Analyzing Fires in Minneapolis Across Space and Time

Ricky Holzer
MN Department
of Transportation

Minneapolis

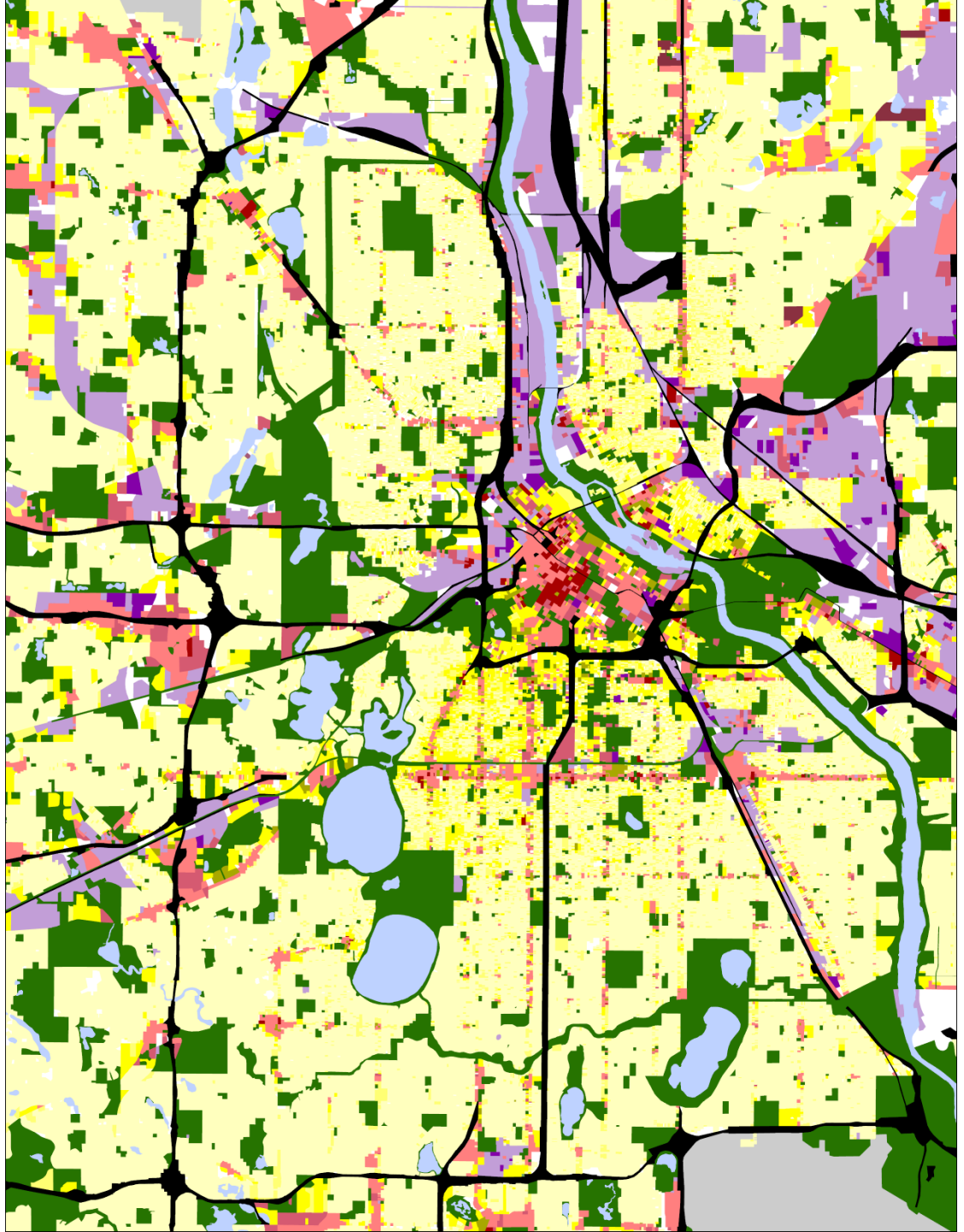
Minneapolis Fast Facts

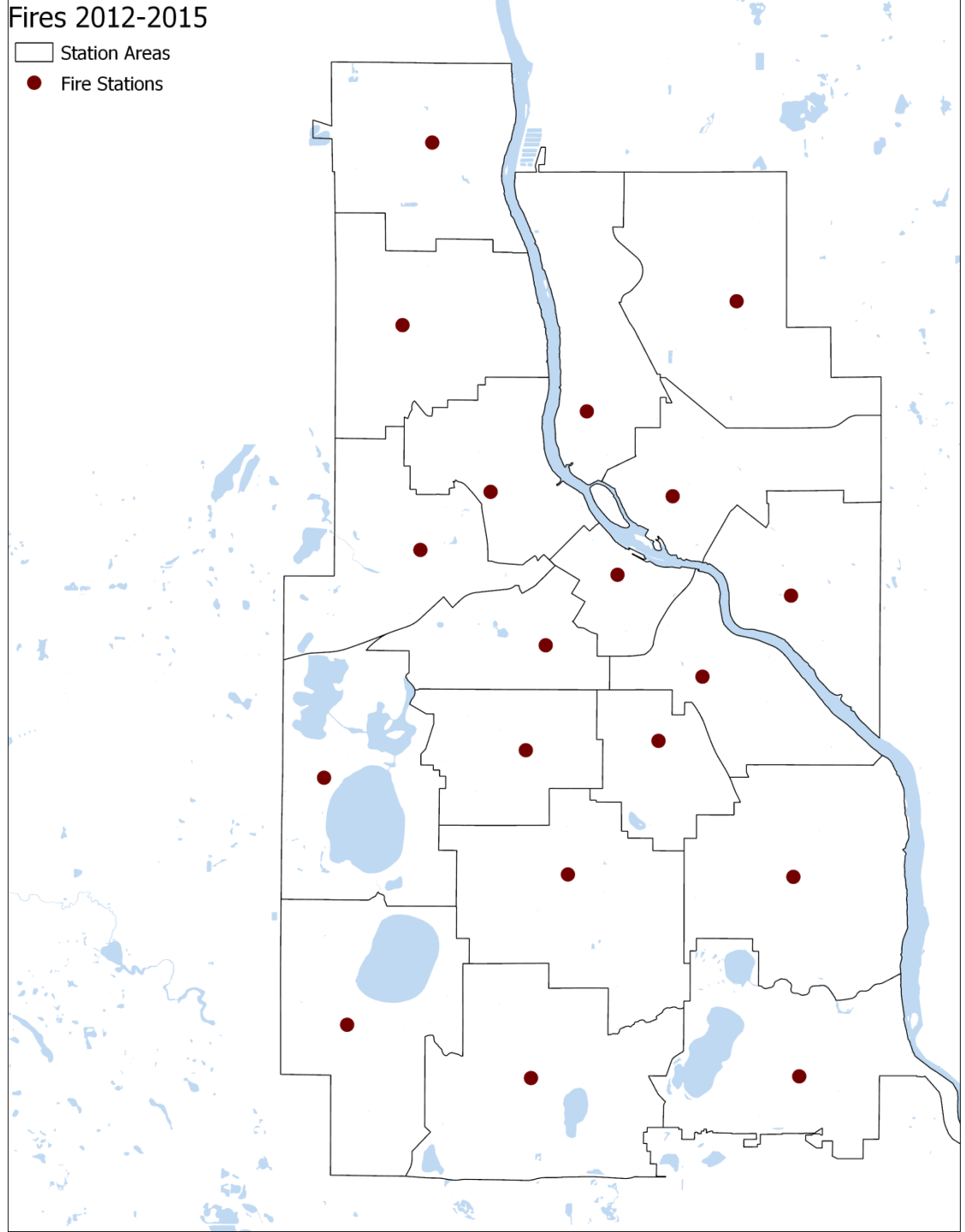
- 425,000 population
- 54 square miles
- 7,600 people/sq. mi.
- Comparable to Oakland, CA in population, area, and density
- Home of the Twins, Timberwolves, and Vikings
- Headquarters of Target, US Bank, and Xcel Energy
- Main campus of the University of Minnesota

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

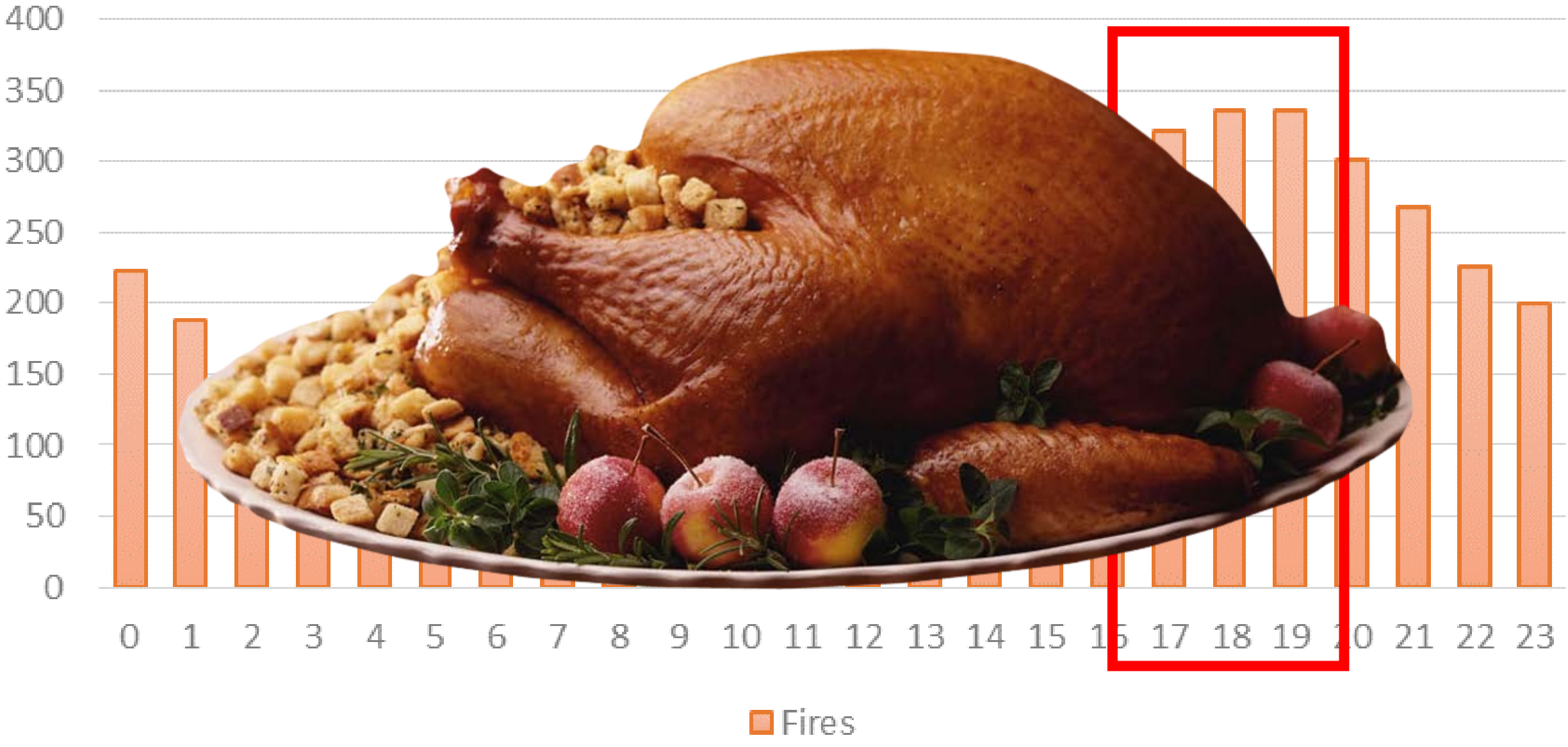
inci_no	inci_type	station	descript	alm_time	alm_date	alm_year	alm_month	alm_hour	alm_datetime	clr_time	clr_date
12-0007830	111	14	Building fire	22:11:02	3/18/2012	2012	3	22	3/18/2012 10:11:00 PM	18:27:51	3/22/2012
12-0027584	164	21	Outside mailbox fire	5:20:20	9/18/2012	2012	9	5	9/18/2012 5:20:00 AM	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	17:51:1	1/24/2013	2013	1	17	1/24/2013 5:51:00 PM	15:40:05	1/25/2013
13-0023061	111	9	Building fire	23:31:4	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
12-0038533	111	22	Building fire	8:09:54	12/28/2012	2012	12	8	12/28/2012 8:09:00 AM	17:53:27	12/28/2012
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
13-0014754	131	12	Passenger vehicle fire	5:33:02	5/21/2013	2013	5	5	5/21/2013 5:33:00 AM	14:47:27	5/21/2013
14-0033981	111	14	Building fire	21:54:37	10/18/2014	2014	10	21	10/18/2014 9:54:00 PM	6:05:34	10/19/2014
14-0005281	111	14	Building fire	4:52:55	2/14/2014	2014	2	4	2/14/2014 4:52:00 AM	12:50:52	2/14/2014
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

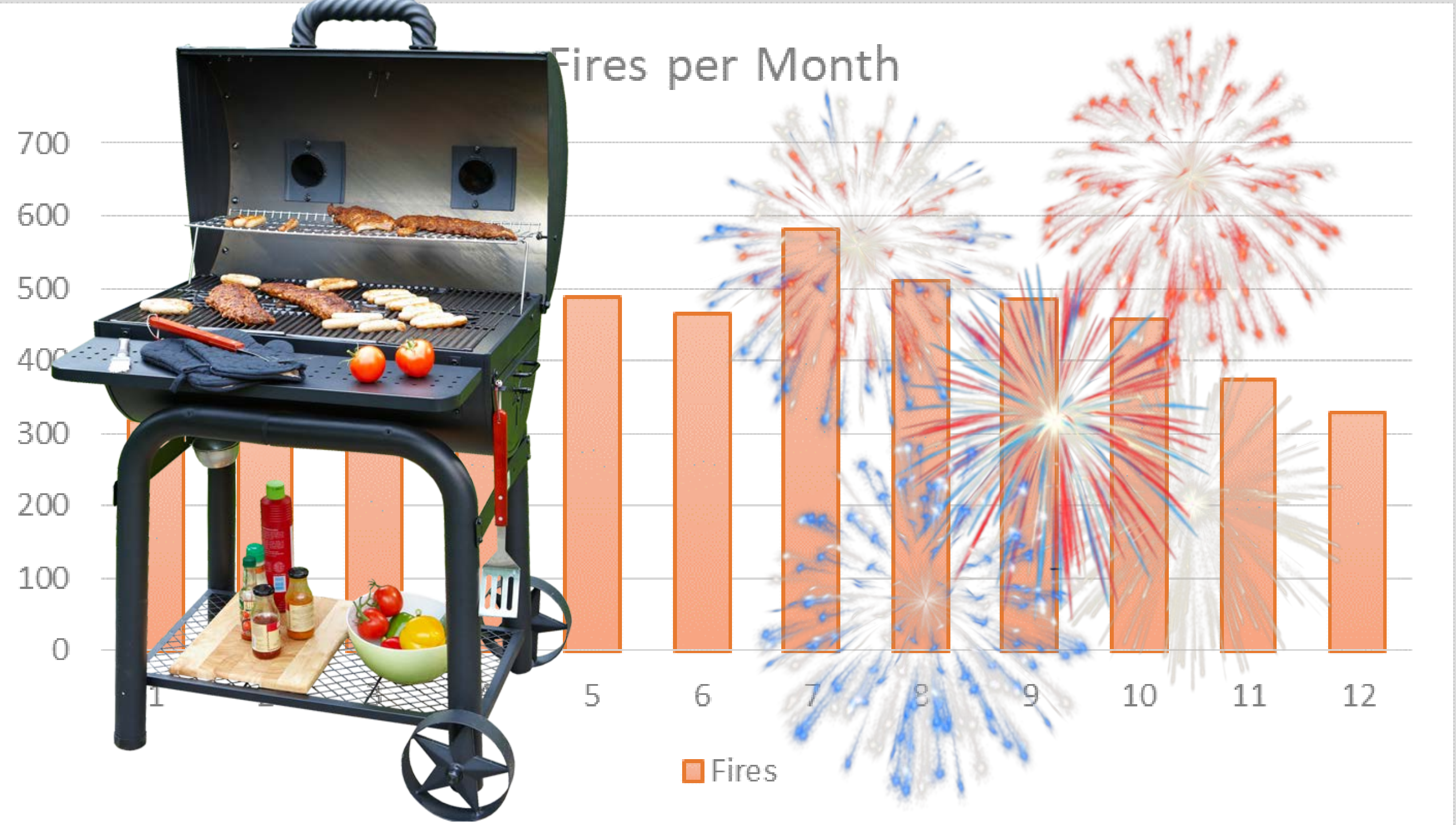
2012-2015

5,152 Fires

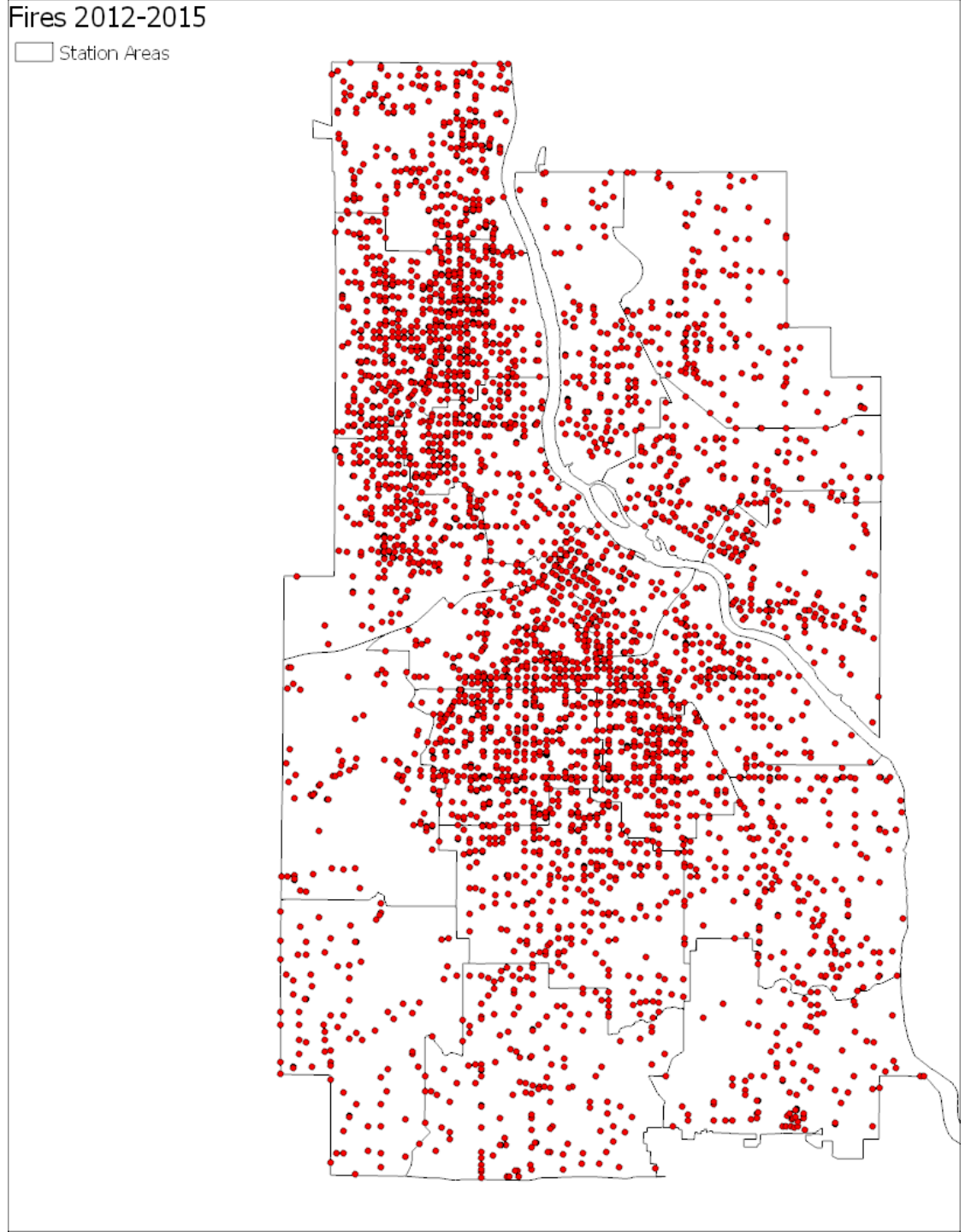
Time

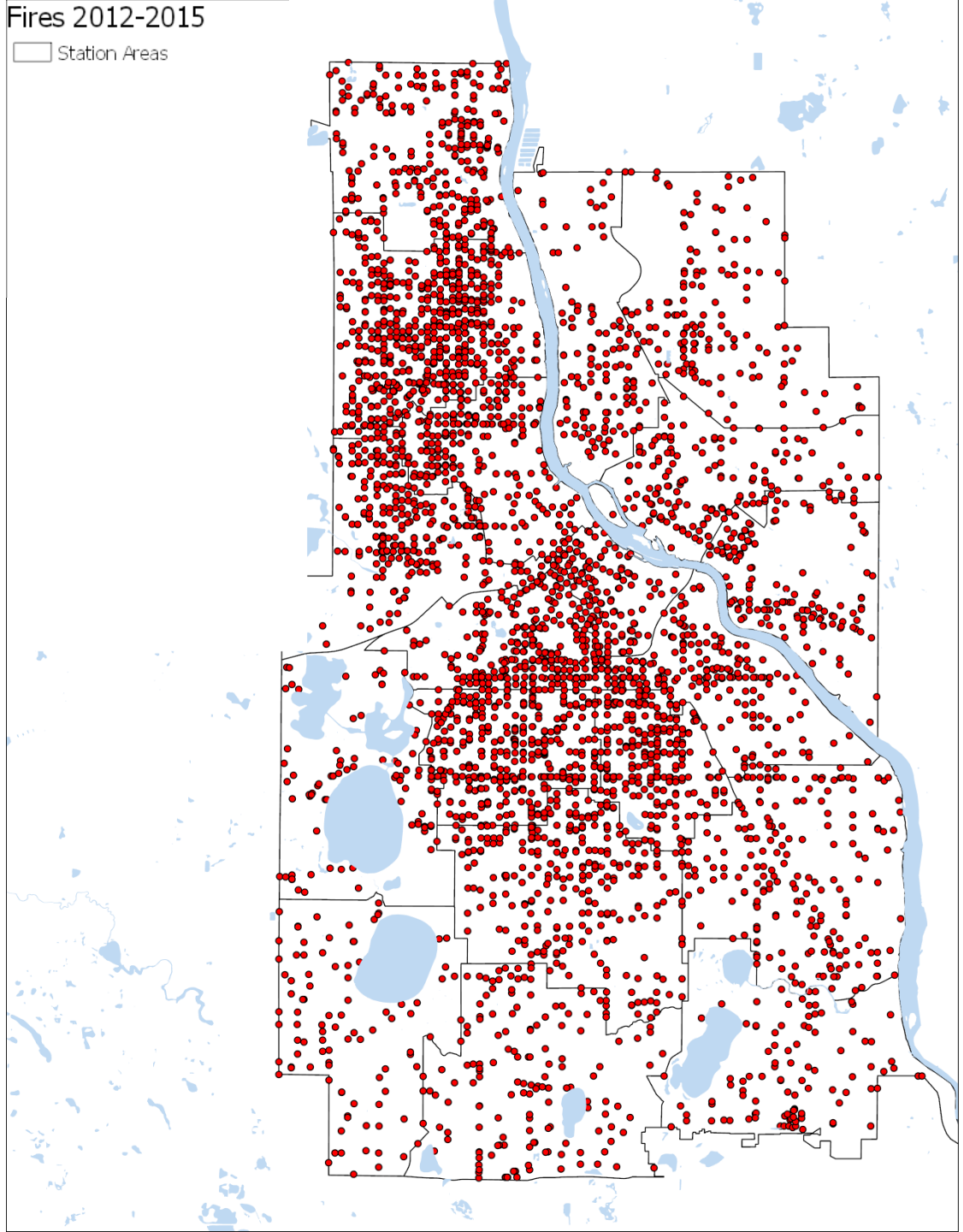
Fires per Hour

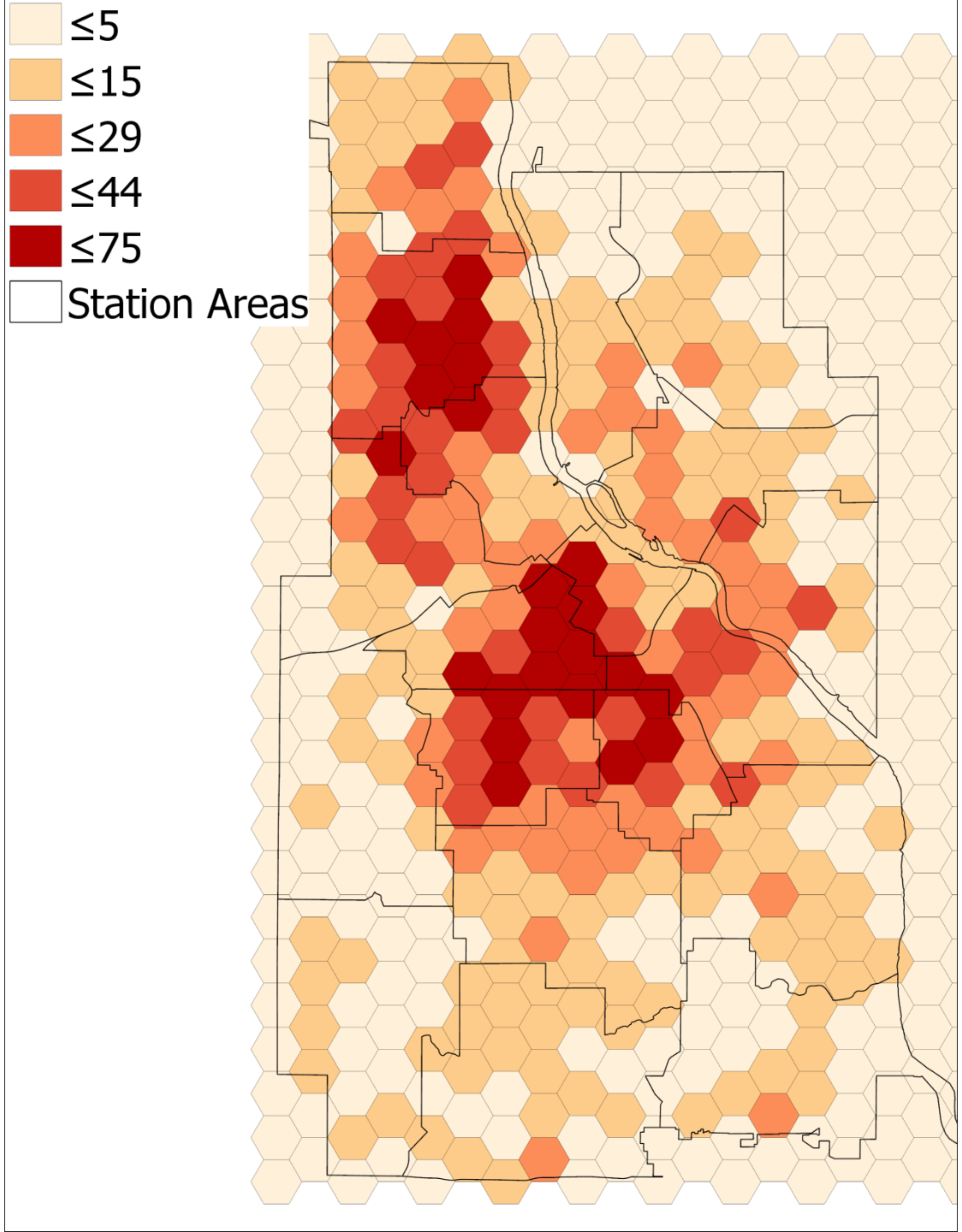



Fires per Month
700
600
500
400
300
200
100
0
5
6
7
8
9
10
11
12
Fires

Space

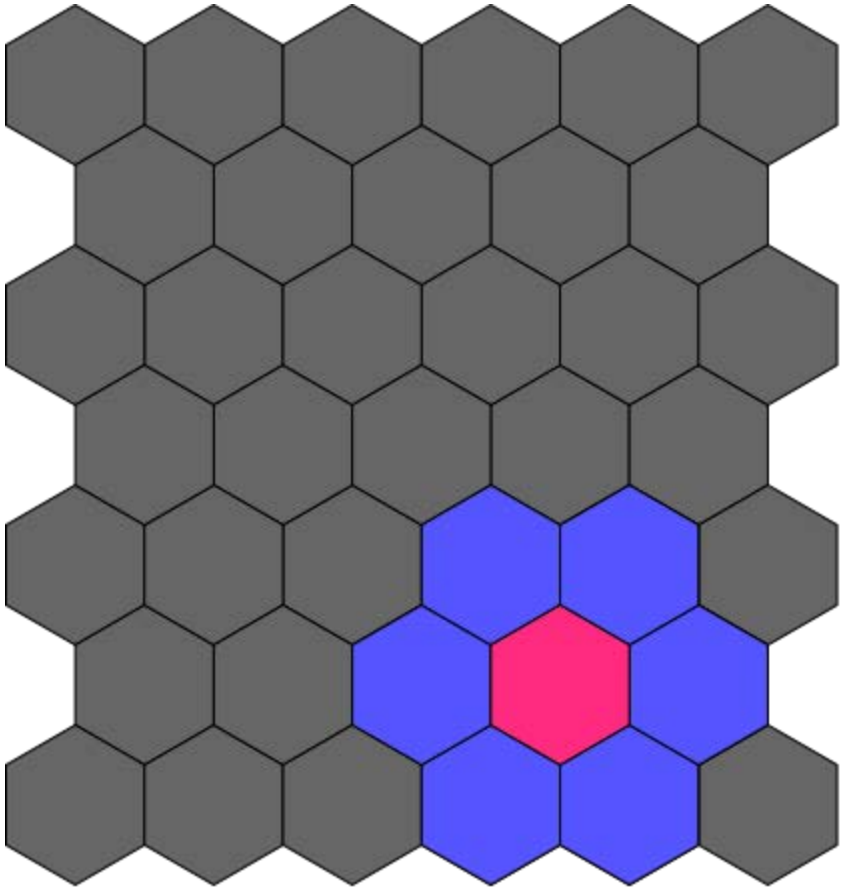

Fires 2012-2015
Station Areas


Fires 2012-2015
Station Areas

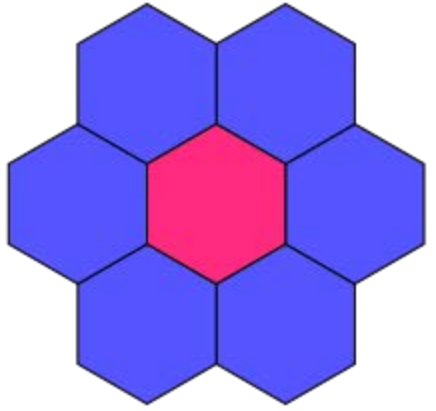

≤5
≤15
≤29
≤44
≤75
Station Areas

Cluster Analysis

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



1km width



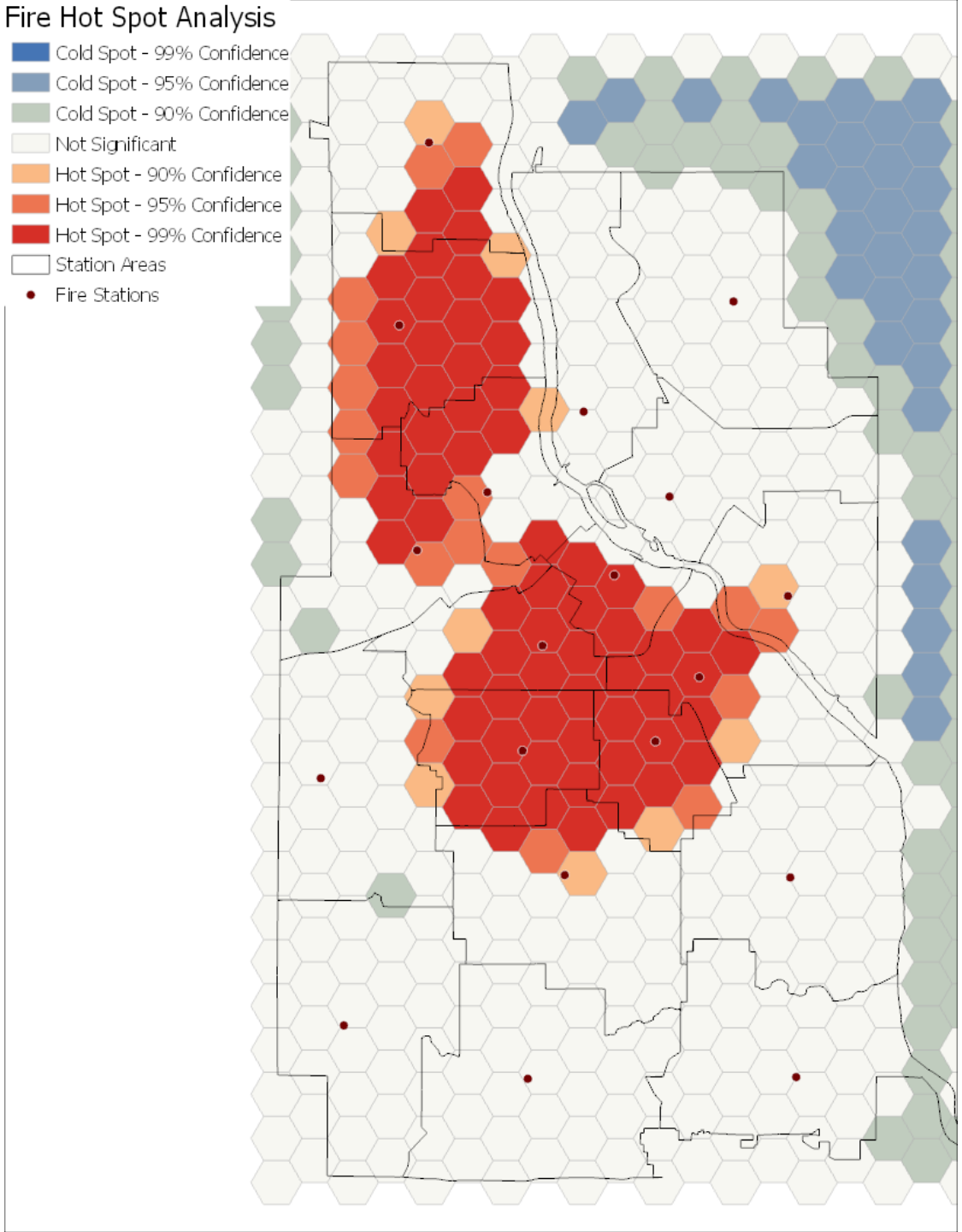
Study Area

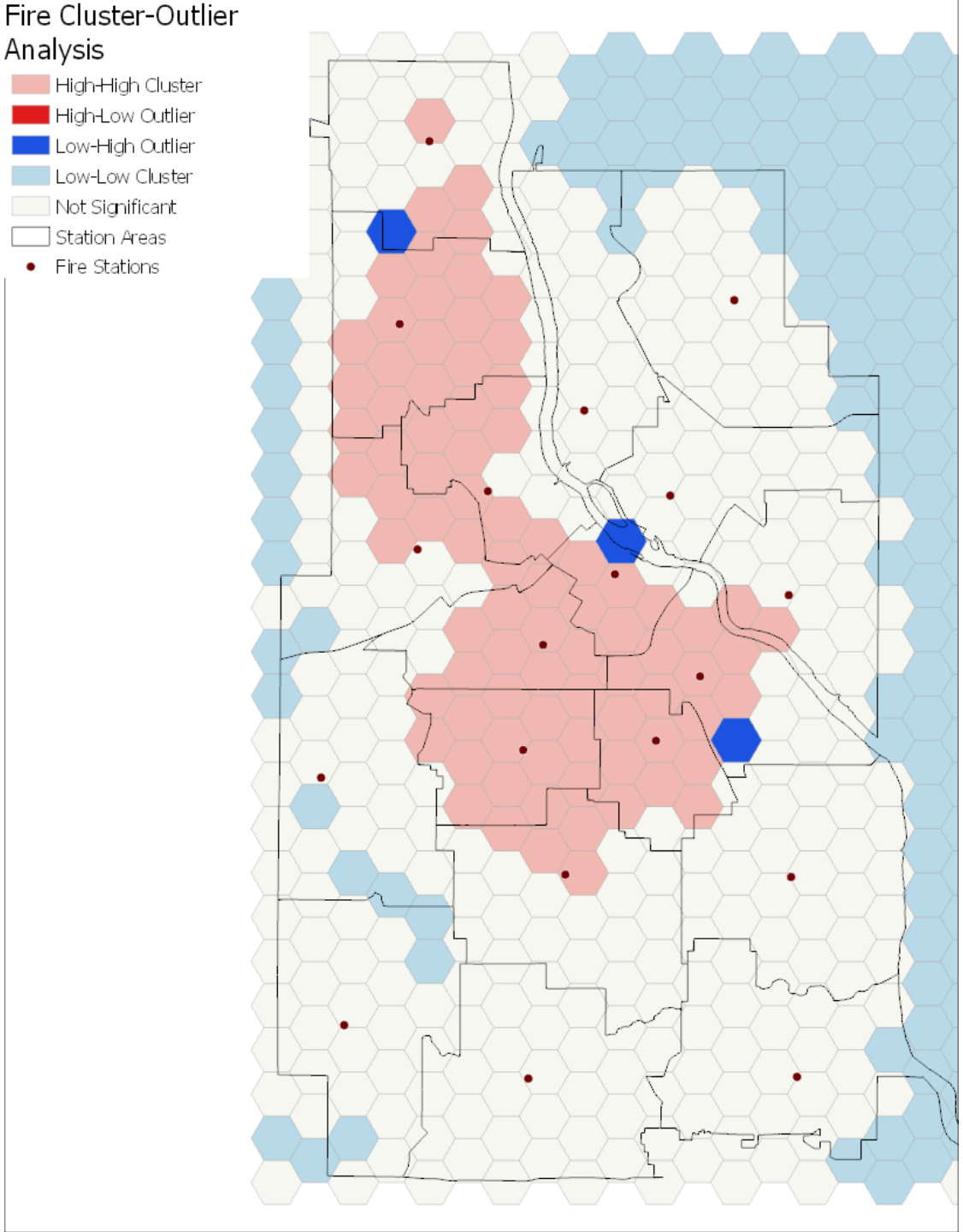
Neighborhood

Cell

Hot Spot Analysis

How does the “neighborhood compare to the study area?





Cluster-Outlier Analysis

How does the neighborhood compare to the study area?

AND

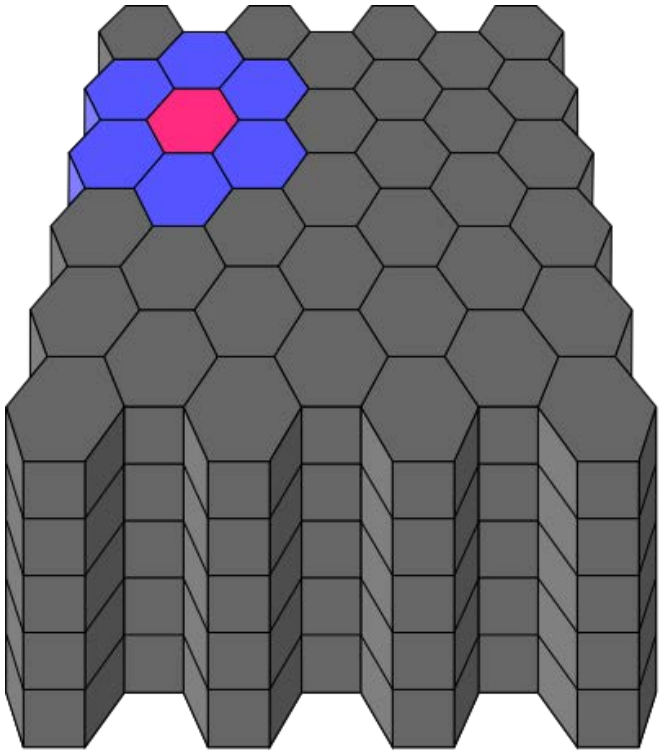
How does the cell compare to the neighborhood?

Space Time

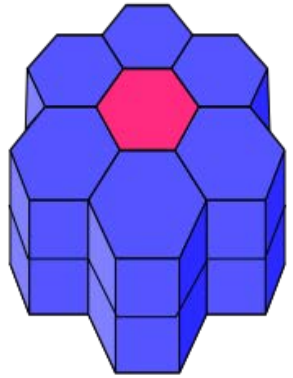
Space Time Pattern Mining Toolbox

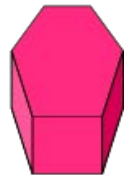
- Finds clusters in space AND time
- No special license necessary!
- Free Space Time Cube Explorer add-on for visualization

1km width



3 month height

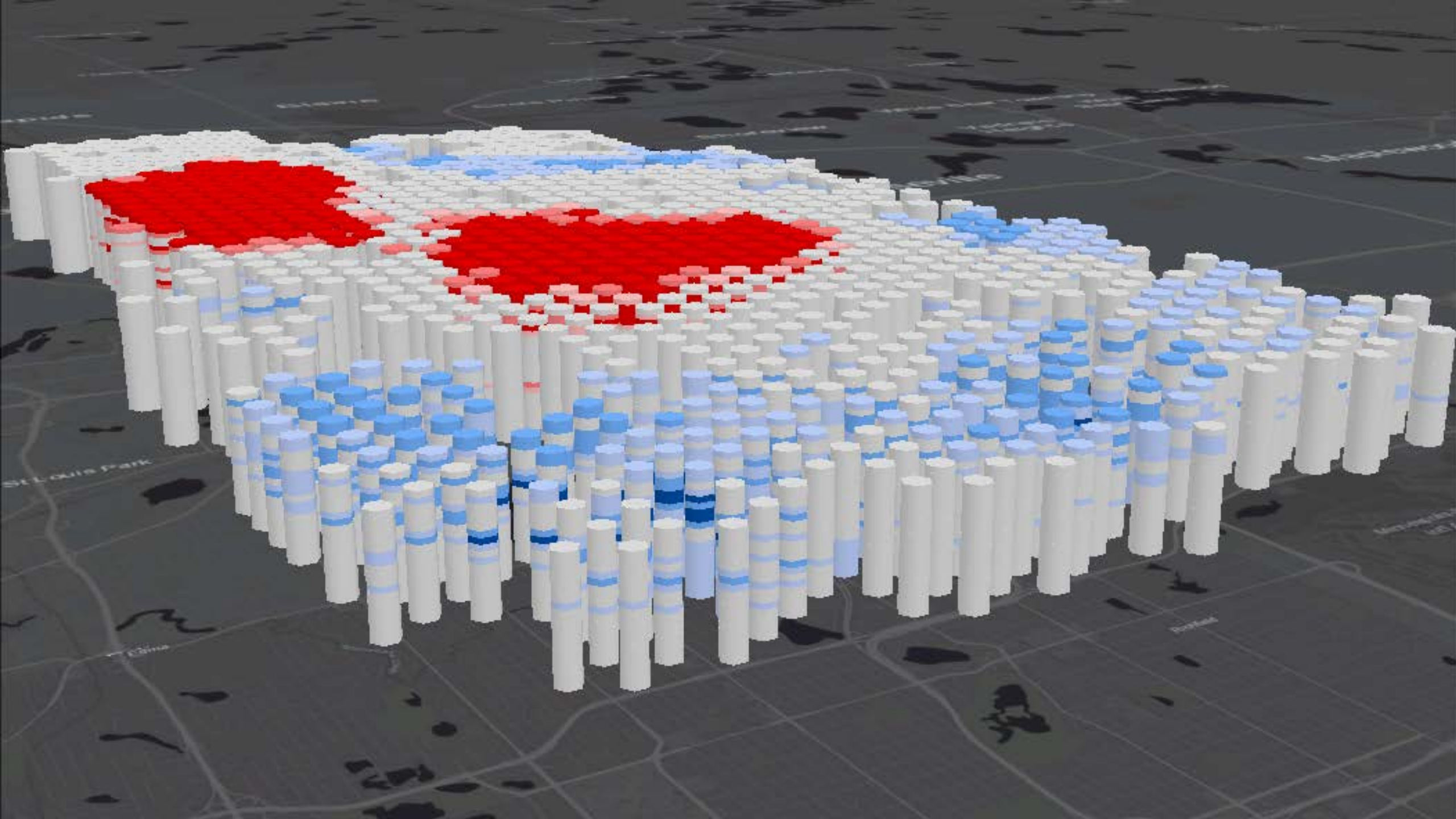




Study Area

Neighborhood

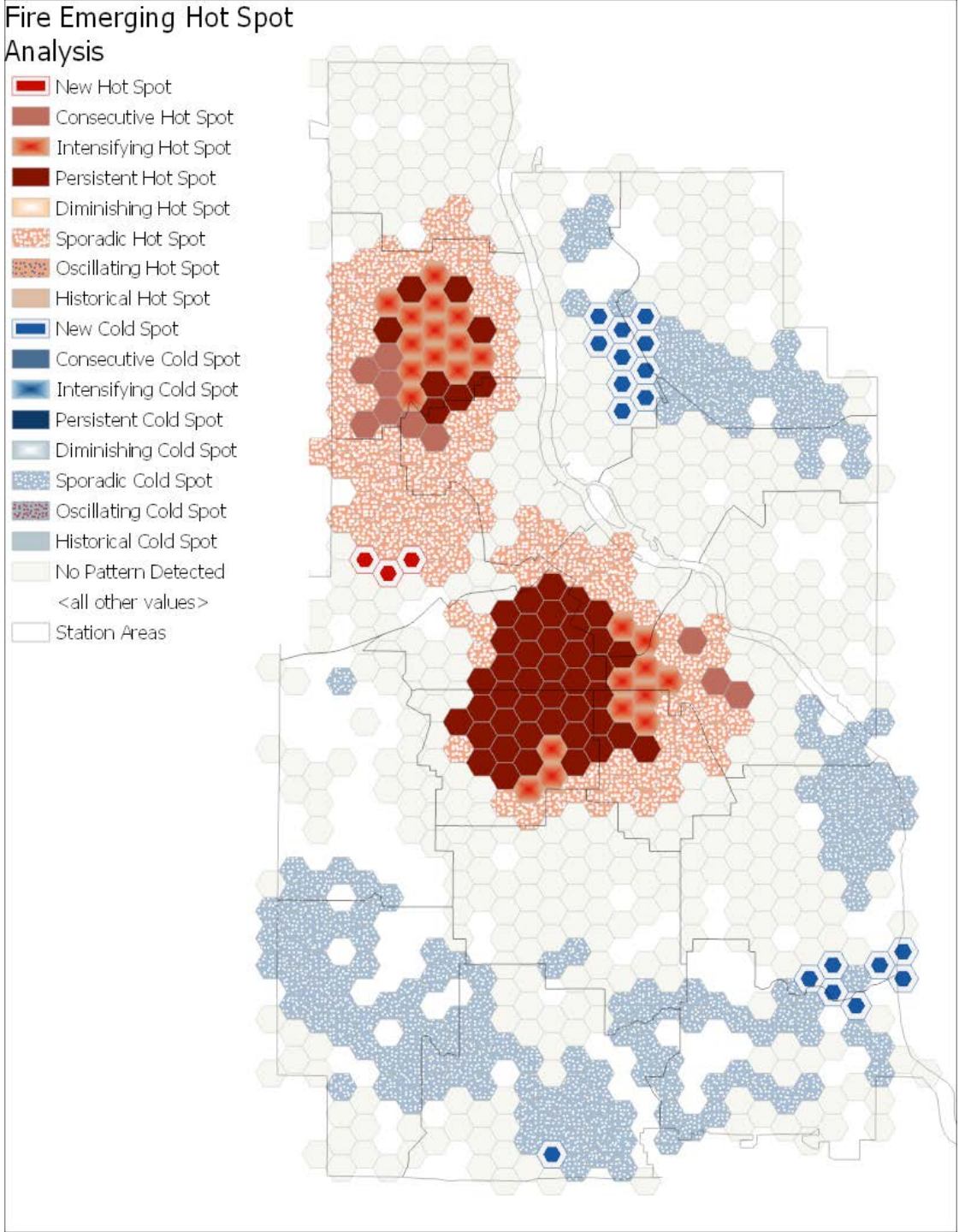
Cell

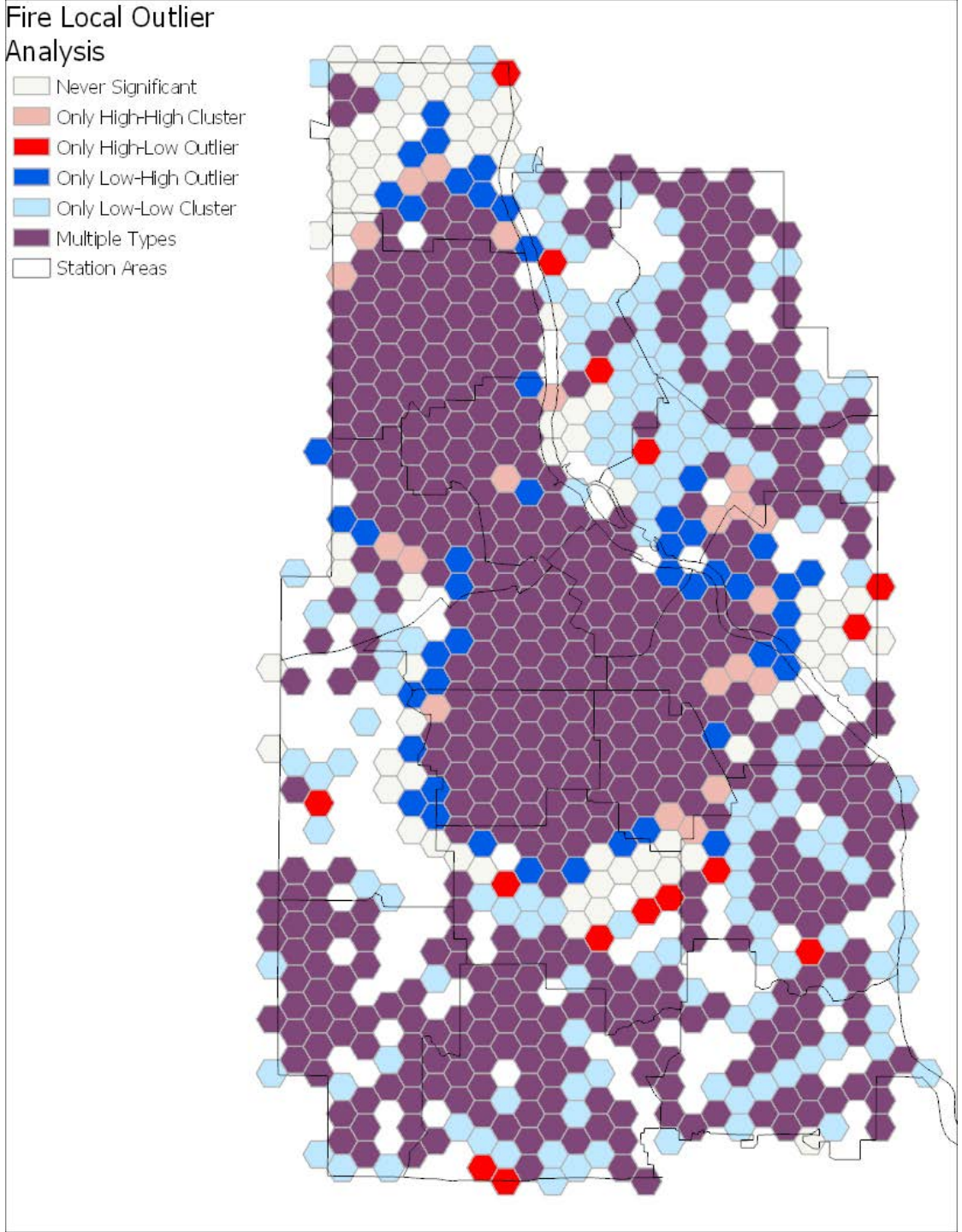


Emerging Hot Spot Analysis

3D counterpart to Hot Spot Analysis

How does the “neighborhood compare to the study area?





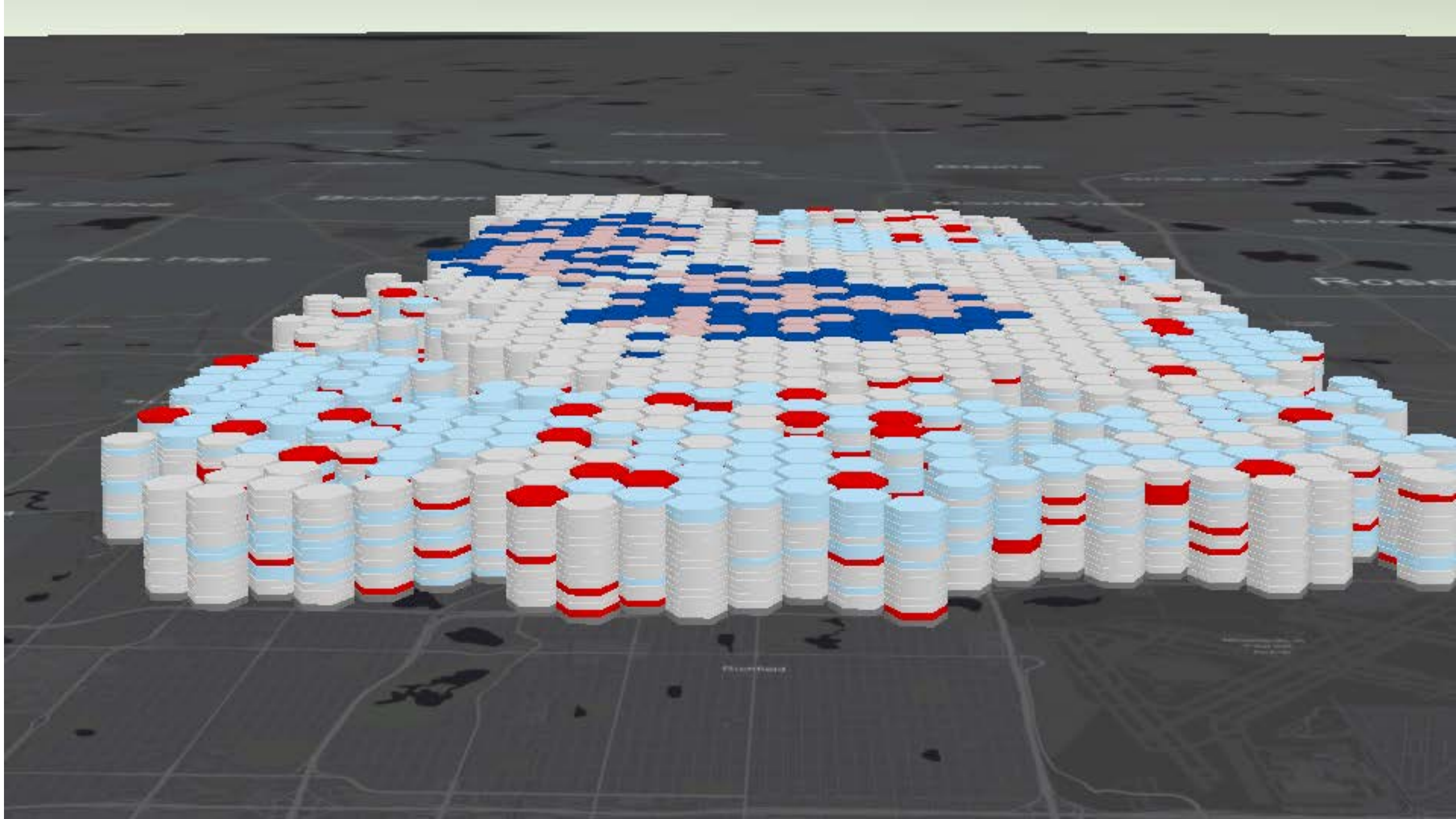
Local Outlier Analysis

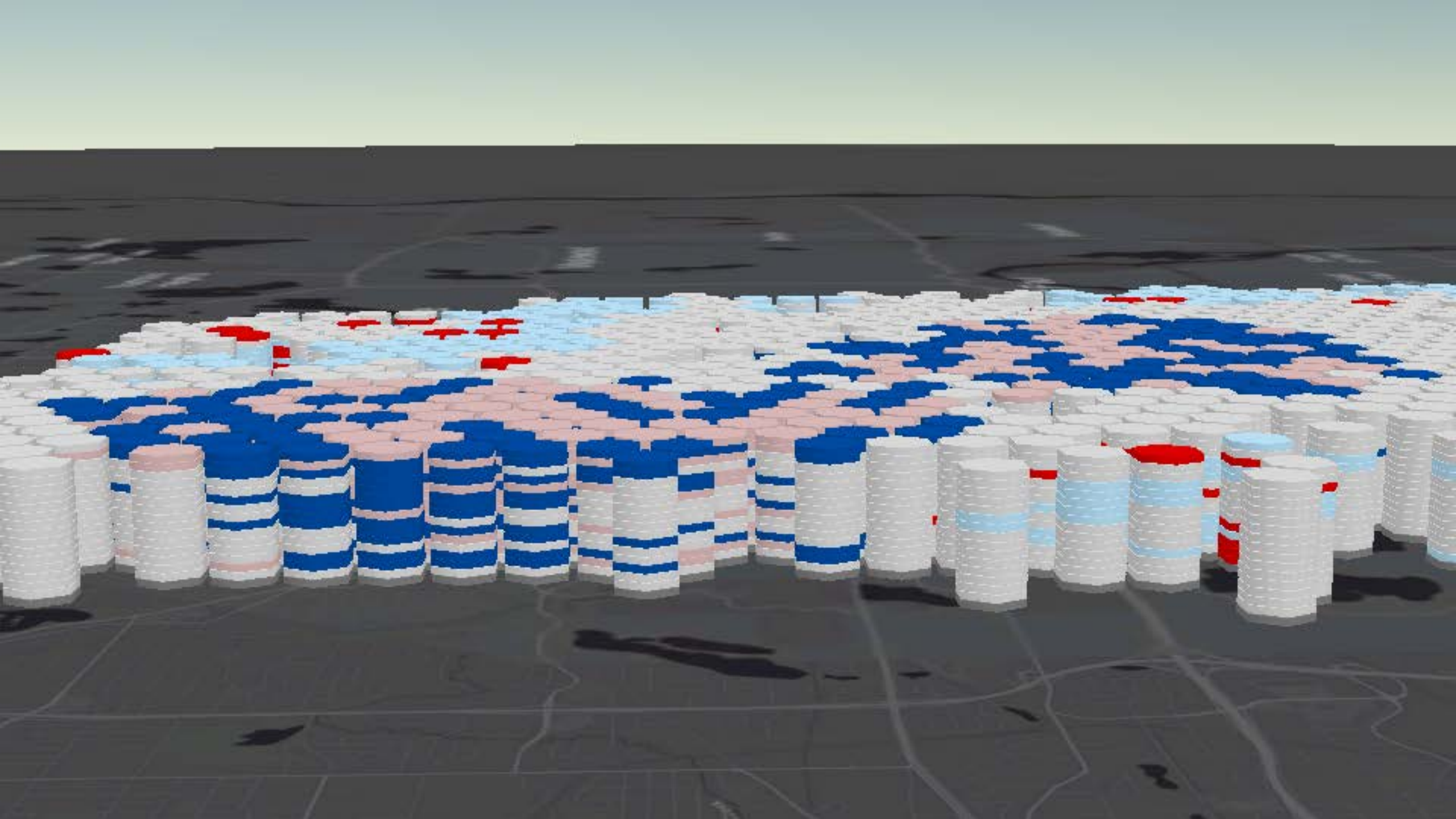
3D counterpart to Cluster-Outlier Analysis

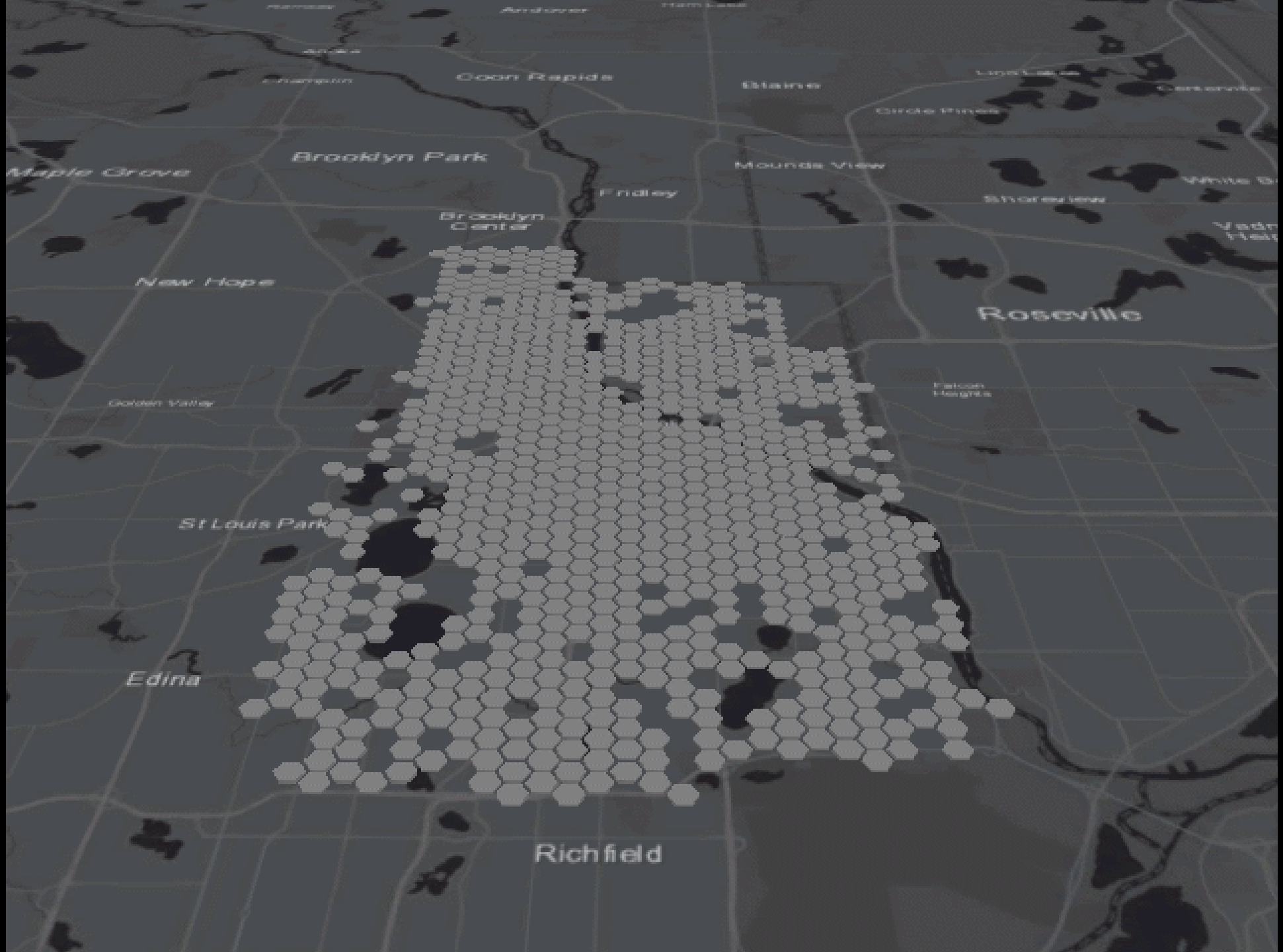
How does the neighborhood compare to the study area?

AND

How does the cell compare to the neighborhood?

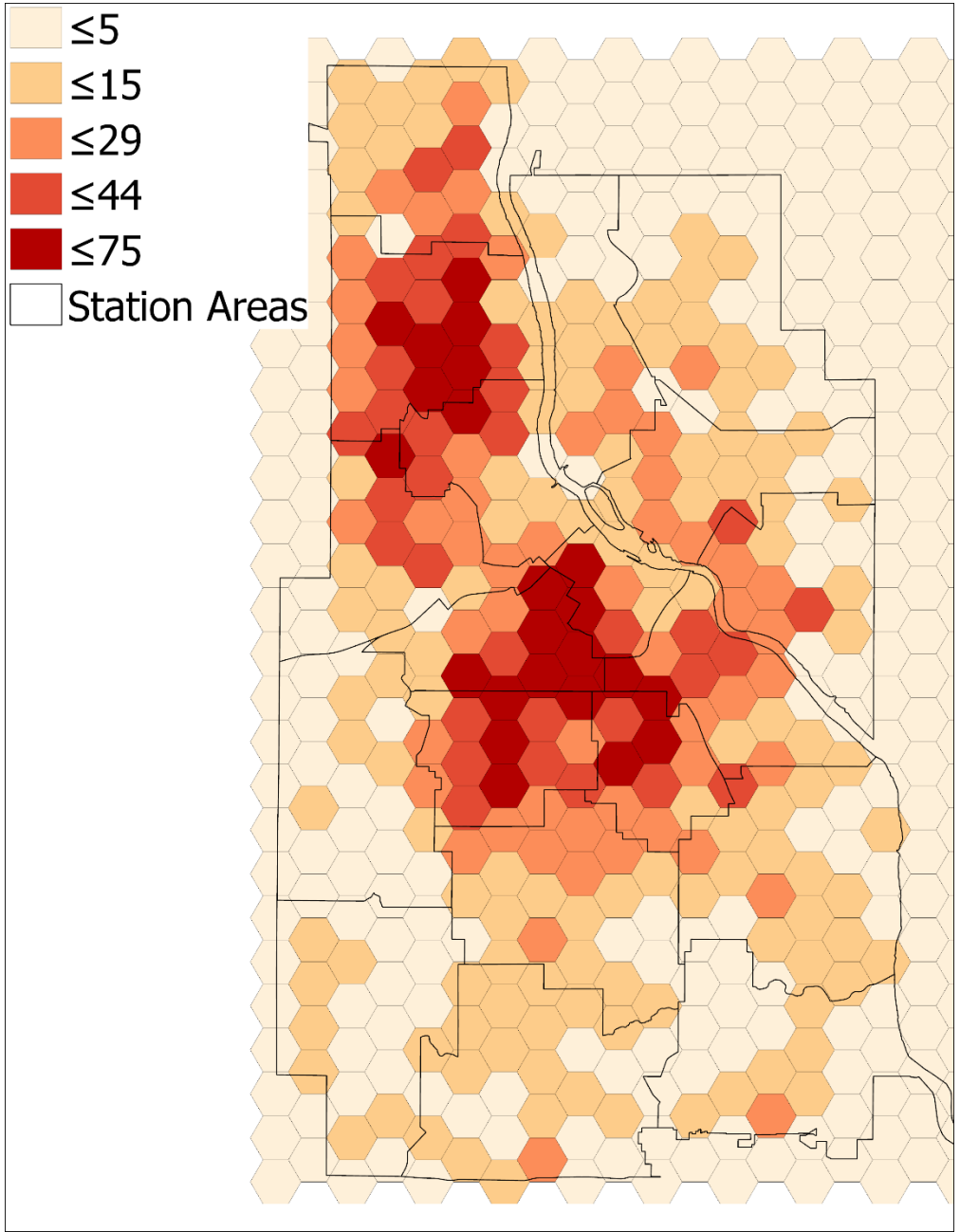


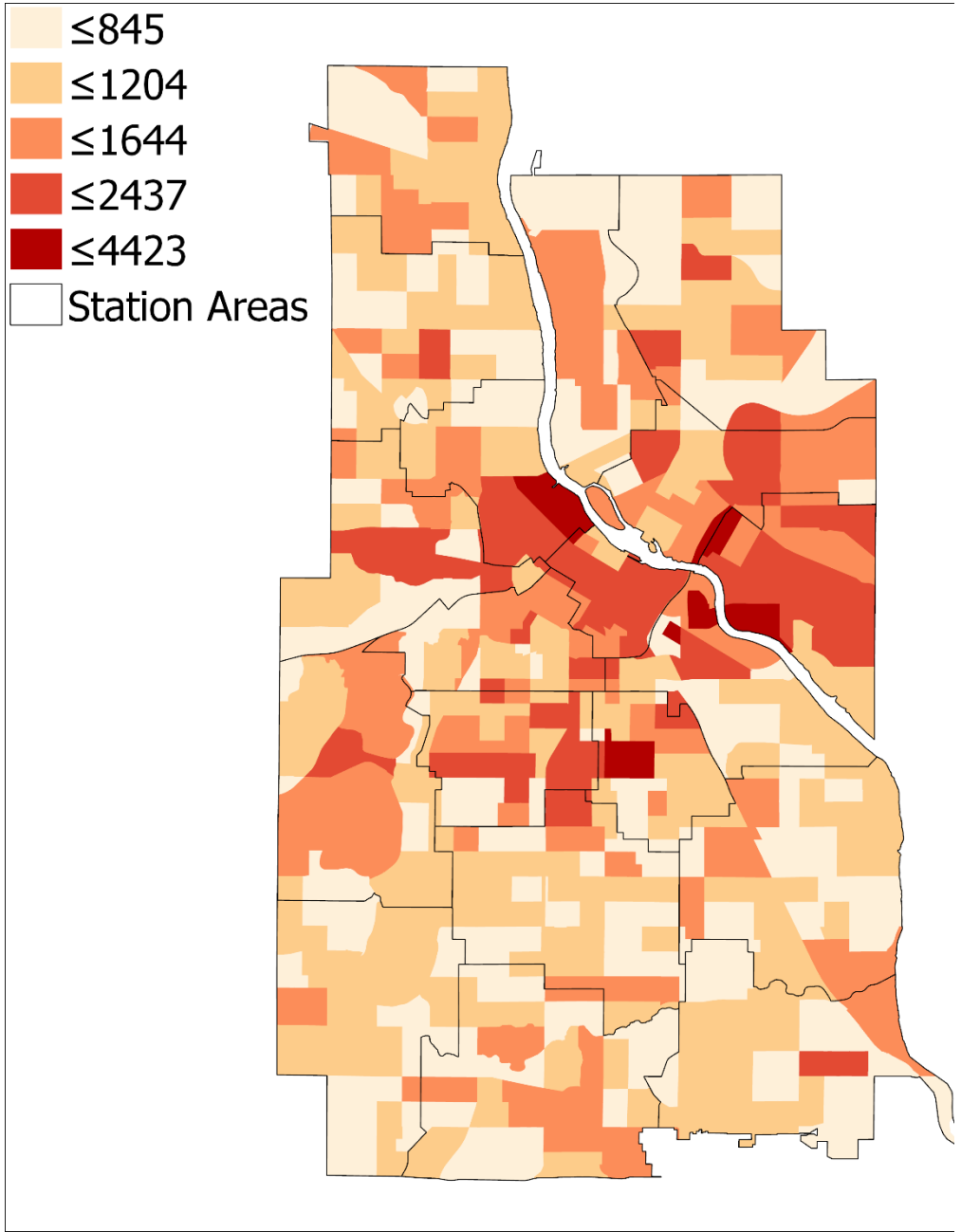



Coon Rapids
Blaine
Brooklyn Park
Maple Grove
Mounds View
Fridley
Brooklyn Center
New Hope
Roseville
Golden Valley
St Louis Park
Edina
Richfield

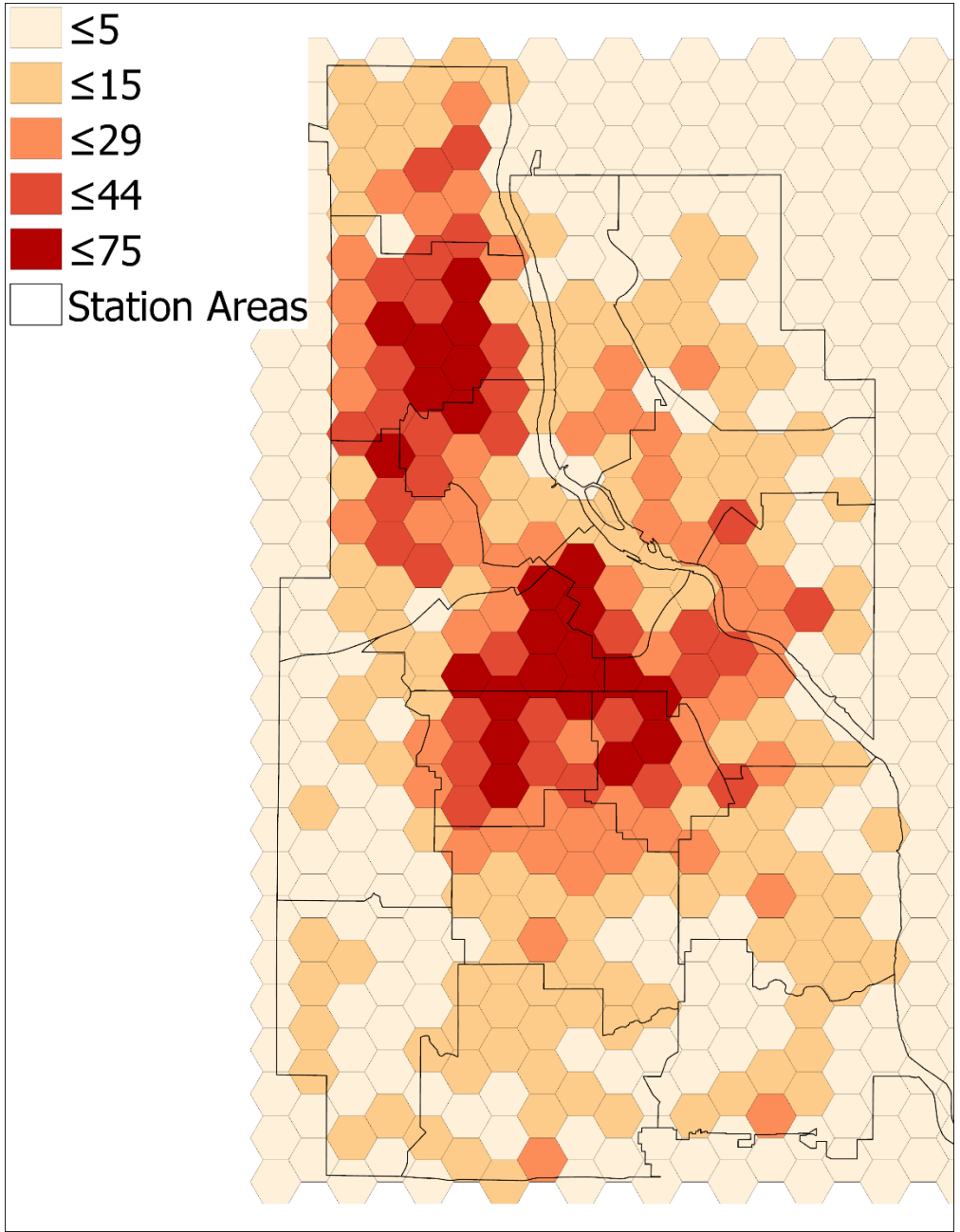
Conclusions

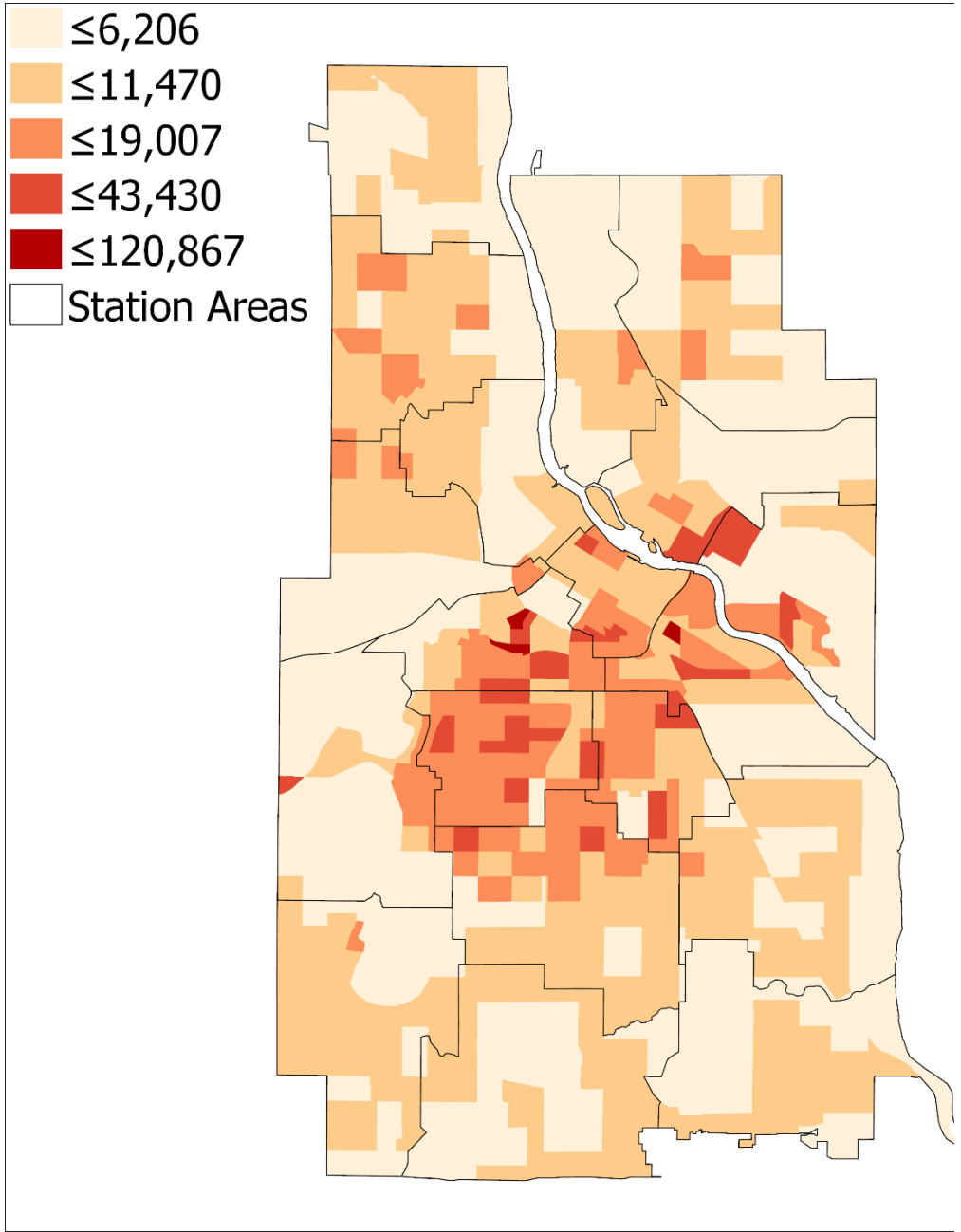
Fires vs. Population



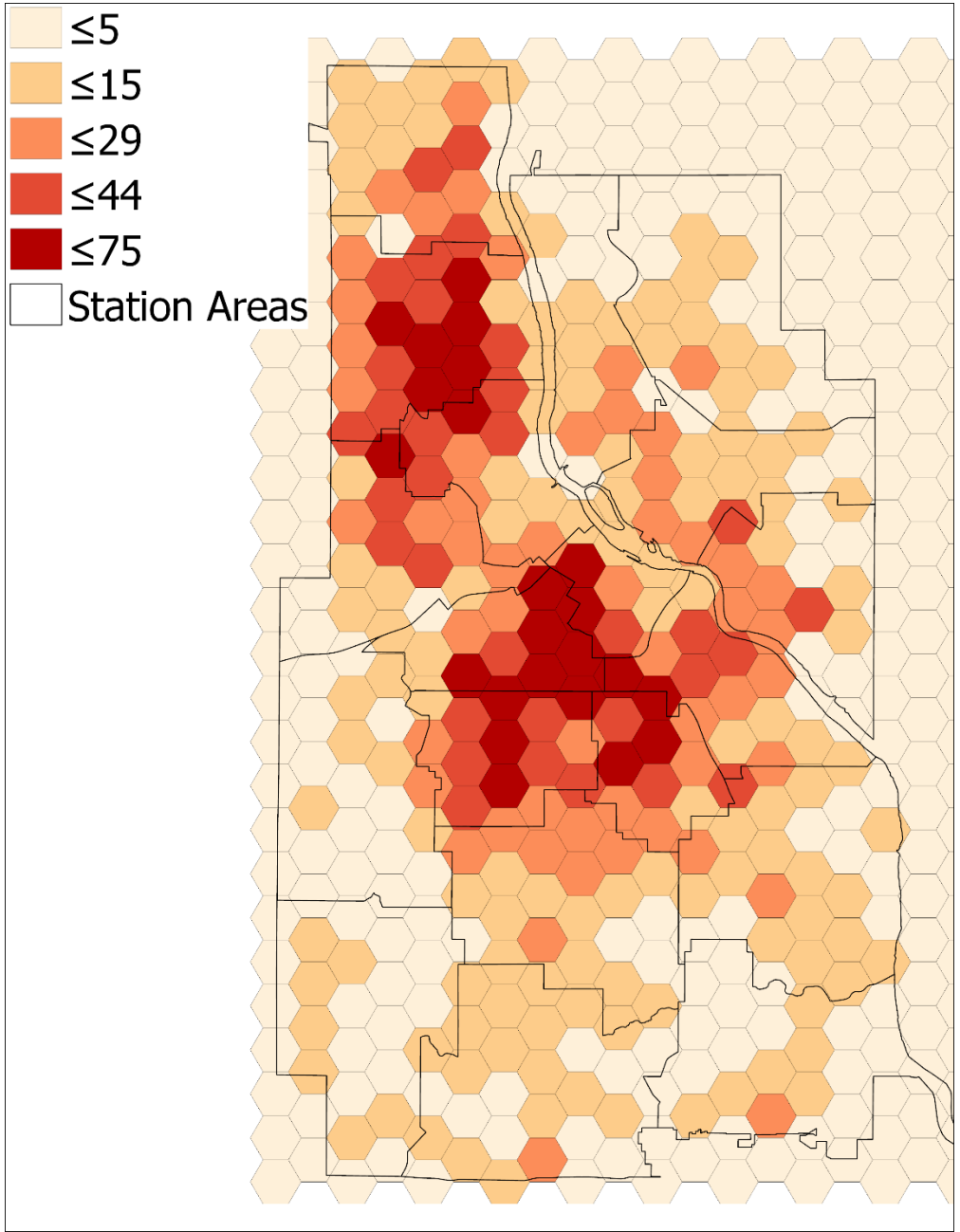


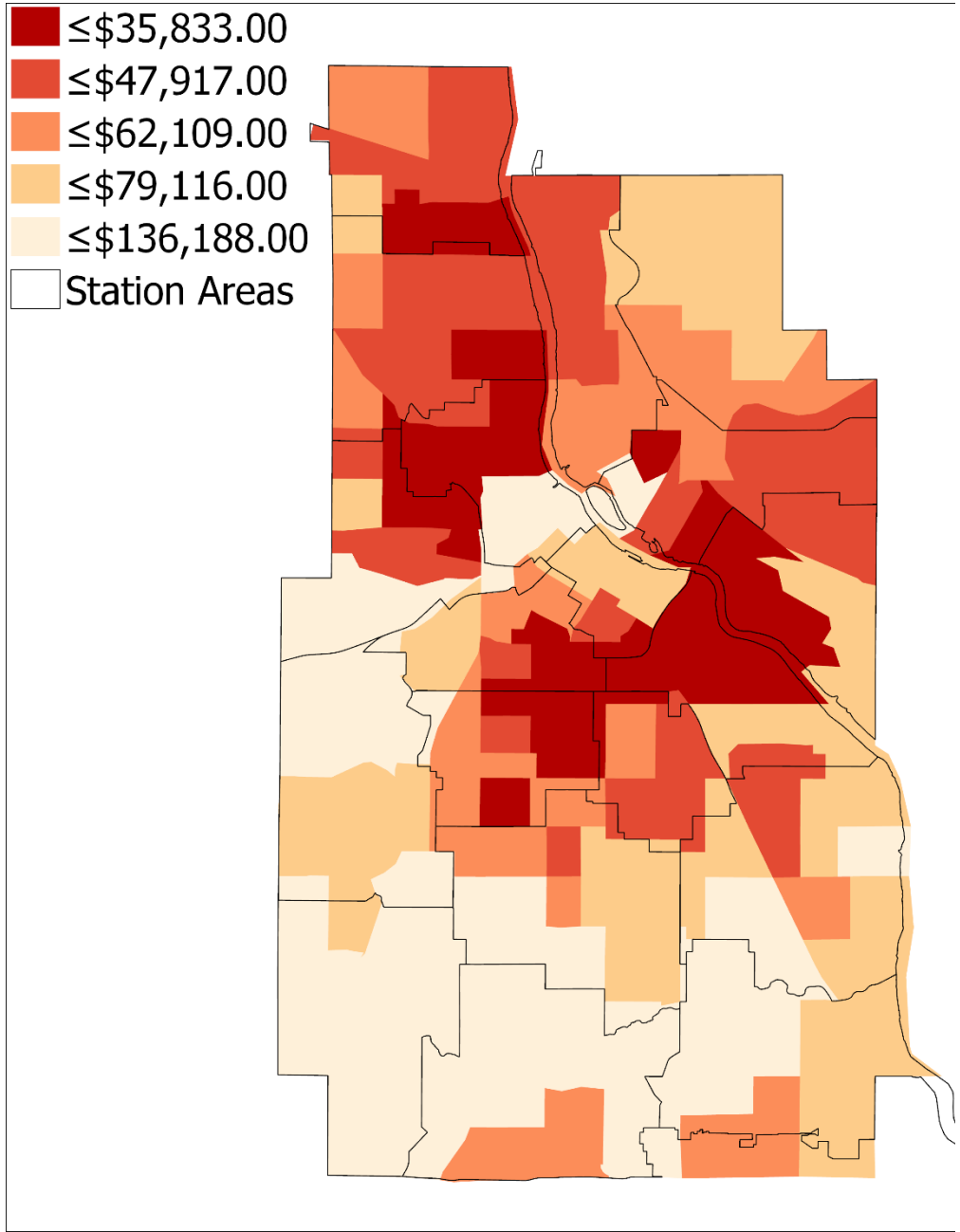
Fires vs. Density





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?

Ricky Holzer

Richard.Holzer@state.mn.us

www.richardholzer.com