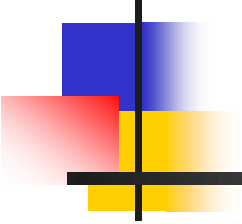


Riparian Buffers and Hedonic Prices: A Quasi-Experimental Analysis of Residential Property Values in the Neuse River Basin

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East Carolina University

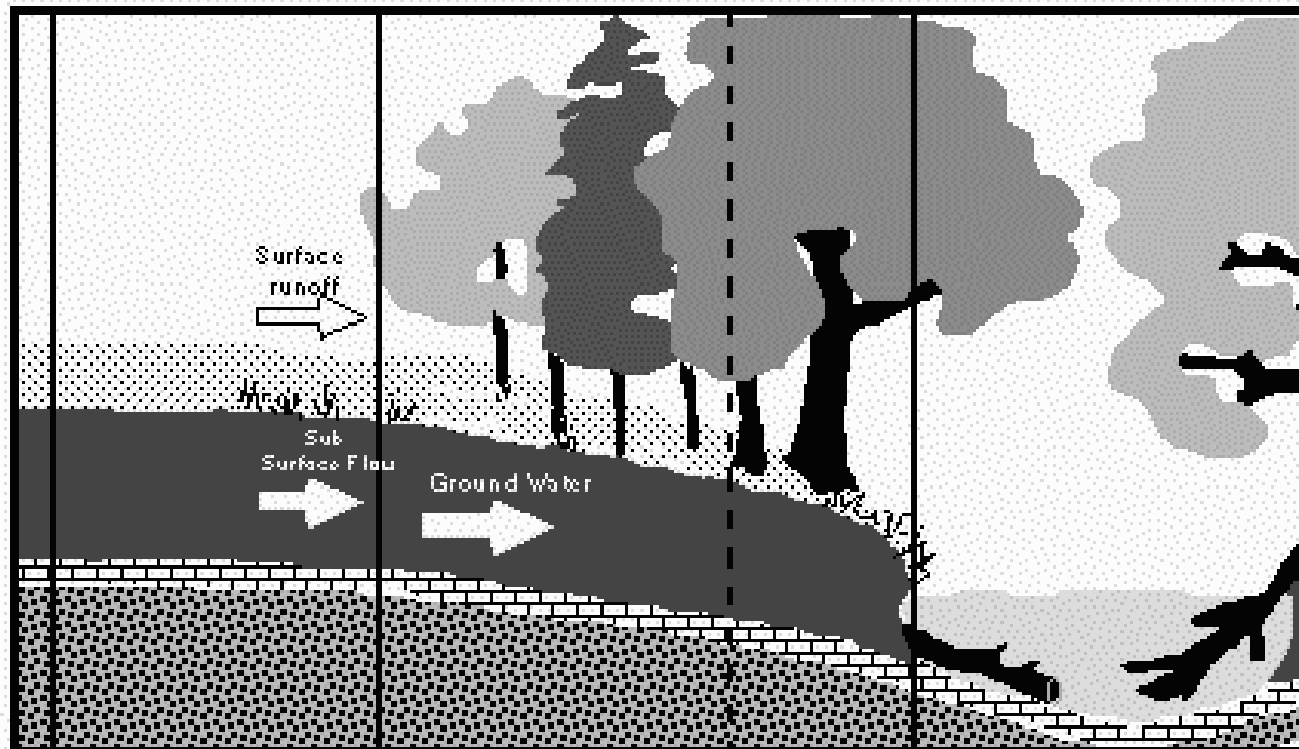




Riparian Buffers

- The strips of trees and shrubs along the banks of rivers and streams
- A key instrument to protect the overall water quality in the U.S.
- Maintain integrity of the stream channel
- Enhance water quality by trapping and filtering pollutants such as sediment and nutrients
- Provide habitat for terrestrial and aquatic plants and animals

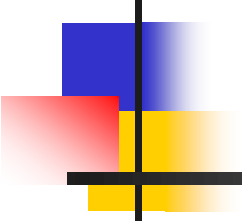
Neuse River Riparian Area Rule



Zone 2: 20 ft.

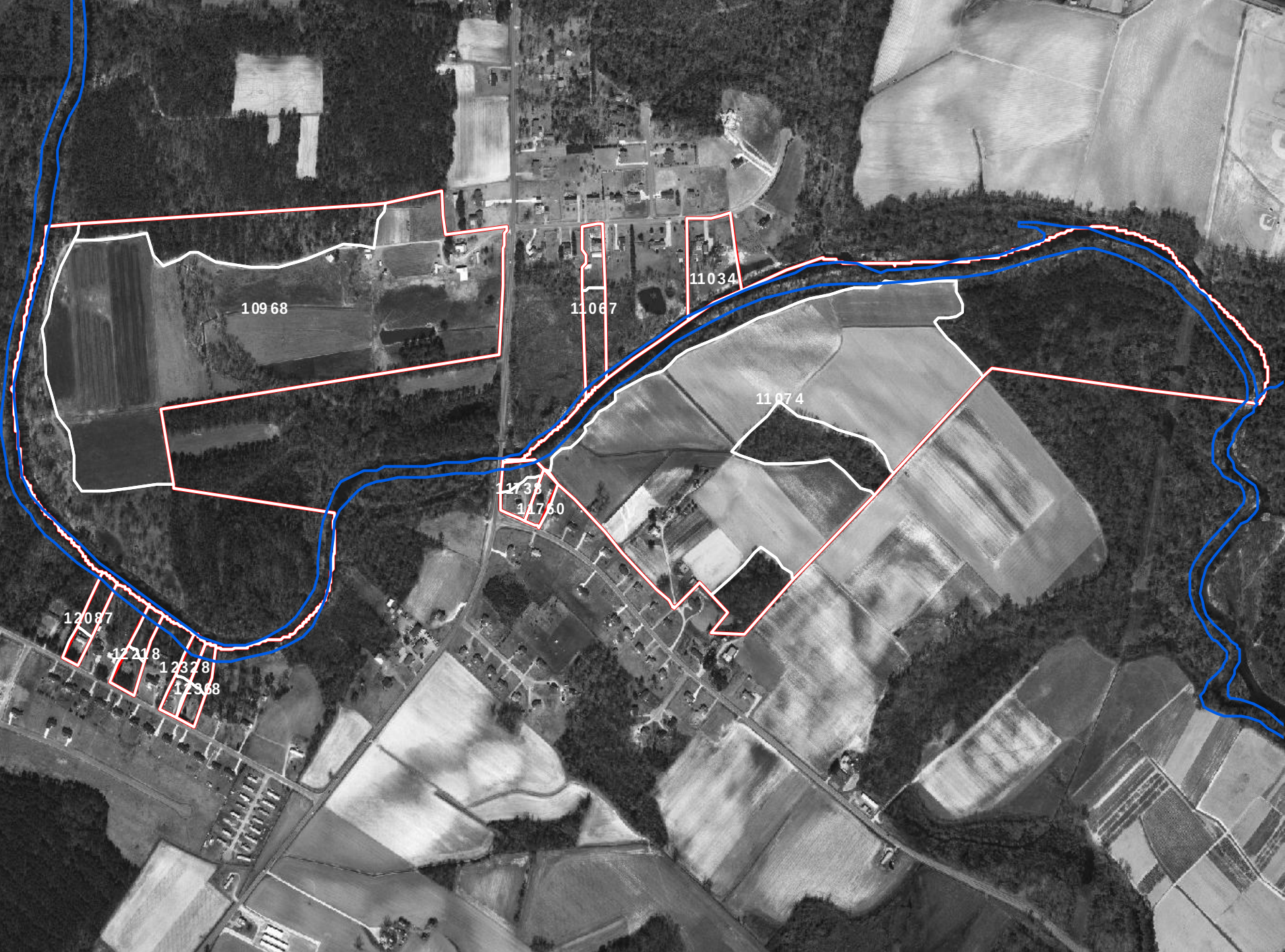
Zone 1: 30 ft.

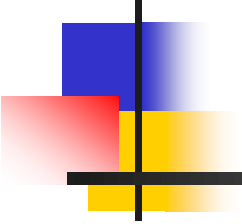
20 ft. limited harvest / 10 ft. undisturbed



Introduction

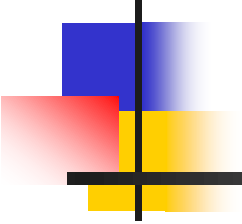
- Riparian buffers impose a restriction on the use of private property limiting harvest and development.
- The buffers may also provide aesthetic and recreational values to property owners.
- The magnitude of the countervailing effects is an empirical matter.
- This study offers quasi-experimental evidence of the effect of the Neuse River riparian buffer rule on the value of property adjacent to the waterway.





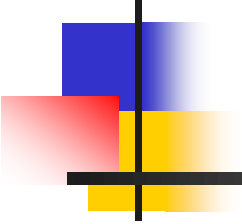
Introduction

- Hedonic price analysis
 - Sales price = $f(\text{structural, neighborhood, environmental})$
 - Use flexible statistical model to estimate this relationship and recover marginal implicit prices
 - Marginal implicit price = $\partial \text{price} / \partial \text{attribute} = \partial f(.) / \partial x$
 - Or, for discrete factors: $\Delta f(.) / \Delta x$



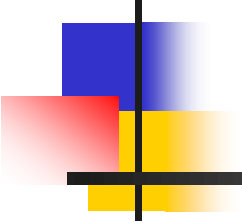
Literature – Hedonic Prices and Water

- Proximity to water: Shabman and Bertelson (1979), Milon, Gressel, and Mulkey (1984), and Earnhart (2001)
- View amenity: Kulshreshtha and Gillies (1993), Lansford and Jones (1995) and Bin et al. (2008)
- The quality of amenity: Streiner and Loomis (1996), Benson et al. (1998), and Leggett and Bockstael (2000)

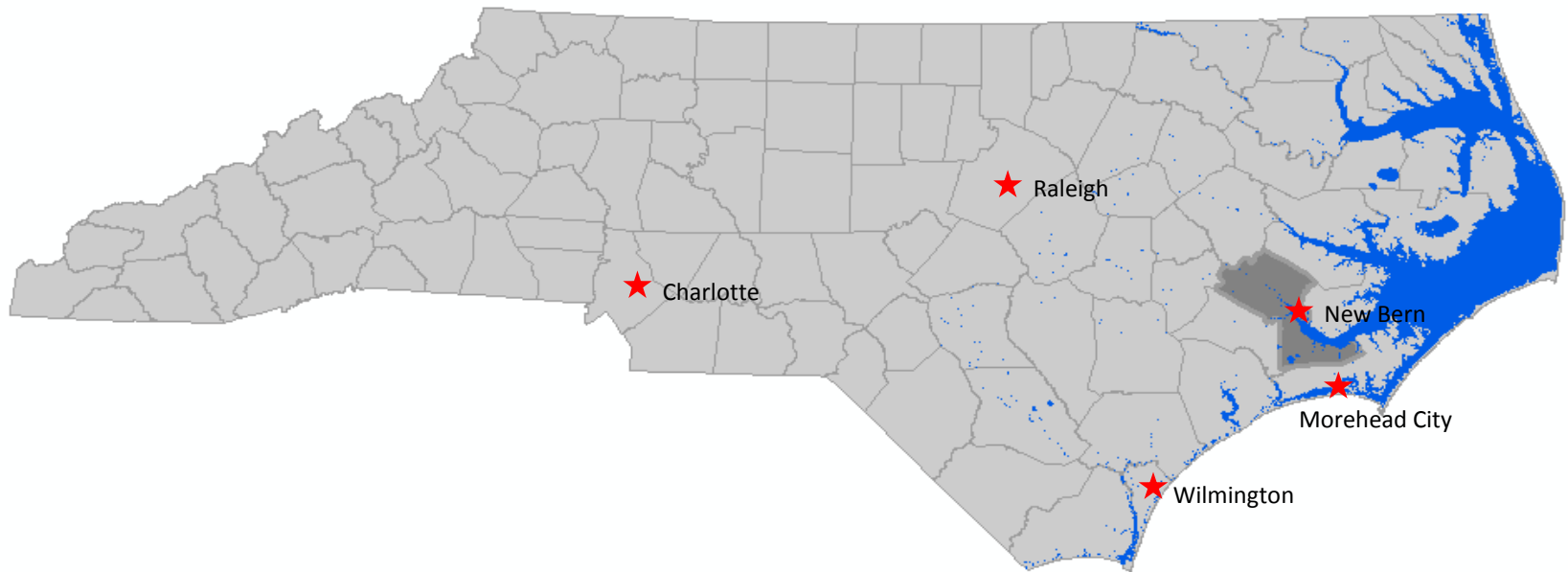


Literature – Riparian Buffers

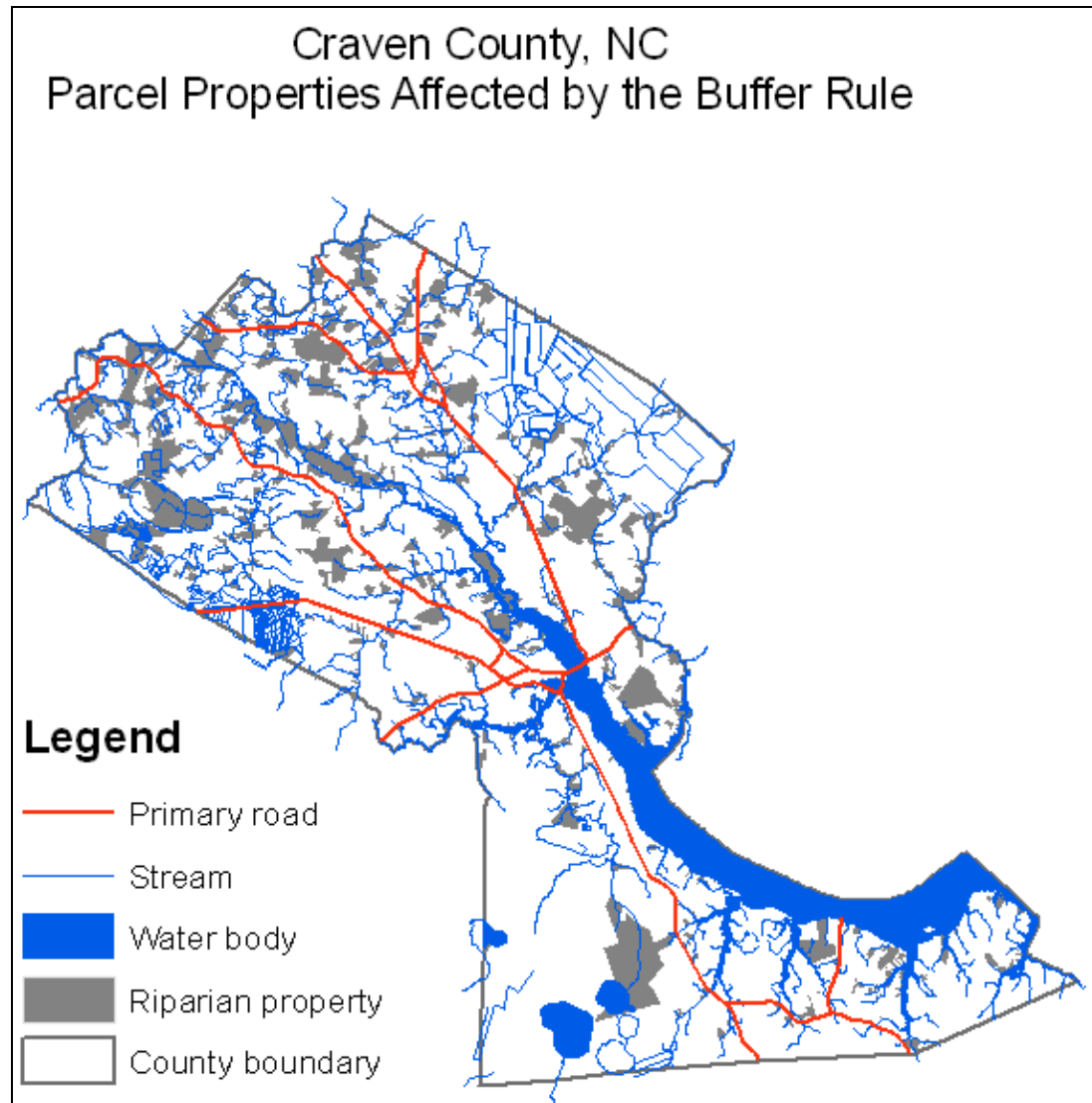
- Riparian landowner's willingness to accept: Kline, Alig, and Johnson (2000) and Amigues et al. (2002)
- Riparian buffers on agricultural land: Lynch and Brown (2000) and Ryan, Erickson, and De Young (2003)
- Mooney and Eisgruber (2001) find a negative effect of buffer width on assessed residential property value in Western Oregon.

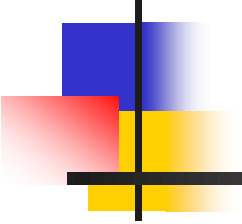


Study Area – Craven County, NC



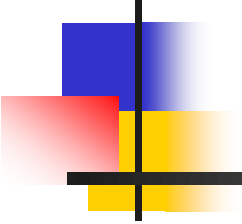
Study Area – Craven County, NC





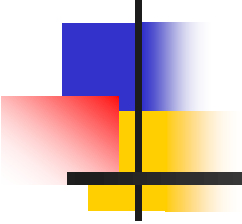
Study Area

- The Neuse River Basin is the third largest river basin in North Carolina, which encompasses approximately 6,192 square miles in 23 counties and supports 1.5 million people.
- The Neuse River Basin comprises only 20% of the total land area that drains into the Pamlico and Albemarle Sounds.
- The Neuse River contributes 35% of the total nitrogen and 45% of the total phosphorus to the Pamlico and Albemarle Sounds.



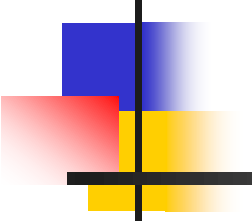
The Neuse Rule

- Record rainfalls during summer 1995 delivered a tremendous load of nitrogen into the Neuse River causing fish kills.
- In 1996, NC drafted a strategy titled Neuse River Nutrient Sensitive Waters Management Strategy, which set a 30% reduction goal for nitrogen.
- The Riparian Buffer Area Rule plays an important role in overall nitrogen reduction strategy.
- The rule was introduced as a temporary rule in July 1997 and after minor changes became a permanent rule in August 2000.



The Neuse Rule

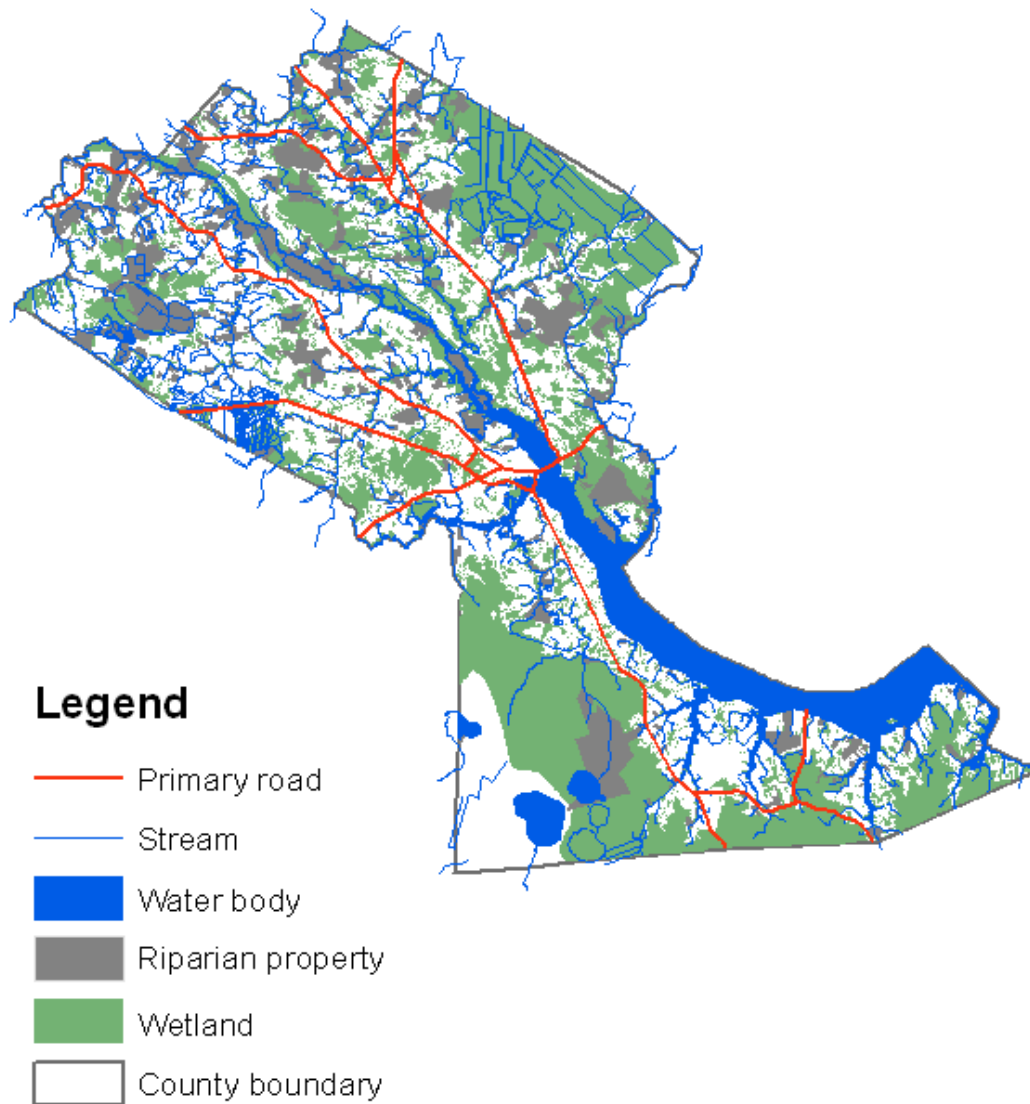
- It requires that first 50 feet of riparian area be protected and maintained on the banks of waterways in the area.
- The rule applies to all perennial and intermittent streams, lakes, ponds and estuaries in the Neuse River Basin.
- It protects undisturbed forest vegetation in the first 30 feet of land directly adjacent to any water with few exceptions. A limited amount of harvesting is allowed in the outer 20 feet of the first 30 feet of land.



Data

- Several GIS and spatial data sources are combined.
- This study uses 3,106 “straightforward” single-family residential property transactions from 1992 to 2002.
- The stream coverage dataset was selected from the Neuse River watershed streams data obtained from the North Carolina Center for Geographic Information Analysis (CGIA).
- Other geo-coded neighborhood amenities/disamenities include the distance to nearest swine/hog operation, hazardous substance disposal site, and major highway.

Data

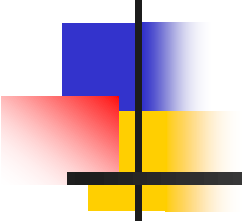


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Data

Variable	Definition	Mean	Std. Dev.
PRICE	Sales price adjusted to 2002 dollars	126,496.360	74,528.840
NEW BERN	New Bern township (= 1)	0.332	0.471
AGE	Age of house	18.473	21.238
BEDRM	Number of bedrooms	2.959	0.569
LOTSIZE	Total lot size measured in acres	0.512	0.704
SQFT	Total structure square footage	1,452.900	449.430
HOG	Distance in feet to nearest swine/hog operations	7,045.350	3,305.320
HSDS	Distance in feet to hazardous substance disposal sites	6,359.860	4,995.070
HWY	Distance in feet to major highways	1,419.580	1,517.140
WETLAND	On wetland (= 1)	0.207	0.405
RIPARIAN	On riparian zone (= 1)	0.069	0.253
RULE	Sold after the riparian buffer rule (= 1)	0.562	0.496



Methods

- The quasi-experiment approach requires property transactions for the time period before and after the imposition of the buffer rule for both riparian and non-riparian properties (Meyer 1995).
- The treatment is the imposition of the buffer rule.
- The treatment group is the riparian properties that are subject to the riparian buffer rule.
- The untreated comparison group is the non-riparian properties that do not receive the treatment but experience some or all the other influences that affect the treatment group.

Methods – Spatial Autoregression

$$\ln P_{it}^j = \beta_0 + \sum_{k=1}^K \beta_k X_{kit} + \gamma_1 d_t + \gamma_2 d^j + \gamma_3 d_t^j + \varepsilon_{it}^j$$

$$\varepsilon_{it}^j = \lambda W_i \varepsilon + u_{it}^j$$

- First-order spatial error model
- Lambda is spatial autoregression parameter
- W_i is i th row of spatial weights matrix – defines the extent of spatial autocorrelation
- u is an i.i.d. error term

Methods – Difference-in-differences

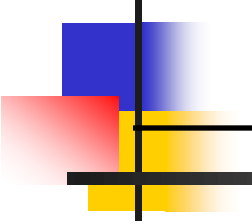
$$\ln P_{it}^j = \beta_0 + \sum_{k=1}^K \beta_k X_{kit} + \gamma_1 d_t + \gamma_2 d^j + \gamma_3 d_t^j + \varepsilon_{it}^j$$
$$\varepsilon_{it}^j = \lambda W \varepsilon_{it}^j + u_{it}^j$$

- Gamma one captures the effect influenced by time for both riparian and non-riparian properties.
- Gamma two represents other time-invariant differences between riparian and non-riparian properties.
- Gamma three represents the true causal effect of the imposition of the buffer rule on the riparian property values.

Methods – Difference-in-differences

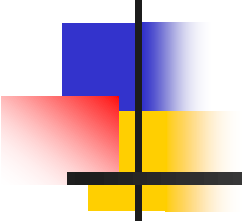
- Key identifying assumption: $E[\varepsilon_{it}^j | d_t^j] = 0$
 - Gamma three would be zero in the absence of treatment
- Treatment effect for relevant group of interest is given by:

$$\tilde{\gamma}_3 = \overline{\ln P_1^1} - \overline{\ln P_0^1} - (\overline{\ln P_1^0} - \overline{\ln P_0^0})$$



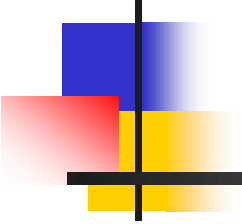
Results

Variable	Model I – Linear MLE			Model II - Spatial MLE		
	Coefficient	Std. Err.	P-value	Coefficient	Std. Err.	P-value
AGE	-0.019	0.001	<0.0001	-0.019	0.001	<0.0001
AGE ²	1.22e-04	5.50e-06	<0.0001	1.15e-04	5.81e-06	<0.0001
BEDRM	0.129	0.056	0.0184	0.111	0.053	0.0375
BEDRM ²	0.005	0.009	0.5597	0.005	0.008	0.5529
LOTSIZE	0.152	0.020	<0.0001	0.176	0.020	<0.0001
LOTSIZE ²	-0.015	0.002	<0.0001	-0.016	0.002	<0.0001
SQFT	0.001	6.27e-05	<0.0001	0.001	6.05e-05	<0.0001
SQFT ²	-1.09e-05	1.82e-06	<0.0001	-9.27e-06	1.73e-06	<0.0001
<i>ln</i> (HOG)	0.038	0.014	0.0069	0.068	0.016	<0.0001
<i>ln</i> (HSDS)	-2.79e-04	0.010	0.9763	-0.003	0.011	0.8297
<i>ln</i> (HWY)	0.038	0.006	<0.0001	0.051	0.007	<0.0001
WETLAND	-0.031	0.015	0.0422	-0.036	0.017	0.0353
RIPARIAN	0.216	0.037	<0.0001	0.259	0.036	<0.0001
RULE	0.094	0.012	<0.0001	0.104	0.011	<0.0001
RIPARIAN*RULE	0.044	0.047	0.3477	0.003	0.042	0.9524
LAMBDA				0.349	0.016	<0.0001



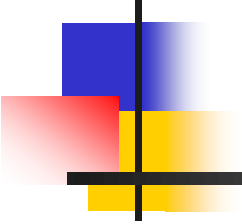
Results

Variable	Marginal Willingness to Pay		
	95% Lower Bound	Mean	95% Upper Bound
HOG	\$673.77	\$1,226.65	\$1,760.20
HWY	\$3,291.08	\$4,503.11	\$5,701.14
WETLAND	-\$8,528.00	-\$4,416.15	-\$413.30
RIPARIAN	\$26,299.25	\$37,423.17	\$48,998.86



Results

- Riparian property commands a substantial premium and raises the property values by 25.9% or \$ 37,423.
- The mandatory buffer rule had no significant impacts on the riparian property values.
- The property location within a classified wetland lowers the property values by 3.6% or \$4,381.
- Decreasing distance to nearest hog operation by 1,000 feet results in \$1,227 decrease in property value.



Conclusions

- This study offers quasi-experimental evidence of the effect of the mandatory riparian buffer rule on the willingness to pay for riparian buffers using a quasi-experimental approach.
- A restriction on a land parcel's use should not increase its value, but if the restriction is simultaneously placed on neighboring properties with the result being an improvement in water quality and general aesthetics, then it is possible that such a rule may enhance riparian property values.
- Our results provide only a limited measure of economic effects of riparian buffers.