



Phase 6 Model Construction Land-Use

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Purpose

- MDE has developed a methodology for refining construction acreage estimates in P6
- Why?
 - To ascertain whether permit data or P532 data is truly reflective of disturbed construction on the ground in MD
 - Guiding Questions
 - Is the P532 method accurate?
 - Is permit data accurate?
 - What is a reasonable approach for estimating construction acres?

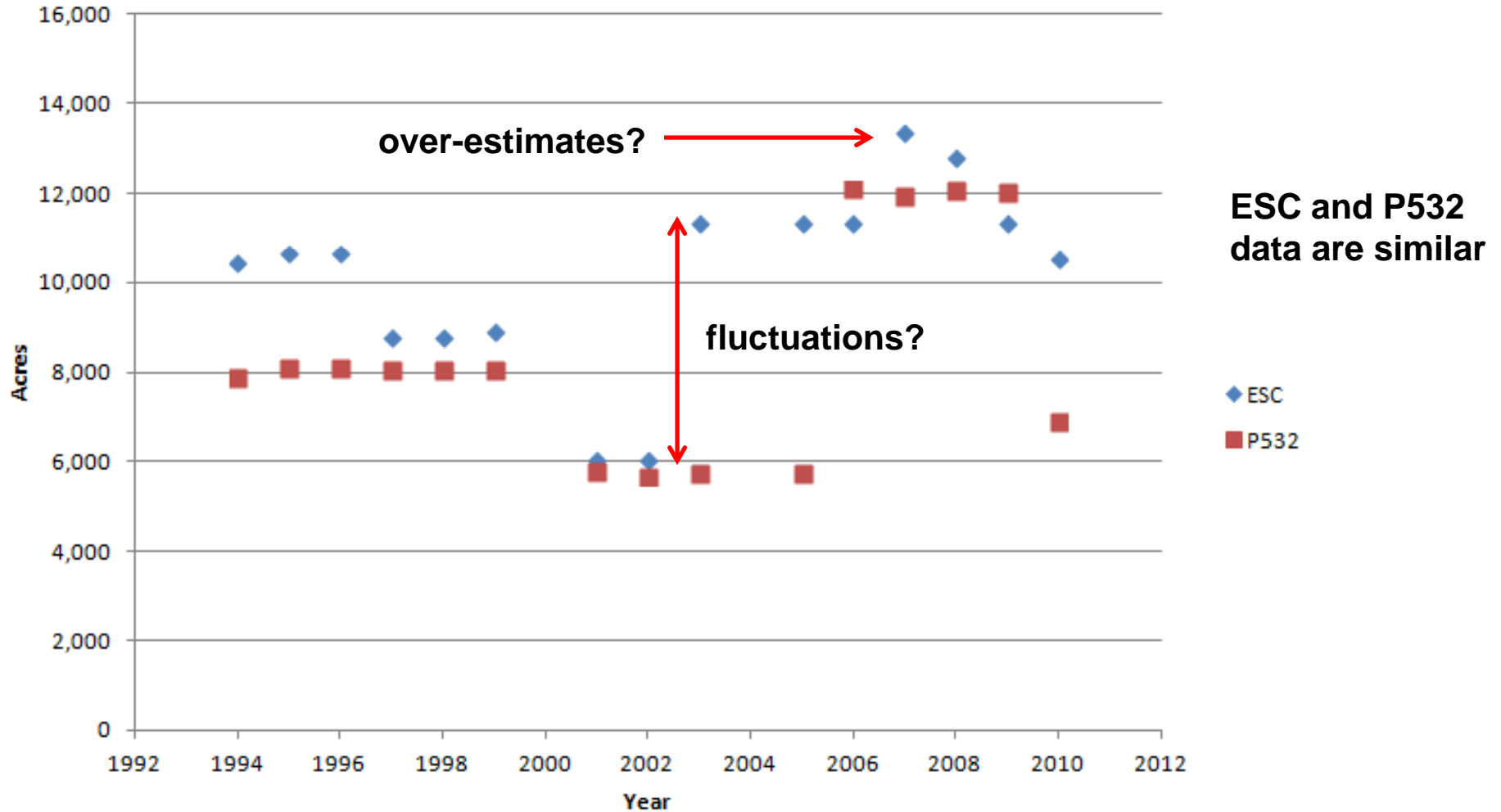


Current Estimates

- ESC data (aka *permit data*)
 - Acres under ESC reported by delegated jurisdictions and by MDE for non-delegated jurisdiction
 - Issue
 - Reported acres = 2 year average
 - 5 year lifespan
 - » Example:
 - » 2005 Reporting
 - » County X: 500 acres
 - » Any single acre (1/500) could have been disturbed as early as 2000
 - Data not available for all model simulation years
 - What is disturbed at any given time may not match total permitted disturbance acres
- Phase 532 model estimates
 - Annual change in impervious surface
 - Multiplied by the disturbed to impervious acre ratio
 - » Issue:
 - » Ratio based off permit (ESC) data
 - » 2005-2007



Prince George's County





MDE alternative approach

- Use MD P6 methods for estimating annual change in impervious surface to identify recently developed parcels
 - Areas where construction has recently occurred
- Derive new ratio of disturbed to impervious acres and/or disturbed to total parcel acres using random sampling and statistical analysis
- Consider two separate methods:
 - One for historic data (calibration) and one for annual Progress

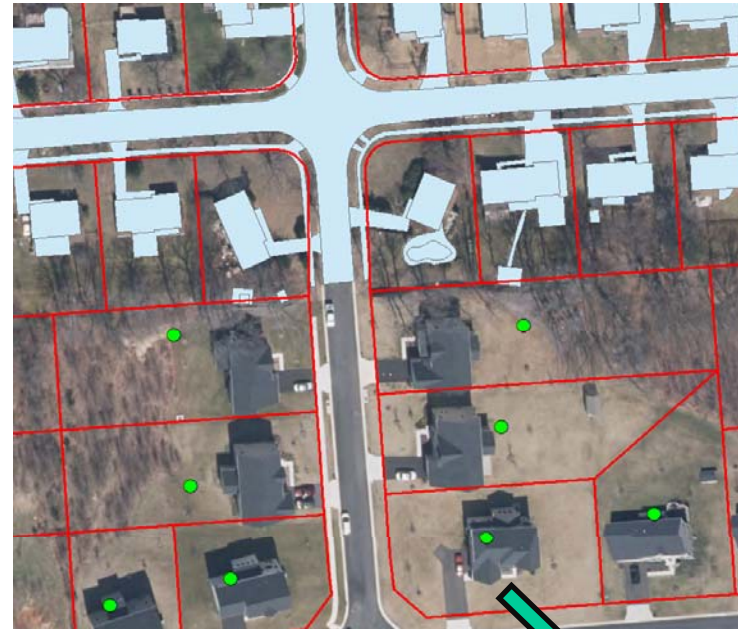
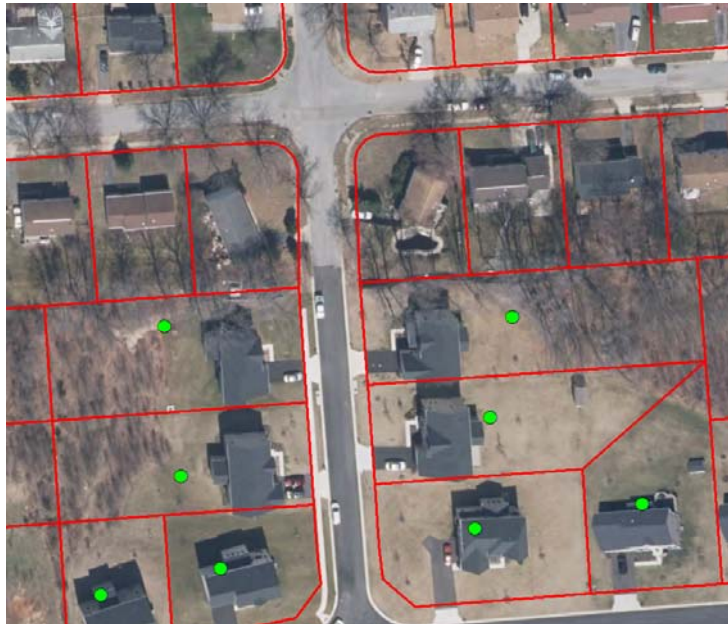


MDE Analysis – Pilot (PG County)

- Considerations
 - Is there a difference in disturbed area trends between residential and non-residential development?
 - What about temporal aspect?
 - What about additional disturbed area associated with residential development associated with HOA/Exempt parcels?
 - Does disturbed area correlate with impervious footprint, total parcel size, both, or neither?
 - Major Highways (SHA maintained roads)?



Impervious Surface Projection



- Use MDP parcel information
- res + com parcels
- structure built year
- accurate for tax purposes

county data = 2008
parcel built years = 2012 + 2013

Apply impervious coefficients to parcels

County	Residential Parcel	Zone	Total Acres - 2008	Impervious Acres - 2008	Impervious %
Prince George's	Residential	LOW DENSITY RESIDENTIAL	21734.69250890000	3978.58396175000	18%
Prince George's	Residential	MEDIUM DENSITY RESIDENTIAL	22040.23107730000	5379.899084	24%
Prince George's	Residential	MIXED USE	219.35324687200	49.70758244470	23%
Prince George's	Residential	MUNICIPALITY	109.80234018900	28.16596652450	26%
Prince George's	Residential	VERY LOW DENSITY RESIDENTIAL	5748.08797694000	594.65809880500	10%

Unique to zone and parcel type

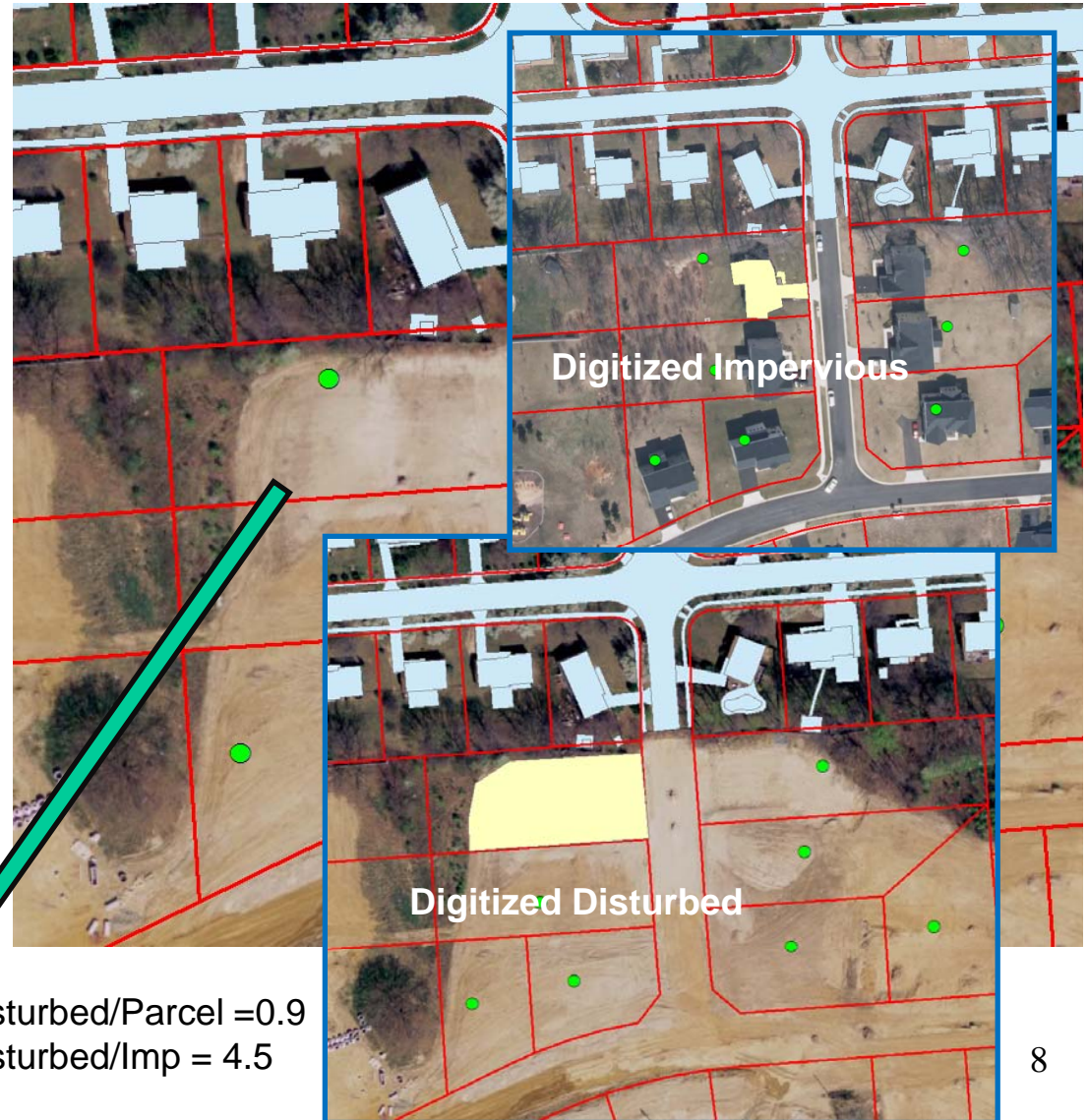


Relate to Construction Activity

- Sample recently developed parcels in Prince George's county
 - Have historic aerial imagery for MD (NAIP + MD 6-inch) since 2005
 - Sample parcels with built year 2005-2012
 - Digitize disturbed acres
 - Compare disturbed area to parcel and impervious area in sample parcels
 - If need be, digitize impervious (i.e., not in county data)
 - Develop coefficients/relationships

Total parcel area = 0.5 acres
Impervious area = 0.1 acres
Disturbed area = 0.45 acres

Disturbed/Parcel = 0.9
Disturbed/Imp = 4.5



Temporal Considerations

2005



2006



2007



2008



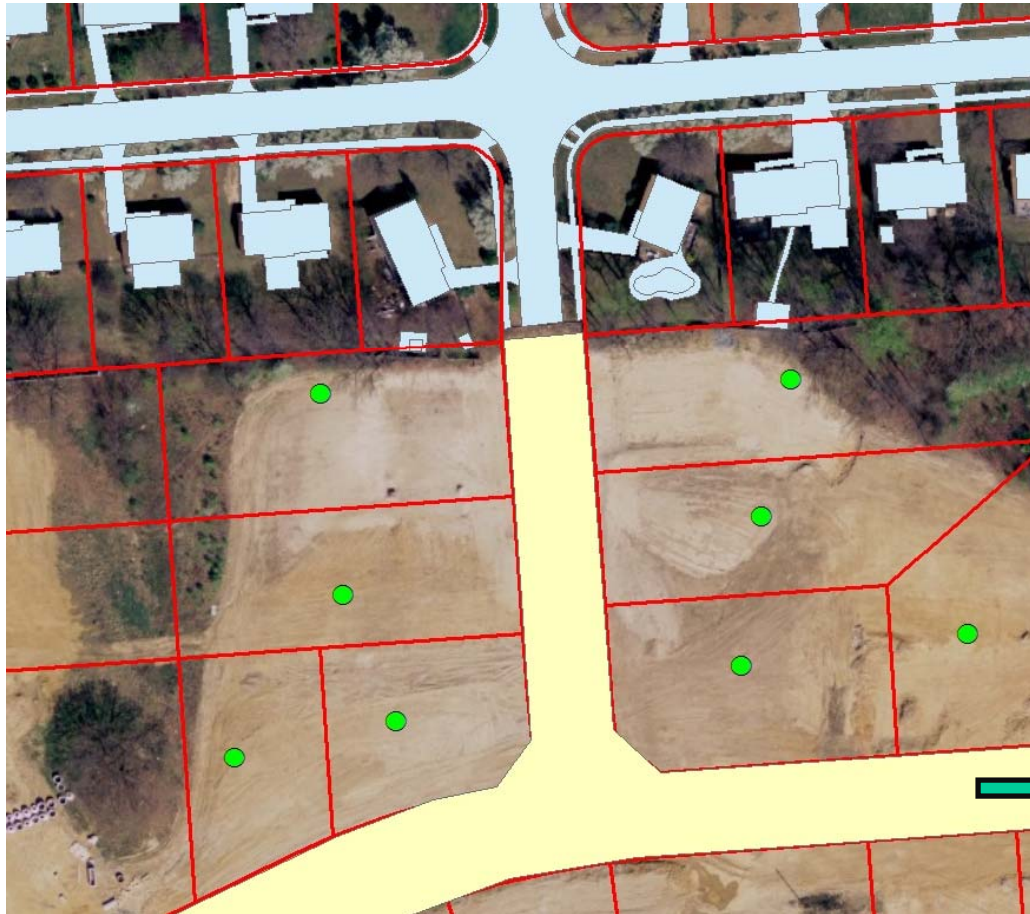
2009



2010



HOA Parcel Considerations



- Current coefficient for residential parcels does not account for disturbed areas associated with roads/HOA areas
- Sample sub-divisions to develop coefficients between disturbed area on residential parcels and disturbed area on associated HOA/Exempt parcels.

→ Digitized HOA disturbed area

Total residential disturbed area = 3 acres
HOA/Exempt disturbed Area = 1 acre

→ HOA Disturbed/Residential Disturbed = 0.33



MDE conceptual framework

2010 constr. acres = 2010 residential constr. acres + 2010 non-res constr. acres +
major highway constr. acres

$$\text{2010 residential constr. acres} = [(RDF \times NRA_{2011}) + (RDF \times NRA_i) + (RDF \times NRA_{i+1}) + \dots]$$

RDF = Residential Disturbance Factor, how much acreage is disturbed per are of new residential development (two sub-factors: one for actual parcel area disturbed, and one for associated HOA/Exempt area disturbed)

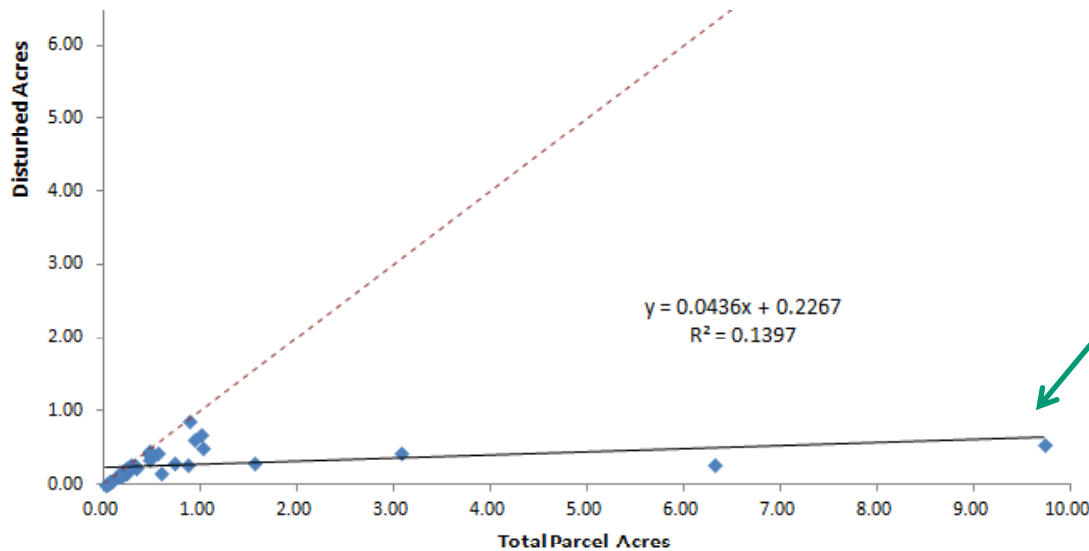
NRA_{2011} = New Residential Acres, the total acreage of residential parcels with a built-year of 2011

NRA_i = Temporal Component; acres disturbed in 2010 based not only on parcels with built year of 2011 but also parcels with built year 2012, 2013, etc. Exact number of years is based on average number of years parcels are disturbed for (see results of temporal analysis).

- Do the same for non-residential construction
- The non-residential disturbance factor does not need to account for associated disturbed area outside of the parcel



Residential Coefficient Results



Leveling off effect (disturbed area does not increase with increasing parcel size)

Regression not predictive

Disturbance on residential parcels relatively constant, i.e., disturbed acres not > 1, no matter parcel size.

Therefore, disturbed to impervious ratio better predictor of total disturbed acres

n = 53

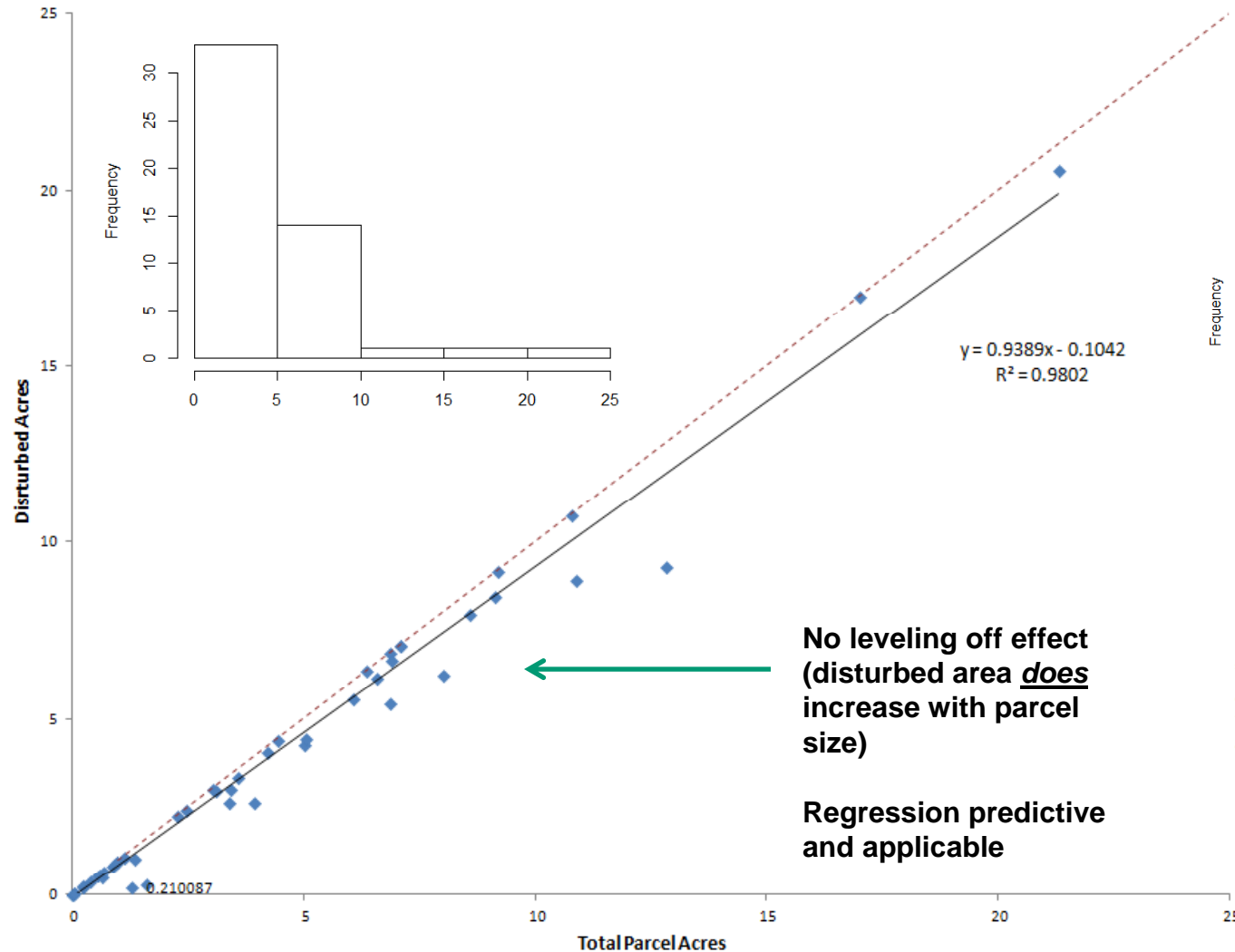
SEQNUMBMDP	TOTALP	CONSTRUCTION	NON-CONSTRUCTION	IMPERVIOUS	CON/IMP	CON/TOTALP
16369	0.173	0.173	0.000	0.071	2.430	1.000
149155	0.167	0.128	0.039	0.071	1.818	0.769
119335	0.163	0.160	0.003	0.049	3.257	0.981
233580	0.154	0.143	0.011	0.060	2.360	0.926
146460	0.142	0.142	0.000	0.053	2.710	1.002
145131	0.066	0.066	0.000			
294524	0.061	0.061	0.000			
290423	0.06	0.060	0.000			
185427	0.05	0.050	0.000			
107376	0.041	0.041	0.000			
188129	0.041	0.041	0.000			
290911	0.039	0.039	0.000	0.034	1.151	1.000
37675	0.037	0.037	0.000	0.027	1.376	1.003
29919	0.034	0.034	0.000	0.019	1.776	1.013
77287	0.028	0.028	0.000	0.019	1.435	0.984
195220	0.023	0.023	0.000	0.022	1.047	0.998
57814	0.017	0.017	0.000	0.017	1.000	0.982
SUM	35.76	13.58	22.19	4.24	N/A	N/A
AVG	0.67	0.26	0.42	0.08	3.21	0.84

	Total Area (ACRES)				
	PARCEL	IMPERVIOUS	CONSTRUCTION		
			DIGITIZED	PREDICT - AVG CON/IMP	PREDICT - AVG CON/TOTALP
SAMPLE	35.76	4.24	13.58	13.61	30.02

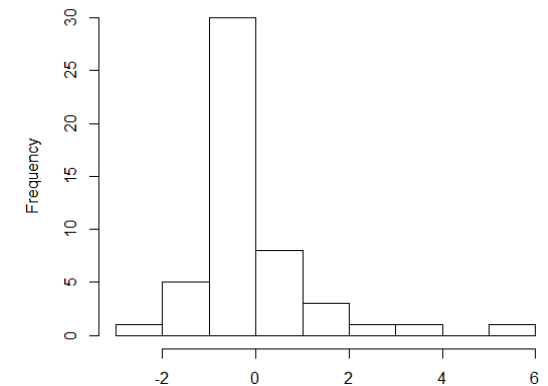
Results in over-estimate because of larger parcels



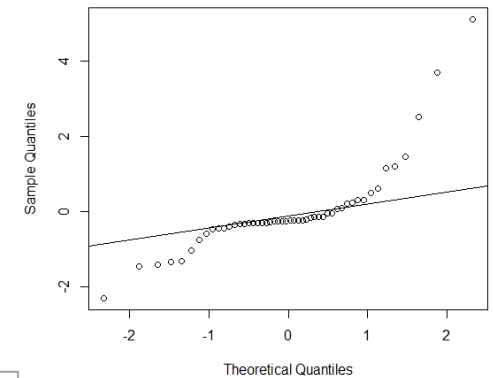
Non-Residential Coefficient Results



Residuals



Normal Q-Q Plot





Temporal Coefficient Results

Non-residential

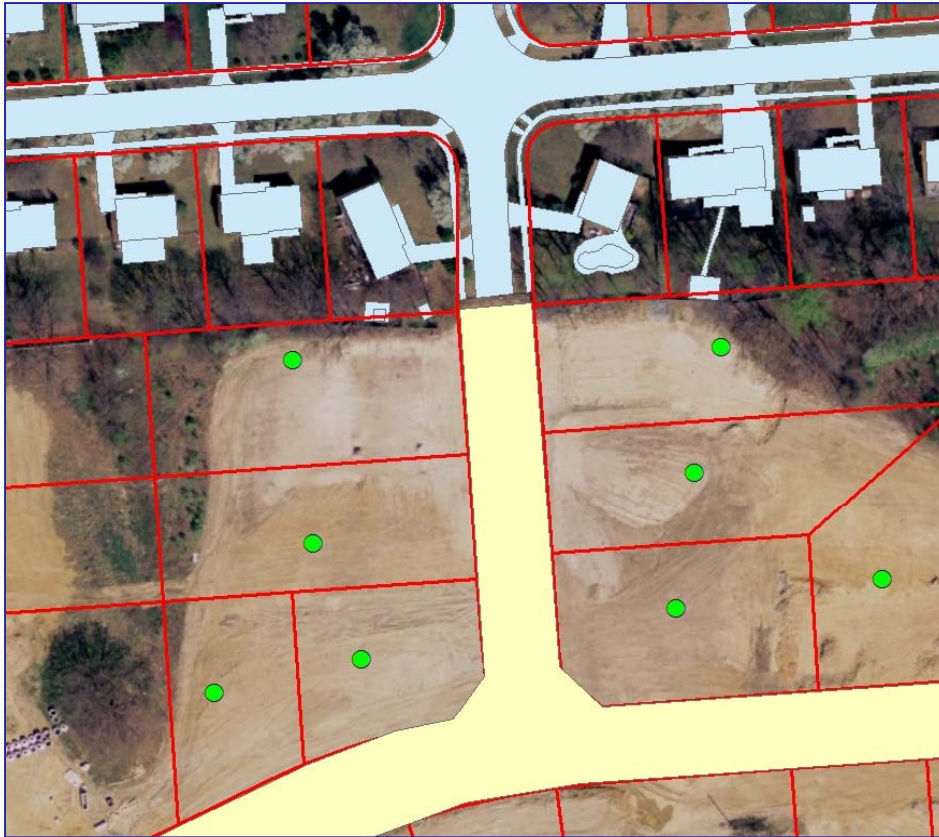
SEQNUMB	NAIP			6 INCH	NAIP	6 INCH	NAIP	6 INCH	# of years under
	2005	2006	2007	2007/2008	2009	2010/2011	2011	2011/2013	
19000	Nothing	Open	Open	Open	Open	Complete	Complete	Complete	4
21995	Nothing	Nothing	Nothing	Open	Complete	Complete	Complete	Complete	1
23321	Nothing	Nothing	Open	Open	Complete	Complete	Complete	Complete	2
31312	Nothing	Nothing	Open	Open	Open	Complete	Complete	Complete	3
67576	Nothing	Nothing	Nothing	Nothing	Open	Complete	Complete	Complete	1
67587	Nothing	Nothing	Nothing	Nothing	Open	Complete	Complete	Complete	1
163074	Nothing	Open	Open	Open	Complete	Complete	Complete	Complete	3
170111	Nothing	Nothing	Nothing	Open	Complete	Complete	Complete	Complete	1
170112	Nothing	Nothing	Nothing	Open	Complete	Complete	Complete	Complete	1
177323	Nothing	Nothing	Open	Open	Complete	Complete	Complete	Complete	2
186375	Nothing	Open	Open	Open	Open	Open	Open	Open	7
190404	Nothing	Nothing	Open	Open	Complete	Complete	Complete	Complete	2
254215	Nothing	Open	Complete	Complete	Complete	Complete	Complete	Complete	1
278039	Nothing	Nothing	Nothing	Nothing	Nothing	Nothing	Open	Open	2
282016	Nothing	Nothing	Nothing	Nothing	Open	Complete	Complete	Complete	1
								Average	2.1333

2010 Non-Residential Construction = (DF x 2011 Parcel Acres) + (DF x 2012 Parcel Acres)

Residential Average = 3.125 years



HOA Coefficient Results



# Development	Res Disturbed	HOA/Exempt Disturbed	Ratio
1	29.85	12.70	0.43
2	82.06	42.52	0.52
3	28.55	16.80	0.59
4	8.32	6.91	0.83
5	11.75	8.95	0.76
6	43.18	18.61	0.43
7	18.66	8.37	0.45
8	39.52	19.77	0.50
9	46.94	16.60	0.35
10	23.19	22.58	0.97
11	26.68	9.93	0.37
12	26.54	22.88	0.86
13	14.13	6.35	0.45
14	4.78	7.82	1.64
15	26.55	4.40	0.17
16	5.82	9.83	1.69
17	187.10	24.08	0.13
18	93.25	127.76	1.37
19	54.27	16.76	0.31
20	7.26	1.58	0.22
21	10.01	2.64	0.26
22	11.61	11.30	0.97
23	19.60	3.56	0.18
24	1.97	6.37	3.24
25	5.90	1.48	0.25
SUM	827.48	430.56	17.94
AVG	33.10	17.22	0.72



Highway Construction

- Major highways
 - SHA maintained roads
 - Not much disturbance on annual basis
 - Most disturbance on the fringes of the paved surface or ROW
 - Significant disturbance
 - Limited to new roads or major road expansion
- County/local roads
 - Captured in our HOA coefficient results

Highway Construction

- How can we capture the significant disturbance?

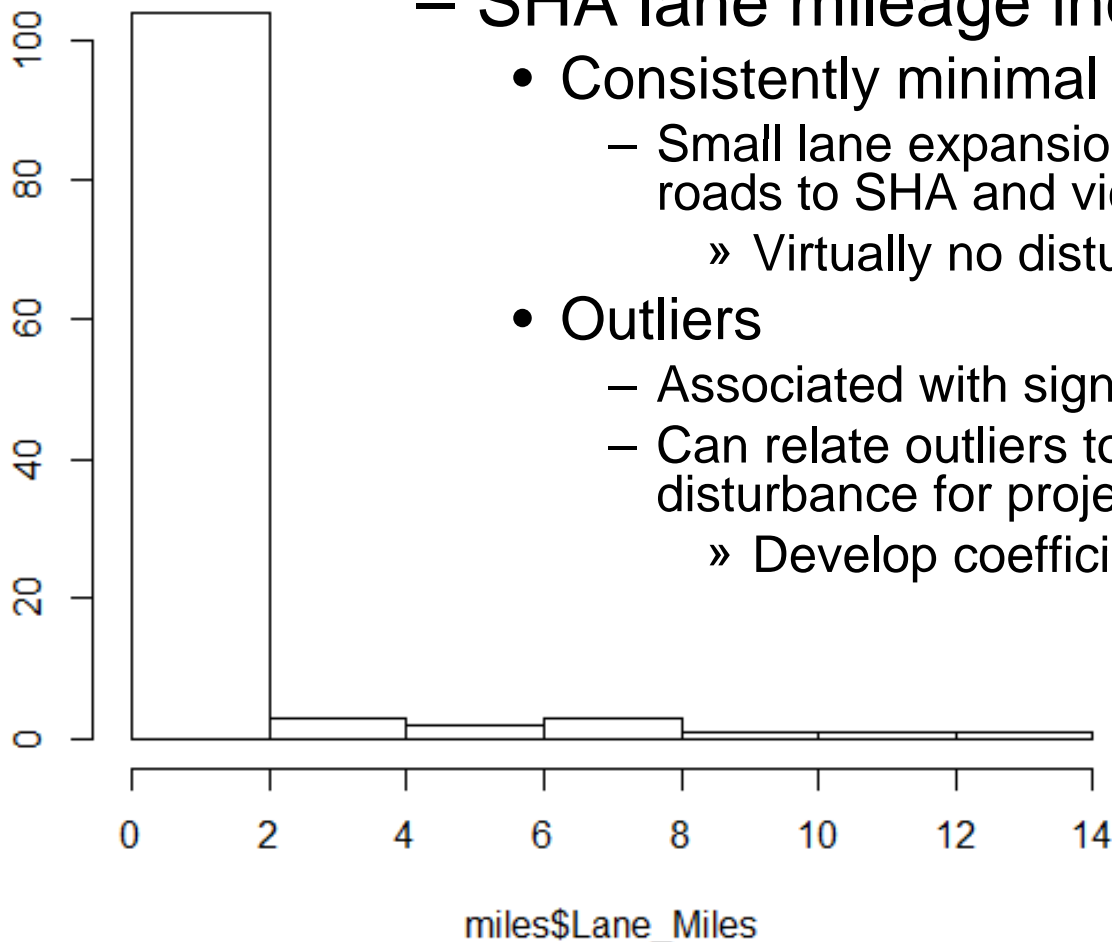
- SHA lane mileage increase data

- Consistently minimal

- Small lane expansions, transfer of county/locals roads to SHA and vice versa, reinventory
 - » Virtually no disturbed area

- Outliers

- Associated with significant disturbance
- Can relate outliers to specific projects then digitize disturbance for project
 - » Develop coefficient with disturbed areas



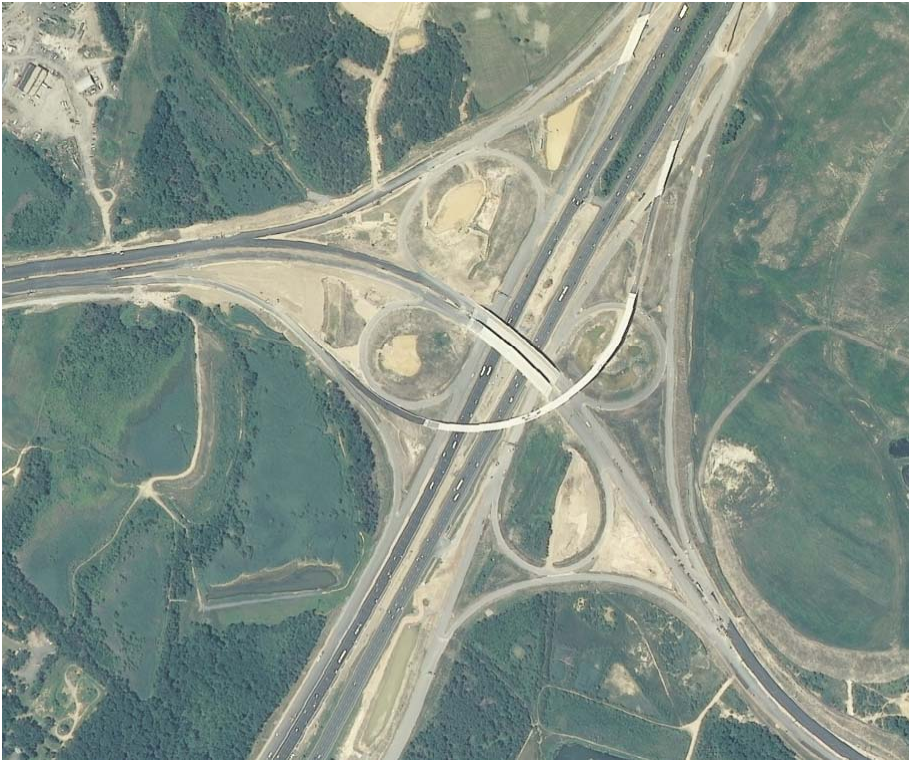


Highway Lane Mileage Data

A	D	E	F	G	H	I	N	O
County	2011 (lane miles)	Δ (%)	2010 (lane miles)	Δ (%)	2009 (lane miles)	Δ (%)	2006-2011 Δ (lane miles)	Δ (%)
ALLEGANY	557	0.2%	560	0.0%	559	0.0%	-1.9	-0.3%
ANNE ARUNDEL	1,173	0.0%	1,169	0.0%	1,169	0.0%	3.8	0.3%
BALTIMORE	1,320	0.1%	1,320	0.0%	1,319	0.0%	1.9	0.1%
CALVERT	327	0.0%	327	0.5%	327	0.3%	2.4	0.7%
CAROLINE	318	0.1%	316	0.0%	316	0.0%	5.8	1.9%
CARROLL	498	0.5%	496	2.7%	493	0.1%	16.6	3.5%
CECIL	431	-0.3%	431	0.0%	432	0.0%	-1.4	-0.3%
CHARLES	517	0.0%	517	0.0%	517	0.2%	1.9	0.4%
DORCHESTER	309	0.0%	309	0.0%	309	0.0%	0.0	0.0%
FREDERICK	929	0.1%	929	-0.2%	928	-0.6%	-6.5	-0.7%
GARRETT	492	0.0%	492	0.0%	492	0.0%	-0.2	0.0%
HARFORD	640	0.0%	640	0.0%	640	-0.2%	-0.9	-0.1%
HOWARD	682	0.0%	682	0.1%	682	0.5%	3.0	0.4%
KENT	346	0.0%	346	0.0%	346	0.0%	0.0	0.0%
MONTGOMERY	1,395	0.7%	1,393	0.0%	1,383	0.0%	11.5	0.8%
PRINCE GEORGE'S	1,534	0.0%	1,522	0.5%	1,521	-0.1%	20.3	1.3%
QUEEN ANNE'S	531	0.0%	531	0.0%	531	0.1%	1.3	0.3%
ST. MARY'S	479	1.0%	479	-0.1%	474	0.0%	4.6	1.0%
SOMERSET	248	0.0%	248	0.0%	248	0.0%	0.0	0.0%
TALBOT	307	0.0%	307	0.0%	307	0.2%	2.8	0.9%
WASHINGTON	711	0.0%	711	0.0%	711	-0.1%	-0.3	0.0%
WICOMICO	463	0.0%	463	-0.2%	463	-0.2%	-1.0	-0.2%
WORCESTER	547	0.0%	541	1.5%	541	0.0%	20.9	4.0%



Highway Disturbed Coefficient



Identify projects causing significant increase in lane miles

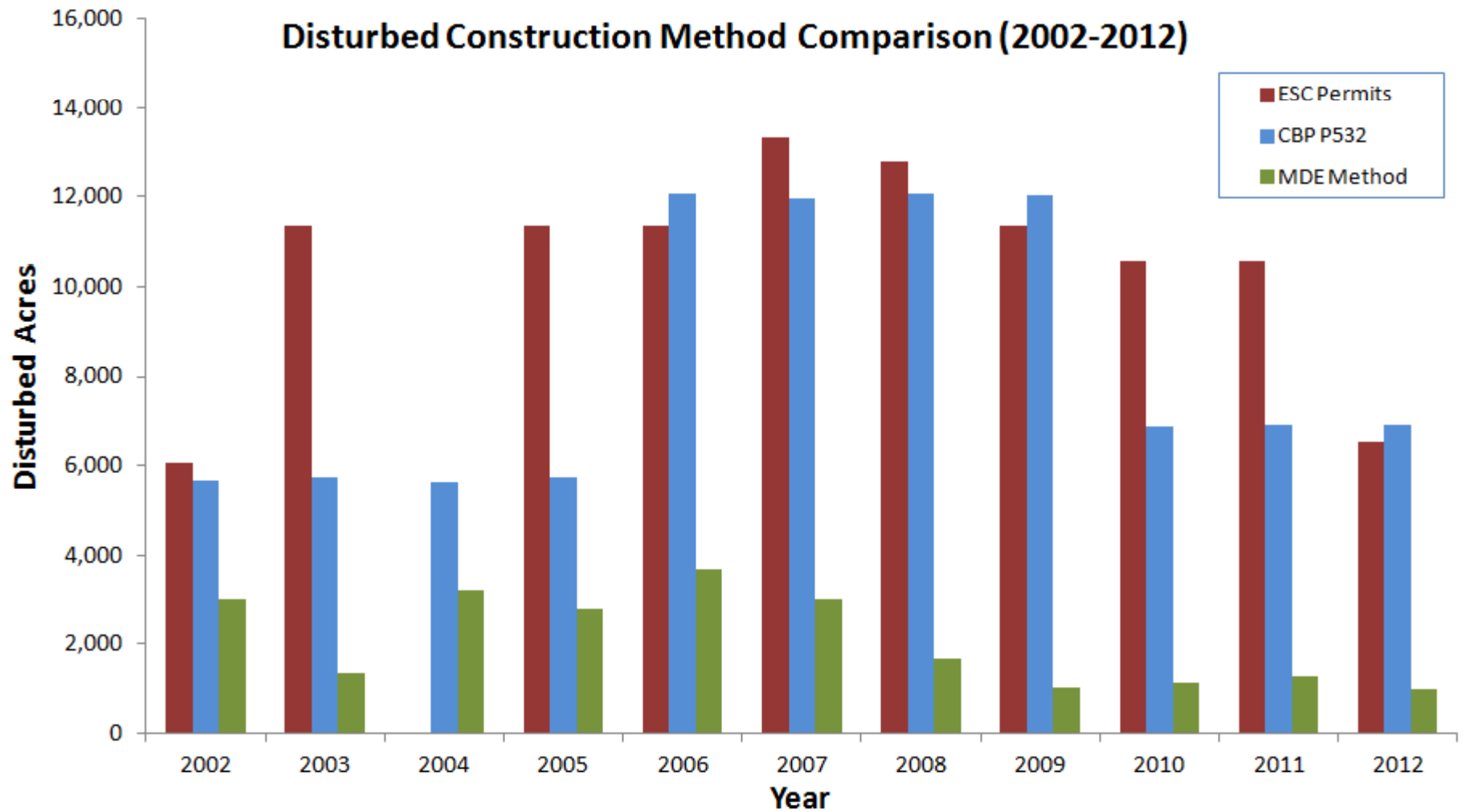
Digitize disturbance



Coefficient = X (acres/lane mile) = Y (digitized disturbed acres)/ Z (lane miles from SHA data) 19

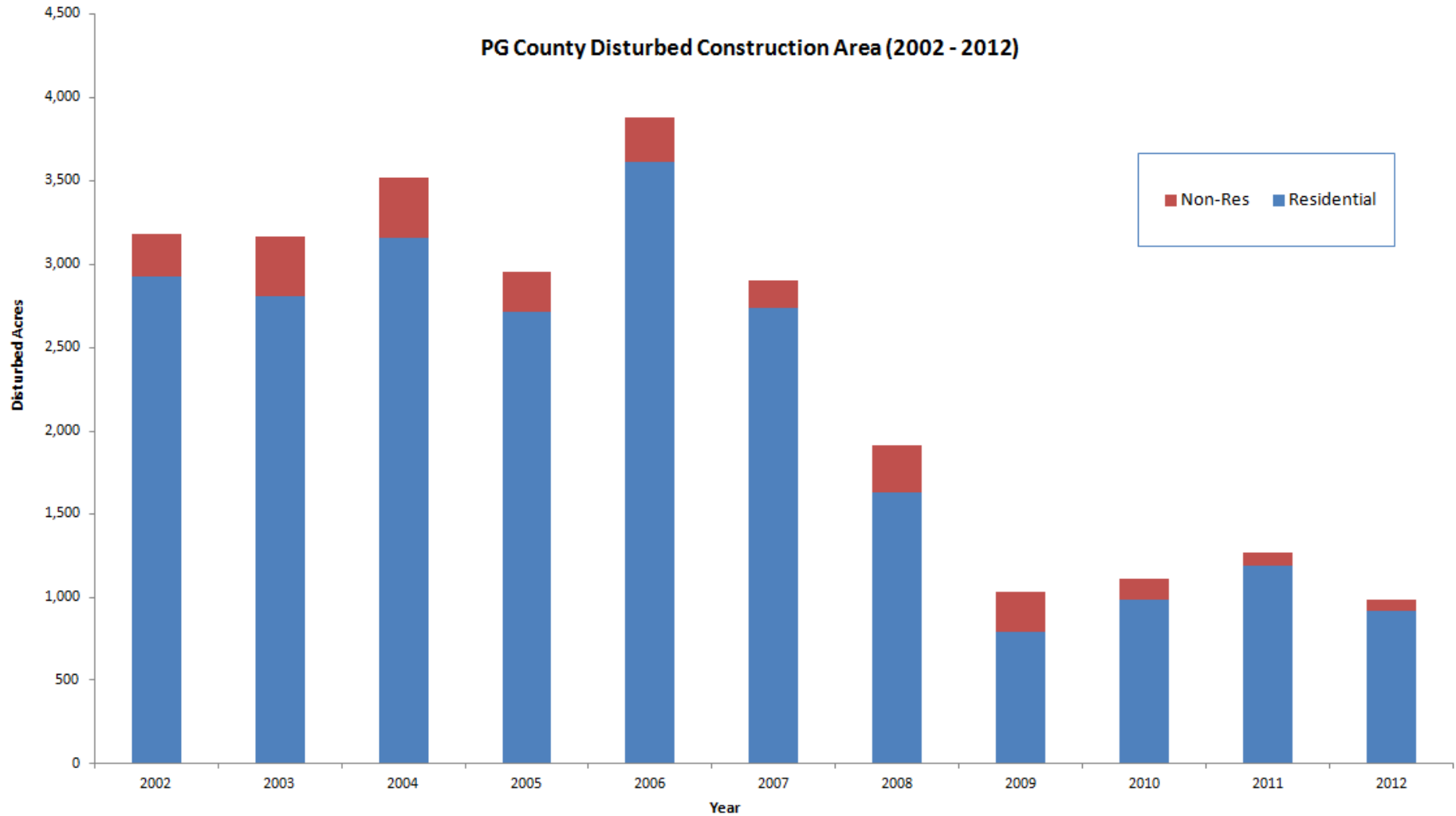


Results





Results





Conclusions and Verification

- Conclusions
 - MDE estimates significantly less disturbed area than in P532 and using ESC data
 - Believed to be more representative of actual conditions
- Verification
 - Conducting further verification to assess accuracy of results
 - Sampling to calculate coefficients in other counties to see if consistent across the state