



# 2006 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

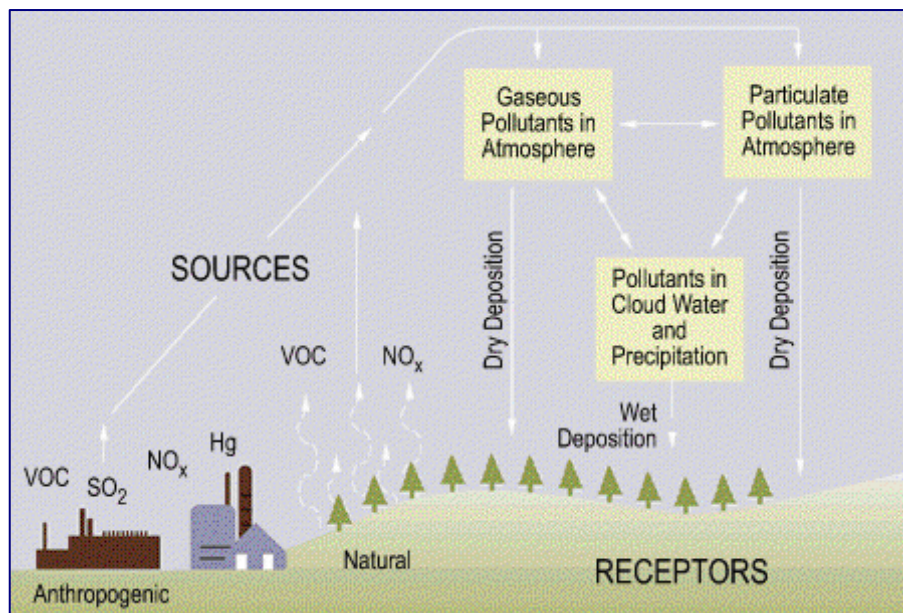
## NATURE AND SOURCES

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 (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), mercury (Hg), and volatile organic compounds (VOCs). SO<sub>2</sub> 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<sub>x</sub> also contributes to the acid deposition problem and can contribute to eutrophication of water bodies as well. Hg will accumulate in fish by a process

known as bio-magnification. Small amounts 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](http://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

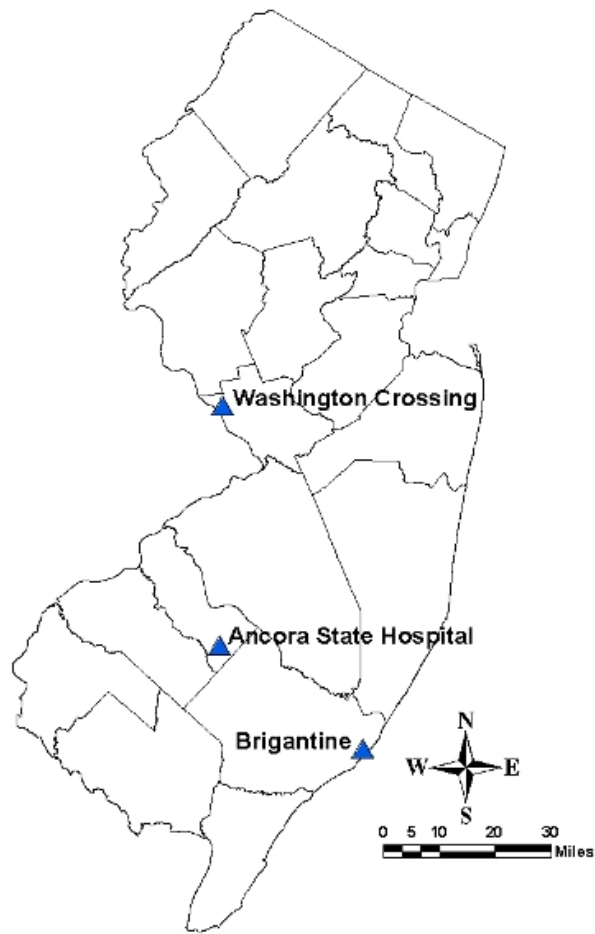
Web Site: <http://www.epa.gov/airmarkets/acidrain/index.html#what>

## MONITORING LOCATIONS

In 2006 there were three active deposition monitoring sites in New Jersey. Two of them are part of the National Atmospheric Deposition Program's (NADP) National Trends Network (NTN). These sites are located at Washington Crossing State Park and the Edwin B. Forsythe National Wildlife Refuge (NWR), also known as Brigantine, and are shown in Figure 2. A sample is collected each week from the sites, and is then shipped to the Central Analytical Laboratory (CAL) at the Illinois State Water Survey (ISWS) for analysis. The CAL analyzes each sample with the goal of providing data on amounts, trends, and geographic distributions of acids, nutrients, and base cations in precipitation. The resulting data is then used by the U.S. Environmental Protection Agency to assess national deposition patterns and trends. (NADP, 2007)

In addition to the NADP sites, the state collected samples at a site at the Ancora State Hospital in Camden County. Samples from that site are normally analyzed at the Department's own laboratory, but this year there were problems with the laboratory equipment and these samples have not been analyzed. Each of the sites has a sampler for collecting wet deposition (rain and snow) and a rain gauge for determining precipitation amounts.

**Figure 2**  
**Acid Precipitation Monitoring**  
**Network - 2006**



## SUMMARY OF 2006 DATA

A summary of the 2006 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 4.43 and the Edwin B. Forsythe NWR sampler recorded a mean pH of 4.70.

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 in Table 1.

**Table 1**  
**Acid Precipitation Monitoring Network - 2006**  
**Annual and Seasonal Averages**

Weighted by Precipitation Amount

Ca <sup>2+</sup>	- Calcium	Cond.	- Specific conductance
Mg <sup>+</sup>	- Magnesium	cm	- Centimeter
K <sup>+</sup>	- Potassium	uS/cm	- MicroSiemens per centimeter
Na <sup>+</sup>	- Sodium	mg/L	- Milligrams per liter
NH <sub>4</sub>	- Ammonium	<MDL	- Below minimum detection limit
NO <sub>3</sub> <sup>-</sup>	- Nitrate	Winter	- December – February
Cl <sup>-</sup>	- Chloride	Spring	- March – May
SO <sub>4</sub> <sup>2-</sup>	- Sulfate	Summer	- June – August
-	- No Data	Fall	- September – November

**Edwin B. Forsythe National Wildlife Refuge – Weekly**

	Precip. cm	pH	Cond. uS/cm	Ca <sup>2+</sup> mg/L	Mg <sup>+</sup> mg/L	K <sup>+</sup> mg/L	Na <sup>+</sup> mg/L	NH <sub>4</sub> <sup>-</sup> mg/L	NO <sub>3</sub> <sup>-</sup> mg/L	Cl <sup>-</sup> mg/L	SO <sub>4</sub> <sup>2-</sup> mg/L
Winter	29.41	4.76	14.97	0.077	0.089	0.033	0.784	0.075	0.587	1.394	0.849
Spring	16.82	4.63	22.41	0.150	0.123	0.055	0.967	0.369	1.214	1.748	1.777
Summer	33.30	4.52	20.73	0.080	0.053	0.094	0.362	0.306	0.939	0.700	1.864
Fall	40.73	4.92	20.34	0.114	0.238	0.080	2.007	0.073	0.396	3.610	1.053
Annual	111.05	4.70	19.50	0.101	0.134	0.074	1.103	0.181	0.697	1.996	1.353

**Washington Crossing State Park – Weekly**

	Precip. cm	pH	Cond. uS/cm	Ca <sup>2+</sup> mg/L	Mg <sup>+</sup> mg/L	K <sup>+</sup> mg/L	Na <sup>+</sup> mg/L	NH <sub>4</sub> <sup>-</sup> mg/L	NO <sub>3</sub> <sup>-</sup> mg/L	Cl <sup>-</sup> mg/L	SO <sub>4</sub> <sup>2-</sup> mg/L
Winter	28.04	4.64	15.81	0.070	0.049	0.020	0.413	0.107	0.915	0.751	0.964
Spring	19.28	4.50	21.28	0.136	0.047	0.035	0.284	0.396	1.576	0.526	1.815
Summer	41.05	4.16	37.99	0.137	0.031	0.016	0.094	0.484	1.847	0.238	3.648
Fall	45.09	4.69	12.66	0.049	0.032	0.022	0.253	0.154	0.614	0.469	1.055
Annual	127.61	4.43	22.23	0.095	0.037	0.022	0.237	0.289	1.202	0.455	1.953

## WET DEPOSITION

Acid deposition is primarily the result of sulfuric and nitric acids and ammonium derived from atmospheric emissions of sulfur dioxide, nitrogen oxides, and ammonia. Excessive deposition of these materials can have significant environmental impacts on both terrestrial and freshwater ecosystems through acidification of soil and water bodies, reducing the diversity of aquatic organisms and stressing native vegetation. (Driscoll et al, 2003)

Sulfate, for example, 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 (i.e. Aquatic Effect Level). Deposition in rain and snow is often expressed as mass per unit land area over time.

Figures 3 and 6 show the change in the amount of sulfate ion deposited over the last several years at the sites in Washington Crossing State Park and the Edwin B. Forsythe NWR, respectively. Figures 4 and 7 show the change in the amount of ammonium ion deposited at these sites, and Figures 5 and 8 shows the change in the amount of nitrate ion deposited. All figures below show "wet deposition" only. They do not include dry particulate deposited when no precipitation was occurring. Therefore, the total deposition is higher than what is

shown here.

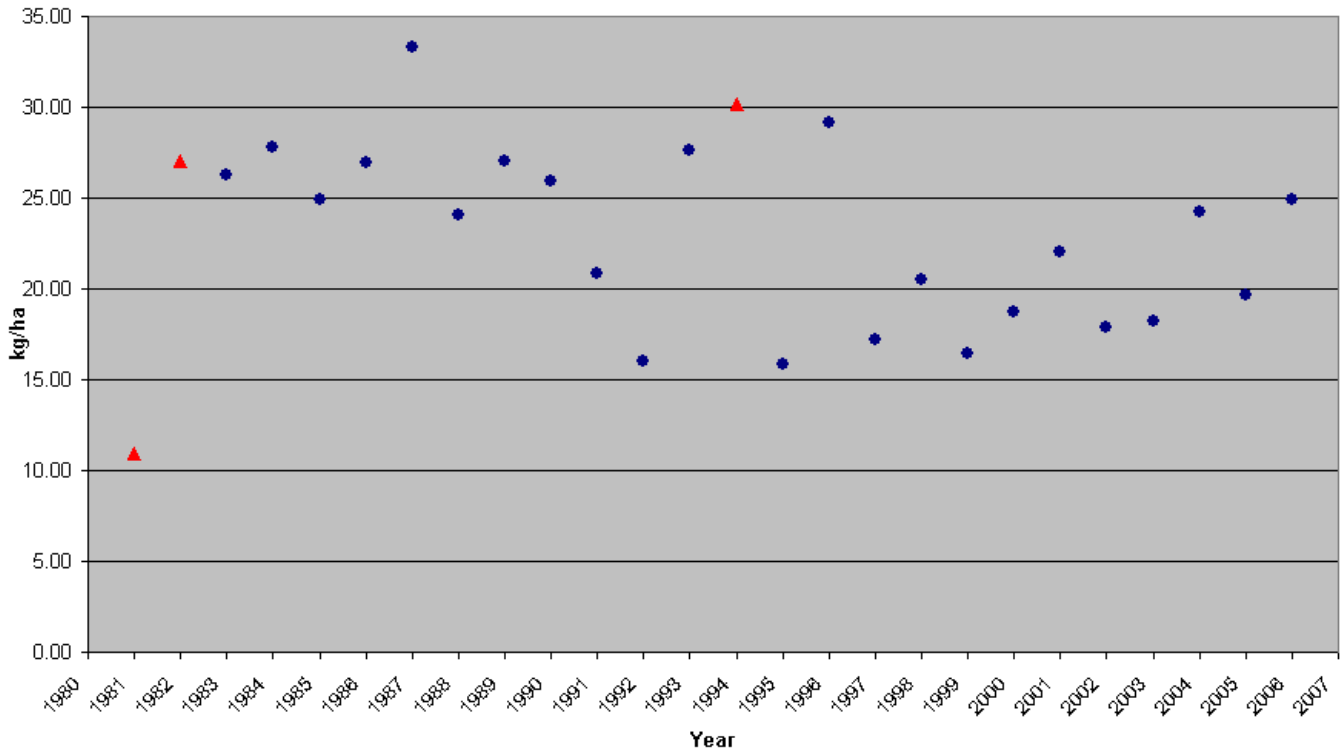
The year to year variations in the charts below are a function of both the concentrations of sulfate, nitrate, and ammonium in air and cloud droplets, and the total amount of precipitation that occurs each year. For example, in 1991 and 1992, both the sulfate concentrations and the total precipitation were below normal, while they were high in 1993 and 1994. Since the data is in the form of annual totals, it is also sensitive to loss of samples due to contamination or other factors.

According to the New Jersey Comparative Risk Project Ecological Technical Work Group, streams and lakes with significant buffering capacity are somewhat protected from the effects of acid deposition. It is for this reason that actual risk assessments are primarily based on the direct observation of pH in streams and lakes, and on actual observed effects on aquatic species, rather than on deposition measurements alone.

To convert the values shown in Figure 3 through Figure 8 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 3 through 8 Data Legend	
●	Met Criteria
▲	Did Not Meet Criteria
All Raw Data for Figure 3 through 8 were obtained from the NADP website. NADP criteria requirements can also be found at <a href="http://nadp.sws.uiuc.edu/">http://nadp.sws.uiuc.edu/</a> .	

**Figure 3**  
**Sulfate (SO<sub>4</sub>) NADP/NTN Site NJ99 (Washington Crossing State Park)**  
**Annual Wet Depositions (1981 - 2006)**  
**Kilograms Per Hectare (kg/ha)**



**Figure 4**  
**Ammonium (NH<sub>4</sub>) NADP/NTN Site NJ99 (Washington Crossing State Park)**  
**Annual Wet Depositions (1981 - 2006)**  
**Kilograms Per Hectare (kg/ha)**

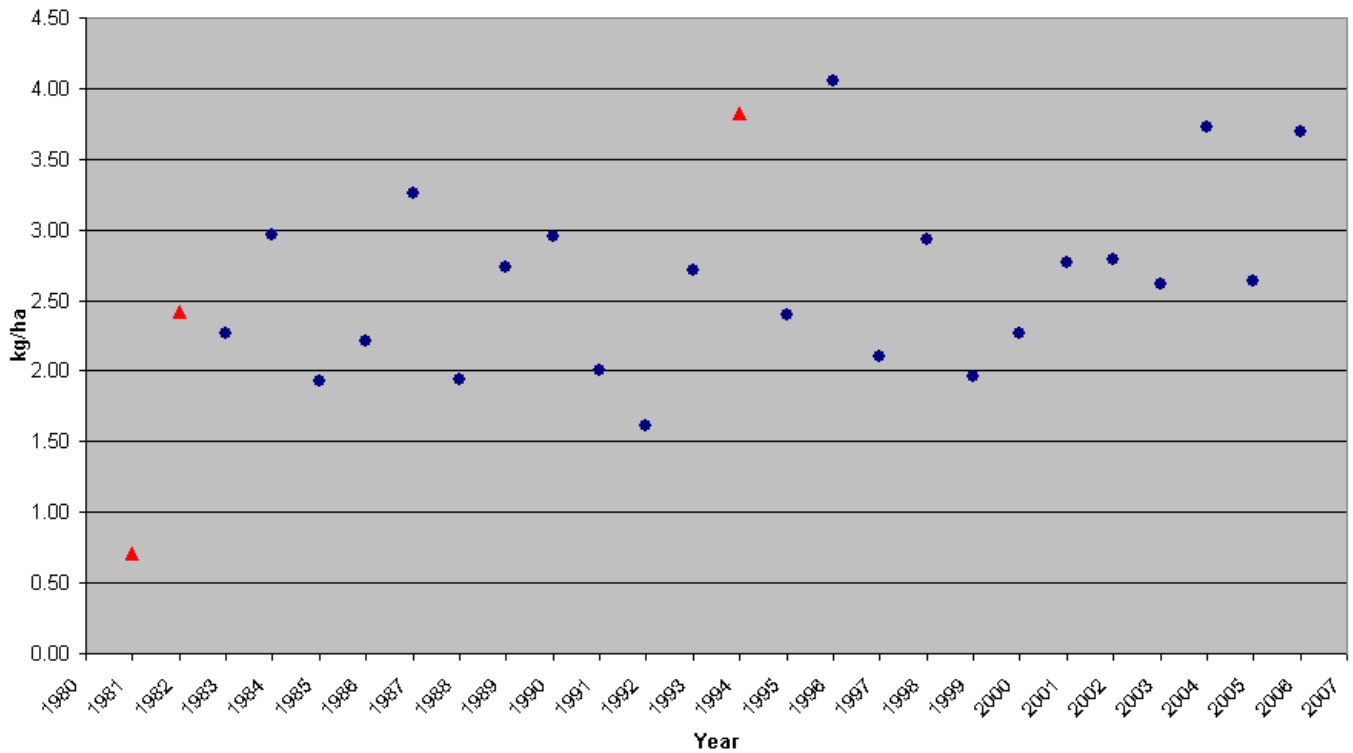


Figure 5  
 Nitrate (NO3) NADP/NTN Site NJ99 (Washington Crossing State Park)  
 Annual Wet Depositions (1981 - 2006)  
 Kilograms Per Hectare (kg/ha)

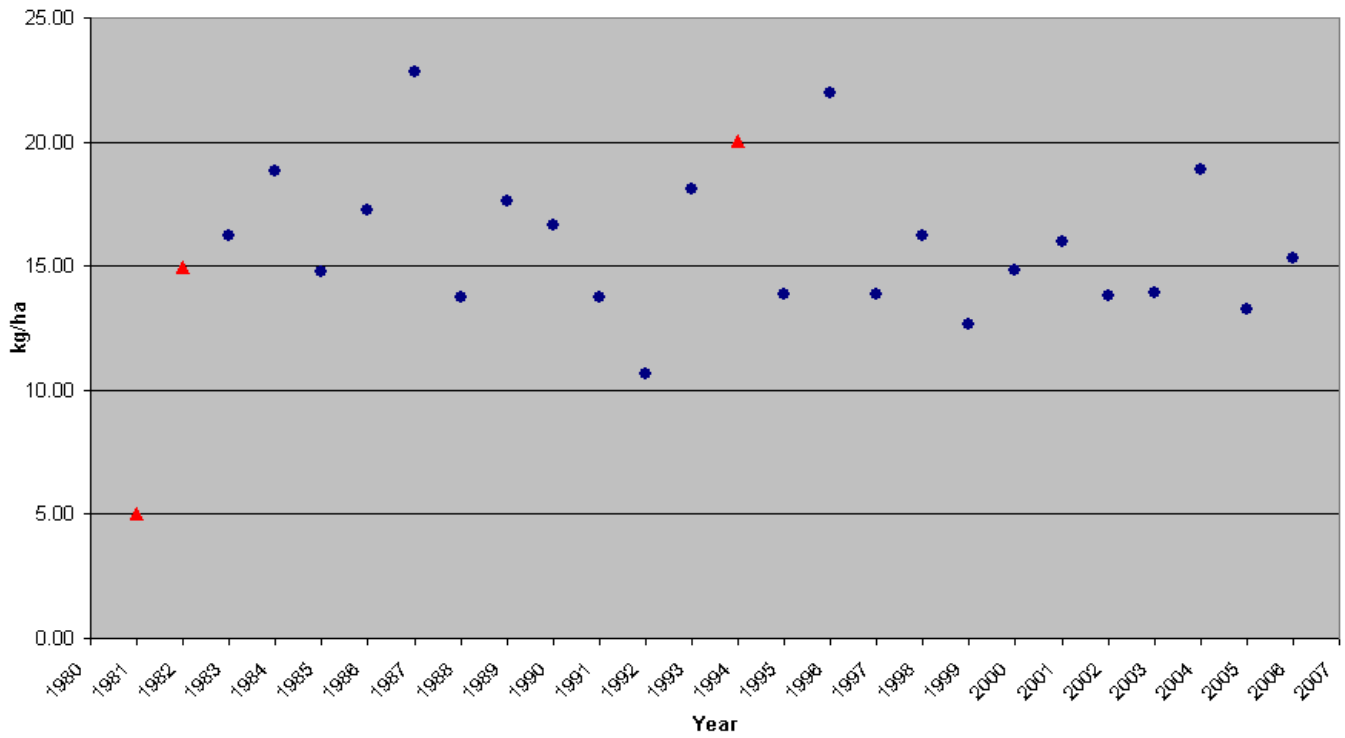
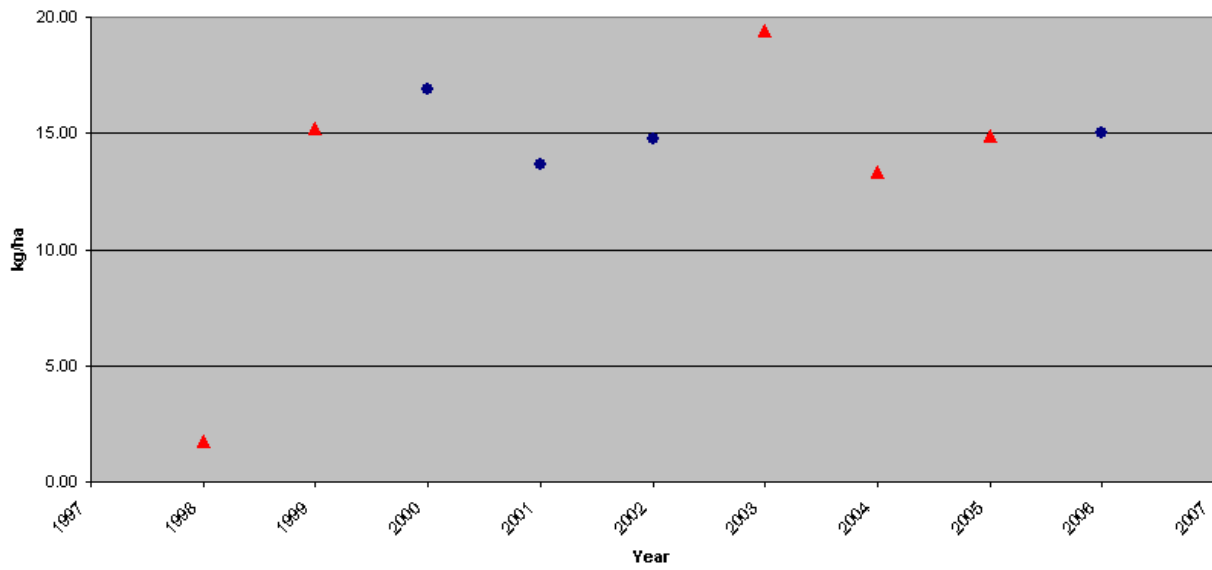
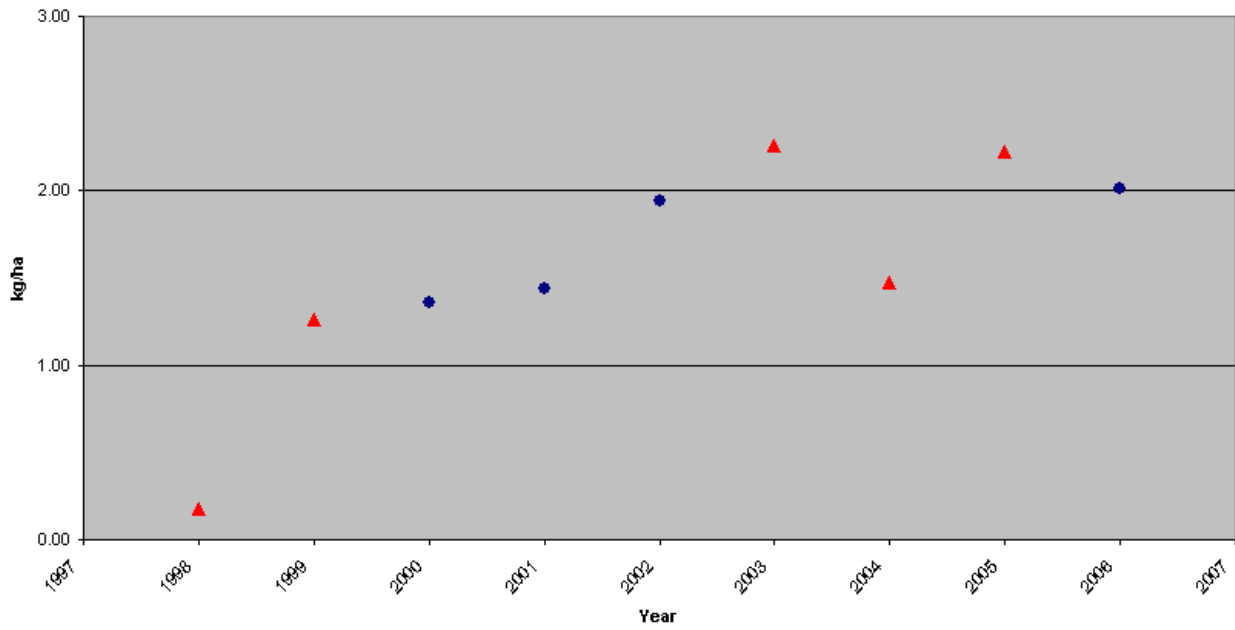


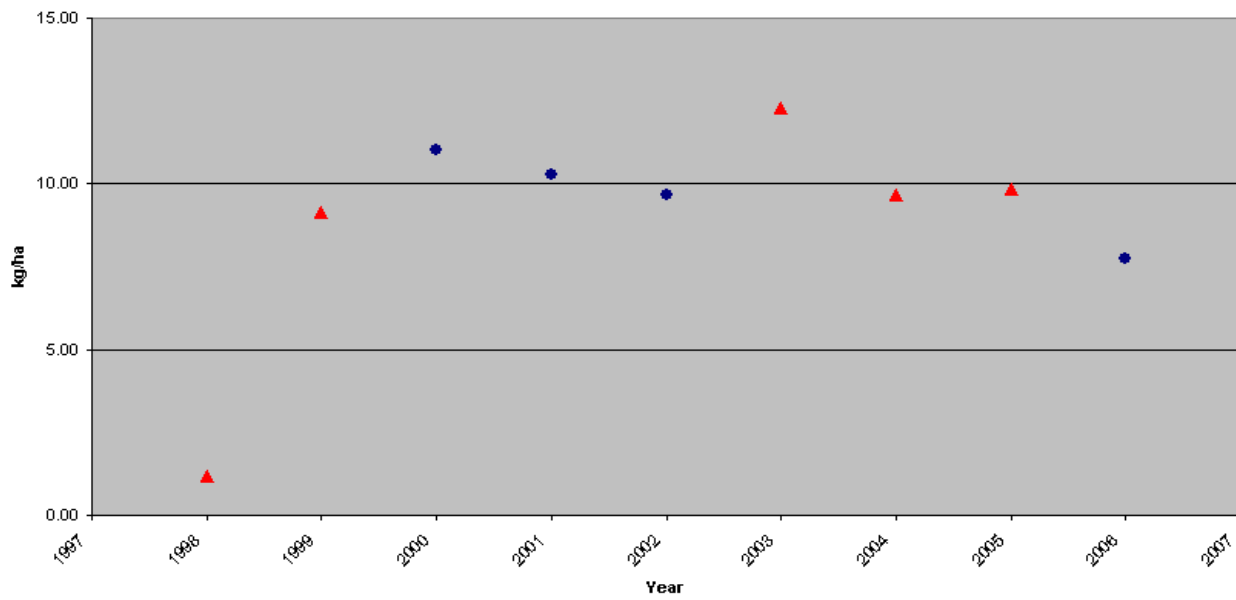
Figure 6  
 Sulfate (SO4) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)  
 Annual Wet Depositions (1998 - 2006)  
 Kilograms Per Hectare (kg/ha)



**Figure 7**  
**Ammonium (NH<sub>4</sub>) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)**  
**Annual Wet Depositions (1998 - 2006)**  
**Kilograms Per Hectare (kg/ha)**



**Figure 8**  
**Nitrate (NO<sub>3</sub>) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)**  
**Annual Wet Depositions (1998 - 2006)**  
**Kilograms Per Hectare (kg/ha)**



## REFERENCES

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Driscoll, C.T., Driscoll, K.M., Mitchell, M.J. and D.J. Raynal. 2003. Effects of acidic deposition on forest and aquatic ecosystems in New York State. *Environmental Pollution*, 123(3):327-336. <http://www.esf.edu/hss/HF%20Ref%20PDF/EvnPol.123.327.336.pdf>.

National Atmospheric Deposition Program (NRSP-3). 2009. NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820. <http://nadp.sws.uiuc.edu/>

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