The Corsica River

Targeted Watershed Project

Quentin Forrest

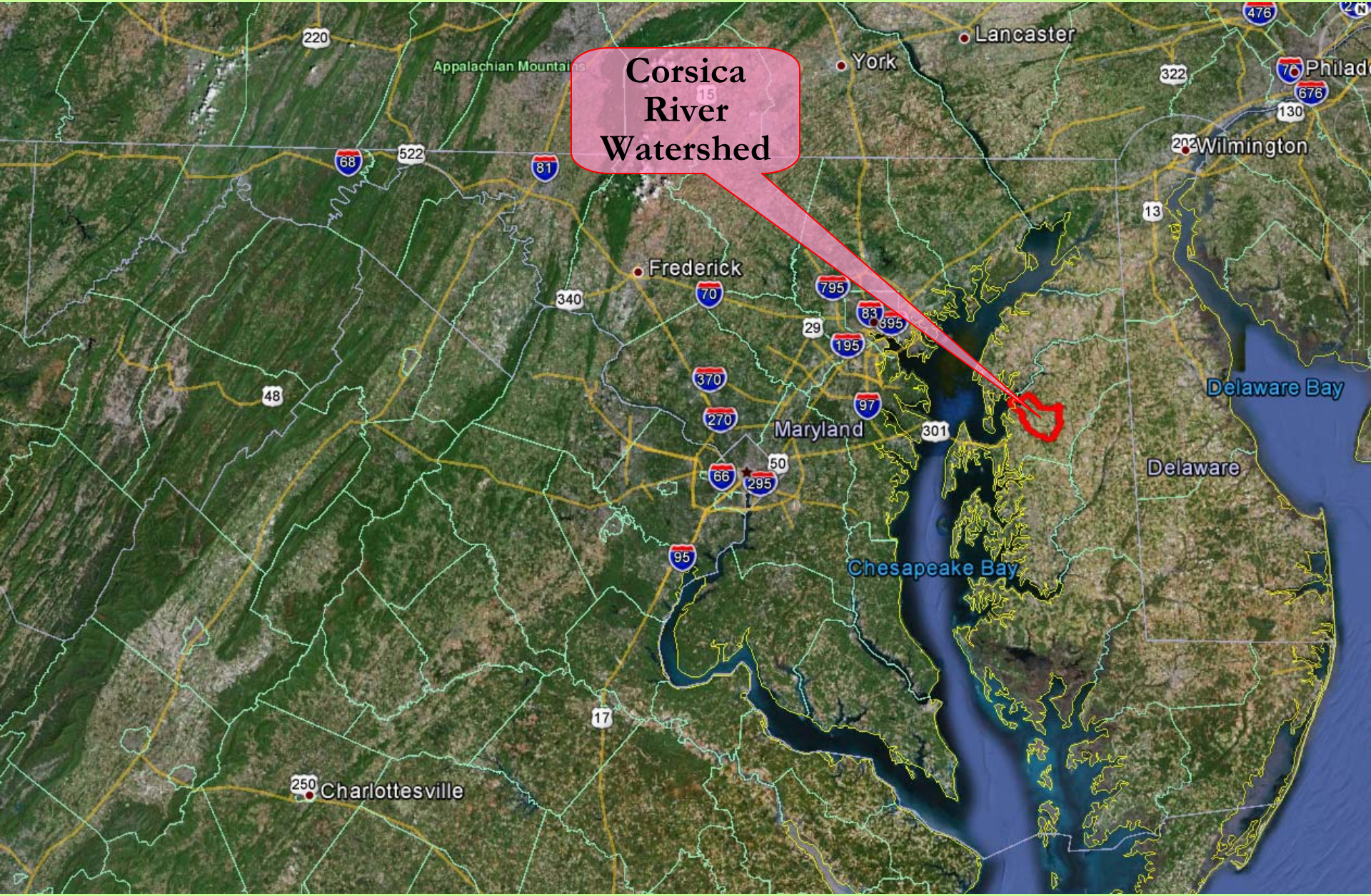
Maryland Department of the Environment

Science Services Administration

Field Operations Program

Chemical & Biological Monitoring Division

5-7-2013


Corsica
River
Watershed
Lancaster
York
Appalachian Mountains
Wilmington
Frederick
Maryland
Delaware Bay
Delaware
Chesapeake Bay
Charlottesville
220
68
522
81
340
70
795
83
395
29
195
370
270
97
301
50
66
295
95
17
250
322
476
676
130
202
13
48

5-7-2013


Chestertown Rd
291
Morgnec
21
544
Dudley Corner
Sudlersville Rd
290
446
300
302
Barclay Rd
454
20
289
445
Eastern Neck Rd
405
19
Church Hill Rd
Price Station Rd
313
311
Queen Anne's
287
Ruthsburg Rd
304
Oakland Rd
213
Main St
481
314
18
662
309
552
404
312
Queen Anne Hwy
Ocean Gateway
303
Caroline
317
Greensboro Rd
Cordova Rd
Denton
5-7-2013


Church Hill Rd
405
Centreville
Queen Anne's
301
Ruthsburg Rd
304
Starr Rd
309
Queenstown
2.63 mi
50
Image U.S. Geological Survey
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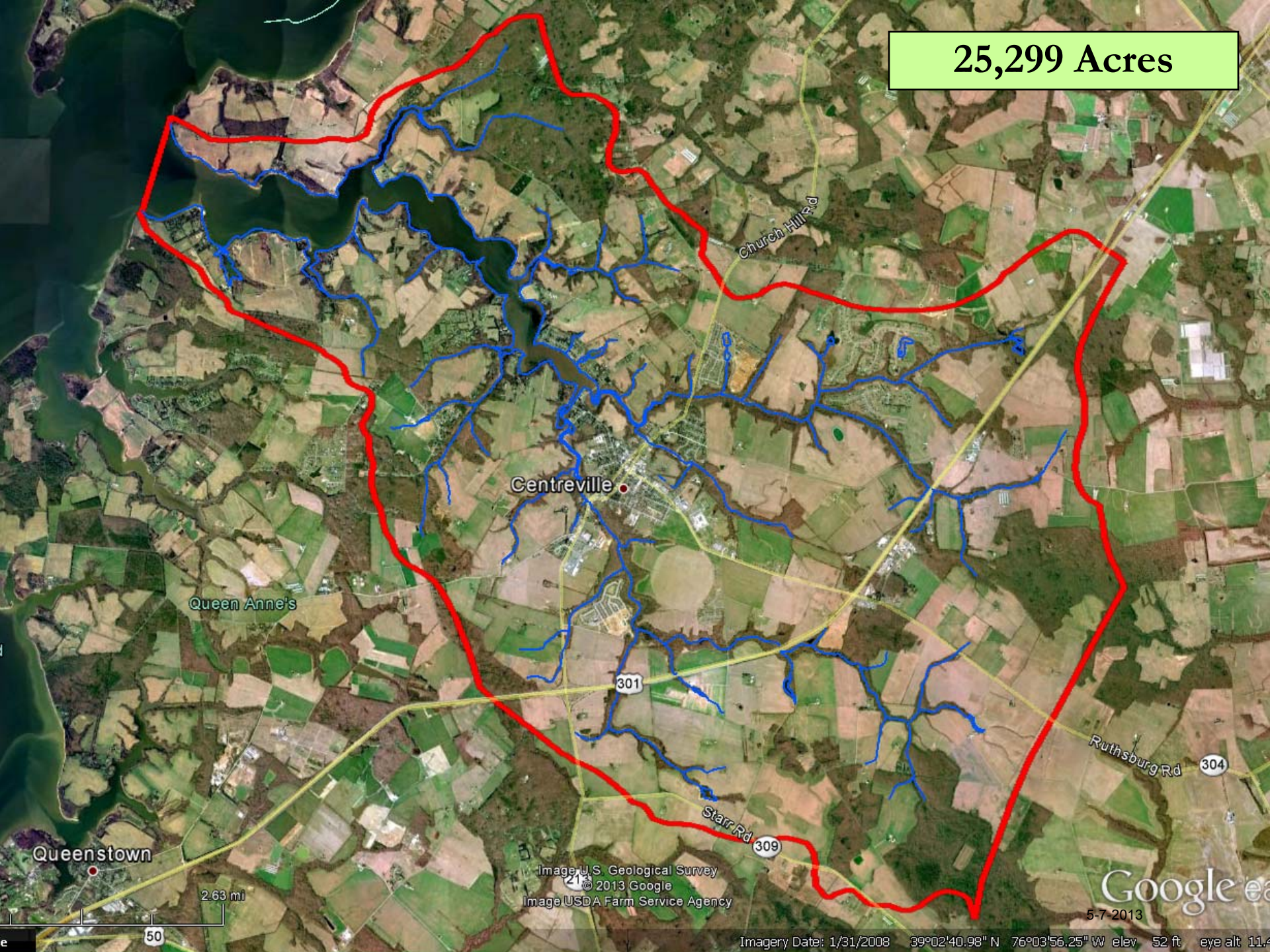
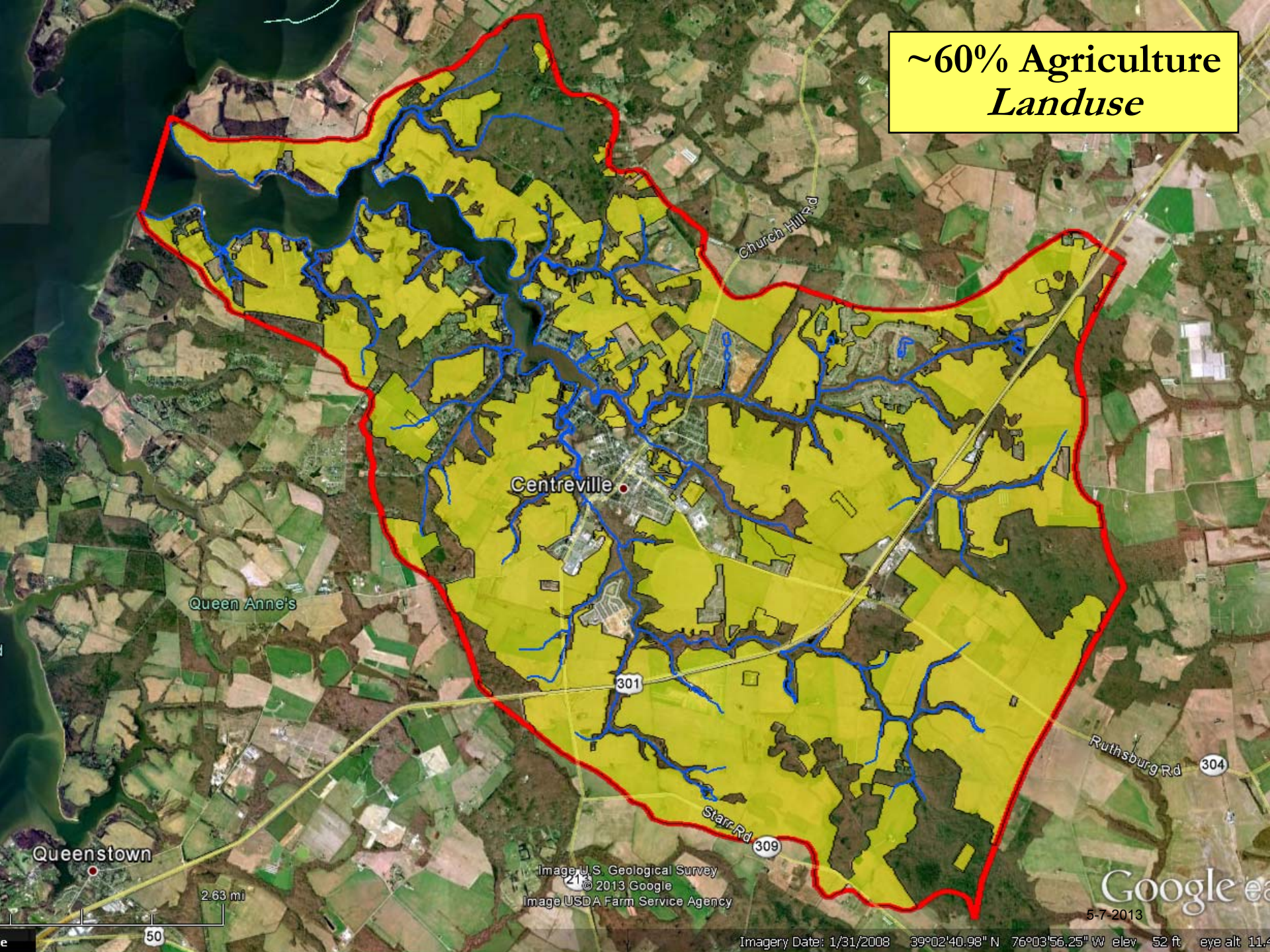
Image USDA Farm Service Agency
Google
5-7-2013
39°03'26.43" N 76°11'18.44" W elev -15 ft eye alt 11.4


25,299 Acres
Church Hill Rd
Centreville
Queen Anne's
301
Ruthsburg Rd
304
Starr Rd
309
Queenstown
2.63 mi
50
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'40.98" N 76°03'56.25" W elev 52 ft eye alt 11.4


~60% Agriculture
Landuse
Church Hill Rd
Centreville
Queen Anne's
301
Ruthsburg Rd
304
Starr Rd
309
Queenstown
2.63 mi
50
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
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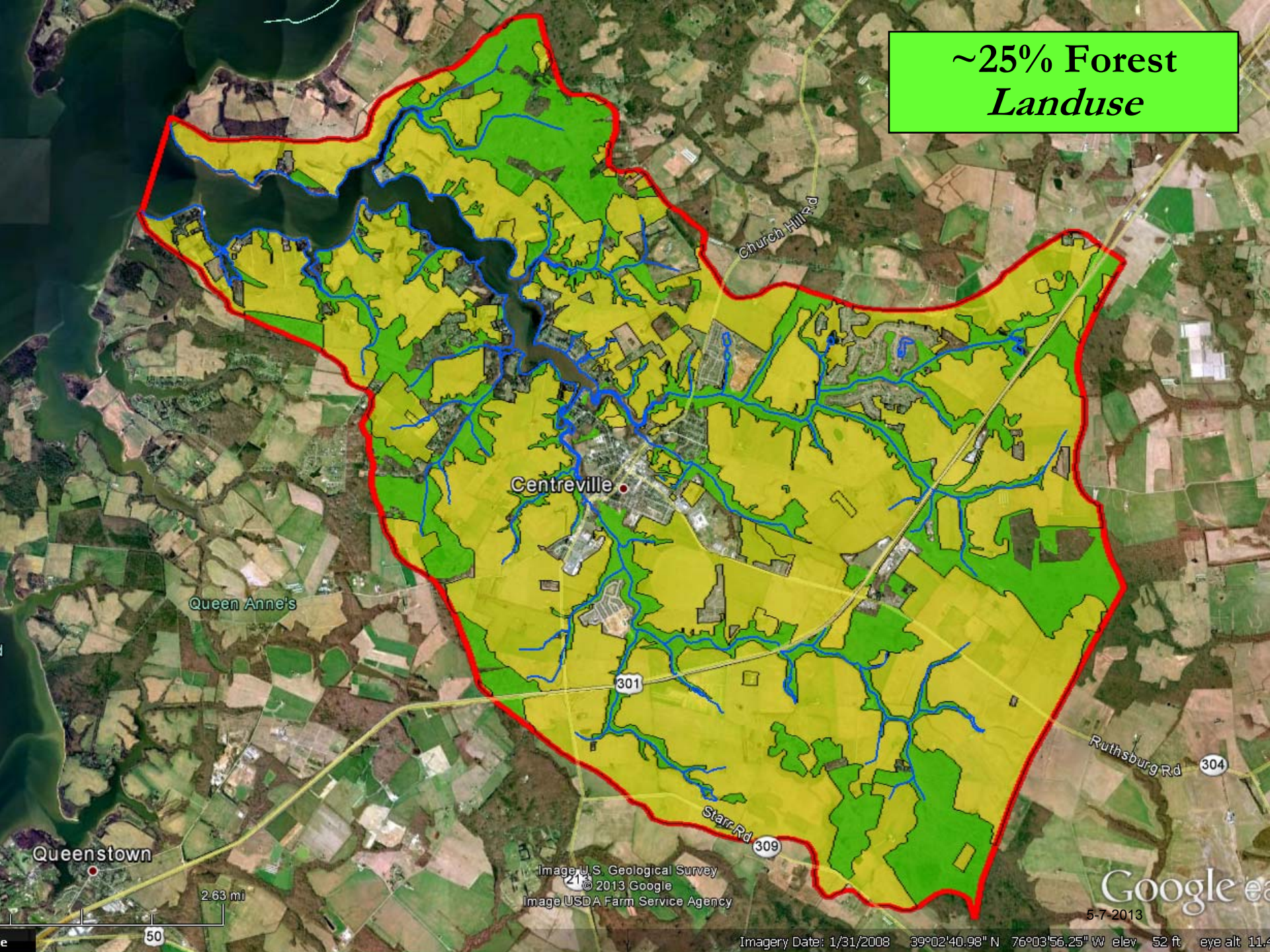

~25% Forest
Landuse
Church Hill Rd
Centreville
Queen Anne's
301
Ruthsburg Rd
304
Starr Rd
309
Queenstown
2.63 mi
50
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'40.98" N 76°03'56.25" W elev 52 ft eye alt 11.4

Corsica River Initiative Background

- **1996**: Corsica River (8 Digit MDWatershed) "listed" as impaired for excess ***nitrogen & phosphorus (Eutrophication)***, fecal coliform (bacteria), and substantial negative impacts to biological communities.
- **2000**: MDE/TMDL for ***nitrogen & phosphorus*** was developed and approved
  - Tidal: DO of 5 mg/l and peak chl-a levels < 50 µg/l
- **2003**: Watershed Restoration Action Strategy (WRAS) was developed
- **2005**: Corsica designated as MD "***Targeted Watershed Initiative***"

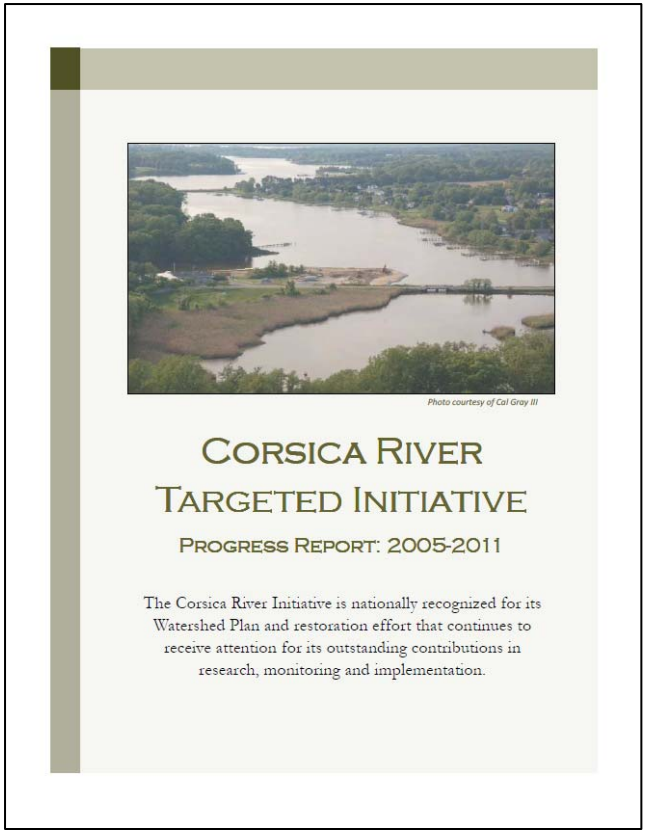
  The Corsica River Watershed was chosen based on several factors including:
  - Size of the watershed (25,299 acres) and opportunities for improvement
  - Accepted EPA nationally recognized Watershed Restoration Plan
  - Willing partners to invest resources and time for restoration
    - *Corsica Implementation Committee formed*
  - Endpoint to eventually "de-list" the Corsica River
  - *Document improvements with extensive water quality monitoring plan*
- **2009**: In addition to the established TDML, Dr. Walter Boynton, et.al. (CBL) produced a report in 2009 that suggested:

  "**50% reduction in N loading to the estuary would produce a 70% decline in chlorophyll-a**."

Corsica River Initiative Background

2011: The *Corsica Implementation Committee* made up of MDE, DNR, MDA, QASCD, Town of Centreville, QA County and local concerned residents were wondering…

Where do things stand…BMPs, WQ, …?



WRAS Best Management Practice (BMP) Implementation	2005 - 2011	
	Original Goal 2005	Status End of 2011
1. Agriculture Buffers	100 acres	94.3 acres
2. Agriculture Cover Crops	3,000 acres annually	3,374 acres annual avg.
3. Ag. Nutrient Mgmt/Horse Farms	5 Projects	3 Planned
6. Wetland Creation	50 acres	88.3 acres
7. Retrofit Septic systems	30 Systems	16 Systems
8. WWTP Upgrade	Enhance Nutrient Removal (ENR)	Biological Nutrient Removal (BNR): Operating @ ENR levels with BNR treatment, based on annual average
9. LID Projects (Rain barrels/gardens)	200	>308 RG/>170 RB
10. Easements & Land Acquisition	1,710 acres	5,800 acres
11. Oyster Reef Replenishment	20 acres=100 mspat	10 acres=50 mspat
12. New Code & Ordinance		*Town*:Tree & pet waste *County*:Septic pump out & lawn fertilizer maintenance
13. Establish Stormwater Retrofits	300 acres	113 acres
14. Establish SAV	10 acres	0
15. Stream Restoration	2 miles	**0**

MDE to Document Improvements With Extensive Non-Tidal Water Quality Monitoring Plan

1. Continuous Long-Term & Storm Event Water Quality
   - Demonstrate the impact of a comprehensive watershed restoration program on ***non-tidal*** surface water nutrient concentrations and loads

     (*DNR monitors the tidal portion for DO and chl-a concentrations*)

2. Synoptic Survey
   - Target efforts for BMP implementation

3. On-Site Septic Disposal System (OSDS) Retrofit
   - Demonstrate effectiveness of on-site sewage disposal systems (OSDS) with nitrogen removal technology at reducing nutrient concentrations delivered to groundwater

4. Stormwater & Stormwater Retrofit
   - Demonstrate effectiveness of urban stormwater management retrofits at reducing nutrient and contaminant loads discharged to surface waters

Document Improvements With Extensive Water Quality Monitoring Plan

1. Continuous Long-Term & Storm Event Water Quality
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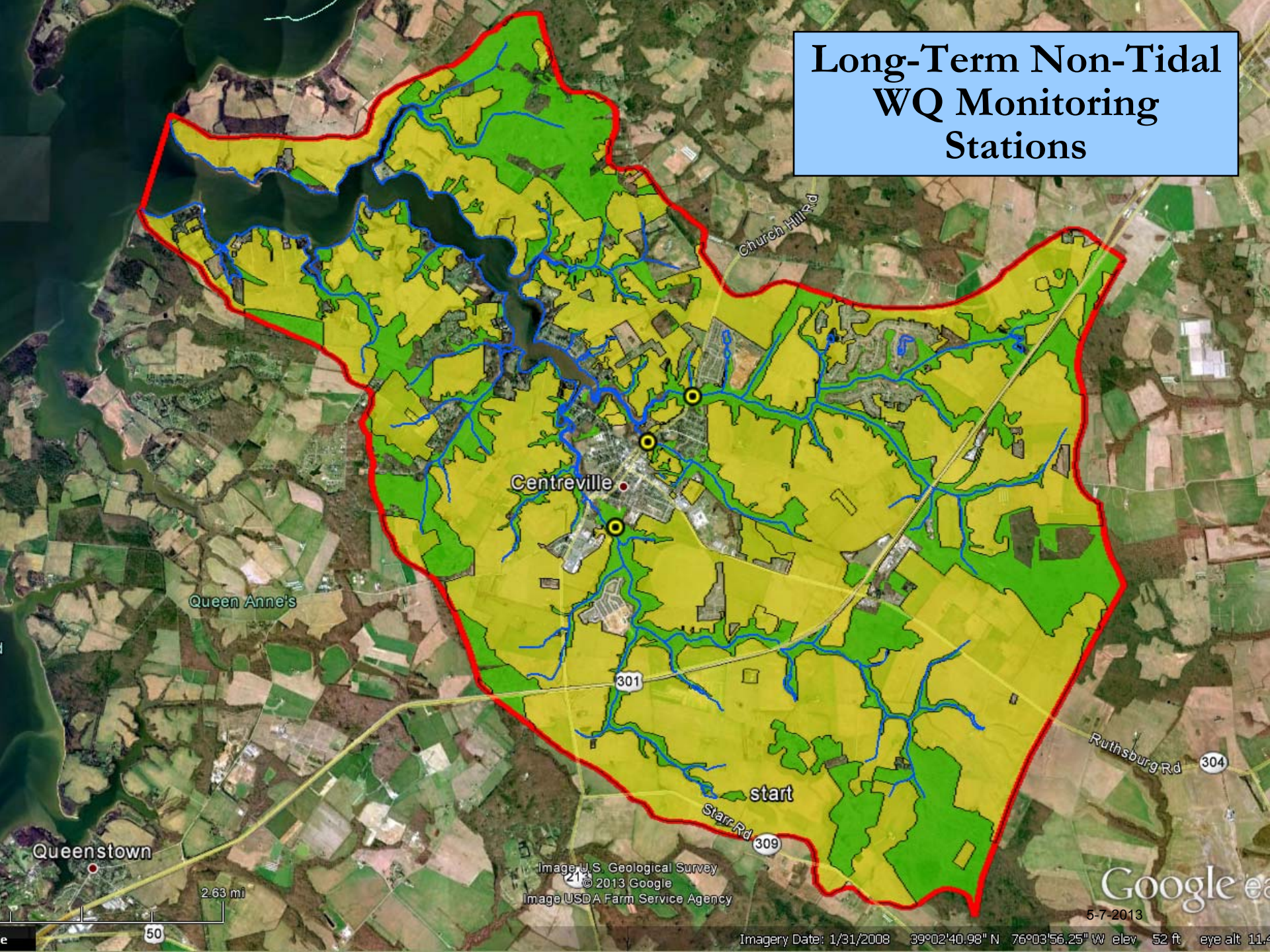
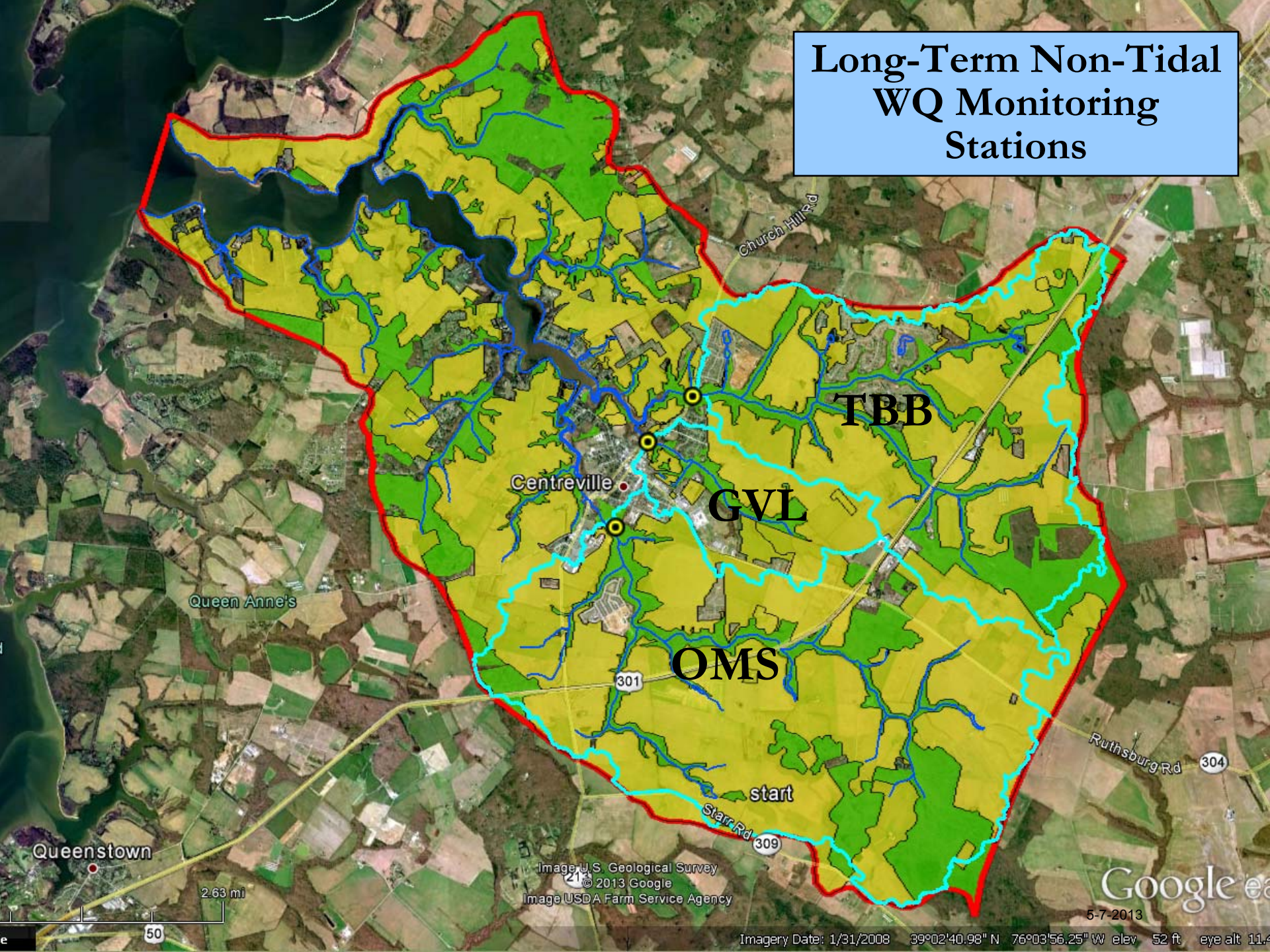
Long-Term Non-Tidal WQ Monitoring Stations




Long-Term Non-Tidal WQ Monitoring Stations
TBB
GVL
OMS
Centreville
Queen Anne's
Church Hill Rd
301
Ruthsburg Rd
304
start
Starr Rd
309
Queenstown
2.63 mi
50
Image U.S. Geological Survey
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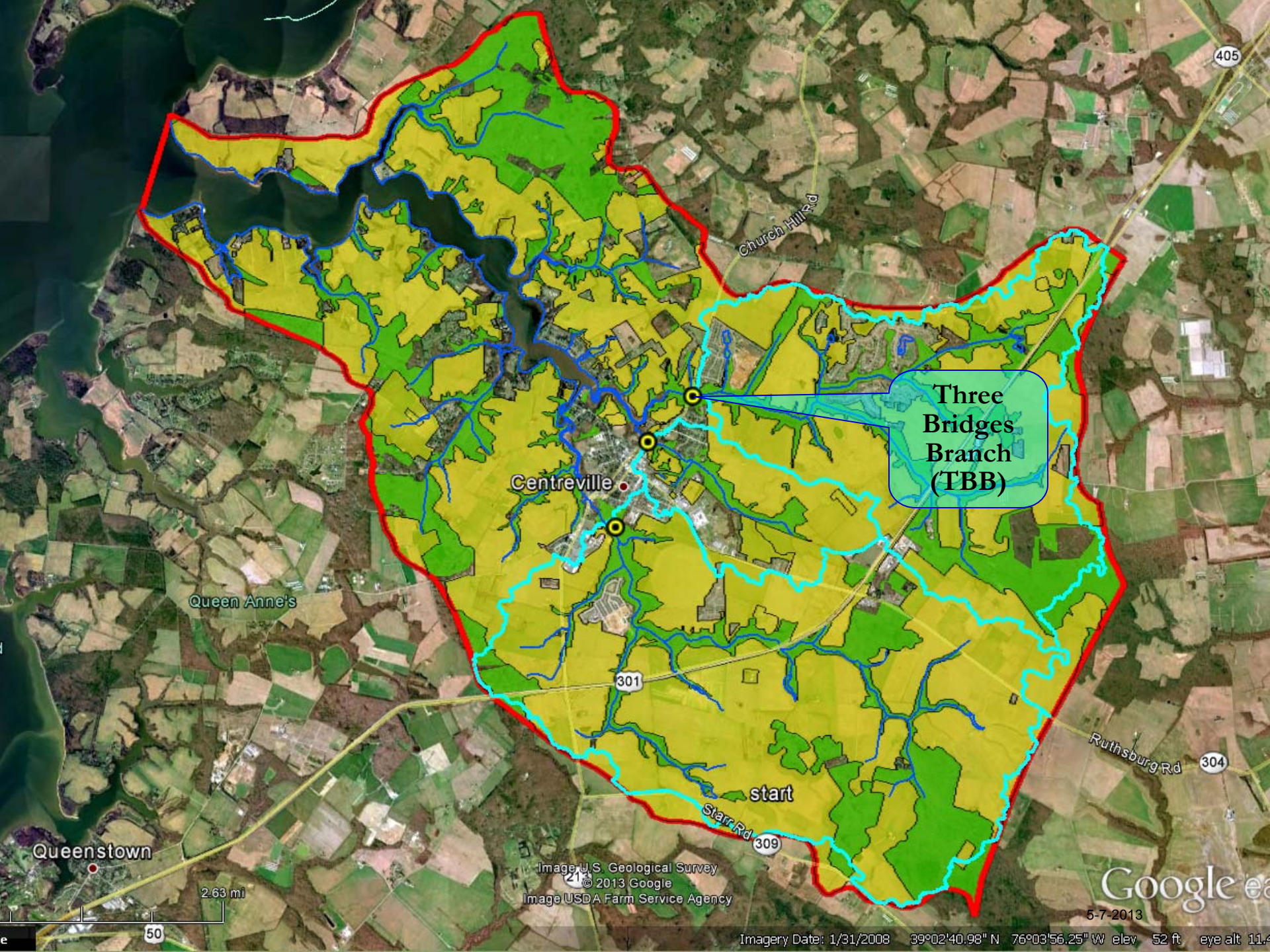
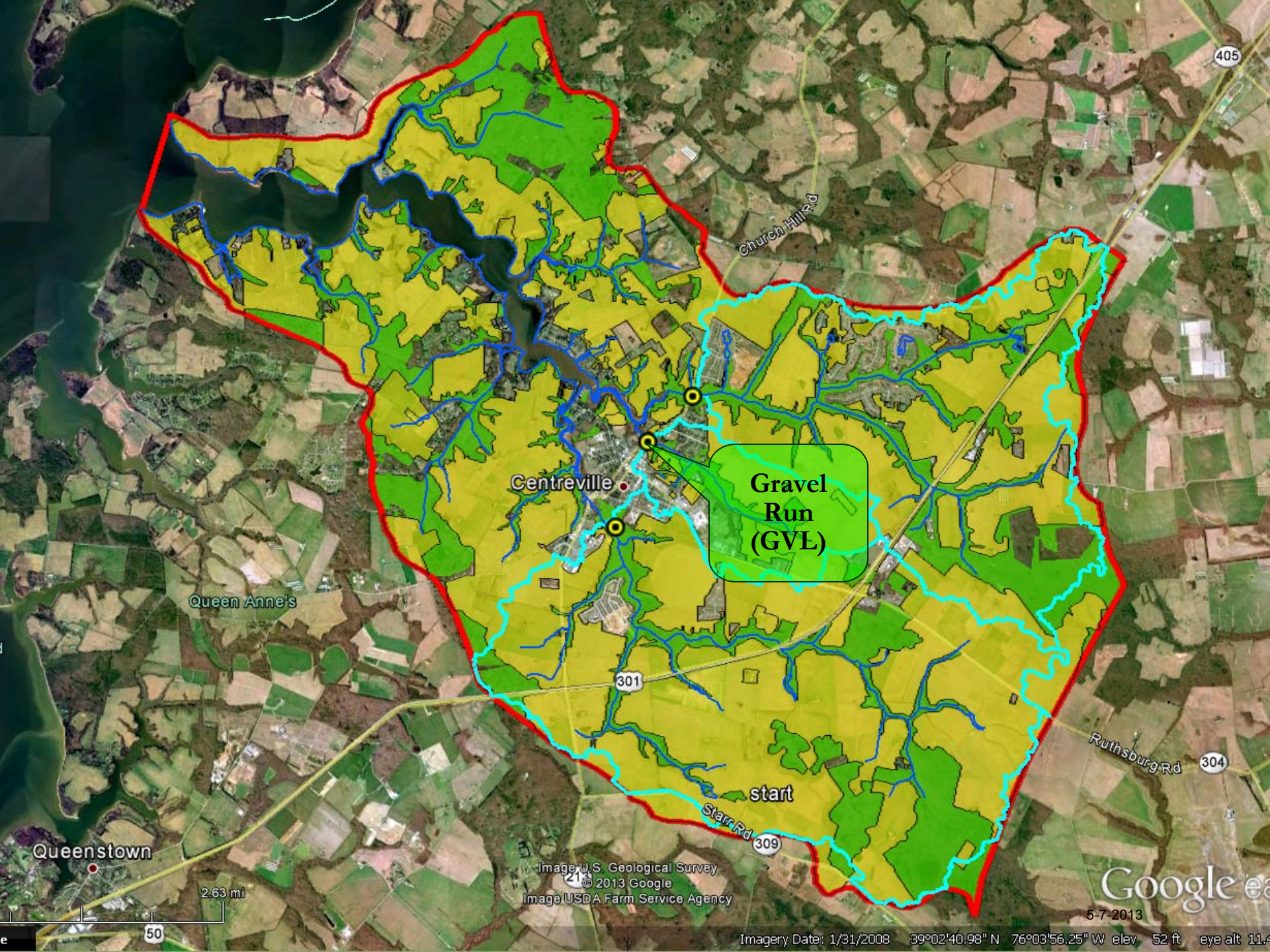
Imagery Date: 1/31/2008 39°02'40.98" N 76°03'56.25" W elev 52 ft eye alt 11.4

Continuous Long-Term & Storm Event Water Quality Monitoring Sites

3 Corsica Non-Tidal Tributary Monitoring Sites:

- Weekly surface water *grab* samples
- Continuous flow weighted *composite* samples to capture storm events
- Automated stage height recording to estimate cumulative stream discharge (*to establish loadings*)
- Water samples analyzed for TN, TP, NO_2, NO_2+NO_3, NH_4 & PO_4
- Monitoring Timeline: August, 2005 to Present


Three Bridges Branch (TBB)
Centreville
Queen Anne's
Queenstown
start
Church Hill Rd
Ruthsburg Rd
Starr Rd
405
301
304
309
2.63 mi
50
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'40.98" N 76°03'56.25" W elev 52 ft eye alt 11.4


Gravel Run (GVL)
Centreville
Queen Anne's
Queenstown
start
Church Hill Rd
Ruthsburg Rd
Starr Rd
405
301
304
309
2.63 mi
50
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
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Gravel Branch (GVL) Monitoring Site

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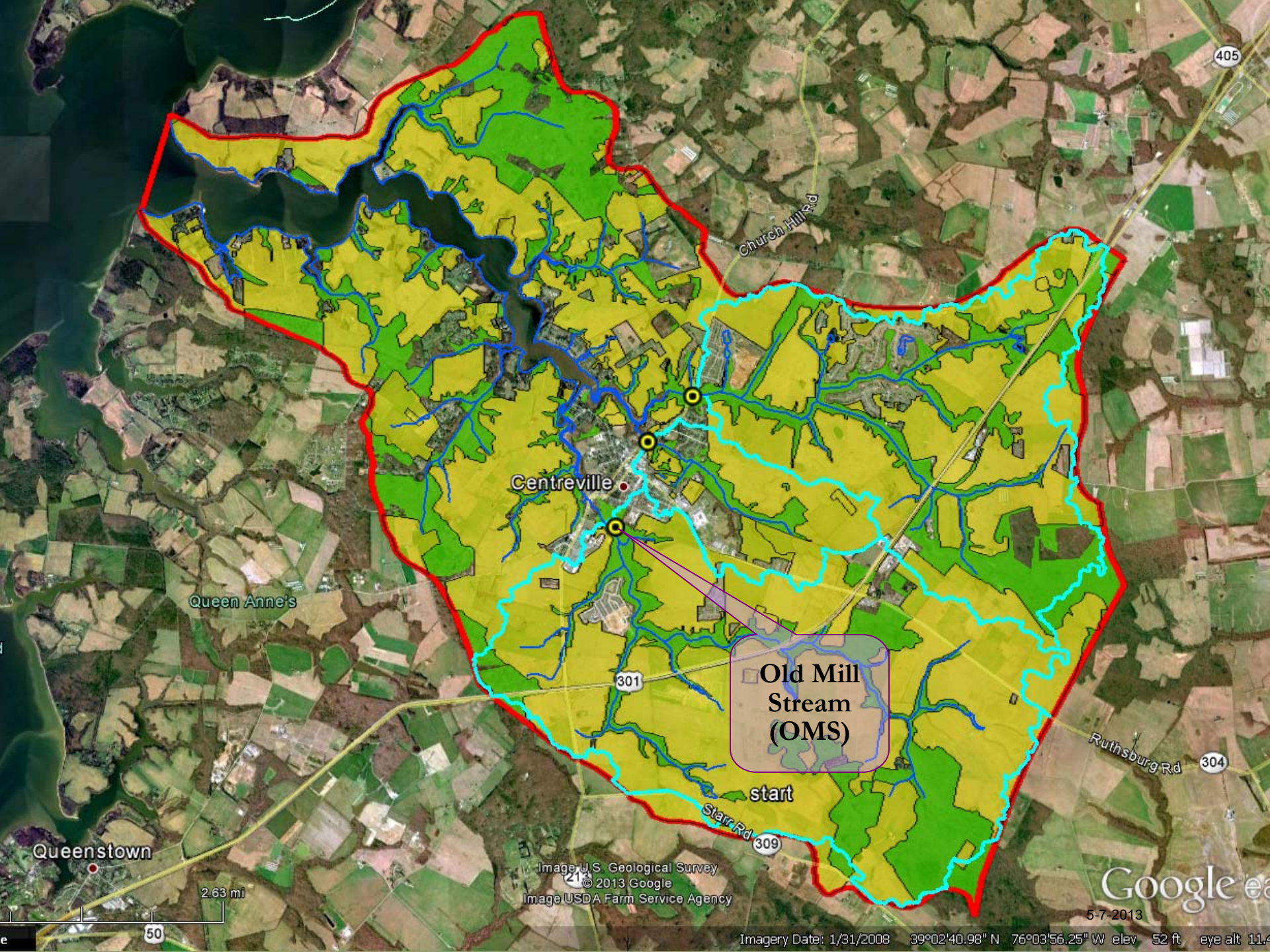
Old Mill Stream (OMS)
start
Centreville
Queen Anne's
Queenstown
Church Hill Rd
Ruthsburg Rd
Starr Rd
405
301
304
309
2.63 mi
50
Image U.S. Geological Survey
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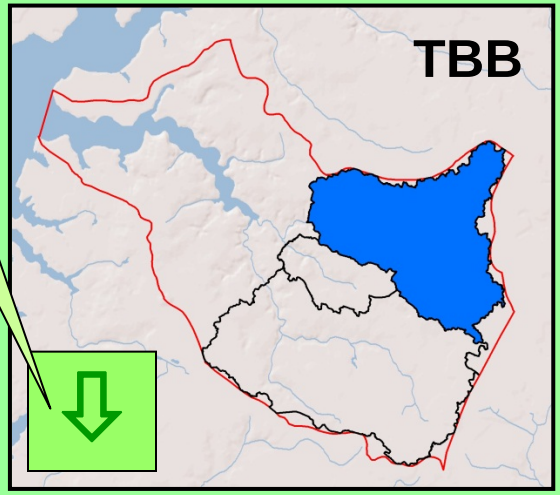
Old Mill Stream (OMS) Monitoring Site

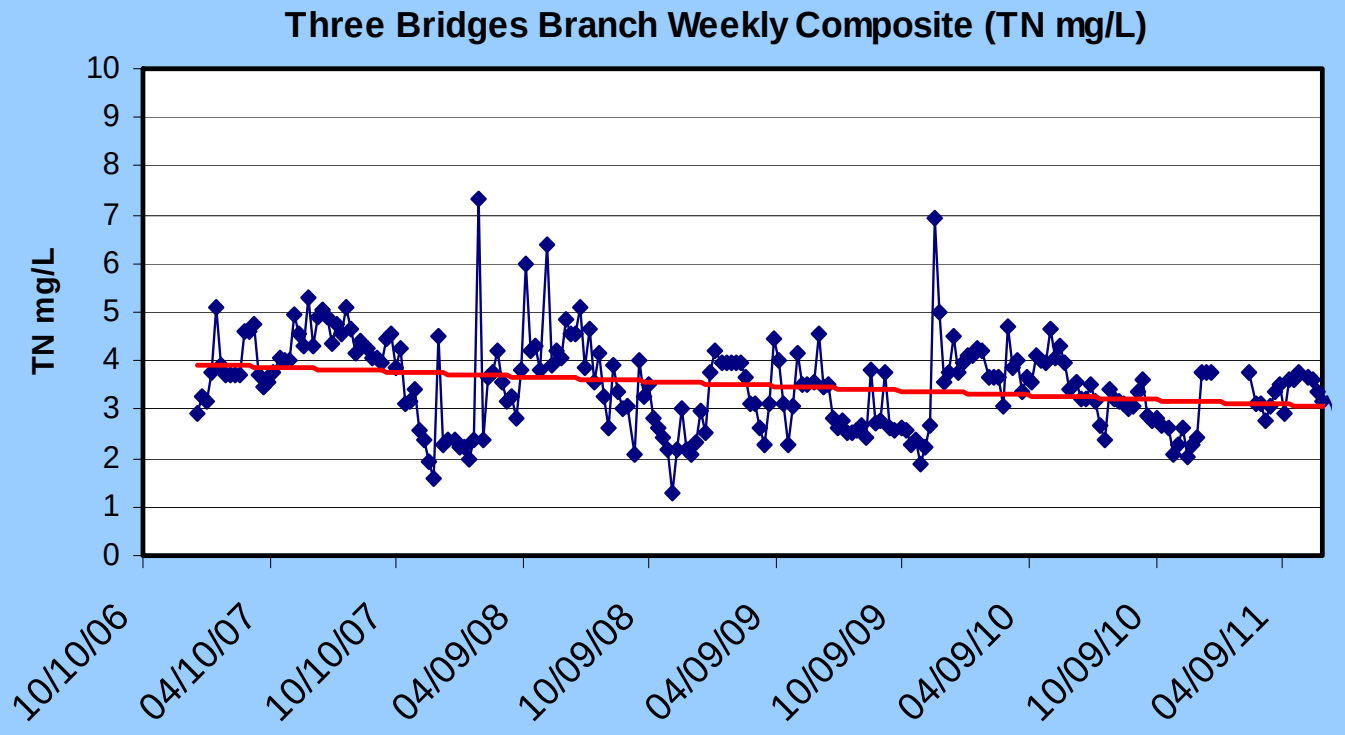
MDE Non-Tidal Results

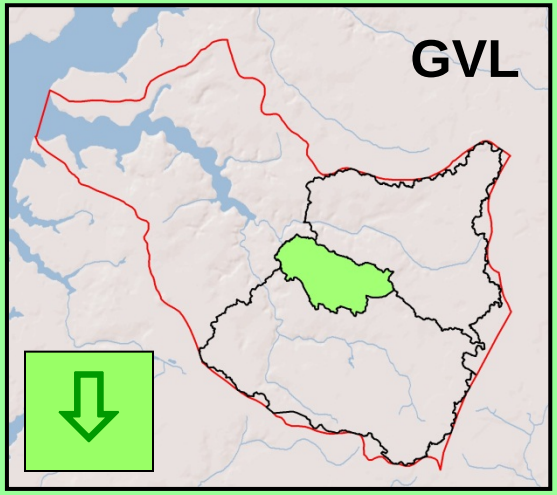
Statistically significant Decline… Includes Statistical Analysis by Jean Spooner, PhD



Total Nitrogen

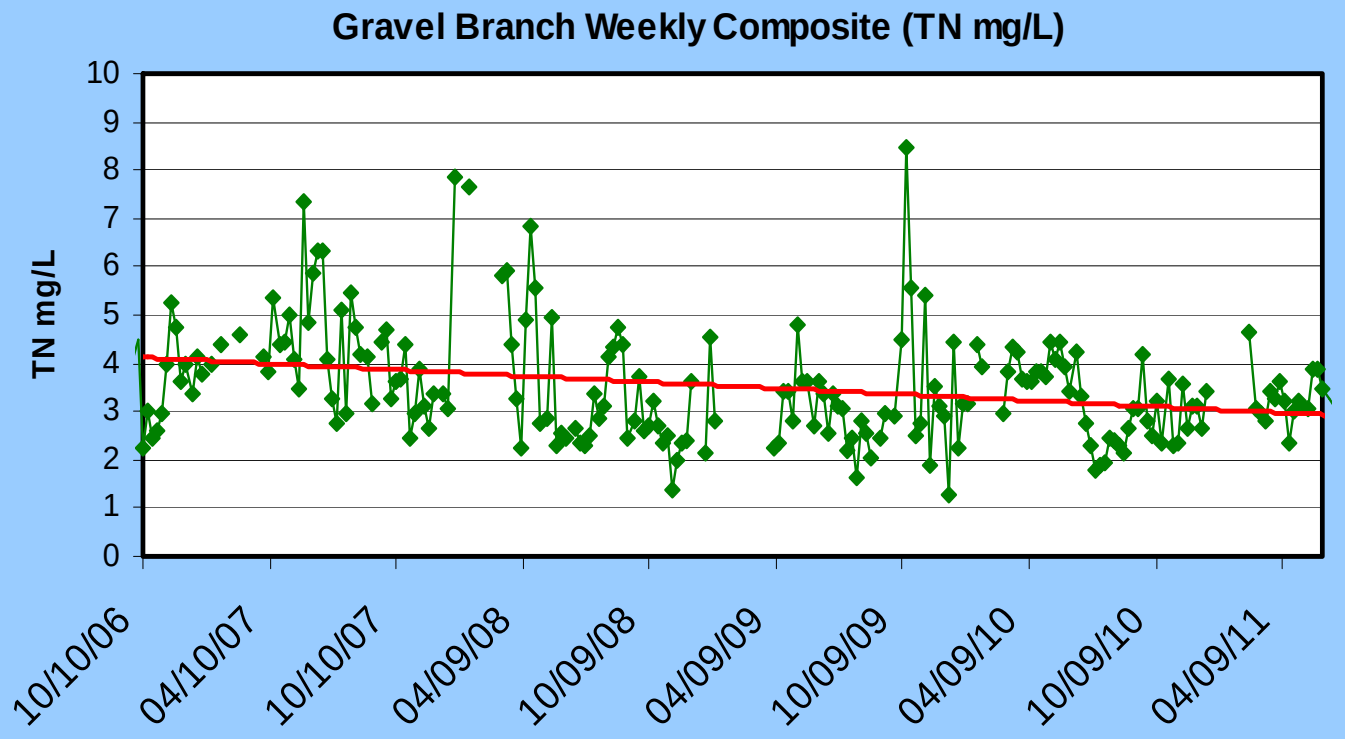
Statistic	TN mg/L
Minimum	1.3
Maximum	7.3
Mean	3.5
Approximate Reduction	1.0

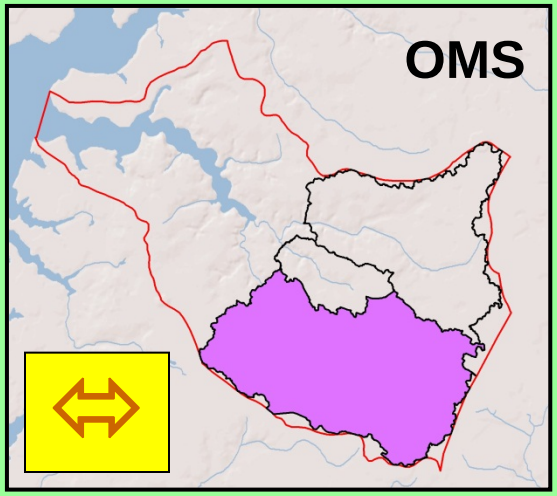




Total Nitrogen

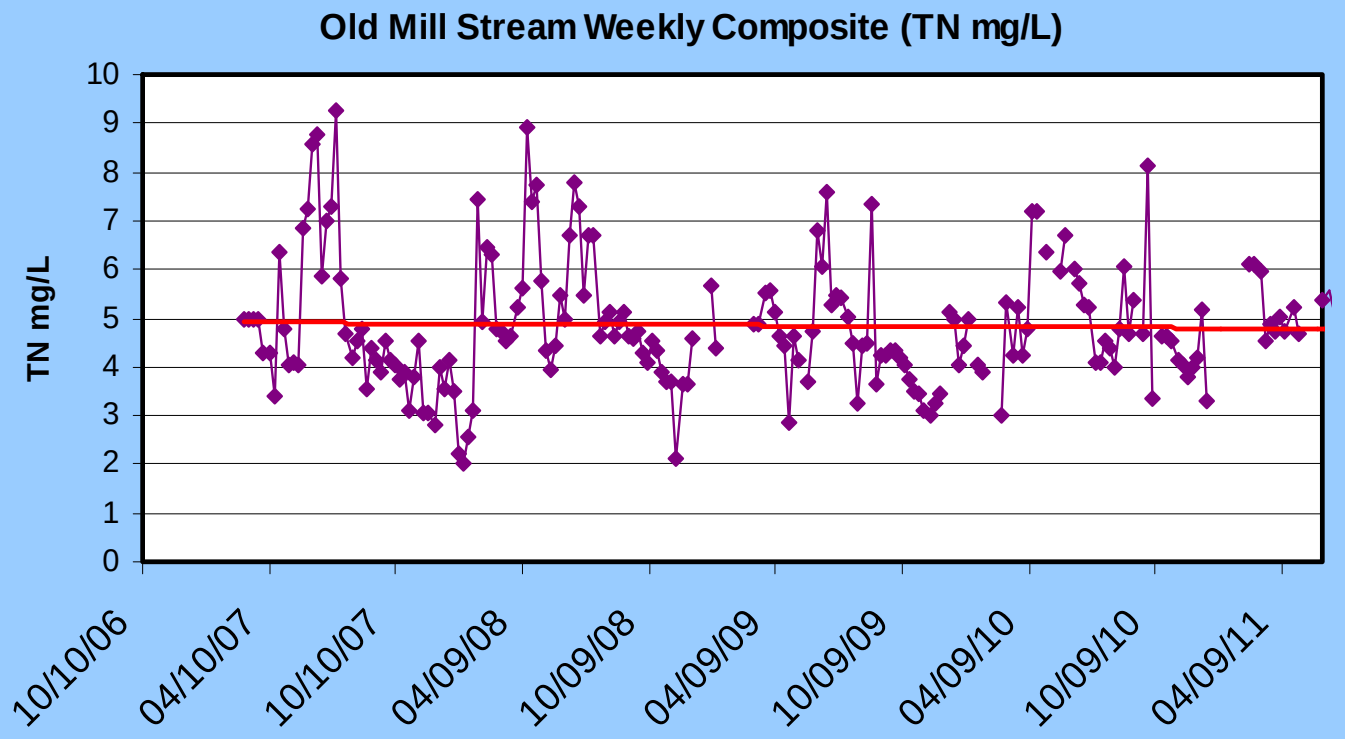
Statistic	TN mg/L
Minimum	1.3
Maximum	8.5
Mean	3.5
Approximate Reduction	1.2



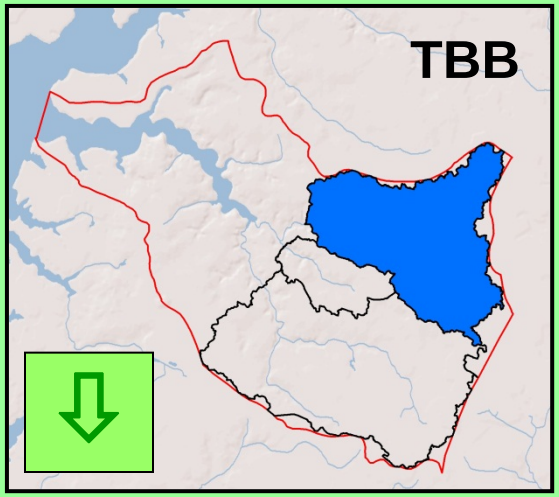


Total Nitrogen

Statistic	TN mg/L
Minimum	2.0
Maximum	9.2
Mean	4.9
Approximate Reduction	0.2

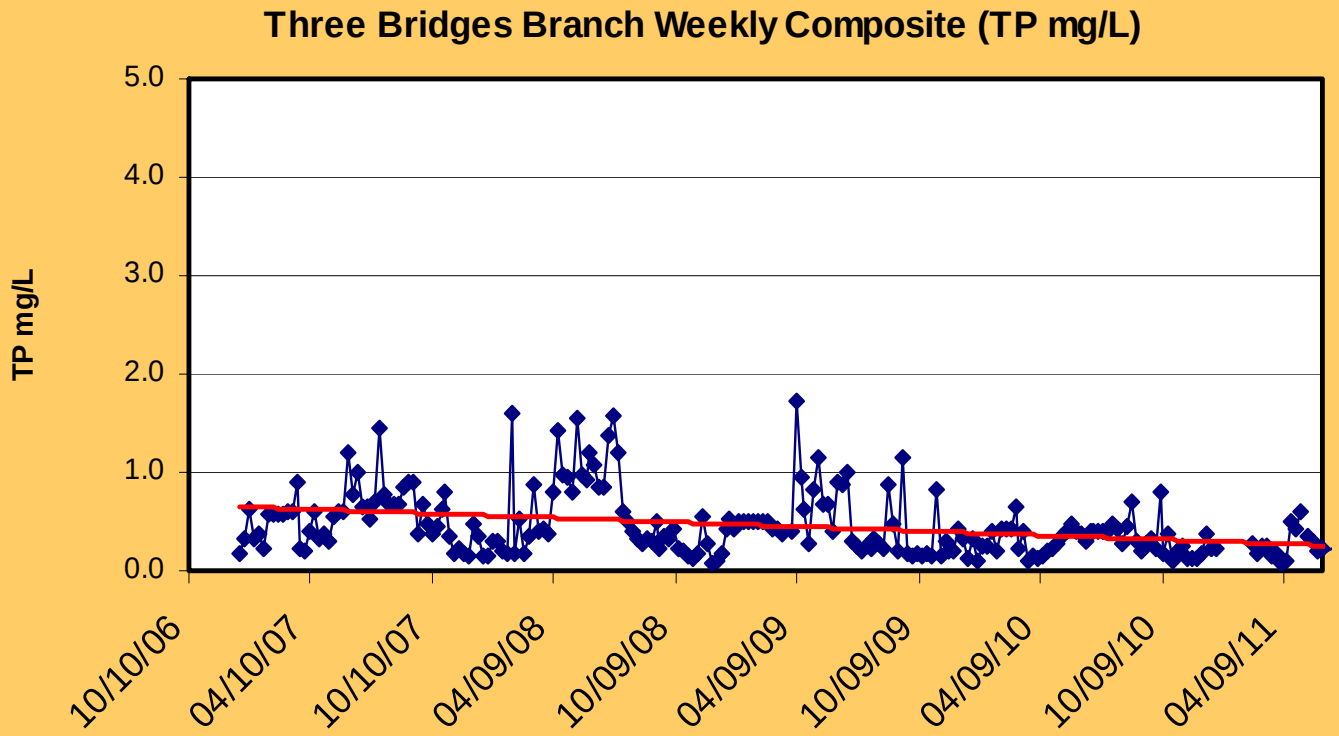


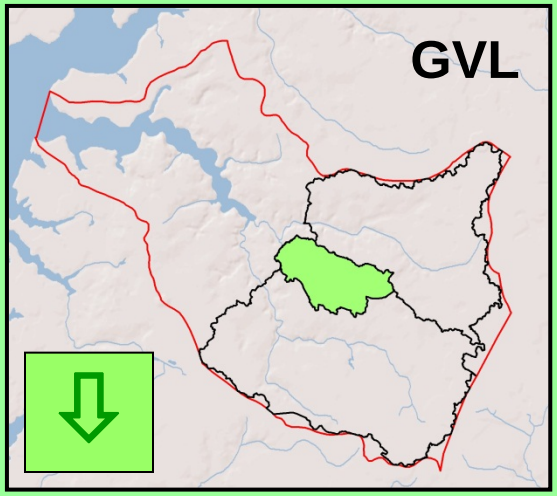
Possibly due to longer grounwater travel lag-time. OMS is the larger of the three subsheds



Total Phosphorous

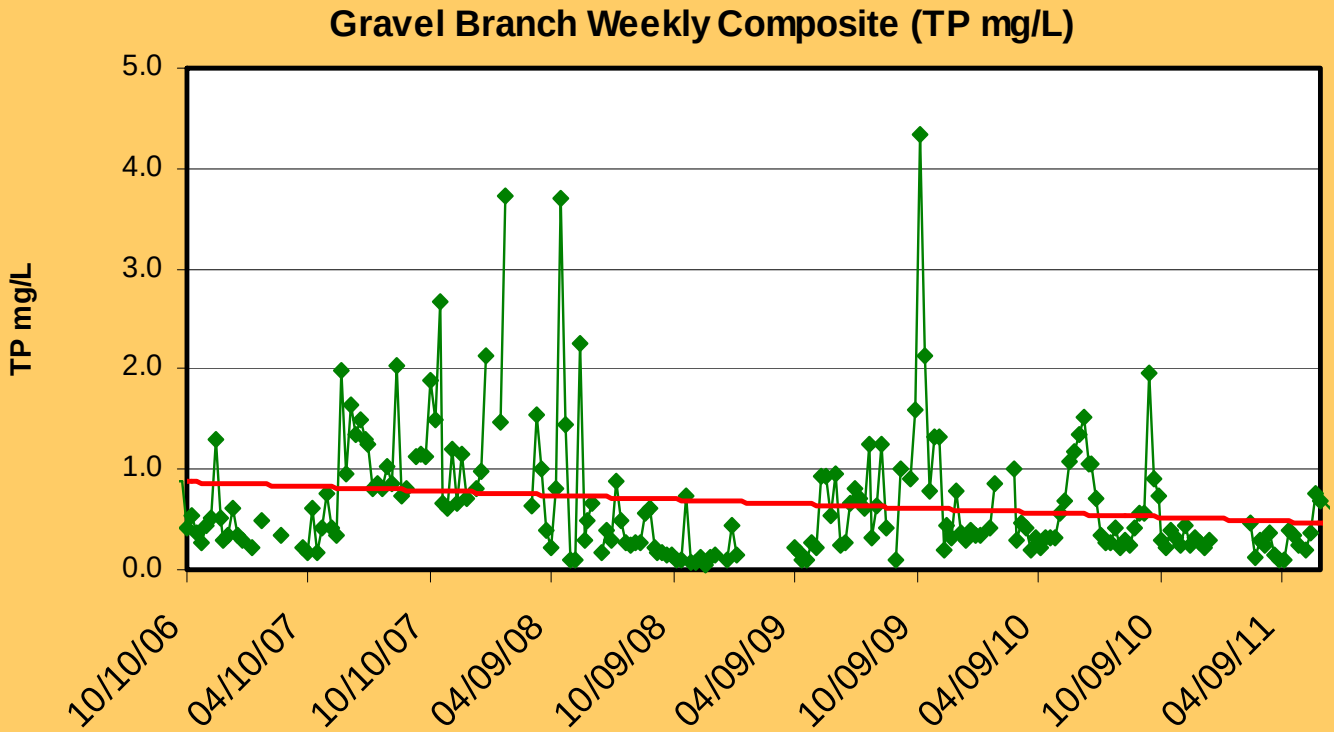
Statistic	TP mg/L
Minimum	0.1
Maximum	1.7
Mean	0.5
Approximate Reduction	0.4

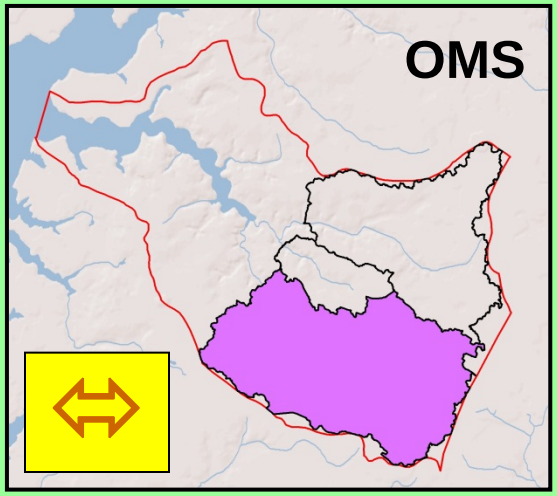




Total Phosphorous

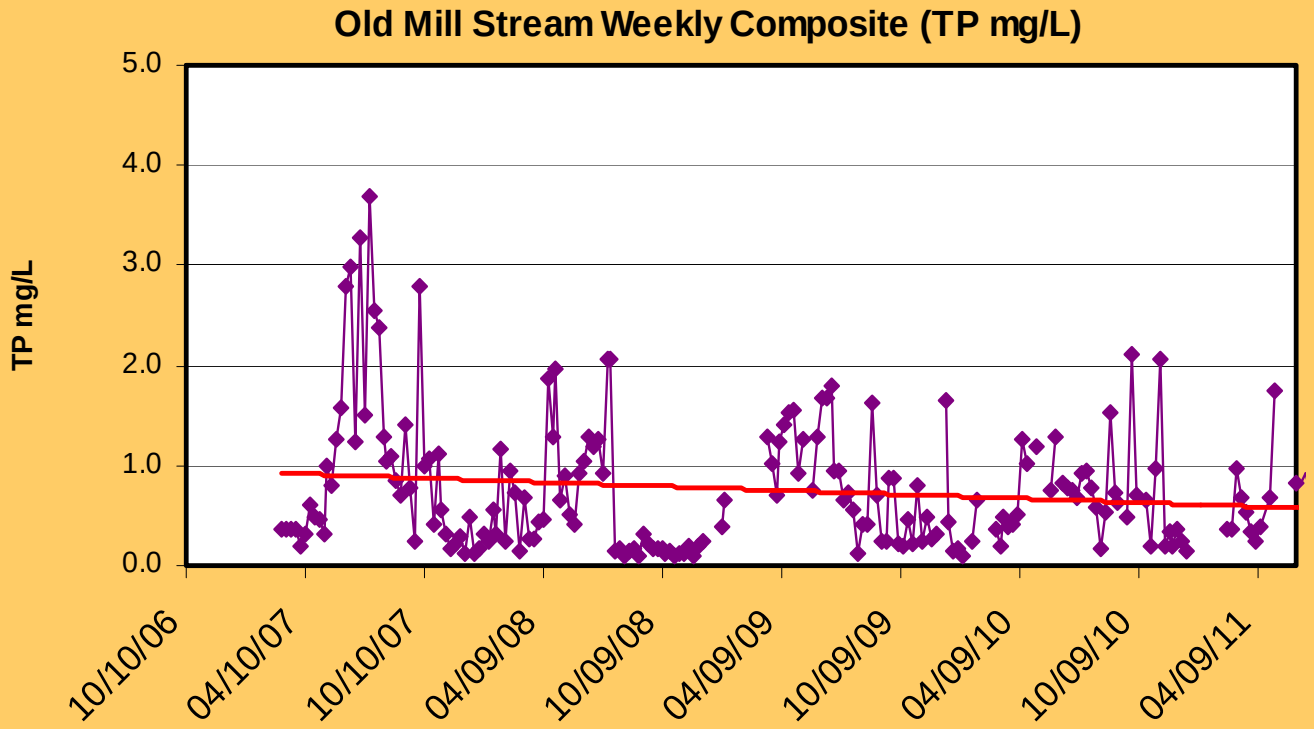
Statistic	TP mg/L
Minimum	0.1
Maximum	4.3
Mean	0.7
Approximate Reduction	0.4



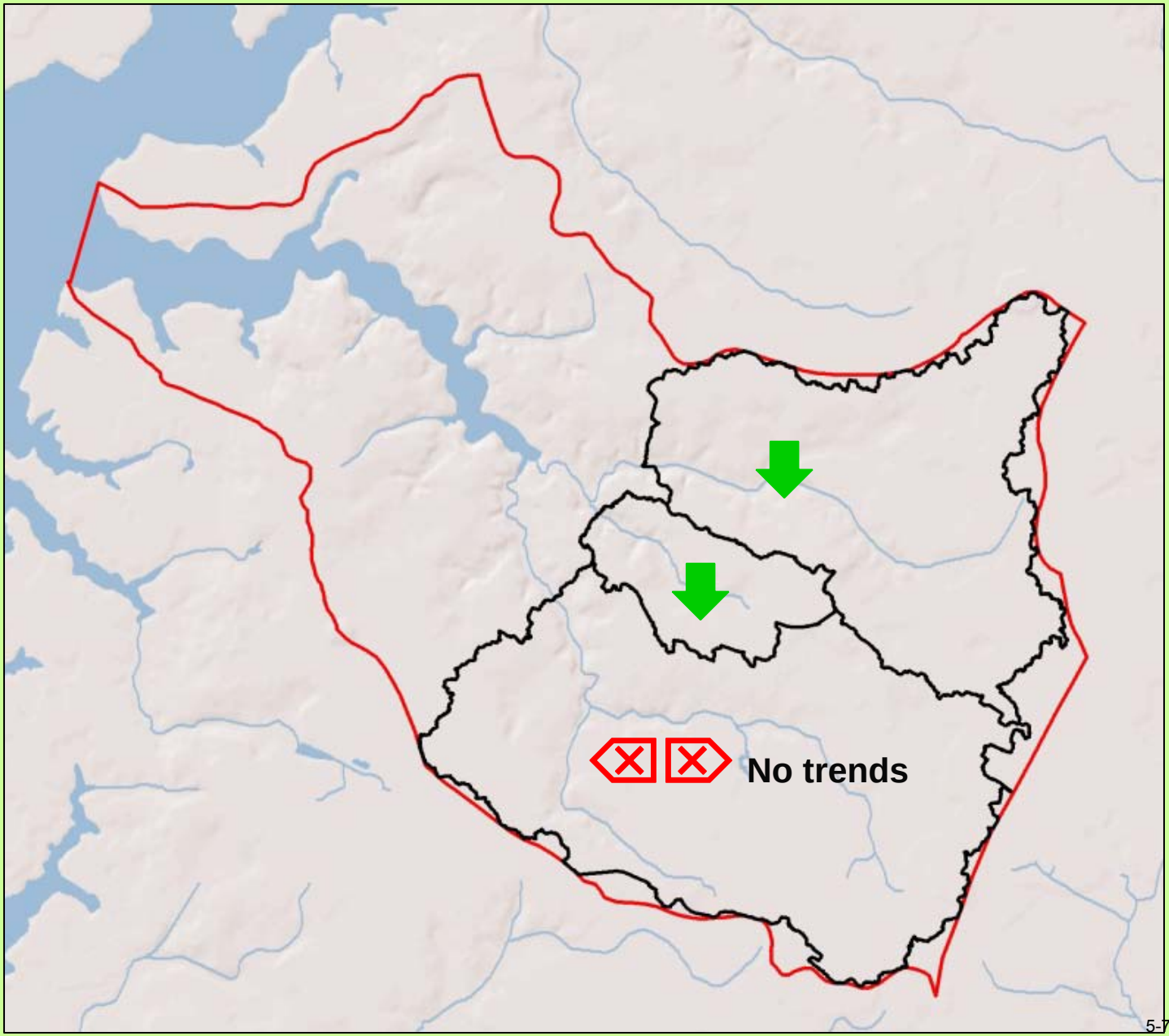


Total Phosphorous

Statistic	TP mg/L
Minimum	0.1
Maximum	3.7
Mean	0.8
Approximate Reduction	0.2



TN & TP Trends Summary



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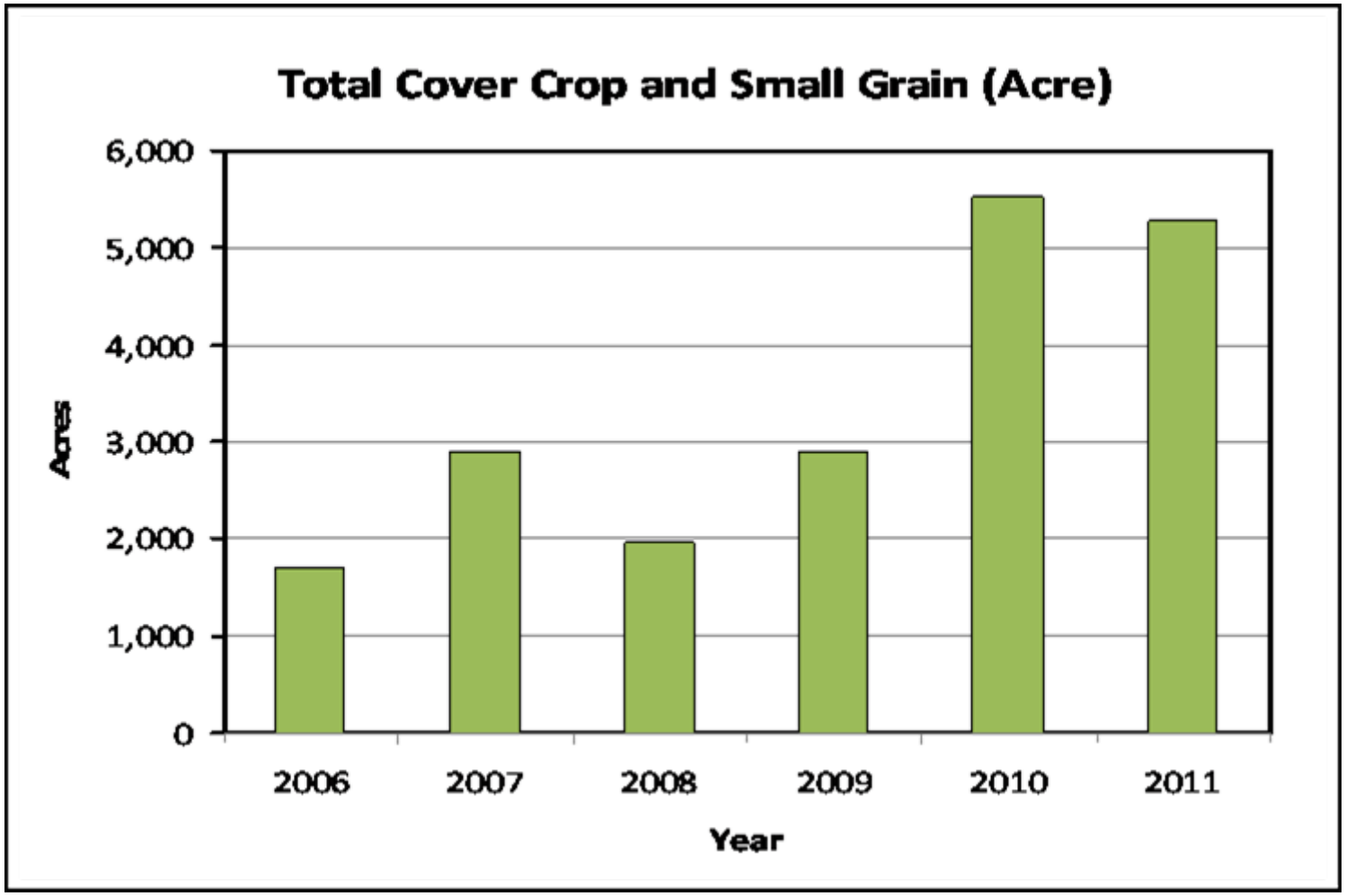
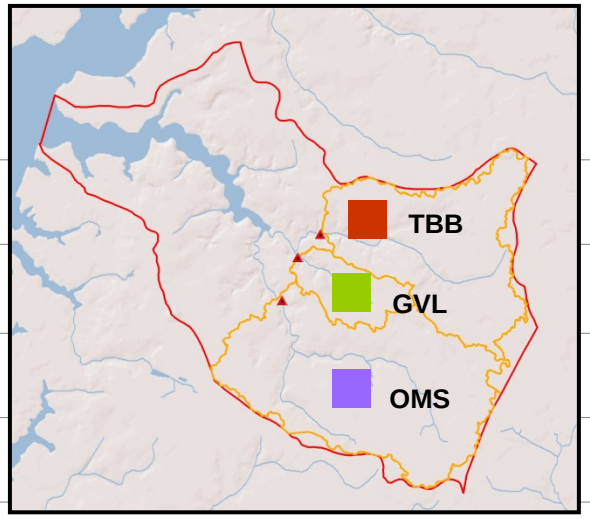
Cover Crop Increase



TBB, GVL, & OMS Cover Crop Acres



Cover Crop Acres

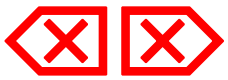
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0

2005 2006 2007 2008 2009 2010 2011

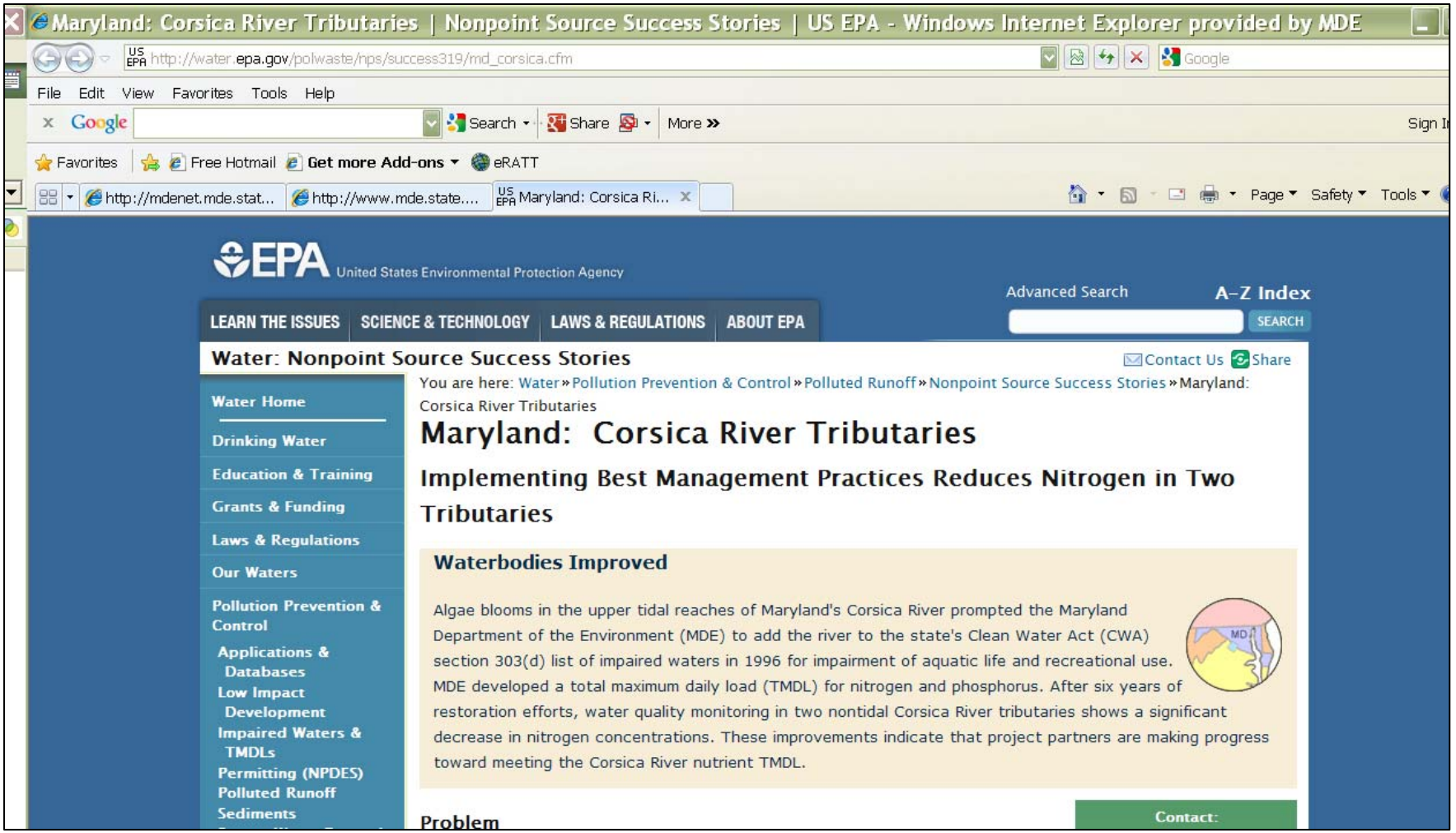
5-7-2013

Cover Crops vs. Nutrient Data

Concentration, Load, & Flow Data vs. Cover Crop Acres

- **TBB:**
  - —  TP/TN conc with corresponding  in cover crops
- **GVL:**
  - —  TP/TN load/conc with corresponding  in cover crops
- **OMS:**
  - —  Nothing yet (*lag time likely?*)  in cover crops

EPA Considers the Corsica Watershed Project One of Maryland's Incremental "Success Stories"



Document Improvements With Extensive Water Quality Monitoring Plan

1. Continuous Long-Term & Storm Event Water Quality
   - Demonstrate the impact of a comprehensive watershed restoration program on non-tidal surface water nutrient concentrations and loads
2. Synoptic Survey
   - Target efforts for BMP implementation
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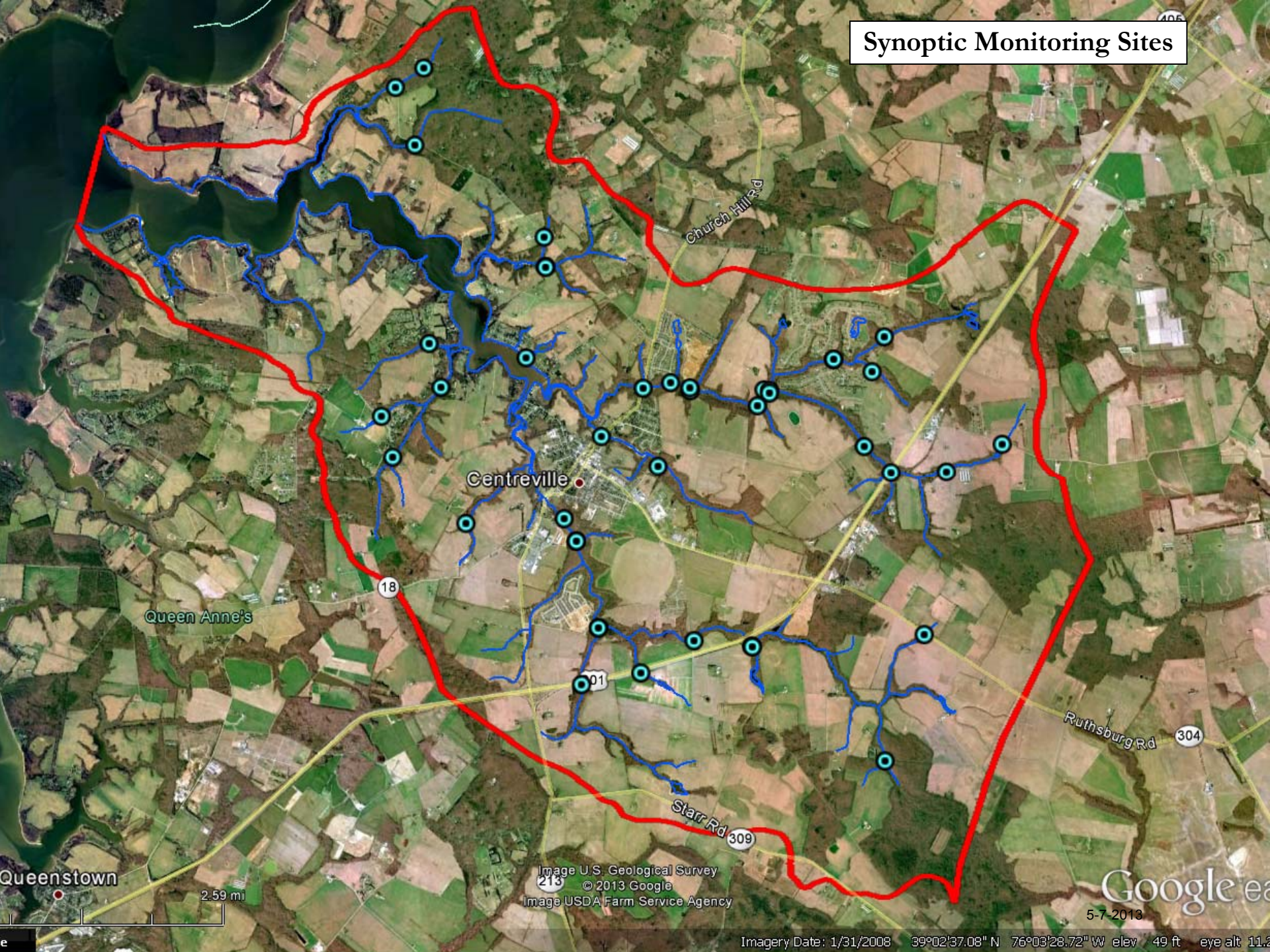
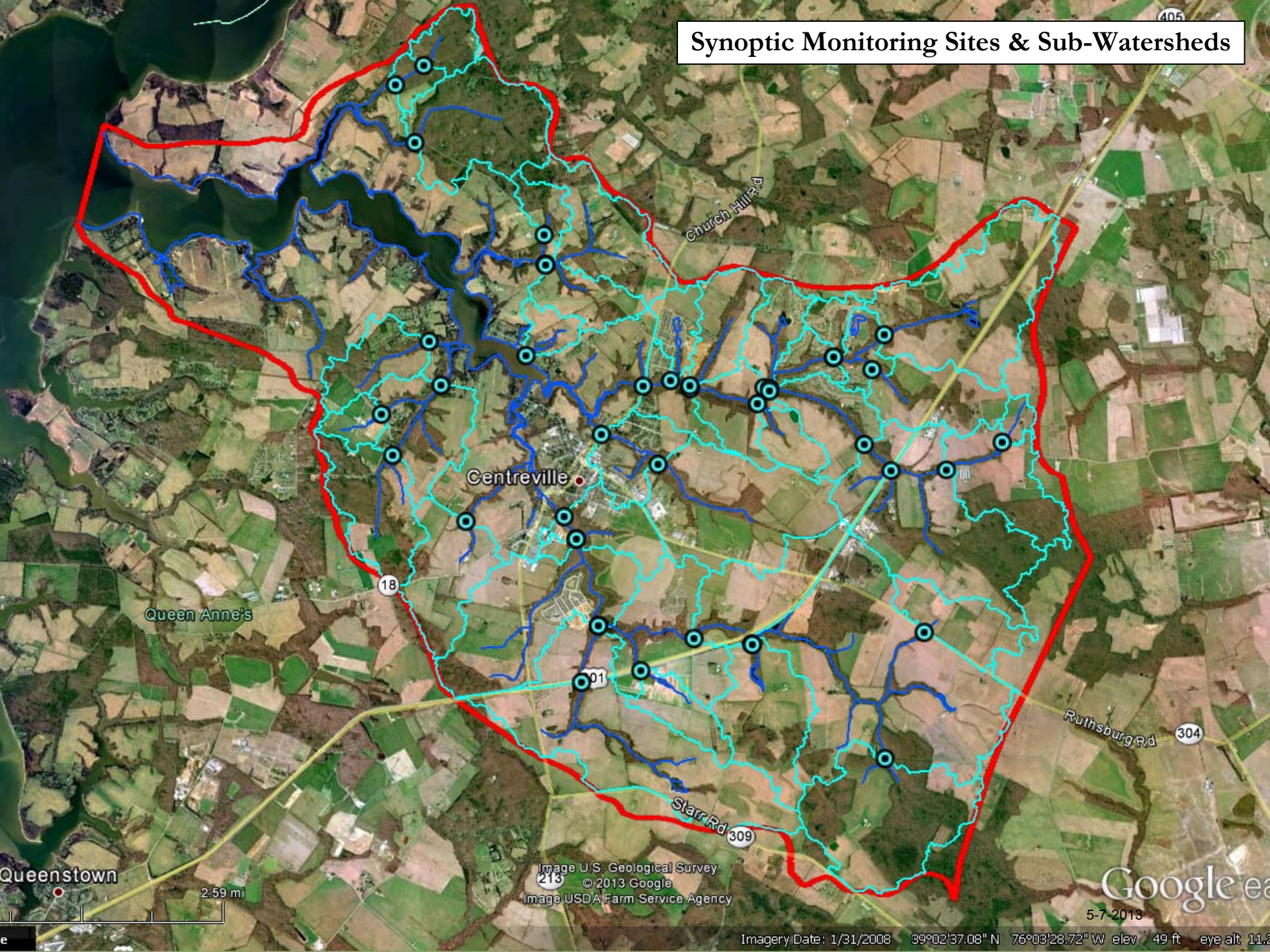
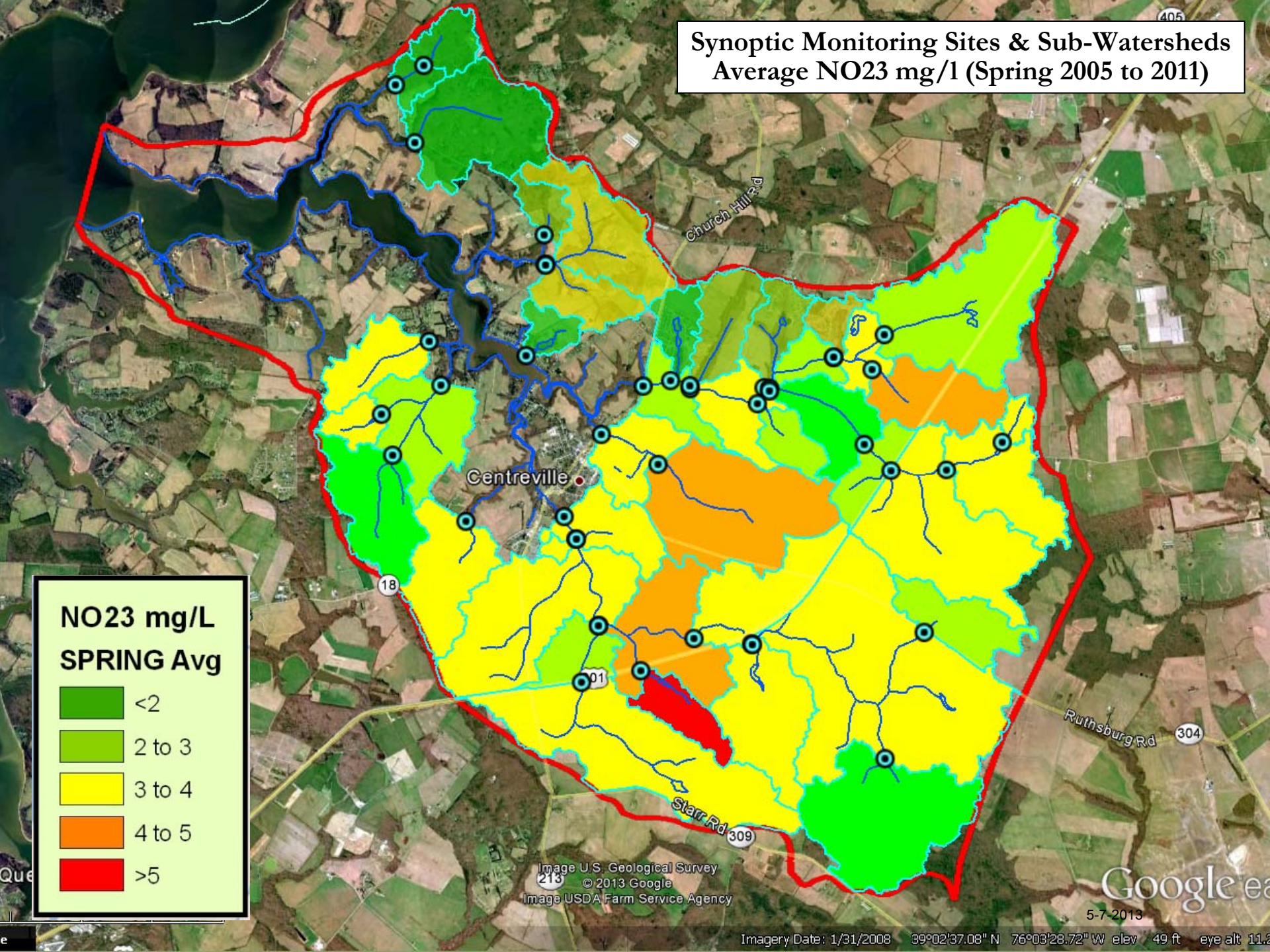
Synoptic Survey Monitoring

- Sampling conducted in Spring and Fall (Base flow)
- ~45 sites sampled during survey (in two days)
- Grab and filter samples (TN, TP, NO_2+NO_3, PO_4)
- In-situ Hydrolab data (Water temp, DO, pH, Cond.)
- Flow measures for discharge/loading calculation
- Data analysis


Synoptic Monitoring Sites
Church Hill Rd
Centreville
18
Queen Anne's
301
Ruthsburg Rd
304
Starr Rd
309
213
Queenstown
2.59 mi
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'37.08" N 76°03'28.72" W elev 49 ft eye alt 11.2

Synoptic Monitoring Sites & Sub-Watersheds




Synoptic Monitoring Sites & Sub-Watersheds
Average NO23 mg/l (Spring 2005 to 2011)
NO23 mg/L
SPRING Avg
<2
2 to 3
3 to 4
4 to 5
>5
Centreville
Church Hill Rd
Ruthsburg Rd
Starr Rd
18
304
309
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
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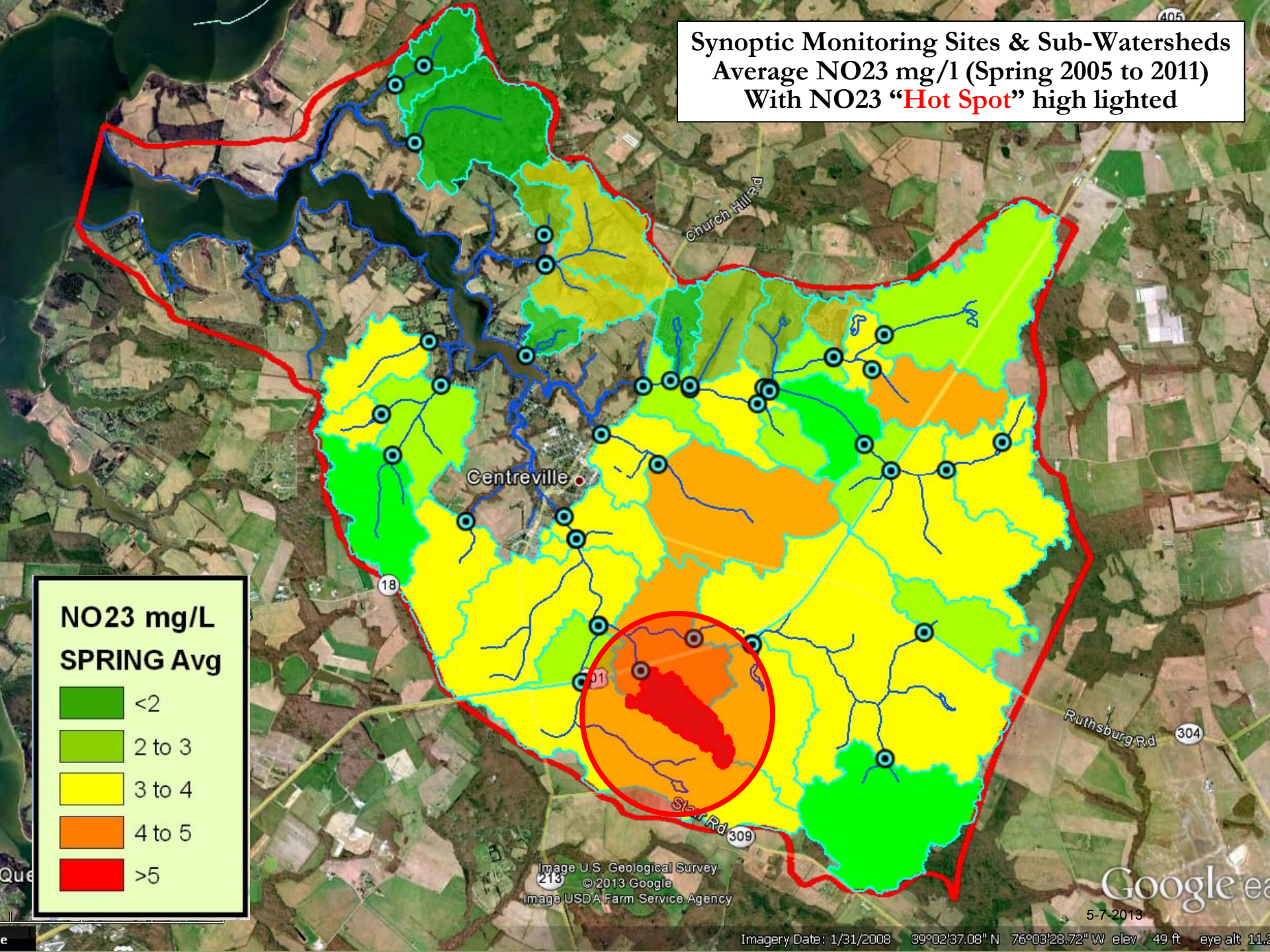
Imagery Date: 1/31/2008 39°02'37.08" N 76°03'28.72" W elev 49 ft eye alt


Synoptic Monitoring Sites & Sub-Watersheds
Average NO23 mg/l (Spring 2005 to 2011)
With NO23 "Hot Spot" high lighted
NO23 mg/L
SPRING Avg
<2
2 to 3
3 to 4
4 to 5
>5
Centreville
Church Hill Rd
Ruthsburg Rd
Slaughter Rd
18
304
309
213
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'37.08" N 76°03'28.72" W elev 49 ft eye alt

What we can learn from synoptic surveys?

- Identify constituent "**HOT SPOTS**"
  - Trigger for ***finer scale*** focus
- Target BMP implementation activities
  - Cover crops, wetlands, denitrifying septic systems, stream buffers, livestock fencing, etc…
- Baseline for measuring or tracking progress

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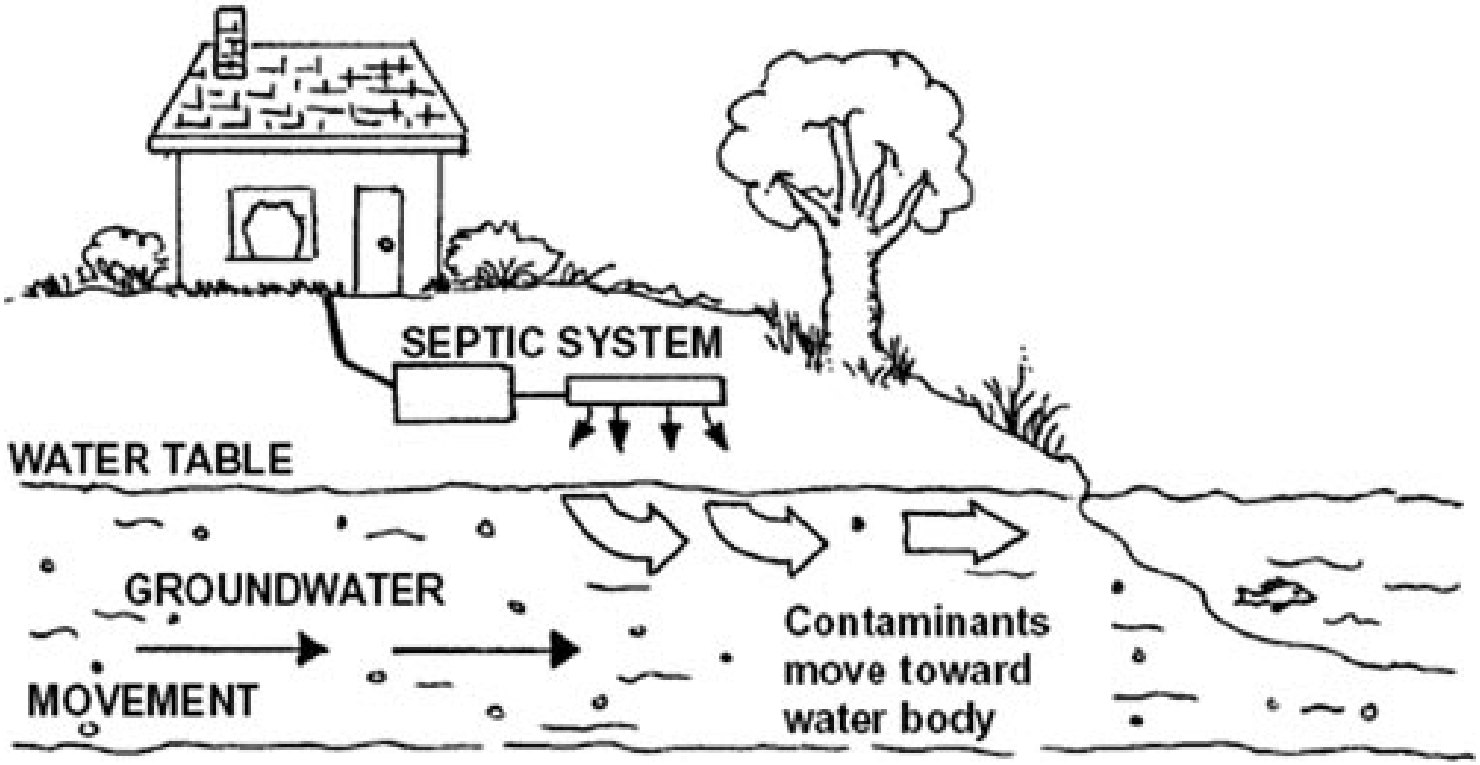
   - Demonstrate effectiveness of urban stormwater management retrofits at reducing nutrient and contaminant loads discharged to surface waters

On-Site Septic Disposal System (OSDS)

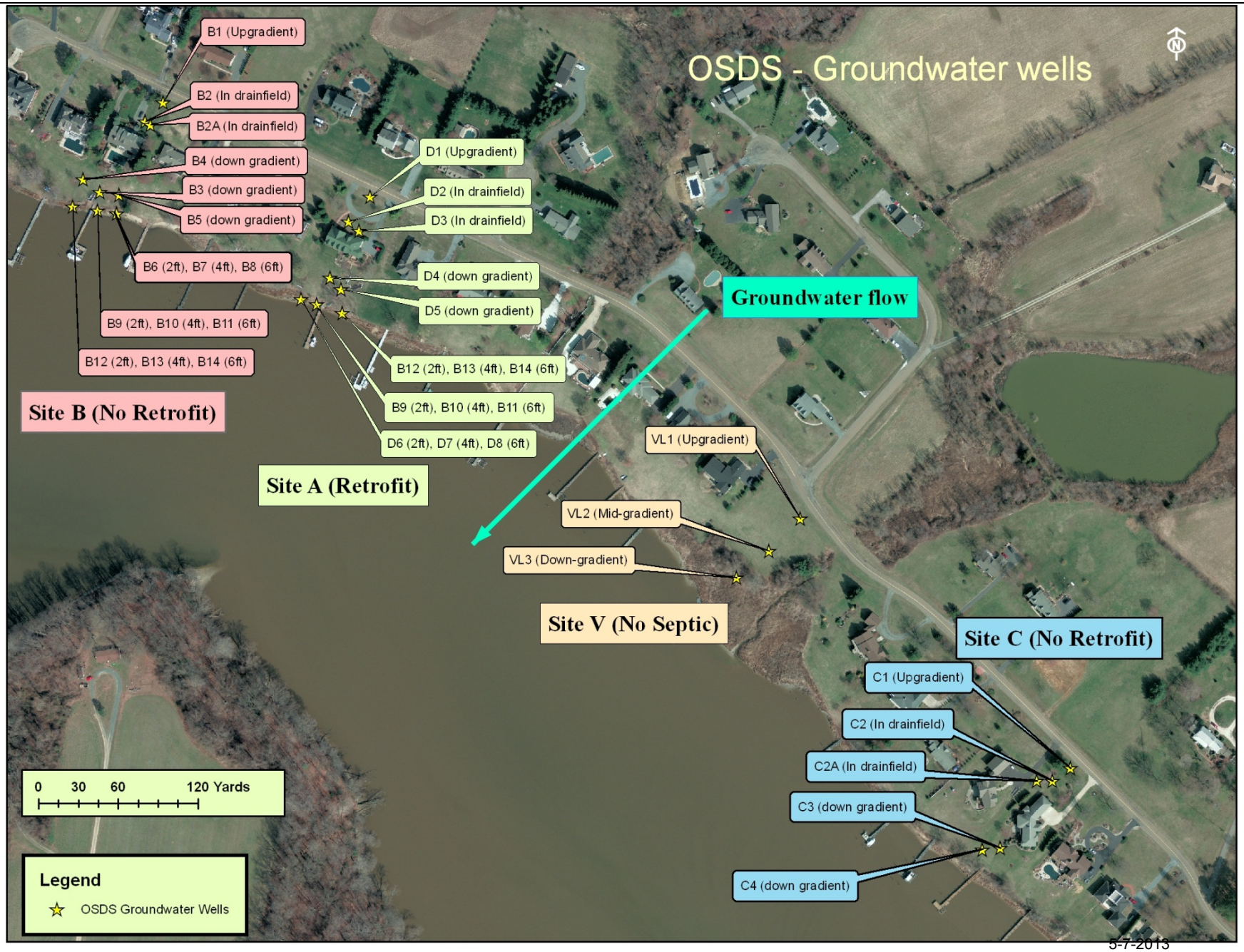


- To quantify reductions in dissolved nitrogen loads delivered to the surface aquifer from septic systems retrofitted with nitrogen reduction technology


• The wells at each site are sampled once a month.
5-7-2013

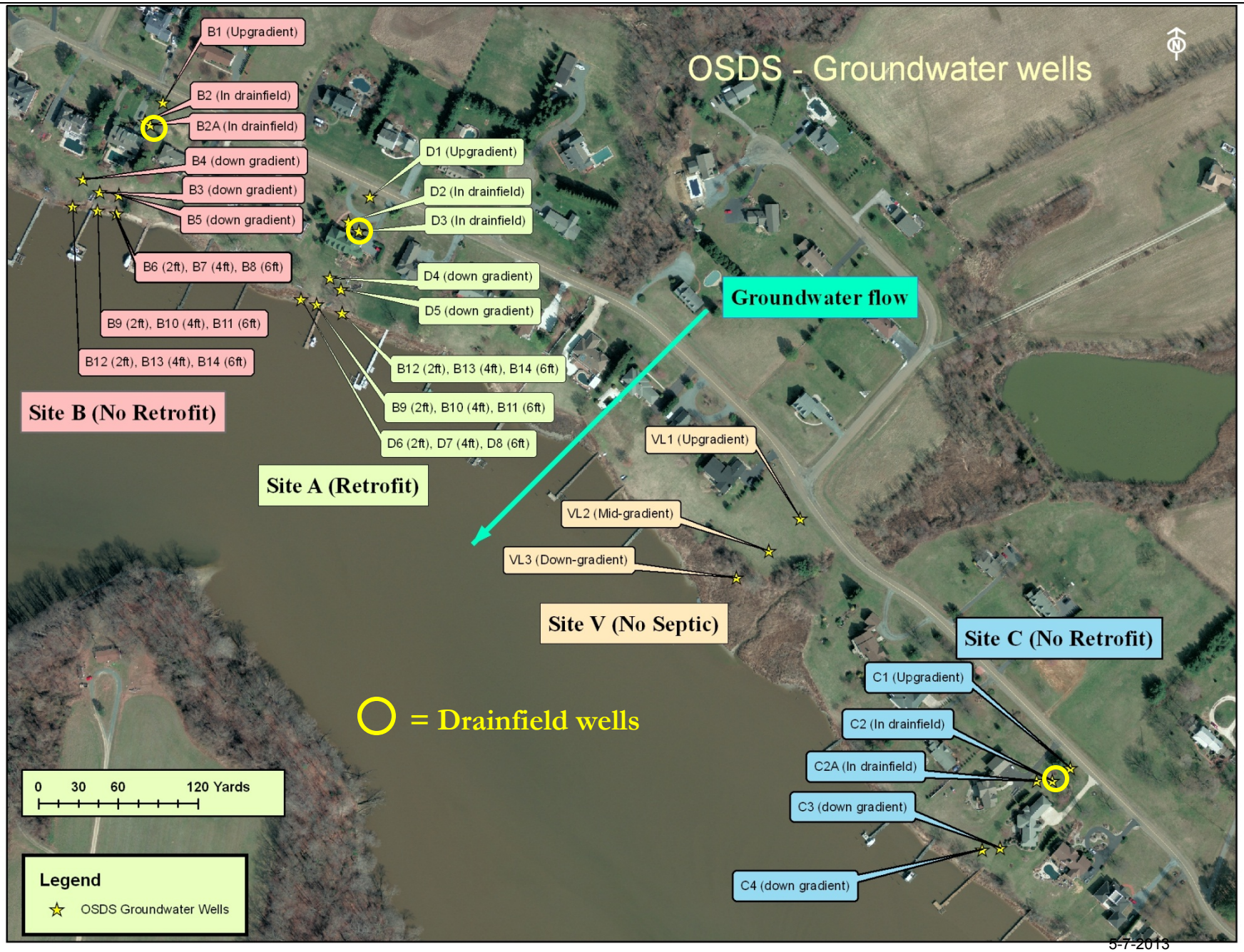

Groundwater Monitoring Well Sites
Forested
Agriculture
Residential
Waterfront Properties
Centreville
Queen Anne's
Queenstown
Church Hill Rd
Ruthsburg Rd
Starr Rd
18
301
304
309
213
2.59 mi
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'37.08" N 76°03'28.72" W elev 49 ft eye alt

Onsite Sewage Disposal System (OSDS)

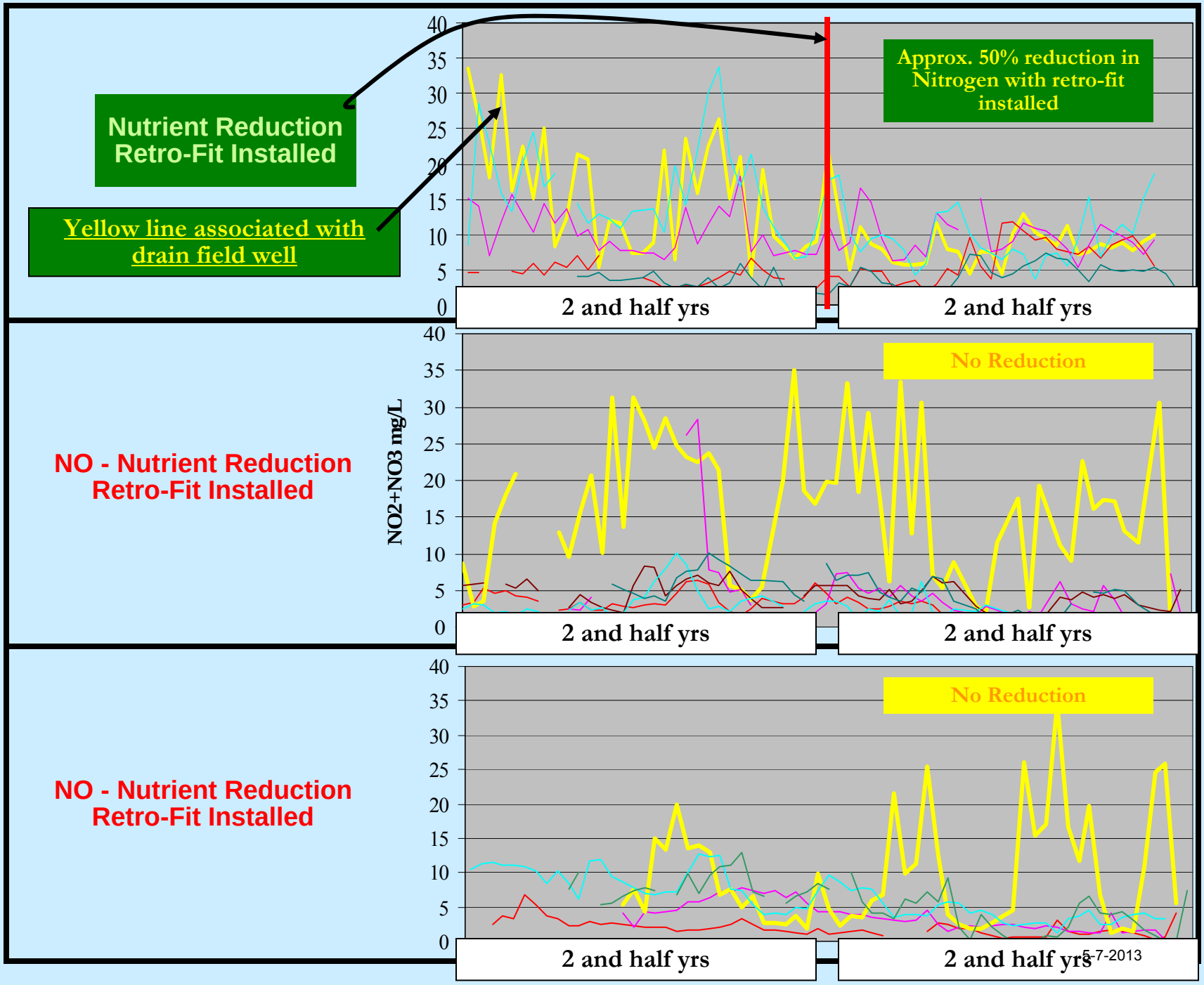


5-7-2013

Onsite Sewage Disposal System (OSDS)

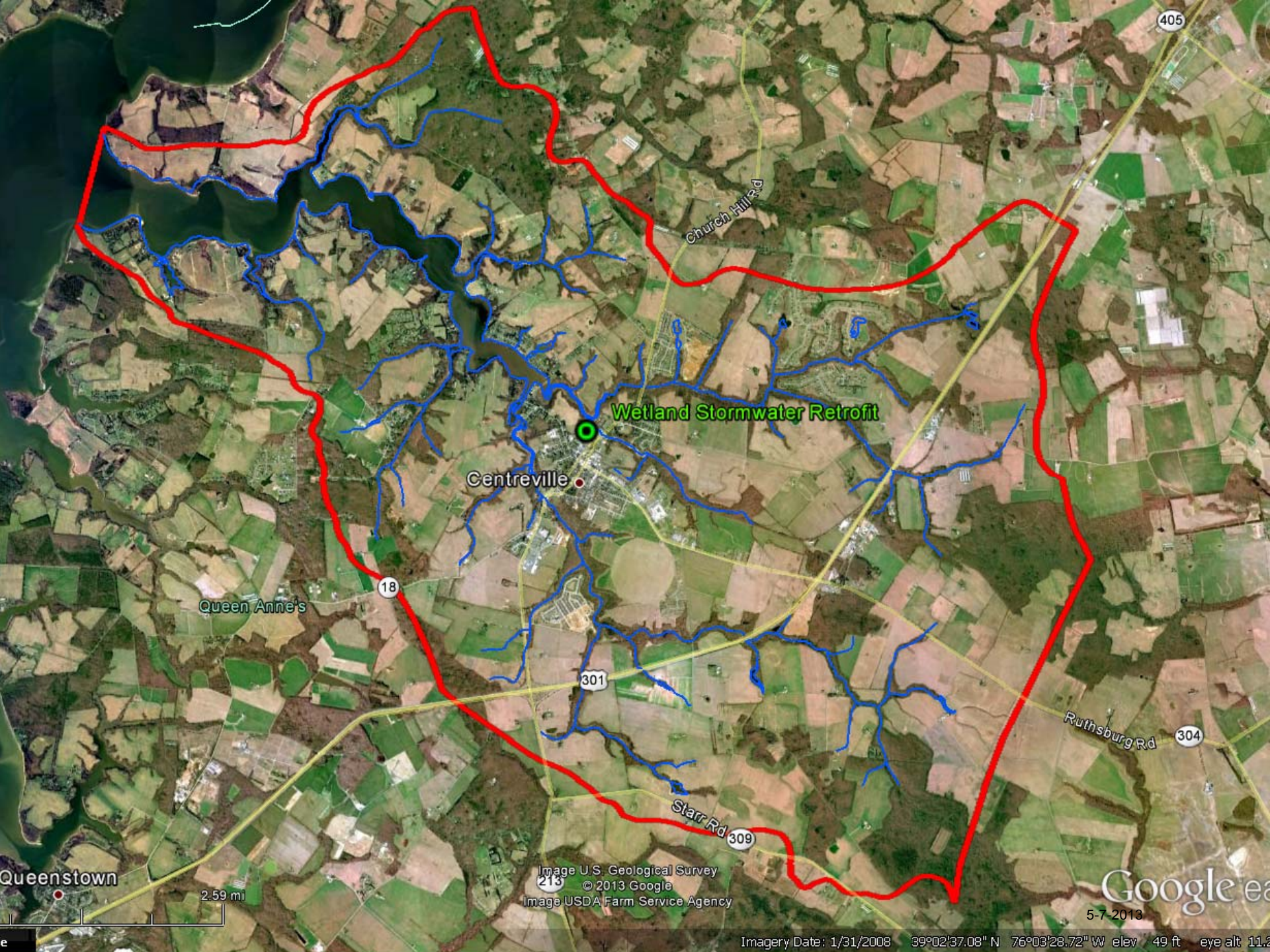


5-7-2013

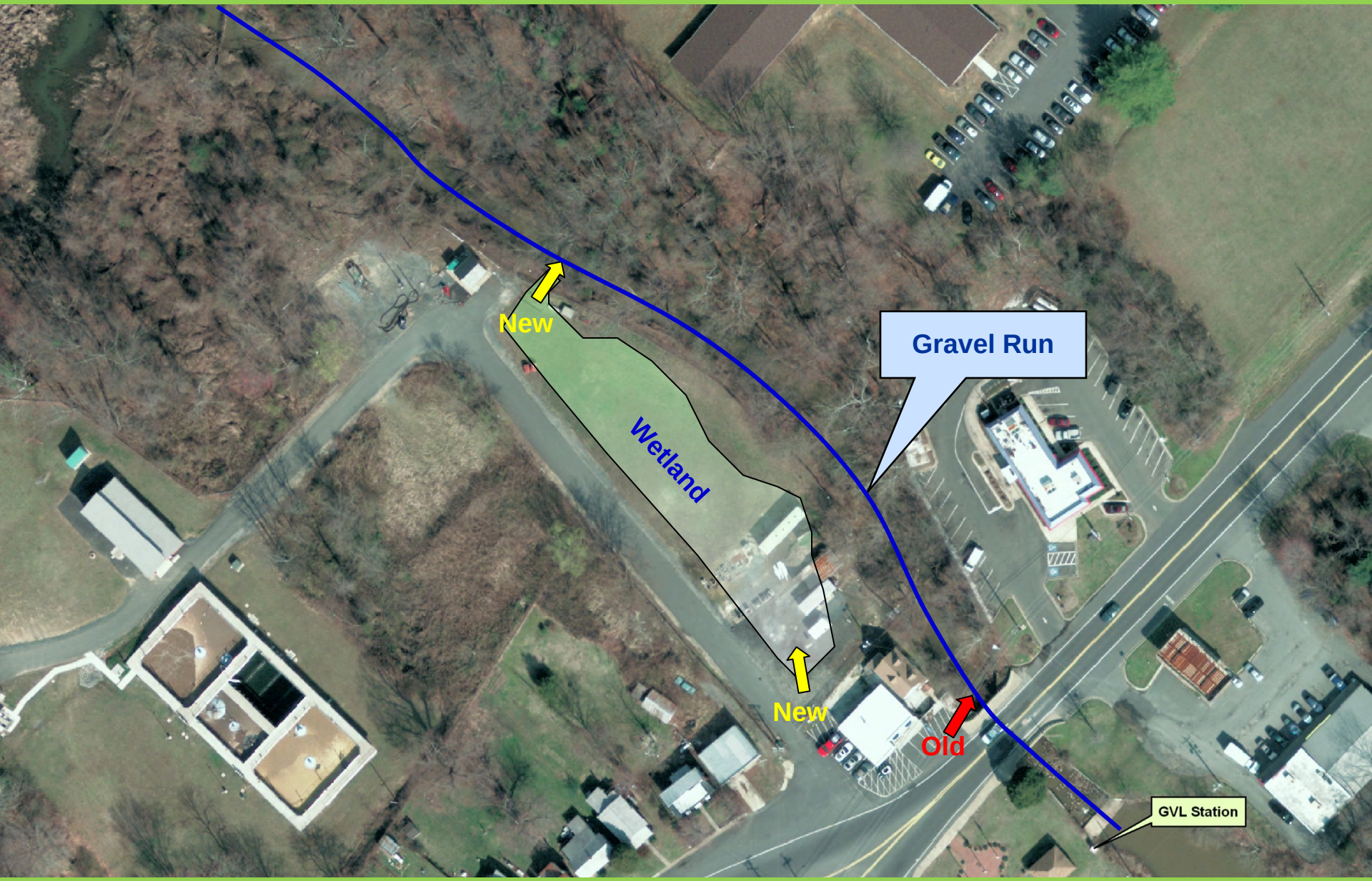

Nutrient Reduction Retro-Fit Installed
Yellow line associated with drain field well
Approx. 50% reduction in Nitrogen with retro-fit installed
2 and half yrs
2 and half yrs
NO - Nutrient Reduction Retro-Fit Installed
NO2+NO3 mg/L
No Reduction
2 and half yrs
2 and half yrs
NO - Nutrient Reduction Retro-Fit Installed
No Reduction
2 and half yrs
2 and half yrs
5-7-2013

Stormwater Monitoring

- Assess stormwater BMPs (Street Sweeping, Rain Barrels, Rain Gardens…) and upgrade/retrofit effectiveness
- Automated sampling at existing stormwater outfalls (TN, TP, NO2, NO2+NO3, NH4)
- Automated sampling at retrofit wetlands outfalls (TN, TP, NO2, NO2+NO3, NH4)


Wetland Stormwater Retrofit
Centreville
Church Hill Rd
Queen Anne's
18
301
Ruthsburg Rd
304
Starr Rd
309
405
213
Queenstown
2.59 mi
Image U.S. Geological Survey
© 2013 Google
Image USDA Farm Service Agency
Google
5-7-2013
Imagery Date: 1/31/2008 39°02'37.08" N 76°03'28.72" W elev 49 ft eye alt 11.2


Wetland Stormwater Retrofit
213
Johnstown Ln
Powell St
Church Hill Rd
N Commerce St
Broadway
N Liberty St
Lawyer's Row
W Water St
N Commerce Rd
Haydens Alley
Banjo Ln
Turpins Ln
S Liberty St
E Water St
491 ft
Image U.S. Geological Survey
© 2013 Google
Google ea
5-7-2013
Imagery Date: 1/31/2008 39°02'45.68" N 76°03'48.20" W elev 51 ft eye alt



Wooded Wetland Stormwater Retrofit

5-7-2013


5-7-2013


5-7-2013


5-7-2013


5-7-2013

Stormwater Wetland Inlet Pond (Forebay)

After 1 Year of Operation

Wetland Forebay is full of sediment

5-7-2013

Stormwater Wetland Inlet Pond (Forebay)

4 Cubic yards of sediment were removed!

5-7-2013

Stormwater Monitoring (Oil & Grease/Metals)

RED = Indicates a reduction from the input

Date	Oil/Grease mg/L		TPH mg/L		Cadmium mg/L		Copper mg/L		Lead mg/L		Zinc mg/L	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
06/25/10	6.3	<5	<5	<5	0.002	0.002	0.047	0.038	0.042	0.083	0.408	0.217
06/29/10	5.6		5.6		0.002		0.04		0.04		0.378	
07/20/10	9.1		<5		0.002		0.02		0.017		0.147	
07/25/10	8.3	<5	<5	<5	0.002	0.002	0.032	0.036	0.024	0.046	0.264	0.123
08/12/10	6.3	<5	<5	<5	0.002	0.002	0.064	0.015	0.038	0.01	0.491	0.058
08/15/10	7		<5		0.002		0.021		0.01		0.164	
08/18/10	5	<5	<5	<5	0.002	0.002	0.028	0.005	0.016	0.01	0.271	0.013
08/23/10	5	<5	<5	<5	0.002	0.002	0.005	0.005	0.01	0.01	0.084	0.013
11/04/10	5		<5		0.004		0.009		0.01		0.141	
12/02/10	5		<5		0.004		0.026		0.014		0.149	
02/23/11	9.5		<5		0.004		0.023		0.021		0.13	
02/28/11	10.6		5.5		0.004		0.079		0.052		0.485	
03/14/11	5		<5		0.004		0.019		0.01		0.121	
04/04/11	5		<5		0.004		0.005		0.01		0.035	
04/12/11	5.7		<5		0.004		0.013		0.01		0.081	
04/16/11	5	<5	<5	<5	0.004	0.004	0.016	0.012	0.01	0.016	0.054	0.052
05/16/11	5		<5		0.004		0.02		0.01		0.096	
07/27/11	5	<5	<5	<5	0.004	0.004	0.005	0.013	0.01	0.01	0.005	0.023
08/01/11	5	<5	<5	<5	0.004	0.004	0.005	0.014	0.01	0.011	0.005	0.044
08/06/11	5		<5		0.004		0.009		0.01		0.082	
08/13/11	5	<5	<5	<5	not sampled	0.004		0.005		0.01		0.026
08/21/11	5		<5		not sampled							
08/27/11	5		<5		not sampled							
10/04/11	5		<5		0.004		0.005		0.01		0.048	

= Rain triggered input monitor but not the output monitor (stormwater retention)

Lessons Learned/Moving Forward

- Evaluate effectiveness of:
  - Targeted Watershed Plan
  - Monitoring effort
  - Ability to communicate conservation goals in the watershed (OUTREACH)
  - Ability to engage local communities in protection and restoration effort
  - Data collection, management and analysis
  - Sustainability of effort ($)
- Continue to develope clear, measurable, science-based restoration and conservation strategies
- Form and maintain a project implementation team that includes state, county, municipal, agricultural and local citizen representatives
- Narrow focus to the sub-watershed level to assess non-tidal impacts and impairments
- Account for "lag time" that can be associated with water quality improvements
- Have a central tracking repository for data and implementation activities, as well as, analyzing data results *annually*
- Big Picture: Relate Corsica information to other watesheds, as well as, associated TMDLs and the Chesapeake Bay WIP


Questions/Comments?
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