Non-tidal Stream Monitoring Synthesis

CHESAPEAKE BIOLOGICAL LABORATORY

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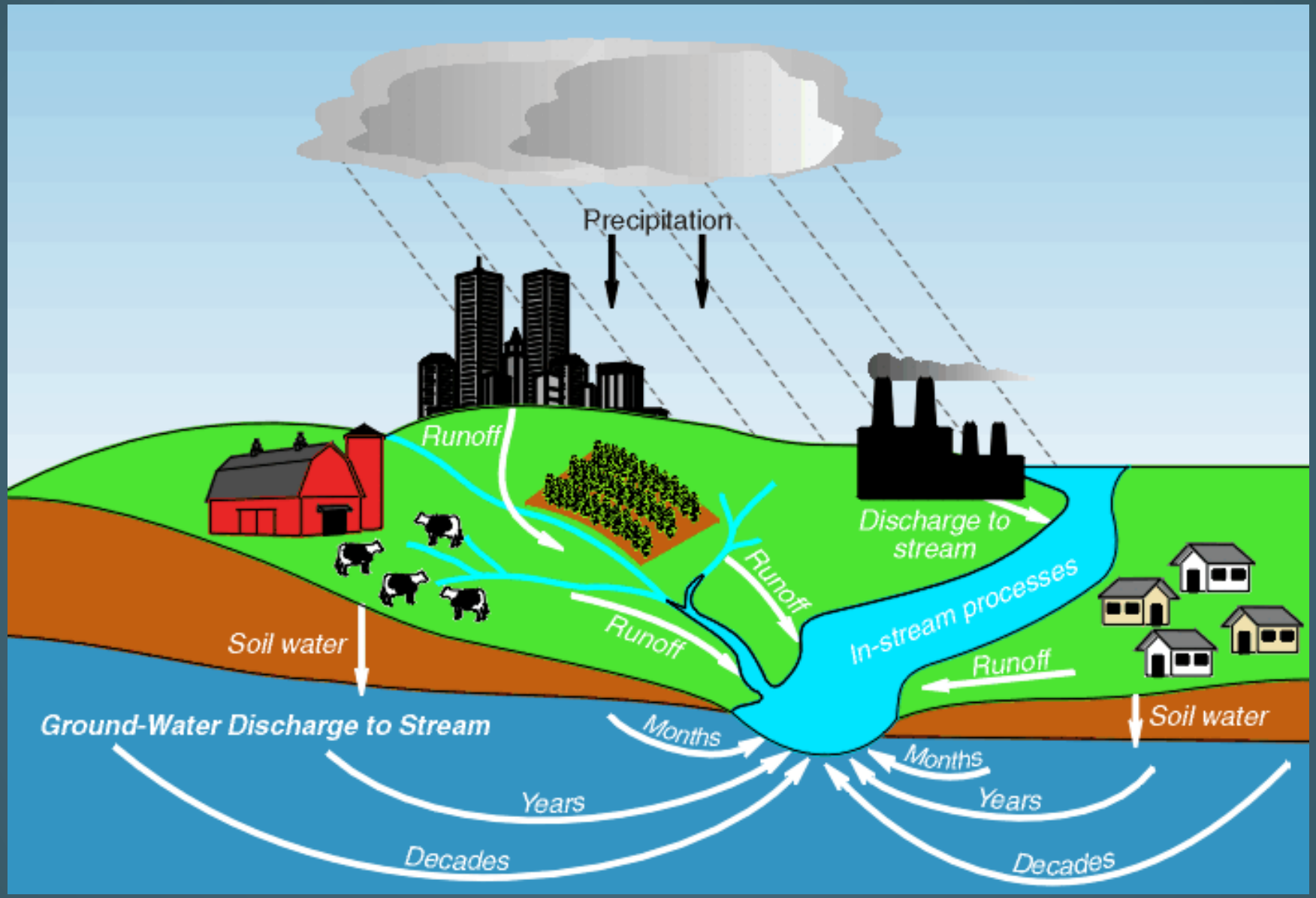
It has been said that streams are the gutters down which flow the ruins of continents

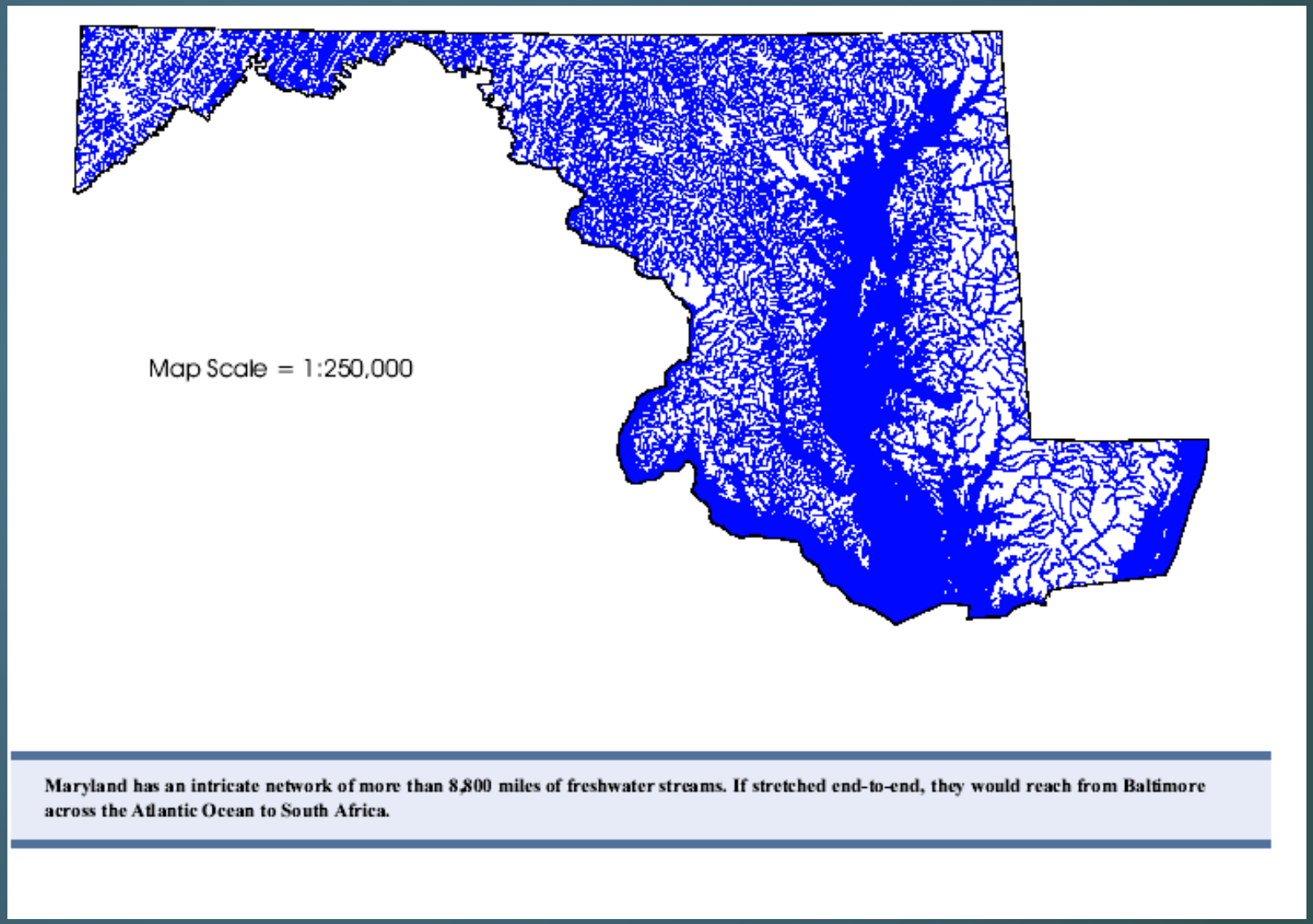
L. B. Leopold et al. 1964



USGS Fact Sheet FS-150-99

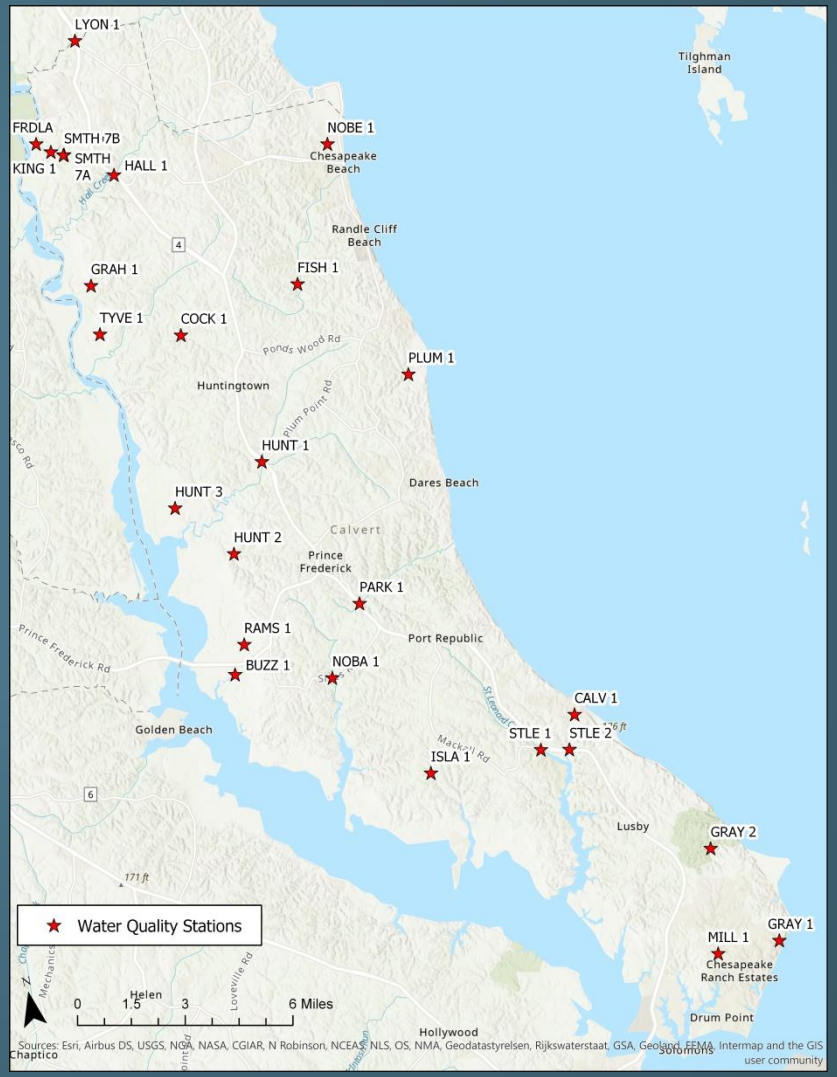
In Maryland…streams are everywhere…almost everywhere

- In Maryland there are about 8,800 miles of streams
- Large diversity of stream types
- Large % of streams are impacted in some or many ways
- Streams are the primary connection between the uplands and the estuaries
- So, at flood stage (river flow is fast), how long does it take for a nitrate molecule to make it from Cooperstown, NY to Chesapeake Bay?



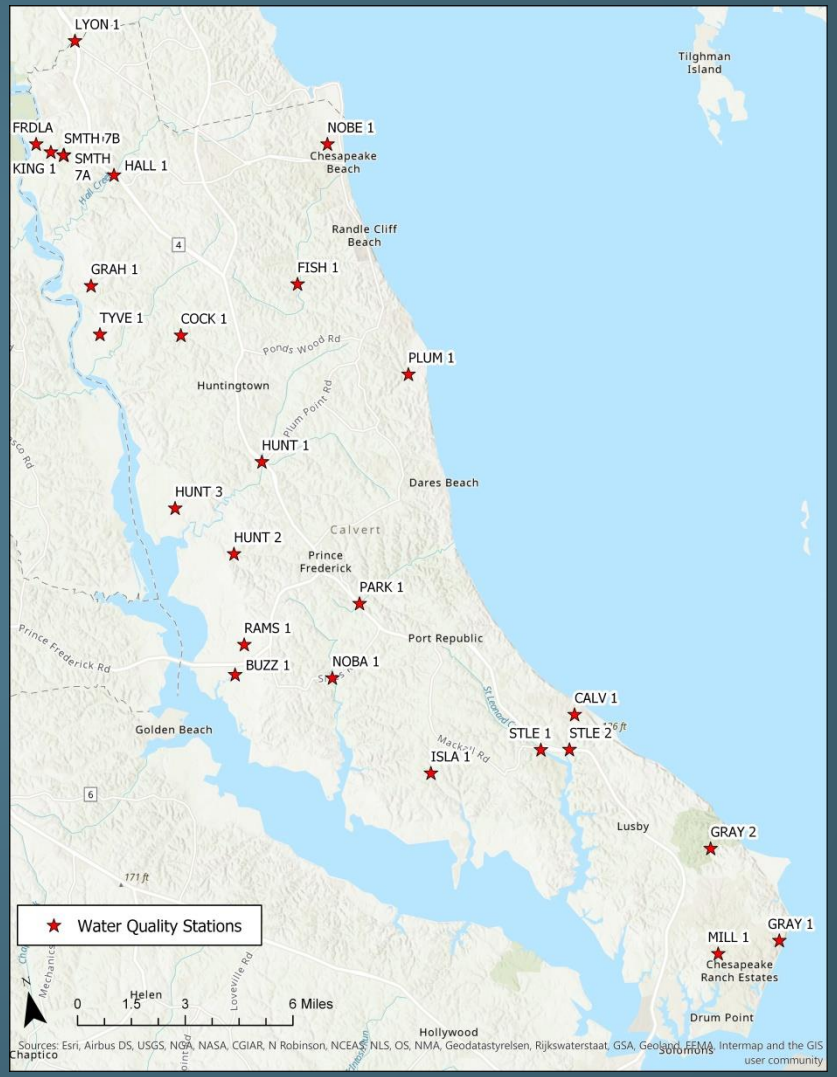
Non-tidal (stream) Water Quality Sampling Program in Calvert County

- Calvert County has monitoring data for ~26 non-tidal stream sampling sites
- Phosphorus, nitrogen, total suspended solids, stream discharge and more
- We cleaned up the data and worked on analyses



Non-tidal (stream) Water Quality Sampling Program in Calvert County

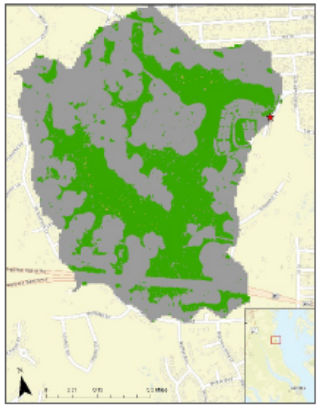
- We looked at data over time
- We compared stations with one another
- We used a version of the Chesapeake Bay Program's watershed model to predict loads



Station by Station Summary Sheets

Station NOBE 1: North Beach

NOBE 1 is close to the median for NO_{23} and PO_4 and slightly above for NH_4 and TSS. When discharge was measured, yields were higher than the median for all stations. More than half of the station basin is developed land use (62.1%)

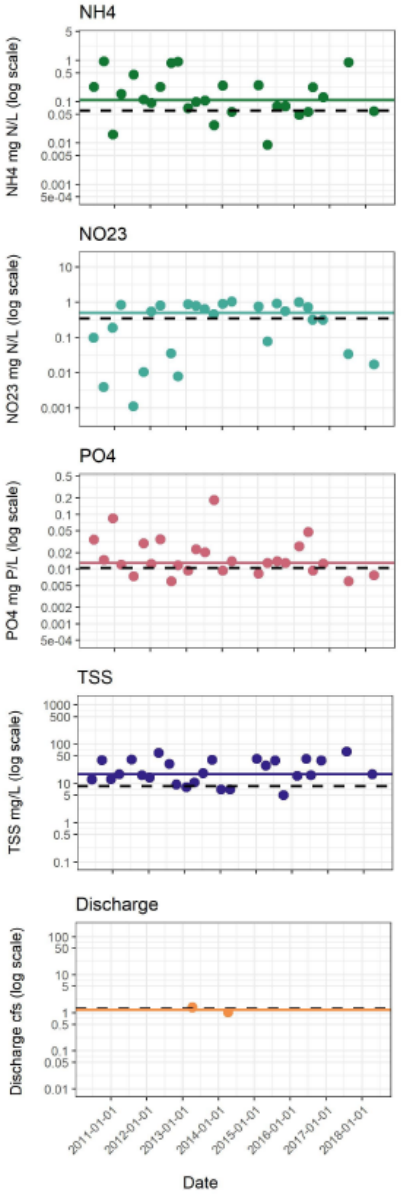


Watershed Land Use

Station
Watershed
Agriculture (Ag)
Developed (Dev)
Natural (Nat)

Station Nutrients & Discharge

Median for All Stations
Median for Station



Size, Land Use (%), & Septic (#) Comparison

	Acres	Ag	Dev	Nat	Septic
Station Basin	300	0.1	62.1	37.8	210
L-R Basin	14,395	6.7	25.3	68.0	-

L-R (Land-River) Segment N24009WL0_4772_0000

CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
Nitrogen	4	1640	301	2248	4193
Phosphorus	0	215	115	NA	330

Downscaled from CAST modeled loads for L-R Segment

Station Concentrations & Discharge Summary

	Median	*Min*	*Max*
TSS, mg/L	17.1	5.0	65.0
NH_4, mg N/L	0.106	0.009	0.944
NO_{23}, mg N/L	0.500	0.001	1.030
PO_4, mg P/L	0.0129	0.0060	0.1810
Discharge, cfs	1.205	1.03	1.38

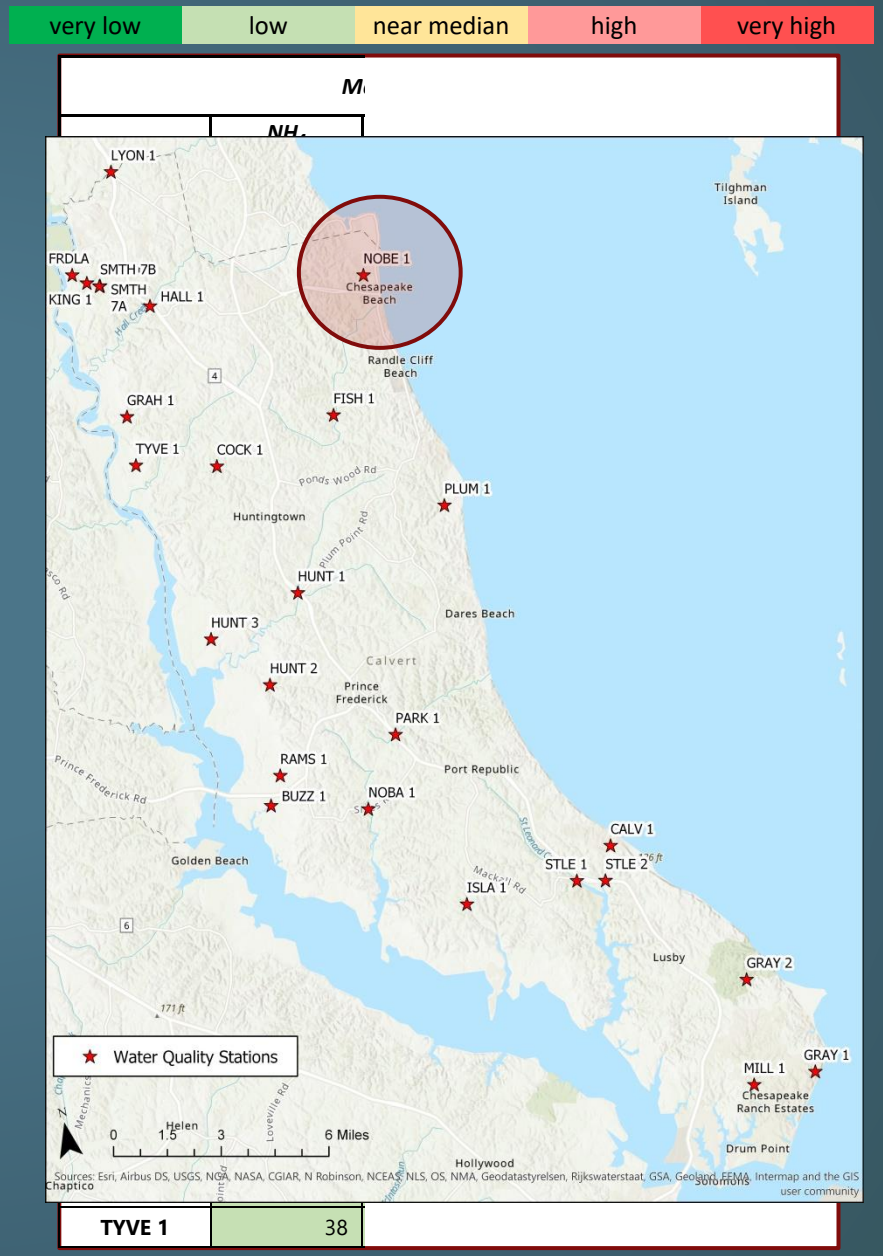
Watershed Nutrient & Sediment Yields Summary

	Median	*Min*	*Max*	*Median for All*
TSS, mg/acre/day	88,555	58,846	118,264	28,677
NH_4, mg N/acre/day	797	479	1114	165
NO_{23}, mg N/acre/day	8756	8659	8853	1,596
PO_4, mg P/acre/day	188	116	259	35

Calculated using instantaneous flow. Further scale up not recommended.

Ranking Sites by Pollutant Yield

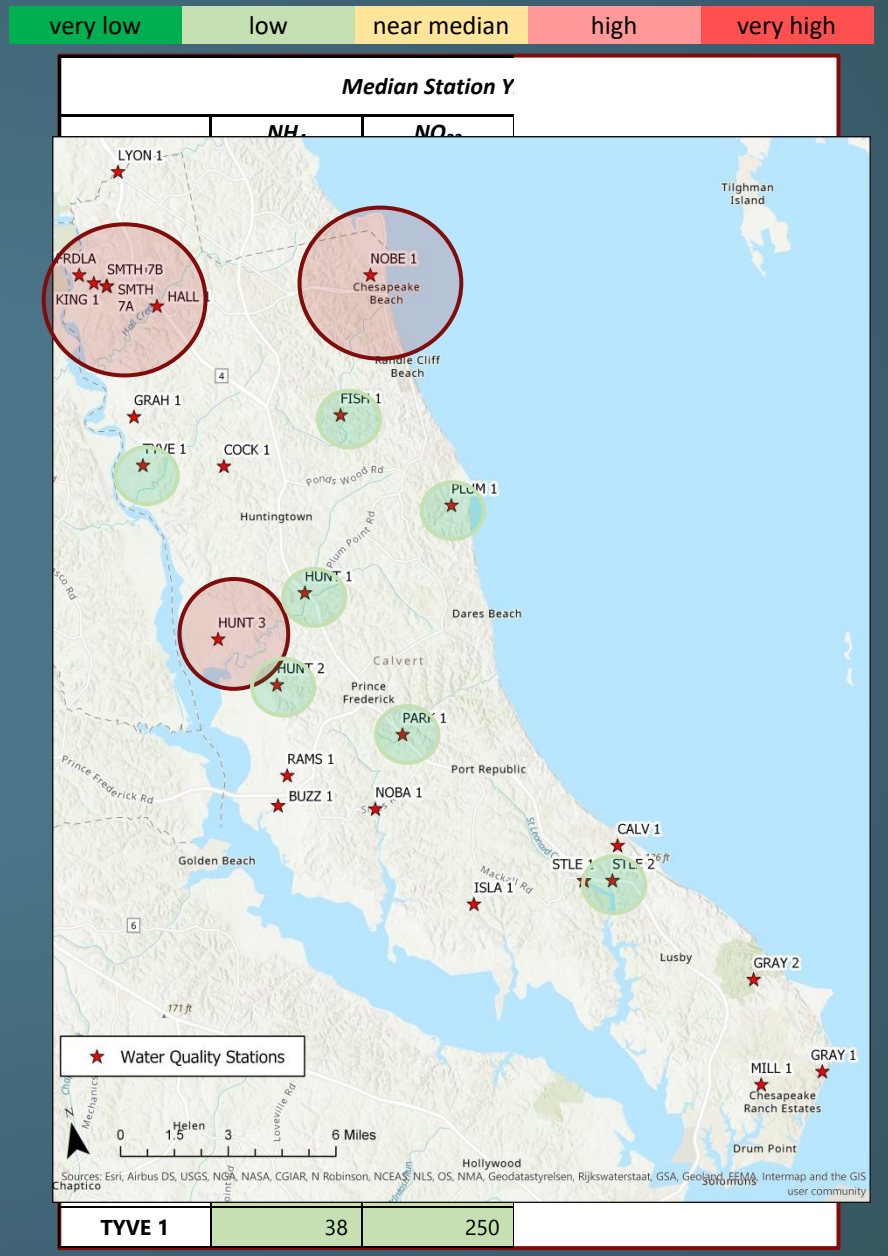
NH4: Very High at NOBE1. All fairly low yields.



Ranking Sites by Pollutant Yield

NH4: Very High at NOBE1. All fairly low yields.

NO23: Very High at NOBE1, HUNT3, KING1, SMTH7. Low at 7 of the 26 stations.



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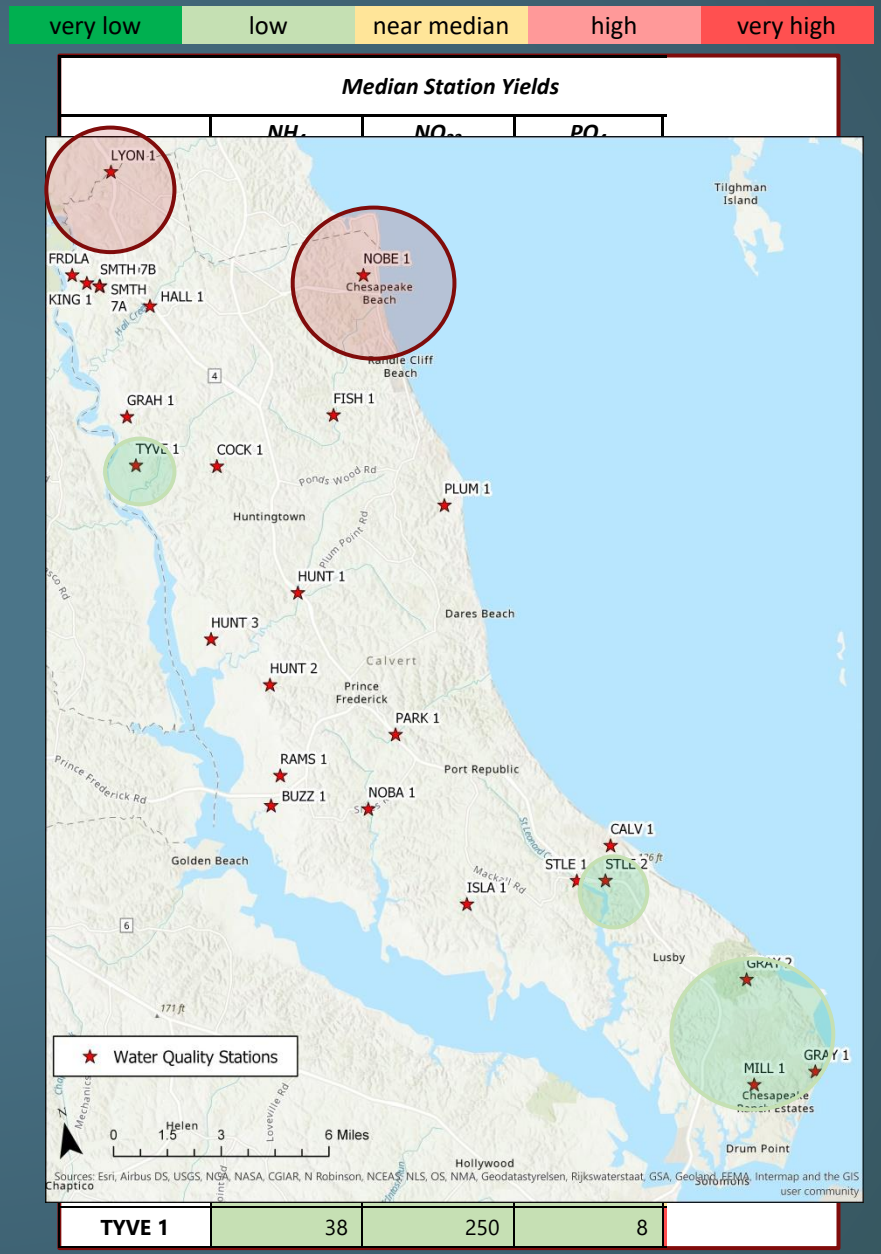
PO4: Very High at HELEN, LYON1, and NOBE1. Low at GRAY1/2, MILL1, SMTH7a, STLE2, TYVE1.



Ranking Sites by Pollutant Yield

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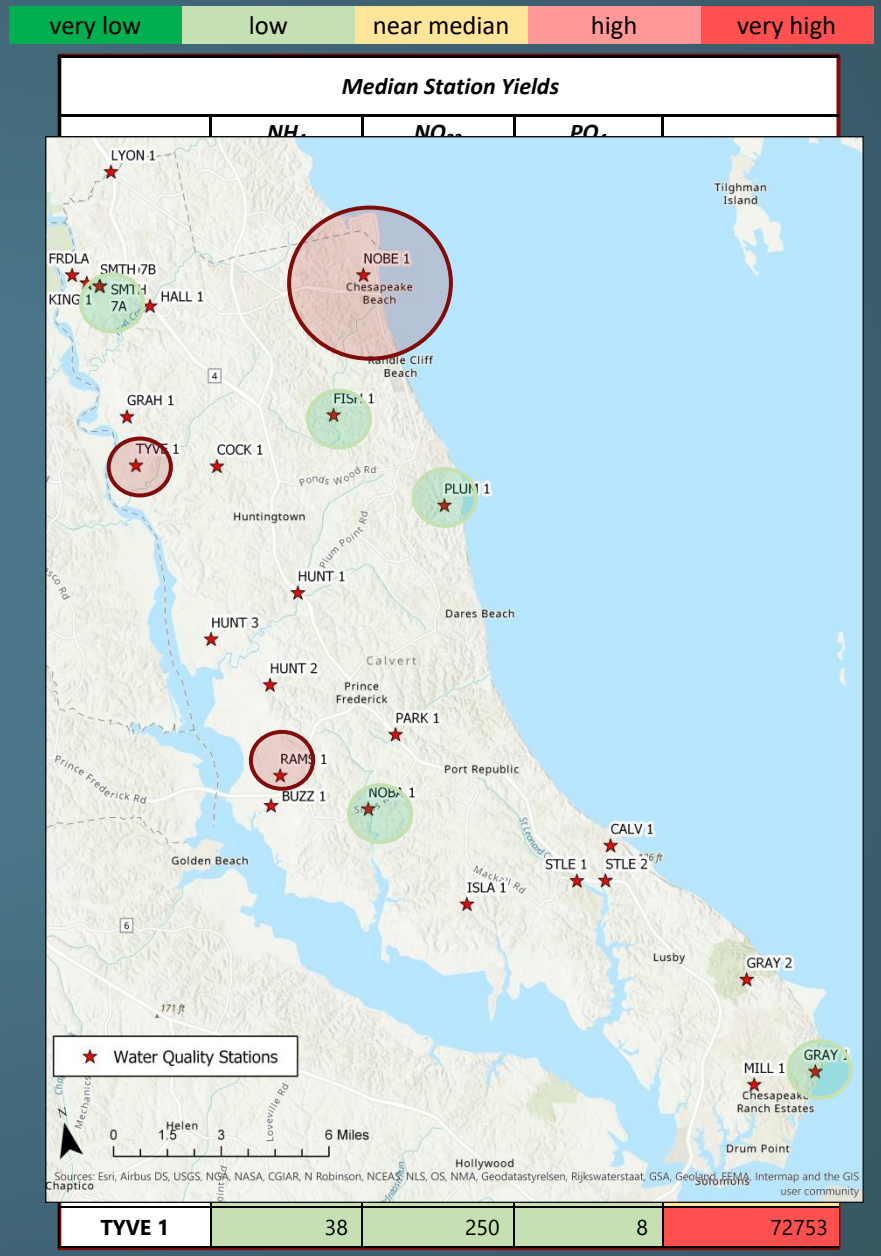
NO23: Very High at NOBE1, HUNT3, KING1, SMTH7. Low at 7 of the 26 stations.

PO4: Very High at HELEN, LYON1, and NOBE1. Low at GRAY1/2, MILL1, SMTH7a, STLE2, TYVE1.

TSS: Very High at HELEN, NOBE1, RAMS1, TYVE1. Low at GRAY1, SMTH7a, Plum1, KING1, FISH1, NOBA1.



Ranking Sites by Pollutant Yield

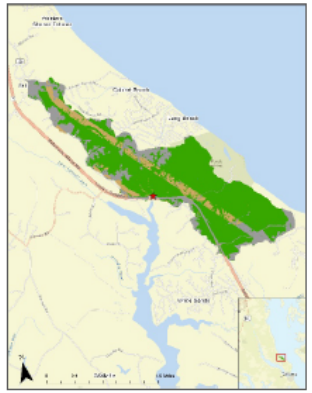
- *There are no all green stations.*
- *Fishing Creek (NOBE) is all dark red for all pollutants*
- *HELEN and GRAH1 are also all red*
- *Several of the stations with high pollutants are in the Hall Creek watershed (SMTH, KING, LYON)*
- *Many other red/yellow mixed stations*
- *Perhaps better stations are: FISH1, GRAY1, PLUM1, STLE2*

very low	low	near median	high	very high

Median Station Yields				
Station	*NH_4 mg N/acre/day*	*NO_{23} mg N/acre/day*	*PO_4 mg P/acre/day*	*TSS mg/acre/day*
CALV 1	221	5399	25	25333
COCK 1	295	2164	72	39021
FISH 1	23	35	24	14746
FRLDA	447	1437	41	38038
GRAH 1	304	3273	91	44255
GRAY 1	65	1537	2	6457
GRAY 2	101	924	5	35801
HALL 1	394	1753	101	51070
HELEN	289	5025	134	124584
HUNT 1	118	347	31	31119
HUNT 2	165	521	35	26050
HUNT 3	210	6400	85	34164
ISLA 1	204	1788	68	46187
KING 1	171	7112	41	12882
LYON 1	245	2156	126	40832
MILL 1	516	2006	7	28677
NOBA 1	68	673	23	19516
NOBE 1	797	8756	188	88555
PARK 1	152	103	26	23445
PLUM 1	23	202	38	14212
RAMS 1	337	1596	45	71128
SMTH 7A	16	8379	11	7332
SMTH 7B	90	27005	65	24305
STLE 1	154	1347	34	25731
STLE 2	37	63	12	27675
TYVE 1	38	250	8	72753

Station STLE 2: St. Leonard Creek 2

STLE 2 is close to the median for TSS, lower for nitrogen and PO_4, and higher for discharge, resulting in yields lower for nitrogen and PO_4 compared to the median for all stations. More than half of the station basin is natural land use (70.0%).

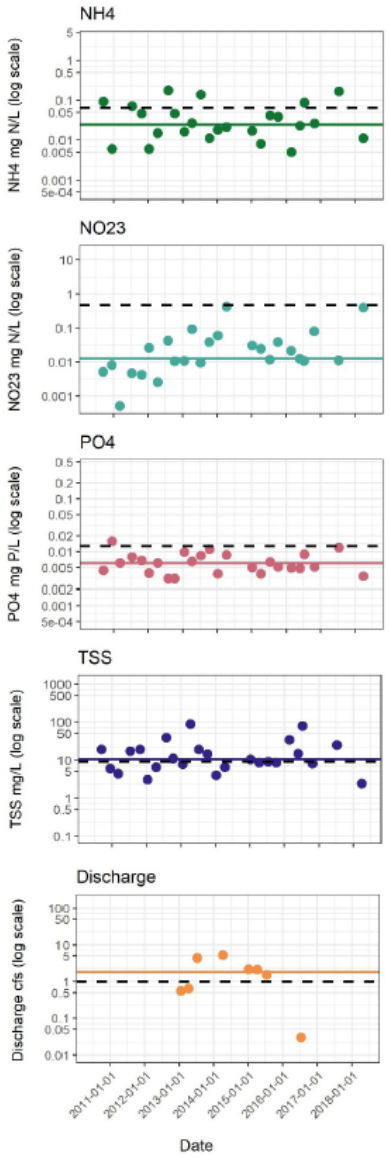


Watershed Land Use

- Station
- Watershed
- Agriculture (Ag)
- Developed (Dev)
- Natural (Nat)

Station Nutrients & Discharge

- Median for All Stations
- Median for Station



Size, Land Use (%), & Septic (#) Comparison

	Acres	Ag	Dev	Nat	Septic
Station Basin	1784	11.3	18.7	70.0	191
L-R Basin	18,512	15.1	18.6	66.3	-

L-R (Land-River) Segment N24009XL0_4954_0000

CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
Nitrogen	3345	3364	3262	2044	12,016
Phosphorus	154	234	1297	NA	1684

Downscaled from CAST modeled loads for L-R Segment

Station Concentrations & Discharge Summary

	Median	Min	Max
TSS, mg/L	10.3	2.4	88.0
NH_4, mg N/L	0.0245	0.005	0.175
NO_{23}, mg N/L	0.012	0.0005	0.421
PO_4, mg P/L	0.0061	0.0031	0.0158
Discharge, cfs	1.83	0.03	5.24

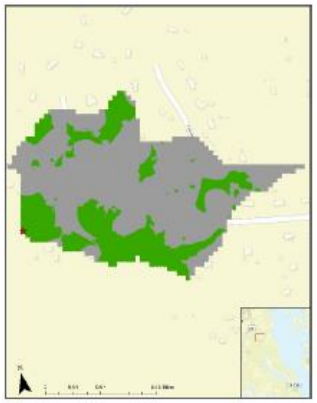
Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
TSS, mg/acre/day	27,675	3,208	114,359	28,677
NH_4, mg N/acre/day	37	4	825	165
NO_{23}, mg N/acre/day	63	0.4	3025	1,596
PO_4, mg P/acre/day	12	0.4	62	35

Calculated using instantaneous flow. Further scale up not recommended.

Station SMTH 7A: Smithville

SMTH 7A is close to the median for TSS and PO_4, higher for NO_{23}, and lower for NH_4 and discharge, while yields are lower for TSS, NH_4, and PO_4 compared to the median for all stations. Most of the station basin is developed land use (68.7%).

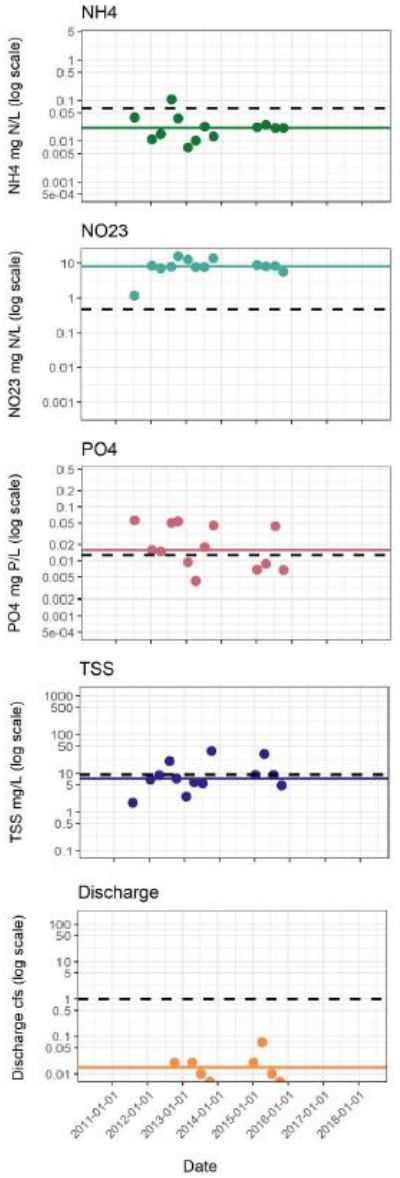


Watershed Land Use

- Station
- Watershed
- Agriculture (Ag)
- Developed (Dev)
- Natural (Nat)

Station Nutrients & Discharge

- Median for All Stations
- Median for Station



Size, Land Use (%), & Septic (#) Comparison

	Acres	Ag	Dev	Nat	Septic
Station Basin	34	0	68.7	31.2	20
L-R Basin	5583	12.6	30.3	57.1	-

L-R (Land-River) Segment N24009XL3_4713_0000

CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
Nitrogen	0	192	30	214	436
Phosphorus	0	26	8	NA	34

Downscaled from CAST modeled loads for L-R Segment

Station Concentrations & Discharge Summary

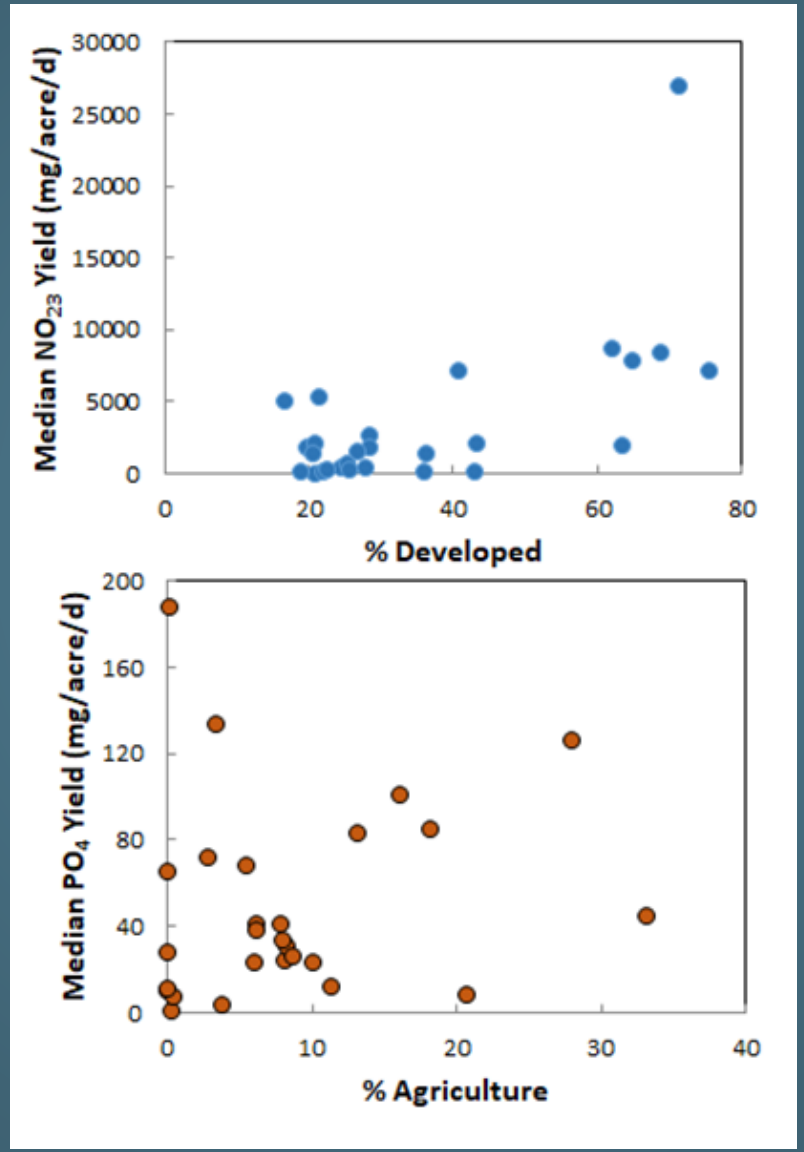
	Median	Min	MaxN
TSS, mg/L	7.2	1.7	37.0
NH_4, mg N/L	0.021	0.007	0.107
NO_{23}, mg N/L	8.020	1.150	15.810
PO_4, mg P/L	0.0156	0.0042	0.0559
Discharge, cfs	0.02	0	0.07

Watershed Nutrient & Sediment Yields Summary

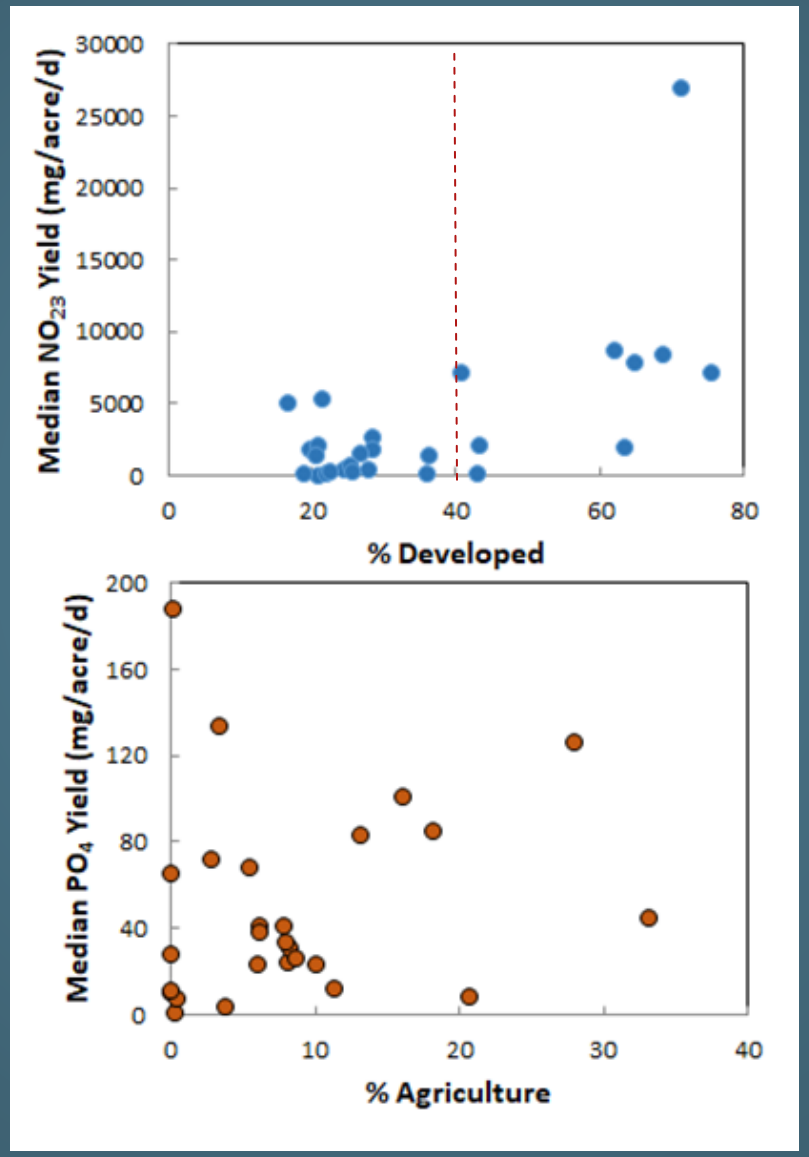
	Median	Min	Max	Median for All
TSS, mg/acre/day	7332	0	154,472	28,677
NH_4, mg N/acre/day	16	0	125	165
NO_{23}, mg N/acre/day	8379	0	39,963	1,596
PO_4, mg P/acre/day	11	0	76	35

Calculated using instantaneous flow. Further scale up not recommended.

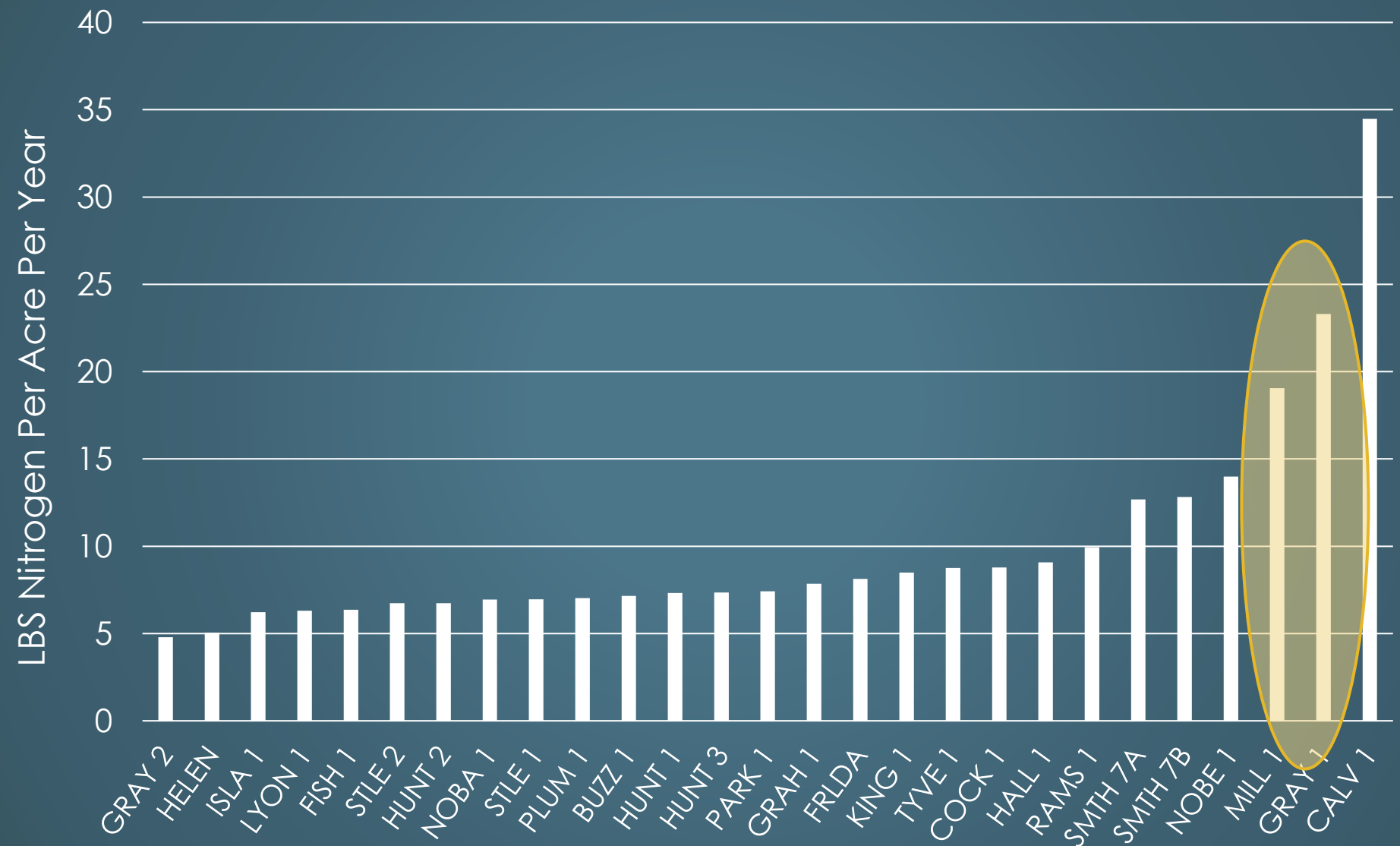
Impact of Land Use

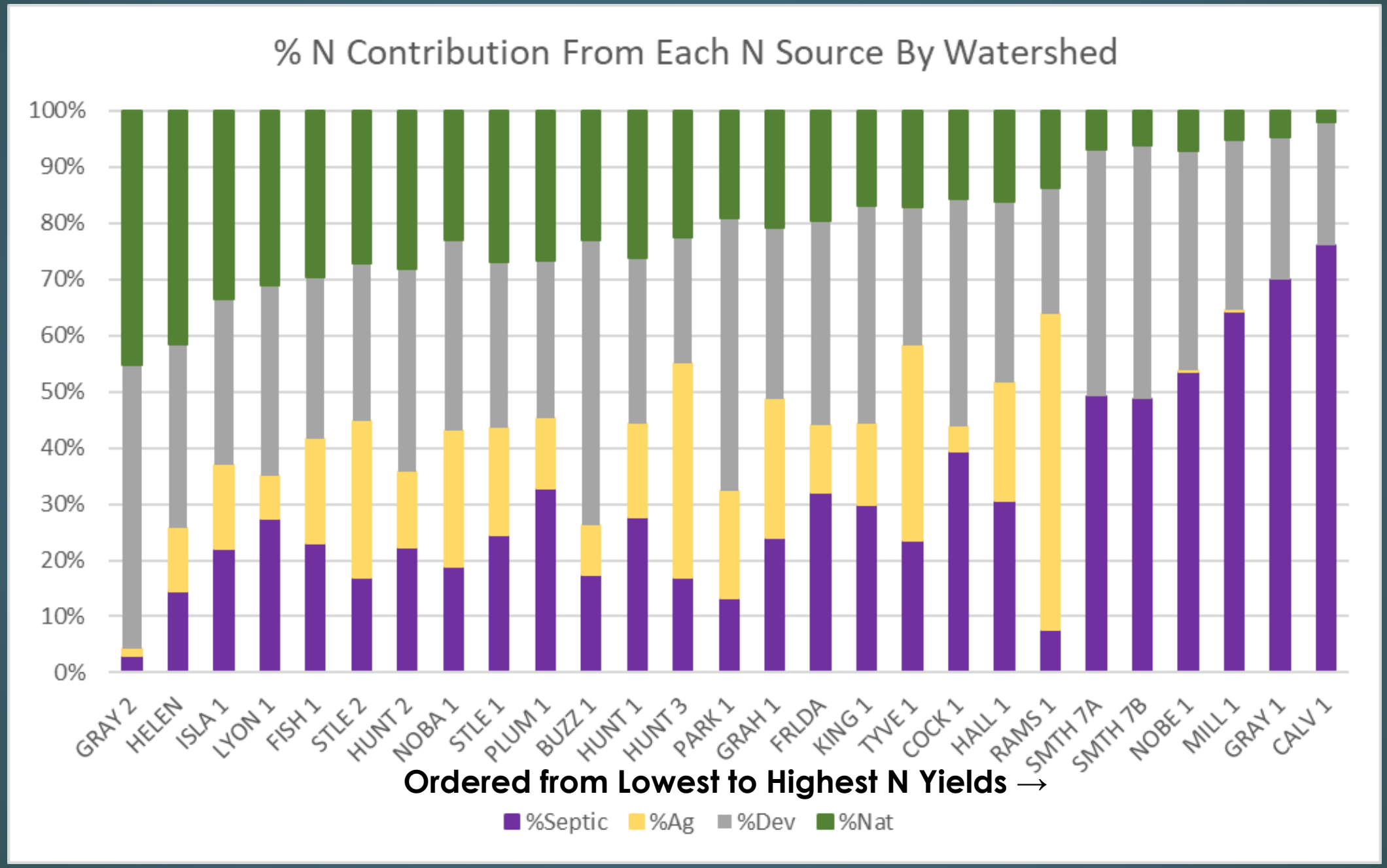


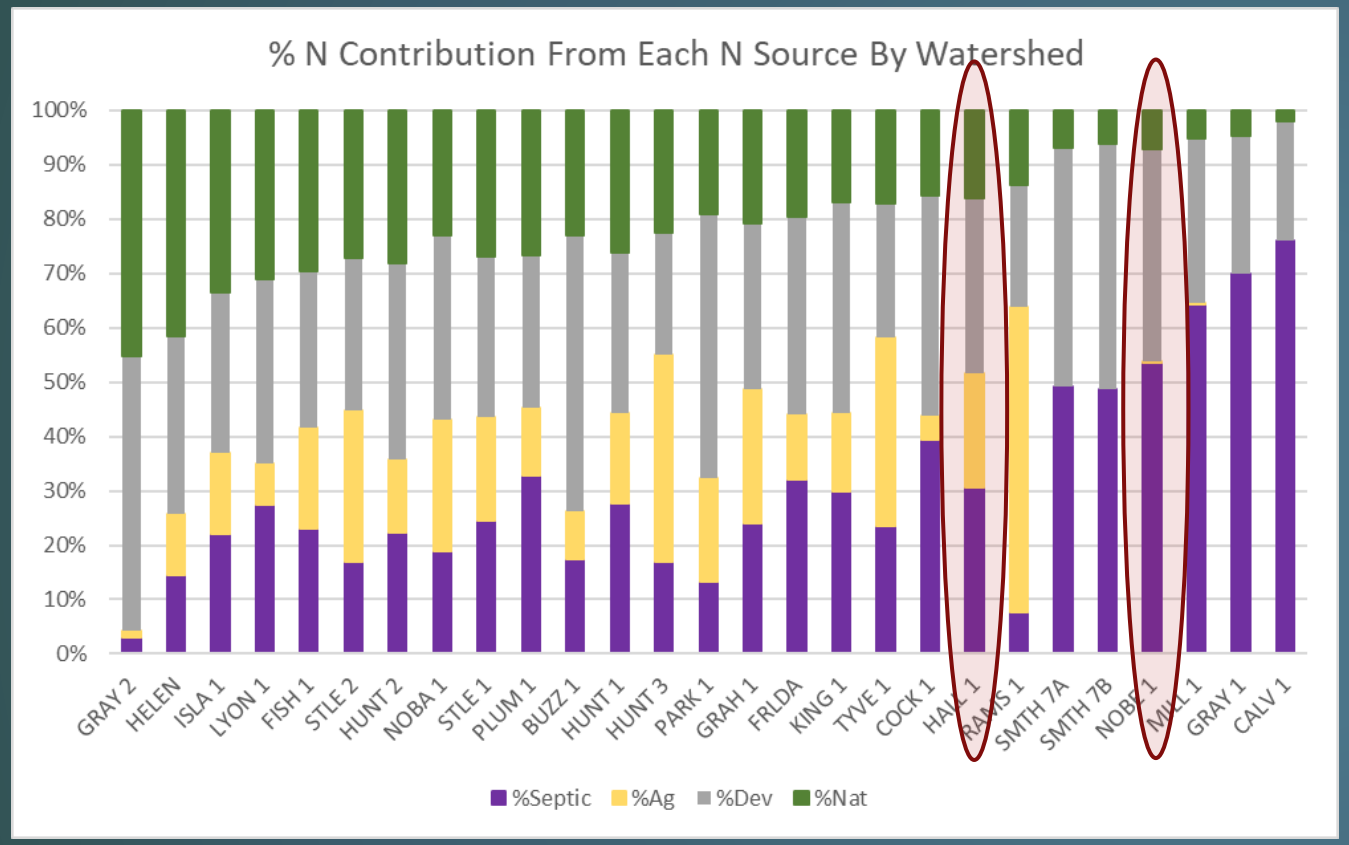
Impact of Land Use



CAST Modeled Nitrogen Yields




% N Contribution From Each N Source By Watershed
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
GRAY 2
HELEN
ISLA 1
LYON 1
FISH 1
STLE 2
HUNT 2
NOBA 1
STLE 1
PLUM 1
BUZZ 1
HUNT 1
HUNT 3
PARK 1
GRAH 1
FRLDA
KING 1
TYVE 1
COCK 1
HALL 1
RAMS 1
SMTH 7A
SMTH 7B
NOBE 1
MILL 1
GRAY 1
CALV 1
Ordered from Lowest to Highest N Yields →
%Septic
%Ag
%Dev
%Nat



- You have some options to look at with these results!
- In North Beach (worst stream pollution) there are options to improve impervious surface and upgrade septics
- In Hall Creek there are options for improvements around agricultural best practices, septics, and impervious surfaces

- Our report has created a set of fact sheets that are useful for informing decisions around pollution reduction in Calvert watersheds
- These measurements provide a baseline for restoration and will empower the county to apply for restoration funds to meet the TMDL
- We recommend reviving the monitoring program to similarly strengthen applications for restoration funds
- We recommend a reduced number of sampling stations and quarterly measurements at baseflow (no storms or rain at time of sampling)
- Some stations stand out as much higher than the others and we recommend looking at restoration efforts in Hall Creek and Fishing Creek watersheds

Questions or Discussion?

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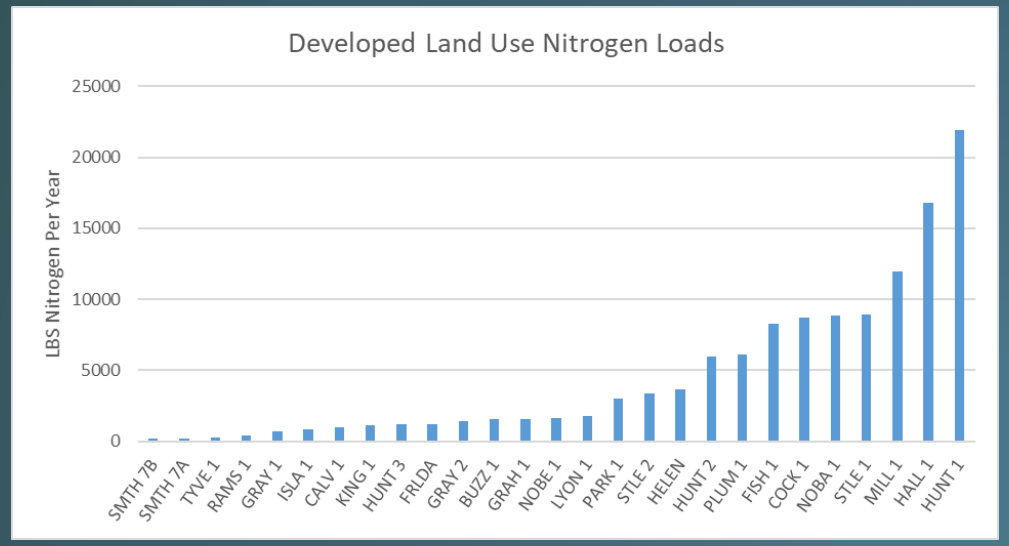
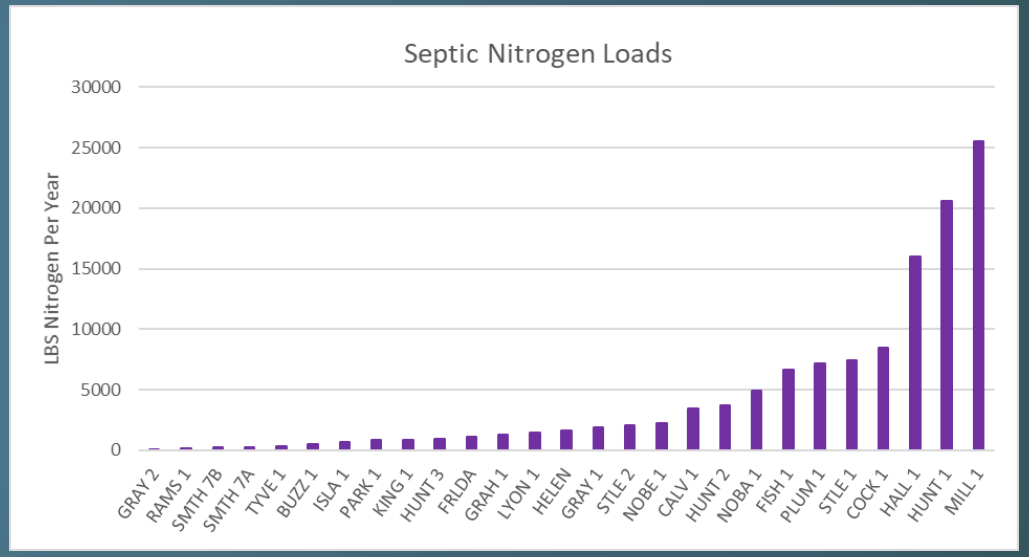
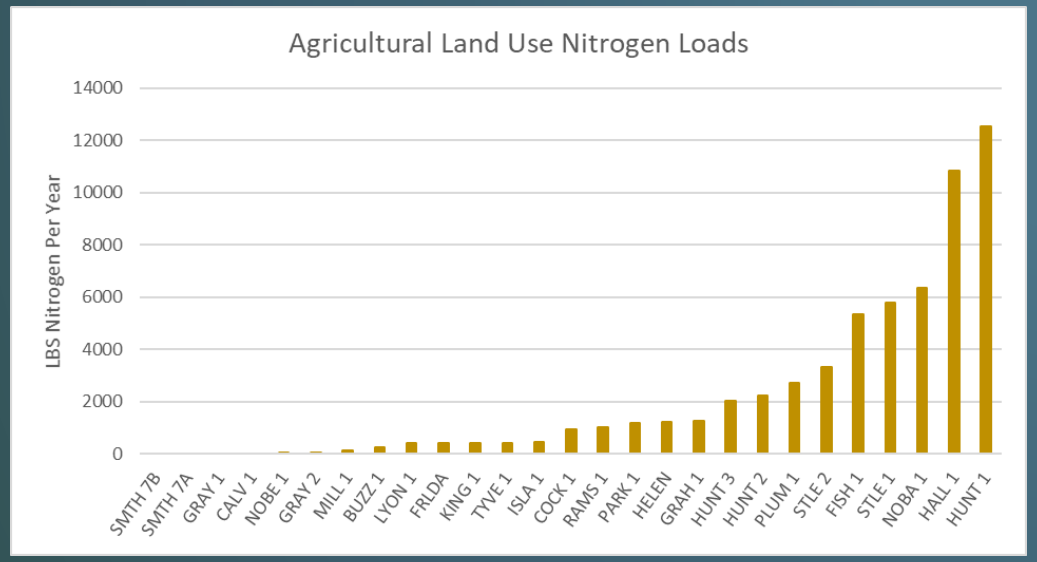
Jeremy Testa: jtesta@umces.edu


Developed Land Use Nitrogen Loads
LBS Nitrogen Per Year
25000
20000
15000
10000
5000
0
SMTH 7B
SMTH 7A
TYVE 1
RAMS 1
GRAY 1
ISLA 1
CALV 1
KING 1
HUNT 3
FRLDA
GRAY 2
BUZZ 1
GRAH 1
NOBE 1
LYON 1
PARK 1
STLE 2
HELEN
HUNT 2
PLUM 1
FISH 1
COCK 1
NOBA 1
STLE 1
MILL 1
HALL 1
HUNT 1


Septic Nitrogen Loads
LBS Nitrogen Per Year
30000
25000
20000
15000
10000
5000
0
GRAY 2
RAMS 1
SMTH 7B
SMTH 7A
TYVE 1
BUZZ 1
ISLA 1
PARK 1
KING 1
HUNT 3
FRLDA
GRAH 1
LYON 1
HELEN
GRAY 1
STLE 2
NOBE 1
CALV 1
HUNT 2
NOBA 1
FISH 1
PLUM 1
STLE 1
COCK 1
HALL 1
HUNT 1
MILL 1


Agricultural Land Use Nitrogen Loads
LBS Nitrogen Per Year
14000
12000
10000
8000
6000
4000
2000
0
SMTH 7B
SMTH 7A
GRAY 1
CALV 1
NOBE 1
GRAY 2
MILL 1
BUZZ 1
LYON 1
FRLDA
KING 1
TYVE 1
ISLA 1
COCK 1
RAMS 1
PARK 1
HELEN
GRAH 1
HUNT 3
HUNT 2
PLUM 1
STLE 2
FISH 1
STLE 1
NOBA 1
HALL 1
HUNT 1