

# Non-Tidal Water Quality Monitoring Data Analysis

Prepared for Calvert County Department of Planning and Zoning

By

Melinda K. Forsyth, Faculty Research Assistant  
Dr. Lora A. Harris, Associate Professor  
Dr. Jeremy M. Testa, Associate Professor  
Jessica Flester, Technician

University of Maryland Center for Environmental Science  
Chesapeake Biological Laboratory  
P.O. Box 38  
Solomons, Maryland 20688-0038

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## Non-tidal Monitoring Program Introduction

A sampling program to monitor nutrients and total suspended solids (TSS) for non-tidal creeks in each of Calvert County's 22 sub-watersheds was developed by the Chesapeake Biological Laboratory (CBL) and Calvert County's Environmental Planners over ten years ago. The program was executed between the years of 2010 and 2018, and was established to collect baseline data to document progress towards the goals set by Water Implementation Plans (WIPs) to meet the Chesapeake Bay Total Maximum Daily Load (TMDL).

The stream sampling was performed by county staff and volunteers, who collected base flow stream conditions, including dissolved nutrients (phosphate ( $\text{PO}_4$ ), nitrate+nitrite ( $\text{NO}_{23}$ ), ammonium ( $\text{NH}_4$ )), total suspended solids (TSS), and discharge (measured after 2012). Sampling was performed quarterly and all nutrient and TSS samples were delivered to the CBL Nutrient and Analytical Services Laboratory (NASL) for analysis.

Establishing a baseline of stream health is aided by a dataset of several years due to the impact of meteorological variability. Fortunately, the available 2010-2018 dataset was extensive enough to cover a range of precipitation conditions. Thus, the curation of the previously-collected monitoring data and the assessment of spatial and temporal patterns in this baseline data set can serve to guide future monitoring decisions and support analysis of temporal changes. Without continued monitoring in the future, we will not be able to detect changes in watershed nutrient and sediment concentration and loads to tidal waters.

In this report, we synthesize the non-tidal stream monitoring data previously collected by Calvert County and analyze these data for spatial and temporal trends and patterns related to watershed features. We specifically related stream concentrations and nutrient yields to independently-estimated watershed inputs from the various land uses. This information is collated and communicated in a collection of summary sheets that describe the data for each sub watershed that was monitored and compares each sub watershed to the other areas of the county. We then attempt to connect watershed nutrient yield patterns with water quality metrics that were independently monitored in associated tidal creeks by CBL (supported by the Calvert County Board of County Commissioners). We conclude the report with a list of recommendations for future stream monitoring activities.

## Methods

The first step in our approach was to collate a complete dataset that includes all past county stream monitoring data. This was necessary because the data were previously stored across multiple files without a consistent format and structure. We provide detail in Appendix I outlining the critical decisions made to construct this dataset, including identification of errors, collation of stations, and standardization. Once we curated this comprehensive data set, we then analyzed stream nutrient and TSS concentrations and discharge for each station, as well as yields (nutrient load per unit watershed area) where applicable. Land uses and estimated nutrient inputs from the watershed were calculated, and stations were compared to each other based on medians of concentration of nutrients and TSS, discharge, and yields. Summary sheets specific to each monitoring station were created to summarize these data and illustrate how each station compares to county-wide patterns. The final step involved assessment of these non-tidal stations with the downstream tidal station monitored by CBL.

## Data Curation

We first assessed the available data sets collected over past years by evaluating the content and extent of various data files and understanding the number and location of stations and measured parameters. We were able to compile a single dataset by reformatting and cleaning a previously collated file. We only included sampling sites that were analyzed in previous reports and were characterized by multiple years of data. Other stations were considered supplemental sites and stored in a separate file. The sites omitted from our analyses include ARBGRN 1, CALV 3, CAVCO 1, CAVCO 2, GOV 1, GREY 3, KEN 1, LAKE 1, MILL 2, MILL 3, RAND 1, SMTH 8A, and SMTH 8B. Data independently collected in Parkers Creek by the American Chestnut Land Trust (ACLT) and CBL were also included in the curated data set. We primarily focused on the nutrient, TSS, and discharge data in our analyses, although measurements of physical characteristics like temperature and conductivity are included in the collated dataset.

We were then able to do some quality assurance by investigating values that were questionable. These data were questionable due to their marked departure from average values. Initial graphing of the nutrient concentrations for each station data highlighted multiple high levels of nutrients, leading to an investigation of why these levels were elevated. We were able to cross reference our built dataset with data from NASL in separate spreadsheets to find seven typos, which were fixed. Other high concentrations could be explained as a consequence of high flow levels during those days. Additionally, field notes suggested murky conditions on the days with these higher levels. These measured high levels were kept in the dataset. Detail around these decisions are included in the memorandum as Appendix I.

## Analyses of Existing Data

### Concentrations and Yields

The 27 stations analyzed are shown in Figure 1. For each station, concentrations of  $\text{NO}_{23}$ ,  $\text{NH}_4$ ,  $\text{PO}_4$ , and TSS, and discharge were graphed, and the median, minimum, and maximum of each was calculated. For comparison, the median for all the stations combined was calculated.

When both discharge and concentration are measured, a load can be calculated (example: mg N/sec). The station watershed acreage is used to give a yield (mg N/acre/day). It is advisable to NOT upscale these instantaneous loading rates to any time scale greater than a day, as this instantaneous yield varies day by day with changes in discharge.

For easier comparison of all stations at once, concentrations and yields were plotted as boxplots to express the medians and distribution for dissolved nutrients and TSS. In addition to limited data, exploratory analysis did not provide any encouragement for additional statistical analyses. Boxplots were colored according to drainage systems used in previous reports, shown in Figure 2.

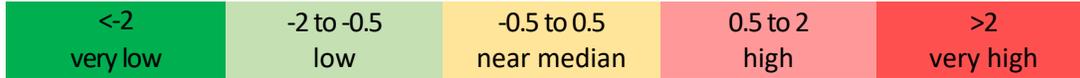
We also report the medians for the stations in a table, color coding based on modified z-scores, where M is the median:

$$z = \text{zscore}_{\text{station}} = 0.6745 * (M_{\text{station}} - M_{\text{allstations}}) / M_{\text{absolute deviation}}$$

And where  $M_{\text{absolute deviation}}$  is the median of all the absolute differences between the 27 station medians and median for all stations:

$$M_{\text{absolute deviation}} = \text{median} (|M_{\text{station}} - M_{\text{allstations}}|),$$

To aid interpretation, we provide color coding to compare each station's concentration and yields in the context of others based on modified z-scores using the following categorization.



### Land Use and Septic Systems

The land use data were sourced from the 2013 US Geological Survey (USGS) Phase 6 land use dataset (<https://chesapeake.usgs.gov/phase6/map/>). This dataset provided 10-m resolution land use data which were used for all watershed land use calculations. Land uses were classified by USGS into three main categories: developed, natural, and agriculture. The land use data were clipped by the watershed boundaries using the Clip tool in ArcGIS. The watershed land use maps were created using 1-m resolution land use data also provided by the 2013 USGS Phase 6 land use dataset. The 1-m resolution data were used for the land use maps rather than the 10-m resolution data because the 1-m resolution data were in a format that was easier to visually manipulate, e.g., change the color of different land use classifications, etc.; the 1-m resolution data were in vector format and the 10-m resolution data were in raster format.

We then compared the watershed-level land use data to that of the larger Land-River (L-R) segment, the smallest watershed segment size used by the Chesapeake Bay Program. This scale of drainage basin differs from the 6-digit Hydrologic Unit Code (HUC) scale used by Calvert County to inform the county-scale Watershed Implementation Plan and the original stream sampling scheme. The non-tidal sampling station watersheds are encompassed within the L-R segments, so they are smaller in area and have different land use composition, thus we would not expect values from the two data sources to be exactly the same, but they are generally comparable. In a few instances, a larger L-R segment crosses county lines, and in these cases we chose to break apart one larger drainage basin into multiple based on jurisdiction by county. In these cases, we report the Calvert County L-R portion acreage and land use. L-R basin acreage and land use files were downloaded from the Chesapeake Bay Program's model, the Chesapeake Assessment Scenario Tool (CAST). Comparing these two scales gives us an indication of how the non-tidal watershed compares to a larger basin in terms of watershed size, land use, and watershed yield.

The number of septic systems in each station basin came from data provided by Calvert County, and were clipped by watershed boundary in ArcGIS to determine the number of septic systems within each station watershed.

### Watershed Loads

CAST (<https://cast.chesapeakebay.net/>) is a Chesapeake Bay Program (CBP) tool used to estimate nutrient and sediment loads for the purpose of environmental planning. CAST uses various computer models including the Airshed Model to predict nitrogen deposition, the Land Use Change Model to account for development growth effects, the Phase 6 Watershed Model to predict watershed loads, and the Estuary Model to predict water quality changes. In conjunction, these models replicate past conditions but also predict current conditions, and various scenarios can be built and explored by applying Best Management Practices (BMPs) to particular areas.

CAST reports nutrient loads, or inputs of nutrients from the watershed, on a number of different scales. We pulled the base scenario for 2017 for the associated L-R segment for each station, the smallest scale available. We took the total nutrient loads for the L-R segment, calculated loading rates per acre of land use, and downscaled to estimate the watershed inputs for each station basin by land use. For stations that cross county borders (Hall 1 and Lyons 1) and thus two different L-R segments, we calculated loads for inside and outside Calvert County

For the septic contribution for the station watersheds, we used a similar guiding equation as CAST, accounting for average people per septic, average nitrogen contribution per person, and attenuation. According to the Chesapeake Bay Program Phase 6 Watershed Model (<https://cast.chesapeakebay.net/FileBrowser/GetFile?fileName=8%20Direct%20Loads.pdf>), attenuation is assumed to be 60%, and thus:

$$\text{septic contribution (lbs N/year)} = (\text{\# people/septic}) * (8.92 \text{ lbs N/person/year}) * 0.4 \text{ (EPA 2020)}.$$

Per CAST calibration inputs ([https://cast.chesapeakebay.net/documentation/CalibrationInputs\\_Septic](https://cast.chesapeakebay.net/documentation/CalibrationInputs_Septic)), approximately three people are on a single septic system in Calvert County.

Wastewater from treatment plants or sewerage was assumed to be null for the stations.

## Summary Sheet Components

For each station, we created a summary sheet that is included in this report with the following key items:

### **Map**

The map displays the station location, the station watershed boundary, and land uses within the watershed. If the watershed goes outside of Calvert County, only the Calvert County portion is mapped. It should be noted that Calvert Beach Run is listed as CALV 1, but we recommend simply calling it CALV in the future. Despite the existence of multiple sites in Calvert Beach Run in the datasets we were provided by the county (CALV1, CALV2), we determined that CALV1 and CALV2 were the same location in the stream, so we now refer to a single site, CALV,

### **Size, Land Use, & Septic Comparison**

The table shows watershed acreage and percent land use of agriculture, natural, and developed categories for both the station basin and larger L-R segment, as well as the number of septic systems for the station watershed.

### **CAST Watershed Loads by Land Use**

Scaling to the station watershed from CAST output, we present the nitrogen and phosphorus loads, or inputs of nutrients from the watershed by land use. For Hall 1 and Lyons 1, we report the Calvert County load and the load from outside the county

Phosphorus from septic systems is considered null. The nitrogen contribution from septic systems was calculated from the number of systems in each station watershed. Wastewater outflows from treatment plants/sewerage are not accounted for in these calculations as none occur within the station drainage basins.

### **Station and Nutrients & Discharge Graphs**

The measured nitrogen, phosphorus, TSS concentrations, and discharge measured at each station are graphed on a log scale, which allows for easier viewing. The median for the station is a solid colored line, and the dashed black line displays the median for all the stations together, allowing for comparison of an individual station to all the stations.

### **Station Concentrations & Discharge Summary**

The median, minimum, and maximum for the nutrient or TSS concentration and stream discharge for each station are displayed.

### **Watershed Nutrient & Sediment Yields Summary**

The table indicates the median, minimum, and maximum for station yields calculated from discharge, concentration, and watershed acreage. The right column indicates the median for all of the stations. For this, we used the entire watershed size for those that were outside of the county.

#### Comparison with Tidal Stations

Calvert County is a peninsula of land that lies between the tidal Patuxent River Estuary and the western shore of the Chesapeake Bay. Each of its streams eventually finds an outlet to tidal water, often through sub-estuarine tidal “creeks”. Fortunately, CBL is supported by the Calvert County BOCC to sample water quality in a number of these tidal creek systems. In order to assess for relationships between upstream non-tidal stations and downstream tidal stations, the non-tidal stations flowing into the tidal stations were identified. We chose the furthest upstream tidal station for comparison, assuming these might have the closest association with non-tidal stream conditions. For instance, Battle Creek has three sampling locations in the tidal monitoring program, with BAT 3 being the furthest upstream. We then compared BAT 3 with the North Battle Creek (NOBA) station. The tidal and non-tidal stations compared to each other are mapped in Figure 3 and listed in Table 1.

We compared the time series median for the non-tidal station concentrations against the time series median of the same time period for the tidal station concentrations. For most stations, this time frame was 2010-2018.

We engaged in a number of exploratory analyses to determine if the non-tidal measurements could be linked to tidal conditions. This included examining yearly non-tidal station concentrations vs. their associated tidal stations, using the yearly mean for the non-tidal station vs. the summer mean (when sampling was done) for the tidal station. We also compared tidal summer concentrations to non-tidal water year concentrations. For instance, a tidal summer mean of DO for 2013 was compared to the water year non-tidal mean of phosphate for 2013 (October 2012 through September 2013). We also evaluated the impact of wet and dry years.

Yields can give a better indication of the effects of the non-tidal station. Discharge was only measured from 2013-2017 for most of the stations, allowing for load calculations. These loads were then divided by the station watershed acreage to give yields in mg/acre/day. The tidal station medians were calculated for only the years the upstream non-tidal station had yield data, and these time-series medians were compared to each other.

## **Results**

The detailed results of our data analysis for each station, including plots of nutrient concentration vs. date (i.e., concentrations changes over time), histograms of nutrient concentrations, and nutrient and TSS loading rates (mg/s) by date can be found in Appendix I. The newly combined and cleaned dataset is attached as Appendix II and includes the consistently measured water properties at the stations with extensive data. The station-specific summary sheets that illustrate watershed characteristics and stream water properties for the 27 stations we analyzed are located at the end of the report, beginning on page 22. While we will not describe the content of these summary sheets in detail here, note that one can use these sheets to (1) understand the location and watershed features of each water sampling station, (2) obtain several estimates of watershed nutrient load and yield, and (3) quickly compare the concentration of nutrients and TSS from that station to the typical values for all of the monitoring streams in the county.

#### Station Comparison: Concentrations

We focus our discussion of the watershed nutrient and TSS concentrations on describing those stations that had particularly high or low concentrations. We report the median values of nutrient and TSS concentrations at each station along with the color coding from the z-scores analysis in Table 2. This table suggests that five stations have particularly high  $\text{NO}_{23}$  concentrations, including CALV 1, GRAY 1, HUNT 3, KING 1, and SMITH 7A and 7B, while two stations have particularly high  $\text{PO}_4$  concentrations (HALL 1, LYON 1). Five of these eight stations are in the far northwest section of the county, suggesting that this should be an area of sustained sampling in the future. In particular, HUNT 3 had extremely high values for all concentrations ( $\text{NH}_4$ ,  $\text{NO}_{23}$ ,  $\text{PO}_4$ , and TSS) and might be a site to target for future monitoring. Finally, NOBE 1 and TYVE 1 had high TSS concentrations but not elevated nutrient concentrations, which merits further investigation in the future. It is also clear from this table that streams sampled in this program were more susceptible to extreme measured values for nitrogen and TSS than phosphorus. Figure 4 displays the box and whisker plot created for each station for each parameter (TSS,  $\text{NO}_{23}$ ,  $\text{NH}_4$ ,  $\text{PO}_4$ ), and these station-specific features of nutrient concentration are further illustrated in this figure.

As in previous reports, we also broke down the creeks into zones based on drainage to either the west Chesapeake Bay, the middle Patuxent River, or the lower Patuxent River (Fig. 2), with the lower Patuxent divided into two regions. While we did not find any differences in water properties between these four regions of the county, we do note the cluster of high nutrient stations in the northwest corner of the segment that discharges into the middle Patuxent River.

#### Station Comparison: Yields

We also plotted (Figure 5) and tabulated (Table 3) nutrient and TSS yields (where data availability allowed for their estimation) using box and whisker plots and z-score tables. The yield per day is calculated from an instantaneous rate per second, but we would not recommend extrapolating these estimates to longer timescales because the discharge rates used to compute yield vary substantially over even short periods of time. Thus, the yields are a snapshot. The yields, which are computed from drainage acreage and discharge, estimate the amount of nutrient or TSS generated from a standard fixed land area, allowing for these numbers to be compared across stations without bias due to watershed or stream size. For instance, a station may have a high concentration, but lower flow and/or a larger drainage basin for that station, can mean that the yields (per acre/day) can be lower and less of a concern. We found that two of the stations (HELEN and NOBE 1) had extremely high (red cells in Table 3) levels of all three nutrients and TSS, while two of the stations (GRAH 1 and LYON 1) had high levels for three of the four properties. Only two of these four stations also had extremely high nutrient or TSS concentrations, suggesting that HELEN and GRAH 1 have watersheds that generate a higher-than average amount of pollution.

## Relationship of Land Use and Stream Conditions

We also examined the relationship between  $\text{NO}_{23}$  and  $\text{PO}_4$  concentrations and yields with the percent agriculture and developed land in the watersheds across all locations in the database (Figure 6). Agricultural lands can contribute to these pollutants through fertilizer application and/or erosion, while developed lands include concentrated inputs of lawn-fertilizer and human waste, and can increase stormwater runoff, sending atmospherically derived nitrogen to streams more rapidly. In watersheds with developed land coverage above 60%, the monitoring data reveal higher concentrations and yields for nitrogen. This is in line with a phenomenon termed the “urban stream syndrome”, where flashier hydrology and higher nitrate concentrations have emerged in a pattern of global measurements when development is greater than 60% (Walsh et al. 2005). In contrast, watersheds with more concentrated agricultural lands have higher  $\text{PO}_4$  concentrations and yields, although the relationships is relatively weak.

## Tidal vs. Non-tidal Comparison

If a tidal creek is responsive to local watershed conditions, we would expect that there might be a relationship between measured or modeled nutrient loads from the drainage basin and the conditions of the tidal creek. A challenge in building these types of relationships with the available dataset is that non-tidal stream stations are sometimes located some distance from the tidal creek, or there is a mismatch in the timing of sampling the two water bodies. Nevertheless, we evaluated whether any relationships could be found where increases in upstream nutrients and TSS were reflected downstream with degraded water quality (chlorophyll, dissolved oxygen, or DO). Figures 7 and 8 show correlations between the yield medians for the time series of the non-tidal station’s nutrient or TSS, against the DO and chlorophyll concentration for the nearest associated tidal station. Comparison of the non-tidal concentrations instead of yields show a similar lack of patterns.

We did not find clear correlations between the time series medians for the tidal and non-tidal sites, nor when comparing the years individually. In a few cases, we found the opposite of what we would expect, with an increase in TSS yield leading to increased DO. The absence of clear relationships occurs for a number of reasons. First, we have limited measurements of stream chemistry and properties (~4 samples per year), so we may not be adequately capturing the true condition of that watershed given how rapidly stream inputs can change. This is also true for the tidal monitoring, which is only characterized by three summer samples that may not represent the entire year. Secondly, there can be multiple, often opposing effects of stream inputs on tidal waters. For example, high stream flow can elevate nutrient inputs and stimulate algal growth and DO in tidal waters, but high streamflow can also flush algae downstream and thus reduce DO (and chlorophyll). Improved comparisons of tidal and stream data could be done in the future with more coordinated, complete datasets, perhaps with the aid of modeling to quantitatively examine the wide-variety of factors that influence tidal water quality.

## Conclusions and Recommendations

In general, the non-tidal stations water quality has varied from year to year over the record of monitoring. For most of the stations, the conditions vary depending on which nutrient or TSS is being examined, with few stations being similar across all parameters. With a limited time-series, we have only had baseline conditions to examine, but the addition of 2-3 more years of sampling will allow for more detailed trends analysis.

Currently, no ties are found between tidal and non-tidal stations, but more exploration with modeling or a different sampling approach may capture the relationship better. We recommend that future watershed or

stream sampling be closely coordinated with tidal water sampling to make sure we are monitoring each of these at the timescale that allows the stream effects to be realized in the estuary. This linkage between tidal and non-tidal sampling would be enhanced with more frequent sampling.

In terms of future work, we recommend to continue sampling on a minimum of a quarterly basis and removing the infrequently-sampled stations not included in this larger analysis, leaving 27 main stations. We have developed a Quality Assurance Project Plan for the continued sampling, currently based on the 27 stations. We also suggest standardizing sampling to baseflow conditions on a quarterly basis. One of the challenges of the dataset was changing station names and adjusted sampling locations. If the program is initiated again, we strongly encourage an approach that documents GPS locations of stream sampling using RTK GPS methods, and to establish a marker and written description with photographs for all sampling sites.

We are suggesting that a collaborative effort between CBL and Calvert County prioritize future sampling stations based on goals for future analysis and what stations are the most useful. For instance, are there areas of the county that will be hotspots for implementation of WIPs? Do we want to build upon the tidal and non-tidal comparison? The baseline analysis presented here suggests that an area in the northwest corner of the county is a hotspot for high nutrient concentrations, while a subset of four stations have exceptionally high watershed yields of all pollutants. These stations should be further analyzed to understand why they have poor conditions.

## References

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## Tables

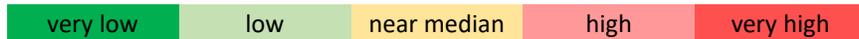
SYSTEM	TIDAL STATION	NON-TIDAL STATION
<b>FLAG HARBOR</b>	FLG 2	CALV
<b>FISHING CREEK</b>	FSH 3	FISH 1
<b>HALL CREEK</b>	HAL 3	HALL 1
<b>HUNTING CREEK A</b>	HUN 3	HUNT 1
<b>HUNTING CREEK B</b>	HUN 3	HUNT 2
<b>HUNTING CREEK C</b>	HUN 3	HUNT 3
<b>ISLAND CREEK</b>	IC 3	ISLA 1
<b>MILL CREEK</b>	7 Ranch Club	MILL 1
<b>BATTLE CREEK</b>	BAT 3	NOBA 1
<b>PARKERS CREEK</b>	BS	PARK 1
<b>PLUM POINT CREEK</b>	PLM 3	PLUM 1
<b>ST. LEONARD CREEK A</b>	SLC 4	STLE 1
<b>ST. LEONARD CREEK B</b>	SLC 4	STLE 2

**Table 1.** Tidal and non-tidal stations paired for each system.



<i>Median Station Concentrations</i>				
<i>Station</i>	<i>NH<sub>4</sub></i> <i>mg N/L</i>	<i>NO<sub>23</sub></i> <i>mg N/L</i>	<i>PO<sub>4</sub></i> <i>mg P/L</i>	<i>TSS</i> <i>mg/L</i>
<b>CALV 1</b>	0.06	1.62	0.01	8.00
<b>COCK 1</b>	0.09	0.49	0.02	10.00
<b>FISH 1</b>	0.02	0.01	0.01	7.20
<b>FRLDA</b>	0.14	0.39	0.02	10.40
<b>GRAH 1</b>	0.08	0.72	0.03	10.00
<b>GRAY 1</b>	0.08	1.59	0.00	7.30
<b>GRAY 2</b>	0.03	0.18	0.00	5.40
<b>HALL 1</b>	0.11	0.46	0.03	10.00
<b>HELEN</b>	0.05	0.88	0.02	12.15
<b>HUNT 1</b>	0.04	0.14	0.01	7.20
<b>HUNT 2</b>	0.07	0.21	0.02	9.40
<b>HUNT 3</b>	0.08	2.20	0.02	12.50
<b>ISLA 1</b>	0.04	0.45	0.02	8.75
<b>KING 1</b>	0.06	2.04	0.01	3.80
<b>LYON 1</b>	0.06	0.64	0.04	8.60
<b>MILL 1</b>	0.13	0.57	0.00	6.00
<b>NOBA 1</b>	0.04	0.27	0.01	7.70
<b>NOBE 1</b>	0.11	0.50	0.01	17.10
<b>PARK 1</b>	0.08	0.11	0.01	6.80
<b>PLUM 1</b>	0.02	0.16	0.02	9.20
<b>RAMS 1</b>	0.08	0.77	0.01	9.50
<b>SMTH 7A</b>	0.02	8.02	0.02	7.20
<b>SMTH 7B</b>	0.02	3.48	0.01	2.40
<b>STLE 1</b>	0.03	0.36	0.01	6.80
<b>STLE 2</b>	0.02	0.01	0.01	10.30
<b>TYVE 1</b>	0.03	0.14	0.00	20.00

**Table 2:** Median concentrations for each station are reported. Statistical analysis compares the station median to the overall median for each nutrient, indicated by the coloring.



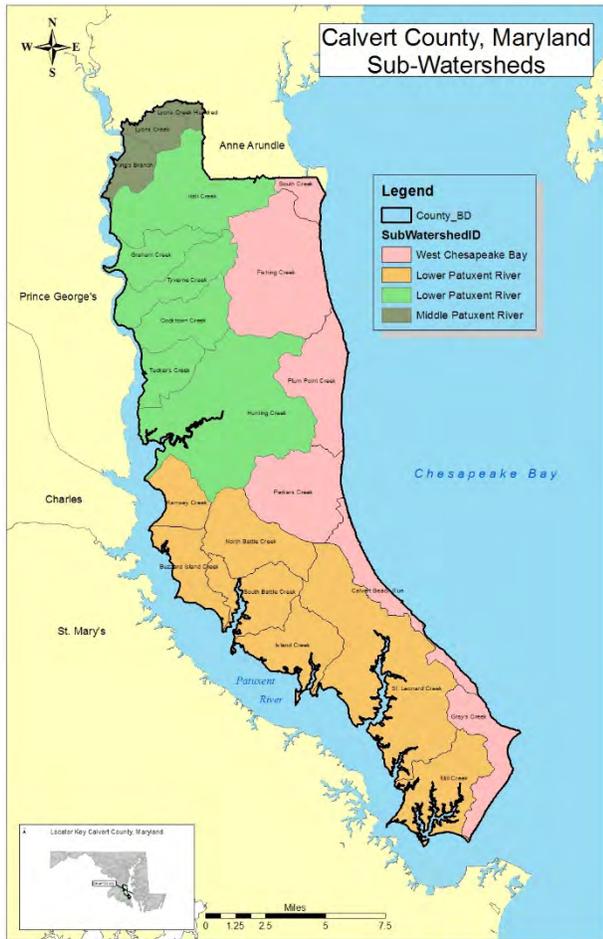
<i>Median Station Yields</i>				
<i>Station</i>	<i>NH<sub>4</sub> mg N/acre/day</i>	<i>NO<sub>23</sub> mg N/acre/day</i>	<i>PO<sub>4</sub> mg P/acre/day</i>	<i>TSS mg/acre/day</i>
<b>CALV 1</b>	221	5399	25	25333
<b>COCK 1</b>	295	2164	72	39021
<b>FISH 1</b>	23	35	24	14746
<b>FRLDA</b>	447	1437	41	38038
<b>GRAH 1</b>	304	3273	91	44255
<b>GRAY 1</b>	65	1537	2	6457
<b>GRAY 2</b>	101	924	5	35801
<b>HALL 1</b>	394	1753	101	51070
<b>HELEN</b>	289	5025	134	124584
<b>HUNT 1</b>	118	347	31	31119
<b>HUNT 2</b>	165	521	35	26050
<b>HUNT 3</b>	210	6400	85	34164
<b>ISLA 1</b>	204	1788	68	46187
<b>KING 1</b>	171	7112	41	12882
<b>LYON 1</b>	245	2156	126	40832
<b>MILL 1</b>	516	2006	7	28677
<b>NOBA 1</b>	68	673	23	19516
<b>NOBE 1</b>	797	8756	188	88555
<b>PARK 1</b>	152	103	26	23445
<b>PLUM 1</b>	23	202	38	14212
<b>RAMS 1</b>	337	1596	45	71128
<b>SMTH 7A</b>	16	8379	11	7332
<b>SMTH 7B</b>	90	27005	65	24305
<b>STLE 1</b>	154	1347	34	25731
<b>STLE 2</b>	37	63	12	27675
<b>TYVE 1</b>	38	250	8	72753

**Table 3:** Median yields for each station. Statistical analysis compares the station median to the overall median for each nutrient, indicated by the coloring.

# Figures



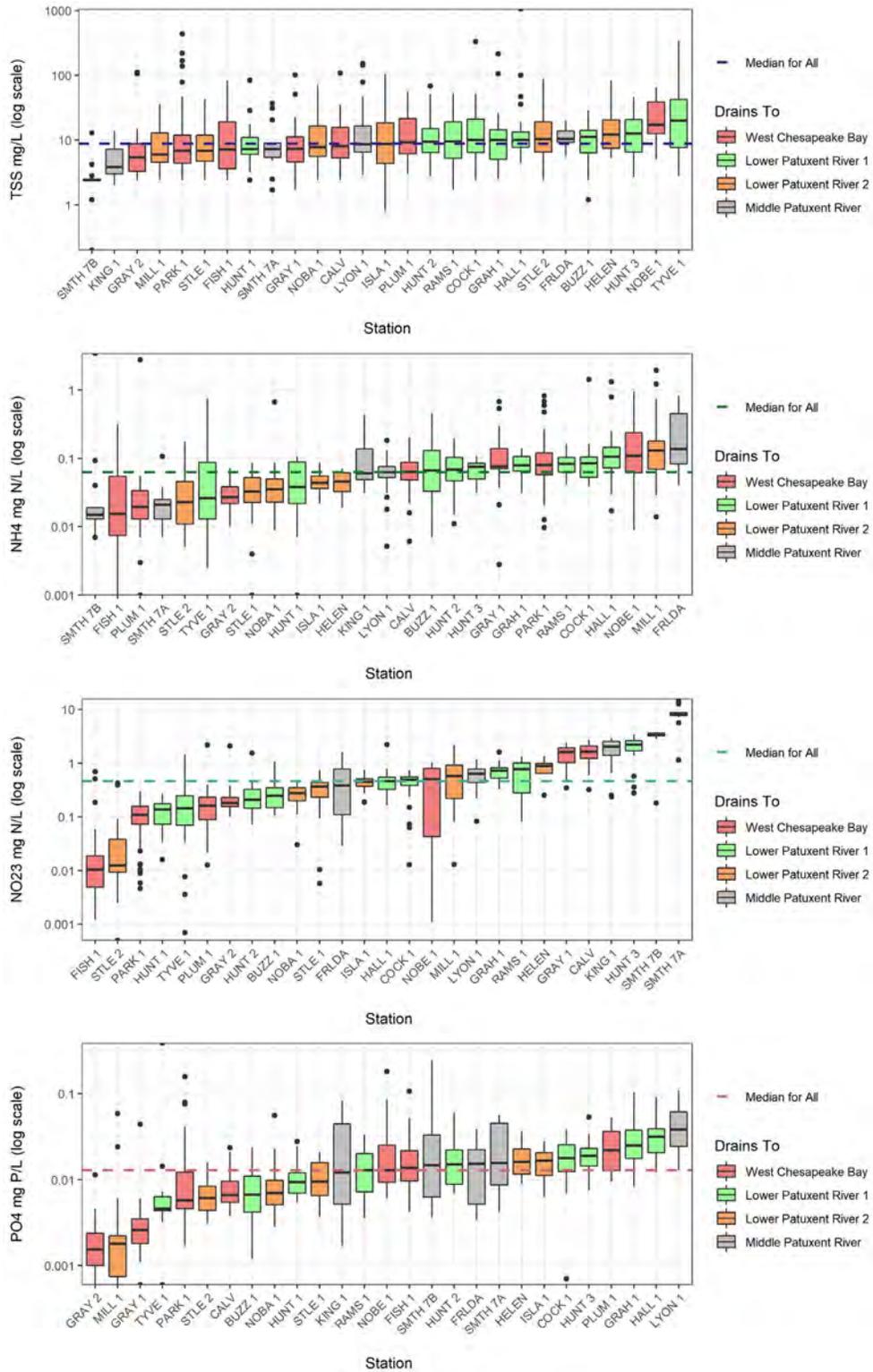
**Figure 1.** Location of the main stations monitored by Calvert County.



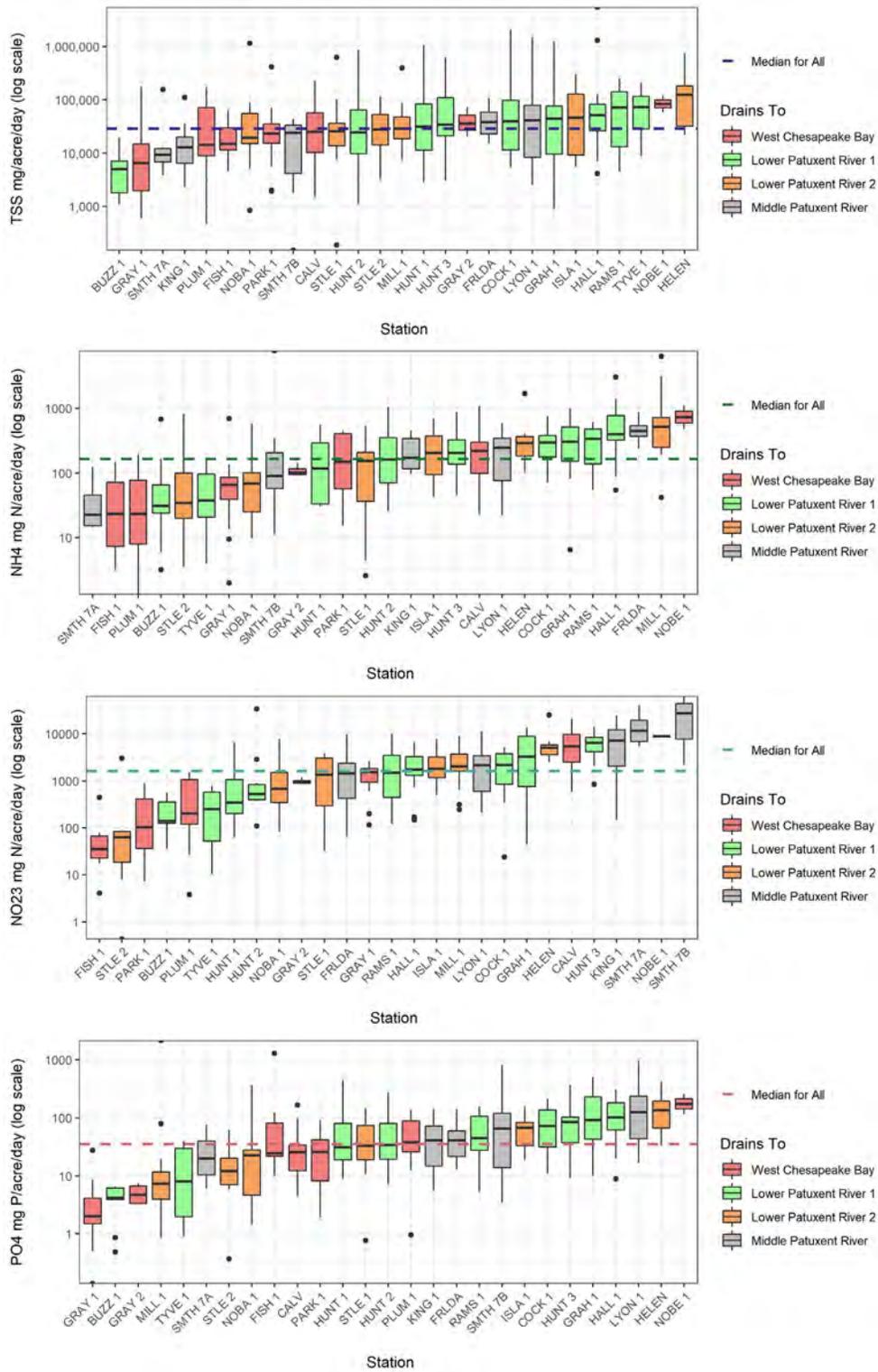
**Figure 2.** Division of the county into four larger drainage systems.



**Figure 3.** Subset of stations for the tidal vs. non-tidal analysis. The tidal station compared to is the uppermost station sampled by CBL.



**Figure 4.** Box and whisker plots of non-tidal station vs. concentrations (TSS, NH<sub>4</sub>, NO<sub>23</sub>, and PO<sub>4</sub>), ordered from lowest to highest. The median for all the stations is indicated by the dashed line, and each box plot is color coded to the system for which it drains into.



**Figure 5.** Box and whisker plots of non-tidal station vs. yields (TSS, NH<sub>4</sub>, NO<sub>23</sub>, and PO<sub>4</sub>), ordered from lowest to highest. The median for all the stations is indicated by the dashed line, and each box plot is color coded to the system for which it drains into.

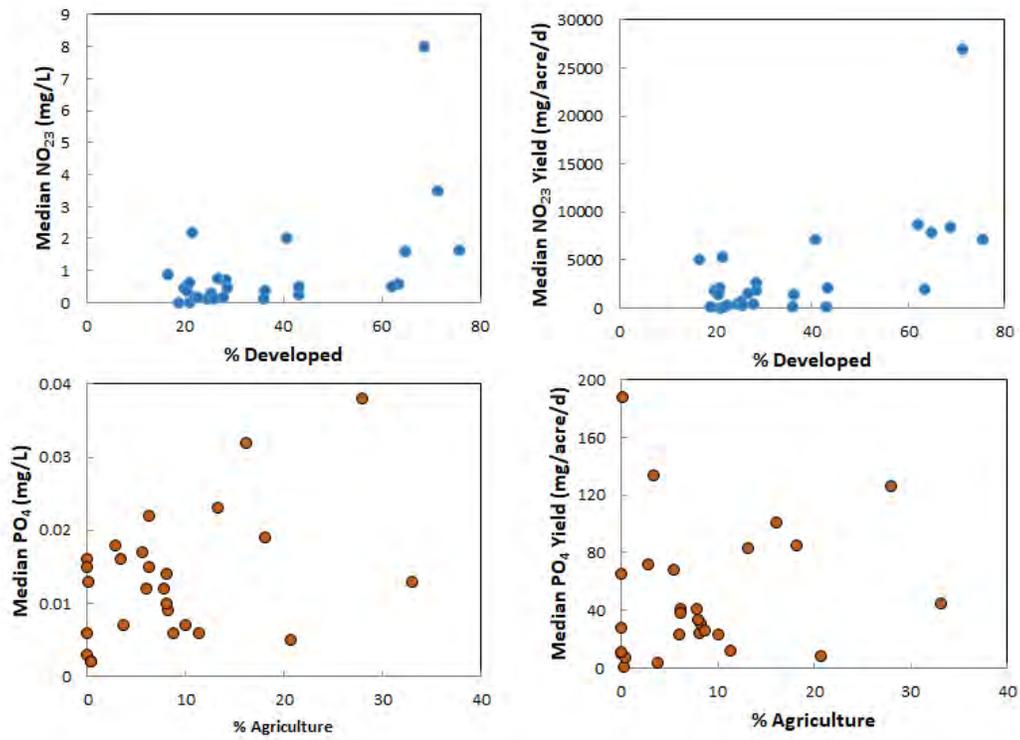
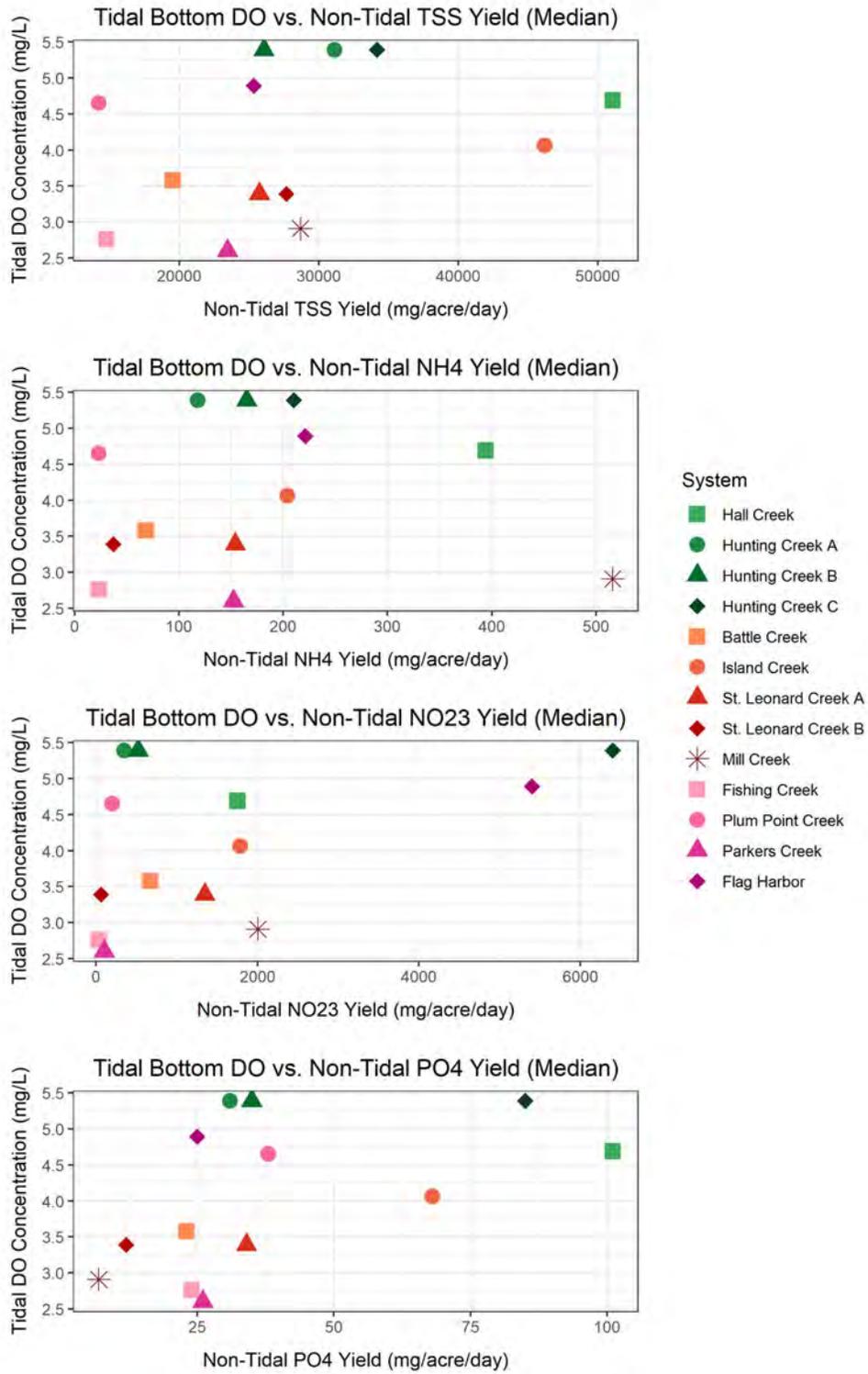
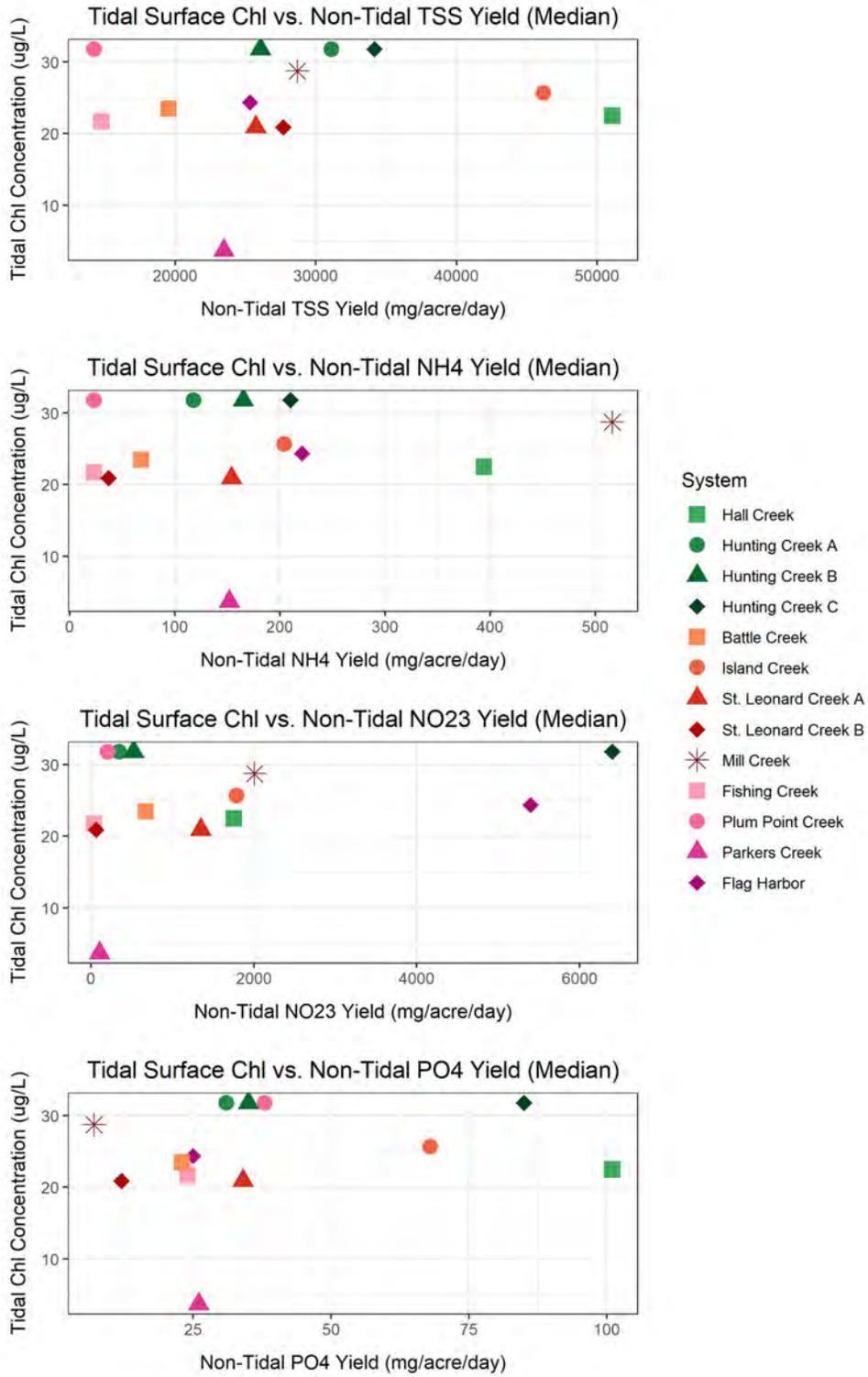


Figure 6. Percent land use vs. the median PO<sub>4</sub> and NO<sub>23</sub> concentrations and yields.



**Figure 7.** Comparison of time-series median of bottom tidal DO concentration and non-tidal nutrient and TSS yields.



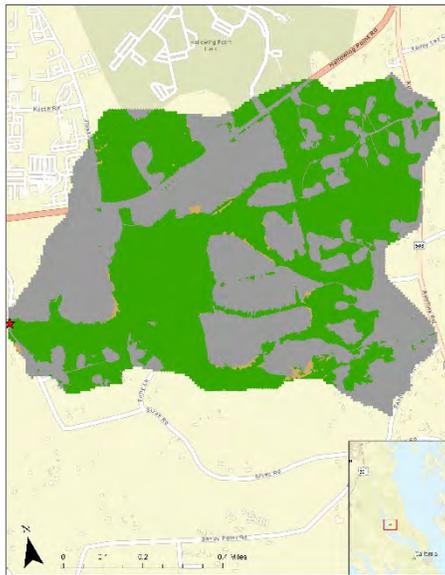
**Figure 8.** Comparison of time-series median of surface tidal chlorophyll concentration and non-tidal nutrient and TSS yields.

# Summary Sheets

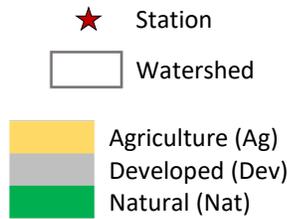
BUZZ 1: Buzzard Island Creek.....	23
CALV : Calvert Beach Run.....	24
COCK 1: Cocktown Creek .....	25
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FRLDA: Ferry Landing Woods.....	27
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# Station BUZZ 1: Buzzard Island Creek

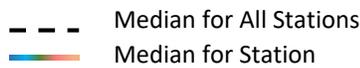
BUZZ 1 is close to the median for  $NH_4$  and TSS, but lower for  $NO_{23}$ ,  $PO_4$ , and discharge, leading to lower yields. Approximately half of the station basin is natural land use (53.3%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	428	3.7	43.0	53.3	50
<b>L-R Basin</b>	3,736	38.8	23.0	38.2	-

L-R (Land-River) Segment N24009XL0\_5343\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	265	1554	706	535	3060
<b>Phosphorus</b>	16	150	163	NA	330

Downscaled from CAST modeled loads for L-R Segment

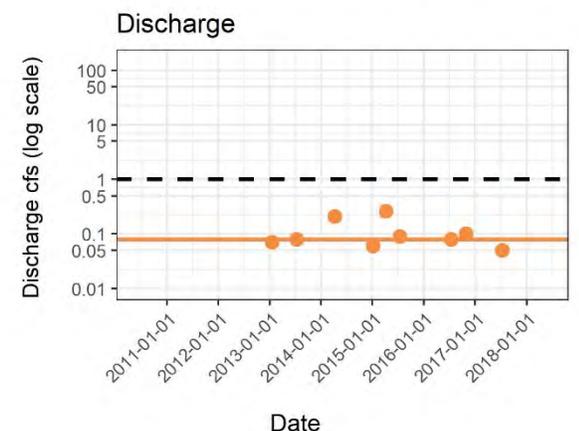
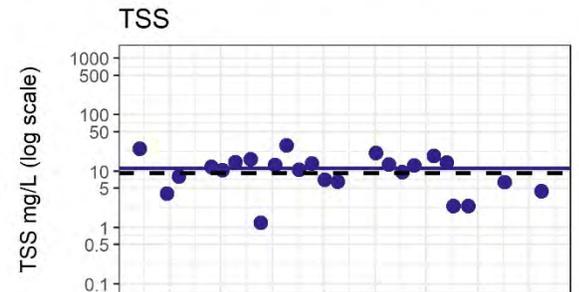
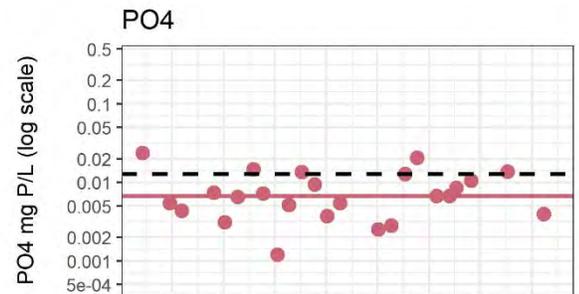
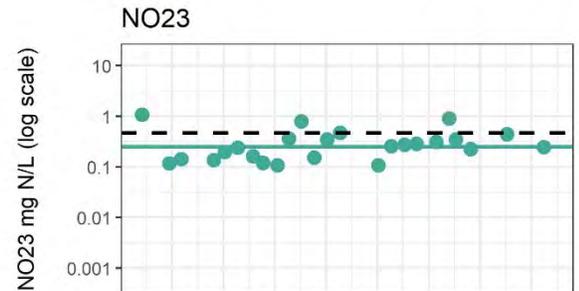
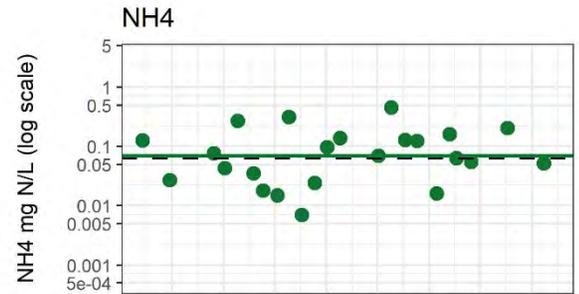
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	11.2	1.2	28.5
<b><math>NH_4</math>, mg N/L</b>	0.070	0.007	0.455
<b><math>NO_{23}</math>, mg N/L</b>	0.247	0.106	1.065
<b><math>PO_4</math>, mg P/L</b>	0.0067	0.0012	0.0237
<b>Discharge, cfs</b>	0.08	0.05	0.26

## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	4938	1097	19,317	31,119
<b><math>NH_4</math>, mg N/acre/day</b>	31	3	676	152
<b><math>NO_{23}</math>, mg N/acre/day</b>	139	36	554	1596
<b><math>PO_4</math>, mg P/acre/day</b>	4	0	7	34

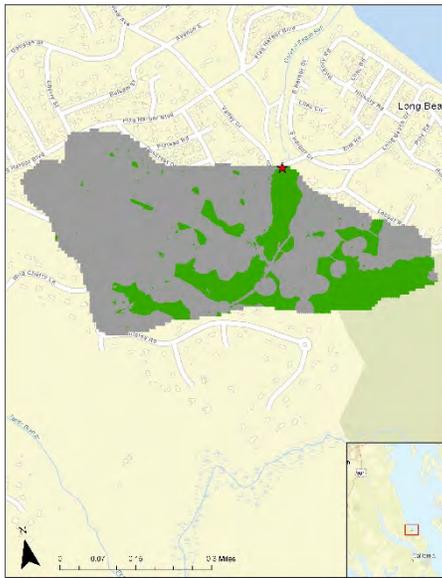
Calculated using instantaneous flow. Further scale up not recommended



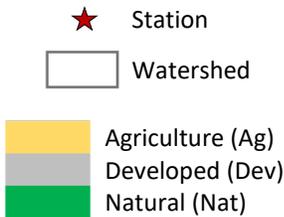
Date

# Station CALV 1: Calvert Beach Run

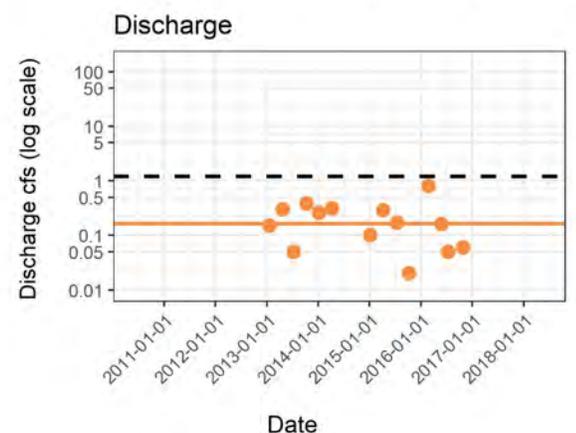
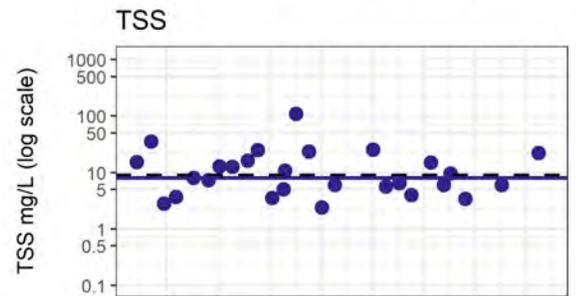
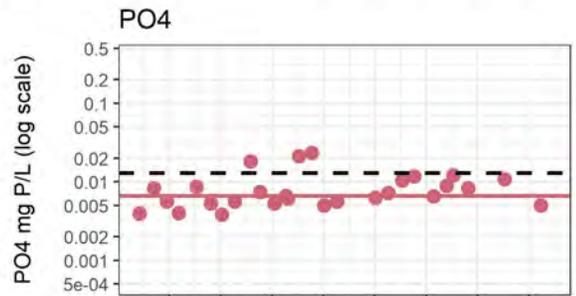
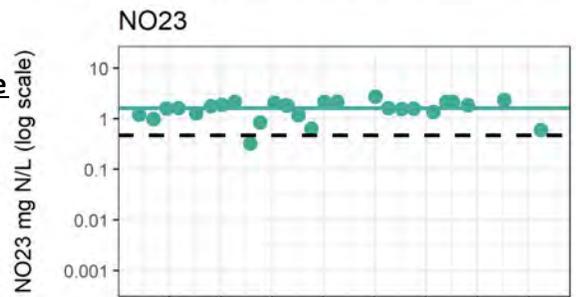
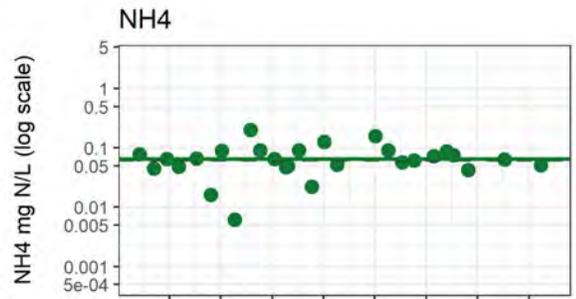
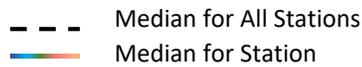
CALV 1 is close to the median for  $NH_4$  and TSS, higher for  $NO_{23}$ , and lower for  $PO_4$  and discharge. Yields for TSS,  $NH_4$ , and  $NO_{23}$  were higher than the median for all stations. Most of the station basin (75.6%) is developed.



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	131	0	75.6	24.4	321
<b>L-R Basin</b>	3,577	6.7	33.4	59.9	-

L-R (Land-River) Segment N24009WLO\_4922\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	0	991	89	3436	4516
<b>Phosphorus</b>	0	64	22	NA	86

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	8	2.4	108.0
<b><math>NH_4</math>, mg N/L</b>	0.065	0.006	0.201
<b><math>NO_{23}</math>, mg N/L</b>	1.620	0.320	2.690
<b><math>PO_4</math>, mg P/L</b>	0.007	0.0038	0.0234
<b>Discharge, cfs</b>	0.28	0.05	0.38

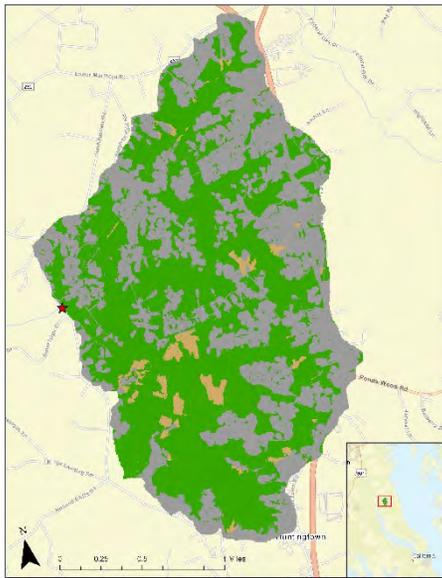
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	25,332	1,495	223,959	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	221	23	1090	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	5399	583	20,580	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	25	4	166	35

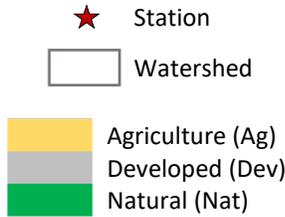
Calculated using instantaneous flow. Further scale up not recommended.

# Station COCK 1: Cocktown Creek

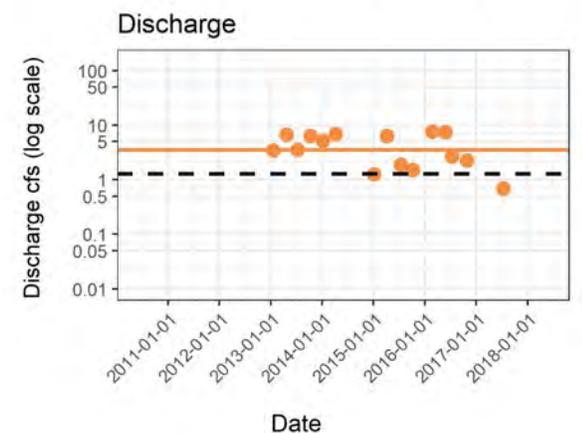
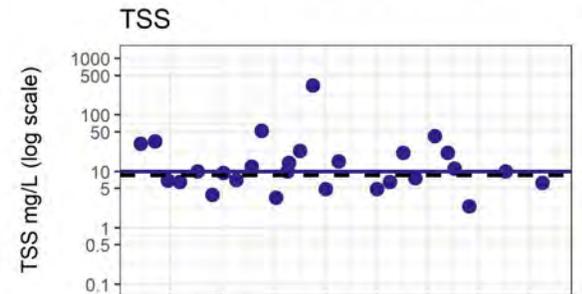
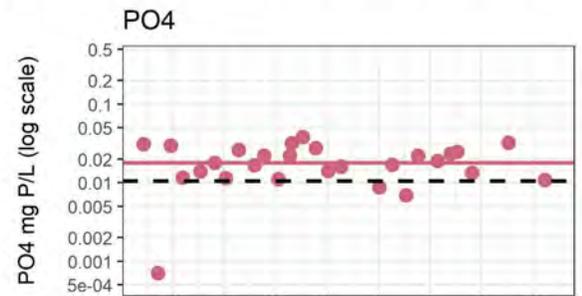
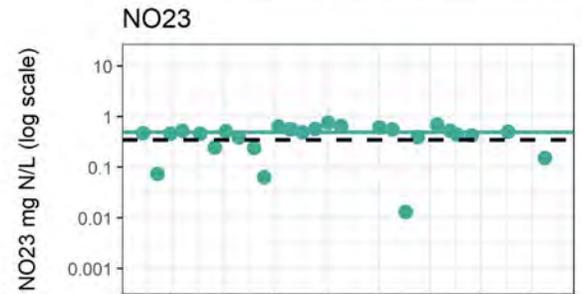
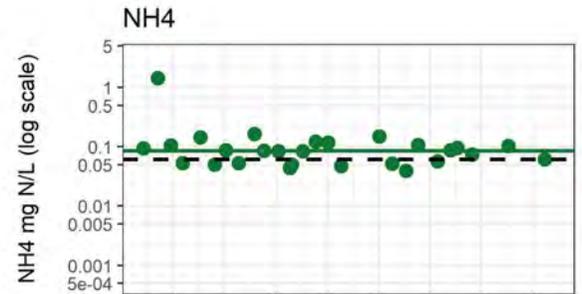
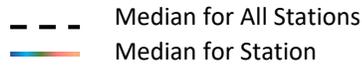
COCK 1 is close to the median for  $NO_{23}$  and TSS and slightly higher for  $NH_4$ ,  $PO_4$ , and discharge leading to higher yields than the median for all stations. More than half of the station basin is natural land use (54%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	2,449	2.8	43.1	54.0	790
<b>L-R Basin</b>	7,877	8.0	28.4	63.6	-

L-R (Land-River) Segment N24009XL3\_4951\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	959	8719	3377	8456	21,511
<b>Phosphorus</b>	76	1234	1189	NA	2500

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	10.0	2.4	332.0
<b><math>NH_4</math>, mg N/L</b>	0.086	0.039	1.431
<b><math>NO_{23}</math>, mg N/L</b>	0.485	0.013	0.746
<b><math>PO_4</math>, mg P/L</b>	0.0178	0.0007	0.0378
<b>Discharge, cfs</b>	3.52	0.69	7.56

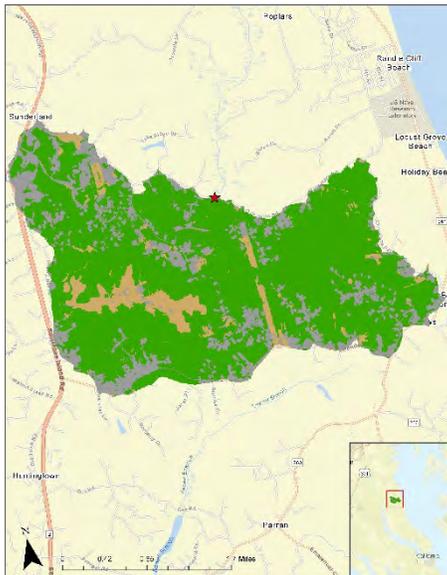
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	39,021	5371	2,082,897	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	295	71	753	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	2164	24	5189	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	72	11	213	35

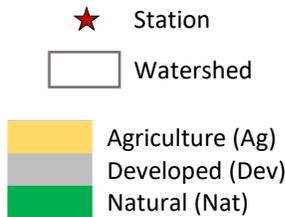
Calculated using instantaneous flow. Further scale up not recommended.

# Station FISH 1: Fishing Creek

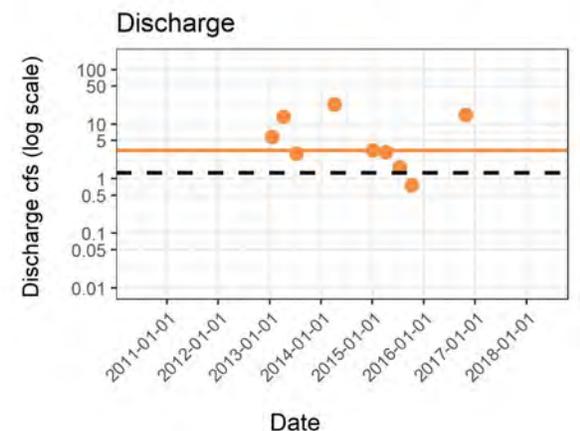
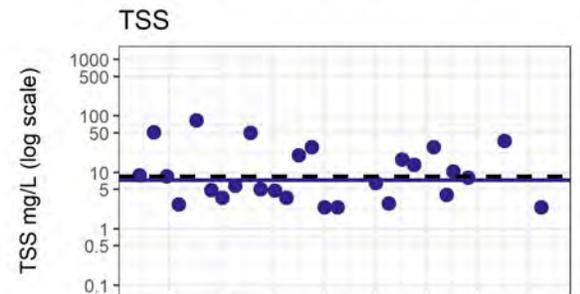
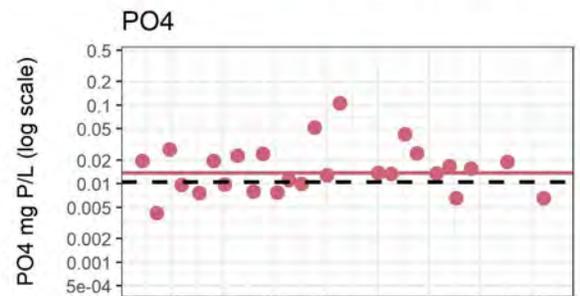
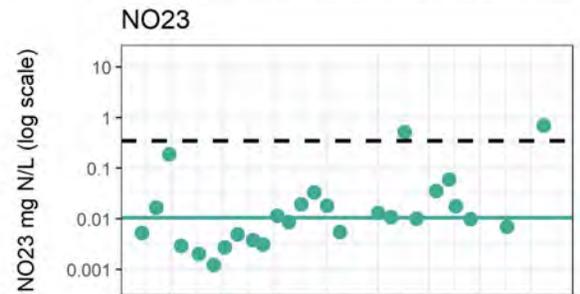
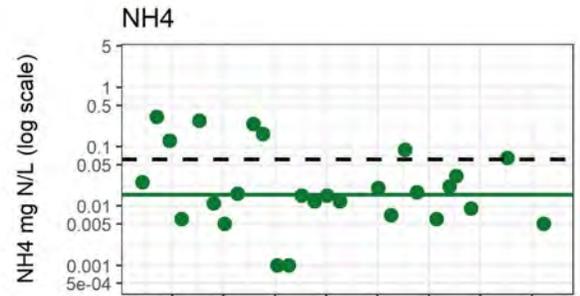
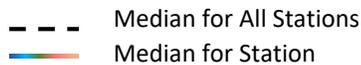
FISH 1 is close to the median for PO<sub>4</sub> and TSS, lower for nitrogen, and higher for discharge, while yields are lower than the median for all stations. A majority of the station basin is natural land use (71.1%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	4,538	8.1	20.8	71.1	621
<b>L-R Basin</b>	14,395	6.7	25.3	68.0	-

L-R (Land-River) Segment N24009WLO\_4772\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	5356	8317	8580	6647	28,899
<b>Phosphorus</b>	419	1089	3286	NA	4794

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	7.2	2.4	82.7
<b>NH<sub>4</sub>, mg N/L</b>	0.016	0.001	0.317
<b>NO<sub>23</sub>, mg N/L</b>	0.010	0.001	0.693
<b>PO<sub>4</sub>, mg P/L</b>	0.0136	0.0042	0.1060
<b>Discharge, cfs</b>	3.31	0.76	22.92

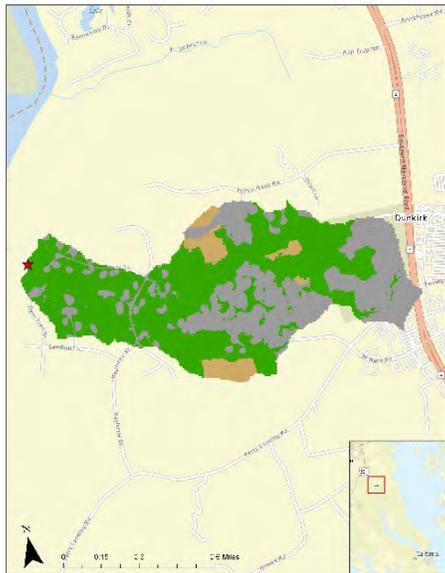
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	14,746	4,588	63,697	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	23	3	148	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	35	4	442	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	24	10	1,310	35

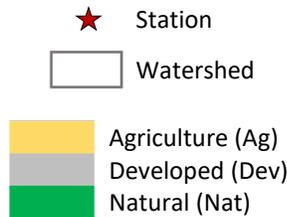
Calculated using instantaneous flow. Further scale up not recommended.

# Station FRLDA: Ferry Landing Woods

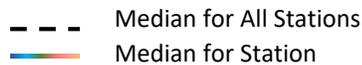
FRLDA is close to the median for  $NO_{23}$ ,  $PO_4$ , and TSS, but slightly higher for  $NH_4$  and lower for discharge, while yields for TSS and  $NH_4$  are higher than the median for all stations. More than half of the station basin is natural land use (57.6%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	421	6.2	36.2	57.6	103
<b>L-R Basin</b>	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
<b>Nitrogen</b>	410	1241	671	1103	3424
<b>Phosphorus</b>	29	169	187	NA	385

Downscaled from CAST modeled loads for L-R Segment

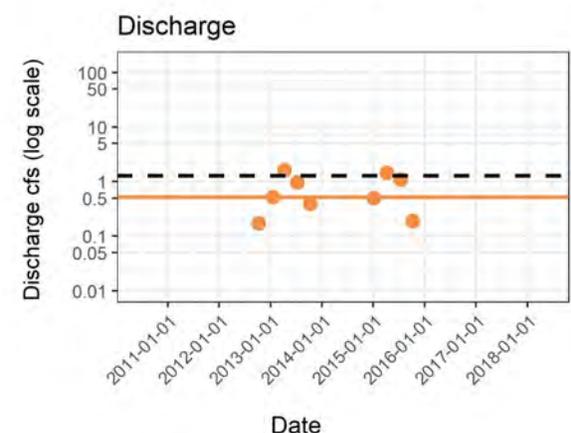
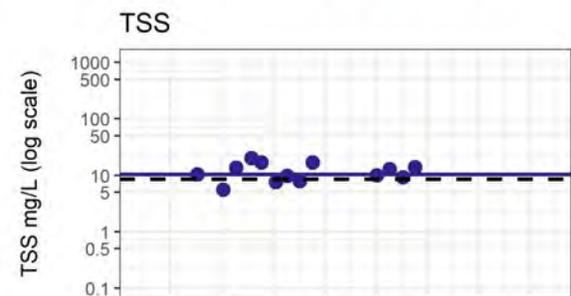
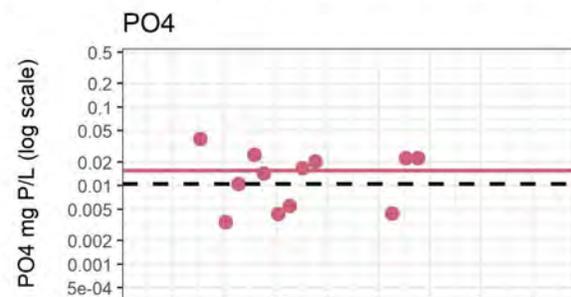
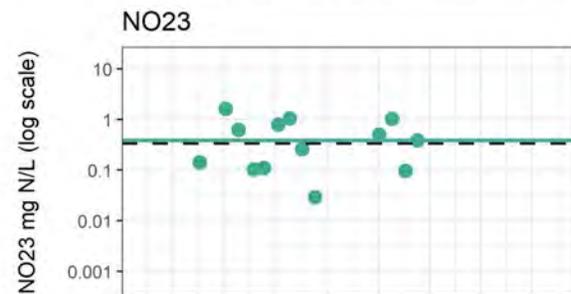
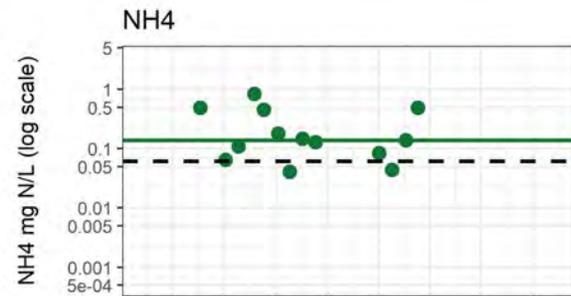
### Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	10.4	5.5	20.0
<b><math>NH_4</math>, mg N/L</b>	0.138	0.041	0.831
<b><math>NO_{23}</math>, mg N/L</b>	0.385	0.029	1.600
<b><math>PO_4</math>, mg P/L</b>	0.0154	0.0034	0.0390
<b>Discharge, cfs</b>	0.52	0.17	1.60

### Watershed Nutrient & Sediment Yields Summary

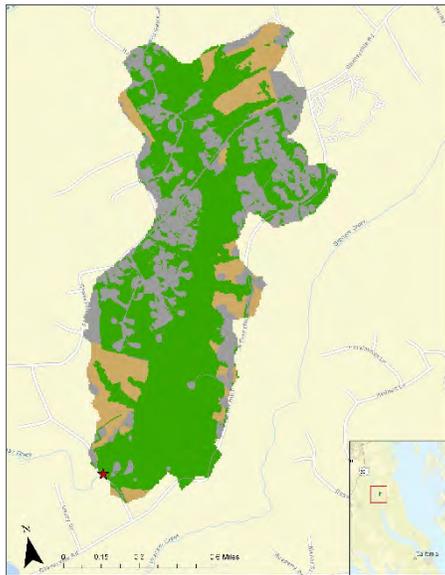
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	38,038	15,112	107,007	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	447	241	873	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	1437	66	9753	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	41	13	141	35

Calculated using instantaneous flow. Further scale up not recommended.

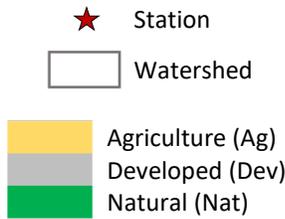


# Station GRAH 1: Graham Creek

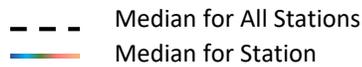
GRAH 1 is close to the median for TSS and discharge, but slightly higher for nitrogen and PO<sub>4</sub> while yields are higher than the median for all stations. More than half of the station basin is natural land use (58.6%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	664	13.2	28.3	58.6	117
<b>L-R Basin</b>	18,120	17.4	30.3	52.3	-

L-R (Land-River) Segment N24009XL3\_4950\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	1284	1585	1087	1252	5208
<b>Phosphorus</b>	100	224	290	NA	614

Downscaled from CAST modeled loads for L-R Segment

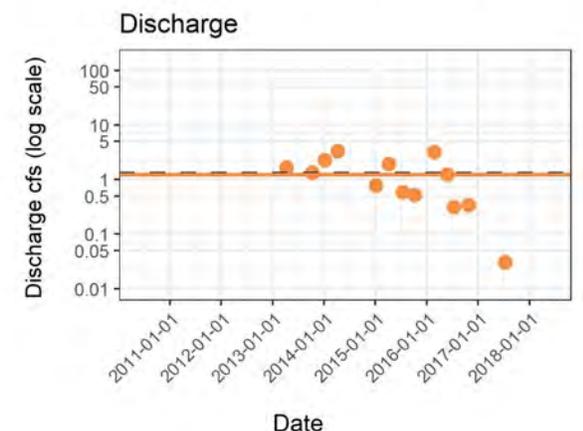
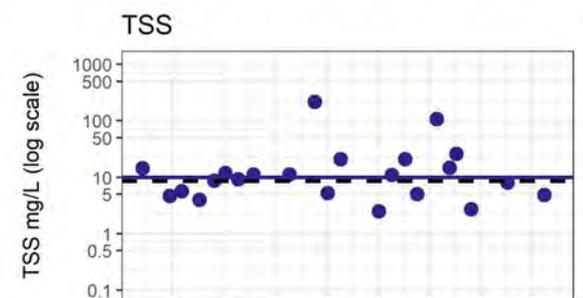
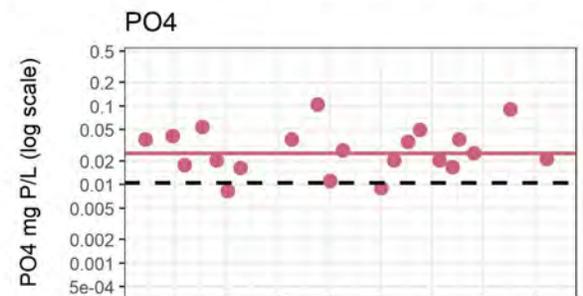
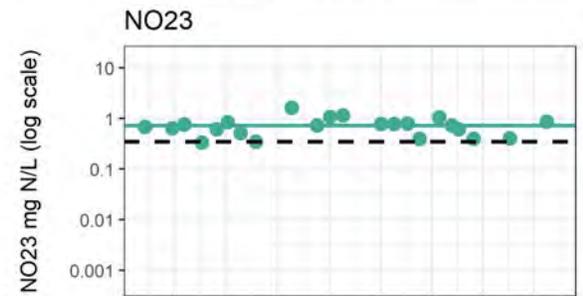
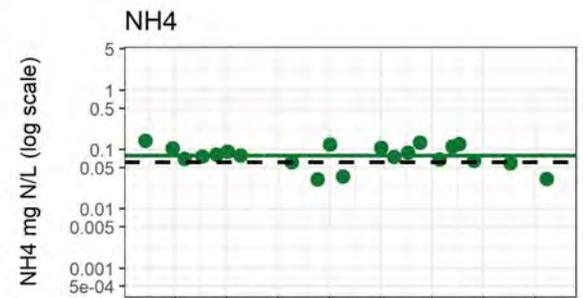
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	10	2.5	214.0
<b>NH<sub>4</sub>, mg N/L</b>	0.079	0.031	0.141
<b>NO<sub>23</sub>, mg N/L</b>	0.722	0.330	1.590
<b>PO<sub>4</sub>, mg P/L</b>	0.025	0.0083	0.1040
<b>Discharge, cfs</b>	1.00	0.03	3.29

## Watershed Nutrient & Sediment Yields Summary

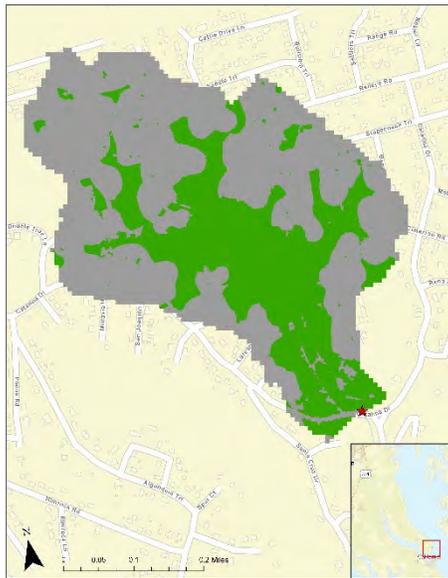
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	44,255	885	1,246,402	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	304	7	999	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	3273	44	13,704	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	90	10	510	35

Calculated using instantaneous flow. Further scale up not recommended.

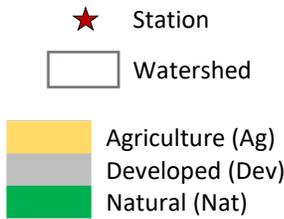


# Station GRAY 1: Gray's Creek

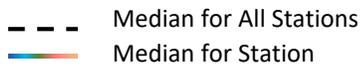
GRAY 1 is close to the median for  $NH_4$  and TSS, higher for  $NO_{23}$ , and lower for  $PO_4$  and discharge, while yields are higher for TSS and nitrogen compared to the median for all the stations. More than half of the station basin is developed land use.



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	114	0	64.7	35.3	173
<b>L-R Basin</b>	2,275	0.5	50.6	48.8	-

L-R (Land-River) Segment N24009WL0\_4925\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	0	675	124	1852	2650
<b>Phosphorus</b>	0	45	15	NA	60

Downscaled from CAST modeled loads for L-R Segment

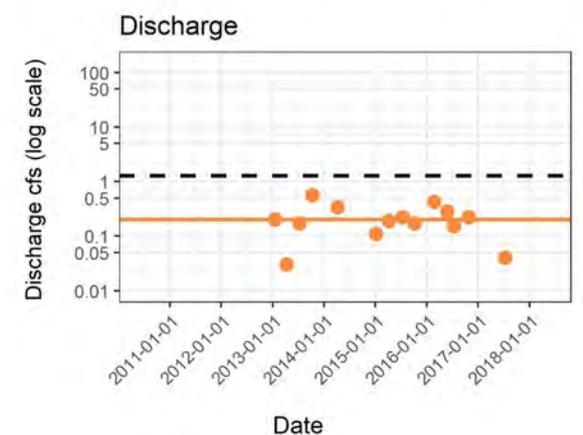
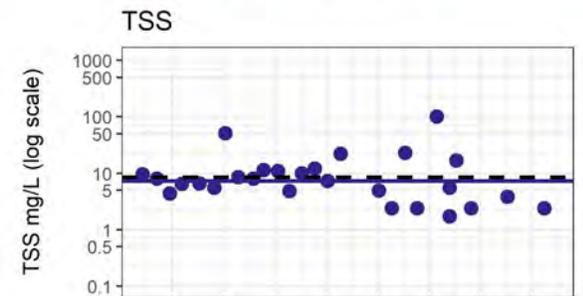
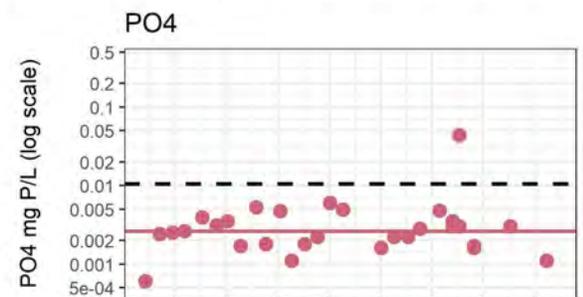
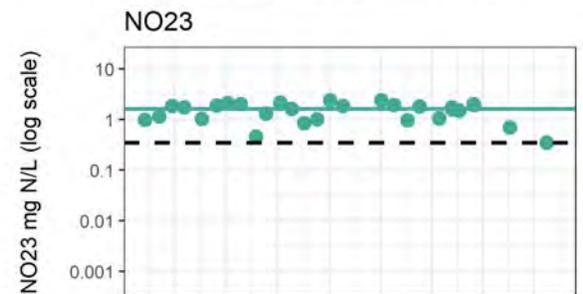
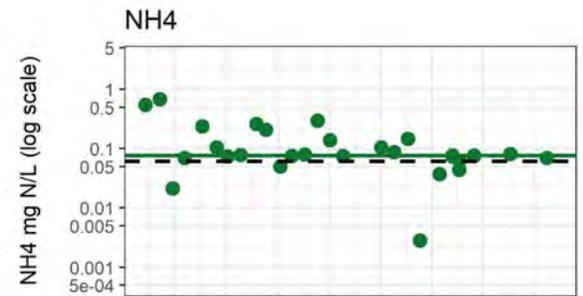
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	7.3	1.7	101.0
<b><math>NH_4</math>, mg N/L</b>	0.077	0.003	0.676
<b><math>NO_{23}</math>, mg N/L</b>	1.59	0.344	2.400
<b><math>PO_4</math>, mg P/L</b>	0.0026	0.0006	0.0439
<b>Discharge, cfs</b>	0.20	0.03	0.56

## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	6,456	604	177,850	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	65	2	697	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	1537	114	2622	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	2	0.1	28	35

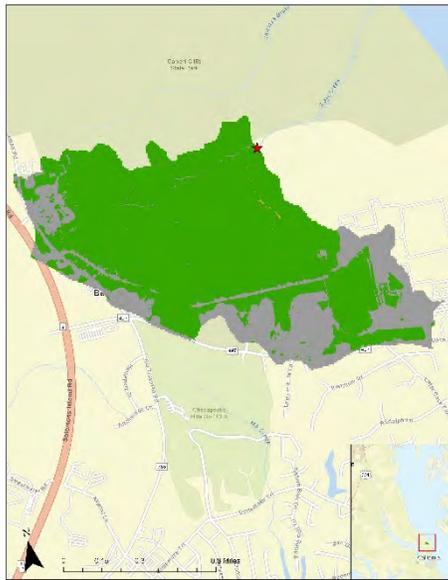
Calculated using instantaneous flow. Further scale up not recommended.



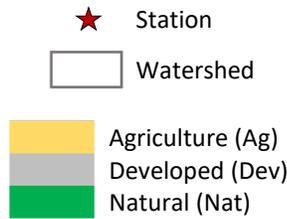
Date

# Station GRAY 2: Gray's Creek

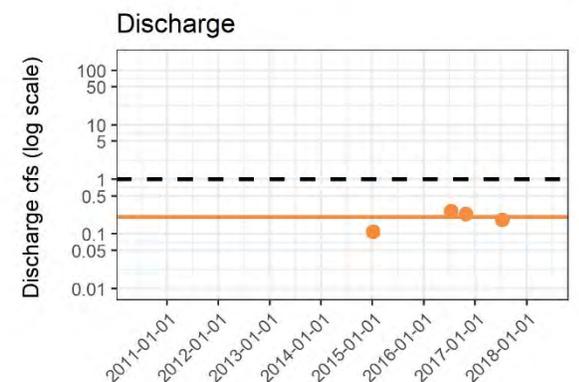
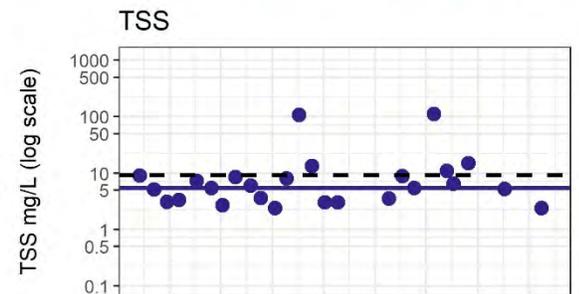
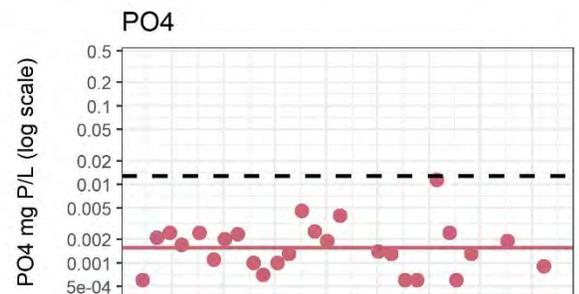
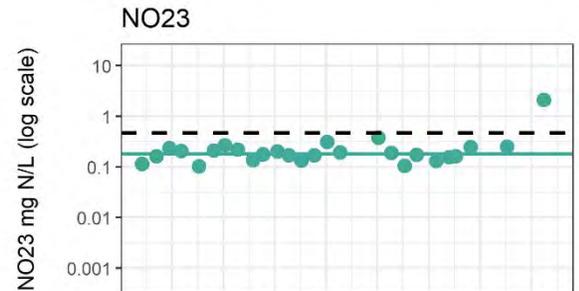
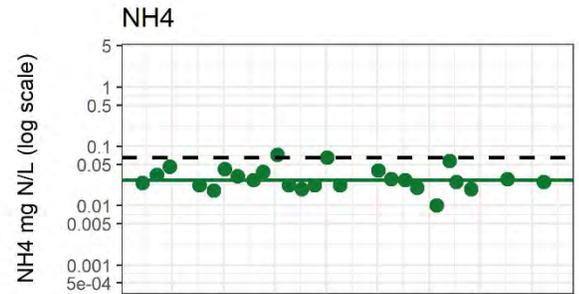
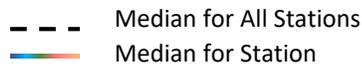
GRAY 2 is lower than the median for all parameters ( $NH_4$ ,  $NO_{23}$ ,  $PO_4$ , and TSS) leading to lower yields when discharge measured, compared to the median for all stations. Most of the station basin is natural land use (77.8%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	584	0.3	21.9	77.8	8
<b>L-R Basin</b>	2,012	1.1	13.0	85.8	-

L-R (Land-River) Segment N24009WLO\_4923\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	30	1411	1263	86	2790
<b>Phosphorus</b>	1	81	1145	NA	1227

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	5.4	2.4	111.0
<b><math>NH_4</math>, mg N/L</b>	0.027	0.010	0.072
<b><math>NO_{23}</math>, mg N/L</b>	0.180	0.101	2.100
<b><math>PO_4</math>, mg P/L</b>	0.0016	0.0006	0.0114
<b>Discharge, cfs</b>	0.21	0.11	0.26

## Watershed Nutrient & Sediment Yields Summary

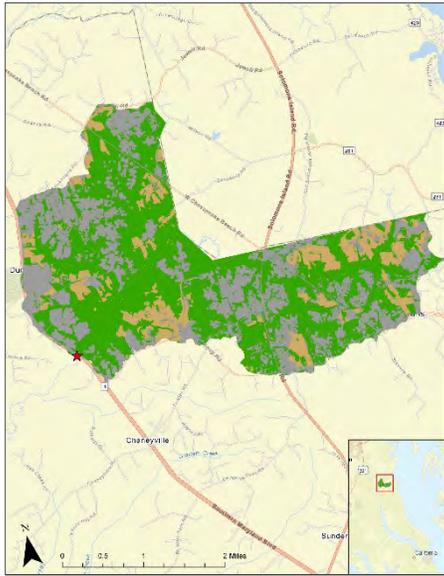
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	35,801	20,138	73,732	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	101	92	139	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	924	889	1193	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	5	3	7	35

Calculated using instantaneous flow. Further scale up not recommended.

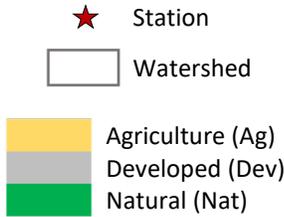
Date

# Station HALL 1: Hall Creek

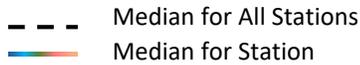
HALL 1 is close to the median for  $NO_{23}$  and TSS and higher for  $NH_4$ ,  $PO_4$ , and discharge, leading to higher yields for TSS,  $NH_4$ , and  $PO_4$  compared to the median for all stations. About half of the station basin within Calvert County is natural land use.



### Watershed Land Use



### Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	5727*	12.9*	34.8*	52.3*	1492*
<b>L-R Basin</b>	18,120	17.4	30.3	52.3	-

L-R (Land-River) Segment N24009XL3\_4950\_0000

\*Calvert Co. acres only, total acres=8978

### CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	10857* (+9953)	16813* (+5861)	8366* (+4737)	15,970*	52,007*
<b>Phosphorus</b>	845* (+817)	2373* (+817)	2231* (+2057)	NA	5450*

Downscaled from CAST modeled loads for L-R Segment

\*Calvert Co. only, (+ outside county contribution)

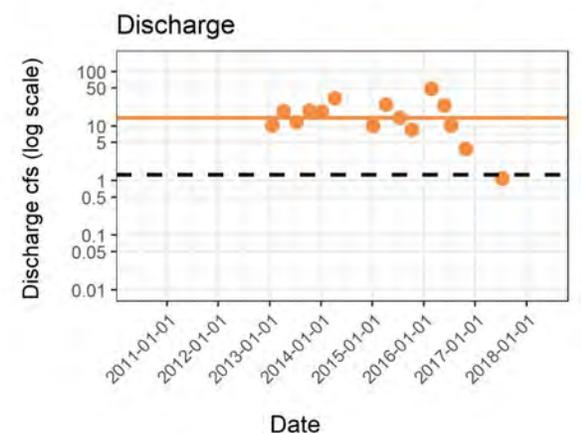
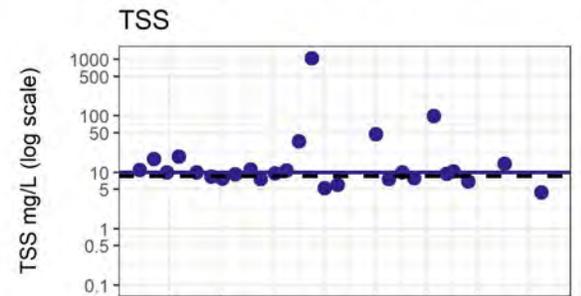
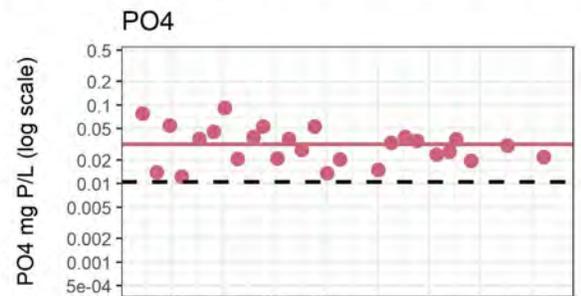
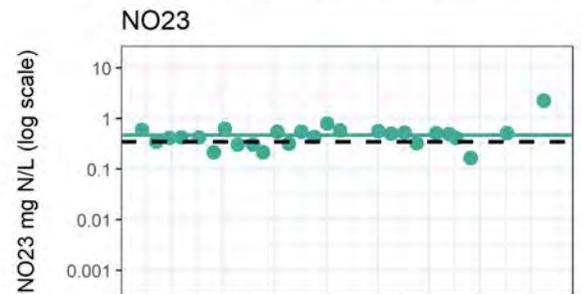
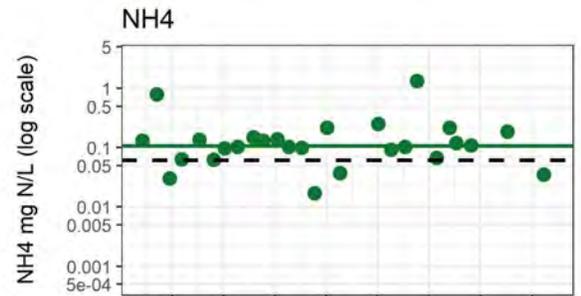
### Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	10.0	4.4	1050.0
<b><math>NH_4</math>, mg N/L</b>	0.109	0.017	1.330
<b><math>NO_{23}</math>, mg N/L</b>	0.461	0.165	2.210
<b><math>PO_4</math>, mg P/L</b>	0.0315	0.0122	0.0920
<b>Discharge, cfs</b>	14.19	1.08	48.20

### Watershed Nutrient & Sediment Yields Summary

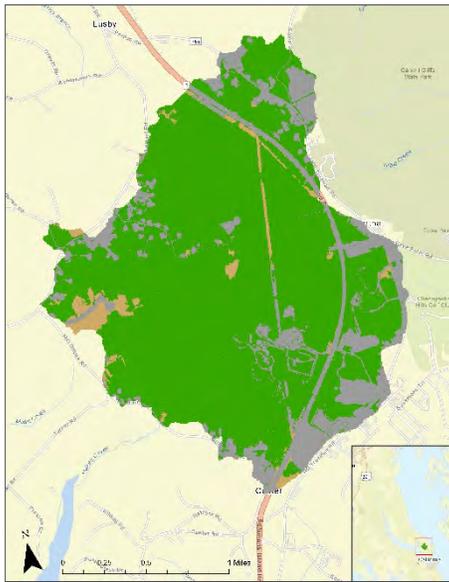
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	51,070	4120	5,419,149	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	394	54	3,052	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	1753	148	6,685	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	101	9	305	35

Calculated using instantaneous flow. Further scale up not recommended.

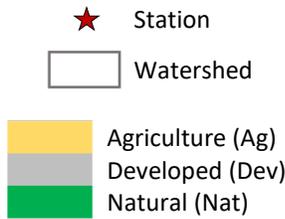


# Station HELEN: Hellen Creek

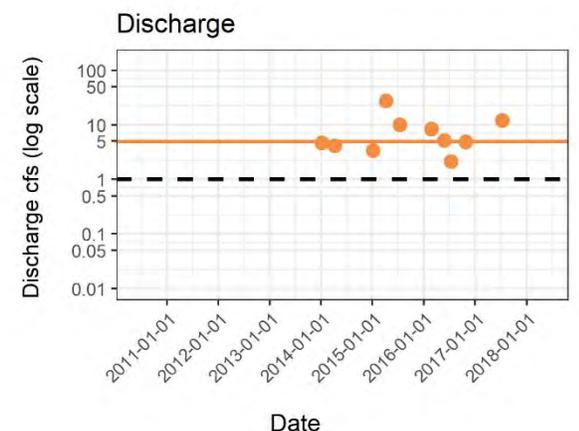
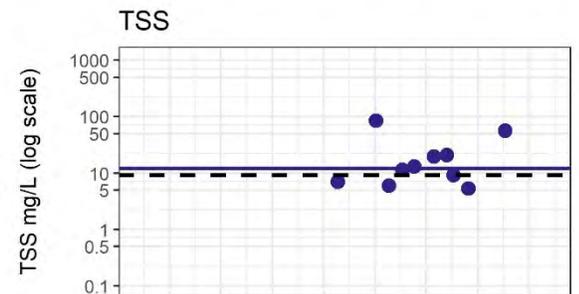
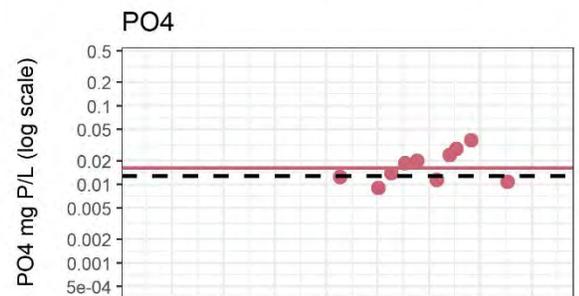
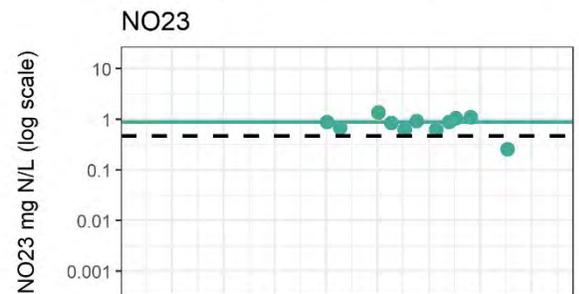
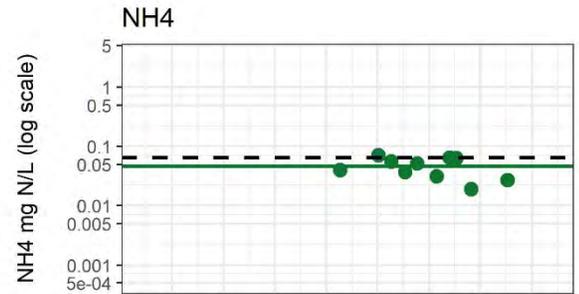
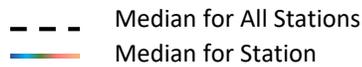
HELEN is slightly higher than the median for most parameters measured ( $NO_{23}$ ,  $PO_4$ , TSS, and discharge), but slightly lower for  $NH_4$  leading to higher yields than the median for all stations. Most of the station basin is natural land use (80.1%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	2197	3.4	16.5	80.1	150
<b>L-R Basin</b>	18,512	15.1	18.6	66.3	-

L-R (Land-River) Segment N24009XLO\_5348\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	1239	3655	4595	1606	11,095
<b>Phosphorus</b>	57	254	1827	NA	2137

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	12.2	5.3	84.0
<b><math>NH_4</math>, mg N/L</b>	0.046	0.019	0.071
<b><math>NO_{23}</math>, mg N/L</b>	0.876	0.252	1.360
<b><math>PO_4</math>, mg P/L</b>	0.0163	0.0090	0.0363
<b>Discharge, cfs</b>	4.96	2.13	27.15

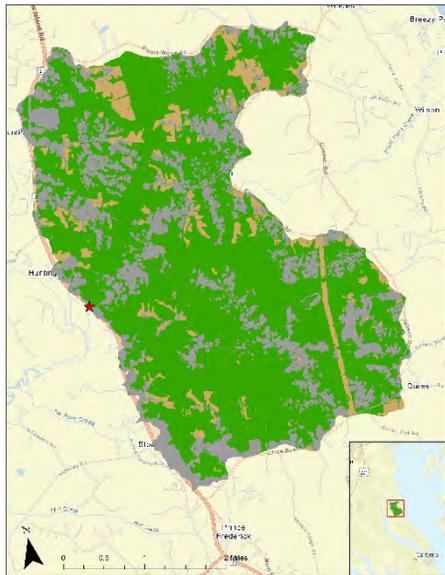
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	124,584	21,823	742,137	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	289	102	1693	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	5025	2491	25,126	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	134	34	420	35

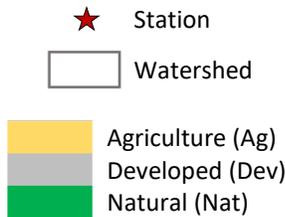
Calculated using instantaneous flow. Further scale up not recommended.

# Station HUNT 1: Hunting Creek 1

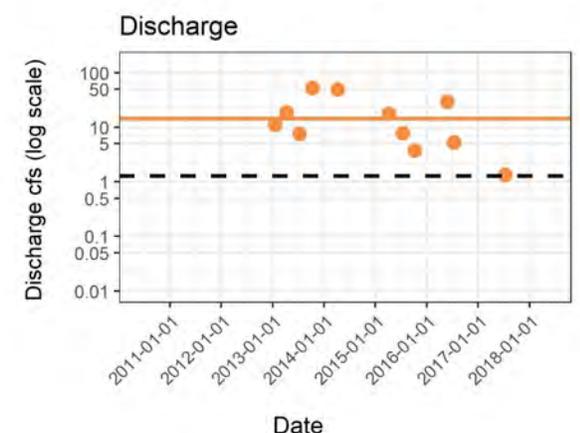
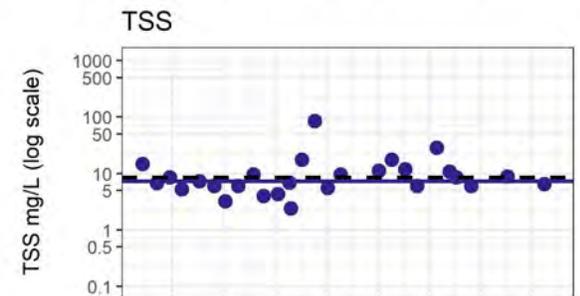
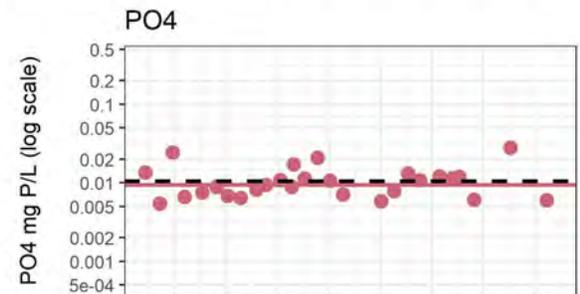
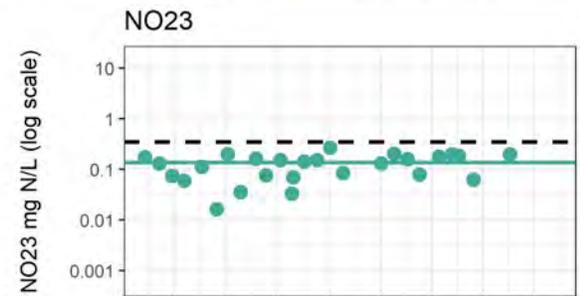
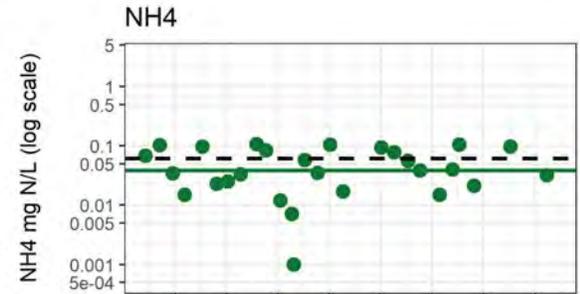
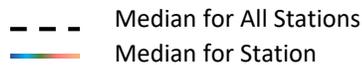
HUNT 1 is below the median for all parameters ( $NH_4$ ,  $NO_{23}$ ,  $PO_4$ , and TSS) with a higher discharge, leading to mostly lower yields compared to the median for all stations. Most of the station basin is natural land use (67.3%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	10,174	8.2	24.5	67.3	1923
<b>L-R Basin</b>	11,140	12.8	27.4	59.7	-

L-R (Land-River) Segment N24009XLO\_5350\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	12,528	21,899	19,543	20,584	74,553
<b>Phosphorus</b>	800	2182	6070	NA	9053

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	7.2	2.4	84.0
<b><math>NH_4</math>, mg N/L</b>	0.039	0.001	0.107
<b><math>NO_{23}</math>, mg N/L</b>	0.1362	0.0160	0.2660
<b><math>PO_4</math>, mg P/L</b>	0.0094	0.0054	0.0278
<b>Discharge, cfs</b>	14.40	1.32	154.60

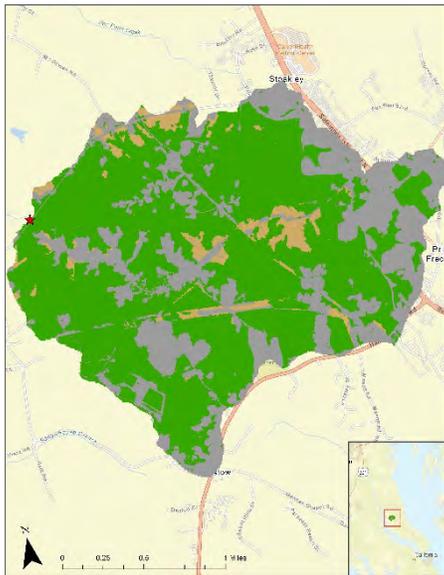
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	31,119	2793	1,059,552	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	118	30	558	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	347	62	6,506	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	31	9	450	35

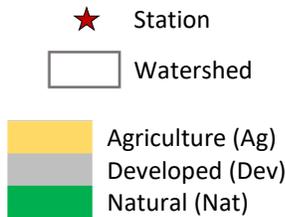
Calculated using instantaneous flow. Further scale up not recommended.

# Station HUNT 2: Hunting Creek 2

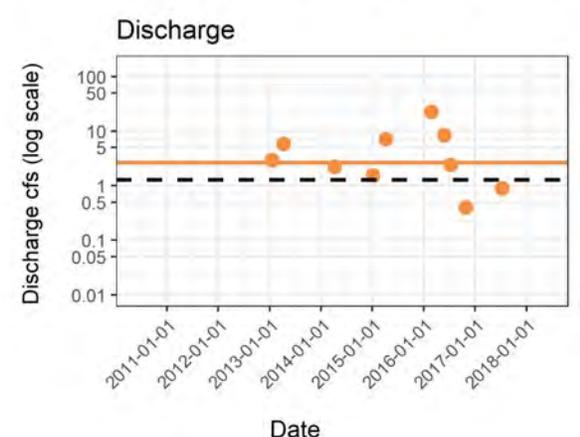
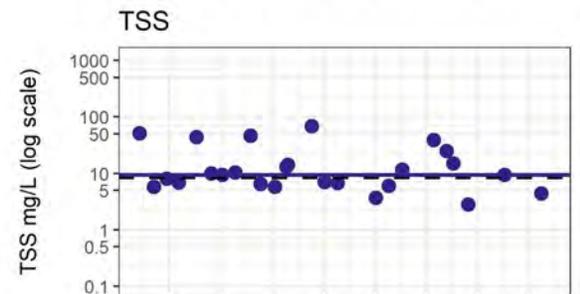
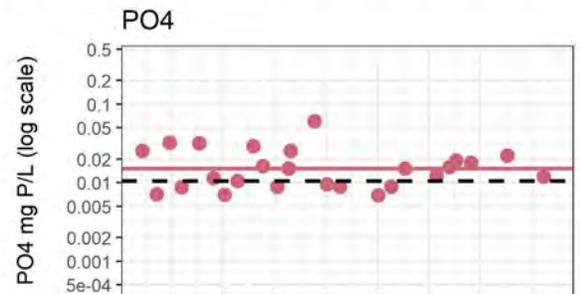
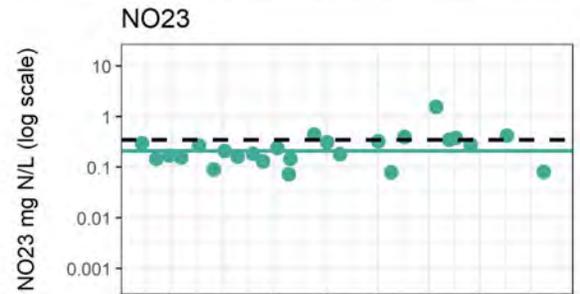
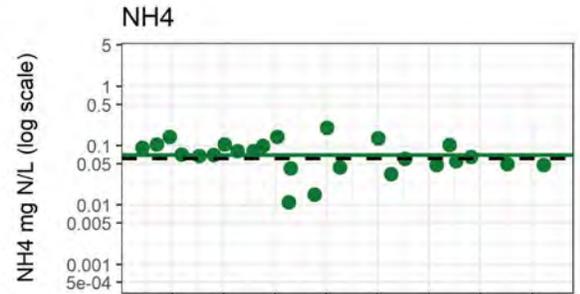
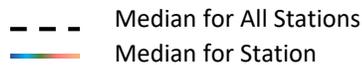
HUNT 2 is close to the median for  $NH_4$ ,  $PO_4$ , and TSS, lower than the median for  $NO_{23}$ , and higher than the median for discharge, while yields are lower than the median for all stations. Most of the station basin is natural land use (66.3%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	2458	6.0	27.7	66.3	347
<b>L-R Basin</b>	11,140	12.8	27.4	59.7	-

L-R (Land-River) Segment N24009XLO\_5350\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	2215	5982	4651	3714	16,562
<b>Phosphorus</b>	142	596	1445	NA	2182

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	9.4	2.8	68.0
<b><math>NH_4</math>, mg N/L</b>	0.069	0.011	0.198
<b><math>NO_{23}</math>, mg N/L</b>	0.209	0.072	1.540
<b><math>PO_4</math>, mg P/L</b>	0.015	0.0069	0.0601
<b>Discharge, cfs</b>	2.30	0.40	22.32

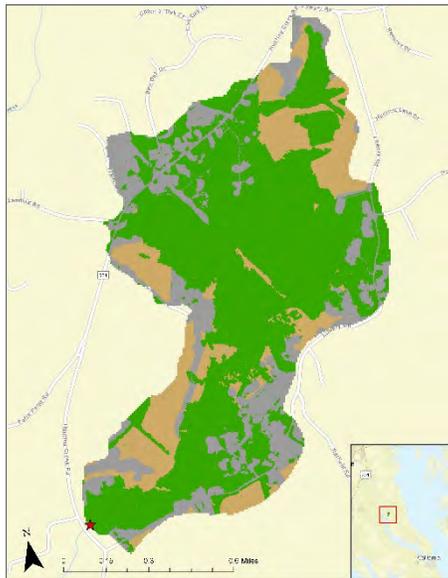
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	26,050	1,115	866,414	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	165	25	1,044	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	521	109	34,212	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	35	7	271	35

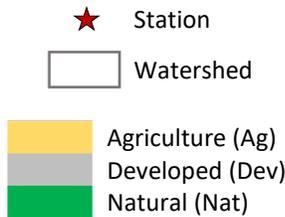
Calculated using instantaneous flow. Further scale up not recommended.

# Station HUNT 3: Hunting Creek 3

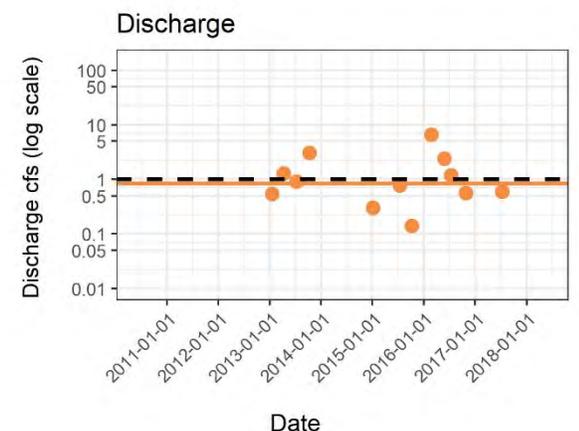
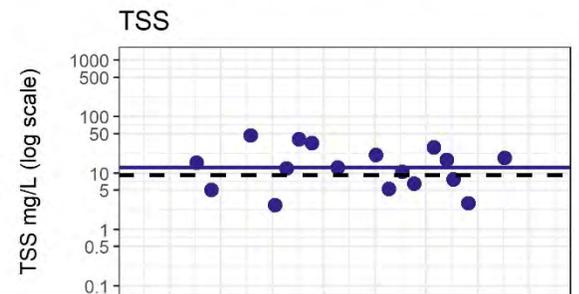
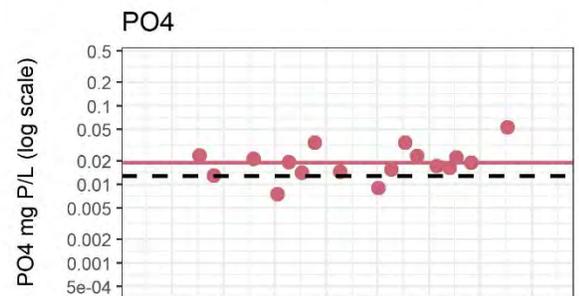
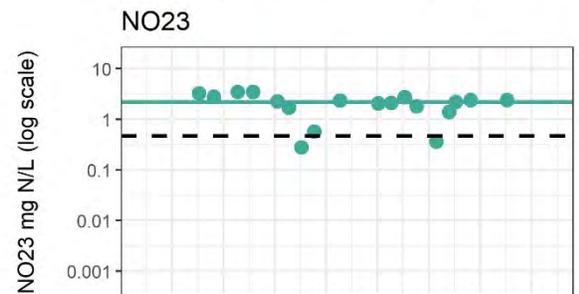
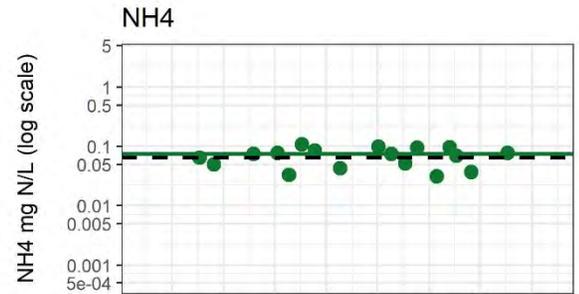
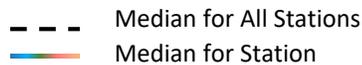
HUNT 3 is close to the median for  $NH_4$  and discharge and higher for  $NO_{23}$ ,  $PO_4$ , and TSS, while yields are higher than the median for all stations for  $NO_{23}$ ,  $PO_4$ , and TSS. More than half of the station basin is natural land use (60.6%).



### Watershed Land Use



### Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	725	18.1	21.3	60.6	84
<b>L-R Basin</b>	2051	30.7	20.5	48.9	-

L-R (Land-River) Segment N24009XL3\_4952\_0000

### CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	2030	1195	1200	899	5324
<b>Phosphorus</b>	195	185	411	NA	791

Downscaled from CAST modeled loads for L-R Segment

### Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	12.5	2.7	46.0
<b><math>NH_4</math>, mg N/L</b>	0.075	0.031	0.108
<b><math>NO_{23}</math>, mg N/L</b>	2.200	0.277	3.420
<b><math>PO_4</math>, mg P/L</b>	0.0188	0.0075	0.0533
<b>Discharge, cfs</b>	0.84	0.14	6.52

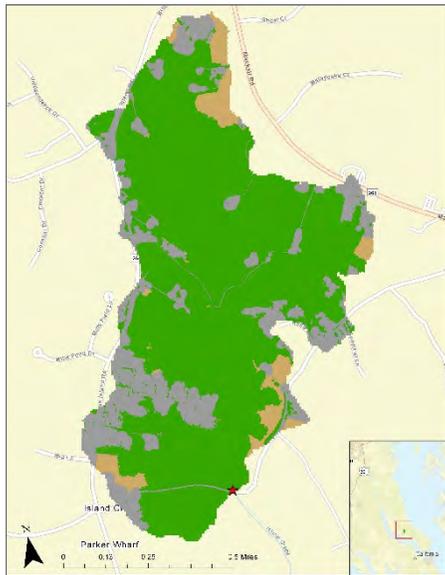
### Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	34,164	3071	624,929	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	210	45	878	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	6400	841	12,250	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	85	9	374	35

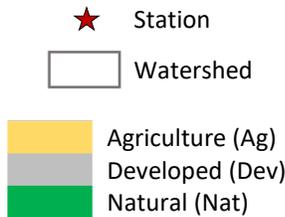
Calculated using instantaneous flow. Further scale up not recommended.

# Station ISLA 1: Island Creek

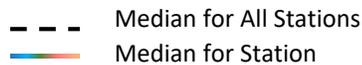
ISLA 1 is close to the median for all parameters measured ( $NH_4$ ,  $NO_{23}$ ,  $PO_4$ , TSS, and discharge), with higher yields than the median for all stations. Most of the station basin is natural land use (74.7%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	477	5.5	19.8	74.7	61
<b>L-R Basin</b>	5255	23.4	18.0	58.5	-

L-R (Land-River) Segment N24009XLO\_5346\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	442	879	995	653	2969
<b>Phosphorus</b>	21	77	395	NA	493

Downscaled from CAST modeled loads for L-R Segment

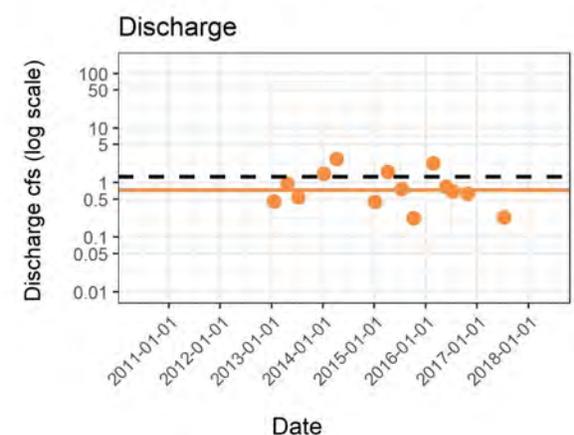
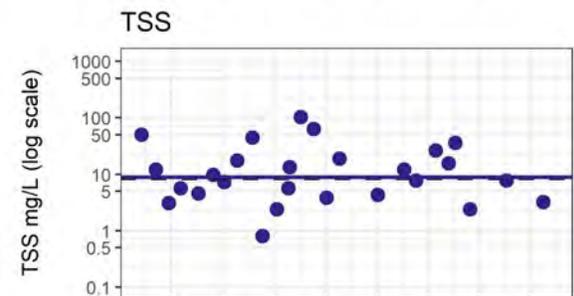
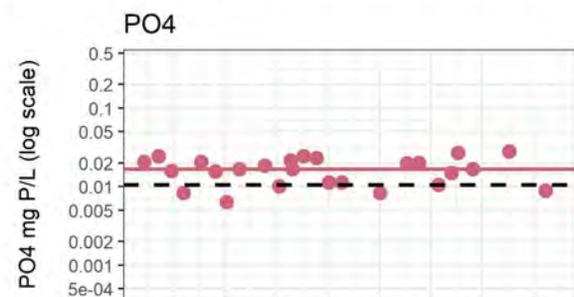
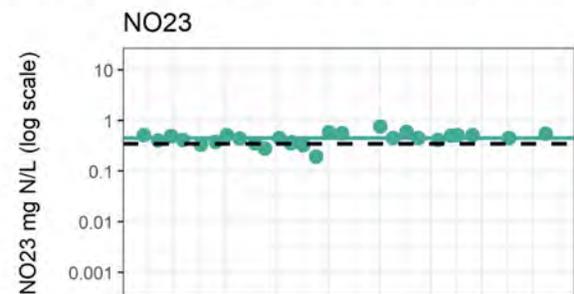
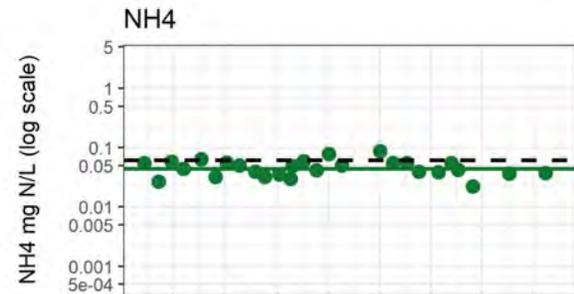
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	8.8	0.8	103.0
<b><math>NH_4</math>, mg N/L</b>	0.046	0.022	0.087
<b><math>NO_{23}</math>, mg N/L</b>	0.446	0.189	0.756
<b><math>PO_4</math>, mg P/L</b>	0.0165	0.0063	0.0280
<b>Discharge, cfs</b>	0.72	0.22	2.71

## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	46,187	5,542	302,123	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	204	42	695	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	1788	500	7705	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	68	19	156	35

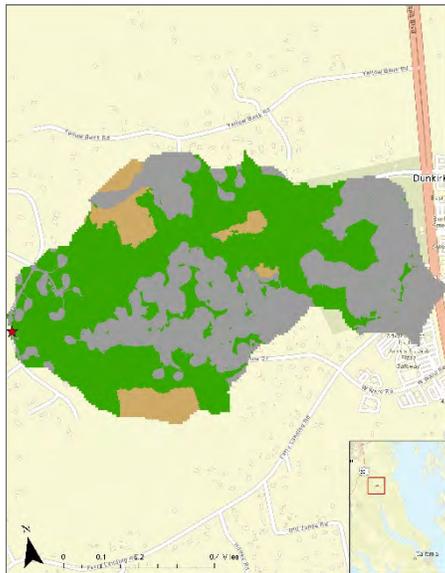
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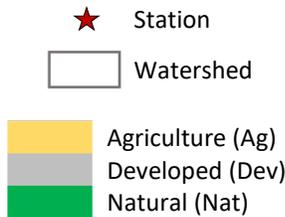
Date

# Station KING 1: Kings Branch

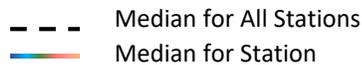
KING 1 is close to the median for  $PO_4$  and  $NH_4$ , higher for  $NO_{23}$ , and lower for TSS and discharge, resulting in higher yields for nitrogen and phosphorus compared to the median for all stations. About half of the station basin is natural land use.



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	337	7.8	40.6	51.7	80
<b>L-R Basin</b>	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
<b>Nitrogen</b>	413	1114	482	856	2864
<b>Phosphorus</b>	29	151	135	NA	315

Downscaled from CAST modeled loads for L-R Segment

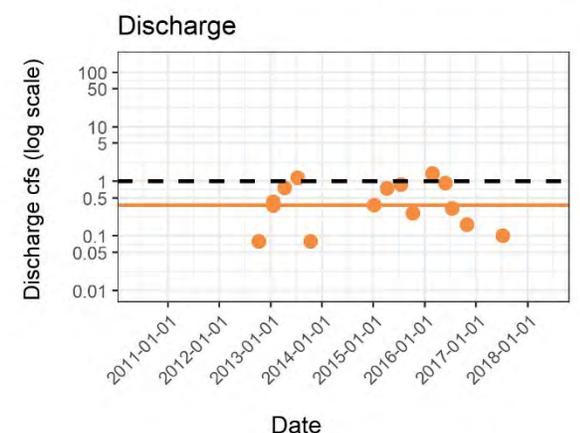
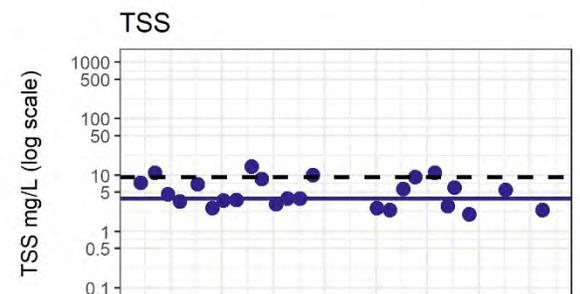
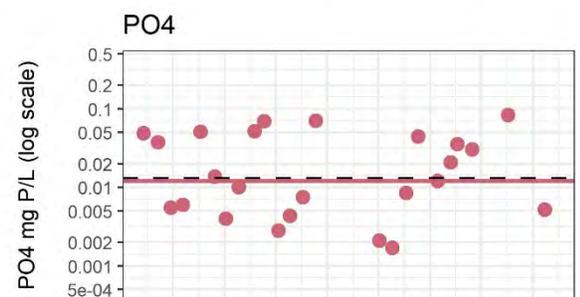
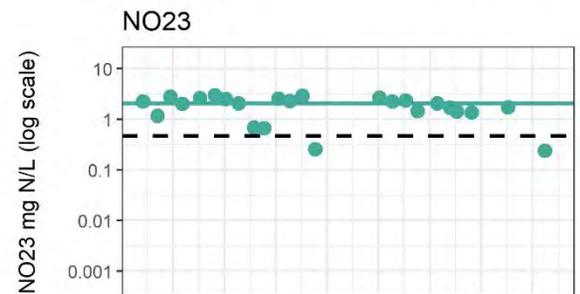
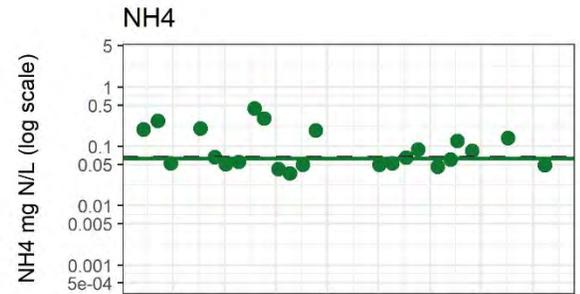
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	3.8	2.0	14.0
<b><math>NH_4</math>, mg N/L</b>	0.062	0.035	0.433
<b><math>NO_{23}</math>, mg N/L</b>	2.040	0.235	2.940
<b><math>PO_4</math>, mg P/L</b>	0.0121	0.0017	0.0832
<b>Discharge, cfs</b>	0.37	0.08	1.38

## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	12,882	2321	110,110	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	171	97	450	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	7112	146	24,107	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	41	6	141	35

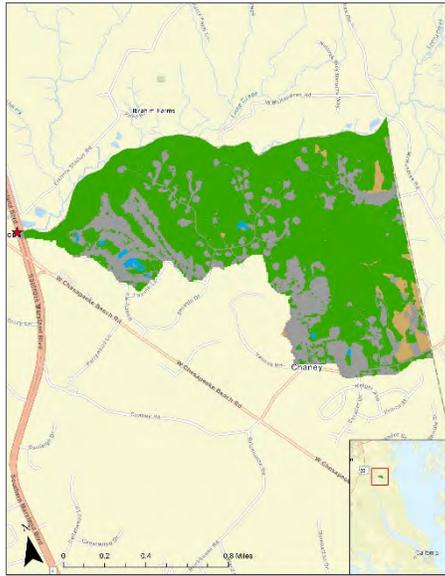
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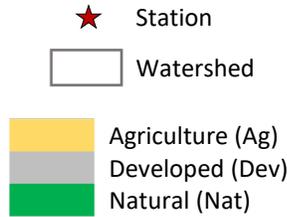
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# Station LYON 1: Lyons Creek

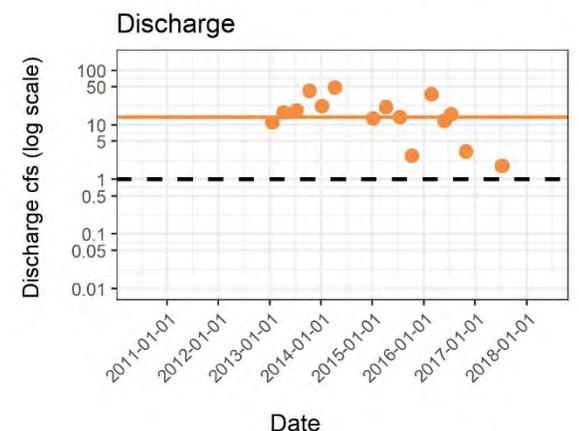
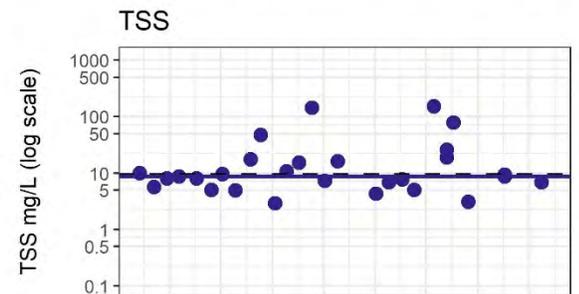
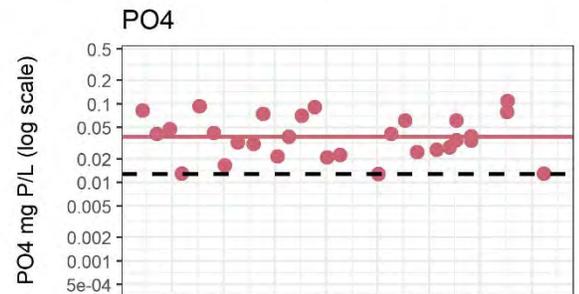
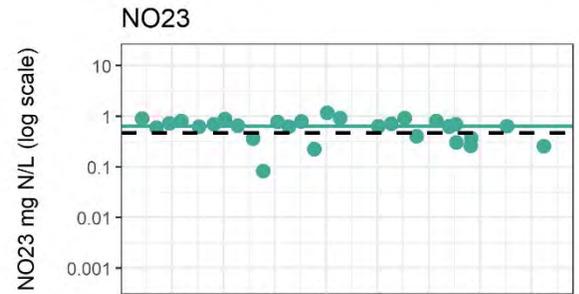
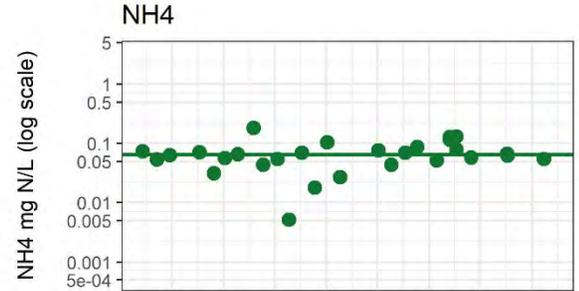
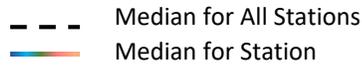
LYON 1 is close to the median for  $NH_4$  and TSS, and higher for  $NO_{23}$ ,  $PO_4$ , and discharge, resulting in higher yields for all parameters compared to the median for all stations. More than half of the station basin is natural land use in Calvert County.



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	839*	3.1*	26.3*	70.6*	136*
<b>L-R Basin</b>	5583	12.6	30.3	57.1	-

L-R (Land-River) Segment N24009XL3\_4713\_0000

\*Calvert Co. acres only, total acres=9583

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	404* (+39,693)	1794* (+15,666)	1639* (+11,381)	1456*	5293*
<b>Phosphorus</b>	28* (+3160)	244* (+2133)	458* (+4214)	NA	730*

Downscaled from CAST modeled loads for L-R Segment

\*Calvert Co. only, (+ outside county contribution)

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	8.6	2.9	151.0
<b><math>NH_4</math>, mg N/L</b>	0.065	0.005	0.183
<b><math>NO_{23}</math>, mg N/L</b>	0.637	0.082	1.170
<b><math>PO_4</math>, mg P/L</b>	0.0382	0.0128	0.1078
<b>Discharge, cfs</b>	13.68	1.77	48.10

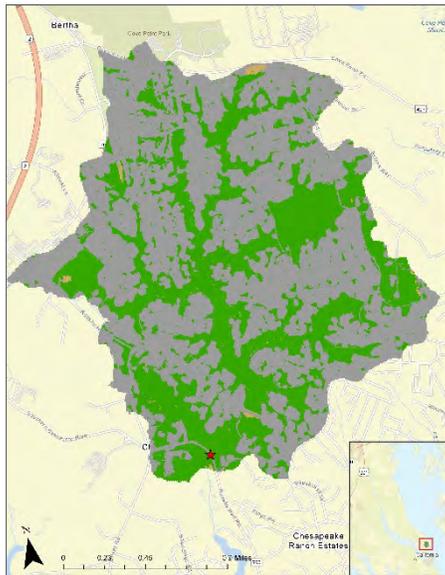
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	40,832	2548	1,508,068	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	245	22	587	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	2156	211	11,199	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	126	17	963	35

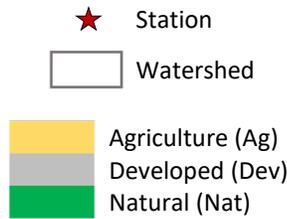
Calculated using instantaneous flow. Further scale up not recommended.

# Station MILL 1: Mill Creek

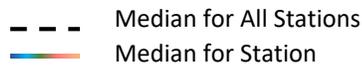
MILL 1 is close to the median for  $NO_{23}$ , higher for  $NH_4$  and discharge, lower for  $PO_4$  and TSS, while yields are higher for nitrogen compared to the median for all stations. More than half of the station basin is developed (63.3%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	2086	0.4	63.3	36.3	2396
<b>L-R Basin</b>	6276	1.3	56.2	42.5	-

L-R (Land-River) Segment N24009XLO\_4954\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	136	11,997	2059	25,540	39,732
<b>Phosphorus</b>	7	938	204	NA	1148

Downscaled from CAST modeled loads for L-R Segment

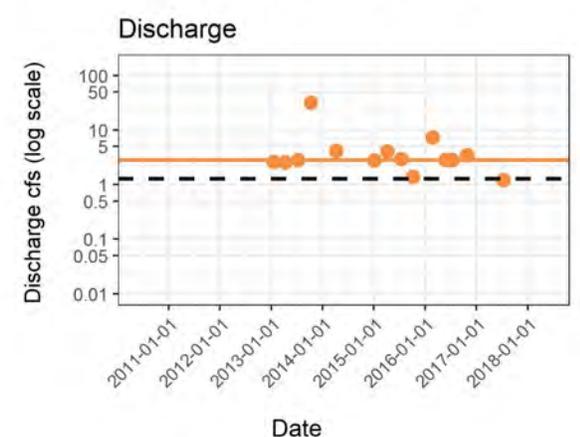
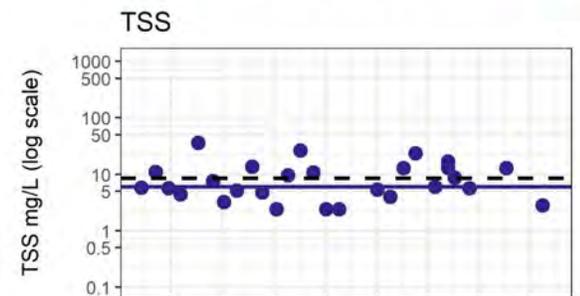
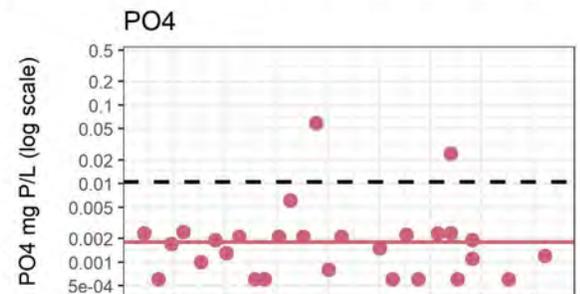
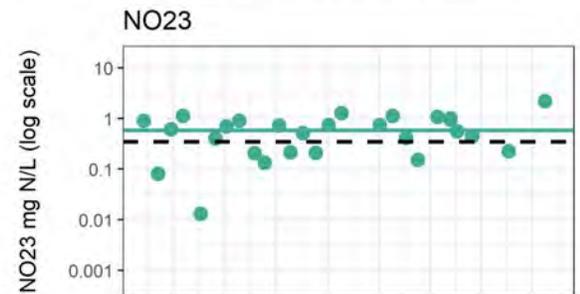
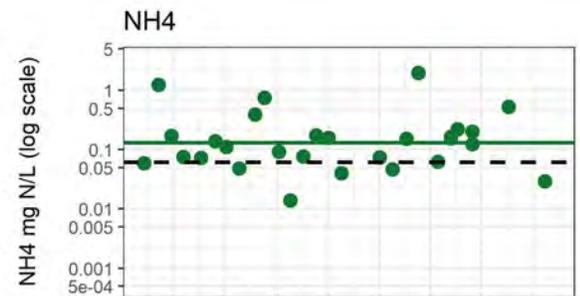
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	6.0	2.4	36.0
<b><math>NH_4</math>, mg N/L</b>	0.131	0.014	1.950
<b><math>NO_{23}</math>, mg N/L</b>	0.575	0.013	2.190
<b><math>PO_4</math>, mg P/L</b>	0.0018	0.0006	0.0588
<b>Discharge, cfs</b>	2.82	1.21	31.29

## Watershed Nutrient & Sediment Yields Summary

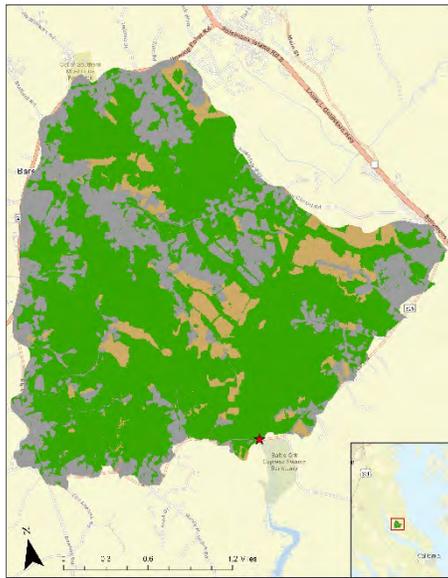
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	28,677	7320	396,404	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	516	42	6350	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	2006	244	9112	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	7	1	2158	35

Calculated using instantaneous flow. Further scale up not recommended.

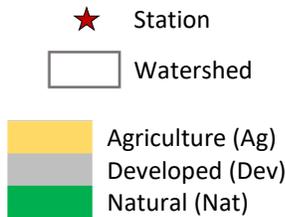


# Station NOBA 1: North Battle Creek

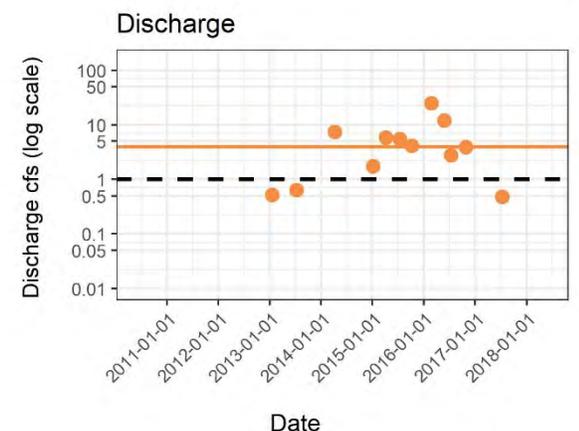
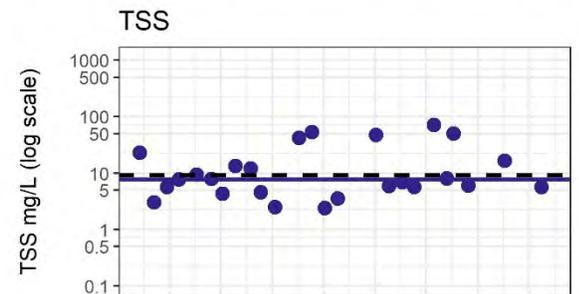
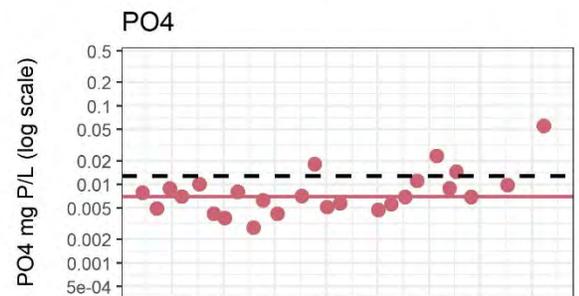
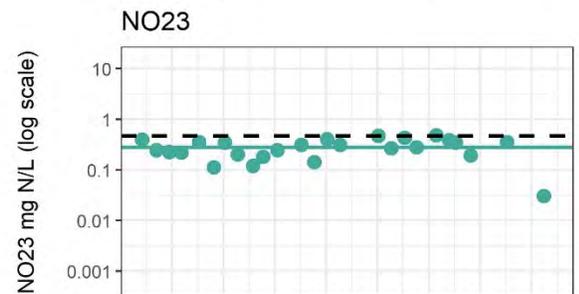
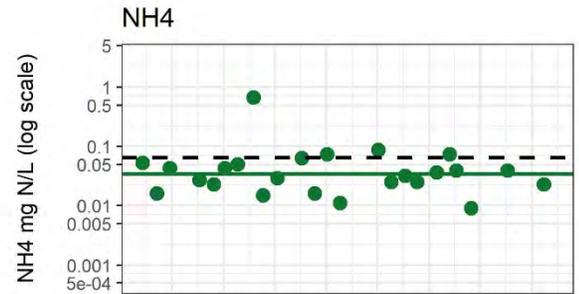
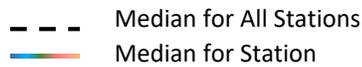
NOBA 1 is close to the median for TSS, lower for nitrogen and PO<sub>4</sub> and higher for discharge, while yields are lower for all parameters compared to the median of all stations. More than half of the station basin is natural land use (64.8%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	3,760	10.0	25.2	64.8	460
<b>L-R Basin</b>	6,403	8.5	22.3	69.1	-

L-R (Land-River) Segment N24009XLO\_5342\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	6340	8847	6006	4924	26,117
<b>Phosphorus</b>	274	668	2345	NA	3288

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	7.7	2.4	71.5
<b>NH<sub>4</sub>, mg N/L</b>	0.034	0.009	0.671
<b>NO<sub>23</sub>, mg N/L</b>	0.274	0.030	0.479
<b>PO<sub>4</sub>, mg P/L</b>	0.0070	0.0028	0.0556
<b>Discharge, cfs</b>	3.97	0.48	24.76

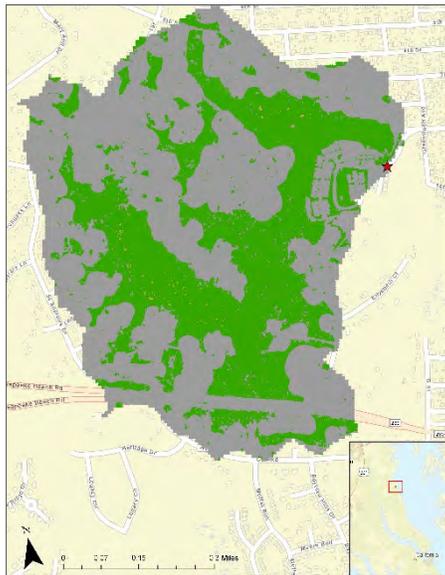
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	19,516	846	1,508,069	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	68	10	580	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	673	82	7717	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	23	1	367	35

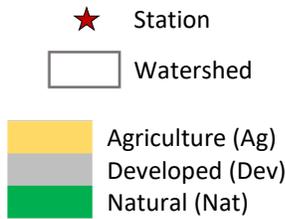
Calculated using instantaneous flow. Further scale up not recommended.

# Station NOBE 1: North Beach

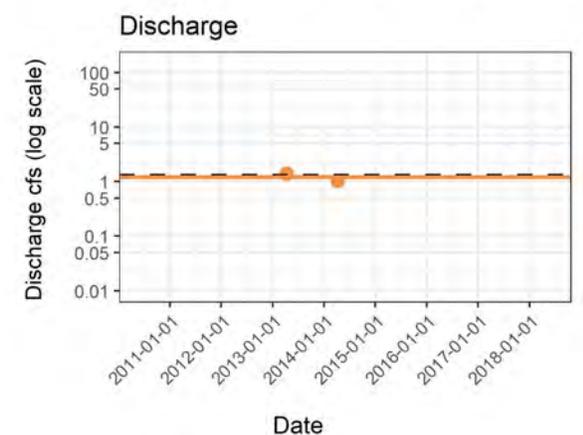
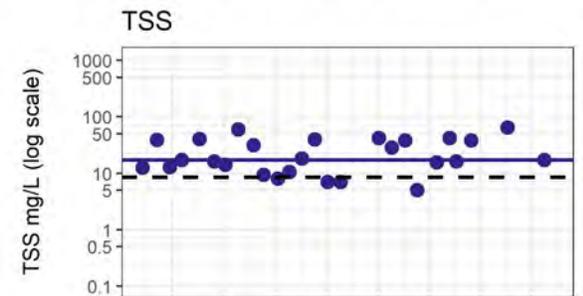
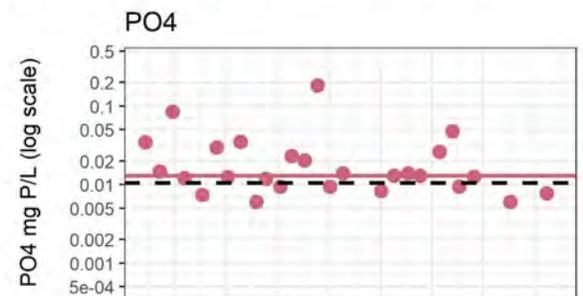
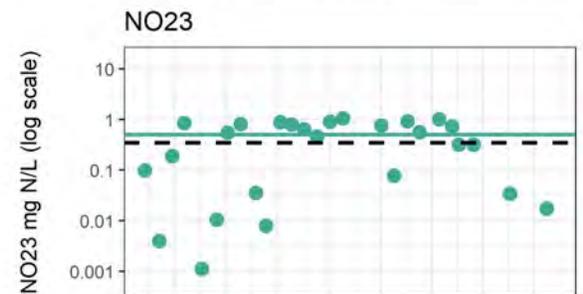
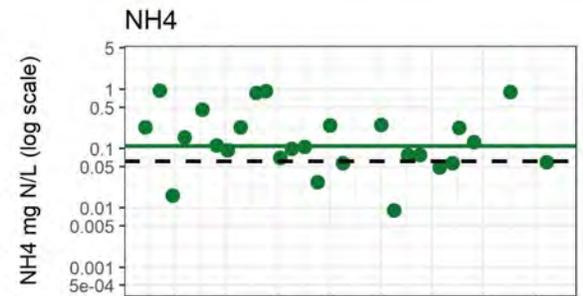
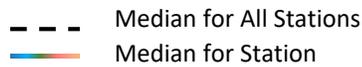
NOBE 1 is close to the median for  $NO_{23}$  and  $PO_4$  and slightly above for  $NH_4$  and TSS. When discharge was measured, yields were higher than the median for all stations. More than half of the station basin is developed land use (62.1%)



## Watershed Land Use



## Station Nutrients & Discharge



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

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

L-R (Land-River) Segment N24009WLO\_4772\_0000

## CAST Watershed Loads (lbs/year) by Land Use

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

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

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

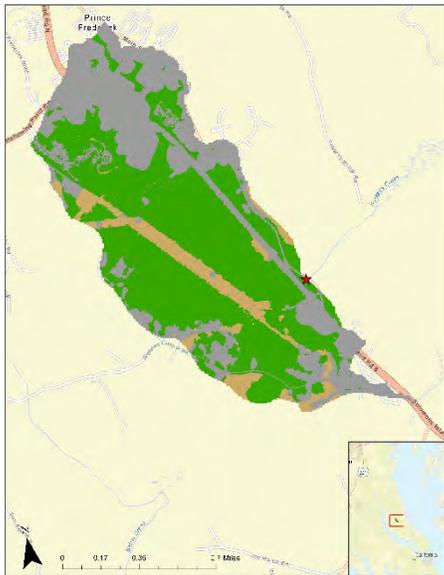
## Watershed Nutrient & Sediment Yields Summary

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

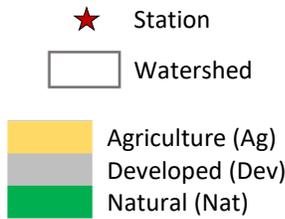
Calculated using instantaneous flow. Further scale up not recommended.

# Station PARK 1: Parkers Creek

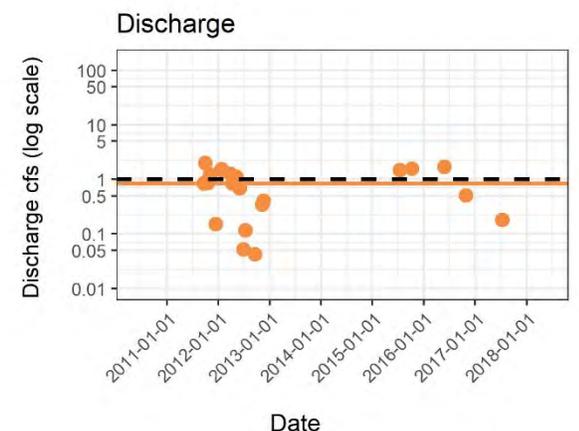
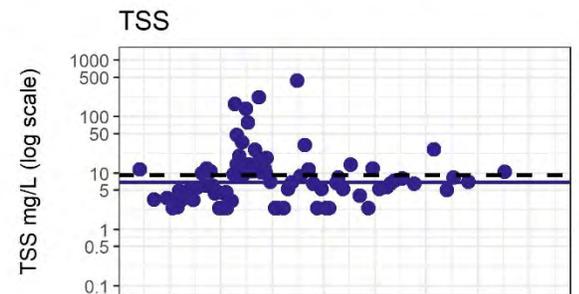
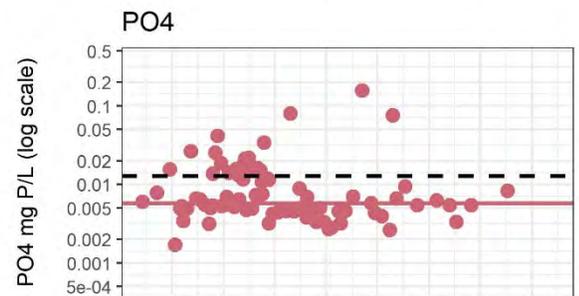
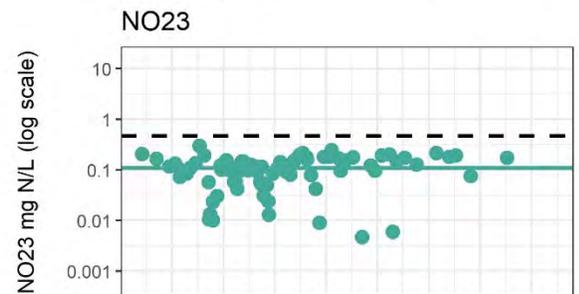
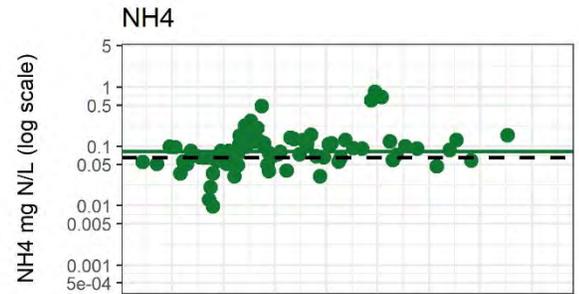
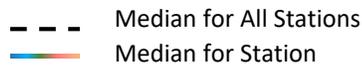
PARK 1 is close to the median for discharge, below for  $NO_{23}$ ,  $PO_4$ , and TSS, and slightly above for  $NH_4$ , while yields were lower than the medians for all stations. More than half of the station basin is natural land use (55.4%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	830	8.7	36.0	55.4	76
<b>L-R Basin</b>	7,634	9.5	14.1	76.5	-

L-R (Land-River) Segment N24009WLO\_4921\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	1178	2997	1169	814	6157
<b>Phosphorus</b>	51	204	784	NA	1040

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	6.8	2.4	431
<b><math>NH_4</math>, mg N/L</b>	0.082	0.010	0.828
<b><math>NO_{23}</math>, mg N/L</b>	0.109	0.005	0.294
<b><math>PO_4</math>, mg P/L</b>	0.0058	0.0017	0.1570
<b>Discharge, cfs</b>	0.845	0.04	1.99

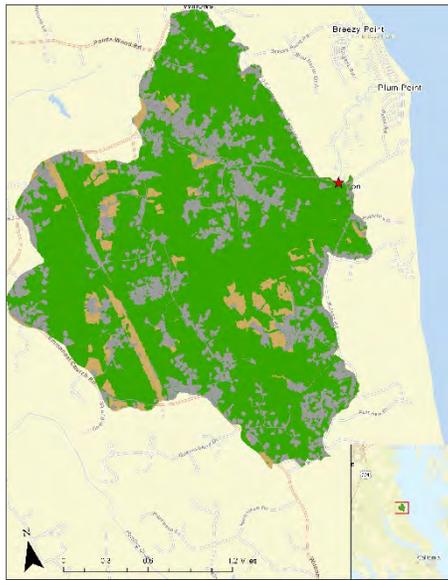
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	23,445	1921	415,033	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	152	15	448	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	103	7	886	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	26	2	92	35

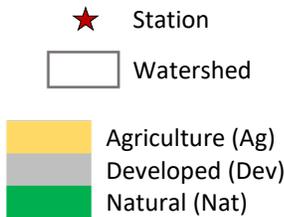
Calculated using instantaneous flow. Further scale up not recommended.

# Station PLUM 1: Plum Point Creek

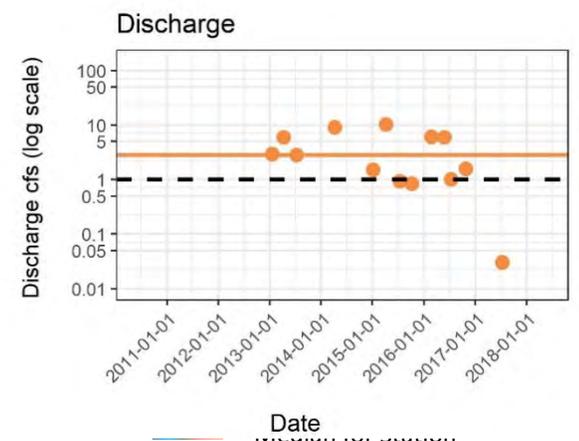
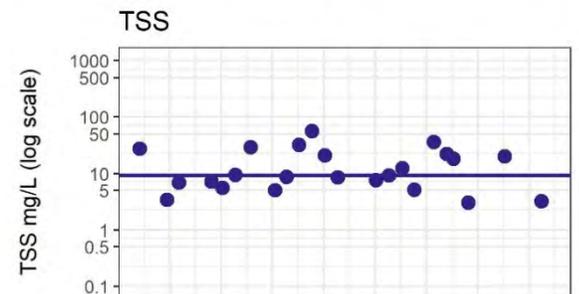
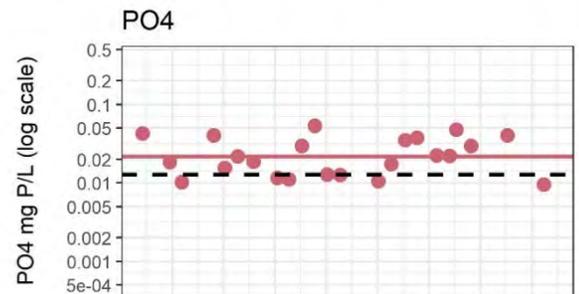
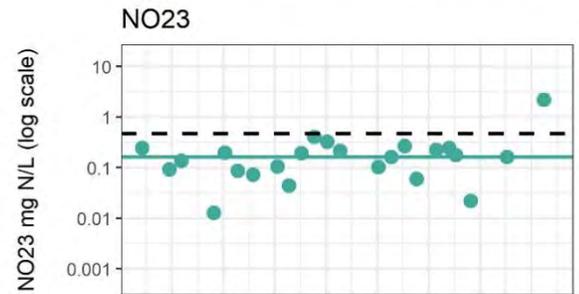
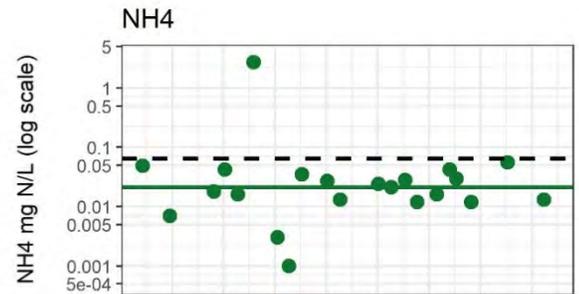
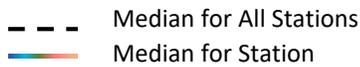
PLUM 1 is close to the median for TSS, lower for nitrogen, and higher for PO<sub>4</sub> and discharge, resulting in lower yields for nitrogen and TSS compared to the median of all stations. Most of the station basin is natural land use (71.2%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	3099	6.2	22.6	71.2	667
<b>L-R Basin</b>	6005	6.3	25.9	67.8	-

L-R (Land-River) Segment N24009WLO\_4920\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	2710	6137	5804	7140	21,791
<b>Phosphorus</b>	212	688	2703	NA	3602

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	9.2	3.0	56.0
<b>NH<sub>4</sub>, mg N/L</b>	0.021	0.001	2.755
<b>NO<sub>23</sub>, mg N/L</b>	0.161	0.013	2.190
<b>PO<sub>4</sub>, mg P/L</b>	0.0218	0.0095	0.0528
<b>Discharge, cfs</b>	2.80	0.03	10.11

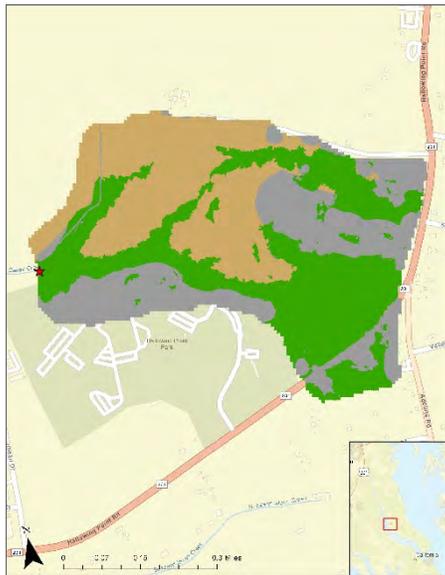
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	14,212	474	171,118	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	23	1	195	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	202	4	1501	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	38	1	137	35

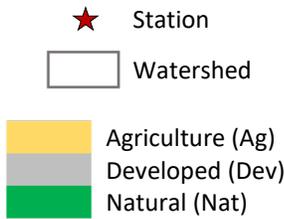
Calculated using instantaneous flow. Further scale up not recommended.

# Station RAMS 1: Ramsey Creek

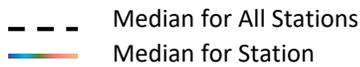
RAMS 1 is close to the median for PO<sub>4</sub> and TSS, slightly higher for nitrogen, and lower for discharge, while yields were higher for TSS, NH<sub>4</sub>, and PO<sub>4</sub> compared to the median for all stations. The stations basin has large areas in each land use category.



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	182	33.1	26.7	40.1	13
<b>L-R Basin</b>	3075	37.3	18.8	43.9	-

L-R (Land-River) Segment N24009XLO\_5341\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	1015	409	249	139	1811
<b>Phosphorus</b>	70	43	90	NA	203

Downscaled from CAST modeled loads for L-R Segment

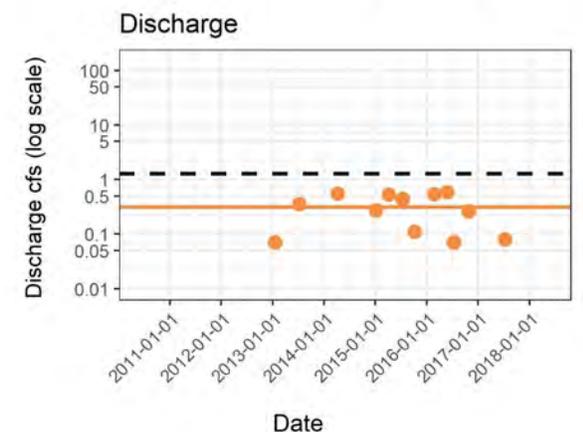
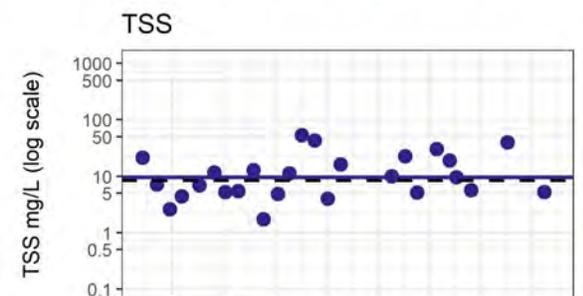
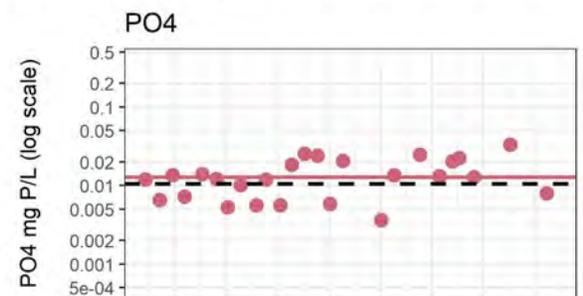
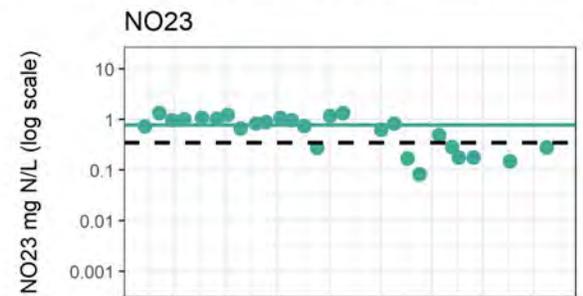
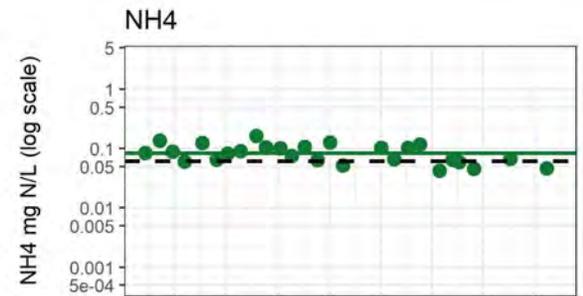
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	9.5	1.7	53.0
<b>NH<sub>4</sub>, mg N/L</b>	0.084	0.042	0.163
<b>NO<sub>23</sub>, mg N/L</b>	0.775	0.081	1.330
<b>PO<sub>4</sub>, mg P/L</b>	0.0128	0.0036	0.0332
<b>Discharge, cfs</b>	0.31	0.07	0.58

## Watershed Nutrient & Sediment Yields Summary

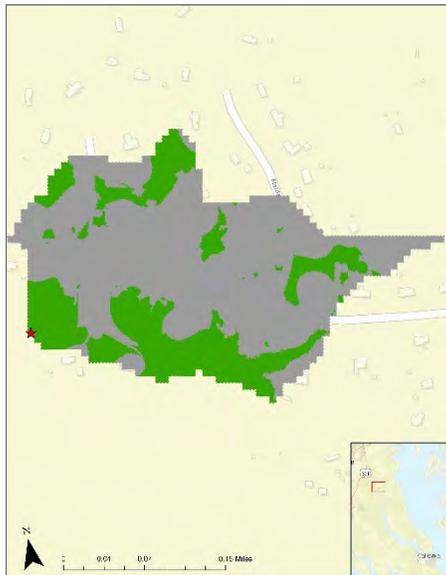
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	71,128	4509	248,948	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	337	55	608	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	1596	120	9817	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	45	5	156	35

Calculated using instantaneous flow. Further scale up not recommended.

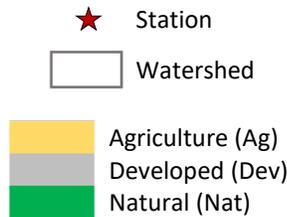


# Station SMTH 7A: Smithville

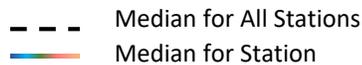
SMTH 7A is close to the median for TSS and PO<sub>4</sub>, higher for NO<sub>23</sub>, and lower for NH<sub>4</sub> and discharge, while yields are lower for TSS, NH<sub>4</sub>, and PO<sub>4</sub> compared to the median for all stations. Most of the station basin is developed land use (68.7%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	34	0	68.7	31.2	20
<b>L-R Basin</b>	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
<b>Nitrogen</b>	0	192	30	214	436
<b>Phosphorus</b>	0	26	8	NA	34

Downscaled from CAST modeled loads for L-R Segment

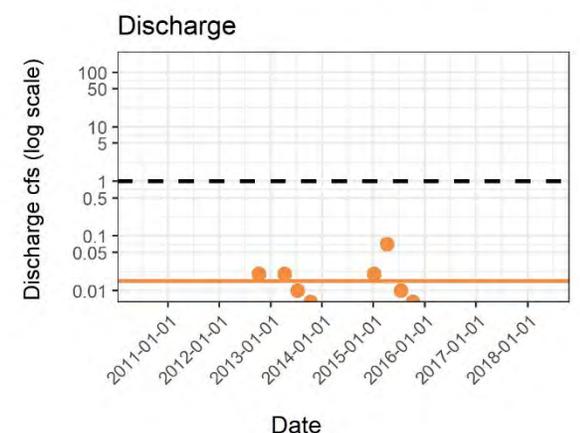
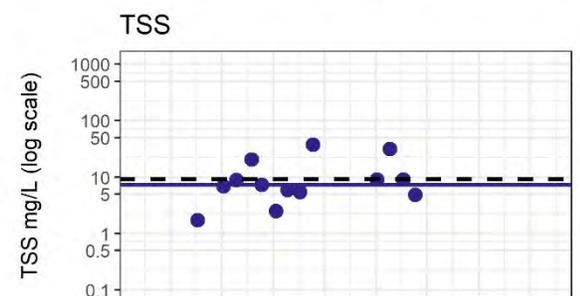
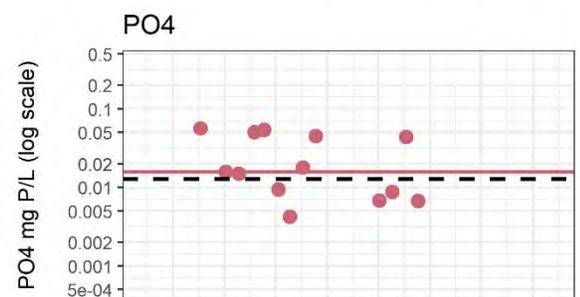
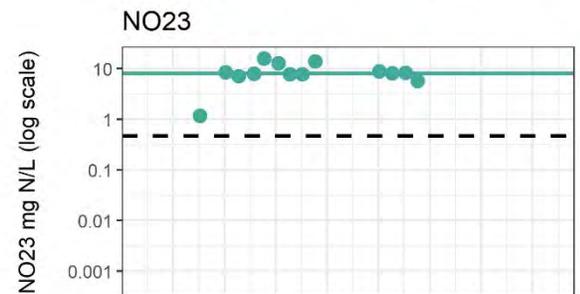
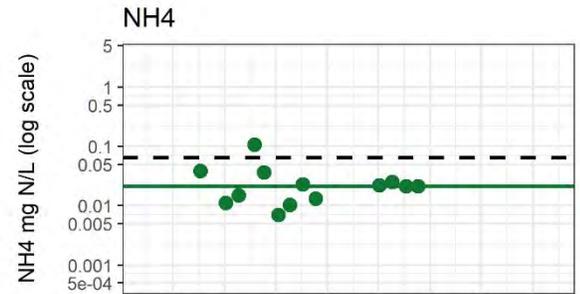
## Station Concentrations & Discharge Summary

	Median	Min	MaxN
<b>TSS, mg/L</b>	7.2	1.7	37.0
<b>NH<sub>4</sub>, mg N/L</b>	0.021	0.007	0.107
<b>NO<sub>23</sub>, mg N/L</b>	8.020	1.150	15.810
<b>PO<sub>4</sub>, mg P/L</b>	0.0156	0.0042	0.0559
<b>Discharge, cfs</b>	0.02	0	0.07

## Watershed Nutrient & Sediment Yields Summary

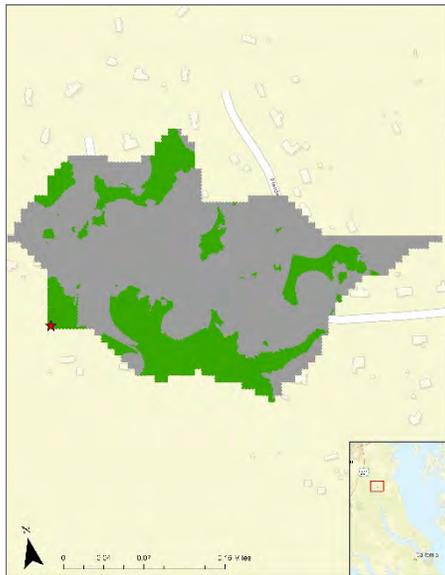
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	7332	0	154,472	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	16	0	125	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	8379	0	39,963	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	11	0	76	35

Calculated using instantaneous flow. Further scale up not recommended.

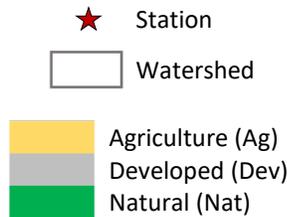


# Station SMTH 7B: Smithville

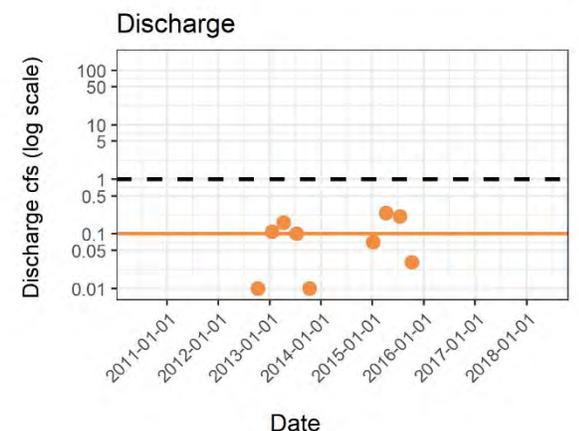
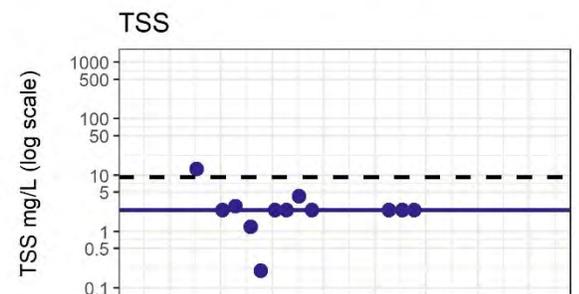
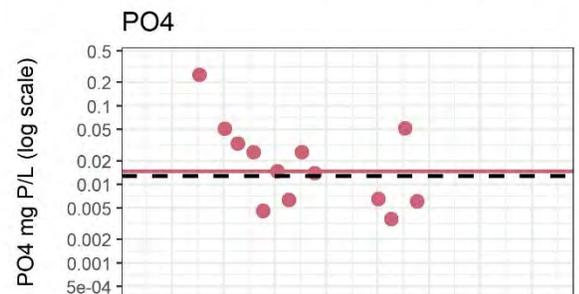
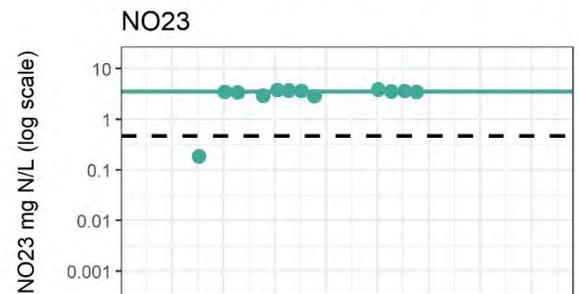
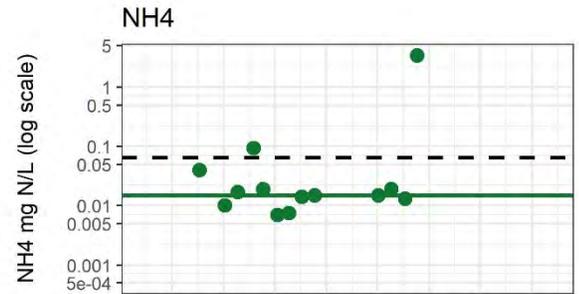
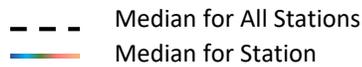
SMTH 7B is close to the median for PO<sub>4</sub>, higher for NO<sub>23</sub>, and lower for NH<sub>4</sub>, TSS, and discharge, while yields are higher for NO<sub>23</sub> and PO<sub>4</sub> compared to the median for all stations. Most of the station basin is developed land use (71.2%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	33	0	71.2	28.8	19
<b>L-R Basin</b>	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
<b>Nitrogen</b>	0	189	26	203	418
<b>Phosphorus</b>	0	26	7	NA	33

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	2.4	0.2	12.8
<b>NH<sub>4</sub>, mg N/L</b>	0.015	0.007	3.430
<b>NO<sub>23</sub>, mg N/L</b>	3.480	0.181	3.790
<b>PO<sub>4</sub>, mg P/L</b>	0.0146	0.0036	0.2467
<b>Discharge, cfs</b>	0.10	0.01	0.24

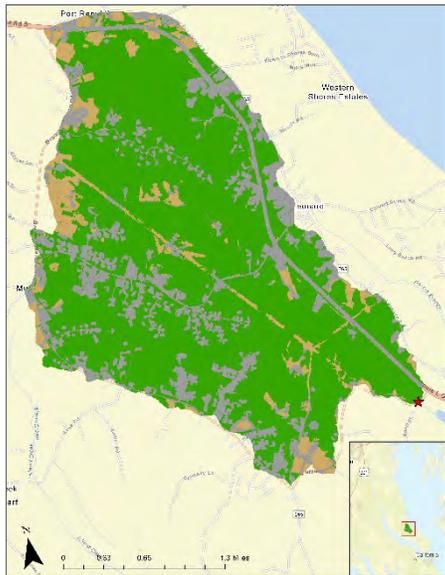
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	24,305	150	43,208	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	90	11	7719	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	27,005	2137	63,192	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	65	3	814	35

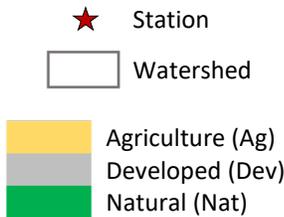
Calculated using instantaneous flow. Further scale up not recommended.

# Station STLE 1: St. Leonard Creek 1

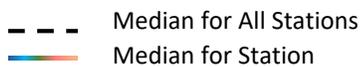
STLE 1 is close to the median for  $NO_{23}$ , slightly below for  $NH_4$ ,  $PO_4$ , and TSS, and higher for discharge. Yields are the median for  $NH_4$  and  $PO_4$  and lower than the median for all stations for TSS and  $NO_{23}$ . Most of the station basin is natural land use.



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	4360	8.0	20.4	71.6	694
<b>L-R Basin</b>	18,512	15.1	18.6	66.3	-

L-R (Land-River) Segment N24009XLO\_4954\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	5786	8967	8151	7429	30,332
<b>Phosphorus</b>	266	623	3240	NA	4129

Downscaled from CAST modeled loads for L-R Segment

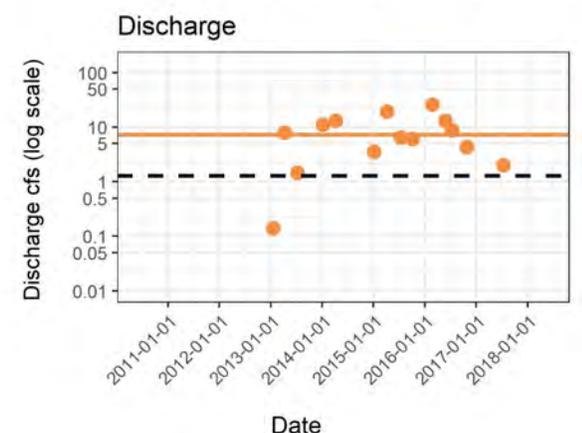
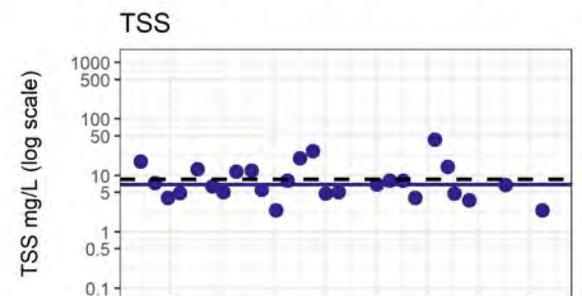
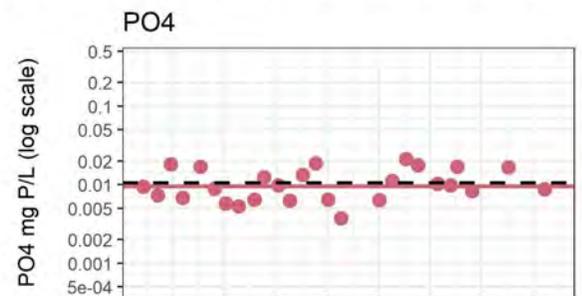
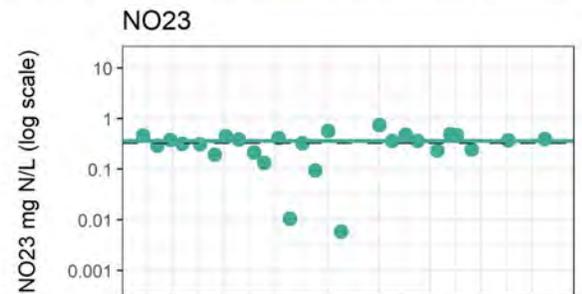
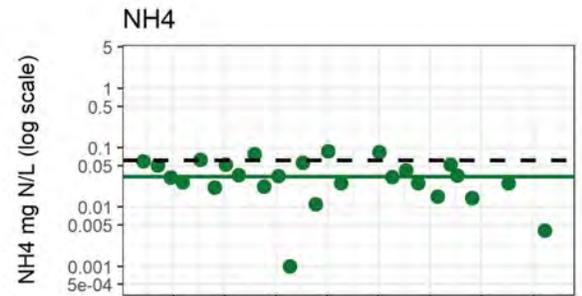
## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	6.8	2.4	43.0
<b><math>NH_4</math>, mg N/L</b>	0.033	0.001	0.086
<b><math>NO_{23}</math>, mg N/L</b>	0.362	0.006	0.740
<b><math>PO_4</math>, mg P/L</b>	0.0095	0.0037	0.0210
<b>Discharge, cfs</b>	7.16	0.14	25.93

## Watershed Nutrient & Sediment Yields Summary

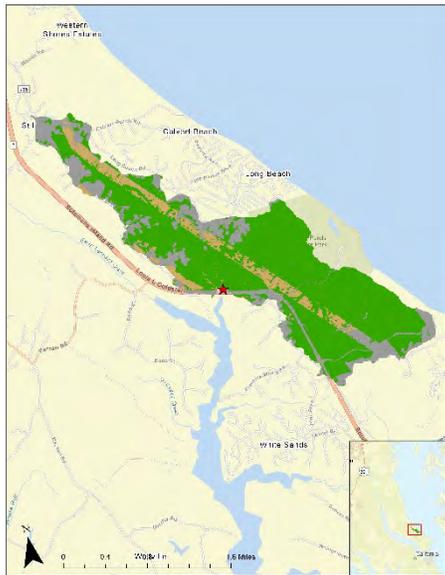
	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	25,731	189	625,732	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	154	3	531	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	1345	32	3834	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	34	1	148	35

Calculated using instantaneous flow. Further scale up not recommended

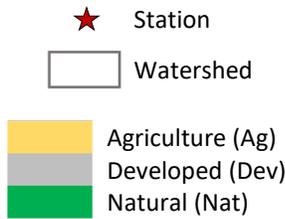


# Station STLE 2: St. Leonard Creek 2

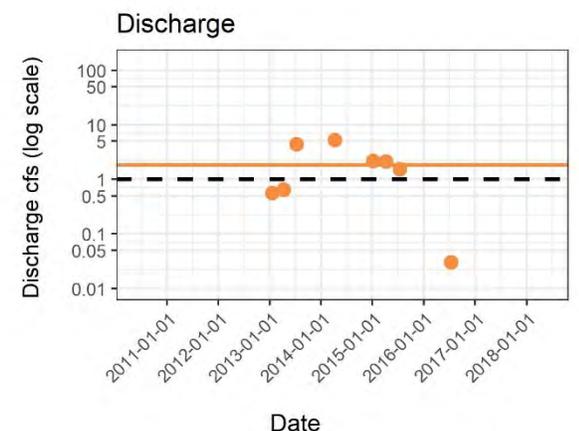
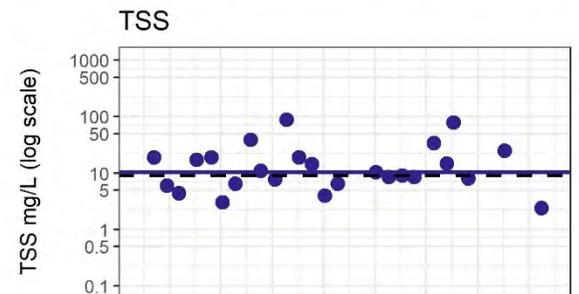
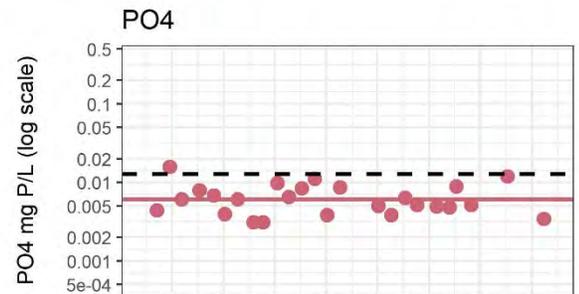
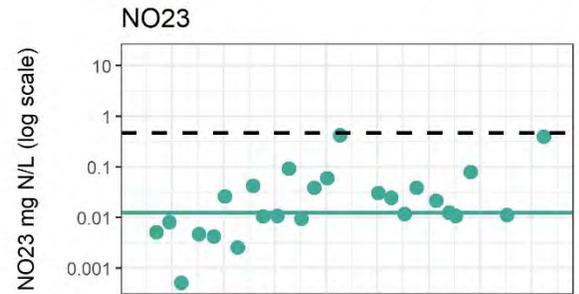
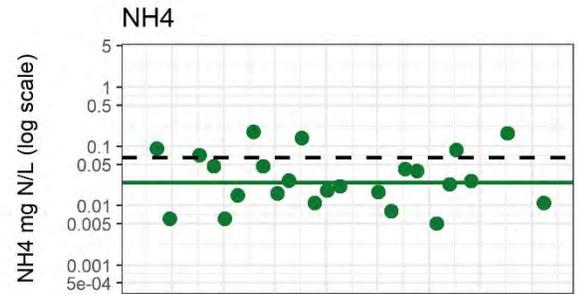
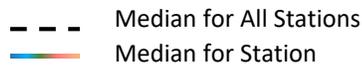
STLE 2 is close to the median for TSS, lower for nitrogen and PO<sub>4</sub>, and higher for discharge, resulting in yields lower for nitrogen and PO<sub>4</sub> compared to the median for all stations. More than half of the station basin is natural land use (70.0%).



## Watershed Land Use



## Station Nutrients & Discharge



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

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

L-R (Land-River) Segment N24009XLO\_4954\_0000

## CAST Watershed Loads (lbs/year) by Land Use

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

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	10.3	2.4	88.0
<b>NH<sub>4</sub>, mg N/L</b>	0.0245	0.005	0.175
<b>NO<sub>23</sub>, mg N/L</b>	0.012	0.0005	0.421
<b>PO<sub>4</sub>, mg P/L</b>	0.0061	0.0031	0.0158
<b>Discharge, cfs</b>	1.83	0.03	5.24

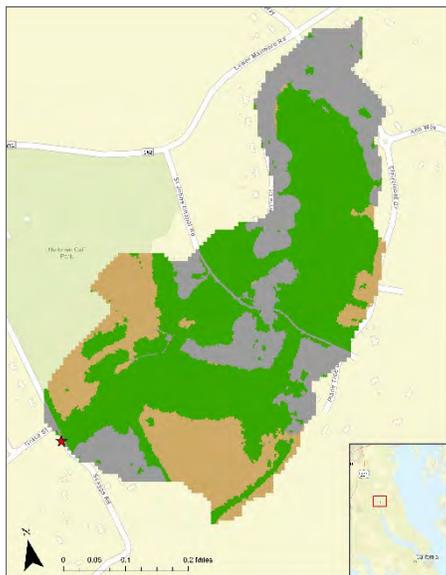
## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	27,675	3,208	114,359	28,677
<b>NH<sub>4</sub>, mg N/acre/day</b>	37	4	825	165
<b>NO<sub>23</sub>, mg N/acre/day</b>	63	0.4	3025	1,596
<b>PO<sub>4</sub>, mg P/acre/day</b>	12	0.4	62	35

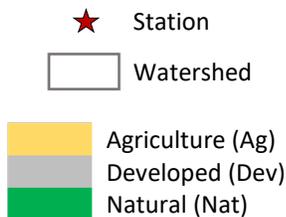
Calculated using instantaneous flow. Further scale up not recommended.

# Station TYVE 1: Tyverne Creek

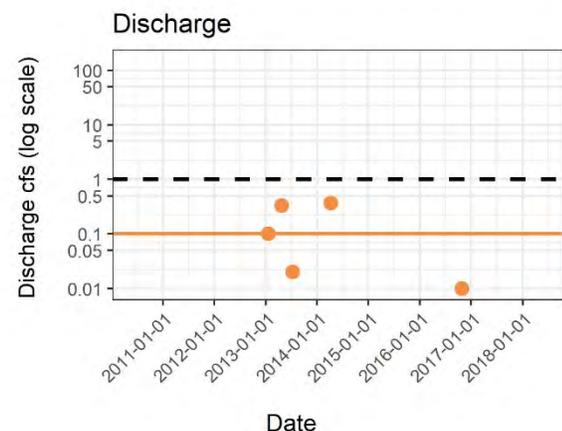
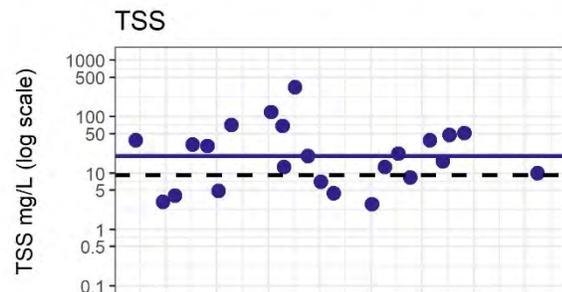
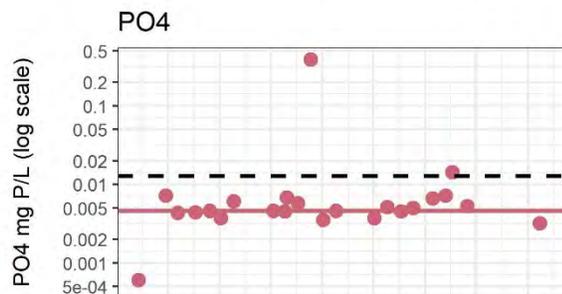
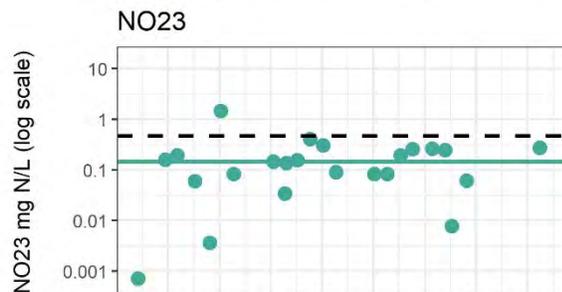
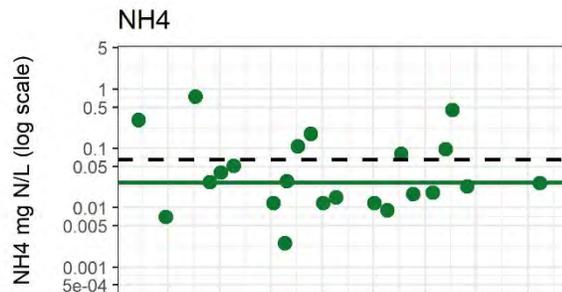
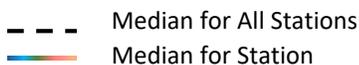
TYVE 1 is lower than the median for  $NH_4$ ,  $NO_{23}$ ,  $PO_4$ , and discharge and higher for TSS, leading to lower yields for  $NH_4$ ,  $NO_{23}$ , and  $PO_4$  compared to the median for all stations. Half the station basin is natural land use (53.6%).



## Watershed Land Use



## Station Nutrients & Discharge



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

	Acres	Ag	Dev	Nat	Septic
<b>Station Basin</b>	141	20.7	25.7	53.6	27
<b>L-R Basin</b>	18,120	17.4	30.3	52.3	-

L-R (Land-River) Segment N24009XL3\_4950\_0000

## CAST Watershed Loads (lbs/year) by Land Use

	Ag	Dev	Nat	Septic	Total
<b>Nitrogen</b>	428	306	211	289	1233
<b>Phosphorus</b>	33	43	56	NA	133

Downscaled from CAST modeled loads for L-R Segment

## Station Concentrations & Discharge Summary

	Median	Min	Max
<b>TSS, mg/L</b>	20.0	2.8	334.0
<b><math>NH_4</math>, mg N/L</b>	0.027	0.003	0.751
<b><math>NO_{23}</math>, mg N/L</b>	0.144	0.0007	1.440
<b><math>PO_4</math>, mg P/L</b>	0.0046	0.0006	0.386
<b>Discharge, cfs</b>	0.10	0.01	0.37

## Watershed Nutrient & Sediment Yields Summary

	Median	Min	Max	Median for All
<b>TSS, mg/acre/day</b>	72,753	8766	208,313	28,677
<b><math>NH_4</math>, mg N/acre/day</b>	38	4	160	165
<b><math>NO_{23}</math>, mg N/acre/day</b>	250	11	768	1,596
<b><math>PO_4</math>, mg P/acre/day</b>	8	1	39	35

Calculated using instantaneous flow. Further scale up not recommended.

