



# Using Deep Learning Algorithms to Create Land Cover 2.0

October 13, 2021

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# Background

- Land Cover 1.0 was produced for us (LARIAC4) by University of Vermont
- Used eCognition
- Advantages:
  - First of its kind in LA
- Disadvantages:
  - Cannot replicate work
  - Limited classes

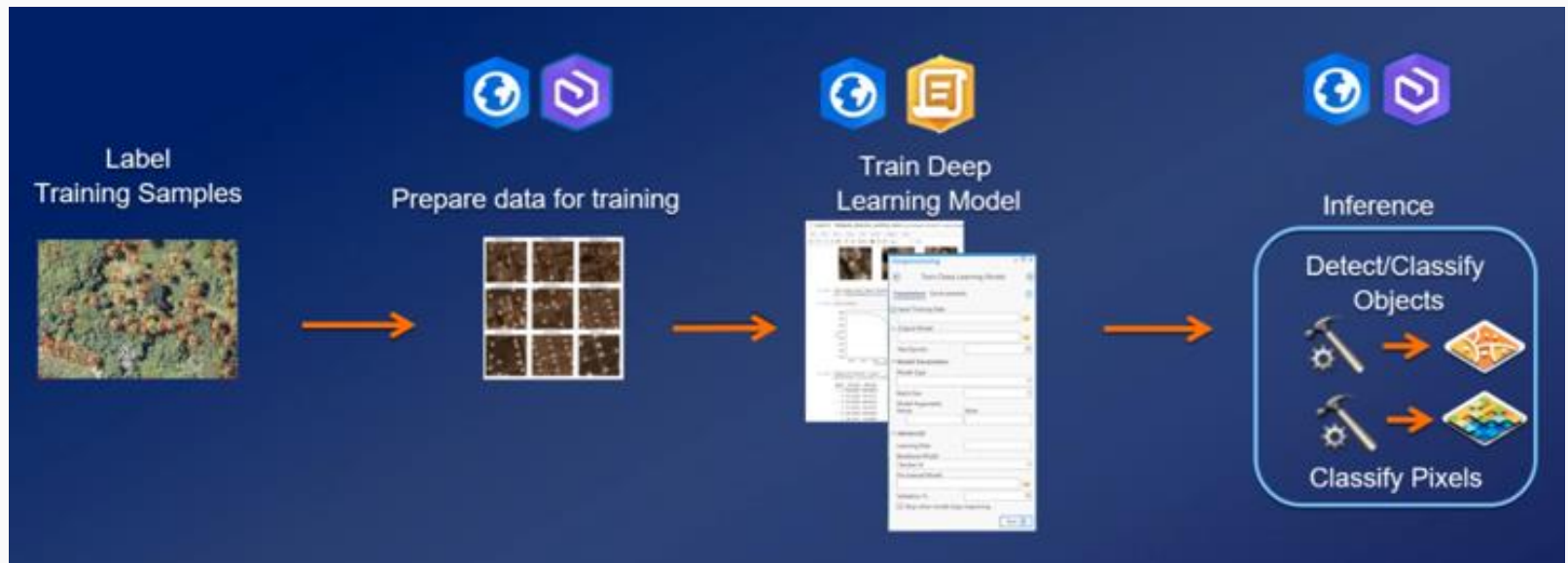


# Goals

- PW Stormwater Planning Division will update the parcel-based assessment fee for Measure W
  - The calculated tax is based upon the parcel's impermeable area as determined by the County Landcover Survey or other applicable tool.
- Create a parcel fee change report
- Include additional classes (e.g. gravel)
- Have control over the deep learning algorithms

# New Methodology for Land Cover 2.0

- Deep learning with imagery in ArcGIS



Source: Esri

End-to-end process from raw imagery to structured information products

# Hardware & Software Acquisition

- 3 high performance computers with Graphical Processing Units (GPUs)
  - Precision 7920 Xeon 4216 2.1GHz, 16 Core processor, includes 1TB PCIe NVMe drive
  - Additional 64GB upgrade on CCPP
  - Separate open market purchase the Nvidia Quadro RTX5000, 16GB, 4DP, VirtualLink graphics card
- 32-inch monitors
- Esri Image Analyst extension

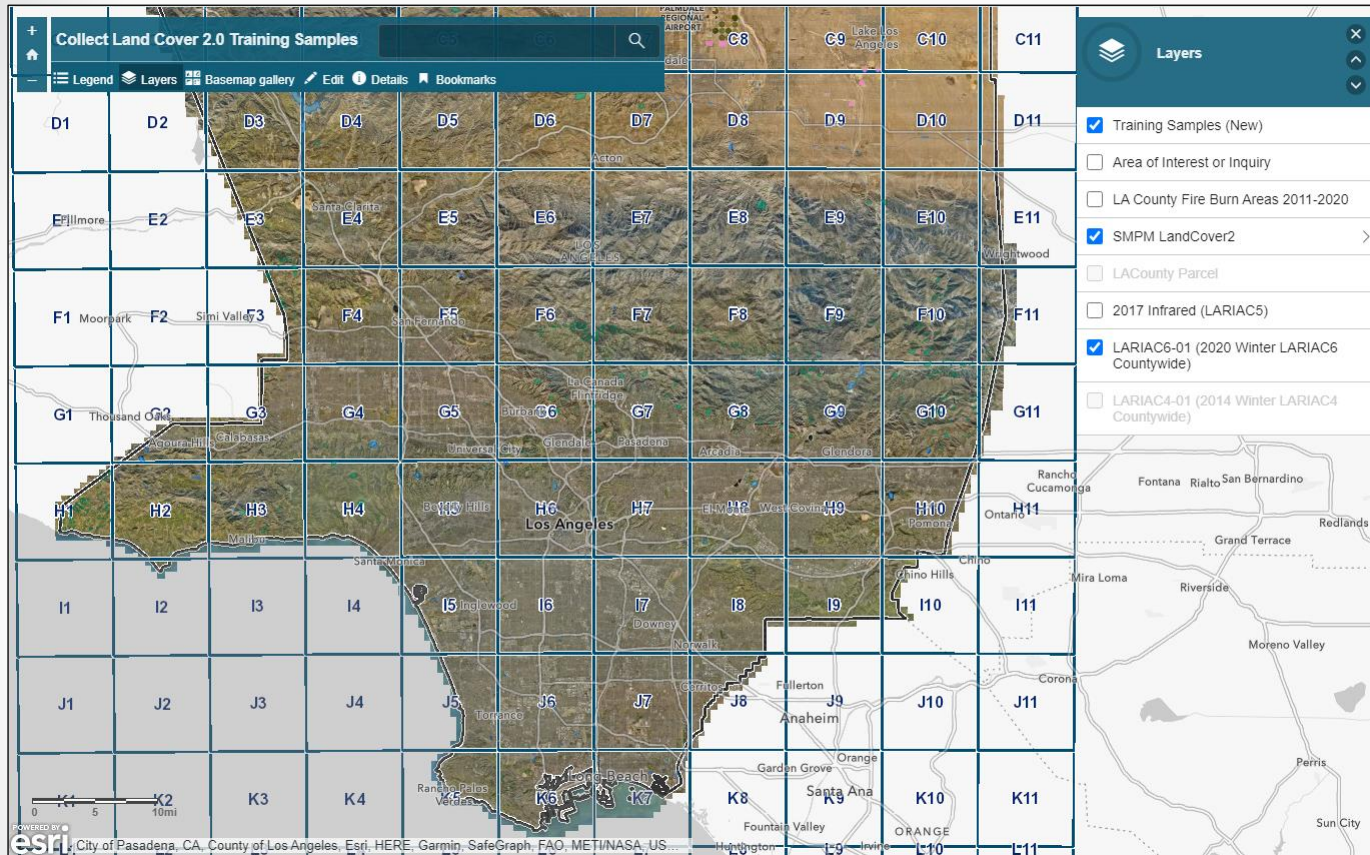
# Data Inventory

- LARIAC4 LiDAR (2016)
- LARIAC5 Imagery (2020): 4-inch, 4 band RGB-IR ortho
- LARIAC5 Building outlines (2020)
- CAMS street centerlines
- Parcels with gravel

# Land Cover Classes

Land Cover 1.0	Land Cover 2.0
Tree Canopy	Tree Canopy
Grass/Shrubs	Urban Grass/Shrubs
Tall Shrubs	Rural Shrubland
Bare Soil	Bare Soil
Water	Water Bodies
Buildings	Buildings
Roads/Railroads	Roads/Railroads
Other Paved	Other Paved
	Gravel
	Pools/Fountains

# Collect Land Cover 2.0 Training Samples Web App



## Training Samples (New)

-  Water Bodies
-  Pools/Fountains
-  Urban Grass/Shrubs
-  Rural Shrubland
-  Tree Canopy
-  Other Paved
-  Bare Soil
-  Gravel

Not included:

Buildings  
Roads/railroads



# Create Training Polygons



# Create Training Polygons



# QA/QC Web App

Home ▾ Land Cover 2.0 Training Sample WebMap (FOUO) ✎ Open in new Map Viewer New Map Christine ▾

Details Add ▾ Edit Basemap Analysis Save ▾ Share Print ▾ Directions Measure Bookmarks

**Contents**

- Training Samples (New)
- Area of Interest or Inquiry
- LA County Fire Burn Areas 2011-2020
- SMPM LandCover2
- LACounty Parcel
- 2017 Infrared (LARIAC5)
- LARIAC6-01 (2020 Winter LARIAC6 Countywide)
- LARIAC4-01 (2014 Winter LARIAC4 Countywide)
- Human Geography

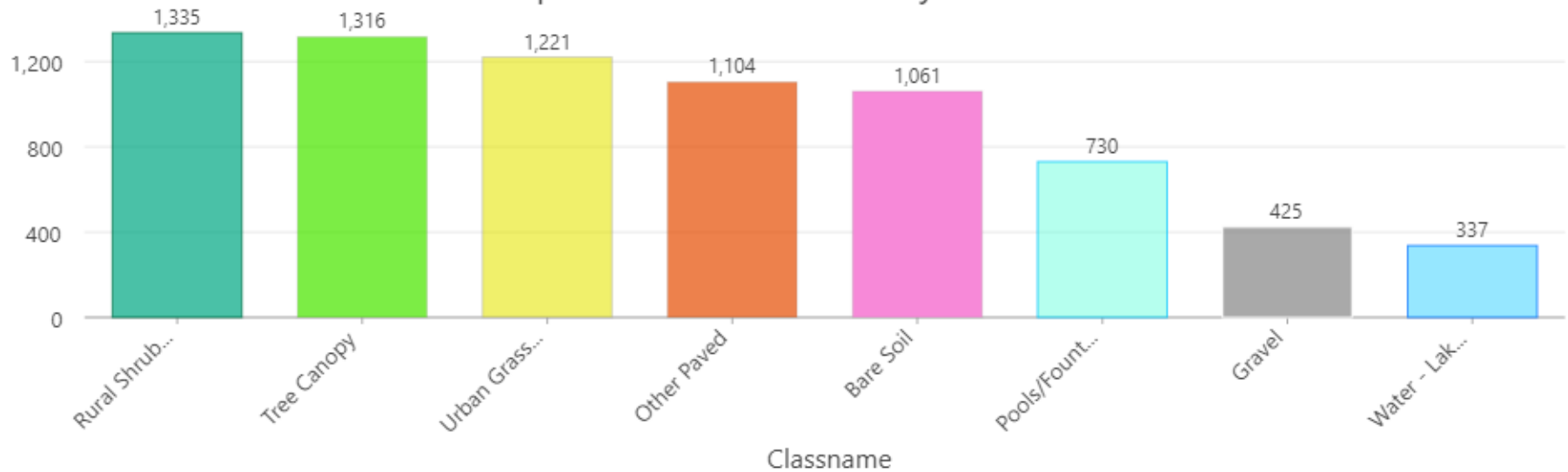
Esri Community Maps Contributors, County of Los Angeles, © OpenStreetMap contributors, Micro...

**Training Samples (New) (Features: 7529, Selected: 1)**

Classvalue	Classname	SampleCreator	SampleEdited	SampleDate	CreationDate	Creator
4	Water - Lakes, Reservoirs, Channels, Streams, etc	TMorita@dpw.lacounty.gov_lacounty	8/16/2021	8/9/2021	9/1/2021	TMorita@dpw.lacounty.gov_lacounty
5	Other Paved	MGreninger@dpw.lacounty.gov_lacounty	8/10/2021	8/10/2021	9/1/2021	TMorita@dpw.lacounty.gov_lacounty
2	Urban Grass/Shrubs	MGreninger@dpw.laco	8/10/2021	8/10/2021	9/1/2021	TMorita@dpw.lacounty

# Training Polygon Counts

Comparison of data counts by Classname



Not included:

Buildings  
Roads/railroads

# Geoprocessing Tools in ArcGIS Pro

- Export Training Data for Deep Learning to create image chips

**Export Training Data For Deep Learning**  
(Image Analyst Tools)

**Started:** Wednesday, September 8, 2021 at 8:23:45 AM  
**Completed:** Thursday, September 9, 2021 at 11:31:17 PM  
**Elapsed Time:** 1 Day 15 Hours 7 Minutes 32 Seconds

**Parameters** Environments Messages

Input Raster	Countywide
Output Folder	E:\Land_Cover_Working \Export_Training_20210908v5
Input Feature Class Or Classified Raster Or Table	TrainingSamples_Vin
Image Format	TIFF
Tile Size X	512
Tile Size Y	512
Stride X	256
Stride Y	256
Output No Feature Tiles	ONLY_TILES_WITH_FEATURES
Metadata Format	Classified_Tiles
Start Index	0
Class Value Field	Classvalue
Buffer Radius	0
Input Mask Polygons	
Rotation Angle	0
Reference System	MAP_SPACE
Processing Mode	PROCESS_AS_MOSAICKED_IMAGE
Blacken Around Feature	NO_BLACKEN
Crop Mode	FIXED_SIZE
Additional Input Raster	

# Geoprocessing Tools in ArcGIS Pro

- Train Deep Learning Model

The screenshot shows the 'Train Deep Learning Model' tool interface in ArcGIS Pro. The tool is titled 'Train Deep Learning Model' and has a 'Pending edits.' status bar. The 'Parameters' tab is active, showing the following settings:

- Input Training Data:** Export\_Training\_20210908v5
- Output Model:** Deep\_Learning\_v3
- Max Epochs:** 20
- Model Parameters:**
  - Model Type:** U-Net (Pixel classification)
  - Batch Size:** 2
- Model Arguments:**

Name	Value
class_balancing	False
mixup	False
focal_loss	False
ignore_classes	
chip_size	224

At the bottom, there is a link to '> Advanced'.

# Geoprocessing Tools in ArcGIS Pro

- Classify Pixels Using Deep Learning

The screenshot shows the 'Classify Pixels Using Deep Learning' tool interface in ArcGIS Pro. The tool is titled 'Classify Pixels Using Deep Learning' and has two tabs: 'Parameters' and 'Environments'. The 'Parameters' tab is active. The tool has three main input fields: 'Input Raster' (set to 'Imagery'), 'Output Classified Raster' (set to 'predicted\_Jargearea'), and 'Model Definition' (set to 'C:\Esri\_project\Edge\_detection\_Ready\_to\_use\_model\data\_for\_ec'). Below these fields is an 'Arguments' section with a table of parameters and their values.

Name	Value
padding	56
batch_size	4
thinning	False

# Final Steps

- QA/QC and Accuracy Assessment
  - Manual inspection
  - Accuracy report
- Parcel Fee Change Report
  - All parcels will have a new impervious surface calculation and a difference is calculated for each parcel.
- February 2022 is targeted completion date
- Release to LARIAC6 members



# ANY QUESTIONS?

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