

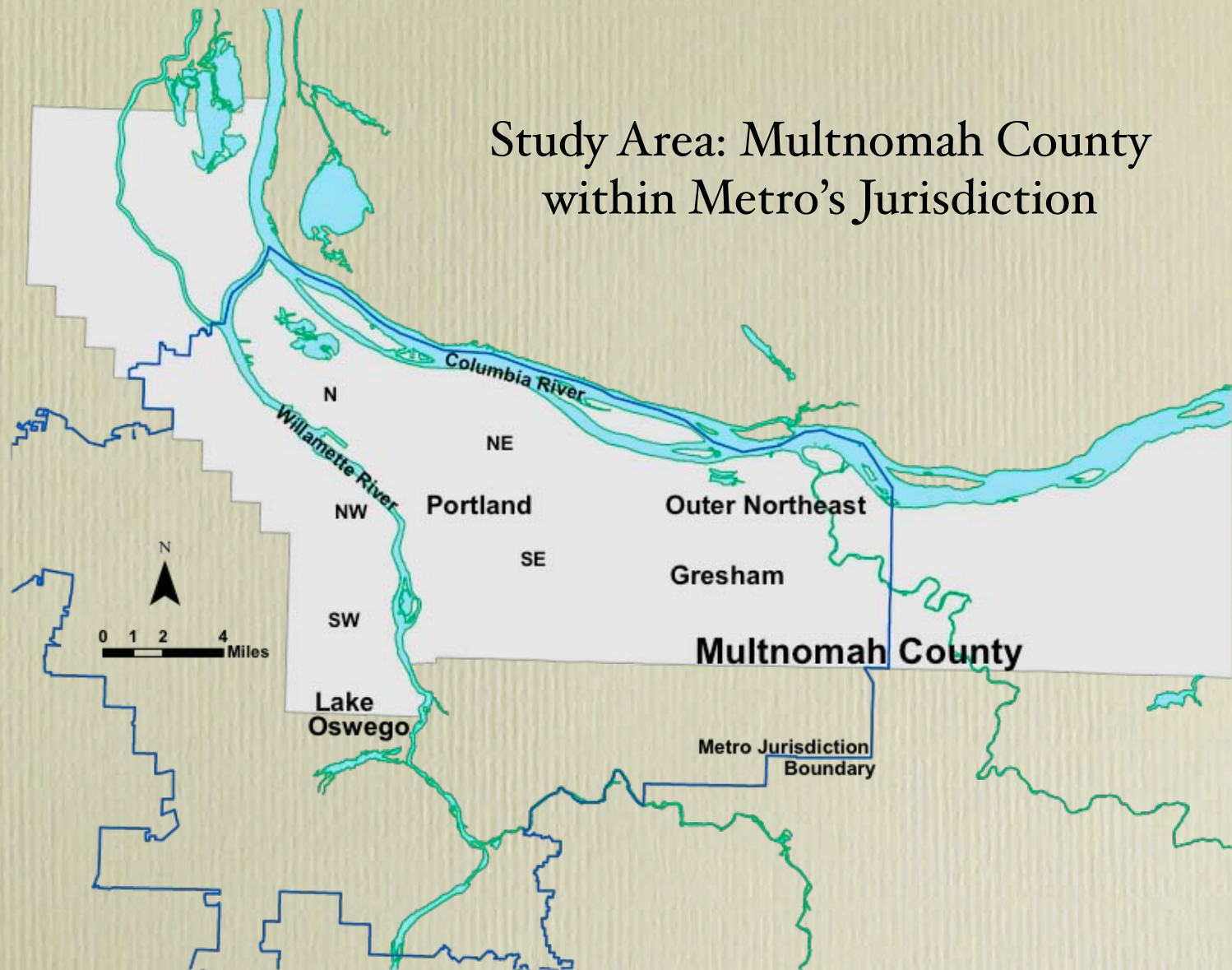


Valuing Landscape Patterns in an Urban Environment

Jonathan Kadish
Noelwah R. Netusil

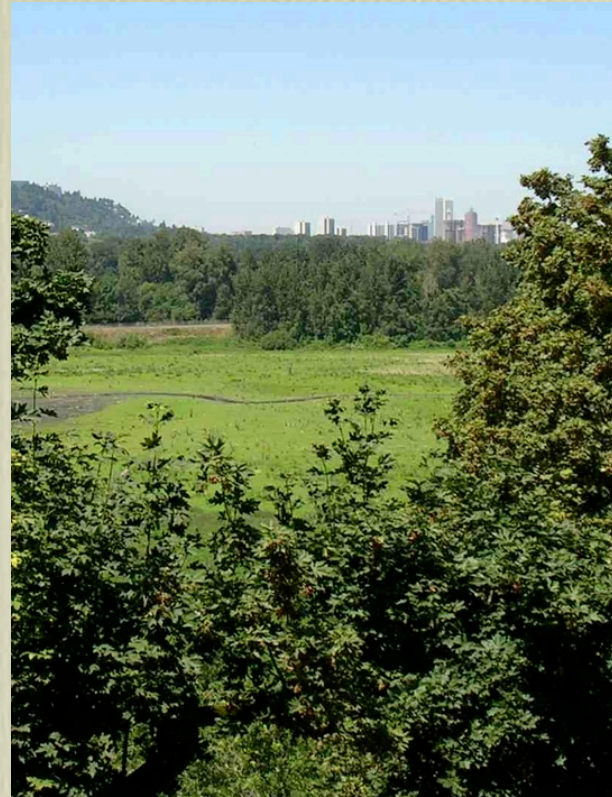
June 25, 2010
Prepared for Camp Resources XVII

Study Area: Multnomah County within Metro's Jurisdiction



Study Area and Problem

- Urban Growth Boundary
- Water quality
- Combined Sewer System
- Eight months of rain
- Combined Sewer Overflow
Projects: \$1.4 billion
- Is there a better approach?



*Oaks Bottom Wildlife Refuge
Portland, Oregon*

Grey to Green

\$50 million over five years to make “stormwater management more sustainable, restore watershed health, and enhance Portland’s livability”

Goals include:

- Plant 33,000 yard trees and 50,000 street trees – “Treebate” program
- Purchase and protect 419 acres of high priority natural areas



*NE Knott St. at 42nd Ave.
Portland, Oregon*

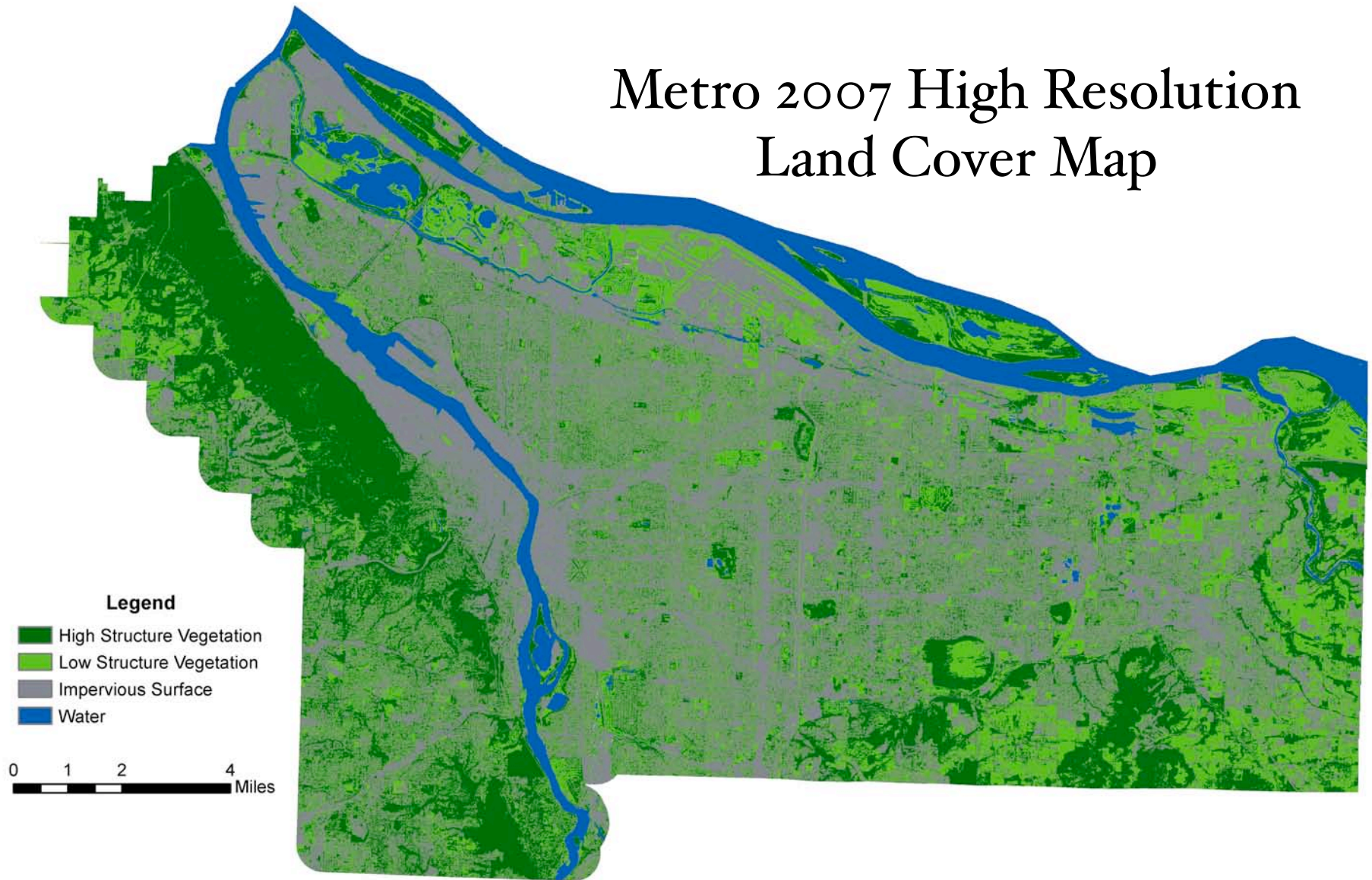
Research Questions

Is there a relationship between the sale price of single-family residential properties and:

- (1) land cover types on and around the property?
- (2) the spatial configuration of land cover types around the property?

Does incorporating landscape patterns change estimated coefficients on land cover variables?

Metro 2007 High Resolution Land Cover Map



Landscape Metrics

Composition Metrics

- Classify the number of land cover types and amount of each type in an area
- Examples: proportional abundance of each land cover, richness, evenness, diversity
- Commonly used in hedonic literature

Spatial Configuration Metrics

- Captures the spatial character of land cover patches within a mosaic
- Examples: patch-size distribution and density, patch-shape complexity, contagion, connectivity

Previous Research

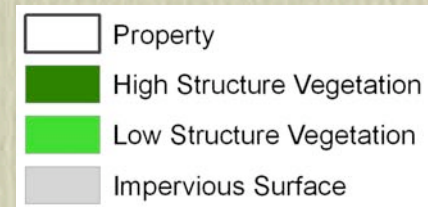
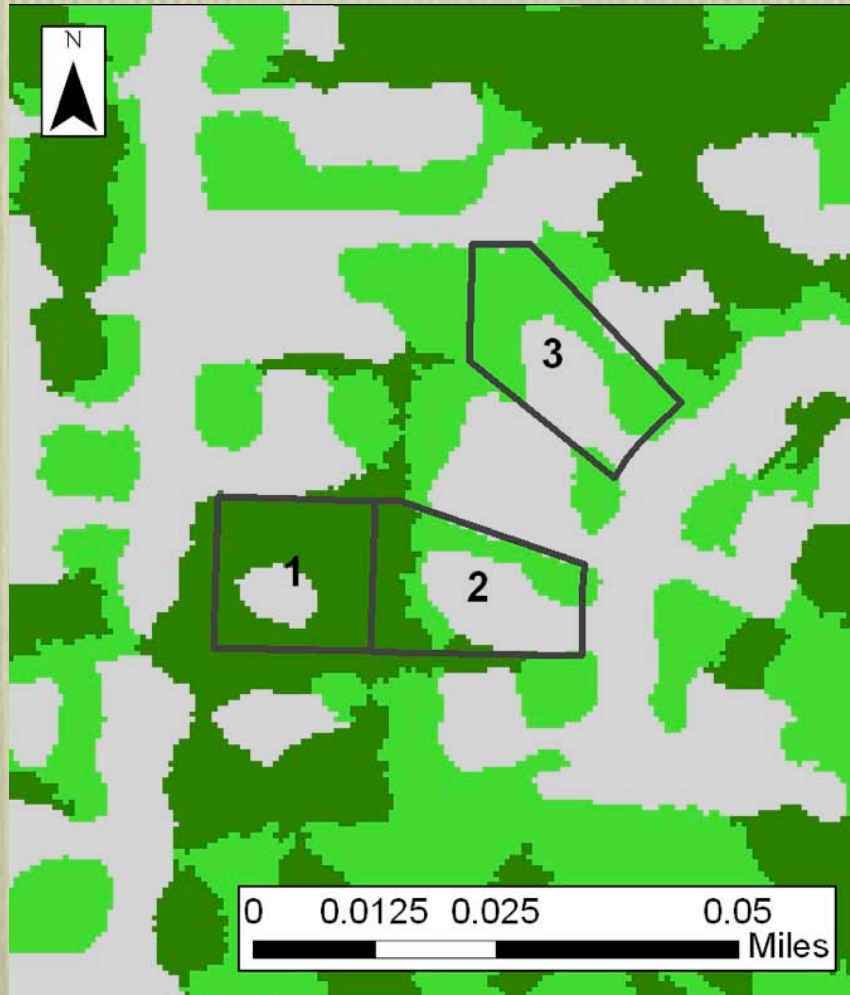
Vegetation

- Des Rosiers et al. (2002)
- Kestens et al. (2004)
- Mansfield et al. (2005)

Landscape Metrics

- Geoghegan et al. (1997)
- Acharya and Bennett (2001)
- Kong et al. (2007)

Composition Metrics: On-Property Land Cover



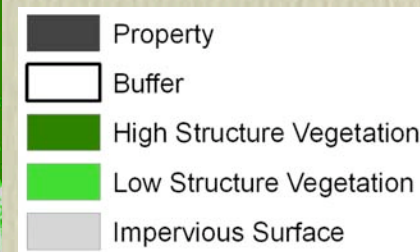
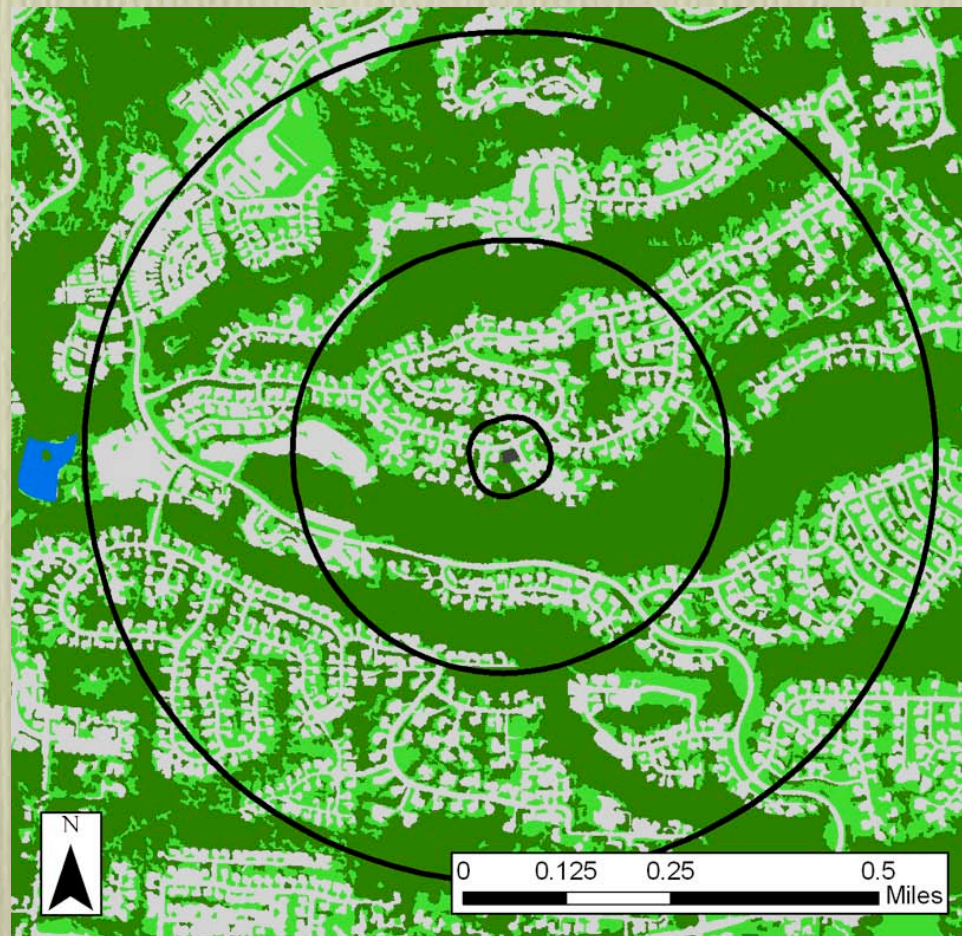
	High Structure	Low Structure	Impervious
Property 1	84.77%	0%	15.23%
Property 2	26.07%	29.66%	44.26%
Property 3	0%	61.01%	38.99%

Composition Metrics: On-Property

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	Mean	Standard Deviation	Minimum	Maximum
High Structure Vegetation	26.08%	22.13%	0	100%
Low Structure Vegetation	29.67%	19.18%	0	100%
Impervious Area	44.24%	19.60%	0	100%
Open Water	0.01%	0.57%	0	72.61%

Composition Metrics: Buffers



	High Structure	Low Structure	Impervious
200 foot	36.83%	17.45%	45.72%
200 foot- 1/4 mile	57.33%	16.64%	26.04%
1/4 mile- 1/2 mile	46.08%	23.46%	30.46%

Composition Metrics: Within 200 Feet

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	Mean	Standard Deviation	Minimum	Maximum
High Structure Vegetation	25.59%	14.58%	0	99.91%
Low Structure Vegetation	28.23%	10.33%	0	90.19%
Impervious Area	46.09%	13.22%	0	96.64%
Open Water	0.09%	1.53%	0	67.71%

Spatial Configuration Metrics

Patch Size Distribution and Density Metrics

- Patch Density
- Largest Patch Index
- Mean Patch Area
- Edge Density
- Landscape Shape Index

Contagion Metrics

- Contagion
- Aggregation Index

Shape Complexity Metrics

- Mean Shape Index
- Mean Fractal Dimension Index
- Mean Contiguity Index

Connectivity Metric

- Patch Cohesion Index

Factor Analysis

Created 3 factors accounting for 90% of the variation; factors scaled between 0 and 1

Aggregation Factor

- Patch Density
- Mean Patch Area
- Edge Density
- Largest Shape Index
- Contagion
- Aggregation Index

Shape Factor

- Mean Shape Index
- Mean Fractal Dimension Index

Connectivity Factor

- Largest Patch Index
- Cohesion

Models

- 36,798 single-family residential transactions
- January 1, 2005-December 31, 2007
- Semi-log specification
- Quadratic terms to account for a priori expectations about diminishing returns
- Model 1: composition metrics only
- Model 2: composition and spatial metrics

Results: Spatial Metrics

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Variable Name	Estimated Coefficients (robust standard errors)
Aggregation	-0.3117*** (0.0373)
Aggregation Squared	0.1838*** (0.0583)
Shape	-0.8446*** (0.0945)
Shape Squared	0.6158*** (0.0843)
Connectivity	-0.2171*** (0.0664)
Connectivity Squared	-0.02559 (0.0813)

***p< 0.01, **p< 0.05, *p<0.1

Results: Landscape Factors

Real Sale
Price

Aggregation,
Connectivity

Real Sale
Price

Shape

Calculations

■

Impact of 1-SD increase above mean

Landscape Factor

Percentage

Dollar Amount*

Aggregation

-1.8%

-\$5,772

Shape

4.72%

\$15,004

Connectedness

-2.22%

-\$7,065

**Evaluated at mean property value of \$317,602*

Findings

The spatial distribution of land cover types around a property affects its sales price

- Higher aggregation and connectivity are associated with a decrease in sale price
- More regular patch shapes are associated with an increase in sale price

Estimates of land cover values generally diminish with the inclusion of landscape factors – omitted variable bias

Implications

People prefer homogenous land uses in the area within $\frac{1}{4}$ -mile around their property – consistent with previous research

Policy initiatives should consider impact on spatial distribution of land cover types

- Treebate program could further fragment land cover, increasing property values
- Ecological value (water and air quality, wildlife habitat) of natural area preservation must be weighed against potential impact on property values

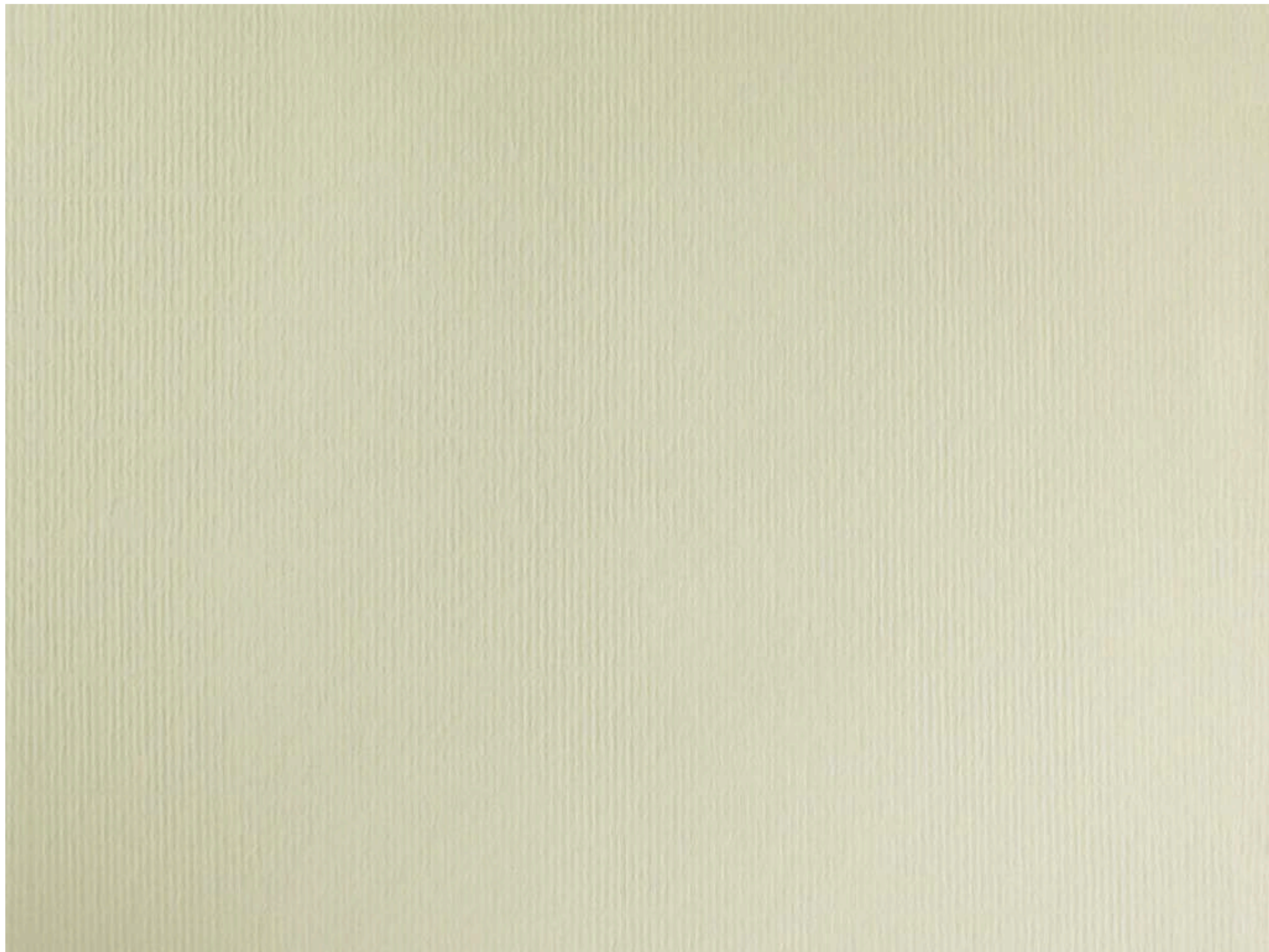
Questions?

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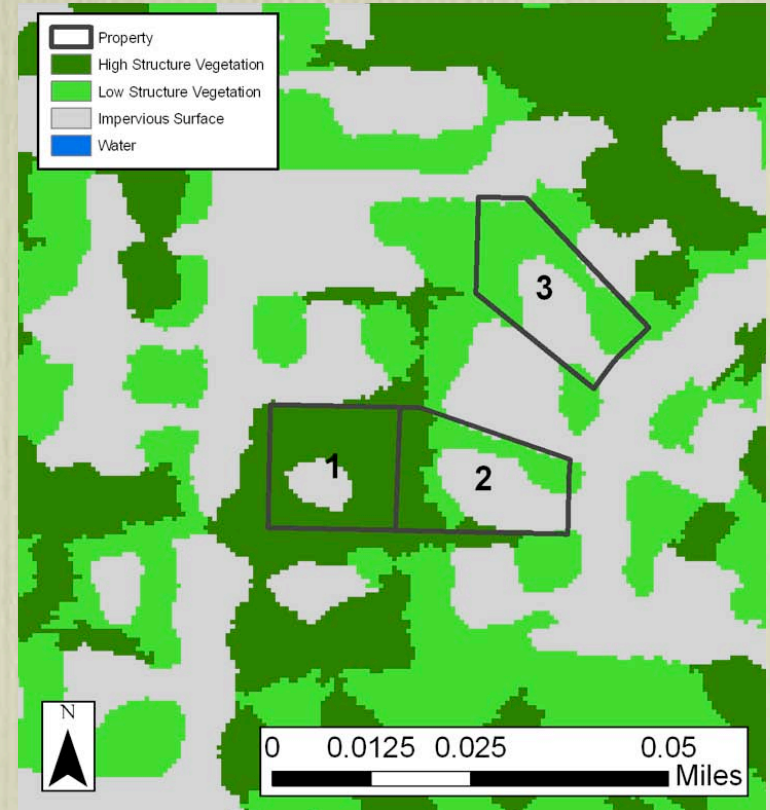
Property Data (2005-2007)

36,798 transactions

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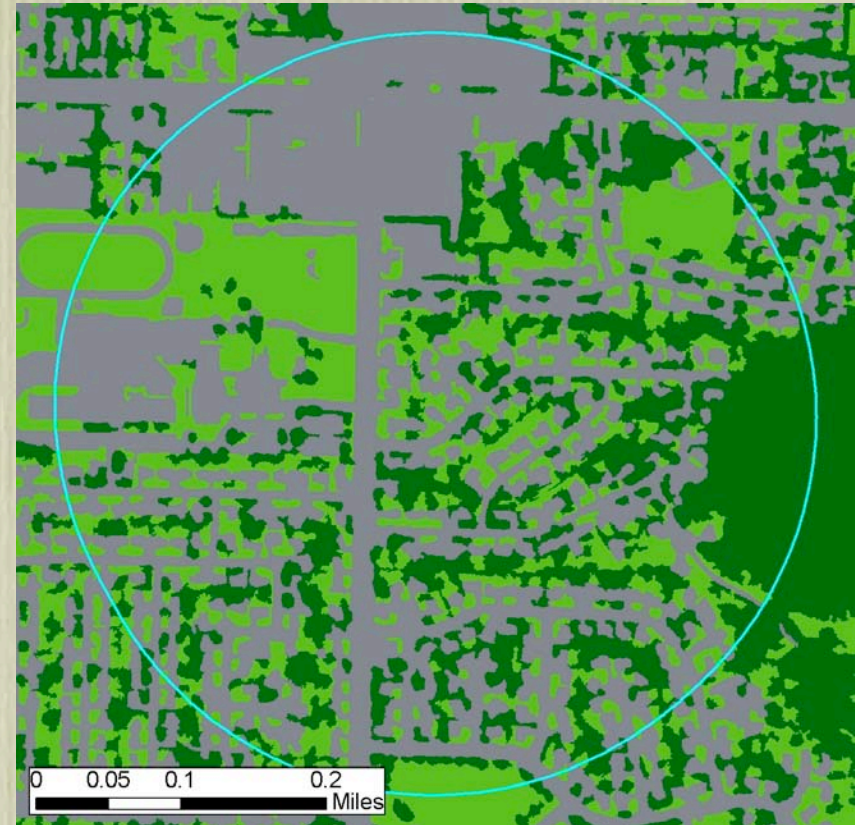
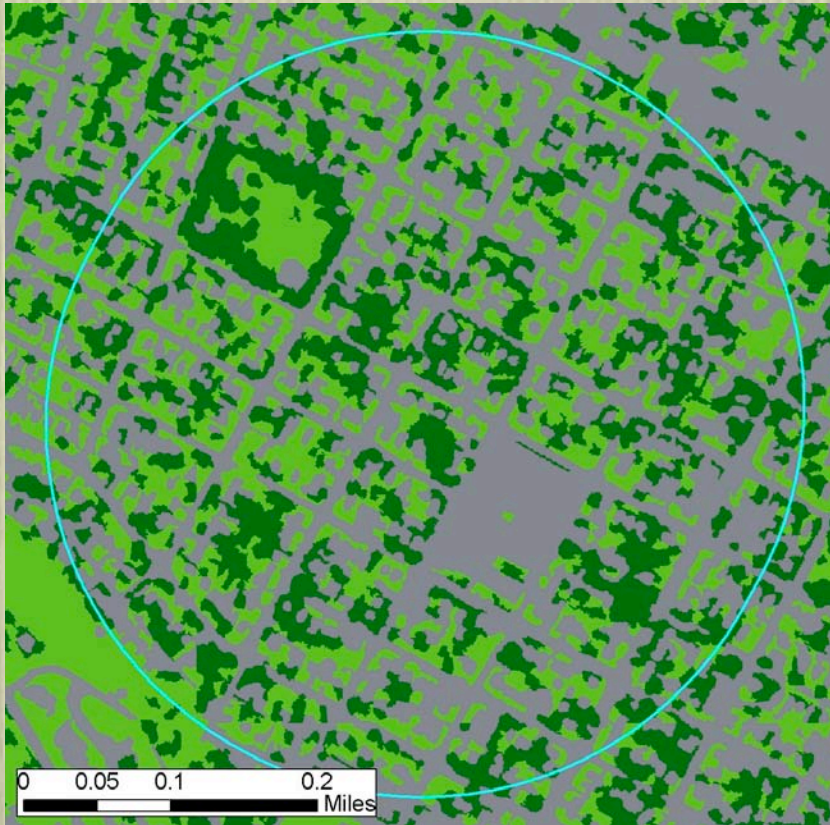
Variable	Mean	Standard Deviation	Minimum	Maximum
Real Sale Price (2007 dollars)	\$317,602	\$190,816	\$58,920	\$4,349,733
Lot Square Footage	7,718	19,378	808	845,250
Building Square Footage	1,933	869	360	12,177
Age	53.4	31.77	0	137

On-Property Land Cover

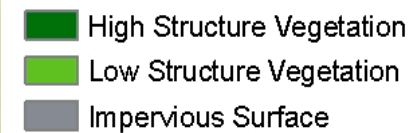


	High Structure	Low Structure	Impervious
Property 1	84.77%	0%	15.23%
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Property 3	0%	61.01%	38.99%

Spatial Configuration Metrics



Factor	Value	Value
Aggregation	0.1771	0.4582
Shape	0.5509	0.7691
Connectedness	0.5409	0.4870



Results: On Property

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Variable Name	Estimated Coefficients (robust standard errors)
High Structure Vegetation	0.0896*** (0.0169)
High Structure Vegetation Squared	-0.143*** (0.0224)
Low Structure Vegetation	0.0422* (0.0224)
Low Structure Vegetation Squared	-0.105*** (0.0332)
Open Water	-0.333 (0.316)

***p< 0.01, **p< 0.05, *p<0.1

Results: Within 200 Feet

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Variable Name	Estimated Coefficients (robust standard errors)
High Structure Vegetation	0.138*** (0.0332)
High Structure Vegetation Squared	0.0224 (0.0509)
Low Structure Vegetation	0.350*** (0.0576)
Low Structure Vegetation Squared	-0.342*** (0.0872)
Open Water	0.932*** (0.148)

***p< 0.01, **p< 0.05, *p<0.1

Results: 200 Feet to 1/4 Mile

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Variable Name	Estimated Coefficients (robust standard errors)
High Structure Vegetation	0.374*** (0.0536)
High Structure Vegetation Squared	-0.0329 (0.0792)
Low Structure Vegetation	0.392*** (0.104)
Low Structure Vegetation Squared	-0.315*** (0.0885)
Open Water	0.315*** (0.0885)

***p< 0.01, **p< 0.05, *p<0.1

Results: 1/4 Mile to 1/2 Mile

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Variable Name	Estimated Coefficients (robust standard errors)
High Structure Vegetation	0.556*** (0.0584)
High Structure Vegetation Squared	-0.298*** (0.0846)
Low Structure Vegetation	0.812*** (0.112)
Low Structure Vegetation Squared	-0.683*** (0.173)
Open Water	0.479*** (0.046)

***p< 0.01, **p< 0.05, *p<0.1

Results - Vegetation

Real
Sale
Price

^ High Structure Vegetation: on property
& 1/2-mile buffer
Low Structure Vegetation: all areas

Real
Sale
Price

^ Water: on
property

Real
Sale
Price

^ High Structure
Vegetation: 200
foot & 1/4-mile
buffers

Real
Sale
Price

^ Water: 200 foot,
1/4 mile and 1/2
mile buffers

Calculations

- 30.46%: Amount of on-property high structure vegetation that maximizes sale price
- 26.04%: Average for properties in our study
- Estimated increase in sale price of \$122
- Present discounted cost: \$230+
- Private benefits < private costs
- 40% urban tree canopy goal?

Overall Benefits

- Increase in high structure vegetation in surrounding buffers also has a positive effect on sale price
- Other benefits that may not be included in our estimates:
 - Water flow
 - Water quality
 - Carbon sequestration
 - Air quality
 - Aesthetics
 - Wildlife habitat