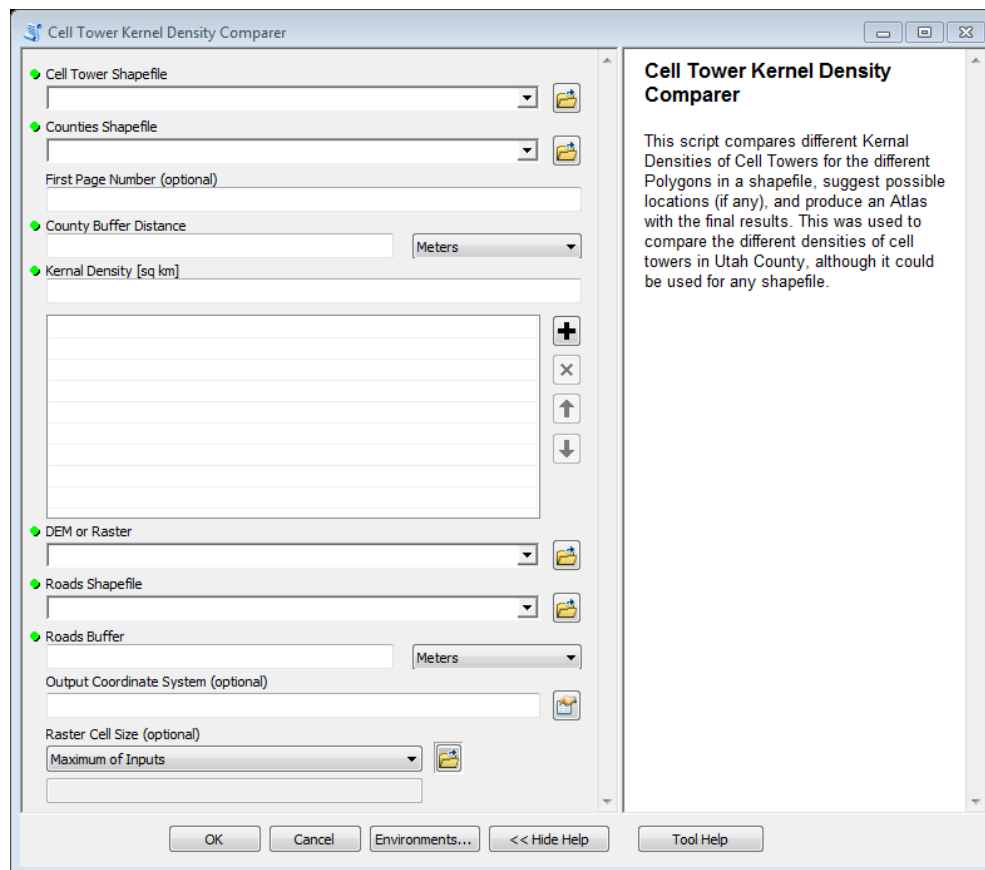
- Cell Tower Shapefile (Point)  
[http://wireless.fcc.gov/geographic/index.htm?job=licensing\\_database\\_extracts](http://wireless.fcc.gov/geographic/index.htm?job=licensing_database_extracts)
- Main Highways Shapefile (Polyline)  
<http://gis.utah.gov/data/sgid-transportation/roads-system/>
- Shapefile of Area of Interest (Polygon)  
<http://gis.utah.gov/data/boundaries/citycountystate/>
- DEM of Area of Interest (Raster)  
<http://gis.utah.gov/data/elevation-terrain-data/10-30-meter-elevation-models-usgs-ned>
- Background Image  
[server.arcgisonline.com](http://server.arcgisonline.com)



## Using the Software

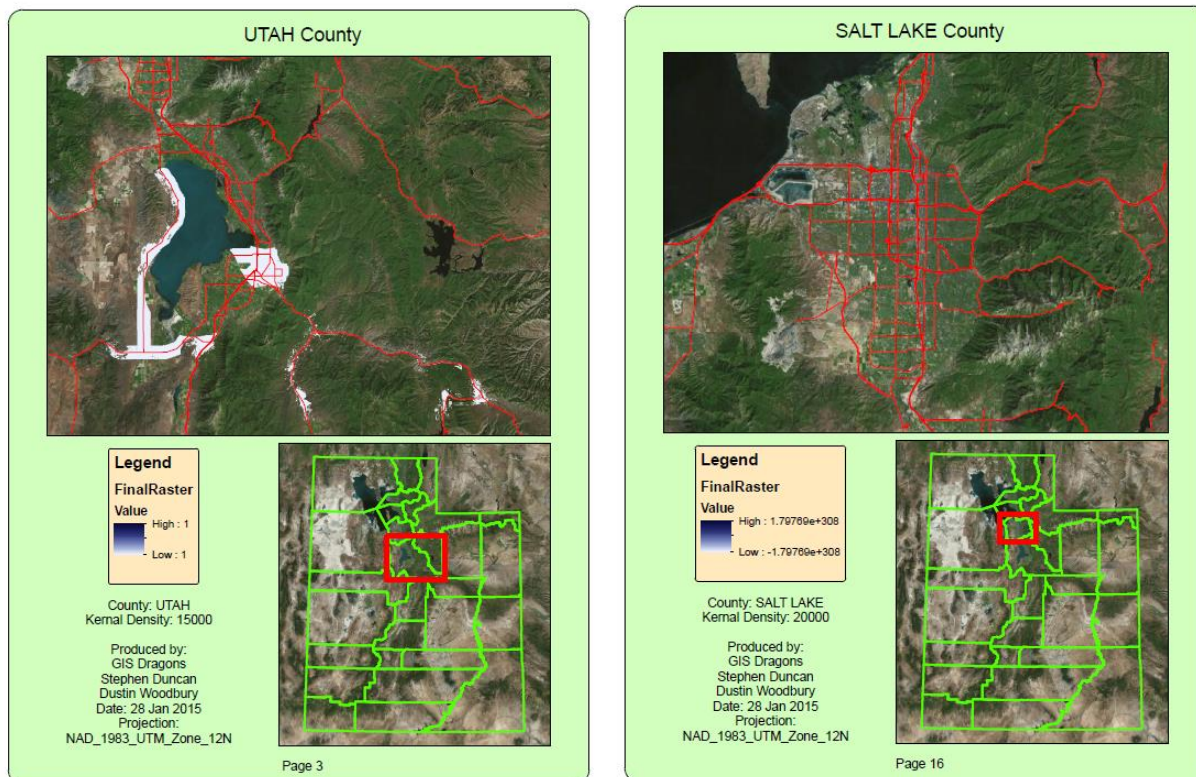
Once the tool has been installed it is easy to access in ArcMap. Simply open ArcMap, Click the “Catalog” button on the top right-hand side of the screen, open the toolbox you created when installing the tool, and finally double click the script. This will launch the window that allows the user to input information and run the tool.

The tool is integrated into the ArcMap system of tools. As such its formatting follows the same design as other tools in ArcMap. This design is intuitive and easy to use. Below is a screen shot of what will appear when the tool is opened.

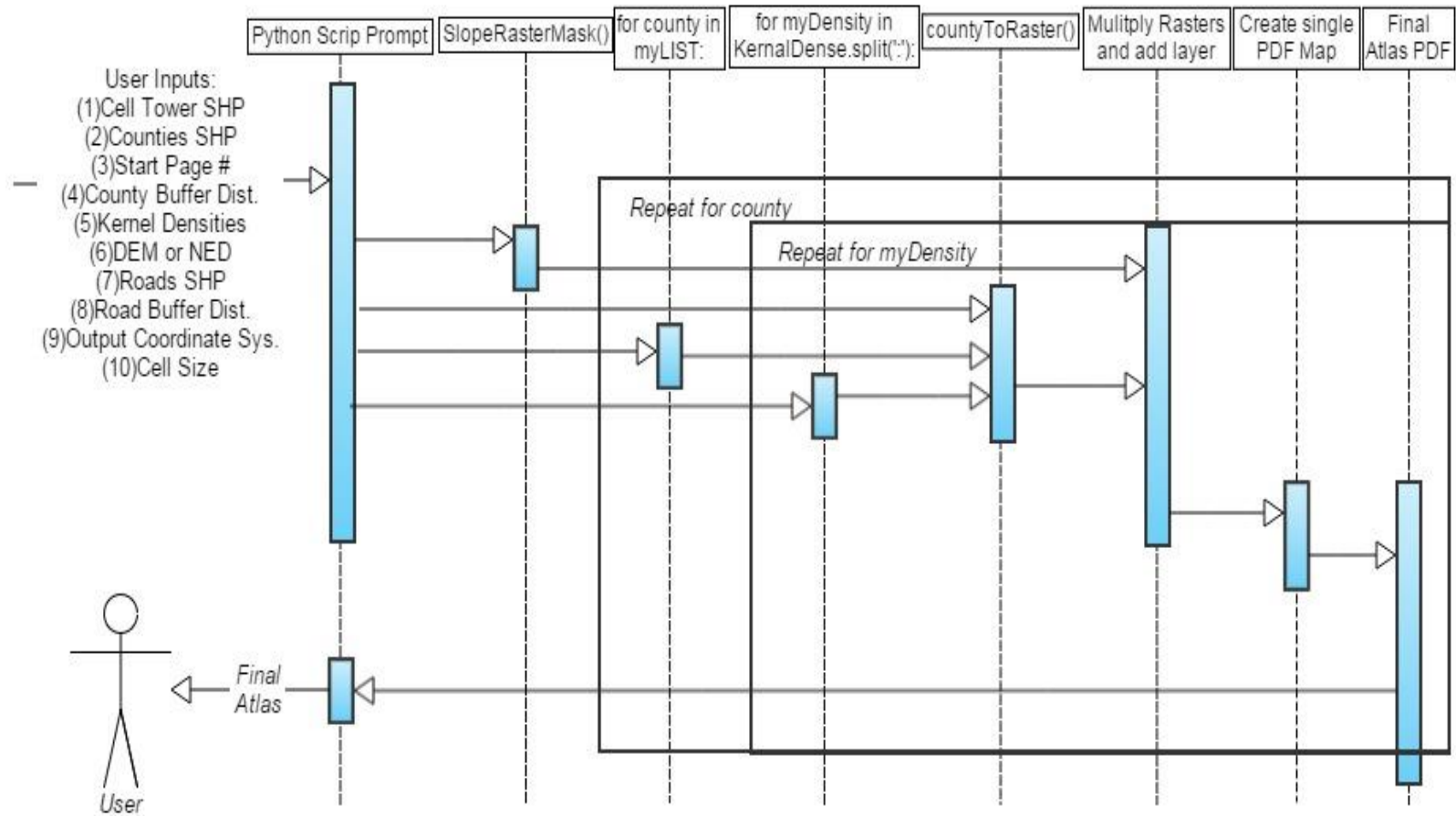


Within this window load the required files, select a buffer distance and kernel density or densities, and run the tool by pressing OK. A comment box will appear explaining what is happening. Depending on the number of inputs for kernel density you have and the number of polygons in your shapefile, it may take only a few moments before the atlas will have been compiled and your maps will be ready to view.

Below is an example to two maps from a sample pdf generated by the tool. In the Utah County Map on the left the shaded area on the map represents acceptable areas for cell phone tower placement given the specified kernel density. Note that in the Salt Lake County Map on the right there is no shaded area and the scale in the legend shows very extreme numbers. This indicates that there are no suitable areas within Salt Lake County for cell phone towers given the input parameters, specifically kernel density.



The following page shows a diagram of the function of the software once run. The user enters a series of inputs (as shown above), the various functions are called to process the data, and the atlas is returned to the user as the end result.



## Restrictions

This code was created at Brigham Young University for the CE 594R “GIS Programming” class under the direction of Dr. Daniel P. Ames. We have chosen to use the MIT License for sharing and distributing this code:

The MIT License (MIT)

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