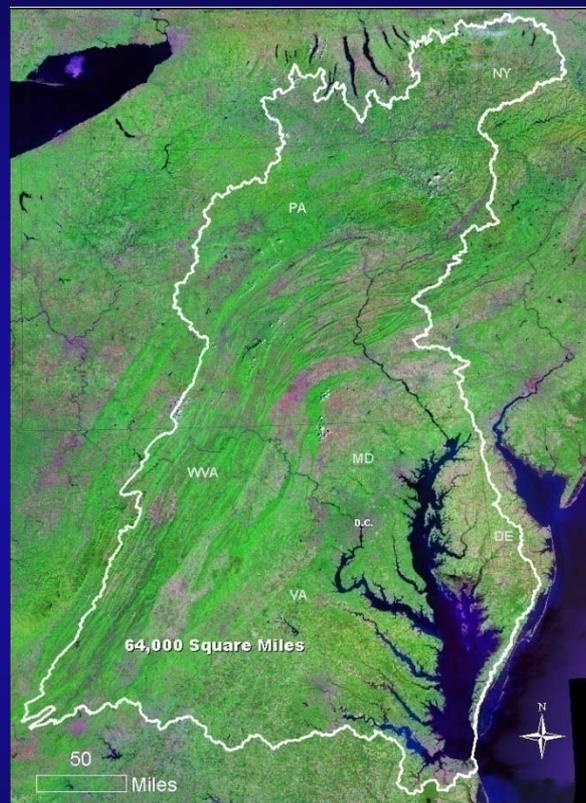


Land Cover Maps and Change Metrics for the Chesapeake Bay Watershed 1984 - 2006

Presented by
Frederick M. Irani

Chesapeake Bay Watershed Land Cover Change Data: 1984 1992 2001 2006

- History
- Design
- Methodology
- Results
- Applications



Chesapeake Bay Program



<http://www.ChesapeakeBay.net>



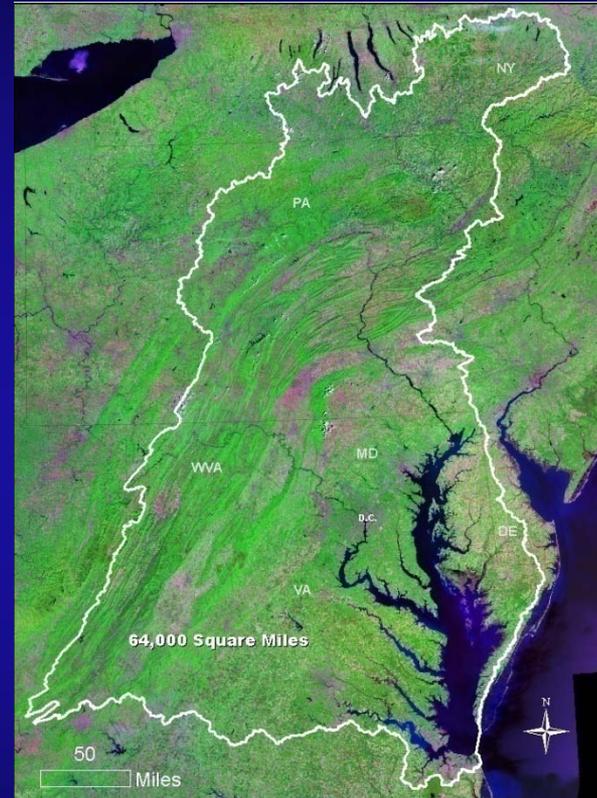
Chesapeake Bay Program Requirement:

Relate

Bay Watershed Land Cover Change

to

Chesapeake Bay Water Quality



Bay Watershed Land Cover Data ca. 2006

US Geological Survey (USGS)

National Land Cover Dataset
National Land Cover Database
NLCD Retrofit Change Product

- NLCD 1992
- NLCD 2001
- NLCD '92-'01 Change

National Oceanographic and Atmospheric Agency (NOAA)

Coastal Change Analysis Program (CCAP)

Coastal Zone Standardized Change

- CCAP 1996, 2001, 2005

~1990

Chesapeake Bay Program (CBP)

~1983

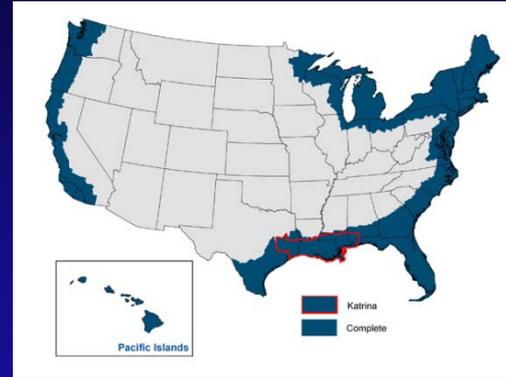
Regional Earth Science Applications Center (RESAC)

- Impervious Surface 1991, 2000
- Land Cover 2001



NOAA Coastal Change Analysis Program

CCAP



- Standardized Land Change
- Monitor Coastal and Adjacent Uplands in 5 Year Intervals
- Two time periods (1996, 2001) of mapping now complete
- Next (2005/06) national update scheduled for 2010
- Facilitates cause-and-effect studies of coastal changes

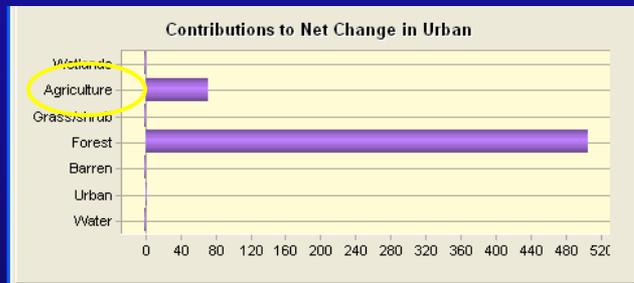
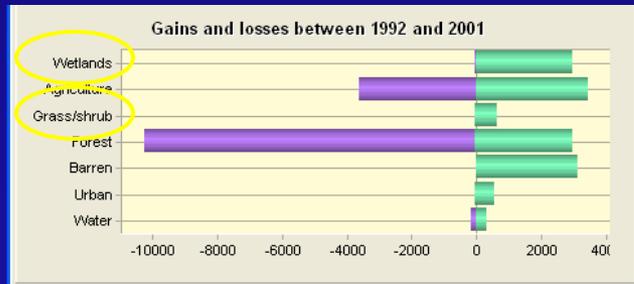


To the Point: Why This Project?

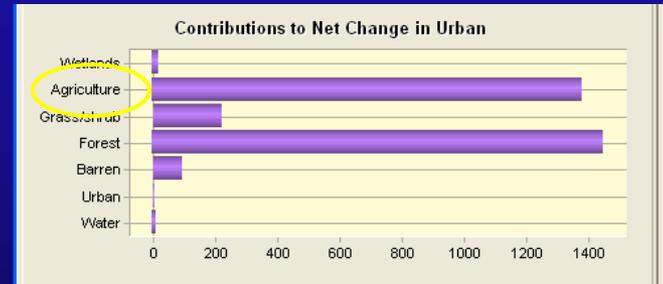
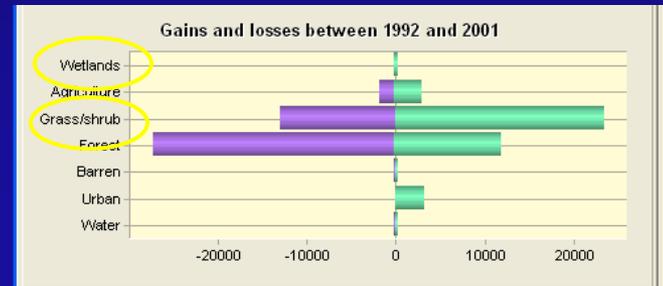
York River
Watershed
1992 - 2001



NLCD Change Product



C-CAP Change Product

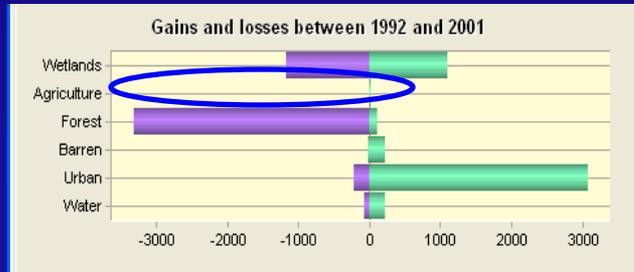


To the Point: Why This Project?

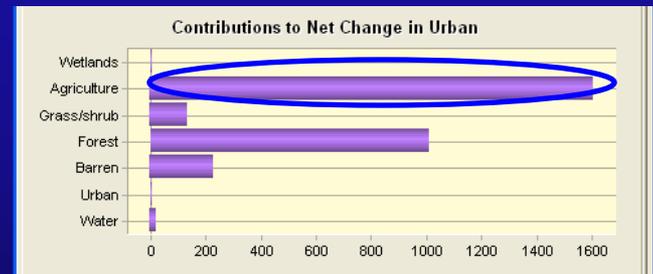
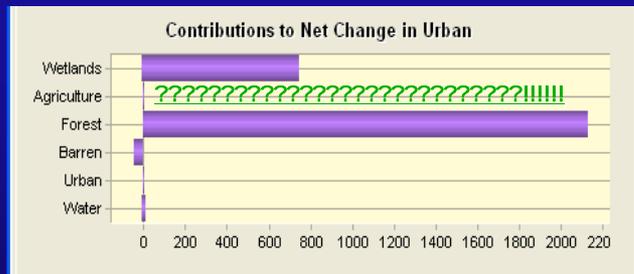
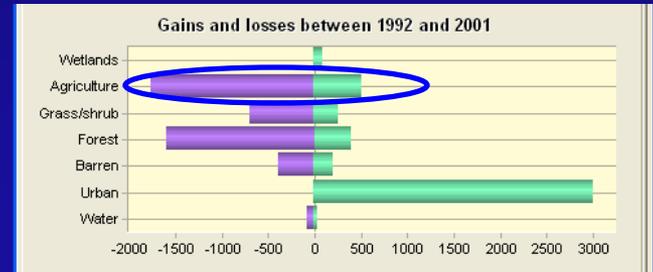
Patuxent River Watershed 1992 - 2001



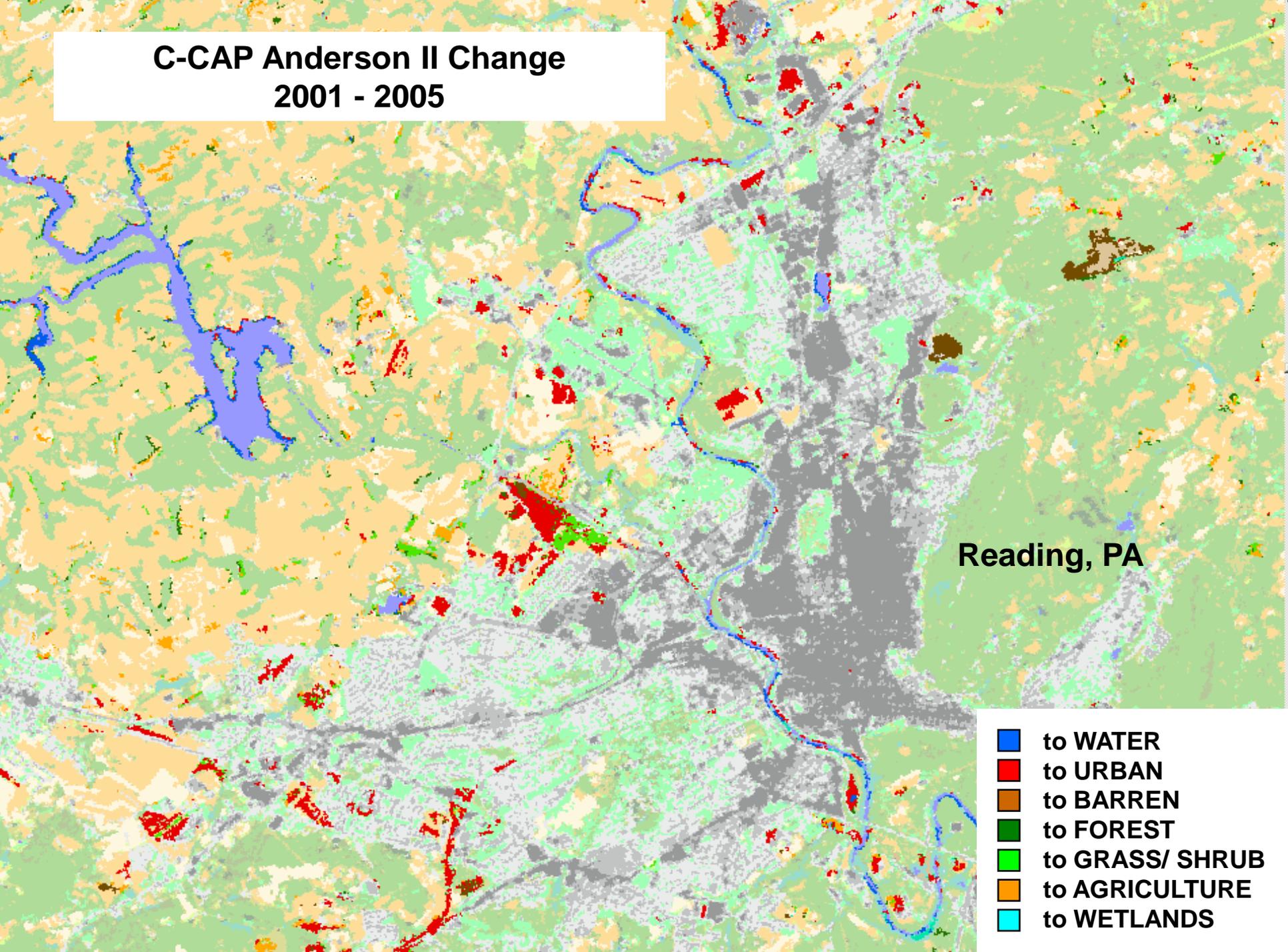
NLCD Change Product



C-CAP Change Product



C-CAP Anderson II Change 2001 - 2005

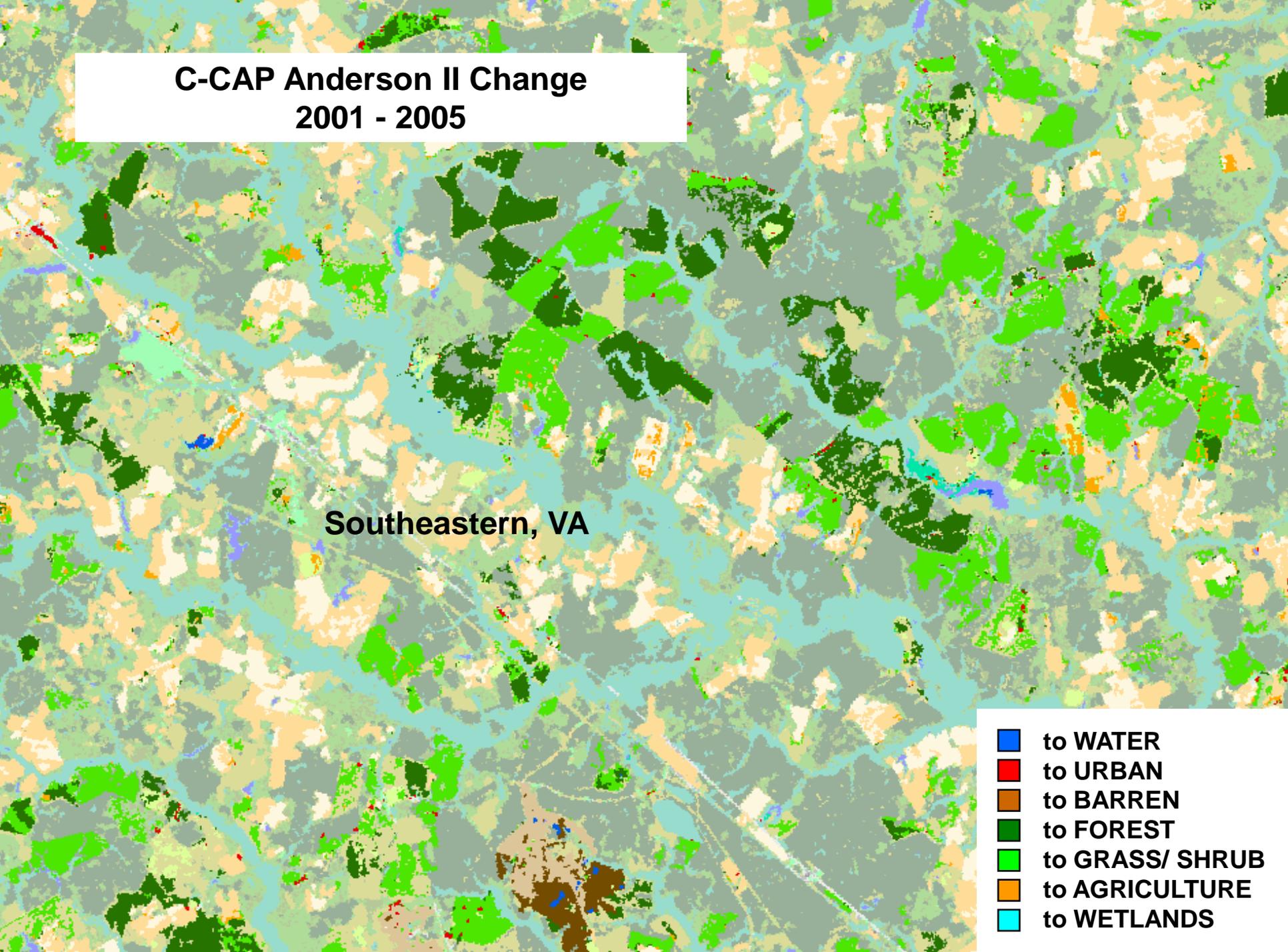


Reading, PA

- to WATER
- to URBAN
- to BARREN
- to FOREST
- to GRASS/ SHRUB
- to AGRICULTURE
- to WETLANDS

**C-CAP Anderson II Change
2001 - 2005**

Southeastern, VA

- 
-  to WATER
 -  to URBAN
 -  to BARREN
 -  to FOREST
 -  to GRASS/ SHRUB
 -  to AGRICULTURE
 -  to WETLANDS

Chesapeake Bay Land Cover Data

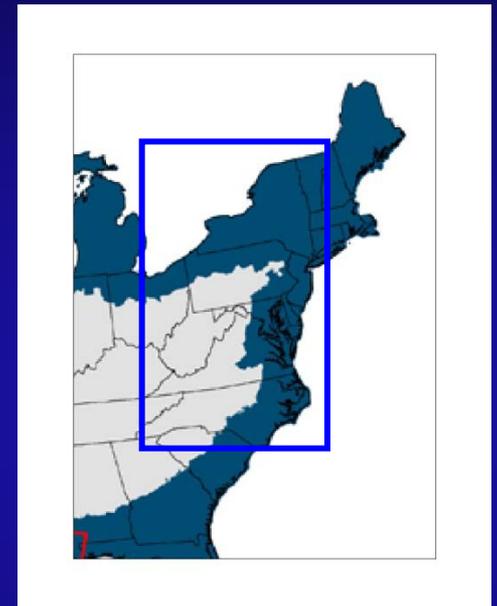
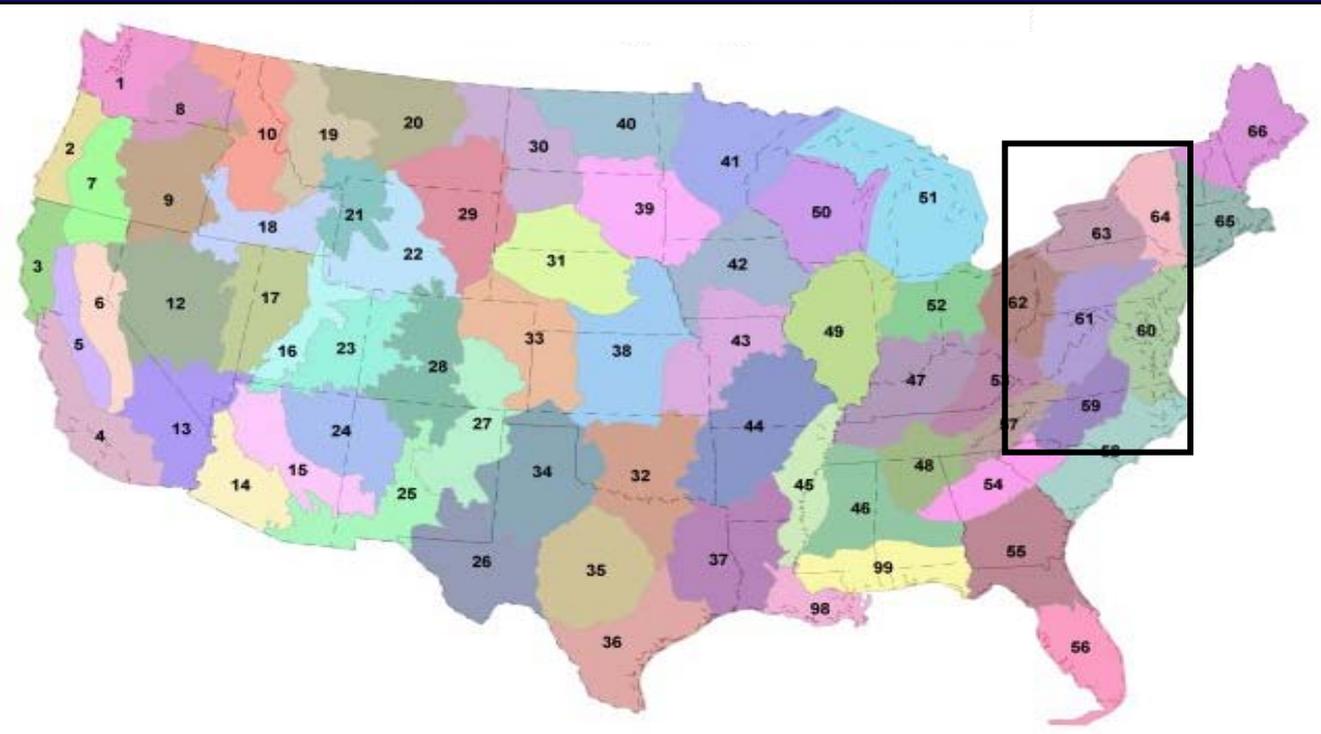
Why these dates:

- **1984-** Earliest cloud free Bay-wide Landsat 5
- **1992-** Coincident with NLCD and 1990 Census
- **2001-** Coincident with NLCD and 2000 Census
- **2005/6-** Coincident with CCAP '05 and NLCD '06

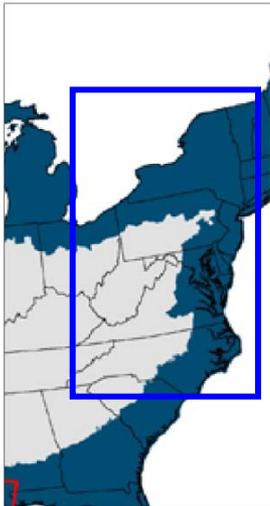


MRLC Mapping Zones (CONUS)

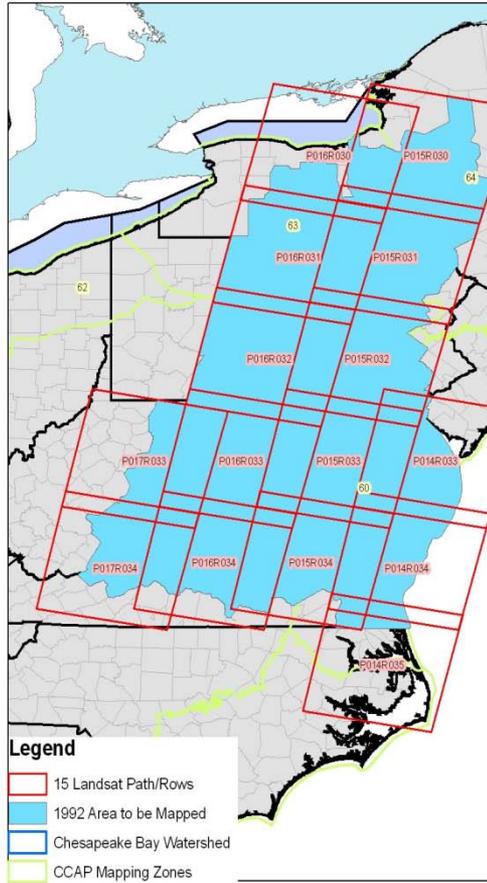
CCAP '96 '01 Completed



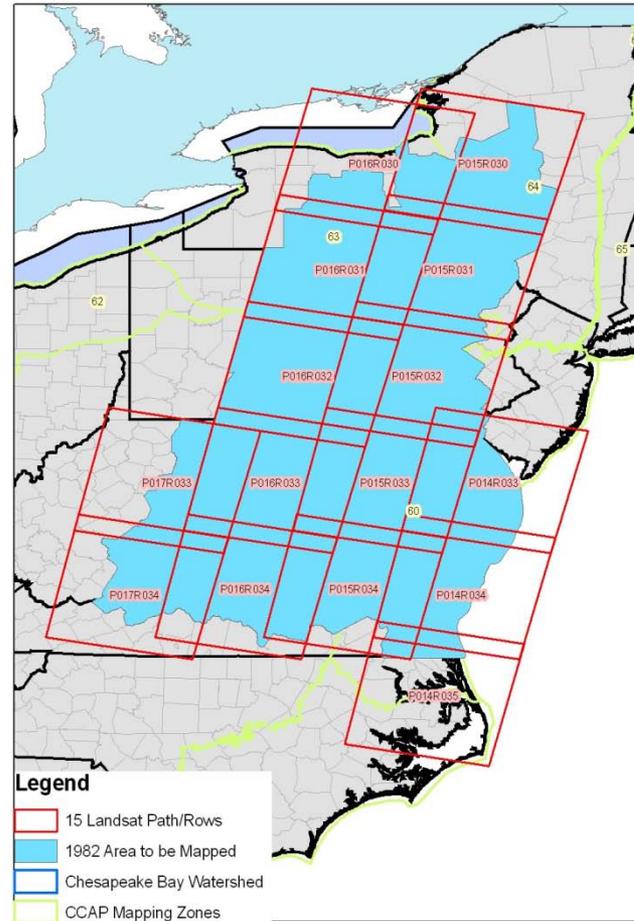
Leverage CCAP Zones 59, 60, 63, 64 with Zone 61



Chesapeake Bay Watershed - 1992 Update
100,400 Square Miles

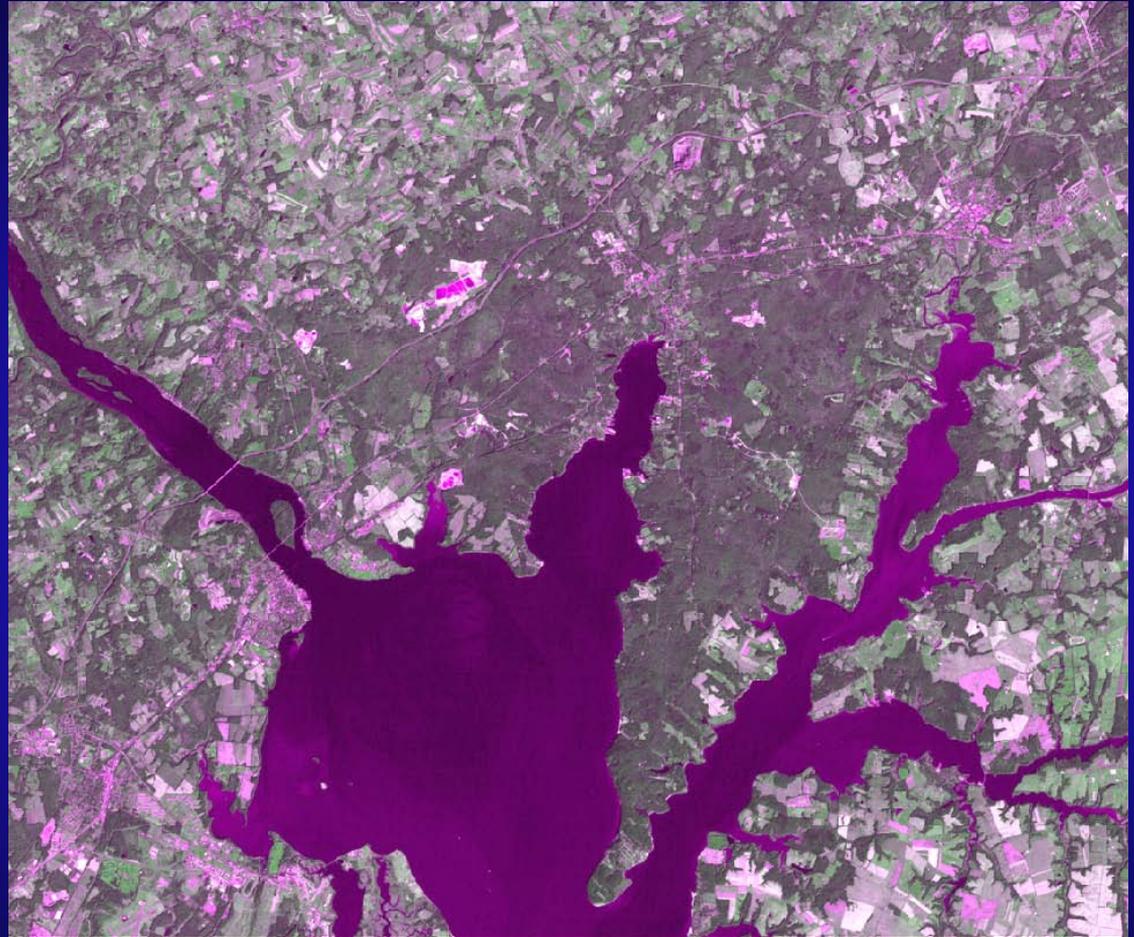


Chesapeake Bay Watershed - 1984 Update Area
100,400 Square Miles



Cross Correlation Analysis

1992
Reflectance



Cross Correlation Analysis

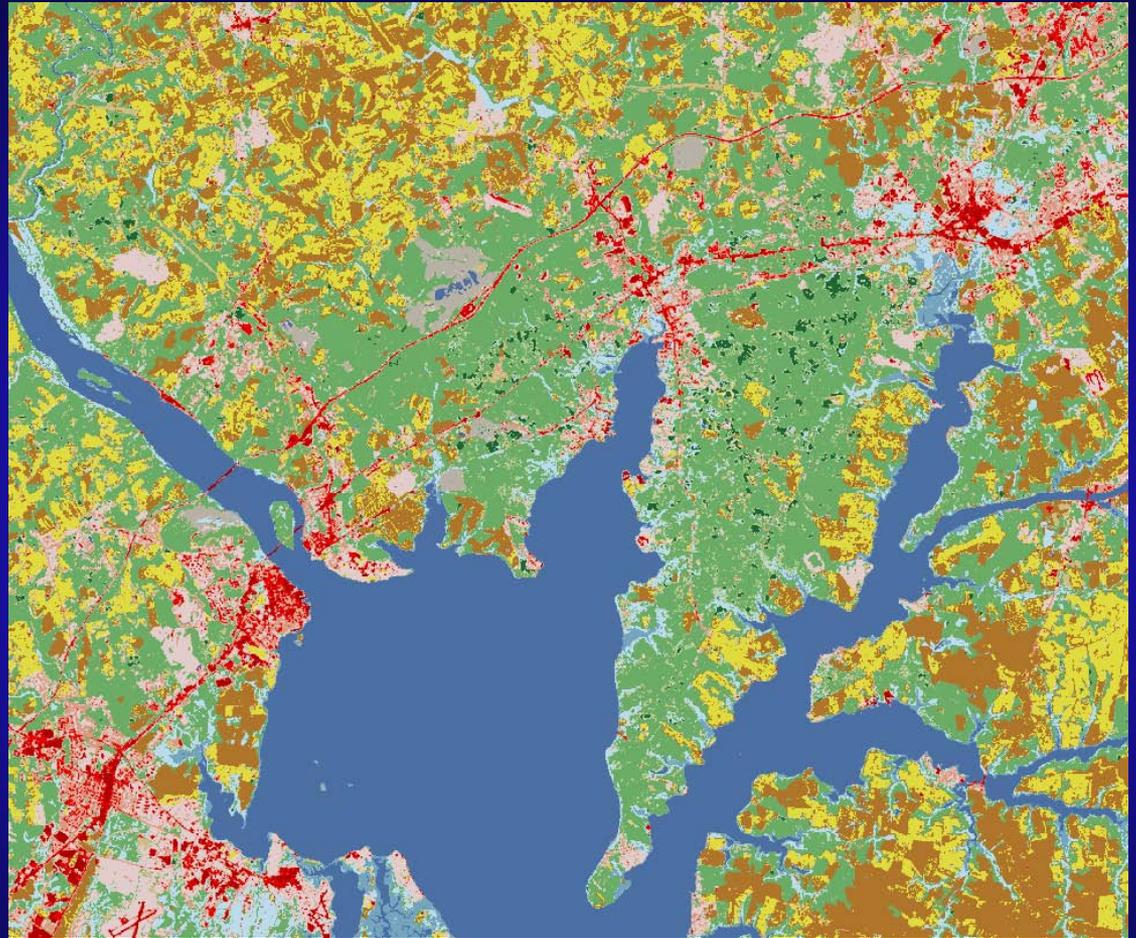
2001
Reflectance



Cross Correlation Analysis

Stratified
Baseline Data

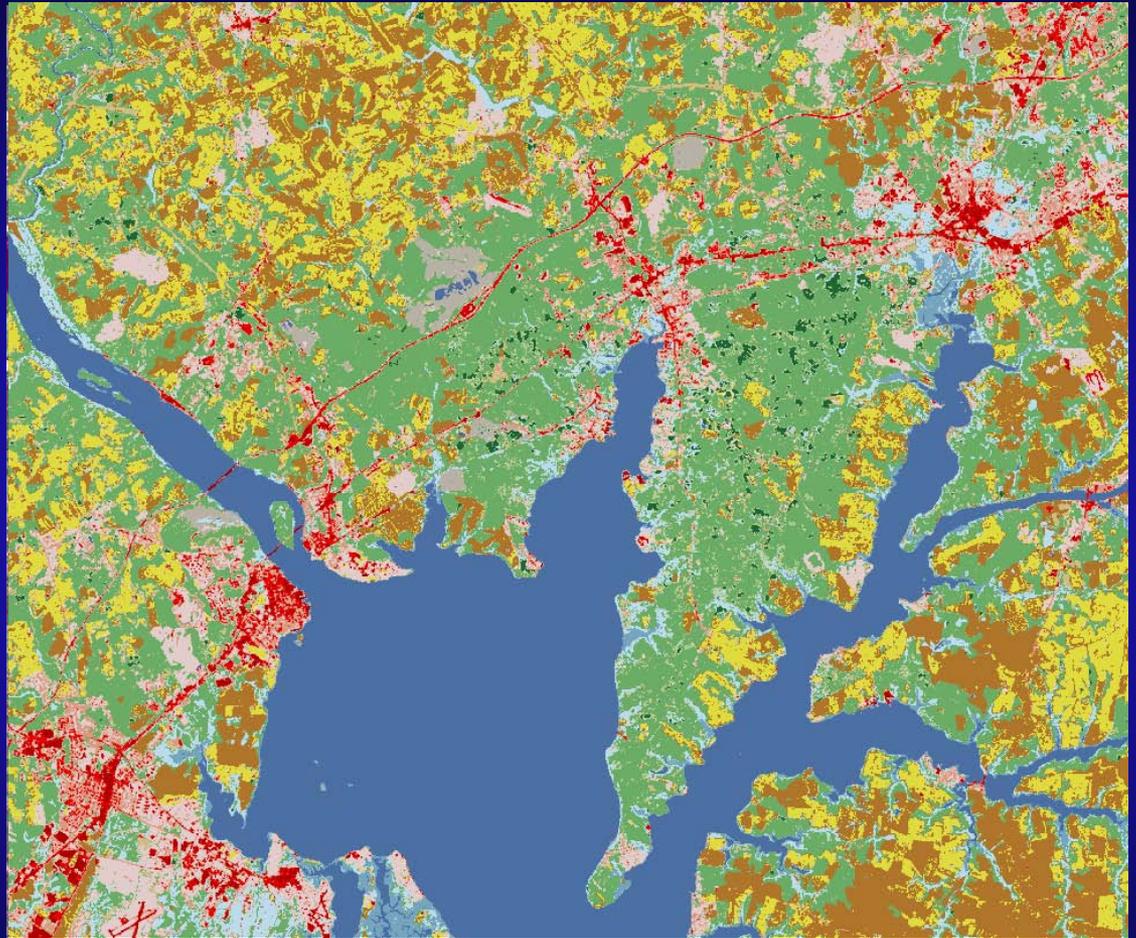
2001



Cross Correlation Analysis

1992
Reflectance

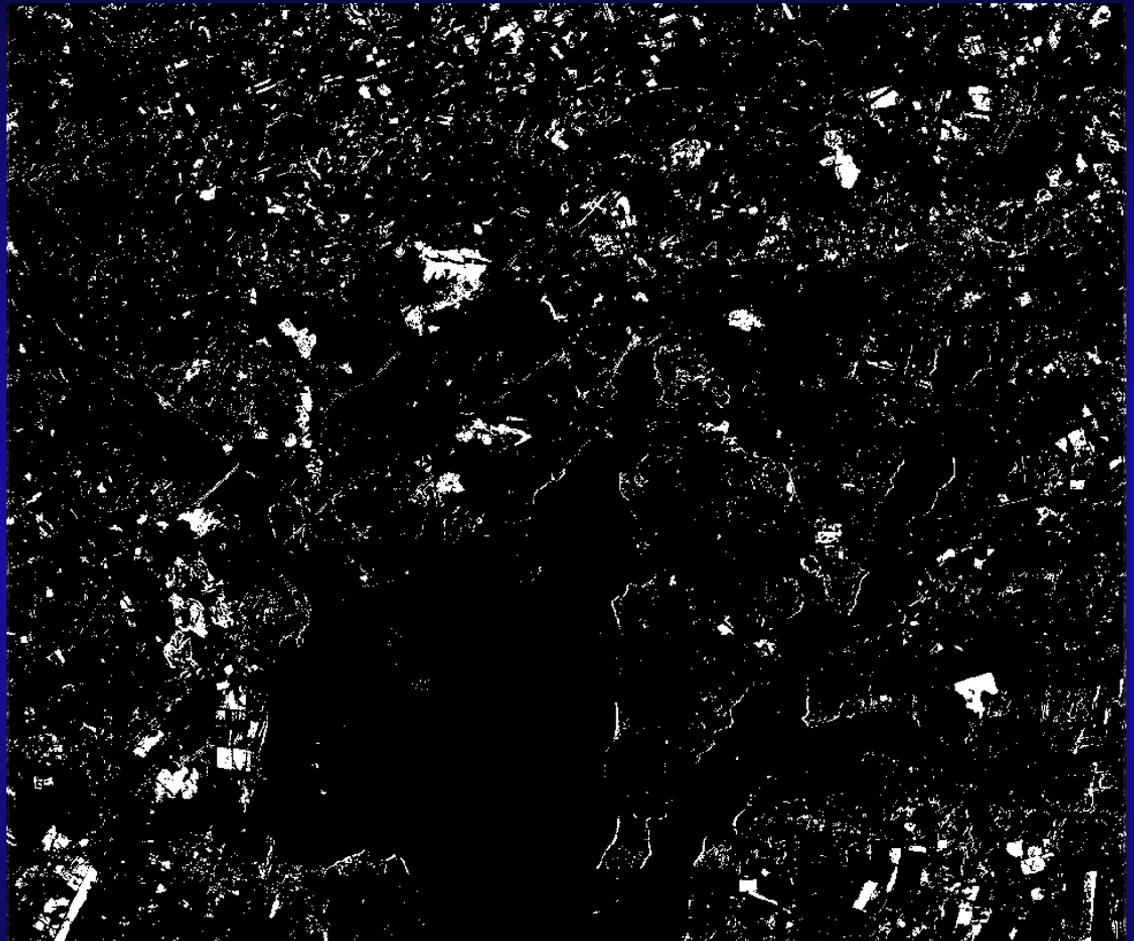
2001



Cross Correlation Analysis

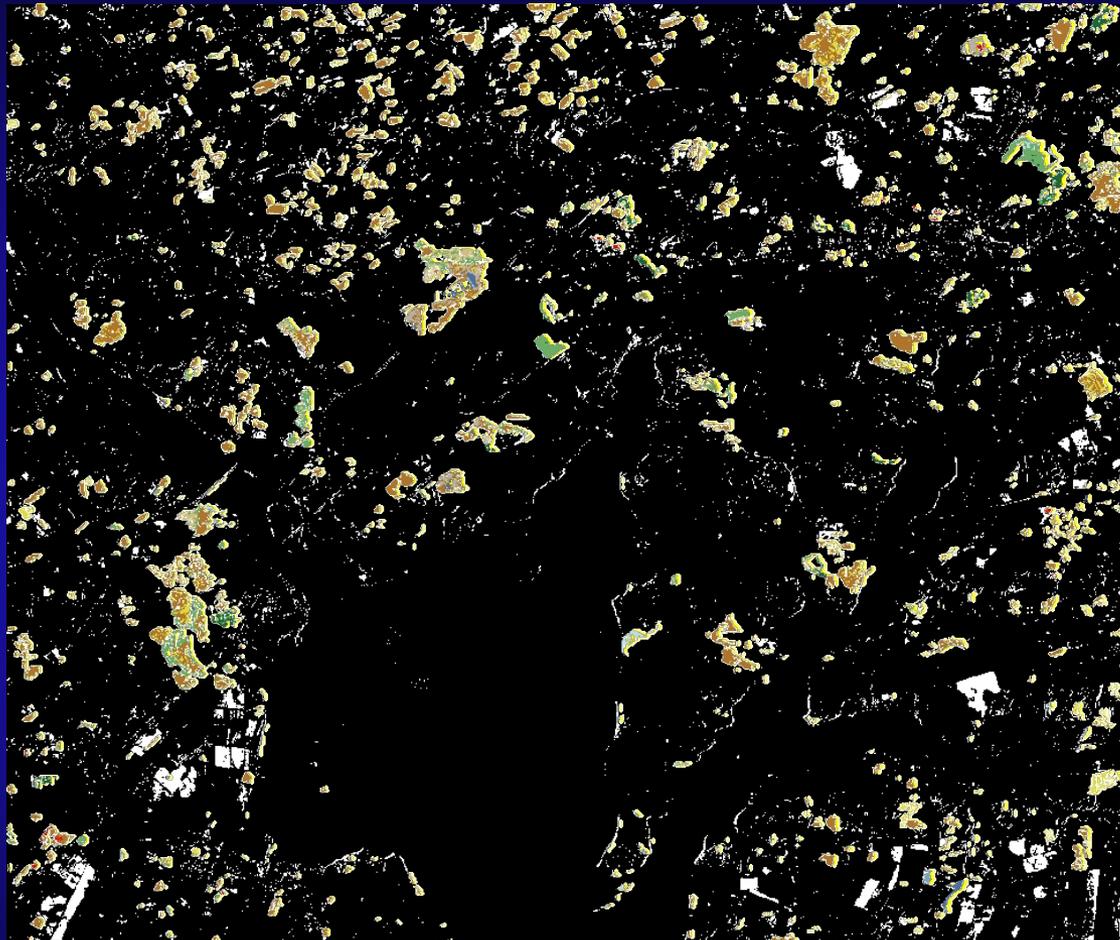
Z Scores
“Thresholded”
To Changed
Pixels

$$Z = \sum_{i=1}^n \left(\frac{\text{Observed}_i - \text{Expected}_i}{\text{Std.Dev.}_i} \right)^2$$



Cross Correlation Analysis

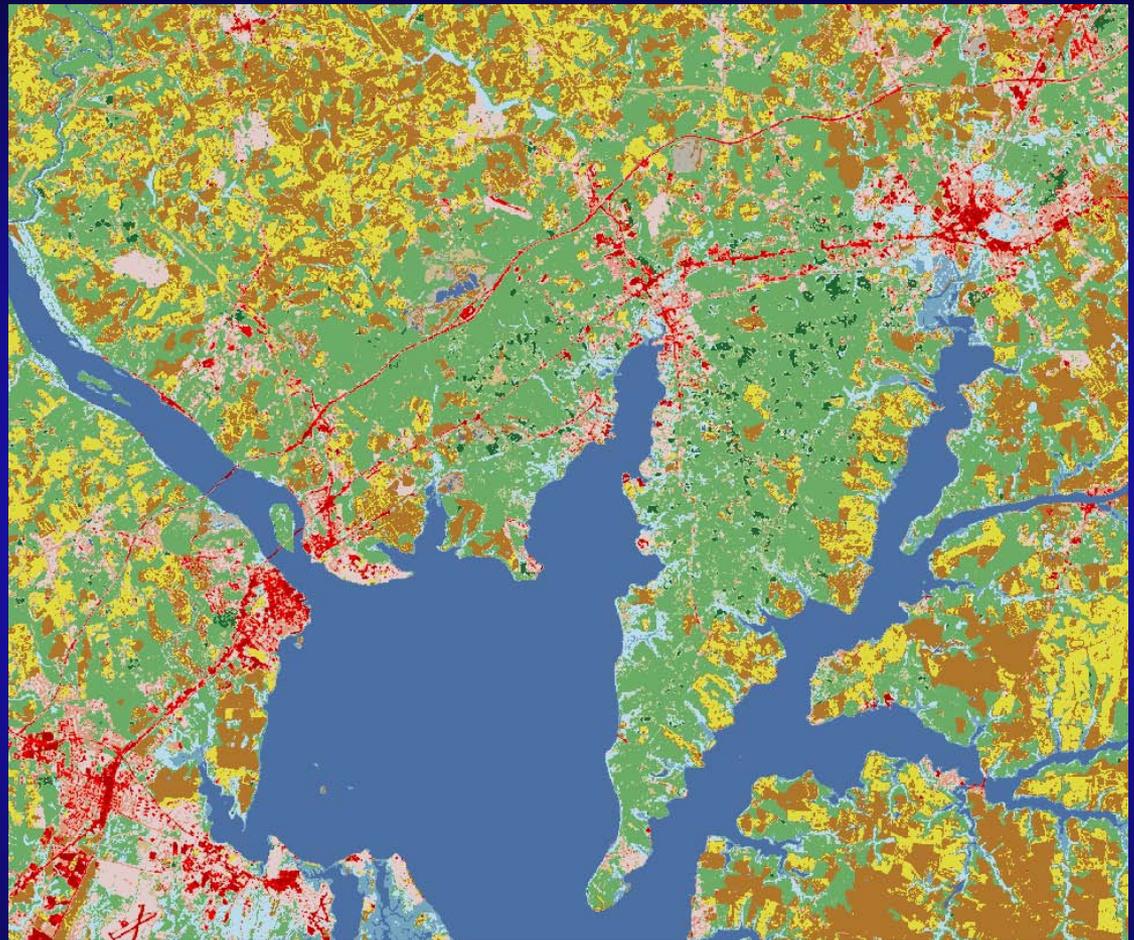
Changed Pixels
Classified via
CART Analysis



Cross Correlation Analysis

Only changed areas are
Classified and
burned in
to the Baseline
to create the
target year
land cover
dataset

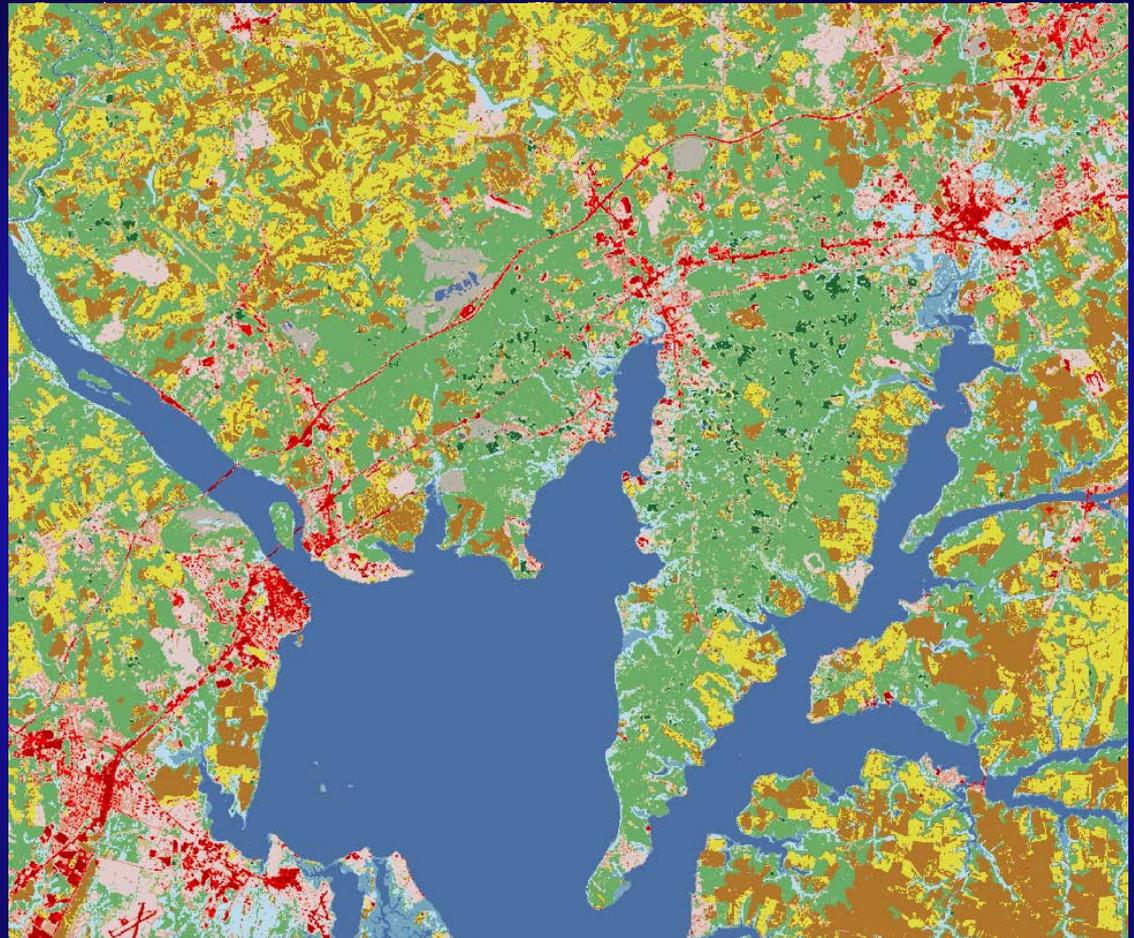
1992



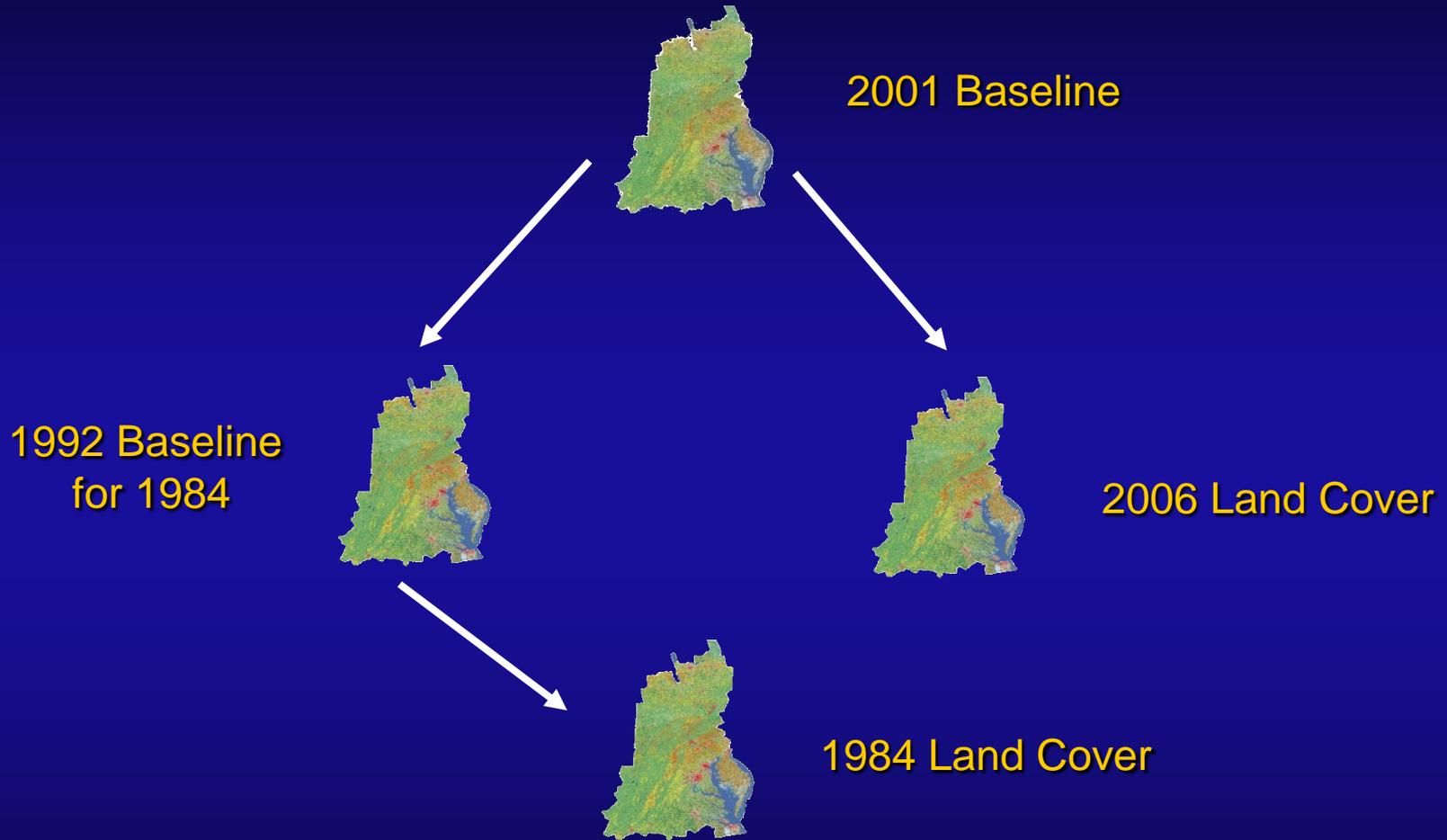
Cross Correlation Analysis

Only changed areas are
Classified and
burned in
to the Baseline
to create the
target year
land cover
dataset

2001



Production Scenario:



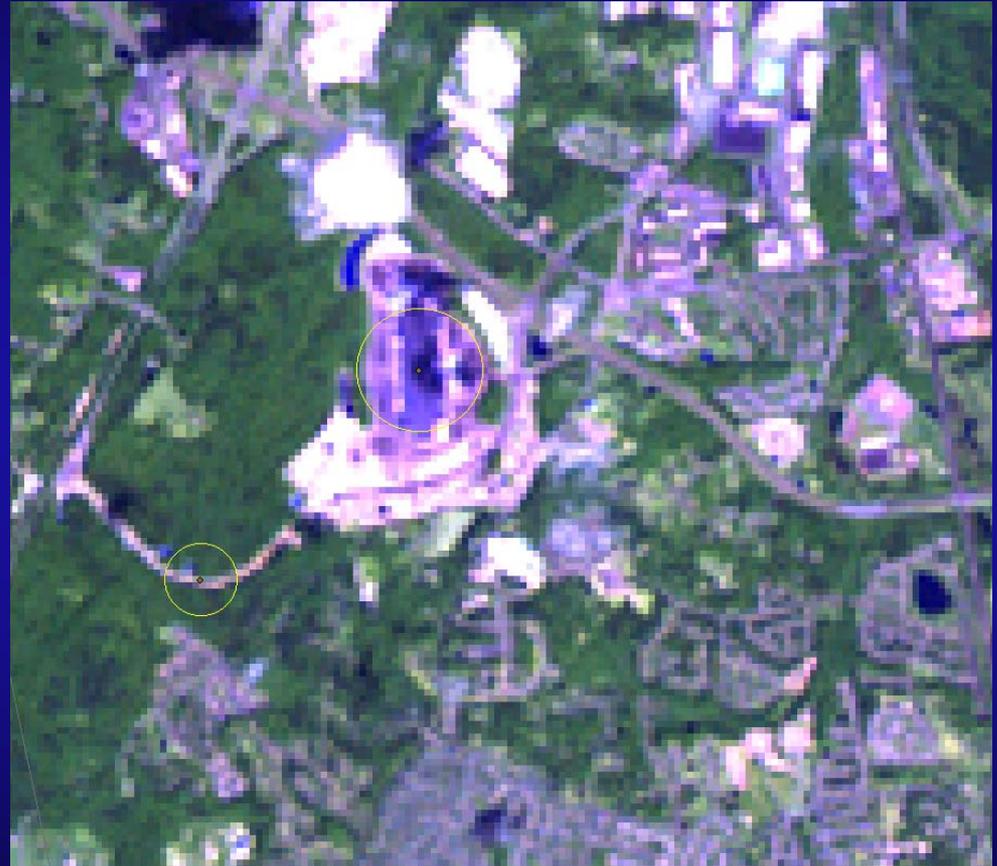
Example: New Shopping Mall

- 1992 Reflectance



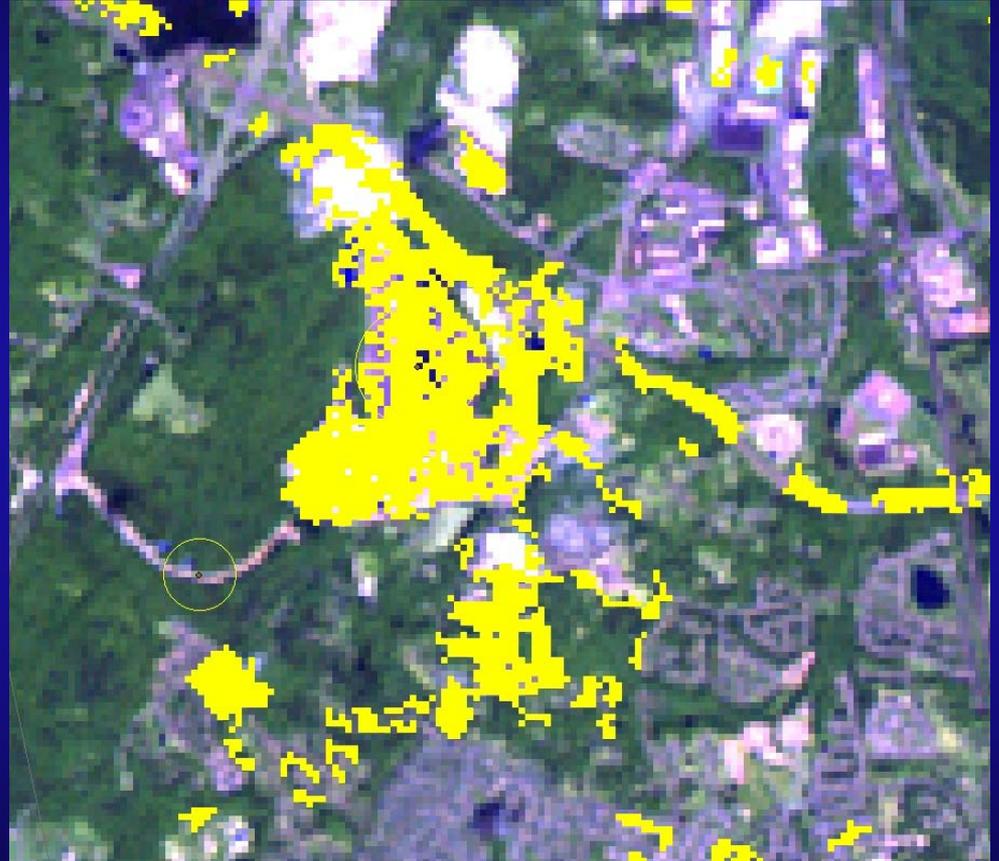
Example: New Shopping Mall

- 2001 Reflectance



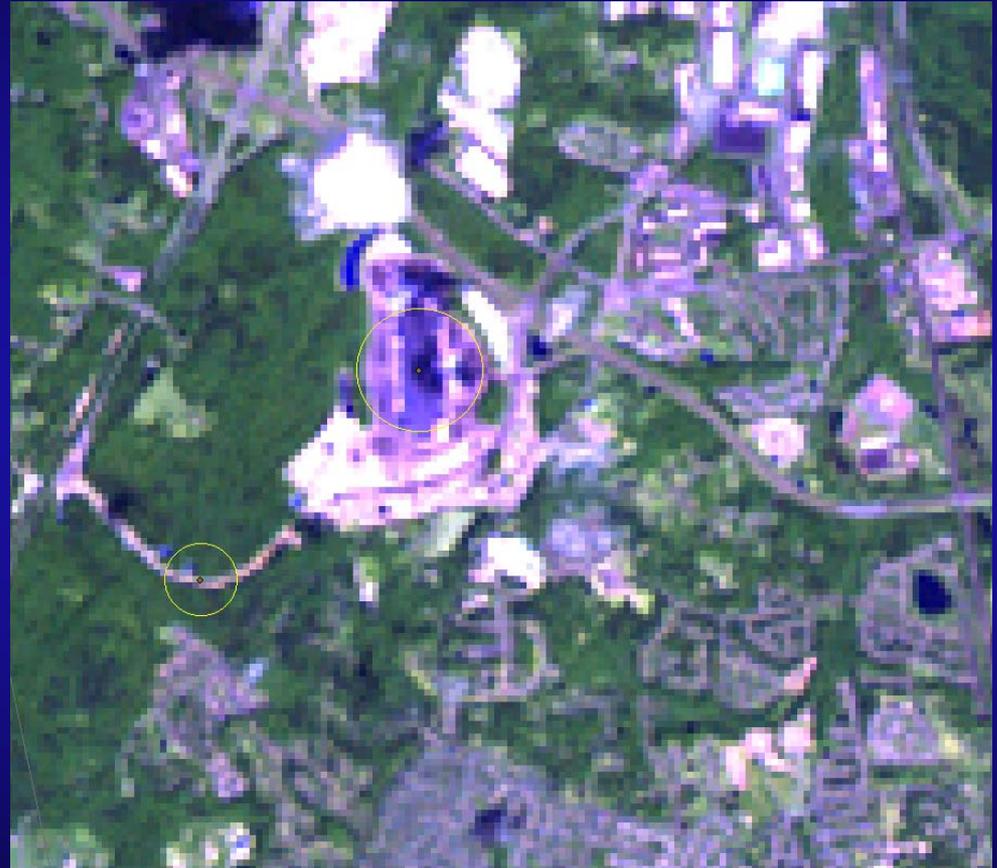
Example: New Shopping Mall Example: New Shopping Mall

- '92-'01 Change
(Draft)



Example: New Shopping Mall

- 2001 Reflectance



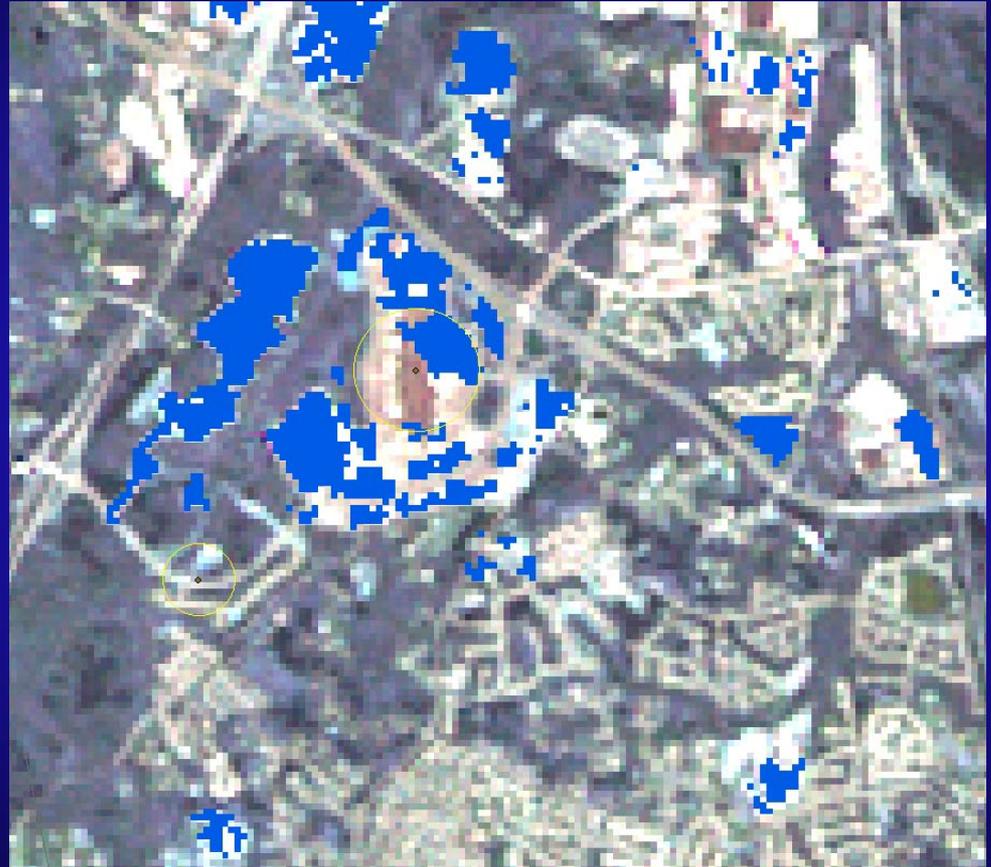
Example: New Shopping Mall

- 2006 Reflectance



Example: New Shopping Mall

- '01-'06 Change
(Draft)



**Dorchester
County
MD
1992**



**Dorchester
County
MD
2001**





**Dorchester
County
MD
2001**

**All '92-'01
Change**

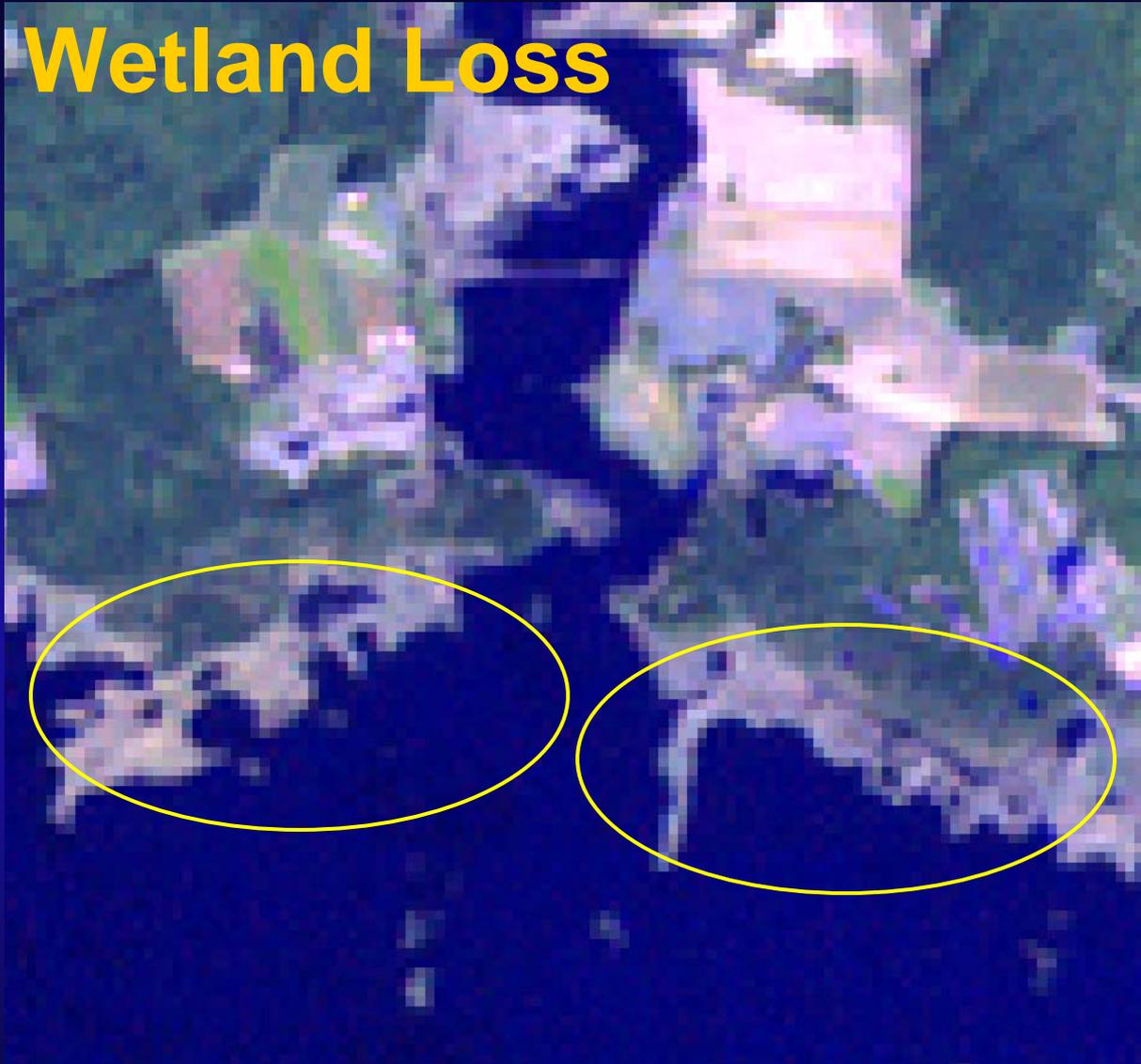


**Dorchester
County
MD
1992-2001
Emergent
Wetland
Loss**



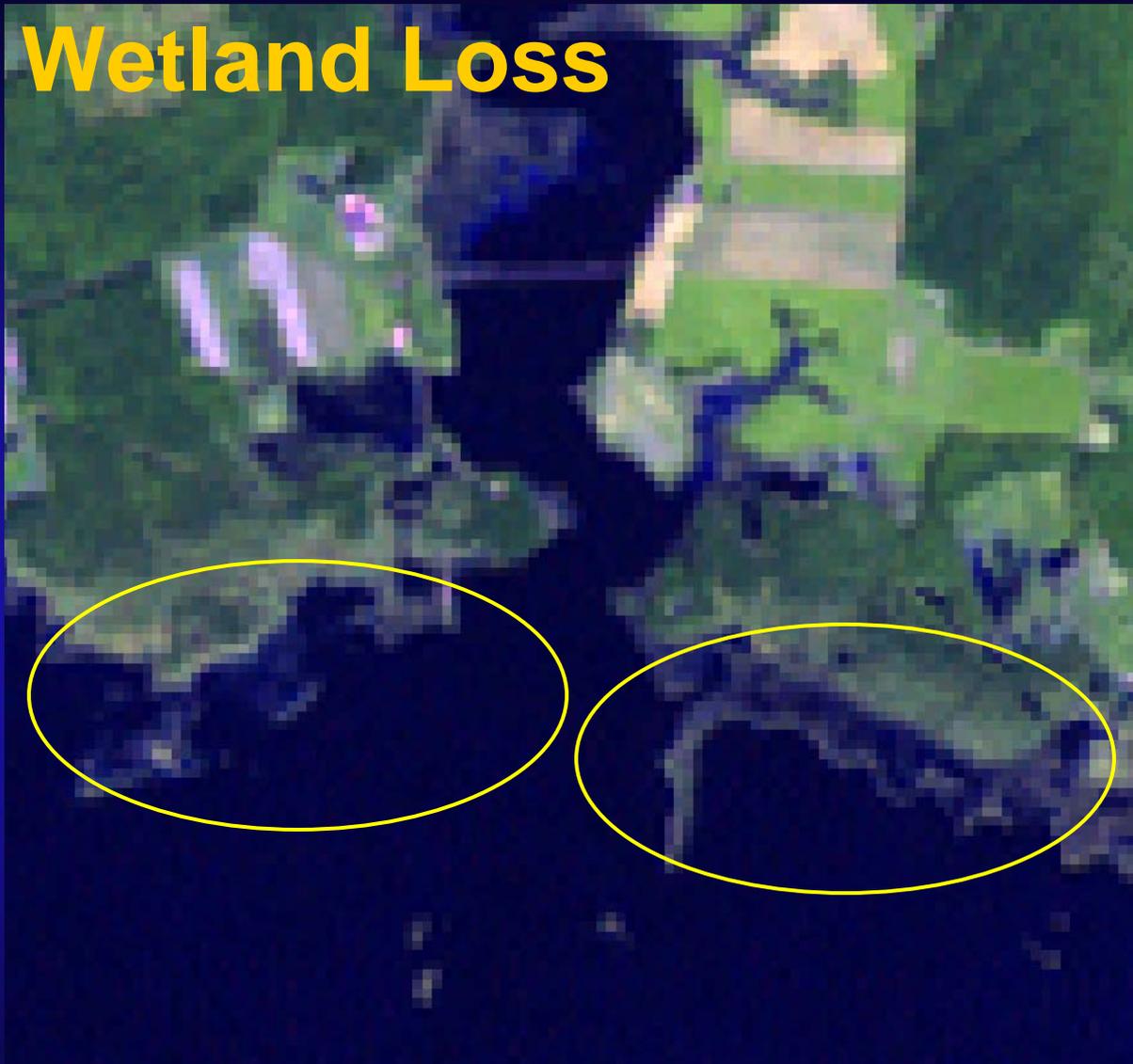
Wetland Loss

■ 1992



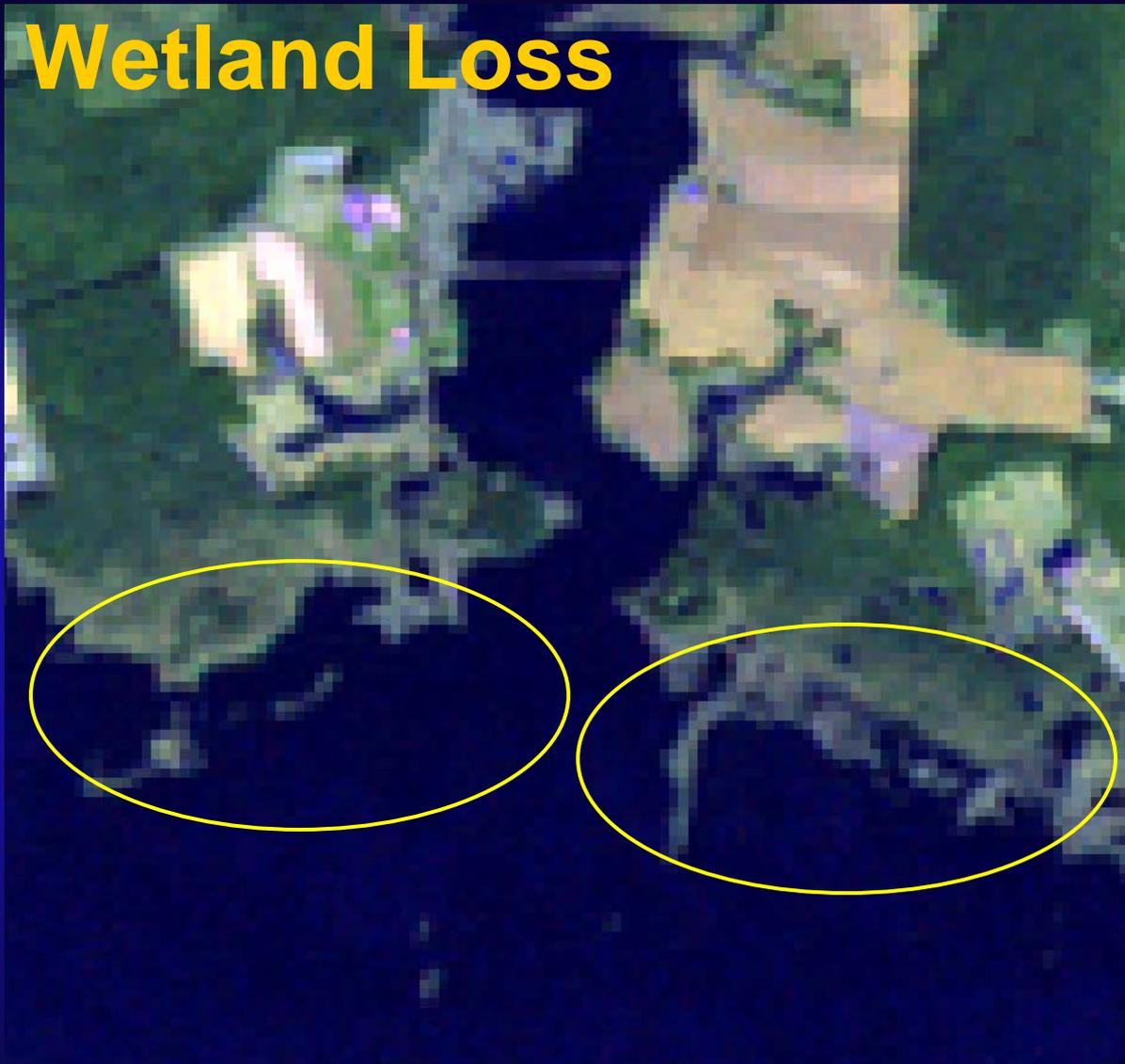
Wetland Loss

■ 1992

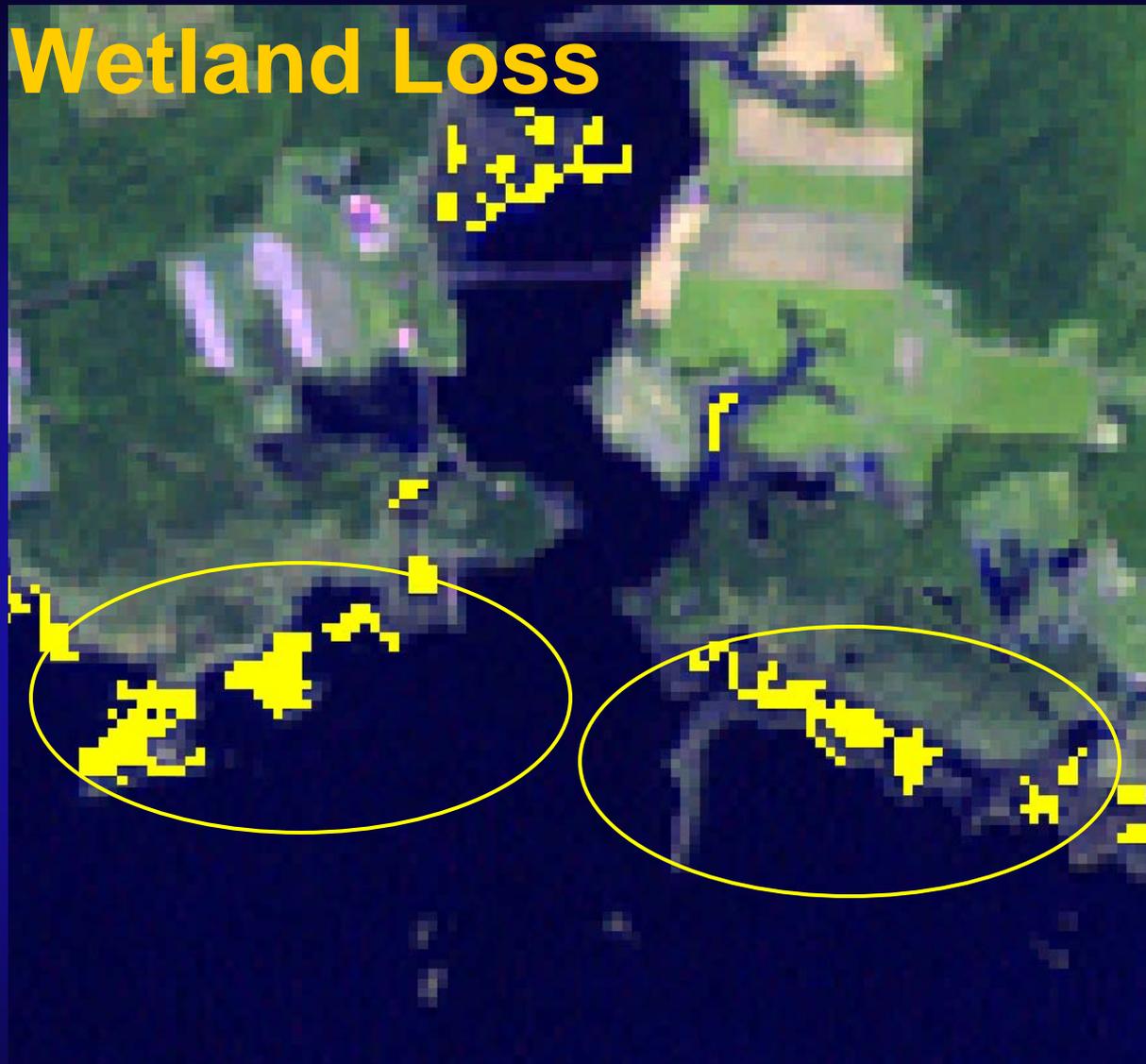


Wetland Loss

■ 2005



Wetland Loss



- 1992 -2001
Emergent
Wetland
Loss



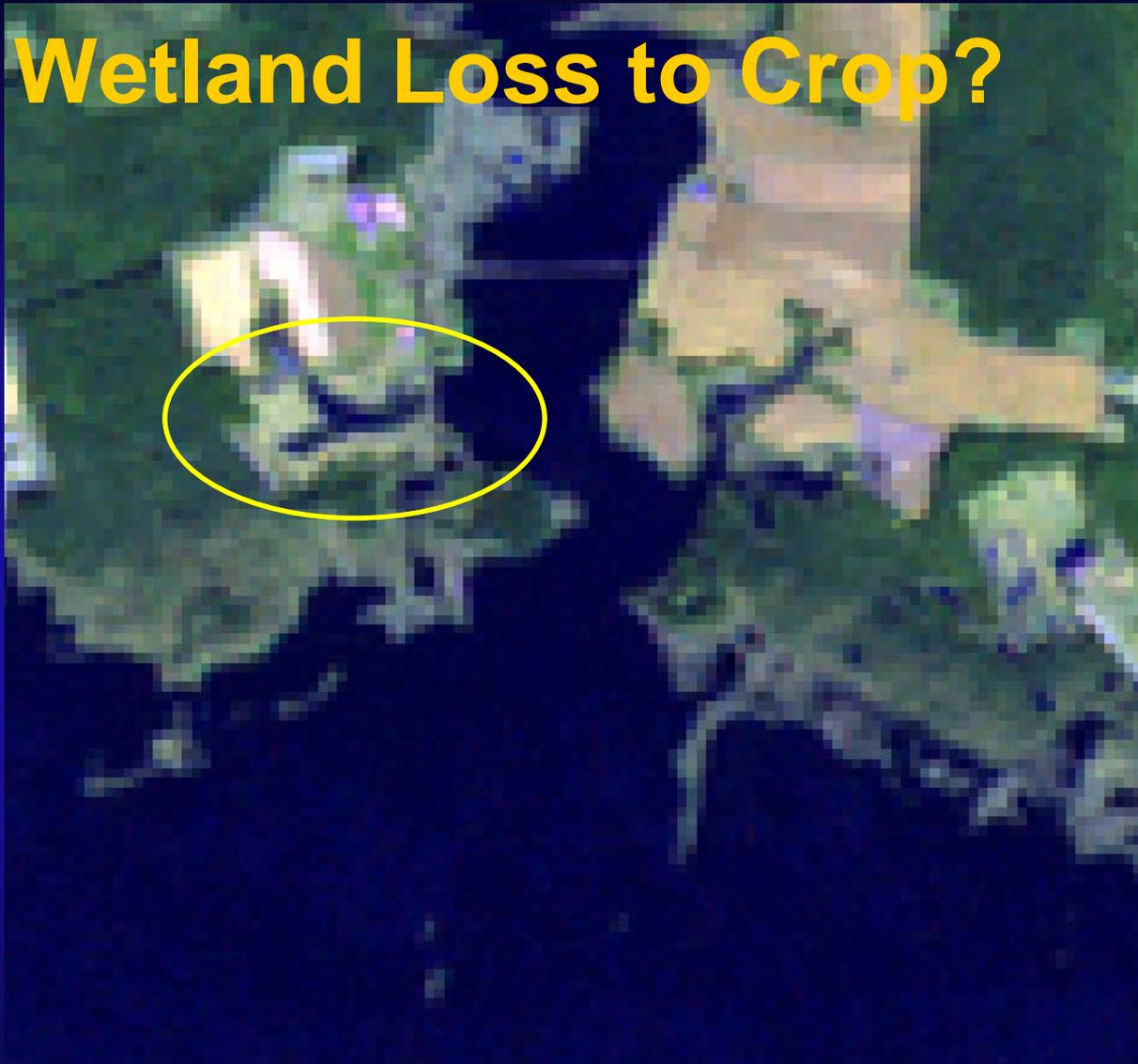
Wetland Loss to Crop?



■ 2001



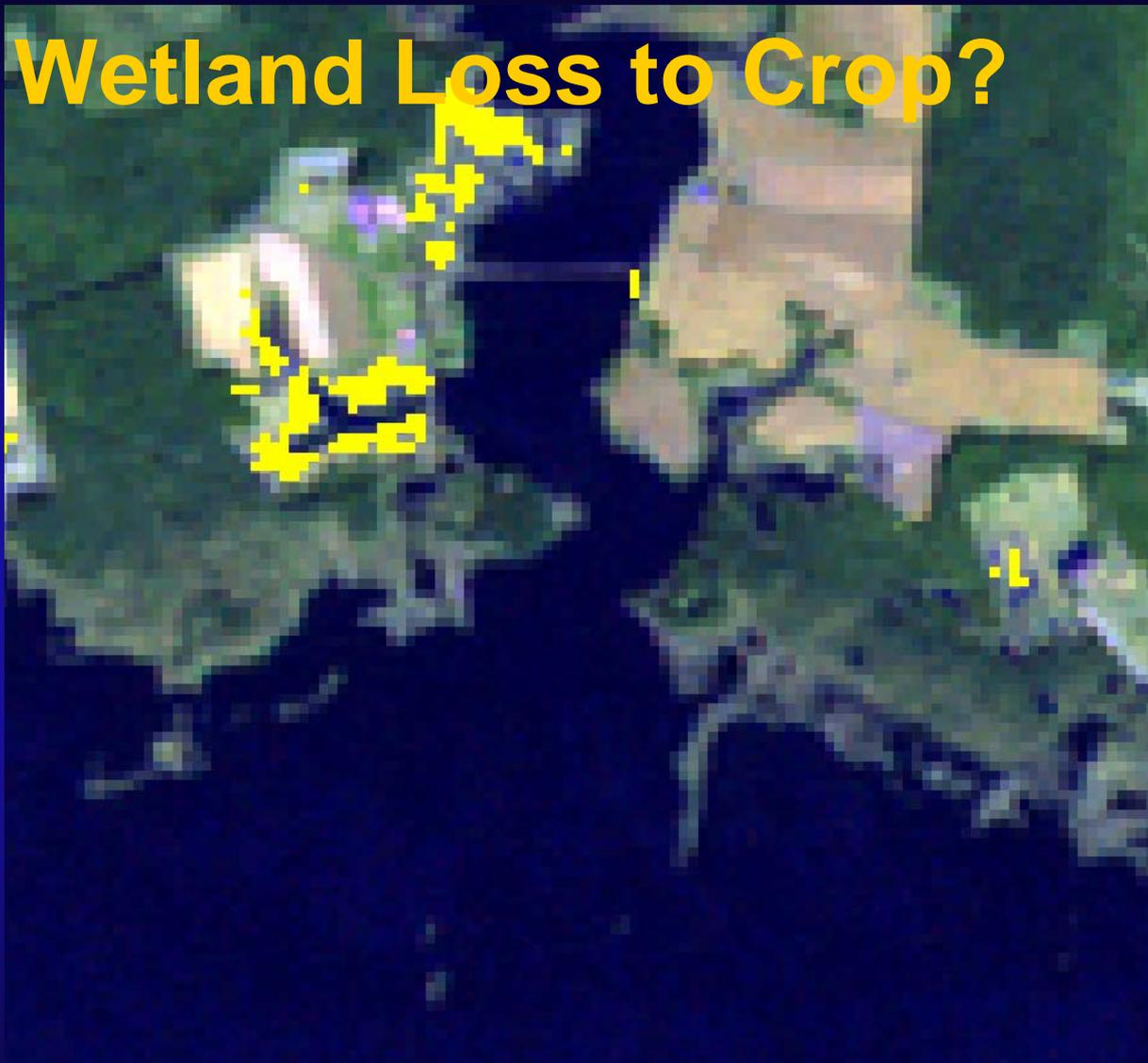
Wetland Loss to Crop?



■ 2005



Wetland Loss to Crop?



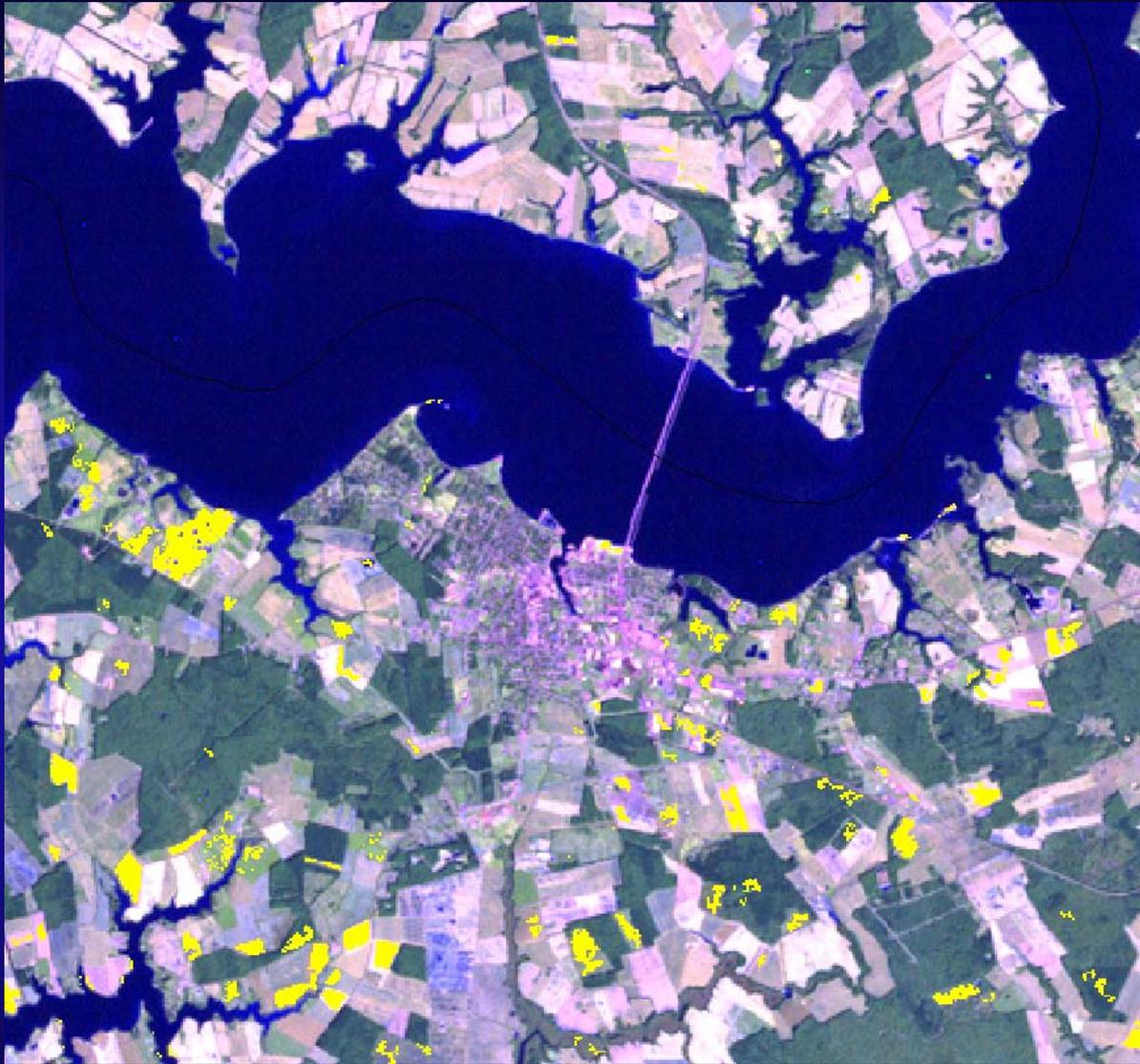
- 01-05
Change





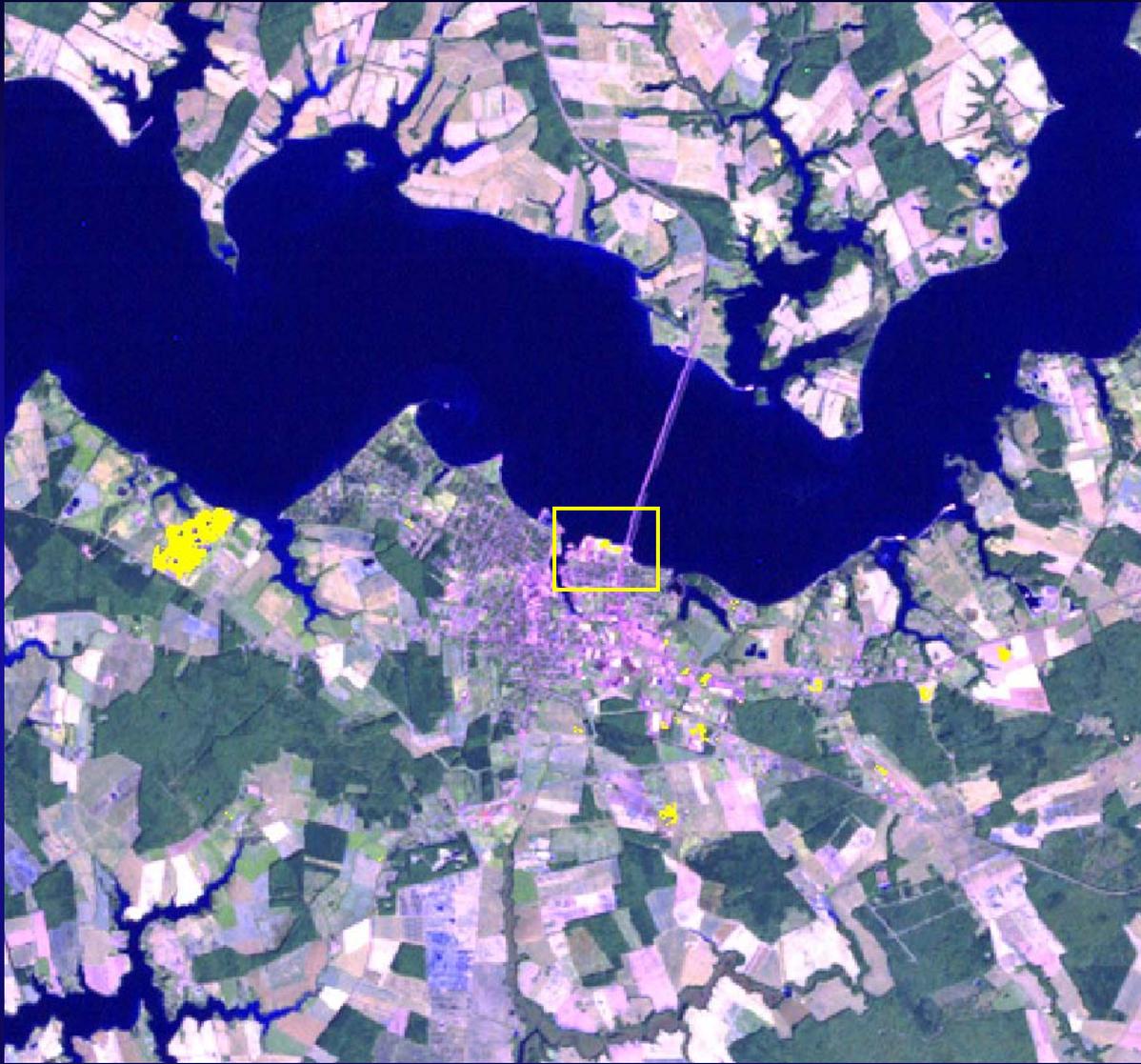
**Dorchester
County
MD
2001
New
Development**





- Cambridge, MD: All Change





- Cambridge, MD: Urban Change Only





■ 2001
(Draft Change)





■ 2001





■ 1988-95





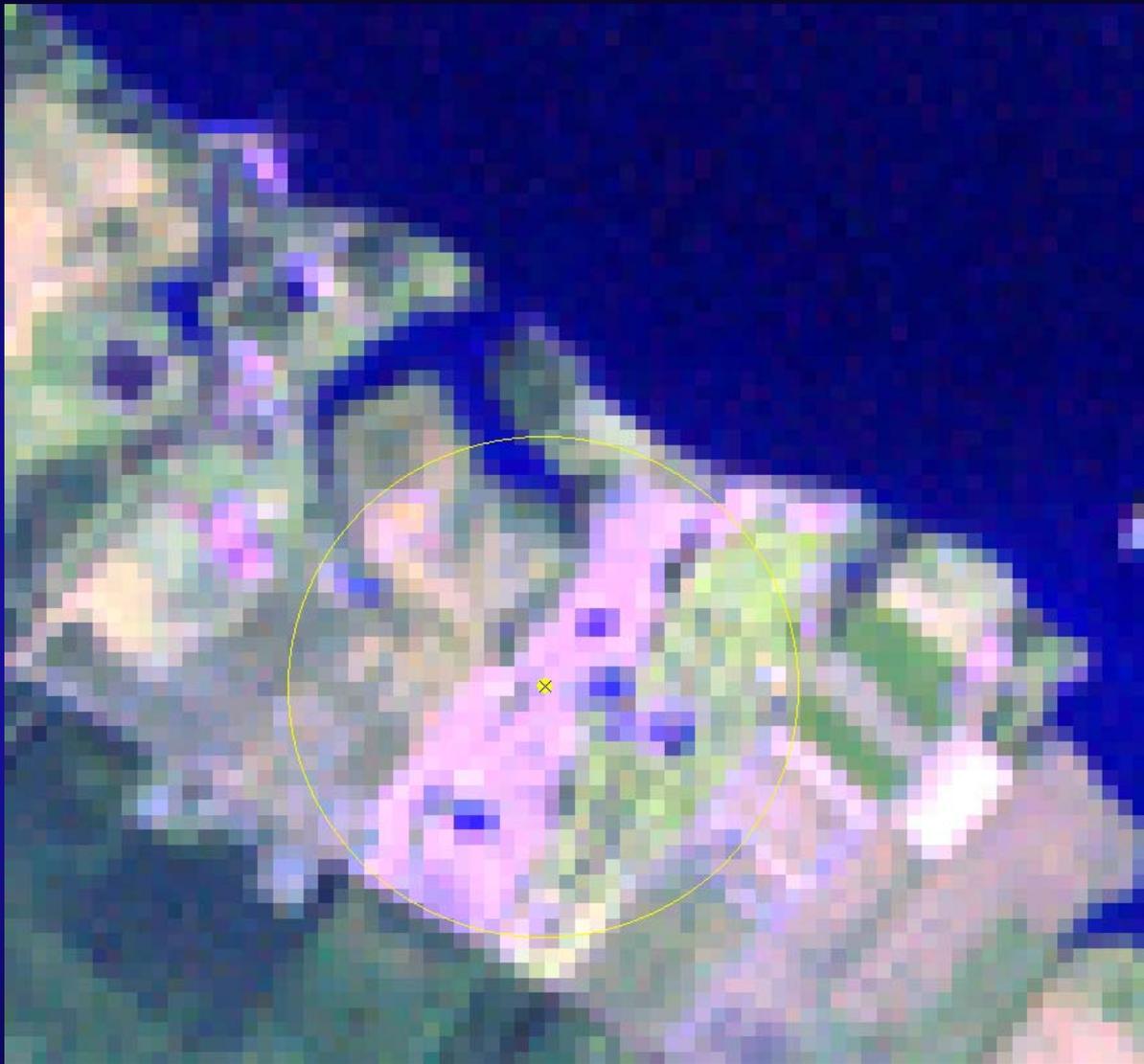
- Cambridge, MD: Urban Change Only





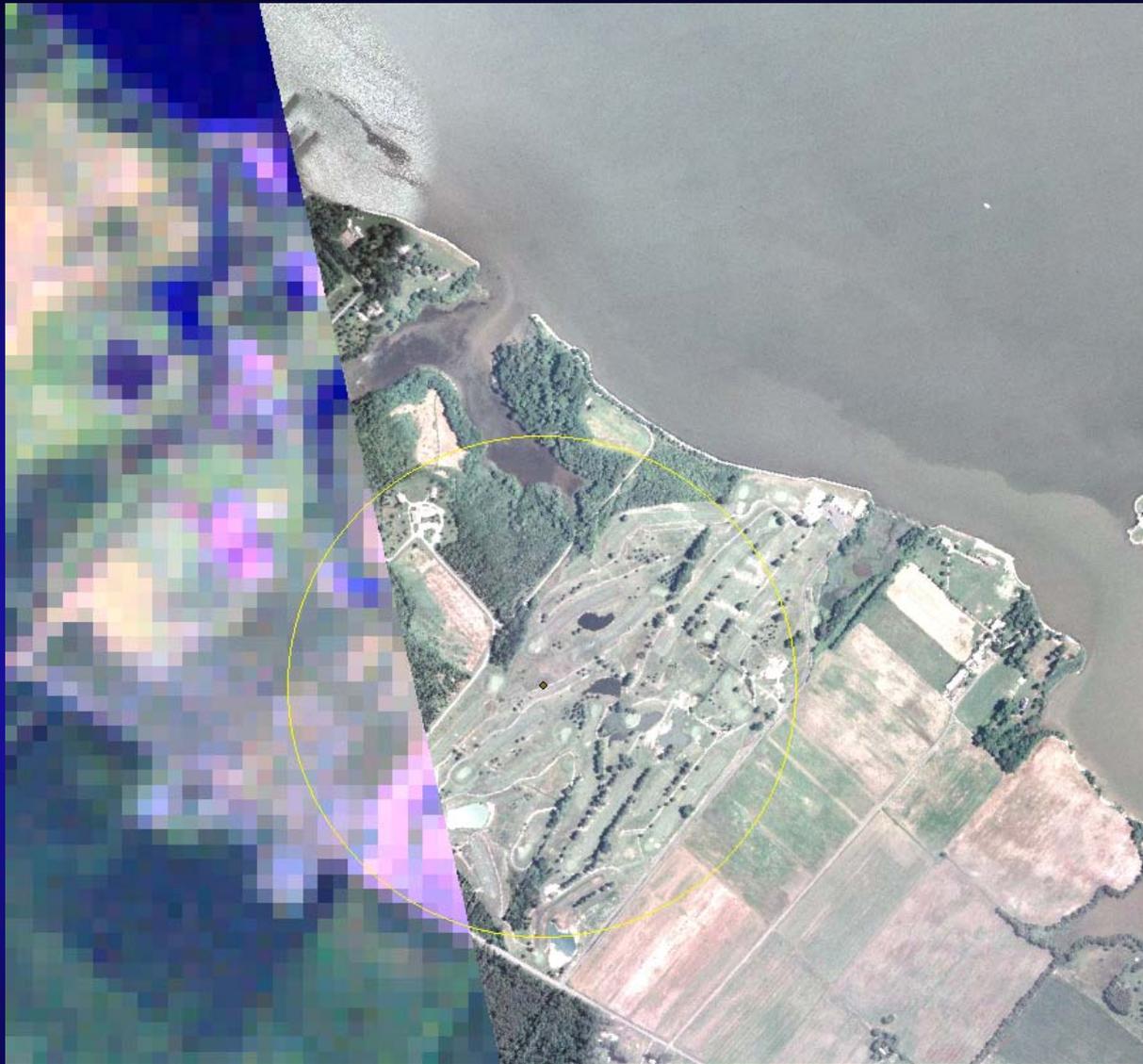
■ 1992





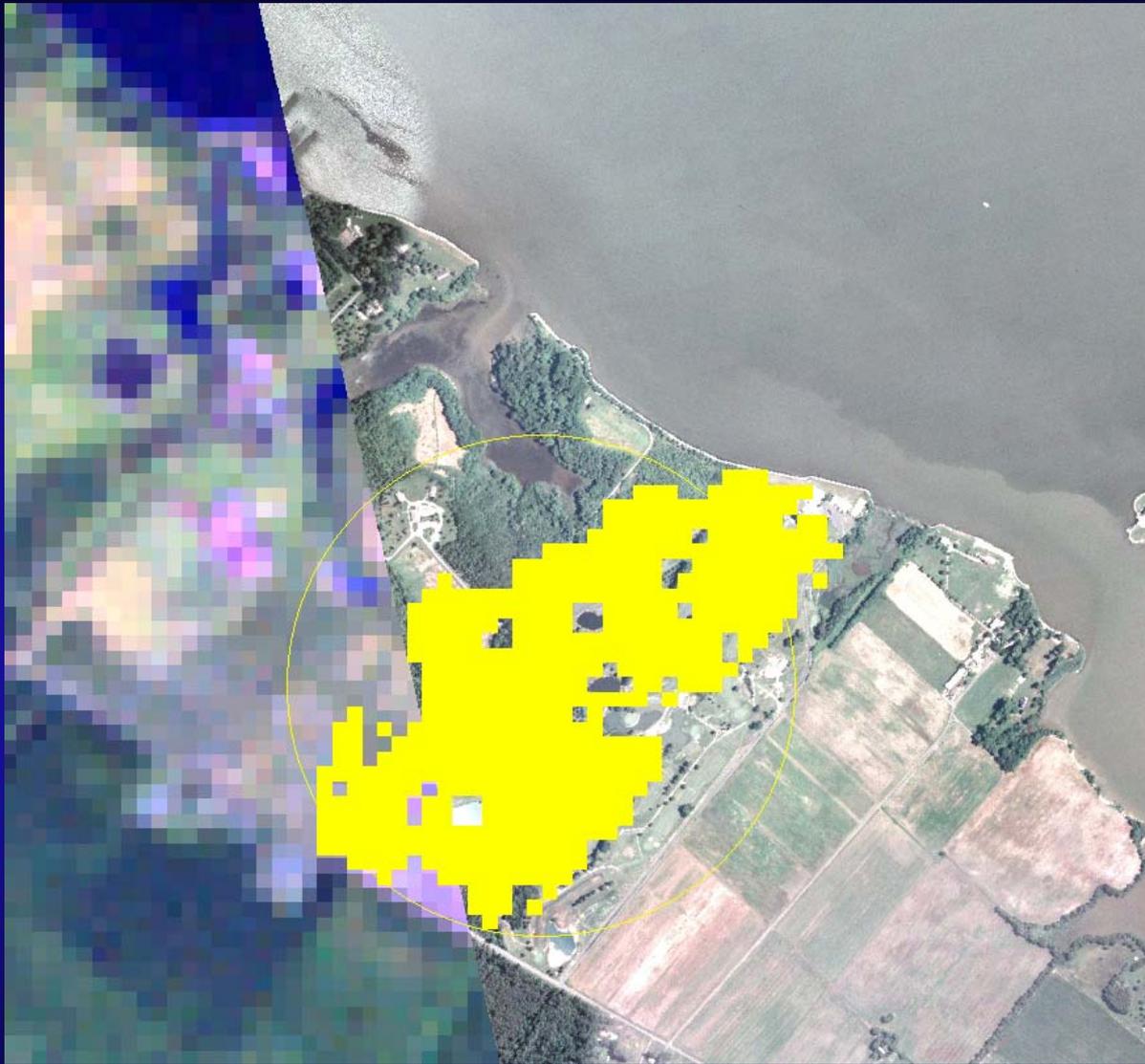
■ 2001





■ 2005 NAIP





■ 2005 NAIP





■ 2005 NAIP

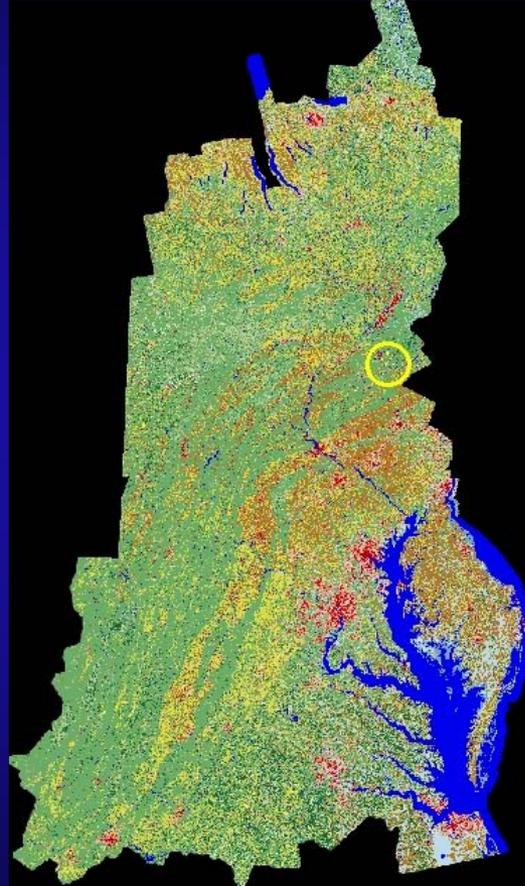




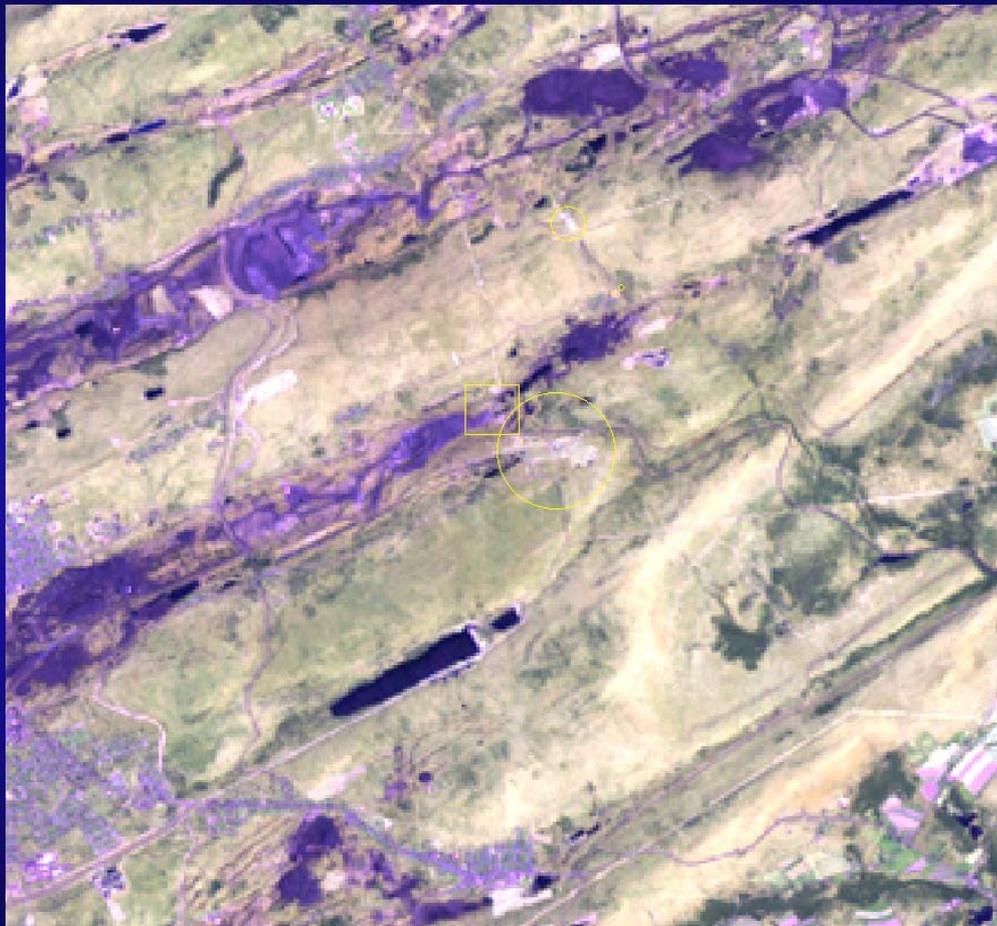
■ 1988-95



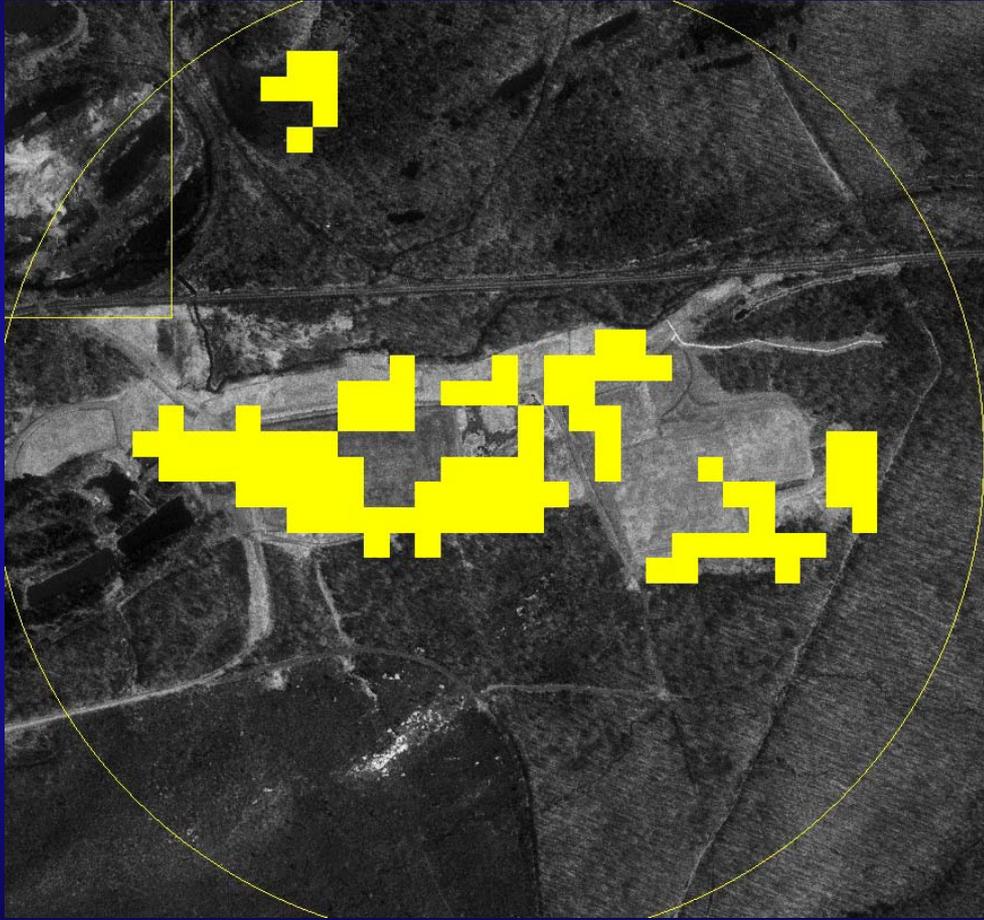
Hazleton, Pa. Superfund Site



Superfund Site



Cultivated ('92) to Deciduous ('01)



■ 2001



Cultivated ('92) to Deciduous ('01)



■ 2001



Superfund Site



■ 1992



Southern Va: Forest Clear-cut



■ 1992



Southern Va: Forest Clear-cut



■ 2001



Southern Va: Forest Clear-cut



■ 1992 - 2001



Southern Va: Forest Clear-cut



■ 2001



Southern Va: Forest Clear-cut



■ 2006



Southern Va: Forest Clear-cut



■ 2001 - 2006



Southern Va: Forest Clear-cut



■ 2006



Southern Va: Forest Clear-cut



■ 1992



Southern Va: Forest Clear-cut



- '92 – '06
- Change Areas Combined (Draft)



Product Delivery

- Land Cover 1984, 1992, 2001, 2006
- 16 Land Cover Classes
- Date Mosaics
- Bivariate From-To Pixels Image
- Intermediate Products (Z-Scores)
- Year to Year Change Tables
- FGDC Compliant Metadata
- FTP Download

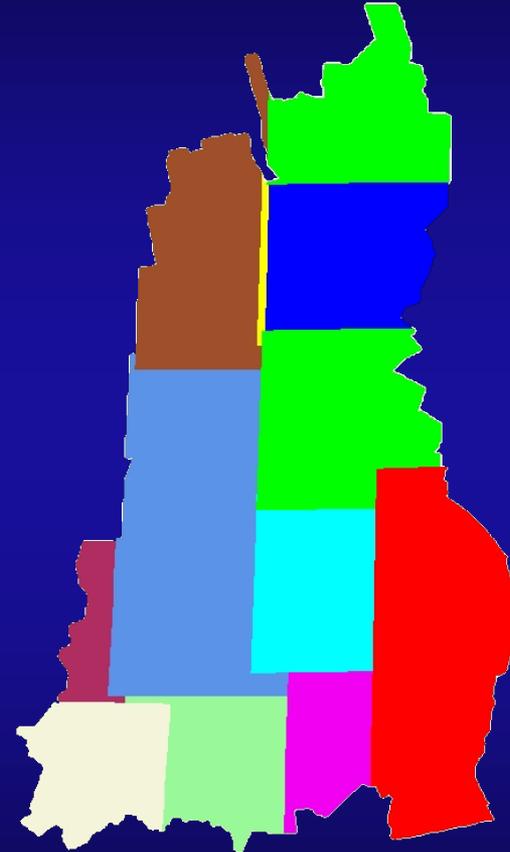


16 Classes

	Open water
	Developed open space
	Low intensity developed
	Med. intensity developed
	High intensity developed
	Barren
	Unconsolidated Shore
	Deciduous forest
	Evergreen forest
	Mixed forest
	Shrub/scrub
	Grassland/herbaceous
	Pasture/hay
	Cultivated crops
	Woody wetlands
	Emergent wetlands



Reflectance Data and Date Masks



Change Matrix

1992-2001	Water	DOS	LID	MID	HID	Barren	DF	EF	MF	S/S	G/H	P/H	Crop	WWL	EWL
Water	1,491,369					1,437	215	30	2	208	77	77	582	525	1,463
DOS	181	837,121				805	10,512	1,816	49	1,542	892	11,442	34,788	596	214
LID	118	697	2,579,103			803	26,025	8,948	168	492	1,954	2,664	21,745	378	44
MID	171	733	1,577	894,494		531	18,832	4,453	167	212	298	4,752	14,452	1,292	240
HID	467	2,305	2,470	4,997	630,108	415	13,888	2,149	440	181	502	7,177	13,401	753	234
Barren	1,913					55,867	1,189	218	6	606	222	274	2,166	211	524
DF							7,916,287		364	6,505	32,071	679	1,943	266	61
EF								1,247,077	159	2,381	31,007	115	764	942	248
MF							7,349	471	1,143,536	1,033	4,751	69	247	144	131
S/S	38					53	11,057	3,840	99	519,549	4,177	615	3,470	1,929	79
G/H	37					56	12,500	9,547	86	3,495	96,206	384	1,804	669	32
P/H	71					80	8,269	6,210	21	1,113	629	2,419,729	88,461	217	302
Crop	181					771	6,095	3,480	14	2,273	1,282	60,580	2,090,179	1,295	288
WWL												86	1,118	766,574	1,058
EWL												65	703	3,224	197,588

1992 Land Cover X 2001 Land Cover



Planned/Potential Applications

- Targeting
- Indicators
- Emergent WL Changes
- Forest Dynamics
- Riparian Forest Buffer Change
- Temporal Sequence of Change
- Data Mining



Acknowledgements

- **USGS**

- Peter Claggett
- Colin Homer
- Jon Dewitz
- Michael Coan



- **NOAA**

- Nate Herold
- John McCombs



- **MDA Federal Staff**

- David Cunningham
- Mehzabeen Hoosein
- Francois Smith



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End

