Managing Air Quality in National Park Service Wilderness

Introduction

Direction in the CAA, along with mandates under the NPS Organic Act and associated management policies, give the NPS a responsibility to work collaboratively with air regulators and other agencies to protect air resources and "perpetuate the best possible air quality in parks" (2006 NPS Management Policies, Section 4.7). The NPS Organic Act and NPS Management policies direct that all units of the National Park System be managed to protect resources (including air resources) "unimpaired for the enjoyment of future generations."

With respect to resource protection and management goals for parks, the CAA provisions compliment, but do not supersede the requirements of the NPS Organic Act or other agency responsibilities (e.g., under NEPA). For Class II parks, air management goals and objectives are established by the NPS Organic Act, the unit's enabling legislation and NPS management policies. The air resource goals stemming from the "no impairment" mandate in the NPS Organic Act are very similar to the CAA AQRV protection goals for Class I areas. Furthermore, air pollutant reductions established to benefit Class I areas also benefit air quality in Class II parks.

The no-impairment mandate of the Organic Act is one of many legal requirements managers must consider and comply with when authorizing activities in parks. In some cases, requirements of air quality or other environmental laws and regulations might prohibit certain impacts on natural resources or values, irrespective of whether NPS managers would consider the impacts to rise to the level of "impairment." In other cases, impacts technically allowed by law might be prohibited in a park because they would be considered by NPS managers to be an impairment of park resources. Generally, the most stringent test should be applied prior to approving an activity.

Section 6.11 in NPS Director's order #41 has additional guidance for managers in efforts to protect air quality related values (AQRVs) in wilderness areas: "Managers should define AQRVs for each wilderness, select sensitive indicators, collect baseline data, establish a long-term monitoring program to track changes, and establish the acceptable level of protection needed to protect AQRVs [. . .] Managers must ensure that agency actions conform to the air pollution regulations and do not contribute to long-term negative impacts to wilderness air quality [. . .] Managers will work with Federal and State regulatory agencies to identify air pollution effects and develop protection strategies [. . .] Managers should review proposed emission source projects with the potential to impact wilderness and make recommendations to mitigate the impacts of these sources."

Air quality measures for NPS Wilderness Character Monitoring

The NPS has identified "strongly encouraged" measures for monitoring and assessing air trends when implementing wilderness character monitoring (WCM). These measures are just that: strongly encouraged for use by parks and wilderness managers. Though not required, use of these measures is strongly encouraged for three primary reasons:

1. Their use benefits parks by providing pre-established protocols to support easy compilation of a baseline assessment and monitoring protocol.

2. They have been vetted and refined by subject matter experts, use the best available science, are endorsed by the NPS WASO Wilderness Stewardship Division, and have been field-tested by parks around the country.
3. A nationally supported protocol has been developed for each of the strongly encouraged measures and use of these measures provides increased national consistency to WCM.

Visibility

Effects of haze on visibility is evaluated using the haze index on most impaired days expressed in deciviews. Tracking visibility on the days with the most anthropogenic impairment captures overall trends in human-caused contributions to visibility. Most impaired days are the 20% of sampled days in a given year where measured visibility has the highest contribution from anthropogenic pollution relative to natural conditions. In context of air measures, “impairment” is identified in the Clean Air Act as impairment of visibility resulting from manmade pollution (42 U.S.C. § 7491). Note that this is different from the way impairment is defined in the NPS Organic Act and management policies. Also, note that this measure is different than the measure used for the visibility condition on the Air Conditions & Trends Page.

Annual haze index measures are averaged over a 5-year period for monitoring sites with at least 3-years of complete annual data. This measured 5-year average is used for Class I parks and additional parks with in-park visibility monitors. Estimated 5-year averages are used for parks in the contiguous US that do not have in-park visibility monitoring. To estimate 5-year average values, measured 5-year averages are interpolated across all monitoring locations in the contiguous US using an Inverse Distance Weighting (IDW) method. Note that estimated or measured values for individual parks represent wilderness areas.

A decrease of 1 deciview or more from the baseline data value over a 5-year period is considered an improving trend. An increase of 1 deciview or more from the baseline data value is considered a degrading trend. This threshold was developed by the NPS Air Resources Division. Using most impaired days to evaluate trends in visibility from human-caused haze is recommended by the NPS Air Resources Division and is commonly used by the NPS in wilderness character assessments.

Where to get visibility data (under development, will be live fall 2021):

1. Go to the NPS Explore Air Data Website
2. Select Visibility from the Parameter drop-down.
3. Scroll down to 5-year averages and open the selection pane.
4. Choose “Park” for scope and select a park where the wilderness is located from the “Park Name” drop down list.
5. Choose the latest available end-year and export the data set in a convenient format.

Vegetation health risk from ground-level ozone

The W126 index is a biologically relevant measure that focuses on plant response to continuous ozone exposure. This measure is a better predictor of vegetation response to ozone exposure than the metric used for the human health standard (4th-highest daily maximum 8-hour average ozone concentration) because damage develops slowly under continuous exposure. The W126 index equation preferentially weights the higher ozone concentrations that are more likely to cause plant damage. It sums all of the weighted ozone concentrations during daylight hours because this is when the majority of gas exchange occurs between plants and the atmosphere. The highest 3-month period that occurs during the growing season (March–September) is reported as an annual value in parts per million-hours (ppm-hrs).

Annual W126 index values are averaged over a 5-year period at all monitoring sites with at least 3-years of complete annual data. This measured 5-year average is reported for parks with an in-park or nearby representative monitor in Alaska, Hawaii, Puerto Rico and Virgin Islands. Estimated 5-year averages are used for parks in the contiguous US. To estimate 5-year average values, measured 5-year averages are interpolated across all monitoring locations in the contiguous US using an IDW method. Note that estimated or measured values for individual parks represent wilderness areas.

A decrease of 2 ppm-hrs or more from the baseline data value over a 5-year period is considered an improving trend. An increase of 2 ppm-hrs or more from the baseline data value is considered a degrading trend. This threshold was developed by the NPS Air Resources Division. Using the W126 index to evaluate trends in vegetation health risk from ground-level ozone is recommended by the NPS Air Resources Division and is commonly used by the NPS in wilderness character assessments.

Where to get ozone data:

1. Go to the NPS Air Quality Park Condition & Trends Website.
2. Select the appropriate park where the wilderness is located from the Park drop-down.
3. Select Ozone from the Parameter drop-down.
4. In the Summary tab, scroll to the second section called "Ozone / Vegetation Health" and
5. click on Rationale +. Ozone exposure to vegetation is reported in the Condition text.
6. Report the numeric value for ppm-hrs in the second sentence from the Condition text.

Nitrogen deposition

While ecosystems respond to total (wet and dry) deposition, wet nitrogen deposition is used as a surrogate to track deposition trends because wet deposition is the most widely available source of measured nitrogen deposition data. Unless there are documented changes in natural sources of nitrogen deposition, trends can be attributed to changes in anthropogenic sources. Reporting units for wet deposition are kilograms per hectare per year (kg/ha/yr).

Annual wet nitrogen precipitation weighted mean concentrations are averaged over a 5-year period at monitoring sites with at least 3 years of annual data that meet completeness criteria. Estimated 5-year averages are used for parks in the contiguous US. To estimate 5-year average values, 5-year averages are interpolated across all monitoring locations in the contiguous US using an IDW method. Estimated nitrogen depositions are then calculated by multiplying estimated 5-year average concentrations (mg/L) by normalized precipitation (centimeters [cm]) and dividing by 10 to get deposition (kg/ha). For parks in Alaska, Hawaii, Puerto Rico and Virgin Islands with in-park or nearby representative monitors, measured 5-year averages are used to calculate wet deposition by multiplying average nitrogen concentrations (mg/L) by measured total annual precipitation (centimeters [cm]) and dividing by 10 to get deposition (kilograms per hectare [kg/ha]). Note that estimated or measured values for individual parks represent wilderness areas.

A decrease of 0.5 kg/ha/yr or more from the baseline data value over a 5-year period is considered an improving trend. An increase of 0.5 kg/ha/yr or more from the baseline data value is considered a degrading trend. This threshold was developed by the NPS Air Resources Division. Using wet nitrogen deposition to evaluate nitrogen deposition trends is recommended by the NPS Air Resources Division and is commonly used by the NPS in wilderness character assessments.

Where to get nitrogen deposition data:

1. Go to the NPS Air Quality Park Condition & Trends Website.
2. Select the appropriate park where the wilderness is located from the Park drop-down.
3. Select Nitrogen from the Parameter drop-down.
4. In the Summary tab, click on Rationale +. Nitrogen deposition is reported in the Condition text. Parks with a significant gradient in estimated nitrogen deposition have a range value for their estimated five-year average. For those parks, report the maximum value from the range. For parks without a range, use the numeric value in kg/ha/yr shown in the second sentence from the condition text.

Sulfur deposition

While ecosystems respond to total (wet and dry) deposition, wet sulfur deposition is used as a surrogate for total deposition, because wet deposition is the most widely available source of measured sulfur deposition data. Unless there are documented changes in natural sources of sulfur deposition, trends can be attributed to changes in anthropogenic sources. Reporting units for wet deposition are kilograms per hectare per year (kg/ha/yr).

Annual wet sulfur precipitation weighted mean concentrations are averaged over a 5-year period at monitoring sites with at least 3 years of annual data that meet completeness criteria. Estimated 5-year averages are used for parks in the contiguous US. To estimate 5-year average values, 5-year averages are interpolated across all monitoring locations in the contiguous US using an IDW method. Estimated wet sulfur depositions are then calculated by multiplying estimated 5-year average concentrations (mg/L) by normalized precipitation (centimeters [cm]) and dividing by 10 to get deposition (kg/ha). For parks in Alaska, Hawaii, Puerto Rico and Virgin Islands with in-park or nearby representative monitors, measured 5-year averages are used to calculate wet deposition by multiplying average nitrogen concentrations (mg/L) by measured total annual precipitation (centimeters [cm]) and dividing by 10 to get deposition (kg/ha). Note that estimated or measured values for individual parks represent wilderness areas.

A decrease of 0.5 kg/ha/yr or more from the baseline data value over a 5-year period is considered an improving trend. An increase of 0.5 kg/ha/yr or more from the baseline data value is considered a degrading trend. This threshold was developed by the NPS Air Resources Division. Using wet sulfur deposition to evaluate sulfur deposition trends is recommended by the NPS Air Resources Division and is commonly used by the NPS in wilderness character assessments.

Where to get sulfur deposition data:

1. Go to the NPS Air Quality Park Condition & Trends Website.
2. Select the appropriate park where the wilderness is located from the Park drop-down.
3. Select Sulfur from the Parameter drop-down.
4. In the Summary tab, click on Rationale +. Sulfur deposition is reported in the Condition text. Parks with a significant gradient in estimated sulfur deposition have a range value for their estimated five-year average. For those parks, report the maximum value from the range. For

parks without a range, use the numeric value in kg/ha/yr shown in the second sentence from the condition text.

AQRVs in NPS wilderness areas

Air quality information is generally available for park units and rarely for specific wilderness areas. As a result, information on effects as well as air quality data for individual parks is assumed to be representative of the wilderness areas found in the park. Information on air quality sensitive resources is available from the following sources:

- General information on effects of air pollution in parks.
- Air Profiles summarize park-specific information on air pollution effects for selected parks.
- Refer to the air quality related values (AQRVs) reports discussing effects on park resources from for ozone, particulates, and atmospheric deposition of acids, nutrients, and toxics.

Visibility in your wilderness area

Now it's time to explore the visibility in your wilderness area. From the Air Quality Conditions & Trends page, choose the park with the wilderness area you want to learn about and select "Visibility" for the parameter. Answer the following questions:

- What is the visibility condition (haze index on mid-range days) at your park?
- What is the visual range at your park? What would it be without the effects of pollution?
- Does your park have visibility trends? If so, are the haziest days improving over the last 10 years? What about long-term? Are the clearest days improving over the last 10 years? What about long term? Are the most impaired days improving over the last 10 years and/or long-term?
- What is the haze index for natural conditions on haziest days at the park? For clearest days?
- What pollutant contributes the most to haze at the park on haziest/clearest days?
- Can you observe any changes in composition over the past 10 years and/or long term? What are they?
- How often are visibility samples collected?
- Is there a seasonal pattern to the distribution of haziest/clearest days for your park? What months should a visitor check out park views if they want to see features at long distances (i.e., What months have the clearest days?) (Hint: look at multiple years because wildfires and unusual humidity can affect annual data).

Ozone in your wilderness area

Now it's time to explore how ozone levels affect your wilderness area. From the Air Quality Conditions & Trends page, choose the park with the wilderness area you want to learn about and select "Ozone" for the parameter. Answer the following questions:

- What is the ozone condition for human health at your park?
- Is your park in a nonattainment area for the ozone standard?
- Does your park have an ozone concentration trend? If so, is it improving over the last 10 years? What about long-term?
- What is the primary ozone standard?
- What is the ozone condition for vegetation health at your park?

- Does your park have a rating for plant sensitivity to ozone damage?
- Does your park have ozone sensitive plant species? What are they?
- Does your park have an ozone exposure index for vegetation trend? If so, is it improving over the last 10 years? What about long-term?
- Is there any ozone exceedance information for your park? If so, how many ozone exceedance days have been observed in the past 10 years?

Sulfur deposition in your wilderness area

Now it's time to explore how sulfur deposition levels affect your wilderness area. From the Air Quality Conditions & Trends page, choose the park with the wilderness area you want to learn about and select "Sulfur Deposition" for the parameter. Answer the following questions:

- What is the sulfur deposition/wet deposition condition at your park?
- What is the rating for ecosystem sensitivity to acidification effects? Was the condition adjusted for sensitivity to acidification effects?
- Does your park have acid sensitive plant species? What are they?
- Does your park have sulfur deposition trends? If so, is sulfate in precipitation improving over the last 10 years? What about long-term?
- Does your park have composition information for sulfur deposition? If so, is wet or dry deposition higher at your park?
- Can you observe any changes in composition over the past 10 years and/or long term? What are they?

Nitrogen deposition in your wilderness area

Now it's time to explore how nitrogen deposition levels affect your wilderness area. From the Air Quality Conditions & Trends page, choose the park with the wilderness area you want to learn about and select "Nitrogen Deposition" for the parameter. Answer the following questions:

- What is the nitrogen deposition/wet deposition condition at your park?
- What is the rating for ecosystem sensitivity to nutrient enrichment effects? Was the condition adjusted for sensitivity to nutrient enrichment effects?
- Does your park have plant communities sensitive to nutrient enrichment? What are they?
- Does the combined wet & dry deposition exceed any critical loads for ecosystem health? If so, which ones?
- Does your park have nitrogen deposition trends? If so, is nitrate in precipitation improving over the last 10 years? What about long-term? Is ammonium in precipitation improving over the last 10 years? What about long term?
- Does your park have composition information for nitrogen deposition? If so, is wet or dry deposition higher at your park?
- Can you observe any changes in composition over the past 10 years and/or long term? What are they?

Particulate matter in your wilderness area

These questions explore particulate matter concentrations and how current particulate matter levels may affect visitor health your wilderness area. From the Air Quality Conditions & Trends page, choose the park with the wilderness area you want to learn about and select "Particulate Matter" for the parameter, if available. Answer the following questions:

- Does your park have a particulate matter condition? If so, what is the overall condition for particulate matter?
- Is your park in a nonattainment area for either the PM2.5 or PM10 standard?
- Does your park have PM2.5 and PM10 data?
- Does your park have particulate matter trends? If so, are they improving over the last 10 years? What about long-term?
- Is there any particulate matter exceedance information for your park? If so, how many particulate matter exceedance days have been observed in the past 10 years?

Mercury in your wilderness area

The NPS Air Resources Division assesses mercury conditions using a combination of risk to biota, wet mercury deposition measurements, and landscape sensitivity to mercury methylation. It is important to consider mercury deposition inputs and ecosystem susceptibility to mercury when assessing mercury condition because atmospheric inputs of elemental or inorganic mercury must be methylated before it is biologically available and able to accumulate in food webs. Ecosystem susceptibility includes risk to biota and landscape sensitivity to mercury methylation. Mercury conditions & trends for NPS are coming soon (*Fall of 2021*). In the meantime, there are several resources available:

- Predicted methylmercury mapper: http://wim.usgs.gov/MercuryMapper/MercuryMapper.html
- Estimated wet mercury deposition maps: http://nadp.slh.wisc.edu/MDN/annualmdnmaps.aspx
- Fish advisories by state: https://fishadvisoryonline.epa.gov/Contacts.aspx
- Concentrations of mercury in dragonflies map: https://www.nps.gov/articles/dragonflymercury-map.htm

Permits & importance of park/regions comments

The Clean Air Act specifies that the very largest sources of air pollutants must get a special permit called a Prevention of Significant Deterioration or PSD permit. As part of getting a PSD permit any source that impacts a Federal Class I area. A class I area is defined under the Clean air act are National Parks larger than 6,000 acres, Wilderness areas larger than 5,000 acres, and International parks that were in existence on August 7, 1977. Under 40 CFR 52 the Federal Land manager has an affirmative responsibility to protect the air quality related values (including visibility) of the class I areas. This requires the FLM to consult with the State and EPA to determine whether the source will have an adverse impact on the air quality related areas impacted by the source. The Federal Land Manager has the opportunity to comment on the proposed permit regarding how the allowed emissions may affect the Class I area and the permit issuing authority (either the state or EPA) must respond to those comments.

NPS response

Although the NPS has legal responsibility to protect park air quality related values (AQRVs), we do not have direct authority to control sources of pollution located outside of parks. However, states, tribal governing bodies, and the EPA (our regulatory partners) are required to consult with the NPS to address impacts to parks in their air pollution control plans. Working with external partners is key to protecting air quality and sensitive resources in national parks because most air pollution affecting parks comes from sources outside park boundaries. In order to carry out agency responsibilities, the NPS monitors and comments on the proposals of other federal and state agencies that have the potential to affect park resources.

The NPS provides scientifically based comments as well as technical guidance and related thresholds that are based on known resource effects in national parks. Comments are the NPS's way of influencing SIPs through the CAA while technical guidance and thresholds are used for evaluating internal and external actions that affect air quality and resources sensitive to AQRVs in national parks.

This direction is applied to all planning processes including National Environmental Policy Act (NEPA) and CAA permitting. Guidance and thresholds are useful for assessing and evaluating the severity of air pollution impacts. The NPS guidance provides other agencies with a consistent and objective approach to and methods for evaluating air pollution impacts in national parks.

Working with external partners is important for protecting air quality and AQRVs in national parks because the majority of air pollution impacting parks is generated outside of park boundaries.

See Director's Order #41 section 6.11 Air Quality for additional guidance on managing air quality in NPS wilderness areas.

Agency contact information

The Air Resources Division (ARD) is home to air resource experts, from scientists to policy analysts, that are dedicated to achieving and maintaining clean air in all units of the National Park System. ARD, together with parks and other NPS offices, monitors air quality conditions in parks and conducts research to better understand the sources and effects of air pollution. Additionally, because most pollution in national parks comes from outside park boundaries, the ARD facilitates NPS partnerships with air regulators, industries, and other stakeholders to reduce air pollution. Please contact us via email or reach out to one of our air resource experts.