



# Welcome

## Southwest User Conference

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December 2-4 | Santa Fe, New Mexico

# Creating a Smart 3D City Model



## From Start to Finish

David Vaillancourt



# Workshop Agenda

- Why 3D?
- The process for creating a 3D City
- 3D City Information Model
  - Where to get it?
- Preparing your data using ArcGIS
  - Adding elevation tools
- Working in CityEngine
- Resources



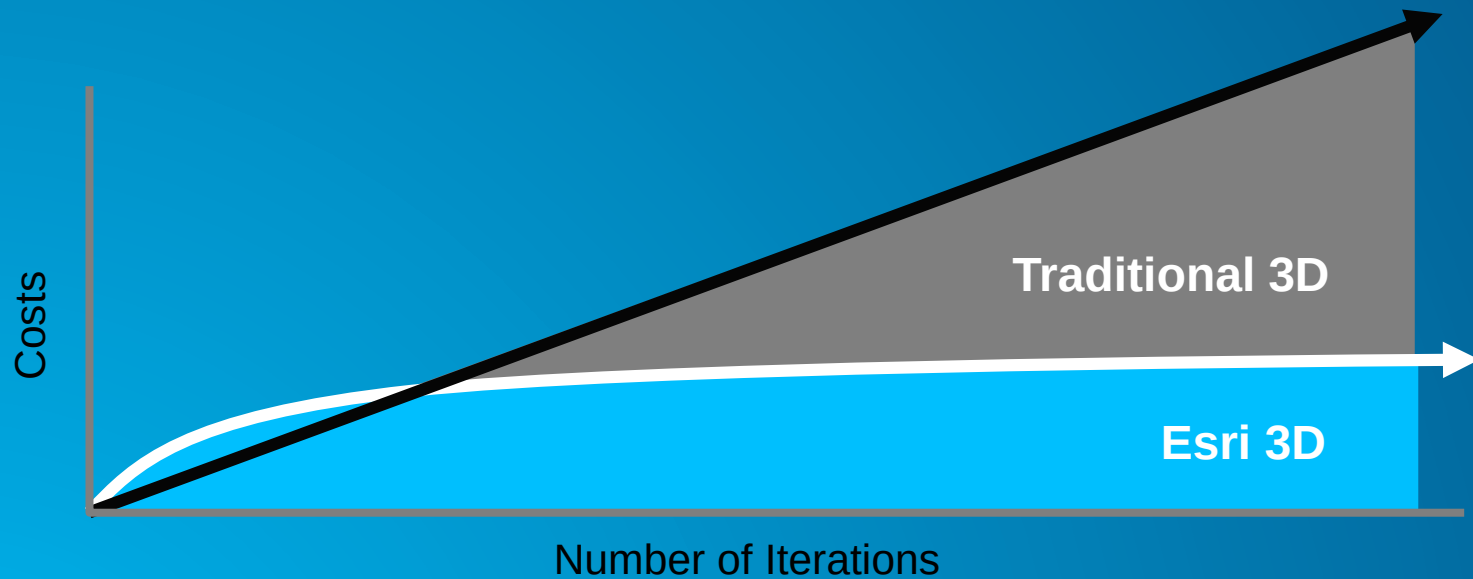


Why 3D?

# Why Procedural Modeling?

Rule-Based Modeling

- Procedural Modeling Saves Time and Costs





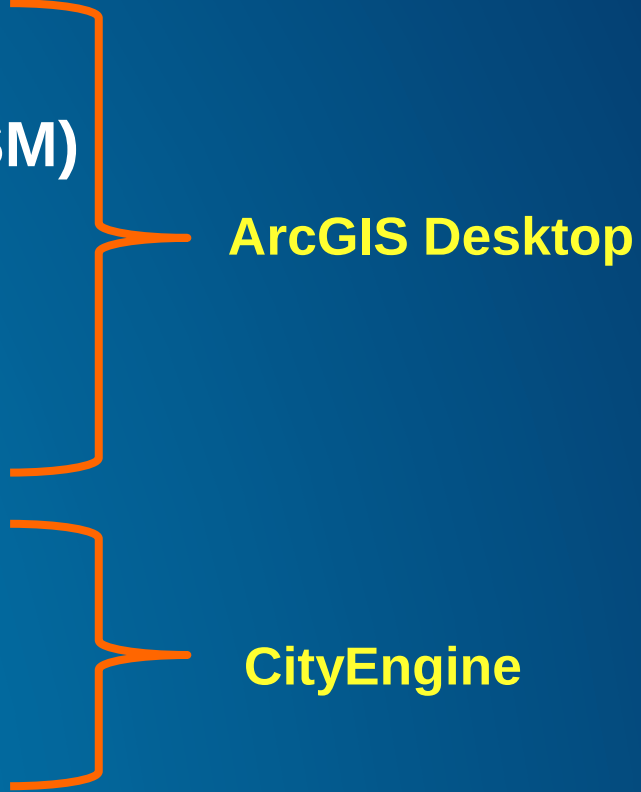
# Creating a Smart 3D City Model

## From Start to Finish



# The process for creating a 3D City

- Prepare your existing data
- Generate elevation products (DTM, DSM, nDSM)
- Create a 3D City (3DCIM) geodatabase
- Load source data
- Use included tools to set building heights
- Create a CityEngine project and scene
- Add datasets
- Apply rules



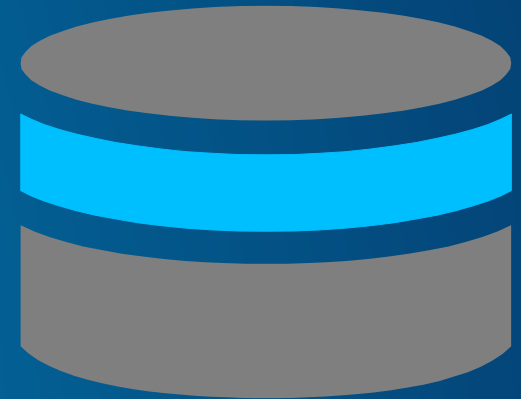
A diagram on a blue background showing a list of steps for creating a 3D city. The steps are grouped into two categories using orange curly braces. The first group, labeled 'ArcGIS Desktop', includes the first five steps: 'Prepare your existing data', 'Generate elevation products (DTM, DSM, nDSM)', 'Create a 3D City (3DCIM) geodatabase', 'Load source data', and 'Use included tools to set building heights'. The second group, labeled 'CityEngine', includes the last three steps: 'Create a CityEngine project and scene', 'Add datasets', and 'Apply rules'.

ArcGIS Desktop

CityEngine

# 3D City Information Model

- What is it?
  - Solution template specifically for 3D city creation and visualization
  - GDB Schema and sample data (Portland)
  - Geoprocessing tools
- Why the 3DCIM?
  - Enterprise Data Model for 3D
  - Transfer from CityGML, or local government data model
  - CityEngine rules align to attributes and are tied to schema
  - *Saves time!*



# 3D City Information Model Data Requirements

Raster and Elevation data

Orthoimagery



- **Minimum Data Requirements**
  - Orthoimagery – To drape over terrain
  - Digital Elevation Model (Low Quality Terrain)

- **Recommended Data**

- Orthoimagery – To drape over terrain
- Lidar
  - DTM
  - DSM
  - nDSM

LiDAR



DTM



DSM



nDSM

www.csc.noaa.gov/datavi x

www.csc.noaa.gov/dataviewer/#

# DIGITAL COAST

NOAA COASTAL SERVICES CENTER

## Data Access Viewer

Enter longitude and latitude location (ex: -80.0,32.9) 

Go or  Draw Area

100 mile buffer ▾

**Refine Search**

Data Type  Licensed Data ☒ Include Data Provider

Results (0) Data Detail Cart (0)

No results to display.

Latitude: 47.4383 Longitude: -92.2511 Scale: 1:4622324

Base Maps  Imagery  Streets 



EE EarthExplorer x

earthexplorer.usgs.gov

# USGS

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**Search Criteria** Data Sets Additional Criteria Results

### 1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

**Address/Place** Path/Row Feature Circle

**Coordinates** Predefined Area Shapetile KML

**Degree/Minute/Second** Decimal

 No coordinates selected.

**Date Range** Result Options

Search from: 01/01/1920  to: 03/24/2014 

Search months: (all) ▾

**Search Criteria Summary (Show)**

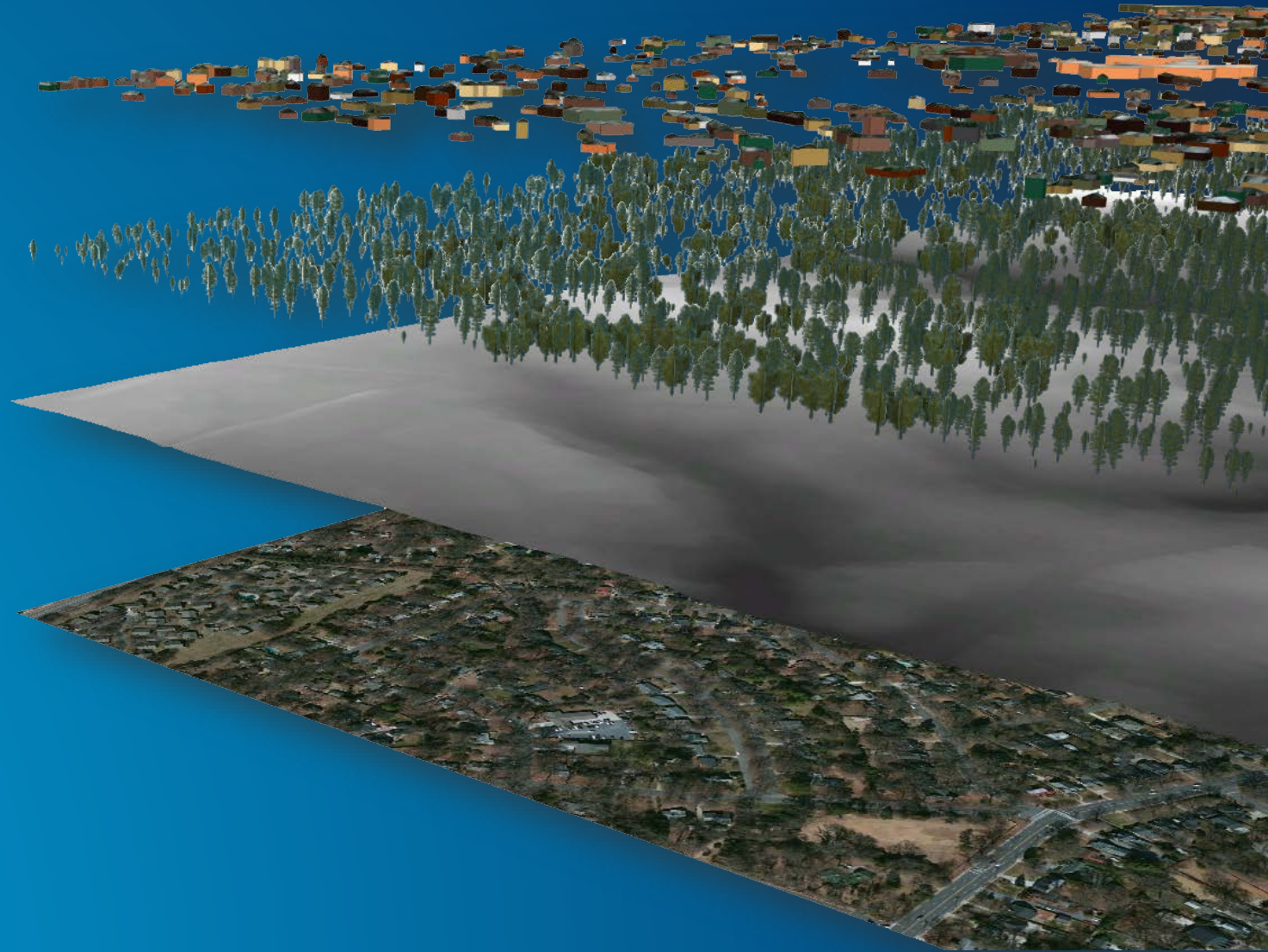
(54° 09' 44" N, 131° 29' 03" W) Options Overlays Map Satellite



# 3D City Model Data Requirements

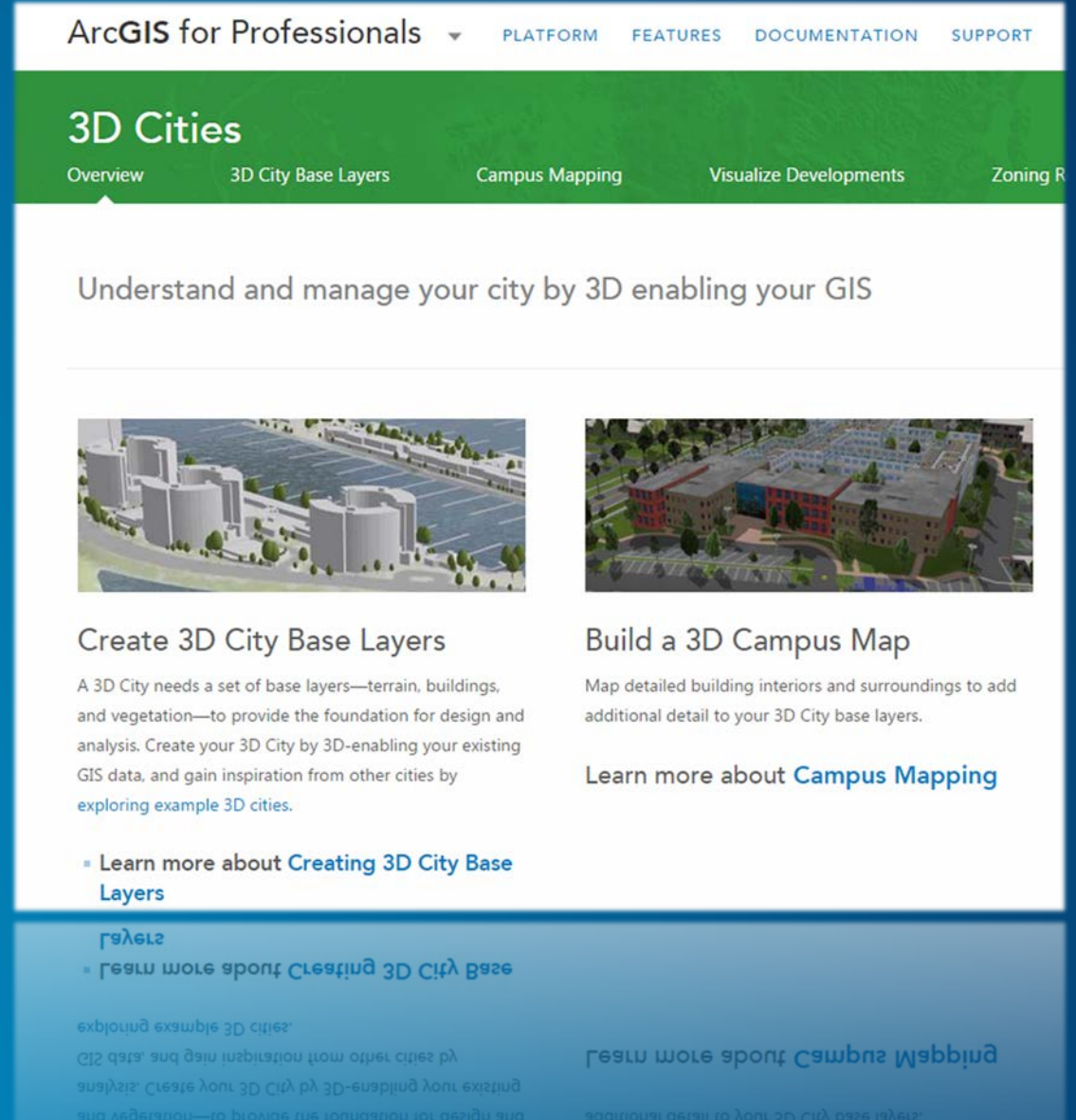
## Vector Data

- **Minimum data requirements**
  - Building footprints
  - Vegetation
- **Recommended data**
  - Building footprints
  - Vegetation
  - Streets
  - Zoning/Land Use
  - Parcels
  - Landcover



# Where to get the 3D CIM

- **GitHub**
  - (search for 3d cities)
- **ArcGIS Professionals Site**



The screenshot shows the '3D Cities' section of the ArcGIS for Professionals website. The page has a green header with the title '3D Cities' and a navigation bar with links: Overview, 3D City Base Layers, Campus Mapping, Visualize Developments, and Zoning R. Below the header, a main heading reads 'Understand and manage your city by 3D enabling your GIS'. The content area is divided into two columns. The left column features an image of a 3D city model and a section titled 'Create 3D City Base Layers' with a descriptive paragraph and a link to 'Learn more about Creating 3D City Base Layers'. The right column features an image of a 3D campus map and a section titled 'Build a 3D Campus Map' with a descriptive paragraph and a link to 'Learn more about Campus Mapping'. The bottom of the page is partially visible, showing the start of another section titled 'Learn more about Creating 3D City Base Layers'.

ArcGIS for Professionals ▾ PLATFORM FEATURES DOCUMENTATION SUPPORT

## 3D Cities

Overview 3D City Base Layers Campus Mapping Visualize Developments Zoning R

Understand and manage your city by 3D enabling your GIS



**Create 3D City Base Layers**

A 3D City needs a set of base layers—terrain, buildings, and vegetation—to provide the foundation for design and analysis. Create your 3D City by 3D-enabling your existing GIS data, and gain inspiration from other cities by exploring example 3D cities.

- [Learn more about Creating 3D City Base Layers](#)



**Build a 3D Campus Map**

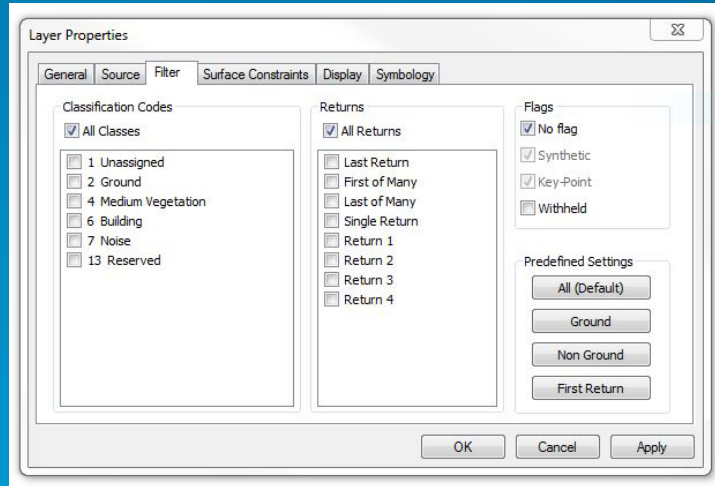
Map detailed building interiors and surroundings to add additional detail to your 3D City base layers.

- [Learn more about Campus Mapping](#)

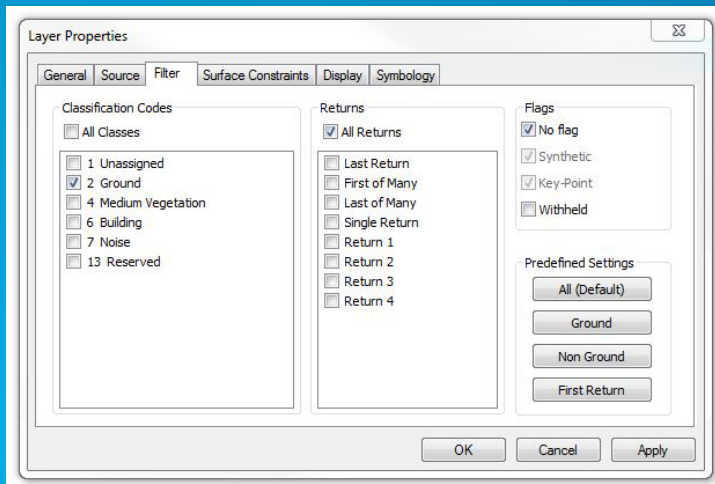
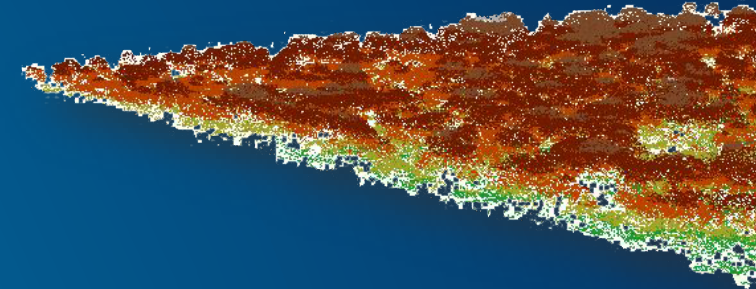
**Learn more about Creating 3D City Base Layers**

**Learn more about Campus Mapping**

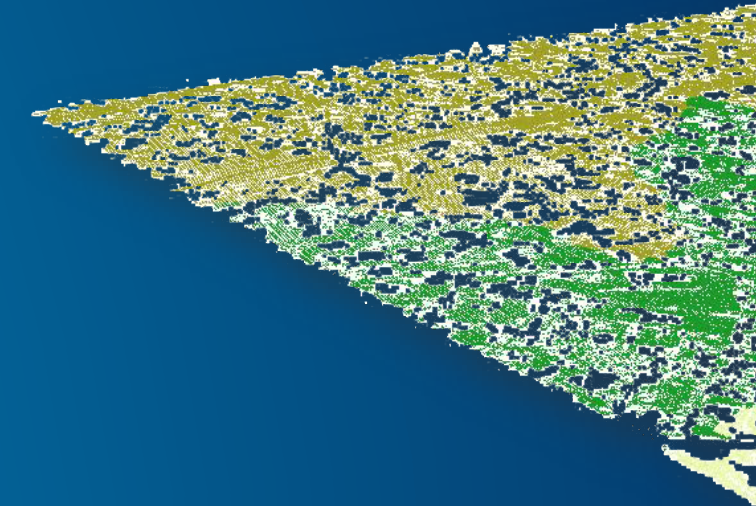
# Extracting Terrain & Surface Models from Lidar



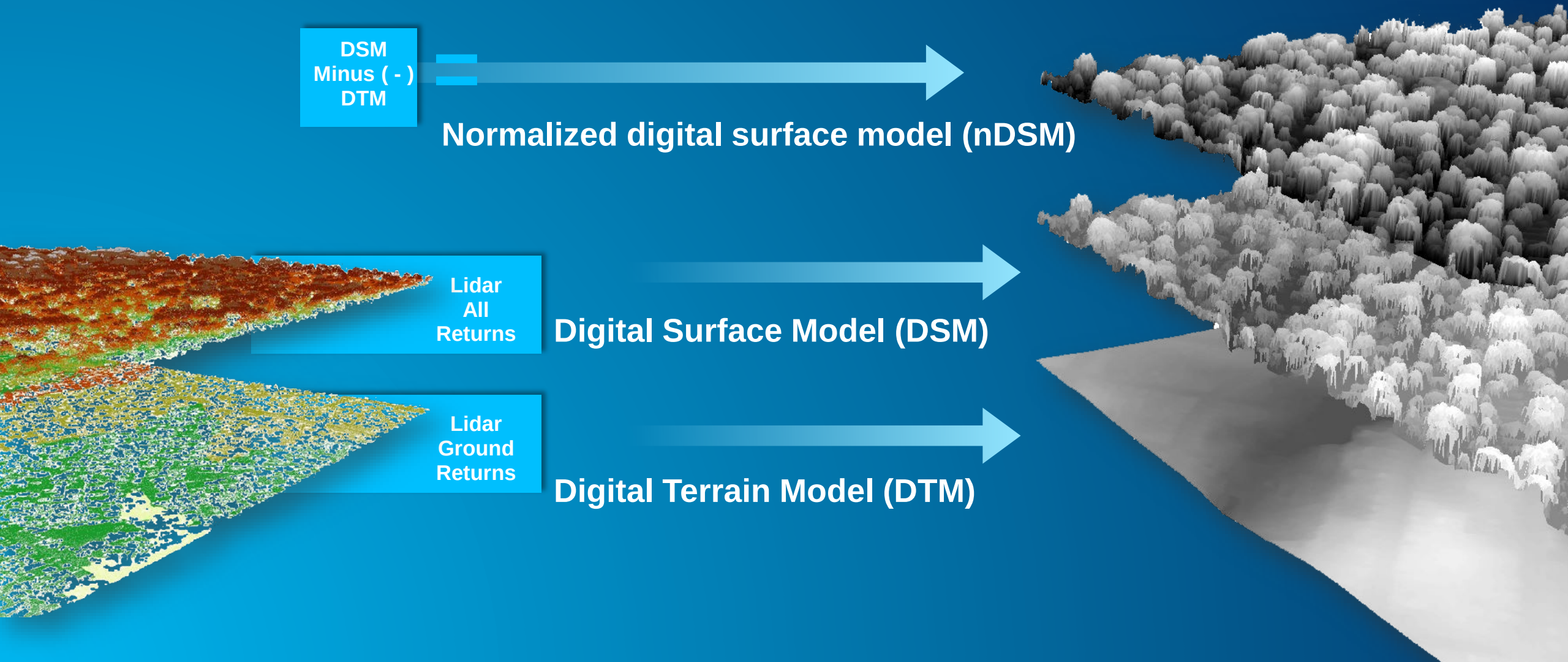
Select All Returns for DSM



Select Ground Returns for DTM

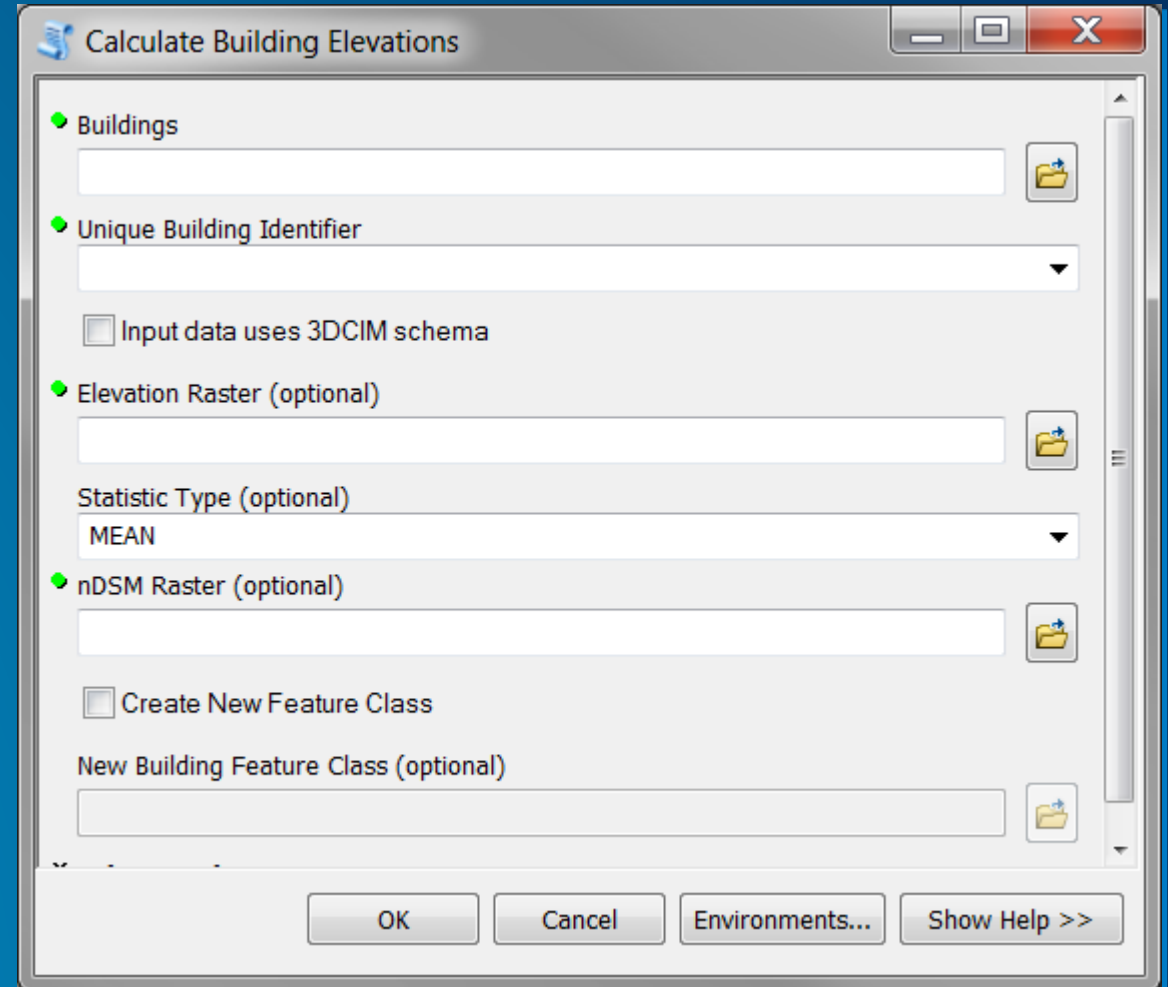


# Extracting Terrain & Surface Models from Lidar

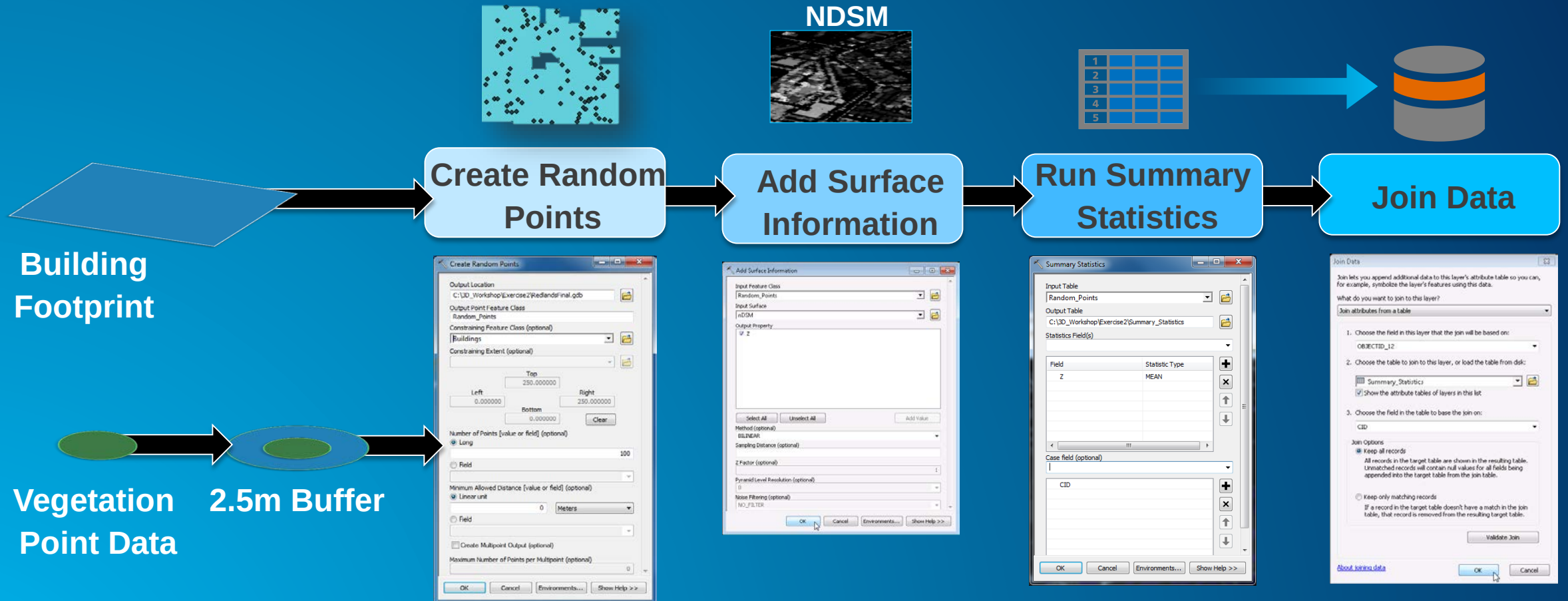


# Adding building heights

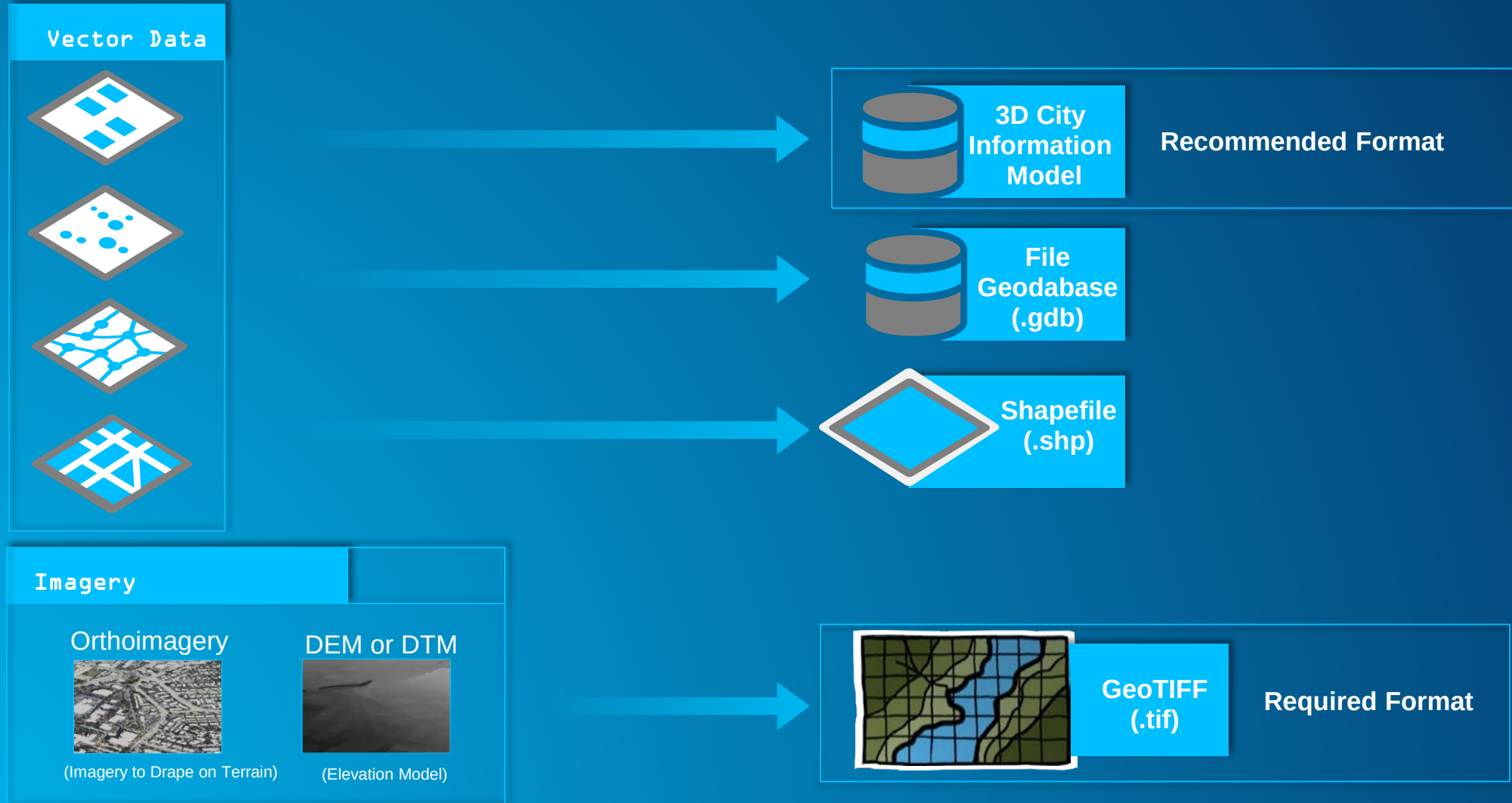
- **Calculate Building Elevations tool**
  - Comes with the download
  - Uses the Building feature class in the 3DCIM
  - Updates the empty building height attributes with data from the nDSM



# Adding Height Data to Features

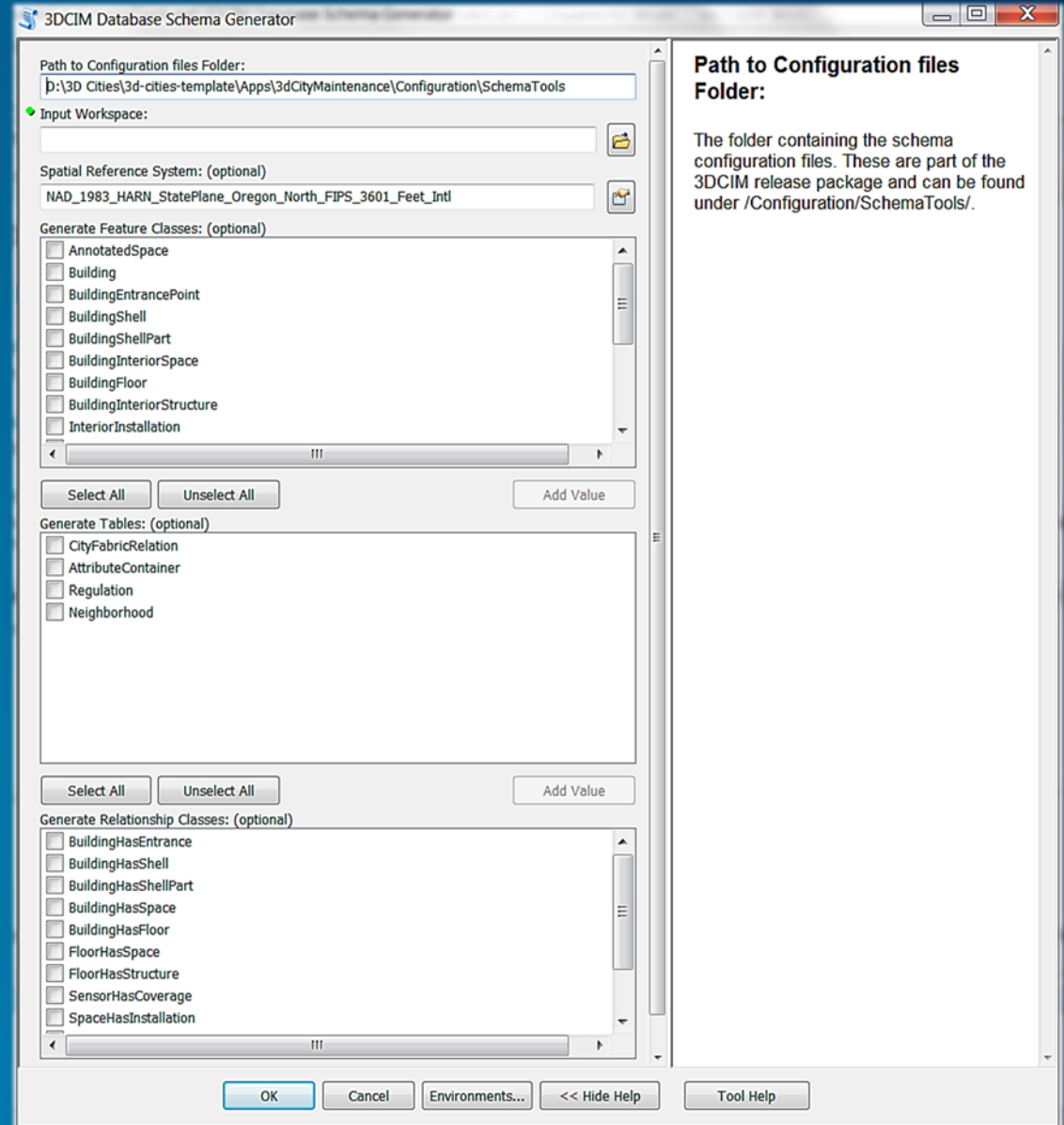


# CityEngine compatible Data Formats

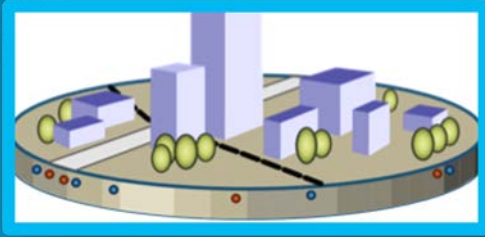


# Create the 3DCIM

- 3DCIM Database Schema Generator
  - Included with the download
  - Enables you to create the empty 3DCIM
- Alternatively create a GDB and import schema



# 3D Cities Information Model: Themes



- **Built Environment**

- *Created and actively managed by people*
  - Structures, utilities, transportation networks, installations



- **Legal Environment**

- *Defines restrictions on land use*
  - Land use zones, property ownership boundaries, regulations



- **Natural Environment**

- *Naturally occurring features on, above, or below the earth's surface*
  - Land cover, subsurface geology, atmosphere/climate/weather

# Demo: Preparing your data

# CityEngine



Transform 2D GIS Data into Smart 3D City Models



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# Esri CityEngine

Transform 2D GIS data into smart 3D city models.

[30-Day Free Trial →](#)[Main](#)[Features](#)[Getting Started](#)[Industries](#)[Pricing](#)[Try It Free](#)

## Design a Smarter City

Esri CityEngine improves urban planning, architecture, and design. Use its 3D visualization power to see the relationships of projects, assess their feasibility, and plan their implementation. CityEngine helps you make quality decisions that benefit your community for decades.

Watch the Video: Build Smart 3D Cities 

*"Turning Zoning laws with CityEngine into vivid three dimensional visualizations, is drastically changing the way we understand and plan our sustainable future environments."*

Niels Lehmann, Urban Synergy Group



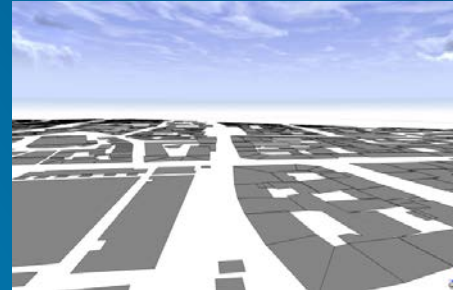
## Build Flexible Scenarios Faster

Compare and analyze building proposals from every angle. See how they fit into your city's overall vision for the future.

# CityEngine

## 3D City Creation

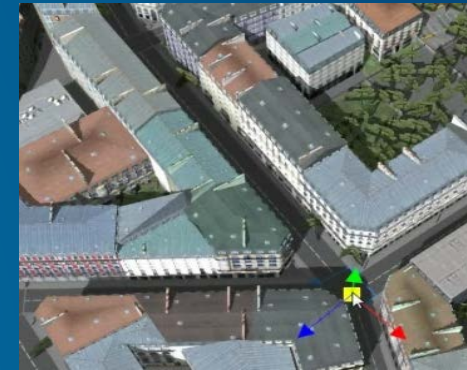
2D GIS data + rules



*Geometry + Attributes + Rules*

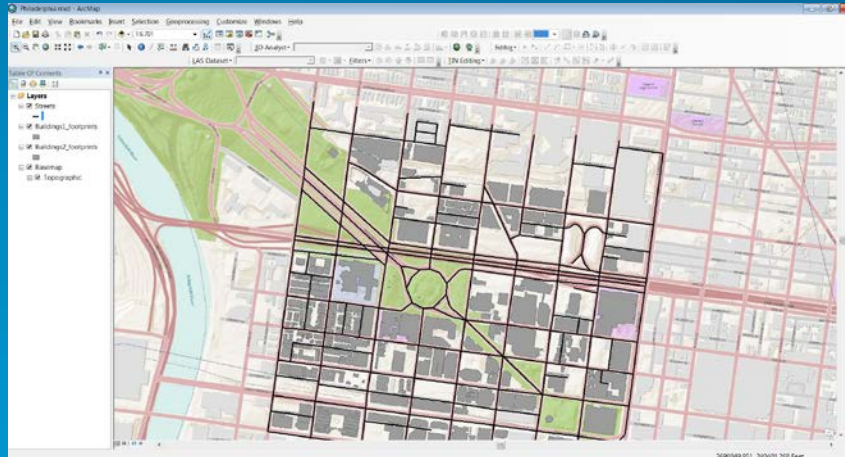
## 3D City Design

Interactive and rule driven  
design in 3D



*Dynamic + Parametric editing*

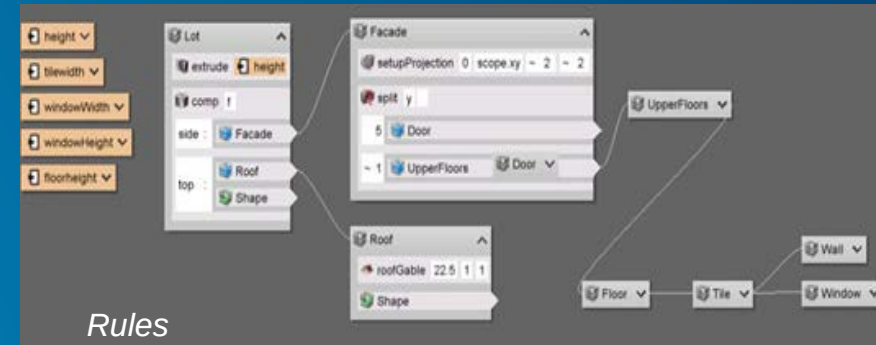
# 2D GIS Data + Rules



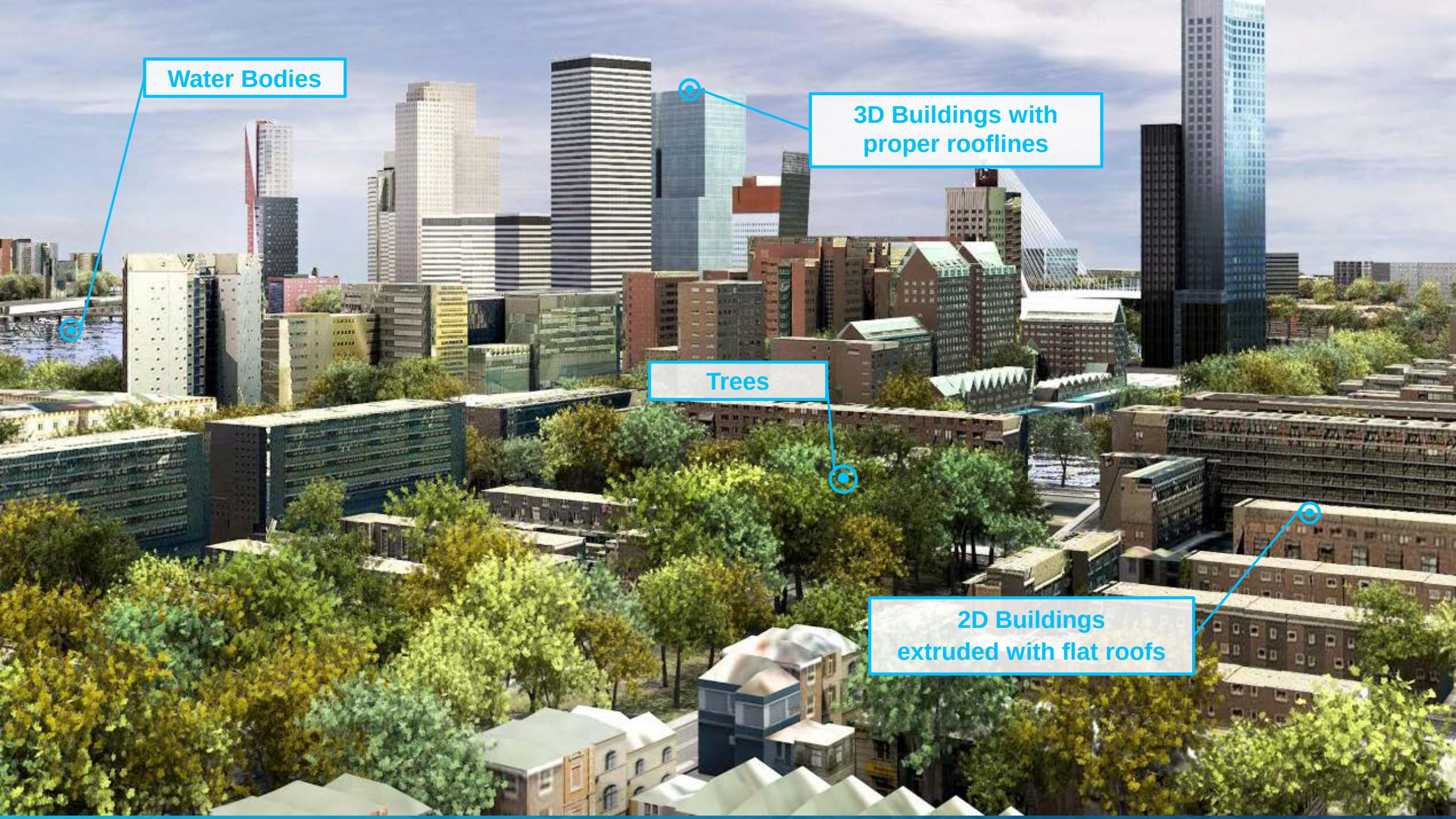
Geometry

| Buildings1_footprints |         |          |           |           |           |           |         |           |              |               |  |
|-----------------------|---------|----------|-----------|-----------|-----------|-----------|---------|-----------|--------------|---------------|--|
| OBJECTID *            | Z_Min   | Z_Max    | Roof_Form | Ridge_Ht  | Eave_Ht   | Z         | Bldg_ID | SHAPE *   | SHAPE_Length | SHAPE_Area    |  |
| 1                     | 20.2522 | 65.412   | flat      | 8.4       | 9.25      | 21.816448 | 25      | Polygon   | 99.688535    | 618.683569    |  |
| 2                     | 21.2607 | 65.6358  | shed      | 9.85      | 8.65      | 22.632911 | 26      | Polygon   | 50.555297    | 159.659554    |  |
| 3                     | 36.9902 | 326.6608 | flat      | 88.308716 | 37.212536 | 120       | Polygon | 406.10474 | 10202.326473 |               |  |
| 4                     | 22.3236 | 57.7997  | shed      | 9.4       | 7.91      | 24.864243 | 34      | Polygon   | 95.637074    | 376.840012    |  |
| 5                     | 23.0041 | 66.9352  | shed      | 12.83     | 12.23     | 28.073111 | 20      | Polygon   | 23.69814     | 32.105874     |  |
| 6                     | 25.6566 | 63.536   | flat      | 3.73      | 3.73      | 28.926017 | 33      | Polygon   | 63.137759    | 135.929382    |  |
| 7                     | 19.7674 | 188.1827 | flat      | 42        | 42        | 22.610424 | 111     | Polygon   | 787.48338    | 27252.421244  |  |
| 8                     | 13.8502 | 65.5997  | butterfly | 15.7      | 14.3      | 13.733557 | 9       | Polygon   | 175.636887   | 1869.287114   |  |
| 9                     | 17.2831 | 588.782  | flat      | 32        | 32        | 33.992004 | 113     | Polygon   | 133.450688   | 958.184113    |  |
| 10                    | 17.2831 | 588.782  | flat      | 159       | 159       | 27.132445 | 113     | Polygon   | 373.955593   | 4960.000774   |  |
| 11                    | 13.8502 | 65.5997  | flat      | 11.04     | 10.29     | 17.432316 | 9       | Polygon   | 148.059964   | 1384.638745   |  |
| 12                    | 8.3995  | 305.2568 | flat      | 91.79     | 90.505211 | 42.188004 | 141     | Polygon   | 1931.426243  | 151219.733606 |  |
| 13                    | 22.3236 | 57.7997  | gable     | 10.59     | 8.5       | 22.695454 | 34      | Polygon   | 93.104492    | 491.056073    |  |
| 14                    | 40.5078 | 69.0667  | flat      | 8.706982  | 8.706982  | 40.395333 | 118     | Polygon   | 48.690123    | 146.674535    |  |
| 15                    | 28.0523 | 104.5985 | flat      | 23.337257 | 23.337257 | 41.944003 | 148     | Polygon   | 1098.27766   | 63200.995068  |  |
| 16                    | 22.3236 | 57.7997  | gable     | 6.71      | 6.82      | 24.665042 | 34      | Polygon   | 109.817427   | 744.40796     |  |
| 17                    | 35.9163 | 69.258   | flat      | 10.165153 | 10.165153 | 37.865566 | 118     | Polygon   | 48.728326    | 146.903501    |  |
| 18                    | 20.2522 | 65.412   | flat      | 11.04     | 10.29     | 21.585776 | 25      | Polygon   | 150.421816   | 1290.000047   |  |

Attributes



Rules

A wide-angle photograph of a city skyline. In the background, several tall, modern skyscrapers with glass and steel facades rise against a cloudy sky. In the middle ground, there are more buildings, some with flat roofs and others with more complex structures. The foreground is dominated by a dense layer of green trees and smaller, older-style buildings with varied rooflines. A body of water is visible on the left side of the image. Five blue callout lines with circular endpoints point to specific features: 'Water Bodies' points to the water on the left; '3D Buildings with proper rooflines' points to a tall glass skyscraper; 'Trees' points to a cluster of trees in the middle ground; '2D Buildings extruded with flat roofs' points to a large, multi-story brick building with a flat roof in the foreground; and an unlabeled line points to another building in the foreground.

**Water Bodies**

**3D Buildings with  
proper rooflines**

**Trees**

**2D Buildings  
extruded with flat roofs**

# Demo: City Engine project and Scene, Import 3DCIM Data

# Resources

- 3D Cities Professionals site: <http://pro.arcgis.com/en/3d-gis/3d-cities/>
  - Download the template, tools, and tutorial
- ArcGIS Online for 3D Cities group (search on arcgis.com)
  - Download the template, see sample web scenes
- GitHub – Search on 3D Cities template
  - Download the template
- YouTube Channel: CityEngineTV
  - Learn how to do stuff!





esri

Understanding our world.