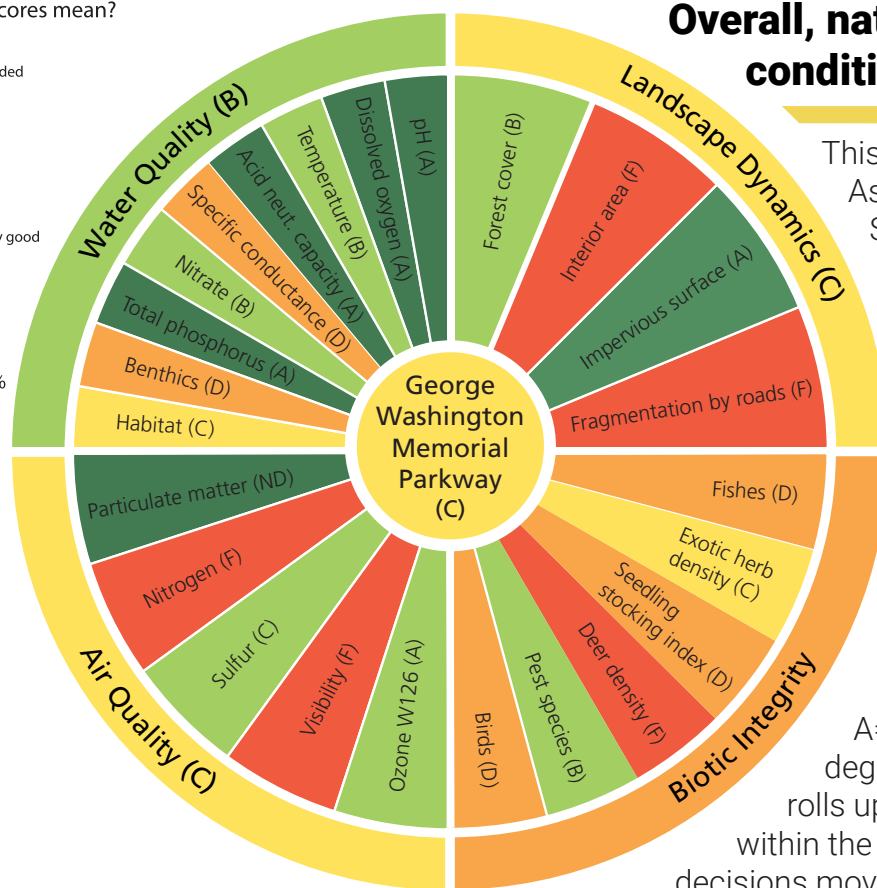# What is the status of George Washington Memorial Parkway natural resources?

What do the scores mean?

F 0–20% Very degraded

D 21–40% Degraded

C 41–60% Moderately good

B 61–80% Good

A 81–100% Very good

ND No data

Summary wheel for George Washington Memorial Parkway (C)

Water Quality (B): pH (A), Dissolved oxygen (A), Temperature (B), Acid neut. capacity (A), Specific conductance (D), Nitrate (B), Total phosphorus (A), Benthics (D), Habitat (C)

Landscape Dynamics (C): Forest cover (B), Interior area (F), Impervious surface (A), Fragmentation by roads (F)

Biotic Integrity: Fishes (D), Exotic herb density (C), Seedling stocking index (D), Deer density (F), Pest species (B), Birds (D)

Air Quality (C): Ozone W126 (A), Visibility (F), Sulfur (C), Nitrogen (F), Particulate matter (ND)

Overall, natural resources condition is moderate.

This summary of Resource Assessments for Management Strategies (RAMS) presents the condition of indicators from the 4 Vital Signs Framework categories: Water Quality, Biotic Integrity, Air Quality, and Landscape Dynamics. Indicator scores are displayed in the summary wheel to the left, using stoplight colors and letter grades to indicate resource condition (Green—A=Very good and Red—F=Very degraded). This visual guide rolls up natural resource conditions within the park to inform management decisions moving forward.

Water Quality Generally, water quality is good. Several indicators, including pH and dissolved oxygen, score as very good or good. Benthic communities are degraded and stream habitat is moderately good. Management to improve stream habitats should be considered.

Biotic integrity Biotic Integrity is degraded. Seedling stocking index is very degraded. Deer density scores an F. Deer depress seedling numbers. Continued management of deer is needed.

Landscape Dynamics Overall, landscape dynamics are in moderately good condition. Impervious surface scores well. The forest cover score is good. Interior forest area forms the core forest habitat and is very degraded. Forest condition needs continued management focus.

Air Quality Although difficult to manage, air quality is important to monitor. Visibility is very degraded, and nitrogen deposition is occurring at levels harmful to plants. The particulate matter indicator is in very good condition. The sulfur and ozone indicators are in good condition.

2022 Version 1

How are park resource conditions measured?

What do the scores tell us?

These scores provide a snapshot of resource condition based primarily on Inventory and Monitoring (I&M) data. It is important to track resource condition even if resources are difficult to manage. Resource conditions at the park and landscape level can be used to guide management strategies.

How is natural resource condition assessed?

The status of each indicator is monitored within National Capital region (NCR) parks. A target threshold for the indicator is based on scientific peer-reviewed literature and/or consensus. We compare each natural resource condition to the target threshold value and assign a score. Indicators may be measured as a pass/fail score, as with deer density; on a graduated scale, as with the Bird Community Index; or may be the actual value of the data, as with interior forest area. For more detailed information on how scores are calculated, please see the RAMS methods document (currently in progress).

Monitoring protocols vary among indicators

The frequency and time of year sampled varies by indicator and category. Most Water Quality indicators are sampled monthly at multiple sampling locations within the park. Physical habitat and benthic communities are sampled less frequently at multiple sites. Many biotic integrity data are collected in rotating subsets of total plots each year, with each plot sampled once every four years. Birds are sampled at different locations, and deer density may be calculated from surveys. Air quality data are collected continuously by the Air Resources Division at monitoring sites within or near parks. Landscape dynamics data are from a national GIS database showing classes of land cover.
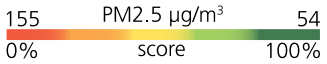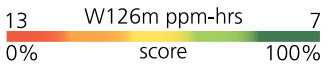
Monitoring helps park managers understand and assess resource condition. Photos clockwise from left: *Erythronium albidum*, Hairstreak Olive on *Pycnanthemum*, Bluebells at Turkey Run Park, Dragonfly.

All photos by Brent Steury

Air Quality monitoring and thresholds

Air Quality reference condition table

Metric	Reference condition			Park average	Overall score (%)	Condition	
(PM) Particulate matter (PM2.5 µg/m³)	155	PM2.5 µg/m³	54	43.00	100%	⬤	Very good
	0%	score	100%				
(N) Nitrogen (kg/ha/yr)	3	kg/ha/yr	1	3.50	0%	⬤	Very degraded
	0%	score	100%				
(SO₄) Sulfur (kg/ha/yr)	3	kg/ha/yr	1	1.50	75%	⬤	Good
	0%	score	100%				
(👓) Visibility (Haze index)	8	Haze index	2	13.40	3%	⬤	Very degraded
	0%	score	100%				
(O₃ W126) Ozone (W126m ppm-hrs)	13	W126m ppm-hrs	7	8.70	72%	⬤	Good
	0%	score	100%				
Air Quality overall condition					50%	⬤	Moderate

Particulate matter (PM) is composed of extremely small droplets and solid particles suspended in air. PM is found in smoke, haze, and dust. It is not measured in every park.

Nitrogen deposited from the air in excess may have harmful effects on living organisms, especially herbaceous plants and water systems. Excess nitrogen may also enable nonnative plant species to outcompete native plants.

Sulfur deposition onto soil, plants, and water can increase acidity in park ecosystems, leading to changes in water and soil chemistry that impact ecosystem condition.

Visibility is reduced when tiny particles in the air scatter and absorb light. High values for visibility supports viewshed integrity. This indicator measures how well and far park visitors can see.

Ozone (W126) is monitored and scored against a high ozone concentration threshold, which are conditions that most likely will affect vegetation. When ozone is too high, it can burn plant tissues and reduce overall plant survival.

An aerial view of Great Falls.

Photo by Brent Steury

Landscape Dynamics monitoring and thresholds

Landscape Dynamics reference condition table

Metric	Reference condition		Park average	Overall score (%)	Condition	
Fragmentation by roads (km/km²)	2 km/km² 1 0% score 100%		7.54	0%	🔴	Very degraded
Impervious surface (% area)	20 % area 10 0% score 100%		6.44	100%	🟢	Very good
Interior forest area (% interior)	0 % interior 100 0% score 100%		5.78	6%	🔴	Very degradeed
Forest cover (% cover)	0 % cover 59 0% score 100%		40.79	69%	🟢	Good
Landscape Dynamics overall condition				44%	🔴🟡🟢	Moderate
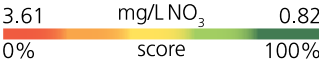
Fragmentation by roads decreases the quality of wildlife habitat, with high road densities fragmenting habitats and increasing the risk of wildlife mortality by collisions with vehicles.

Impervious surfaces negatively impact the condition of various ecological indicators, particularly stream invertebrates, due to increased stormwater runoff.

Interior forest area forms the core of a habitat, and increased interior area improves forest condition.

Forest cover provides habitat, wildlife corridors, and ecological value important to park natural rescources and overall landscape condition.

Roads like the George Washington Memorial Parkway contribute to landscape dynamics. Photo from Library of Congress

Water Quality monitoring and thresholds

Water Quality reference condition table

Metric	Reference condition			Park average	Overall score (%)	Condition	
Habitat (PHI score)	0 / 0%	PHI score / score	100 / 100%	67.00	53%		Moderate
Benthics (BIBI Score)	1 / 0%	BIBI Score / score	5 / 100%	2.33	33%		Degraded
Total phosphorus (mg/L PO$_4$)	0.17 / 0%	mg/L PO$_4$ / score	0.02 / 100%	0.03	85%		Very good
Nitrate (mg/L NO$_3$)	3.61 / 0%	mg/L NO$_3$ / score	0.82 / 100%	1.50	70%		Good
Dissolved oxygen (mg/L)	3 / 0%	mg/L / score	6 / 100%	7.61	99%		Very good
Temperature (degrees C)	30.8 / 0%	degrees C / score	19 / 100%	23.34	65%		Good
Specific conductance (µS/cm)	230 / 0%	µS/cm / score	171 / 100%	561.00	25%		Degraded
pH (pH value)	5 / 0%	6.8–8.5 / 100%	9 / 0%	7.91	94%		Very good
Acid neutralizing capacity (µeq/L)	20 / 0%	µeq/L / score	200 / 100%	1,376	100%		Very good

Water Quality overall condition		69%	Good

Habitat is assessed using Physical Habitat Index indicators such as riffle quality, stream bank stability, and woody debris.

Benthic biota are scored based on the expected benthic faunal assemblage in an unimpaired site.

Total phosphorus is scored based on region-specific threshold categories.

Nitrate is scored based on region-specific threshold categories.

Dissolved oxygen in low concentrations can cause metabolic impacts and death of fishes, invertebrates, and aquatic plants.

Temperature thresholds reflect optimal living conditions for freshwater organisms.

Specific conductance is related to salinity, and measures water's ability to conduct electricity.
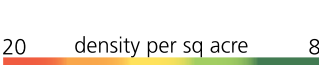
pH, when extreme, limits habitat suitability for aquatic plants and animals.

Acid neutralizing capacity indicates a waterbody's susceptibility to acid rain and runoff inputs.

Biotic Integrity monitoring and thresholds

Biotic Integrity reference condition table

Metric	Reference condition	Park average	Overall score (%)	Condition
Fishes (FIBI score)	1 FIBI score 5 / 0% score 100%	2.34	33%	● Degraded
Seedling stocking index (% adequately stocked plots)	0 % plots 66 / 0% score 100%	14.30	22%	● Degraded
Exotic herb density (% plots with exotics)	100 % plots 8.33 / 0% score 100%	61.70	54%	● Moderate
Birds (BCI score)	20 BCI score 77 / 0% score 100%	46.00	38%	● Degraded
Deer density (density per sq acre)	20 density per sq acre 8 / 0% score 100%	31.70	0%	● Very degraded
Pest species (% plots infested)	100 % plots infested 0 / 0% score 100%	75.00	75%	● Good
Biotic Integrity overall condition			35%	● Degraded

Fish are an important part of the ecosystem. The condition of fish communities reflects the condition of overall aquatic habitat.
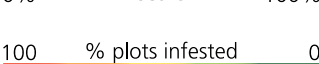
Seedling stocking index is assessed based on the minimum needed native tree seedlings to maintain a self-sustaining forest when deer densities are high.

Exotic herb density, when high, harms ecological communities by crowding out native species and reducing native biodiversity.

Birds are assessed with the Bird Community Index, which uses several characteristics to assess bird communities as ecological indicators.

Deer density can severely impact forest growth and regeneration through browsing. At high densities, deer damage the overall condition of a park.

Pest species infest and damage trees; therefore, any observed presence of certain pest species, such as emerald ash borer, is unacceptable for this indicator.

Spiranthese ovalis growing near the parkway.

Photo by Brent Steury

Looking to the future

The Resource Assessment for Management Strategies provides a snapshot of natural resource conditions in individual parks, and places parks in a landscape context, allowing the assessment of conditions across the NCR. Understanding the value and relevance of park resources at a landscape level facilitates ecosystem-level management, benefiting the parks and neighboring lands. This allows for consideration of resources in a broader context when planning management actions by identifying resources that need improvement and highlighting gaps in data.

The RAMS interface is part of an ongoing NPS NCR-UMCES collaboration to assess and identify conservation needs for significant natural and cultural resources within the NCR parks.

Clara Barton House, home of the founder of the American Red Cross, in Washington, D.C.
Photo by Carol M. Highsmith

Above photo by Emily Zivot

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