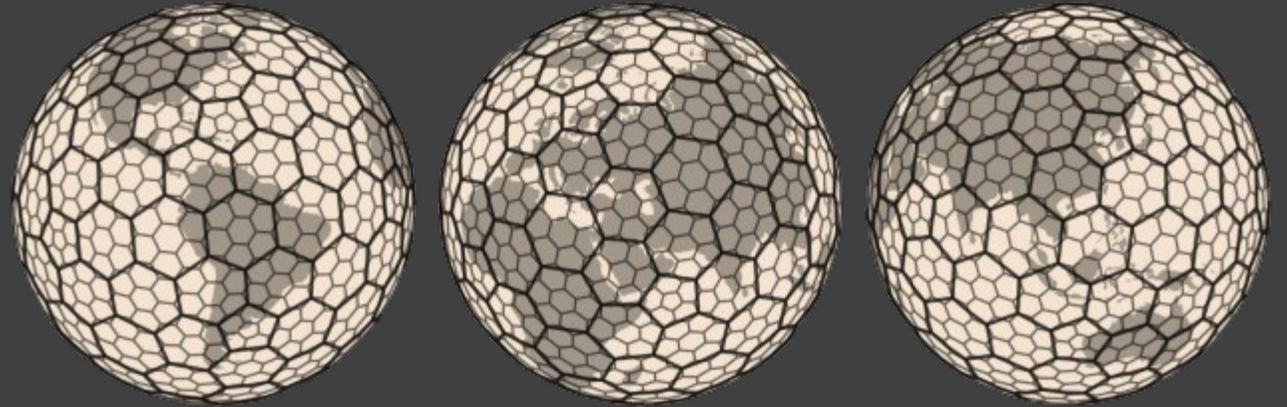


# H3 and VT

An Intro to the H3 Index System



# What is H3?

- A discrete global grid system consisting of a multi-precision hexagonal tiling of the Earth with hierarchical indexes 16 Resolution Levels (0-15)
- Unique Identifier for all hex's/all levels (64 bit integer)
- Coordinate reference system (CRS) is spherical coordinates with the WGS84/EPSSG:4326 (aka web mercator)
- Developed by UBER, now open source, and yet very stable (e.g. it's done)

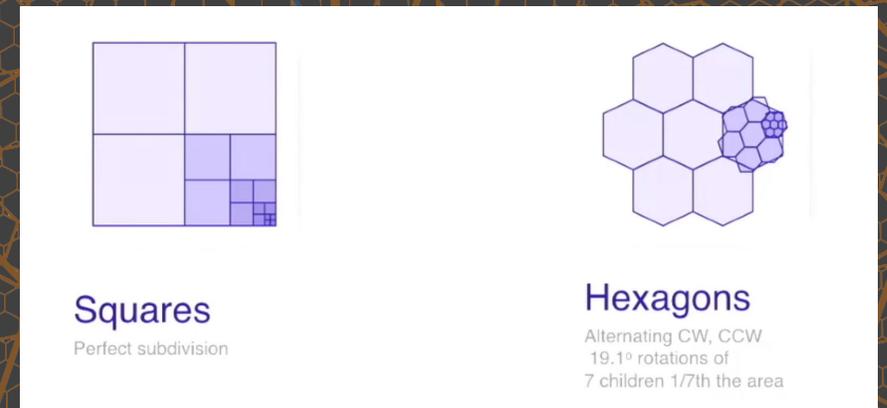
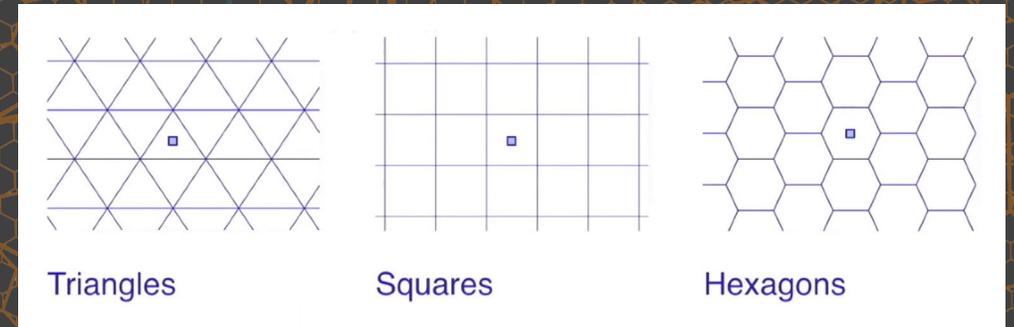
<https://h3geo.org/>

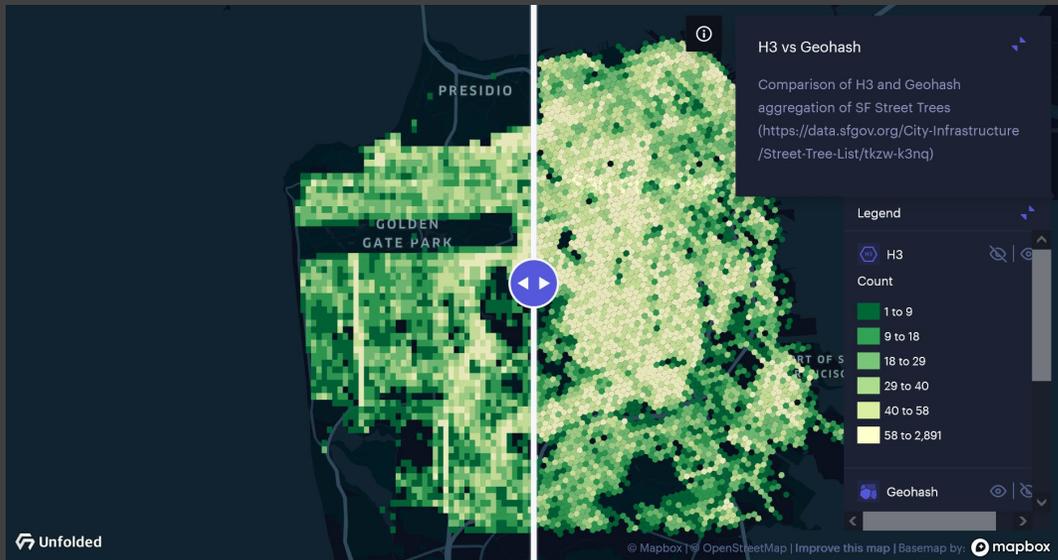
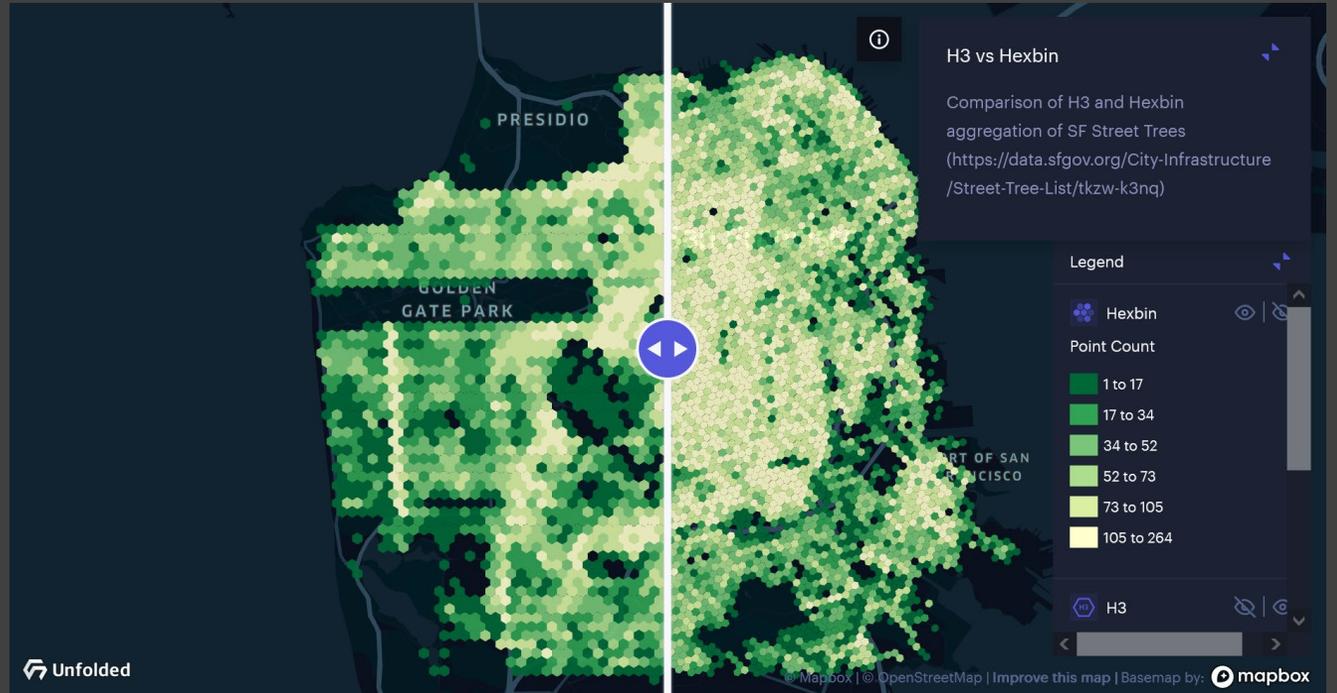
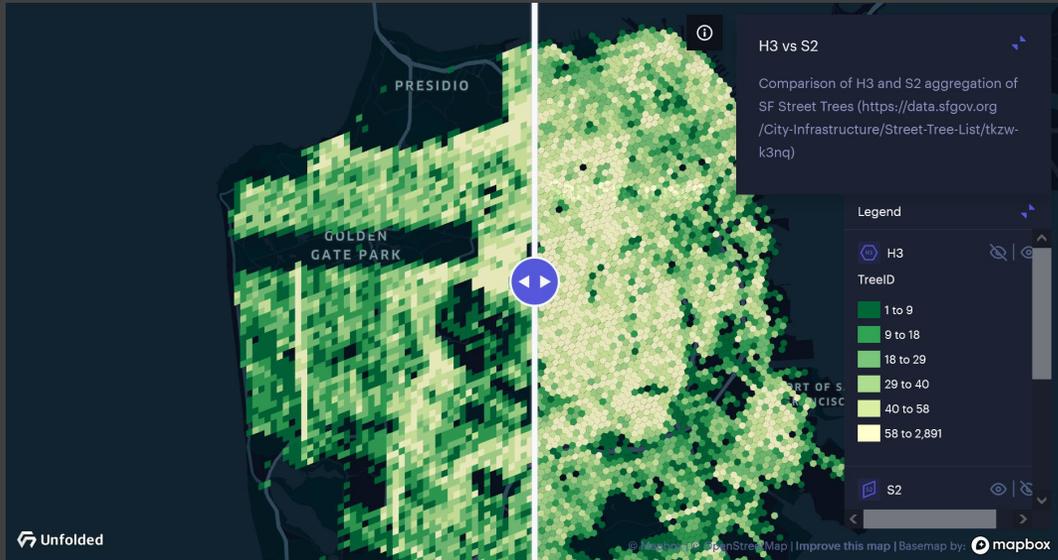
	fid	geom	h3_address	h3_resolution
1	1	Polygon	892a3255147ffff	9
2	2	Polygon	892bab4664bffff	9
3	3	Polygon	892bab5559bffff	9
4	4	Polygon	892ba82de2ffff	9
5	5	Polygon	892b8d88c93ffff	9
6	6	Polygon	892bab7343bffff	9
7	7	Polygon	892b8d9043bffff	9
8	8	Polygon	892bab8238bffff	9
9	9	Polygon	892bab89b33ffff	9
10	10	Polygon	892b8c970d7ffff	9
11	11	Polygon	892b8dae2dbffff	9
12	12	Polygon	892bab98a83ffff	9
13	13	Polygon	892b8db5a83ffff	9
14	14	Polygon	892b8ca6027ffff	9

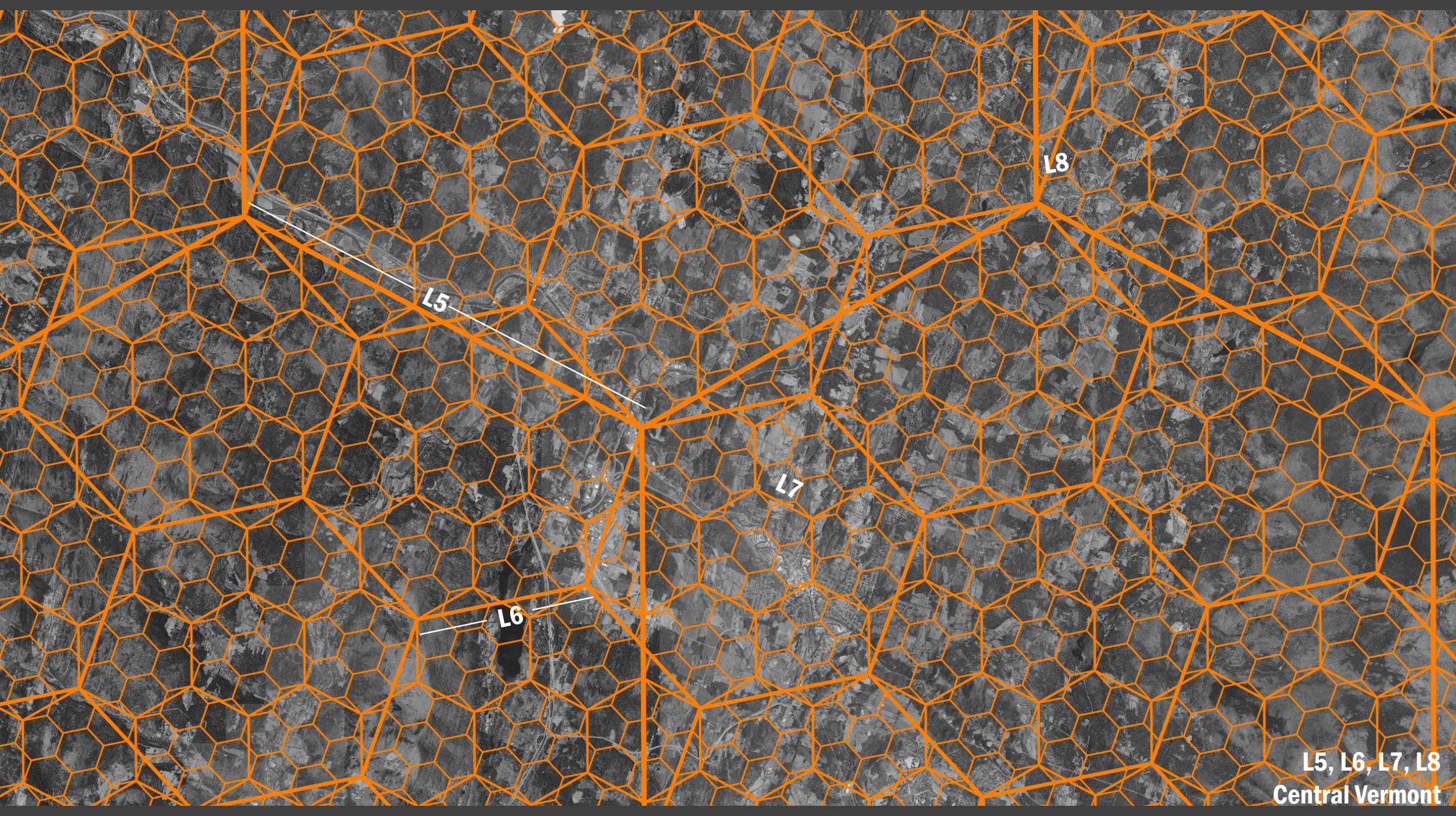
# Useful for?

- Data Analysis and Optimization
  - Point-location analysis (marketplaces, POI's, traffic/transportation flow, logistics, environmental data, mobile/live data, etc.)
- Privacy / Specific Location Concerns
- Uniform Reporting given Unique ID's
- Data interchange and aggregation
- Spatial Indexing at varying yet related levels

<https://h3geo.org/>







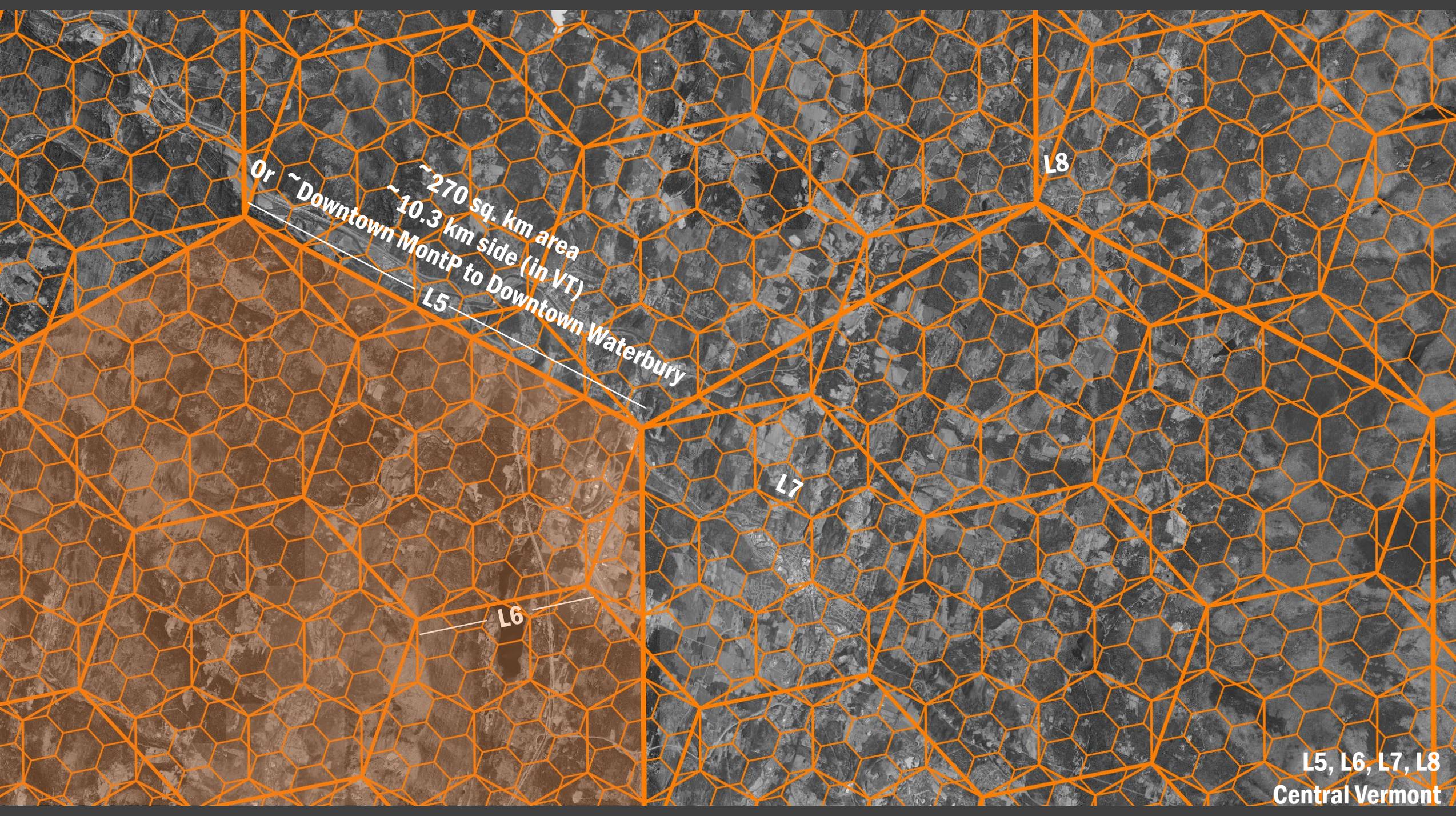
L5

L8

L7

L6

L5, L6, L7, L8  
Central Vermont



Or ~ Downtown MontP to Downtown Waterbury

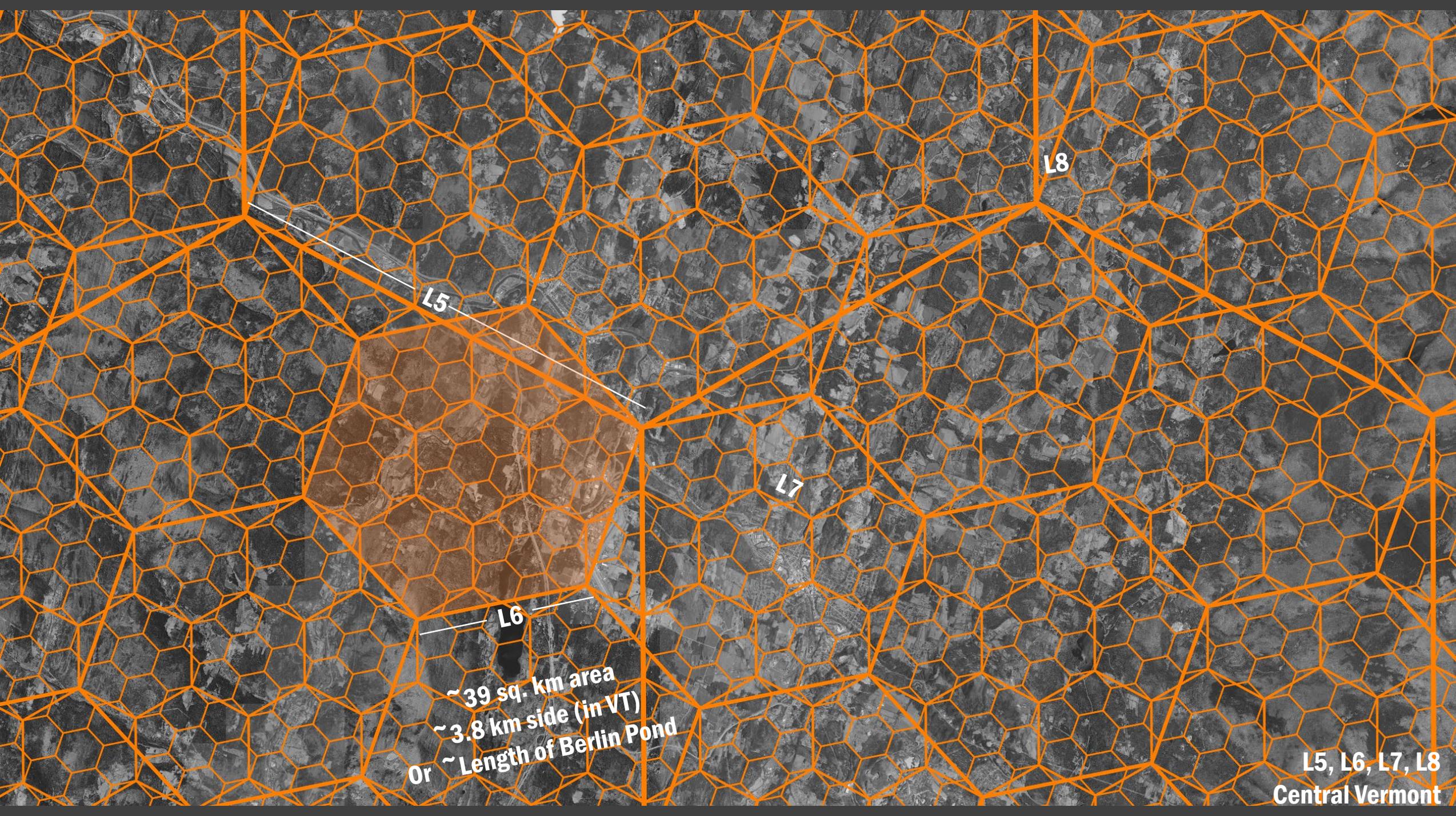
~270 sq. km area  
~10.3 km side (in VT)

L8

L7

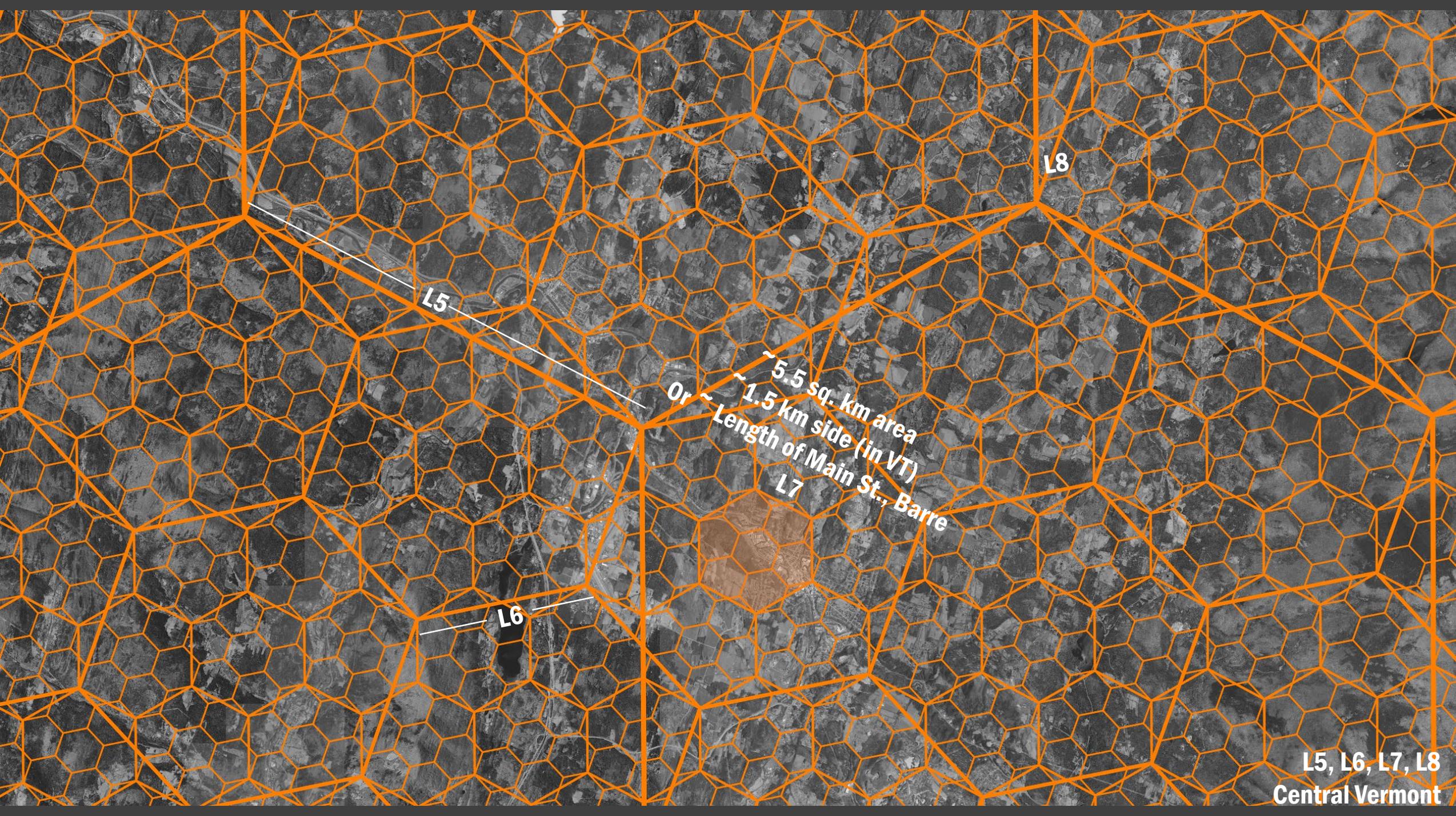
L6

L5, L6, L7, L8  
Central Vermont



~ 39 sq. km area  
~ 3.8 km side (in VT)  
Or ~ Length of Berlin Pond

L5, L6, L7, L8  
Central Vermont



L5

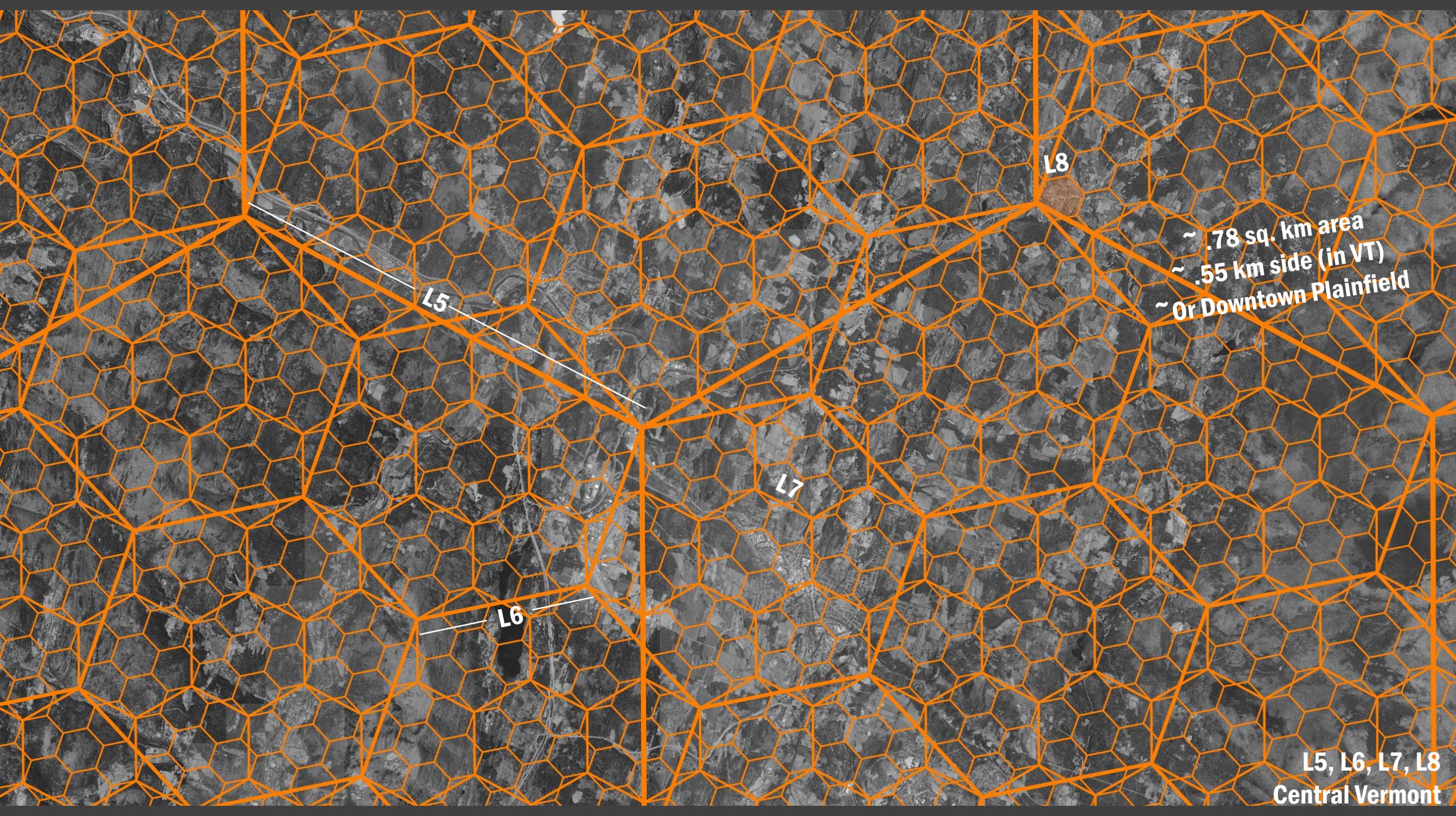
L8

Or ~ 5.5 sq. km area  
~ 1.5 km side (in VT)  
Length of Main St., Barre

L7

L6

L5, L6, L7, L8  
Central Vermont



L5

L8

L7

L6

~ .78 sq. km area  
~ .55 km side (in VT)  
~ Or Downtown Plainfield

L5, L6, L7, L8  
Central Vermont

**ESITES (342,511)**  
**H3 - L4**  
**25 Hexbins**  
**(25 Total / 100%)**  
**120 esites min**  
**50,500 max**  
**13,700 mean**



**ESITES (342,511)**  
**H3 - L5**  
**120 Hexbins**  
**(120 Total / 100%)**  
**2 Min**  
**32,538 Max**  
**2,854 Mean**



**L5**

**ESITES (342,511)**

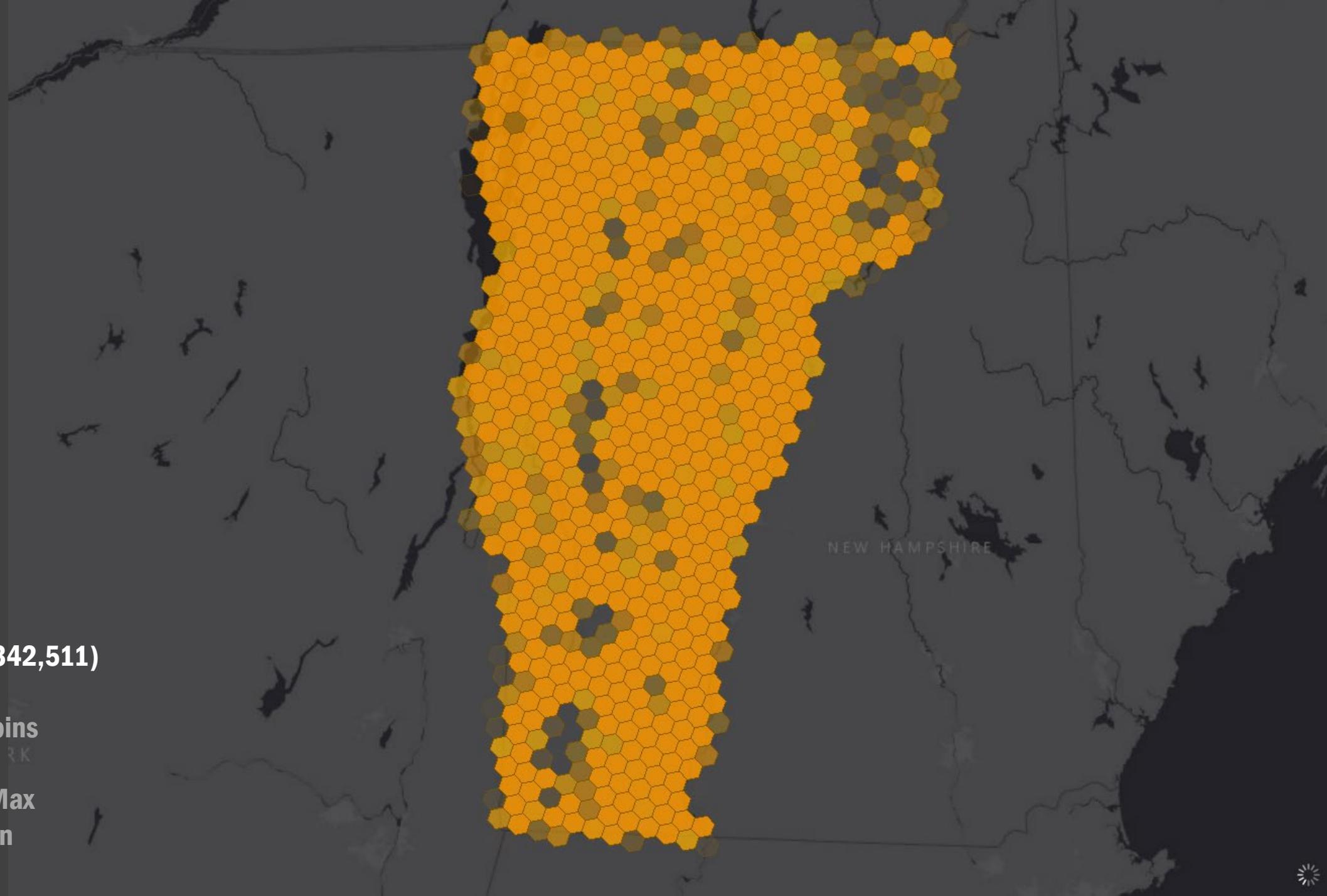
**H3 - L6**

**706 Hexbins**

**1 Min**

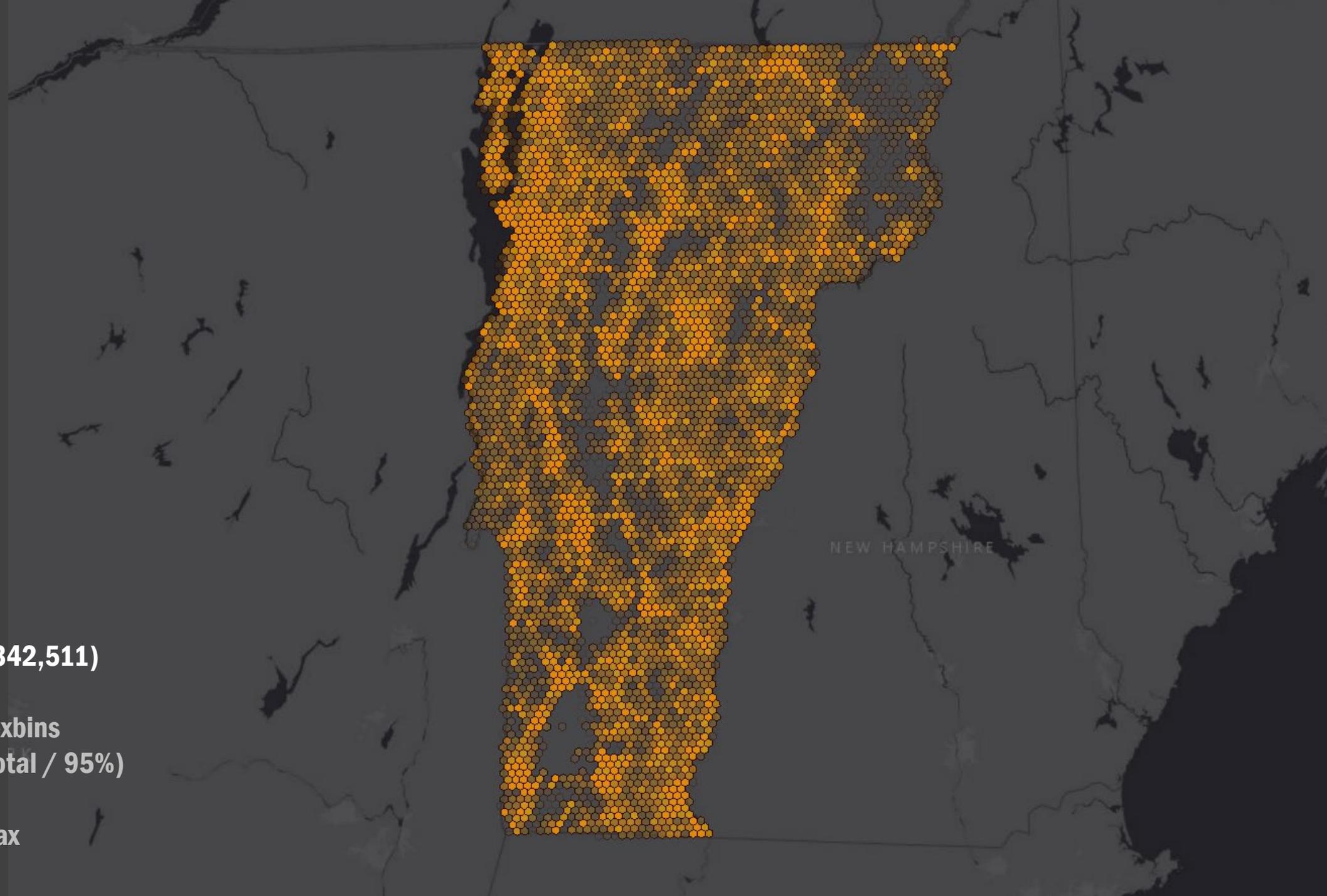
**13,693 Max**

**484 Mean**

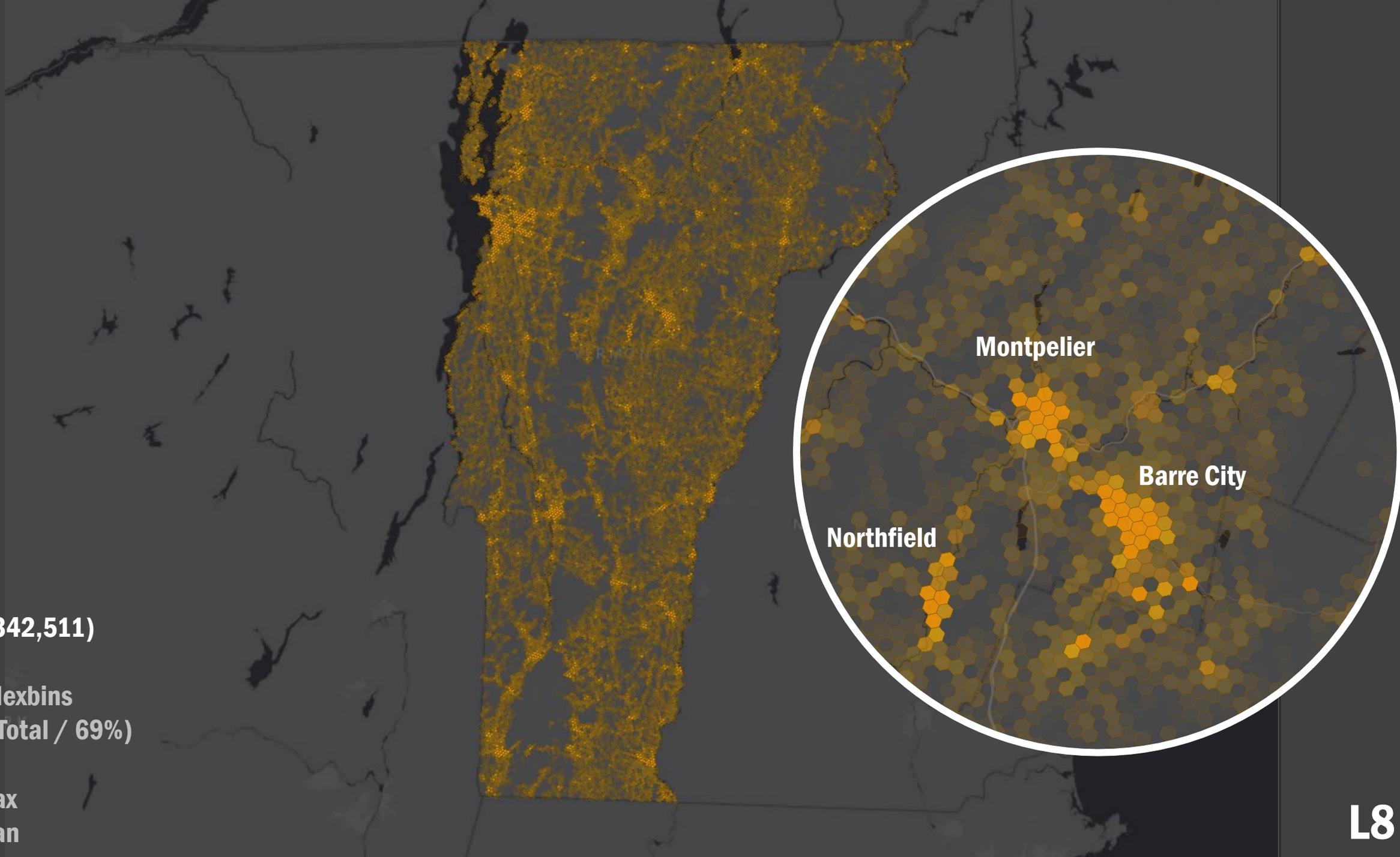


**L6**

**ESITES (342,511)**  
**H3 - L7**  
**4,313 Hexbins**  
**(4,546 Total / 95%)**  
**1 Min**  
**4,084 Max**  
**79 Mean**



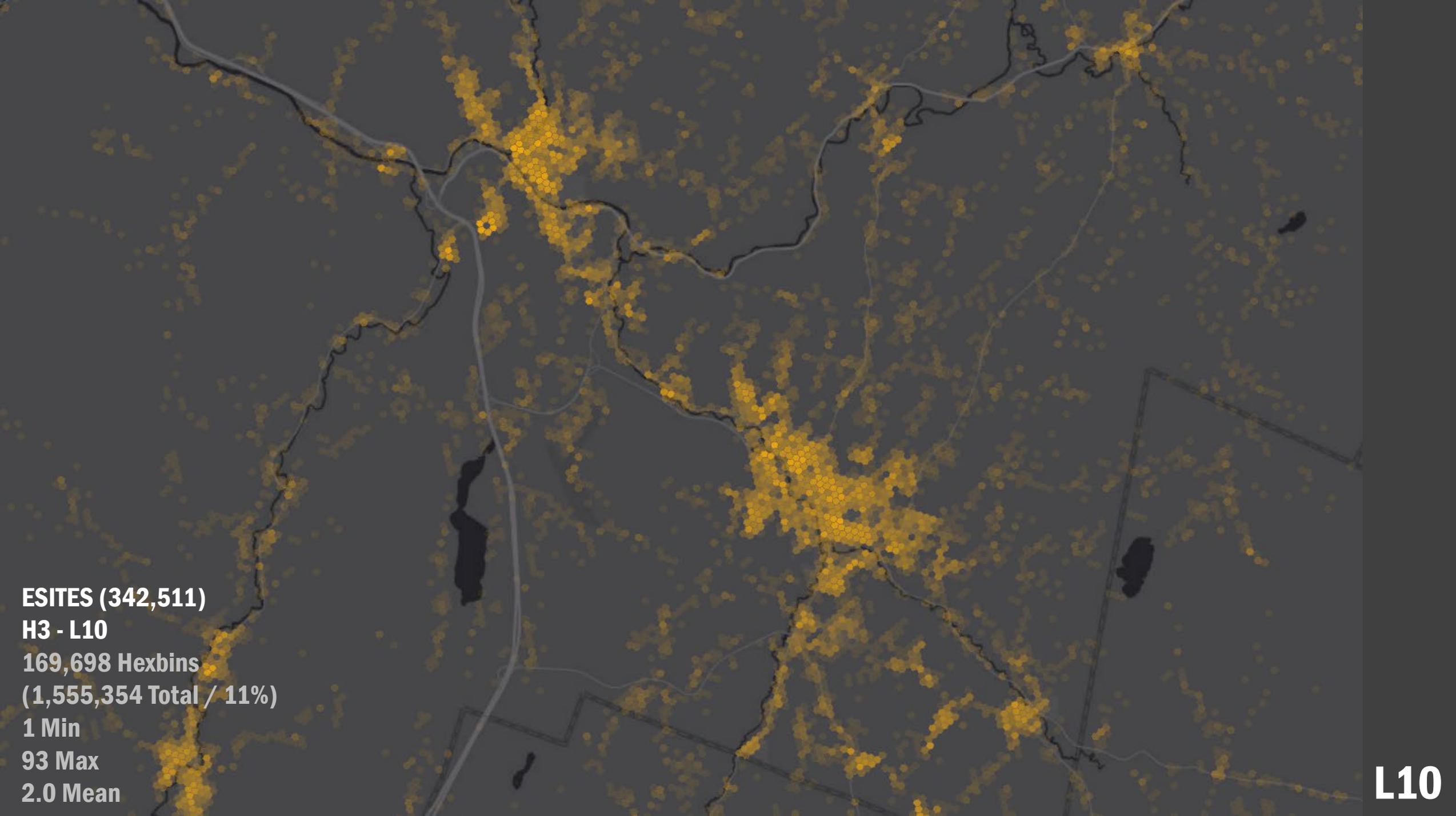
**ESITES (342,511)**  
**H3 - L8**  
**21,996 Hexbins**  
**(31,730 Total / 69%)**  
**1 Min**  
**1,214 Max**  
**15.6 Mean**



**L8**

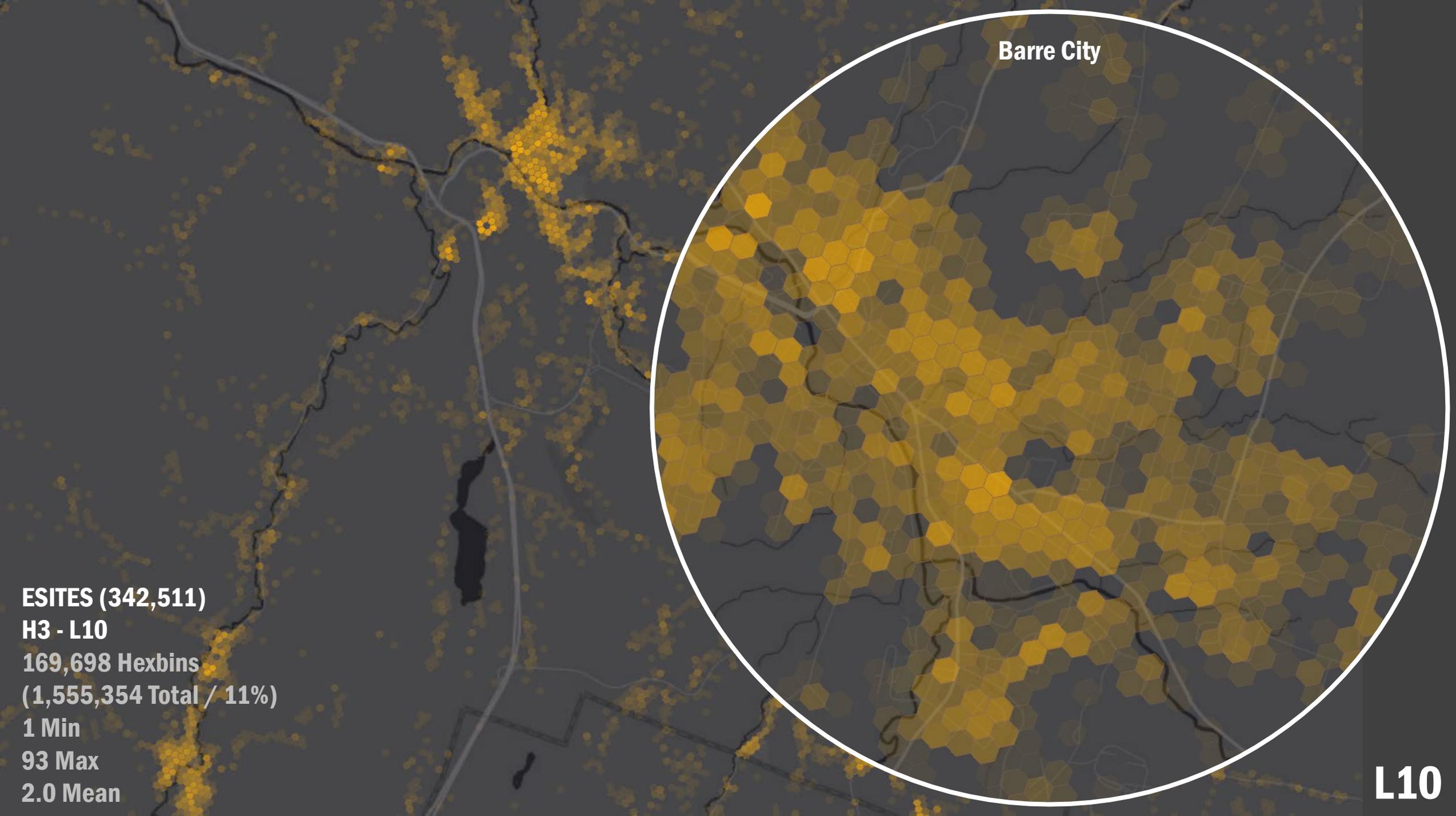
**ESITES (342,511)**  
**H3 - L9**  
**74,409 Hexbins**  
**(222,189 Total / 33%)**  
**1 Min**  
**259 Max**  
**4.6 Mean**

**L9**



**ESITES (342,511)**  
**H3 - L10**  
**169,698 Hexbins**  
**(1,555,354 Total / 11%)**  
**1 Min**  
**93 Max**  
**2.0 Mean**

**L10**

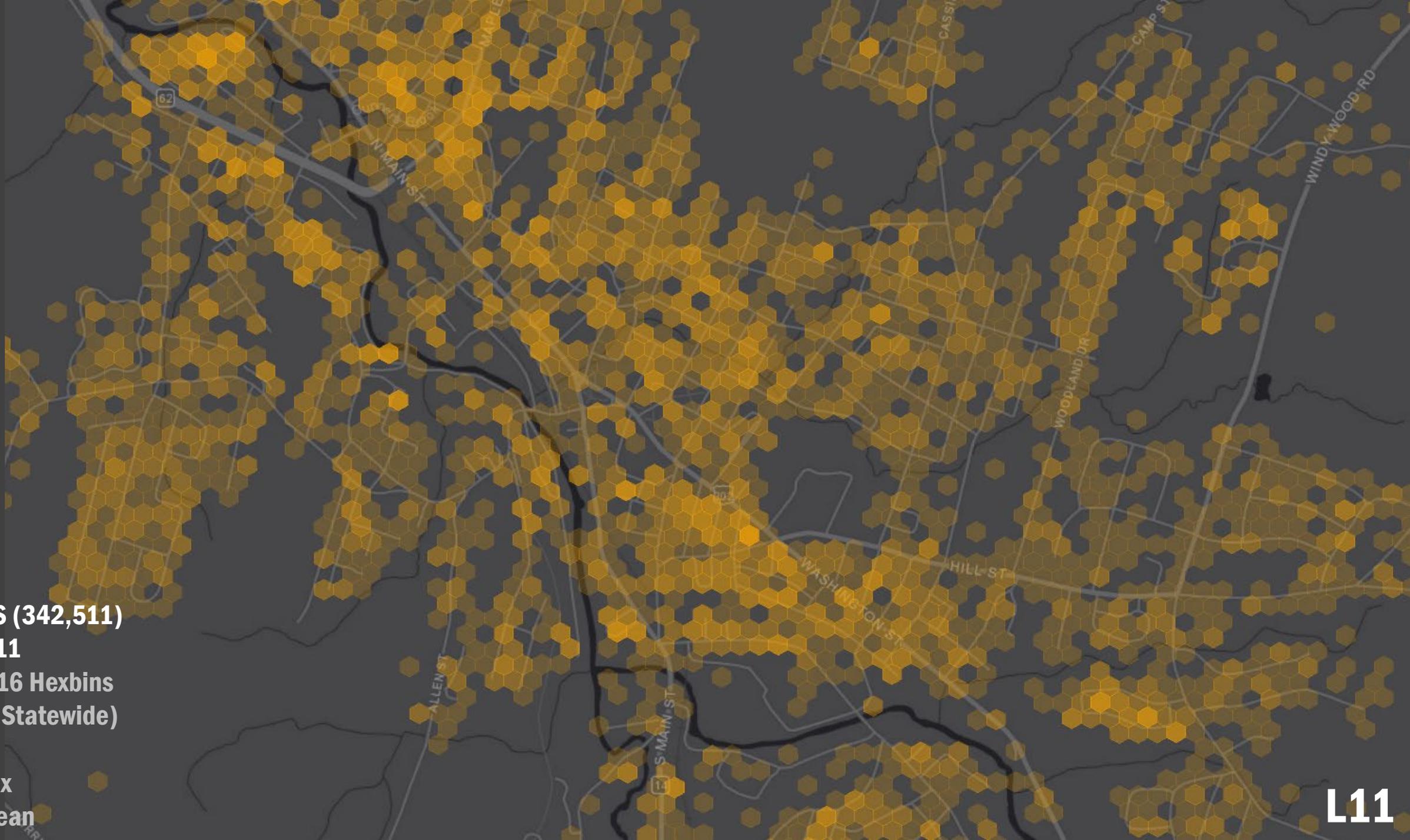


Barre City

**ESITES (342,511)**  
**H3 - L10**  
**169,698 Hexbins**  
**(1,555,354 Total / 11%)**  
**1 Min**  
**93 Max**  
**2.0 Mean**

**L10**

**ESITES (342,511)**  
**H3 - L11**  
**276,616 Hexbins**  
**(LOTS Statewide)**  
**1 Min**  
**24 Max**  
**1.2 Mean**



**L11**

**Sub-Block Level**

**ESITES (342,511)**

**H3 - L11**

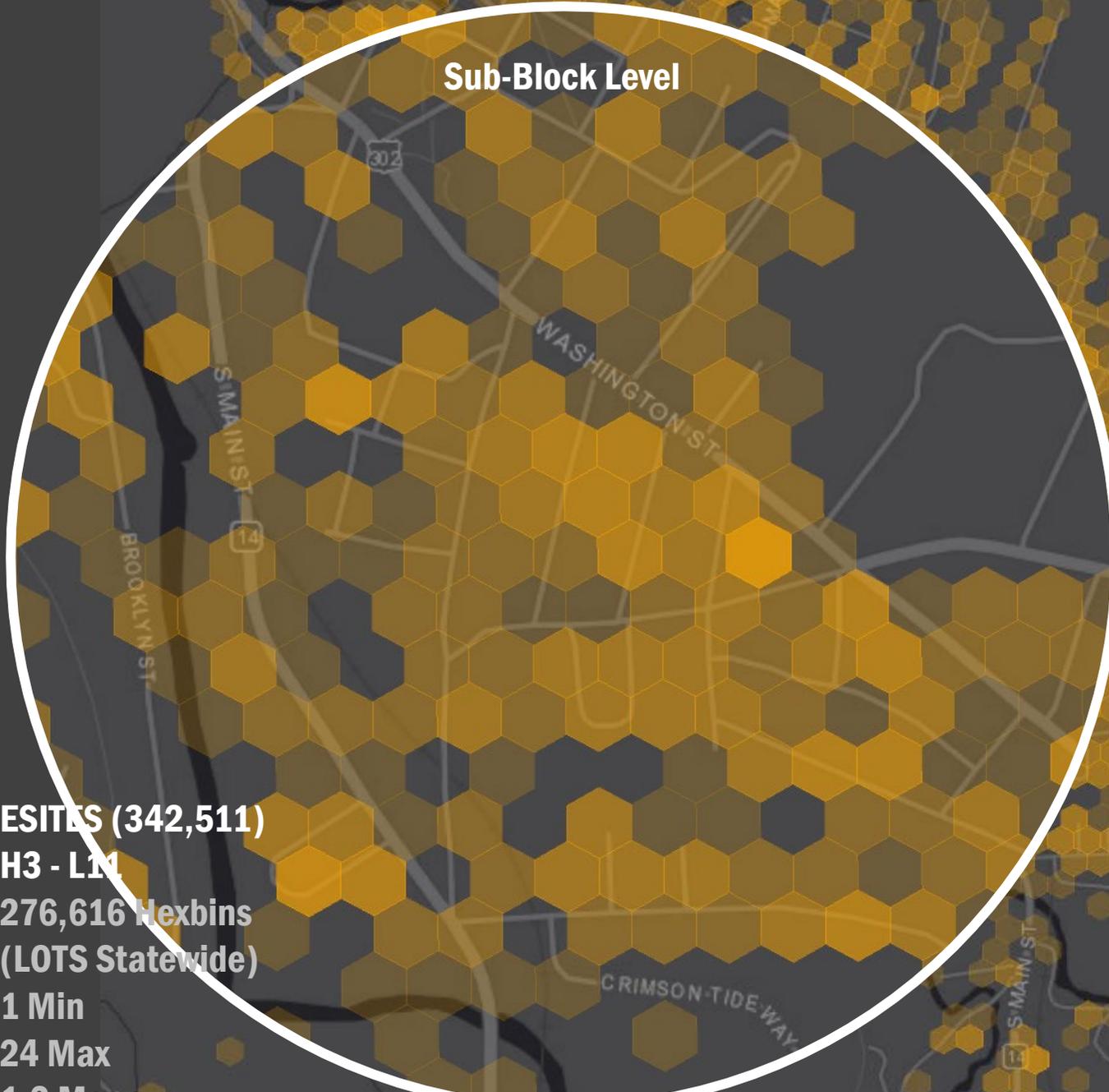
**276,616 Hexbins  
(LOTS Statewide)**

**1 Min**

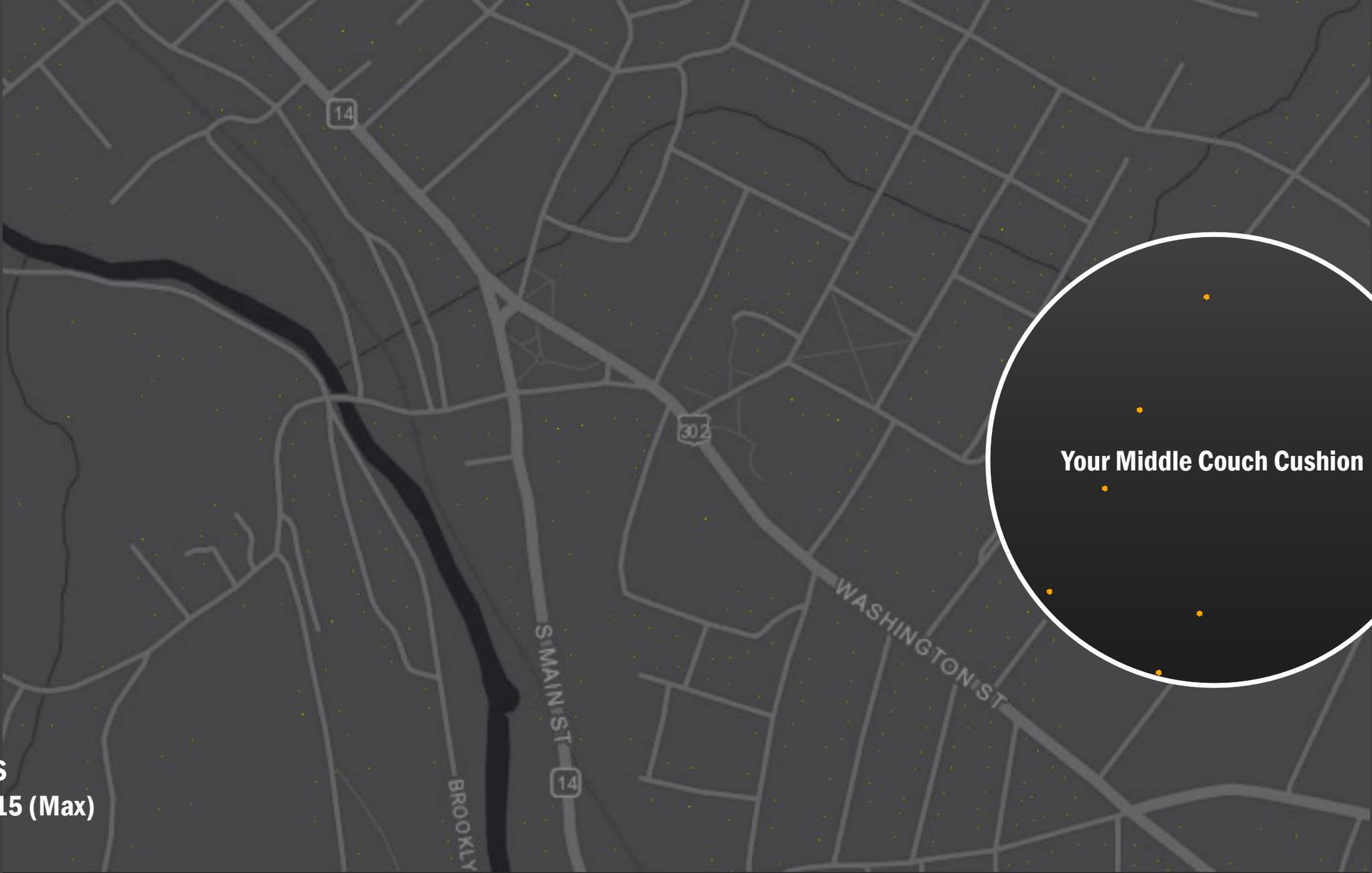
**24 Max**

**1.2 Mean**

**L11**



**ESITES**  
**H3 - L15 (Max)**



**L15**

H3 Resolution	Average Hexagon Area (km2) (World)	Average Hexagon Edge Length (World)	Number of Unique Indexes (World) (Vermont)
0	4,250,546.8477000	1,107.712591000	122
1	607,220.9782429	418.676005500	842
2	86,745.8540347	158.244655800	5,882
3	12,392.2648621	59.810857940	41,162
4	1,770.3235517	22.606379400	288,122 / 13-23
5	252.9033645	8.544408276	2,016,842 / 95-120
6	36.1290521	3.229482772	14,117,882 / 751
7	5.1612932	1.220629759	98,825,162 / 4,546
8	0.7373276	0.461354684	691,776,122 / 31,730
9	0.1053325	0.174375668	4,842,432,842 / 222,189
10	0.0150475	0.065907807	33,897,029,882 / 1,555,354
11	0.0021496	0.024910561	237,279,209,162
12	0.0003071	0.009415526	1,660,954,464,122
13	0.0000439	0.003559893	11,626,681,248,842
14	0.0000063	0.001348575	81,386,768,741,882
15	0.0000009	0.000509713	569,707,381,193,162

**USEFUL RANGE IN VT?**

- ~ County
- ~ Town/Region
- ~ Sub-Town/Cities
- ~ Downtown/Vill./Dev. Areas
- ~ Neighborhood
- ~ Neighborhood/Blocks
- ~ Sub-Block

[Table of H3 Cell Areas \(World Avg.\)](#)

# Using H3

- 3 Example Options (there are others, e.g. API)
  - Python / QGIS → Create H3 Index for Input Bounding Layer
  - FME / Data Interop. → Analyze existing data within H3 Index Structure
  - Geodata Portal → Pre-built downloadable levels statewide (TBD), spatial join to your needs

Browser

- ★ Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\
- GeoPackage
- SpatialLite
- PostGIS
- MSSQL
- Oracle
- DB2
- WMS/WMTS
  - 2016 Base Land Cover WM
  - 2016 Impervious Surfaces WM



Layers

- VT Data - State Boundary
- Hex5-4617-sqmeters
- Hex5-4617-sqkm
- Hex 5
- Hex 6
- Hex 7
- Hex 8
- Hex 9

```

1 Python Console
2 Use iface to access QGIS API interface or Type help(iface) for more info
3 Security warning: typing commands from an untrusted source can lead to data loss a
  nd/or leak
4

```

## [h3-grid-from-layer.py](#)

>>>

Python Console

```

+
Untitled-0
h3-grid-from-layer.py
28 QgsWkbTypes,
29 )
30 from qgis.PyQt.QtCore import QVariant
31 import processing
32 import h3
33
34 debug = False
35
36 ###-----Edit these variables-----
37 # Min & max h3 resolution levels, from 0 to 15 (global to sub-meter)
38 # High resolutions over broad areas can be slow and consume a lot of storage space
39 # https://h3geo.org/docs/core-library/restable
40 # Resolution 7 is ~2,000m across, 9 is ~320m across, 11 is ~45m (in YT Albers)
41 min_resolution = 5
42 max_resolution = 9
43
44 # Output files are {prefix}_{resolution}: Hex_3, Hex_4, ...
45 out_name_prefix = "Hex"
46
47 geographic_coordsys = "EPSG:4617" # e.g. WGS84, NAD83 (CSRS)
48 output_projection = "EPSG:3579" # placeholder, not currently used
49 #-----
50
51 projectPath = os.path.dirname(QgsProject.instance().fileName())
52 geo_crs = QgsCoordinateReferenceSystem(geographic_coordsys)
53 out_crs = QgsCoordinateReferenceSystem(output_projection)
54
55 dataPath = os.path.join(projectPath, "data/")

```

# Using FME's H3HexagonalIndexer Transformer

## 1. Intake Point Features

VT E911 Site Locations
OBJECTID
SEGMENTID
ESITEID
GEONAMEID
PD
PT
SN
ST
SD
PRIMARYNAME
ALIAS1
ALIAS2
ALIAS3
ALIAS4
ALIAS5
CALCADDRESS
GFADDRESS
PRIMARYADDRESS

AttributeManager
OBJECTID
SEGMENTID
ESITEID
GEONAMEID
PRIMAR...DDRESS
SITETYPE
TOWNNAME
COUNTY

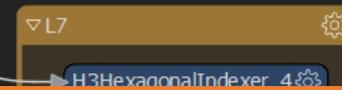
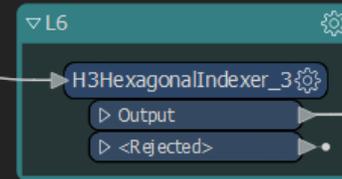
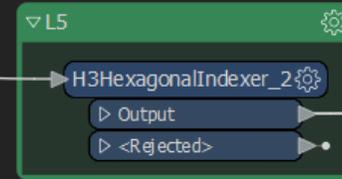
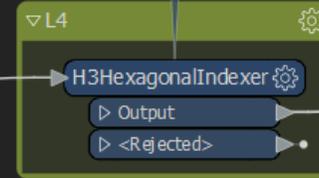
## 2. Reproject to WM

Must Reproject to Web Mercator (4326) to use H3 Index

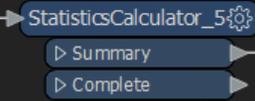
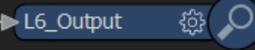
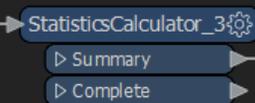
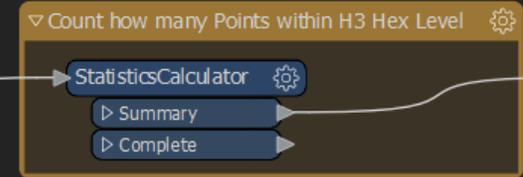


## 3. BIN to Desired Index Level

**H3HexagonalIndexer [H3HexagonalIndexer]**  
Operation:  
Get: Index  
General:  
Index Resolution: 4 (~23 km per edge)  
Geometry Handling: Replace With Hexagon  
Output Attribute Names:  
Index: \_h3index\_L4



## 4. Perform Add'tl Uses



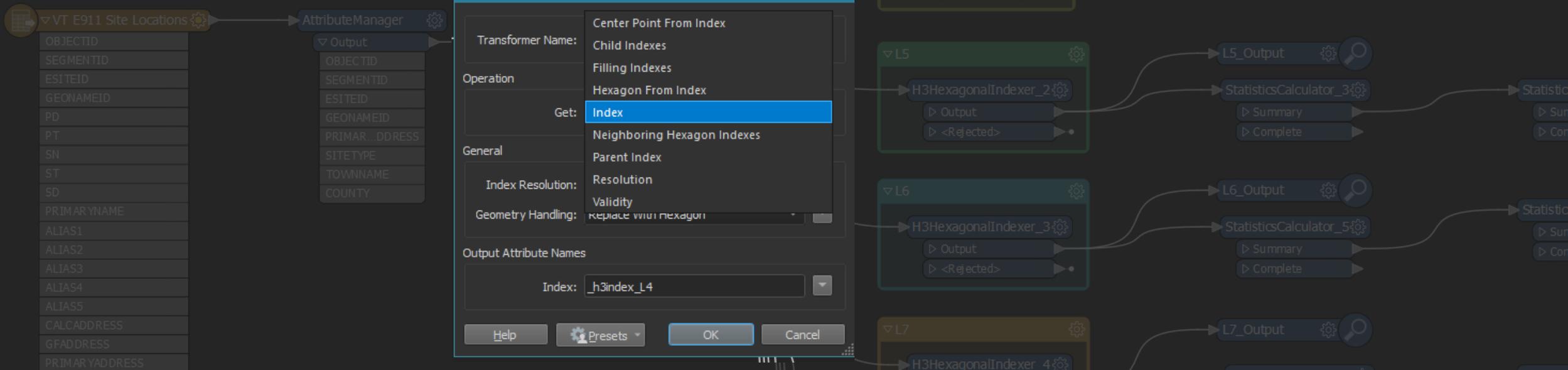
# Using FME's H3HexagonalIndexer Transformer

## 3. BIN to Desired Index Level

## 4. Perform Add'tl Uses

## 2. Reproject to WM

## 1. Intake Point Features



# Helpful Overview / [How-To](#)



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Demo: Snowy Owl Migration	55:08
H3 Surprises	01:08:00
Dale's Hexagon Rap	01:14:14

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## Hexagonify the World: The Theory and Applications of Uber H3

Imagine having more spatial data than you know what to do with, and yet it holds the key to improving your customer's experience and your company's bottom line. That's the situation that Uber found themselves in, so they created a Hexagonal Hierarchical Spatial Indexing library (called H3) that indexes the world in 16 different levels of resolution as the foundation for solving their challenge.

### Webinar Details

Broadcast on February 10th, 2021

[Download Workspaces](#)



Chat with Us

# Portal (TBD)

- Example Layers (Web Map)
- Levels 4-9 (10)? be adequate?
- Service, Downloads...

