Alcohol-serving Businesses as Risky Places

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Risky Places Seminar Series
March 25, 2021

Topics

The role of alcohol-serving businesses on crime and automobile safety

- Violent crime
- Drunk driving vehicle crashes

Emphasis will be on the location of these businesses in a city

- Whether concentration helps or hinders security and safety?

How public policy can affect these?

Excessive Alcohol Use Associated with Many Social Evils

Single Occasions & Chronic

Alcohol-related driving crashes

Crime, especially violent offenses

Child and spousal abuse

Sexual assault

Drowning

Suicide

Many health problems from alcohol-use disorder:

WHO lists more than 200 disease & injury conditions

High blood pressure, STDs,
Heart, stomach, brain, liver & kidney diseases,
Cancers of the breast, throat, esophagus,
Memory loss, HIV, tuberculosis

Studies Showing Alcohol Use in Crime

Many studies of individual cities showing concentration of crime around ABOs

Perceived alcohol use by offenders ***(National Crime Victimization Survey)***

Around 20% of victims of violence reported alcohol use by assailant in 2007

Self-report survey of correctional population in U.S. ***(Survey Of Inmates In State Correctional Facilities, 1997 and 2004)***

33% were estimated as using alcohol during their crime commission

36% for violent crimes (double the percentage using other drugs)

Alcohol-impaired Driving is a Major Health Problem

Improvement in U.S. But Still Serious Problem

28% of roadway fatalities involved alcohol-impaired drivers (2018)

- Down from 49% in 1982

Alcohol-related Fatality rate is 0.32 per 100 million VMT (2018)

- Down from 1.3 per 100 million VMT in 1982

Still around 10,000 deaths from alcohol-impaired drivers per year (2018)

- Down from 26,173 in 1982
- Texas has the highest number & second highest percentage (40%)

Case Study:

Crime and Drunk-driving Crashes Near Alcohol-serving Businesses in Houston, Texas

Research Questions

1. **Whether there is concentration of on-premise alcohol-serving businesses/alcohol beverage outlets (ABO)?**

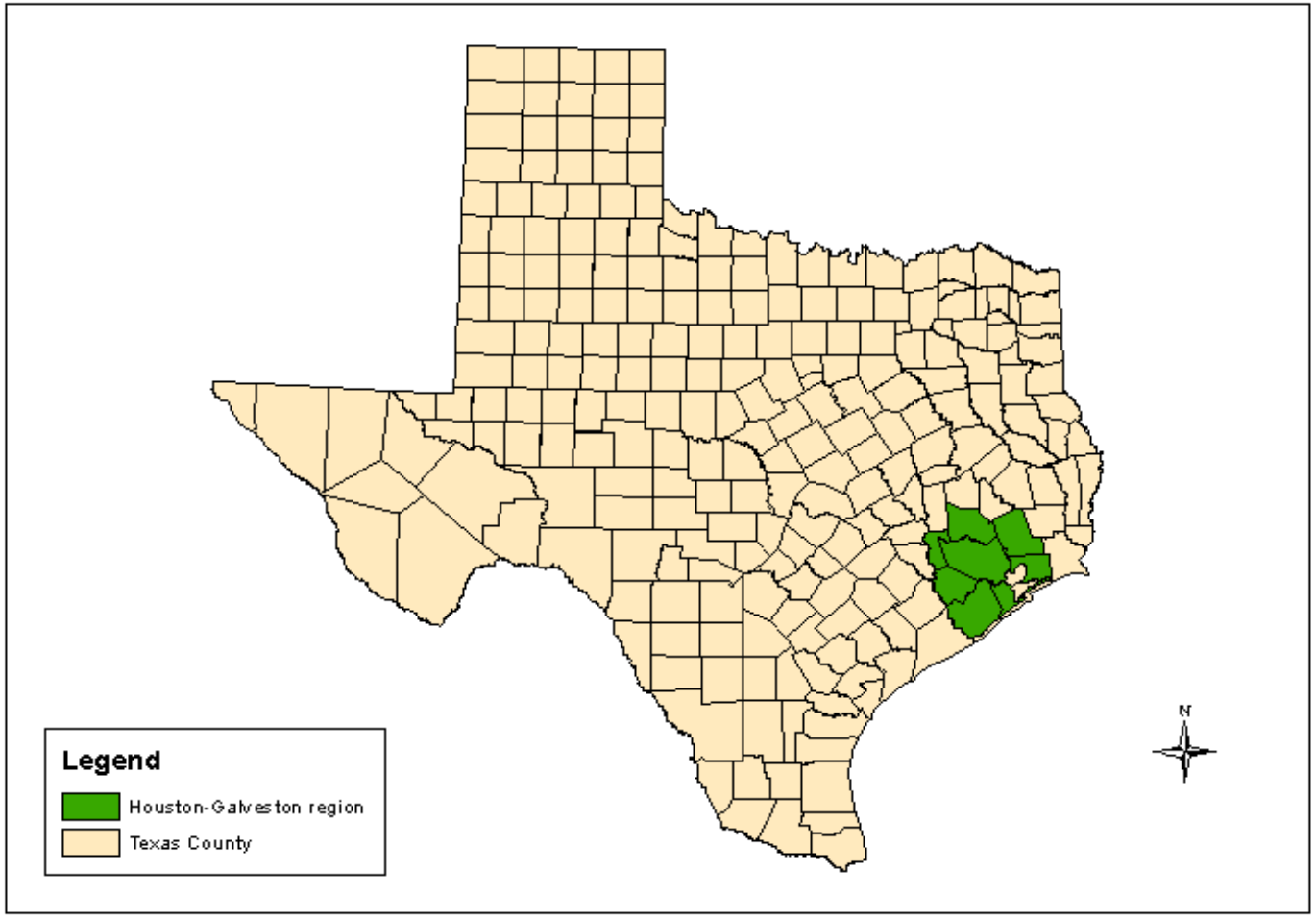
2. **How much do alcohol-serving businesses contribute to crime and to alcohol-related crashes in Houston?**

3. **Whether the concentration of these businesses affects those problems?**

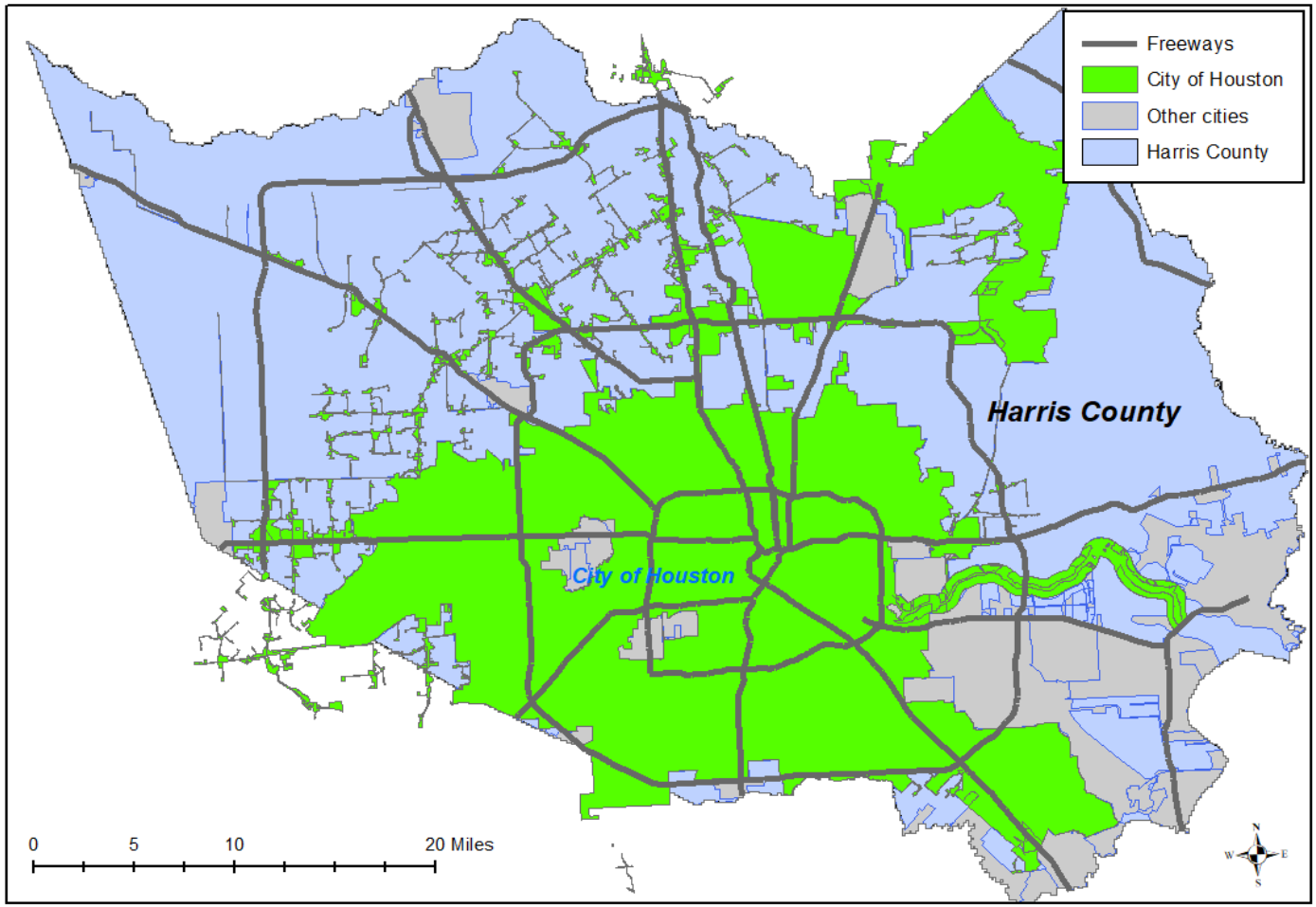
   Does it make a difference how those businesses are spatially organized?

Texas and the Continental United States

Texas and the Houston-Galveston Region



City of Houston and Harris County



Population

City of Houston: 2.3 million (2019)

(fourth largest in U.S.)

639 sq. mi./1655 sq. km.

Metropolitan area: 7.1 million (2019)

(fifth largest in U.S.)

8258 square miles/21388 sq. km.

A Very Large "Automobile-oriented" City

Four Databases for 2012-16 Time Period For City of Houston

1. On-premise alcohol-serving businesses for 2014:
   N=3,299

2. Serious crimes for 2016:
   N=227,279

3. Alcohol-related motor vehicle crashes for 2012-14:
   N=3,154

4. Road segments from transportation modeling network:
   N=4,688

Alcohol-Serving Businesses

Two Kinds of Alcohol-Serving Businesses

On-premise

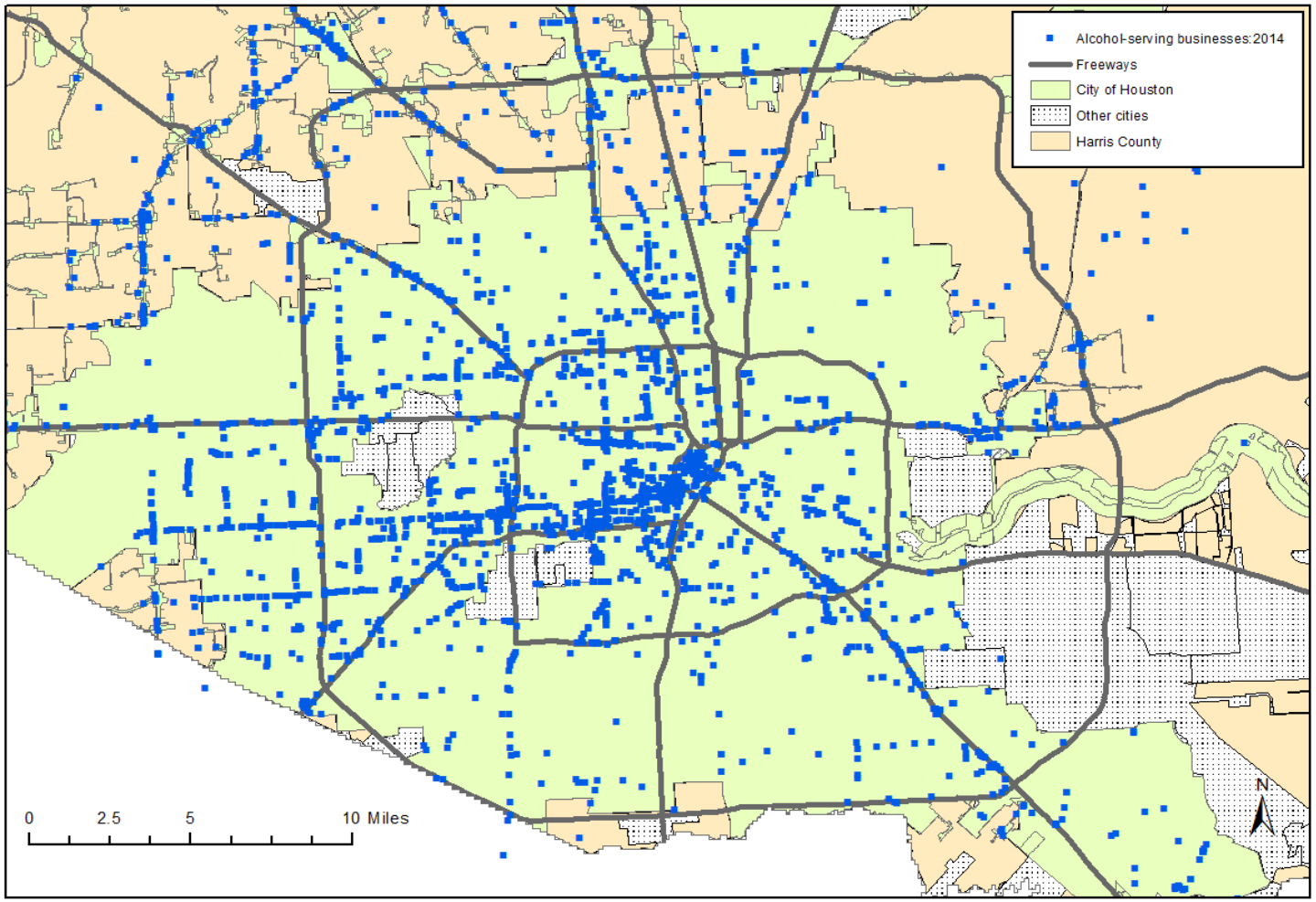
Bars, restaurants, night clubs, private clubs, events, concert halls

Off-premise

Liquor stores, supermarkets, state stores

Houston Businesses that Serve Alcohol On Premise: 2014

N=3,299



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On-premise Alcohol Beverage Outlets (ABO)

(N=3,299)

1,808 restaurants

1,034 bars/taverns

457 mixed, clubs, or undetermined

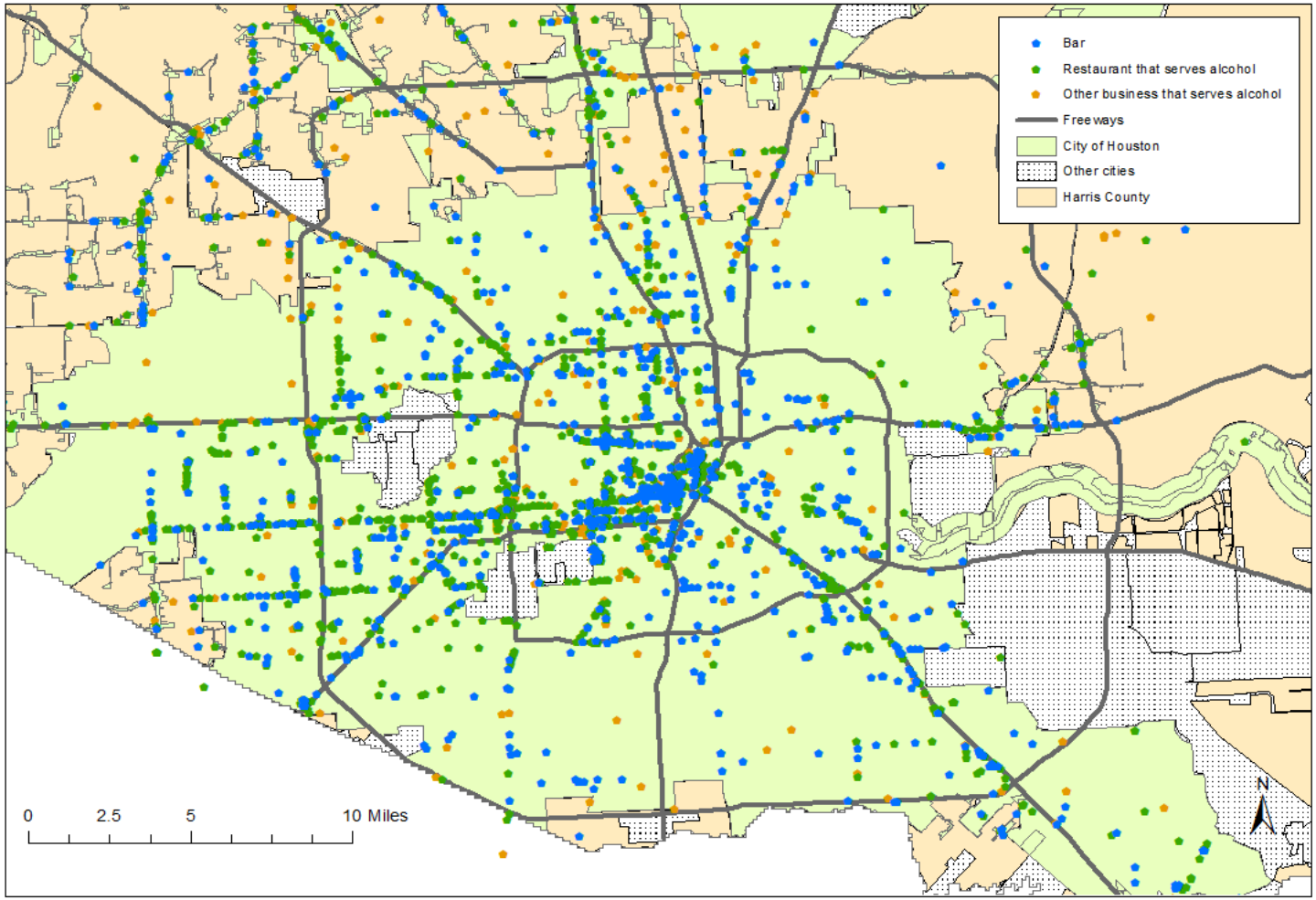
***

1,739 *(52%)* had late night alcohol license

(Midnight–2 am)

City of Houston Alcohol-serving Businesses: 2014

Bars, Restaurants, Other Businesses That Serve Alcohol



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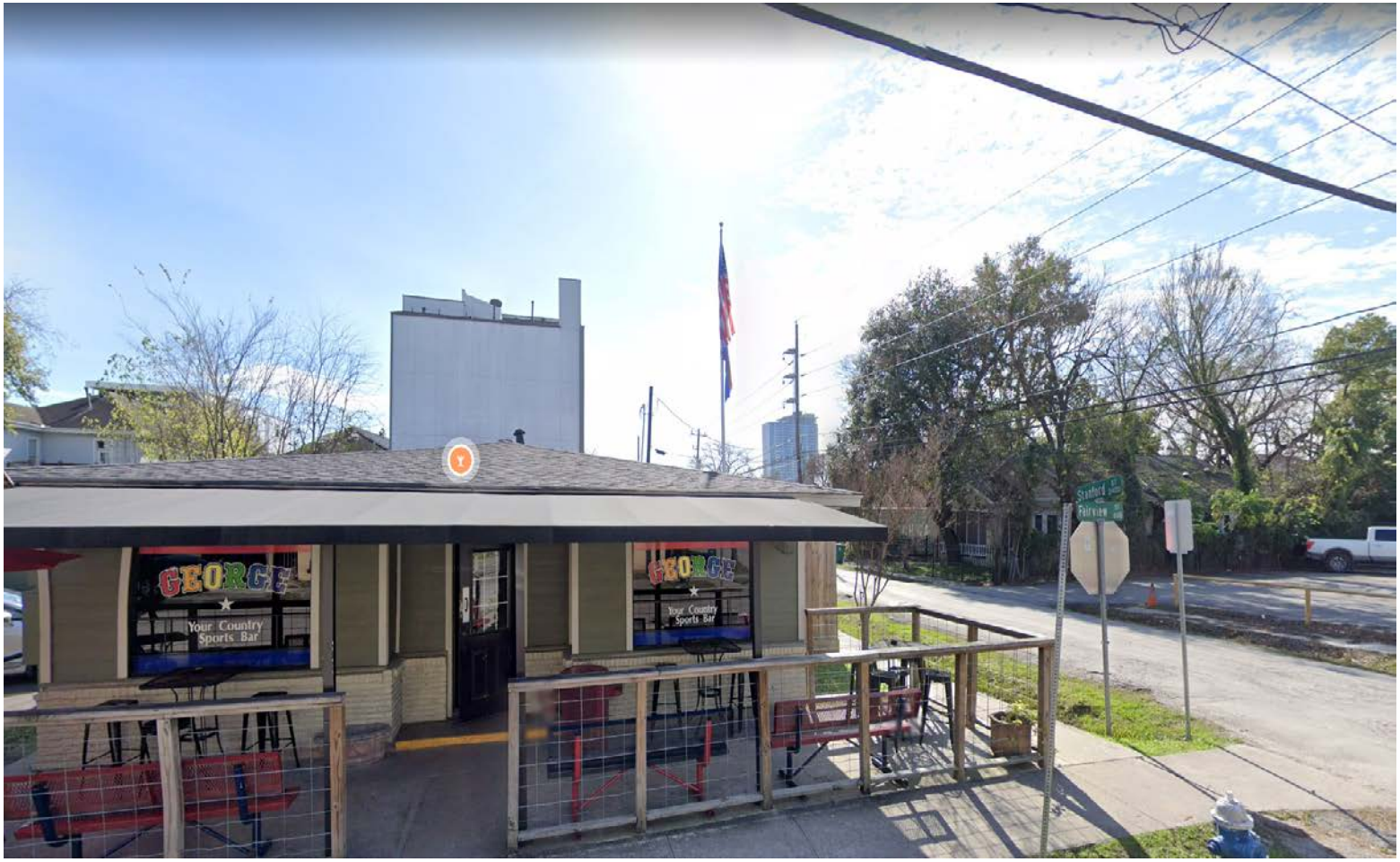
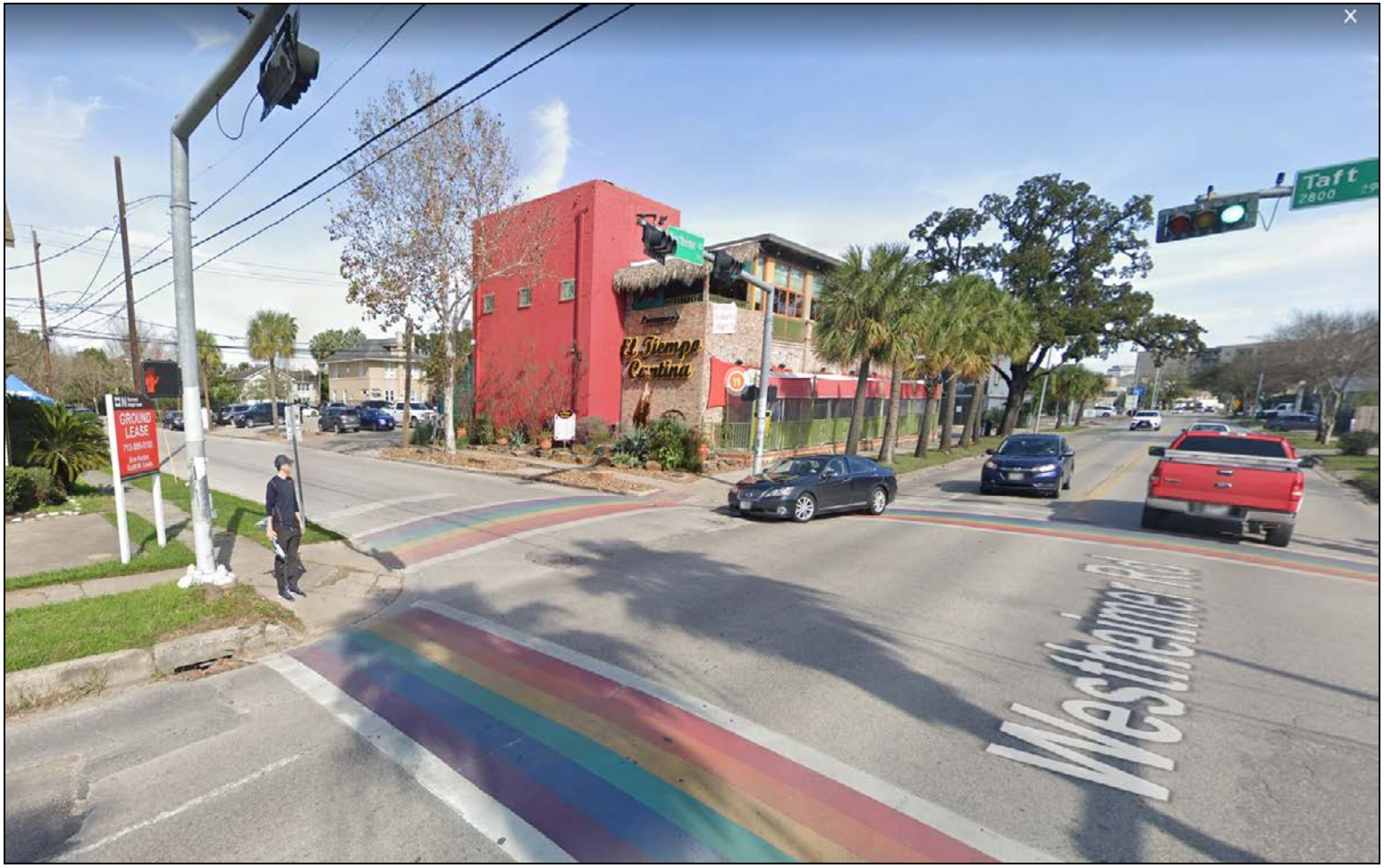
Google Maps, 2021



Google Maps, 2021

Google Maps, 2021



Google Maps, 2021

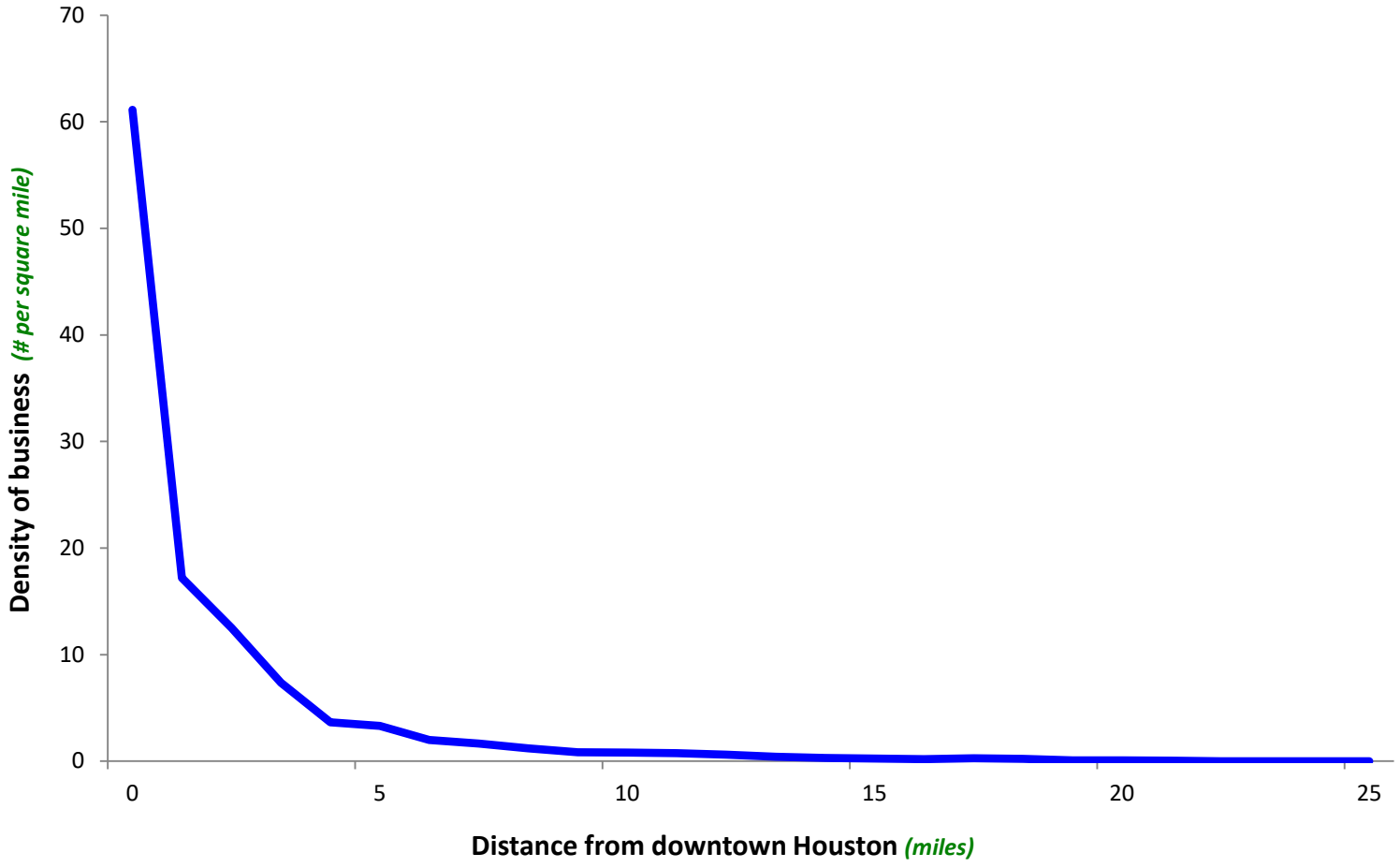
Google Maps, 2021

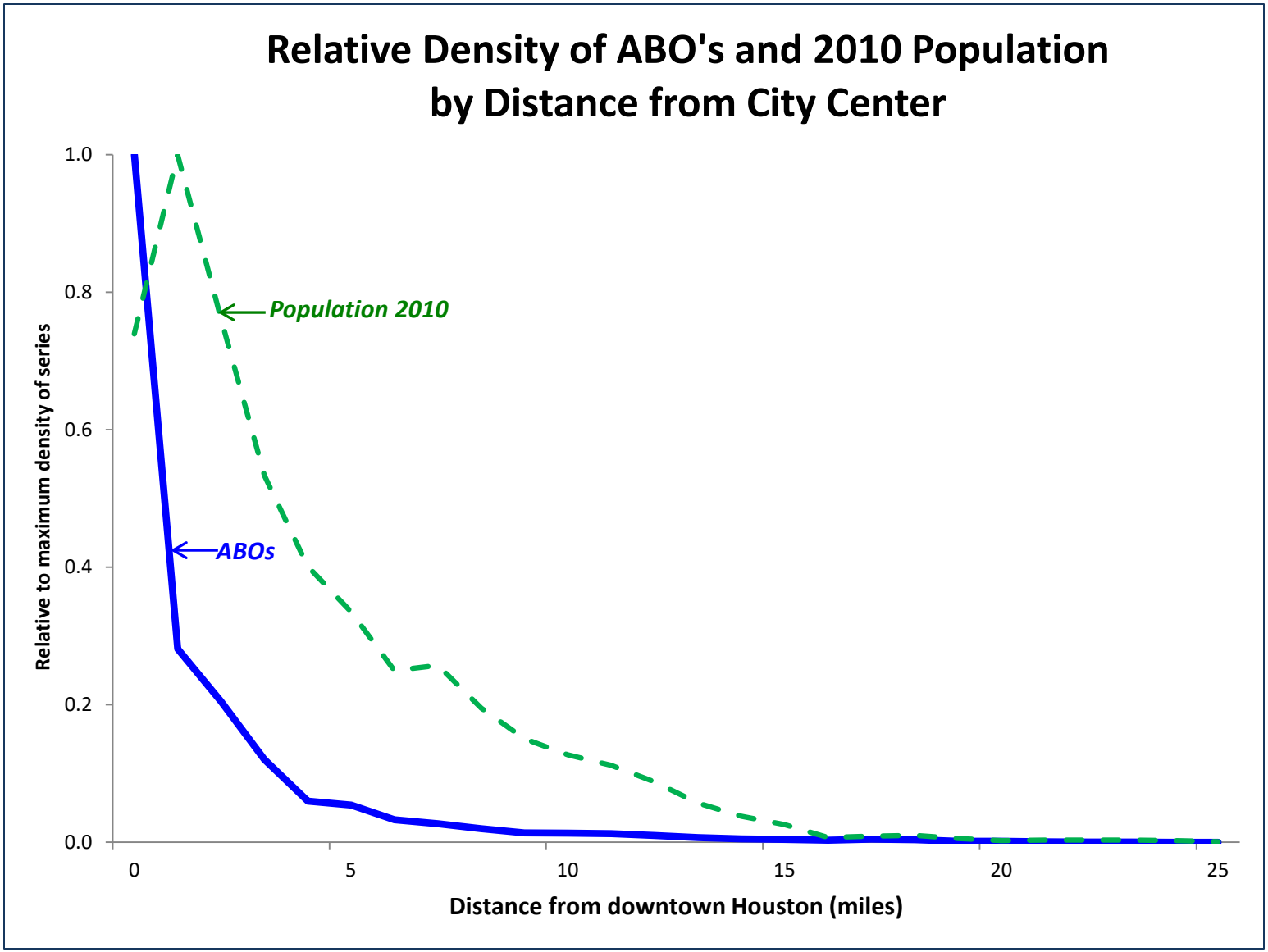
Alcohol-serving Businesses Show Two Types of Spatial Concentration

‘Global’ with respect to the city center

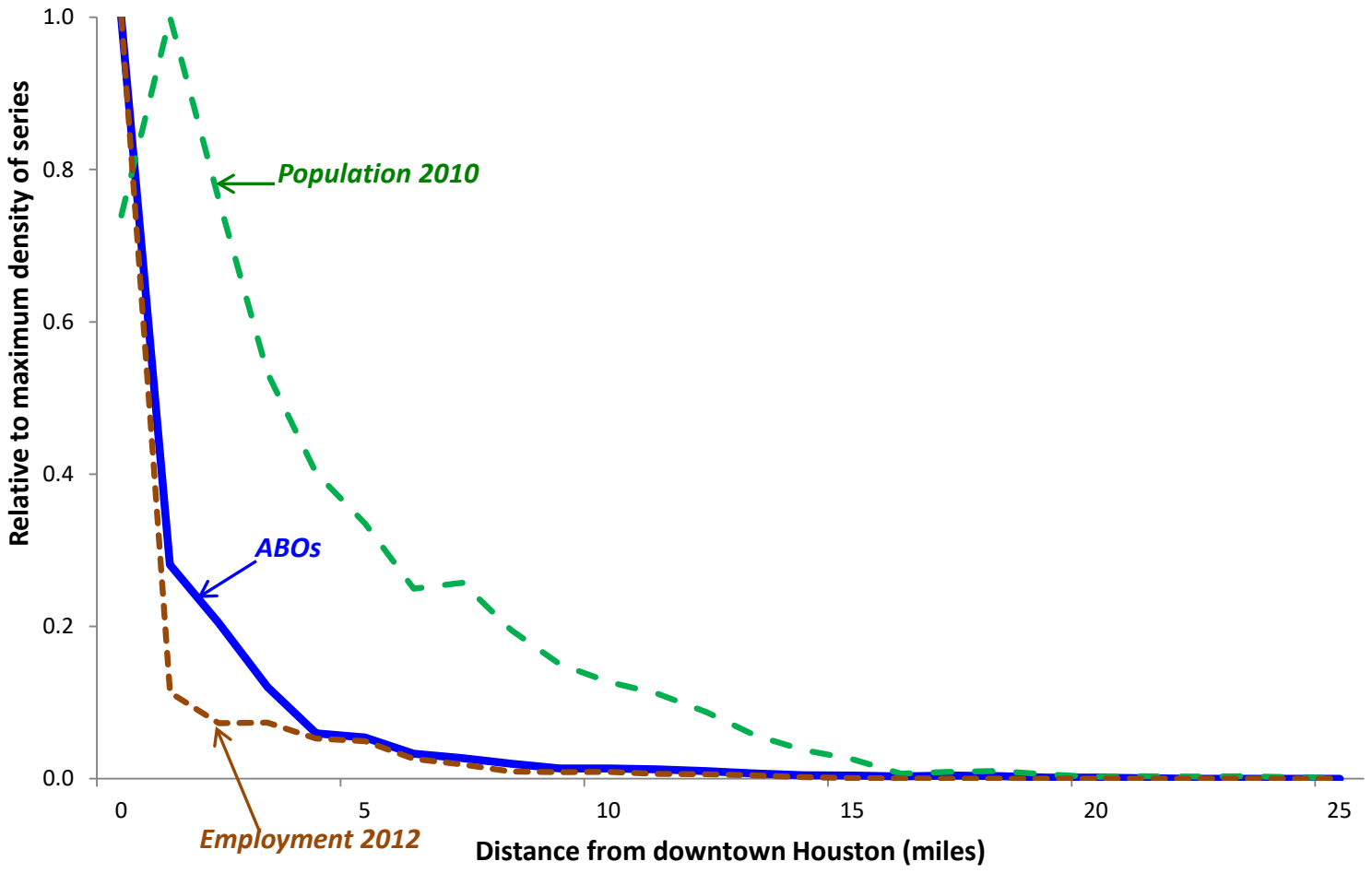
‘Local’ clustering

Density of Alcohol Serving Businesses by Distance from City Center




Relative Density of ABO's and 2010 Population
by Distance from City Center
1.0
0.8
0.6
0.4
0.2
0.0
Relative to maximum density of series
Population 2010
ABOs
0
5
10
15
20
25
Distance from downtown Houston (miles)

Relative Density of ABO's, Population & Employment by Distance from City Center



Local Concentration in Alcohol-serving Businesses

Nearest Neighbor Hierarchical Clustering Algorithm (Nnh)

Grouped businesses together within 0.5 mile (804 m) search radius

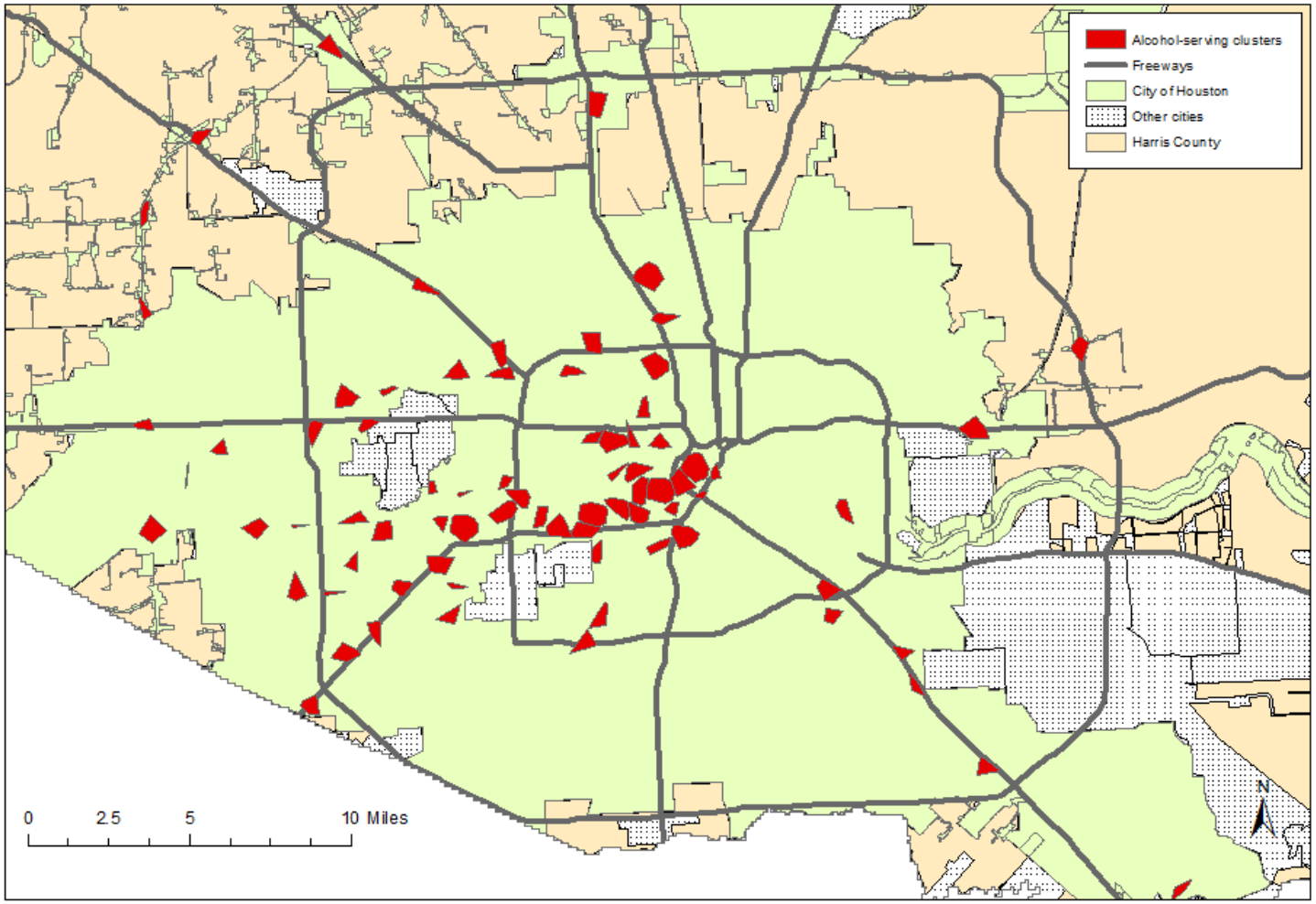
Selected clusters with 10+ businesses

Identified 85 Groupings/Clusters

95% credible intervals for 10,000 Monte Carlo simulations = 11-12 clusters

Clusters of Businesses that Serve Alcohol: 2014

Nnh Clusters with 0.5 Mile Search Radius and Minimum of 10 Businesses



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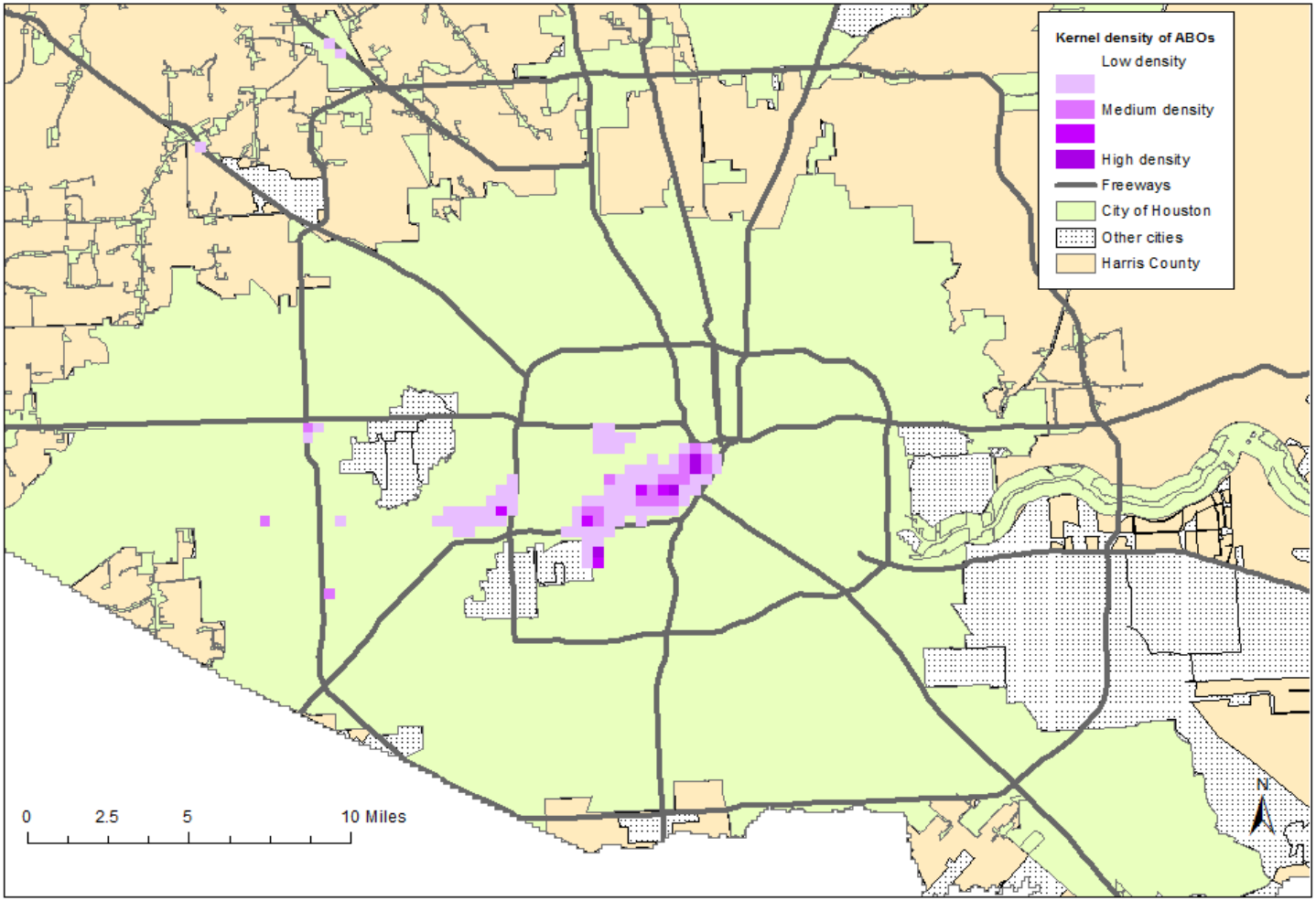
Clusters of Businesses that Serve Alcohol: 2014

Kernel Density Estimation of Alcohol Beverage Outlet 'Clusters' (top 20% of cells)



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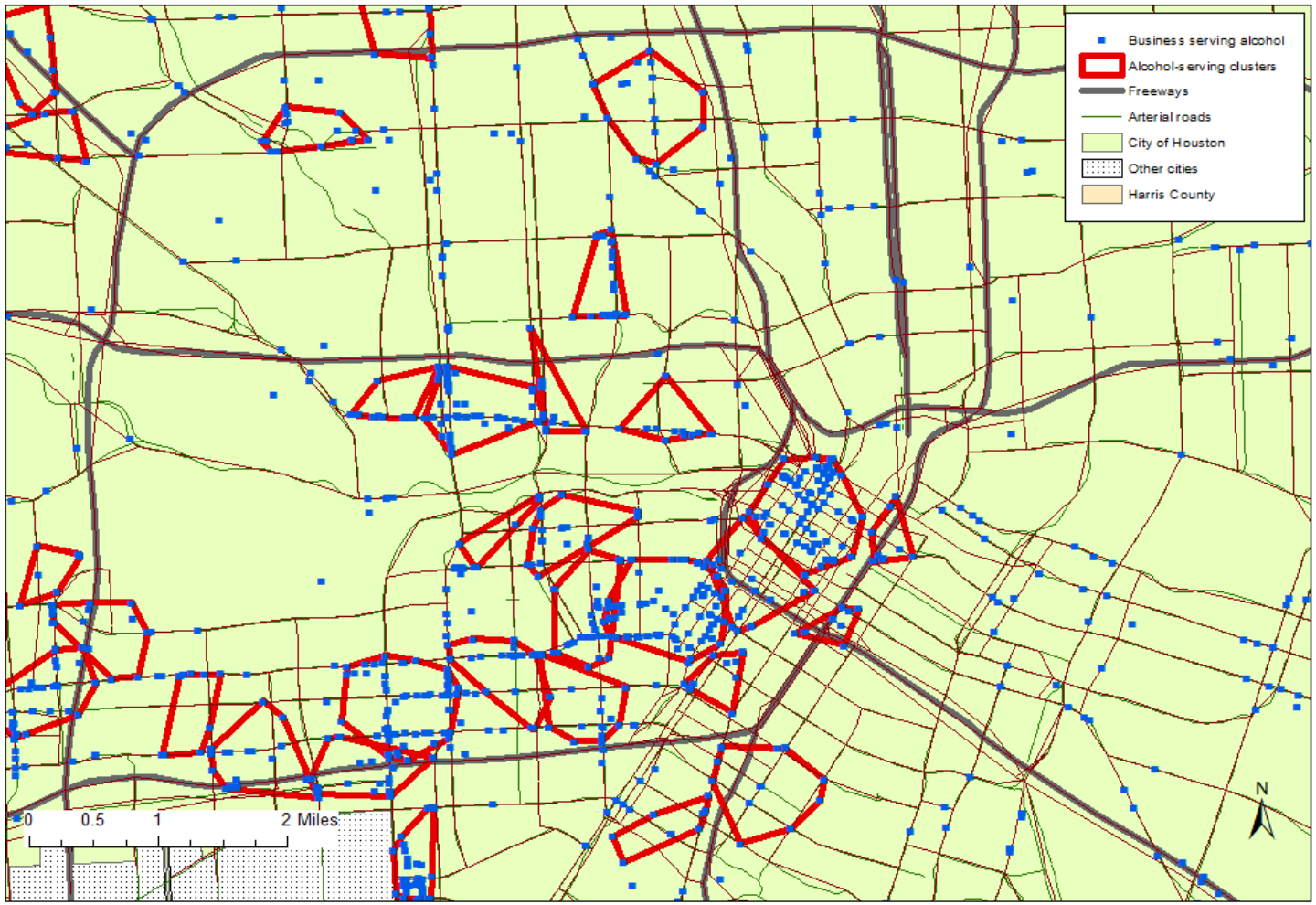
Alcohol Business Clusters Cover Many ABOs

85 clusters: **3% of the city's area**
42% of the alcohol-serving businesses

Clusters of On-premise Businesses that Serve Alcohol: 2014

Nnh Clusters with 0.5 Mile Search Radius and Minimum of 10 Businesses



Crime and Alcohol-Serving Businesses

Categories of Serious Crime

Property

- Arson
- Burglary
- Theft/Larceny
- Vehicle theft
- Vandalism/Criminal mischief

Violent

- Assault/Family violence
- Homicide/Manslaughter
- Rape
- Robbery

Social disorder

- Drugs
- Drunkenness
- Harassment
- Indecency
- Prostitution
- Runaway juveniles

Serious Crimes in the City of Houston: 2016

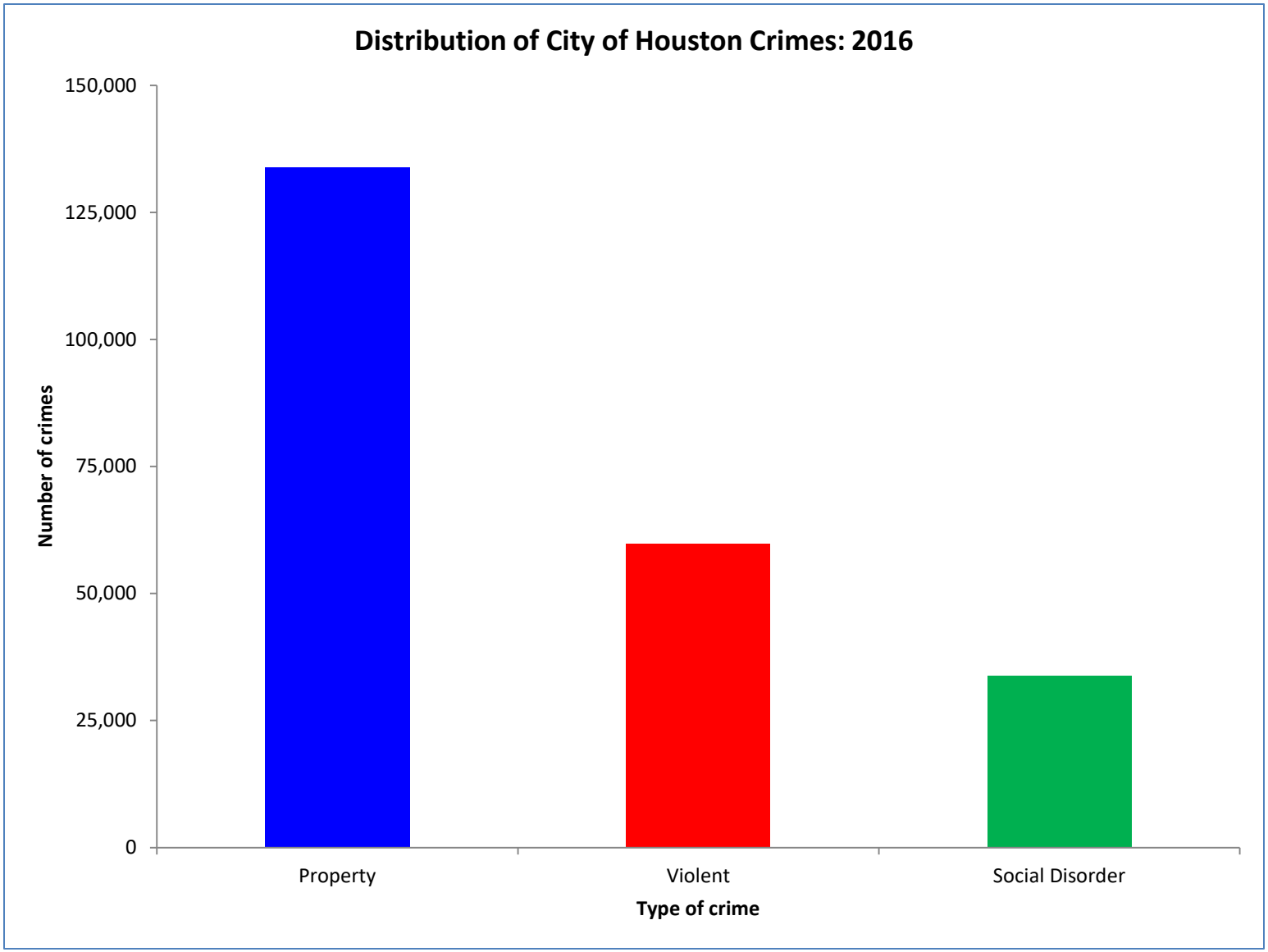
N=227,279

1. **Property crimes**
   N=133,768 *(59%)*

2. **Violent crimes**
   N=59,778 (26%)

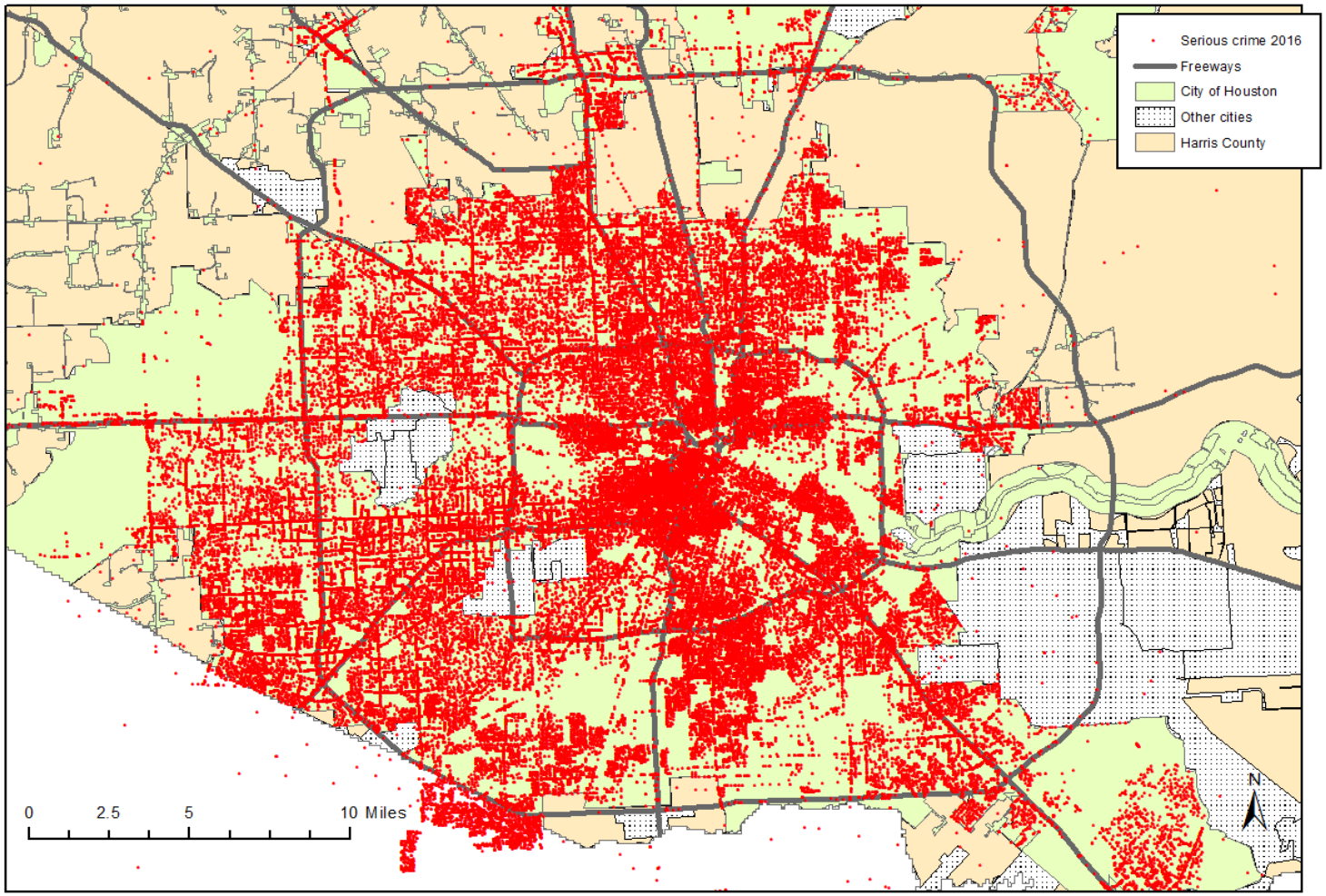
3. **Social disorder crimes**
   N=33,733 (15%)

Excluded vehicle, health, mental health & administrative crimes


Distribution of City of Houston Crimes: 2016
150,000
125,000
100,000
75,000
50,000
25,000
0
Number of crimes
Property
Violent
Social Disorder
Type of crime

Serious Crimes in the City of Houston: 2016

N=227,279



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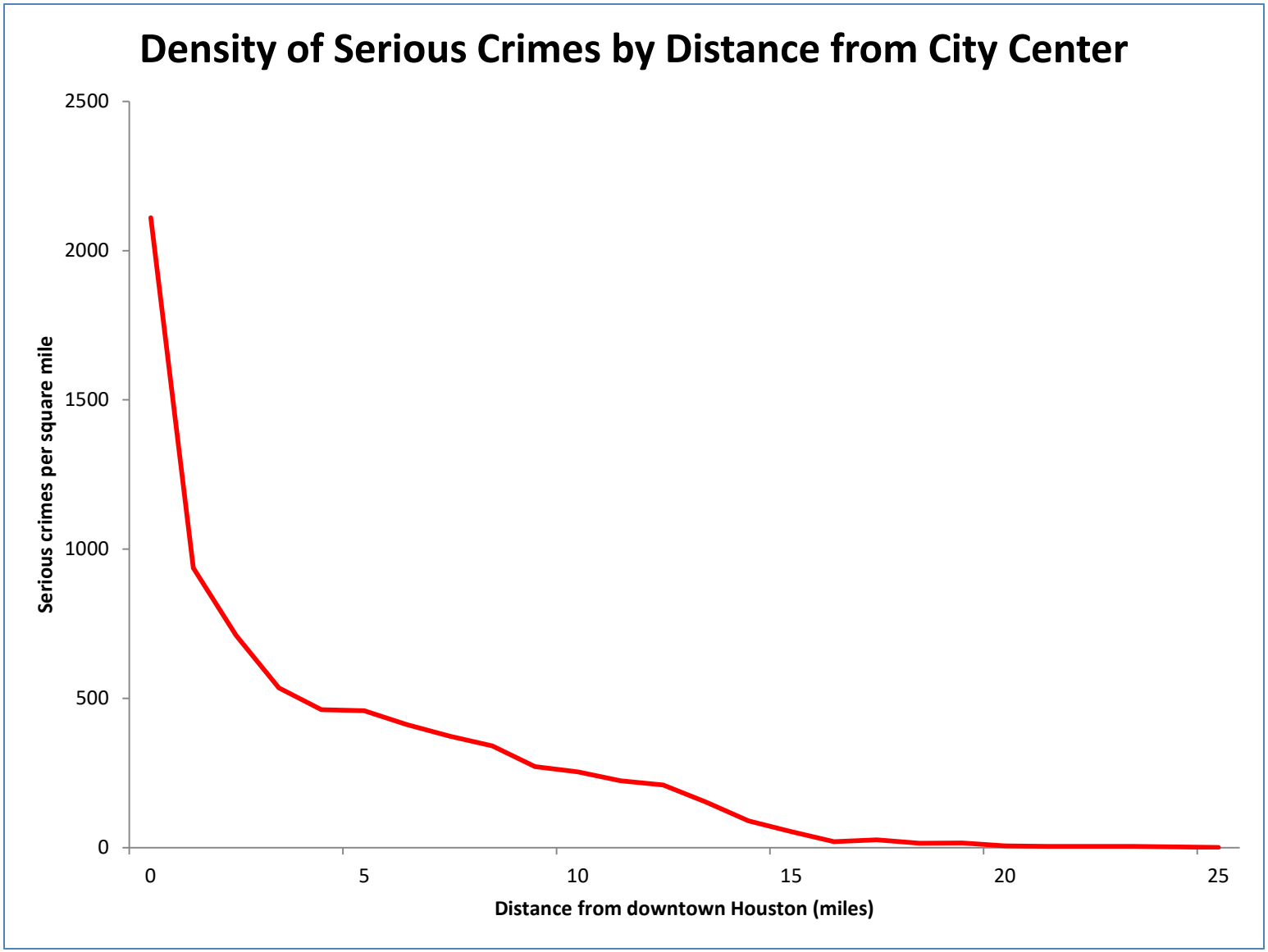

Density of Serious Crimes by Distance from City Center
2500
2000
1500
1000
500
0
Serious crimes per square mile
0
5
10
15
20
25
Distance from downtown Houston (miles)

Adjacency of Crimes to Alcohol-serving Businesses

14% of serious crimes occurred within the 85 ABO clusters

- **15% of those between Midnight and 3:59 am**

Alternative way to examine clustering is look at nearness to ABOs

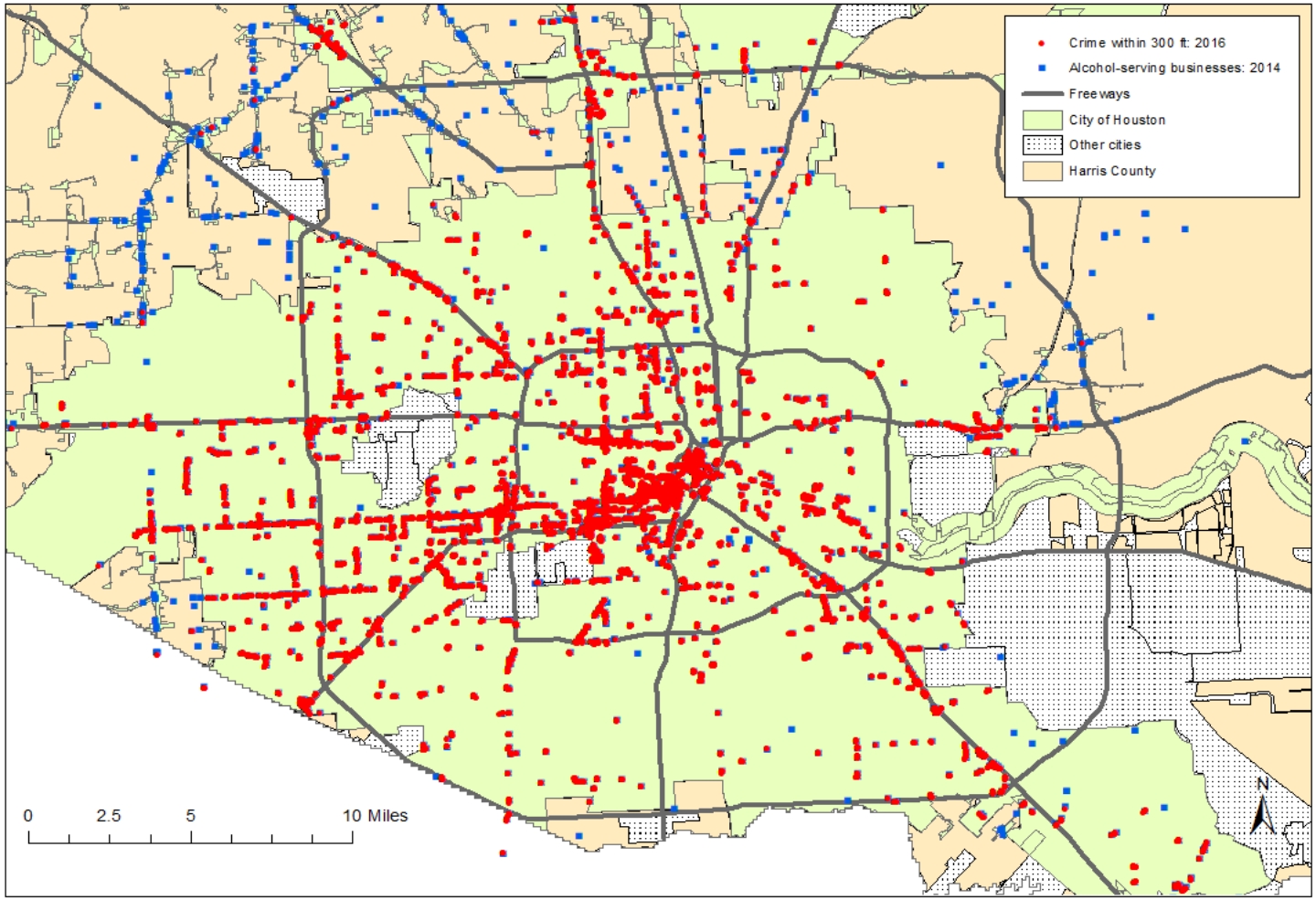
- **Using distance bands around the businesses**
  - ***300 feet/91 meters (approximately one-half block)***
  - ***Band = 3.2% of City's area***

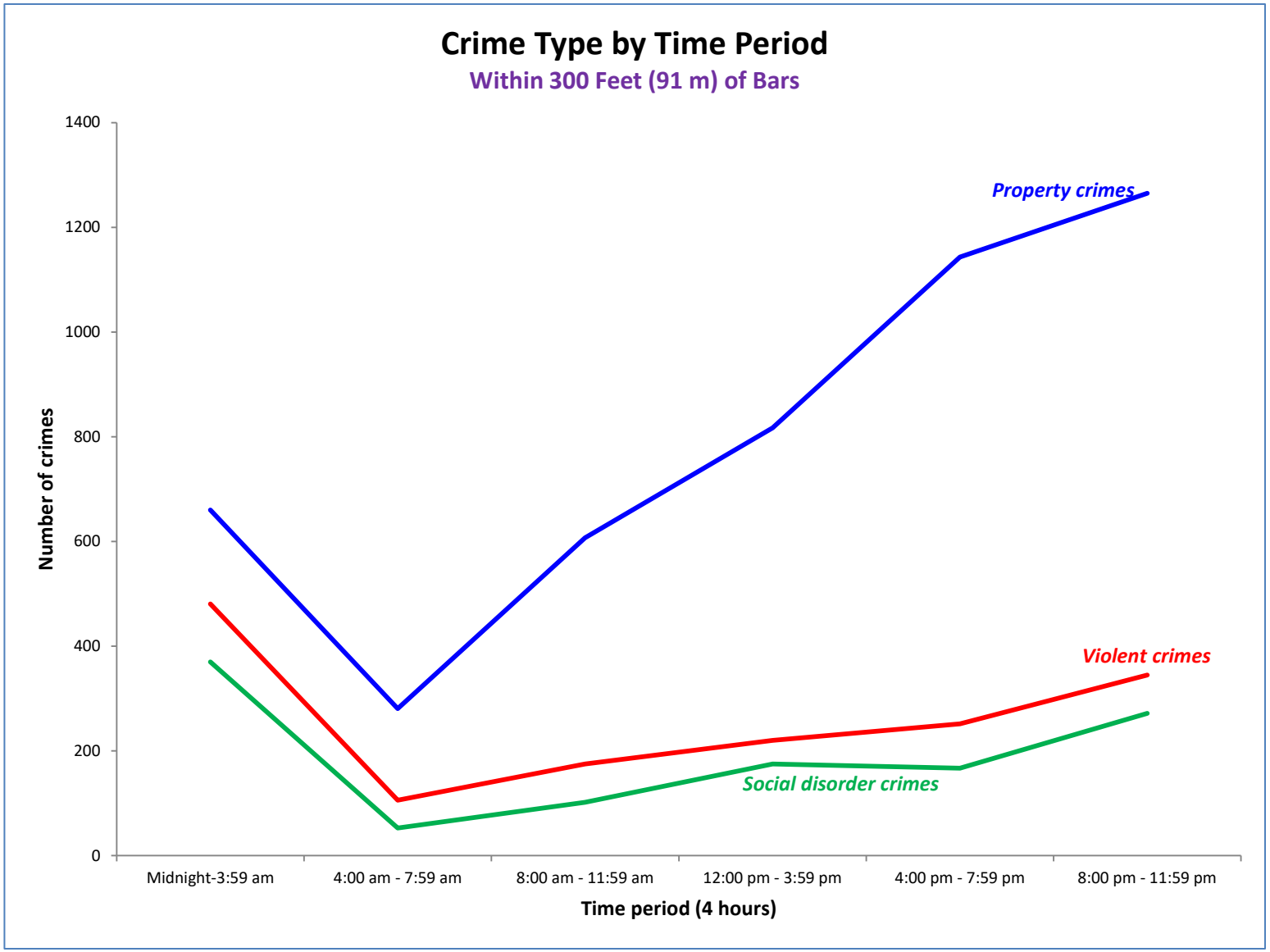
20% of serious crimes occurred within 300 feet of ABO

- **21% of those between Midnight and 3:59 am**

Serious Crimes Near to Alcohol-serving Business: 2016

Within 300 Feet / 91 Meters (N=45,321)




Crime Type by Time Period
Within 300 Feet (91 m) of Bars
1400
1200
1000
800
600
400
200
0
Number of crimes
Property crimes
Violent crimes
Social disorder crimes
Midnight-3:59 am
4:00 am - 7:59 am
8:00 am - 11:59 am
12:00 pm - 3:59 pm
4:00 pm - 7:59 pm
8:00 pm - 11:59 pm
Time period (4 hours)

Crimes Occurring In or Near Alcohol-serving Business Between Midnight – 3:59 am

Within 300 Feet/ 91 m (N=5,965)

Category	Frequency
Assault	1,282
Vehicle burglary/break-in	768
Other theft	575
Burglary	553
Driving while intoxicated *(DWI)*	505
Robbery	412
Vandalism/criminal mischief	365
Drugs	311
Vehicle theft	219
Forgery	174
Drunkenness	162
Disorderly conduct	148
Fraud	139
Weapons	88
Prostitution	80
Juvenile	31
Rape	31
Homicide	10

Problems in Interpreting These Relationships

1. **Whether alcohol was involved:**
   - Perpetrator
   - Victim (for personal crimes)

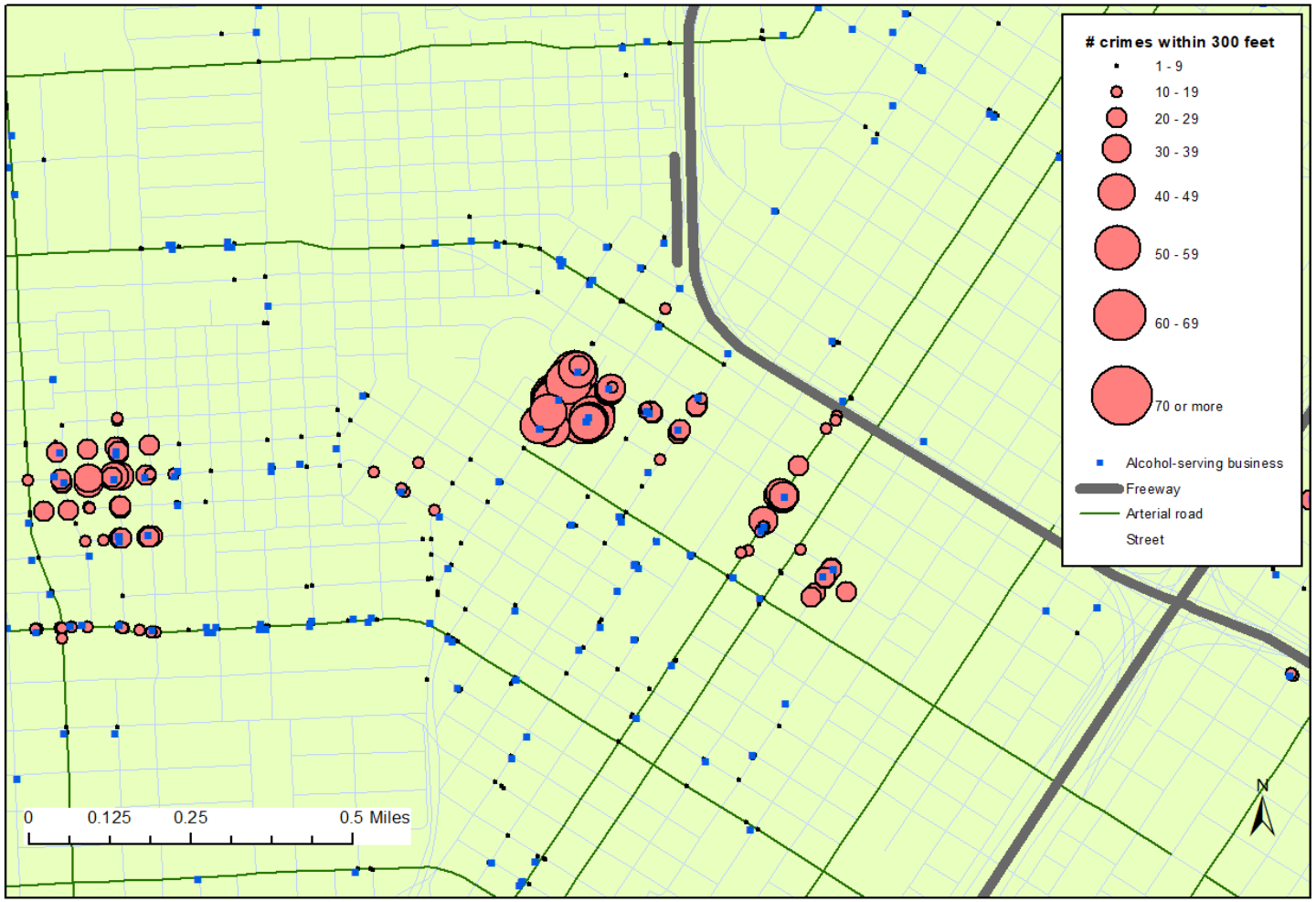
2. **Whether nearest ABO served alcohol to:**
   - Perpetrator
   - Victim (for personal crimes)

3. **Whether ABO was gathering point for perpetrator**

Some ABOs are worse than others in terms of alcohol management

City of Houston Serious Crimes: 2016

Number within 300 Feet of Alcohol-serving Business from Midnight - 3:59 am



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Focus on
Overall Spatial Arrangement of Alcohol-serving Businesses

Alcohol-related Vehicle Crashes and Alcohol-Serving Businesses

Synonyms

Drunk driving
Driving while intoxicated *(DWI)*
Driving under the influence *(DUI)*
Operating a vehicle under the influence of alcohol *(OVI)*
Operating while impaired *(OWI)*

Legal Alcohol Limit for Driving

Blood Alcohol Concentration (BAC)

(g. of alcohol/100 ml of blood)

Texas: 0.08 for adult drivers *(21+)*
0.04 for commercial drivers
0.00 for minors

In most U.S. states	0.08 for adults
England & Wales	0.08 " "
Scotland	0.05 " "
Sweden	0.02 " "
Some countries have	0.00 " "

Seriousness of Alcohol-related Crashes: 2012-14

N=3,154 alcohol-related crashes

295 fatalities ***(0.094 per crash)***

1,795 injuries ***(0.6 per crash)***

1,891 property damage only crashes ***(60%)***

65 involved pedestrians under the influence of alcohol

Compared to:

N=138,709 Non-alcohol-related crashes

722 fatalities ***(0.005 per crash)***

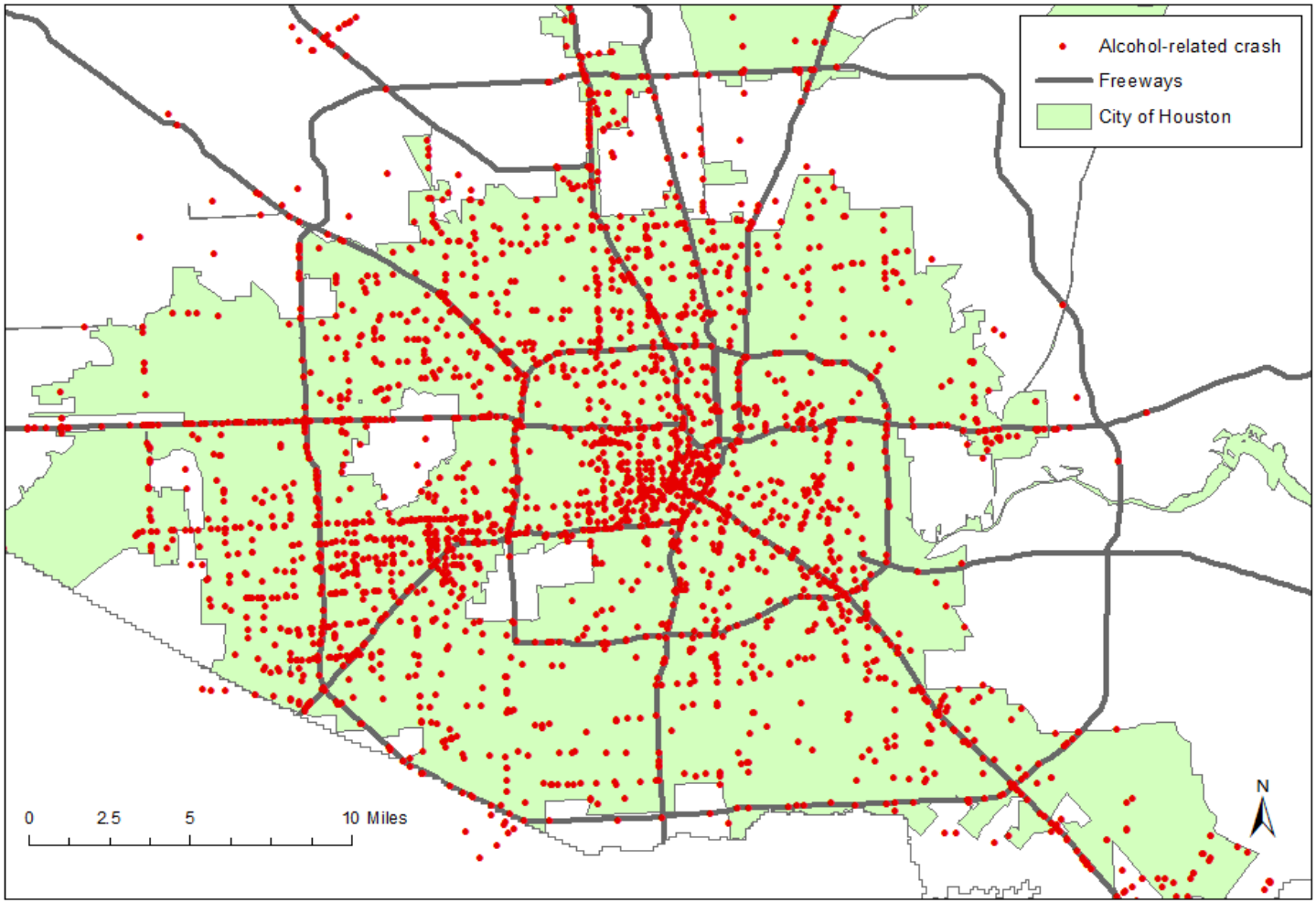
74,237 injuries ***(0.5 per crash)***

89,631 property damage only crashes ***(65%)***

3564 involved pedestrians <u>not</u> under the influence of alcohol

City of Houston Alcohol-related Crashes: 2012-14

Location of Crash



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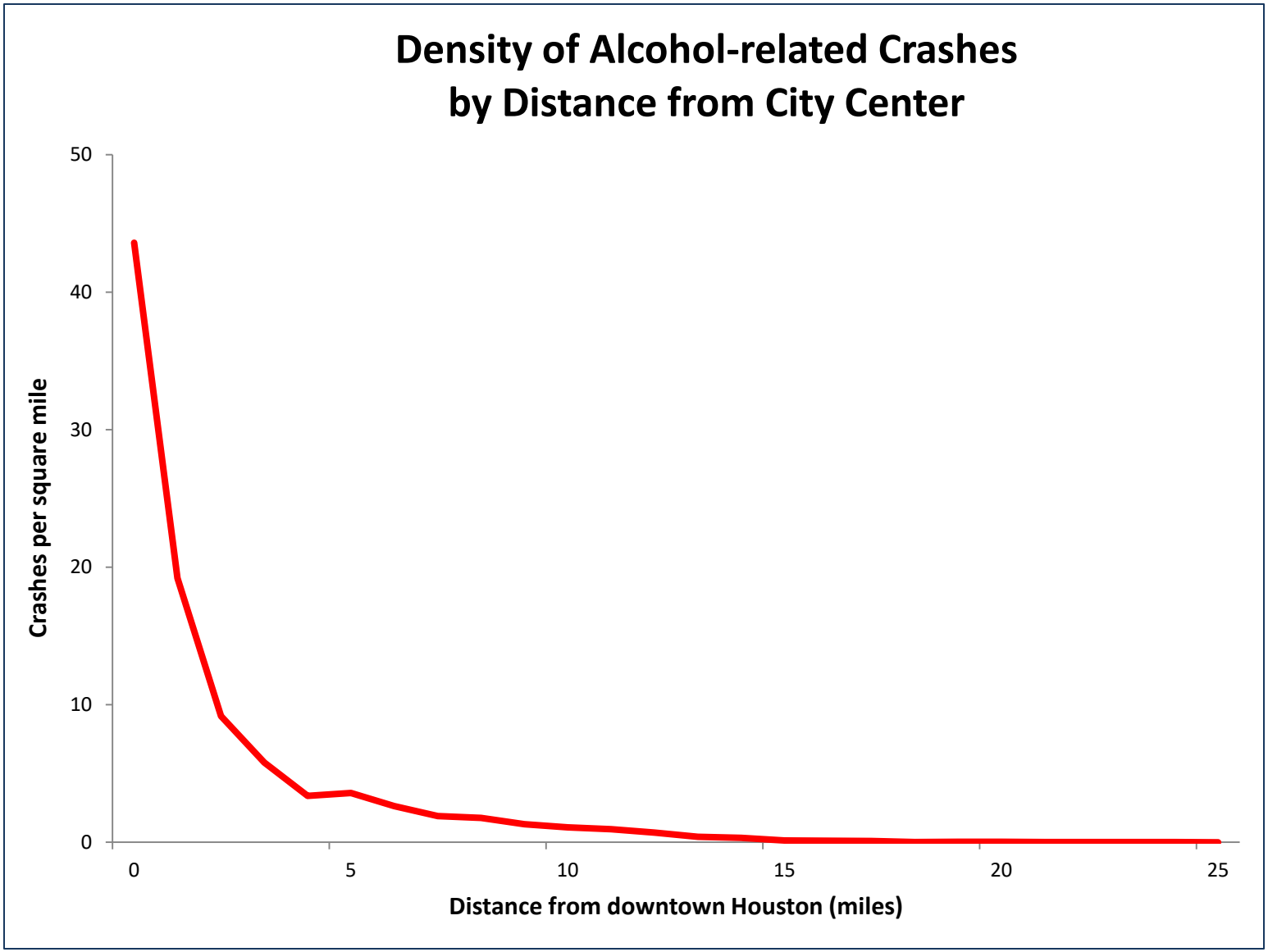

Density of Alcohol-related Crashes
by Distance from City Center
Crashes per square mile
50
40
30
20
10
0
0
5
10
15
20
25
Distance from downtown Houston (miles)

ABO Clusters Account for Many Alcohol-related Crashes
(but not all)

Of the 3,154 alcohol related crashes:

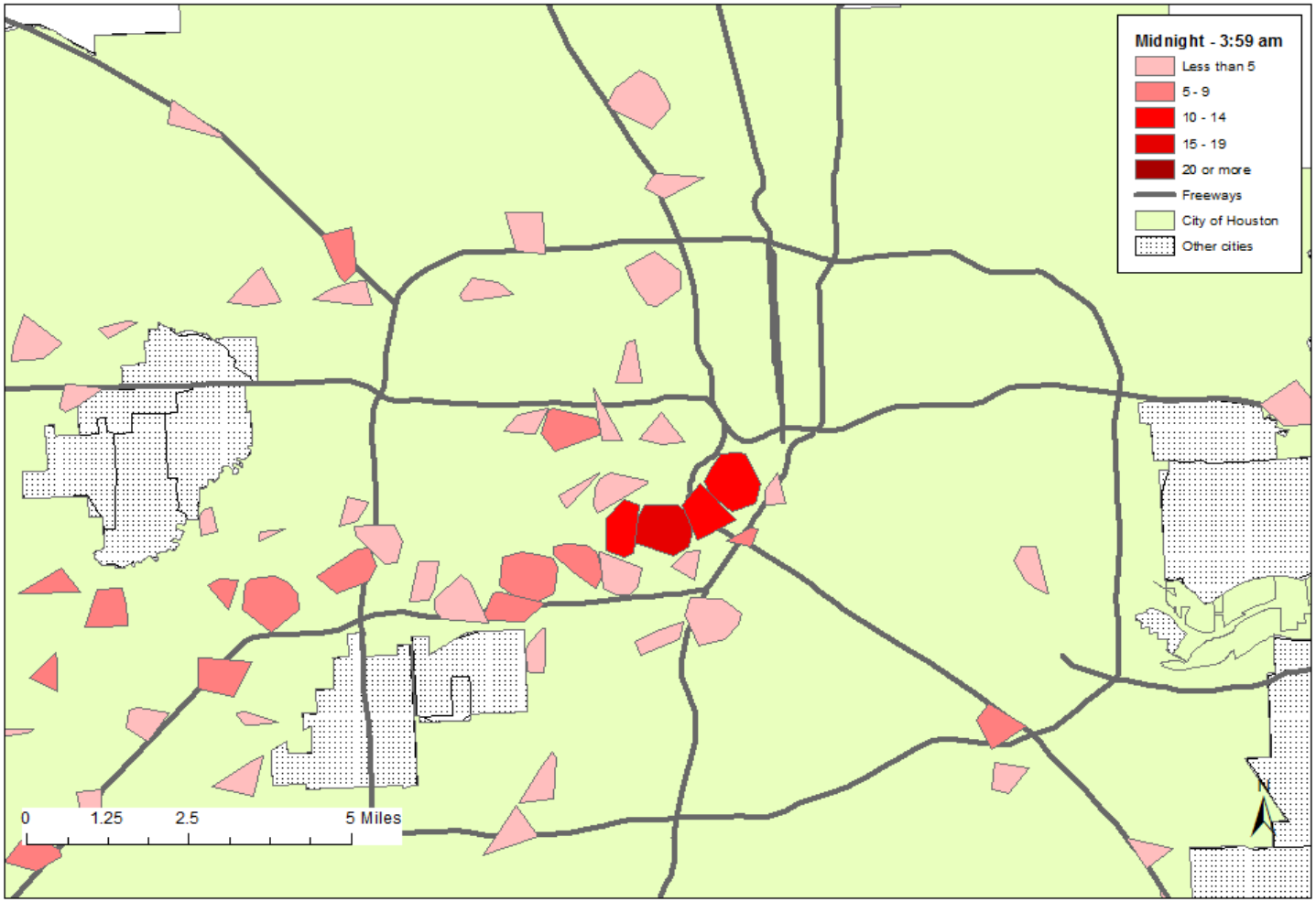
527 *(17%)* occurred within a cluster

1,078 *(34%)* occurred within 0.25 miles (402 m) of a cluster

Pattern Varies by Time of Day

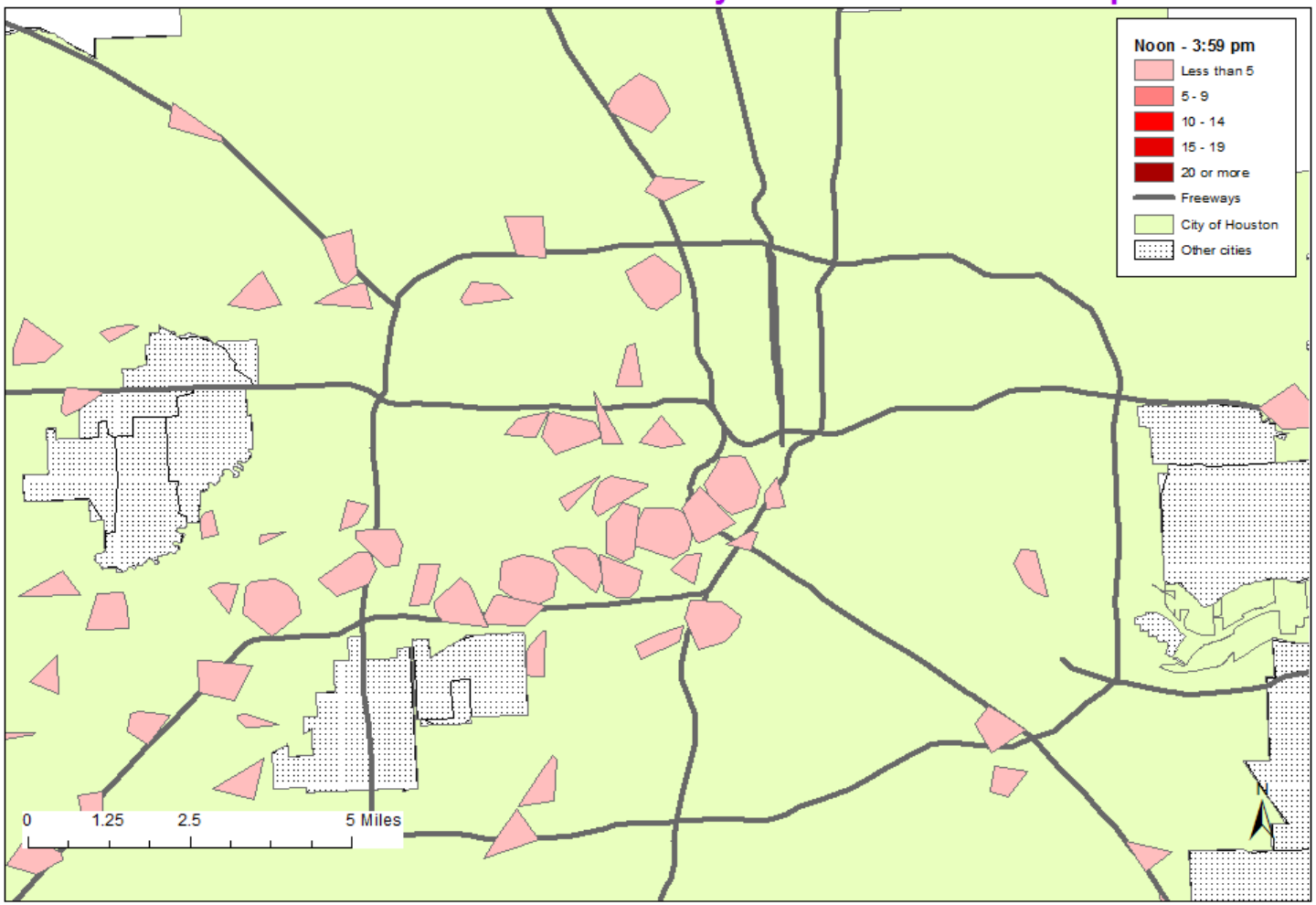
Alcohol-related Crashes and Alcohol-serving Outlets: 2012-14

Number of Alcohol-related Crashes by Clusters: Midnight - 3:59 am

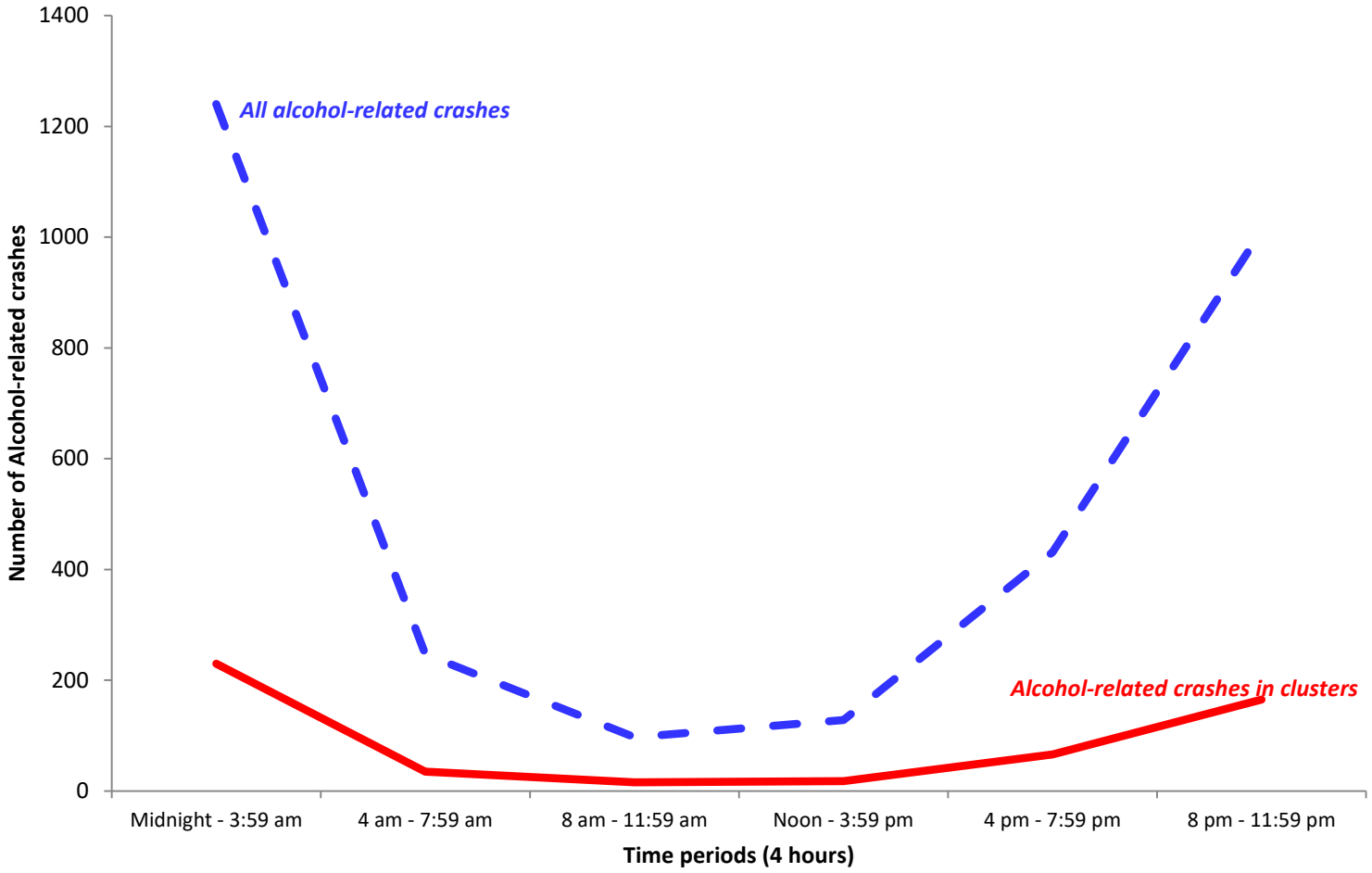


Alcohol-related Crashes and Alcohol-serving Outlets: 2012-14

Number of Alcohol-related Crashes by Clusters: Noon - 3:59 pm



Alcohol-related Crashes by Time Period: All & In Clusters



Crashes in Clusters Approximate Total Distribution

Proportionately more alcohol-related crashes occur at night than captured by the ABO clusters

Some crashes related to drinking at ABOs not in a cluster

Some related to drinking elsewhere

Police enforcement is concentrated around clusters and appears to reduce numbers in those areas

Problems in Interpreting These Relationships

1. **Whether driver was drinking at an ABO or elsewhere**

2. **Whether nearest ABO served alcohol to driver**

Modeling the Relationship between Alcohol-serving Businesses and Alcohol-related Crashes

Apply systematic approach

Examined Relationship on Major Road Segments

Major segments account for bulk of traffic

Including all segments would dilute model

Major Road Segments

Roadway Modeling Network

4,688 Major road segments

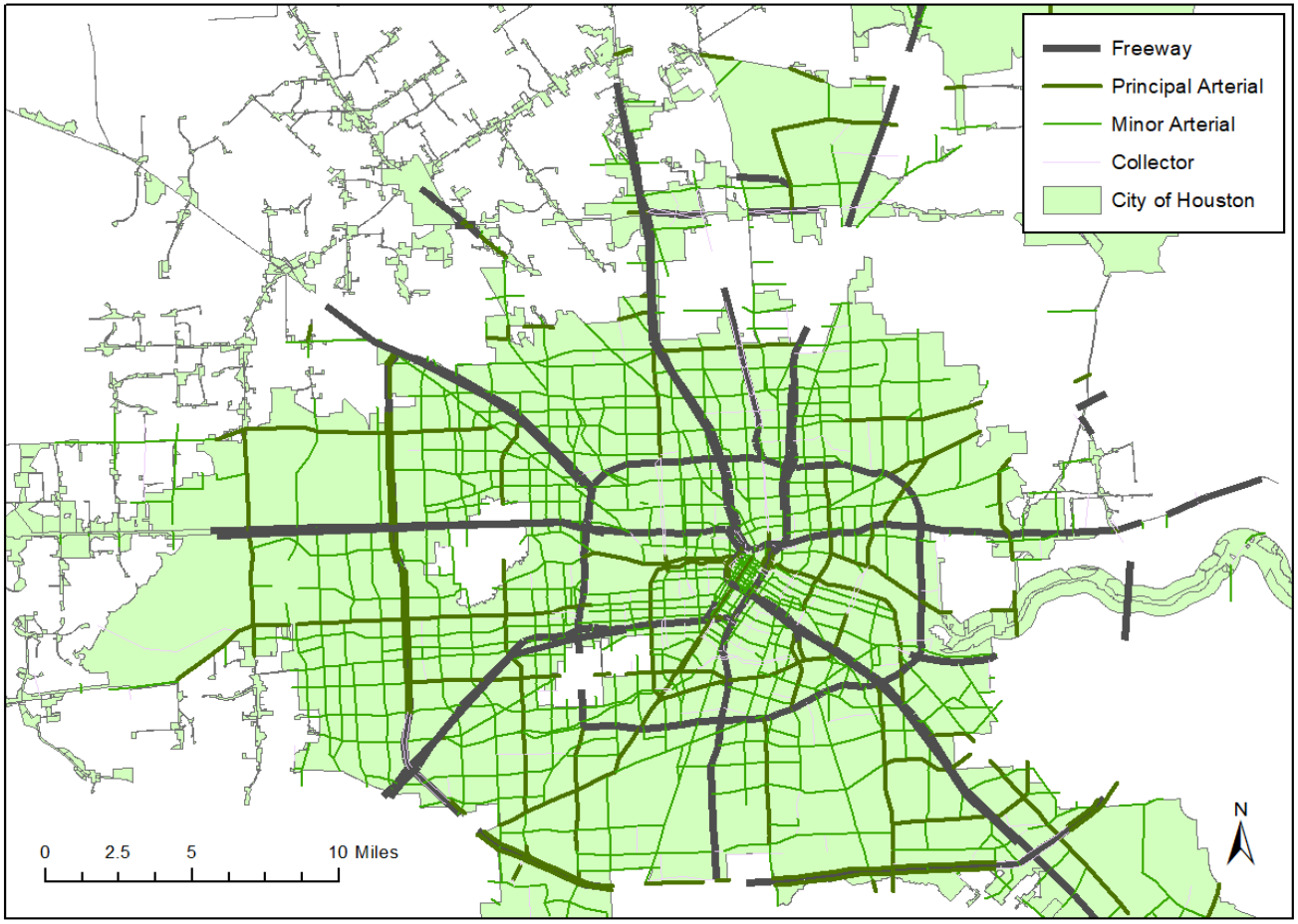
- Freeways
- Principal arterial roads
- Minor arterial roads
- Collector roads

Does not include neighborhood streets

75 foot buffer from centerline

City of Houston Modeling Network

N = 4,688 segments



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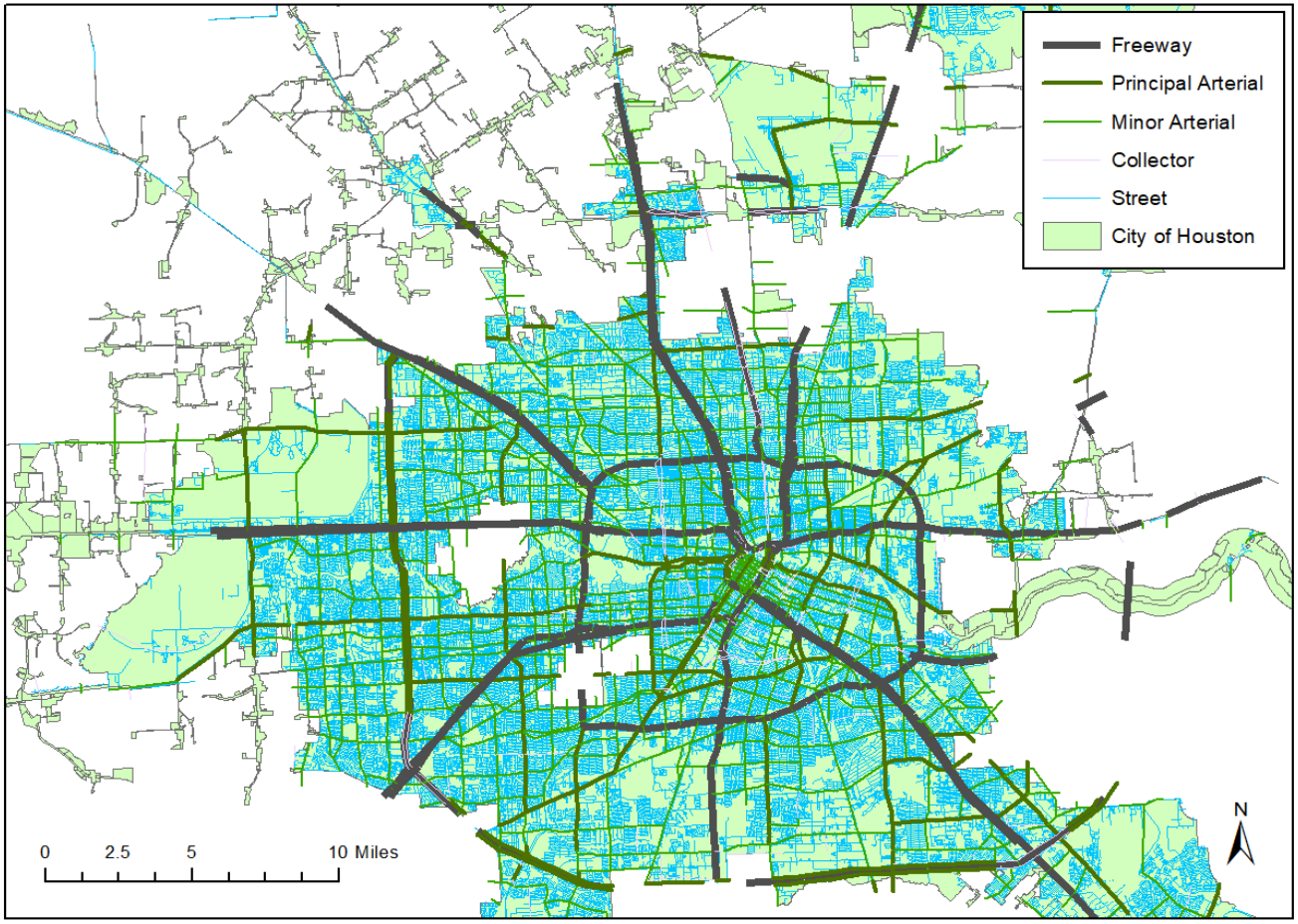
All City of Houston Roads

N = 141,911 segments

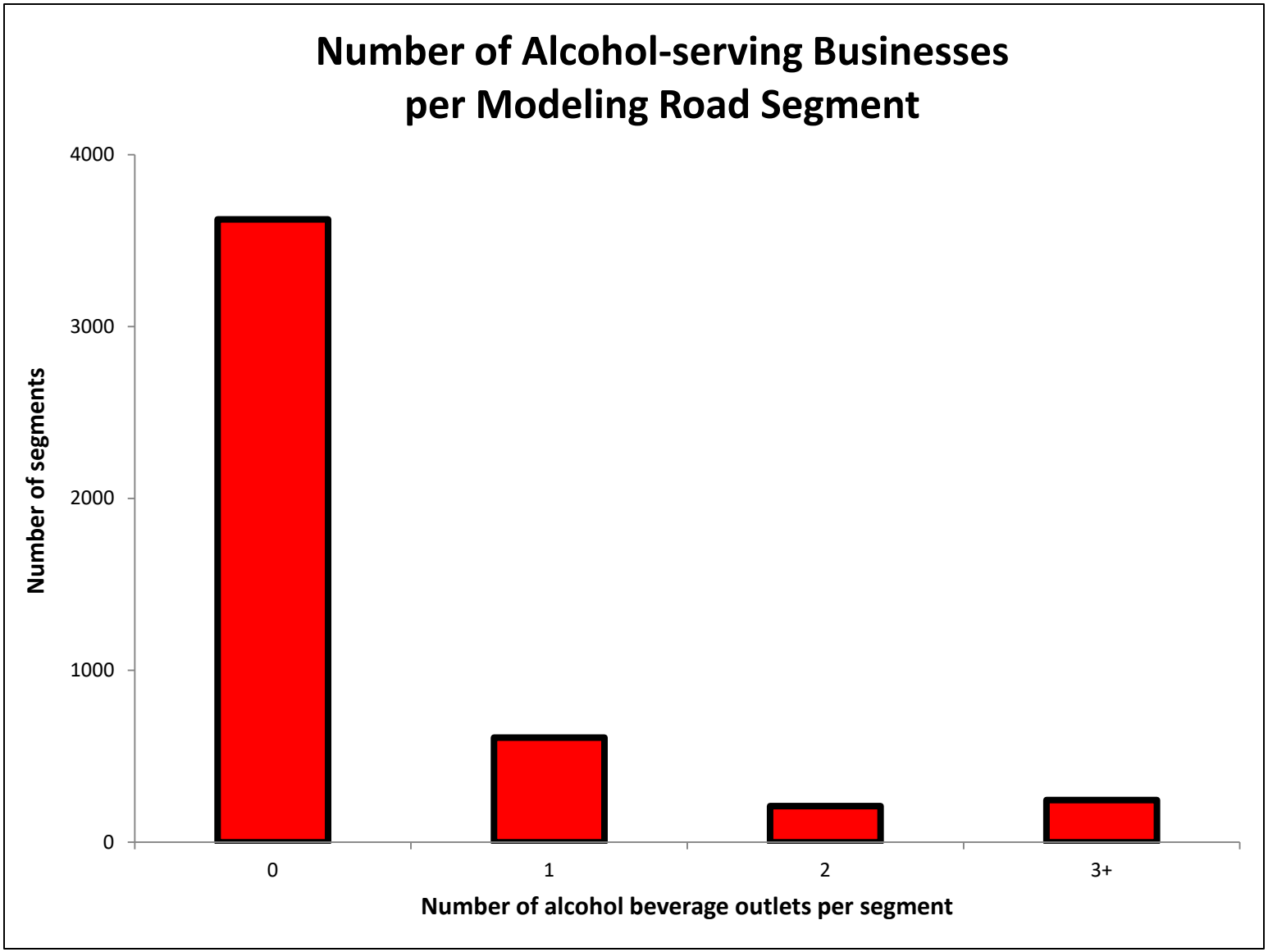


Assign ABOs to Modeling Network

2,174 *(66%)* within 75' *(23 m)* buffer along major road segments

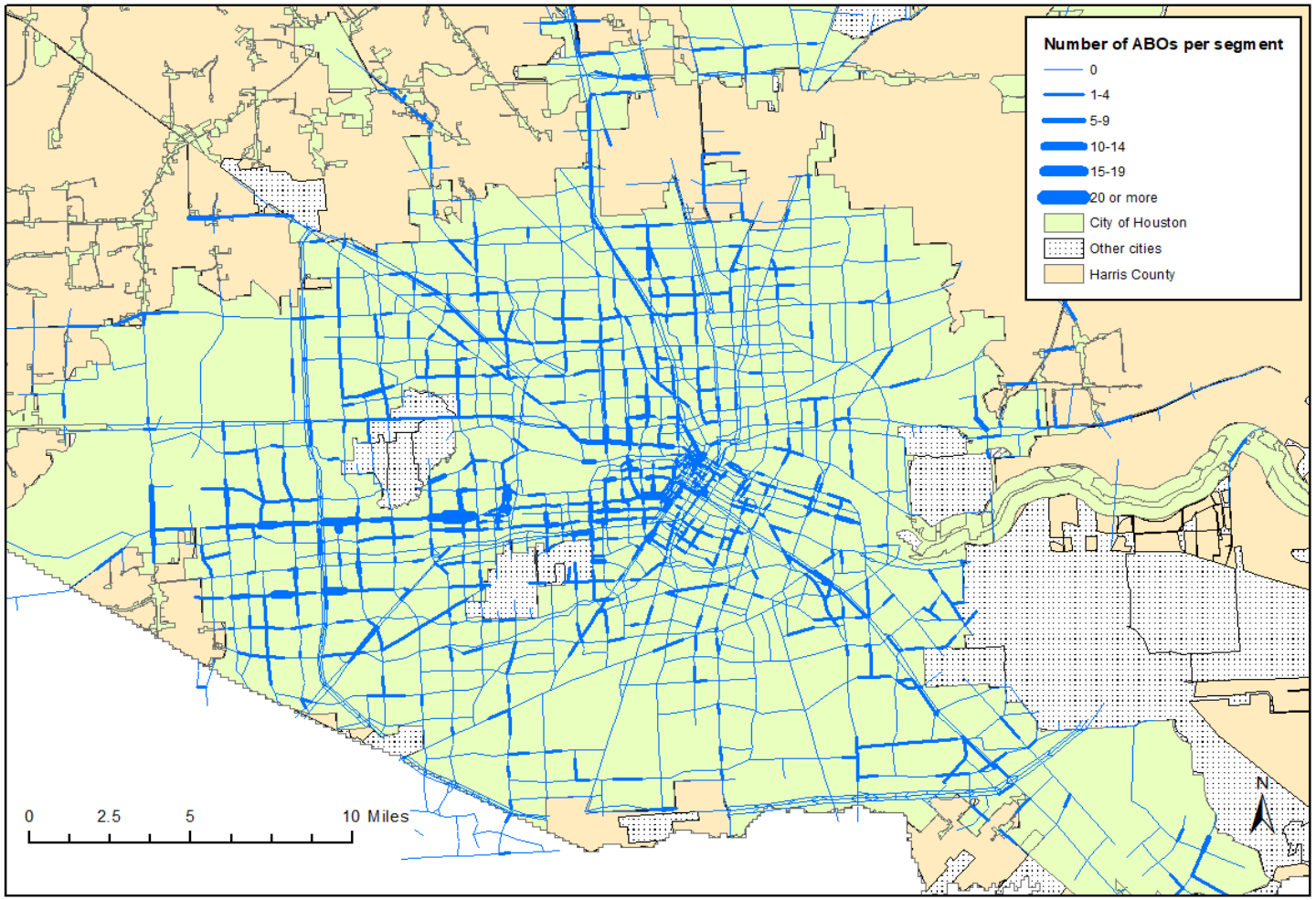
But, extremely skewed

23% of the segments had 1+ ABOs while 77% had 0


Number of Alcohol-serving Businesses per Modeling Road Segment
4000
3000
2000
1000
0
Number of segments
0
1
2
3+
Number of alcohol beverage outlets per segment

Alcohol-serving Businesses on Roadway Network

Number Per Segment (N=4,688)



Assigned Alcohol-related Crashes to Modeling Network

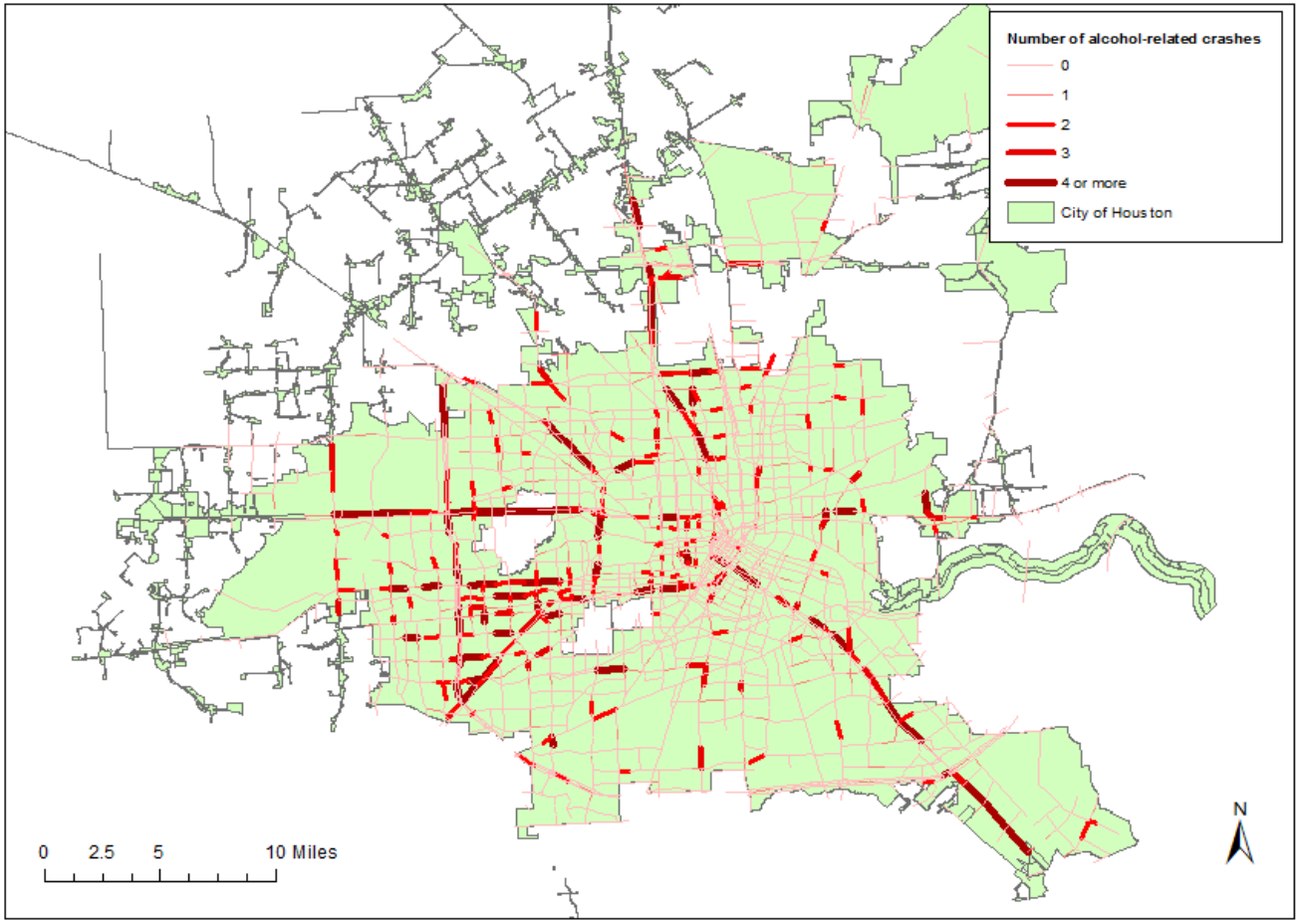
2,267 *(72%)* within 75' *(23 m)* buffer along major road segments

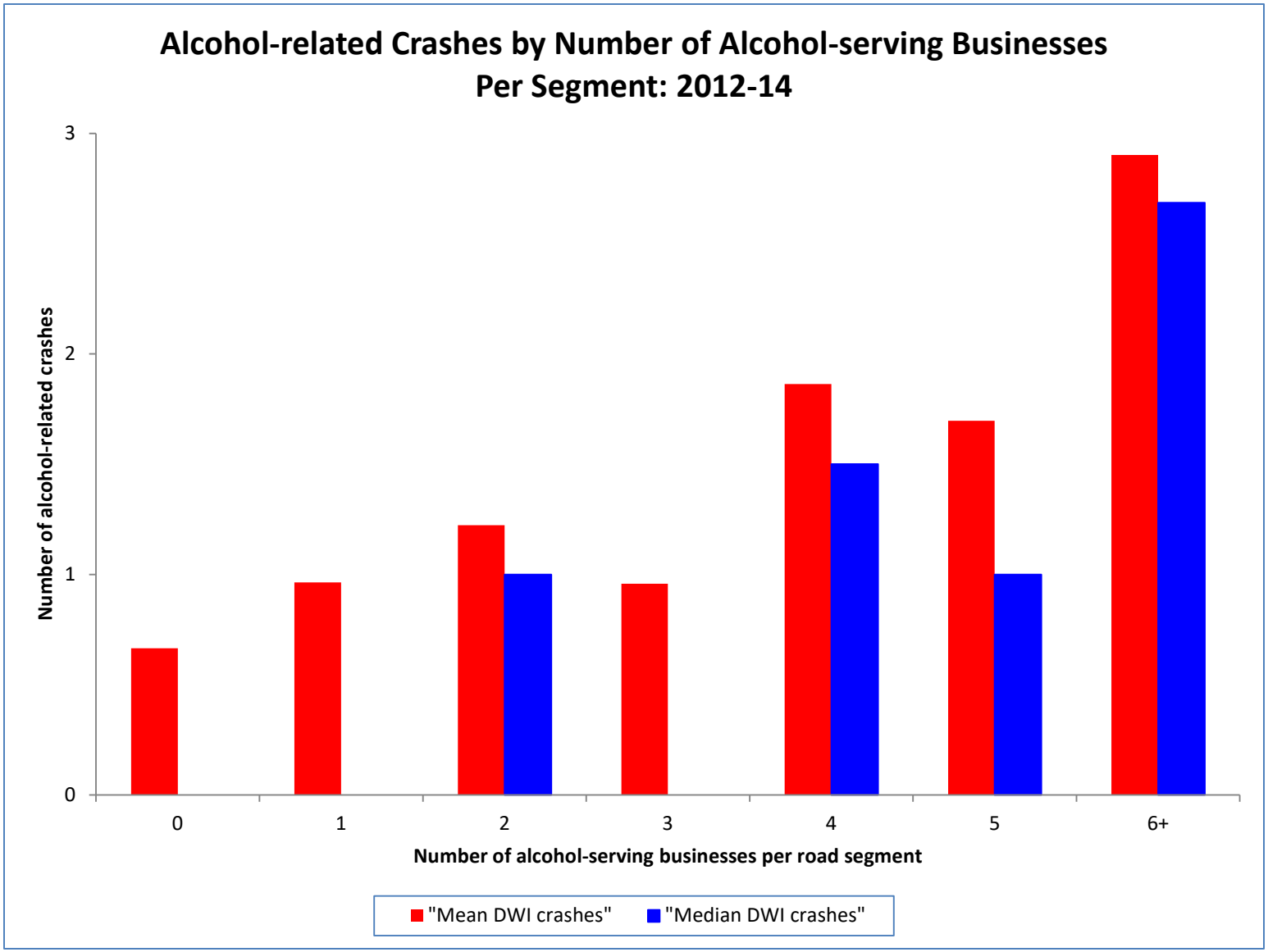
But, also extremely skewed

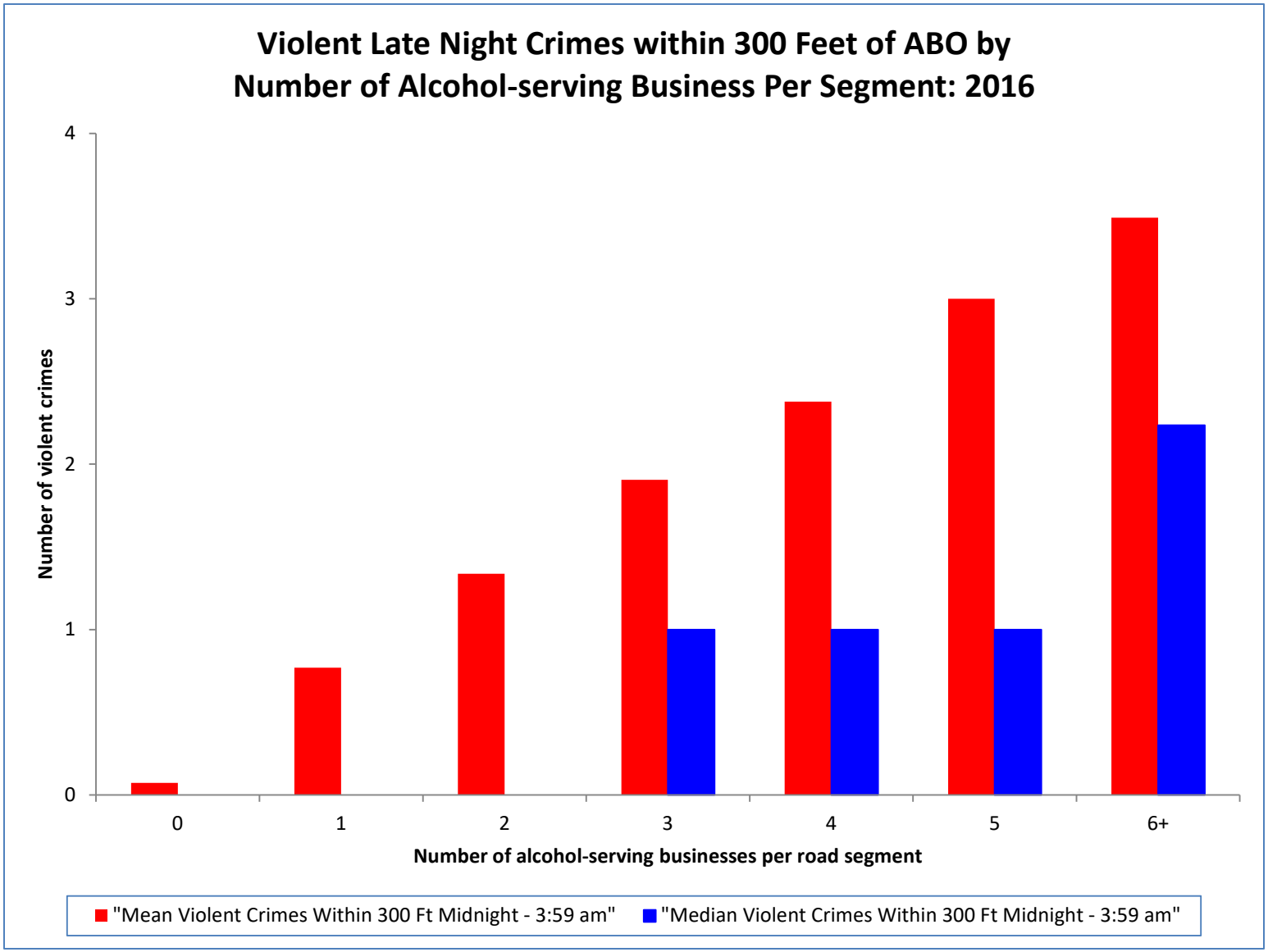
***38%* of the segments had 1+ crashes while 62% had 0 crashes**

Alcohol-related Crashes on Modeling Network

Number per Segment (N=4,688)

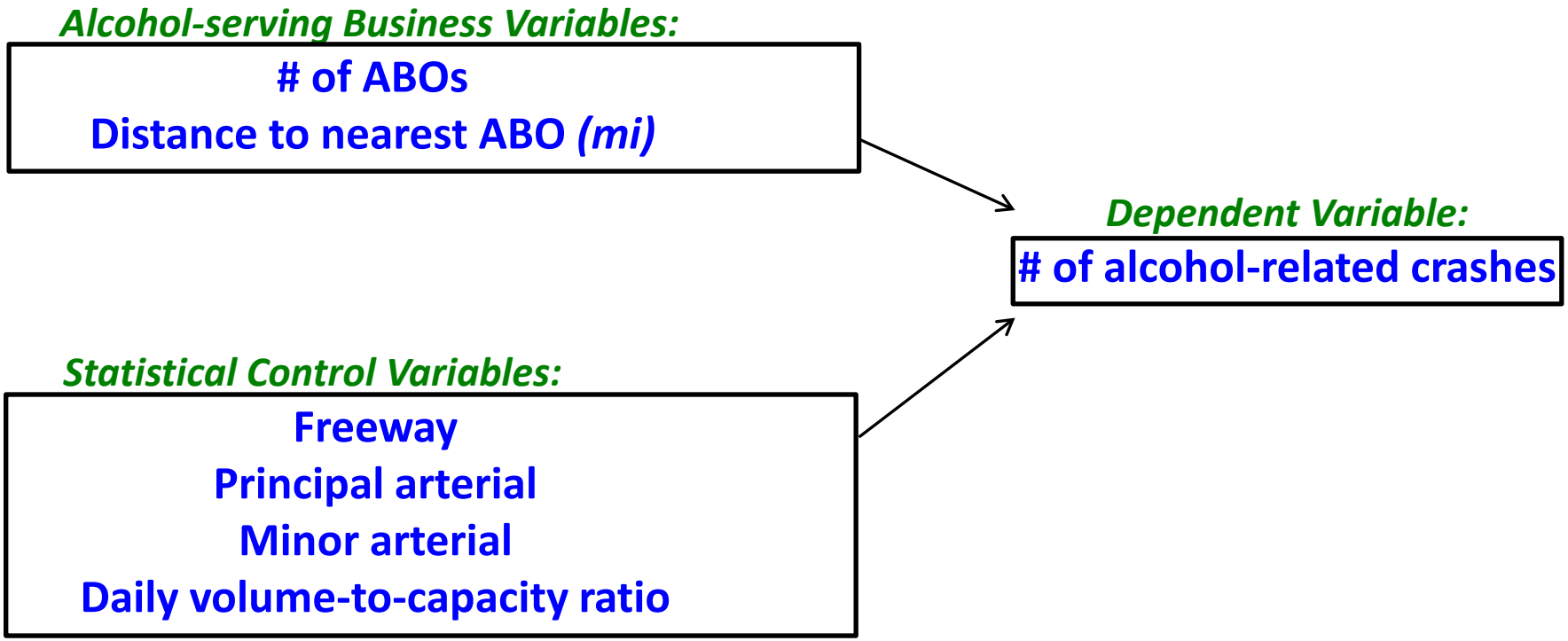



Alcohol-related Crashes by Number of Alcohol-serving Businesses Per Segment: 2012-14
Number of alcohol-related crashes
0
1
2
3
0
1
2
3
4
5
6+
Number of alcohol-serving businesses per road segment
"Mean DWI crashes"
"Median DWI crashes"


Violent Late Night Crimes within 300 Feet of ABO by Number of Alcohol-serving Business Per Segment: 2016
Number of violent crimes
0
1
2
3
4
0
1
2
3
4
5
6+
Number of alcohol-serving businesses per road segment
"Mean Violent Crimes Within 300 Ft Midnight - 3:59 am"
"Median Violent Crimes Within 300 Ft Midnight - 3:59 am"

Formal Model of Late Night Alcohol-related Crashes

By Modeling Segment



Modeled by 4 Hour Time Periods

Poisson-Lognormal-CAR Model

Mixed Function Model

Mean modeled with Poisson distribution

Used for rare events

$$y_i|\lambda_i \sim Poisson(\lambda_i)$$

$$\lambda_i = e^{(x_i^K\beta+\phi_i+\varepsilon_i)} = e^{(x_i^K\beta+\phi_i)} \cdot \xi_i = e^{(x_i^K\beta)} \cdot \Upsilon_i \cdot \xi_i$$

Dispersion modeled with Lognormal distribution

Gamma unreliable with low sample mean

Error term, $\xi_i = e^{\varepsilon_i}$, follows lognormal with mean=0 and variance as inverse gamma

Spatial autocorrelation in residuals modeled with Conditional Autoregressive (CAR) term

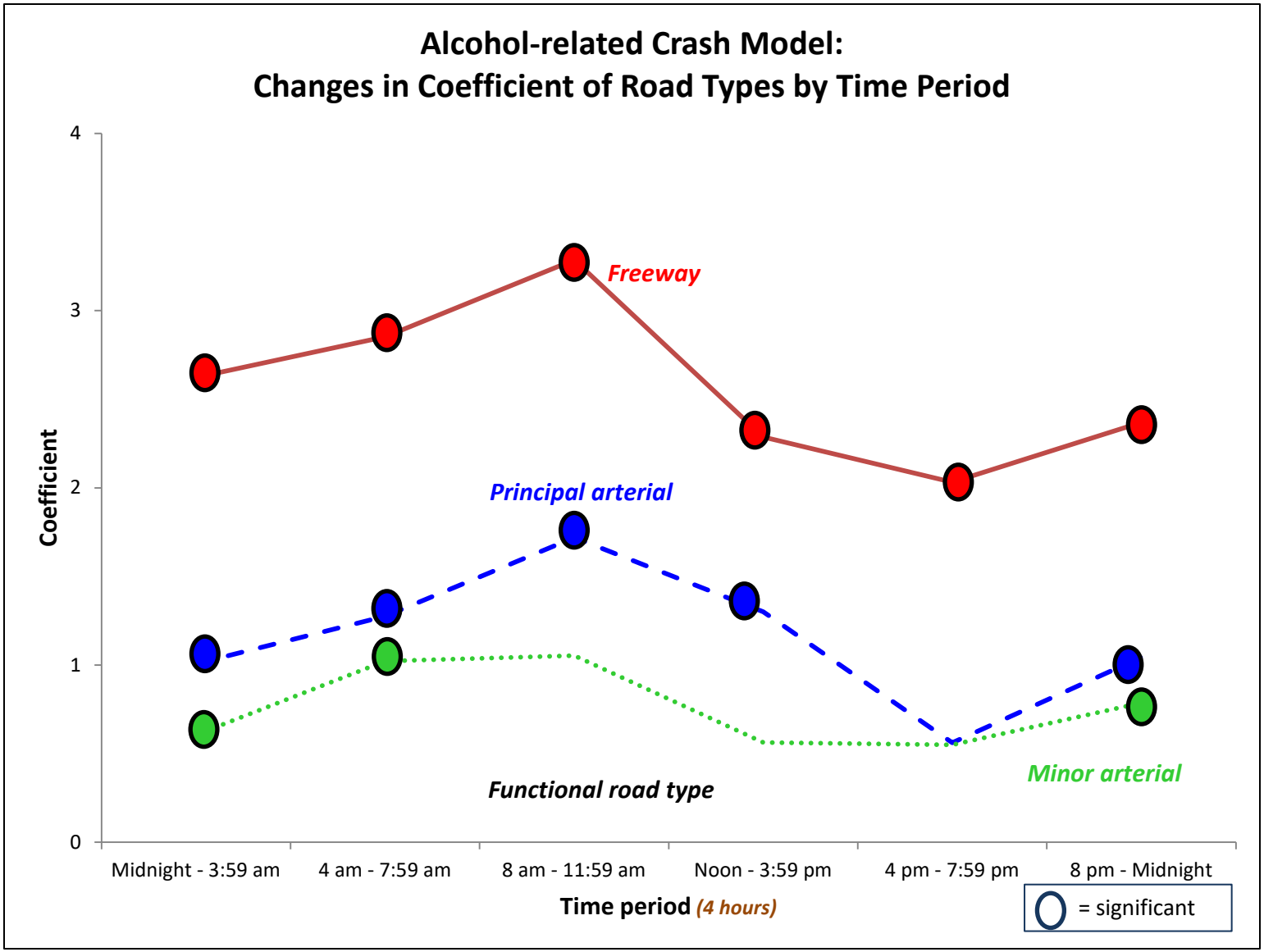
Segment-specific adjustment, $\Upsilon_i = e^{\phi_i}$

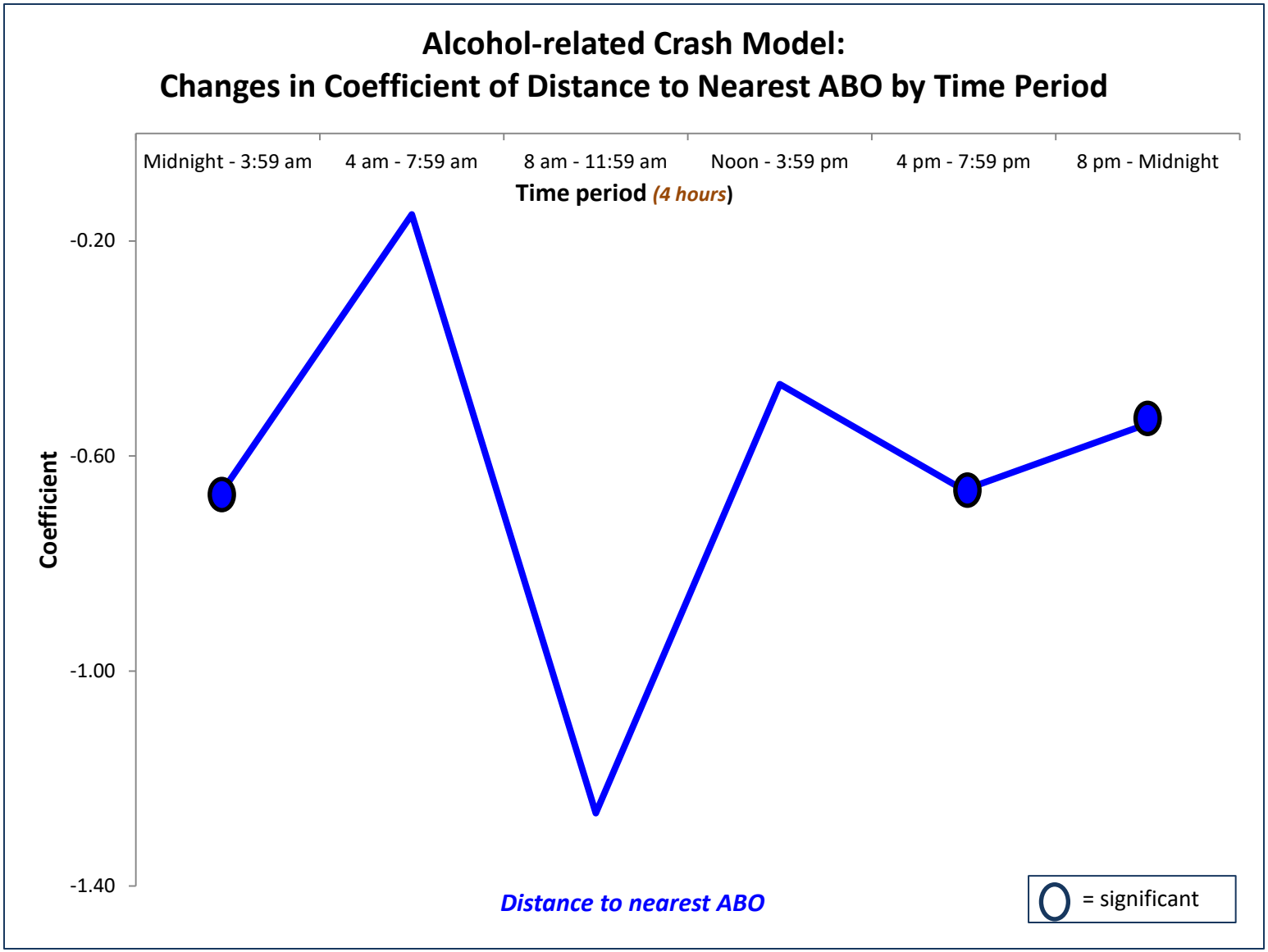
with mean ≈ 0

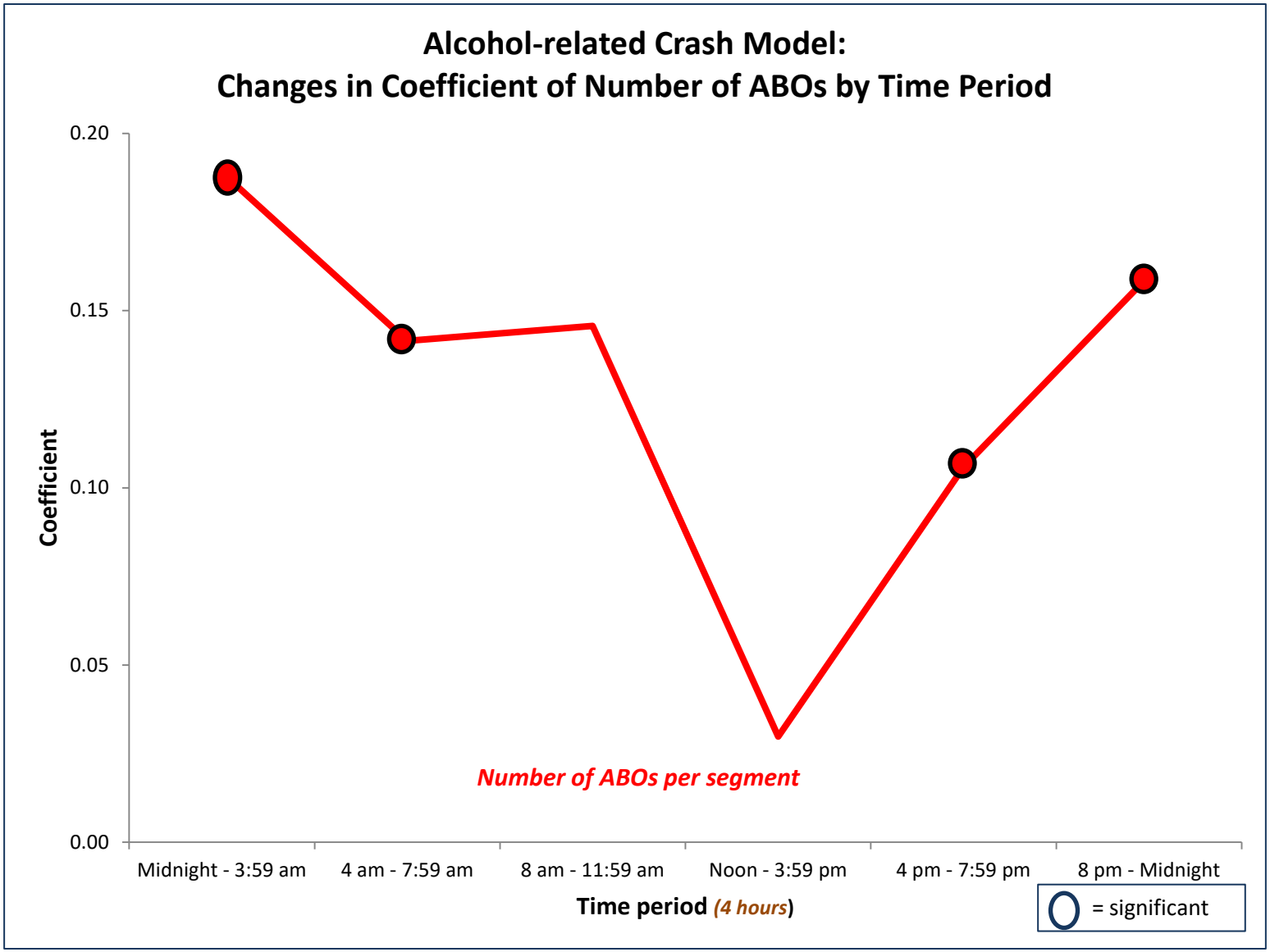
Markov Chain Monte Carlo (MCMC) Simulation

1. Tested with MCMC method in CrimeStat IV
2. Simulation run with 200,000 iterations
3. First 100,000 iterations dropped *('burn in')*
4. Results based on last 100,000 iterations

Model Run for Six Four-hour Time Periods

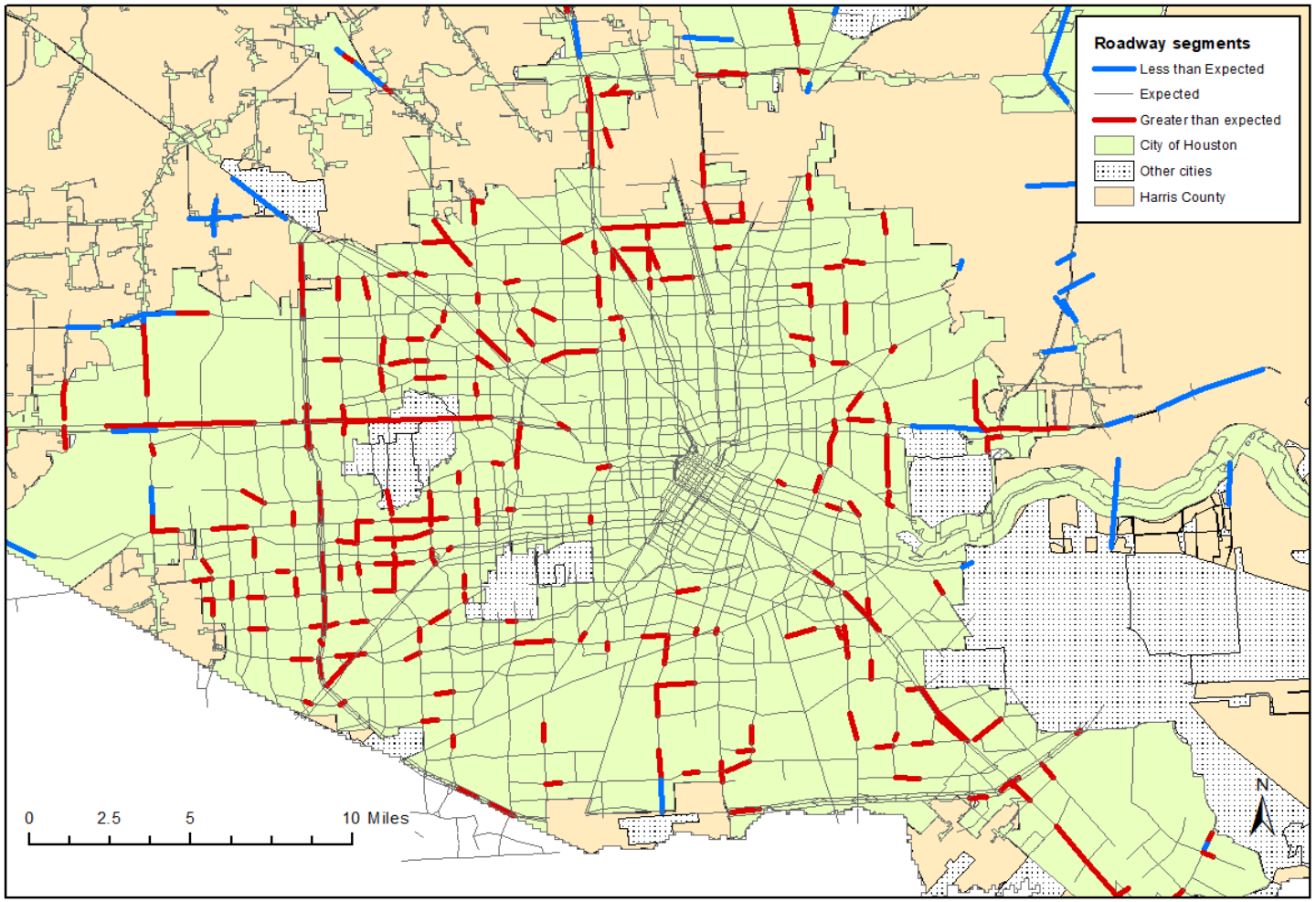

Alcohol-related Crash Model:
Changes in Coefficient of Road Types by Time Period
Coefficient
4
3
2
1
0
Freeway
Principal arterial
Minor arterial
Functional road type
Midnight - 3:59 am
4 am - 7:59 am
8 am - 11:59 am
Noon - 3:59 pm
4 pm - 7:59 pm
8 pm - Midnight
Time period (4 hours)
= significant


Alcohol-related Crash Model:
Changes in Coefficient of Distance to Nearest ABO by Time Period
Midnight - 3:59 am
4 am - 7:59 am
8 am - 11:59 am
Noon - 3:59 pm
4 pm - 7:59 pm
8 pm - Midnight
Time period (4 hours)
-0.20
-0.60
-1.00
-1.40
Coefficient
Distance to nearest ABO
= significant


Alcohol-related Crash Model:
Changes in Coefficient of Number of ABOs by Time Period
0.20
0.15
0.10
0.05
0.00
Coefficient
Number of ABOs per segment
Midnight - 3:59 am
4 am - 7:59 am
8 am - 11:59 am
Noon - 3:59 pm
4 pm - 7:59 pm
8 pm - Midnight
Time period (4 hours)
= significant

Modeled Alcohol-related Vehicle Crashes: 2014

Segments Greater than and Less than Expected: Midnight - 3:59 am



Ned Levine, PhD
Alcohol-serving businesses as risky places

Conclusions

1. **Alcohol-serving businesses (ABO) concentrated spatially, both globally and locally *(clusters)***

2. **Many crimes and alcohol-related crashes *appear* to be related to these businesses**

3. **Alcohol business concentration *appears* to increase alcohol-related crashes *(and most likely crimes)* late at night**

Reasons Why Concentration Leads to Increased Drunk Driving Crashes and Crime

1. **Self-selection by chronic and recreational drinkers to areas with many ABOs, allowing more choice *(niche markets)***

2. **Features of ABOs in concentrated areas that encourage drinking *(crowds, music, 'bar hopping')***

3. **Competition between nearby ABOs that reduce price of alcohol *('Happy Hour', 'Drink specials')***

4. **Minors are more likely to be served in concentrated ABO clusters**

5. **Market price of ABO licenses *appear* to be much greater in central, concentrated ABO areas than in more peripheral areas**

6. **Degree of concentration is much greater than what can be explained by exclusion of ABOs from residential areas**

Need to Address by Public Policy

Joint problem imposed on local government and communities

- ***Law enforcement***
- ***Emergency medical services***
- ***Hospitals and clinics***
- ***Families***
- ***Community***
- ***Nearby businesses***
- ***Local government***
- ***Public at large***

Policy Dimensions

- **Enforcement** ***(police and other public agencies)***
  - Patrolling alcohol business clusters
  - Monitoring of problems
- **Licensing of alcohol distribution**
  - How many and where? ***(Outlet density)***
  - Certification of owners and employees
  - Management practices for intoxication
  - Restrictions on advertising
- **Alternative transportation**
  - Transit ***(Bus, rail)***
  - Ridesharing ***(Uber, Lyft)***
- **Concentration or dispersion?**
  - Central commercial areas v. local commercial areas
  - Entertainment centers
- **Tax revenues**
- **Education and treatment**
- **Direct costs to government**
- **Nearby businesses & residents**
- **Alcohol industry**
- **Non-profit organizations**

References on
Alcohol-serving Businesses, Crime & Traffic Safety

Ahern, J., Margerison-Zilko, C., Hubbard, A. & Galea, S. (2013). Alcohol outlets and binge drinking in urban neighborhoods: The implications of nonlinearity for intervention and policy. *American Journal of Public Health*, 103 (4), e1-e7.

Bernasco W. & Block R. L. (2011) Robberies in Chicago: a block-level analysis of the influence of crime generators, crime attractors, and offender anchor points. *J Res Crime Delinq.* 48(1), 33–57.

Block, R. L. & Block, C. R. (1995). A spatial analysis of liquor places. In Eck, J. & Weisburd, D. (eds), *Crime and Place: Crime Prevention Studies,* 4, Criminal Justice Press, Police Executive Research Forum: Washington, DC.

Campbell, C. A., Hahn, R. A., Elder, R., Brewer, R., Chattopadhyay, S., Fielding, J., Naimi, T. S., Toomey, T., Lawrence, B., Middleton, J. C. & Task Force on Community Preventive Services (2009). The effectiveness of limiting alcohol outlet density as a means of reducing excessive alcohol consumption and alcohol-related harms. *Am. J. Prev. Med.,* Dec 37 (6), 556-69.

Cannon, C. & Carmona, M. (2006). *Alcohol and Violent Crime: What is the Connection? What can be Done?* Report by the National Center for Alcohol Law Enforcement for The Bureau of Justice Assistance: Washington, DC. http://www.nllea.org/documents/Alcohol_and_Crime.pdf.

CDC (2020). *Impaired Driving.* Centers for Disease Control, U.S. Department of Health and Human Services: Washington, DC. https://www.cdc.gov/transportationsafety/impaired_driving/index.html

Donnelly, N., Poynton, S., Weatherburn, D., Bamford, E., & Nottage, J. (2006). Liquor outlet concentrations and alcohol-related neighbourhood problems. *Alcohol Studies Bulletin* (Vol. 8, pp. 15): New South Wales. Bureau of Crime Statistics and Research.

Erickson, D. J., Carlin, B. P., Lenk, K.M., Quick, H.S., Harwood, E. M., & Toomey, T. L. (2015). Do Neighborhood Attributes Moderate the Relationship between Alcohol Establishment Density and Crime? *Prev. Sci*. Feb, 16 (2):254-64. doi: 10.1007/s11121-013-0446-y.

Franklin, FA II, LaVeist, T. A., Webster, D. W. & Pan, W.K.(2010). Alcohol Outlets and Violent Crime in Washington D.C. *Western Journal of Emergency Medicine*, XI (3), 283-290.
http://emorycenterforinjurycontrol.org/static/uploads/WestJEM-VolumeXI-Issue3-FINAL_8-20-10.pdf

Groff, E. (2014). Quantifying the exposure of street segments to drinking places nearby. *Journal of Quantitative Criminology*, 30: 527. doi:10.1007/s10940-013-9213-2

Gruenewald, P.J. (2011). Regulating availability: How access to alcohol affects drinking and problems in youth and adults. *Alcohol Research & Health*, 34 (2), 248-256.

References on Alcohol-serving Businesses *(continued)*

Gruenewald, P. J., Remer, L. G., & Treno, A. J. (2009). Report 1 Alcohol outlets, crime, and disorder in the United States of America. In P. Hadfield (ed), *Nightlife and Crime: Social Order and Governance in International Perspective.* Oxford University Press: Oxford.

Jernigan, D. H., Sparks, M., Yang, E., & Schwartz, R. (2013). Using public health and community partnerships to reduce density of alcohol outlets. *Preventing Chronic Diseases,* 10, Centers for Disease Control and Prevention: Atlanta, GA. http://www.cdc.gov/pcd/issues/2013/12_0090.htm.

Levine, N. (2017). The Location of late night bars and alcohol-related crashes in Houston, Texas. *Accident Analysis & Prevention*. 107, 152-163. http://www.sciencedirect.com/science/article/pii/S0001457517301732

Levine, N. & Canter, P. (2011). Linking origins with destinations for DWI Motor Vehicle Crashes: An application of crime travel demand modeling. *Crime Mapping*, 3, 7-41.

MDCH (2011). The Association of Increased Alcohol Outlet Density & Related Harms Summary of Key Literature. Report by Bureau of Disease Control, Prevention & Epidemiology, Michigan Department of Community Health. October 25. https://www.michigan.gov/documents/mdch/Outlet_Density_Associated_Harms_Summary-3.10.2011_373894_7.pdf

NHTSA (2019). *Alcohol-impaired Driving*. *Traffic Safety Facts*, National Highway Traffic Safety Administration, U.S. Department of Transportation: Washington, DC. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812864

Ratcliffe, J. H. (2012). The spatial extent of criminogenic places on the surrounding environment: a change-point regression of violence around bars. Geogr. Anal. 44(4):302–320.

Snyder, H. N., Rand, M. R. & Sabol, W. J. (2010). *Alcohol and Crime: Data from 2002 to 2008*. Bureau of Justice Statistics, U.S. Department of Justice: Washington, DC. https://www.bjs.gov/index.cfm?ty=pbdetail&iid=5884

Treno, A. J., Johnson, F. W., Remer, L. G., & Gruenewald, P. J. (2007). The impact of outlet densities on alcohol-related crashes: a spatial panel approach. *Accident Analysis & Prevention*, 39(5), 891-901.

WHO (2009). Preventing violence by reducing the availability and harmful use of alcohol. World Health Organization: Geneva. https://www.who.int/violence_injury_prevention/violence/alcohol.pdf

WHO (1994). Lexicon of alcohol and drug terms published by the World Health Organization. World Health Organization: Geneva. https://www.who.int/substance_abuse/terminology/who_lexicon/en/

Extra Slides

CrimeStat IV

http://www.nij.gov/CrimeStat

Alcohol Misuse and Excess

Centers for Disease Control & Prevention (U.S.)

Alcohol Misuse

More than 1 drink per day, on average (women)

More than 2 drinks per day, on average (men)

Binge drinking

4 or more drinks during single occasion (women)

5 or more drinks during single occasion (men)

National Institute on Alcohol Abuse & Alcoholism (U.S.)

Alcohol Misuse

More than 3 drinks per day (women)

More than 4 drinks per day (men)

Alcohol Excess

More than 7 drinks per week (women)

More than 14 drinks per week (men)

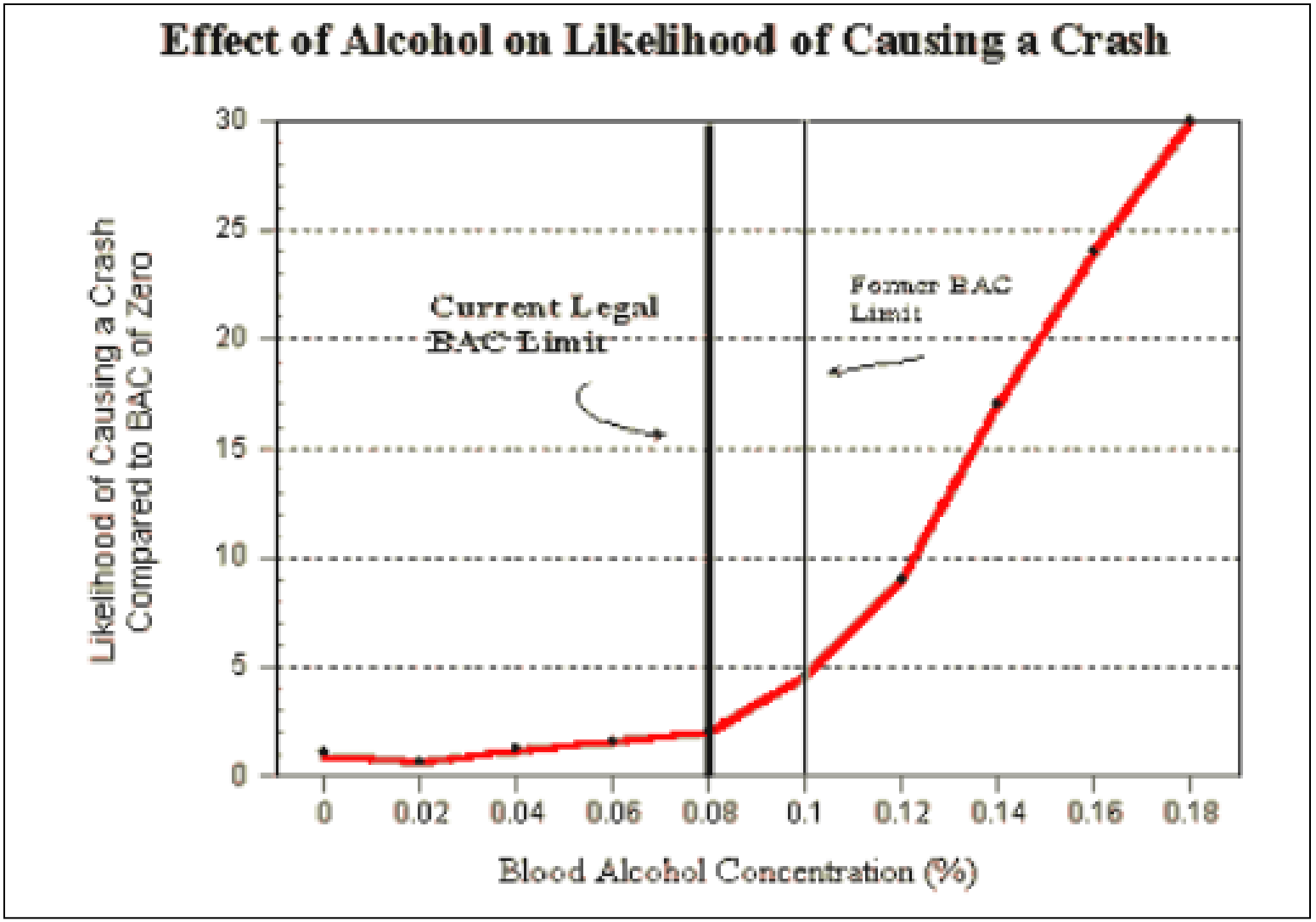
Converting Blood Alcohol Concentration From Weight/Volume to Weight/Weight

1 ml of blood = 1.06 g = 1060 mg

100 ml = 106,000 mg

e.g.

0.08 g/100 ml = 80 mg/100 ml = 80 mg/106,000 mg = 0.08 g/106 mg



University of North Carolina Highway Safety Research Center
http://www.hsrc.unc.edu/safety_info/alcohol/blood_alcohol_concentration.cfm

Limitations of Study

1. Study was of only one city
2. No information on patronage of ABOs nor on alcohol consumption
3. Do not know where perpetrators & victims of crimes or drivers of alcohol-related crashes were drinking
4. Network did not include all ABOs nor alcohol-related crashes
5. Conclusions are from spatial aggregates, not individuals
6. Poisson-Lognormal-CAR model has its own problems