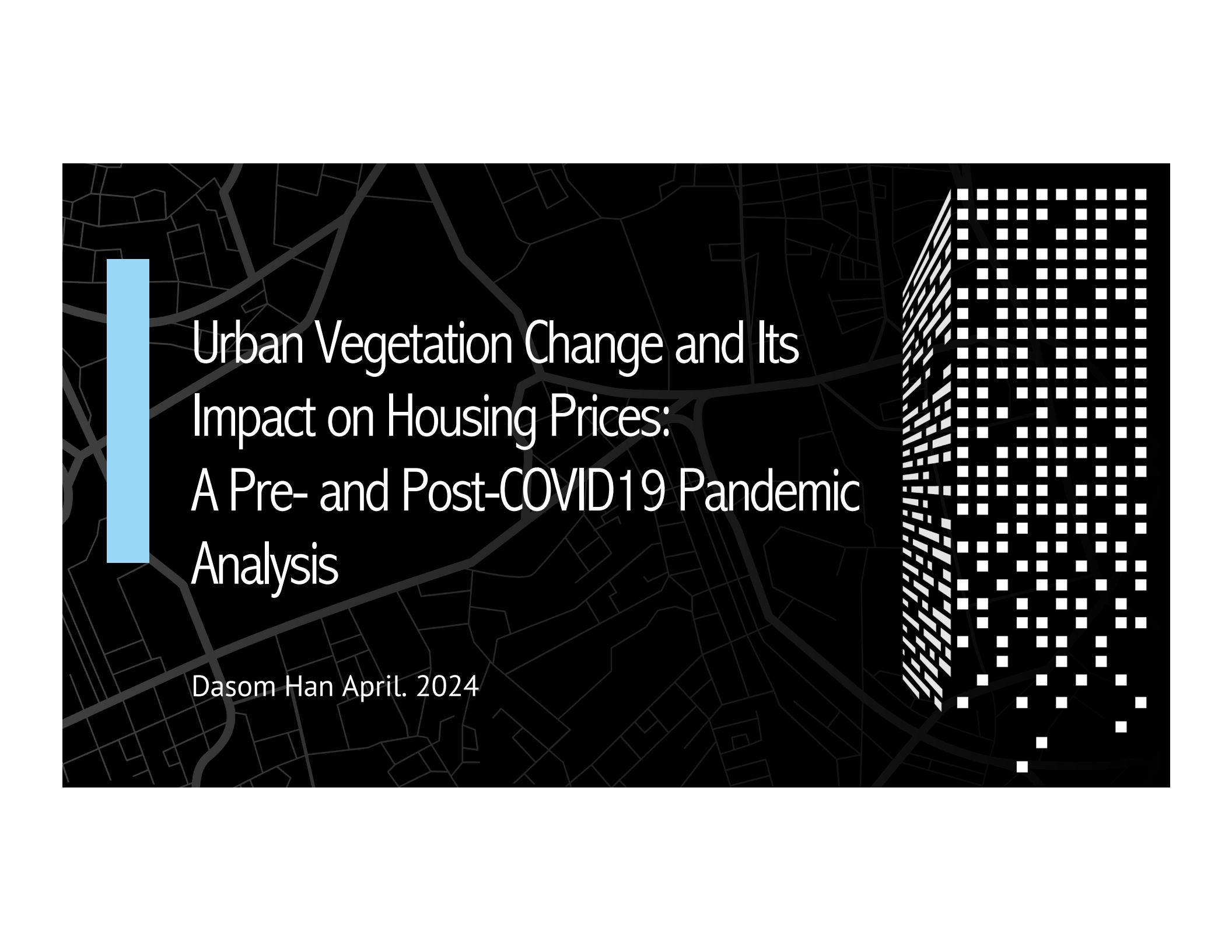


The background of the slide is a dark gray map with white lines representing streets and property boundaries. On the right side, there is a white grid pattern that appears to be a stylized representation of a building or a data grid, with some squares missing or faded towards the bottom right.

Urban Vegetation Change and Its Impact on Housing Prices: A Pre- and Post-COVID19 Pandemic Analysis

Dasom Han April. 2024

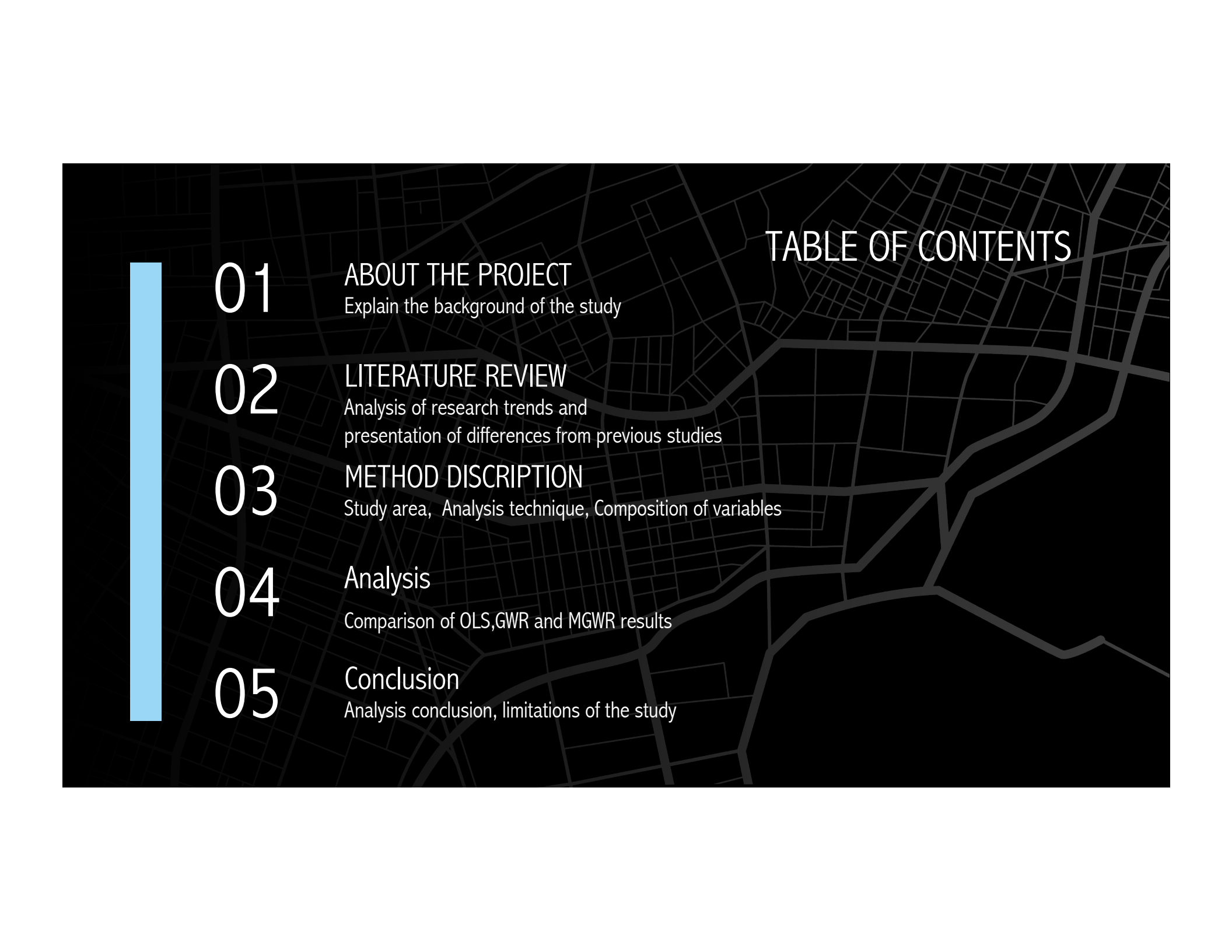


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Analysis conclusion, limitations of the study



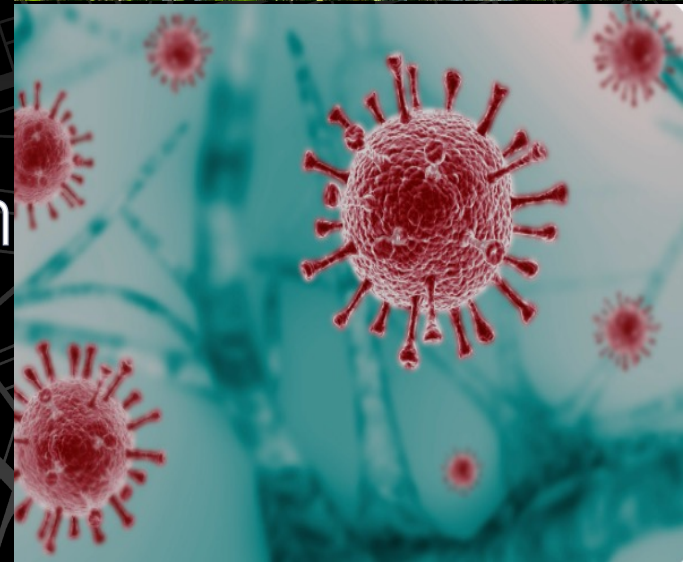
ABOUT THE PROJECT

01

About the Project

Factors Affecting Housing Prices

Policy Change Crime
Infection
Housing Structure
Supply & Demand Vegetation Change
Surrounding Environment segregation
Population Density



The background of the slide is a dark, high-contrast map of a city street grid. The streets are represented by thin, light gray lines on a black background. The grid is dense in some areas and more sparse in others, with some lines curving or branching. In the center of the slide, there is a large, solid blue square. To the right of this square, the number '02' is displayed in a large, white, sans-serif font.

02

LITERATURE REVIEW

A solid, dark gray rectangular block is positioned at the bottom center of the slide, below the 'LITERATURE REVIEW' text. It is a simple, flat rectangle with no text or other markings inside it.

Literature Review

Findings

Authors

Found that urban green spaces enhance local air quality and property values.

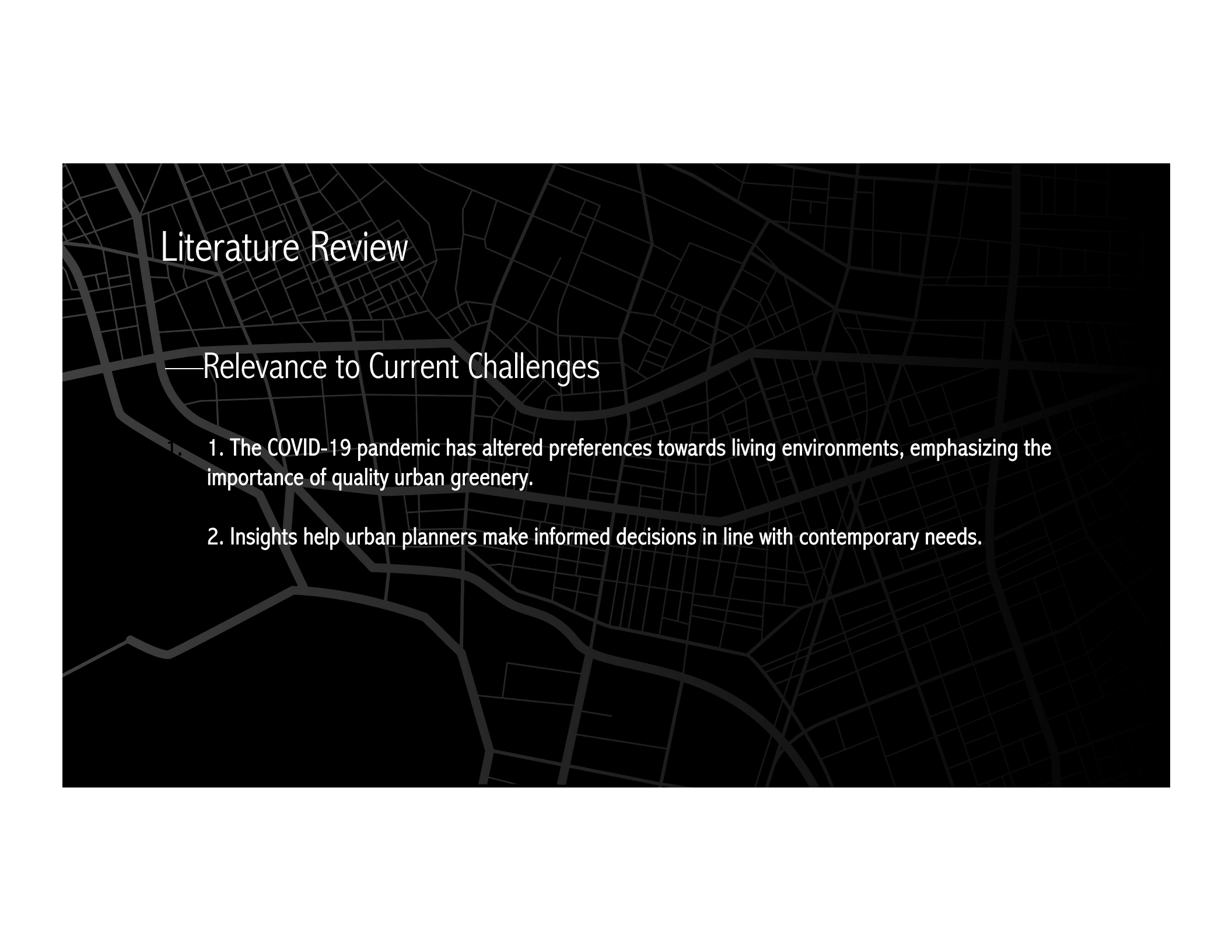
Jim & Chen
(2006)

Proximity to green spaces significantly increases housing prices due to psychological and recreational benefits.

Tyrväinen and
Miettinen (2000))

Quality of green spaces is crucial, with high-quality areas commanding a significant premium.

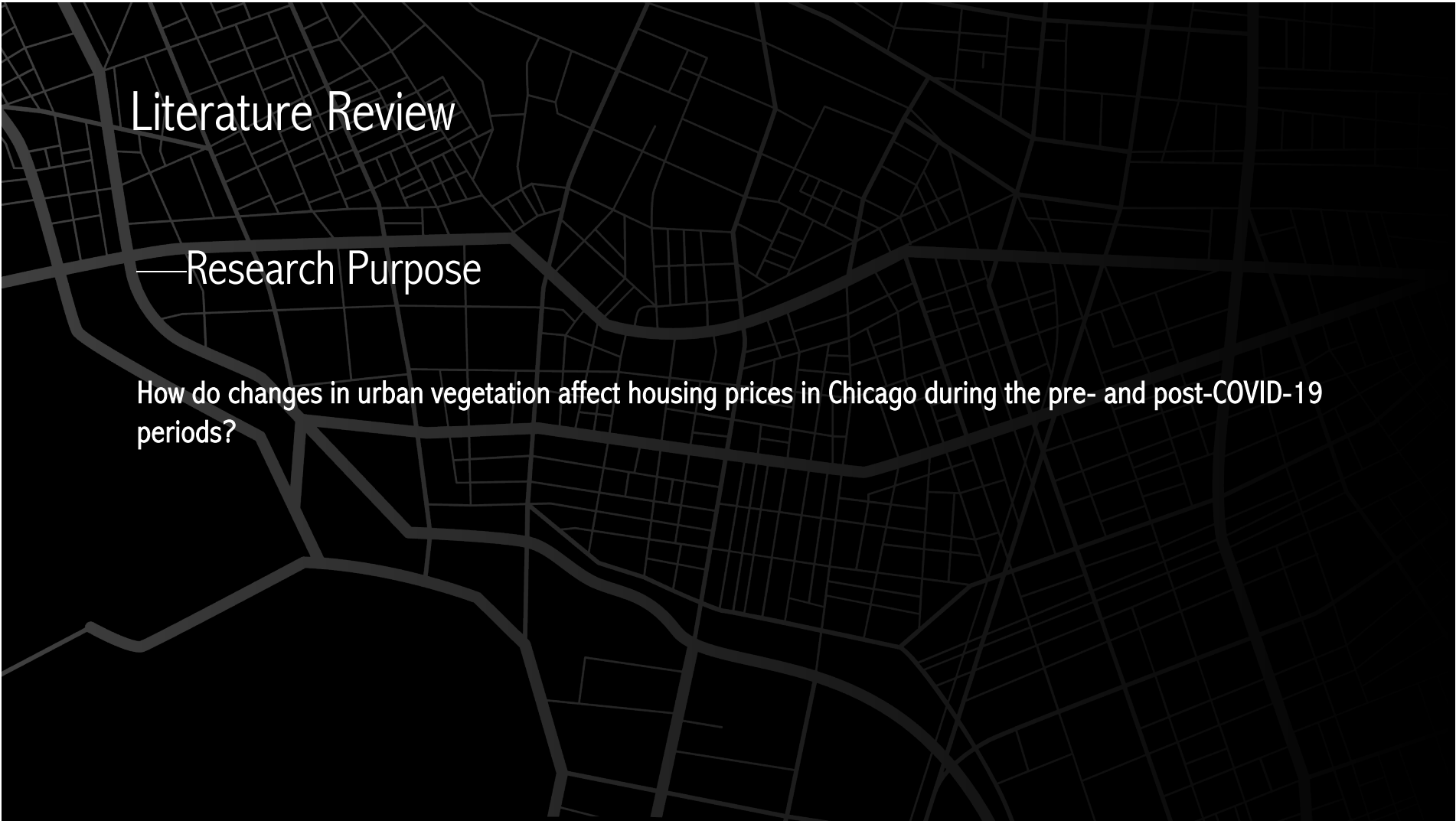
Panduro and
Veie (2013)



Literature Review

—Relevance to Current Challenges

1. The COVID-19 pandemic has altered preferences towards living environments, emphasizing the importance of quality urban greenery.
2. Insights help urban planners make informed decisions in line with contemporary needs.



Literature Review

—Research Purpose

How do changes in urban vegetation affect housing prices in Chicago during the pre- and post-COVID-19 periods?

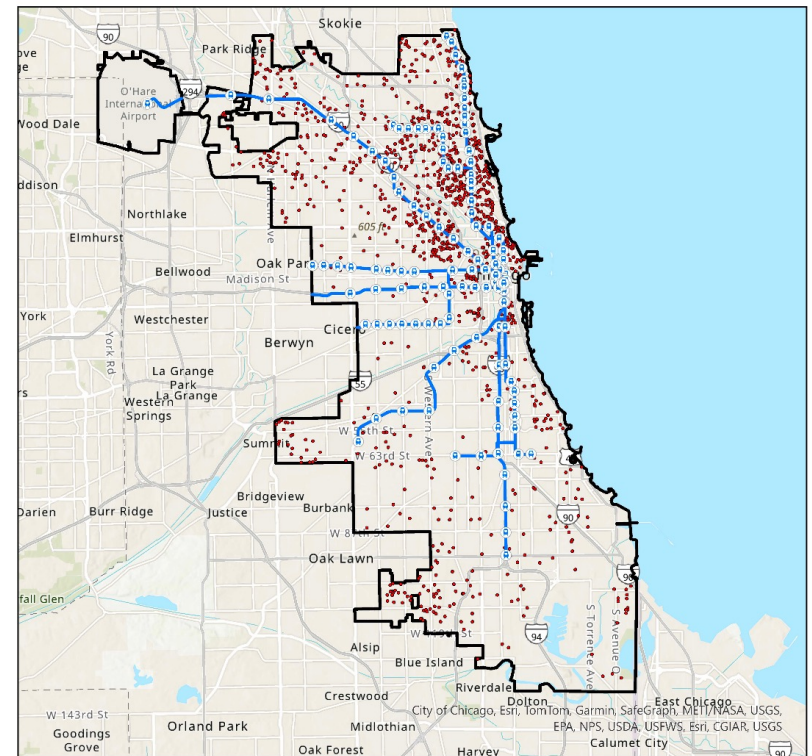
03 METHOD DESCRIPTION



Study Area

Before COVID 19(2016-2019) : 1,381

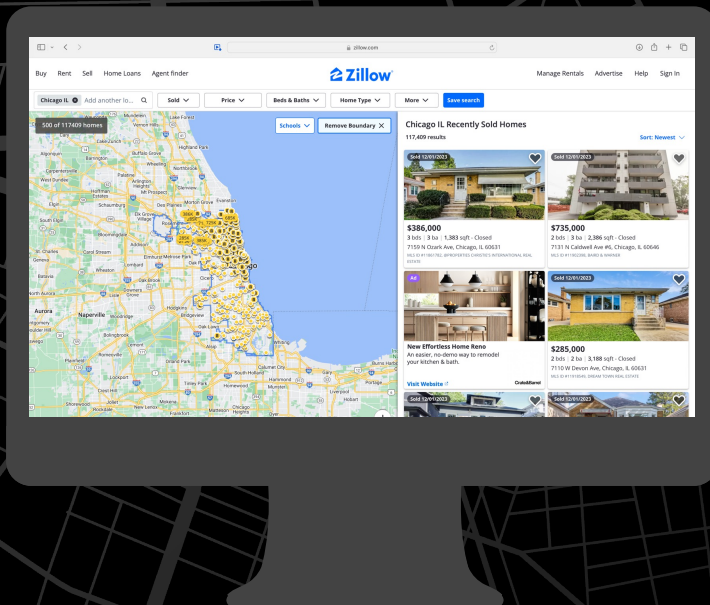
After COVID 19(2020-2023) : 1,381



Legend

- CTA_RailStations
- CTA_RailLines
- Transaction Data
- Chicago Boundary

DATA COLLECTION METHOD



Data from 1,381 houses traded in Chicago over the past three years (November 2021 - November 2023) that had at least one transaction between 2016 and 2019 were collected via Zillow.

Vegetation Calculation Process

Landsat Data



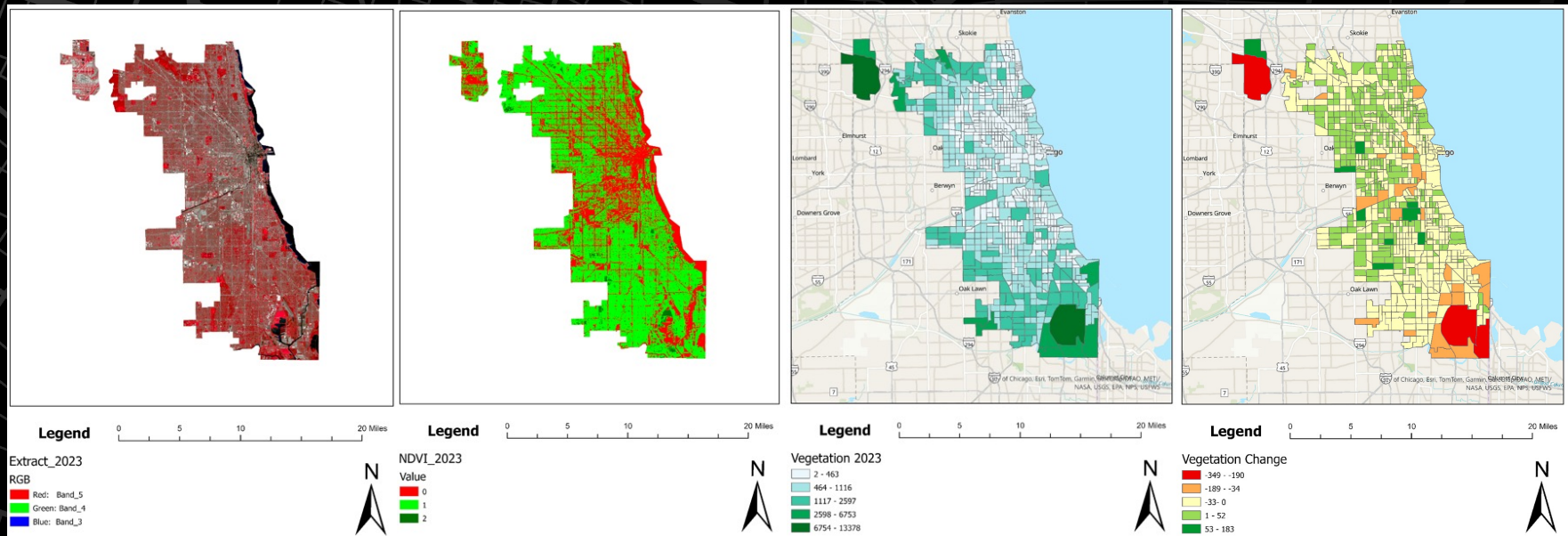
Calculate NDVI



Calculate Vegetation
by Census Tract



2023 – 2019
Vegetation Change



Composition of Variables

Variable category	Variable name		Value type	Definition
Dependent variable	Transaction price (per square feet)		\$(Dollar)	Actual transaction price divided by exclusive use area
	Vegetation Change		Ratio scale	Vegetation change between 2019 and 2023
Independent variable	Period	Before Covid-19 & After Covid-19 Dummy	(0, 1)	Before (0) & After(1) dummy(ref.before covid-19)
		Area for exclusive use	Ratio scale	Area for exclusive use of the target housing (sqft)
		Number of beds	Ratio scale	Number of beds
		Number of baths	Ratio scale	Number of baths
		Year	Ratio scale	Transaction year - Built year
	Housing characteristics	Cooling availability	(0, 1)	Divided into no cooling (0) and cooling ststem available (1) (ref.no cooling)
		Heating availability	(0, 1)	Divided into no heating (0) and heating system available (1) (ref.no heating)
		Parking availability	(0, 1)	Divided into no parking (0) and parking available (1) (ref.no parking)
	Surrounding environment characteristics	Ridership	Ratio scale	Total number of monthly passengers at the nearest station (based on the month transacted)
		Distance to station	Ratio scale	Distance to the nearest Elevated Train station (mile)
Primary school rating		Ratio scale	Based on research conducted by GreatSchools.org, an independent non-profit organization, It is based on four levels of the School Assessment Scale: Student Progress Rating or Academic Progress Rating, College Readiness Rating, Equity Rating, and Test Score Rating.	
High school rating		Ratio scale		
	Distance to general hospital	Ratio scale	Distance to the nearest general hospital (mile)	

Analysis Method

Ordinary Least Squares

Facilitates a foundational understanding of the relationship between housing prices and proximity to green spaces while controlling for confounding variables such as characteristics of the property and the neighborhood.

$$P = \beta_0 + \beta_1 G + \beta_2 C + \beta_3 H + \beta_4 N + \epsilon$$

Geographically Weighted Regression(GWR)

Addresses spatial heterogeneity by providing localized coefficient estimates, which helps in understanding regional variations within the study area.

$$y_i = \beta_0(u_i, v_i) + \sum_k^p \beta_k(u_i, v_i)x_{ik} + \epsilon_i$$

(u_i, v_i) are the geographical coordinates.



Analysis Method

Multiscale Geographically Weighted Regression (MGWR)

Builds on GWR by allowing different variables to operate at their optimal spatial scales, enhancing the model's sensitivity to local context.

04
ANALYSIS RESULT



Analysis Result : OLS Analysis

		Ordinary Least Squares(OLS)		
		B	Std Error	VIF
Vegetation Changes		0.001*	0.000	1.067
Covid Dummy		-0.090***	0.020	1.358
Housing Characteristics	Area	0.000	0.000	3.631
	Number of beds	-0.016***	0.011	2.414
	Number of baths	0.091***	0.016	3.479
	Age	-0.002***	0.000	1.281
	Cooling availability (ref.no cooling)	0.275***	0.032	1.518
	Heating availability (ref.no heating)	-0.112**	0.036	1.552
	Parking availability (ref.no parking)	0.069**	0.020	1.325
Surrounding environment characteristics	Ridership	0.000**	0.000	1.421
	Distance to station	-0.148***	0.009	1.406
	Primary school rating	0.039***	0.004	1.228
	High school rating	0.022***	0.004	1.262
Distance to general hospital		-0.022*	0.009	1.191
Constant		5.566***		
N		2,414		
AICc		2653.668***		
R2		0.359		
Adjusted R2		0.355		

Dependent variable: Transaction price per square feet (\$ Dollar) - * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Analysis Result : Spatial Autocorrelation

Global Moran's I Summary

Moran's Index	0.645556
Expected Index	-0.000414
Variance	0.0007
z-score	24.424081
p-value	0.000000

Comparison of MGWR and GWR Model Indicators

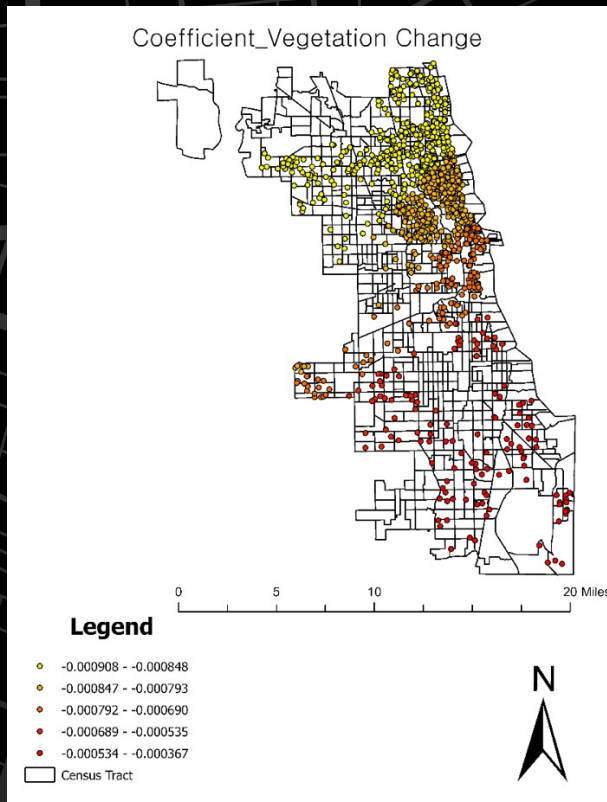
Model Index	MGWR	GWR
Adjusted R^2	0.688	0.825
AICc	4743.196	31347.13
Sum of squares of residuals	476.731	2588354.84

Analysis Result : Comparison of OLS and MGWR

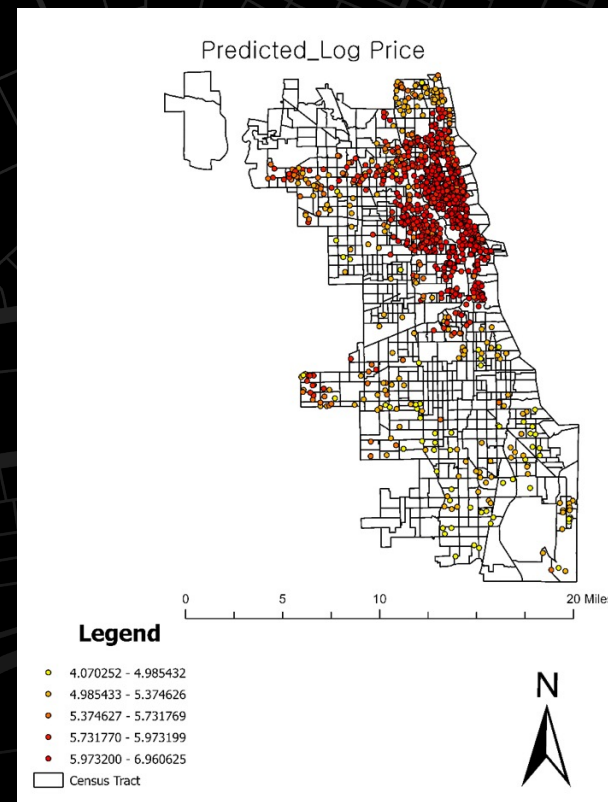
		Ordinary Least Squares(OLS)			Multiscale Geographically Weighted Regression(MGWR)				
		R	Std Error	VIF	Mean	Standard Deviation	Min	Median	Max
Vegetation Changes		0.001*	0.000	1.067	-0.033	0.005	-0.037	-0.034	-0.015
Covid Dummy		-0.090***	0.020	1.358	-0.110	0.058	-0.269	-0.098	-0.017
Housing Characteristics	Area	0.000	0.000	3.631	-0.276	0.190	-0.924	-0.221	0.001
	Number of beds	-0.016***	0.011	2.414	0.155	0.035	0.088	0.151	0.213
	Number of baths	0.091***	0.016	3.479	0.099	0.026	0.077	0.091	0.173
	Age	-0.002***	0.000	1.281	-0.050	0.083	-0.319	-0.036	0.190
	Cooling availability (ref.no cooling)	0.275***	0.032	1.518	0.075	0.068	-0.067	0.059	0.310
	Heating availability (ref.no heating)	-0.112**	0.036	1.552	-0.044	0.004	-0.047	-0.046	-0.031
Surrounding environment characteristics	Parking availability (ref.no parking)	0.069**	0.020	1.325	0.016	0.031	-0.020	0.006	0.089
	Ridership	0.000**	0.000	1.421	0.009	0.003	-0.001	0.010	0.011
	Distance to station	-0.148***	0.009	1.406	-0.170	0.002	-0.172	-0.171	-0.165
	Primary school rating	0.039***	0.004	1.228	0.080	0.003	0.070	0.081	0.082
	High school rating	0.022***	0.004	1.262	0.131	0.002	0.125	0.131	0.132
Distance to general hospital		-0.022*	0.009	1.191	-0.006	0.268	-1.131	-0.009	1.582
Constant			5.566***		0.022	0.640	-2.002	0.206	0.979
N			2,414				2,414		
AICc			2653.668***				4743.196***		
R2			0.359				0.752		
Adjusted R2			0.355				0.688		

Dependent variable: Transaction price per square feet (\$ Dollar) - * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

MGWR Result



Housing prices decline as vegetation increases:
impact is greater in southern areas



Housing prices are higher in the north.



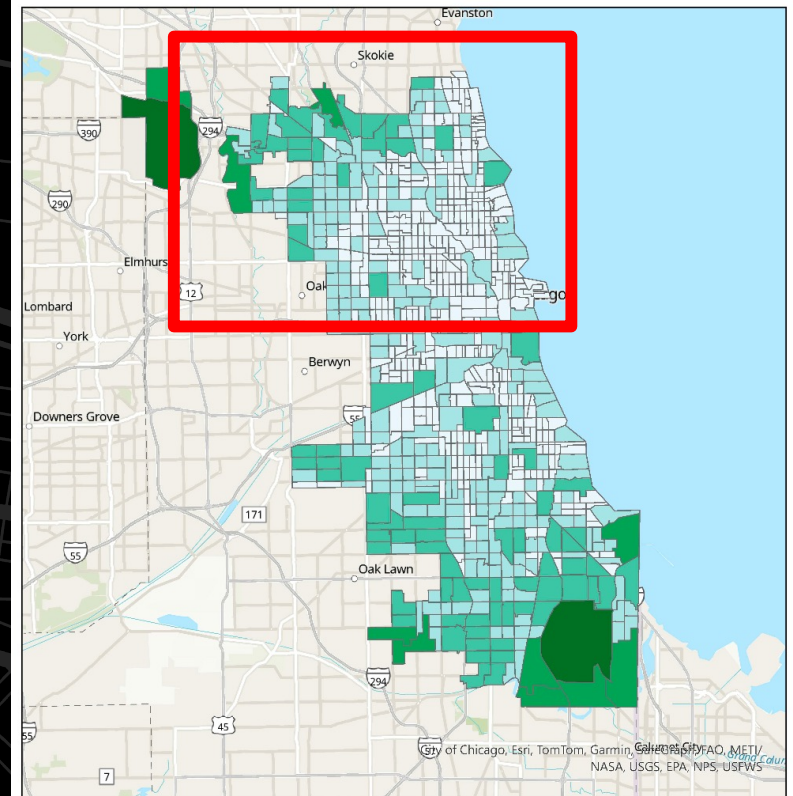
05

Conclusion

Findings

1. Increased vegetation generally reduces housing prices, but effects are uneven across different areas

Particularly significant impact on Chicago's North Side



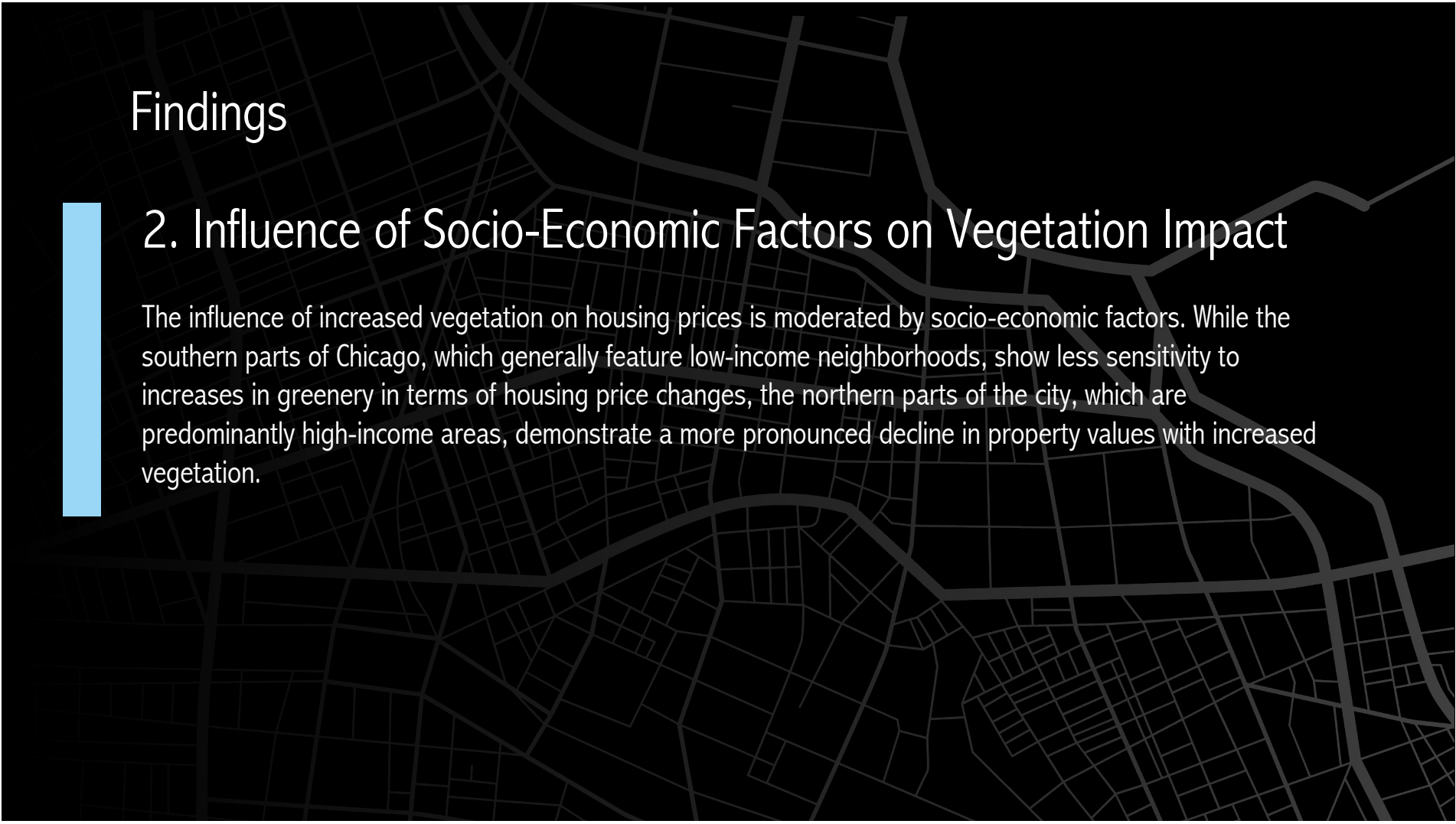
Legend

Vegetation 2023

- 2 - 463
- 464 - 1116
- 1117 - 2597
- 2598 - 6753
- 6754 - 13378

0 5 10 20 Miles



The background of the slide is a dark gray map of Chicago, showing a dense grid of streets. The map is oriented with North at the top. The streets are represented by thin, light gray lines, while major thoroughfares are shown as slightly thicker lines. The overall pattern is a complex, interconnected web of urban infrastructure.

Findings

A solid blue vertical bar is positioned to the left of the section header.

2. Influence of Socio-Economic Factors on Vegetation Impact

The influence of increased vegetation on housing prices is moderated by socio-economic factors. While the southern parts of Chicago, which generally feature low-income neighborhoods, show less sensitivity to increases in greenery in terms of housing price changes, the northern parts of the city, which are predominantly high-income areas, demonstrate a more pronounced decline in property values with increased vegetation.

Policy Implication & Limitation



Limitations

Potential biases in data sources



Policy Implications

Importance of tailored urban planning that considers local conditions and green space integration.





THANKS

Do you have any questions?