

Analyzing Fires in Minneapolis Across Space and Time

The background of the slide is a dark blue space-themed image. It features a grid of thin, light blue lines that create a sense of depth and perspective. Scattered throughout the background are small, white, star-like specks. In the center, a globe of the Earth is visible, showing the continents of North and South America. From the base of the globe, large, bright orange and yellow flames rise upwards, resembling a fire burning on the surface of the planet. The flames are dynamic and detailed, with varying heights and colors ranging from deep orange to bright yellow at the tips.

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Minneapolis

A wide-angle photograph of a city skyline at dusk, viewed from across a body of water. The sky is a deep, dark blue with wispy clouds. The city skyline is silhouetted against the horizon, with a few buildings illuminated. The water in the foreground is calm, reflecting the sky and the city lights. The overall mood is serene and peaceful.

Minneapolis Fast Facts

- 425,000 population
- 54 square miles
- 7,600 people/sq. mi.
- Comparable to Oakland, CA in population, area, and density
- Home of the Twins, Timberwolves, and Vikings
- Headquarters of Target, US Bank, and Xcel Energy
- Main campus of the University of Minnesota

Twin Cities Fast Facts

- 3 million population – comparable to San Diego
- State capitol in St. Paul
- 2nd largest economy in the Midwest



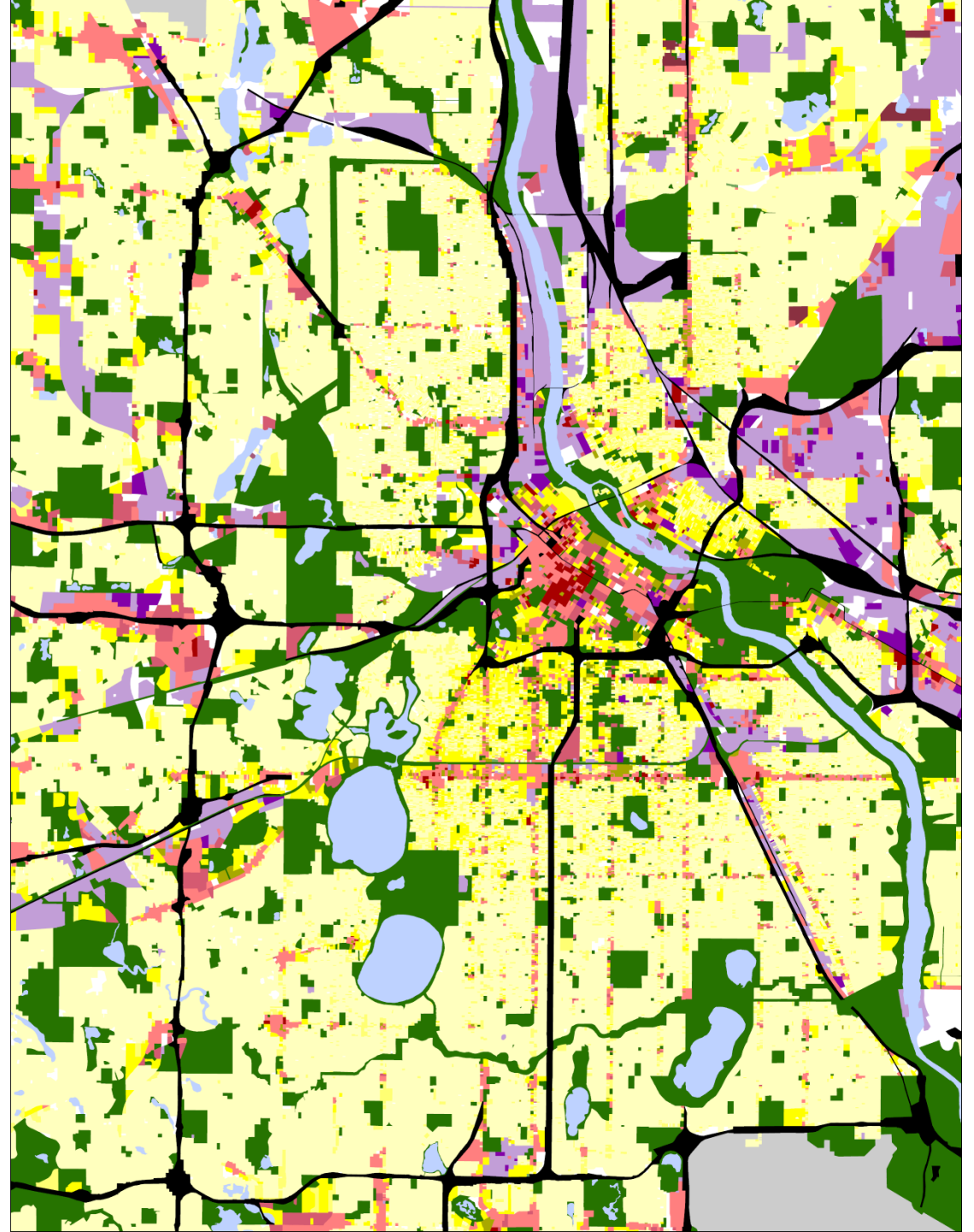






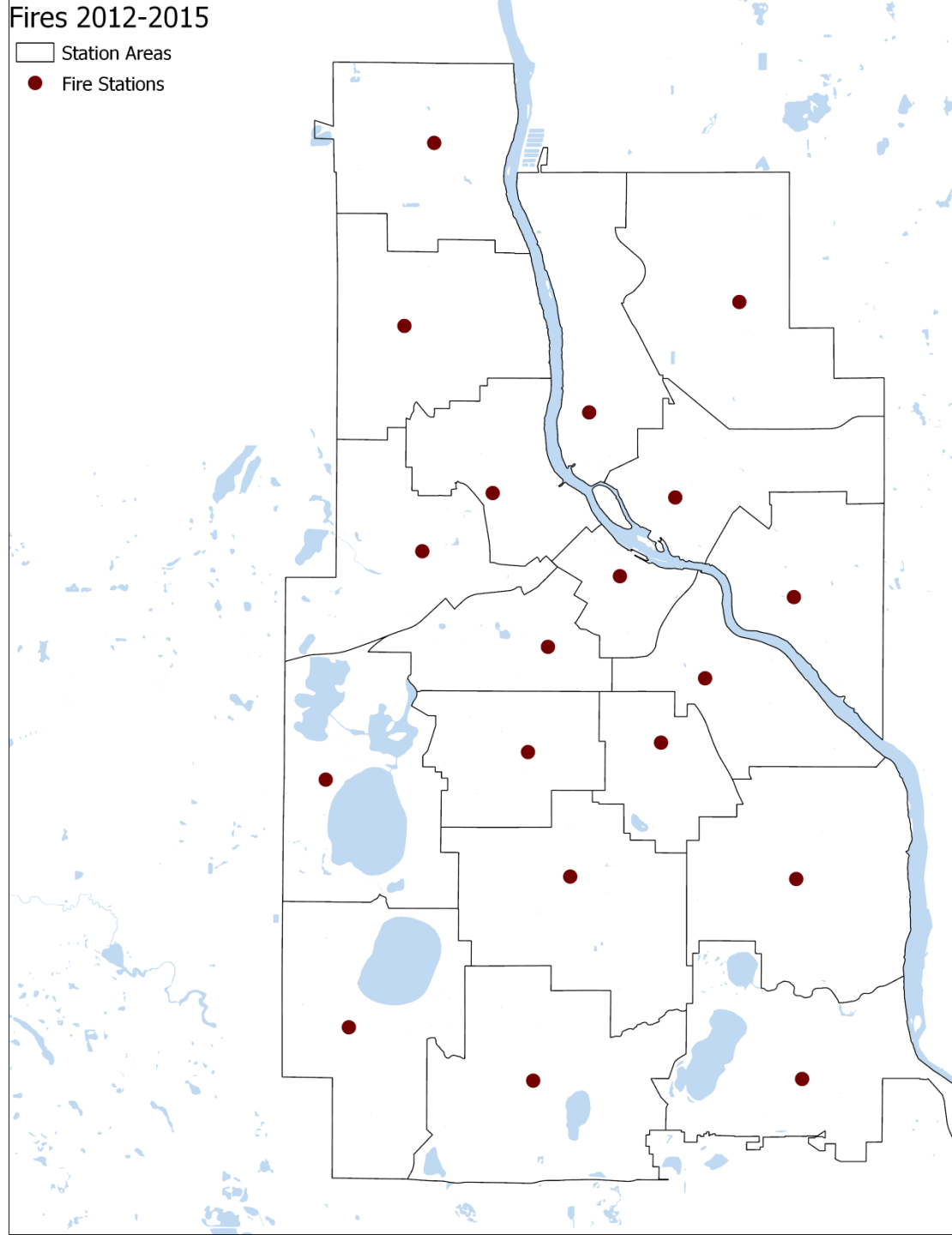


Land Use



Fires 2012-2015

- Station Areas
- Fire Stations

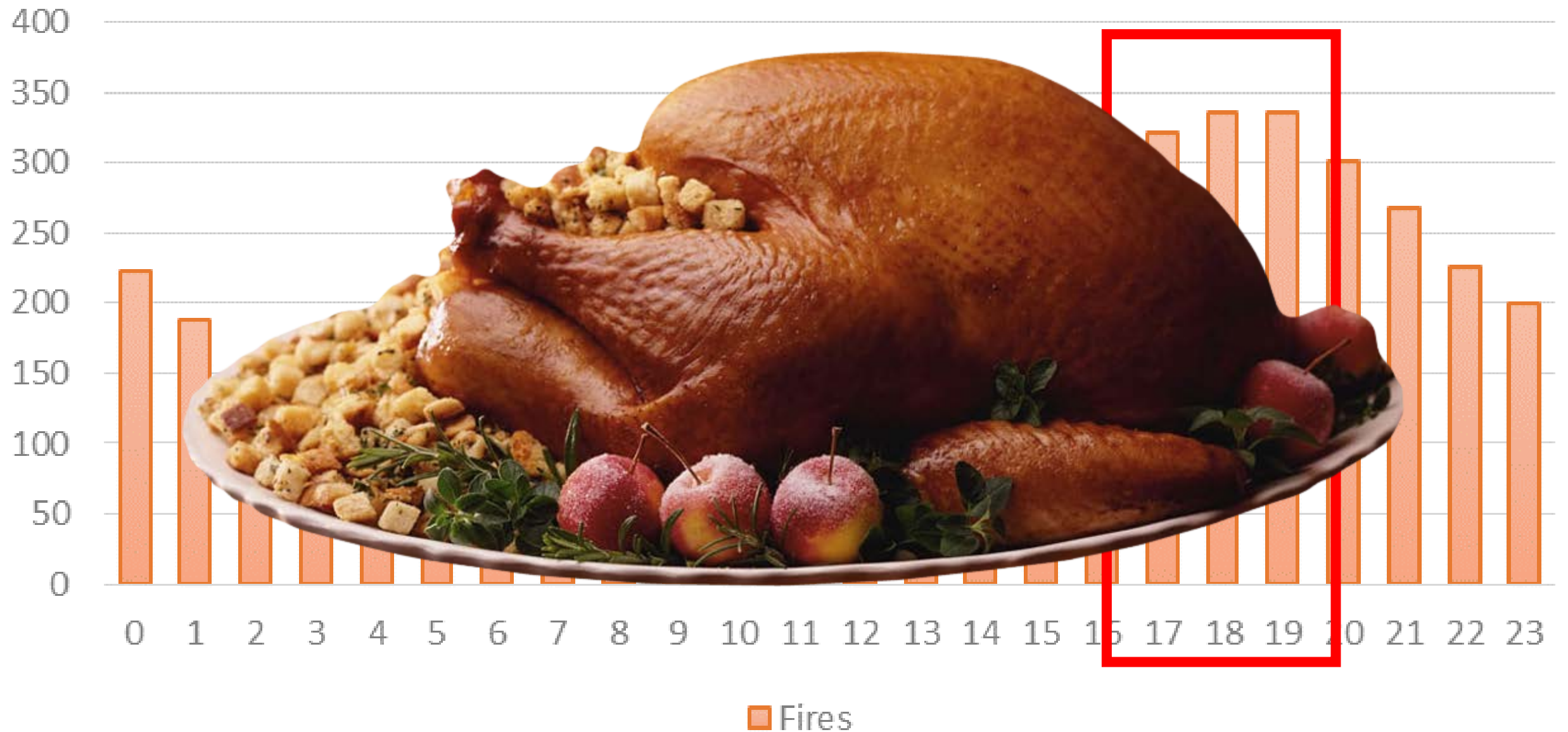


inci_no	inci_type	station	descript	alm_time	alm_date	alm_year	alm_month	alm_hour	alm_datetime	clr_time	clr_date
12-0007830	111	14	Building fire	22:11:02	3/18/2012	2012	3	22	3/18/2012 10:11:00 PM	18:27:51	3/22/2012
12-0027584	164	21	Outside mailbox fire	5:20:20	9/18/2012	2012	9	5	9/18/2012 5:20:00 AM	13:01:00	9/19/2012
12-0027582	141	21	Forest, woods or wild...	5:41:37	9/18/2012	2012	9	5	9/18/2012 5:41:00 AM	13:00:17	9/19/2012
12-0038505	131	20	Passenger vehicle fire	0:27:54	12/28/2012	2012	12	0	12/28/2012 12:27:00 AM	6:55:23	12/29/2012
14-0000052	111	7	Building fire	8:16:10	1/1/2014	2014	1	8	1/1/2014 8:16:00 AM	7:46:42	1/2/2014
15-0011880	111	4	Building fire	8:43:31	4/15/2015	2015	4	8	4/15/2015 8:43:00 AM	7:20:51	4/16/2015
13-0002774	111	17	Building fire	1:51:11	1/24/2013	2013	1	17	1/24/2013 5:51:00 PM	15:40:05	1/25/2013
13-0023061	111	5	Building fire	2:31:54	7/31/2013	2013	7	23	7/31/2013 11:31:00 PM	17:01:40	8/1/2013
12-0014842	111	5	Building fire	20:25:23	5/27/2012	2012	5	20	5/27/2012 8:25:00 PM	13:07:58	5/28/2012
13-0011988	111	5	Building fire	3:02:57	4/25/2013	2013	4	3	4/25/2013 3:02:00 AM	18:38:40	4/25/2013
15-0007616	111	11	Building fire	22:56:08	3/7/2015	2015	3	22	3/7/2015 10:56:00 PM	12:59:31	3/8/2015
12-0006743	111	6	Building fire	2:03:47	3/9/2012	2012	3	2	3/9/2012 2:03:00 AM	13:54:14	3/9/2012
12-0011786	111	14	Building fire	7:03:12	4/28/2012	2012	4	7	4/28/2012 7:03:00 AM	18:22:08	4/28/2012
15-0006461	111	17	Building fire	1:26:24	2/26/2015	2015	2	1	2/26/2015 1:26:00 AM	12:06:55	2/26/2015
15-0012099	131	7	Passenger vehicle fire	0:39:57	4/17/2015	2015	4	0	4/17/2015 12:39:00 AM	11:07:00	4/17/2015
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12-0033006	160	14	Special outside fire,...	3:08:09	11/7/2012	2012	11	3	11/7/2012 3:08:00 AM	12:44:29	11/7/2012
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15-0030157	111	27	Building fire	5:05:55	9/12/2015	2015	9	5	9/12/2015 5:05:00 AM	12:55:02	9/12/2015
12-0012546	160	11	Special outside fire,...	2:25:32	5/6/2012	2012	5	2	5/6/2012 2:25:00 AM	10:04:49	5/6/2012
15-0005522	111	2	Building fire	0:41:40	2/18/2015	2015	2	0	2/18/2015 12:41:00 AM	8:17:24	2/18/2015
14-0036353	113	8	Cooking fire, confine...	12:28:21	11/9/2014	2014	11	12	11/9/2014 12:28:00 PM	19:41:54	11/9/2014
13-0013518	111	15	Building fire	5:56:19	5/10/2013	2013	5	5	5/10/2013 5:56:00 AM	13:06:26	5/10/2013
13-0005473	111	4	Building fire	1:12:40	2/19/2013	2013	2	1	2/19/2013 1:12:00 AM	7:59:14	2/19/2013
12-0008040	111	17	Building fire	6:00:56	3/21/2012	2012	3	6	3/21/2012 6:00:00 AM	12:33:38	3/21/2012

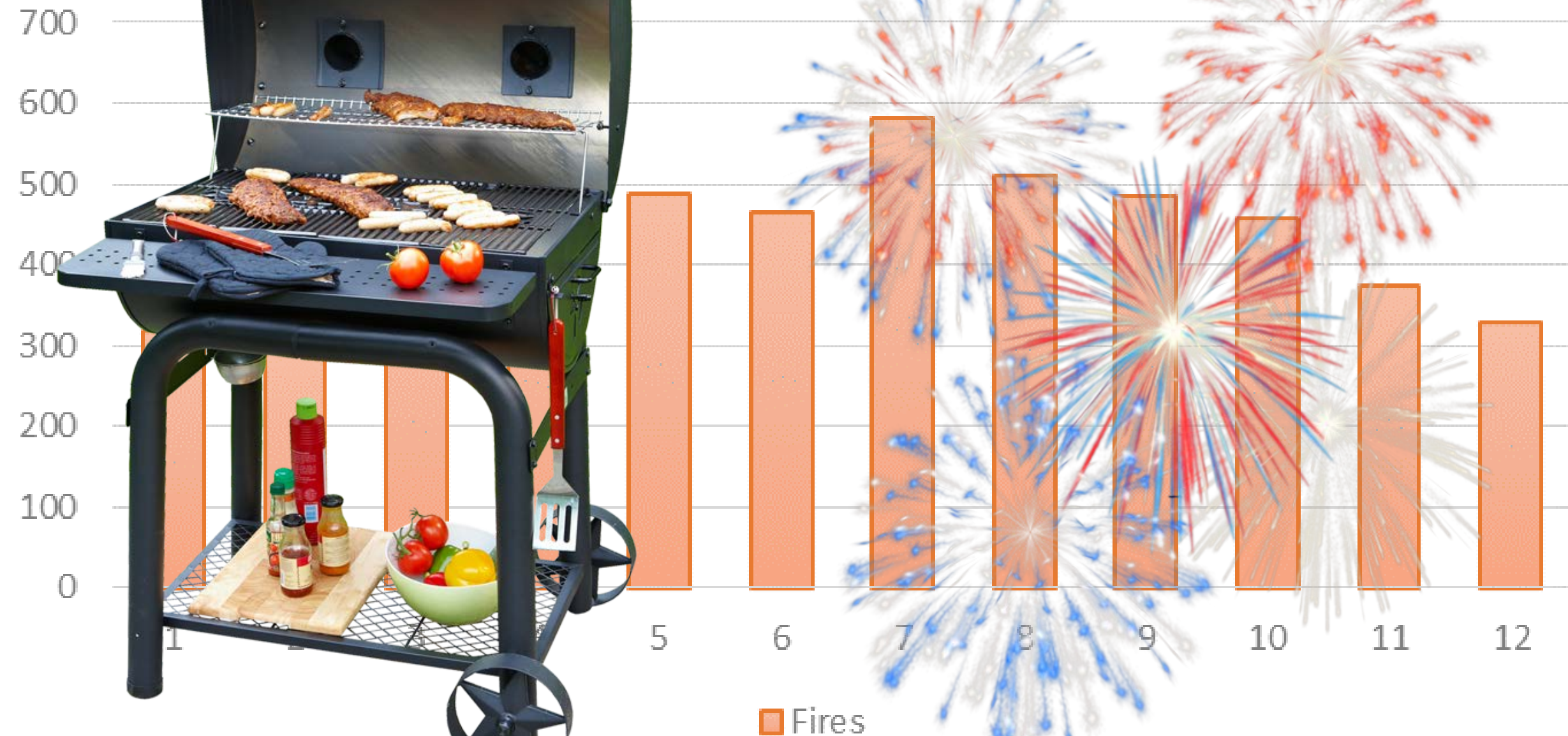


Time

Fires per Hour



Fires per Month

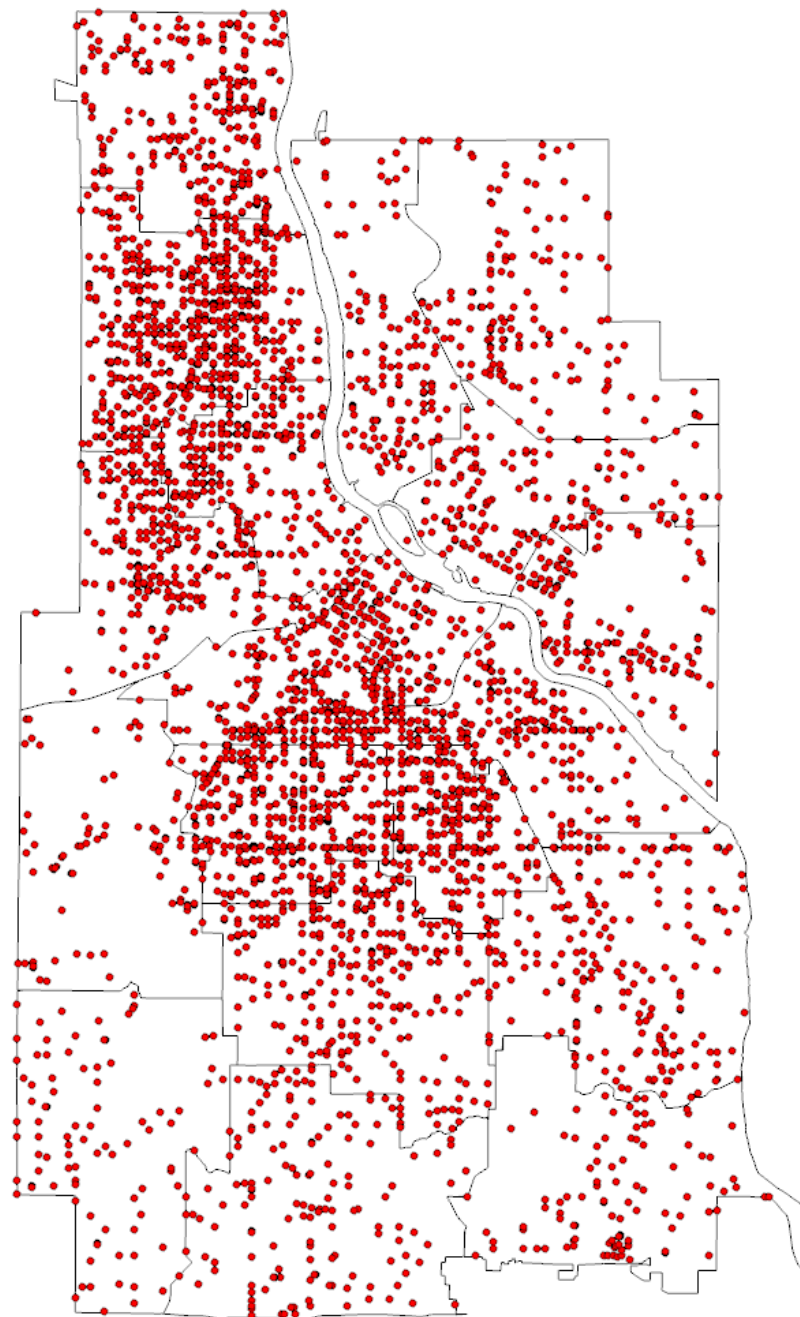


Space



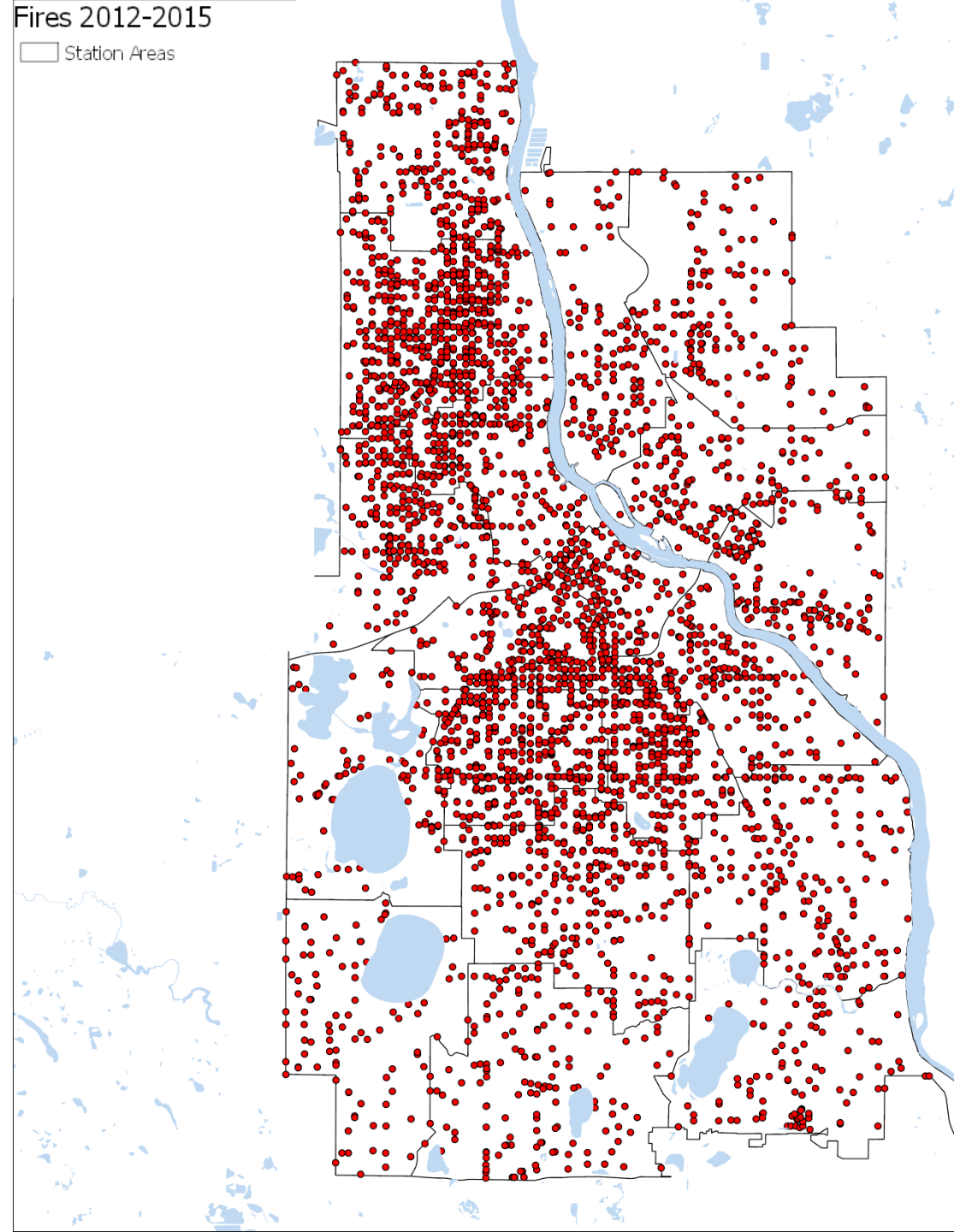
Fires 2012-2015

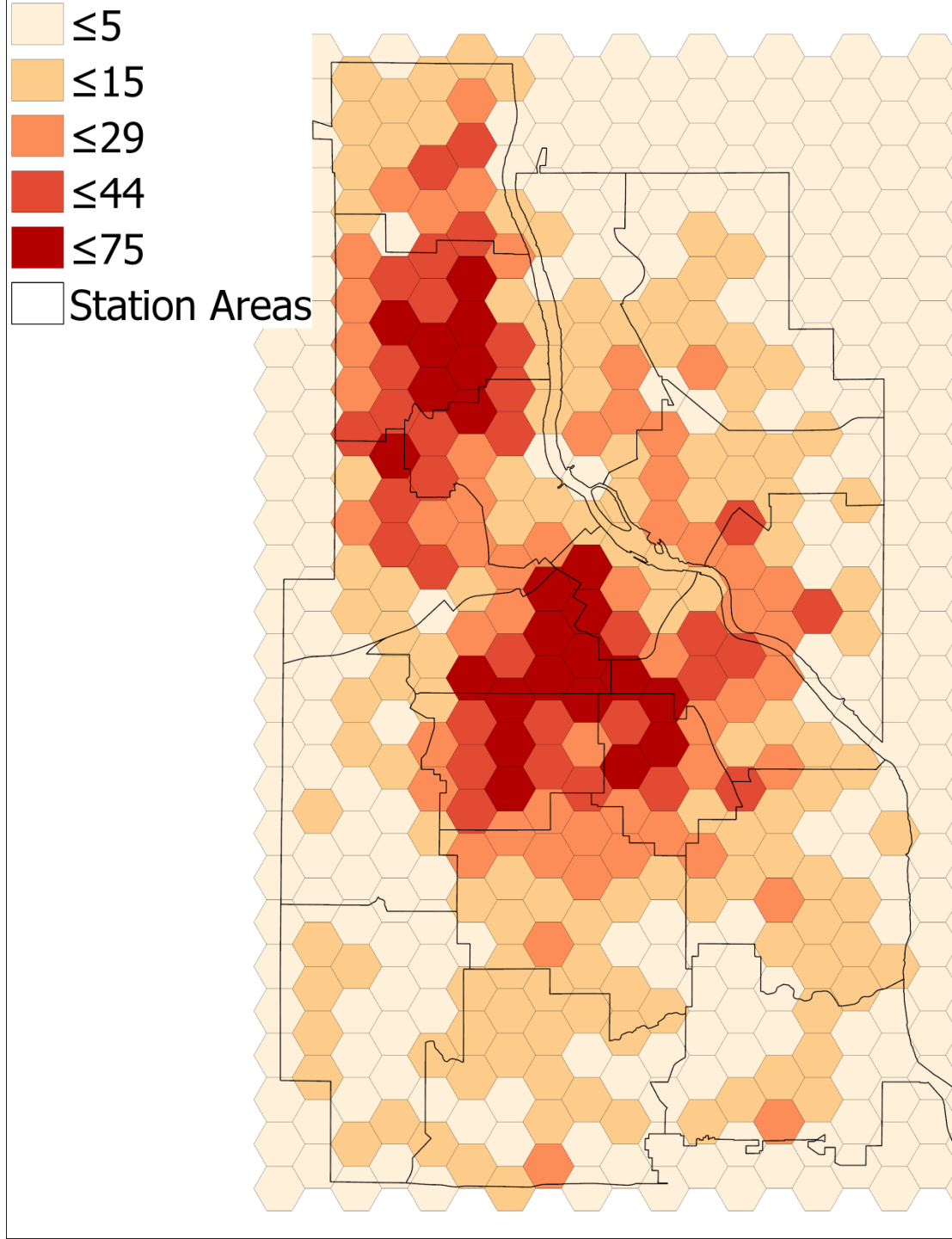
Station Areas



Fires 2012-2015

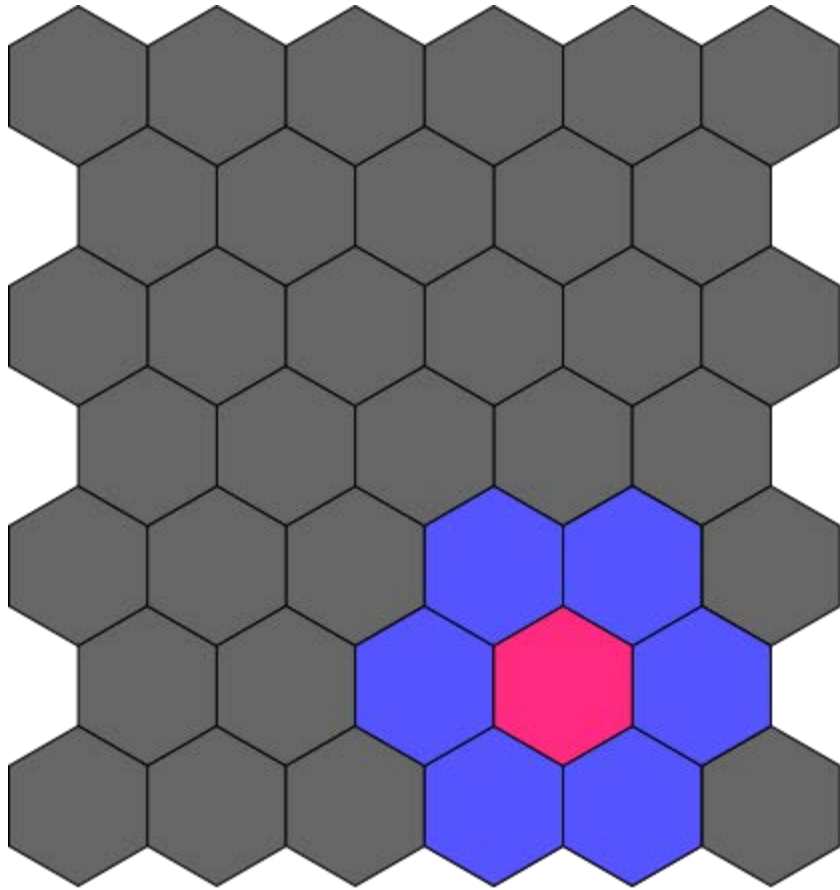
Station Areas





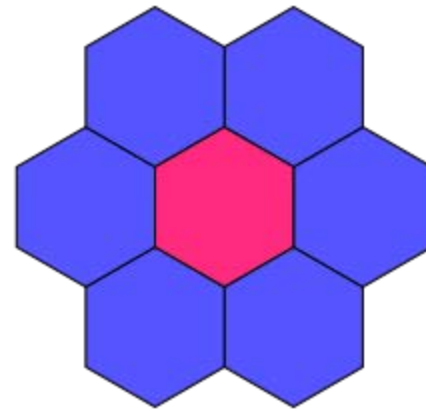
Cluster Analysis

- Spatial Statistics Toolbox > Mapping Clusters
 - Hot Spot Analysis
 - Cluster-Outlier Analysis
- No special license necessary!



Study Area

1km width



Neighborhood

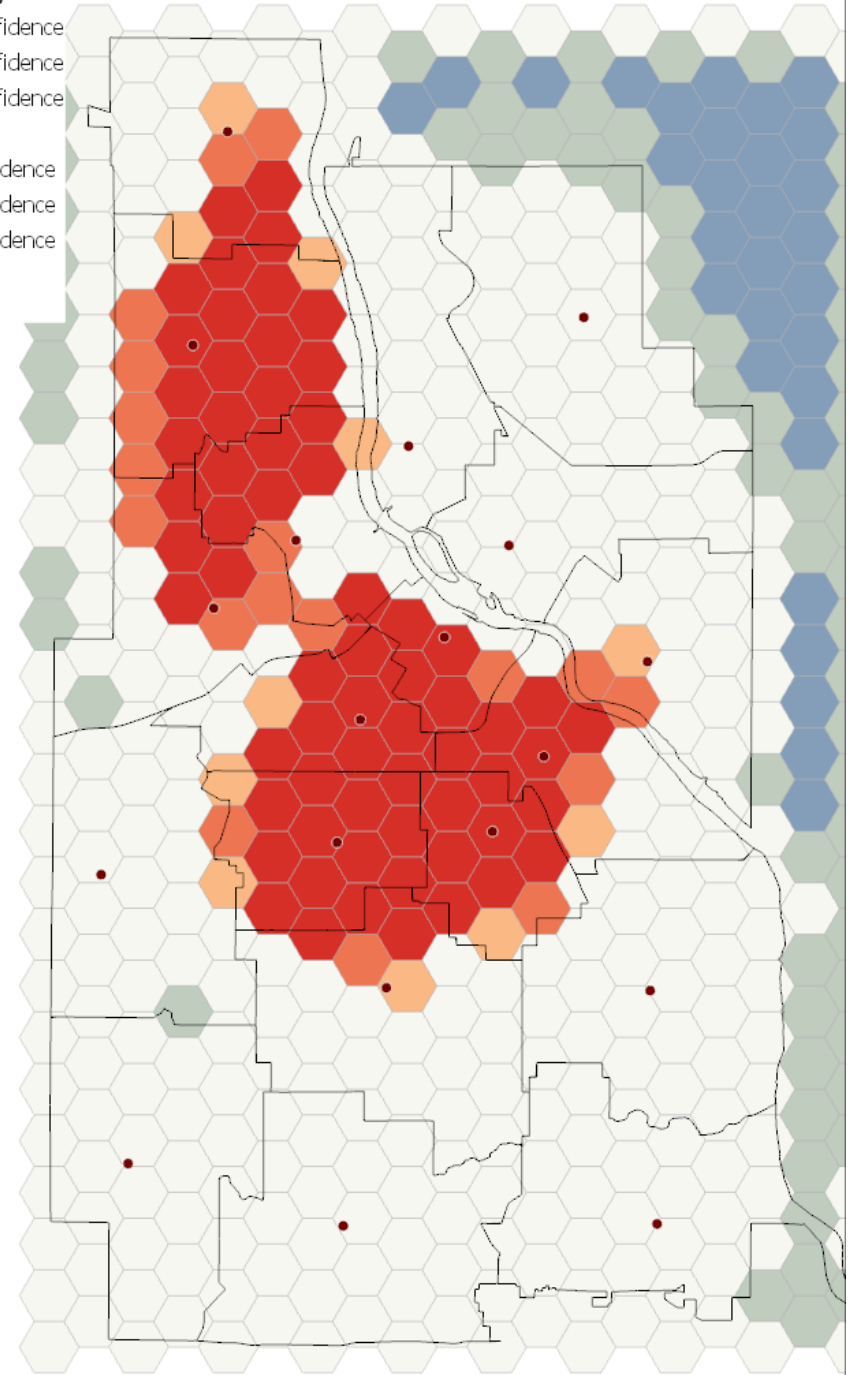
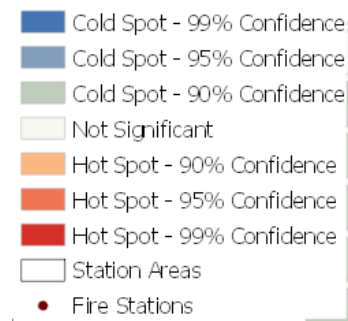


Cell

Hot Spot Analysis

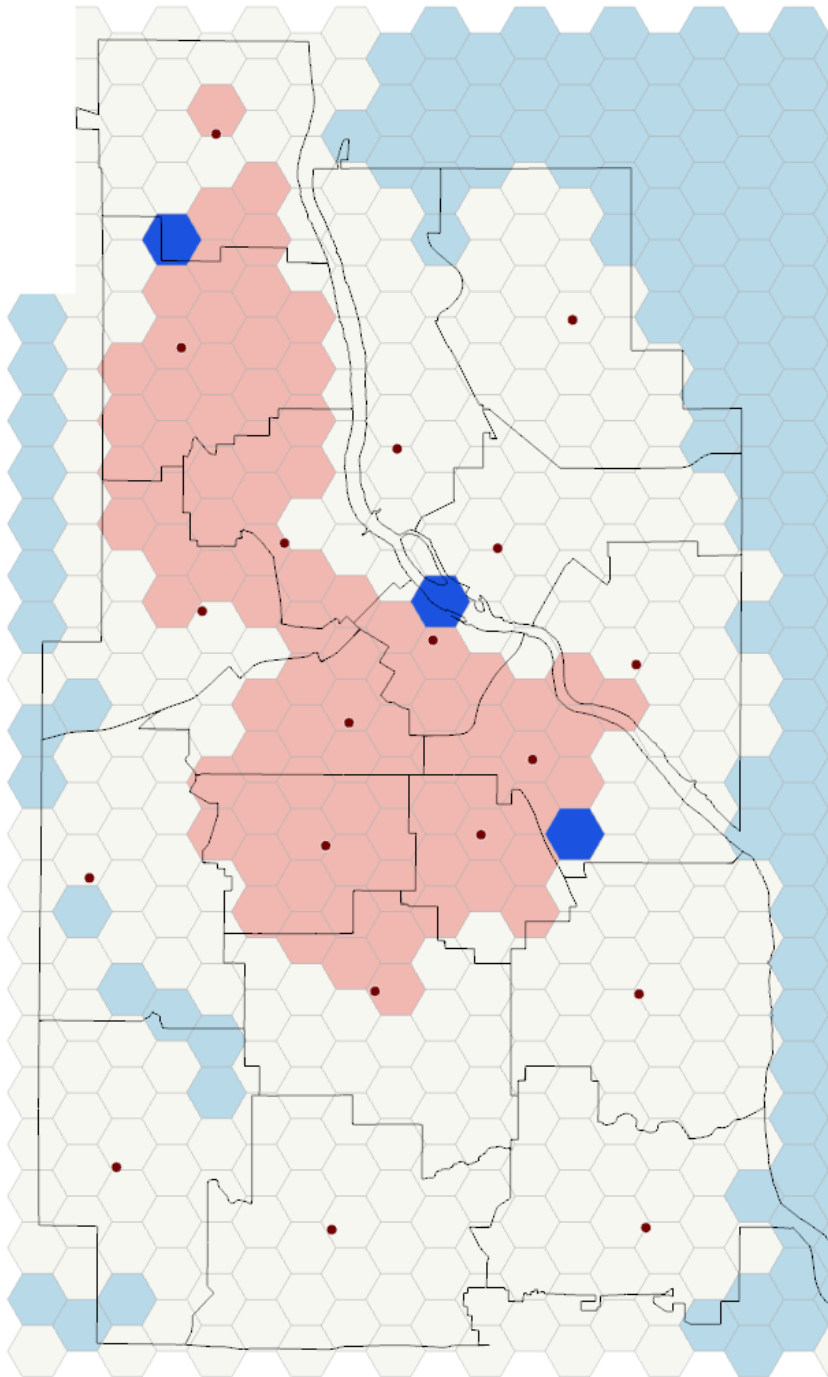
How does the “neighborhood compare to the study area?

Fire Hot Spot Analysis



Fire Cluster-Outlier Analysis

- High-High Cluster
- High-Low Outlier
- Low-High Outlier
- Low-Low Cluster
- Not Significant
- Station Areas
- Fire Stations



Cluster-Outlier Analysis

How does the neighborhood compare to the study area?

AND

How does the cell compare to the neighborhood?

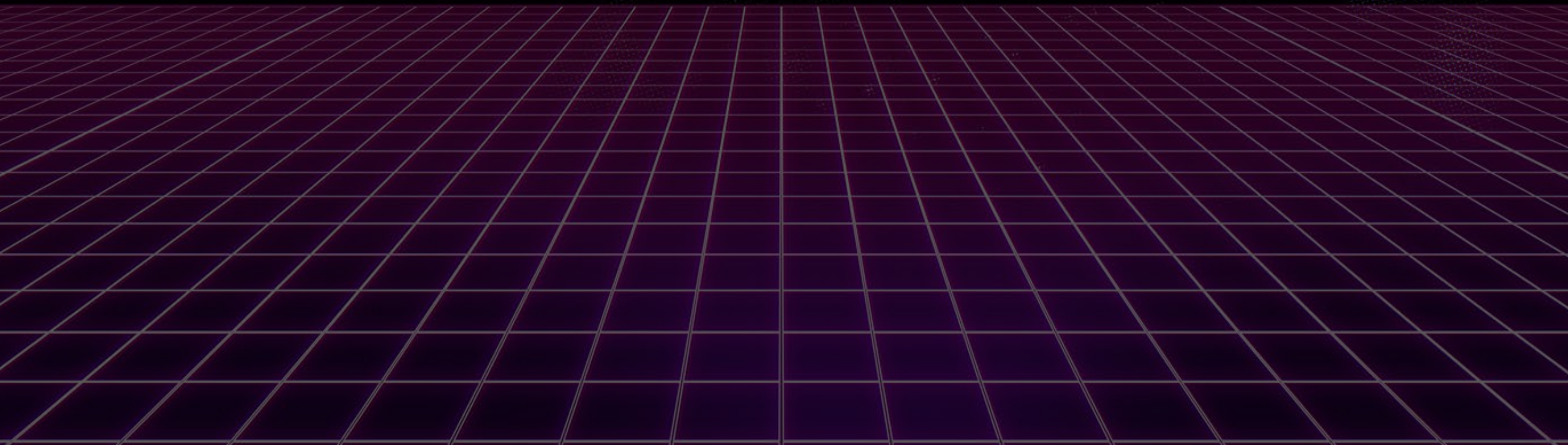
Space



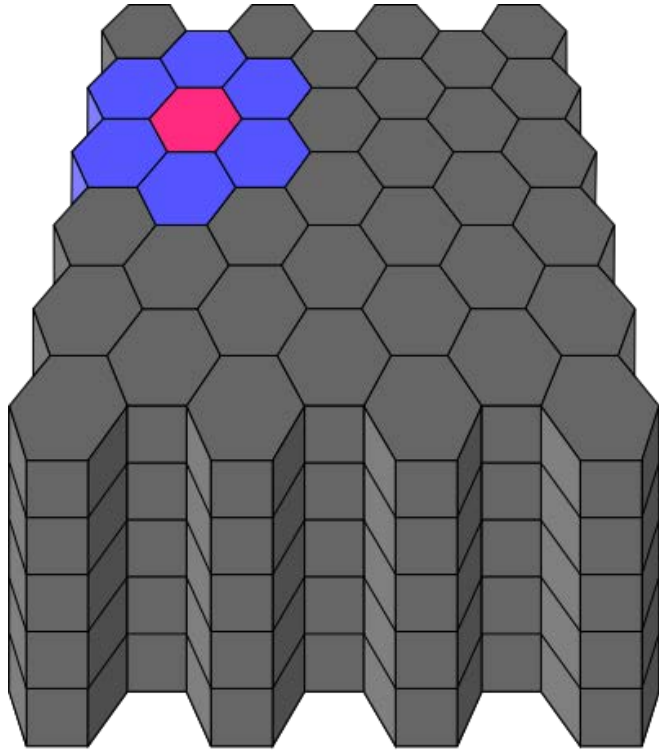
Time

Space Time Pattern Mining Toolbox

- Finds clusters in space AND time
- No special license necessary!
- Free Space Time Cube Explorer add-on for visualization

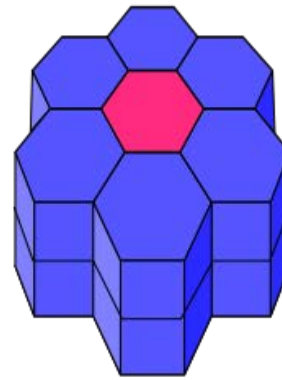


1km width



Study Area

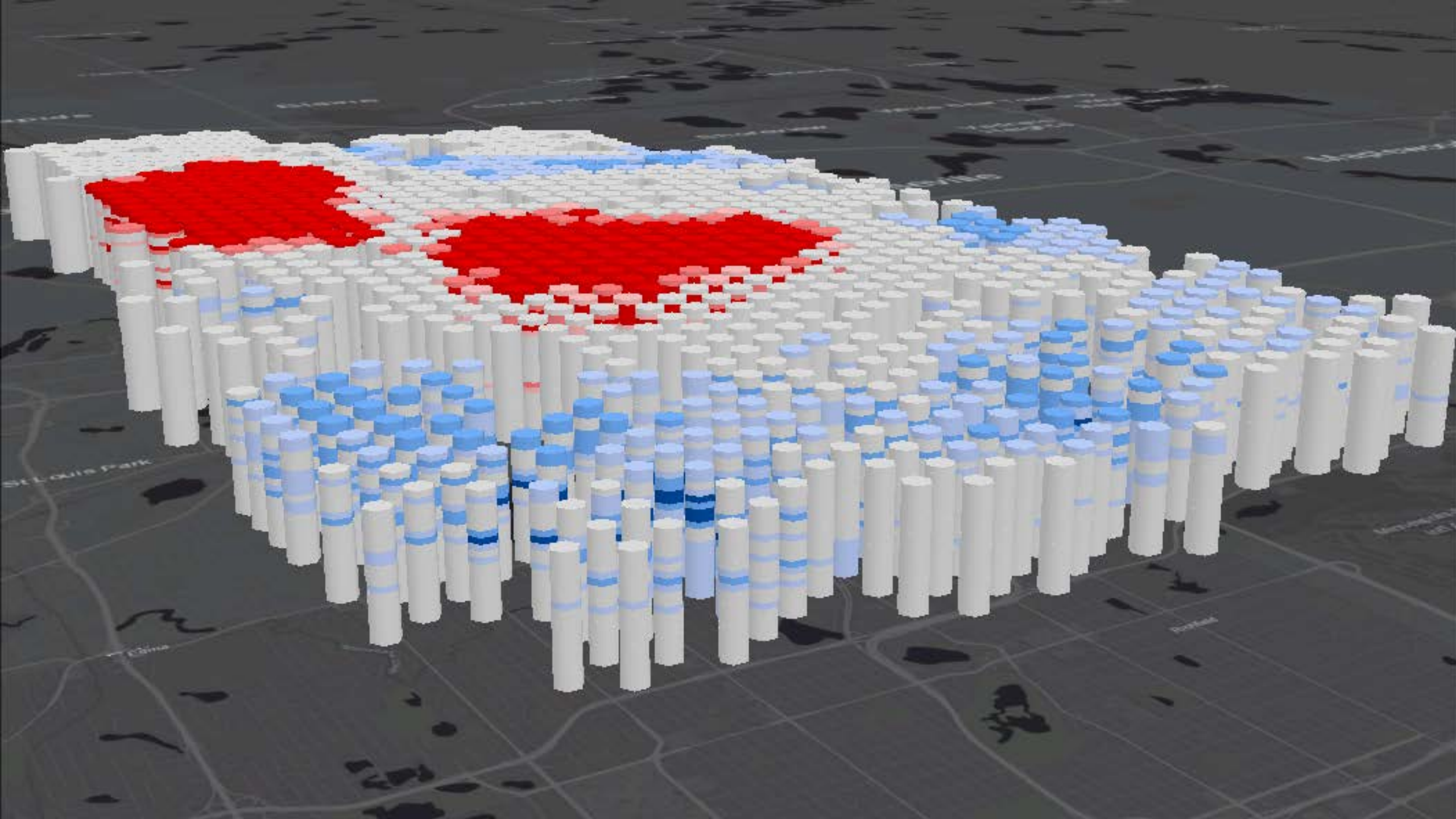
3 month height



Neighborhood



Cell



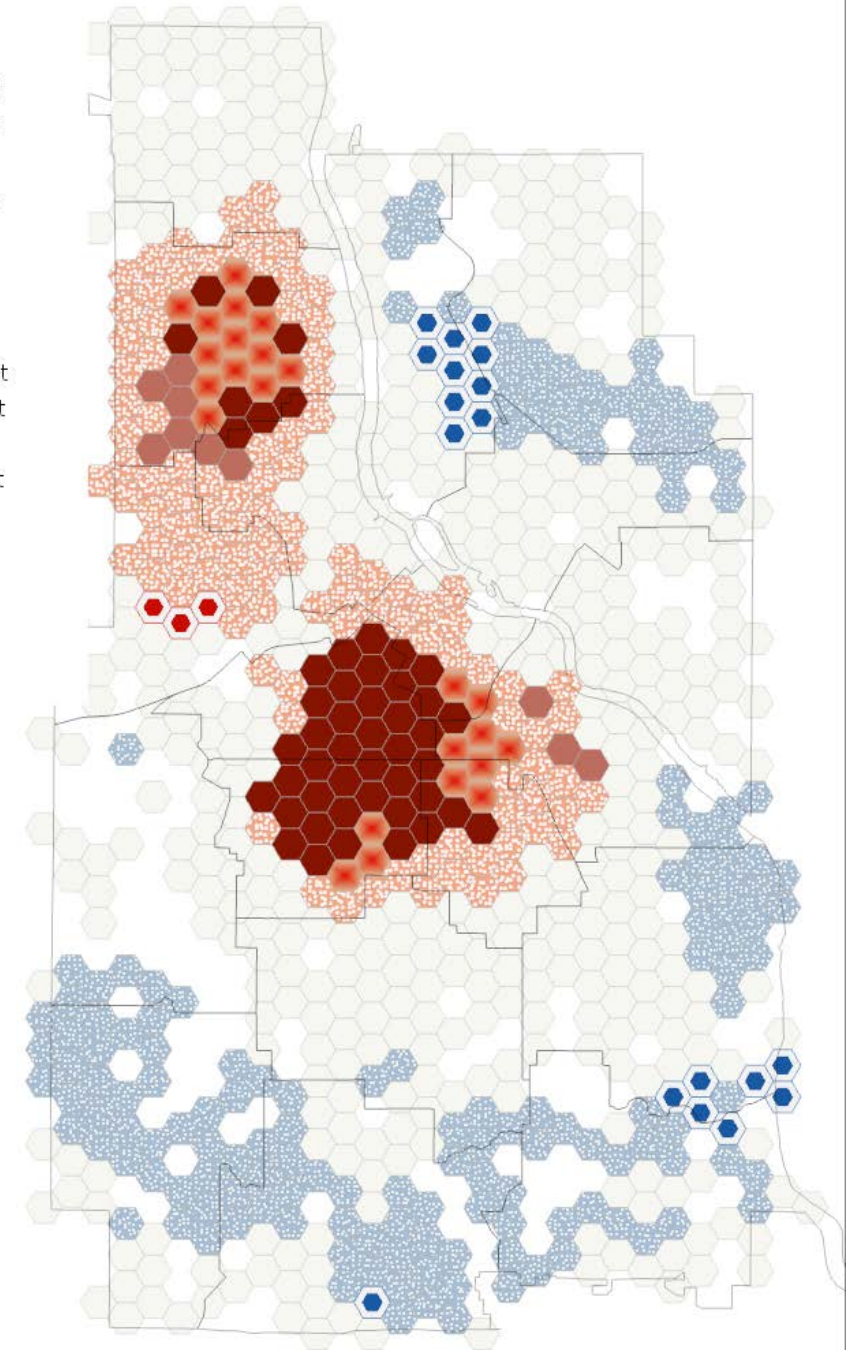
Emerging Hot Spot Analysis

3D counterpart to Hot Spot Analysis

How does the “neighborhood compare to the study area?

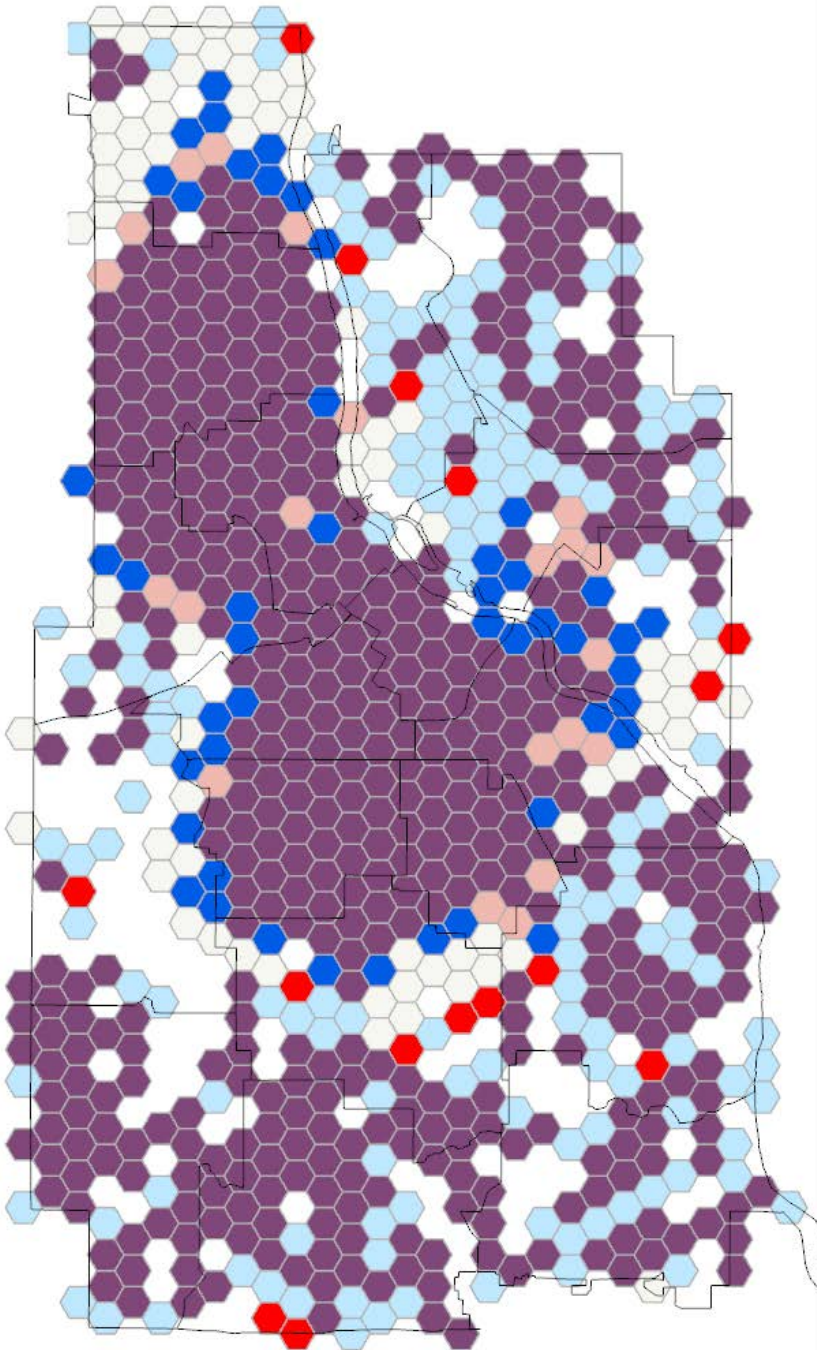
Fire Emerging Hot Spot Analysis

- New Hot Spot
- Consecutive Hot Spot
- Intensifying Hot Spot
- Persistent Hot Spot
- Diminishing Hot Spot
- Sporadic Hot Spot
- Oscillating Hot Spot
- Historical Hot Spot
- New Cold Spot
- Consecutive Cold Spot
- Intensifying Cold Spot
- Persistent Cold Spot
- Diminishing Cold Spot
- Sporadic Cold Spot
- Oscillating Cold Spot
- Historical Cold Spot
- No Pattern Detected
- <all other values>
- Station Areas



Fire Local Outlier Analysis

- Never Significant
- Only High-High Cluster
- Only High-Low Outlier
- Only Low-High Outlier
- Only Low-Low Cluster
- Multiple Types
- Station Areas



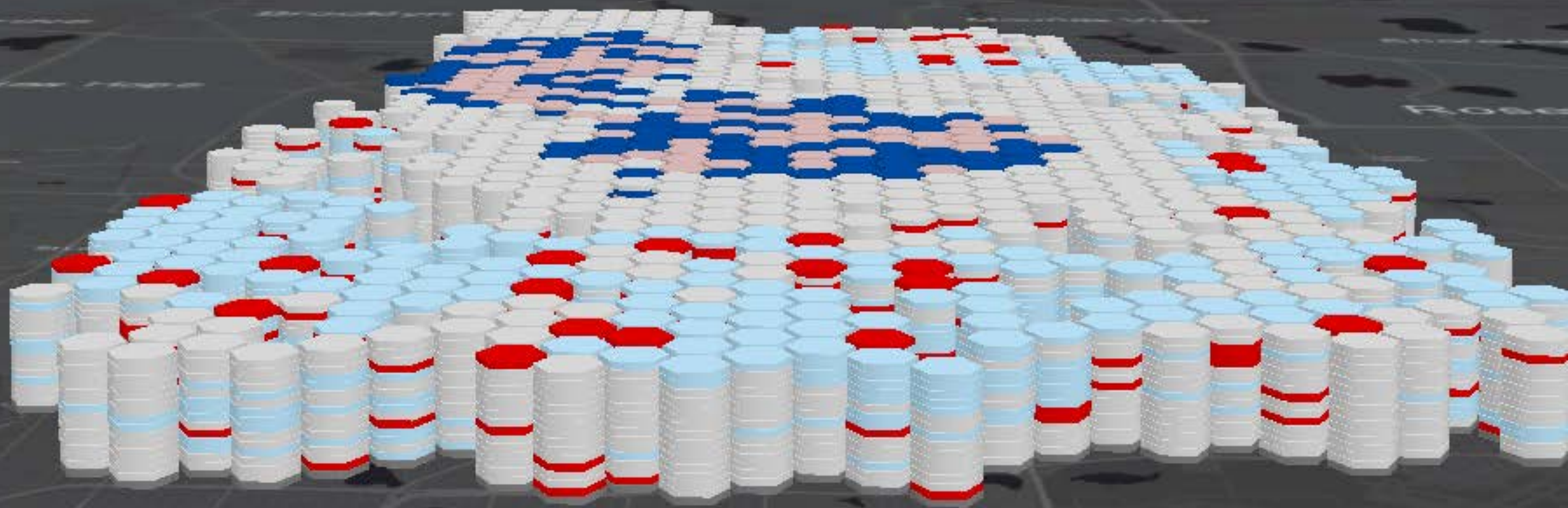
Local Outlier Analysis

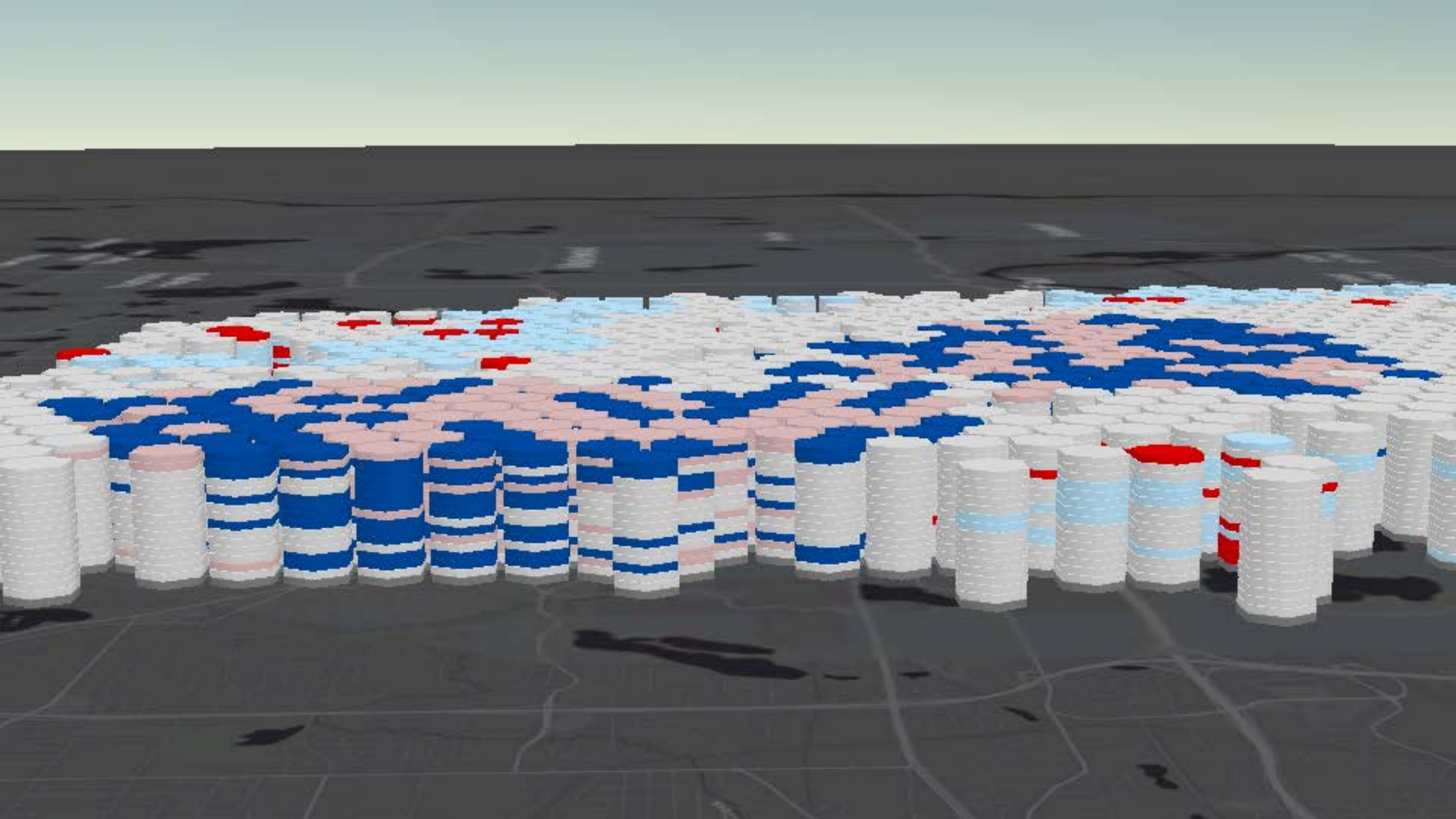
3D counterpart to Cluster-Outlier Analysis

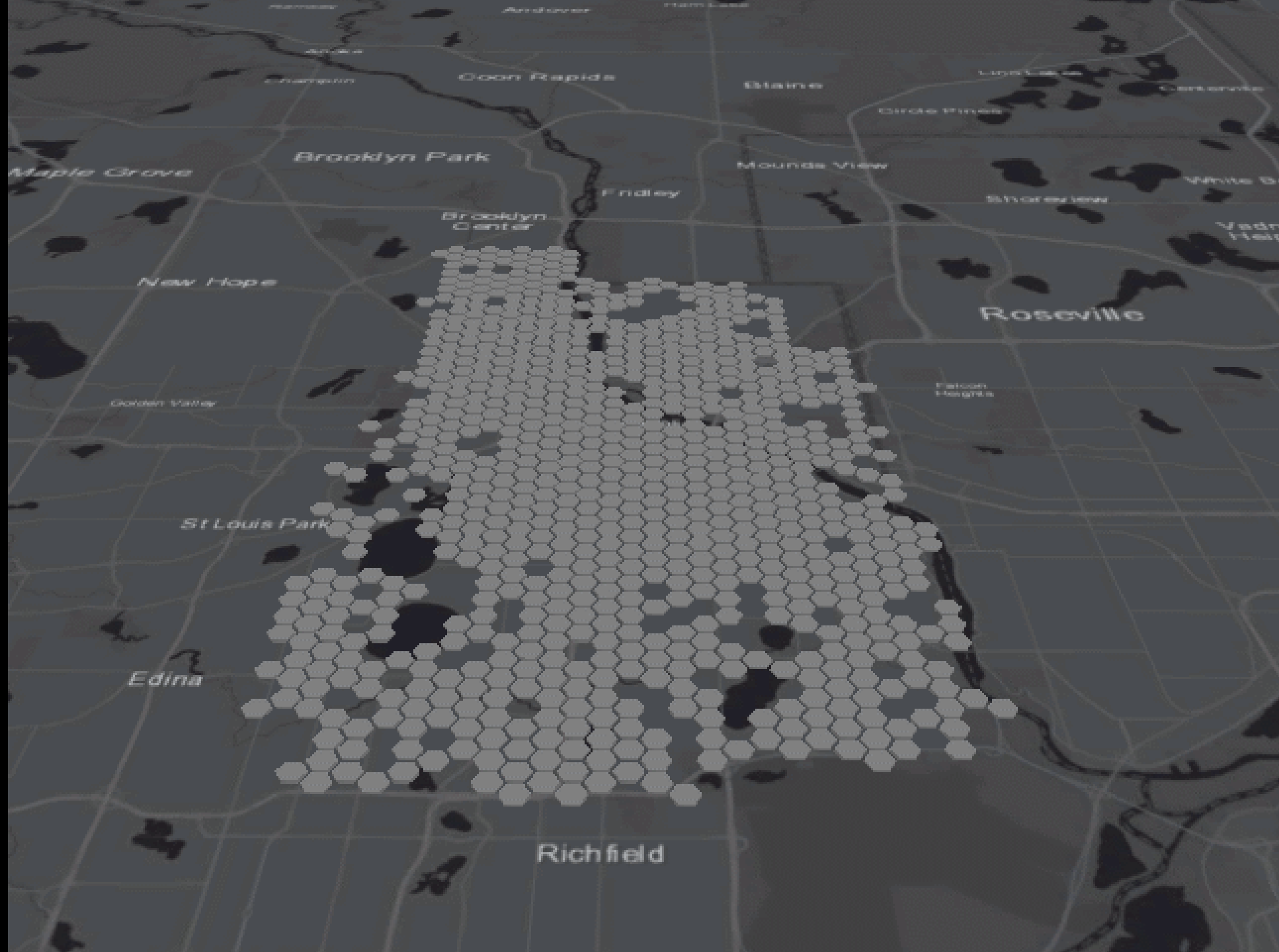
How does the neighborhood compare to the study area?

AND

How does the cell compare to the neighborhood?



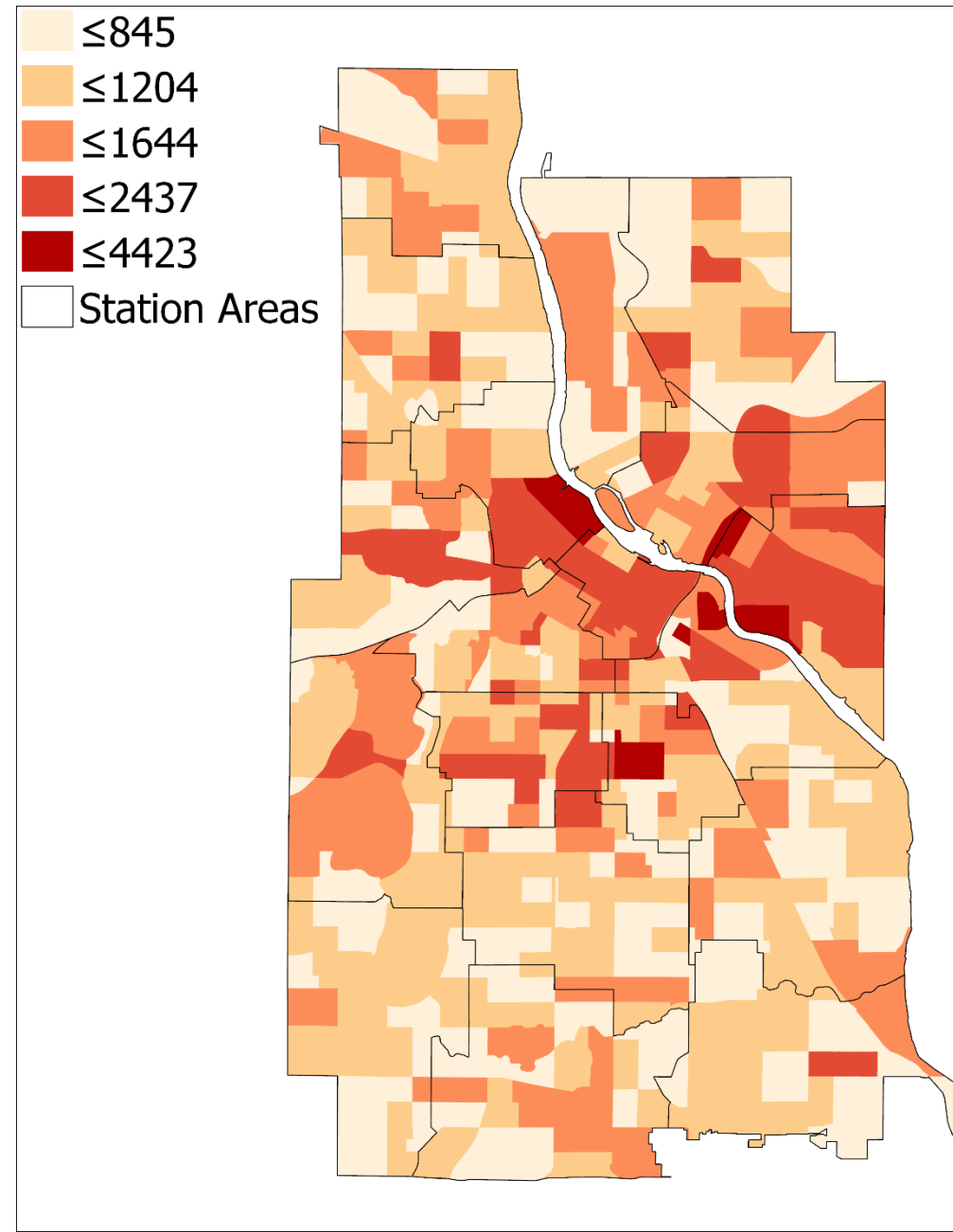
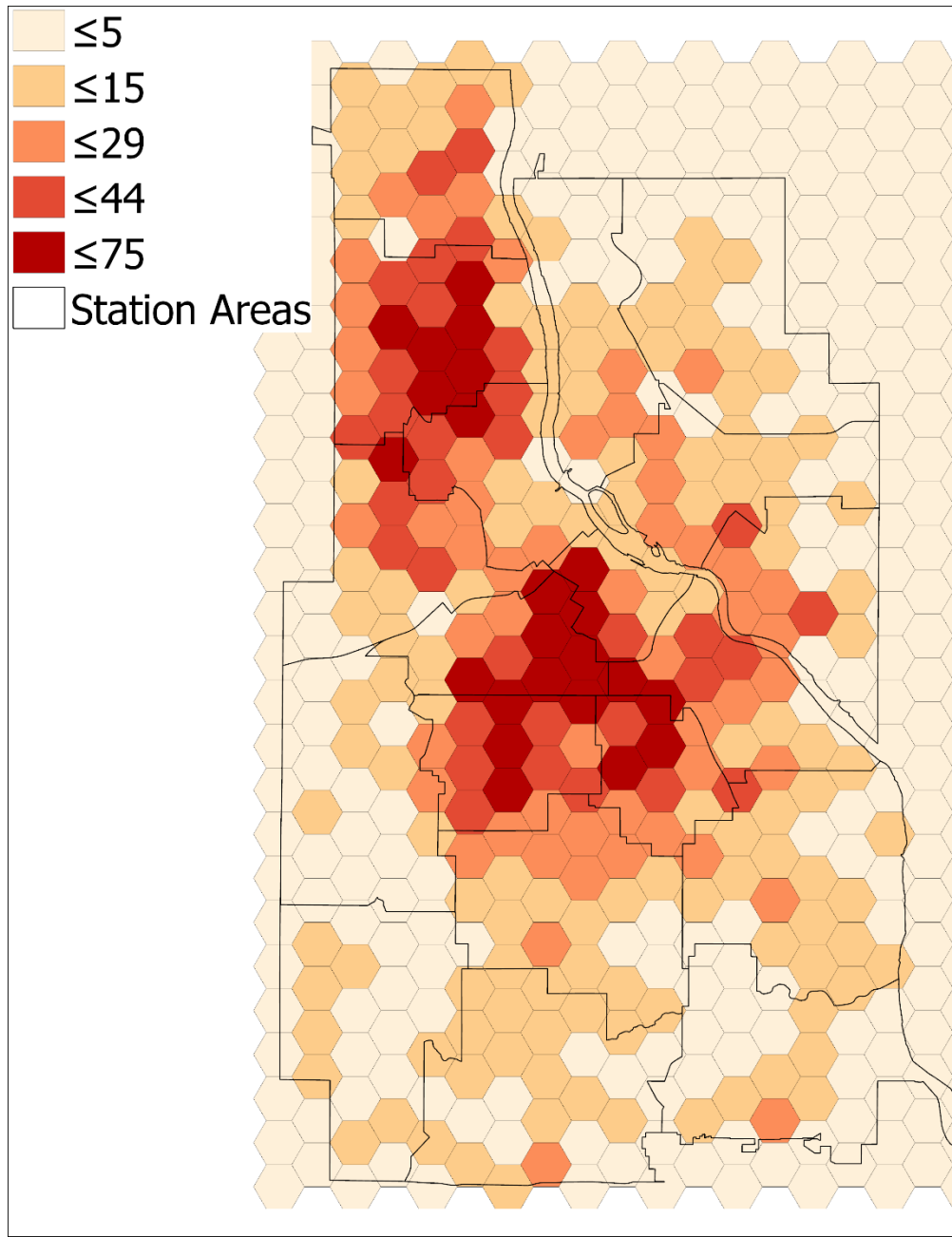




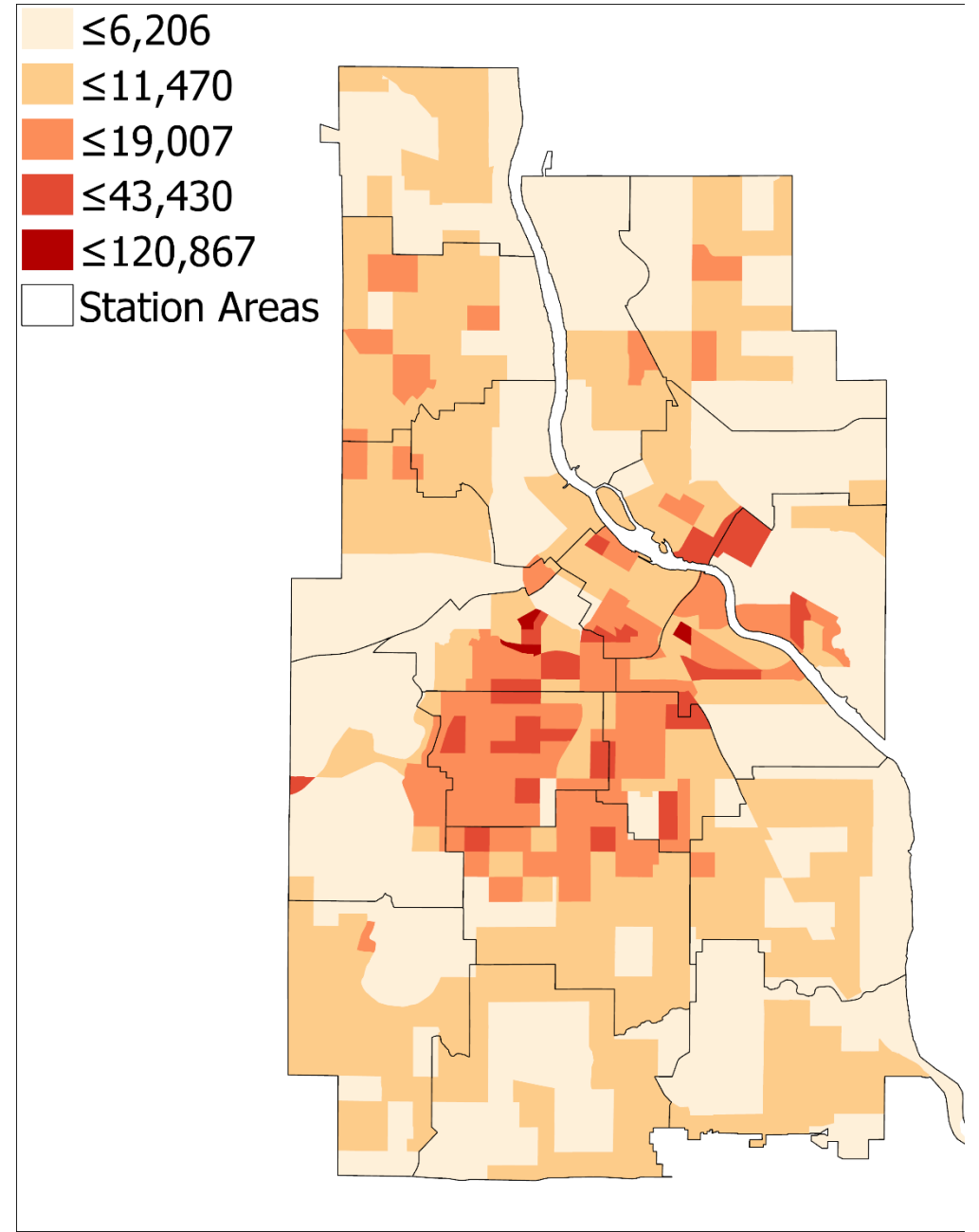
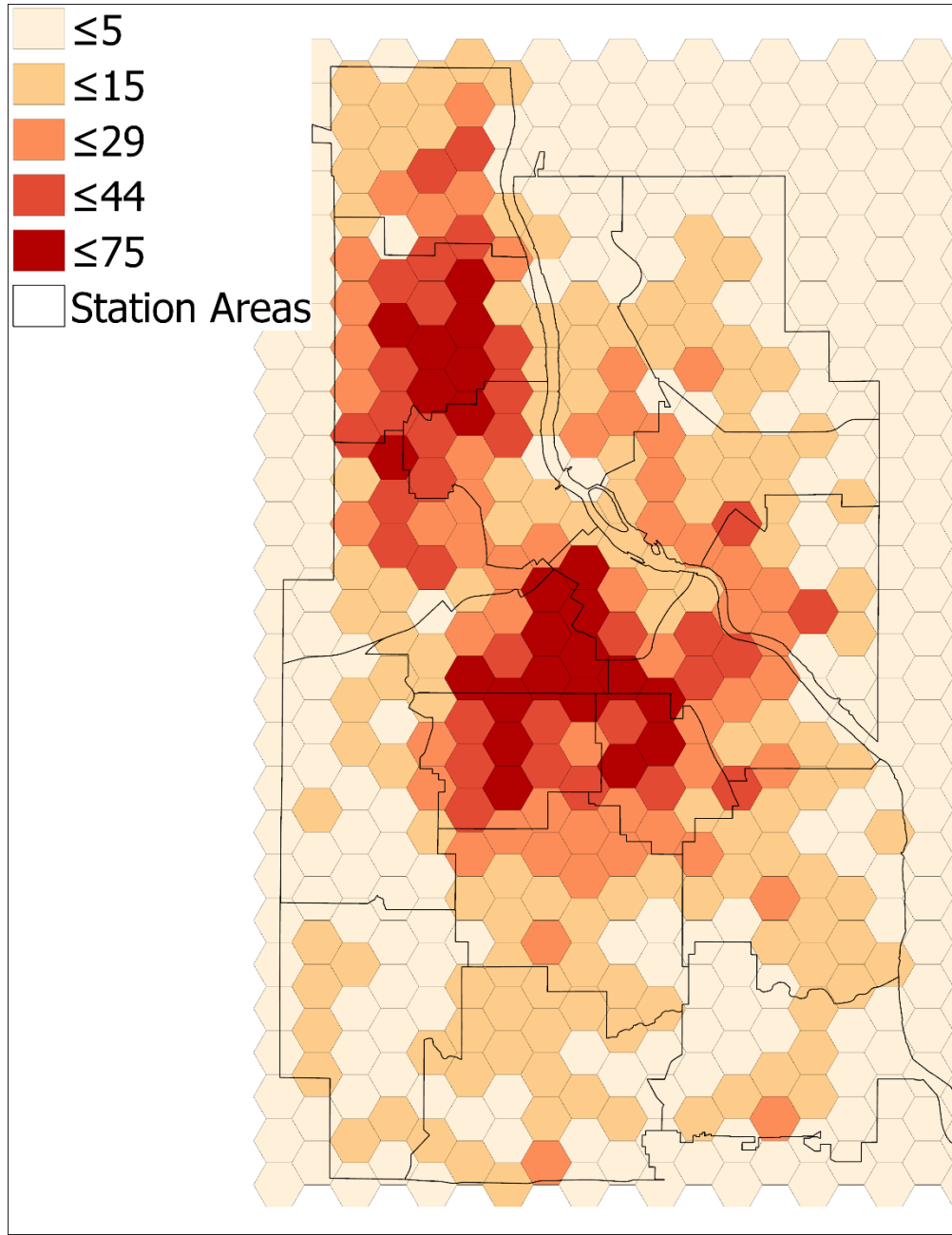
Conclusions



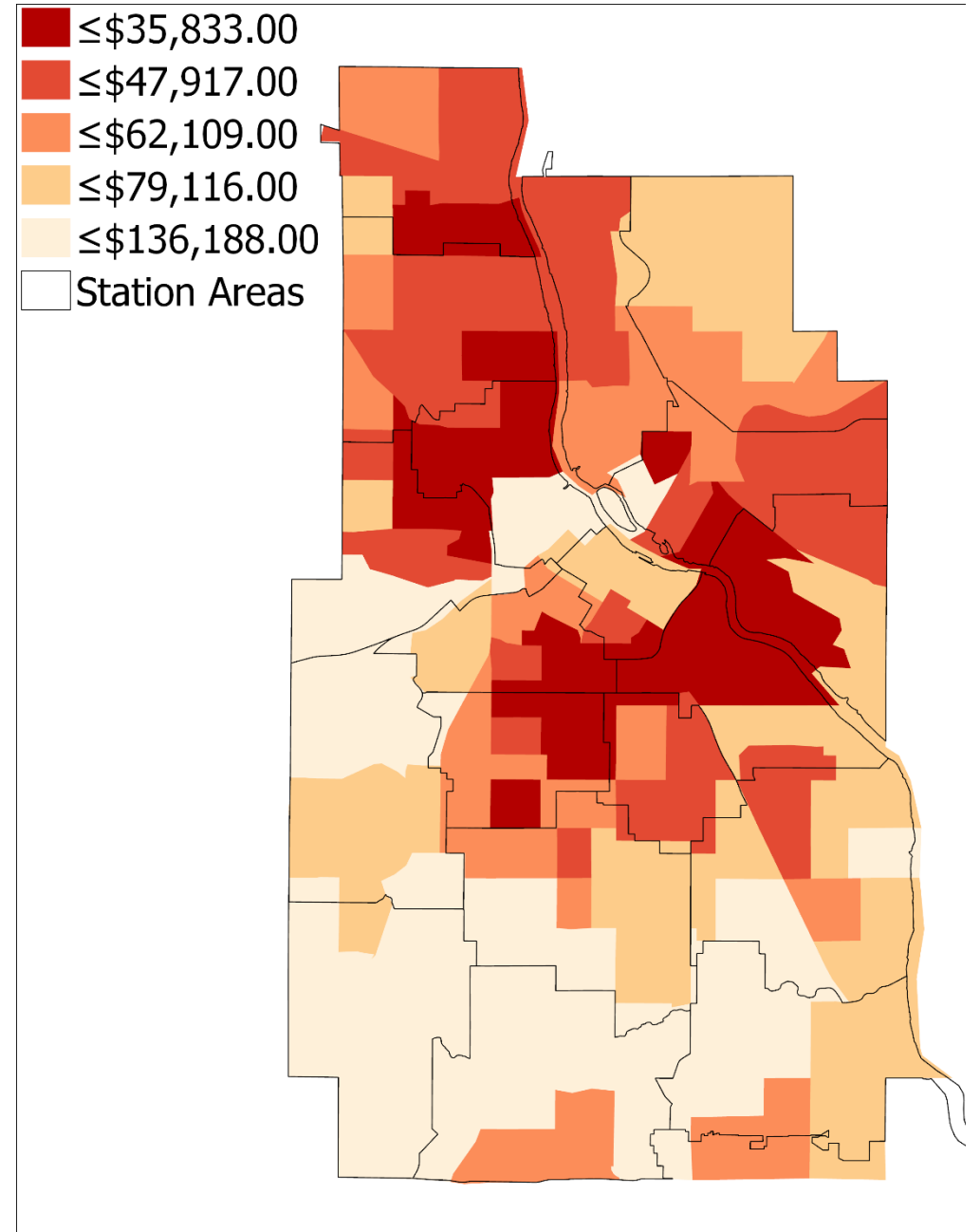
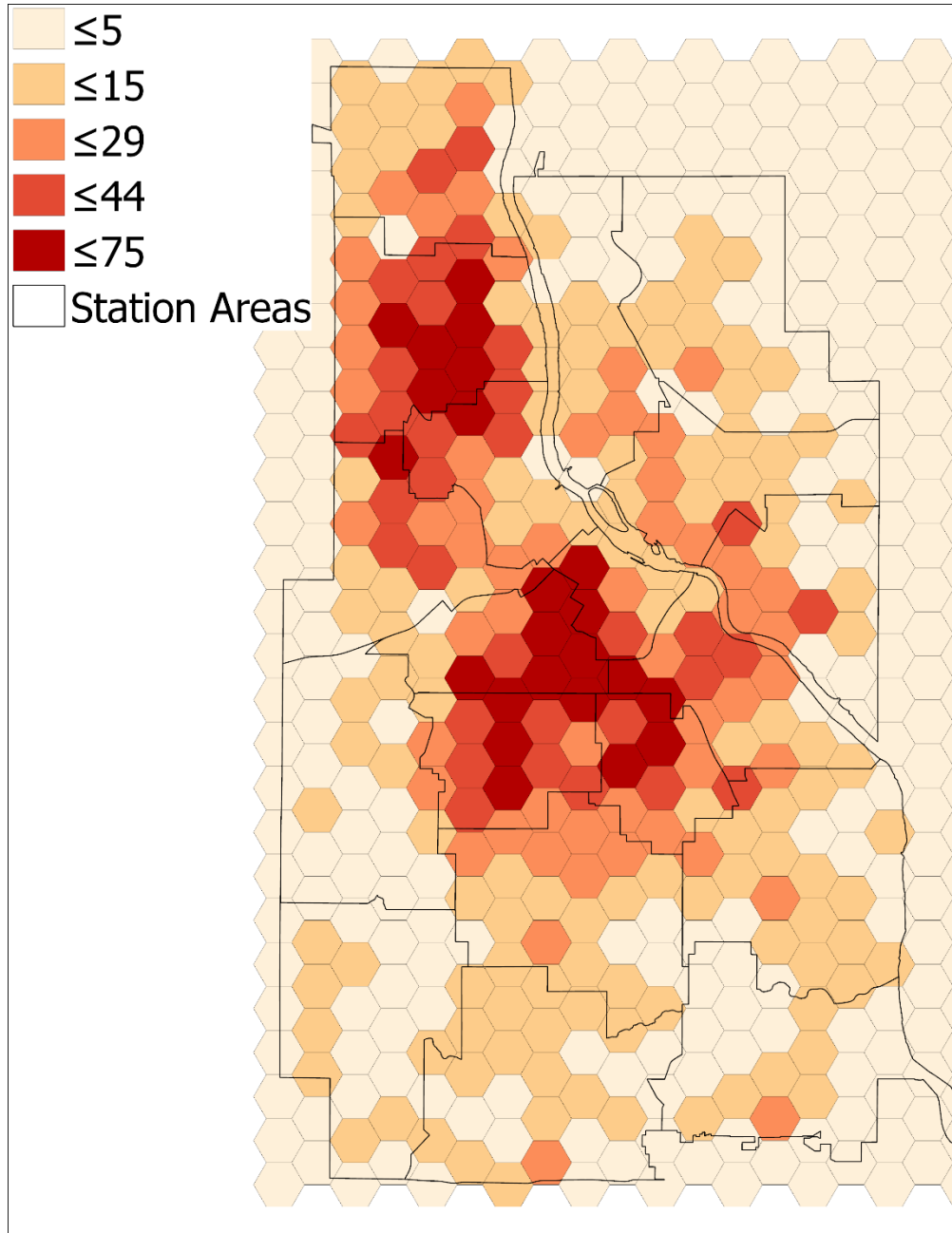
Fires vs. Population



Fires vs. Density



Fires vs. Income



Next Steps

- Research contributing factors
- Share research with fire department

Additional Resources

- Full article about this analysis:
<https://richardholzer.wordpress.com/2018/07/23/analyzing-fires-in-minneapolis-across-space-and-time/>
- Spatial statistics team resource page: <https://spatialstats.github.io/>
- Space Time Pattern Mining Toolbox reference page:
<http://pro.arcgis.com/en/pro-app/tool-reference/space-time-pattern-mining/an-overview-of-the-space-time-pattern-mining-toolbox.htm>
- Space Time Cube Explorer add-in:
<https://spatialstats.github.io/addin/>

Questions?

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