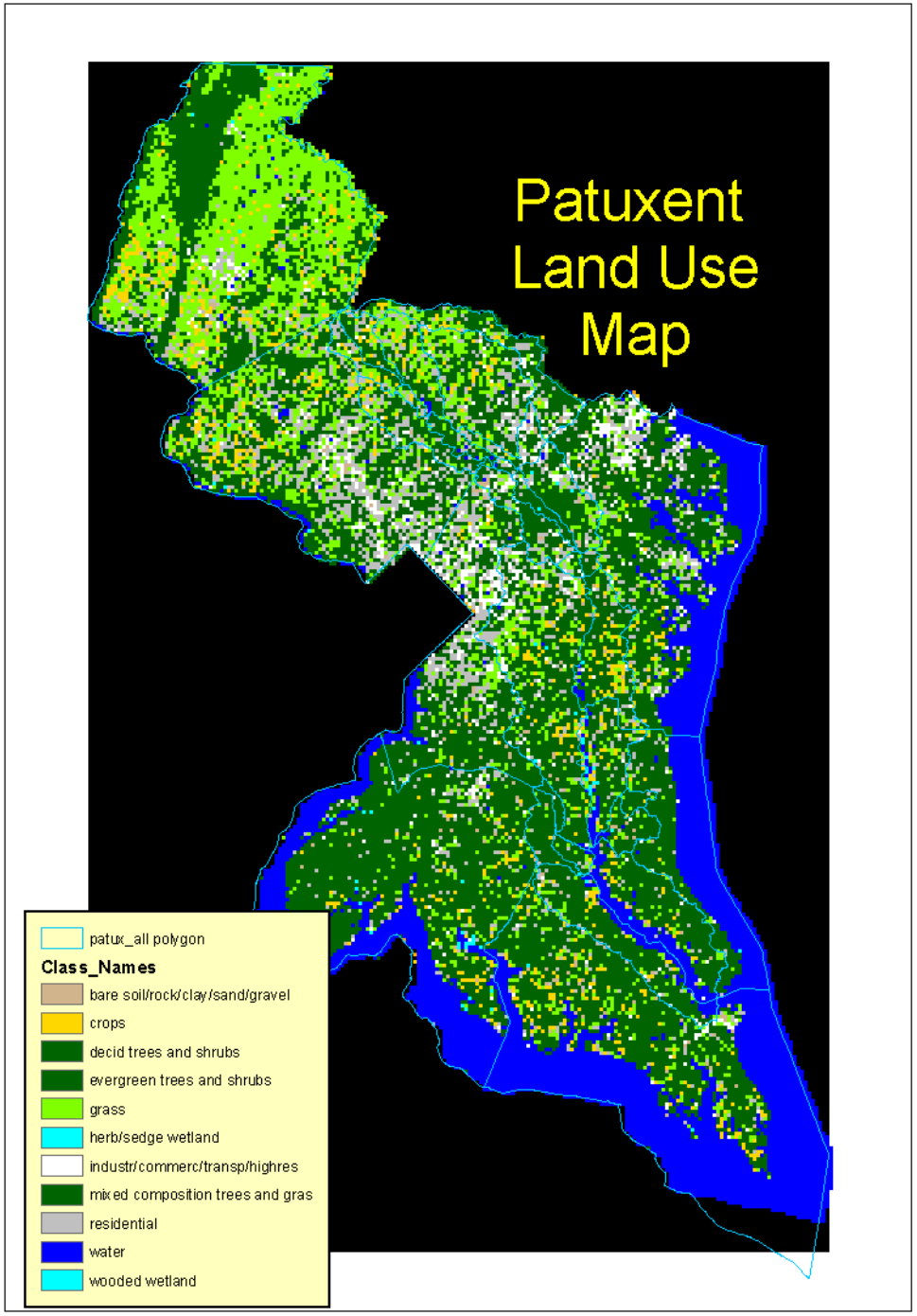
Chesapeake Bay Program P.5 Watershed Model Land Use and Segmentation

Larson, Hopkins, and RESAC July 9, 2002

Chesapeake Bay Program Modeling

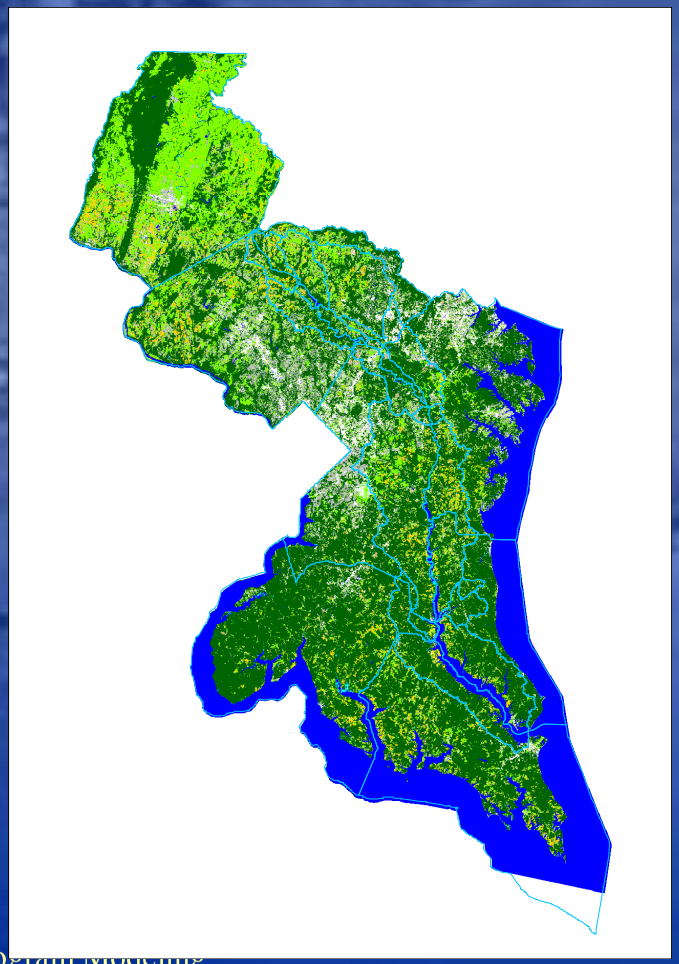
RESAC Land Use Land Cover 2000



RESAC 2000 Land Cover

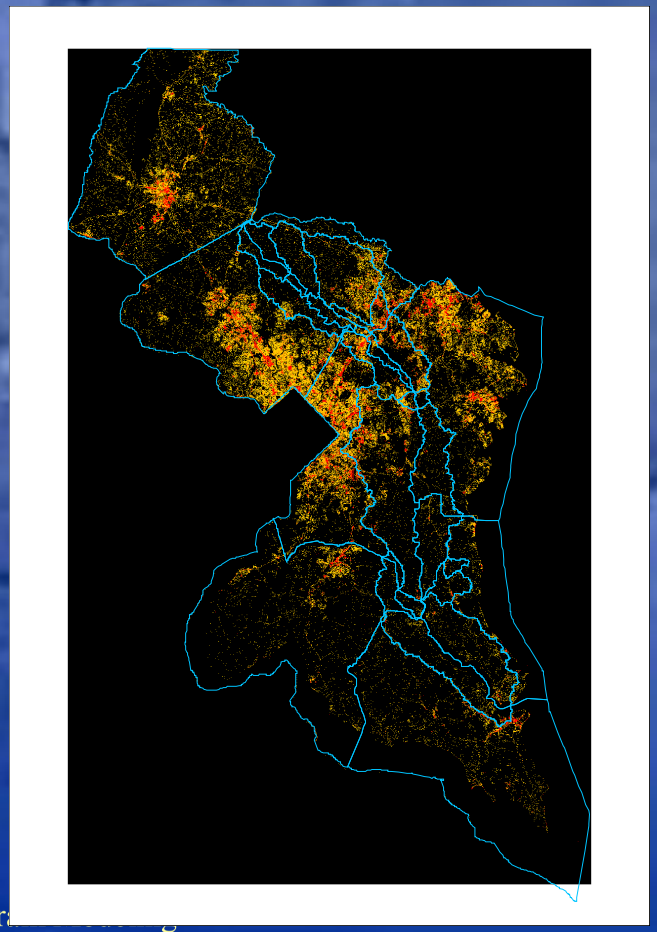
- Delivered for Patuxent
- Available by county-segment
- integrated with impervious map

Class_name
bare soil/rock/clay/sand/gravel
crops
decid trees and shrubs
evergreen trees and shrubs
grass
herb/sedge wetland
industr/commerc/transp/highres
mixed composition trees and grass
residential
water
wooded wetland



RESAC 2000 Impervious Map

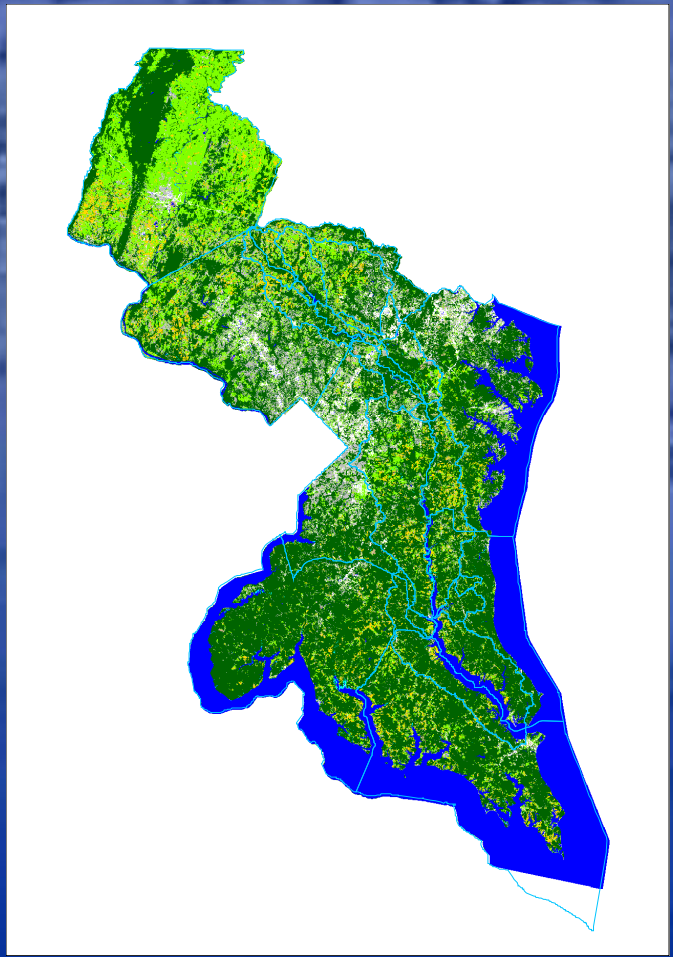
- Data on 30 m pixels
- Able to combine with LU Map
- gather pixel data on land use type and imperviousness.



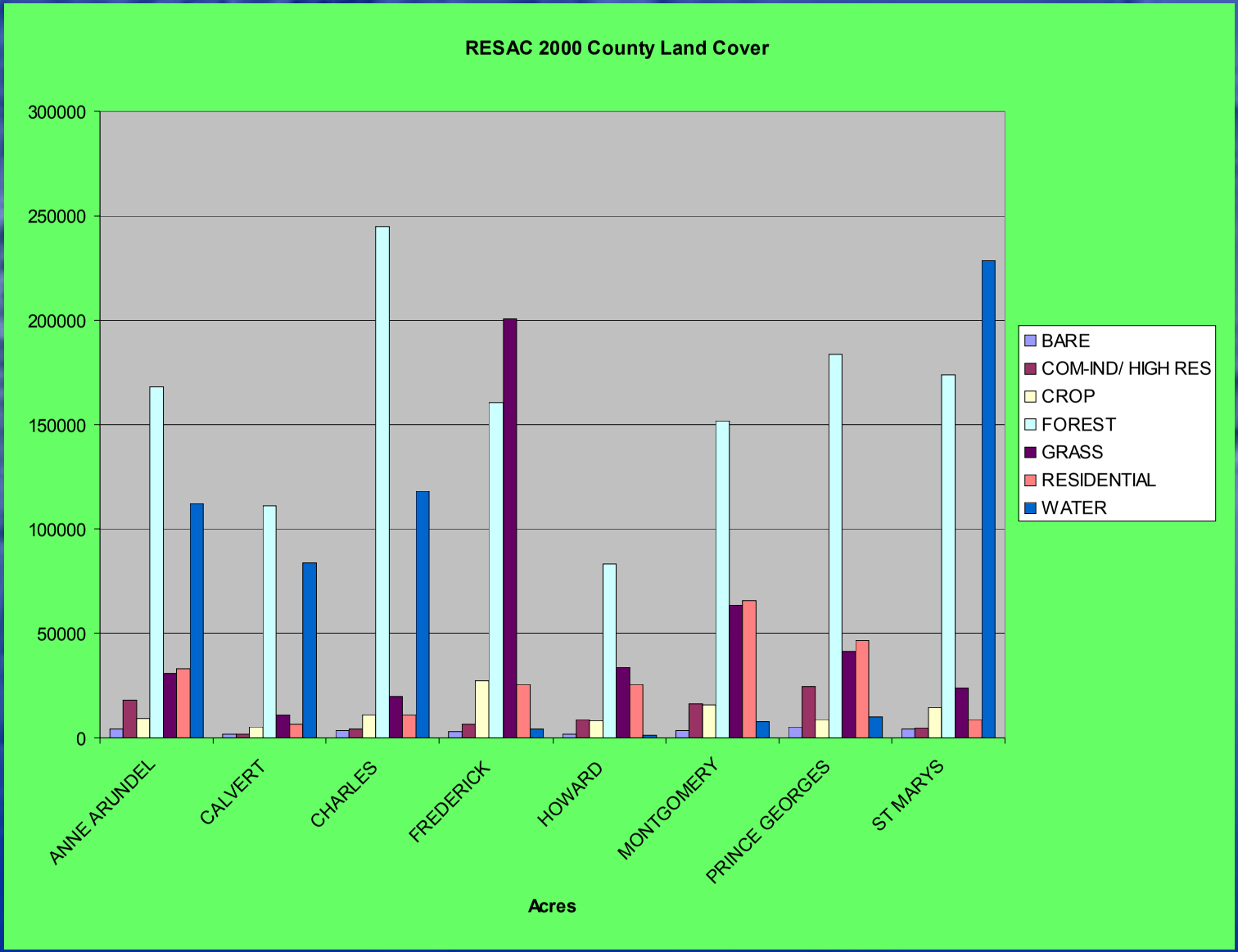
Land Use in P5

- Test land use data set being developed for Patuxent
- RESAC LULC Data, RESAC Impervious data, and Ag Census are combined on a county-segment basis
- Ag census crop ratios will be applied to RESAC crop and grass acres if total areas are in close agreement
- Ag census data are projected annually (1984-2000) based on four data points: 1982, 1987, 1992, and 1997
- RESAC LULC cover will be projected annually based on two data points, approximately 1990 and 2000 (note that the satellite imagery spans these years.)

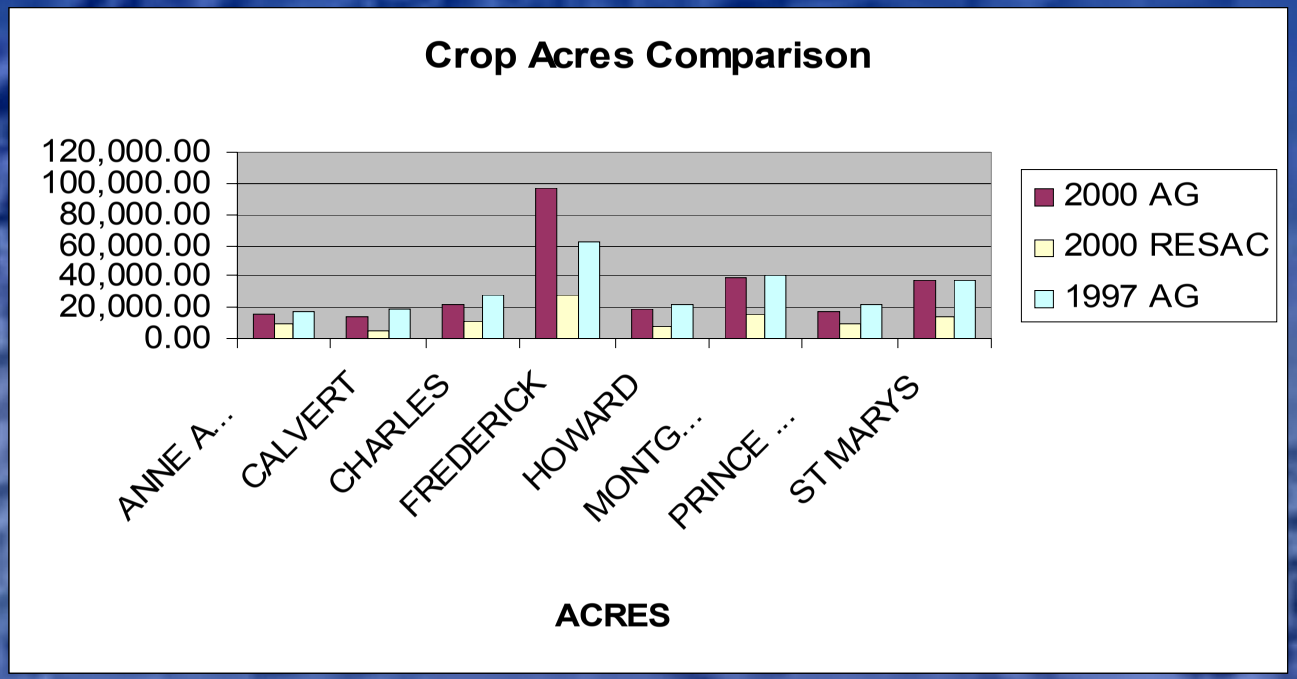
DRAFT PATUXENT LANDUSE



PATUXENT COUNTIES 2000 LAND COVER



RESAC CROP ACREAGE COMPARISON



CNTYNAME	FIPS	2000 AG	2000 RESAC	1997 AG
ANNE ARUNDEL	24003	16,278.36	9,216.71	16,548.00
CALVERT	24009	13,490.33	5,067.71	18,658.00
CHARLES	24017	21,072.84	10,782.81	28,581.00
FREDERICK	24021	97,042.54	27,387.70	62,209.00
HOWARD	24027	18,795.39	7,986.87	22,575.00
MONTGOMERY	24031	38,953.99	15,866.98	40,987.00
PRINCE GEORGES	24033	17,908.53	8,802.39	21,577.00
ST MARYS	24037	37,300.74	14,515.71	36,840.00

- RESAC numbers are currently significantly underestimating crop.
- Further inquiry is necessary to rule out internal error.
- Also RESAC product is draft, increased accuracy is expected in final product.

2000 RESAC vs. AG Census

- Lump RESAC Crop + Grass
- Lump ALL Ag census categories including those that may need to come out of forest or residential
- RESAC Crop + Grass still not matching total AG Census-- Further investigation and revisions needed

CNTYNAME	2000 RESAC CROP + GRASS	2000 ALL AG CENSUS	1990 CBPLU Herbaceous
ARUNDEL	40,098	26,973	49,359
CALVERT	16,006	20,446	29,443
CHARLES	30,289	31,003	62,955
FREDERICK	227,758	190,944	234,740
HOWARD	41,792	32,783	61,710
MONTGOMERY	79,100	63,516	110,738
GEORGES	50,293	28,574	61,991
ST MARYS	38,387	49,029	65,197

RESAC

- Forest is the dominant land cover in all but Frederick County which has aberrantly high ‘grass’ acres
- Coastal Counties (Anne Arundel, Calvert, Charles, and St. Mary’s) have extensive water cover-- THESE WILL GO DOWN WITH SHORELINE CUT OUT.
- Crop areas currently underestimated but revisions are underway to correct this problem.

RESAC 2000 LC And Impervious data can be combined to get total impervious acres, total LU acres, percent impervious, and percent of each land use in each county.

CNTYNAME	CLASS_TYPE	IMP_ACRES	LU_ACRES	PERCENT_IMP	PERCENT_I
ANNE ARUNDEL	BARE	953.30	4,336.48	21.98	1.
ANNE ARUNDEL	COM-IND/ HIGH RES	7,517.45	17,940.15	41.90	4.
ANNE ARUNDEL	CROP	125.95	9,216.71	1.37	2.
ANNE ARUNDEL	FOREST	5,214.61	167,957.48	3.10	44.
ANNE ARUNDEL	GRASS	3,192.17	30,881.75	10.34	8.
ANNE ARUNDEL	RESIDENTIAL	4,945.80	33,357.67	14.83	8.
ANNE ARUNDEL	WATER	630.60	112,423.93	0.56	29.
CALVERT	BARE	113.16	1,986.43	5.70	0.
CALVERT	COM-IND/ HIGH RES	642.66	1,906.37	33.71	0.
CALVERT	CROP	47.44	5,067.71	0.94	2.
CALVERT	FOREST	1,353.35	110,892.52	1.22	50.
CALVERT	GRASS	303.31	10,937.82	2.77	4.
CALVERT	RESIDENTIAL	315.67	6,388.29	4.94	2.
CALVERT	WATER	102.46	83,609.56	0.12	37.
CHARLES	BARE	250.35	3,415.54	7.33	0.
CHARLES	COM-IND/ HIGH RES	1,315.01	4,132.76	31.82	1.
CHARLES	CROP	77.16	10,782.81	0.72	2.
CHARLES	FOREST	1,922.16	244,743.08	0.79	59.
CHARLES	GRASS	548.54	19,506.25	2.81	4.
CHARLES	RESIDENTIAL	637.75	10,877.55	5.86	2.
CHARLES	WATER	100.71	118,190.18	0.09	28.
FREDERICK	BARE	461.00	2,700.32	17.07	0.
FREDERICK	COM-IND/ HIGH RES	2,116.38	6,221.94	34.01	1.
FREDERICK	CROP	561.02	27,387.70	2.05	6.
FREDERICK	FOREST	1,572.65	160,497.02	0.98	37.
FREDERICK	GRASS	6,927.50	200,370.64	3.46	46.
FREDERICK	RESIDENTIAL	2,232.04	25,856.96	8.63	6.
FREDERICK	WATER	630.42	4,175.46	15.10	0.
HOWARD	BARE	421.74	1,836.98	22.96	1.
HOWARD	COM-IND/ HIGH RES	3,492.60	8,634.04	40.45	5.

AG Census Data

AG Census

- AG Census years 1982, 1987, 1992, 1997
- Proposed Phase V crop and pasture categories were based similar nutrient or management usage
- Proposed Methodology for annual projection of AG Census
- Proposed Methodology for incorporating AG Census data with RESAC data

Proposed Phase V Ag Census Crop and Pasture Composites

- Composite land uses are made of individual crops/components. For example:
  - Corn/Small Grain/Soybean Composite includes acreage for corn, sorghum, wheat, rye, oats, soybeans, dry beans and berries
  - Hay w/out Nutrients Applied includes acreage for wild hay, fallow and idle land and orchards

How do we determine Composite Land Types?

- Major Crop Types: Break out the top seven crops by acreage and composite the rest into an 8th land use?
- Crop Rotation Categorization: Identify likely crop rotations in the watershed and to dividing acreage accordingly?
  - This might represent the ag land use “reality” in the watershed better but:
    - How exactly should acreage be divided up?
    - How should BMP’s be applied to a rotation?
    - If year 1 and year 2 of a rotation are the same acreage, but are managed differently (i.e. Corn/Small Grains/Soybeans), wouldn’t it make more sense to composite that rotation and average the nutrient applications rather than breaking the one rotation out into two different land uses?

Composite Crop Methodology

- Combine Major Crop Type and Crop Rotation Categorization:
  - Corn, Small Grains and Soybeans were grouped. Berries were added because they are not so significant in either acreage or nutrient management that they require a separate land use.
  - The other crops were grouped into land uses based on nutrient management similarities.

Composite Crop Methodology cont.

- Hay W/Nutrients: all hays and failed land, except for alfalfa (no nitrogen) and wild hay (no nutrients applied.)
- Hay W/Out Nutrients: wild hay, idle and fallow land and orchards
- Greenhouses and nurseries: insignificant acreage but significant nutrient source.

12 Potential AG Land Uses in Phase V. Watershed Model

- Corn/Small Grain/Soybean Composite
- Alfalfa
- Hay w/ Nutrients Applied
- Hay w/out Nutrients Applied
- Normal Pasture
- Pasture w/ Excess Manure Applied
- Potatoes
- Vegetables
- Peanuts
- Cotton
- Tobacco
- Greenhouse and Nursery

Different composites were assigned to the following RESAC categories based on their likely reflective signature

Crop	Grass	Forest	Residential
Cotton	Pastured Cropland	Pastured Woodland	Other Land Pastured
Tobacco	Alfalfa		Berries
Peanuts	Field and Grass Seed		Orchard
Vegetables	Hay		Greenhouse
Failed			Nursery
Fallow			
Idle			
Corn			
…			

Distribution of AG CENSUS Composite Types

- Derive county based ratios of individual composite types to their total category ie. % of Crop that is Cotton, or percent of Grass that is Alfalfa
- Apply ratio to RESAC LULC totals by county-segment
- One land use may be divided among more than one RESAC category
- For example, “Hay w/out Nutrients Applied” is made up of “Wild Hay”, which is a grass, “Idle and Fallow Land”, which is seen as crop acreage and “Orchard”, which is classified as residential.

ANNUAL AG CENSUS CROP PROJECTIONS

- An annual data set was calculated using the Ag Census from the years 1997, 1992, 1987, and 1982.
- The slope of the best fit line for these four years was determined and then used to estimate the remaining years between 1984 and 2000.
- The same methodology will be used to project RESAC LULC numbers between 1984 and 2000. Annual AG Census ratios will then be applied to annual Land Cover data

To estimate the data for 1994, the results of four calculations are averaged:

- (1997 data) - 3x(slope of best-fit line)
- (1992 data) + 2x(slope of best-fit line)
- (1987 data) + 7x(slope of best-fit line)
- (1982 data) +12x(slope of best-fit line)

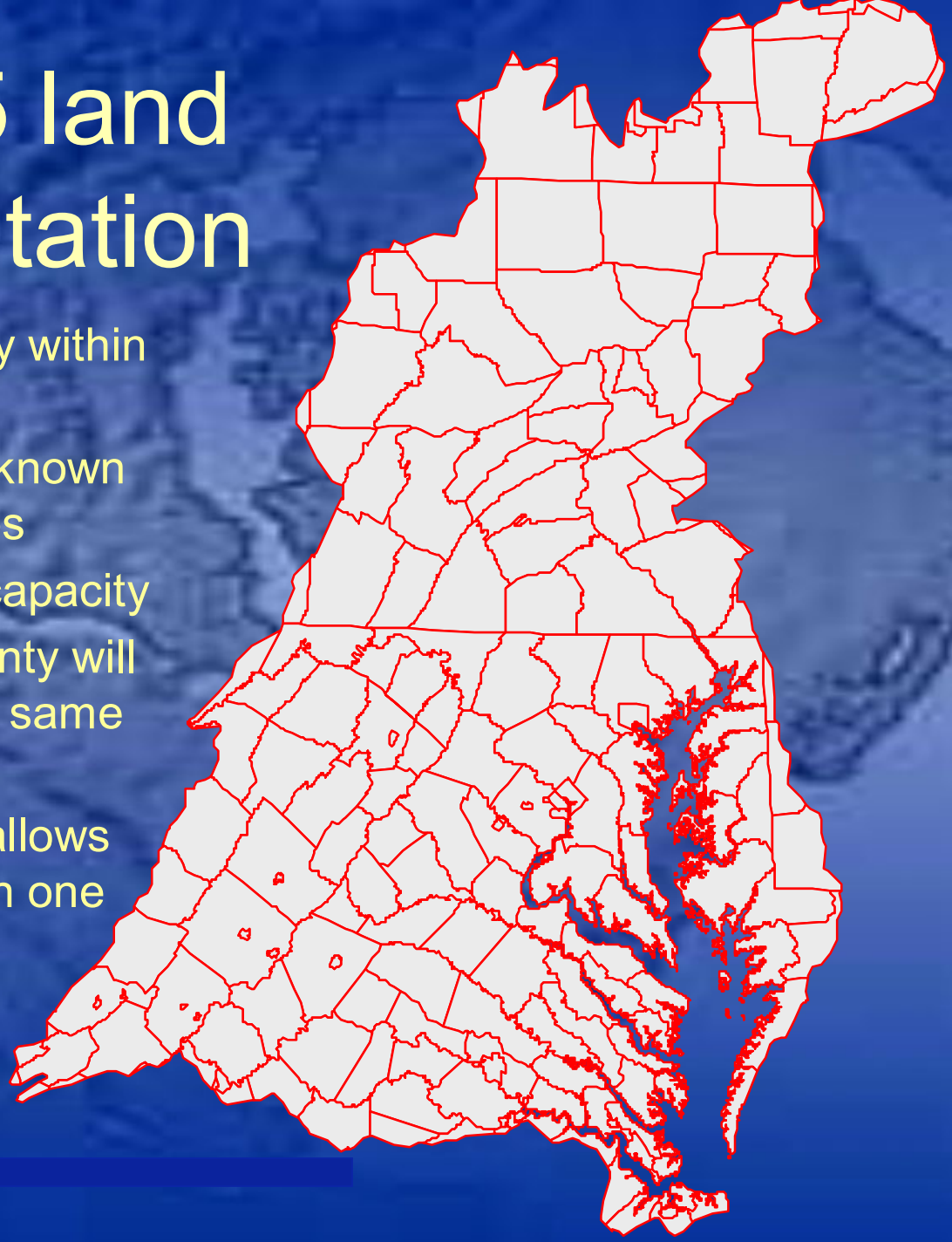
Phase V Segmentation

P. 5 Segmentation has:

- RIVER SEGMENTS
- LAND SEGMENTS

Phase 5 land segmentation

- Most counties are completely within a hydrogeomorphic region
- BMP and Crop data are not known on a finer scale in most cases
- Near the limit of computing capacity
- Each acre of LU in each county will load the reach system at the same rate
- Refined river segmentation allows one county to load more than one reach.

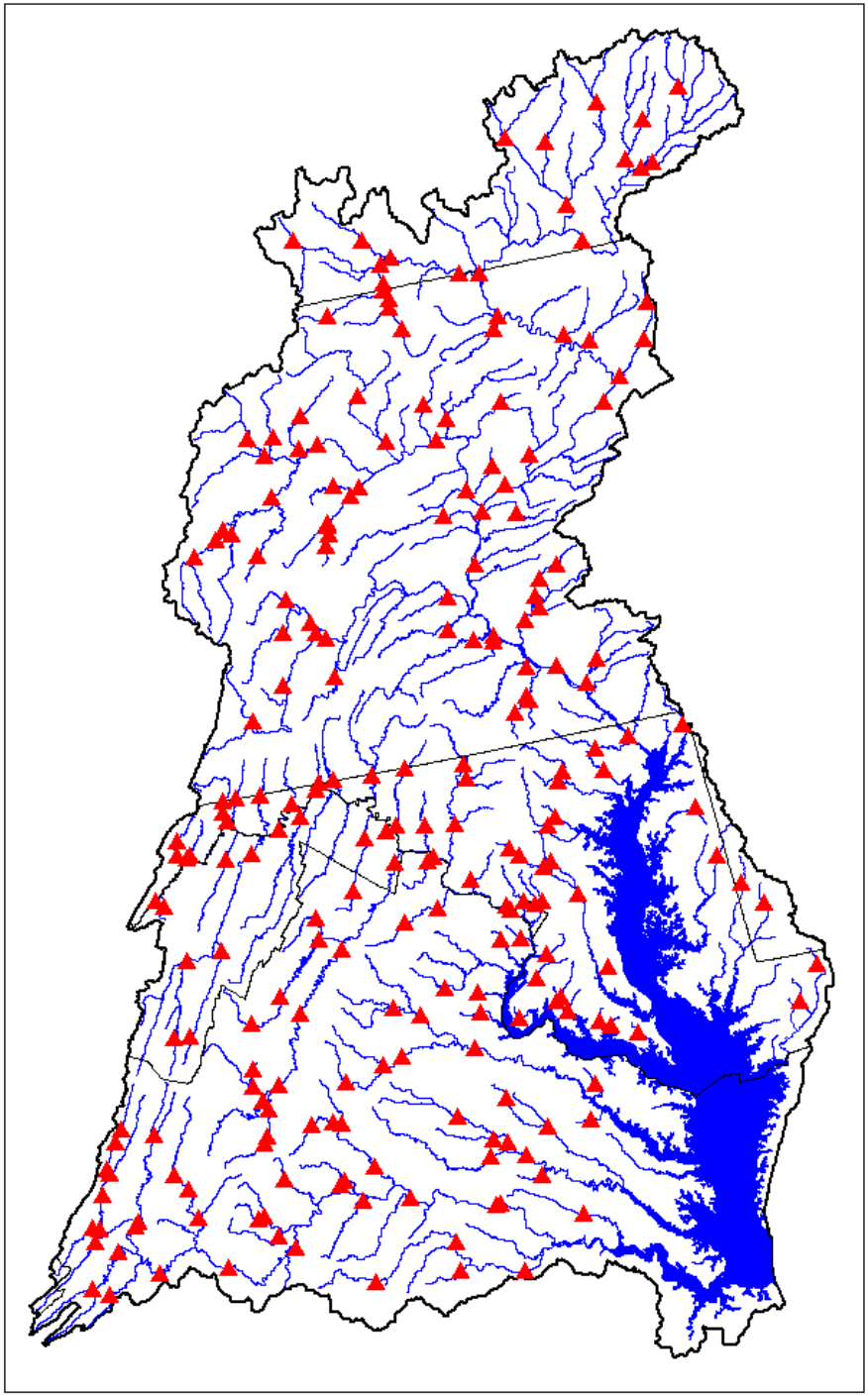


Phase 5 River Segmentation

- Greater than 100 cfs

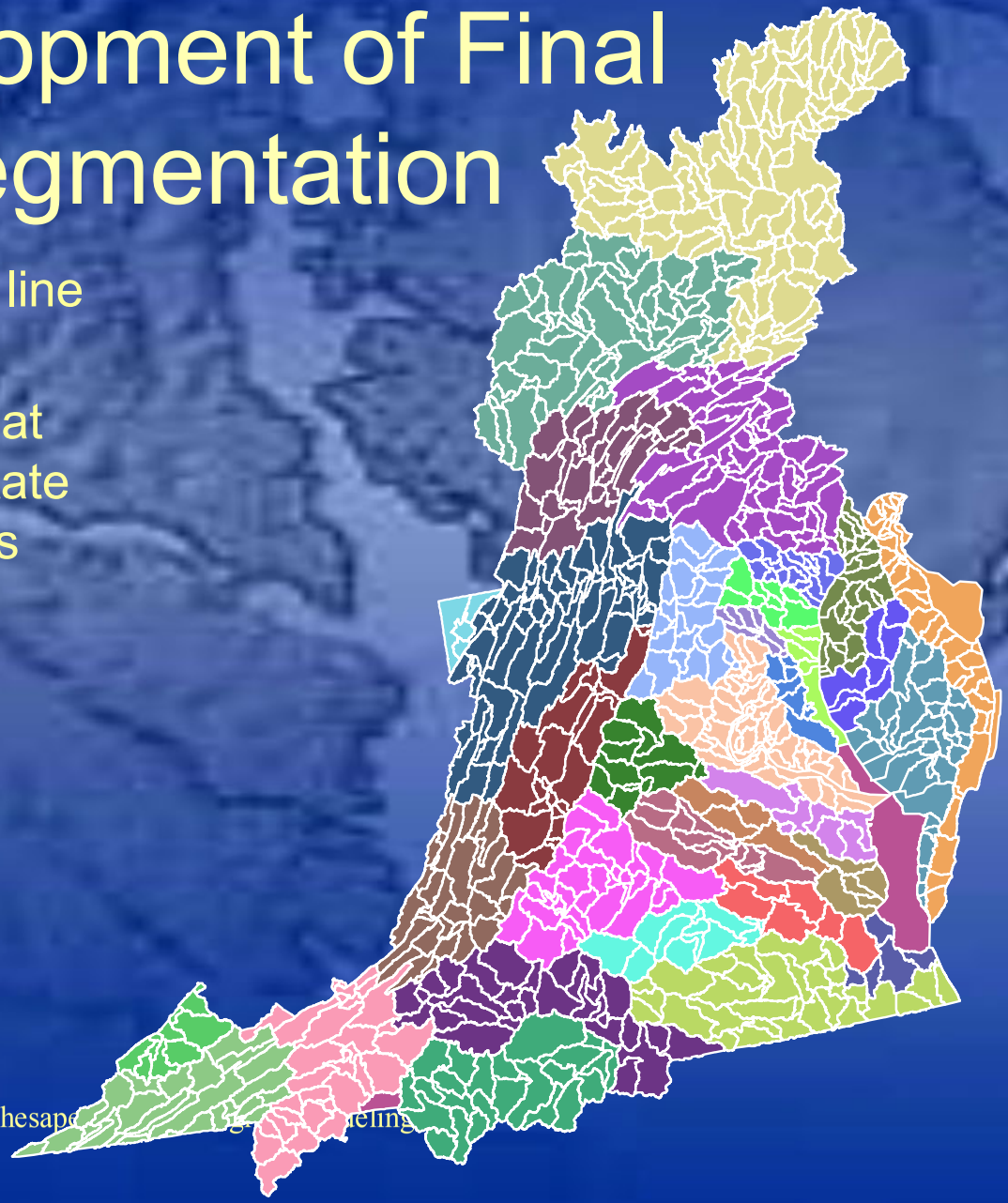
  or

- Has a flow gage

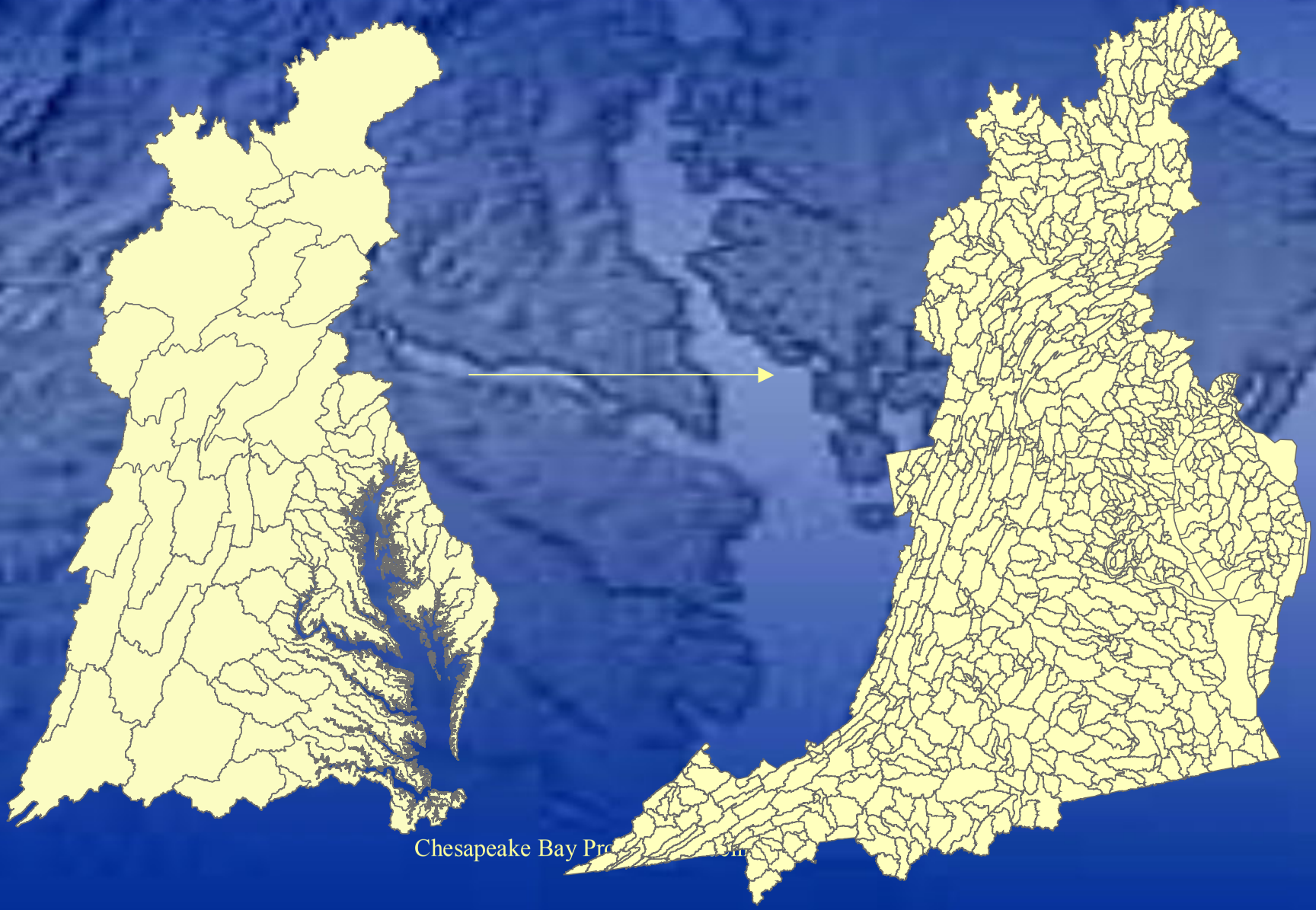


Development of Final Segmentation

- Use State Watershed line work
- Use DEM delineation at monitoring sites if a state watershed boundary is not nearby.



Old Vs. New Segments



Segmentation Status

- Segmentation for Chesapeake Bay Watershed, Delmarva, and all of MD and Virginia are complete.
- MD, VA, and DE have finalized approval
- DC wants to incorporate the CSO-sheds
- NY and WV are still under review by those states, no major revisions are anticipated.