



Paved Horizons

Mapping A Future Land Use Scenario for
the Auckland Region

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Overview

- Who is Morphum Environmental and what do we do?
- Why the need for Mapping Future Land use?
- Leveraging FME for modelling
- Issues, tips and tricks



Who are we?



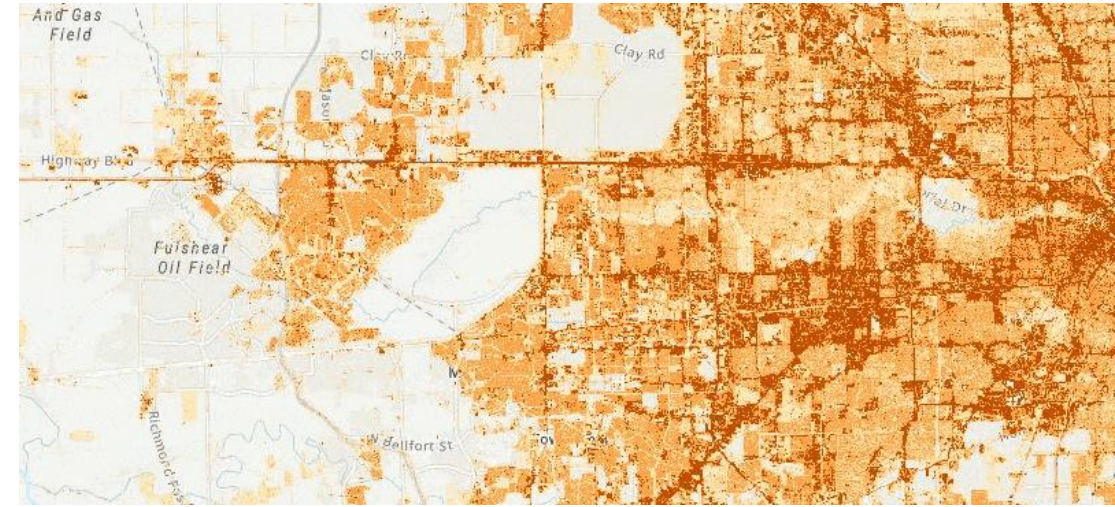


CREATING A FUTURE LAND USE LAYER

Impervious Surface Areas

“Impervious surfaces can be concrete or asphalt, they can be roofs or parking lots, but they all have at least one thing in common—water runs off of them, not through them. And with that runoff comes a host of problems.”

- Frazer L, 2006

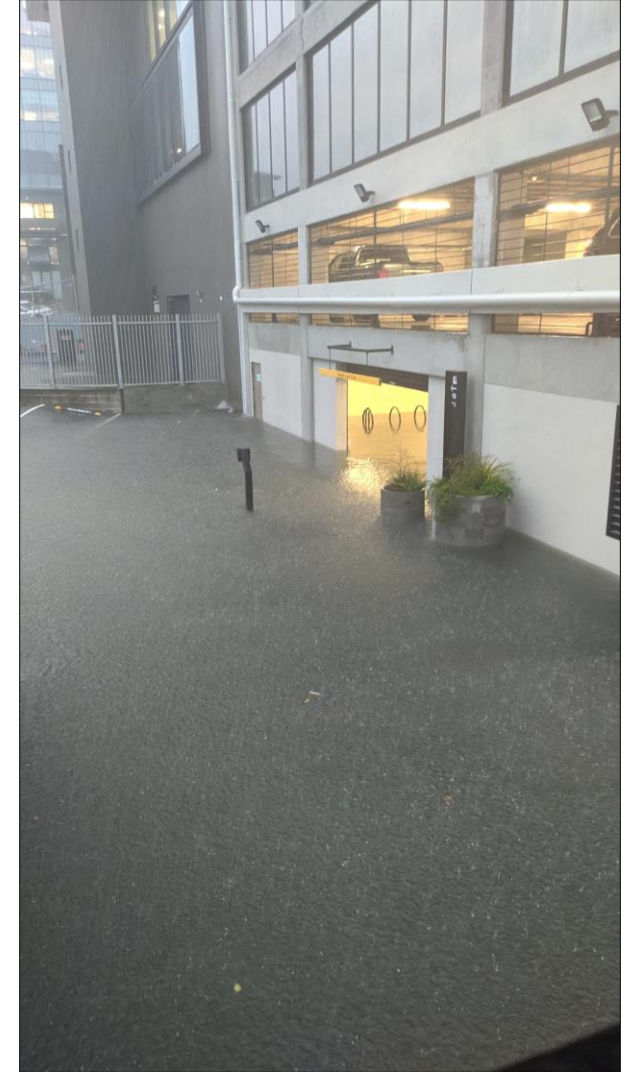


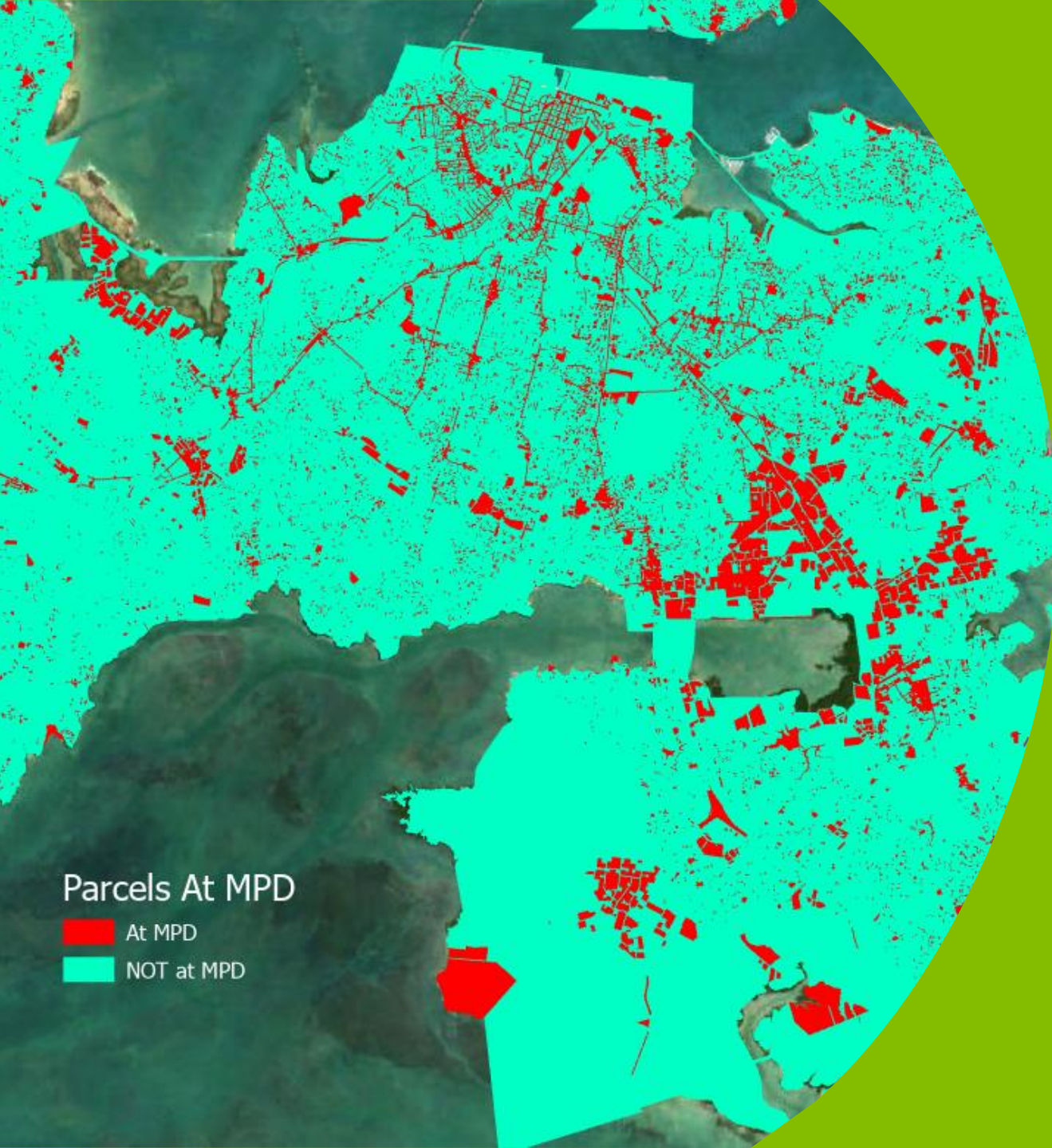
Esri: Impervious Surface changes in West Houston in 2001, 2006, 2011, and 2016



Why do we care?

- **More water quality issues:** *Increases contaminant run-off and pollution of water bodies*
- **More floods:** *Decreases the time of concentration and increases peak discharge*
- **Reduced stream health:** *Increases in-stream temperatures leading to reduction in dissolved oxygen*
- **Intensified droughts:** *Prevents groundwater recharge*
- **Increased temperatures:** *Collects solar heat, contributing to the “urban heat island” effect.*





Parcels At MPD

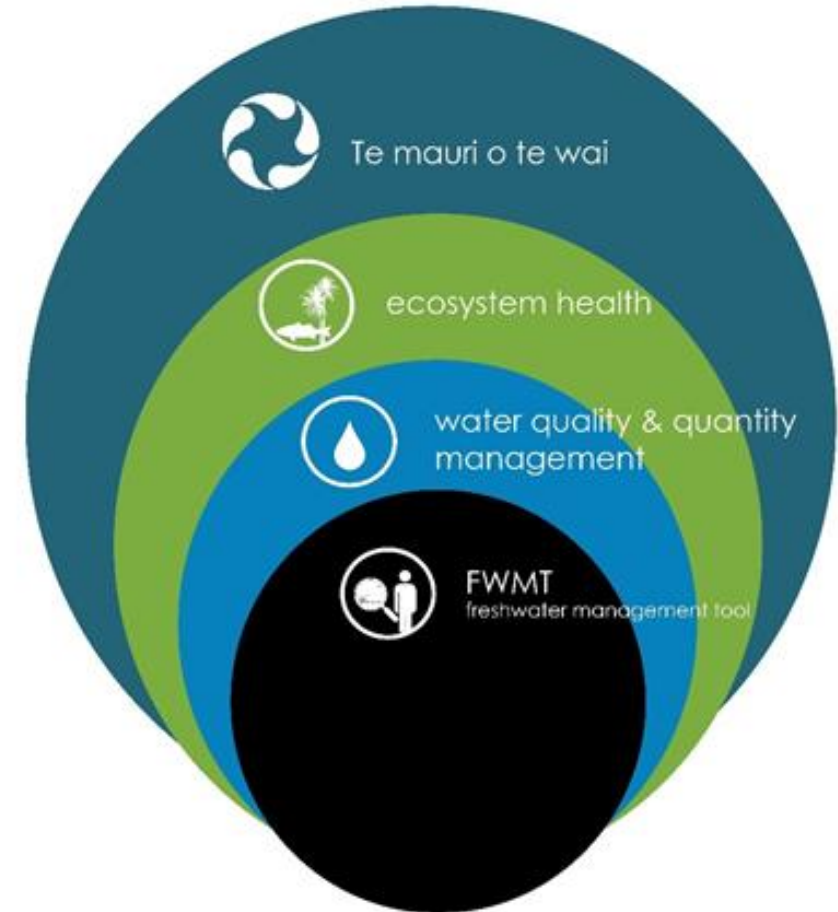
- At MPD
- NOT at MPD

AUCKLAND AT
MAXIMUM PERMITTED
DEVELOPMENT (MPD)

Auckland Freshwater Management Tool (FWMT)

Overarching goals

- Define why and how bad water quality within the region is
- Identify how much worse it is expected to become due to population growth and changing climate
- Identify what we can do to improve or maintain our water quality

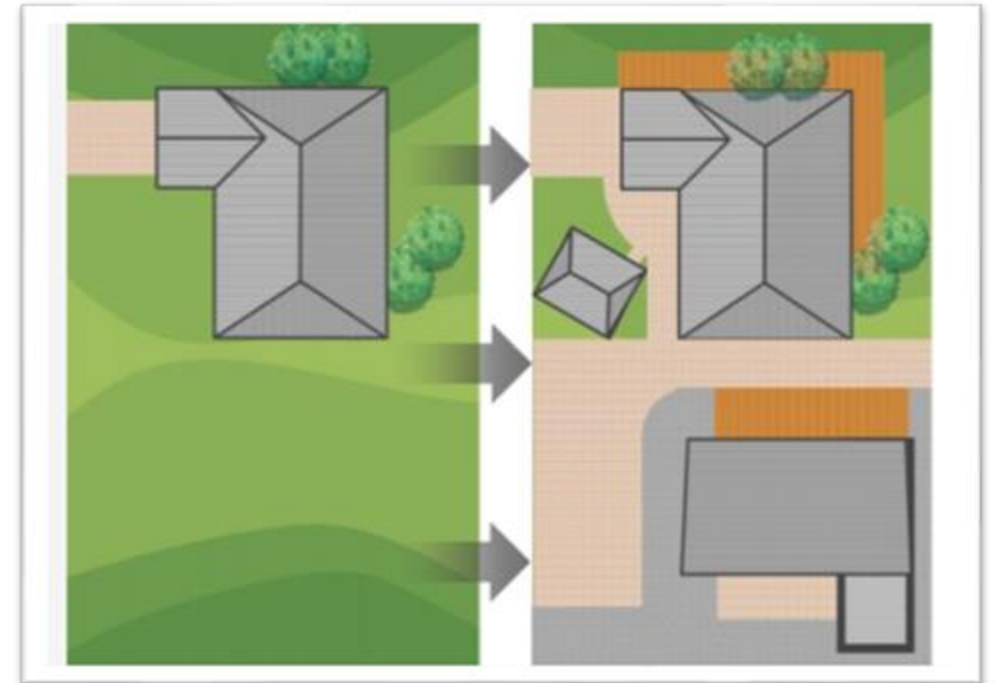


How do we map Maximum Development?

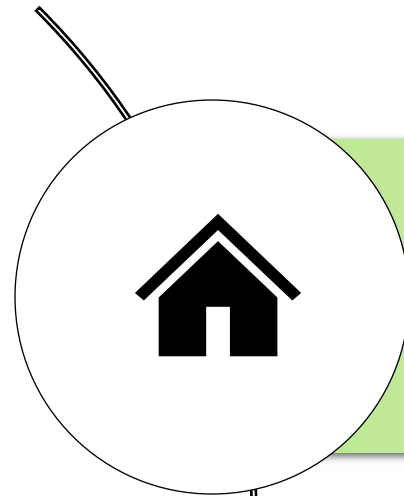
Maximum Development Scenario

- Utilise the Auckland Unitary Plan as a theoretical land development maximum
- Quantify the existing state of land development
- At a parcel scale, assume the “most developed” scenario as the maximum development scenario

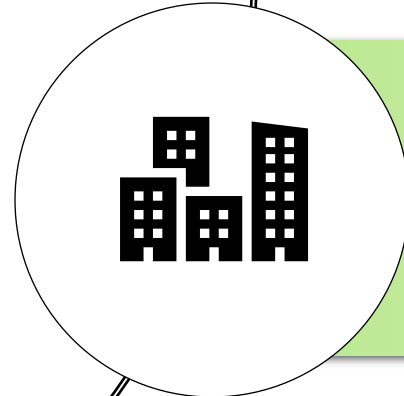
Zone	Maximum Impervious Area
Large Lot	35% of site or 1400 square metres – whichever is the smaller
Rural & Coastal Settlement	35% of site or 1400 square metres – whichever is the smaller
Single House	60% of site
Mixed Housing Suburban	60% of site
Mixed Housing Urban	60% of site
Terraced Housing & Apartment Buildings	70% of site



FME: 

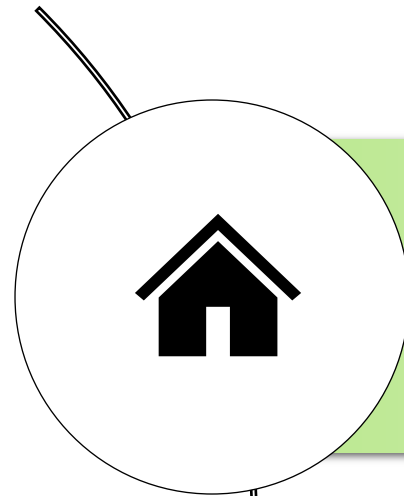


1. Determining maximum impervious development

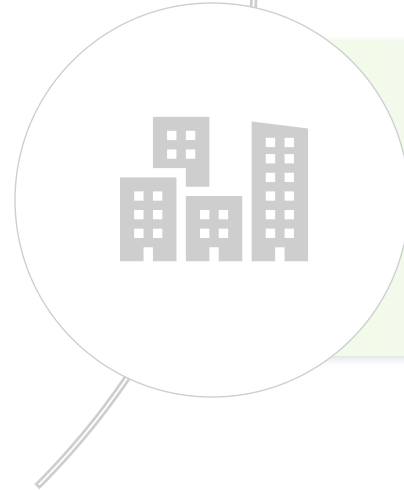


2. SwizPix - Changing pervious to paved





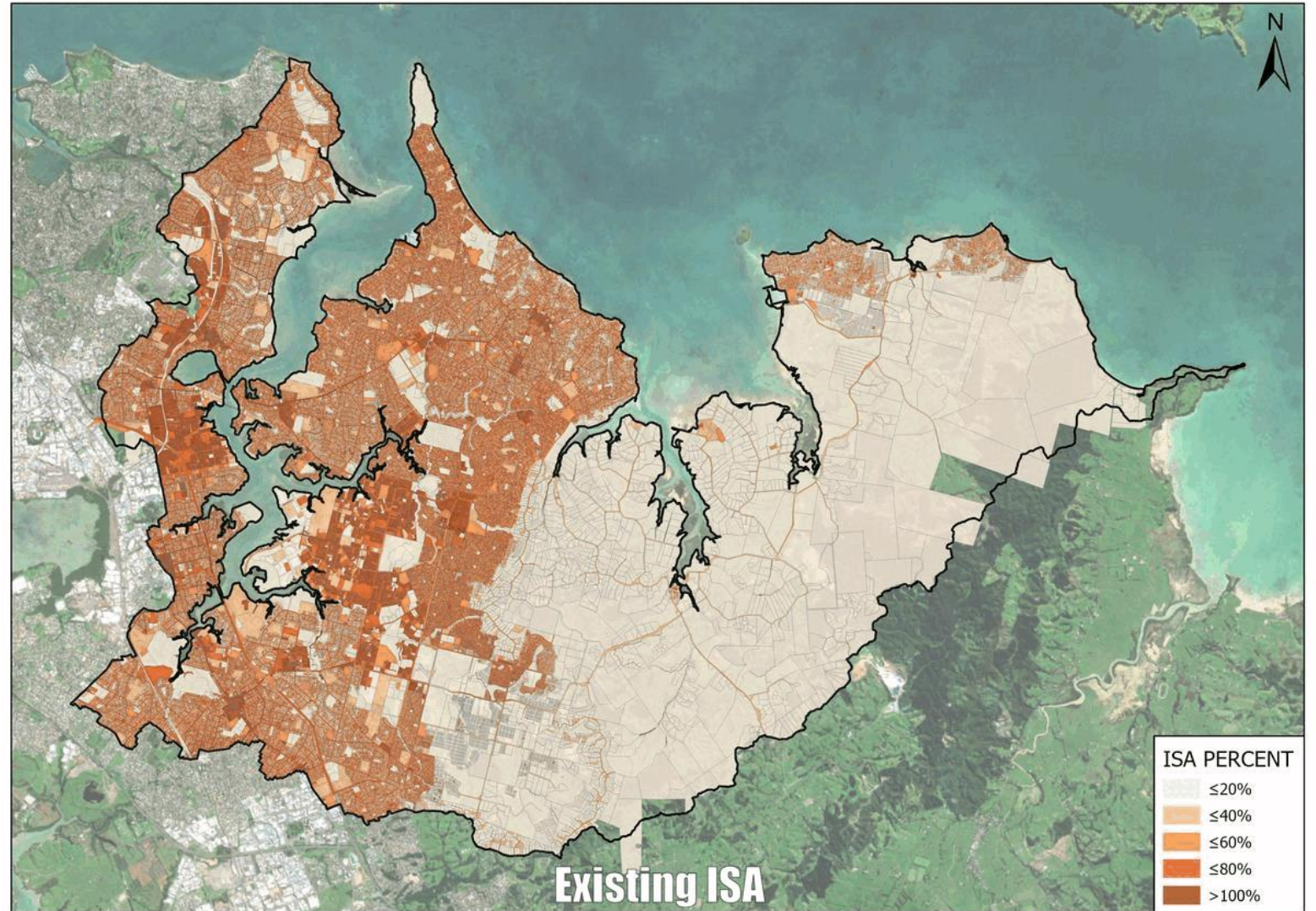
1. Determining maximum impervious development



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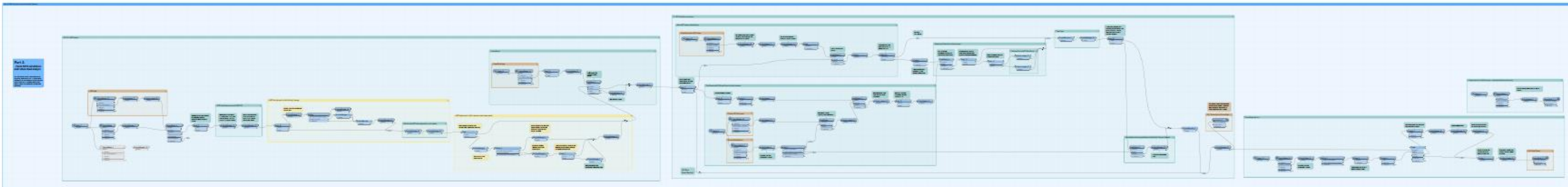
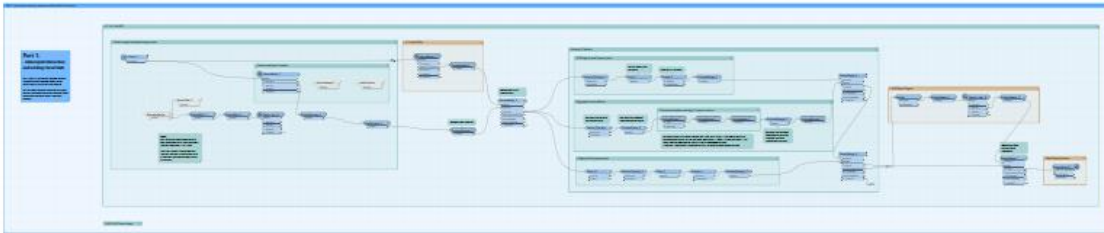
- Which properties can be further developed?
- ...and by how much?
- Which properties exceed the current zone limit?



Properties at MPD - Future Land Use Parcels

INPUTS:

1. Primary Parcels (*approx. 550,000*)
2. Baseline Existing Land use (*43 Types*)
3. AUP/HGI Zones (*87 Zones*)
4. Future Road Networks
5. Predicted Traffic Increases



WORKSPACE PARAMETERS

Importing parameters from a spreadsheet and assigning to “parameter attributes”

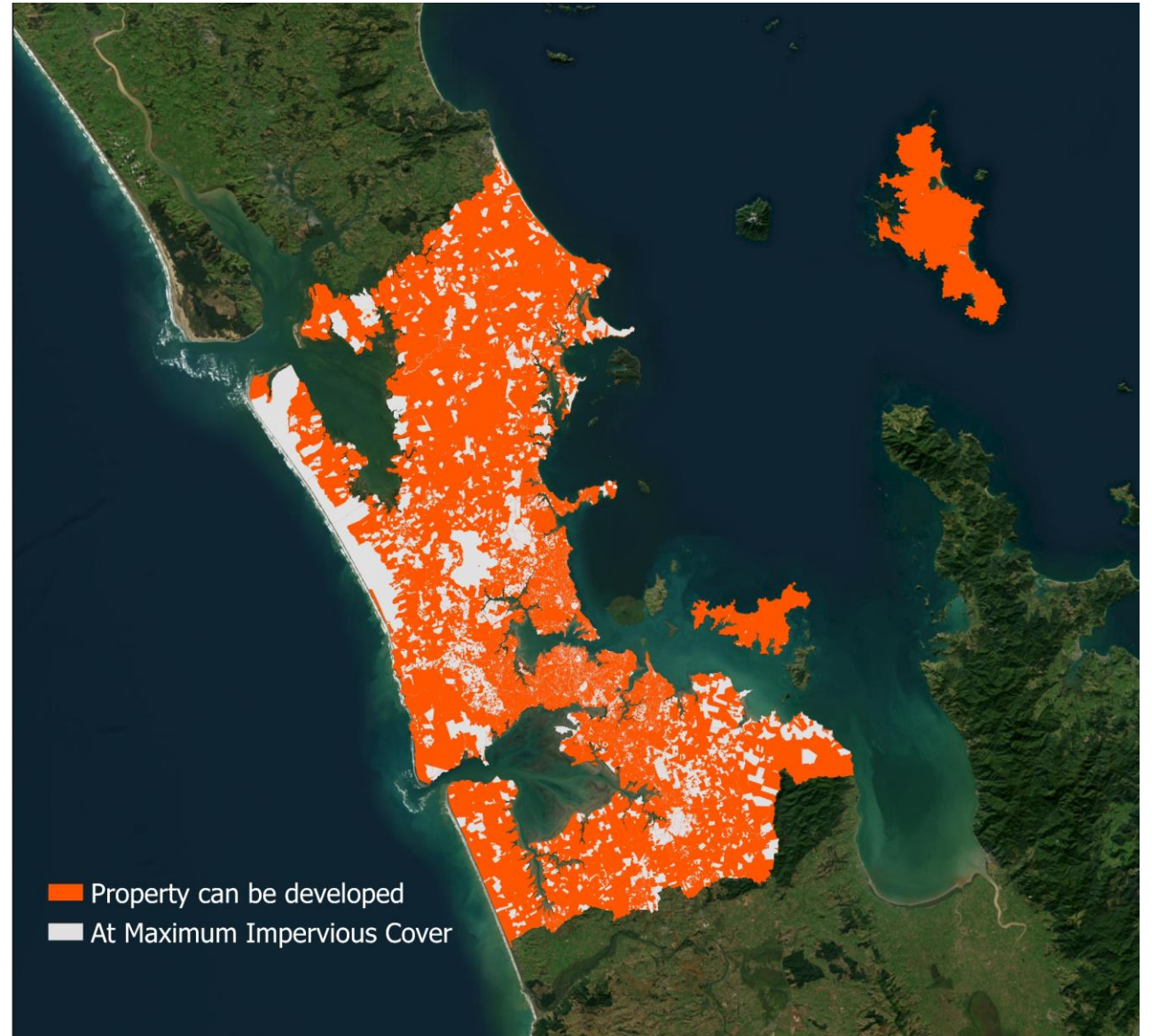
- Parameter updates can be made outside of FME
- Provides a good way of tracking parameters and any justifications, limitations etc

Input	Parameter Name	Exposed Parameter	Parameter Value - Urban	Parameter Value - Rural	Parameter Type	Query Type	Parameter Description	Justification
Extract Opportunity Areas Tool	Minimum Permitted Donut Area (m2)	Yes	10	10	Number		Donut Polygons (interior holes within larger polygons) smaller than this parameter will be removed (m2)	Minor earthworks required or non ground points
Identify Valid Offtakes Tool	Minimum Offtake Pipe Gradient (D-1)	Yes	0.01	0.01	Number		Minimum slope requirement for offtakes pipes or diversions. Slope is calculated with Rise over Run calculation. Note that if a device opportunity is represented with a single estimated elevation value, offtake points within the footprint will have an offtake distance of 0. In this case, the offtake distance will be calculated as a Rise.	Minimum pipe gradient
Identify Valid Offtakes Tool	Maximum Offtake Pipe Distance (m)	Yes	100	20	Number		Maximum offtake pipe or diversion distance permitted between offtake network and perimeter of device footprint. This should be the maximum distance across all device types.	BP1
Identify Valid Offtakes Tool	Assumed Device Excavation Depth (m)	Yes	1.5	0	Number		Assumed excavation depth of device footprint. Generally, a deeper excavation depth will allow for more opportunity by increasing the offtake slope between potential device footprints and offtake points.	Matches lifecycle costing reasonable earthworks
Identify Valid Offtakes Tool	Device Representation Method	Yes	Single Elevation - MEDIAN	Points Along Perimeter	Choice List		Method used to estimate device footprint opportunity by sampling raster elevation values. If "Points Along Perimeter" is selected, elevation values will be extracted along the device footprint boundary. Each perimeter point is considered against all offtake opportunities within the offtake search tolerance. If a "Single Elevation" method is used, the polygon is sampled and elevation is extracted using the selected statistical method.	No significant earthworks costed for Rural Wetlands therefore needs minimum rerouting to connect catchment to opportunity.

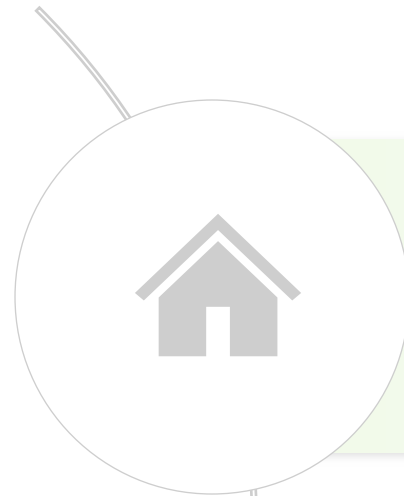


Maximum Developed Properties

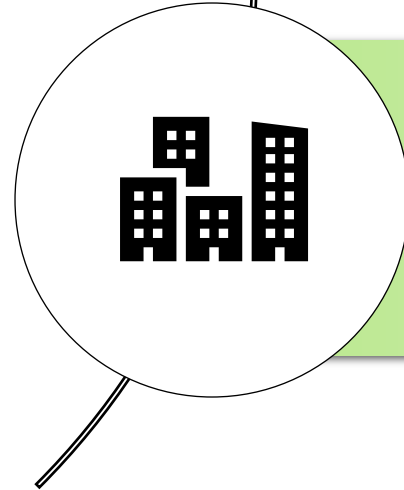
- **89%** of properties have development potential



FME: 



1. Determining maximum impervious development



2. SwizPix - Changing pervious to paved



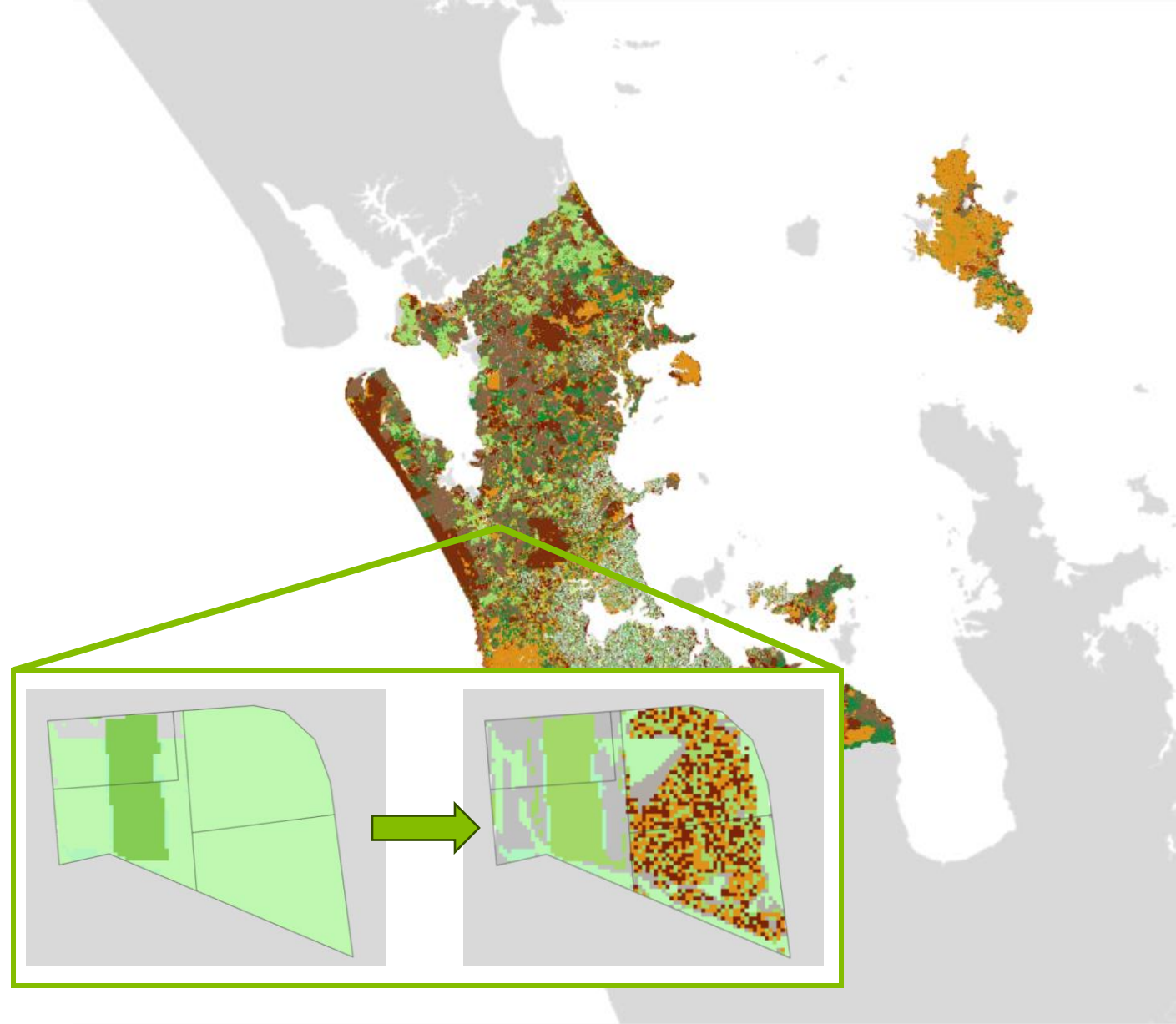
SwizPix: Switching Pervious to Paved

Existing Land Cover switched to represent parcels at maximum impervious coverage

- 475,000 Ha
- Mapping every 2x2 m²

Order of switching is iterative & determined by:

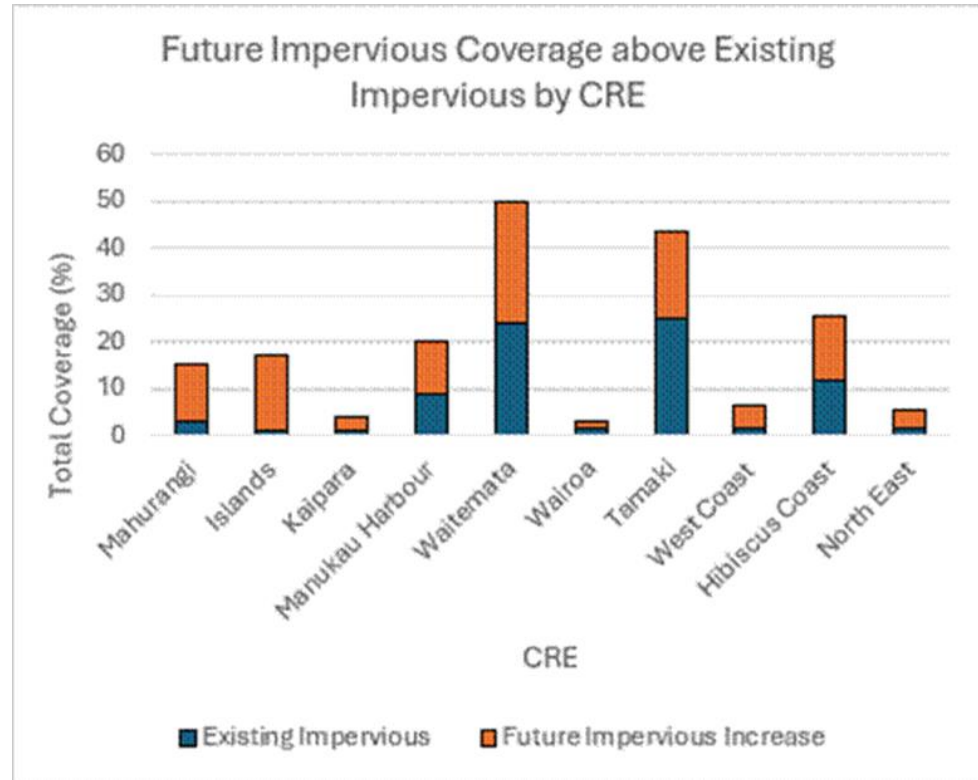
1. Existing pervious land use (ranked)
2. Slope – low slopes changed first



SwizPix: Switching Pervious to Paved



Existing Land Cover

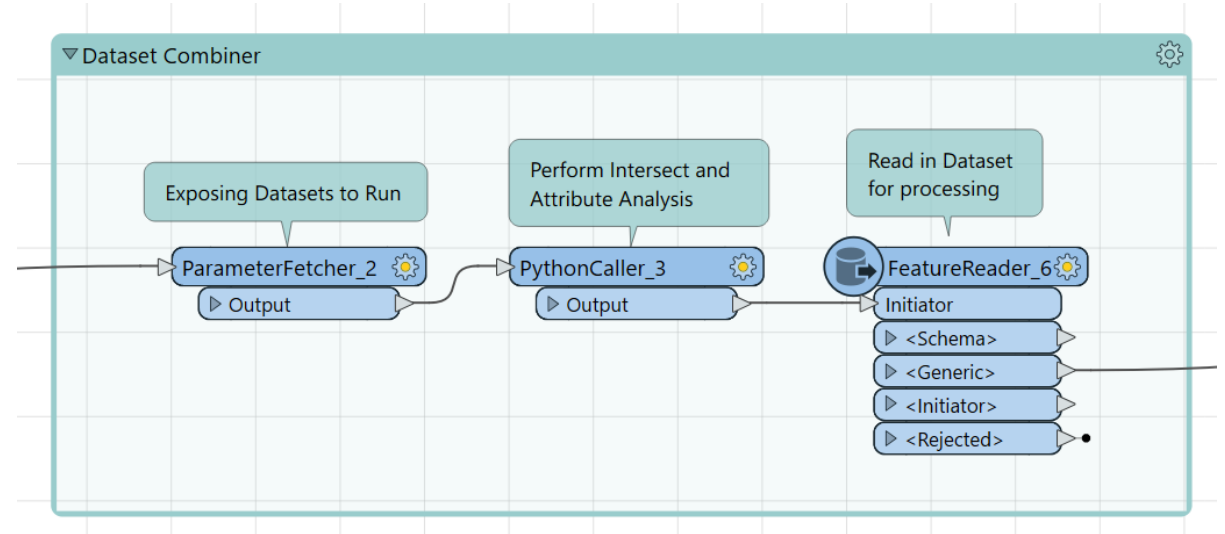




TIPS & TRICKS

Python Caller

- Increased performance on large datasets
- Access to arcpy and other python libs.
- Pass in custom parameters
- Create a seemingly dynamic data combiner

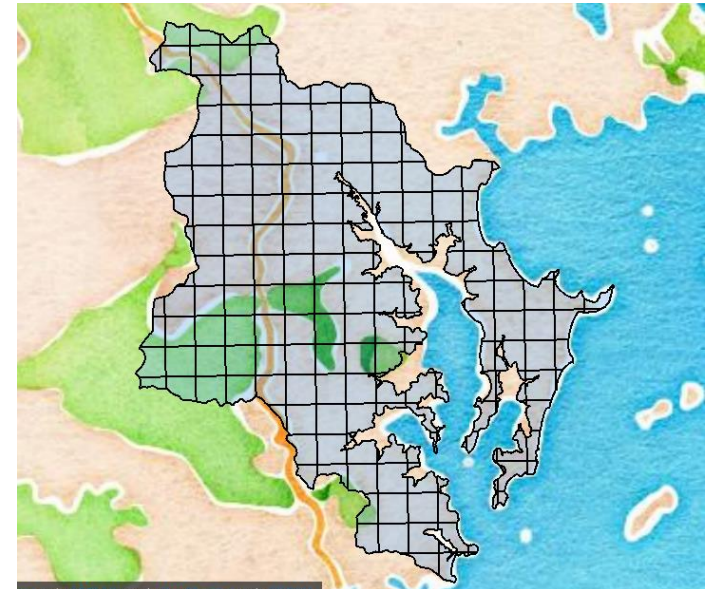
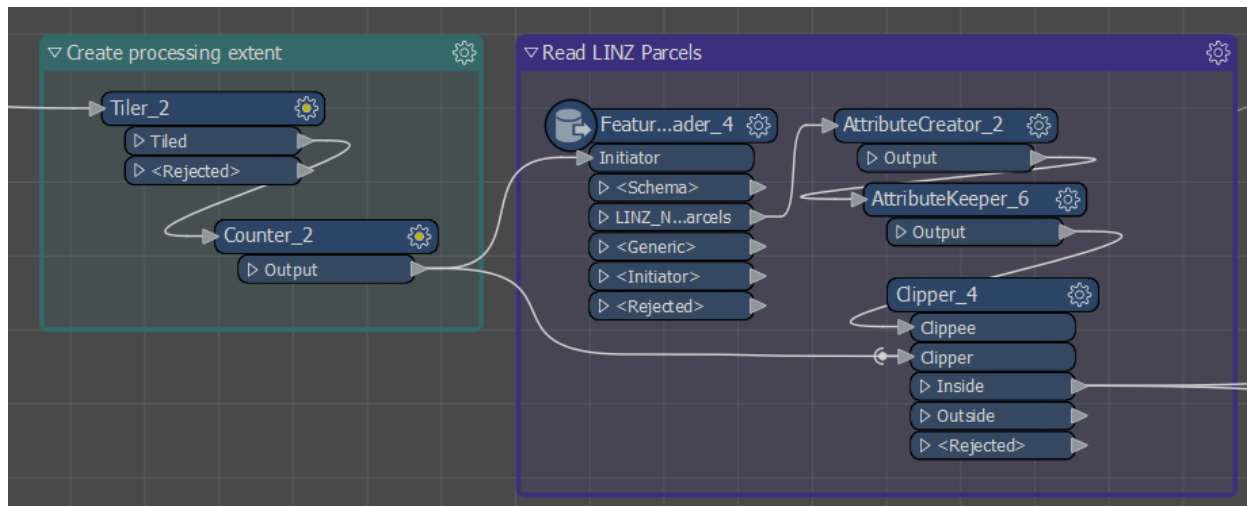


Dealing with BIG Data

- Group by processing

Using the “GroupBy” functionality of spatial intersection tools on large datasets

- Increase processing time
- Enables parallel processing through custom transformers



Dealing with BIG Data

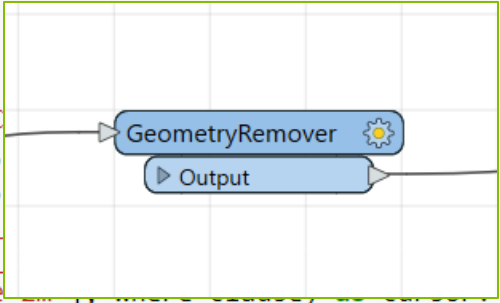
- Python Functions

- Raster and Vector to Dictionaries
 - Getting rid of geometry

- Time Tracking - Life Saver!!

```
# Create empty parcel dict
points_dict = {}

with arcpy.da.SearchCursor(points_layer, ['FLUL_PARC
'pointid',
'LU_Code',
'Pervious_
'Pervious_
'AKL_Slope_
```



```
def print_start_time():
    start_time = time.time()
    formatted_start_time = time.strftime("%Y-%m-%d %H:%M:%S", time.localtime(start_time))
    print(f"Start Time: {formatted_start_time}")
    return start_time

def print_end_time(start_time):
    end_time = time.time()
    formatted_end_time = time.strftime("%Y-%m-%d %H:%M:%S", time.localtime(end_time))
    elapsed_time = end_time - start_time
    hours, remainder = divmod(elapsed_time, 3600)
    minutes, seconds = divmod(remainder, 60)
    print(f"End Time: {formatted_end_time}")
    print(f"Elapsed Time: {int(hours)} hours and {int(minutes)} minutes and {int(seconds)} seconds")
```

```
19 print_end_time(start_time)
20 print("-----")

Start Time: 2024-01-18 17:01:11
-----
...Creating LU Raster
SwizPix Point to Raster Complete.
End Time: 2024-01-18 19:04:51
Elapsed Time: 2 hours and 3 minutes.
-----
```



The logo for Morphum Environmental features the word "MORPHUM" in a bold, white, sans-serif font. The letter "O" is replaced by a circular graphic with a green-to-blue gradient. Below "MORPHUM" is the word "environmental" in a smaller, lowercase, light green sans-serif font.

MORPHUM
environmental

THANK YOU.

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