



2003 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

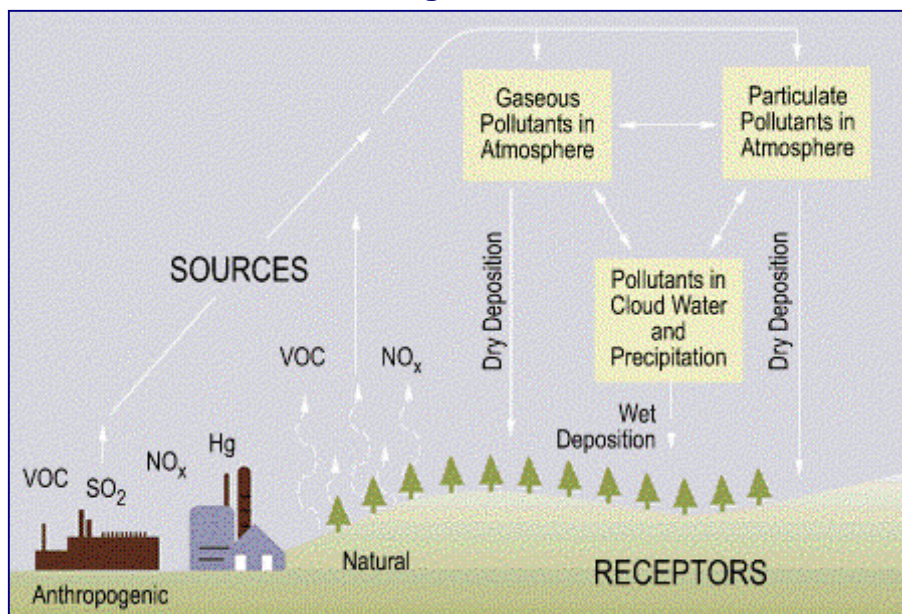
Nature and Sources

Atmospheric deposition refers to pollutants that are deposited on land or water from the air. Deposition is usually the result of pollutants being removed from the atmosphere and deposited by precipitation (wet deposition) or by the settling out of particulates (dry deposition). Dry deposition also includes gaseous pollutants that are absorbed by land or water bodies. Figure 1 shows the basic mechanisms of deposition and the major pollutants of concern. These include sulfur dioxide (SO₂), nitrogen oxides (NO_x), mercury (Hg), and volatile organic compounds (VOCs). SO₂ is a major contributor to acid deposition, which can reduce the ability of water bodies to support certain types of fish and other aquatic organisms. NO_x also contributes to the acid deposition problem and can contribute to the eutrophication of water bodies as well. Hg will accumulate in fish by a process known

as bio-magnification. Small concentrations of Hg in water are concentrated in smaller organisms. These smaller organisms are in turn consumed by larger ones. As the Hg moves up the food chain, it becomes more concentrated. Fish in Hg contaminated water can become contaminated to the point where they are no longer safe for people to eat. For more information on Hg in fish see "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters" which is available at www.state.nj.us/dep/dsr/njmainfish.htm. VOCs are a very diverse group of compounds, some of which are toxic, including known carcinogens.

Atmospheric deposition is the result of pollution from a wide variety of sources and in some cases the pollution can travel great distances before being deposited on the land or water. Some known sources of atmospheric deposition are power plants, motor vehicles, incinerators, and certain industries.

Figure 1



Source: USEPA Clean Air Markets

Web Site: <http://www.epa.gov/airmarkets/acidrain/index.html#what>

MONITORING LOCATIONS

The state monitored wet deposition levels at 3 locations in 2003. These sites are shown in the map to the right. A sample is collected each week from all of the sites and after each significant rain event at the Washington Crossing State Park site. The Washington Crossing site is also part of the National Atmospheric Deposition Program (NADP) network which is used by the U.S. Environmental Protection Agency to assess national deposition patterns and trends. Each of the sites shown in Figure 2 has a sampler for collecting wet deposition (rain and snow) and a rain gauge for determining precipitation amounts.

In addition to the wet deposition monitoring, dry (particulate) sulfate and nitrate are measured at 2 sites as shown in Figure 3. These measurements are taken by analyzing filters used in the PM10 monitoring network (see section on Particulate Matter). Dry sulfate and nitrate are pollutants that form in the atmosphere and can react with water, creating acids that affect the pH of lakes and streams. Nitrates also increase nutrient load in water bodies and can eventually lead to eutrophication (excessive growth of plant life).

Figure 2
Acid Precipitation Monitoring
Network - 2003

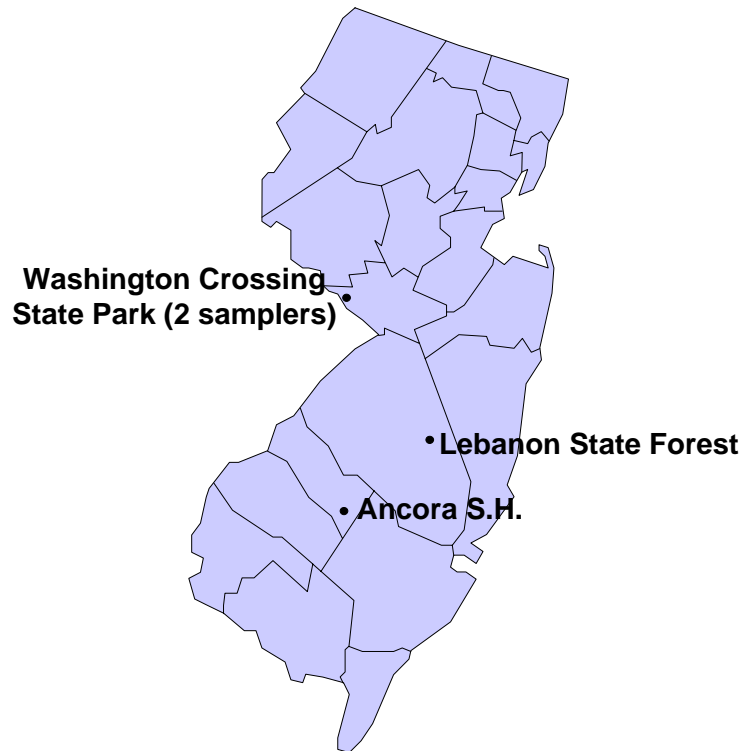
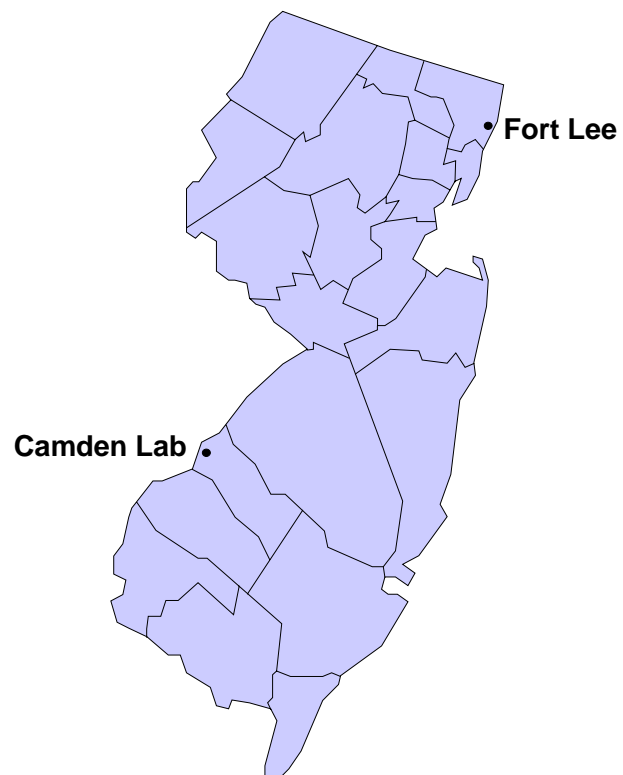


Figure 3
Sulfate and Nitrate
Monitoring Network - 2003



SUMMARY OF 2003 DATA

A summary of the 2003 wet deposition data is provided in Table 1. The table shows total deposition, pH, conductivity and concentrations of several important ions. When acidity is reported on the pH scale, neutral is considered a 7 with decreasing pH values corresponding to increasing acidity. Normal rainfall has a pH of approximately 5.6 due to the natural presence of carbonic acid in the air. The mean pH value recorded at the Washington Crossing State Park weekly sampler was 4.53. The Ancora State Hospital sampler recorded a mean pH of 4.48 and the Lebanon State Forest sampler recorded a mean pH of 4.57.

Conductivity is a measure of the total density of ions in the water collected. It is used as an indicator of the

total amount of pollution in the sample. Conductivity is the ability of the water to conduct electricity and generally increases as the concentration of ions in water increases.

Concentrations of specific ions considered important because they can affect the chemistry of lakes, streams and other water bodies, are also reported for each site. Summaries are provided for each season of the year along with annual averages.

Table 2 shows the concentrations of sulfate and nitrate found on samples of particulate matter collected at two sites. In particulate form, sulfate and nitrate can have significant effects on the acidity and nutrient content of water bodies. These two ions make up, on average, about 17% of the total mass of PM10 collected.

Table 1
Acid Precipitation Monitoring Network - 2003
Annual and Seasonal Averages
Weighted by Precipitation Amount

Ca ²⁺	- Calcium	PO ₄ ³⁻	- Phosphate
Mg ⁺	- Magnesium	Cond.	- Specific conductance
K ⁺	- Potassium	us/cm	- MicroSiemens per centimeter
Na ⁺	- Sodium	mg/l	- Milligrams per liter
NH ₄	- Ammonium	<MDL	- Below minimum detection limit
NO ₃ ⁻	- Nitrate	Winter	- January – March
Cl ⁻	- Chloride	Spring	- April – June
SO ₄ ²⁻	- Sulfate	Summer	- July – September
		Fall	- October – December

Ancora State Hospital – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	10.36	4.49	24.3	0.132	0.071	0.045	0.426	0.213	1.521	0.781	1.954	< MDL
Spring	12.59	4.49	20.7	0.102	0.060	0.041	0.183	0.346	1.366	0.338	1.742	< MDL
Summer	16.09	4.34	29.1	0.099	0.101	0.063	0.596	0.328	1.443	1.077	2.262	< MDL
Fall	13.12	4.69	14.3	0.071	0.061	0.028	0.439	0.134	0.830	0.791	1.085	< MDL
Annual	52.16	4.48	22.4	0.099	0.075	0.045	0.423	0.260	1.286	0.768	1.779	< MDL

Lebanon State Forest – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter*	1.13	4.51	28.1	0.226	0.176	0.075	1.369	0.268	1.229	2.530	1.772	< MDL
Spring	13.40	4.48	18.3	0.091	0.060	0.050	0.231	0.296	1.296	0.382	1.590	< MDL
Summer	14.06	4.52	20.8	0.092	0.092	0.040	0.543	0.273	1.059	0.929	1.637	< MDL
Fall	12.68	4.76	13.2	0.085	0.073	0.039	0.553	0.100	0.810	0.965	0.901	< MDL
Annual	41.27	4.57	17.9	0.093	0.078	0.044	0.467	0.227	1.064	0.807	1.399	< MDL

* Only two weekly samples were available for collection in late March of the 1st Quarter (Winter Quarter).

Table 1 (Continued)
Acid Precipitation Monitoring Network – 2003
Annual and Seasonal Averages
 Weighted by Precipitation Amount

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Washington Crossing State Park – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	9.92	4.69	14.1	0.067	0.026	0.011	0.203	0.092	0.873	0.398	0.968	< MDL
Spring	13.98	4.40	22.4	0.195	0.019	0.022	0.065	0.337	1.500	0.144	1.859	< MDL
Summer	10.98	4.39	24.8	0.096	0.048	0.032	0.308	0.291	1.283	0.600	2.104	< MDL
Fall	17.86	4.71	12.3	0.040	0.028	0.013	0.246	0.103	0.714	0.453	0.911	< MDL
Annual	52.74	4.53	17.9	0.098	0.029	0.019	0.203	0.202	1.071	0.391	1.421	< MDL

Washington Crossing State Park – Event

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	7.74	4.44	22.5	0.103	0.052	0.042	0.306	0.211	1.292	0.561	1.628	< MDL
Spring	10.41	4.31	29.7	0.120	0.055	0.048	0.090	0.446	2.047	0.190	2.390	< MDL
Summer	10.70	4.43	28.3	0.487	0.115	0.162	0.456	0.436	1.612	0.793	3.166	0.156
Fall	17.09	4.66	13.6	0.057	0.035	0.025	0.245	0.109	0.791	0.452	1.045	< MDL
Annual	45.94	4.46	22.2	0.179	0.061	0.065	0.269	0.279	1.351	0.491	1.942	< MDL

Table 2
Acid Deposition Particulate Matter – 2003
 Micrograms per Cubic Meter

N – Number of samples
 Min – Minimum
 Max – Maximum

Sampling Location	Site No.	N	Particulates			Sulfate (SO ₄)			Nitrate (NO ₃)			SO ₄ & NO ₃ % of Particulates
			Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Camden Lab	IP02	42	26.7	4.1	82	5.58	0.80	23.91	0.35	0.01	1.46	22.2
Fort Lee	IP14	58	36.5	8.3	149	4.14	0.97	18.84	0.61	0.05	3.70	13.0

*Camden Lab was off-line after September 2004. Mean concentrations are derived from averaging the sample concentrations obtained before the Site went down in September.

TRENDS

Figure 4 shows the change in the amount of sulfate ion deposited over the last 14 years at the site in Washington Crossing State Park. The figure shows “wet deposition” only. It does not include dry particulate sulfate that was deposited when no precipitation was occurring. Therefore, the total deposition is higher than what is shown here.

The factors controlling the trend are the sulfate concentrations in air and cloud droplets and the total amount of precipitation in a given year. For example, in 1991 and 1992, both the sulfate concentrations and the total precipitation were below normal, while they were high in 1993 and 1994. Since the values shown here are

annual totals, they are also sensitive to loss of samples due to contamination or other factors.

Sulfate can alter soil and water chemistry, and a deposition level of 20 kilograms per hectare per year has been generally accepted as the limit above which damage to sensitive natural resources is likely to occur. However, there are no national or New Jersey standards for sulfate deposition.

Sulfate deposition in rain and snow is expressed as mass per unit land area over time. To convert the values shown in Figure 4 to pounds per acre per year, multiply by 0.89 (since one kilogram equals 2.21 pounds and one hectare equals 2.47 acres)

Figure 4
Trend in Sulfate Deposition in Precipitation at
Washington Crossing State Park, New Jersey, 1990-2003:
Annual Loading

