Sand Branch Public and Technical Advisory Committee Meetings

PC/Laptop View

Minimize the control panel ➔

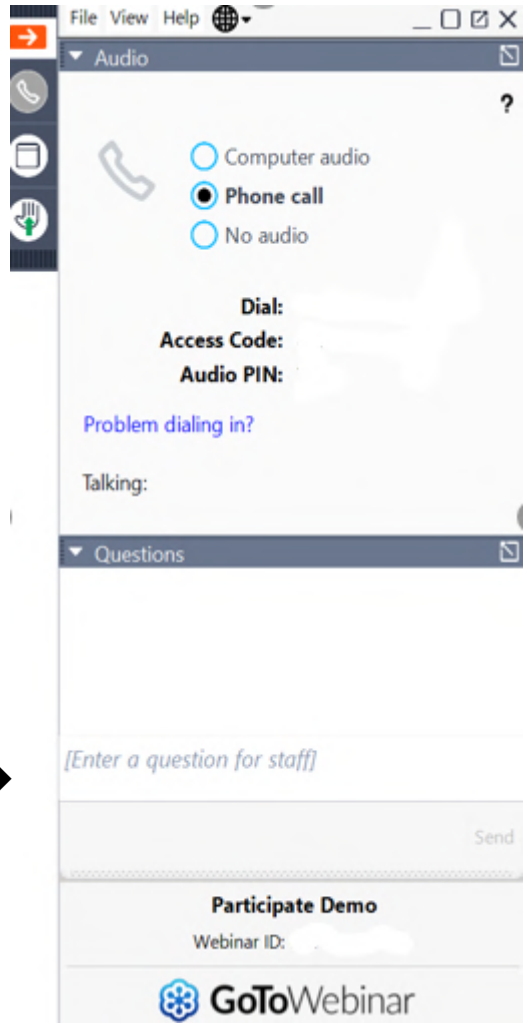
or maximize the control panel

Raise or lower your hand ➔

Select audio method ➚

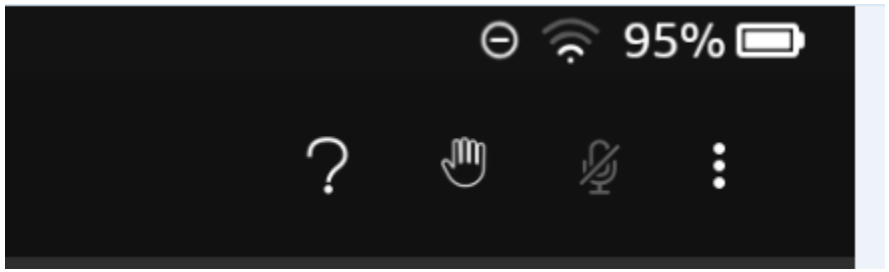
*Phone call provides better quality audio

Enter questions then click send ➔



Mobile Devices View

Android



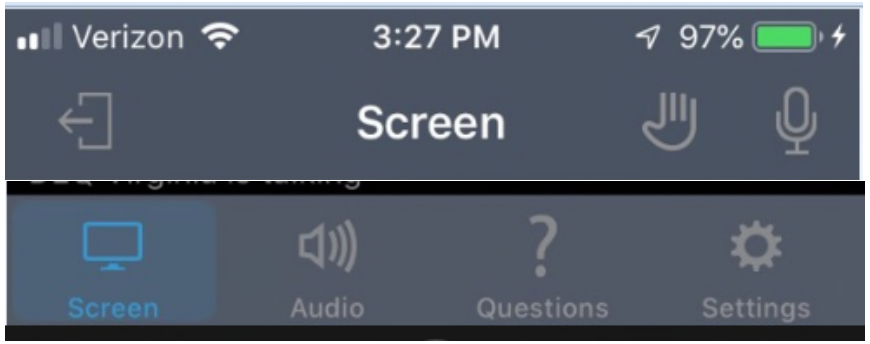
Enter Questions ➚

Raise ➚ Lower Hand

➚ Click 3 dots to open Audio Options

iPhone

Raise ➘ Lower Hand



Audio Options ➚

Enter ➚ Questions

For technical support issues call: 703-583-3906

Sand Branch Benthic TMDL Study

Second Public Meeting

Sarah K. Sivers
Water Quality Planning Team Lead
Virginia Department of Environmental Quality
May 26, 2021

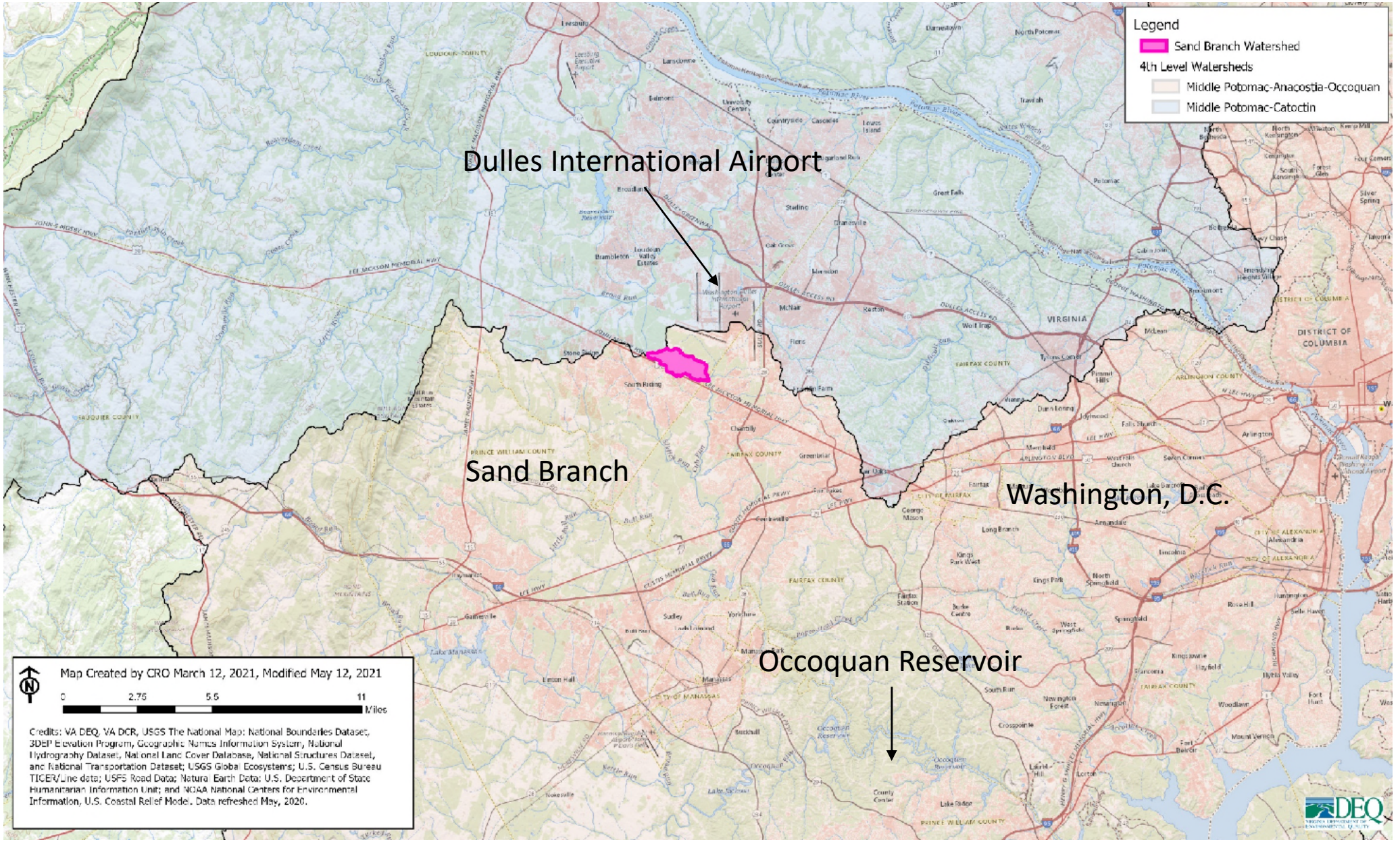
Agenda

- Project Overview
- Benthic Stressor Analysis
  - Analysis Overview
  - Water Quality Chemistry Data Analysis
  - Biological and Habitat Data Analysis
  - CADDIS
  - Probable Stressors
- TMDL Development
  - TMDL Targets
  - Project Timeline
- Wrap-up and Next Steps

Project Overview

Sand Branch

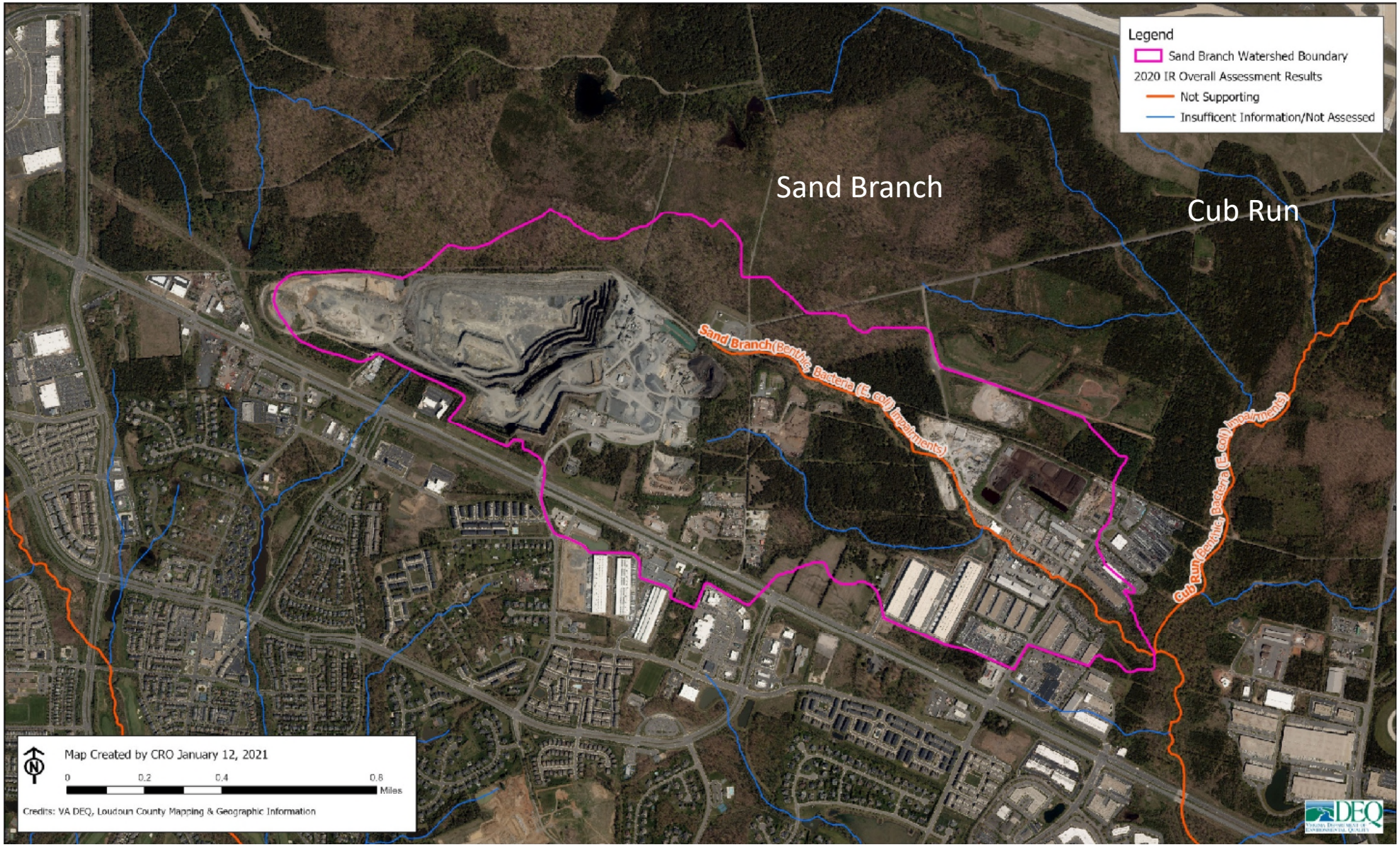
Project Location



For technical support issues call: 703-583-3906

Water Quality Impairments

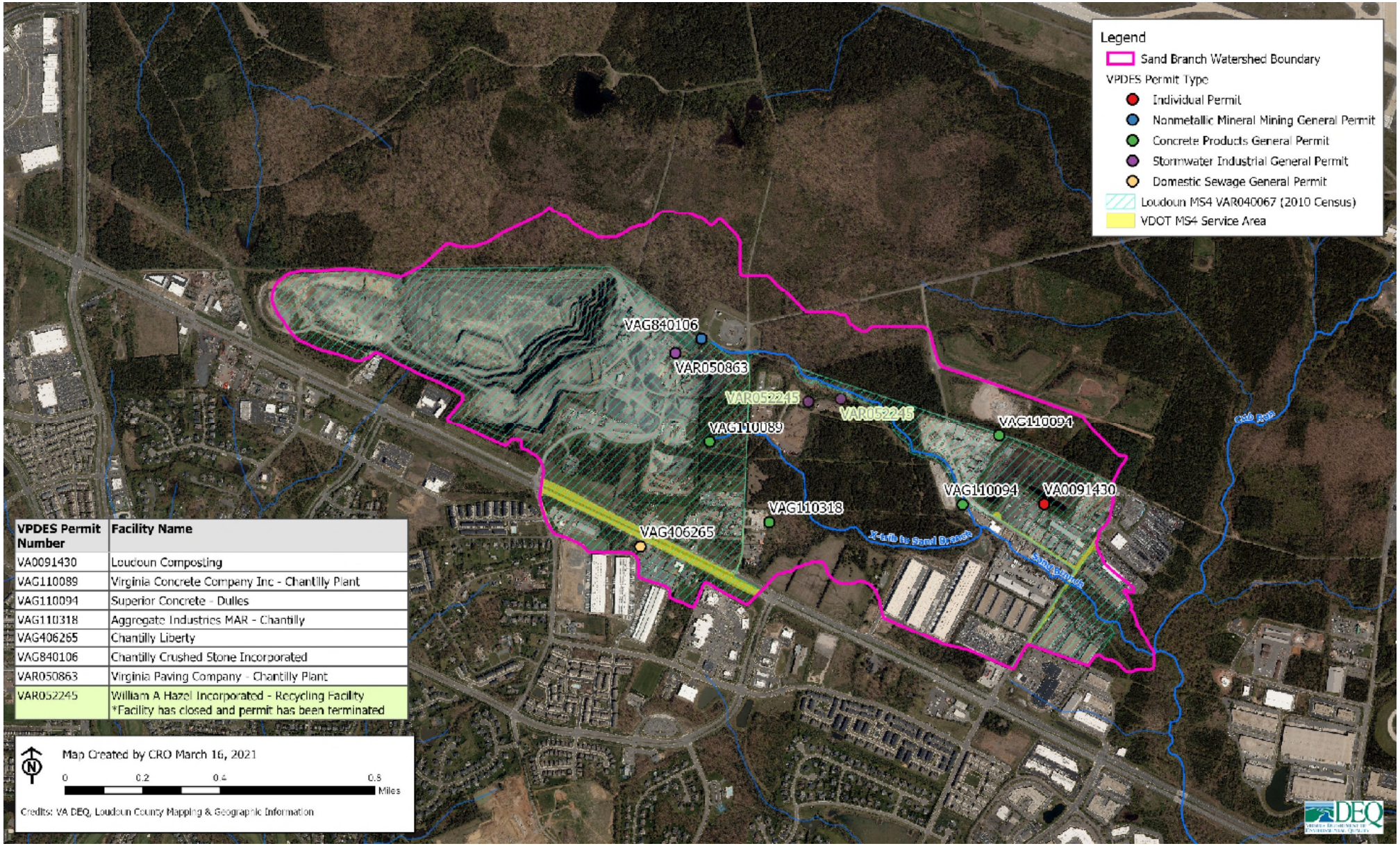
- Recreational Use (E.coli)
- Aquatic Life Use (Benthics)



For technical support issues call: 703-583-3906

DEQ

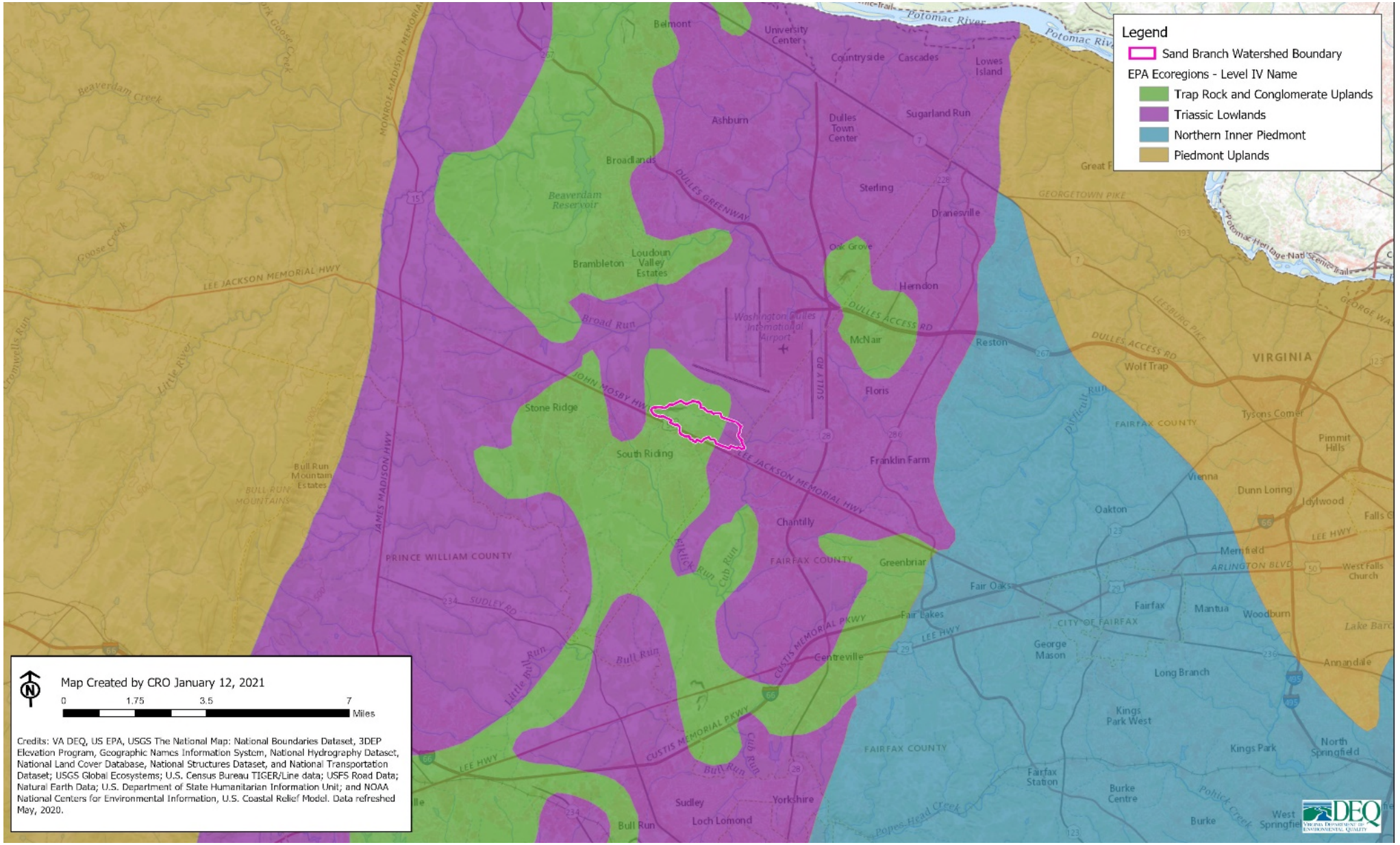
Permitted Discharges



VPDES Permit Number	Facility Name
VA0091430	Loudoun Composting
VAG110089	Virginia Concrete Company Inc - Chantilly Plant
VAG110094	Superior Concrete - Dulles
VAG110318	Aggregate Industries MAR - Chantilly
VAG406265	Chantilly Liberty
VAG840106	Chantilly Crushed Stone Incorporated
VAR050863	Virginia Paving Company - Chantilly Plant
VAR052245	William A Hazel Incorporated - Recycling Facility *Facility has closed and permit has been terminated

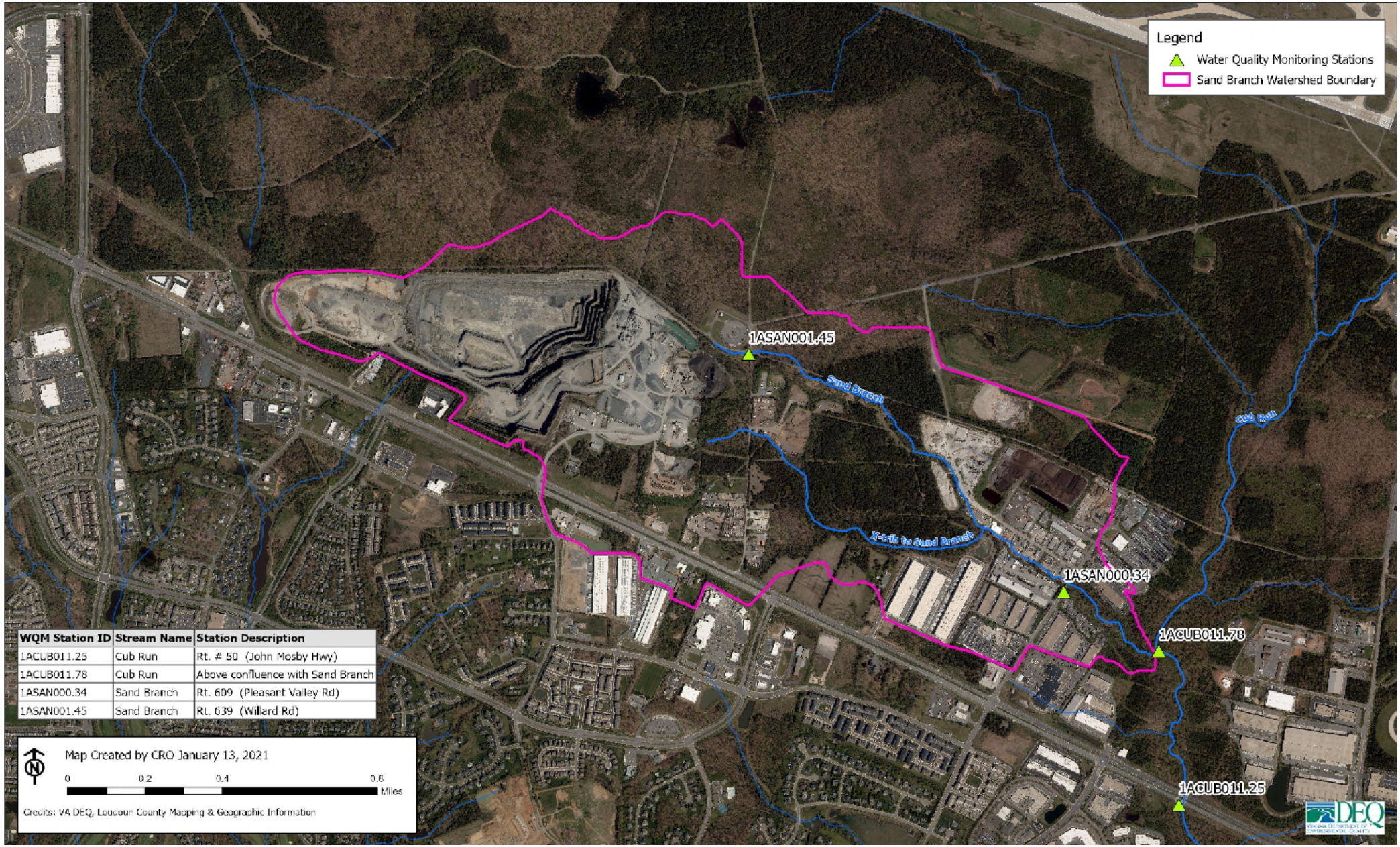
For technical support issues call: 703-583-3906

Ecoregion



For technical support issues call: 703-583-3906

Water Quality Monitoring Stations



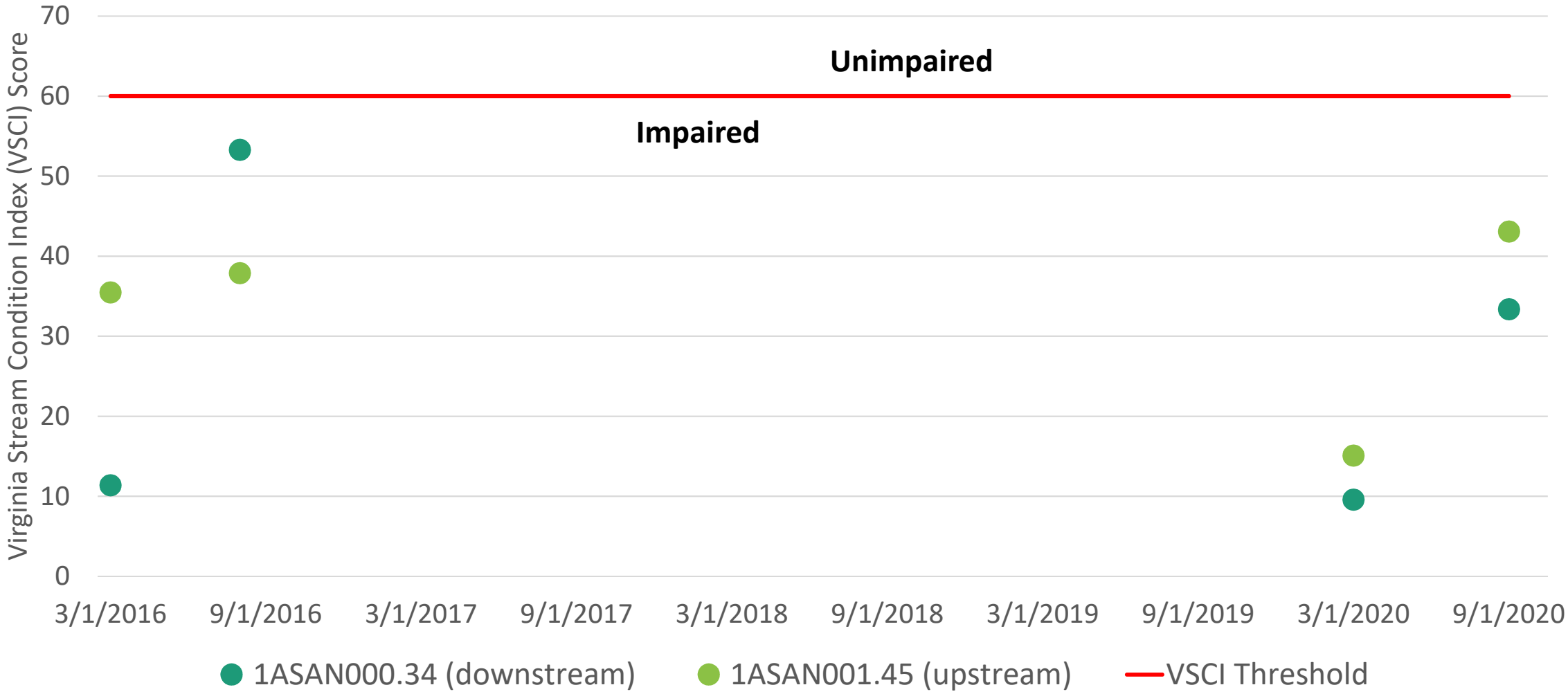
WQM Station ID	Stream Name	Station Description
1ACUB011.25	Cub Run	Rt. # 50 (John Mosby Hwy)
1ACUB011.78	Cub Run	Above confluence with Sand Branch
1ASAN000.34	Sand Branch	Rt. 609 (Pleasant Valley Rd)
1ASAN001.45	Sand Branch	Rt. 639 (Willard Rd)

For technical support issues call: 703-583-3906

Benthic Macroinvertebrate Community

- One metric to evaluate attainment of the Aquatic Life Use
- Indicator of Biological Community Health
  - Live on the stream bottom 1-2 years, relatively sedentary
  - Indicates long-term effect of pollution and ecosystem impact
  - Evaluated using the Virginia Stream Condition Index (VSCI)
    - Multi-metric index
    - Based upon a reference community of organisms

Virginia Stream Condition Index (VSCI) Scores



For technical support issues call: 703-583-3906

DEQ

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

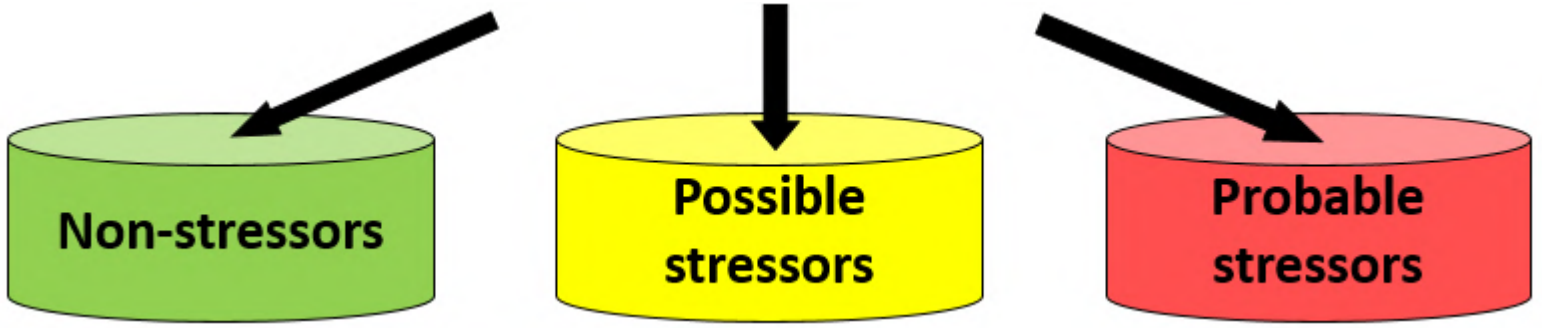
Benthic Stressor Analysis

Analysis Overview

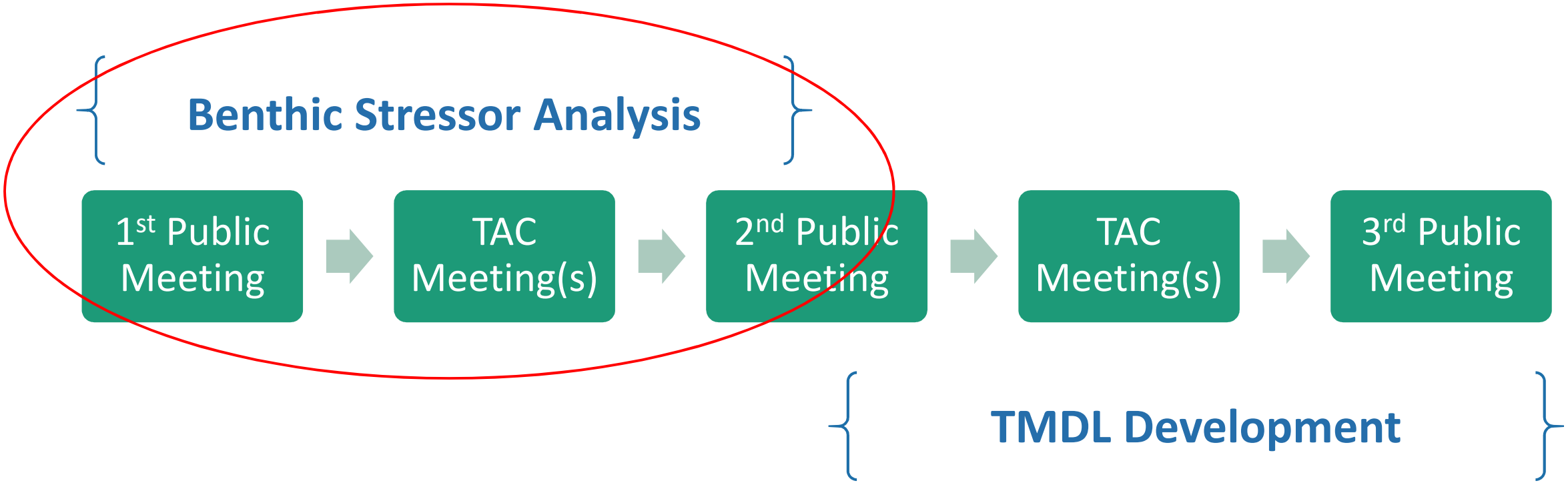
Benthic Stressor Analysis

"What is causing the benthic community to be unhealthy?

1. List all potential causes applicable to the watershed
   - For example: nutrients, sediment, toxics, etc.
2. Analyze the available data and information for and against each possible stressor
   - Such as water chemistry, habitat, land use, point and nonpoint sources
3. Categorize each cause into:



Public Participation in a Benthic TMDL Study



DEQ Water Quality Monitoring Data

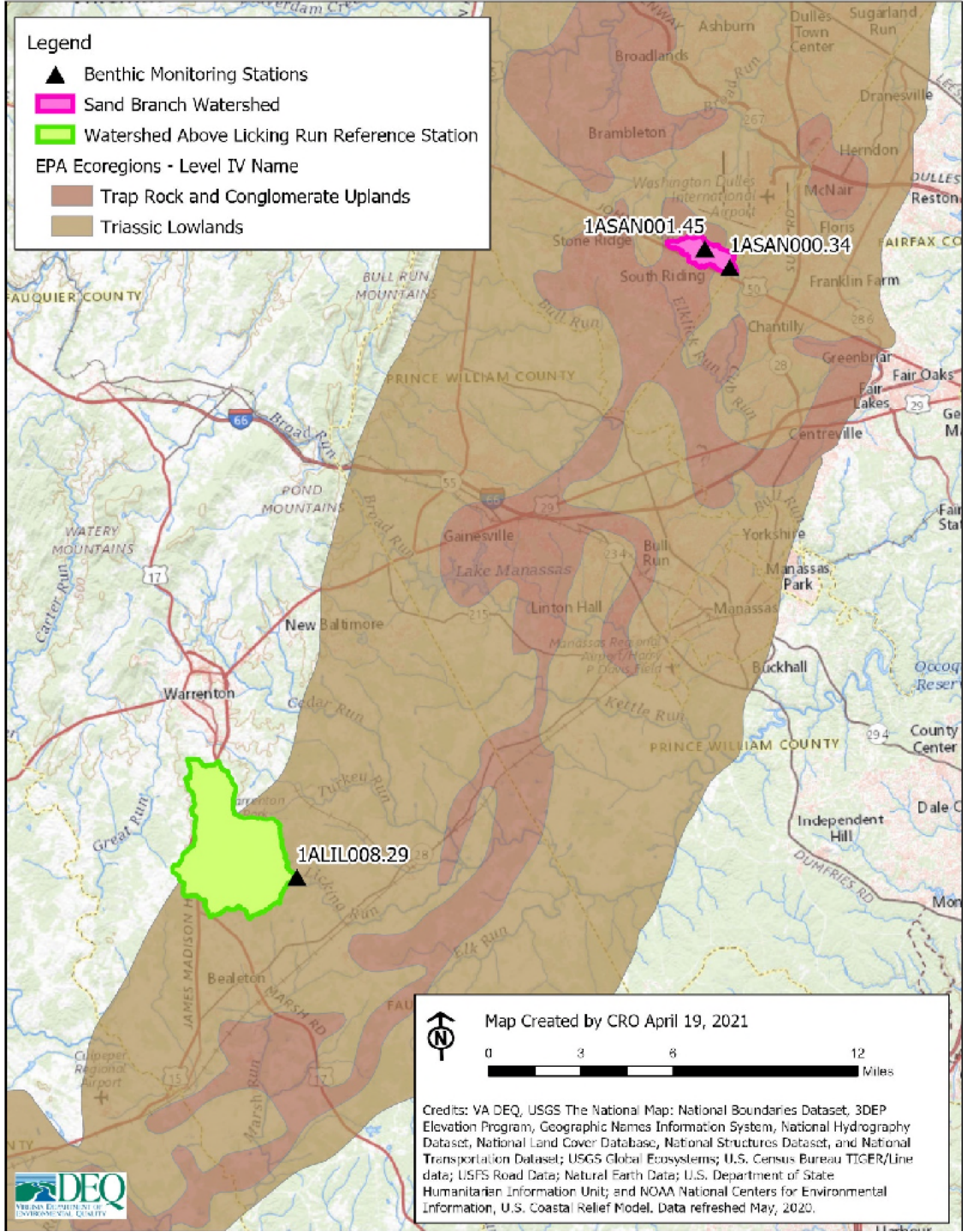
- Chemical (2015-2020)
  - Field parameters (pH, dissolved oxygen, specific conductivity, temp.)
  - Solids (total dissolved solids, total suspended solids)
  - Nutrients (nitrogen, phosphorous)
  - Ionic strength
  - Metals
- Benthic macroinvertebrates (2016 and 2020)
- Bioassay (Toxicity) Testing (ambient)
  - Acute and chronic (1 sample - 2020)
  - Water flea (*Ceriodaphnia dupia*) and Fathead minnow (*Pimephales promelas*)
- Effluent monitoring (collected by VPDES Permit-holders and DEQ, 2014-2018)

For technical support issues call: 703-583-3906

DEQ

Reference Watershed

- Comparison to a reference condition is helpful in evaluating some parameters and biological conditions
- Licking Run
  - Same Triassic Basin ecoregion
  - Unimpaired benthic condition (VSCI = 62.26)
  - Sufficient water quality data



For technical support issues call: 703-583-3906

Considerations for Water Chemistry Data Analysis

- Monitoring data evaluation:
  - Comparison to Water Quality Standards (9VAC25-260)
  - Comparison to stressor thresholds developed from DEQ's Freshwater Probabilistic Monitoring Program[1]
  - Seasonal or daily water quality variations
- Other relevant data considered:
  - Hydrology (stream flow and precipitation)
  - Potential influence of Triassic Basin geology
  - Surrounding land uses

[1]DEQ, 2017. Stressor Analysis in Virginia: Data Collection and Stressor Thresholds. DEQ Technical Bulletin WQA/2017-001

Considerations for Biological Data Analysis

- Review individual metrics of the Virginia Stream Condition Index Score (VSCI) that likely resulted in low scores
- Identify tolerance, sensitivity, taxonomic composition, and functional feeding group of collected benthic organisms
- Bioassay of ambient water sample (downstream DEQ sample location) to learn if the stream exhibits toxicity

USEPA's Causal Analysis/Diagnosis Decision Information System (CADDIS)

- For each candidate stressor and stream
- 18 lines of evidence evaluated
- Scored on a relative scale of -3 to +3 for strength of support
- Scores summed
- Higher relative score, more probable the stressor

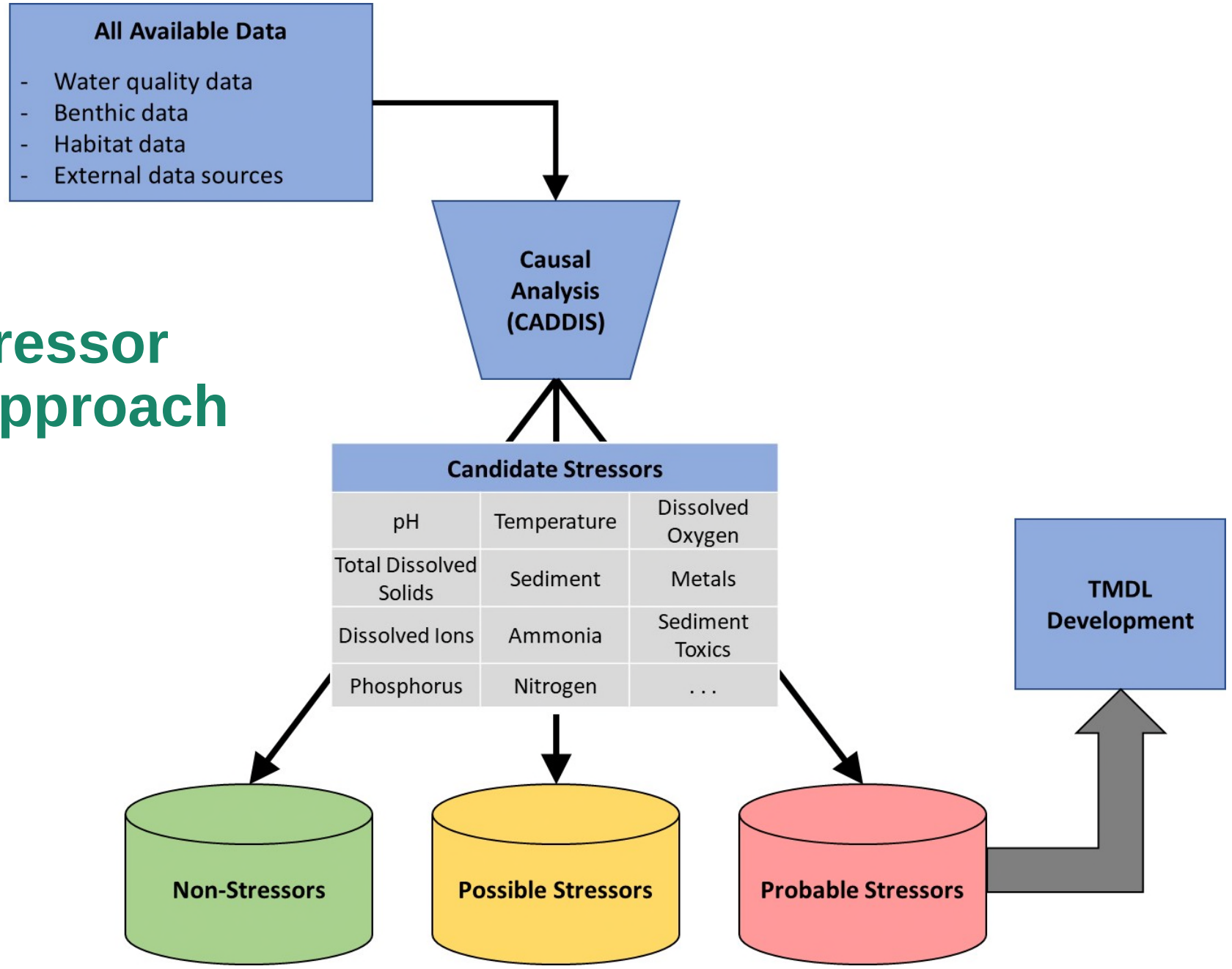
Ex: Candidate Stressor 1

Lines of Evidence	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5	Stream 6
Spatial Co-occurrence	-3	-3	-1	-1	+3	+3
Temporal Co-occurrence	-2	-2	0	0	+2	+2
Causal Pathway						
Stressor-Response Relationships from the Field						
Temporal Sequence						
Symptoms						
Stressor-Response Relationships from Other Field Studies						
Stressor-Response Relationships from Laboratory Studies						
Stressor-Response Relationships from Simulation Models						
Mechanistically Plausible Cause						
Manipulation of Exposure at Other Sites						
Analogous Stressors						
Consistency of Evidence	-3	-2	0	0	0	0
Explanation of the Evidence	-2	-2	0	0	0	0
SUM	**-32**	**-27**	**+1**	**+3**	**+12**	**+10**
	Non-Stressor		**Possible Stressor**		**Probable Stressor**	

Score	Explanation
+3	The line of evidence **strongly supports** the candidate stressor as the cause of the impairment
+2	The line of evidence **moderately supports** the candidate stressor as the cause of the impairment
+1	The line of evidence **weakly supports** the candidate stressor as the cause of the impairment
0	The line of evidence **does not support or refute** the candidate stressor as the cause of the impairment
-1	The line of evidence **weakly refutes** the candidate stressor as the cause of the impairment
-2	The line of evidence **moderately refutes** the candidate stressor as the cause of the impairment
-3	The line of evidence **strongly refutes** the candidate stressor as the cause of the impairment

DEQ

Benthic Stressor Analysis Approach



Benthic Stressor Analysis

Water Chemistry Data Analysis

Chemical / Physical Parameters Analyzed

Candidates <u>with</u> stressor thresholds[1,2]:	***pH***	***Dissolved Oxygen (DO)***	Total Phosphorus	Total Dissolved Solids (TDS)	Potassium
	Temperature	Specific Conductivity	Total Nitrogen	Sulfate	***Chloride***
	Sediment[3]	Sodium	Metal Cumulative Criterion Unit (Metals CCU)		***Individual Metals, Dissolved***
Candidates <u>without</u> stressor thresholds[2]:	Total Suspended Solids (TSS)		***Ammonia***	DO (Saturation)	Turbidity

[1]DEQ's Freshwater Probabilistic Monitoring Program (DEQ, 2017. Stressor Analysis in Virginia: Data Collection and Stressor Thresholds. DEQ Technical Bulletin WQA/2017-001)

[2]Where water quality criteria exists for a parameter, that value was also in the analysis (Water Quality Standards, 9VAC25-260). Those parameters with criteria are denoted in bold, italicized text.

[3] Sediment was evaluated using Log Relative Bed Stability (LRBS) index and Habitat.

For technical support issues call: 703-583-3906

DEQ

Stressor Thresholds: Definitions of Stress Probabilities

Probability of Stress to Aquatic Life	Definition
High Probability	Values that are the highest in Virginia, resulting in degradation of the benthic community.
Medium Probability	Noticeable evidence of harm causing a possible shift in benthic communities, changes noticeably above background conditions.
Low Probability	Slightly above background conditions, but unlikely to cause a major benthic community shift.
No Probability	Background conditions.

Benthic Stressor Analysis Threshold Results

Monitoring Location	Parameter										
	pH	DO	TP	TN	SC	TDS	Sulfate	Chloride	Potassium	Sodium	Metal CCU
1ASAN001.45	Low	No	No	Medium	High	High	High	Low	Low	High	-
1ASAN000.34	Low	Low	Low / Medium	Medium	High	High	High	Low	Medium	High	No
Combined	Low	Low	Low	Medium	High	High	High	Low	Low	High	-

For technical support issues call: 703-583-3906

DEQ

Comparison of Dissolved Metals to Water Quality Criteria

Monitoring Location	Parameter / Sample Exceedance of WQS (Y/N)								
	As	Cd	Cr[2]	Cu	Pb	Ni	Se	Ag	Zn
1ASAN000.34[1]	No	No	No	No	No	No	No	No	No

[1] Results based upon 3 sample events: October 3, 2019, October 31, 2019 and September 17, 2020
[2] Chromium was measured as total dissolved with no distinction among the valent forms, Cr III and Cr VI.

For technical support issues call: 703-583-3906

DEQ

Comparison of Chemical Data to Water Quality Criteria

- Ammonia
  - No excursions of the acute criterion
  - Single sample excursion of chronic criterion on 5/22/18
- No excursions of criteria for:
  - Chloride
  - Dissolved oxygen
  - pH
  - Temperature

	1ASAN000.34			1ASAN001.45		
Monitoring Date	Ammonia (mg/L)	Acute Criteria (mg/L)	Chronic Criteria (mg/L)	Ammonia (mg/L)	Acute Criteria (mg/L)	Chronic Criteria (mg/L)
12/5/2017	0.01 [a]	7.25	1.314	0.01 [a]	6.74	1.187
1/23/2018	0.01 [a]	5.94	1.070	< 0.008 [b]	6.57	1.165
3/12/2018	0.03 [a]	5.01	1.089	< 0.008 [b]	5.75	1.077
5/22/2018	1.5	5.86	1.042	0.06	3.34	0.688
7/26/2018	0.06	2.97	0.627	0.04	3.13	0.650
9/6/2018	0.36	3.21	0.657	0.02 [a]	2.60	0.564
11/8/2018	0.48	9.19	1.494	0.02 [a]	7.13	1.239
12/13/18[c]	--	--	--	0.01 [a]	--	--
10/3/2019	0.05	3.52	0.717	--	--	--
10/31/2019	0.02 [a]	7.55	1.265	--	--	--
3/9/2020	< 0.014 [b]	1.87	0.403	< 0.014 [b]	2.94	0.603
3/11/2020	< 0.014 [b]	6.34	1.130	< 0.014 [b]	3.33	0.667
8/10/2020	0.02 [a]	3.73	0.746			
8/26/2020	< 0.014 [b]	6.38	1.087			

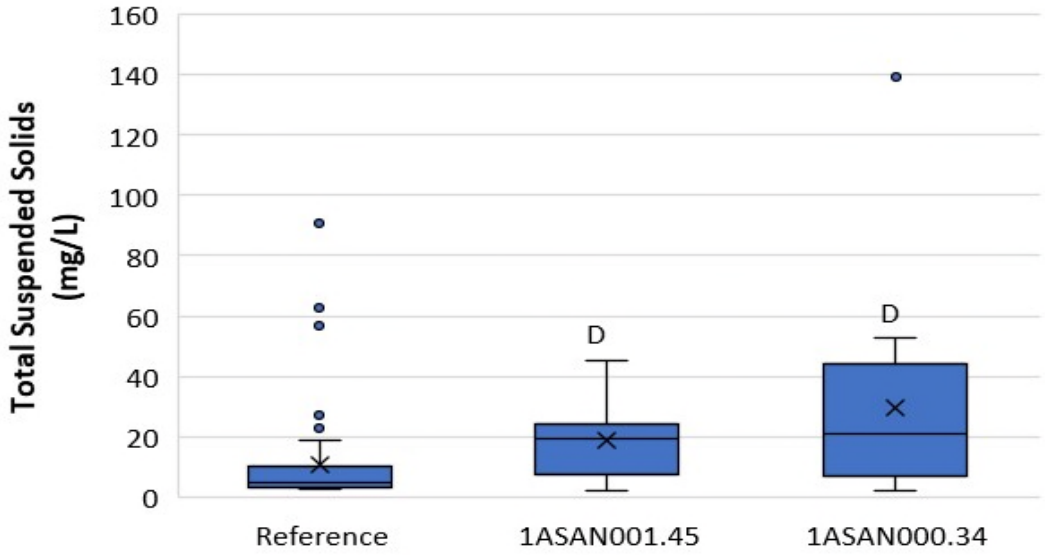
[a] Analyte detected above the method detection level but below the method quantification limit.
[b] Material analyzed for, but not detected. Value is the limit of detection.
[c] pH and temperature data were not collected so acute/chronic criteria cannot be calculated

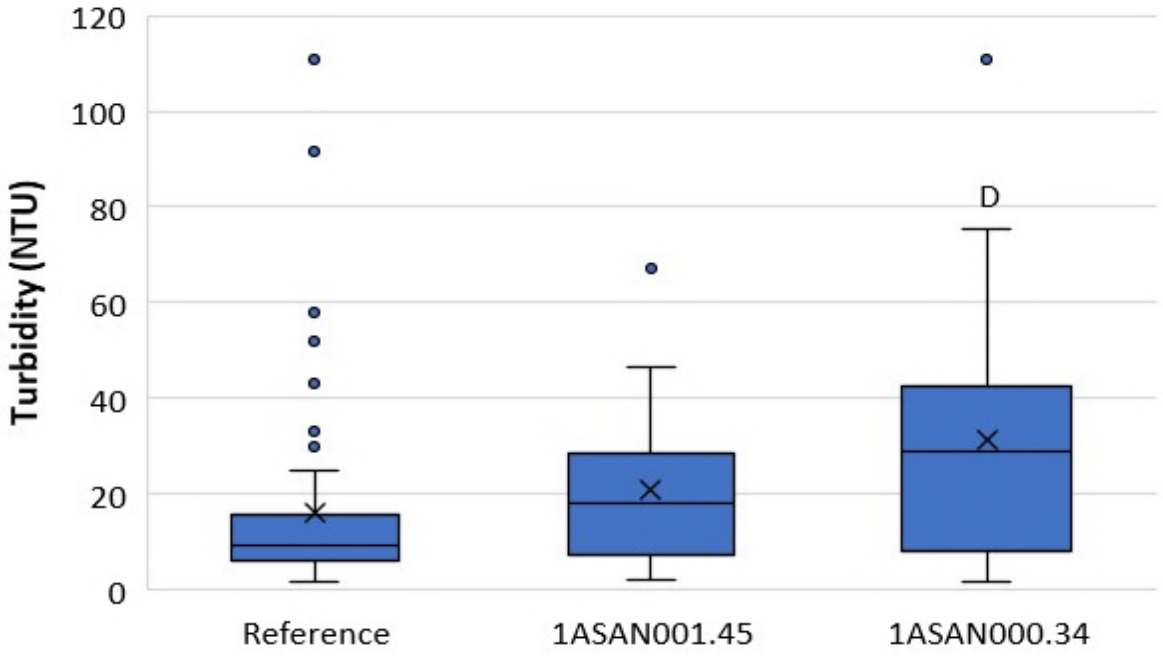
For technical support issues call: 703-583-3906

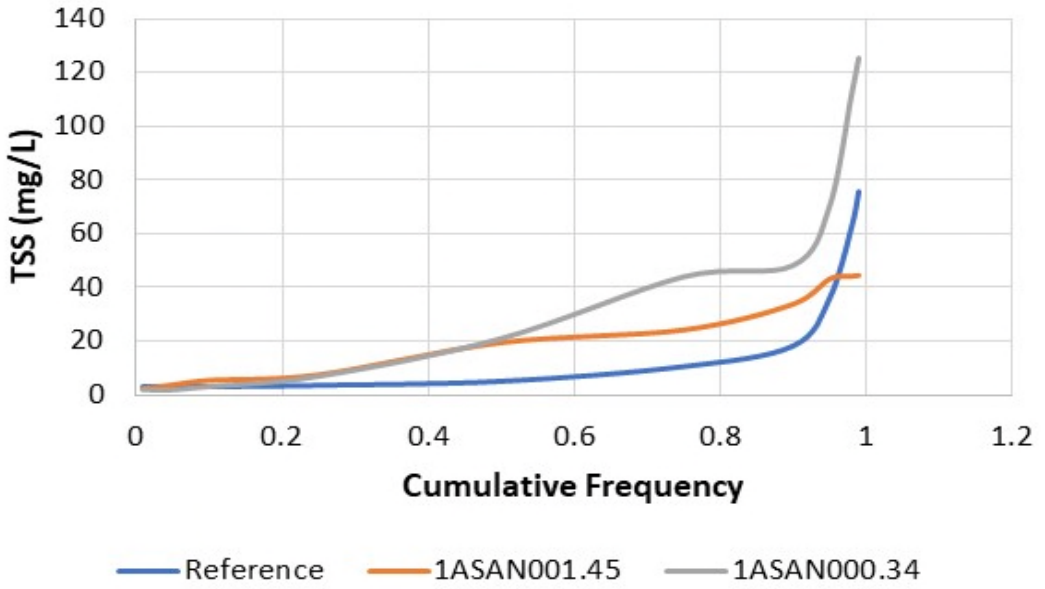
DEQ

Total Suspended Solids (TSS) and Turbidity

- TSS: Higher / more frequent
- Turbidity: Higher levels







DEQ

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

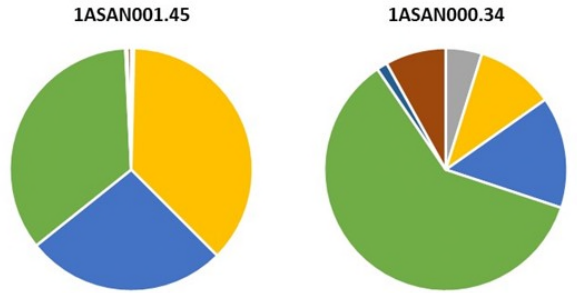
Benthic Stressor Analysis

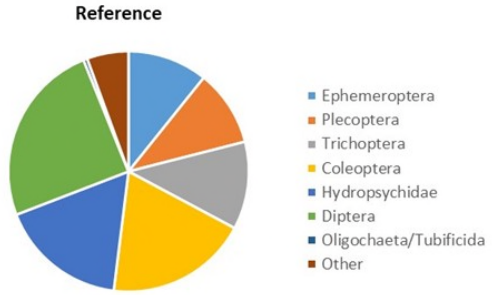
Biological and Habitat Data Analysis

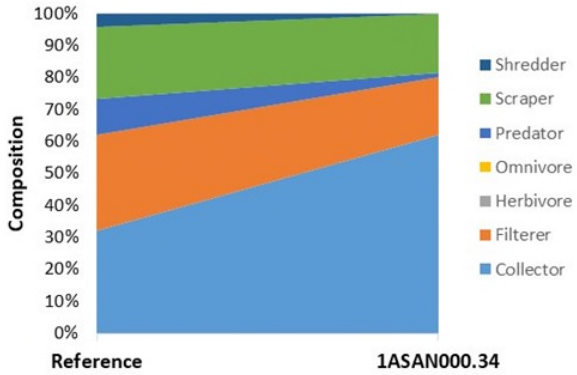
Benthic Data

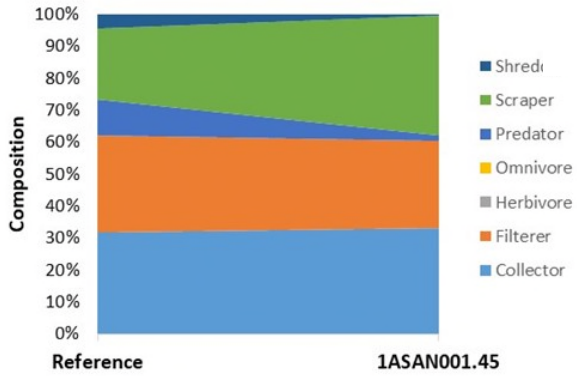
- Community Composition Analysis[1]
  - Loss of almost all sensitive taxa
  - Dominance by a few tolerant taxa
- Functional Feeding Group Analysis[1]
  - Based upon method of feeding (shredders, scrapers, predator, filterer, etc.)
  - Upstream site: Increase in Scrapers
  - Downstream site: Increase in Collectors

[1]Benthic data compared to Licking Run (Reference)







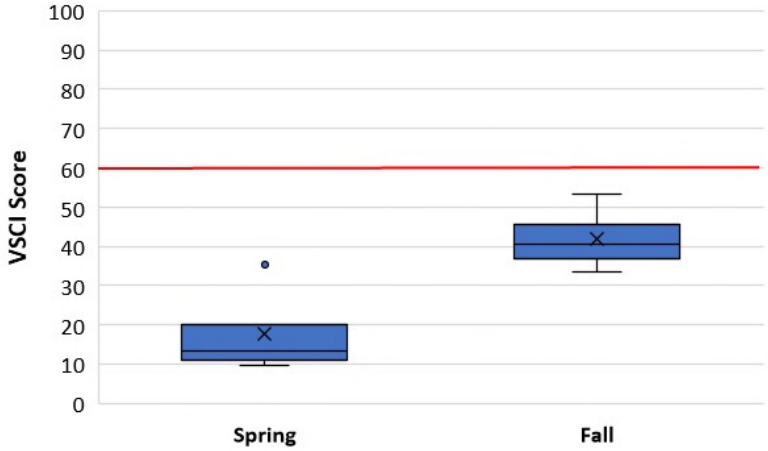


For technical support issues call: 703-583-3906

DEQ

Benthic Data

- Seasonal pattern of VSCI scores
- Biological Condition Gradient (BCG) Analysis
  - Stressor-specific tolerance scores (1-5) for a set of stressors established for benthic macroinvertebrates (genus-level)
  - High scores indicates dominance/tolerance in presence of stressor
  - High scores (4 and 5) top 5 dominant taxa for specific conductivity, nutrients and watershed % imperviousness



Genus Level	No. of Individuals	Functional Feeding Group	General Attribute	Biological Condition Gradient (BCG) Attribute Assignments for Specific Stressors									
				DO	Acidity (pH)	Alkalinity (pH)	Specific Conductance	Chloride	Sulfate	Nutrients	Total Habitat Score	Relative Bed Stability	Watershed % Impervious
Stenelmis	284	Scraper	4	4	4	4	5	4	4	4	5	4	5
Chironomidae (A)	261	Collector	4	4	4	4	4	4	4	4	4	4	4
Cheumatopsyche	123	Filterer	5	4	3	4	5	4	4	5	4	4	5
Hydropsyche	76	Filterer	4	3	3		5	4	5	5	4	4	5
Hydropsychidae	13	Filterer	4	3	3	4	4	3	4	4	4	4	4

For technical support issues call: 703-583-3906

DEQ

Habitat / Physical Data

- Log Relative Bed Stability (LRBS): May indicate a hardening of the substrate (80%) from scour
- Habitat: Individual metrics low for substrate quality and riparian quality

LRBS Metrics	Value
% Sands and Fines	12%
Percentile Sands and Fines[1] (Northern Piedmont / Statewide)	12th / 14th
% Boulders, Cobbles, Gravel	43%
Percentile Boulders, Cobbles, Gravel[1] (Northern Piedmont / Statewide)	52th / 49th
% Hardpan	22%
% Concrete or Asphalt	15%
Average Embeddedness	38%
Percentile Embeddedness (Northern Piedmont / Statewide)	18th / 21th

Monitoring Location	Parameter	
	LRBS	Habitat
1ASAN001.45	-	Medium
1ASAN000.34	No	Medium
Combined	-	Medium

Station ID	Date	Channel Alteration	Banks	Bank Vegetation	Embeddedness	Flow	Riffles	Riparian Vegetation	Sediment	Substrate	Velocity	Total Habitat
1ASAN000.34	2016-03-08	8	11	9	11	15	13	9	12	10	16	114
1ASAN000.34	2016-08-31	10	10	15	9	18	16	9	11	4	18	120
1ASAN000.34	2020-03-11	7	8	10	12	10	9	9	14	10	14	103
1ASAN000.34	2020-09-17	7	10	10	7	20	7	9	10	7	14	101

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Benthic Stressor Analysis

CADDIS Overview

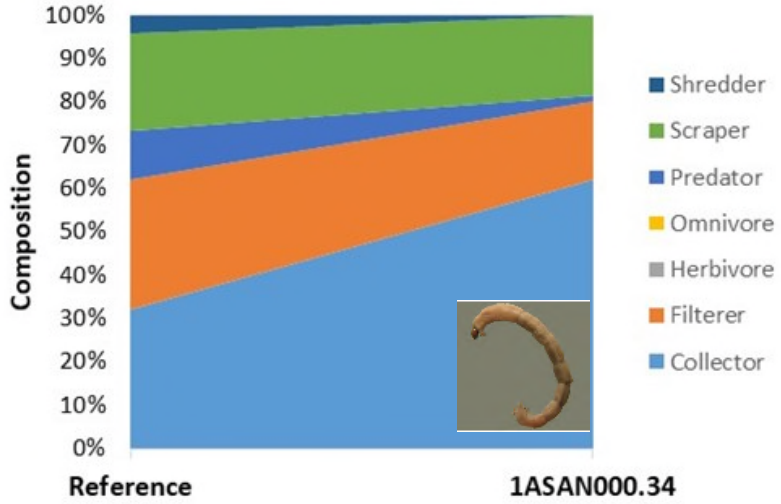
CADDIS Results

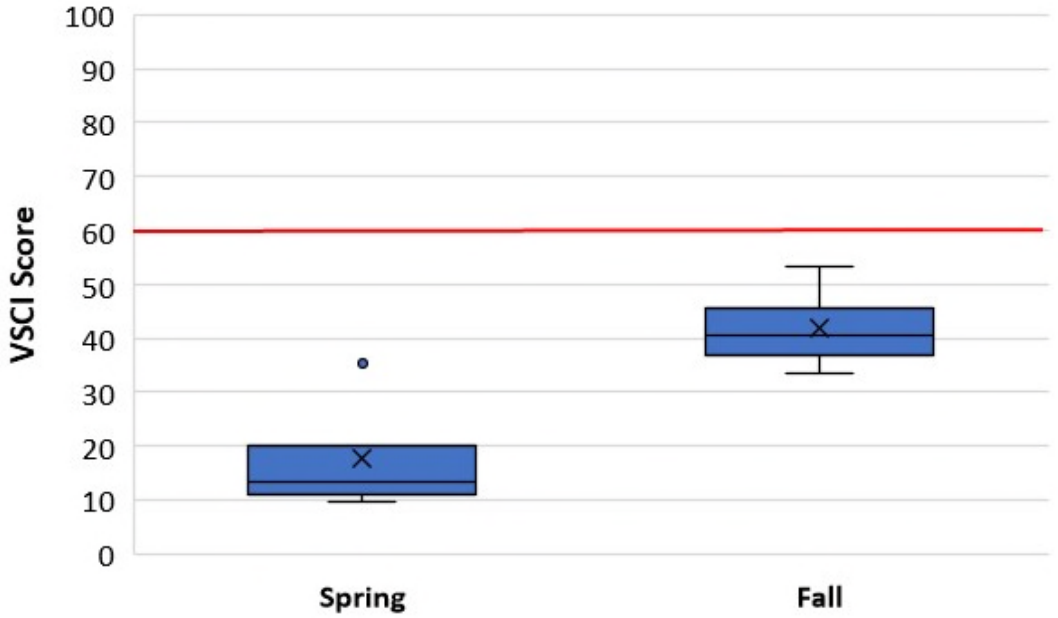
- Non-stressors
- Possible stressors
- Probable stressors

Candidate Stressor	CADDIS Score
pH	-24
Temperature	-13
Dissolved Oxygen	-12
Dissolved Metals	-9
Total Nitrogen	1
Chloride	1
Potassium	1
Ammonia	2
Sodium	3
Sediment	6
Total Phosphorus	16
Sulfate	16
Conductivity/TDS	31

Support for Sediment as a Stressor

- Habitat scores: medium probability range for stress effects
- Seasonal pattern of VSCI scores
- Community composition (pollutant-tolerant)
- Feeding group analysis (collectors/scrapers)
- TSS: higher levels occur more frequently than reference site
- Turbidity: more turbid



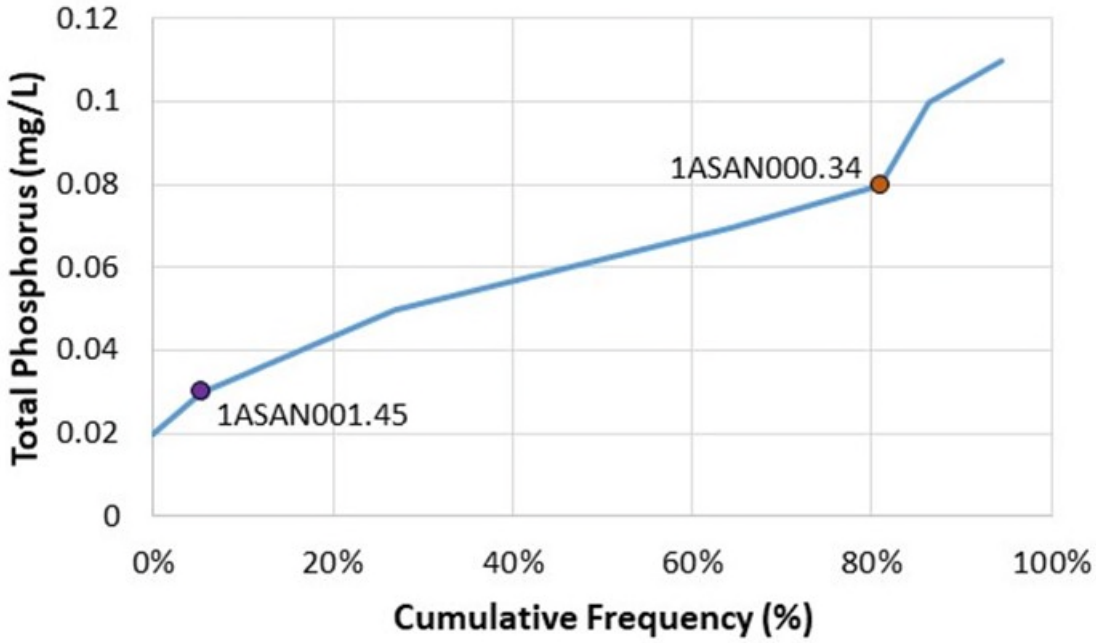


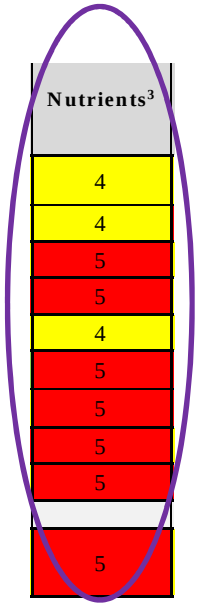
For technical support issues call: 703-583-3906

DEQ

Support for Phosphorus as a Stressor

- Medium probability range for stress effects
- 81st percentile of Triassic Basin ecoregion
- BCG analysis identified nutrients
- Levels exceeded recommended EPA criteria for ecoregion
- Feeding group analysis
- Observations of thick filamentous algae

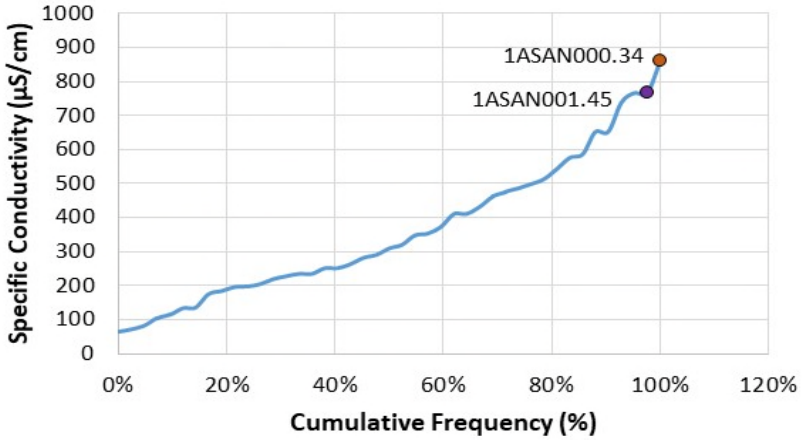


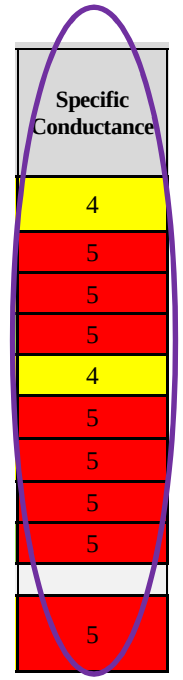


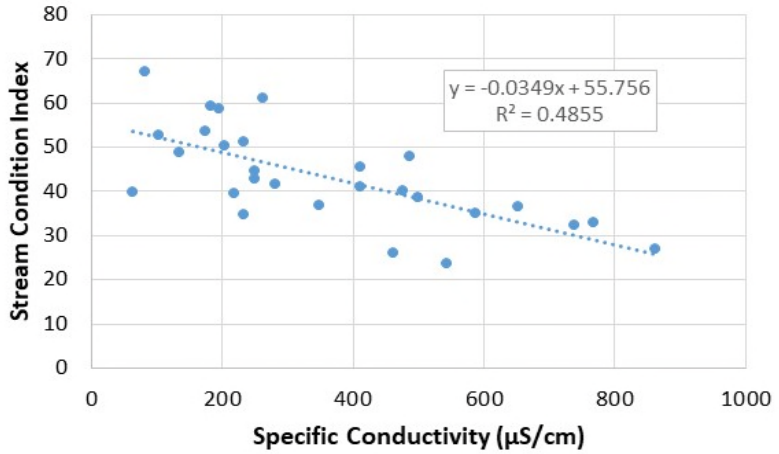
DEQ

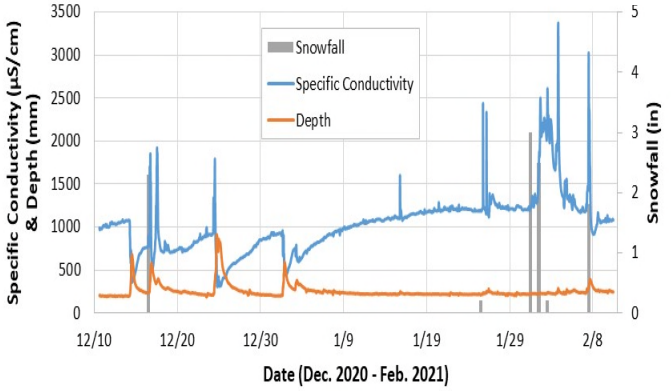
Support for Total Dissolved Solids (TDS) as a Stressor

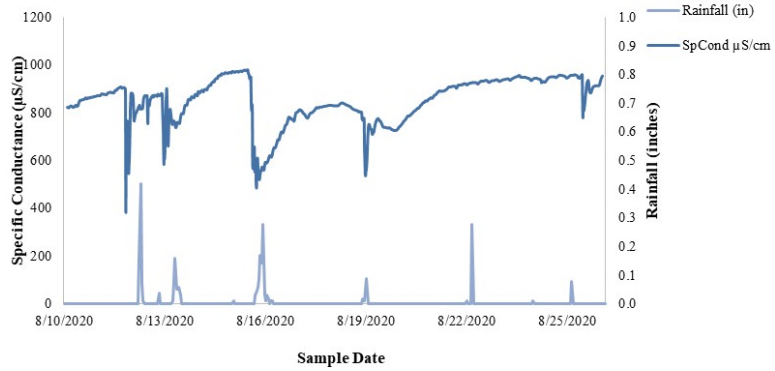
- Conductivity / TDS: high probability range for stress effects
- 98th and 100th percentile of conductivity in Triassic Basin ecoregion
- Conductivity significantly correlated with VSCI in Triassic Basin
- BCG analysis identified specific conductivity
- Ambient toxicity testing
- Continuous monitoring data identified high baseline conductivity with wintertime extremes







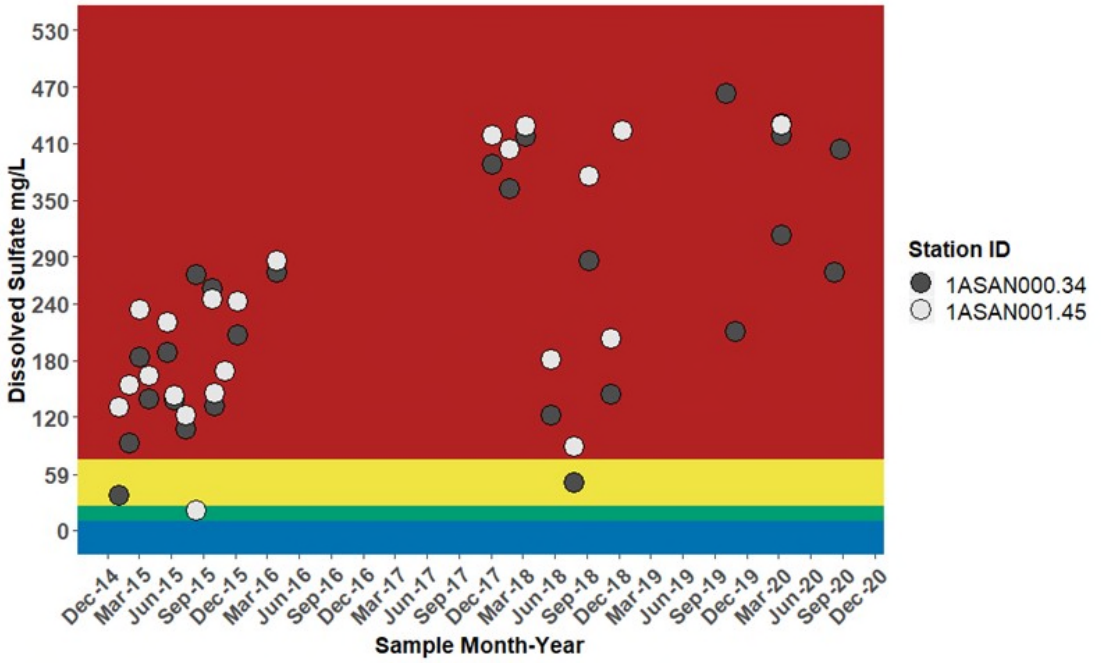


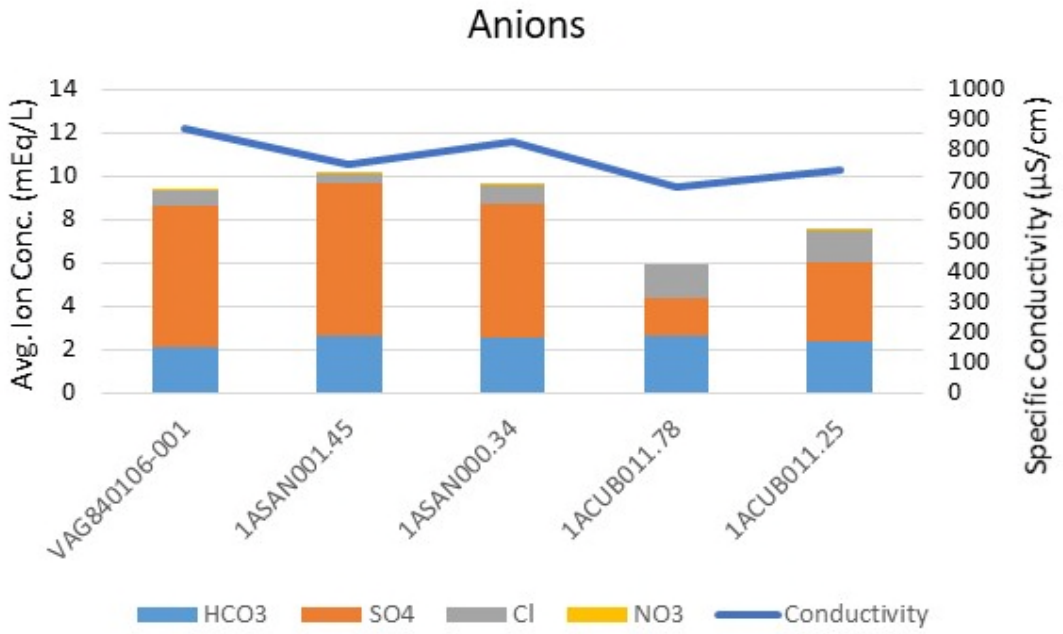


DEQ

Support for Sulfate as a Stressor

- Sulfate: high probability range for stress effects
- Some literature threshold values for sulfate toxicity were exceeded
- Sulfate was the predominant anion contributing to TDS





TMDL Development

TMDL Targets & Project Timeline

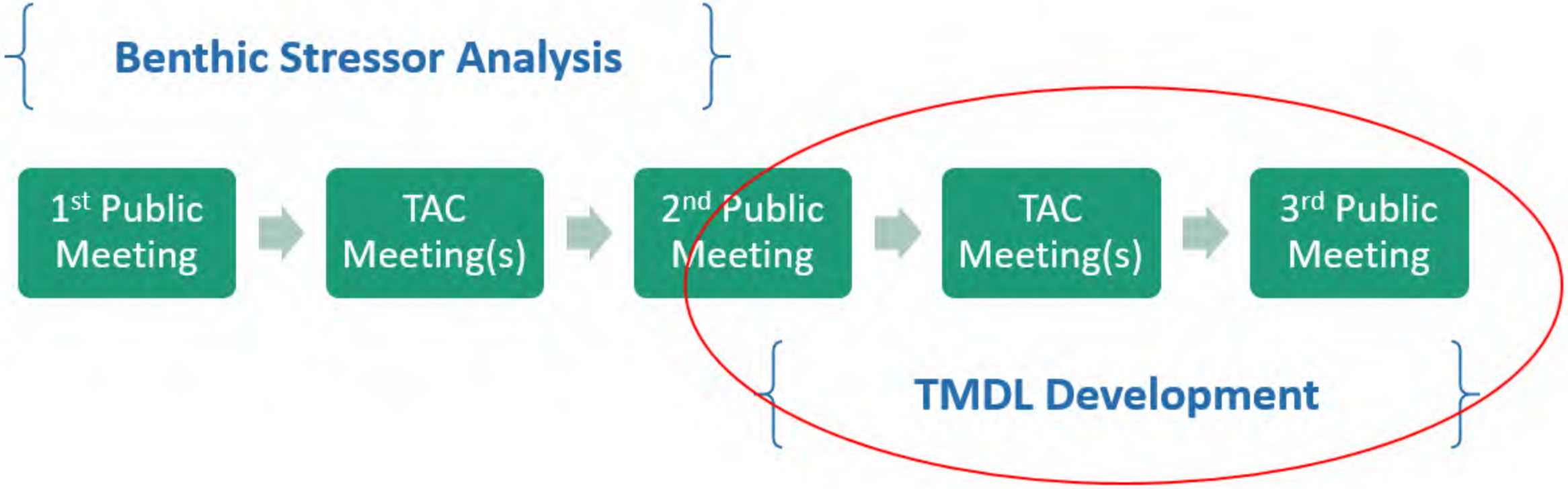
TMDL Targets and Contributing Factors

Stream	TMDL Target
Sand Branch	Total Dissolved Solids (TDS)
	Total Phosphorus
	Sediment

Stream	Contributing Factors
Sand Branch	Underlying Geology
	Land Disturbance
	Percent Imperviousness
	Degraded Riparian Buffer

- TMDL targets identified from multiple lines of evidence
- TDS will collectively address sulfate, and also ions classified as possible stressors (chloride, potassium, and sodium)
- Factors identified that contribute to the impaired benthic community, but not appropriate for TMDL development

Public Participation in a Benthic TMDL Study



For technical support issues call: 703-583-3906

DEQ

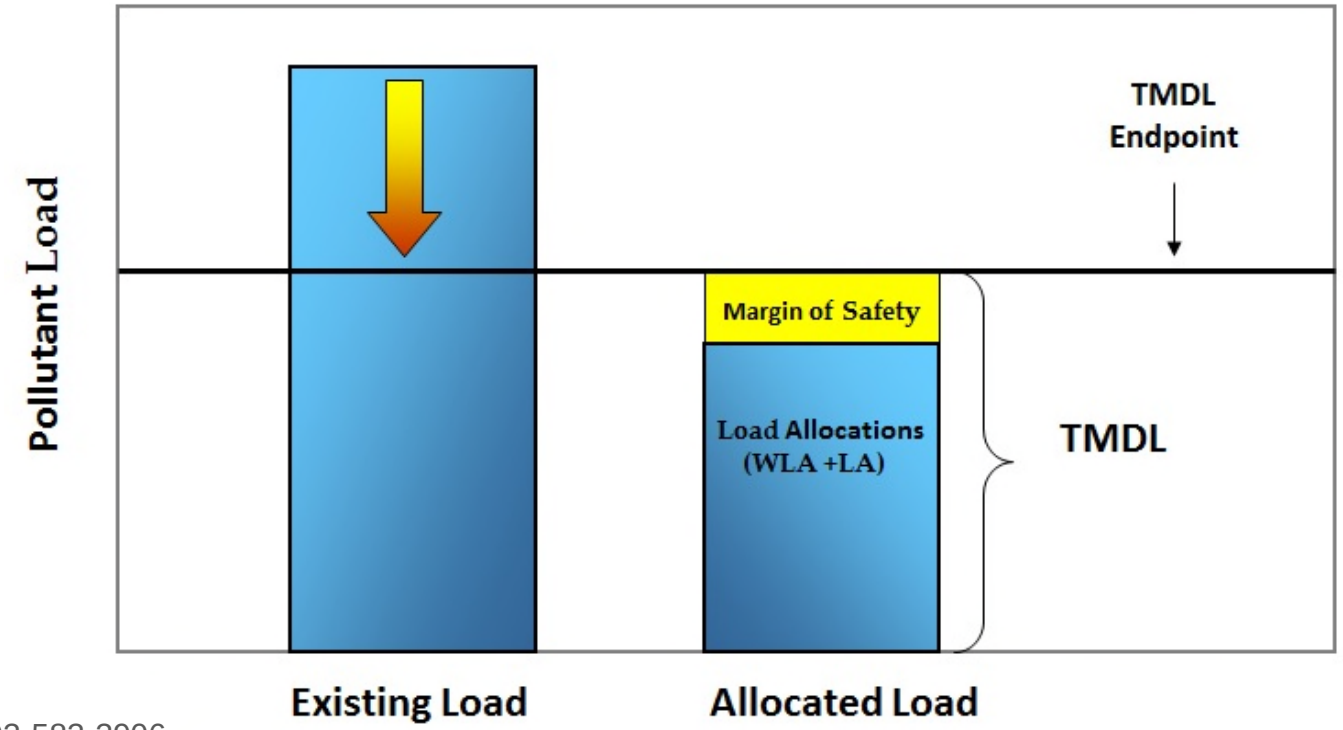
Total Maximum Daily Load (TMDL)

*A **TMDL** is the total amount of a pollutant a waterbody can receive and still meet the water quality criteria for that pollutant*

TMDL = WLA + LA + MOS

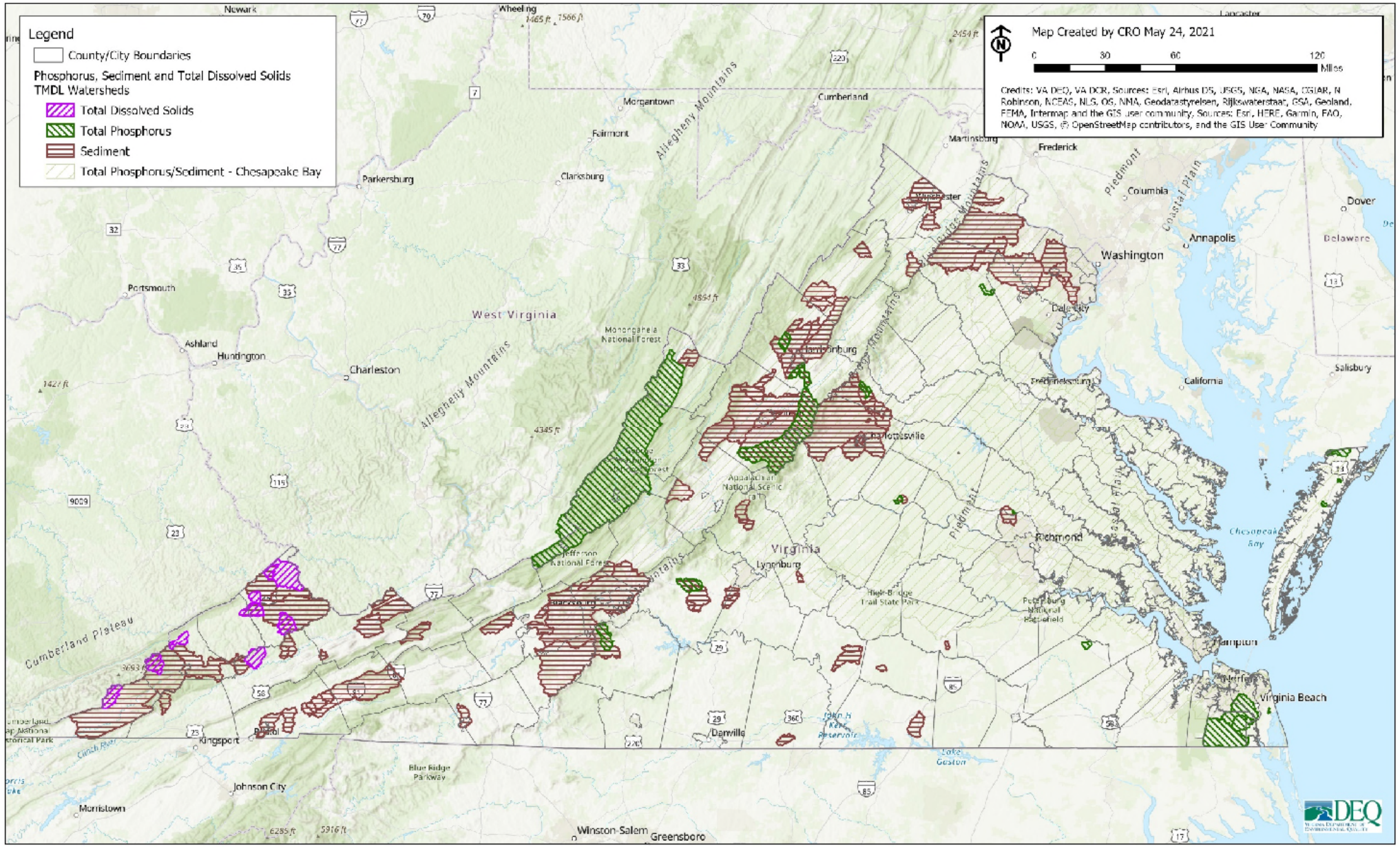
Where:

- WLA = Wasteload Allocation
- LA = Load Allocation
- MOS = Margin of Safety



DEQ

TMDLs Completed for Sediment, Total Phosphorus and Total Dissolved Solids



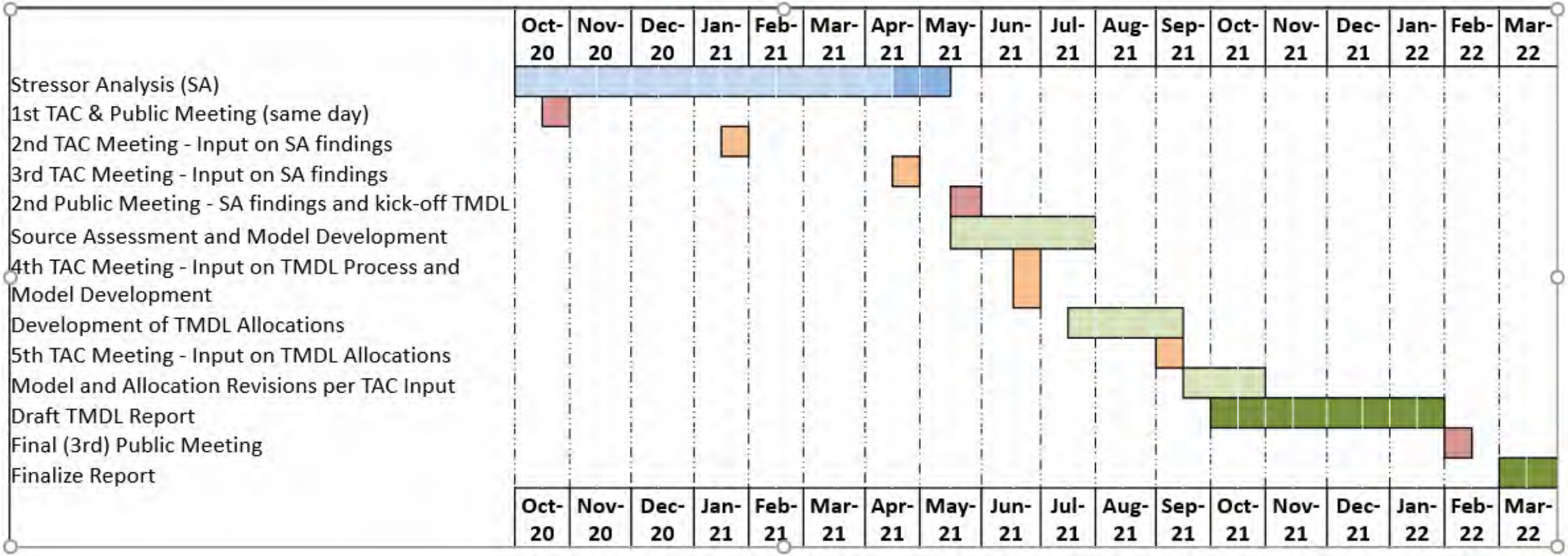
For technical support issues call: 703-583-3906

DEQ

TMDL Development Process

- Characterize the watershed (e.g. land use, soils, hydrology, etc.)
- Identify pollutant sources and associated loadings
- Model the existing baseline condition and projected condition that attains the water quality endpoint
- Calculate pollutant reductions to attain the water quality endpoint
- Assign loadings to wasteload allocations (WLA) and load allocation (LA)

Project Timeline



For technical support issues call: 703-583-3906

DEQ

Next Steps

- Wrap-up benthic stressor analysis
  - 30-day Public Comment Period on Report

    May 27 – June 28
- Begin TMDL development to address the aquatic life use impairment
  - TMDLs for each of the following pollutants:
    - Sediment
    - Total Dissolved Solids (TDS)
    - Total Phosphorus

Meeting Feedback

- Comments (written) on the Benthic Stressor Analysis Report
  - Email: Sarah.Sivers@deq.virginia.gov
  - Mail: 13901 Crown Court, Woodbridge VA 22193
- Project questions or comments
  - Sarah Sivers: (703) 583-3898 or Sarah.Sivers@deq.virginia.gov
- Meeting Feedback
  - Virtual Meeting Public Comment Form (shared by email)
  - Submit to FOIA Board, external to DEQ

For technical support issues call: 703-583-3906

DEQ