Work Flow

Our goal for the project was to develop a virtual reconstruction of a historical landscape using GIS data and 3D models that could be used as a platform for exploring that landscape. To begin the project, we assembled the data necessary to generate building footprints, ground surface, and vegetation/street furniture for downtown Morgantown c.1900.

These sources included:

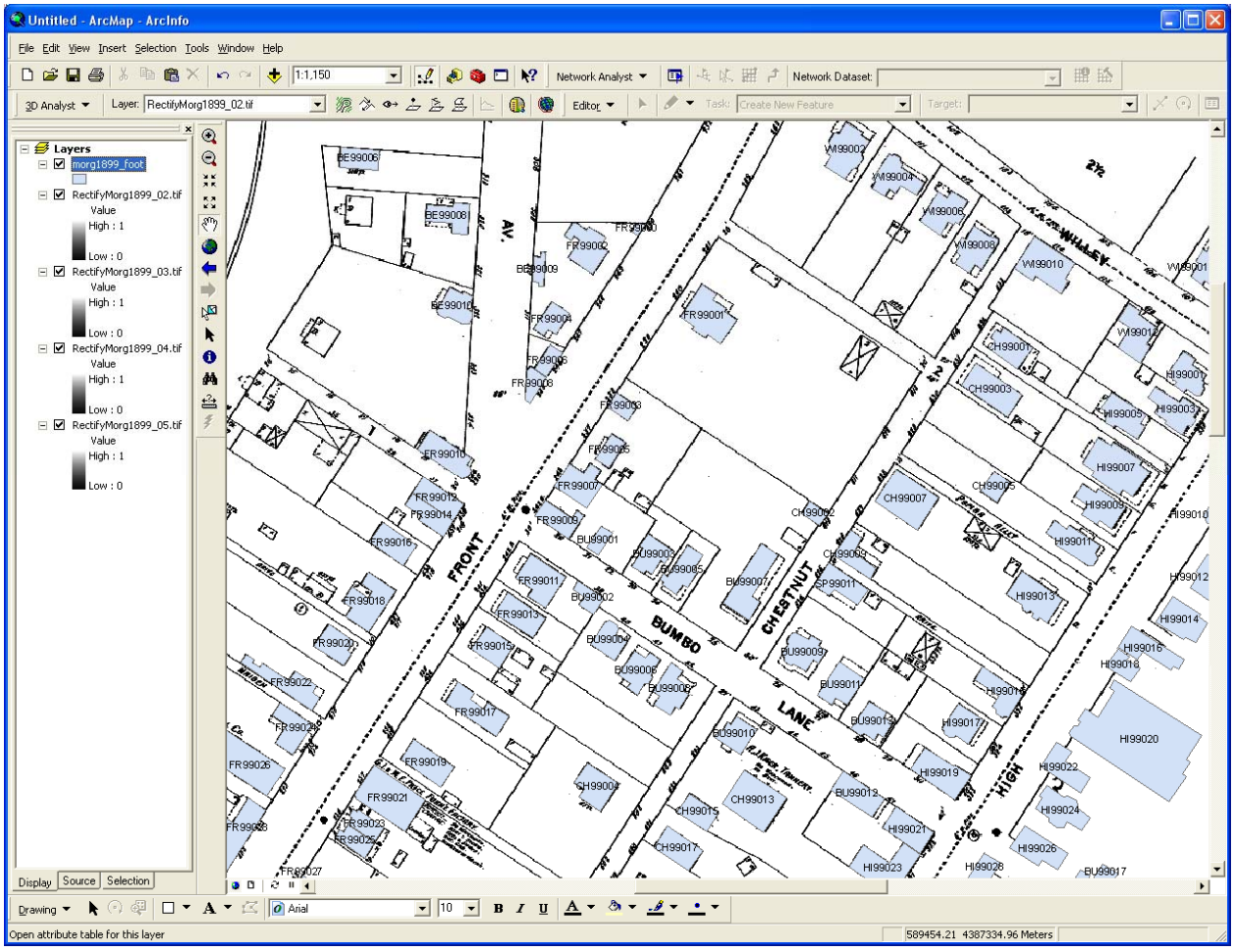
1. Sanborn fire insurance maps for Morgantown, West Virginia in TIFF format
   (1899 was our base year)
   These were used to digitize building footprints, lots and street layout
2. Historical photographs and text descriptions, which were used to guide our model construction, as well as guide placement of point markers for vegetation and street lamps
3. Elevation data gathered from LIDAR points, and converted into ESRI GRID format

Historical photo of Morgantown, WV c. 1894

Once the data was assembled, we began by digitized the building footprints, as these were needed for multiple portions of the project. The team consisted of Sue Bergeron and Jesse Rouse as Project Leaders and GIS specialists, Zach Pride and Lucy Kammer, undergraduate research assistants, and several undergraduate interns.

Building footprints

1. Georeference Sanborn map sheets
    a. Each TIFF was georeferenced to a projected coordinate system
    b. Georeferenced sheets were brought in ArcMap
2. Digitize building footprints into ESRI polygon shapefile
    a. Each building outline was digitized as a single polygon
    b. Each polygon was assigned a BuildingID number as a key field in the shapefile attribute table. In this case, an alphanumeric code was used, where the first two digits represents a two-letter abbreviation for the street name, followed by a two-digit abbreviation for the year of the Sanborn map set, and a three-digit identifier for individual structures (e.g. FR99001)



Digitizing building footprints from georeferenced Sanborn map sheet

GIS layers

Building centroids

1. Use ArcMap tool to generate centroid point shapefile for footprint polygons
2. Assign BuildingID to each centroid to be used as a key field in attribute table
   (Each model is displayed as a 3D marker symbol for a point)

Ground surface

1. Digitize polygons from Sanborn lot and street boundaries
2. Assign code for ground cover type as an attribute
   (Example: 1 - grass cover, 2 – brick, etc.)
3. Add relevant attribute data to table, including address, occupant or business name, and other information

Elevation

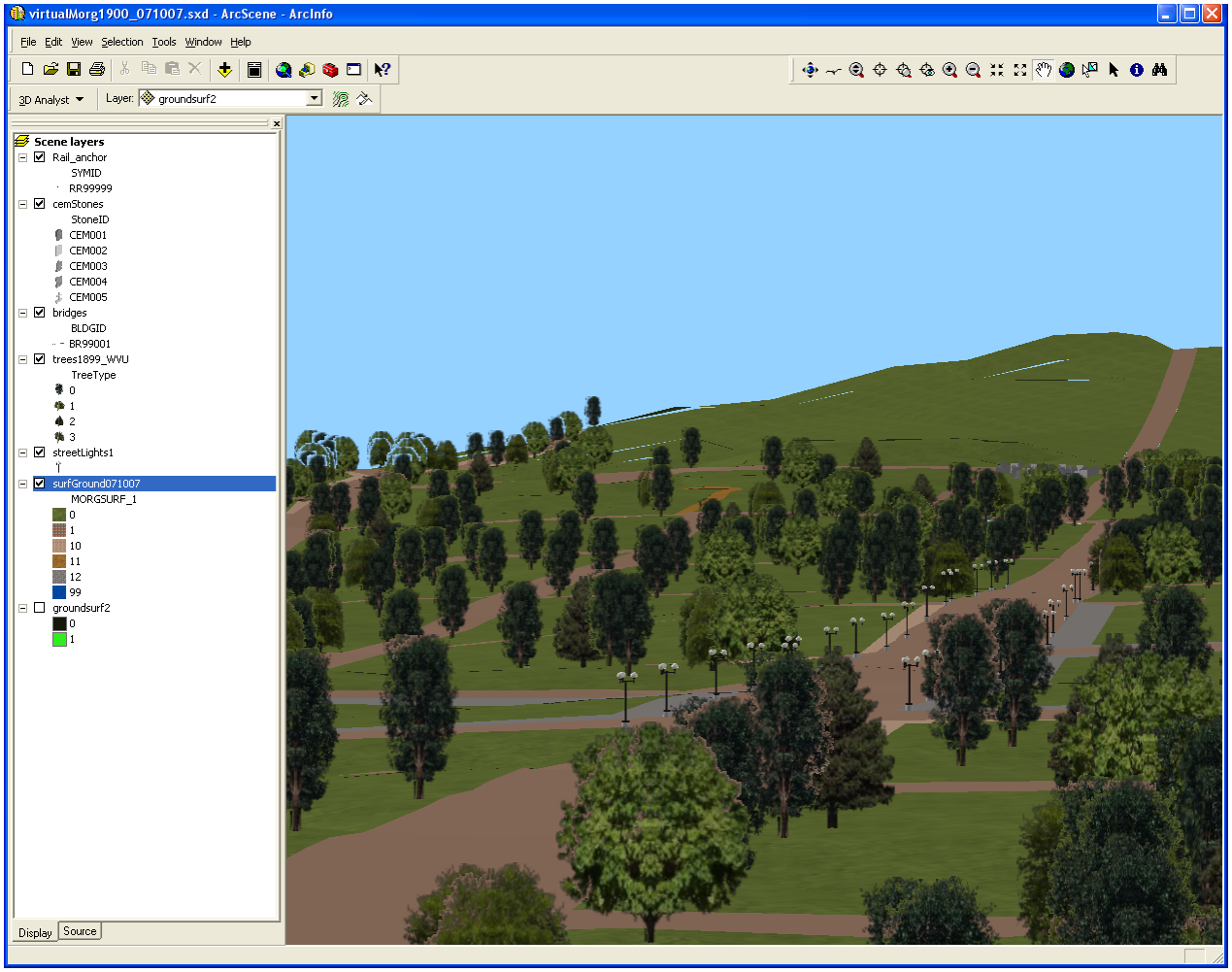
1. Generate surface raster (we have access to LIDAR data that was acquired for the area under a grant)
2. Using zonal statistics in ArcToolbox, assign elevation values to the building centroids

Street Furniture

1. Points were digitized into a shapefile along the streets in the commercial, based on historical photographs
2. The street lamp symbol type was added as a 3D marker symbol in ArcScene.

Vegetation

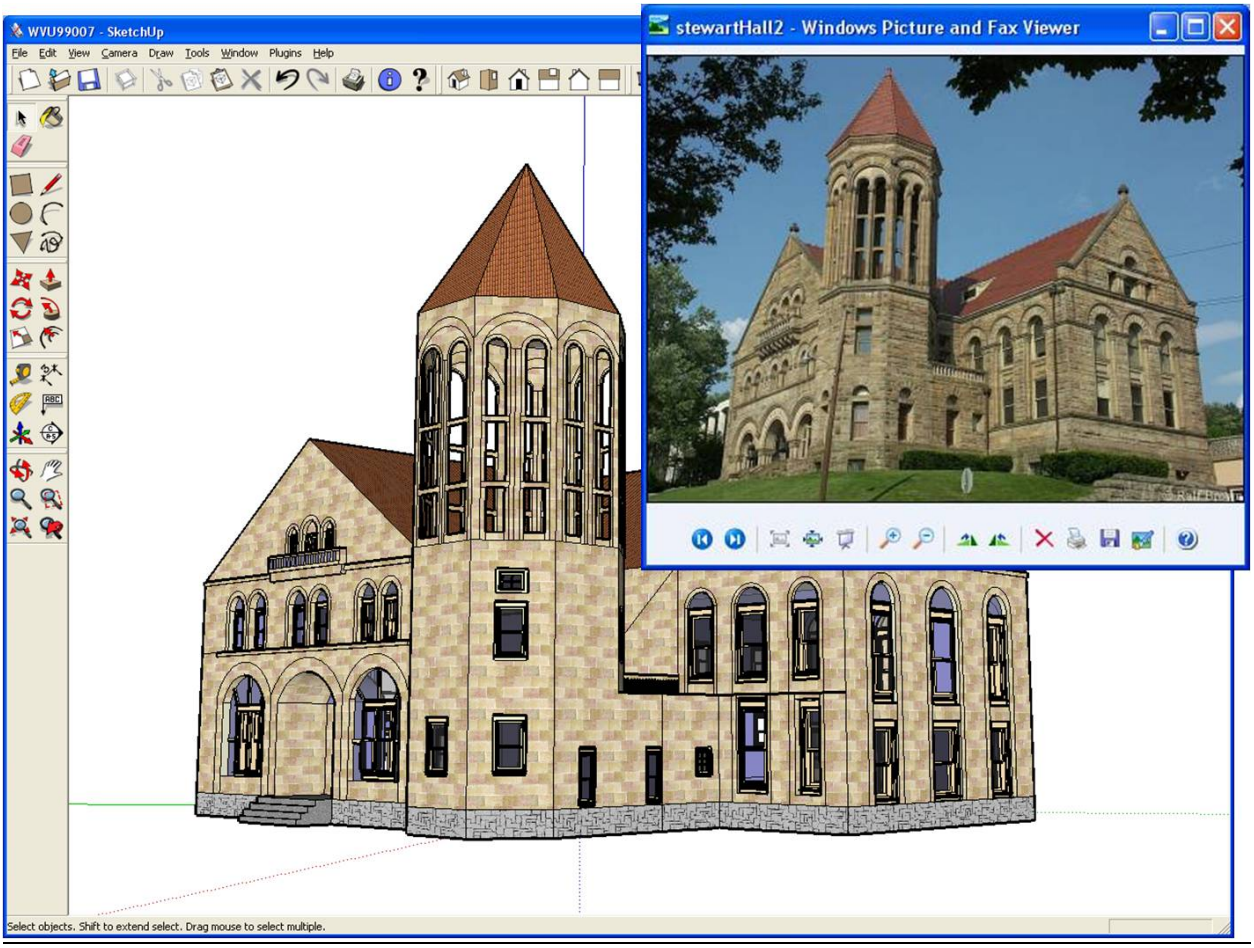
1. Digitize points for tree locations into a shapefile based on historical photographs, and some random locations designed to give a feel for the look of the town in 1900
2. Assign code for tree type as an attribute – we used 5 types for our project
   (Example: 1 - maple, 2 – oak, etc.)
3. Set ESRI 3D tree marker symbols for each tree type



Ground surface layer, trees, and street furniture in ArcScene

3D Models

1. Select footprint for model in ArcMap, and right-click on the footprint shapefile to export the selected footprint to a separate shapefile. Name the exported footprint with its appropriate BuildingID (Example: FR99010.shp)
2. Import footprint into SketchUp (since the footprint was digitized from a georeferenced source, it should already have the correct orientation in X,Y space)
3. Sketch outline of footprint to start SketchUp model (Make sure to check corners for right angles, since georeferencing can stretch the original image and change angle of corners)
4. Once model is completed, save as a SketchUp version 5 model (or Version 4 if you have troubling importing the models into the ESRI style gallery), making sure to name the model with the BuildingID that corresponds to the location (example: HI99001)

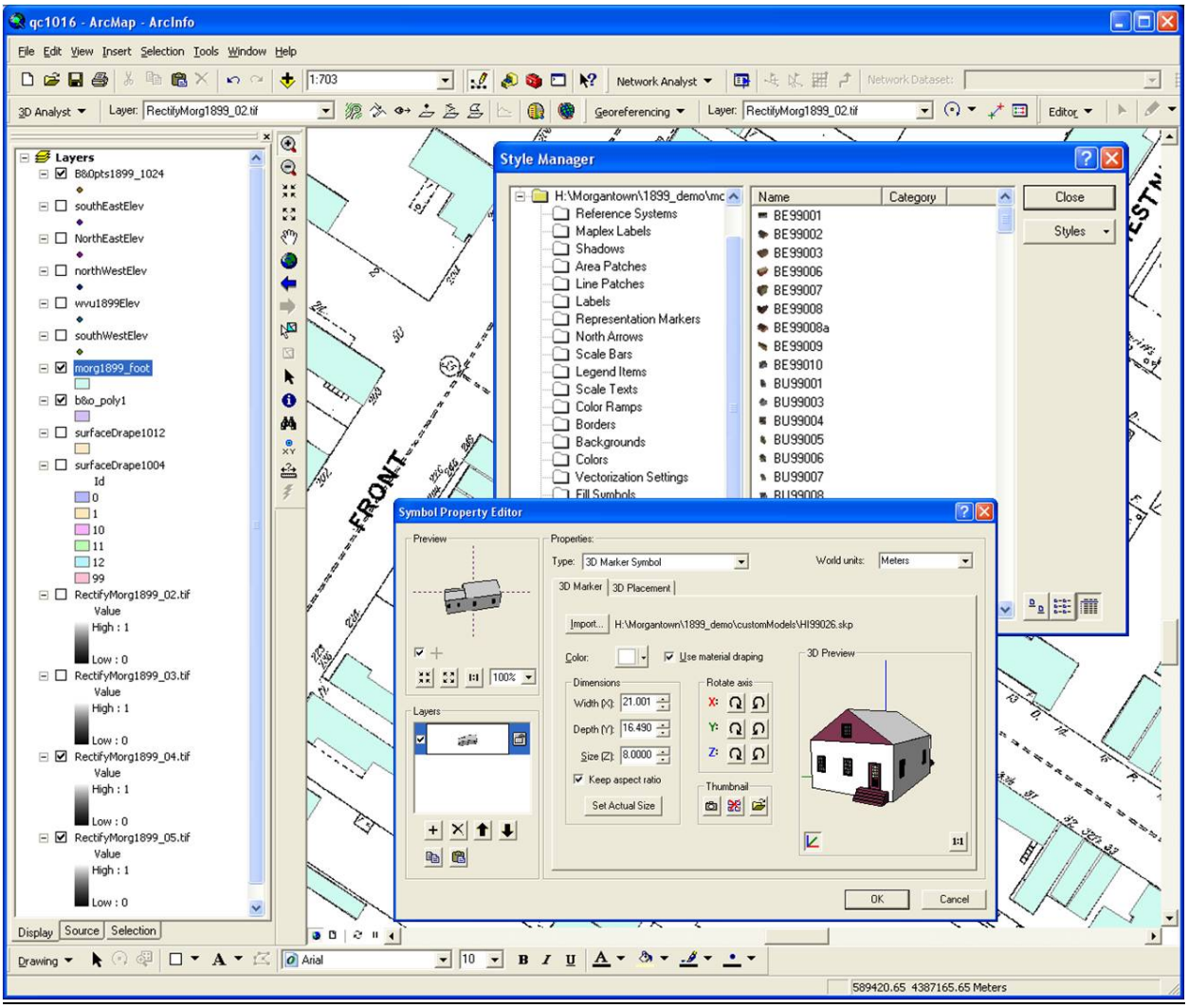


Custom ArcGIS 3D style gallery

1. Create a new custom 3D style gallery
    a) Open Style Manager (Tools|Styles|Style Manager)
    b) Click Style drop-down button, and scroll to bottom and click Create New….
    c) Name your new style and save in an appropriate location for your project

2. Add 3D models to custom style gallery as 3D symbols
    a) Expand your custom style in the Style Manager Tree View, and Click on Marker Symbols. This is where your 3D building symbols will be stored
    b) Right-click in the view on the right, and choose New|Marker Symbol
    c) The Symbol Editor dialog will open, and you will choose 3D marker symbol under Type and navigate to the file location of your SketchUp model, and click Open.

Once the model is in the Symbol Editor, preview it from all angles to make sure there are no errors from the import process. Once you are satisfied, click OK and the 3D model will be added to the style gallery as a 3D marker symbol. It can now be used in any ArcScene project.

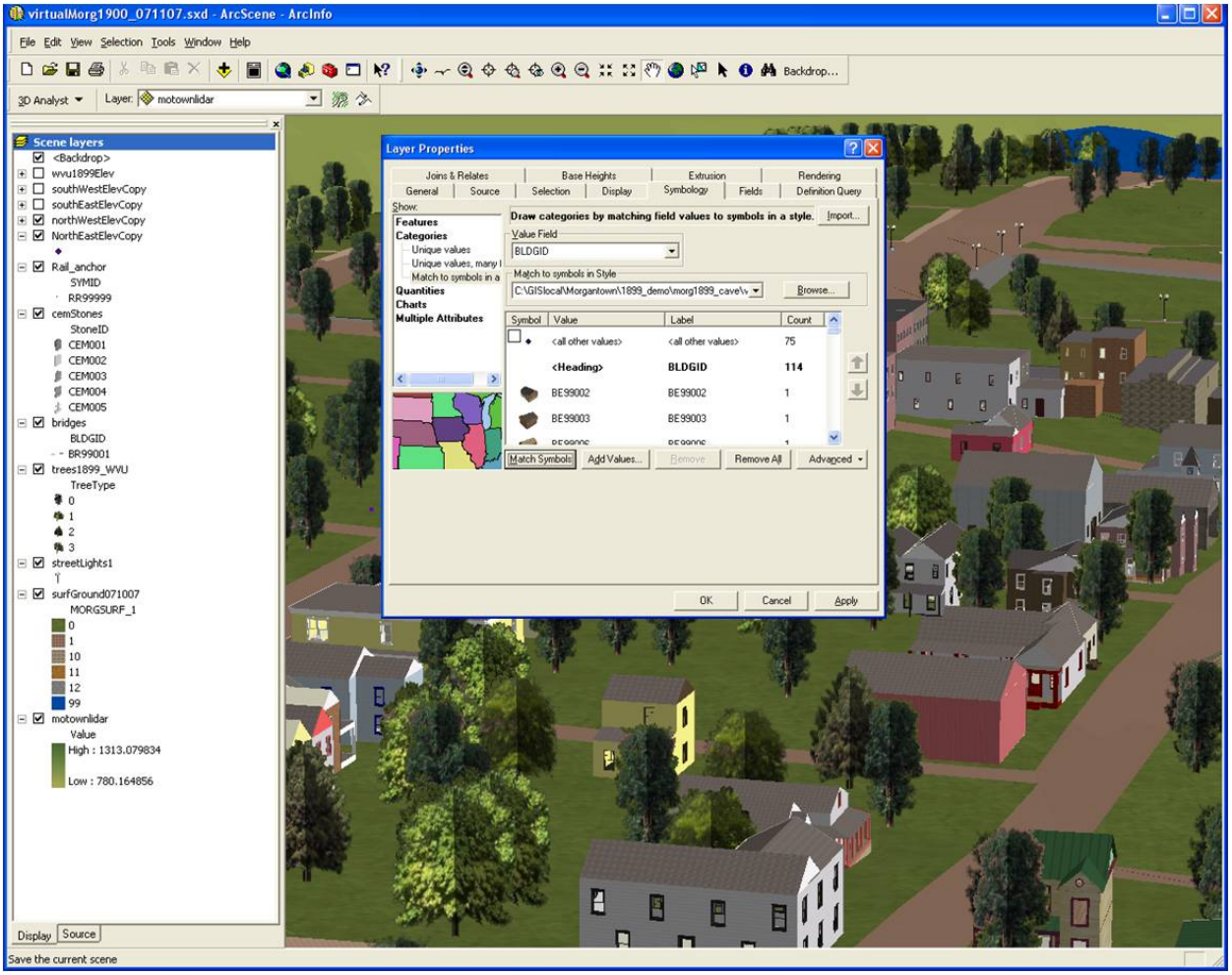


Adding a SketchUp model to the custom style gallery

Build ArcScene project

Once the GIS layers and custom style gallery were completed, all that remains is to assemble the elements of the virtual reconstruction in ArcScene.

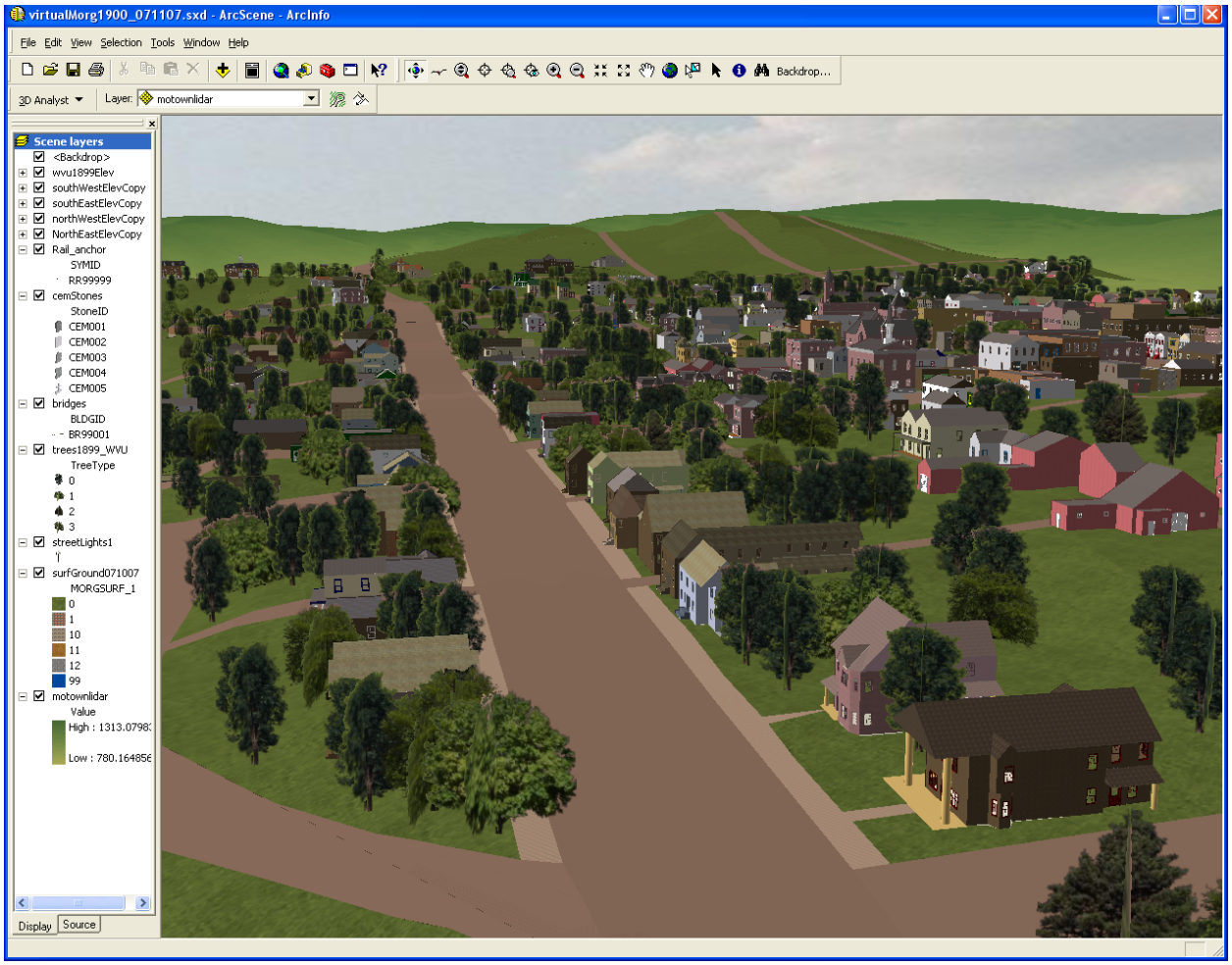
1. Add surface into ArcScene and set Base Heights
2. Add ground surface layer and set Symbology to Fill Textures based on ground cover type
3. Add vegetation and street furniture layers and symbolize with 3D marker symbols based on appropriate type
4. Add point layers for building centroids. In our project, there were five layers, four for the downtown area itself and one for the West Virginia University campus.
5. Right-click on the building layers and go to Symbology tab. Choose Unique values, Match to symbols in a style. Then Choose Add Values and highlight all the values in the dialog box that pops up. Click OK and then click the Match Symbols button. Then click OK and the symbols will be assigned to the points in the layer



Generating symbols by matching to the style gallery

Once everything is added, it is a good idea to turn off the building layers and then save. This way, when the ArcScene project reloads, it will be able to load and cache everything without having to try to draw the symbols as well.

The final step is to perform a QC on the symbols. Although using the georeferenced footprints helps to get the buildings oriented in space, oddly shaped footprints might not be in the right place. In some cases the point itself will have to be moved, in other just a tweak of the angles. The same will be true for the size of the 3D building symbols and even elevation. Another advantage to using the custom style gallery is that the symbol can be edited and then refreshed. Even if a model has to be modified in SketchUp, it needs only to be reloaded into the style gallery and then can be used the next time the ArcScene project is loaded.



Detail of completed ArcScene virtual town

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