# Stream Health in the Deep Creek Lake Watershed


## Stream Health in the Deep Creek Lake Watershed

**DCL Watershed Management Plan Steering Committee**
**March 3, 2014**

**Tony Prochaska**

# Overview

- Importance of Streams and Rivers
- DCL Streams: Statistics
- Water Quality Standards
- Current Monitoring Programs
- Stream Condition
  - Water Quality
  - Biodiversity and Stream Health
- Threats\Stressors\Pollution Sources
- DCL Watershed Characteristics (e.g. Land Use)
- Management Recommendations

# Importance of Streams and Rivers

*Streams and Rivers referred to as lotic systems = flowing water*

- Drinking Water Supply – thousands rely on water from S&Rs
- Flood and Erosion Protection – storage capacity
- Groundwater Recharge - water enters through the streambed
- Pollution Reduction – retain sediment and absorb excess nutrients
- Wildlife Habitat - fish, amphibians, mussels, crayfish, birds and mammals
- Economic Importance – recreation (e.g., fishing, hunting), agriculture and manufacturing

http://water.epa.gov/type/rsl/

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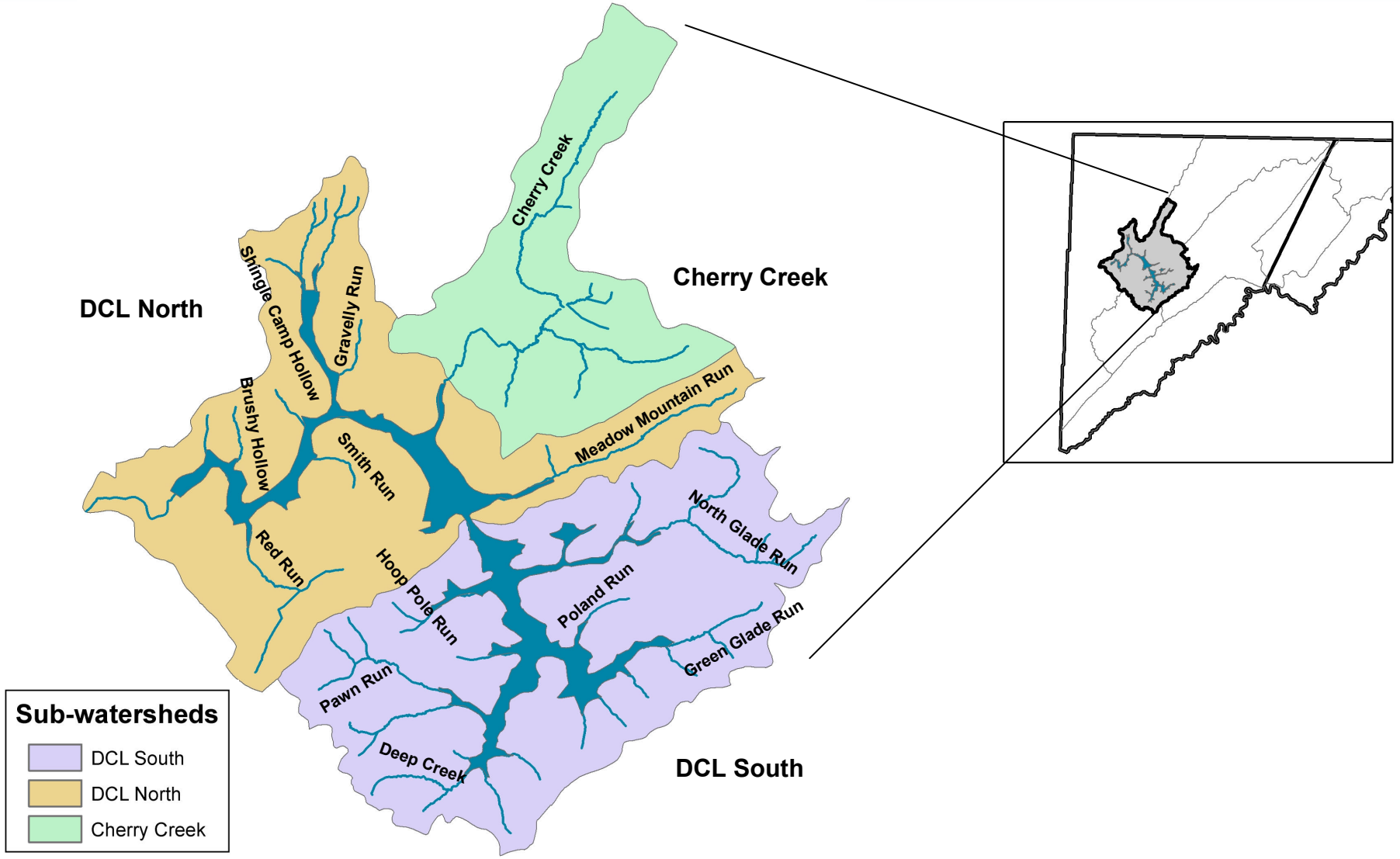
# Stream Health in the Deep Creek Lake Watershed

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# Stream Health in the Deep Creek Lake Watershed

Stream Order – a way to classify streams\rivers based on size

Strahler's Stream Order

Average Stream Width
Statewide: MBSS data
1st order = ~ 7.5 feet
2nd order = ~ 16 feet
3rd order = ~ 28 feet

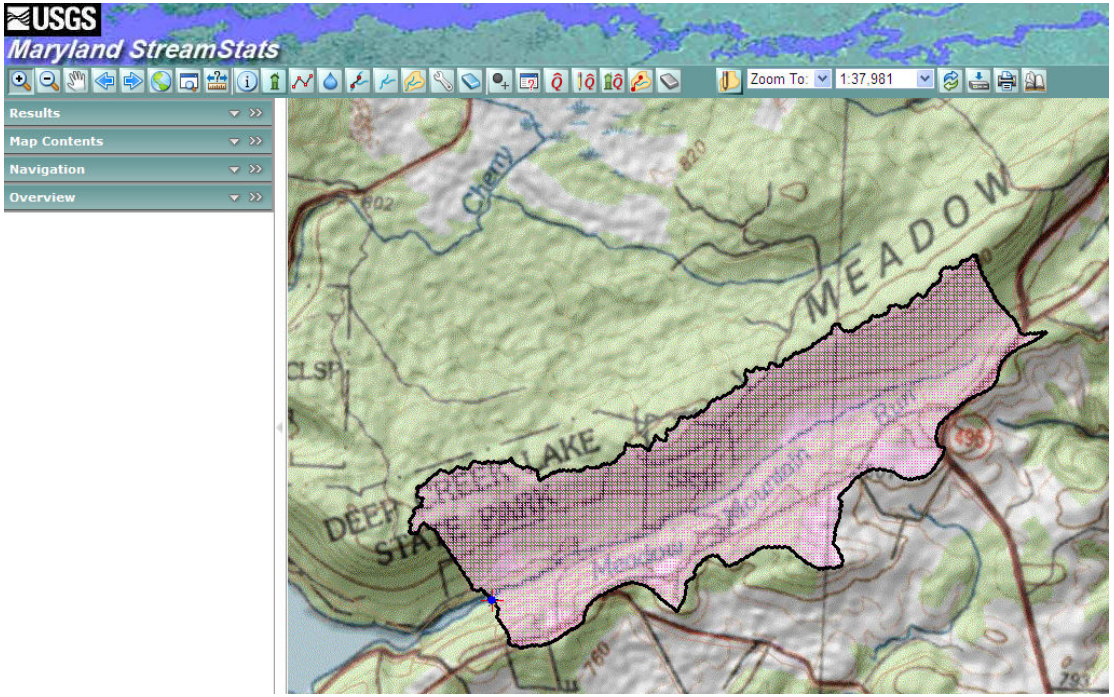
# Miles of DCL Streams - 1:24,000 NHD

| Deep Creek Lake (Total) | 1st Order | 2nd Order | 3rd Order | Total Miles |
|---|---|---|---|---|
| Miles | 35.1 | 11.8 | 2.5 | 49.4 |
| Percent of Total | 71.1% | 23.9% | 5.0% | |
| 12-digit Watersheds | | | | |
| DCL South (0027) | 1st Order | 2nd Order | 3rd Order | Total Stream Miles |
| Miles | 16.4 | 5.2 | 0 | 21.6 |
| Percent of Total | 75.9% | 24.1% | 0% | |
| DCL North (0028) | 1st Order | 2nd Order | 3rd Order | Total Stream Miles |
| Miles | 11.7 | 2.9 | 0 | 14.6 |
| Percent of Total | 80.1% | 19.9% | 0% | |
| Cherry Creek (0029) | 1st Order | 2nd Order | 3rd Order | Total Stream Miles |
| Miles | 7.0 | 3.7 | 2.5 | 13.2 |
| Percent of Total | 53.0% | 28.0% | 18.9% | |

# USGS StreamStats

- Web-based Geographic Information System that provides:
- Streamflow statistics (actual or estimates)
- Drainage basin characteristics, including:
  - Land Use (e.g., % forest and impervious area)
  - Watershed Size
  - Soil Types (Percent)
- Useful information for water resources planning and management

# Meadow Mountain Run




## Meadow Mountain Run

**Basin characteristics report**

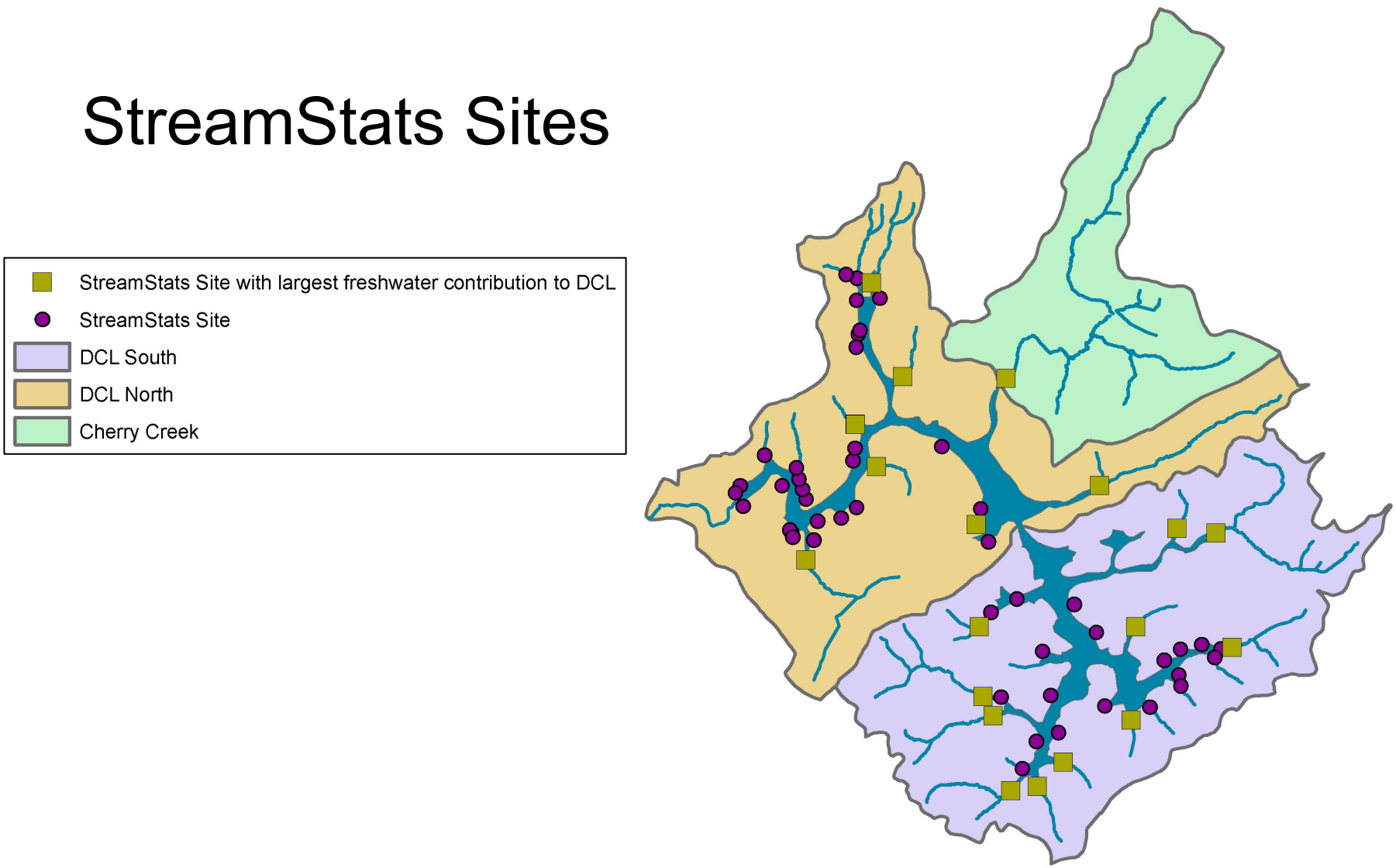
| Parameter | Value |
|---|---|
| Percentage of area of Hydrologic Soil Type A (STATSGO) | 33.9 |
| Percentage of area of limestone geology | 0 |
| Percent of area of Hydrologic Soil Type D (STATSGO) | 5.03 |
| Percent Soil Type A from SSURGO | 0 |
| Coefficient to adjust estimates for percentage of carbonate rock in Western Maryland | 12.4 |
| Percent of area covered by forest (NLCD) | 87.7 |
| Area in square miles | 3.03 |
| Precip 30 year mean (PRISM) in inches | 48.2 |
| Percent Soil Type C and D from SSURGO | 82.8 |
| Mean percent impervious area from MD Landcover 2010 | 2.5 |
| Mean percent impervious area from MD Landcover 2001 | 2.5 |
| Mean basin slope computed from 10 m DEM in feet per foot | 0.14 |
| Percent area forested from Maryland Landuse 2010 | 84 |

**Peak Flows Region Grid Streamflow Statistics**

| Statistic | Flow ($ft^3/s$) | Estimation Error (percent) | Equivalent years of record |
|---|---|---|---|
| PK2 | 142 | 21 | 7.1 |
| PK5 | 241 | 22 | 12 |
| PK10 | 326 | 24 | 14 |
| PK25 | 459 | 29 | 15 |
| PK50 | 582 | 33 | 16 |
| PK1_5 | 118 | 22 | 5.9 |
| PK100 | 726 | 37 | 15 |
| PK200 | 898 | 42 | 15 |
| PK500 | 1170 | 48 | 15 |
| PK1_25 | 93.4 | 24 | 5.7 |

# Stream Health in the Deep Creek Lake Watershed

## StreamStats Sites



# Stream Health in the Deep Creek Lake Watershed

## Findings:StreamStats

- 67 streams flow into DCL

From Surface Waters....

- 20 streams contribute ~ 75% of surface flow to DCL
- 7 streams contribute ~ 50% of surface flow to DCL
- Cherry Creek ~18% of surface flow to DCL
- Percent forest (minimum = 0)
- Percent impervious (maximum = 25)

| Stream Name | PK2 (cfs) | % Total | % Total |
|---|---|---|---|
| Shingle Camp Hollow | 32.6 | 1.6 | |
| Unnamed Tributary 6, East of Brenneman Lane | 33.1 | 1.6 | |
| Poland Run | 34 | 1.7 | |
| Unnamed Tributary 40 crossing Steiding Church Road | 35.4 | 1.7 | |
| Unnamed Tributary - North Glade Cove | 34.6 | 1.7 | |
| Unnamed Tributary 43, east of Pine Tree Point Road | 37.3 | 1.8 | |
| Hoop Pole Run | 37.4 | 1.8 | |
| Unnamed Tributary 3 west of Mosser Hollow Drive | 44.1 | 2.1 | |
| Unnamed Tributary 39 crossing Ardsley Farm Road | 45.8 | 2.2 | |
| Gravelly Run | 46.6 | 2.3 | |
| Smith Run | 48.5 | 2.4 | |
| Unnamed Tributary 36, North of Garrett Hill | 63 | 3.1 | |
| Deep Creek | 67.3 | 3.3 | |
| Unnamed Tributary 29 crossing Glendale Road | 69.4 | 3.4 | 3.4 |
| Green Glade Run | 74.5 | 3.6 | 3.6 |
| Pawn Run | 93.2 | 4.5 | 4.5 |
| Red Run | 136 | 6.6 | 6.6 |
| North Glade Run | 139 | 6.8 | 6.8 |
| Meadow Mountain Run | 142 | 6.9 | 6.9 |
| Cherry Creek | 369 | 17.9 | 17.9 |
| PK2 = maximum instantaneous flow that occurs on average once in 2 years | | **76.9** | **49.7** |

# Water Quality Standards - MDE

Purpose: protect, maintain and improve water quality

## Three Main Components

1. Designated Uses
   - Use I – Water Contact Recreation and Non-tidal Warmwater Aquatic Life
   - Use II – Support Estuarine and Marine Aquatic Life and Shellfish Harvesting
   - Use III – Non-tidal Coldwater
   - Use IV – Recreational Trout Waters
2. Water Quality Criteria to protect those uses
3. Antidegradation Policy
   - Tier I Existing Uses/Minimal Standards
   - Tier II High Quality Waters
   - Tier III Outstanding National Resource Waters (ONRW)

# Maryland's Designated Uses for Surface Waters

| | Use Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Designated Uses** | **I** | **I-P** | **II** | **II-P** | **III** | **III-P** | **IV** | **IV-P** |
| Growth and Propagation of fish (not trout), other aquatic life and wildlife | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Water Contact Sports | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Leisure activities involving direct contact with surface water | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fishing | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Agricultural Water Supply | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Industrial Water Supply | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Propagation and Harvesting of Shellfish | | | ✓ | ✓ | | | | |
| Seasonal Migratory Fish Spawning and Nursery Use | | | ✓ | ✓ | | | | |
| Seasonal Shallow-Water Submerged Aquatic Vegetation Use | | | ✓ | ✓ | | | | |
| Open-Water Fish and Shellfish Use | | | ✓ | ✓ | | | | |
| Seasonal Deep-Water Fish and Shellfish Use | | | ✓ | ✓ | | | | |
| Seasonal Deep-Channel Refuge Use | | | ✓ | ✓ | | | | |
| Growth and Propagation of Trout | | | | | ✓ | ✓ | | |
| Capable of Supporting Adult Trout for a Put and Take Fishery | | | | | | | ✓ | ✓ |
| Public Water Supply | | ✓ | | ✓ | | ✓ | | ✓ |

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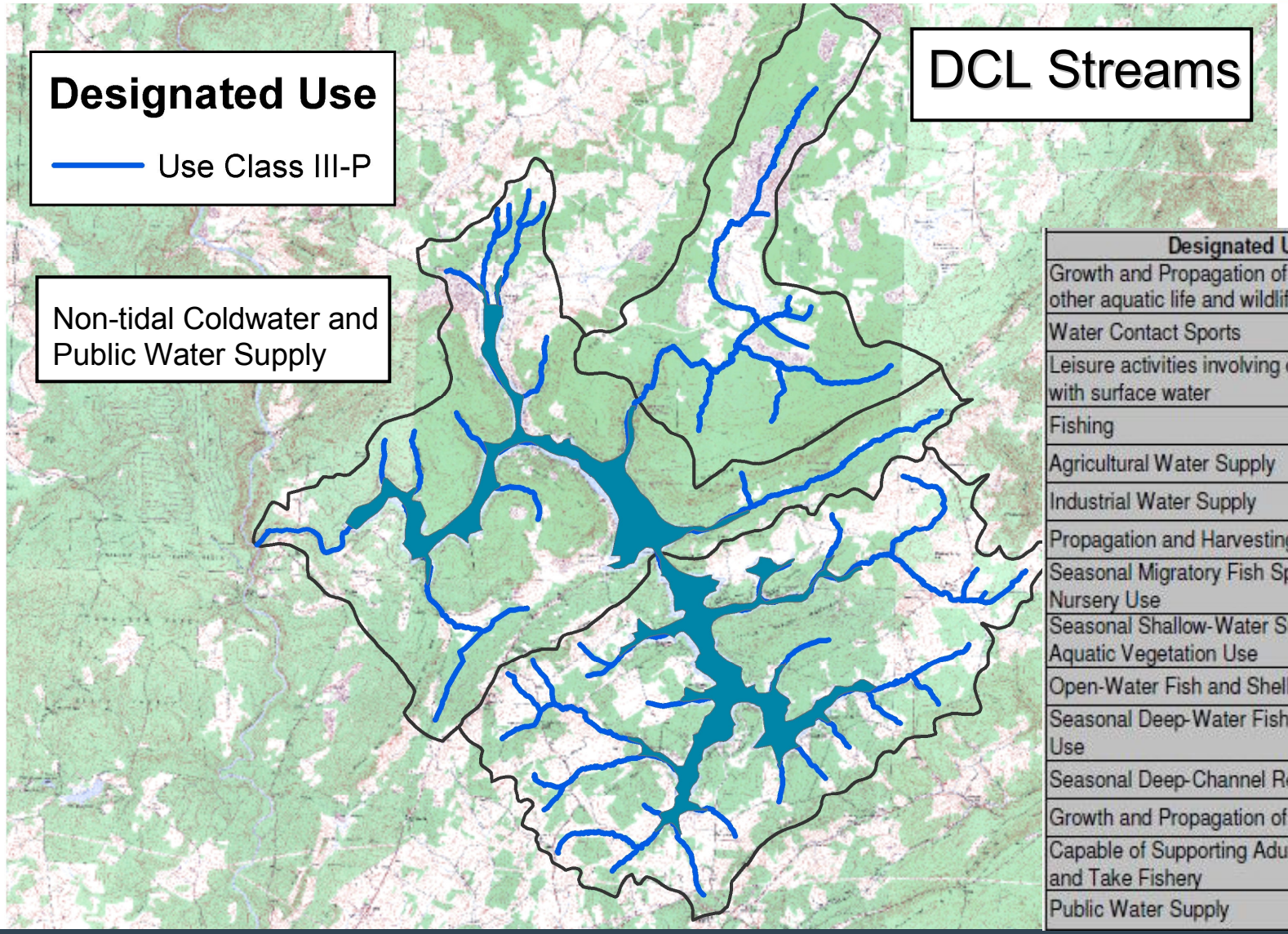



| Designated Uses | III-P |
|---|---|
| Growth and Propagation of fish (not trout), other aquatic life and wildlife | ✓ |
| Water Contact Sports | ✓ |
| Leisure activities involving direct contact with surface water | ✓ |
| Fishing | ✓ |
| Agricultural Water Supply | ✓ |
| Industrial Water Supply | ✓ |
| Propagation and Harvesting of Shellfish | |
| Seasonal Migratory Fish Spawning and Nursery Use | |
| Seasonal Shallow-Water Submerged Aquatic Vegetation Use | |
| Open-Water Fish and Shellfish Use | |
| Seasonal Deep-Water Fish and Shellfish Use | |
| Seasonal Deep-Channel Refuge Use | |
| Growth and Propagation of Trout | ✓ |
| Capable of Supporting Adult Trout for a Put and Take Fishery | |
| Public Water Supply | ✓ |

# Water Quality Criteria Specific to Designated Uses

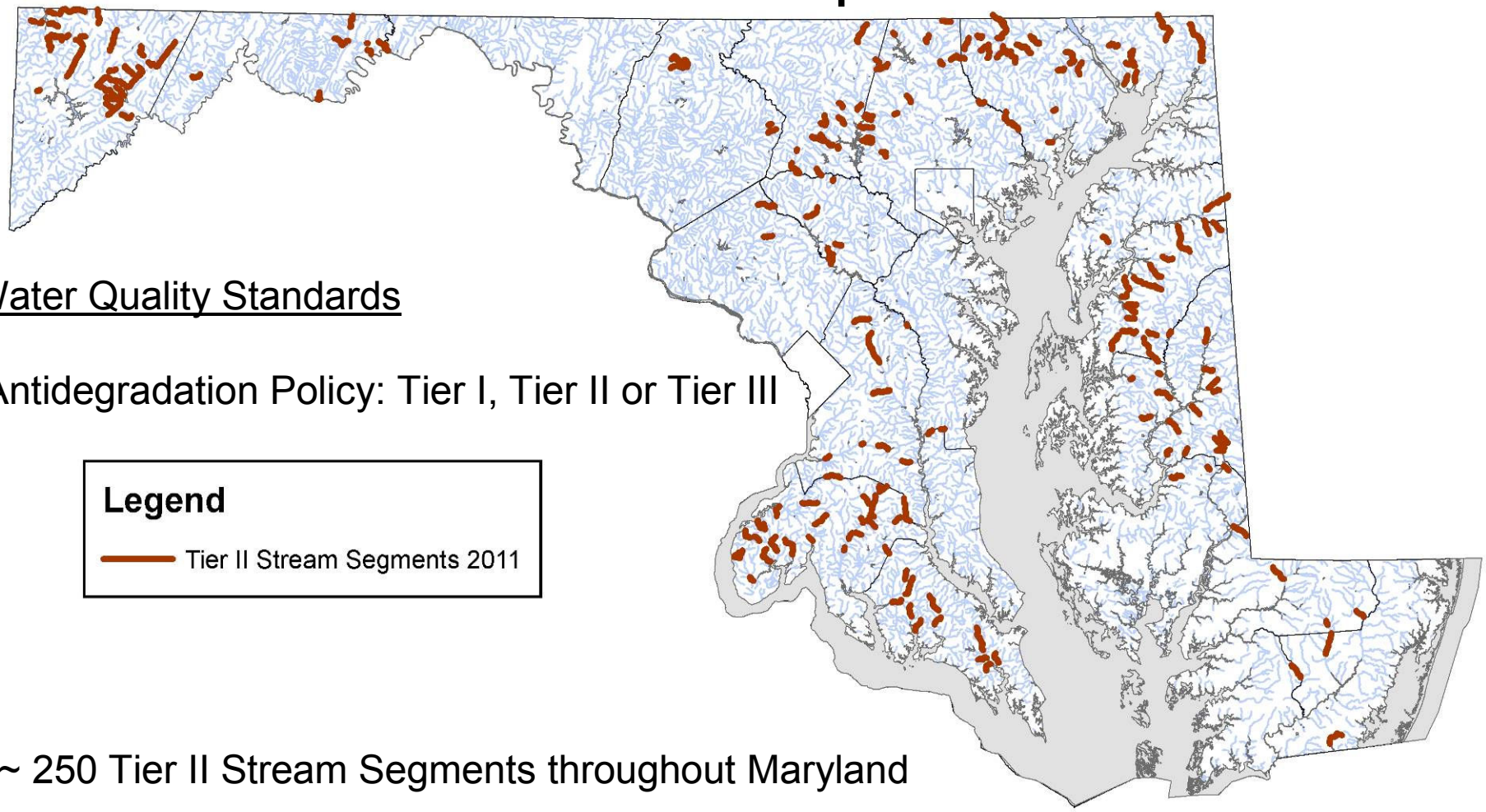
COMAR 26.08.02.02

## Use III-P (subset of Criteria)

- pH – 6.5 to 8.5
- Dissolved Oxygen – not less than 5 mg/L at any time with a minimum daily average ≥ 6 mg/L
- Temperature – may not exceed 68°F (20°C) outside of the mixing zone
- Turbidity – may not exceed 150 units at any time or 50 units as a monthly average (measurements in Nephelometric Turbidity Units, or NTUs)
- Others include: Bacteriological, Color, Toxic Substances

http://www.dsd.state.md.us/comar/getfile.aspx?file=26.08.02.03-3.htm

# Tier II Map




Water Quality Standards

Antidegradation Policy: Tier I, Tier II or Tier III

~ 250 Tier II Stream Segments throughout Maryland

# MDE/DNR Collaboration

## Tier II: High Quality Waters in Maryland

- Identified via DNR/MBSS stream sampling data
- Biological communities
  - Benthic macroinvertebrates
  - Fishes
- Useful indicators of ecological health

# Current Monitoring Programs to Determine Stream Condition

Current = Year 2000 - 2013

- DNR Programs, including:
  - Maryland Biological Stream Survey (MBSS)
  - Stream Waders (SW)
  - Core\Trend Program (CoreTrend)
  - DCL Management Office (DCLMO)
  - Marcellus Monitoring Coalition (MMC)
  - Maryland Synoptic Stream Chemistry Survey (MSSCS)
  - Special Project: Poland Run

- MDE Programs
  - Bureau of Mines (BOM)
  - Science Services Administration (SSA)

# Overview of Monitoring Programs

## Maryland Biological Stream Survey (MBSS)

- 2000 – 2009
- 5 sites randomly selected
- Three streams
- Fish, benthic macroinvertebrates, other animal groups, land use, physical habitat (no pebble counts, sediment facies, bedload transport, etc.)

## Stream Waders

- 2004-2012
- 89 sites sampled by volunteers, not random
- 23 streams
- Benthic macroinvertebrates only

# Overview of Monitoring Programs (continued)

## Core\Trend Program

- 2000 – current: monthly samples
- Cherry Creek only – one station
- Extensive water quality (> 20 parameters measured with focus on nutrients and sediment)

## DCL Management Office

- Fall 2011 and Spring 2012
- 10 major tributaries to DCL
- Water quality and benthic macroinvertebrate data

# Overview of Monitoring Programs (continued)

## Marcellus Monitoring Coalition (MMC)

- 2012 – current: monthly sampling
- Cherry Creek (3) and Shingle Camp Run (1)
- Water quality and benthic macroinvertebrate data

## Maryland Synoptic Stream Chemistry Survey (MSSCS)

- April 2012
- Six streams sampled
- Water quality: ANC, pH, conductivity, dissolved organic carbon, dissolved inorganic carbon, color, chloride, nitrate, TN, TP and sulfate
- Repeat of samples collected 25 years ago

# Overview of Monitoring Programs (continued)

## Special Project: Poland Run

- 2009 - 2012
- 1 Station on Poland Run
- Extensive water quality (parameters measured with focus on nutrients and sediment)

*Poland Run gage*

# Overview of Monitoring Programs (continued)

**MDE: Bureau of Mines**

- 2000 – 2012
- Cherry Creek (7 sites)
- Extensive water quality (pH with a focus on metals)

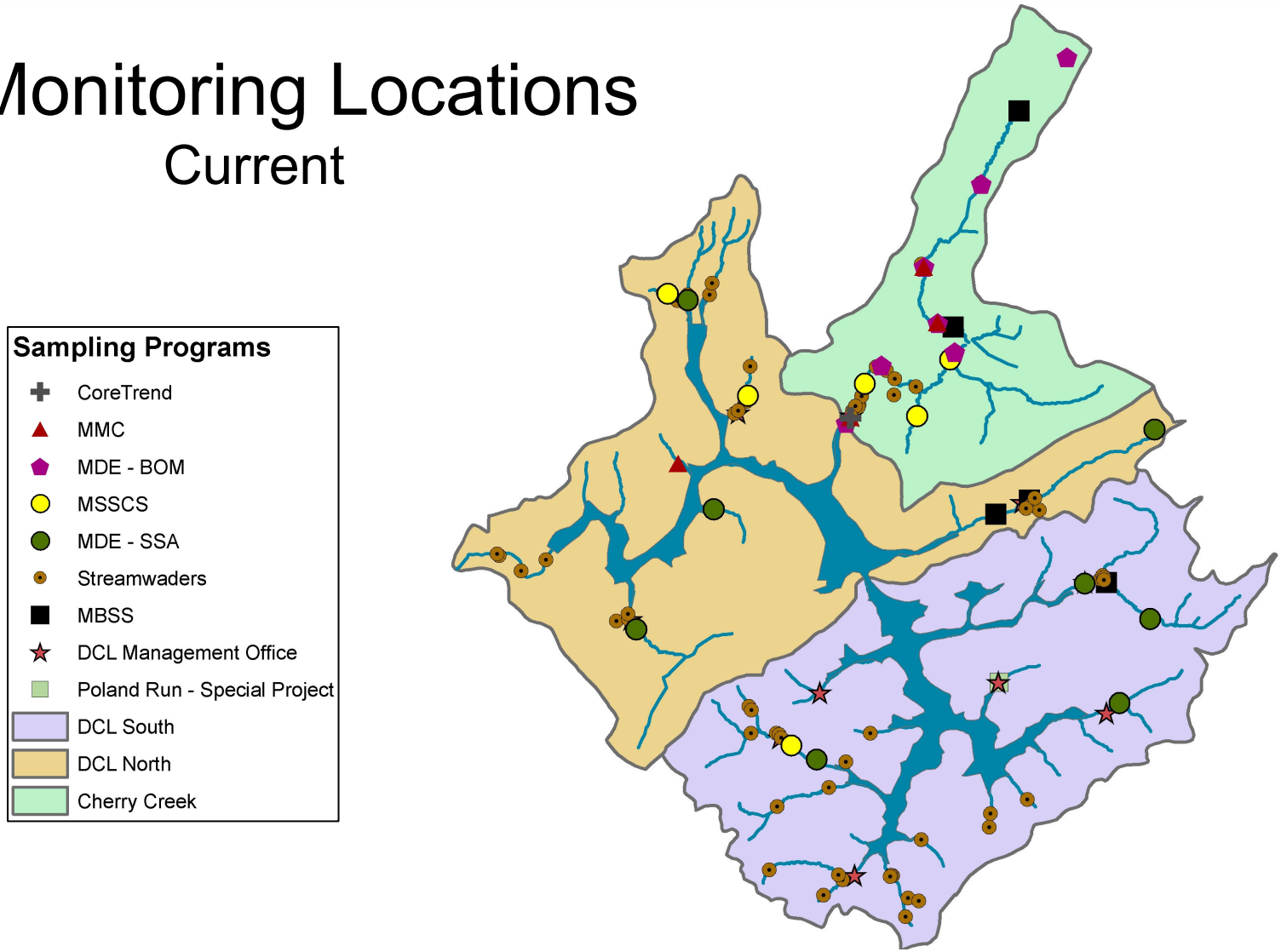
**MDE: Science Services Administration**

- 2000 - 2008
- 8 Sites (8 streams)
- Extensive water quality data

# Stream Health in the Deep Creek Lake Watershed

## All Monitoring Locations

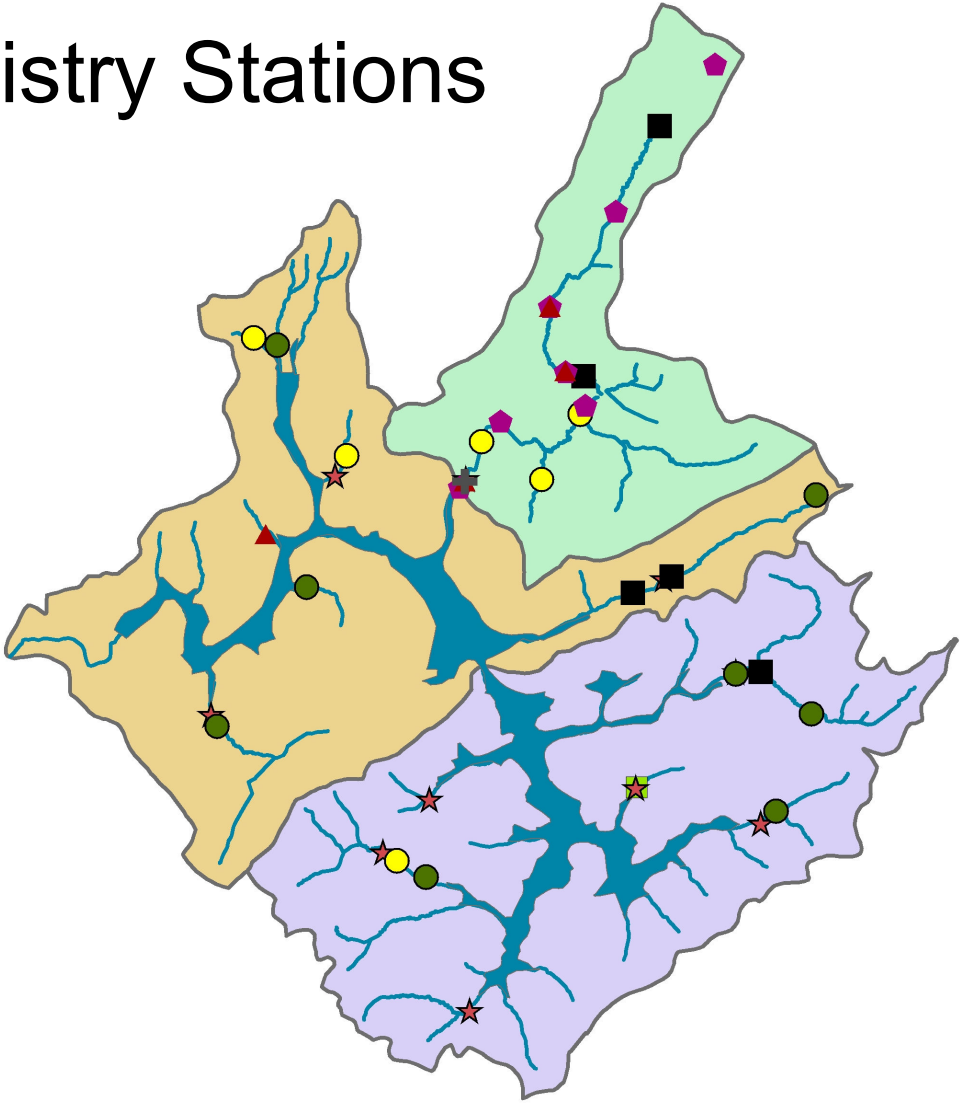
### Current



# Stream Health in the Deep Creek Lake Watershed

## Water Chemistry Stations

| Program | Number of Sites |
|---|---|
| Core\Trend | 1 |
| MBSS | 5 |
| DCL Management Office | 10 |
| MSSCS | 6 |
| MDE\SSA | 8 |
| MDE\BOM | 7 |
| MMC | 4 |
| Poland Run – Special Project | 1 |



# Math Dictionary

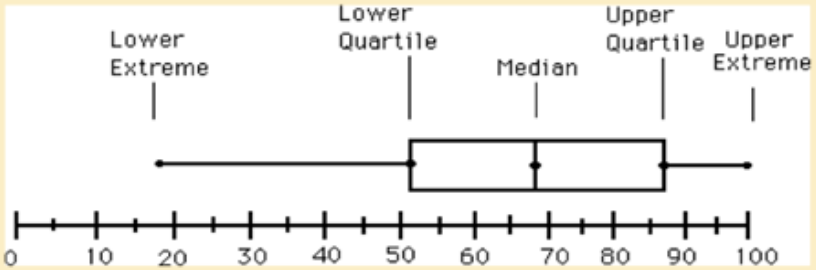

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K | L | M |
| N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

***Definition***

***Box-and-Whisker Plot:*** a graphic way to display the median, quartiles, and extremes of a data set on a number line to show the distribution of the data.

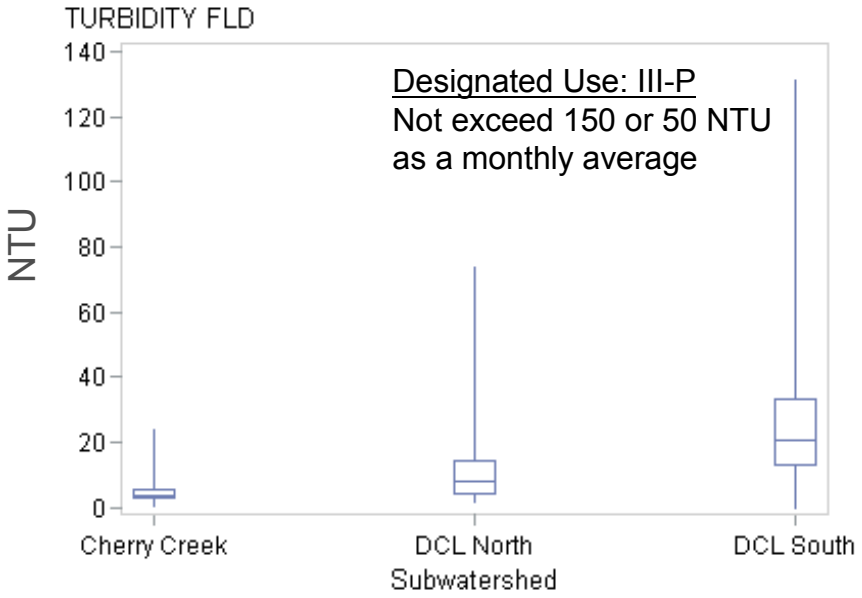
***Hawaiian Translation:*** Pakuhi Pahu Me Ka ʻUmi ʻUmi

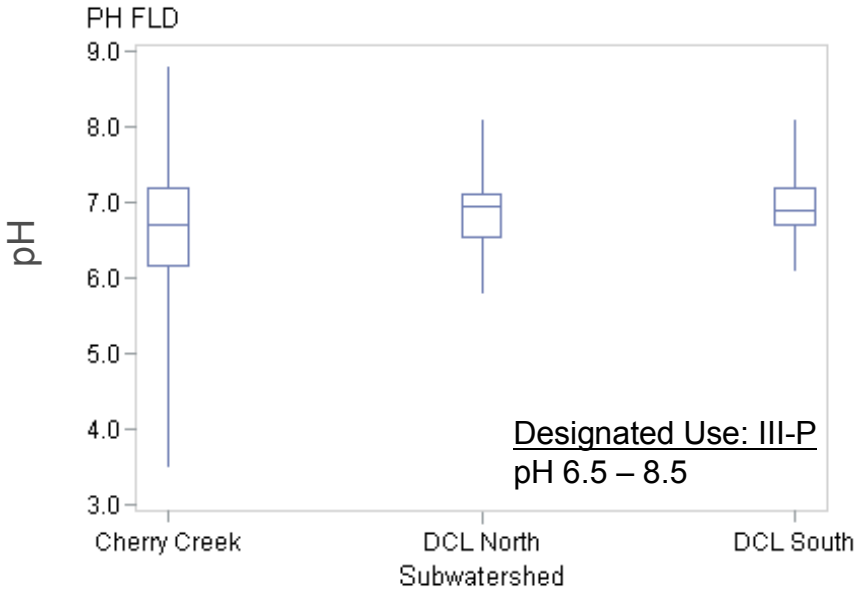
***Example***

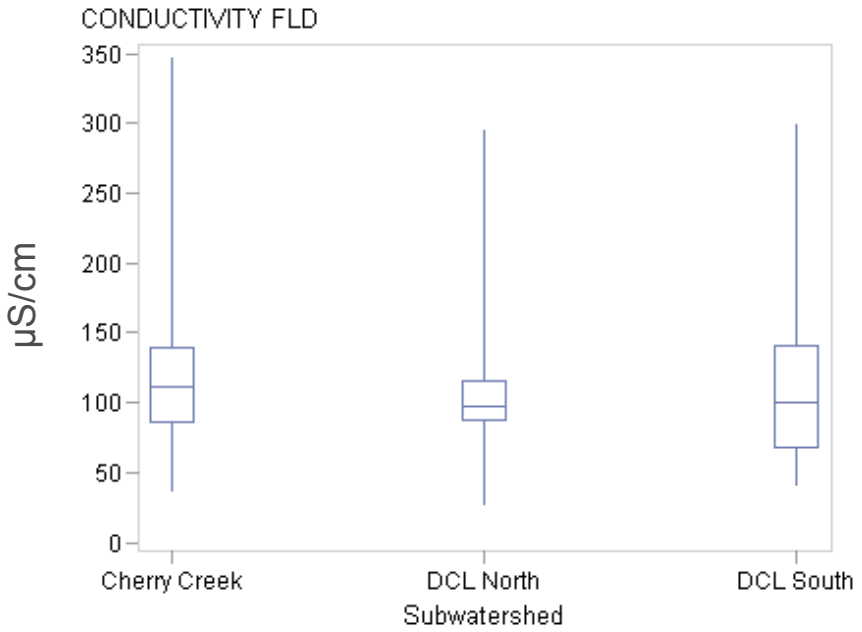


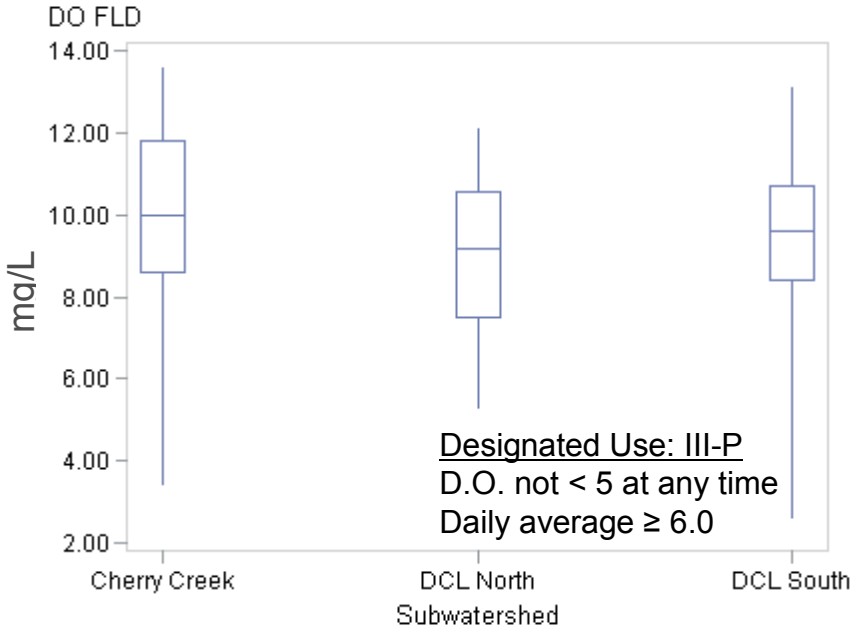

Check to see what the Maths Dictionary says by clicking on this link, then clicking on the B category, then clicking on the words "Box and whisker plot".

# Water Quality Results – DCL Subwatersheds



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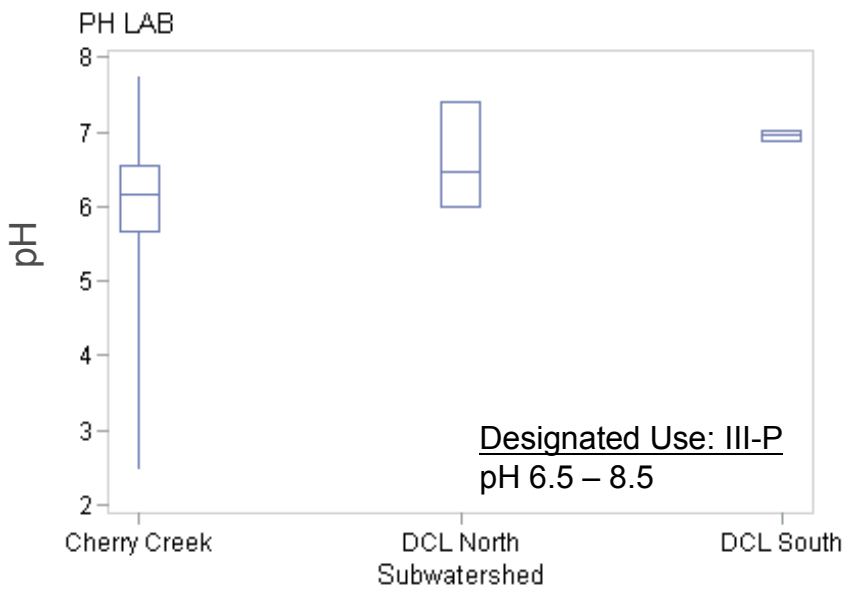


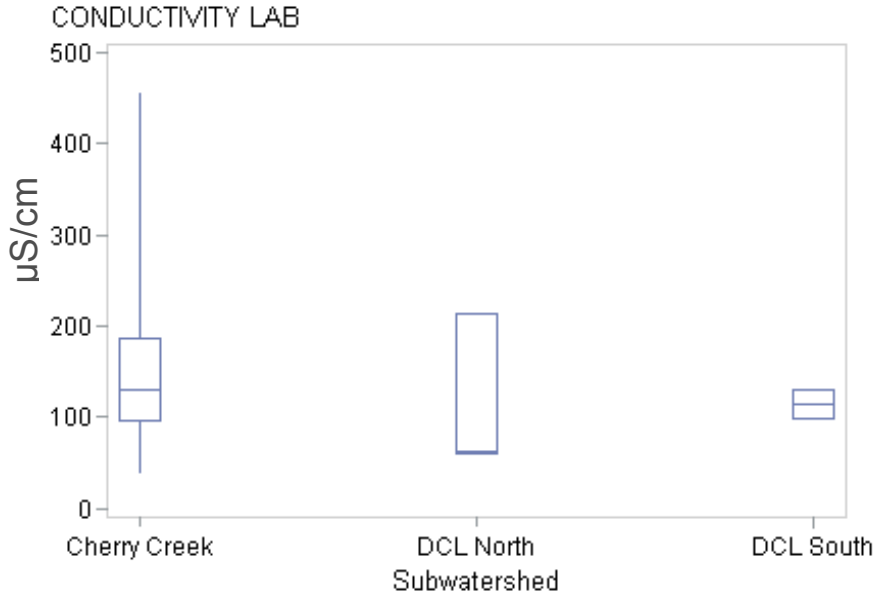



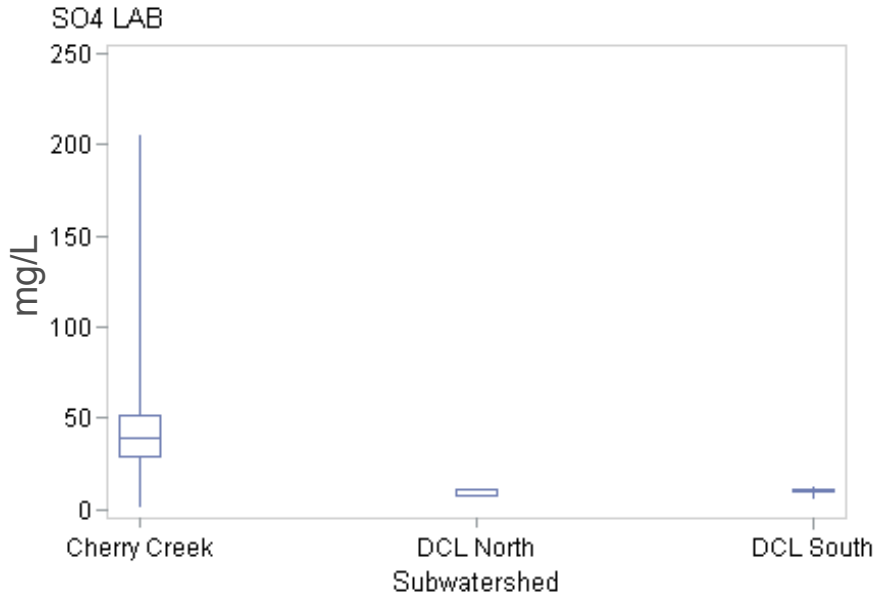

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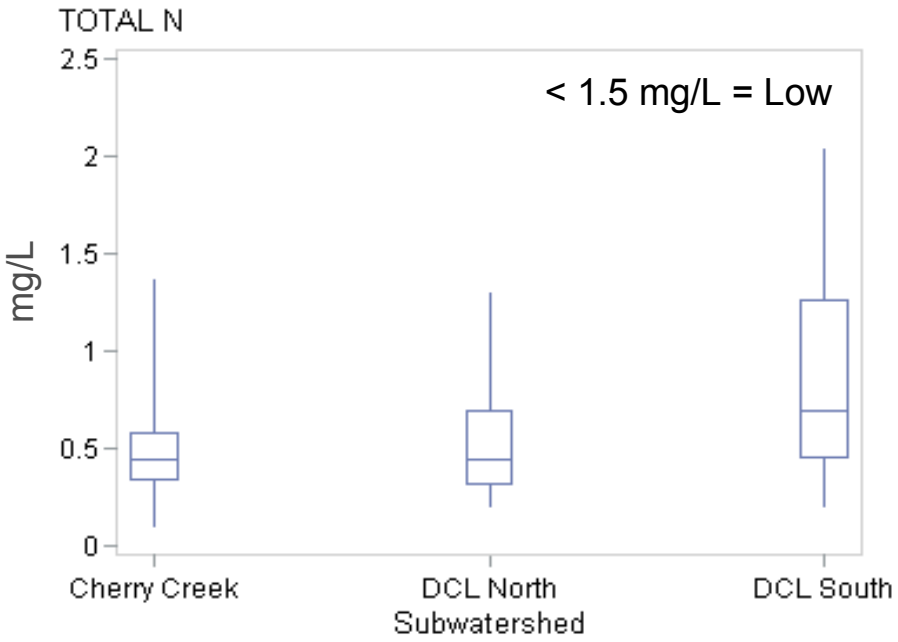


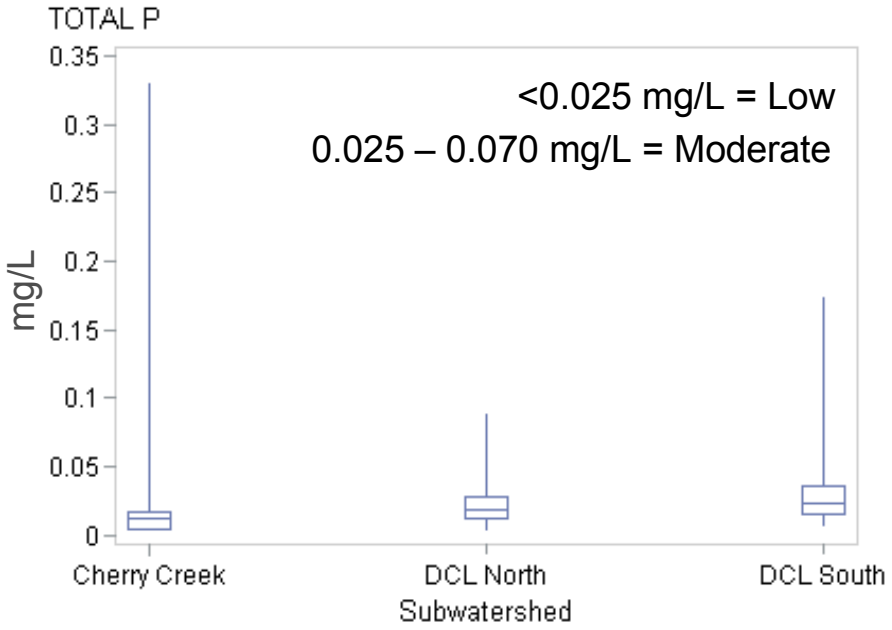

# Stream Biodiversity

- Herpetofauna (reptiles and amphibians)
- Freshwater Mussels (not detected in DCL streams)
- Crayfish
- Fishes
- Benthic Macroinvertebrates

# Stream Biodiversity

## Herpetofauna

10 species (29 in Youghiogheny Basin)


Photo: William Harbold

### Frogs and Toads

AMERICAN BULLFROG

EASTERN AMERICAN TOAD

NORTHERN GREEN FROG

NORTHERN SPRING PEEPER

### Salamanders

EASTERN RED-BACKED SALAMANDER

LONG-TAILED SALAMANDER

NORTHERN DUSKY SALAMANDER

NORTHERN TWO-LINED SALAMANDER

RED-SPOTTED NEWT

SEAL SALAMANDER


Photos: Rebecca Chalmers

# Stream Biodiversity

**Crayfish (6 species)**

- Allegheny Crayfish (Native)
- Rock Crawfish (Native)
- Upland Borrowing Crayfish (Native)
- Virile Crayfish (Introduced/Invasive)
- White River Crawfish (Introduced/Not Inv.)
- Little Brown Mudbug (Introduced/Not Inv.)

Virile Crawfish: This introduced species is known from impoundments in the Youghiogheny River basin including Deep Creek Lake. This species is considered invasive and is known to compete with and displace native species. Although it is not currently widespread in streams in the basin, it represents the largest threat to populations of the Allegheny Crayfish if it invades these habitats.

Allegheny Crayfish: This native species is common to abundant in the Little Youghiogheny, Youghiogheny, and Casselman rivers and larger tributaries. It is found in highest abundance in streams with good habitat quality and low urban development. Allegheny Crayfish can also be found in the rocky littoral portions of Deep Creek Lake.

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# Stream Health in the Deep Creek Lake Watershed

## Stream Biodiversity

### Fishes (21 Species)

**38 Species in Yough. Basin**

| Family | Species | Native or Introduced | Gamefish | Status | Tolerance | Trophic Position |
|---|---|---|---|---|---|---|
| Pickerels | Chain Pickerel | Introduced | Game | | Moderate | Top Predator |
| | Redfin Pickerel | Introduced | Non-Game | | Tolerant | Top Predator |
| | Northern Pike | Introduced | Game | | Moderate | Top Predator |
| Catfish | Yellow Bullhead | Native | Non-Game | | Moderate | Omnivore |
| | Brown Bullhead | Native | Non-Game | | Moderate | Omnivore |
| Trout | Brook Trout | Native | Game | Watch List | Intolerant | Top Predator |
| | Rainbow Trout | Introduced | Game | | Moderate | Top Predator |
| | Brown Trout | Introduced | Game | | Moderate | Top Predator |
| Suckers | White Sucker | Native | Non-Game | | Tolerant | Omnivore |
| Minnows | Common Carp | Introduced | Non-Game | | Moderate | Omnivore |
| | Golden Shiner | Native | Non-Game | | Tolerant | Omnivore |
| | Creek Chub | Native | Non-Game | | Tolerant | Generalist |
| Perches | Walleye | Native | Game | | Moderate | Top Predator |
| | Yellow Perch | Native | Non-Game | | Moderate | Generalist |
| | Johnny Darter | Native | Non-Game | Watch List | Moderate | Invertivore |
| Sunfishes | Smallmouth Bass | Native | Game | | Moderate | Top Predator |
| | Largemouth Bass | Native | Game | | Tolerant | Top Predator |
| | Rock Bass | Native | Non-Game | | Moderate | Generalist |
| | Pumpkinseed | Native | Non-Game | | Tolerant | Invertivore |
| | Bluegill | Native | Non-Game | | Tolerant | Invertivore |
| | Black Crappie | Native | Non-Game | | Moderate | Generalist |

# Stream Biodiversity

## Benthic Macroinvertebrates

- 5 Phyla, 7 Classes, 23 Orders; 149 Families; 237 Genera (478 total Genera statewide based on DNR/MBSS)
- Most Diverse Orders:
  - Diptera (true flies) – 52 genera
  - Trichoptera (caddisflies) – 23 genera
  - Ephemeroptera (mayflies) – 17 genera
  - Plecoptera (stoneflies) – 17 genera
  - Coleoptera (beetles) – 8 genera
- No Obligate Coldwater Taxa
- Coldwater Taxa – two caddisflies, three mayflies, one stonefly

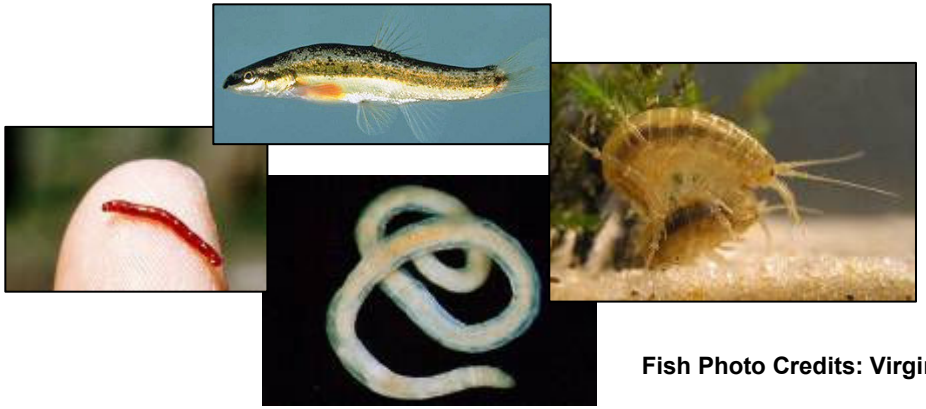
# Stream Health Based on Fish and Benthic Communities

## Pristine

High diversity
Sensitive taxa
Specialists

## Impacted

Low diversity
Tolerant taxa
Generalists



Fish Photo Credits: Virginia Tech

# Indices of Biotic Integrity (IBIs)

## Multi-metric Index to Rate Stream Health

Ex. Highland BIBI

**Species Diversity**
Number of Taxa
Number of EPT Taxa
Number of Ephemeroptera Taxa

**Abundance**
% Tanytarsini
% Swimmer
% Diptera

**Good**
**Fair**
**Poor**
**Very Poor**

**Tolerance**
% Intolerant

**Functional Feeding Groups**
% Scraper

# Stream Health in the Deep Creek Lake Watershed

## *IBI Score and Narrative Rating*

| IBI Score Range | Narrative Rating |
|---|---|
| 4.0 – 5.0 | Good |
| 3.0 – 3.9 | Fair |
| 2.0 – 2.9 | Poor |
| 1.0 – 1.9 | Very Poor |

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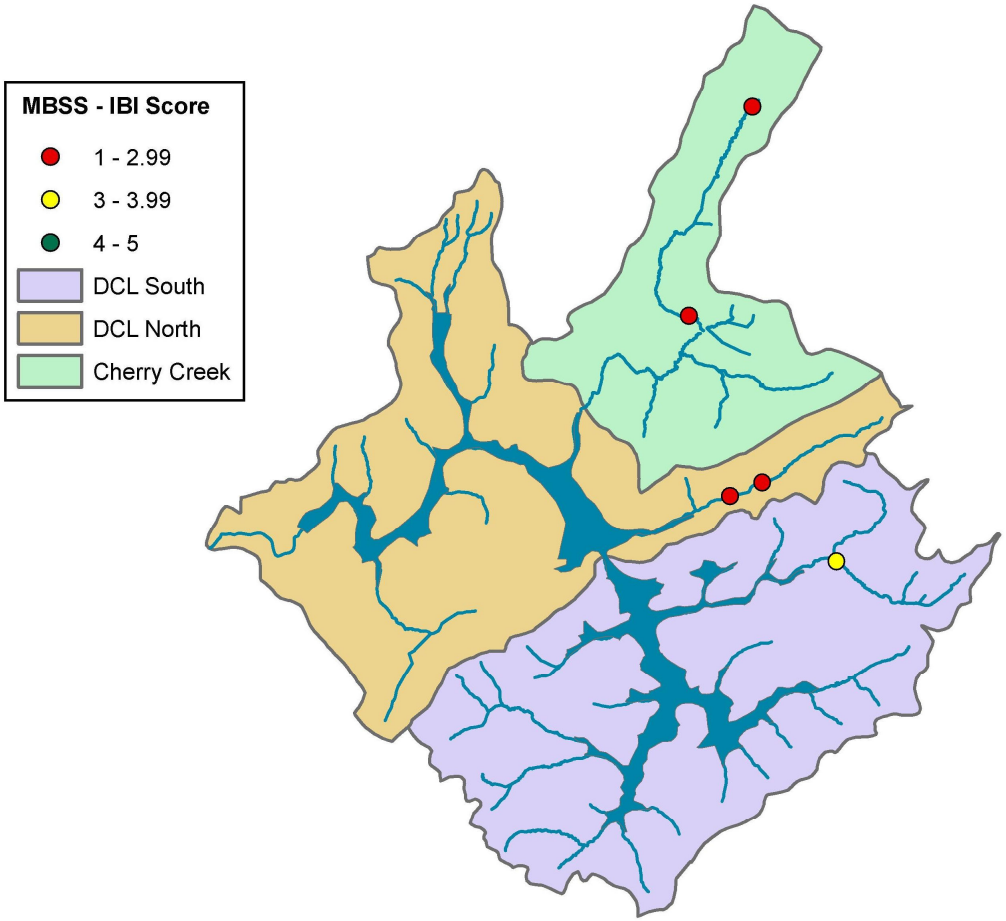
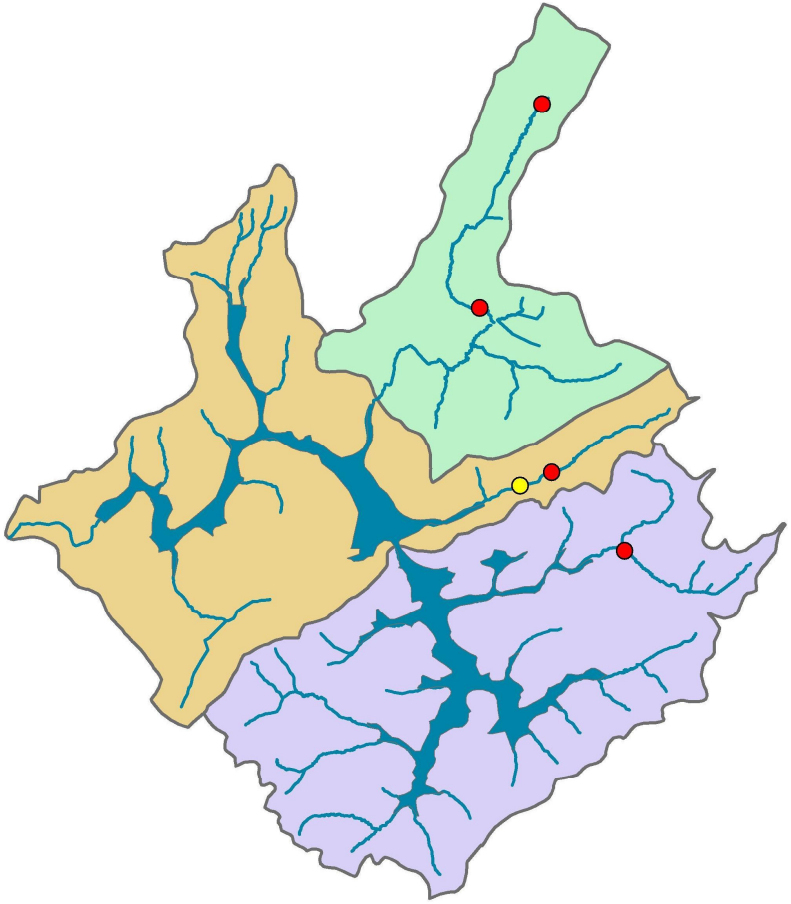
## MBSS Benthic IBI

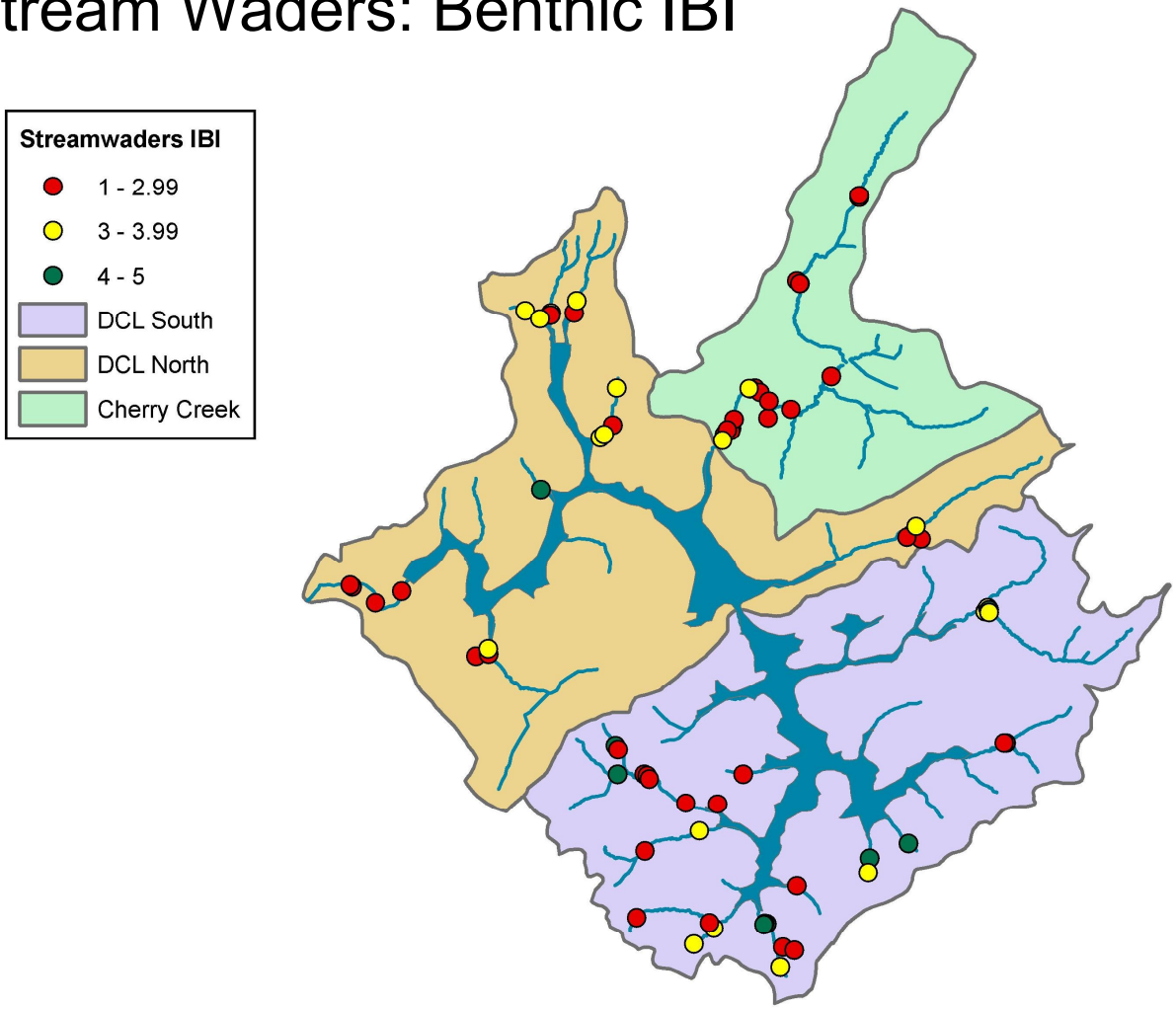



## MBSS Fish IBI



# Stream Health in the Deep Creek Lake Watershed

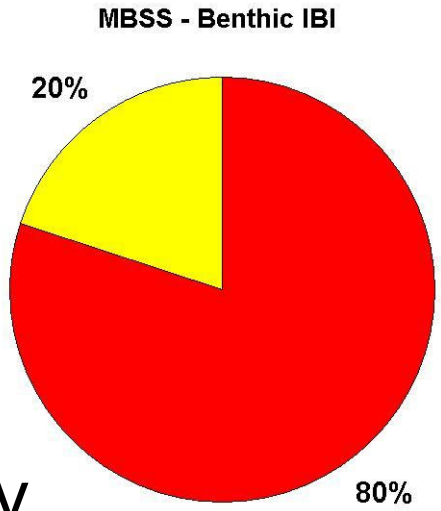
## Stream Waders: Benthic IBI

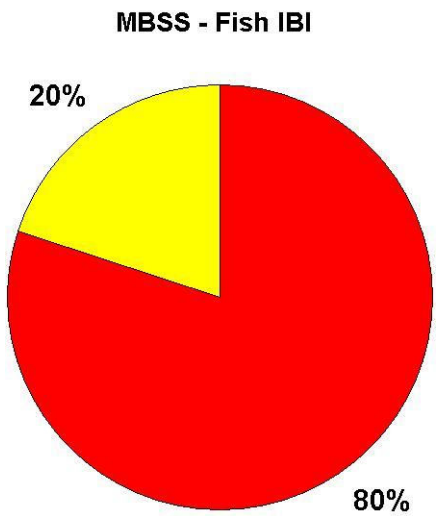


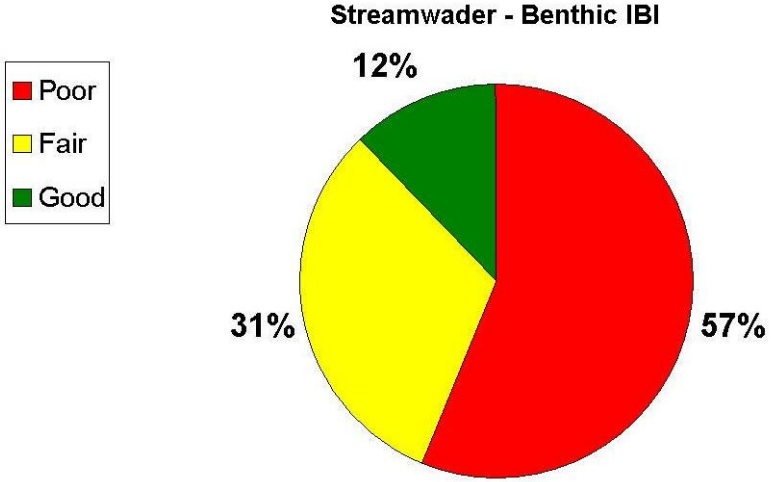
# Stream Health in the Deep Creek Lake Watershed

## Stream Health Summary

## DCL Watershed



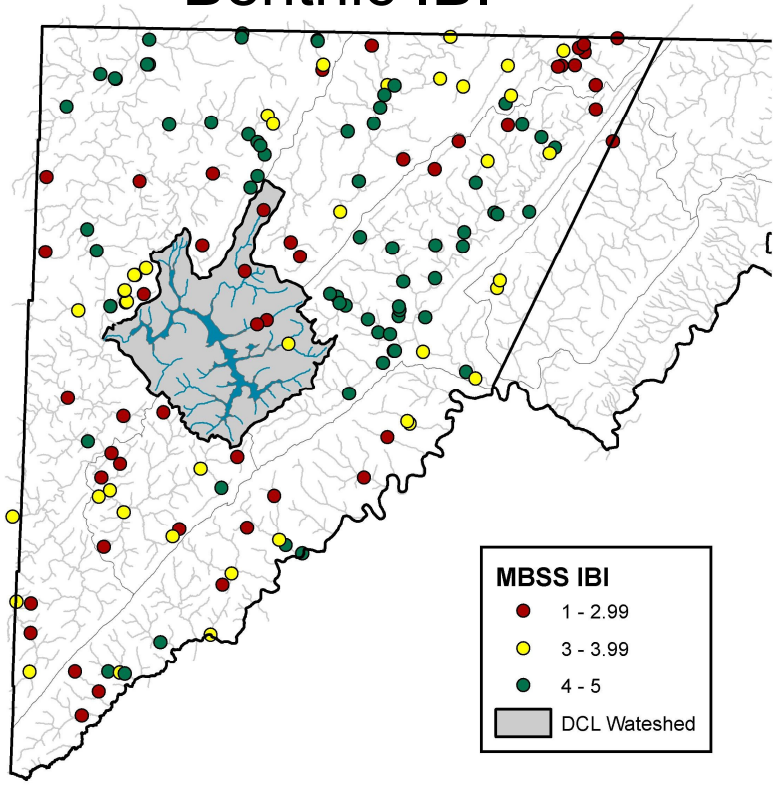



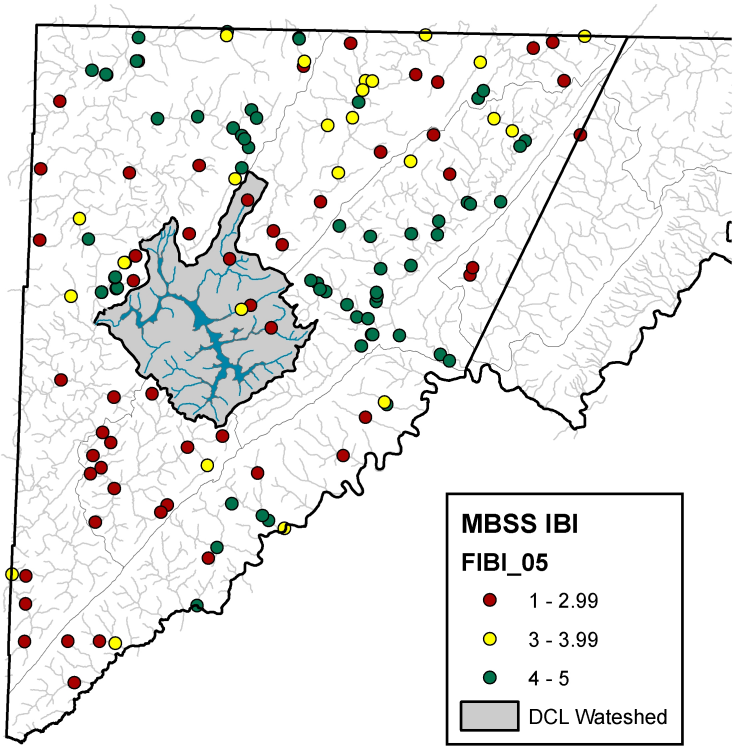
# Stream Health in the Deep Creek Lake Watershed

## Garrett County MBSS IBI Scores: 2000 – 2012 (N=203)

### Benthic IBI




### Fish IBI



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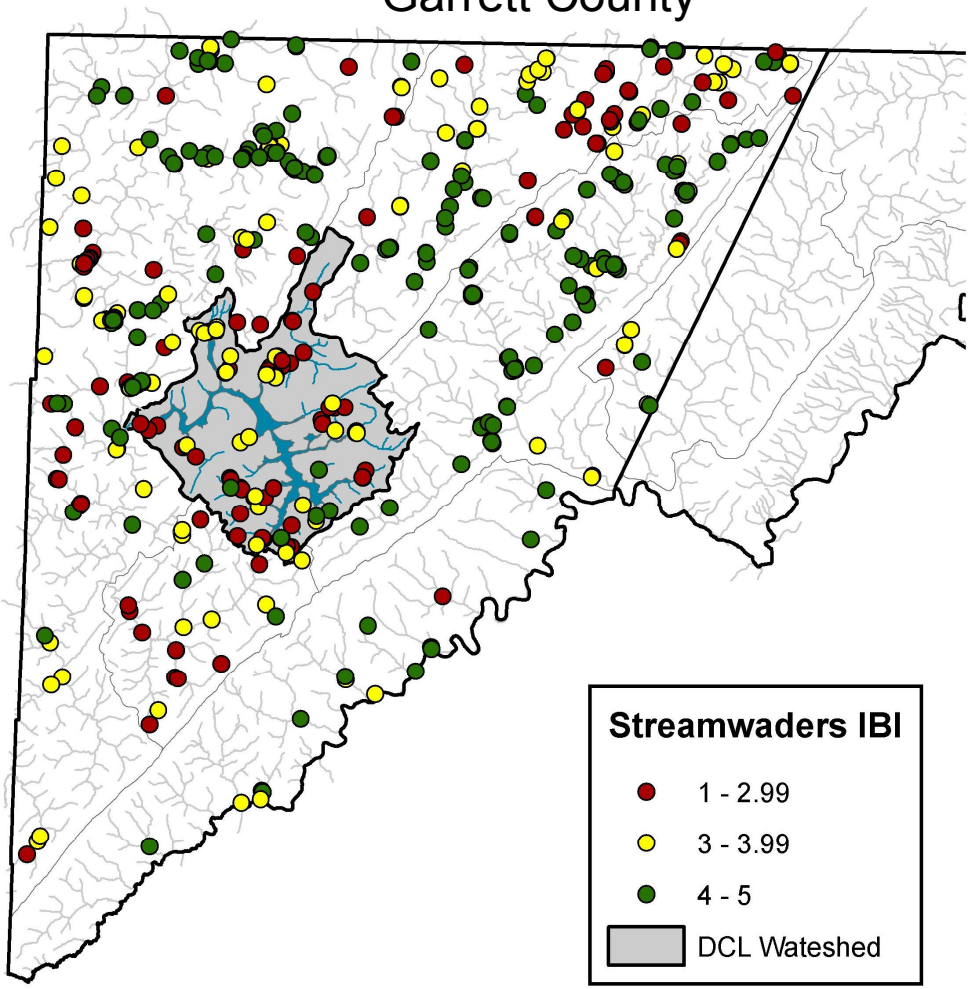
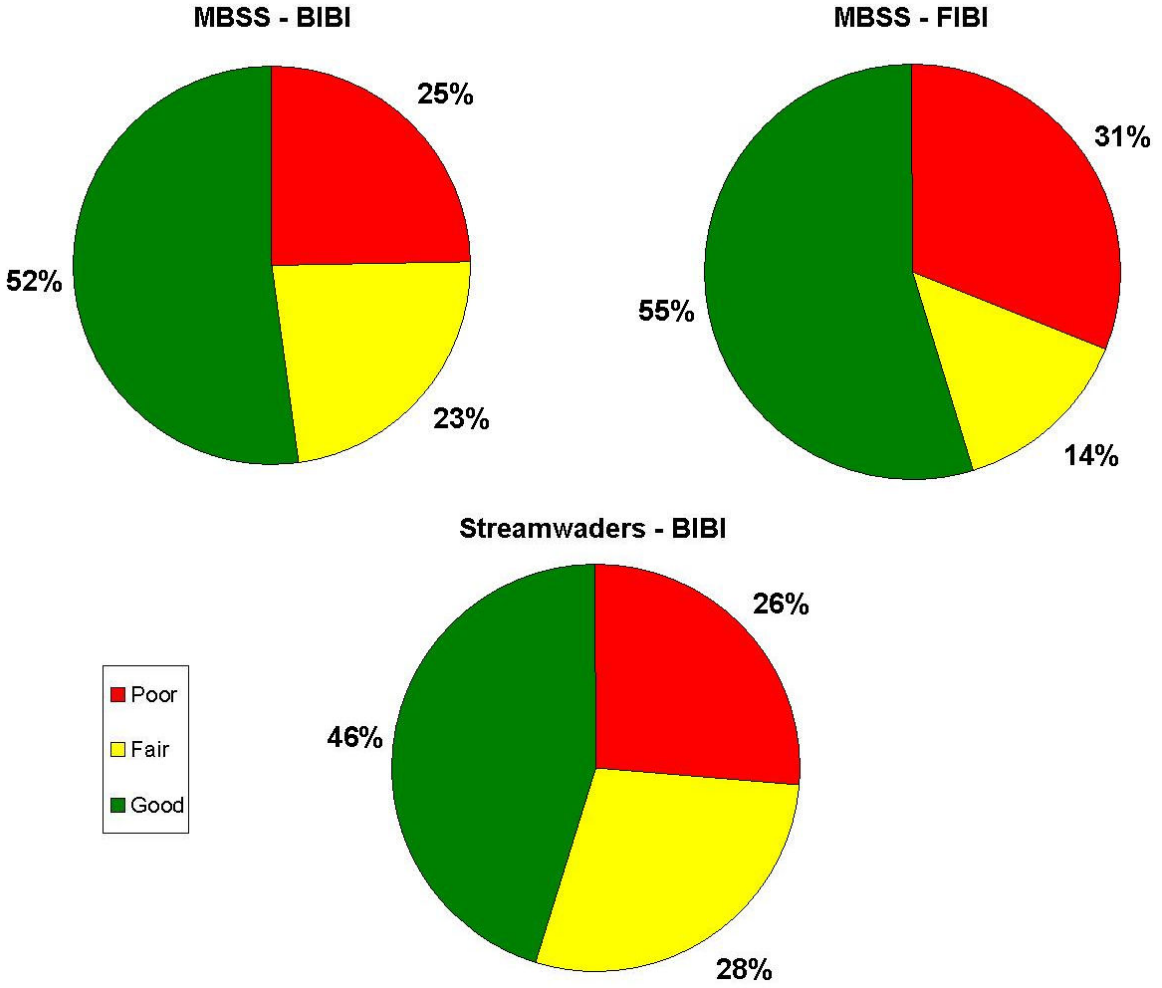
# Stream Health in the Deep Creek Lake Watershed

## Stream Waders: 2000 - 2012 (N=486)

Garrett County



# Garrett County Stream Health Summary: 2000 - 2012



# Stream Health in the Deep Creek Lake Watershed

REVISED FINAL

**Watershed Report for Biological Impairment of the Deep Creek Lake Watershed in Garrett County, Maryland Biological Stressor Identification Analysis Results and Interpretation**

**REVISED FINAL**

DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard, Suite 540
Baltimore, Maryland 21230-1718

Submitted to:

Water Protection Division
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

January 2012

# DCL Poor Stream Health –MDE Report Findings

- MBSS data\results – DCL watershed was placed on the State's Integrated List (Listed as Impaired) because of impacts to its biological communities in streams
- MBSS does not determine source of biological impairments
- MDE developed Biological Stressor Identification Analysis (BSID) (risk based approach) – determines the predominate cause of reduced biological condition

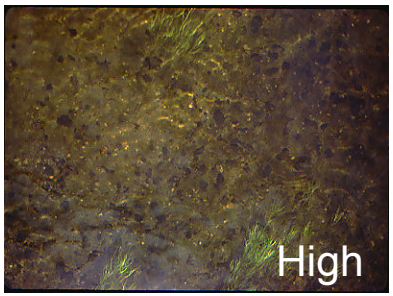
**BSID Approach**

- uses habitat and water quality monitoring data to determine causes of impairment
- also uses habitat and land use to determine the source of the impairment

# BSID: Probable Causes and Source of Impairment

## DCL Streams: Biological Impairment

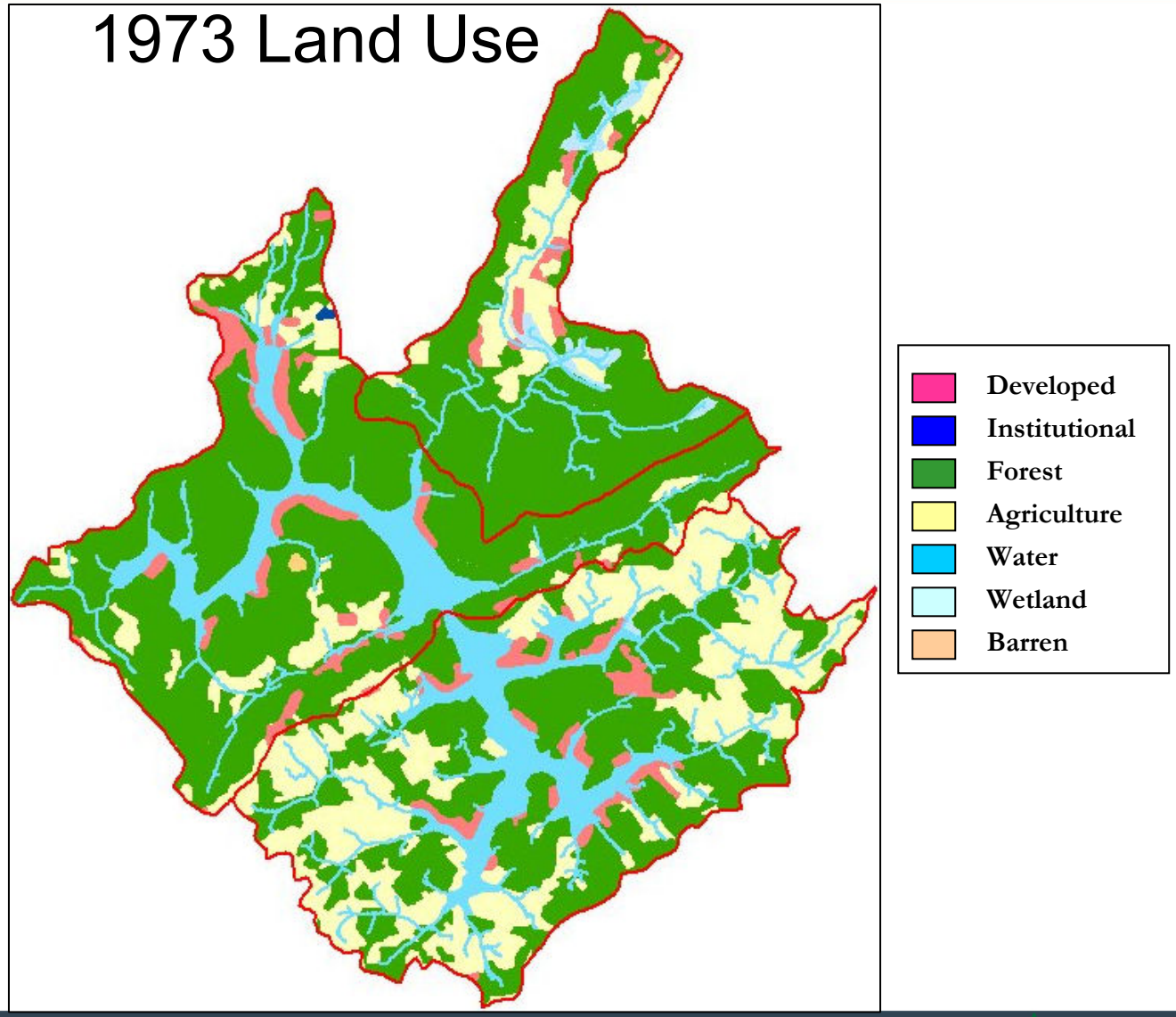
- Acidity is the cause for Biological Impairment for Cherry Creek, indicated by low pH and low Acid Neutralizing Capacity (ANC) - BOM
- Elevated sulfate concentrations – presence of AMD is a potential source
- Stressors associated with stream morphology, including:
  - high embeddedness
  - poor epifaunal substrate
  - poor instream habitat
  - poor riffle/run quality


- Note: Not necessary due to high sediment load, but presence of low gradient streams

- Large and small scale human activities – impacting physical habitat

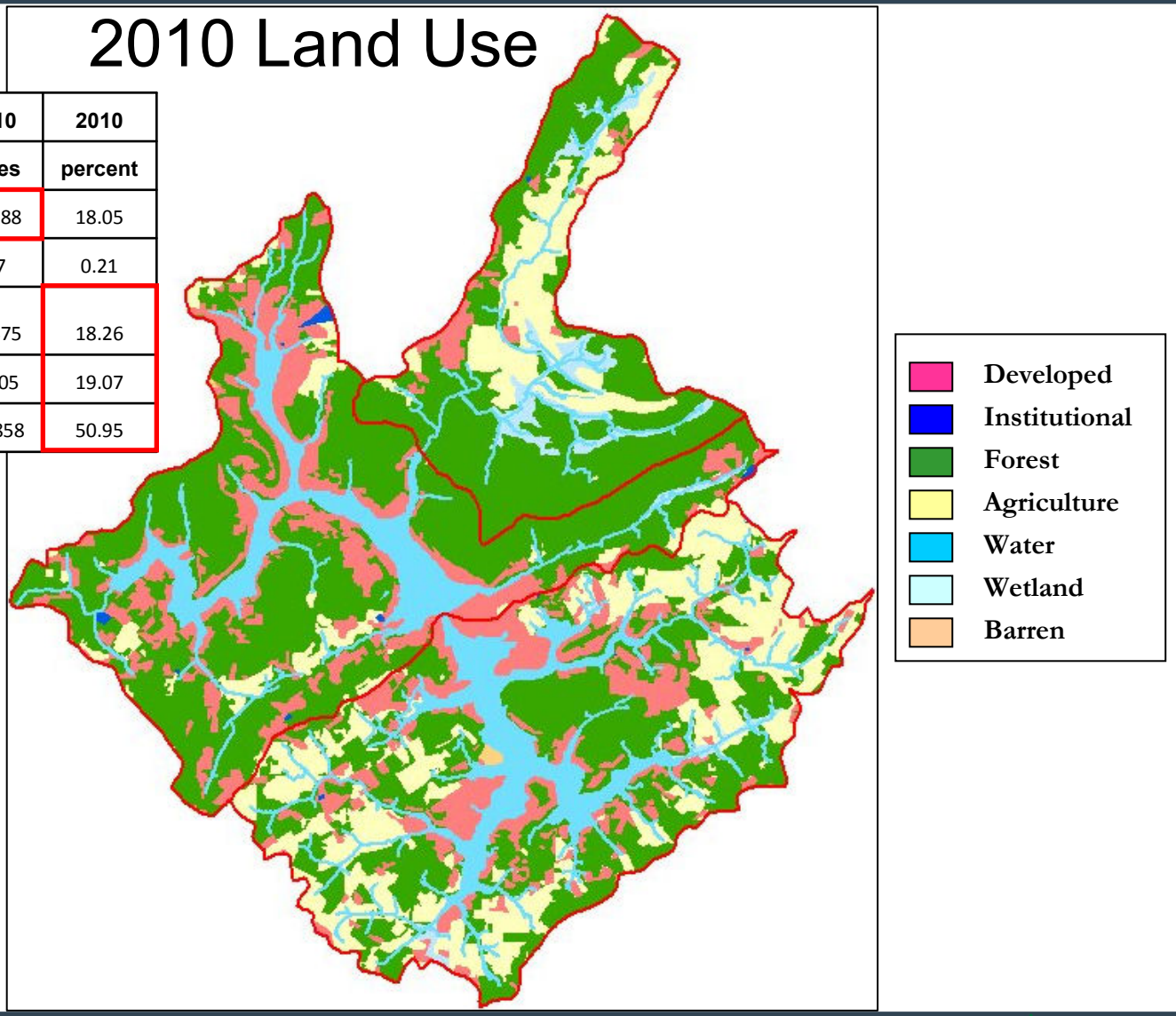
# Stream Health in the Deep Creek Lake Watershed



MARYLAND DEPARTMENT OF NATURAL RESOURCES

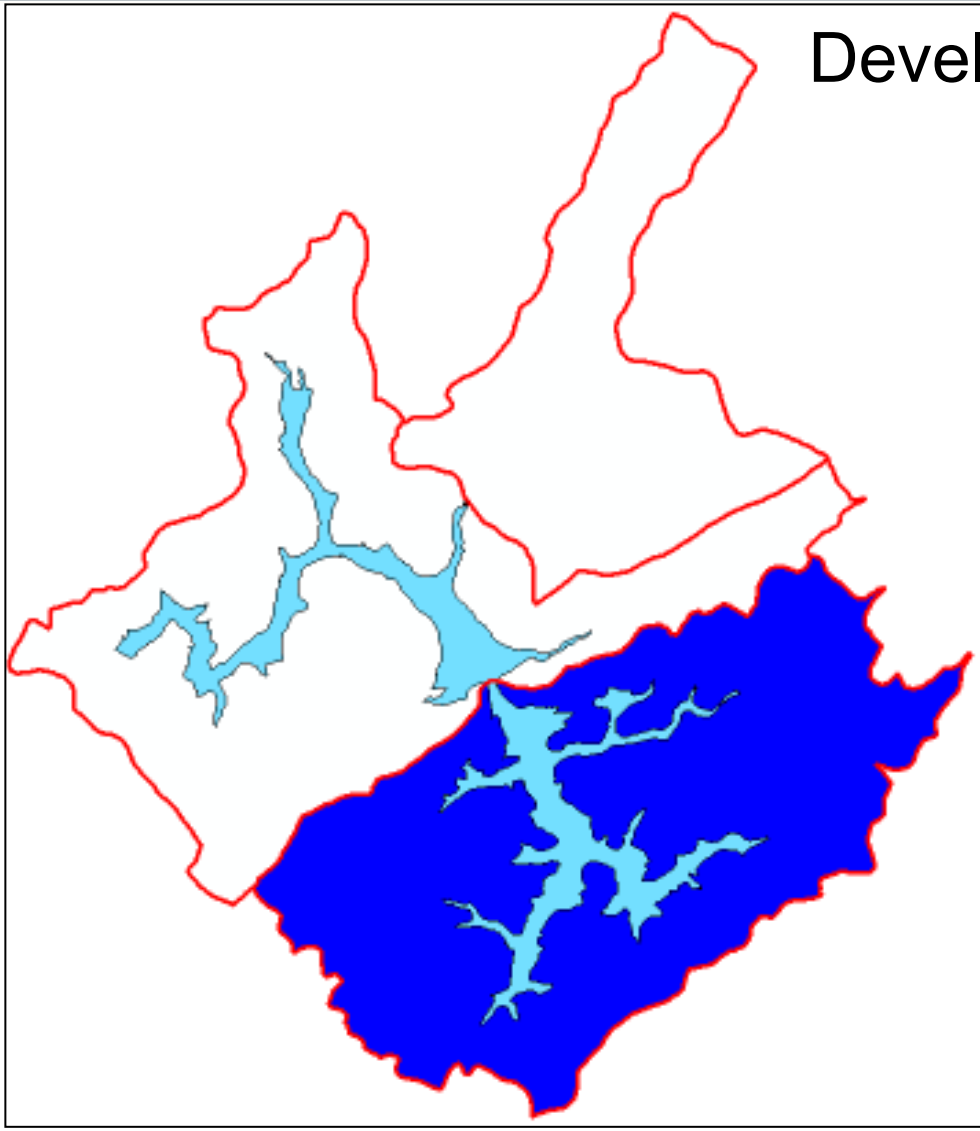
# Stream Health in the Deep Creek Lake Watershed

| Land Use | 1973 acres | 1973 percent | 2010 acres | 2010 percent |
|---|---|---|---|---|
| Developed | 2,240 | 5.47 | 7,388 | 18.05 |
| Institutional | 20 | 0.05 | 87 | 0.21 |
| Developed T (D+I) | 2,261 | 5.52 | 7,475 | 18.26 |
| Ag | 9,431 | 23.04 | 7,805 | 19.07 |
| Forest | 25,074 | 61.25 | 20,858 | 50.95 |




MARYLAND DEPARTMENT OF NATURAL RESOURCES

# Stream Health in the Deep Creek Lake Watershed



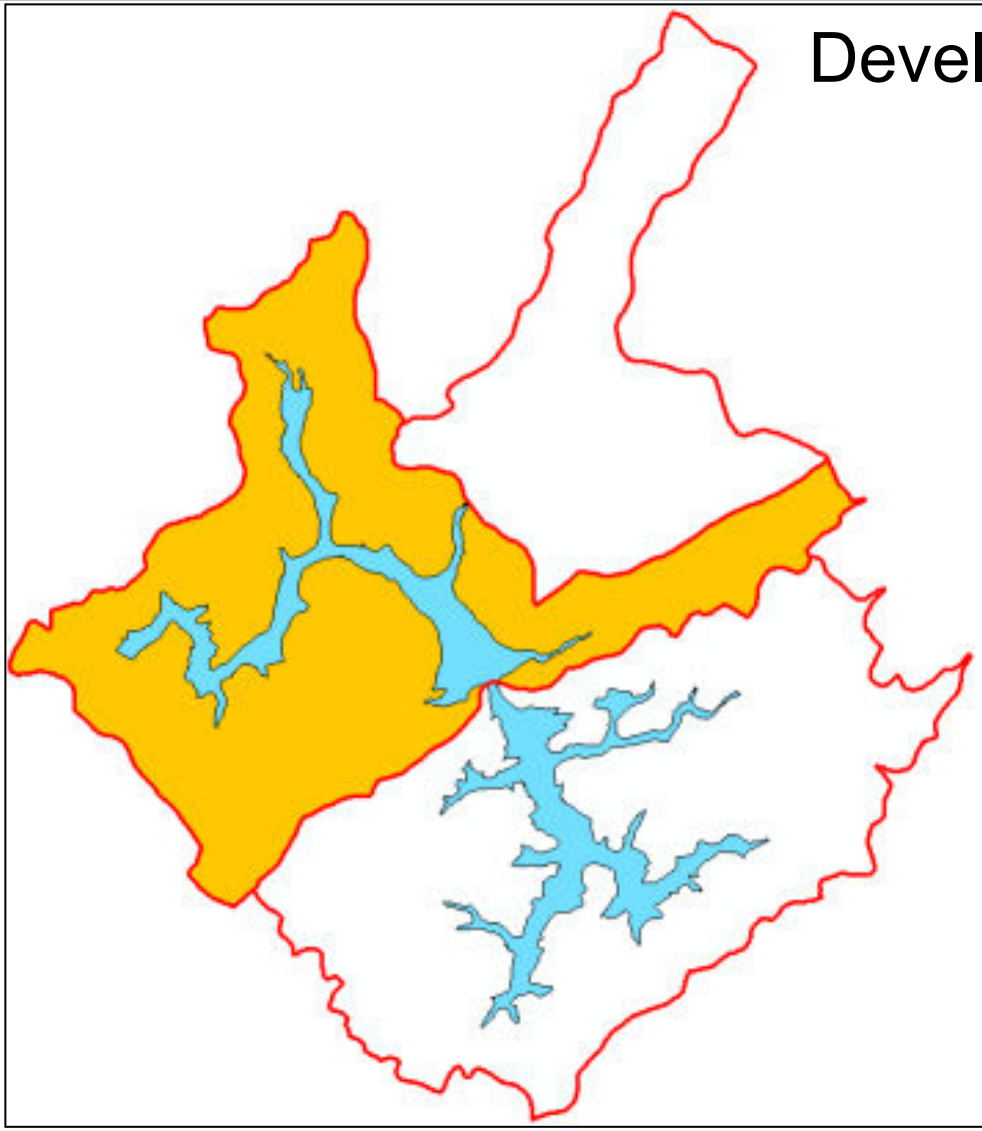
## Development: DCL South (0027)

| Decade | Number of Parcels | Acres per Parcel | Average Structure Size (square feet) |
|---|---|---|---|
| 1860-1899 | 10 | 54.7 | 1,860 |
| 1900 | 11 | 50.7 | 2,015 |
| 1910 | 11 | 38.0 | 1,503 |
| 1920 | 10 | 41.9 | 2,349 |
| 1930 | 22 | 15.0 | 1,803 |
| 1940 | 89 | 1.1 | 1,512 |
| 1950 | 189 | 2.9 | 1,494 |
| 1960 | 279 | 2.0 | 1,429 |
| 1970 | 312 | 3.0 | 1,470 |
| 1980 | 393 | 2.3 | 1,739 |
| 1990 | 400 | 2.0 | 2,099 |
| 2000 | 548 | 1.8 | 2,319 |
| 2010-2013 | 72 | 1.2 | 2,692 |
| Total | 2,346 | 3.1 | 1,868 |

61.5 square kilometers (non-water)

38.2 parcels per square kilometer

# Stream Health in the Deep Creek Lake Watershed



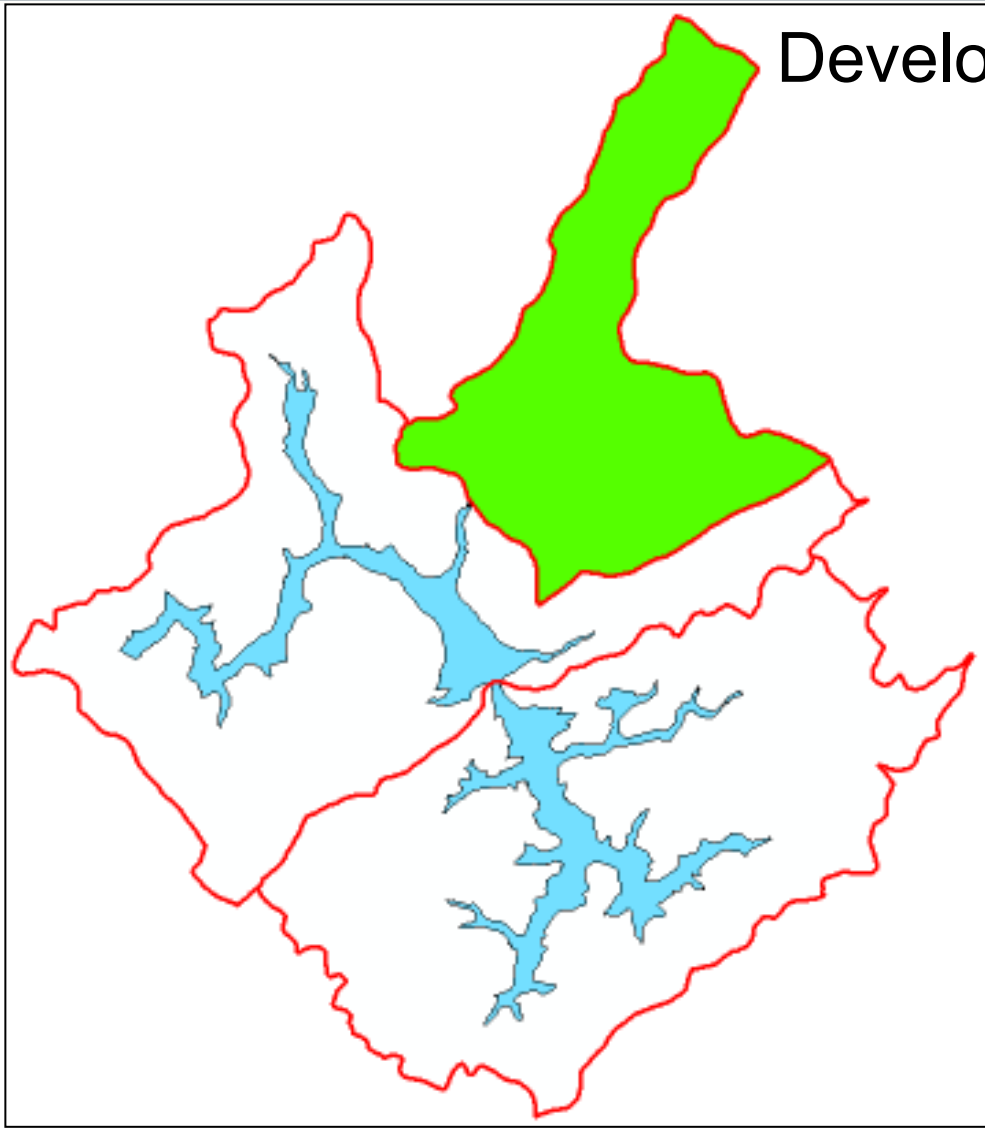
## Development: DCL North (0028)

| Decade | Number of Parcels | Acres per Parcel | Average Structure Size (square feet) |
|---|---|---|---|
| 1850-1899 | 7 | 101.1 | 2,739 |
| 1900 | 8 | 22.8 | 1,185 |
| 1910 | 4 | 11.9 | 1,860 |
| 1920 | 11 | 9.5 | 2,432 |
| 1930 | 48 | 7.8 | 1,761 |
| 1940 | 103 | 1.4 | 1,550 |
| 1950 | 181 | 1.7 | 1,443 |
| 1960 | 193 | 10.9 | 1,774 |
| 1970 | 223 | 2.8 | 1,517 |
| 1980 | 637 | 1.2 | 1,871 |
| 1990 | 555 | 1.4 | 2,162 |
| 2000 | 980 | 4.5 | 2,319 |
| 2010-2013 | 59 | 2.4 | 5,775 |
| Total | 3,009 | 34.4 | 2,078 |

57.3 square kilometers (non-water)

52.5 parcels per square kilometer

# Stream Health in the Deep Creek Lake Watershed



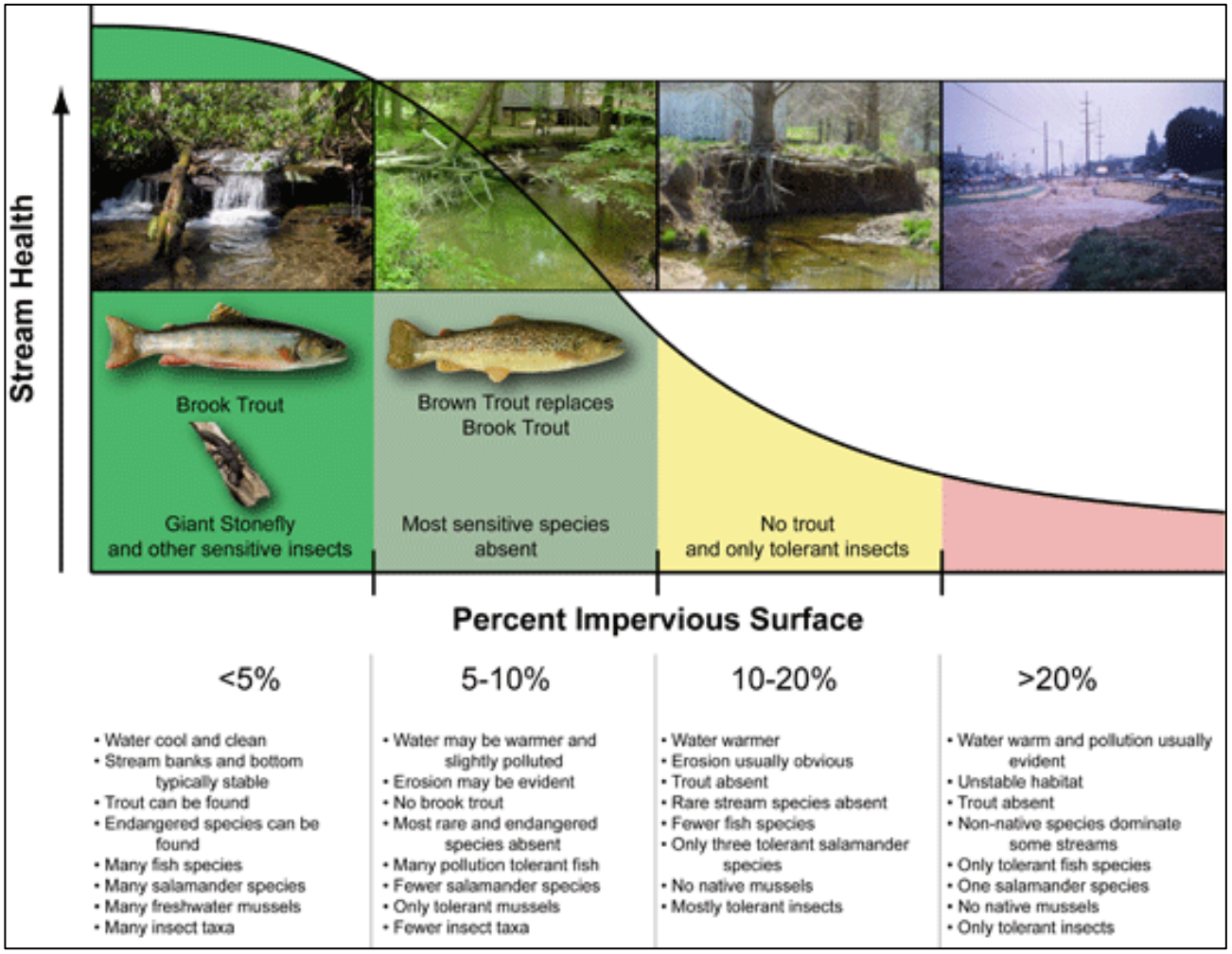
## Development: Cherry Creek (0029)

| Decade | Number of Parcels | Acres per Parcel | Average Structure Size (square feet) |
|---|---|---|---|
| 1870-1899 | 2 | 161.5 | 1,668 |
| 1900 | 2 | 37.6 | 1,154 |
| 1910 | 3 | 1,141.32 | 2,704 |
| 1920 | 1 | 90.5 | 1,665 |
| 1930 | 2 | 23.0 | 930 |
| 1940 | 2 | 72.9 | 1,608 |
| 1950 | 3 | 18.8 | 1,262 |
| 1960 | 10 | 2.1 | 4,135 |
| 1970 | 22 | 4.2 | 1,429 |
| 1980 | 27 | 8.2 | 1,592 |
| 1990 | 23 | 4.9 | 1,793 |
| 2000 | 24 | 2.1 | 1,733 |
| 2010-2013 | 7 | 18.9 | 1,404 |
| Total | 128 | 37.4 | 1,818 |

32.0 square kilometers (non-water)

4.0 parcels per square kilometer

# Development and Stream Impacts



# Shoreline Development and Lake Impacts

Most Information – from Wisconsin, Minnesota and Michigan

Development\Impervious Surface

- decrease ability for shoreline to serve their natural functions
- eliminate wildlife habitat
- fish spawning grounds become unproductive due to sediment input
- water clarity impacts (property values and SAV)
- runoff carries pollutants to the lake

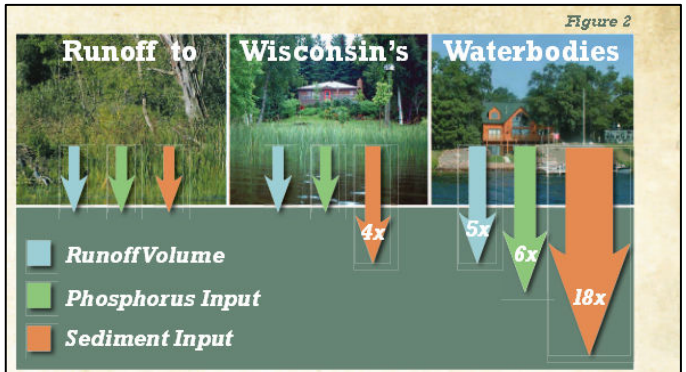



*Figure 2:* The far left picture indicates a half-acre undeveloped shoreland lot that causes minimal runoff, phosphorus and sediment inputs to the lake. The middle picture portrays a typical 1940s shoreland development with approximately 8% of its area covered by impervious surfaces. The picture to the right shows a shoreland lot with approximately 20% of its area covered by impervious surfaces. Notice how sediment inputs drastically increase as impervious surface coverage increases.[6]

http://www.shorelandmanagement.org/quick/is.html

http://www.wisconsinlakes.org/attachments/article/25/07sum_impsurface%28Markham%29.pdf

http://learningstore.uwex.edu/Assets/pdfs/GWQ061.pdf

http://www.uwsp.edu/cnr-ap/clue/Documents/Zoning/Shoreland_Development_Density_and_Impervious_Surfaces.pdf

# Stream Health in the Deep Creek Lake Watershed

**Shoreland Development Density and Impervious Surfaces**

*How do they affect water resources?*
*How much is too much for our lakes and streams?*

Center for Land Use Education

Table 3. Surface water pollutants

| Pollutant | Source in Nature | Role in Natural Ecosystem | Source in Developed Areas | Role of Excess Pollutant |
|---|---|---|---|---|
| Sediment | Banks of meandering channels and shorelines | Maintain stream profile and energy gradient; store nutrients | Construction sites; eroding banks | Abrade fish gills; carry excess nutrients and chemicals; block sunlight; cover gravel (spawning) & bottom habitats |
| Organic Compounds | Decomposing organic matter | Store nutrients | Car oil; herbicides; pesticides; fertilizers | Deprive water of oxygen by decomposition |
| Nutrients | Native soils & decomposing organic matter transported by natural runoff rates | Support ecosystems Sustain plant base of food chain | Organic compounds; organic litter; fertilizers; food waste; sewage | Unbalance ecosystems; produce algae blooms & aquatic plant excess; deprive water of oxygen by decomposition |
| Trace Metals | Mineral weathering | Support ecosystems | Cars; construction materials; coal burning power plants; anthropogenic chemicals | Reduce resistance to disease; reduce reproductive capacity; alter behavior; chronic & acute toxicity depending on concentration |
| Chloride | Mineral weathering | Support ecosystems | Pavement deicing salts, water softener salt | Sterilize soil and reduce biotic growth |
| Bacteria | Native animals | Natural decomposition & nutrient cycling | Waste handling areas; domestic & agricultural animals | Cause risk of disease to humans & wildlife |
| Oil | Decomposing organic matter | Store nutrients | Cars, paving | Deoxygenate water |

Modified from Ferguson, B. K. 1998. *Introduction to Stormwater: Concept, Purpose, Design*, New York: John Wiley & Sons, Inc.

# Management Recommendations

**(March 2014)**

- Tree plantings in areas with inadequate buffers
  - Streams and Rivers
  - Perimeter of the Lake
- Additional Monitoring
  - Stream Corridor Assessment (SCA)
  - Synoptic Survey (SS) – e.g., to identify high nutrient concentrations
  - MBSS – targeting (high quality streams or streams based on SCA and SS results)

# Stream Health in the Deep Creek Lake Watershed