

Linking air pollution impacts to ecosystem services, indicators, and thresholds. Ecological thresholds given are typical values that can vary depending on ecological and environmental conditions¹.

Impact	Ecosystem	Ecological Response	Ecosystem Services Impacted	Indicator	Ecological Threshold	
Sulfur and Nitrogen Deposition						
Acidification	Terrestrial	<ol style="list-style-type: none"> Decreased forest growth Increased susceptibility to disease 	<ol style="list-style-type: none"> Timber production Climate regulation Biodiversity Resilience to disturbance 	Ca:Al ³⁺ ratios in soil	<1 – heightened risk to trees >10 – low risk	
				Soil percent base saturation	<10% - risk of nutritional deficiencies in sensitive trees >30% - low risk	
				Foliar chemistry	<5000 ppm Ca and <700 ppm Mg – limiting to growth of sugar maple	
	Freshwater	<ol style="list-style-type: none"> Reduced species richness Degraded water quality 	<ol style="list-style-type: none"> Recreational fishing Biodiversity Water quality 	Acid neutralizing capacity	0 µeq/L – risk for chronic acidification 20-50 µeq/L – risk for episodic acidification >100 µeq/L – low risk to aquatic biota	
				Base cation surplus in soil	0 µeq/L – risk of Al ³⁺ leaching to streams	
				pH	<6.0 – reduced number of fish species	
				Inorganic Al ³⁺	>2 µmol/L – toxic to aquatic biota	
				Calcium	<1.5 mg/L – sub-optimal for crustaceans	
	Nitrogen Deposition					
	Nitrogen Enrichment	Terrestrial	<ol style="list-style-type: none"> Loss of sensitive plant species Increase in invasive plants Increased tree mortality 	<ol style="list-style-type: none"> Biodiversity Soil fertility 	Shifts in lichen communities	5 kg N/ha/yr atmospheric deposition
N concentration in plant or lichen tissue					1.0% in lichen (<i>Letharia vulpine</i>)	
C:N ratio in soil					<20-25 or less – elevated risk of nitrate leaching	
Freshwater		<ol style="list-style-type: none"> Loss of sensitive diatom (single-celled algae) species Degraded water quality 	<ol style="list-style-type: none"> Biodiversity Water quality 	Shifts in diatom communities	1.5 kg N/ha/yr wet deposition	
				Nitrate concentrations	<2 µeq/L – low risk >20 µeq/L - degraded	
Coastal		<ol style="list-style-type: none"> Increased algal blooms Decreased dissolved oxygen 	<ol style="list-style-type: none"> Habitat preservation Commercial fishing Recreational fishing Swimming, tourism, aesthetics 	Dissolved nitrogen	High (≥1 mg/L) Medium (≥0.1 and <1 mg/L) Low (≥0 and <0.1 mg/L)	
				Dissolved phosphorus	High (≥0.1 mg/L) Medium (≥0.01 and <0.1 mg/L) Low (≥0 and <0.01 mg/L)	
Mercury Deposition						
Mercury toxicity	Terrestrial	<ol style="list-style-type: none"> Toxicity to fish-eating wildlife Toxicity to wildlife 	Wildlife health	Hg in songbirds	1.3 µg/g in blood	
				Hg in bats	10.0 µg/g in hair	
	Freshwater	<ol style="list-style-type: none"> Mercury bioaccumulation 	<ol style="list-style-type: none"> Recreational fishing Food production Human health 	Hg in fish	0.2 – 0.3 µg/g	
				Fish and wildlife health	Hg in diet Hg in fish-eating birds	0.16 µg/g in prey fish 3.0 µg/g in blood

¹Fenn, ME, KF Lambert, T Blett, DA Burns, LH Pardo, GM Lovett, R Haeuber, DC Evers, CT Driscoll, DS Jeffries. 2011. Setting limits: Using air pollution thresholds to protect and restore U.S. ecosystems. *Issues in Ecology* 14: 1-21.