



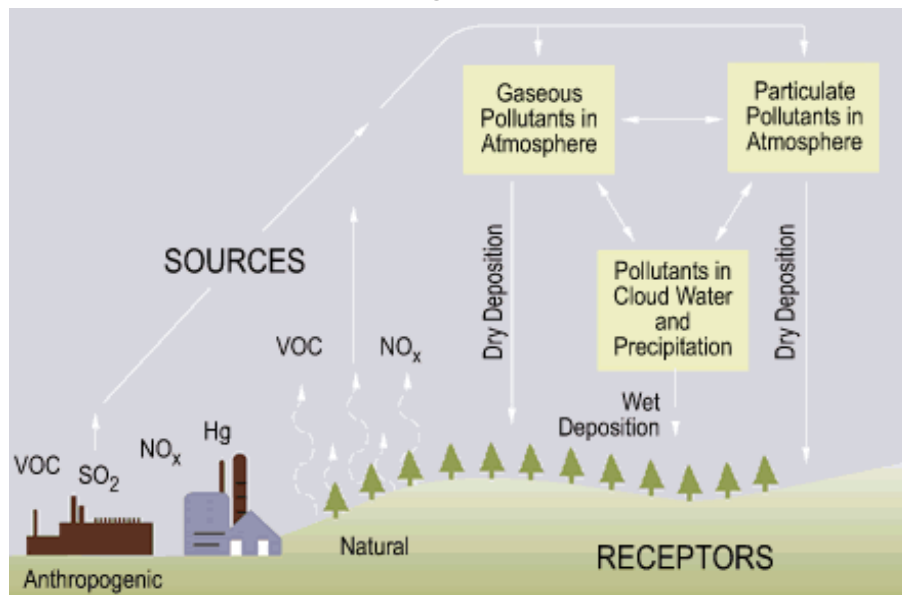
2014 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Atmospheric deposition is a process in which pollutants are deposited on land or water from the air. It occurs when pollutants are removed from the atmosphere and deposited by precipitation (wet deposition), or by the settling out of particulates (dry deposition). Dry deposition also occurs when gaseous pollutants 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_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and mercury. SO_2 is a major contributor to acid deposition, which can acidify water bodies and reduce their ability to support certain types of fish and other aquatic organisms. NO_x also contributes to the acid deposition problem, and can contribute to eutrophication of water bodies as well. VOCs are a large and diverse group of compounds, some of which are toxic or carcinogenic. Mercury will accumulate in fish by a process known as bio-magnification. Small amounts of mercury in water are absorbed by small organisms. These small organisms are in turn consumed by larger ones. As the mercury moves up the food chain, it becomes more concentrated. Fish in mercury-contaminated water can become contaminated to the point where they are no longer safe for people to eat. For more information on mercury 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.

Figure 1



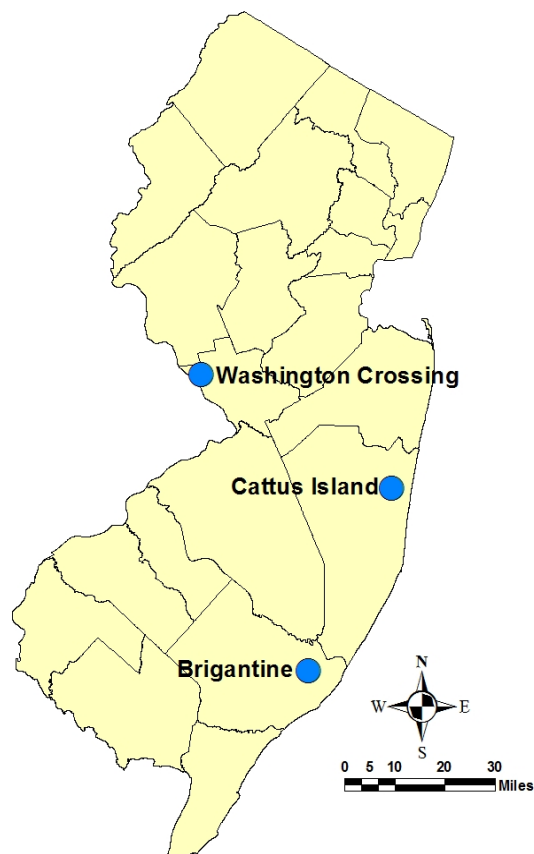
Source: www.epa.gov/acidrain/what/index.html

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

MONITORING LOCATIONS

Figure 2 shows the three active deposition monitoring sites in New Jersey for 2014: Washington Crossing State Park, Cattus Island, and the Edwin B. Forsythe National Wildlife Refuge (NWR), also known as Brigantine. Each of the sites has a sampler for collecting wet deposition (rain and snow) and a rain gauge for determining precipitation amounts. They are part of the National Atmospheric Deposition Program's (NADP) National Trends Network (NTN). A sample is collected every week from each site. The New Jersey Department of Environmental Protection (NJDEP) collects all samples from Washington Crossing and Cattus Island. The United States Fish and Wildlife Service, Air Quality Branch (USFWS-AQB), is responsible for sample collection at the Edwin B. Forsythe NWR. All collected samples are shipped to the Central Analytical Laboratory (CAL) at the Illinois State Water Survey (ISWS) for analysis. 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 (USEPA) to assess national deposition patterns and trends.

Figure 2
Acid Precipitation Monitoring Network - 2014



SUMMARY OF 2014 DATA

A summary of the 2014 wet deposition data is provided in Table 1. Raw data was obtained from the NADP website. The table shows total deposition, pH, conductivity, and concentrations of several important ions (calcium, magnesium, potassium, sodium, ammonium, nitrate, chloride, and sulfate).

When acidity is reported on the pH scale, 7 is considered neutral, 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 values recorded at the Washington Crossing State Park and Cattus Island weekly samplers was 5.09 and 5.04 respectively. The Edwin B. Forsythe NWR sampler recorded a mean pH of 5.08.

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.

Certain ions can affect the chemistry of lakes, streams and other water bodies. Concentrations of these specific ions are reported in Table 1 for each site, for each season of the year, along with annual averages.

Table 1
 Acid Precipitation Monitoring Network - 2014
 Annual and Seasonal Averages
 Weighted by Precipitation (Precip.) Amount

Ca ²⁺ - Calcium	Cond. - Specific conductance
Mg ²⁺ - Magnesium	cm - Centimeter
K ⁺ - Potassium	uS/cm - MicroSiemens per centimeter
Na ⁺ - Sodium	mg/L - Milligrams per liter
NH ₄ ⁺ - Ammonium	Winter - December-February
NO ₃ ⁻ - Nitrate	Spring - March-May
Cl ⁻ - Chloride	Summer - June-August
SO ₄ ²⁻ - Sulfate	Fall - September-November

Edwin B. Forsythe National Wildlife Refuge

	Precip. (cm)	pH	Cond. (uS/cm)	Ca ²⁺ (mg/L)	Mg ²⁺ (mg/L)	K ⁺ (mg/L)	Na ⁺ (mg/L)	NH ₄ ⁺ (mg/L)	NO ₃ ⁻ (mg/L)	Cl ⁻ (mg/L)	SO ₄ ²⁻ (mg/L)
Winter	35.10	4.92	13.41	0.067	0.108	0.043	0.918	0.122	0.569	1.602	0.693
Spring	28.07	5.07	9.97	0.069	0.076	0.043	0.600	0.164	0.514	1.072	0.504
Summer	39.57	5.21	7.99	0.065	0.059	0.103	0.435	0.165	0.460	0.811	0.456
Fall	33.66	5.09	11.95	0.066	0.109	0.072	0.948	0.125	0.446	1.723	0.583
Annual	133.20	5.08	10.97	0.069	0.094	0.073	0.773	0.141	0.487	1.389	0.565

Washington Crossing State Park

	Precip. (cm)	pH	Cond. (uS/cm)	Ca ²⁺ (mg/L)	Mg ²⁺ (mg/L)	K ⁺ (mg/L)	Na ⁺ (mg/L)	NH ₄ ⁺ (mg/L)	NO ₃ ⁻ (mg/L)	Cl ⁻ (mg/L)	SO ₄ ²⁻ (mg/L)
Winter	30.15	4.93	8.44	0.037	0.014	0.012	0.106	0.142	0.728	0.188	0.490
Spring	34.61	5.26	7.07	0.090	0.040	0.037	0.262	0.231	0.631	0.457	0.544
Summer	28.13	5.14	7.32	0.100	0.026	0.149	0.063	0.299	0.859	0.121	0.584
Fall	22.42	5.06	6.84	0.042	0.027	0.018	0.201	0.136	0.541	0.371	0.416
Annual	114.11	5.09	7.50	0.073	0.030	0.058	0.176	0.214	0.704	0.315	0.525

Cattus Island

	Precip. (cm)	pH	Cond. (uS/cm)	Ca ²⁺ (mg/L)	Mg ²⁺ (mg/L)	K ⁺ (mg/L)	Na ⁺ (mg/L)	NH ₄ ⁺ (mg/L)	NO ₃ ⁻ (mg/L)	Cl ⁻ (mg/L)	SO ₄ ²⁻ (mg/L)
Winter	27.76	4.96	12.16	0.044	0.094	0.032	0.780	0.108	0.528	1.408	0.607
Spring	32.57	4.85	15.07	0.152	0.091	0.053	0.663	0.364	1.264	1.143	1.148
Summer	31.17	5.21	8.09	0.053	0.061	0.033	0.537	0.154	0.408	0.986	0.423
Fall	31.37	5.07	14.80	0.086	0.158	0.058	1.328	0.128	0.535	2.433	0.700
Annual	123.88	5.04	12.54	0.075	0.112	0.046	0.937	0.153	0.579	1.704	0.651

WET DEPOSITION

Acid deposition is primarily the result of deposition of sulfuric and nitric acids and ammonium that are formed 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, 4 and 5 show the change in the amount of sulfate ion deposited over the last several years at the Washington Crossing State Park, Edwin B. Forsythe NWR, and Cattus Island sites, respectively. Figures 6, 7 and 8 show the amount of ammonium ion deposited at these sites, and Figures 9, 10 and 11 show 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 actual 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 in 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 the loss of samples due to contamination or other factors.

According to the New Jersey Comparative Risk Project (NJCRP) 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 (NJCRP 2003).

To convert the values shown in Figures 3 through 11 to pounds per acre per year, multiply by 0.89 (since one kilogram equals 2.21 pounds and one hectare equals 2.47 acres).

Figures 3 through 11 Data Legend	
•	Met Criteria
▲	Did Not Meet Criteria
All raw data for Figures 3 through 8 were obtained from the NADP website. NADP criteria requirements can also be found at http://nadp.isws.illinois.edu/ .	

Figure 3
 Sulfate (SO₄²⁻) NADP/NTN Site NJ99 (Washington Crossing State Park)
 Annual Wet Deposition 1981-2014
 Kilograms per Hectare (kg/ha)

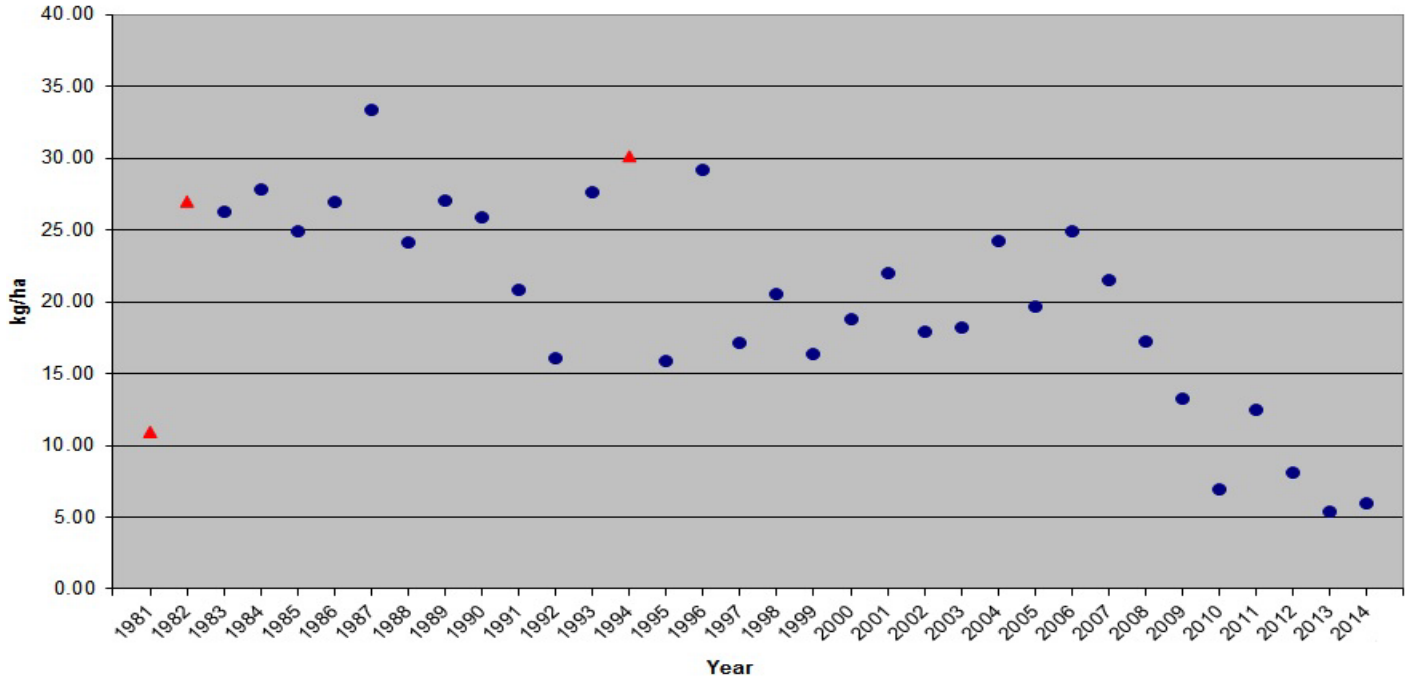


Figure 4
 Sulfate (SO₄²⁻) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
 Annual Wet Deposition 1998-2014
 Kilograms per Hectare (kg/ha)

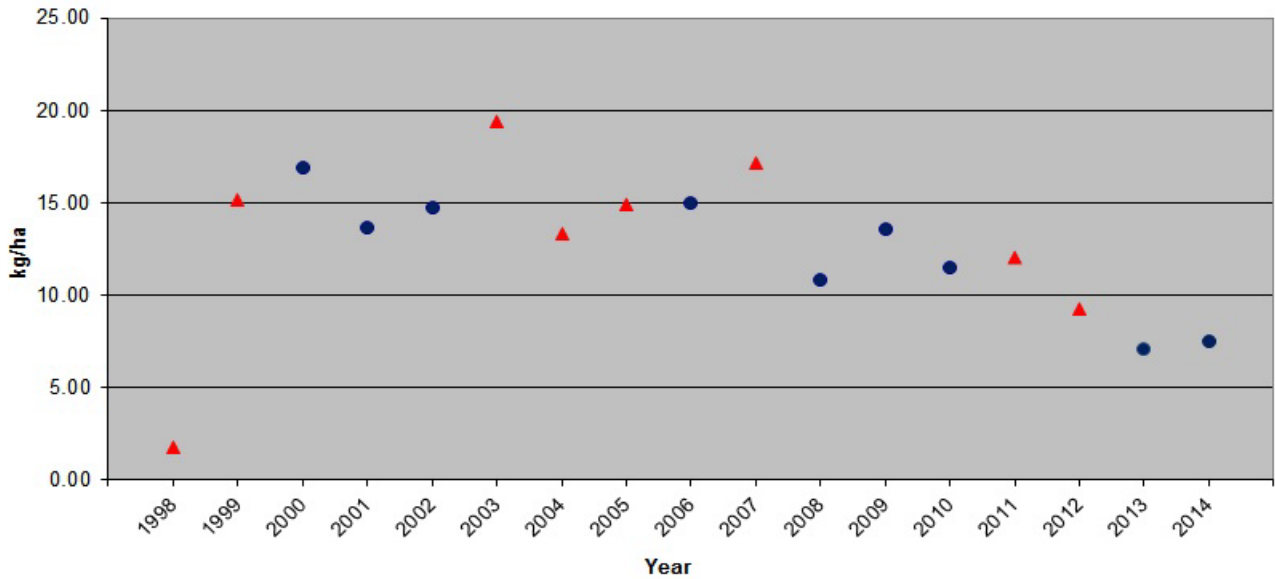


Figure 5
 Sulfate (SO_4^{2-}) NADP/NTN Site NJ39 (Cattus Island)
 Annual Wet Deposition 2012-2014
 Kilograms per Hectare (kg/ha)

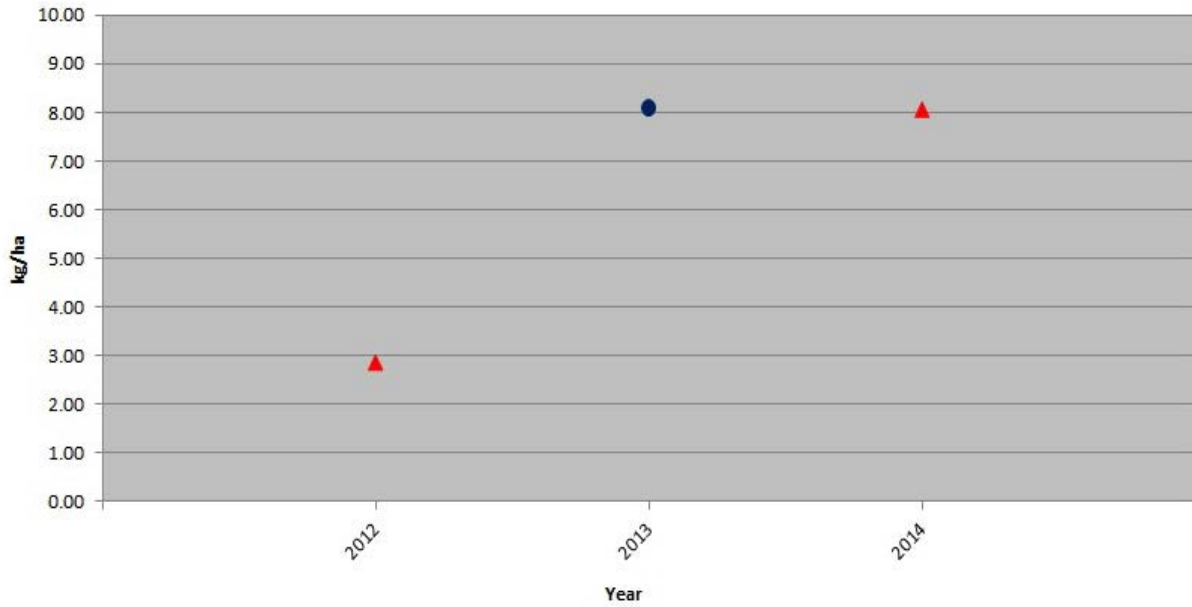


Figure 6
 Ammonium (NH_4^+) NADP/NTN Site NJ99 (Washington Crossing State Park)
 Annual Wet Deposition 1981-2014
 Kilograms per Hectare (kg/ha)

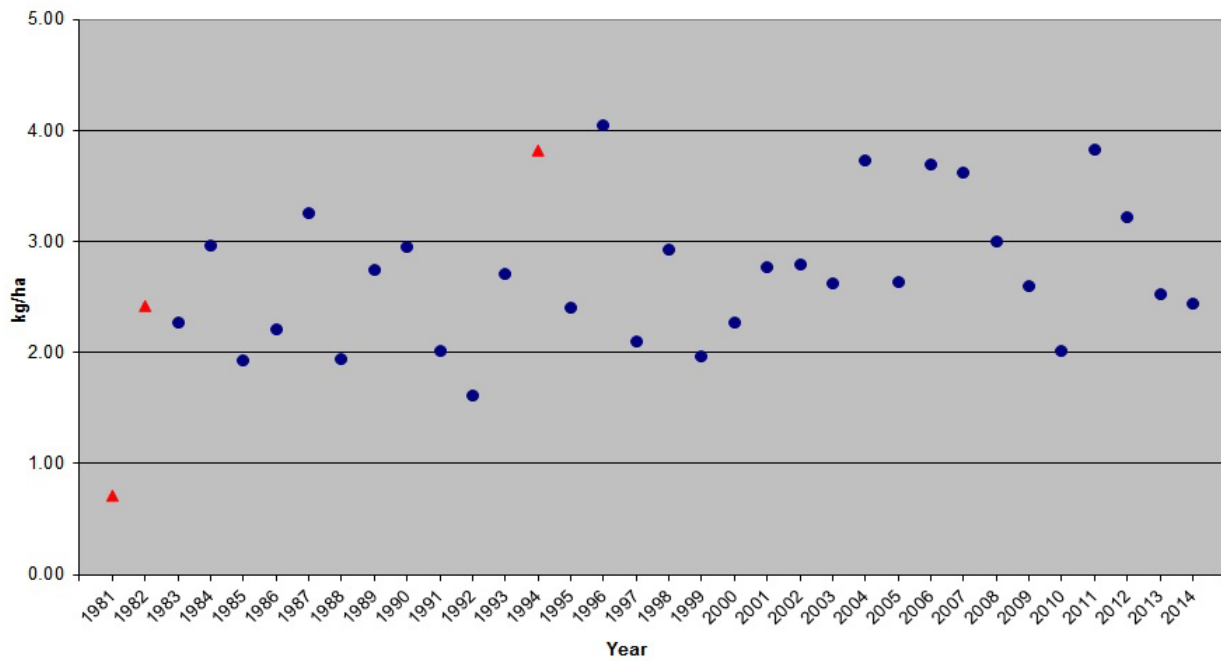


Figure 7
 Ammonium (NH_4^+) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
 Annual Wet Deposition 1998-2014
 Kilograms per Hectare (kg/ha)

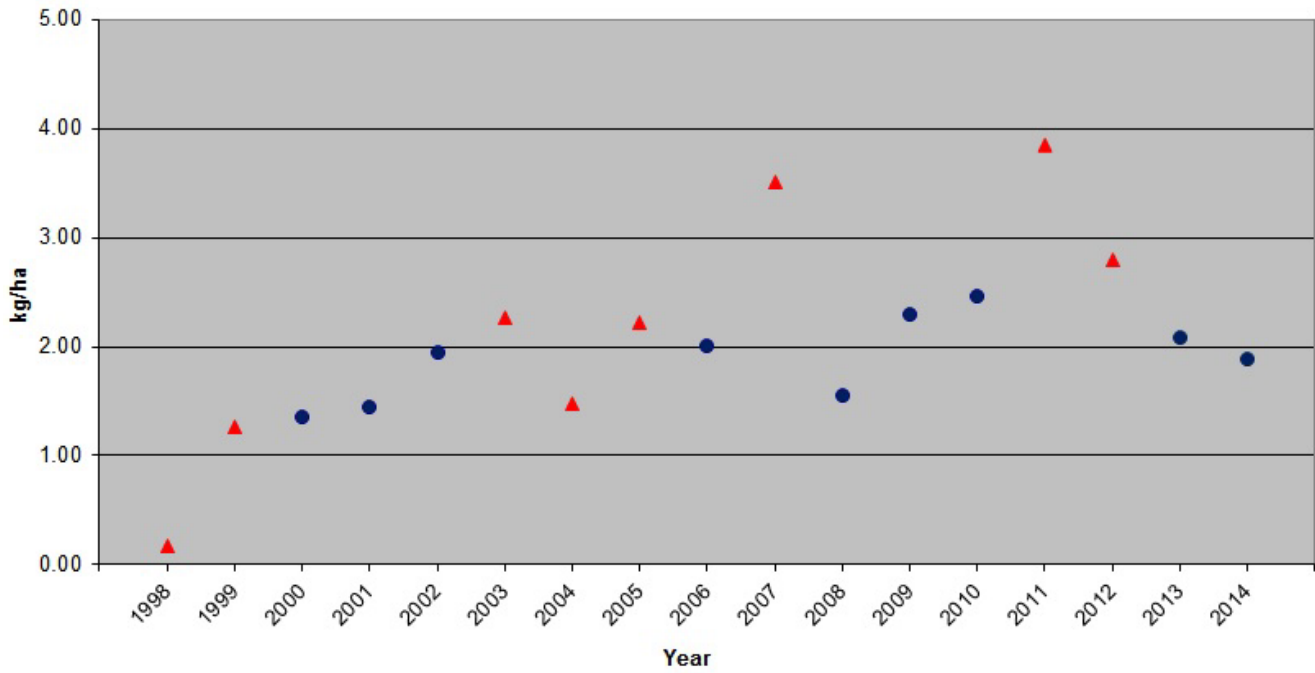


Figure 8
 Ammonium (NH_4^+) NADP/NTN Site NJ39 (Cattus Island)
 Annual Wet Deposition 2012-2014
 Kilograms per Hectare (kg/ha)

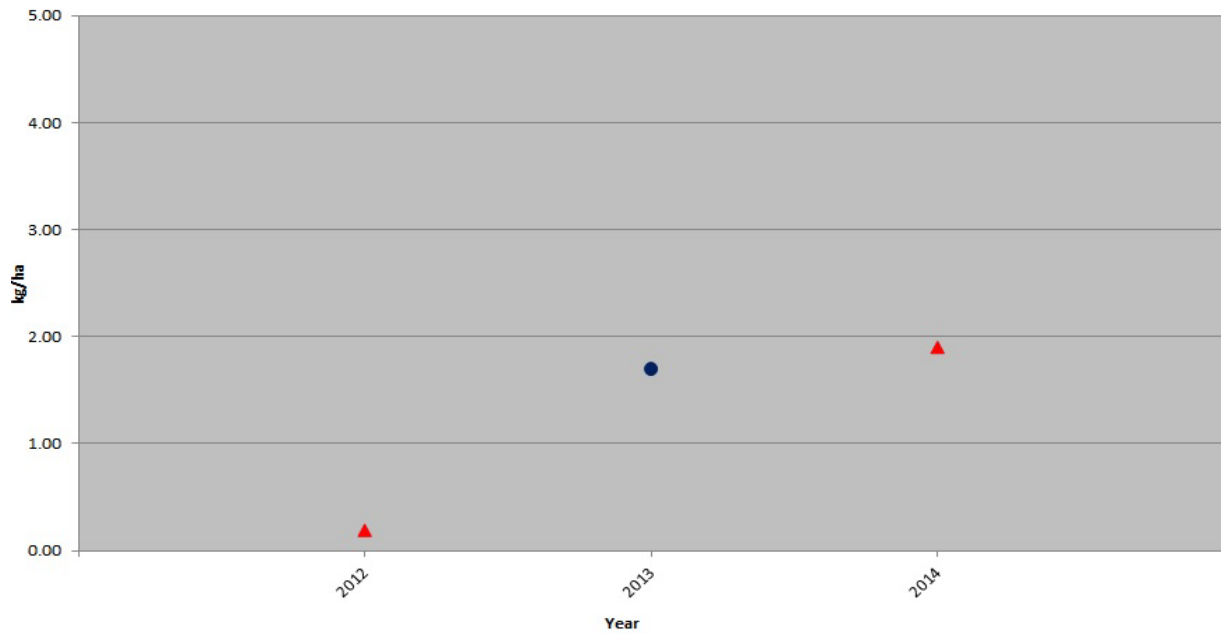


Figure 9
 Nitrate (NO₃⁻) NADP/NTN Site NJ99 (Washington Crossing State Park)
 Annual Wet Deposition 1981-2014
 Kilograms per Hectare (kg/ha)

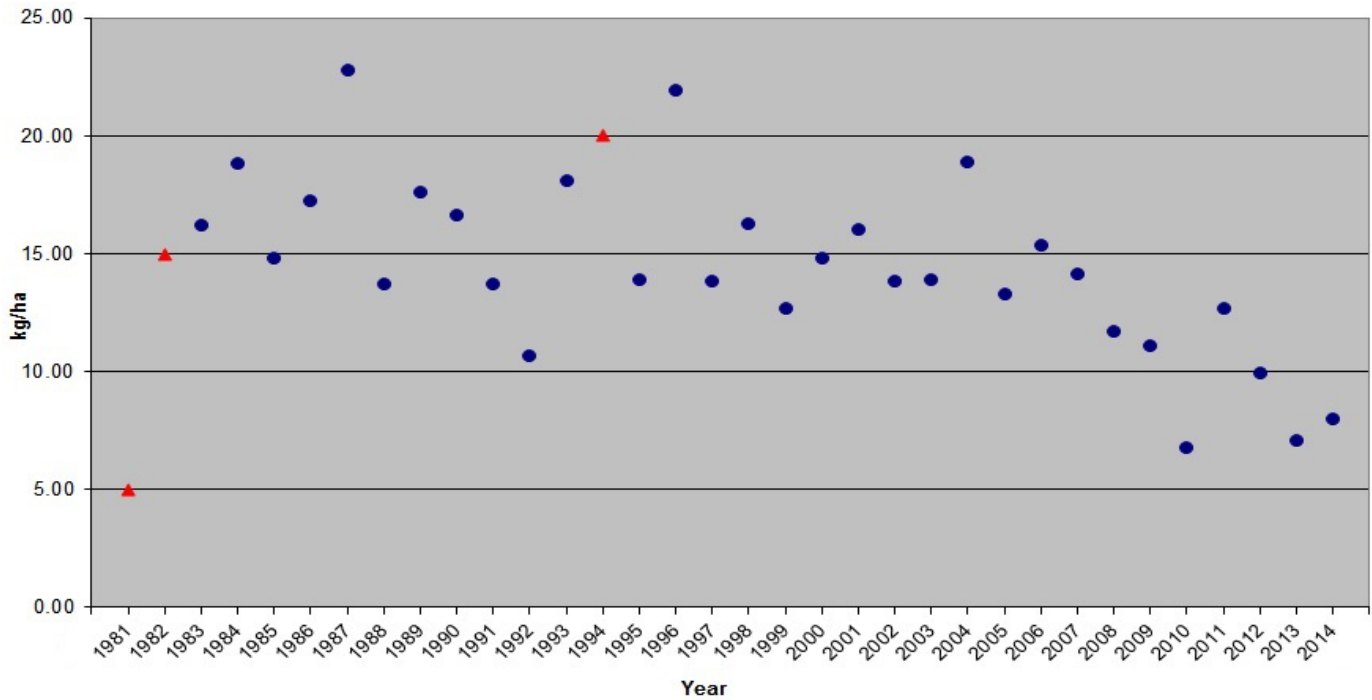


Figure 10
 Nitrate (NO₃⁻) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
 Annual Wet Deposition 1998-2014
 Kilograms per Hectare (kg/ha)

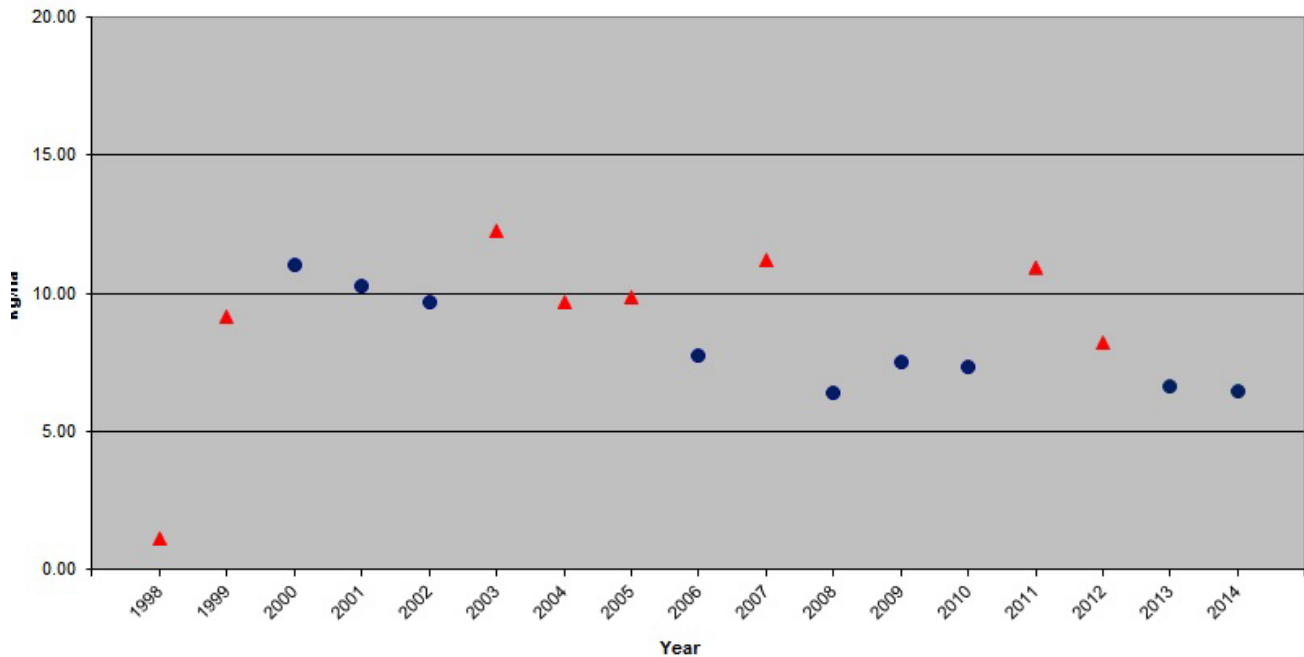
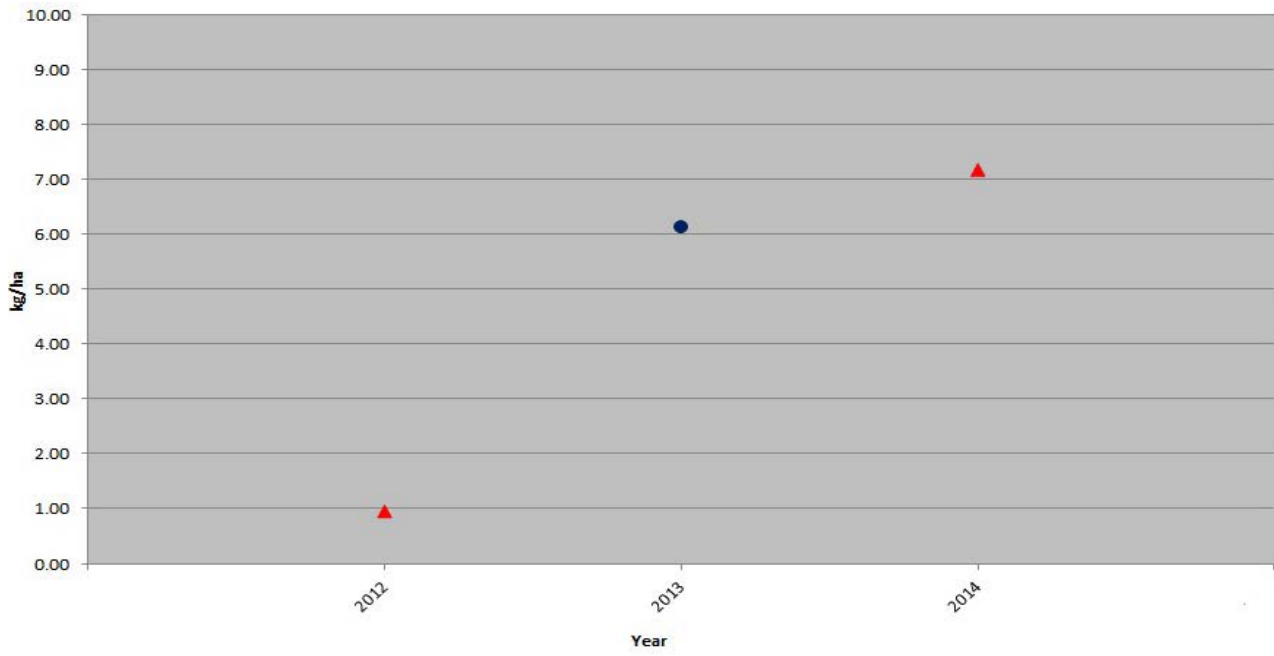


Figure 11
Nitrate (NO_3^-) NADP/NTN Site NJ39 (Cattus Island)
Annual Wet Deposition 2012-2014
Kilograms per Hectare (kg/ha)



REFERENCES

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