Mapping and Modeling Residential Development in Baltimore County

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Residential development in Baltimore County

Land use trends and zoning policies

Subdivision data in 1960-2008

Residential land-use change models in 1996-2007

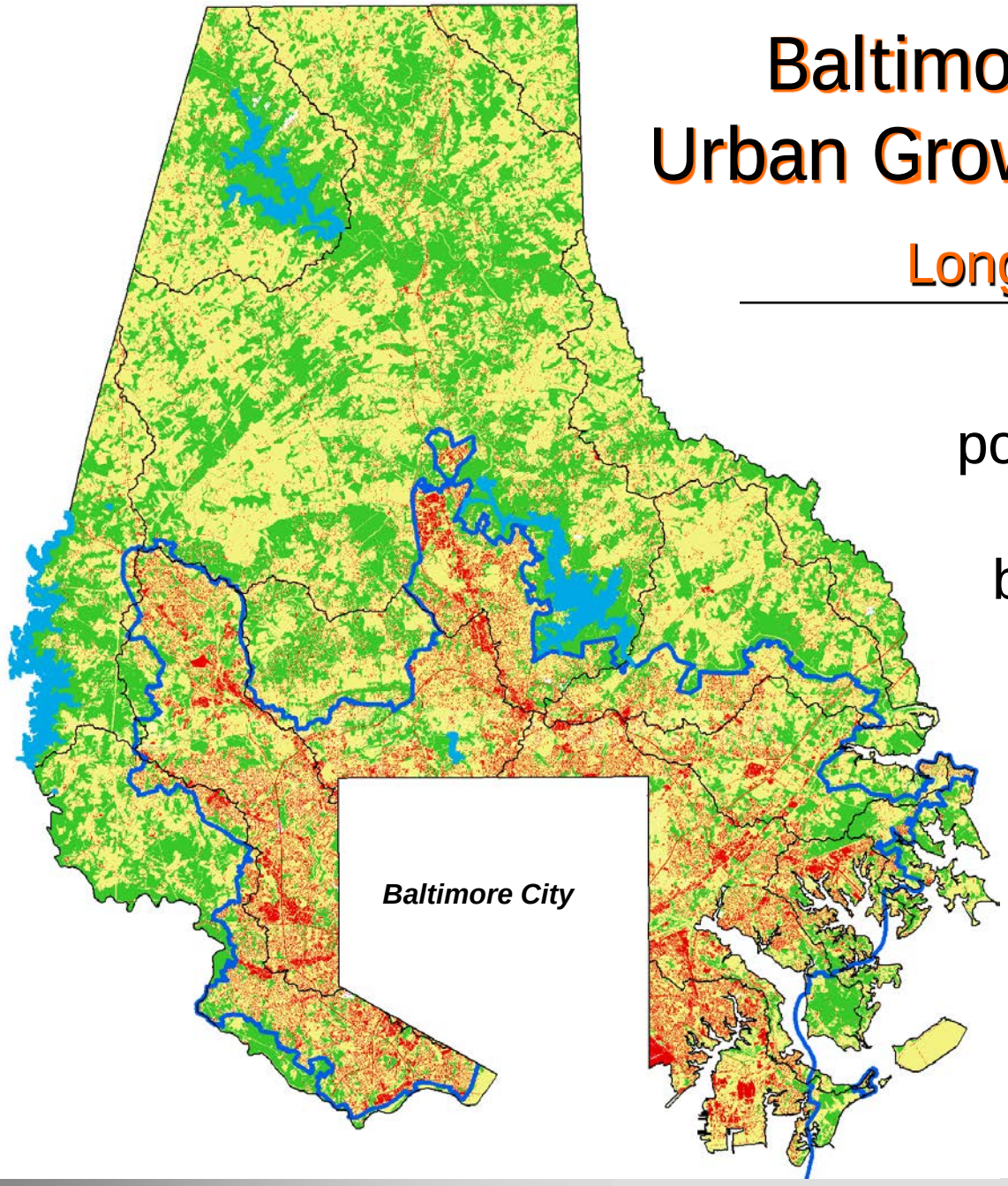
Excess zoned capacity and septic law in Maryland

- Business as usual (before septic law)
- After septic growth tiers adopted

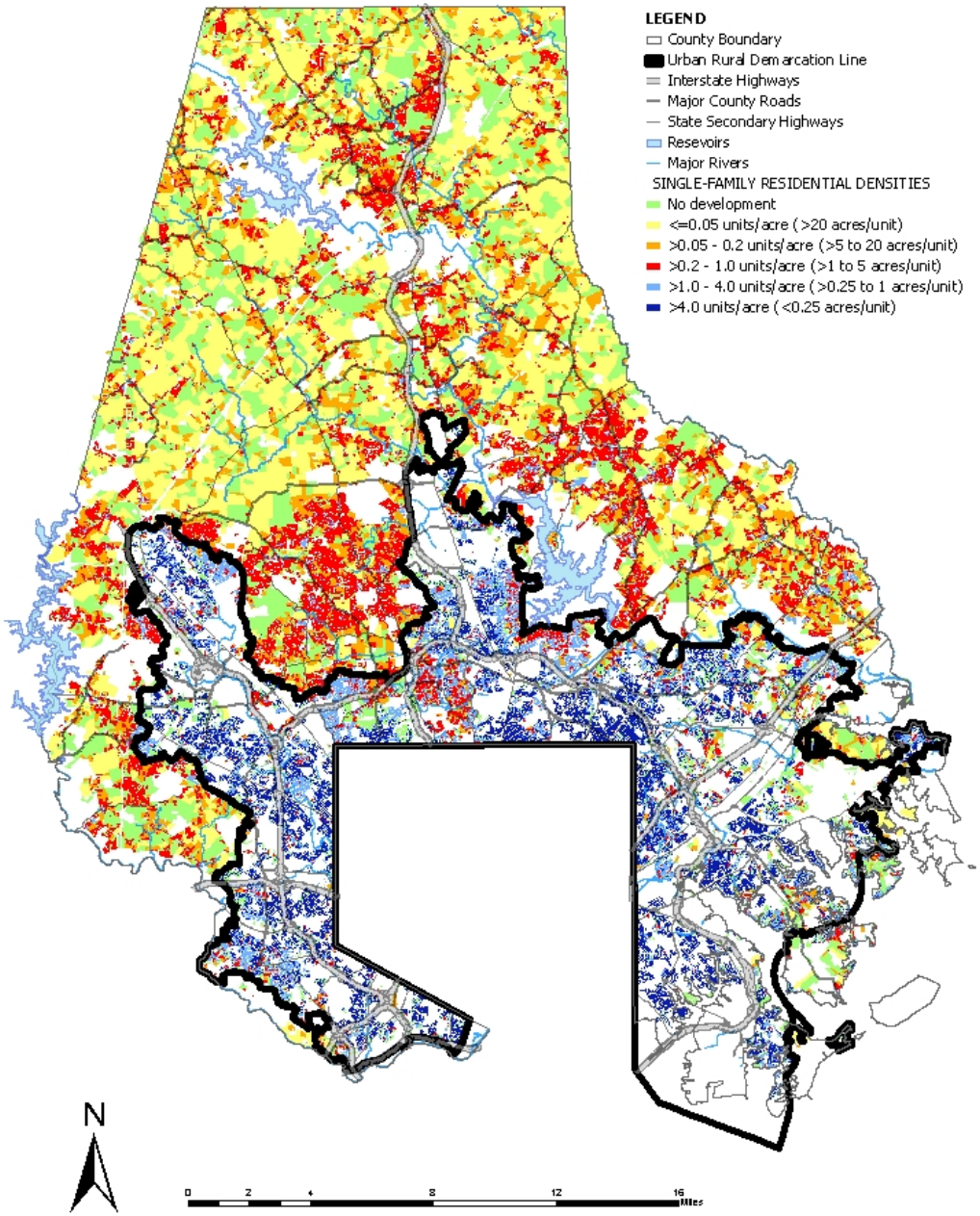
Baltimore County Urban Growth Boundary

Long-Term Results

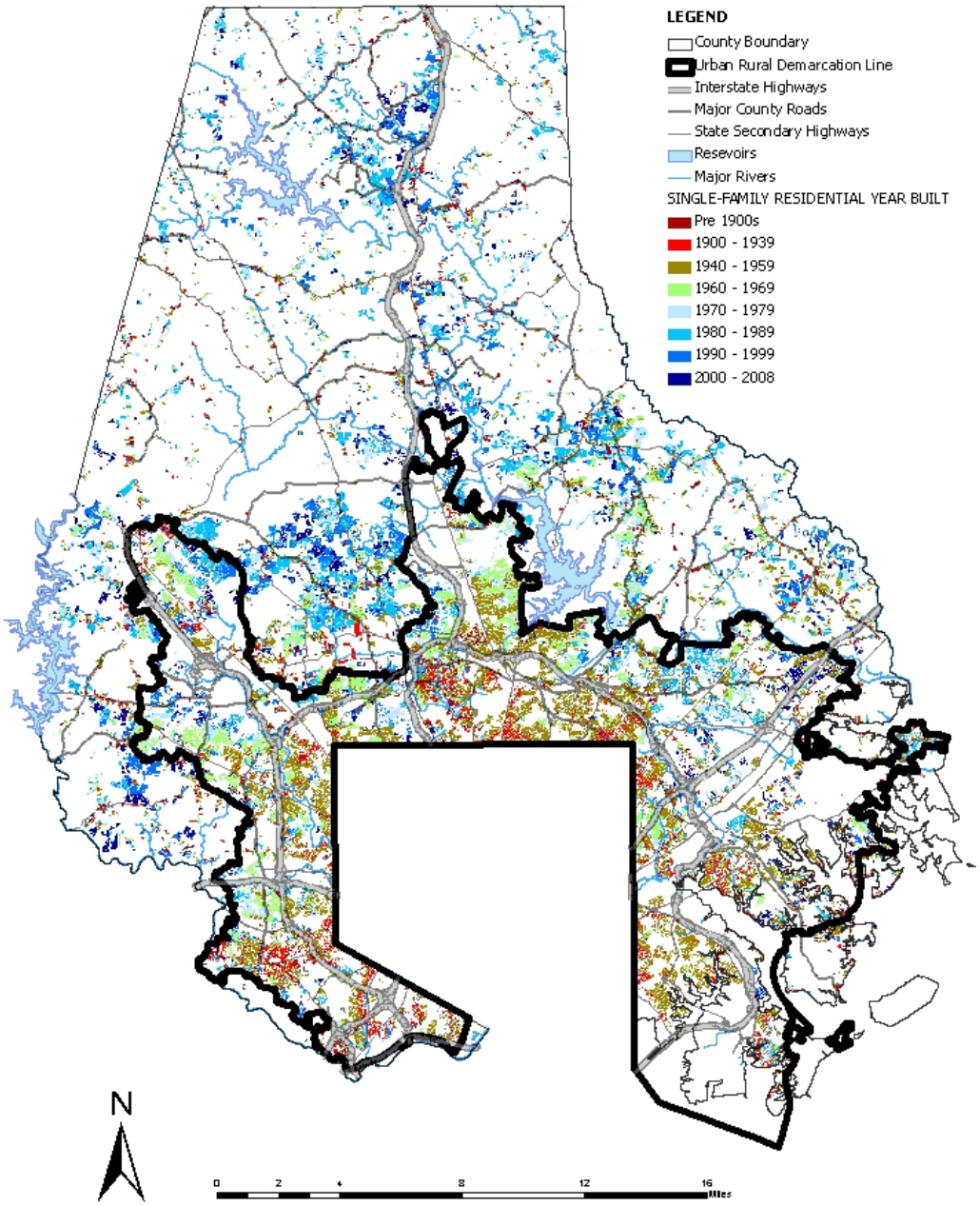
90% of year 2000 population lived inside the urban growth boundary (UGB) on 1/3 of the land



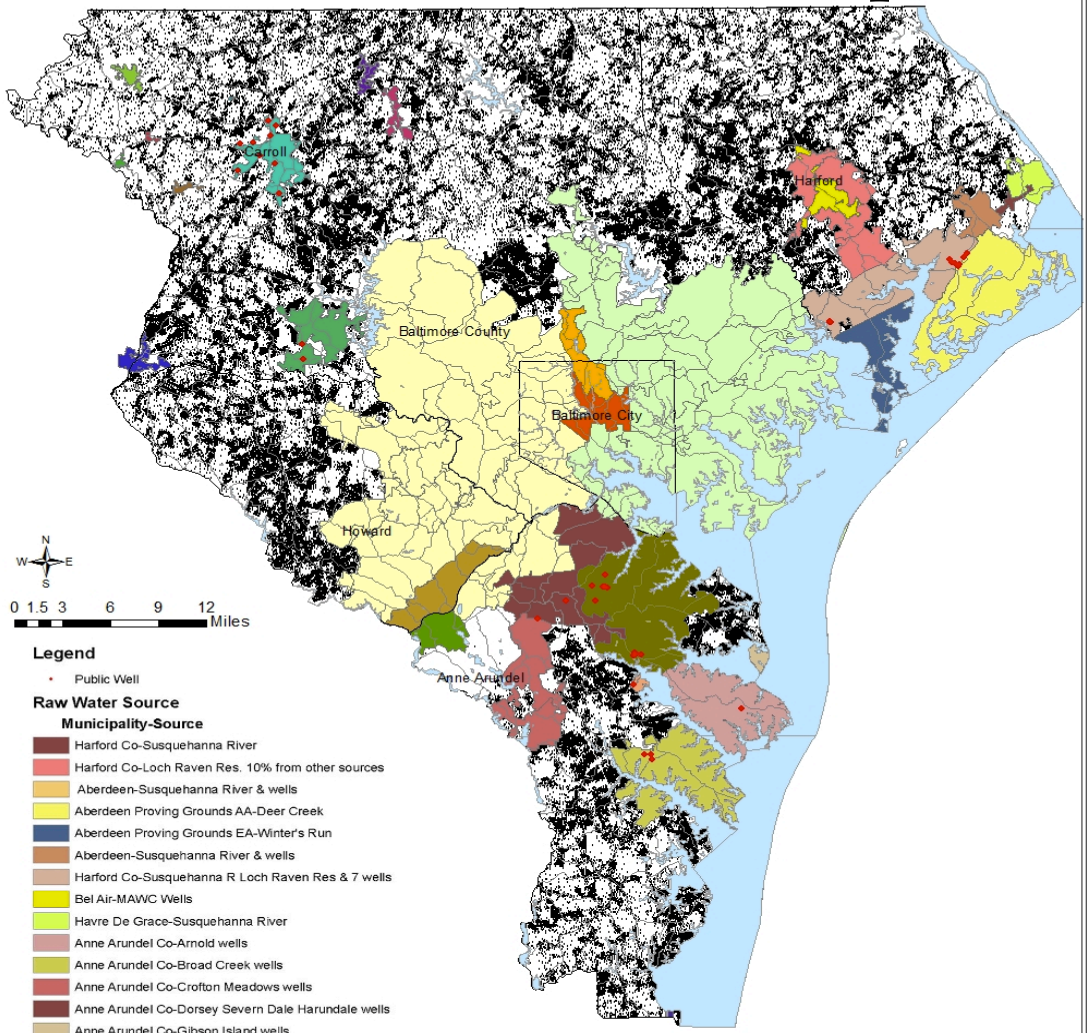
Residential density in 2008



Residential Development by Year Built



Groundwater wells and septic



Legend

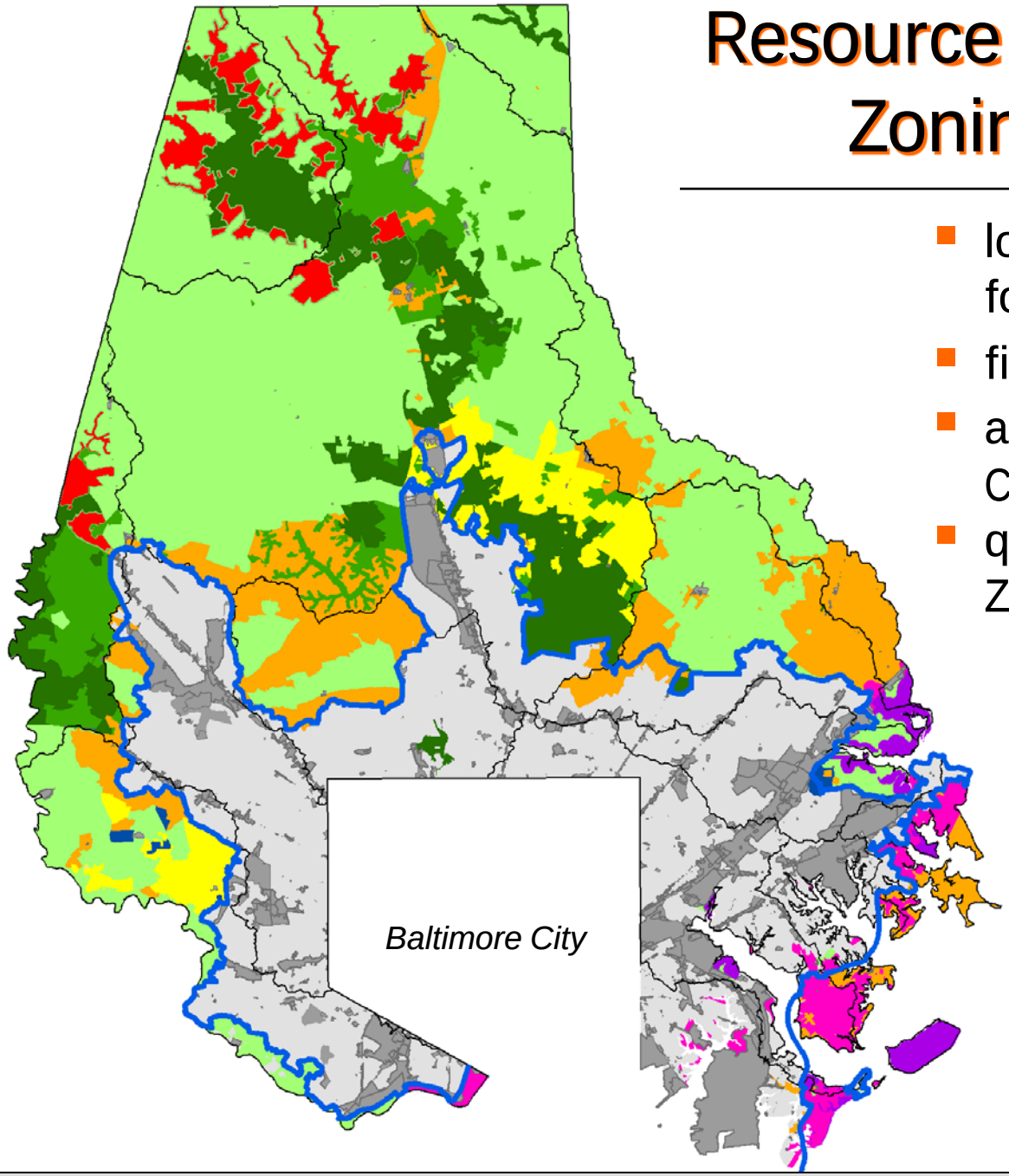
- Public Well

Raw Water Source

Municipality-Source

- Harford Co-Susquehanna River
- Harford Co-Loch Raven Res. 10% from other sources
- Aberdeen-Susquehanna River & wells
- Aberdeen Proving Grounds AA-Deer Creek
- Aberdeen Proving Grounds EA-Winter's Run
- Aberdeen-Susquehanna River & wells
- Harford Co-Susquehanna R Loch Raven Res & 7 wells
- Bel Air-MAWC Wells
- Havre De Grace-Susquehanna River
- Anne Arundel Co-Arnold wells
- Anne Arundel Co-Broad Creek wells
- Anne Arundel Co-Crofton Meadows wells
- Anne Arundel Co-Dorsey Severn Dale Harundale wells
- Anne Arundel Co-Gibson Island wells
- Anne Arundel Co-Herald Harbor wells
- Anne Arundel Co-Liberty Reservoir & Dorsey wells
- Anne Arundel Co-Rose Haven wells
- Anne Arundel Co-Severn Dale & Harundale wells
- Carrol County-Liberty Reservoir & 2 wells
- Bramble Hills-Cranberry Reservoir & 2 wells
- Hampstead-17 wells
- Manchester-14 wells
- Mt. Airy-10 wells
- New Windsor-2 wells
- Westminster-Cranberry Reservoir & 9 wells
- Pleasant Valley-wells
- Bark Hill-wells
- Howard Co-T. Howard Duckett Reservoir
- Baltimore City-50% Liberty Reservoir 50% Loch Raven Reservoir
- Baltimore City County Anne Arundell Co-Loch Raven Reservoir
- Baltimore City County-75% Loch Raven Reservoir 25% Liberty Reservoir
- Blatimore City County Howard Co Anne Arundel Co-Liberty Reservoir
- Maryland HUC 8 Watersheds
- Maryland Counties

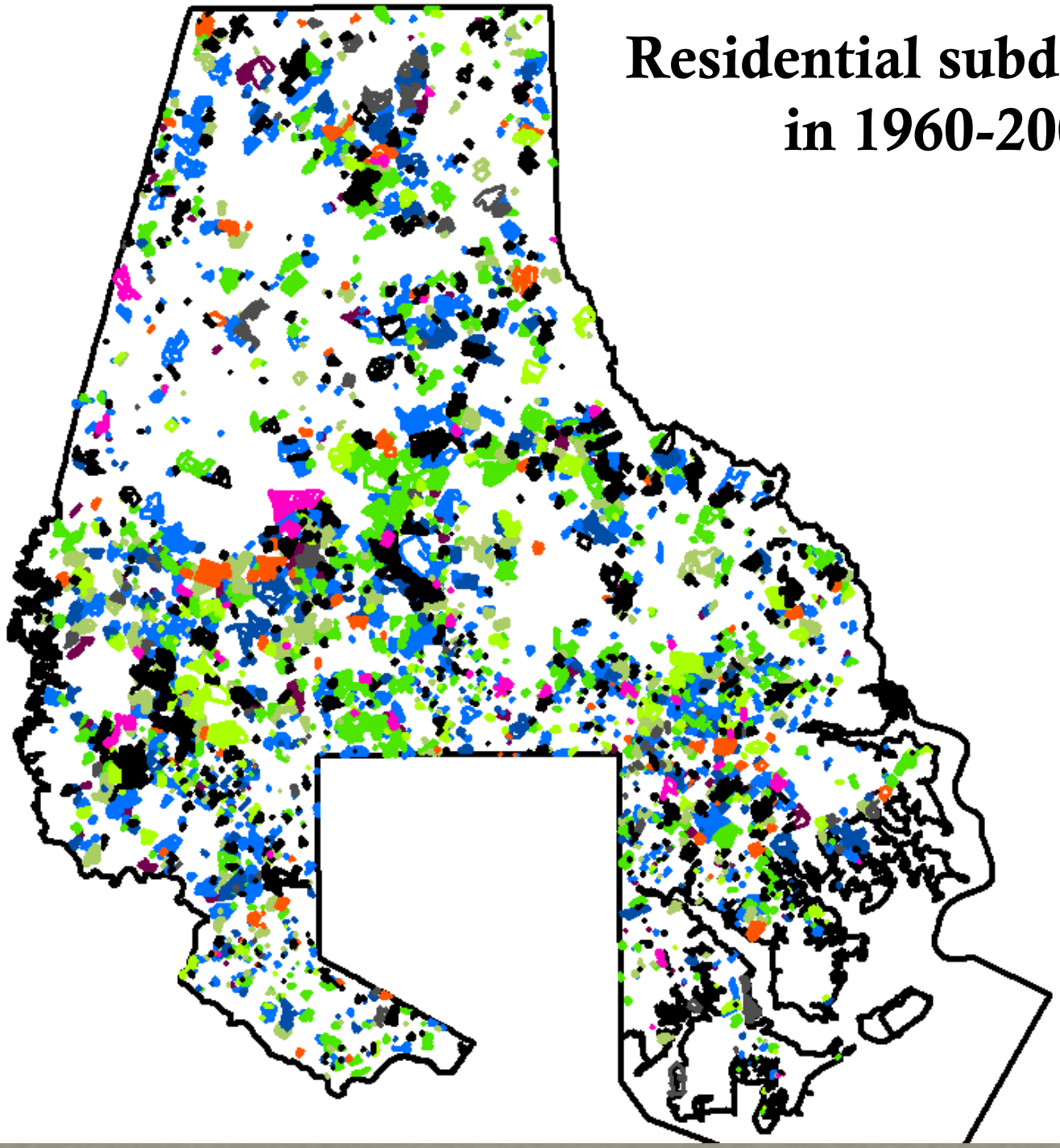
Resource Conservation Zoning - 2008



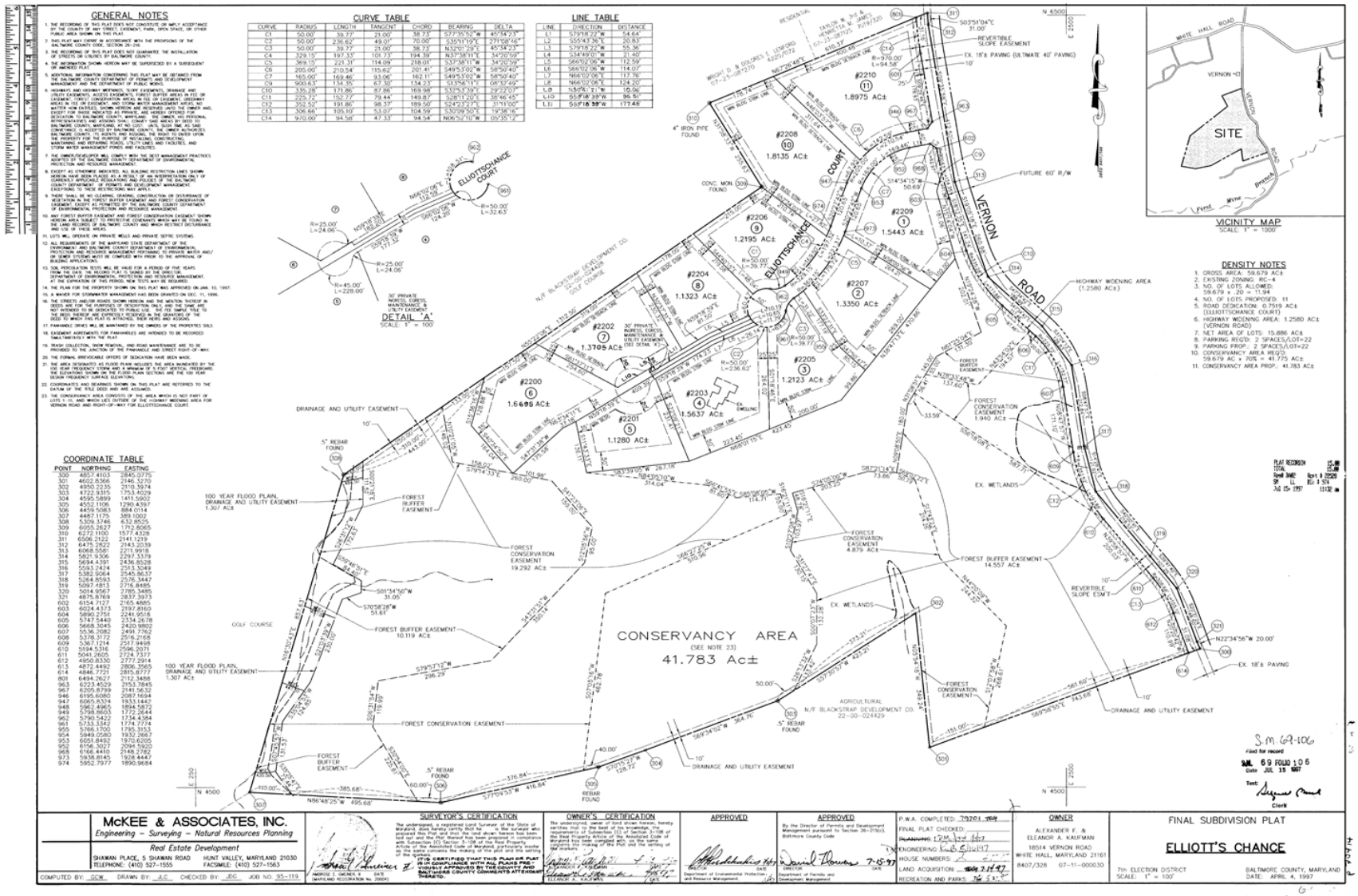
- low-density zoning protects forests and water resources
- first adopted in 1975
- applies to about 2/3 of the County
- quadrennial Comprehensive Zoning Map Process

RC-2 0.02 du/ac (1:50)
RC-4 0.20 du/ac (1:5)
RC-5 0.66 du/ac (1:2)
RC-6 0.20 du/ac (1:5
RC-7 0.04 du/ac (1:25)
RC-8 0.02 du/ac (1:50)
RC-20 CBCA's RC-5
RC-50 CBCA's RC-2
Urban Residential
Urban Non-Residential
URDL

Residential subdivisions in 1960-2008



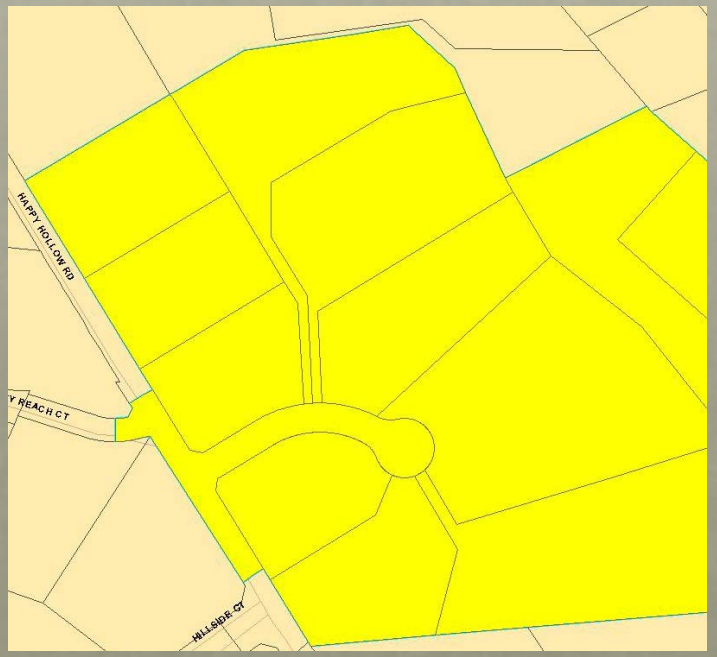
Subdivision in RC4 zoning



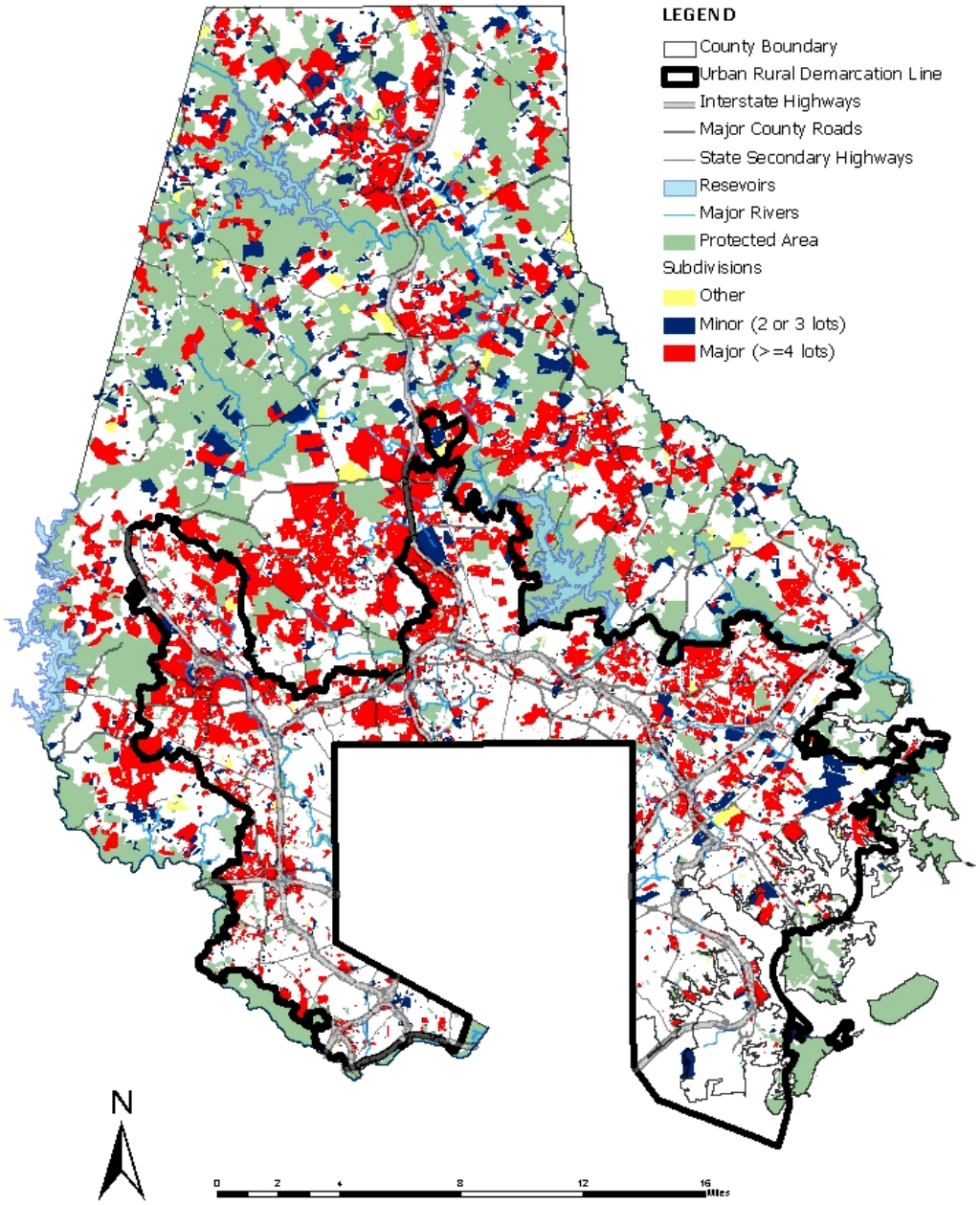
Subdivisions

MD Property View parcel data to reconstruct historic subdivisions 1960-2008:

- Identify polygons in MDPV parcel layer within same subdivision
- Dissolve individual parcels into original parent parcel
- Record year start and number of lots in subdivision



Residential Subdivisions in 1960-2008



Major versus minor subdivisions

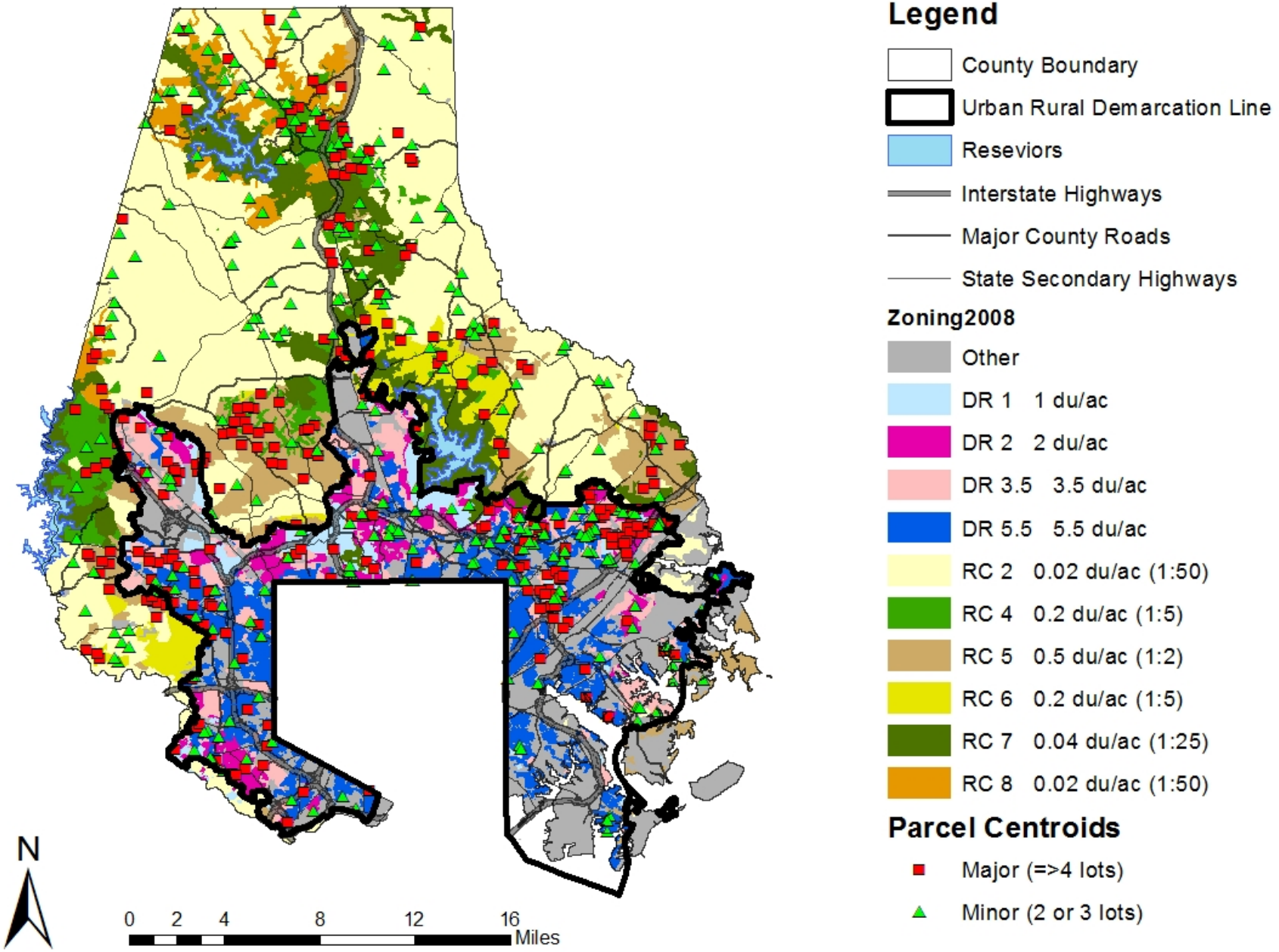
Major subdivisions (4+ lots)

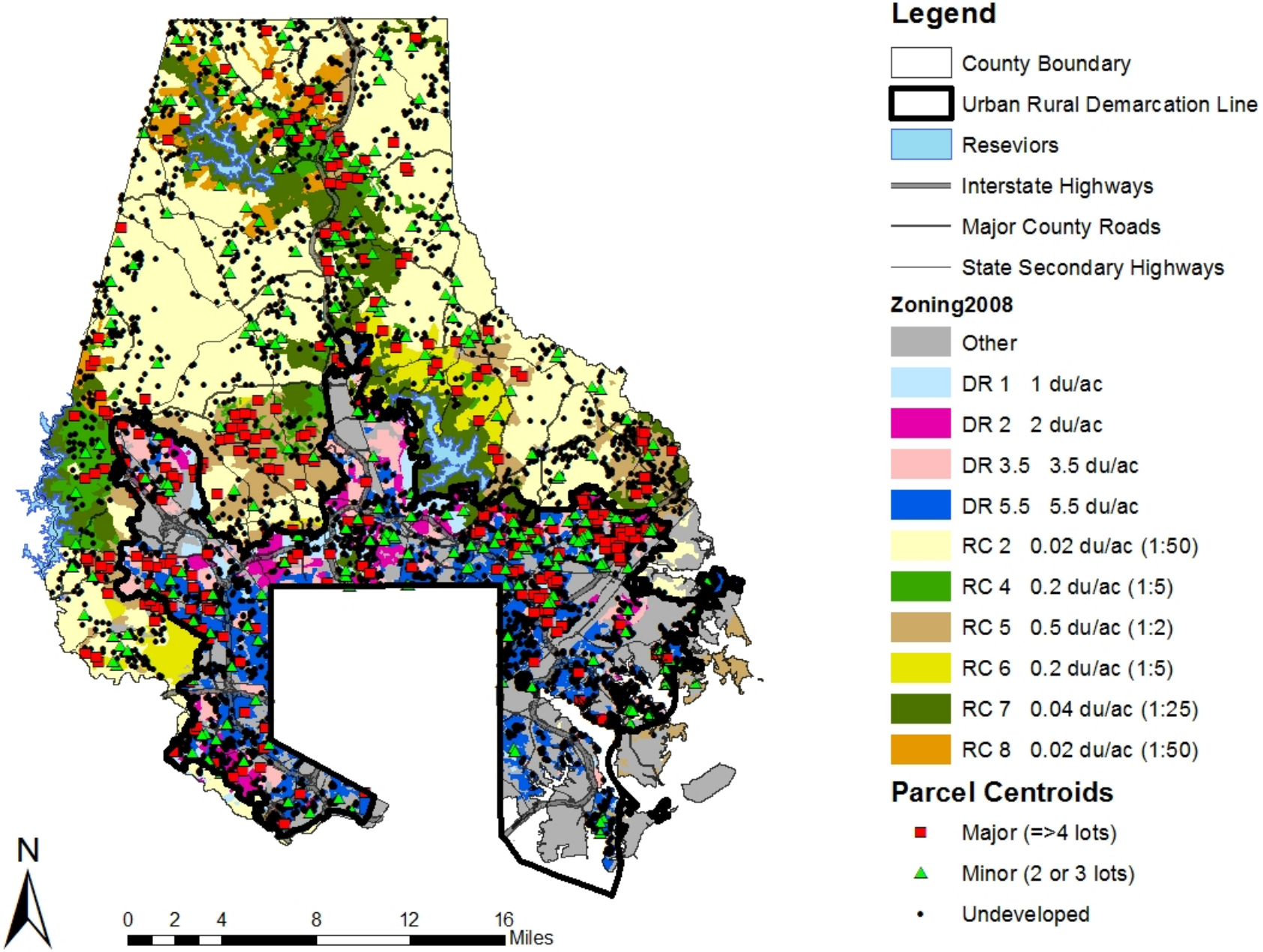
- Formal public hearing for subdivision approval
- Longer permit review process

Minor subdivisions (2 or 3 lots)

- No formal public hearing (only planning board approval needed)
- Shorter permit review process
- Minor exemption rules in RC2 and RC4 zoning
  - RC2 zoning (50-acre min lot size): Allows 2 lots for parcels between 2 and 100 acres
  - RC4 zoning (5-acre min lot size): Allows 2 lots for parcels between 6 and 10 acres

Residential subdivisions in 1996-2007




Legend
County Boundary
Urban Rural Demarcation Line
Reseviors
Interstate Highways
Major County Roads
State Secondary Highways
Zoning2008
Other
DR 1 1 du/ac
DR 2 2 du/ac
DR 3.5 3.5 du/ac
DR 5.5 5.5 du/ac
RC 2 0.02 du/ac (1:50)
RC 4 0.2 du/ac (1:5)
RC 5 0.5 du/ac (1:2)
RC 6 0.2 du/ac (1:5)
RC 7 0.04 du/ac (1:25)
RC 8 0.02 du/ac (1:50)
Parcel Centroids
Major (=>4 lots)
Minor (2 or 3 lots)
Undeveloped
N
0 2 4 8 12 16
Miles

Residential land-use change model

Binary model specification

Baseline data

Developable parcels in 1996 (zoning allows 2 or more lots)

Residential development model (first-stage)

Binary probit model for land-use transitions in 1996-2007

Categories: Develop or remain developable

Truncated count model (second-stage)

Number of buildable lots in subdivision, conditional on development in 1996-2007

Truncated negative binomial model

Subdivision must have 2 or more lots (truncated at zero or one)

Explanatory variables

Zoning attributes

- Zoning type
- Authorized lots minor

Accessibility attributes

- Distance to Baltimore City
- Distance to major road

Physical land attributes

- Parcel area
- Slope
- Elevation
- Soil quality (good/fair, poor, very poor)
- Water table depth
- 100-year floodplain
- Existing house
- Rural Legacy area

Residential land-use change model

	Binary Probit Model		Truncated Negative Binomial Model	
Variables	**Coefficient**	**Rob. St. Err.**	**Coefficient**	**Rob. St. Err.**
RC2 (0.02 du/ac)	-0.795**	(0.136)	-4.574**	(0.247)
RC8 (0.02 du/ac)	-0.908**	(0.242)	-4.421**	(0.836)
RC7 (0.04 du/ac)	-0.617**	(0.235)	-2.683**	(0.438)
RC6 (0.2 du/ac)	-0.566*	(0.242)	-1.928**	(0.316)
RC4 (0.2 du/ac)	-0.516**	(0.109)	-3.014**	(0.188)
RC5 (0.5 du/ac)	-0.420**	(0.083)	-2.292**	(0.134)
DR1 (1 du/ac)	-0.266**	(0.093)	-1.497**	(0.174)
DR2 (2 du/ac)	-0.278**	(0.071)	-0.767**	(0.129)
DR3.5 (3.5 du/ac)	-0.044	(0.050)	-0.350**	(0.093)
Auth lots_2	-0.293**	(0.080)	-0.518*	(0.236)
Auth lots_3	-0.131*	(0.057)	-0.457*	(0.183)

Baseline zoning = DR5.5 (5.5. du/ac)

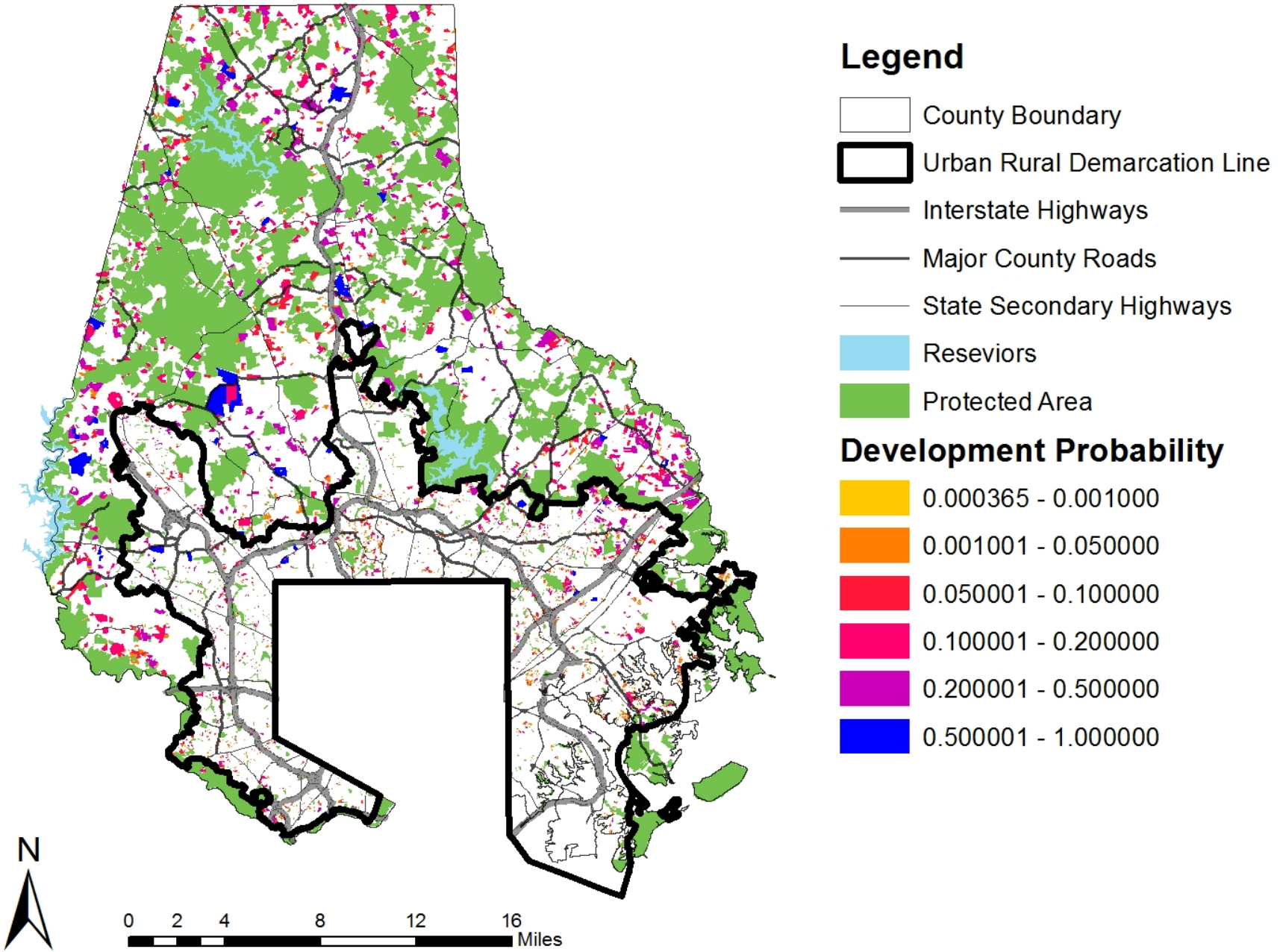
Significance at the 1 %, and 5% level are represented by ** and * respectively

Residential land-use change model (cont'd)

	Binary Probit Model		Truncated Negative Binomial Model	
Variables	**Coefficient**	**Rob. St. Err.**	**Coefficient**	**Rob. St. Err.**
Distance to Baltimore City	-0.003	0.003	-0.001	0.006
Distance to major road	-0.045	0.029	-0.054	0.058
Ln(parcel area)	0.336**	0.021	1.166**	0.033
Slope	-0.014**	0.004	-0.015	0.008
Elevation	0.024**	0.004	0.014	0.007
Poor soil	0.066	0.046	-0.067	0.090
Very poor soil	-0.071	0.109	-0.778**	0.210
Water table depth	-0.011	0.018	0.005	0.032
Floodplain_100yr	-0.637**	0.159	-1.125**	0.410
Existing house	-0.302**	0.039	-0.096	0.058
Rural Legacy	0.263**	0.061	-0.241*	0.121
Alpha	-	-	0.177**	0.023
Constant	-2.580**	0.102	0.438*	0.202
Number of observations	68,531		559	

Time fixed effects for 1996-2006 are estimated but not shown here.
Significance at the 1 %, and 5% level are represented by ** and * respectively

Predicted probability of development in 1996-2007



Predicted development in 1996-2007

Subdivisions

	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	116	112	228
Major small (4-19 lots)	141	112	254
Major large (20+ lots)	47	35	83
Total	304	259	564

Buildable lots

	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	277	256	534
Major small (4-19 lots)	1116	966	2084
Major large (20+ lots)	3739	1467	5209
Total	5133	2689	7827

Acreage developed

	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	193	2429	2622
Major small (4-19 lots)	671	5303	5976
Major large (20+ lots)	1507	4025	5533
Total	2370	11757	14131

Excess zone capacity and septic law in Maryland

Septic Law

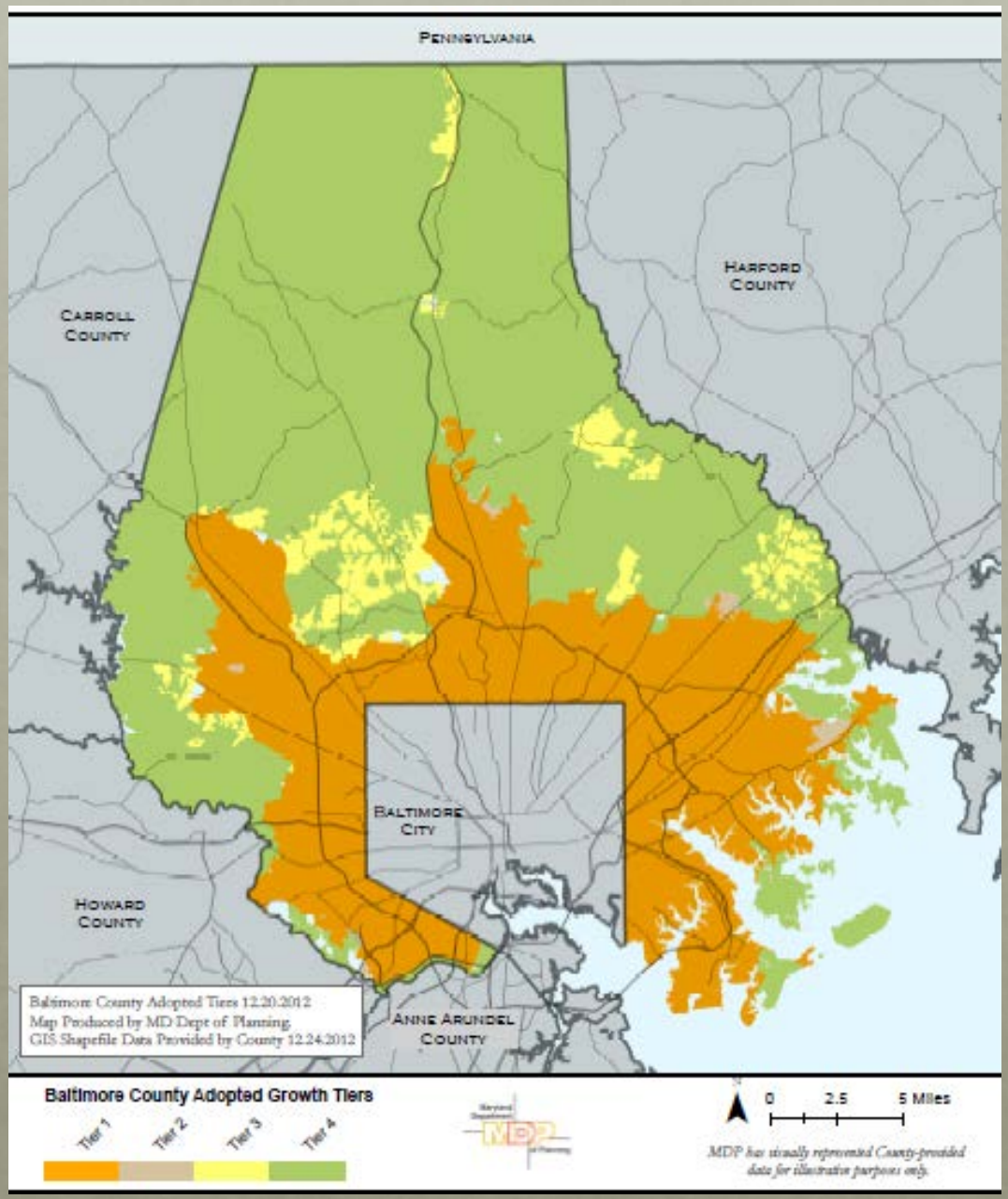
Sustainability Growth and Agricultural Preservation Act ("septic bill") passed by State of Maryland in 2012

Purpose: Restrict major subdivisions on septic systems in resource areas dominated by agricultural and forest lands (Tier 4)

Four tier system:

- Tier 1 = Existing sewer service areas
- Tier 2 = Planned sewer areas (future growth areas)
- Tier 3 = Major subdivisions on septic allowed (Large-lot residential development and rural villages)
- Tier 4 = No major subdivisions on septic (Agricultural and forest dominated areas)
    - Only minor subdivision are allowed

Baltimore County Growth Tiers



Tier 1 and Tier 2 = Inside URDL (existing and planned sewer)

Tier 3 = RC5 zoning mainly

Tier 4 = All other RC zoning types and portion of RC5 zoning

- Only minor subdivision with 3 lots are allowed

Excess zoned capacity (EZC)

$$\text{EZC} = \frac{\text{Parcel area}}{\text{Minimum lot zoning}} - \text{Number of existing houses}$$

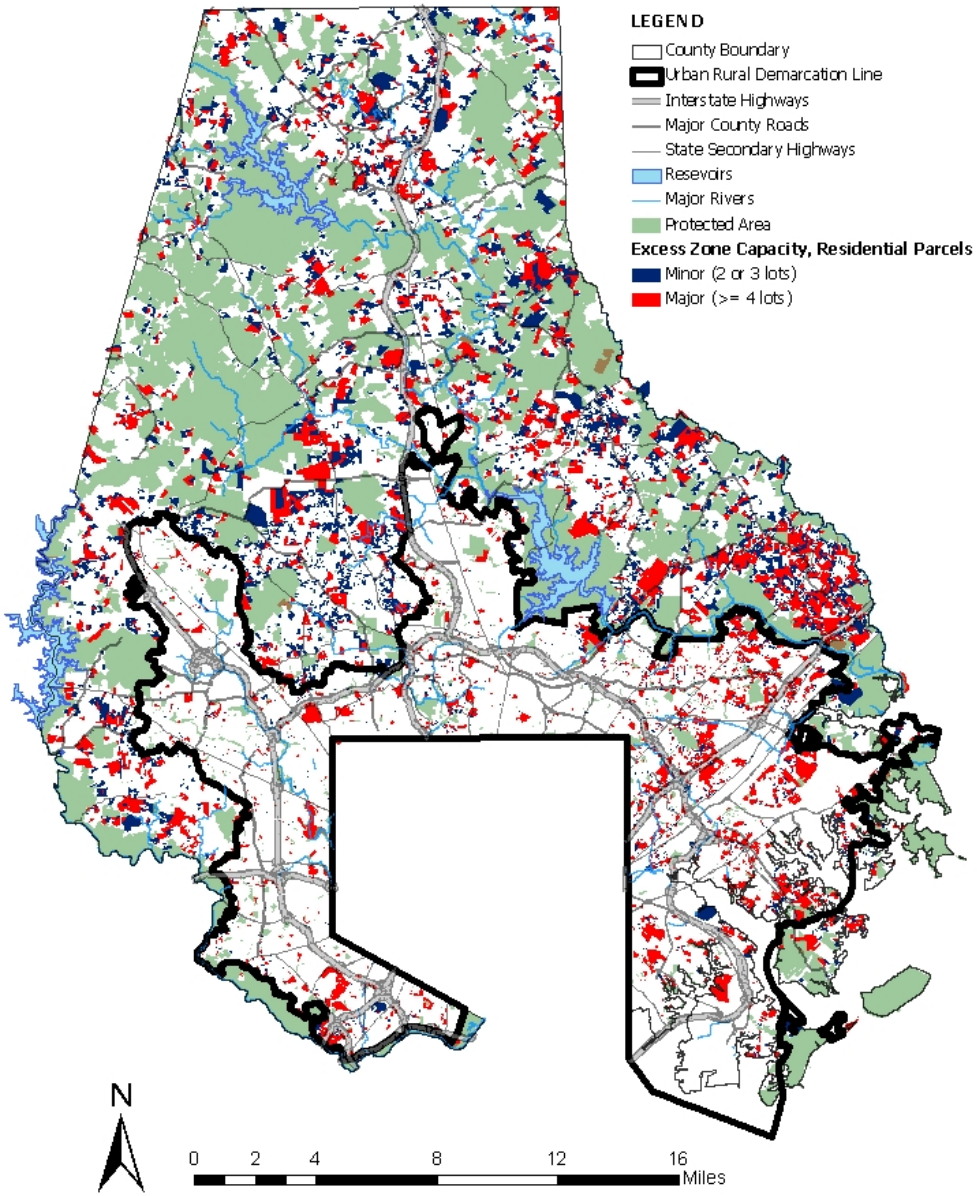
Example #1: 75-acre vacant parcel in RC4 zoning (5-acre min lot zoning).

$$\text{EZC} = \frac{75}{5} - 0 = 15 \text{ lots remaining}$$

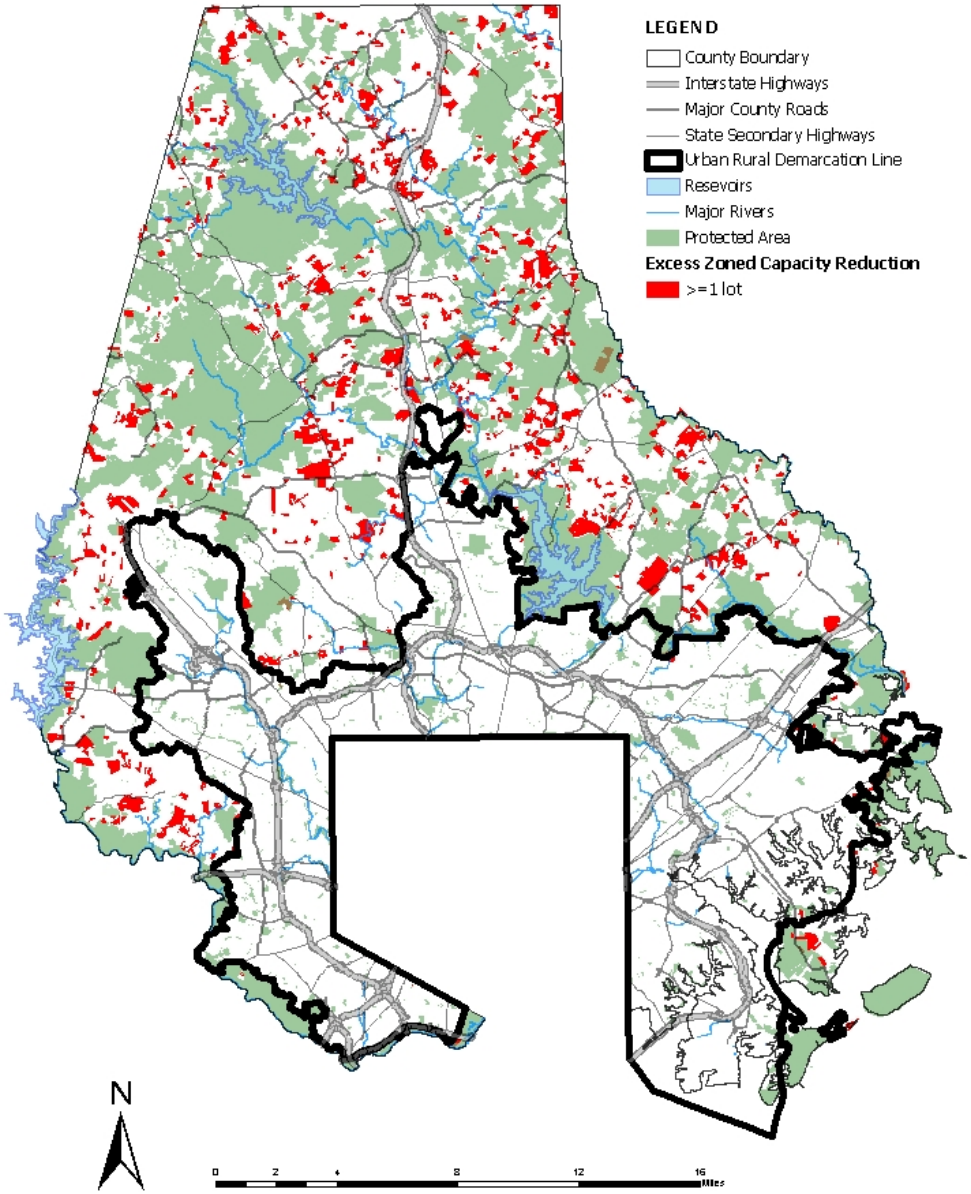
Septic bill impact on EZC = 15 – 3 = 12 lot reduction

Assumes minor subdivision with 3 lots built in Baltimore County.
In contrast, Carroll County has redefined minors to 7 lots.

Excess Zoned Capacity



Excess Zoned Capacity Reduction



Septic bill impacts in Tier 4

All rural watersheds (Baltimore County only)

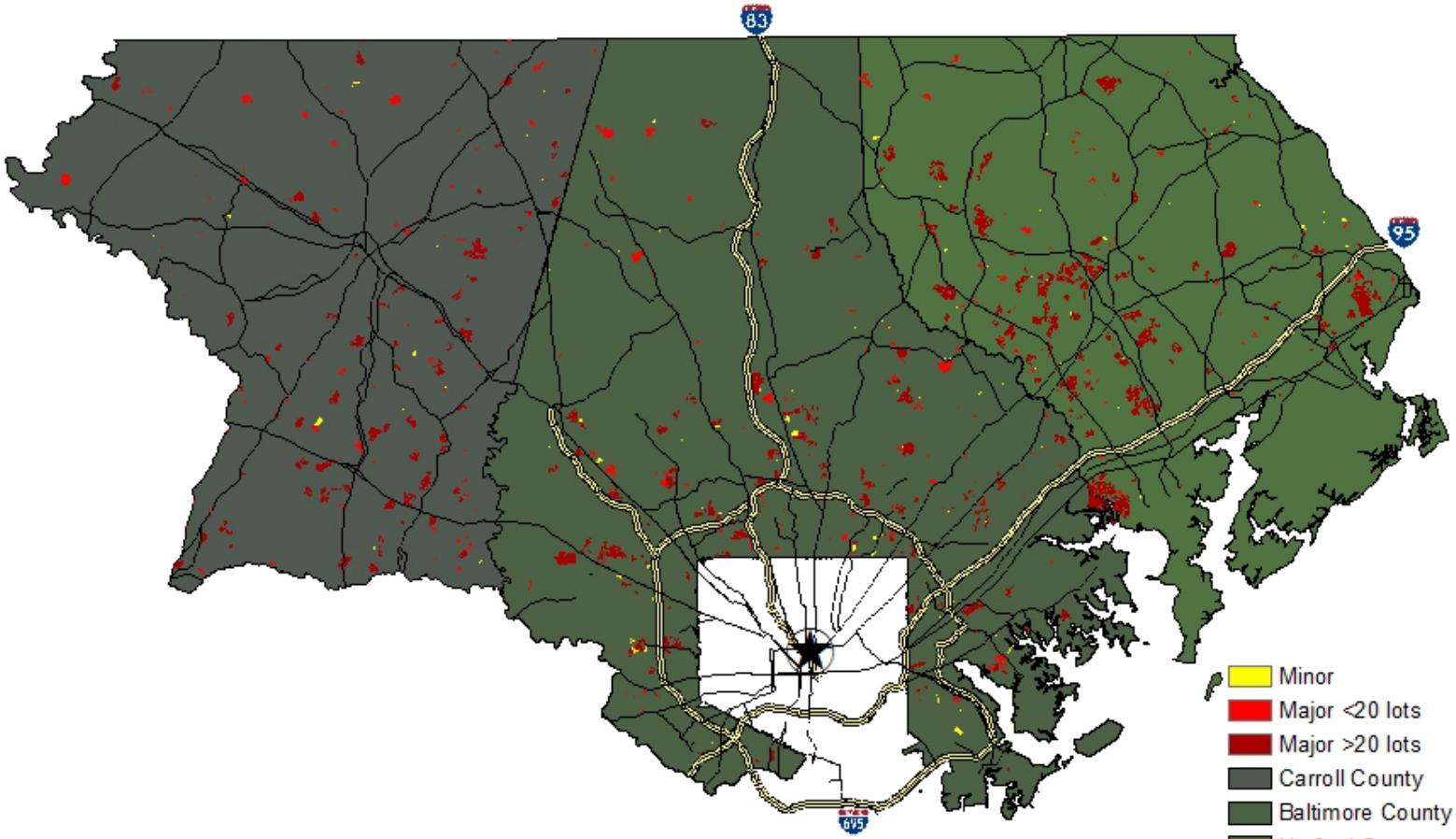
	Subdivision potential	RC2	RC4	RC5	RC6	RC7	RC8	Total
Parcels	Developed already	11,699	3,787	3,163	3,397	1,445	1,461	25,329
	Potential minor (2 or 3 lots)	3,595	134	146	52	14	101	4,055
	Potential major (4+ lots)	10	70	182	53	22	0	345
Buildable lots	Existing house	8,895	2,893	2,054	2,889	993	1,087	18,995
	Potential minor (2 or 3 lots)	5,044	212	262	99	29	164	5,831
	Potential major (4+ lots) (BEFORE)	57	591	1,872	514	407	0	3,516
	Potential major (4+ lots) (AFTER)	30	210	546	159	66	0	1,035
	Septic bill impact (CHANGE in Lots)	27	381	1,326	355	341	0	2,481
	% Septic impact/Potential major	47%	64%	71%	69%	84%	NA	71%
	% Septic impact/Potential major + minor	1%	47%	62%	58%	78%	0%	27%
	% Septic impact/Existing + potential	0%	10%	32%	10%	24%	0%	9%

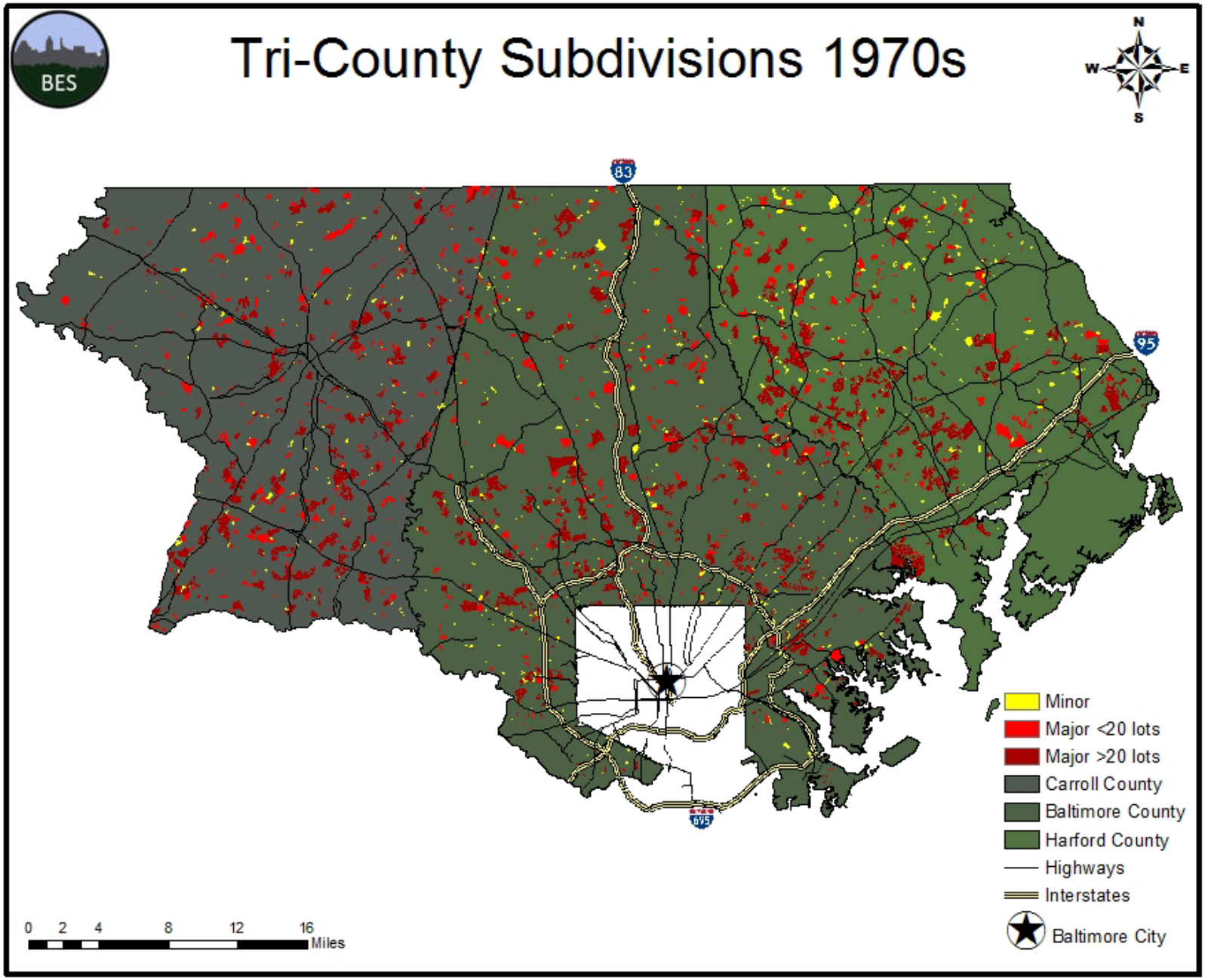
Lot reduction in major subdivisions in Tier 4 are mainly in RC5 and RC4/RC6.

RC2 has 5,044 potential buildable lots in minor subdivisions, due to minor exemption rule (i.e. parcels with 2-100 acres allowed 2 lots).

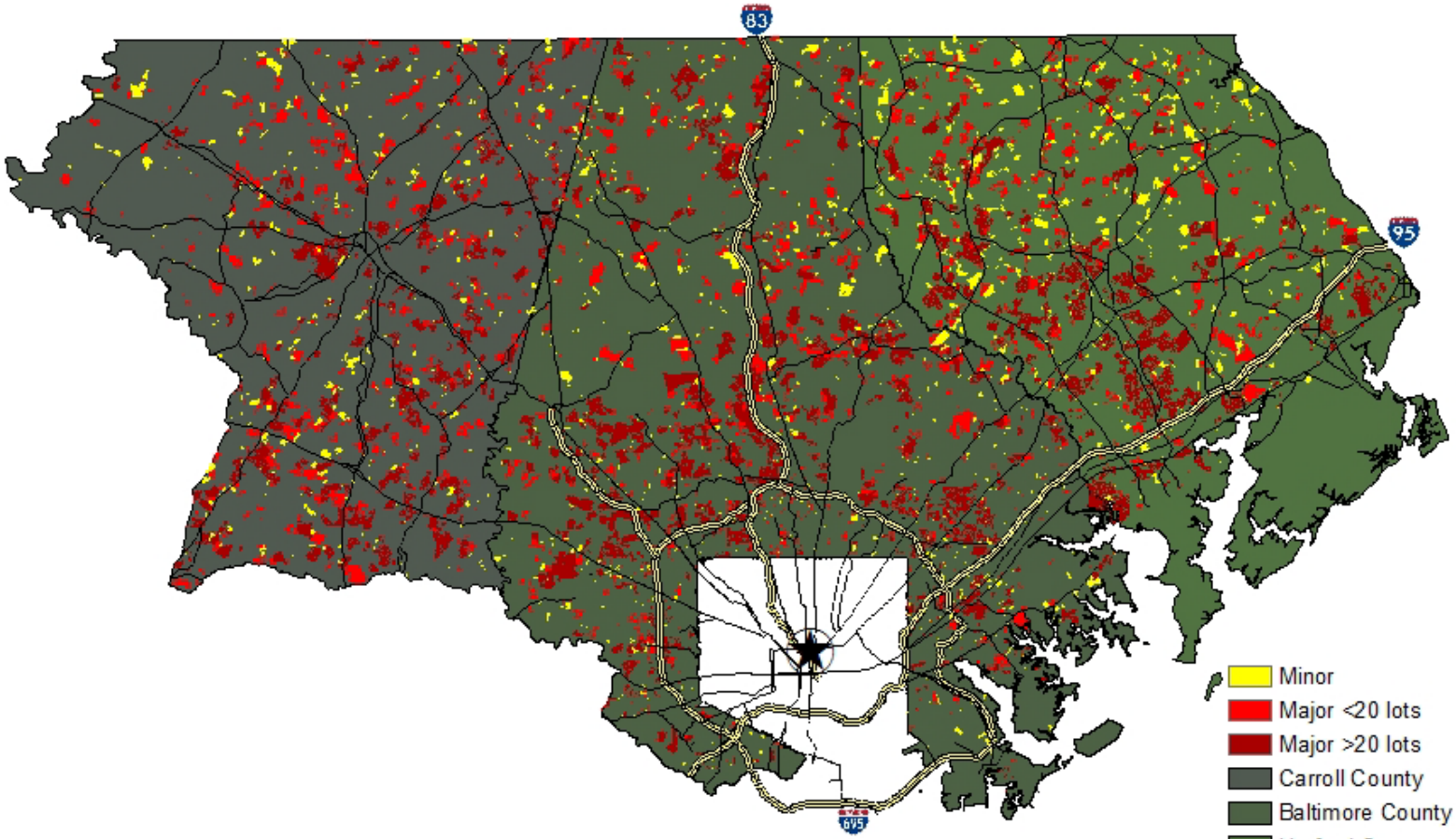
Existing lots (18,955 lots) are much greater than potential minor and major.

Tri-County Subdivisions 1960s

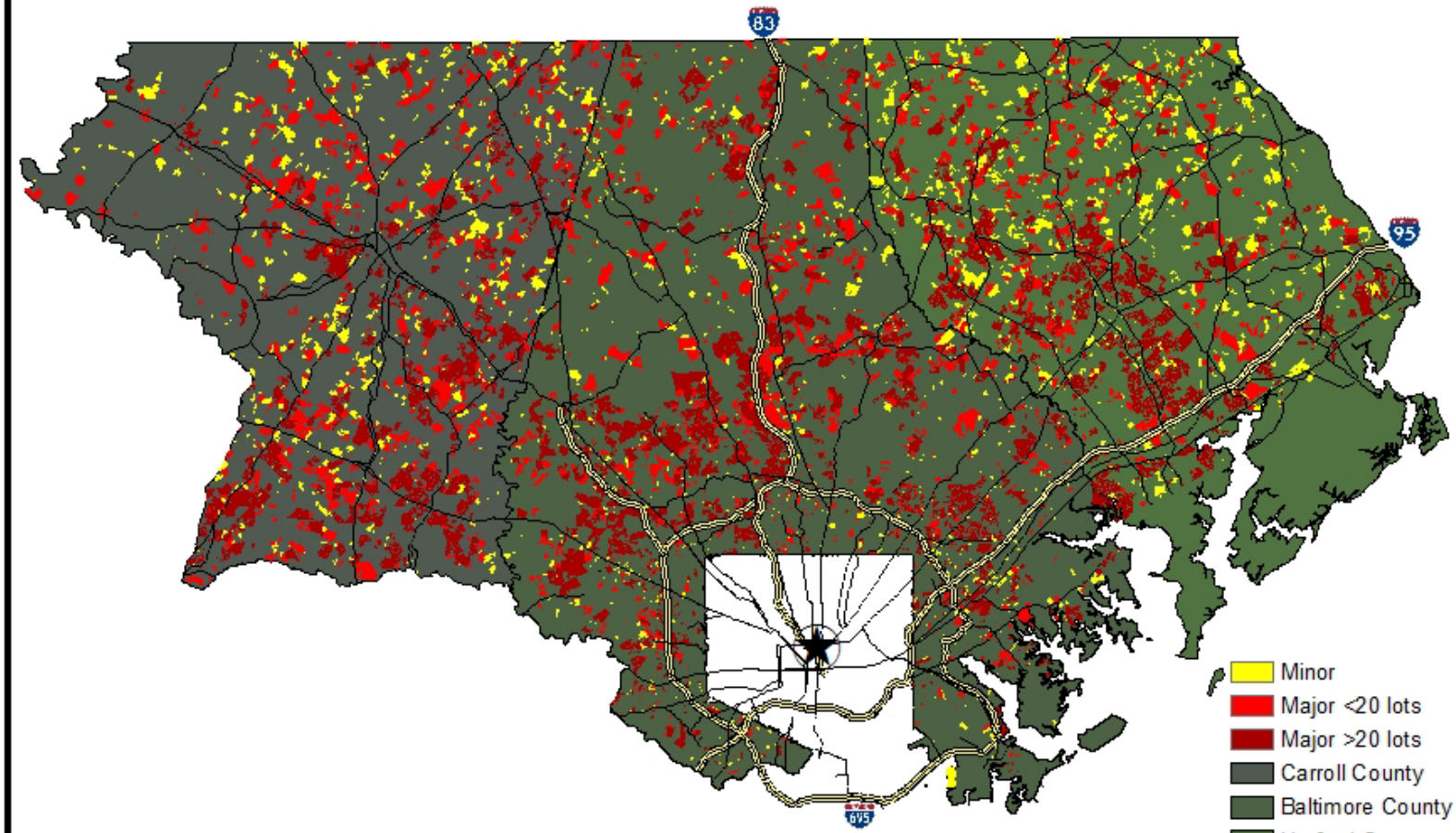



BES
Tri-County Subdivisions 1970s
N
W
E
S
83
95
695
Minor
Major <20 lots
Major >20 lots
Carroll County
Baltimore County
Harford County
Highways
Interstates
Baltimore City
0 2 4 8 12 16
Miles

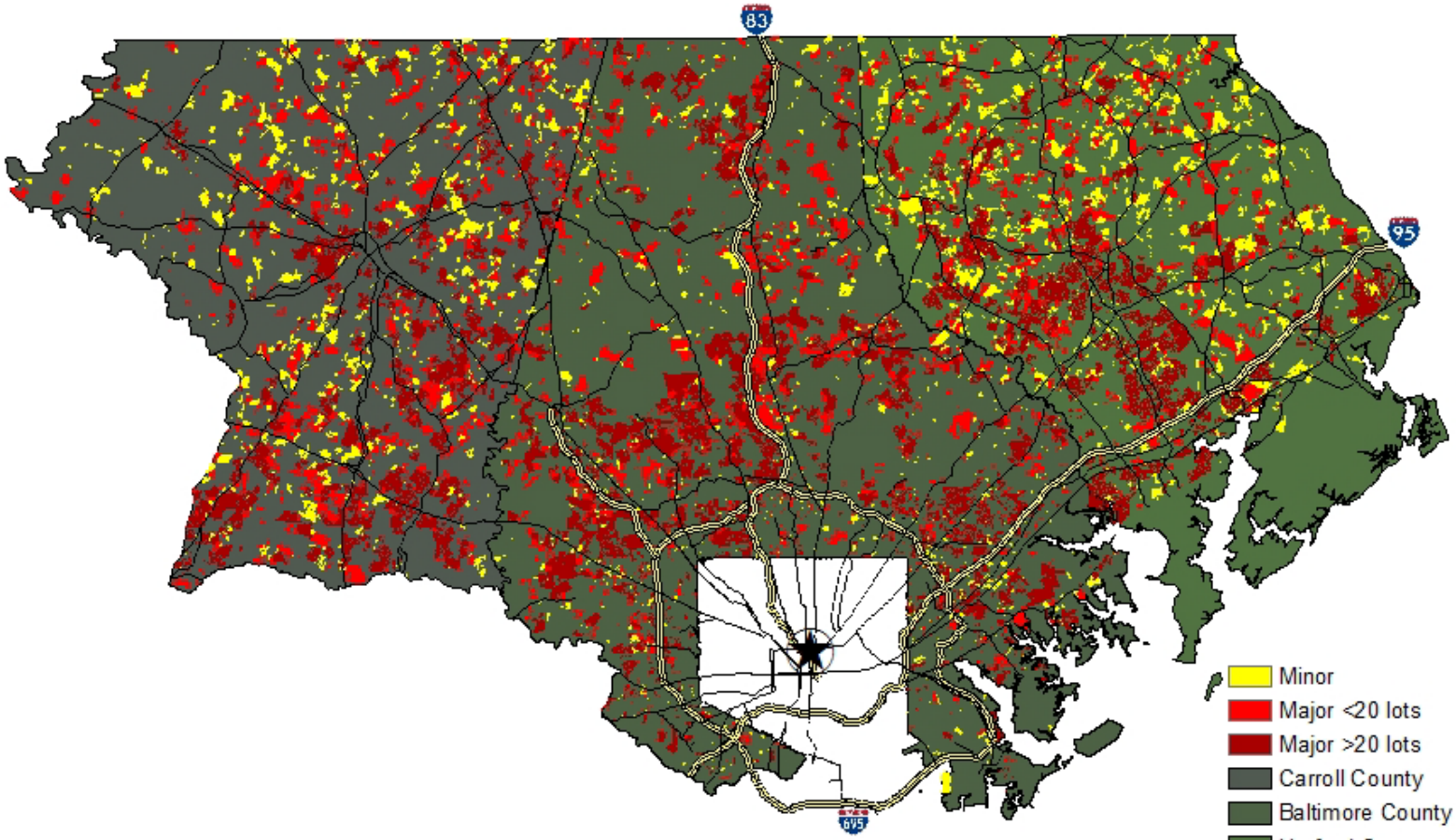
Tri-County Subdivisions 1980s



Tri-County Subdivisions 1990s



Tri-County Subdivisions 2000s



Thank you!

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Main findings in Baltimore County

Zoning impacts

Minimum lot size zoning regulations strongly affect both the probability of development and density

Urban vs. Rural impacts

Majority of new buildable lots occur within urban area
(5,139 lots inside URDL vs. 2,410 outside URDL)

But majority of acreage developed still occurs within rural area
(2,670 acres inside URDL vs. 11,200 outside URDL)

Septic bill regulations

Septic bill results in 71% reduction on major subdivisions in Tier 4 areas.

But there is still a significant number of potential minor subdivisions on septic systems in Tier 4.

Septic bill impacts

All rural watersheds in Baltimore County

	Subdivision potential	Tier 3	Tier 4	Total
Parcels	Developed already	9,731	25,329	35,060
	Potential minor (2 or 3 lots)	225	4,055	4,280
	Potential major (4+ lots)	97	345	442
Buildable lots	Existing house	8,298	18,995	27,293
	Potential minor (2 or 3 lots)	361	5,831	6,192
	Potential major (4+ lots)	719	3,516	4,235
	Septic bill impact (change in AuthLots)	0	2,481	2,481
	% Septic impact/Potential major	0%	71%	59%
	% Septic impact/Potential major + minor	0%	27%	24%
	% Septic impact/Existing + potential	0%	9%	7%

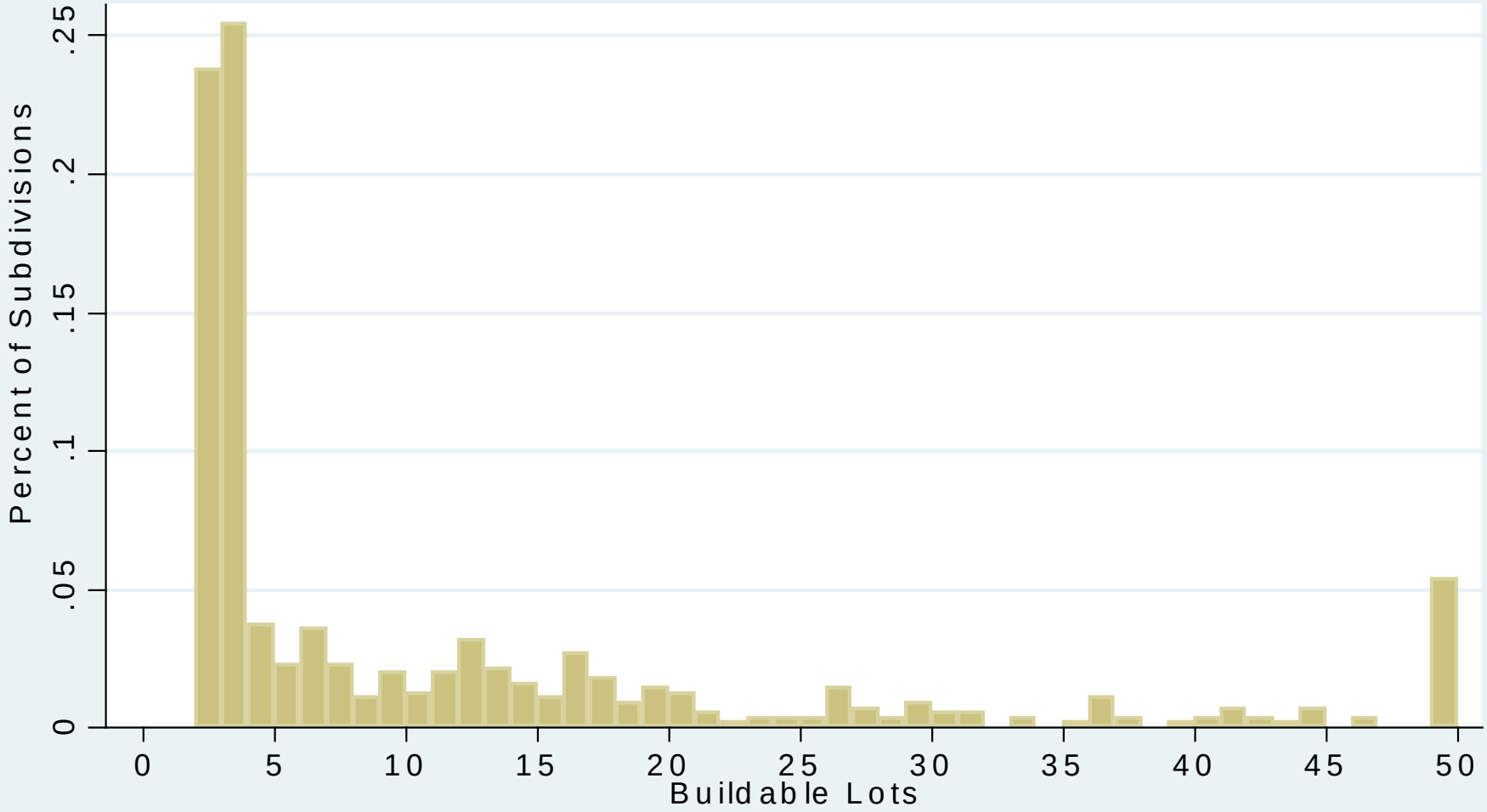
Reduction of 2,481 buildable lots (71%) on major subdivisions in Tier 4 areas.

But this is only a 27% reduction in Tier 4 due to minor subdivision potential.

Overview

- **Subdivision data**
  - Parcel-level residential development from tax assessment records (MD Property View)
- **Residential land-use change model**
  - Binary probit model (first stage)
    - Develop or remain developable in 1996-2007
  - Truncated count model (second stage)
    - Number of buildable lots, conditional on development
  - Explanatory variables using parcel attributes
    - Zoning, accessibility, land quality
- **Purpose**
  - Determine whether zoning regulations affect the probability of development and density
  - Policy scenarios
    - Current zoning (business as usual)
    - Septic bill regulations

Subdivision size by buildable lots



Recent development in 1996-2007

Subdivisions

	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	150	125	275
Major (4+ lots)	156	128	284
Total	306	253	559

Buildable lots

	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	403	289	692
Major (4+ lots)	4736	2121	6857
Total	5139	2410	7549

Acreage developed

	Inside URDL	Outside URDL	Total
Minor (2-3 lots)	272	2675	2947
Major (4+ lots)	2398	8525	10923
Total	2670	11200	13870

Excess zoned capacity (EZC)

$$\text{EZC} = \frac{\text{Parcel area}}{\text{Minimum lot zoning}} - \text{Number of existing houses}$$

Example #2: 200-acre vacant parcel in RC2 zoning (50-acre min lot zoning).

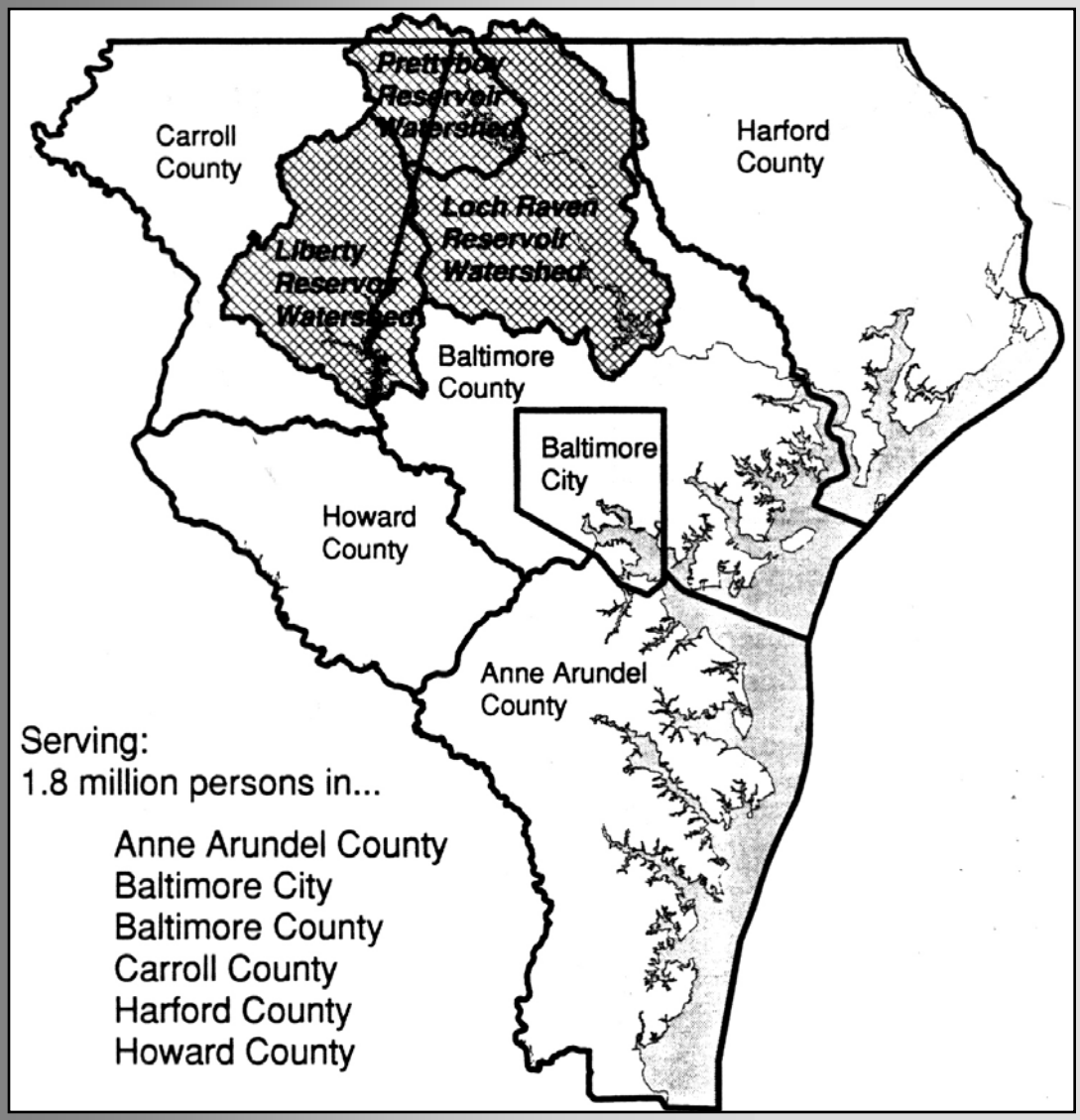
$$\text{EZC} = \frac{200}{50} - 0 = 4 \text{ lots remaining}$$

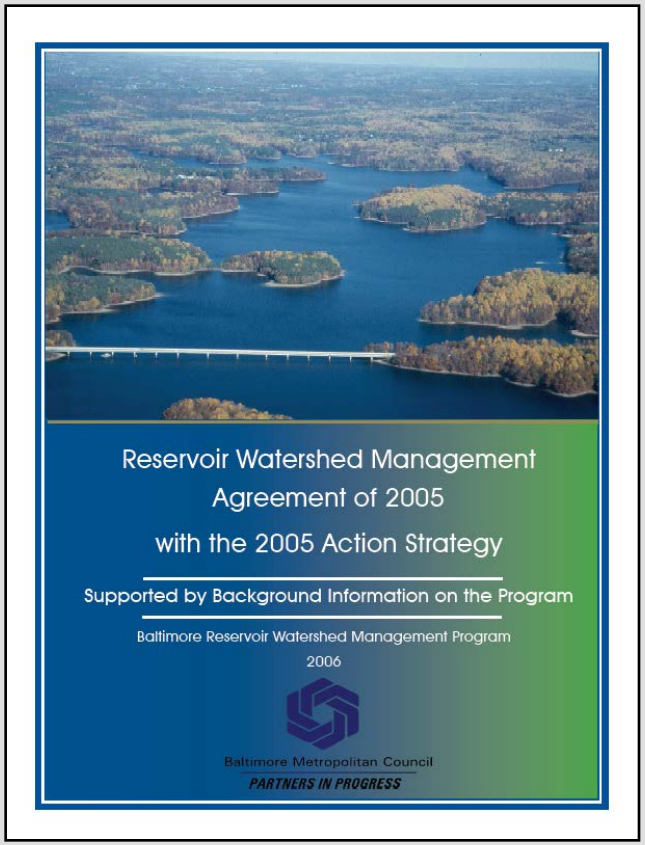
Septic bill impact on EZC = 4 – 3 = 1 lot reduction

Example #3: 12-acre vacant parcel in RC2 zoning

Still allows subdivision into 2 lots (EZC=2) due to minor exemptions

Protecting Drinking Water Sources





www.baltometro.org

Baltimore County

- 63% of the region's 294 sq. mi. of reservoir watersheds
- 48% of the County