Using *Building Footprint Extraction - USA* model in ArcGIS Pro

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Introduction

This document explains how to use the Building footprint extraction - USA pre-trained model available on ArcGIS Living Atlas of the World. The model is used to extract building footprints from high-resolution (10–40 cm) imagery.

Building footprint layers are useful in preparing base maps and analysis workflows for urban planning and development. They also have use in insurance, taxation, change detection, infrastructure planning, and a variety of other applications.

Digitizing building footprints from imagery is a time-consuming task and is commonly done by digitizing features manually. Deep learning models are highly capable of learning these complex semantics and can produce superior results. Use this deep learning model to automate the tedious manual process of extracting building footprints, reducing time and effort required significantly.

Licensing requirements

ArcGIS Desktop – ArcGIS Image Analyst and ArcGIS 3D Analyst extensions for ArcGIS Pro
ArcGIS Enterprise – ArcGIS Image Server with raster analytics configured
ArcGIS Online – ArcGIS Image for ArcGIS Online

Model overview

- Input – Raster, mosaic dataset, or image service.
- Output – Feature class containing building footprints.
- Compute – This workflow is compute-intensive, and a GPU with minimum CUDA compute capability of 6.0 is recommended.
- Applicable geographies – This model is expected to work well in the United States.
- Architecture – This model uses the MaskRCNN model architecture implemented in ArcGIS API for Python.
- Accuracy metrics – This model has an average precision score of 79.1 percent.

Accessing the model

Download the Building Footprint Extraction - USA pre-trained model from ArcGIS Living Atlas of the World. Alternatively, access the model directly from ArcGIS Pro 2.7 (and later), or consume it in ArcGIS Image for ArcGIS Online.

Downloading the model

1. Browse to ArcGIS Living Atlas of the World.
2. Sign in with your ArcGIS Online credentials.
3. Search for **Building Footprint Extraction – USA** and open the item page from the search results. Alternatively, download the pre-trained model from here.
4. Click the **Download** button to download the model. The downloaded DLPK file can be directly used in ArcGIS Pro, or uploaded and used in ArcGIS Enterprise. Additionally, you can even fine-tune the pre-trained model if necessary.

Preprocessing

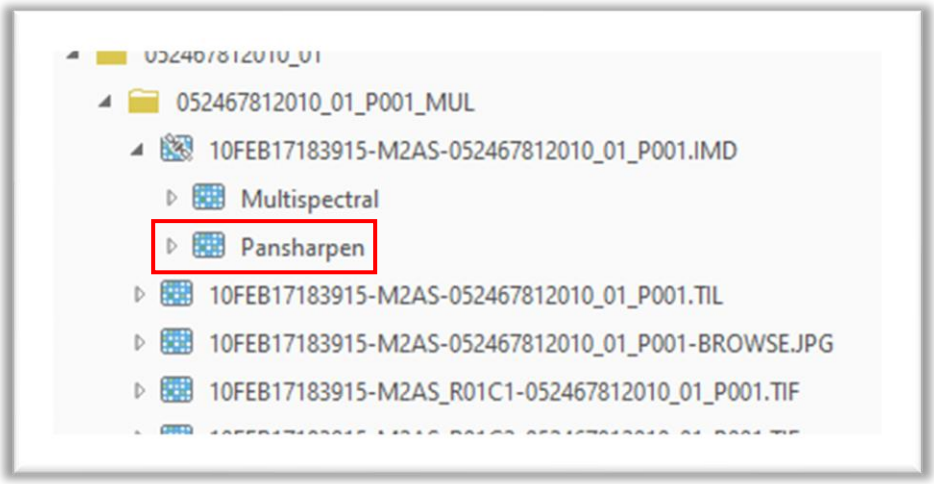
Recommended imagery configuration

- Resolution – High resolution (10-40 cm)
- Dynamic range – 8-bit
- Bands – Three bands (for example – Red, Green, and Blue)
- Imagery – Orthorectified imagery (both on-the-fly and persisted ortho products work)

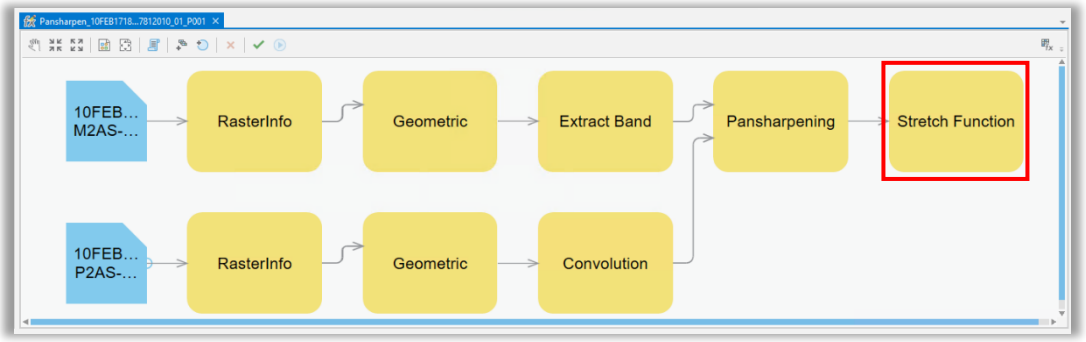
  (Note: Off-nadir imagery or imagery with a high obliquity angle will not produce suitable results)

Example - Processing Worldview-2 imagery

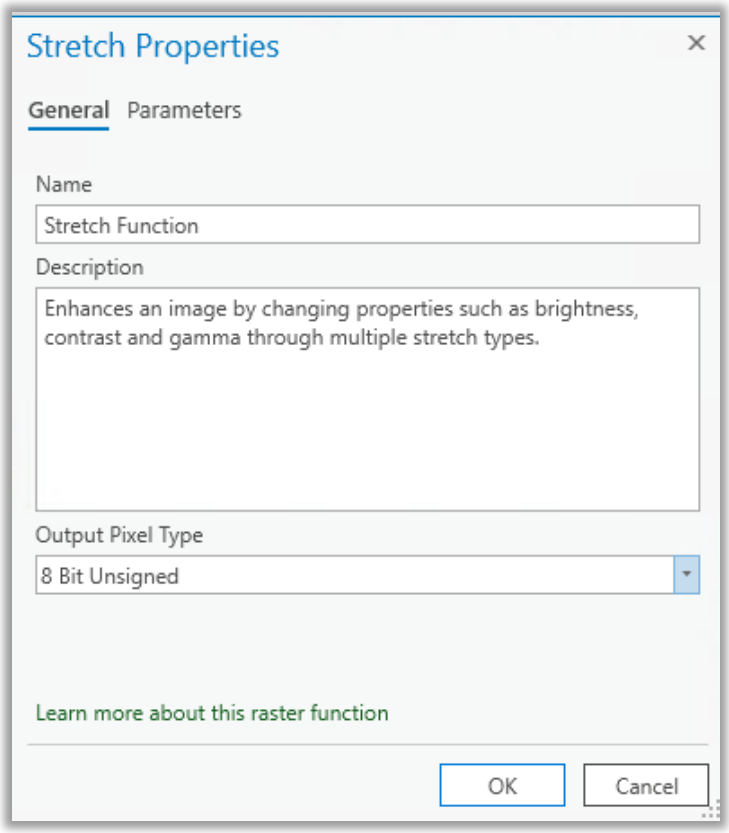
1. Open ArcGIS Pro and navigate to the image product in the **Contents** pane.
2. Expand the product (.imd file) and add the Pansharpen layer to the map.

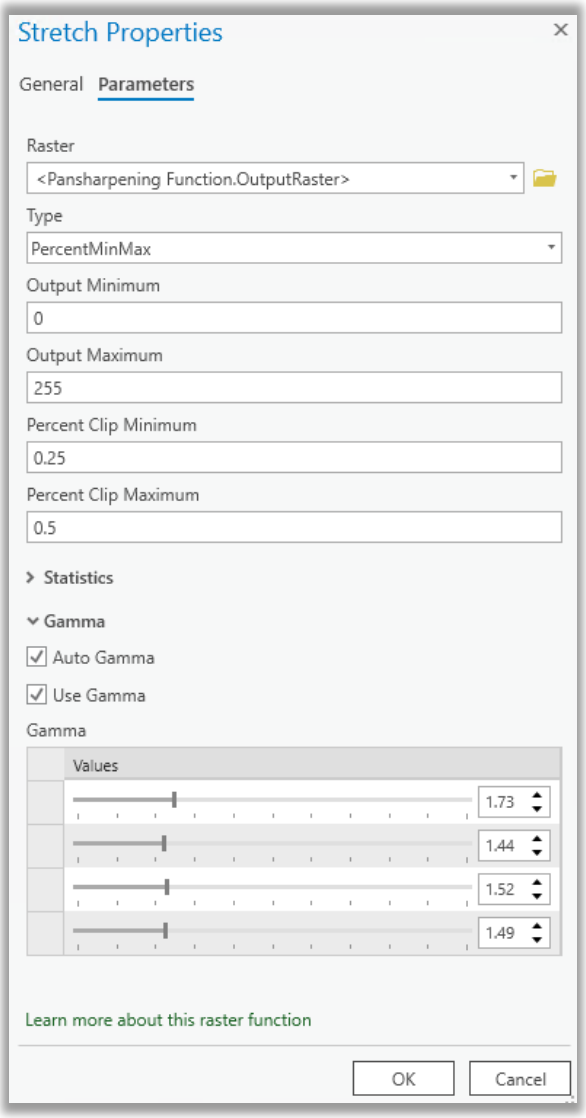


3. Right-click the newly added layer and select **Edit Function Chain**.
4. Click **Stretch Function** in the function chain window to edit the stretch properties.

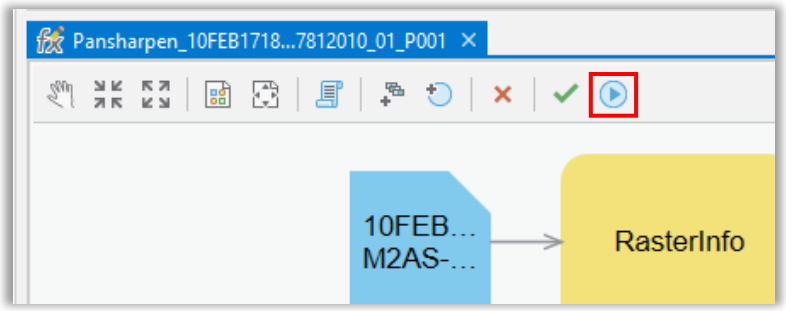


5. Change the **Stretch Properties**.



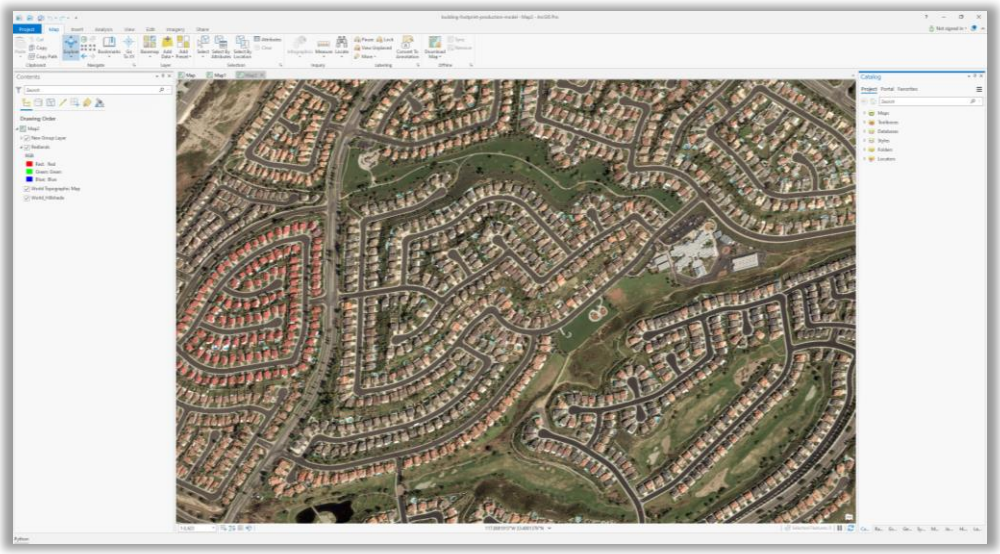


6. Click the **Apply** button to apply the changes.

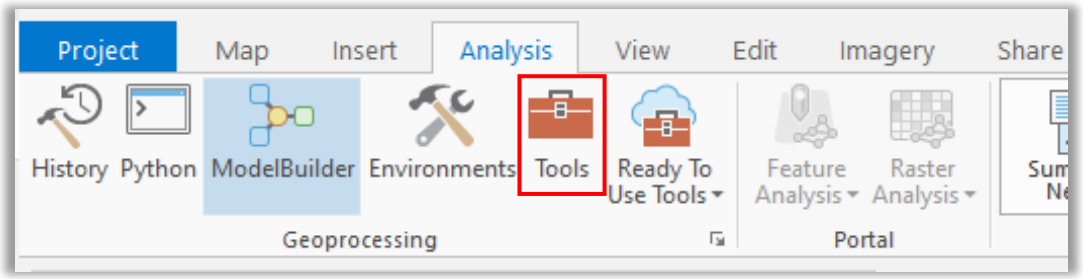


Using the model

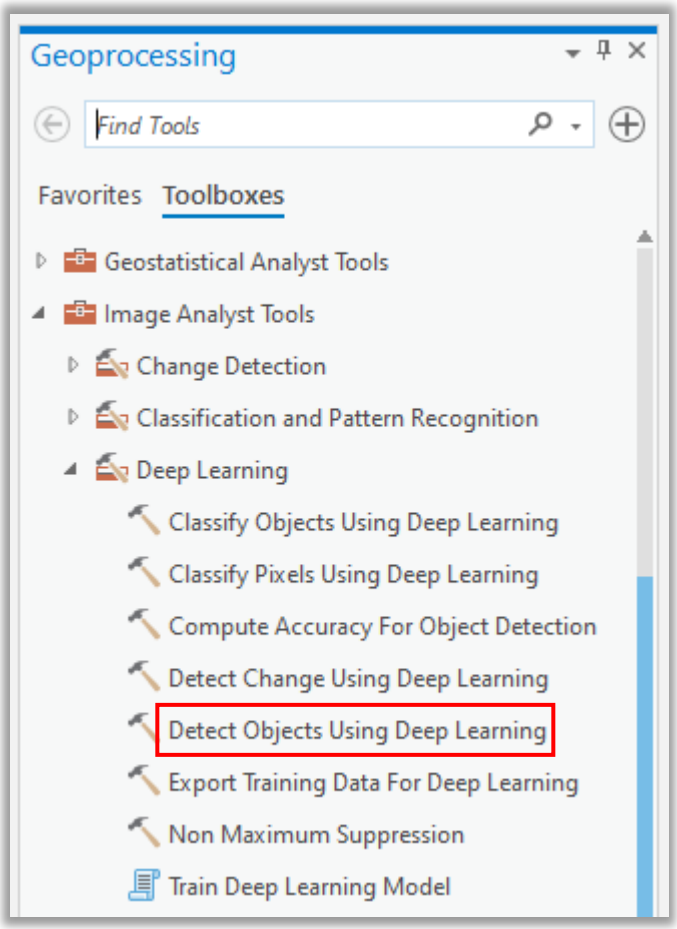
1. Make sure you have downloaded the Building Footprint Extraction - USA model and added the imagery layer in ArcGIS Pro.
2. Zoom to an area of interest.



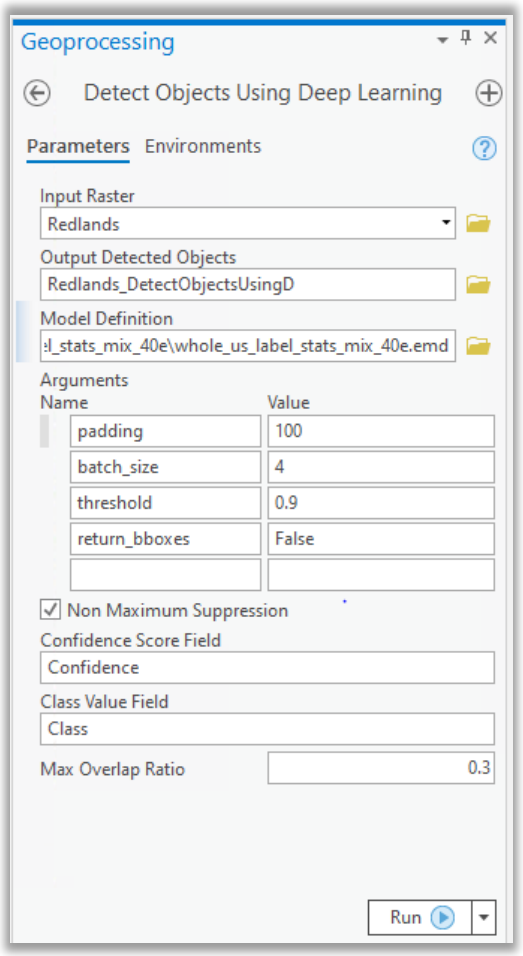
3. Browse to **Tools** under **Analysis** tab.



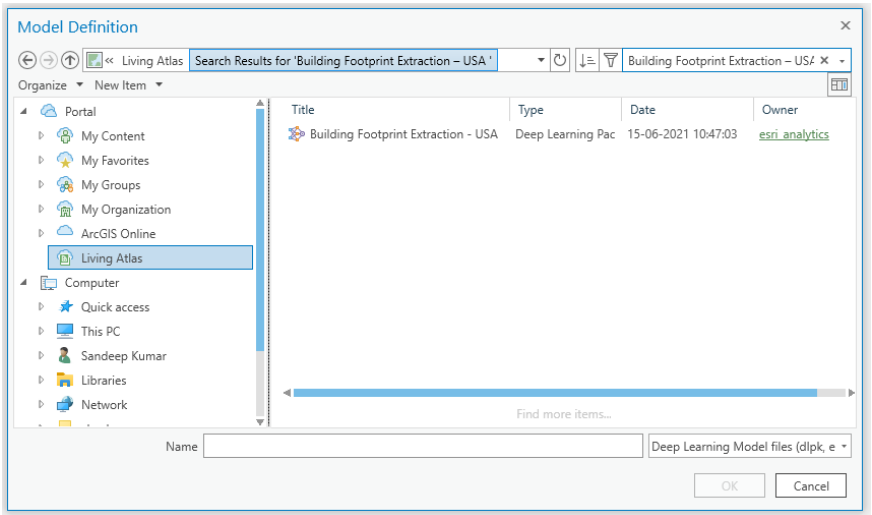
4. Click **Toolboxes** tab in the Geoprocessing pane, select **Image Analyst Tools** and browse to Detect Objects Using Deep Learning **tool** under **Deep Learning**.



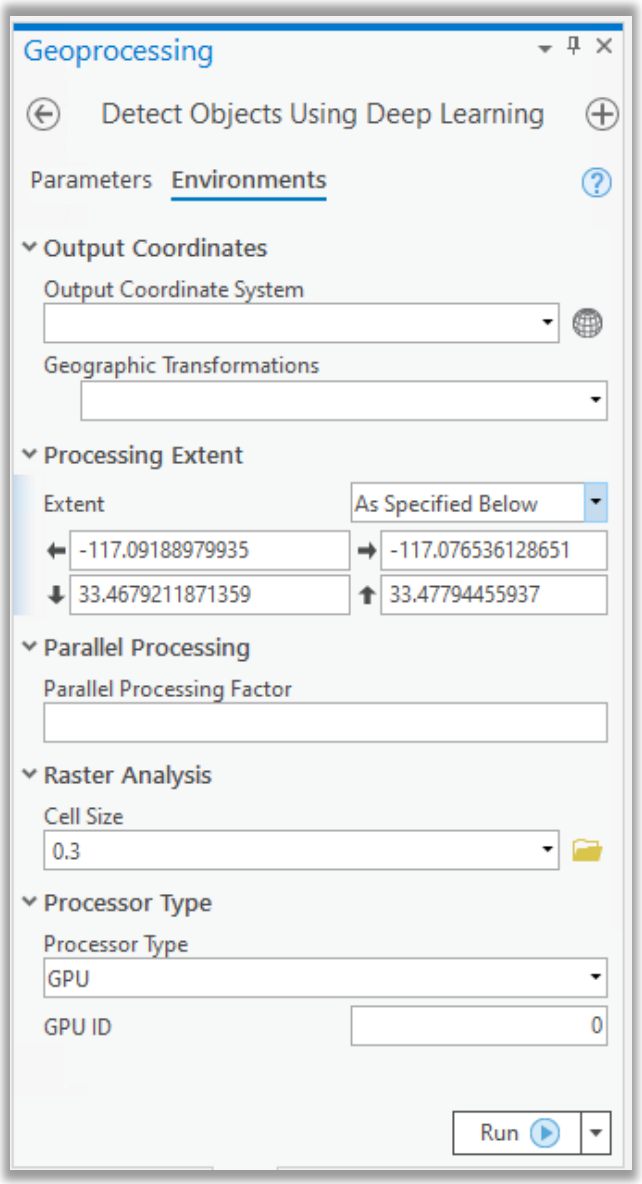
5. Set the variables under **Parameters** tab as follows:
    a **Input Raster** – Select the imagery.
    b **Output Detected Objects** – Set the output feature class that will contain the detected objects.
    c **Model Definition** – Select the pre-trained/fine-tuned model DLPK file.
    d **Model Arguments** (optional) – Change the values of the arguments if required.
    e **Non Maximum Suppression** (optional) – Toggle the checkbox as needed. If checked:
        i Set the **Confidence Score Field** (optional).
        ii Set the **Class Value Field** (optional).
        iii Set the **Maximum Overlap Ratio** (optional).



Note: To access the model directly from ArcGIS Pro (supported in ArcGIS Pro 2.7 and later), click on the browse button and search for the model as depicted below.



6. Set the variables under **Environments** tab as follows:
    a) **Processing Extent** – Select Current Display Extent or any other option from the drop-down menu.
    b) **Cell Size (required)** – Set the value to **0.3**. (Note: 0.3 meters is the raster resolution.)
    c) **Processor Type** - Select CPU/GPU as per the need. (Note: If GPU is available, it is recommended to select GPU and set **GPU ID** to specify the GPU to be used.)

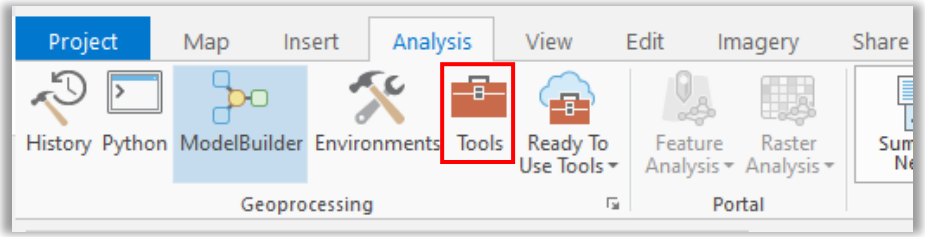


7. Click **Run** to execute. As soon as processing finishes, the output layer is added to the map.

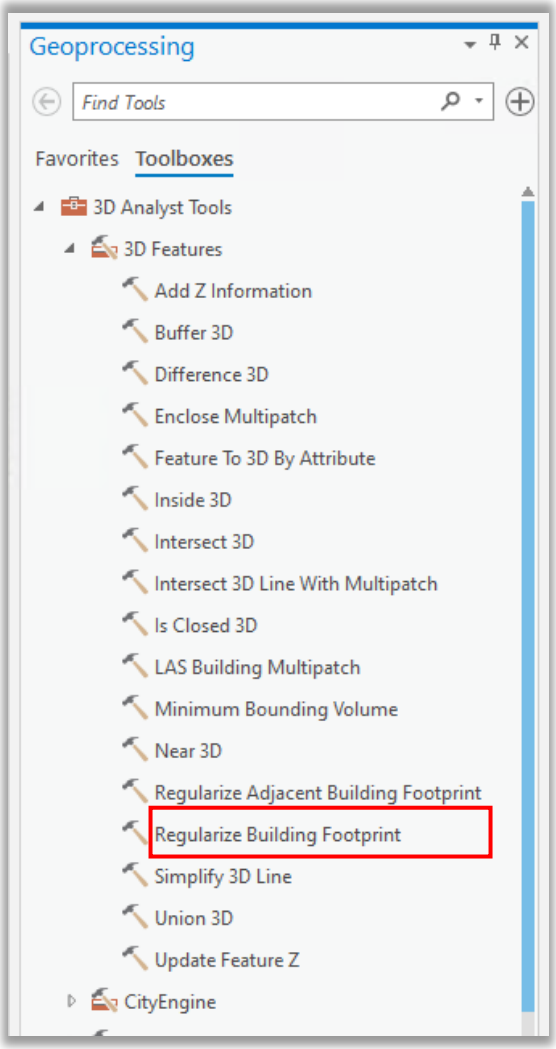
Postprocessing

Follow the steps below to improve the visual appearance of the extracted building footprint features.

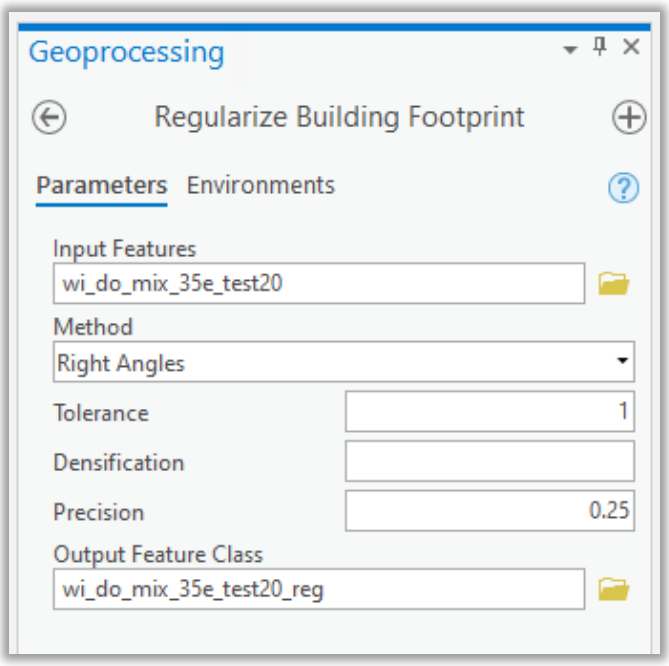
1. Browse to **Tools** under **Analysis** tab.



2. Click **Toolboxes** tab in the Geoprocessing pane, select **3D Analyst Tools** and browse to Regularize Building Footprints tool.



3. Set the variables under **Parameters** tab as follows:
    a. **Input Features** – Select the imagery layer.
    b. **Arguments** (optional) – Change the values of the arguments if required.
    c. **Output Feature Class** – Set the output feature class that will contain the regularized building footprints.



4. Click **Run**. As soon as processing finishes, the output layer is added to the map.

Here is a close look at the results: