Trend Analyses for Idaho's Nitrate Priority Areas, 1994-2007

Kenneth W. Neely
Technical Hydrogeologist
Idaho Department of Water Resources
Planning & Technical Services Division

322 E. Front Street
Boise, ID 87320
208-287-4800
www.idwr.idaho.gov/

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Executive Summary

In 1998, the Idaho Department of Environmental Quality (IDEQ), in cooperation with the Ground Water Monitoring Technical Committee (GWMTC), delineated 33 Nitrate Priority Areas (NPA) based on several existing data sources. The NPAs were ranked on the basis of several factors including the presence or absence of trends. In 2000, the U.S. Geological Survey (USGS) was contracted to determine if nitrate trends had occurred for the NPAs.

The USGS conducted their analyses by compiling nitrate data from multiple sources and performing statistical analyses on these data for the NPAs. As part of their approach, the USGS added a one-mile buffer around each NPA, which resulted in the overlapping of several NPAs. The overlapping NPAs were grouped together, and the result was the reduction of NPAs from 33 to 25. The USGS examined a total of 8,465 nitrate analyses from 2,931 wells with dates ranging from June 1961 to February 2001. The USGS analyses revealed that long-term increasing trends (over 10-year time periods) occurred at 6 NPAs, long-term decreasing trends occurred at 4 NPAs, short-term increasing trends (over 4-year time periods) occurred at 7 NPAs and short –term decreasing trends occurred at only 1 NPA. These results were based on the 95% confidence level. The USGS published their findings in a Water Resources Investigations Report 02-4056 in 2002.

In 2007 and 2008 IDEQ compiled nitrate results from ground water quality monitoring conducted since the last NPA ranking in 2002. IDEQ, in conjunction with the GWMTC, used the data to identify and delineate 32 NPAs. The criteria for a NPA remains unchanged from 2002 (at least 25% of the wells tested had nitrate concentrations at or above 5 milligrams per liter).

Recently, the IDEQ desired to know the trends in nitrate concentrations since the analyses conducted by the USGS. The IDEQ contracted with the Idaho Department of Water Resources to perform statistical analyses for trends using the same overall ranking process that was done by the USGS in 2002. IDEQ and IDWR determined that two Time Periods would be examined, with both encompassing seven years. Time Period 1 (Time 1) is the analyses conducted from 1994 to 2000. Time Period 2 (Time 2) included the analyses done from 2001 to July 2007.

The IDWR received two databases from the IDEQ which contained a total of 74,000 records. The IDWR also received a draft GIS coverage that contained revised NPAs based on probability mapping and regional factors. Since the original 2001 NPA coverage, several NPAs had been dropped, some had been added, and the boundaries of many had been changed slightly to significantly. The IDWR sorted the nitrate data for each NPA according to Time 1 and Time 2, selected the maximum nitrate value for each site, and eliminated duplicate sites between the two databases. After accomplishing this, it was discovered that three NPAs did not have enough data for statistical analyses. For the other 29 NPAs, the number of nitrate results used in the analyses was 2,343 in Time 1 and 2,473 in Time 2. Some of these results are “paired” data meaning that the same site

was sampled in both time periods; others were sites that were sampled in either Time 1 or Time 2.

In July, 2008, the GWMTC decided to use a confidence level of 85% as the cutoff between No Trend and Significant Trend. The results from this study showed that six NPAs had nitrate trends at a greater than 85% confidence level. Five NPAs (Ada/Canyon, Marsing, NE Star, Twin Falls and Weiser) had increasing nitrate trends; one NPA (Homedale) has a decreasing nitrate trend. Only NE Star had an increasing nitrate trend at a greater than 95% confidence level. Nineteen NPAs had increases in median values ranging from 0.1 mg/L to 6.7 mg/L. Nine NPAs had decreases in median values ranging from 0.1 mg/L to 13.0 mg/L. One area showed no change in median values. Because five NPAs showed increasing nitrate trends, significant at a greater than 85% confidence level, and because twice as many NPAs had increases in median values than decreases, IDWR recommends that trend analyses be conducted every five to seven years.

Previous Analyses

The GWMTC played a substantial role in developing a process and criteria to be used in prioritizing areas of nitrate-degraded ground water. Trend analyses, together with population, water quality, number of public water systems and beneficial use were criteria that the committee felt should be used in the scoring process. In 2002, the U.S. Geological Survey (USGS) completed nitrate trend analyses of ground water for the Idaho Department of Environmental Quality (IDEQ) to use in scoring the nitrate areas. The study was designed to compile and assess nitrate data for 33 Nitrate Priority Areas (NPAs) in Idaho. The method that the USGS employed for the analyses included a one-mile buffer zone around each NPA. This resulted in the overlapping of several NPAs. The overlapping NPAs were combined, and the number of NPAs for analyses was reduced from 33 to 25.

The USGS examined 8,465 individual nitrate samples from 2,931 wells. The dates of the nitrate analyses used in the assessment ranged June 1961 to February 2002. The USGS used time-period and time-series comparisons in the trend analysis. Specifically, summary statistics, boxplots, and the Mann-Whitney rank sum test were statistical tools used in the nitrate analysis.

The USGS conducted "long-term" and "short-term" analyses for nitrate trends. Long-term trend assessments were accomplished by grouping the data into the following decades: 1970s, 1980s, and 1990s. Short term evaluations were done by grouping the data from 1990 to 2000 into three time categories based on the sampling intervals for the Statewide Ground Water Quality Monitoring Program; 1991 – 1994, 1995-1998, and 1999-2000. Table 1 is a condensed summary of the USGS trend analyses findings.

For this study, the IDEQ was interested in knowing whether the recent nitrate data from 2001 to 2007 was exhibiting any significant trends (increasing or decreasing). It was decided to compare two time periods of nearly equal length. Thus, Time 1 encompasses the nitrate data collected from 1994 through 2000 (7 full years). Time 2 includes the nitrate data collected from 2001 through July of 2007 (6.5 years).

Additional information since the USGS assessment in 2002 allowed the IDEQ to modify several of the NPAs prior to the nitrate analyses conducted in this report. In three situations, a large area was subdivided into two or three smaller areas. In one case, two areas were combined into one new area. Six new areas were designated by IDEQ since 2002. Two of the areas from 2002 were discontinued. The boundaries of most areas had either minor, moderate, or major changes. Overall, the number of NPAs changed from 33 to 32 (Figure 1 and Table 2).

Table 1. Results from USGS' long-term and short–term nitrate trend analyses from 1970-2000.
(comparisons made between two group; at least 4 samples in each group; probability (p) values were 0.05 or less which indicated a significant trend at the 95% confidence level[1])

Area	Priority Area Name	Long-Term Trend	Short-Term Trend
1	Genesee/Cow Creek	X[2]	X
2	Lapwai Creek	X	No trend
3	Camas Prairie	X	Increasing
4	Weiser	Increasing	Increasing
5	Payette	No trend	No trend
6	Lower Boise-Canyon	No trend	Increasing
7	Eagle/Star	X	No trend
8	Homedale/Marsing	X	No trend
9	Meridian	Decreasing	Decreasing
10	Grand View	Increasing	Increasing
11	Bruneau	No trend	No trend
12	Mountain Home	Decreasing	No trend
13	Hammett	Increasing	Increasing
14	Bliss	X	X
15	Twin Falls	Increasing	Increasing
16	Rupert	Decreasing	No trend
17	Burley/Marsh Creek	Decreasing	Increasing
18	Pocatello	Increasing	No trend
19	Fort Hall	No trend	No trend
20	Preston/Cache Valley	X	No trend
21	Soda Springs/Bear Lake	No trend	No trend
22	Mud Lake	No trend	No trend
23	Hibbard	X	No trend
24	St. Anthony	No Trend	No trend
25	Ashton-Teton River	Increasing	No trend

[1]Probability and Confidence Level are the statistical measures used to describe the certainty of changes when comparing different datasets. Probability is the calculated number that a statistical test produces when comparing one dataset to another. In the USGS study and in this current study, the null hypothesis was that the medians between the datasets were not significantly different. High probability numbers indicate the null hypothesis cannot be rejected, whereas the lower the probability, the more likely the null hypothesis can be rejected (and the datasets are truly different). The confidence level is 1 minus the probability. In statistical testing, the 95% confidence level is often used as a yardstick for significant difference, and the results are reported as "significantly different at a greater than 95% confidence level", when they exceed this threshold.
[2]X = Insufficient data to perform analysis

Data Sources and Compilation

IDEQ provided two databases to IDWR for this project. Database 1 had 8,465 records with sample dates ranging from 1961 to 2001. In Database 1, the sources of nitrate data include IDEQ (special studies and regulated public drinking water system monitoring), the Idaho State Department of Agriculture (ISDA), IDWR and the USGS. Database 2 had 65,535 records with sample dates ranging from 1942 to July of 2007. Sources of nitrate data in Database 2 included IDEQ, IDWR, ISDA, and USGS.

Data in both databases were filtered according to the date sampled and the Nitrate Priority Areas in ESRI ArcView®. Once the data were sorted into the two time periods in ArcView®, the data were imported into Microsoft Excel® files. The files for each NPA were examined to remove duplicate sites and to select the maximum value for each site. Next, the data were imported into Systat™ statistical software which was used to run descriptive statistics and the non-parametric Mann-Whitney test for changes in medians. Finally, the data were imported into Minitab™ statistical software which was used to create the boxplots.

It should be noted that in most cases, the number of samples in Time 1 are not equal to the number of samples in Time 2. The beginning and ending dates for regional/local projects will impact the number of sites sampled in a time period; for example, if a project was sampled in 1998 but not again, the samples would only be included in Time 1.

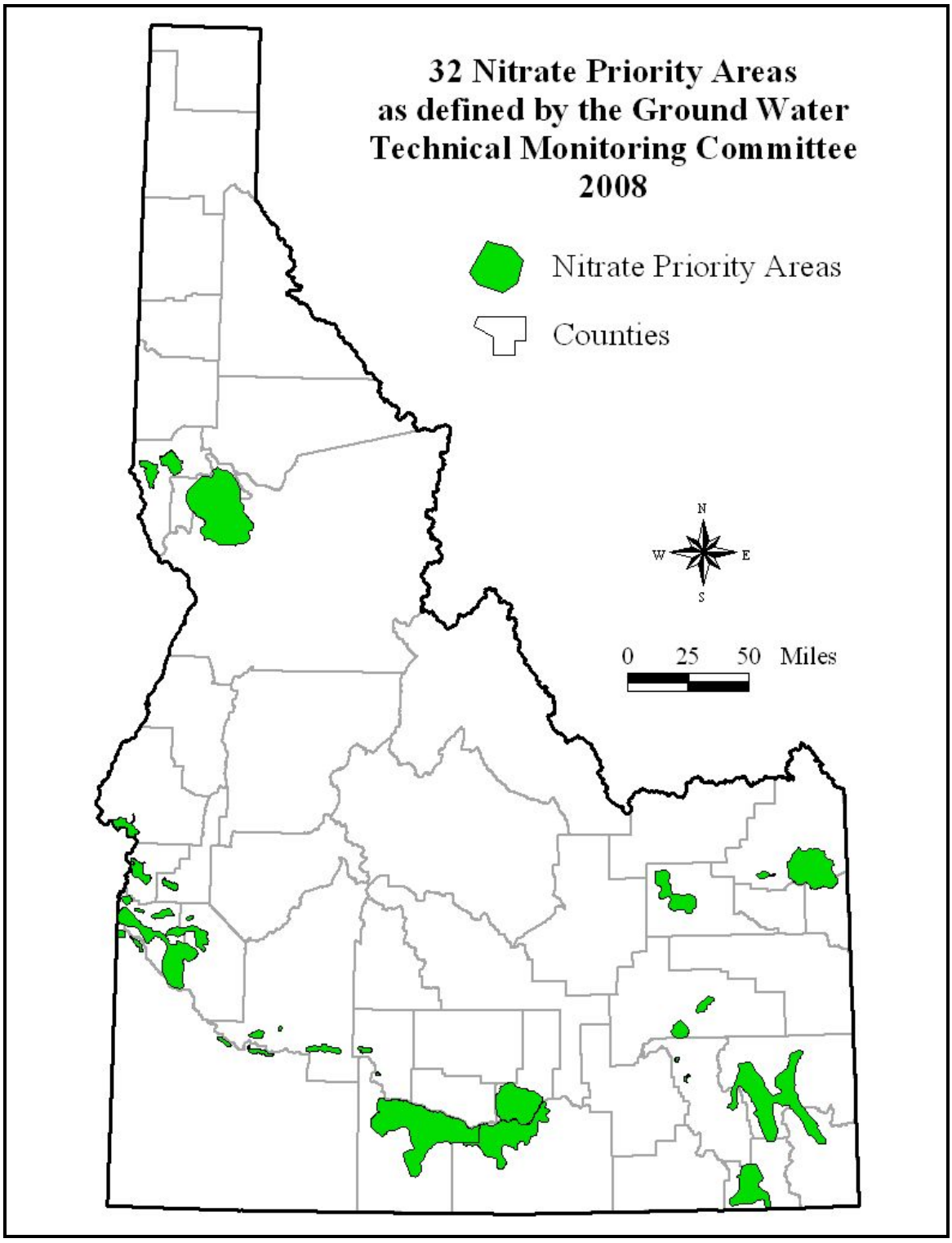


Figure 1. 32 Nitrate Priority Areas as designated by the Idaho Department of Environmental Quality with the GWMTC, 2008.

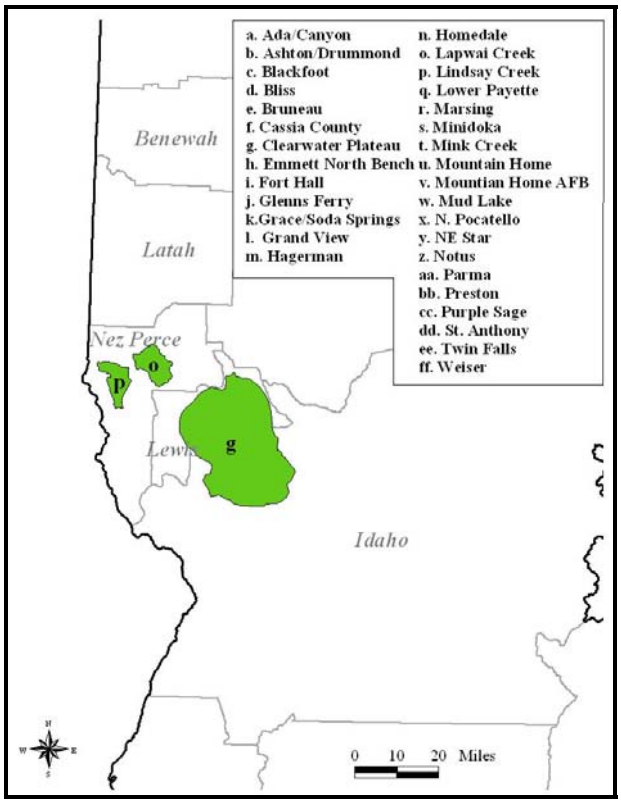


Figure 2. Nitrate Priority Areas in the north-central part of Idaho, 2008.

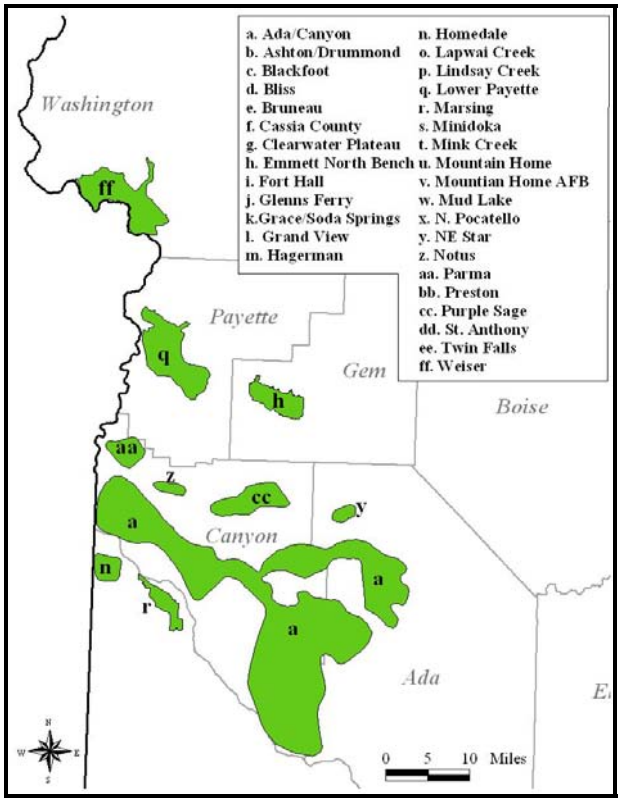


Figure 3. Nitrate Priority Areas in the southwest part of Idaho, 2008.

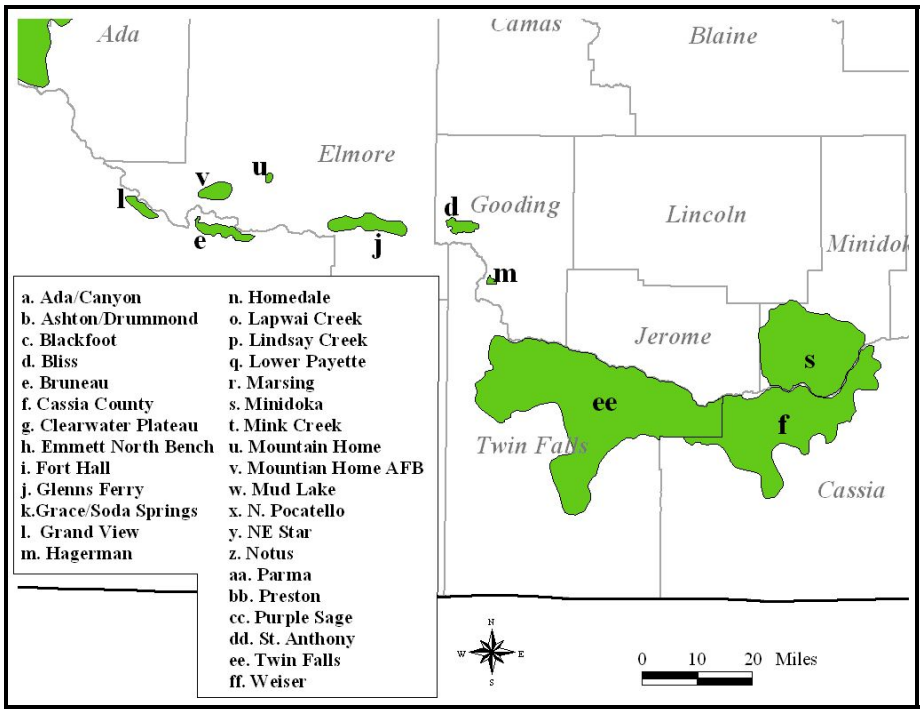


Figure 4. Nitrate Priority Areas in the south central part of Idaho, 2008.

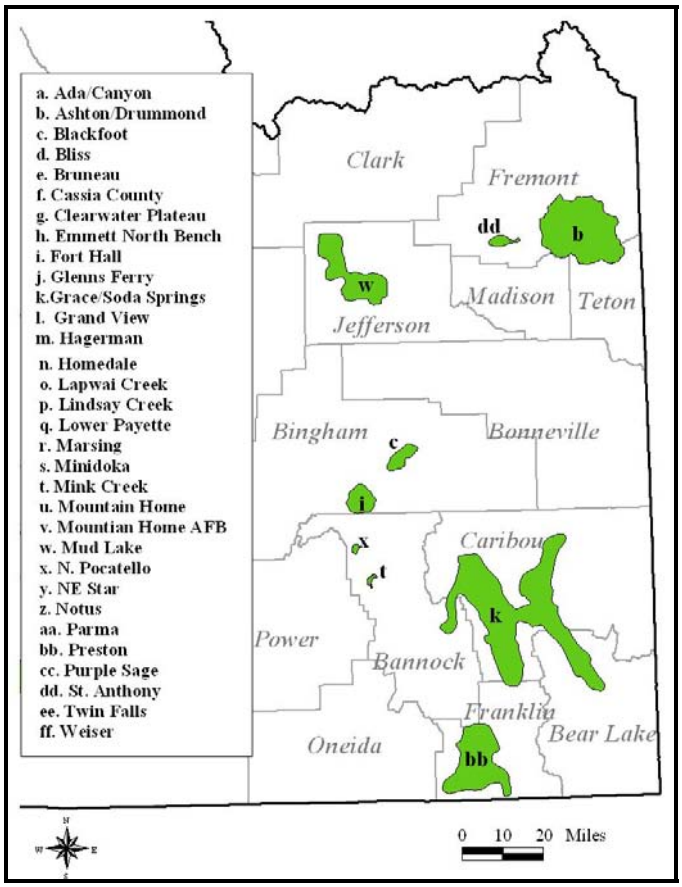


Figure 5. Nitrate Priority Areas in the eastern part of Idaho, 2008.

Table 2. Comparison of Nitrate Priority Areas from 2008 to 2002.

NPA as of 2008	NPA in 2002 report	Comments
Ada/Canyon	Lower Boise-Canyon and Boise Meridian	Lower Boise-Canyon was subdivided into 3 NPAs. Boise Meridian was grouped into Ada/Canyon
Ashton/Drummond	Ashton/Drummond/Teton R	Minor changes in boundaries
Blackfoot		New area
Bliss	Bliss	Minor changes in boundaries
Bruneau	Bruneau	Major changes in boundaries
Cassia	Burley/Marsh Creek	Major changes in boundaries
Clearwater Plateau	Camas Prairie	Major changes in boundaries
Emmett North Bench		New area
Fort Hall	Fort Hall	Minor changes in boundaries
	Genesee/Cow Creek	Discontinued
Glenns Ferry	Hammett	Major changes in boundaries
Grace/Soda Springs	Soda Springs/Bear River	Minor changes in boundaries
Grandview	Grandview	Major changes in boundaries
Hagerman		New area
	Hibbard	Discontinued
Homedale	Homedale/Marsing	Homedale/Marsing was subdivided
Lapwai	Lapwai	Major changes in boundaries
Lindsay Creek		New area
Lower Payette	Payette	Major changes in boundaries
Marsing	Homedale/Marsing	Homedale/Marsing was subdivided
Minidoka	Rupert	Minor changes in boundaries
Mink Creek	Pocatello	Pocatello was subdivided into 2 areas
Mountain Home	Mountain Home	Major changes in boundaries
Mountain Home AFB		New area
Mud Lake	Mud Lake	Minor changes in boundaries
N. Pocatello	Pocatello	Pocatello was subdivided into 2 areas
NE Star	Eagle/Star	Name change and minor changes in boundaries
Notus	Lower Boise-Canyon	Lower Boise-Canyon was subdivided into 3 NPAs
Parma	Lower Boise-Canyon	Lower Boise-Canyon was subdivided into 3 NPAs
Preston	Preston/Cache Valley	Minor changes in boundaries
Purple Sage		New area
St Anthony	St Anthony	Minor changes in boundaries
Twin Falls	Twin Falls	Major changes in boundaries
Weiser	Weiser	Moderate changes in boundaries

Results

Of the 32 NPAs, 29 had enough nitrate samples to allow for the analyses of trends (Bruneau, Hagerman, and Notus did not have a sufficient number of samples). Nineteen NPAs had increases in median values ranging from 0.1 mg/L to 6.7 mg/L. Nine areas had decreases in median values ranging from 0.1 mg/L to 13.0 mg/L. One area showed no change in median values (Figure 6).

Trend analysis is one of the criteria that is used to differentiate the areas from each other so that they can be ranked. In July, 2008, the GWMTC decided that the use of a 95% confidence level did not provide adequate information to help rank the areas because only one area exceeded that level. The GWMTC decided to use a confidence level of 85% as the cutoff between No Trend and Significant Trend. Consequently, the results from this study showed that six NPAs had nitrate trends at a greater than 85% confidence level. Five of these NPAs (Ada/Canyon, Marsing, NE Star, Twin Falls and Weiser) had increasing nitrate trends; one NPA (Homedale) has a decreasing nitrate trend. Only NE Star had an increasing nitrate trend at a greater than 95% confidence level.

The following select NPAs showed some of the most interesting results for either increasing or decreasing nitrate trends.

Ada/Canyon. The median value increased from 3.8 mg/L in Time 1 to 4.4 mg/L in Time 2, which was significant at the 89% confidence level. The number of samples collected in Time 2 was almost half the number collected in Time 1; this difference may have affected the statistical results depending on the reason(s) for the reduction in samples, and the geographic distribution of the samples. The percentage of samples with nitrate concentrations equal to or greater than 5 mg/L increased from 36% for Time 1 to 44% for Time 2.

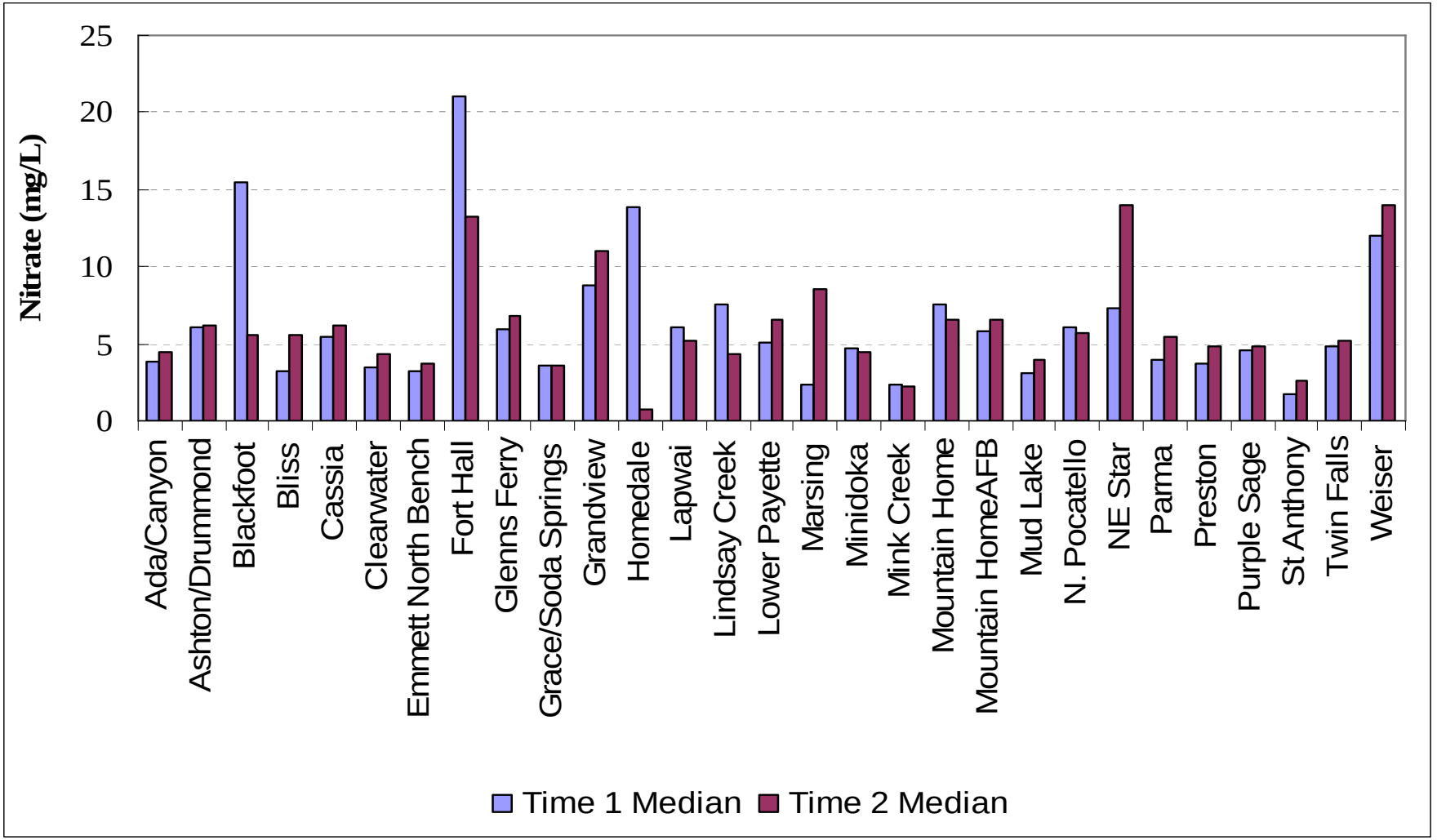


Figure 6. Median values for Time 1 (1994-2000) and Time 2 (2001-2007) for 29 Nitrate Priority Areas (3 areas are not included because of insufficient sample numbers).

Table 3. Trends between Time 1 (1994-2000) and Time 2 (2001-2007) for 32 Nitrate Priority Areas.

2008 NPA	Time 1 # of Sites	Time 1 Median	Time 2 # of Sites	Time 2 Median	Probability[1]	Trend Results and Confidence Level[1] if > 85%
Ada/Canyon	710	3.8	374	4.4	0.109	Increasing Trend (> 85% Confidence Level)
Ashton/Drummond	140	6.1	80	6.2	0.917	No Trend
Blackfoot	5	15.5	13	5.6	0.153	No Trend
Bliss	25	3.2	18	5.6	0.278	No Trend
Bruneau	3		4		Insufficient samples	Insufficient samples
Cassia	218	5.5	354	6.4	0.357	No Trend
Clearwater	110	3.5	115	4.3	0.491	No Trend
Emmett North Bench	20	3.2	18	3.7	0.357	No Trend
Fort Hall	7	21	6	13.3	0.774	No Trend
Glenns Ferry	6	5.9	11	6.8	0.546	No Trend
Grace/Soda Springs	70	3.6	73	3.6	0.992	No Trend
Grandview	14	8.8	12	11	0.247	No Trend
Hagerman	7		3		Insufficient samples	Insufficient samples
Homedale	16	13.8	22	0.8	0.066-	Decreasing Trend (> 90% Confidence Level)
Lapwai	7	6.1	16	5.2	0.593	No Trend
Lindsay Creek	9	7.5	43	4.3	0.672	No Trend
Lower Payette	77	5.1	66	6.5	0.35	No Trend
Marsing	18	2.3	30	8.5	0.097+	Increasing Trend (at > 90% Confidence Level)
Minidoka	173	4.7	261	4.5	0.842	No Trend
Mink Creek	7	2.4	40	3.0	0.509	No Trend
Mountain Home	29	7.6	28	6.6	0.817	No Trend
Mountain Home AFB	11	5.8	34	6.6	0.436	No Trend
Mud Lake	36	3.1	53	4	0.325	No Trend
N. Pocatello	12	6.1	10	5.7	0.741	No Trend
NE Star	55	7.3	23	14	0.016+	Increasing Trend (> 95% Confidence Level)
Notus	6		1		Insufficient samples	Insufficient samples
Parma	12	4	8	5.5	0.536	No Trend
Preston	51	3.7	54	4.8	0.198	No Trend
Purple Sage	18	4.6	78	4.8	0.782	No Trend
St Anthony	17	1.7	11	2.6	0.335	No Trend
Twin Falls	400	4.8	523	5.2	0.109	Increasing Trend (> 85% Confidence Level)
Weiser	61	12	89	14	0.127	Increasing Trend (> 85% Confidence Level)

[1]Probability is the result of testing the null hypothesis: $Median_{Time\ 1} = Median_{Time\ 2}$. The confidence level is equal to 1 minus the probability.

Blackfoot. The median value decreased from 15.5 mg/L in Time 1 to 5.6 mg/L in Time 2. Although this was a large change, numerically, it was significant at only about the 85% confidence level. Perhaps the small number of samples (5) in Time 1 had an effect on the overall statistics.

Bliss. The median value increased from 3.2 mg/L in Time 1 to 5.6 mg/L in Time 2. Although this was a large change, numerically, it was significant only at the 72% confidence level. Bliss was one of the NPAs where most of the sites were sampled in both Time 1 and Time 2, with few being sampled in only one Time period.

Cassia. The median value increased from 5.5 mg/L in Time 1 to 6.4 mg/L in Time 2, which was a significant change at the 64% confidence level. The percentage of sites with nitrate equal to or greater than 5 mg/L increased from 56% for Time 1 to 64% for Time 2.

Fort Hall. The median decreased from 21.0 mg/L in Time 1 to 13.3 mg/L in Time 2. Although this was a large change, numerically, it was significant at only about the 23% confidence level. Perhaps the small number of samples in Times 1 and 2 had an effect on the overall statistics.

Grand View. The median increased from 8.8 mg/L in Time 1 to 11.0 mg/L in Time 2. Although this was a large change, numerically, it was significant at only about the 75% confidence level. The sample size was reasonable (14 in Time 1 and 12 in Time 2), so the statistics should be pretty representative. The change is especially noteworthy because it means that median value went from below the drinking water standard (of 10 mg/L) to above it.

Homedale. The median value decreased from 13.8 mg/L in Time 1 to 0.8 mg/L in Time 2, which was a significant change at the 93% confidence level. The nitrate data from the two Time Periods had quite different signatures. Time 1 had 9 of 16 sites (56%) with nitrate over 10 mg/L, compared to Time 2 which only had 4 of 22 sites (18%) with nitrate over 10 mg/L. Furthermore, the maximum nitrate value in Time 1 was 45.6 mg/L compared to 27 mg/L in Time 2. Figure 7 shows that the distribution of sites for the two Time Periods was quite different with only six of them being sampled in both Time Periods. The large difference in medians may be accounted for by these or other reasons.

Lindsay Creek. The median decreased from 7.5 mg/L in Time 1 to 4.3 mg/L in Time 2, but this change was only significant at the 33% confidence level. Figure 28 shows that the interquartile ranges changed less than the medians, resulting in the lower probability. Also, the number of samples for the two time periods was quite different (9 for Time 1, and 43 for Time 2).

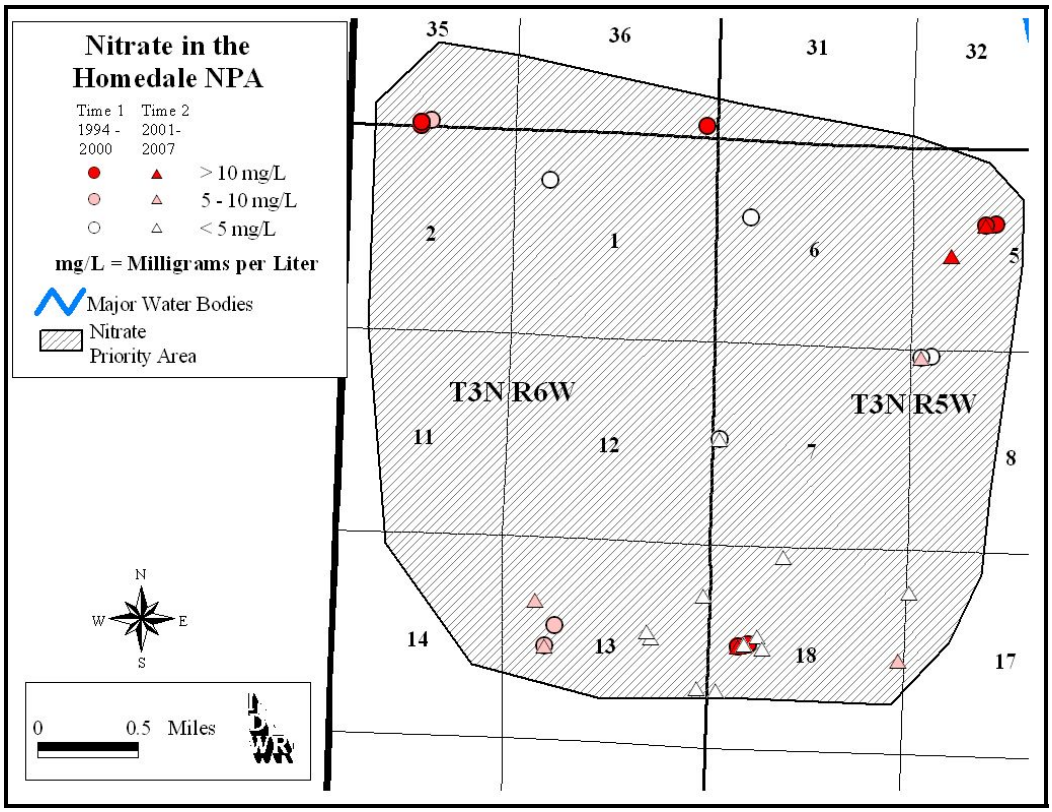


Figure 7. Nitrate concentrations for Time 1 and Time 2 in the Homedale NPA, 2008.

Lower Payette. The median value increased from 5.1 mg/L in Time 1 to 6.5 mg/L in Time 2, which is significant at the 65% confidence level. Although the percentage of sites with nitrate equal to or greater than 5 mg/L increased only slightly from Time 1 to Time 2 (51% to 53%), the percentage of sites with nitrate over 10 mg/L increased from 17% in Time 1 to 27% in Time 2. Figure 8 shows the locations of six sites with nitrate over 10 mg/L that were sampled in Time 2 but not in Time 1; most of these sites are in the central and southern areas of the NPA.

Marsing. The median value increased from 2.3 to 8.5 mg/L, which is significant at the 90% confidence level. Marsing had the second-most significant increase in nitrate medians of all the NPAs. The change is undoubtedly affected by the number of samples in each Time period and the nitrate concentrations at these sites. The number of samples increased from 18 in Time 1 to 30 in Time 2. Figure 9 shows that more sites had higher nitrate concentrations in Time 2 than in Time 1. In Time 1, 8 sites had nitrate concentrations of 5 mg/L or more (44%); in Time 2, there were 19 sites with concentrations in this range (63%). To verify that the statistical change is truly reflective of water quality conditions, it would be important to know how the new sites in Time 2 were selected, and thus, if their addition to the data pool added any bias to the median nitrate value.

NE Star. The median value increased from 7.3 to 14.0 mg/L, which is significant at the 98% confidence level. NE Star showed the most significant increase in nitrate medians of all the NPAs. However, there was a large difference in the number of samples in each

Time period (55 in Time 1 and 23 in Time 2) which may have had an effect on the statistical results. In Time 1, 39% of the sites had nitrate greater than 10 mg/L. But in Time 2, 70% of the sites had nitrate greater than 10 mg/L. Almost half of the samples collected in Time 2 occurred in eastern half of Section 34 (Figure 10). Other places in the NE Star NPA are relatively devoid of samples from Time 2. The effects of the sampling patterns for the two Time periods might have on the statistics is unknown.

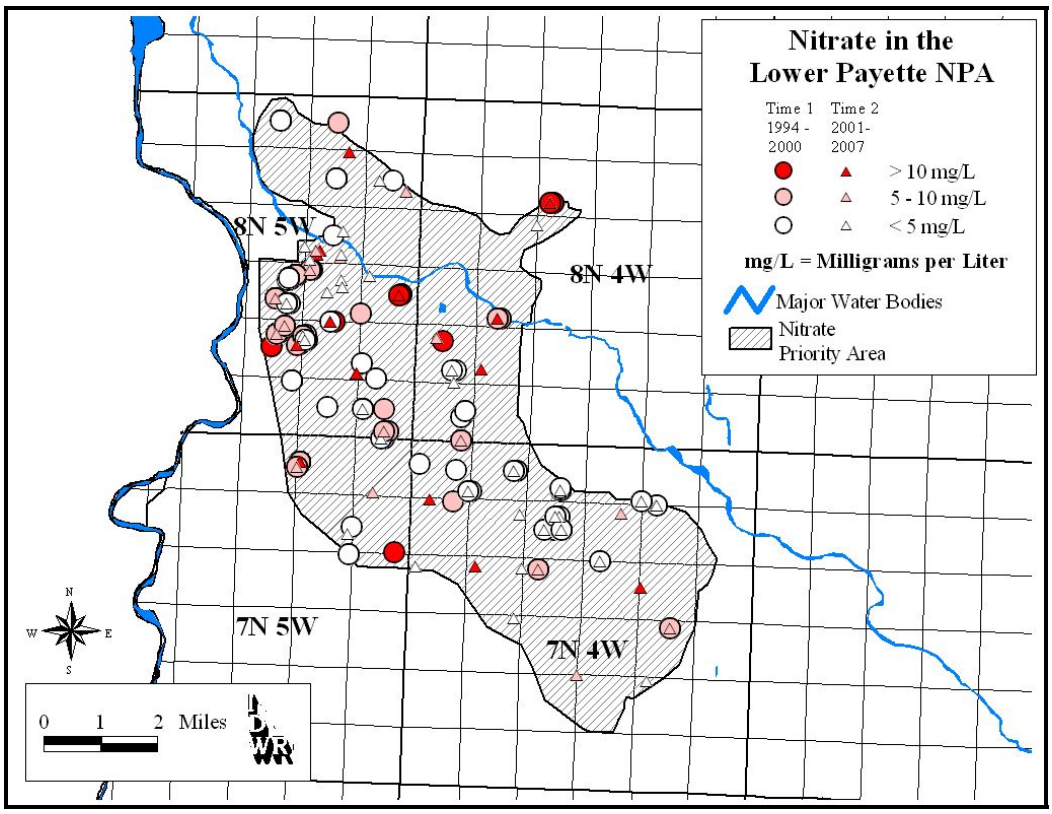


Figure 8. Nitrate concentrations for Time 1 and Time 2 in the Lower Payette NPA, 2008.

Preston. The median value increased from 3.7 to 4.8 mg/L, which is significant at the 80% confidence level. In Time 1, 35% of the sites had nitrate equal to or greater than 5 mg/L. In Time 2, 46% of the sites had nitrate equal to or greater than 5 mg/L. The distribution of the sites with these nitrate concentrations seems quite uniform throughout the NPA, with no obvious clusters that might indicate the addition of bias to the results (Figure 11).

Twin Falls. The median value increased from 4.8 to 5.2 mg/L, which is significant at the 89% confidence level. A visual inspection of the two Time periods indicates that an area encompassing parts of 9S 16E, 9S 17E, 10S 17E, and 10S 18E had more sites with elevated nitrate concentrations in Time 2 than in Time 1 (Figures 12 and 13). The number of samples in Time 1 was 400 and in Time 2 was 523. Forty-eight percent of the sites in Time 1 had nitrate equal to or greater than 5 mg/L. In Time 2, 53% of the samples had nitrate concentrations equal to or greater than 5 mg/L.

Weiser. The median value increased from 12.0 to 14.0 mg/L, which is significant at the 87% confidence level. Time 2 had considerably more samples with nitrate over 10 mg/L than Time 1 (Figures 14 and 15). In the northern part of the NPA (north of 10N 5W), there were 18 samples in Time 1 with nitrate over 10 mg/L and 24 samples in Time 2. In 10N 5W, the number of samples with nitrate over 10 mg/L was 9 in Time 1 and 22 in Time 2. Obviously, the cluster of samples in Sections 8, 9, 16 and 17 with nitrate greater than 10 mg/L had a significant impact on the statistical analysis. In an attempt to evaluate the bias from these high nitrate sites, an analysis was conducted by selecting an average nitrate value for the extra sites in this area that were sampled in Time 2. The subsequent statistical analysis reduced the median value for Time 2 to 13.0 mg/L, which resulted in a significant difference between medians at only the 55% confidence level.

Figure 16 is an explanation of boxplots for Figures 17 through 45, which show the boxplots for the 29 NPAs analyzed for nitrate trends in this study.

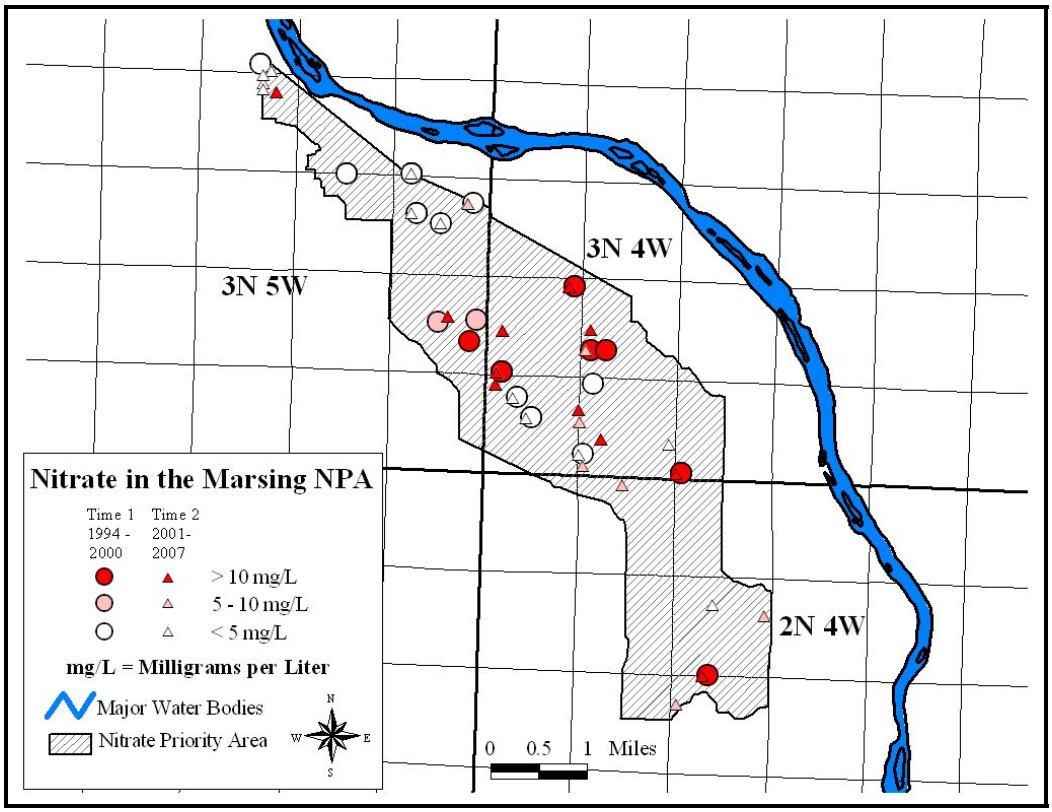


Figure 9. Nitrate concentrations for Time 1 and Time 2 in the Marsing NPA, 2008.

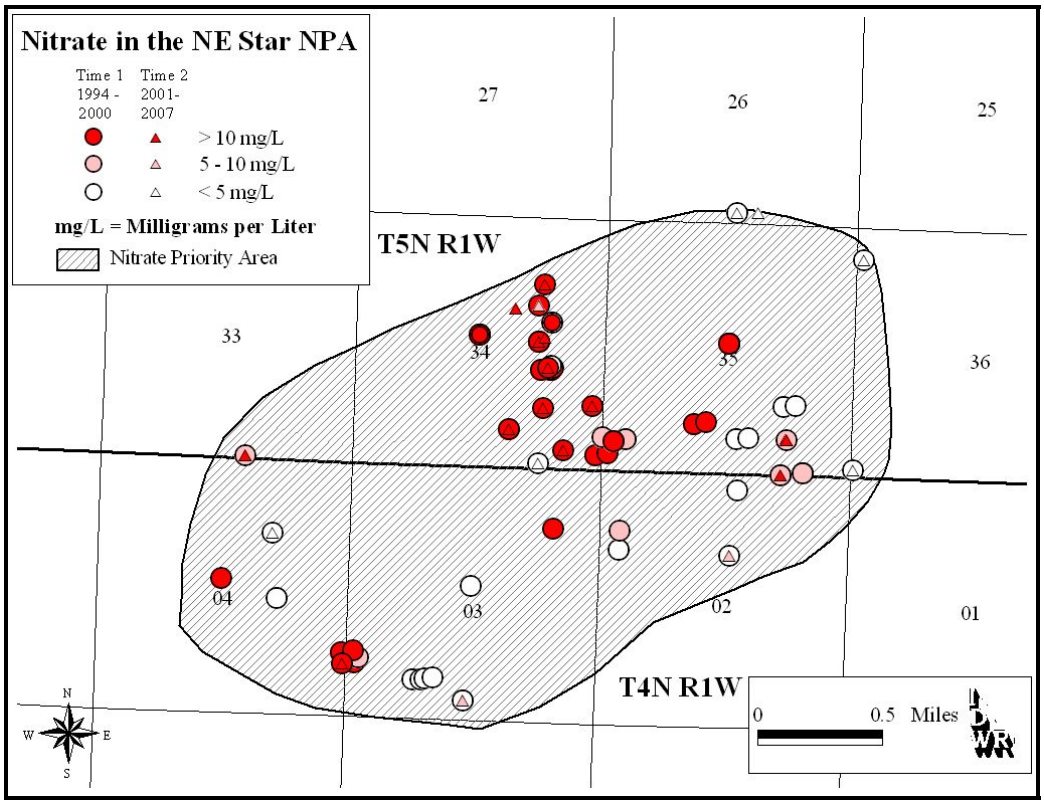


Figure 10. Nitrate concentrations for Time 1 and Time 2 in the NE Star NPA, 2008.

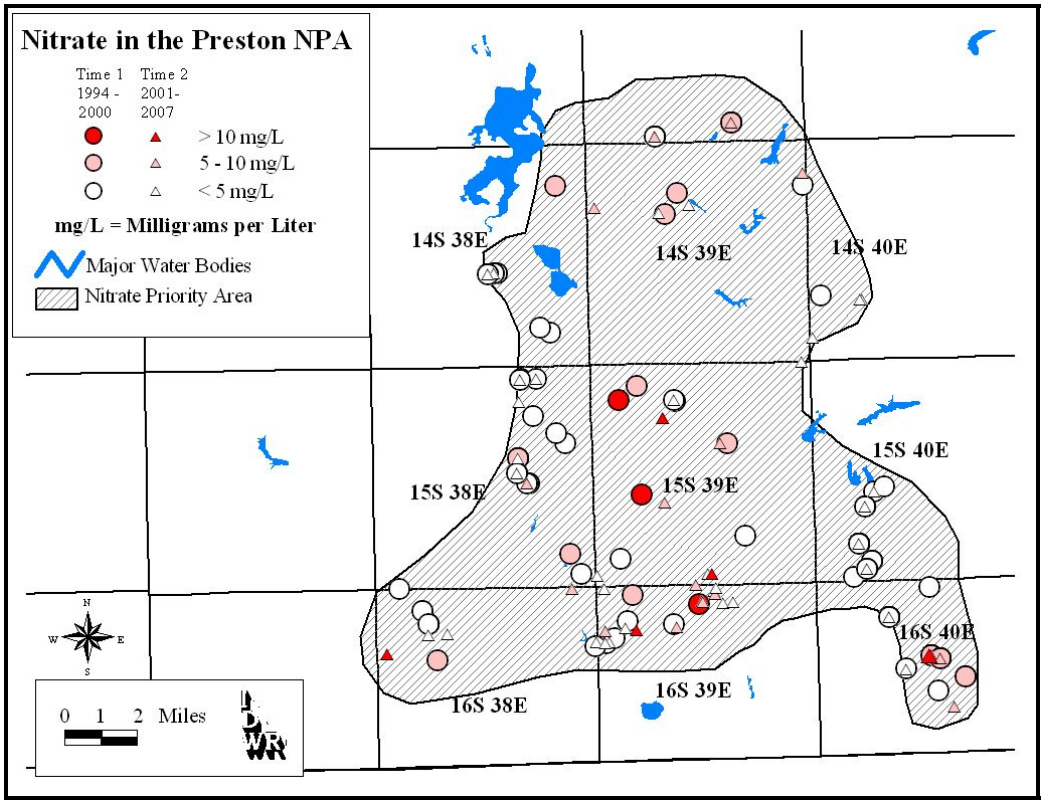


Figure 11. Nitrate concentrations for Time 1 and Time 2 in the Preston NPA, 2008.

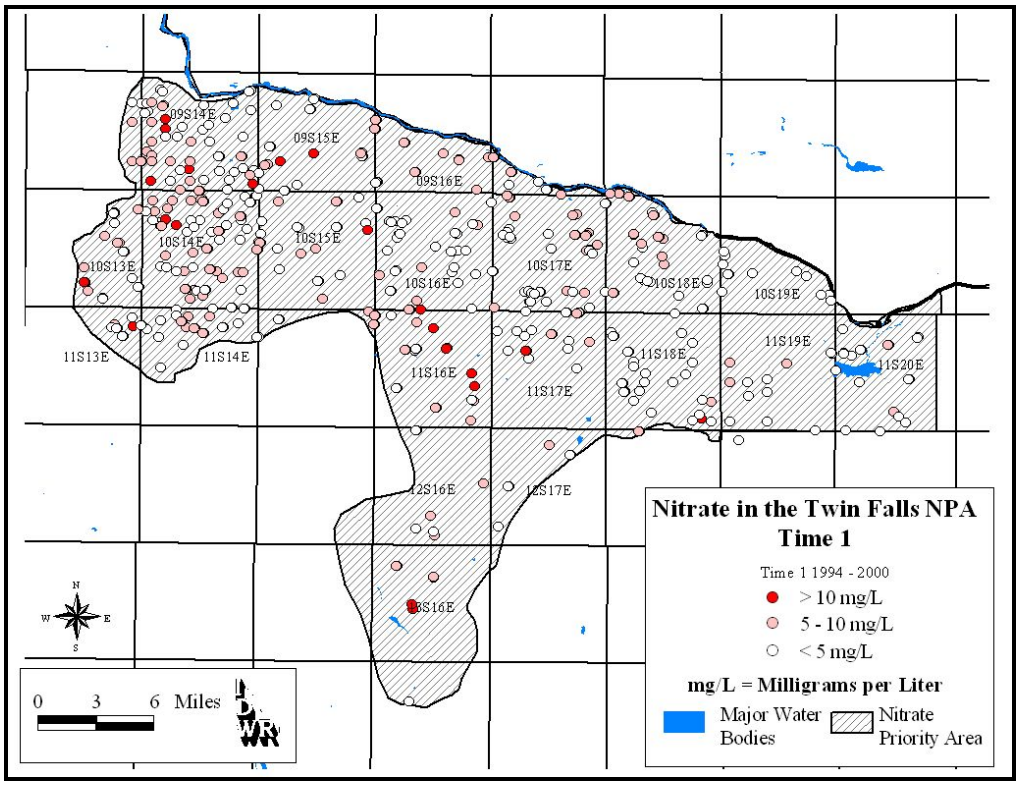


Figure 12. Nitrate concentrations for Time 1 in the Twin Falls NPA, 2008.

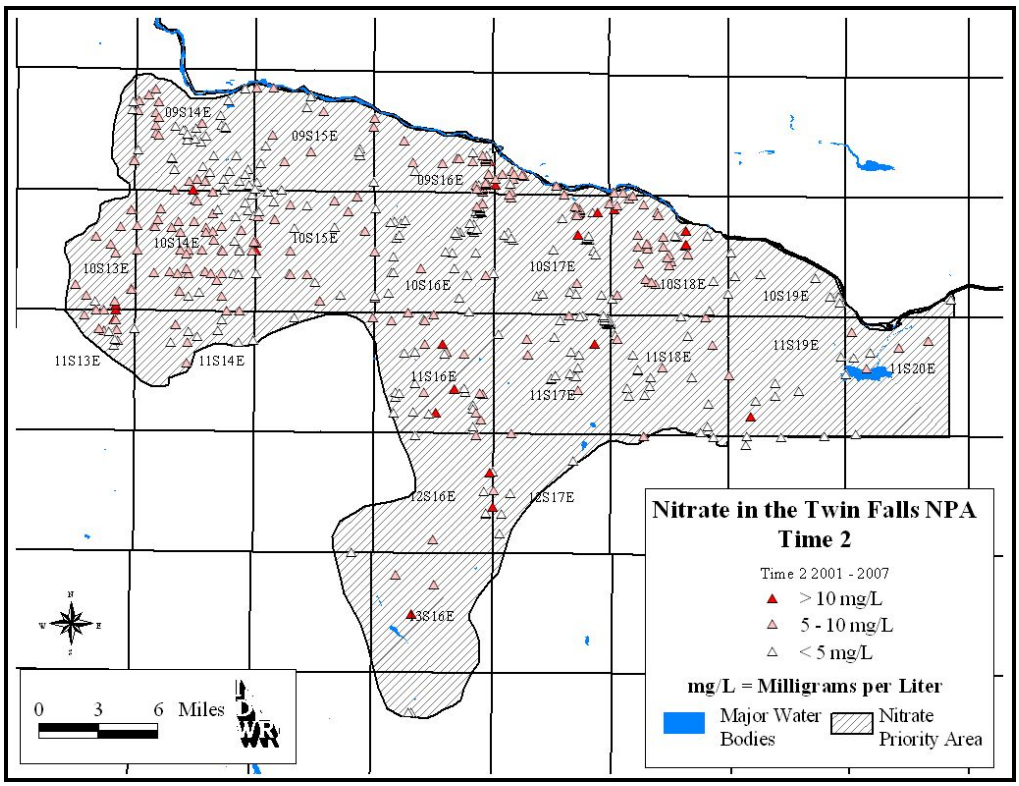


Figure 13. Nitrate concentrations for Time 2 in the Twin Falls NPA, 2008

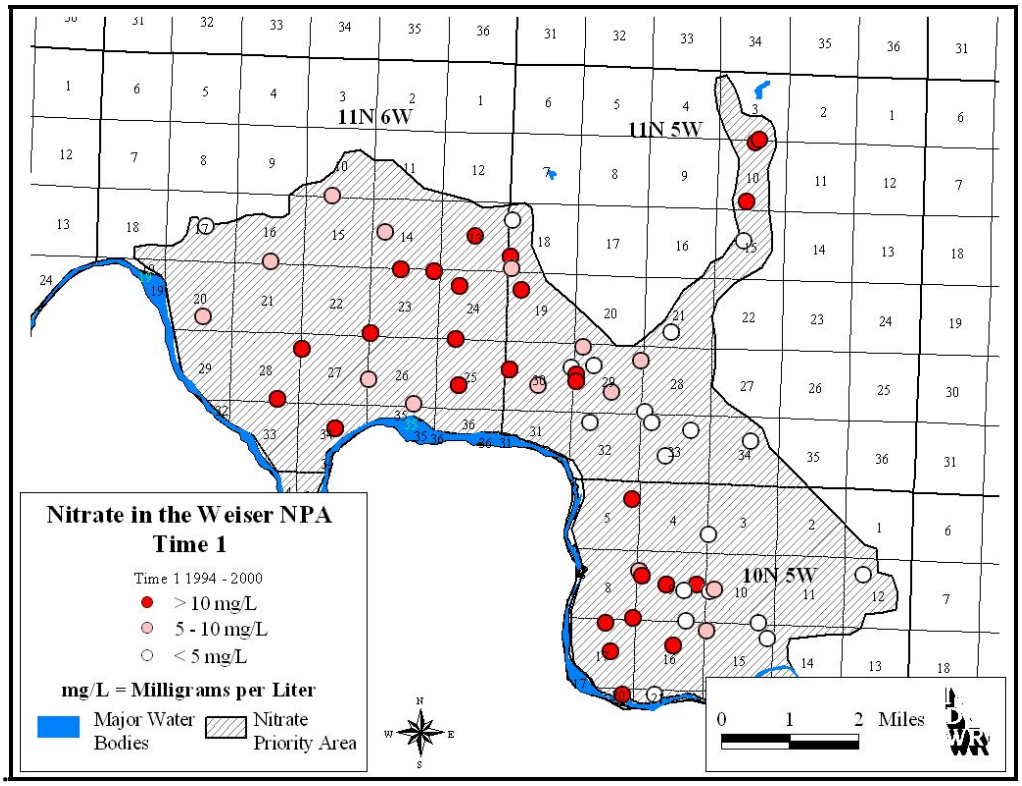


Figure 14. Nitrate concentrations for Time 1 in the Weiser NPA, 2008.

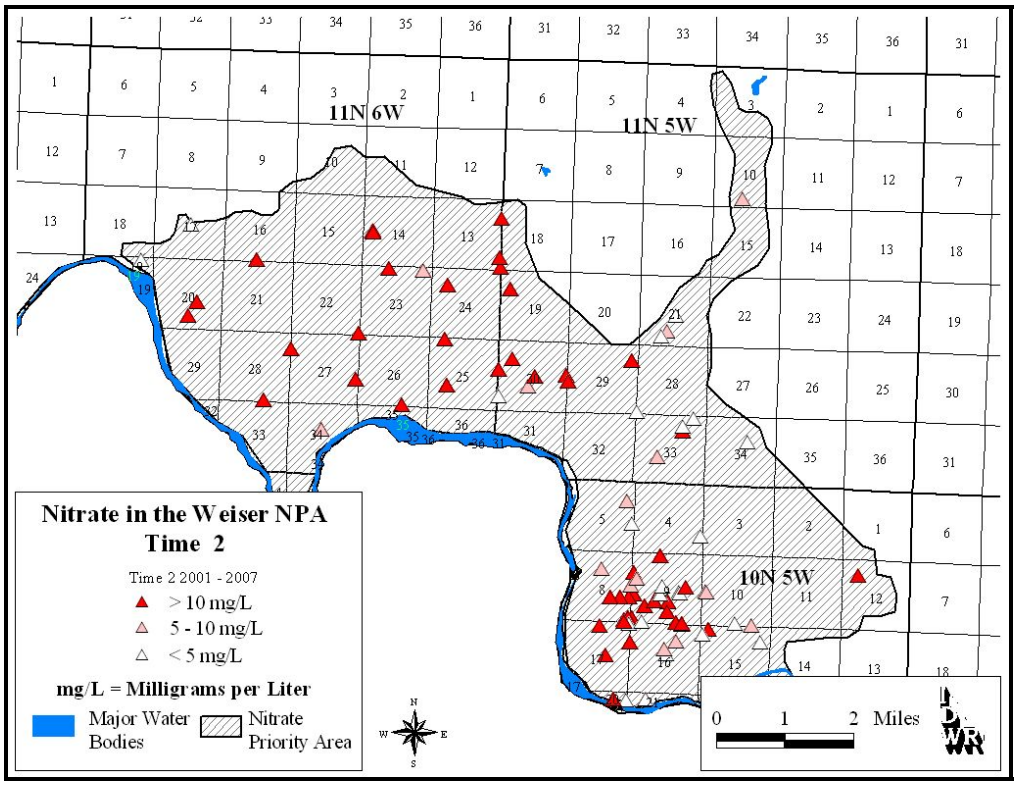
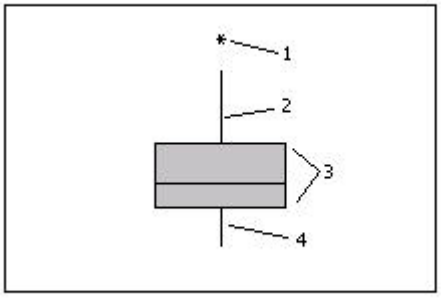


Figure 15. Nitrate concentrations for Time 2 in the Weiser NPA, 2008.



1 **Outlier (*)** – Observation that is beyond the upper or lower whisker

2 **Upper whisker** – Extends to the maximum data point within 1.5 box heights from the top of the box

3 **Interquartile range box** – Middle 50% of the data

- Top line – Q3 (third quartile). 75% of the data are less than or equal to this value.
- Middle line – Q2 (median). 50% of the data are less than or equal to this value.
- Bottom line – Q1 (first quartile). 25% of the data are less than or equal to this value.

4 **Lower whisker** – Extends to the minimum data point within 1.5 box heights from the bottom of the box

Figure 16. Explanation for boxplots in Figures 17-45.

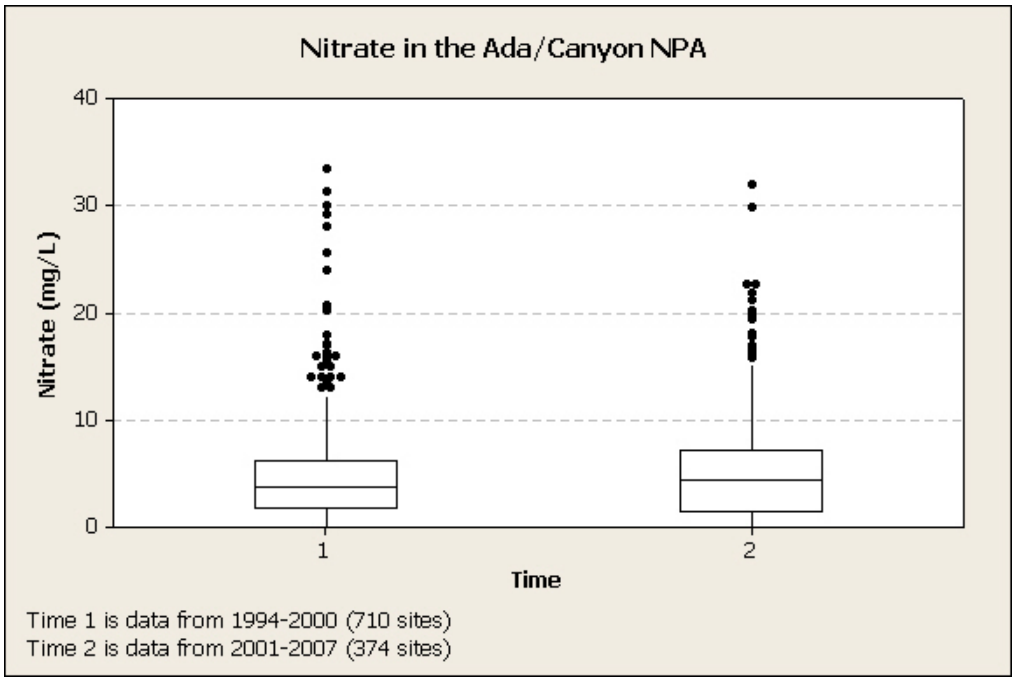


Figure 17. Nitrate boxplots for the Ada/Canyon NPA for Time 1 and 2.

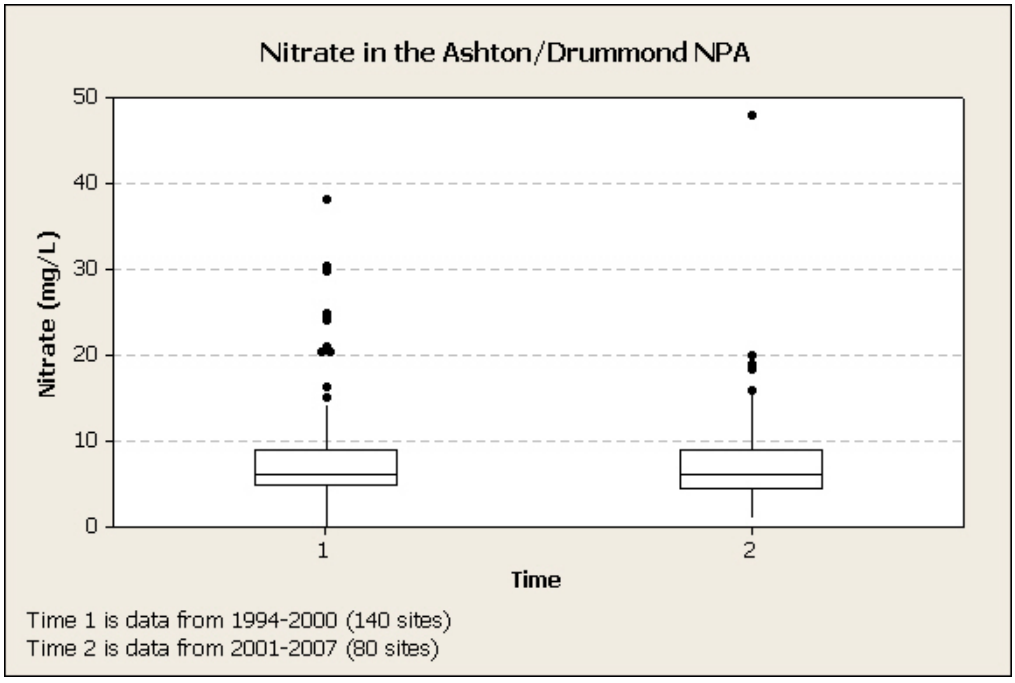


Figure 18. Nitrate boxplots for the Ashton/Drummond NPA for Time 1 and 2.

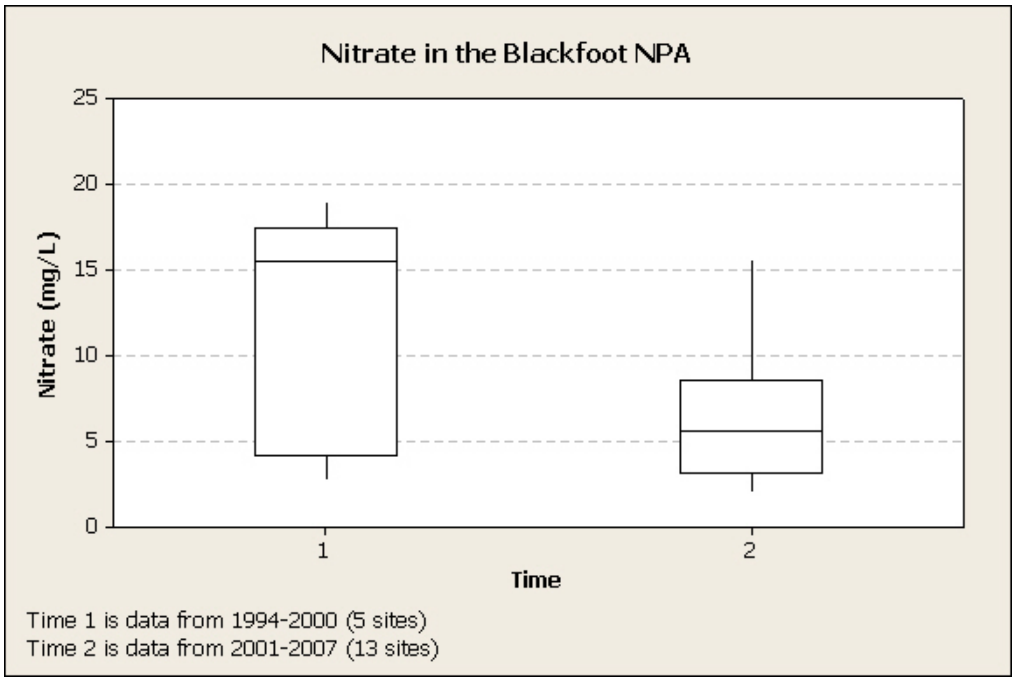


Figure 19. Nitrate boxplots for the Blackfoot NPA for Time 1 and 2.

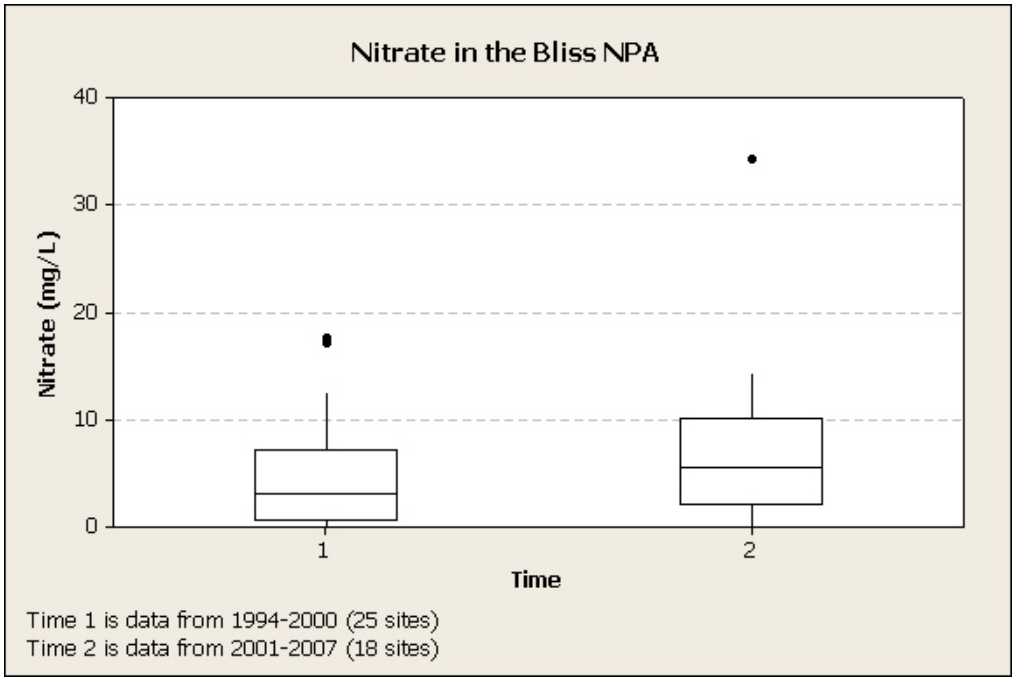


Figure 20. Nitrate boxplots for the Bliss for Time 1 and 2.

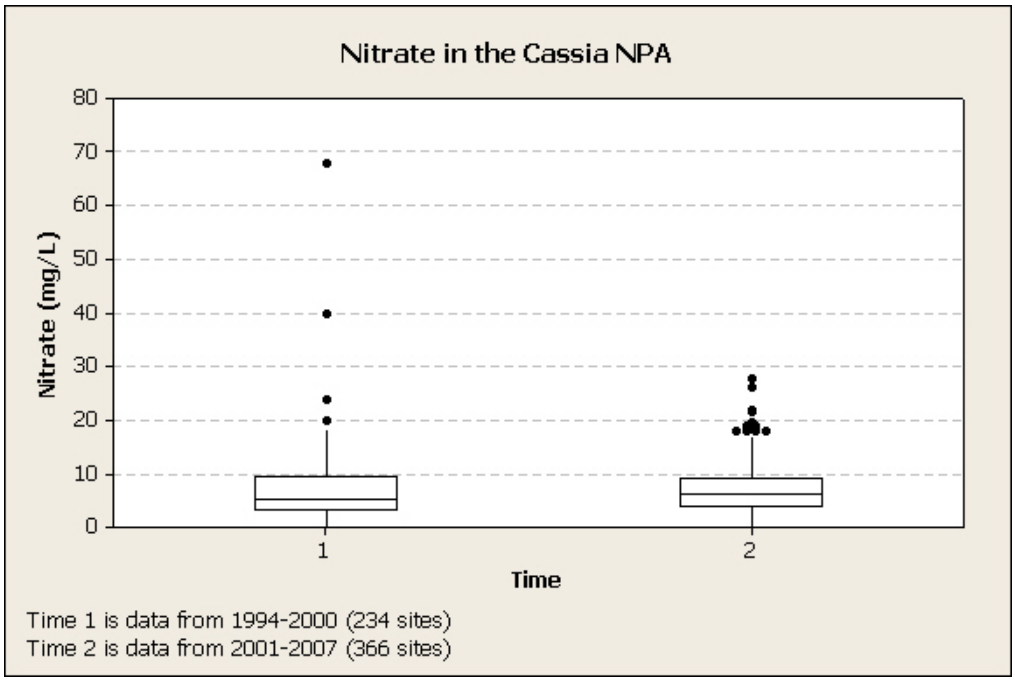


Figure 21. Nitrate boxplots for the Cassia County NPA for Time 1 and 2.

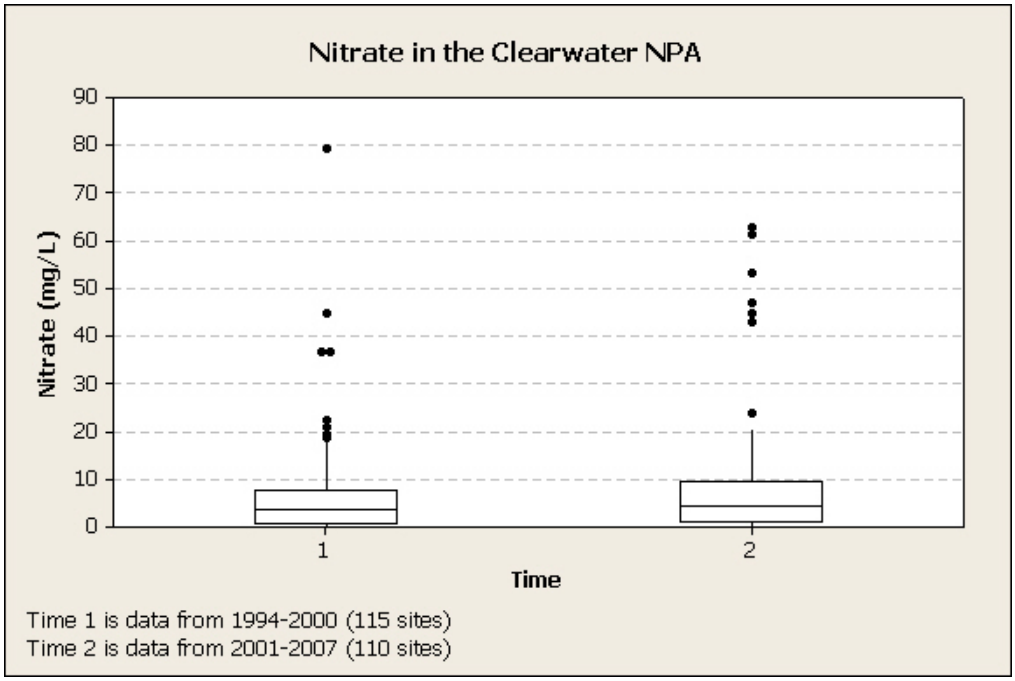


Figure 22. Nitrate boxplots for the Clearwater NPA for Time 1 and 2.

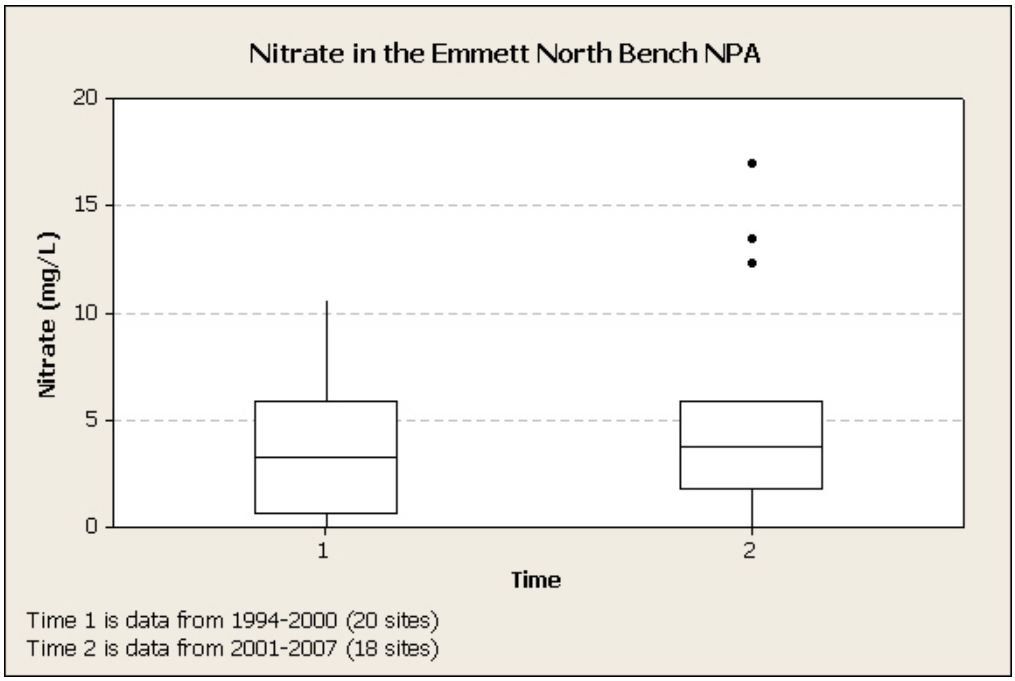


Figure 23. Nitrate boxplots for the Emmett North Bench NPA for Time 1 and 2.

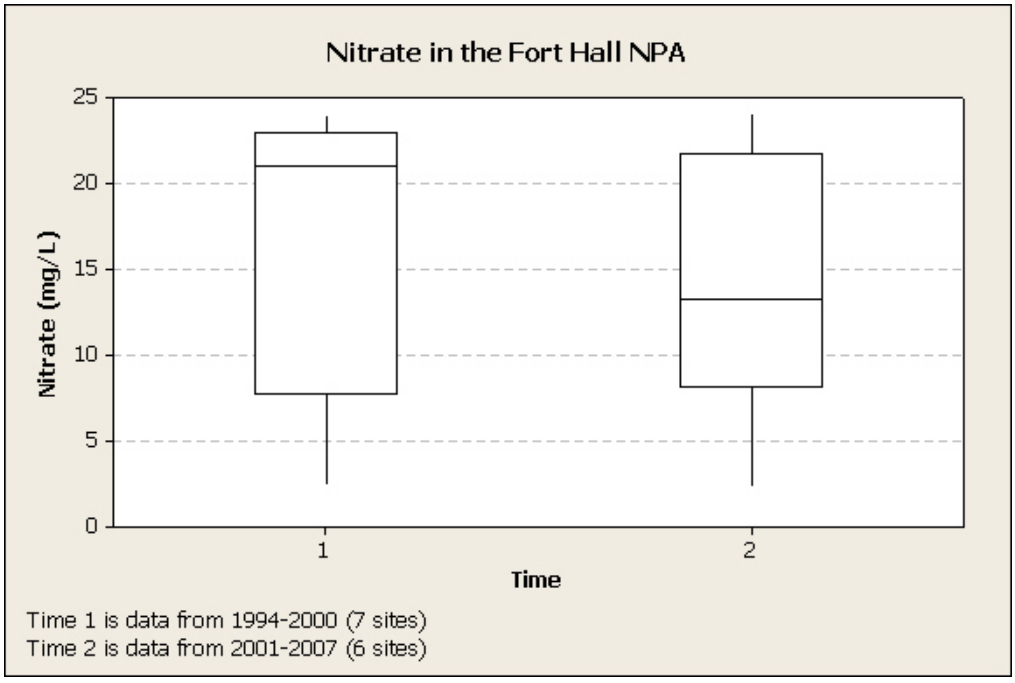


Figure 24. Nitrate boxplots for the Fort Hall NPA for Time 1 and 2.

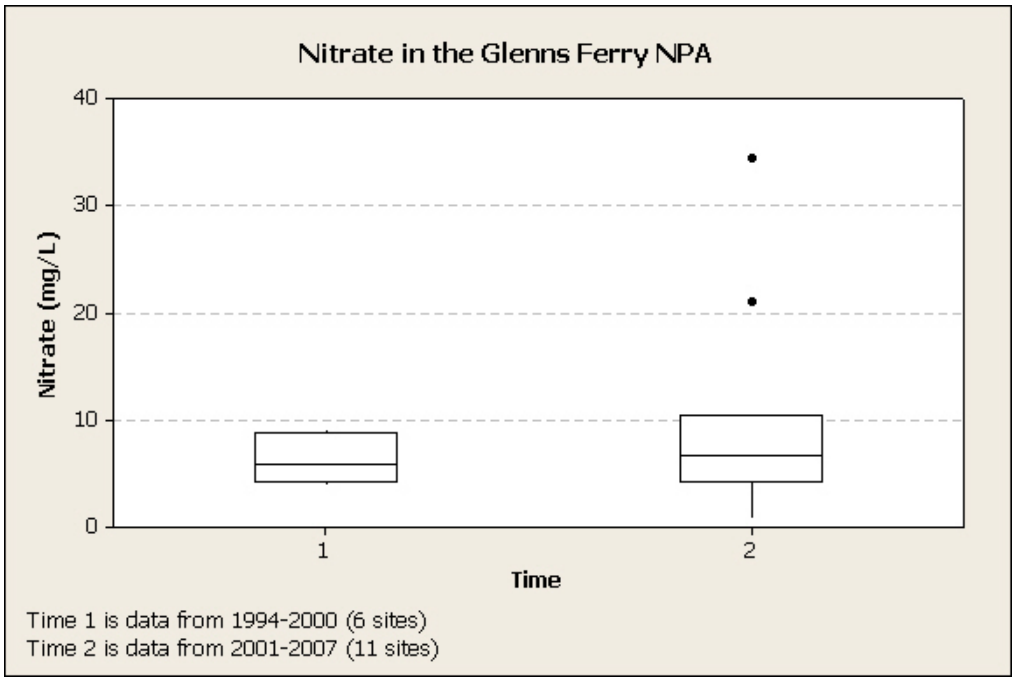


Figure 25. Nitrate boxplots for the Glenns Ferry NPA for Time 1 and 2.

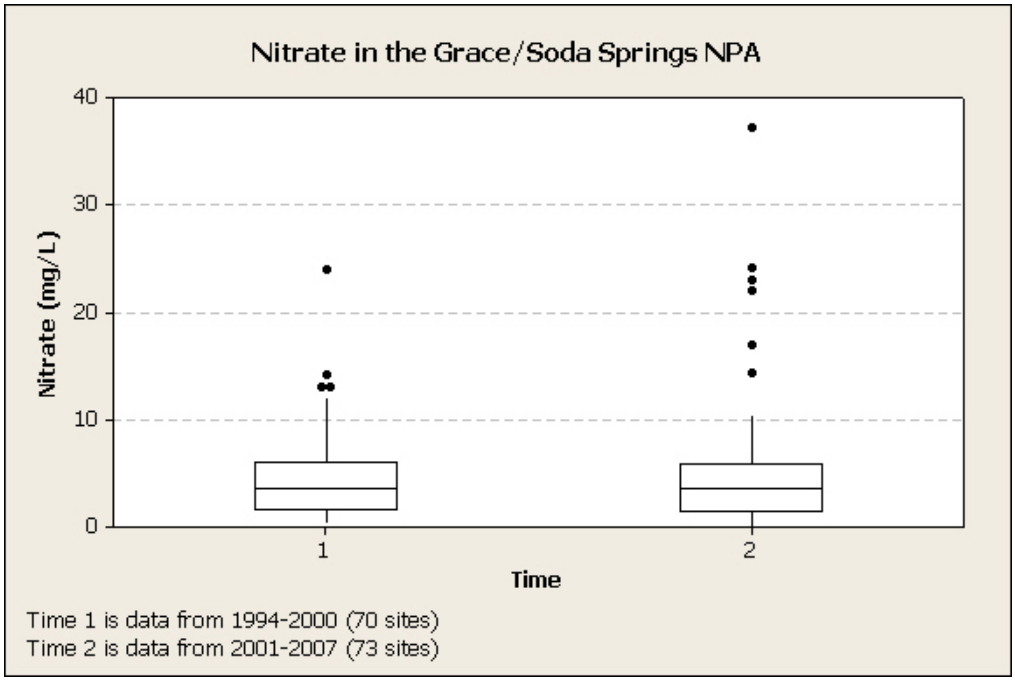


Figure 26. Nitrate boxplots for the Grace/Soda Springs NPA for Time 1 and 2.

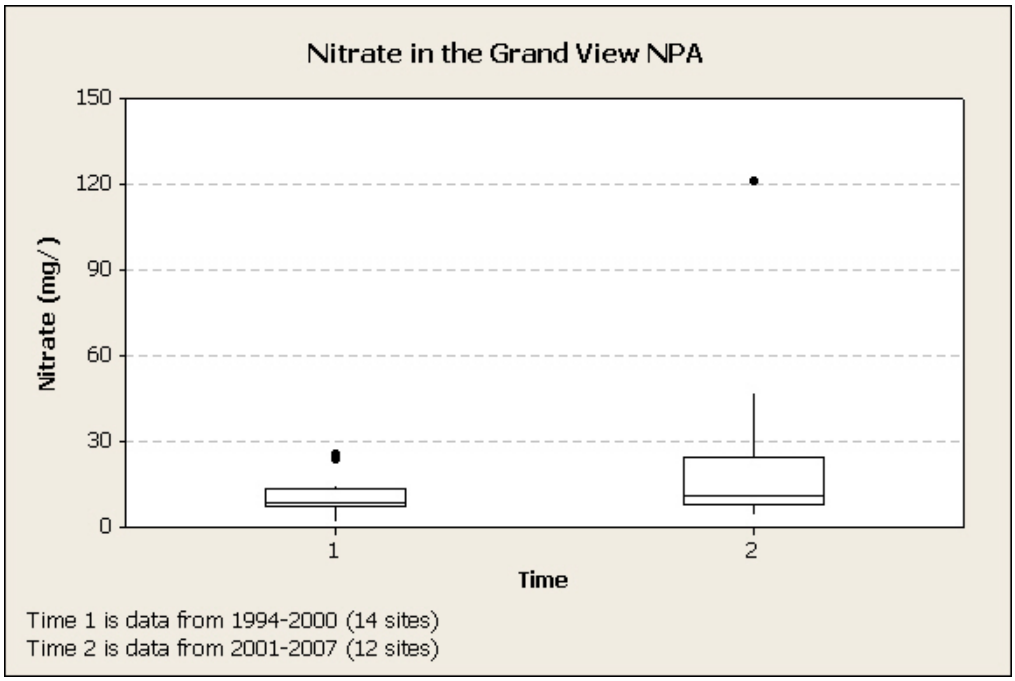


Figure 27. Nitrate boxplots for the Grand View NPA for Time 1 and 2.

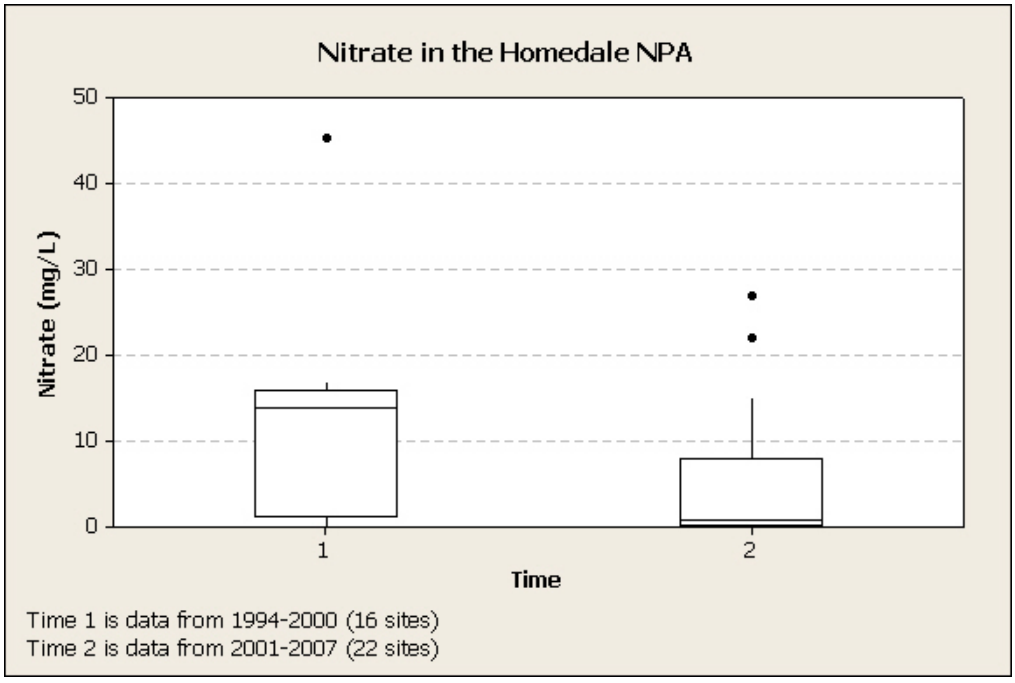


Figure 28. Nitrate boxplots for the Homedale NPA for Time 1 and 2.

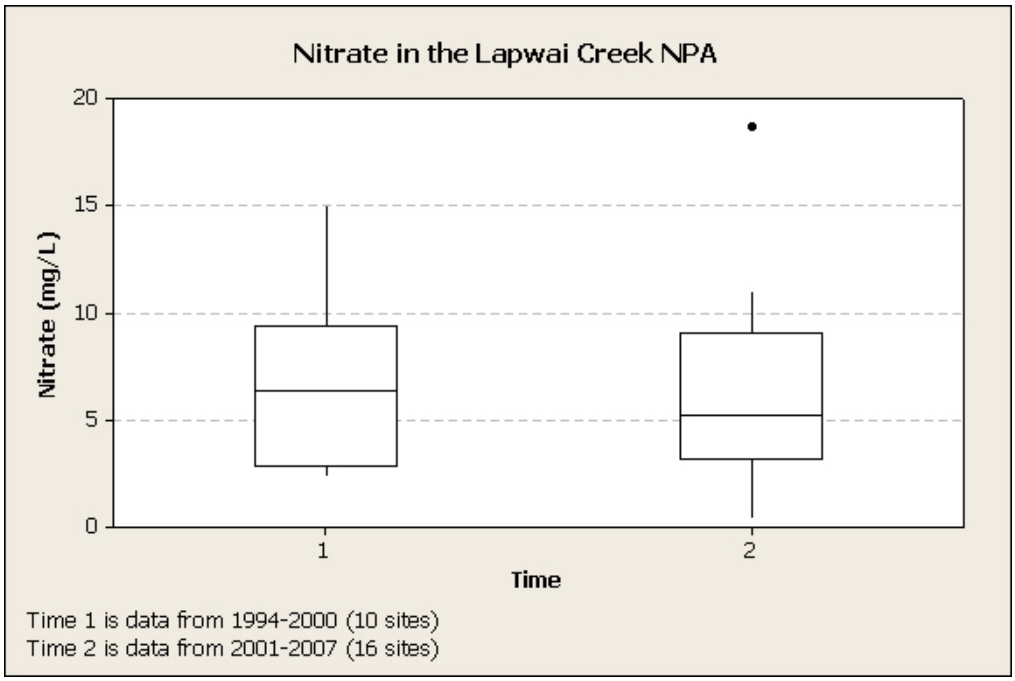


Figure 29. Nitrate boxplots for the Lapwai Creek NPA for Time 1 and 2.

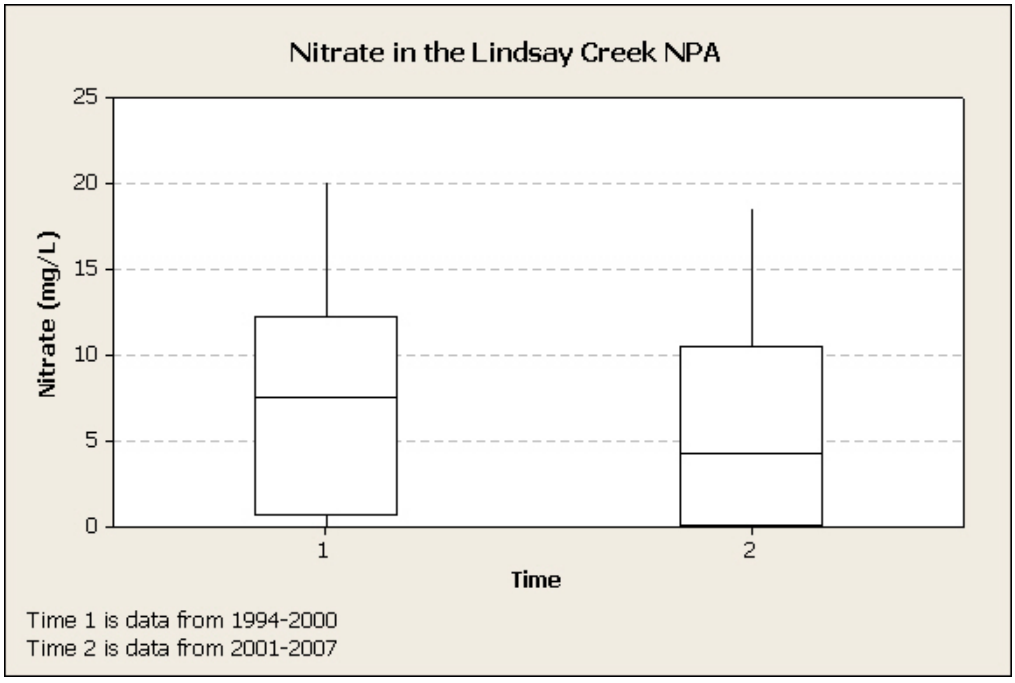


Figure 30. Nitrate boxplots for the Lindsay Creek NPA for Time 1 and 2.

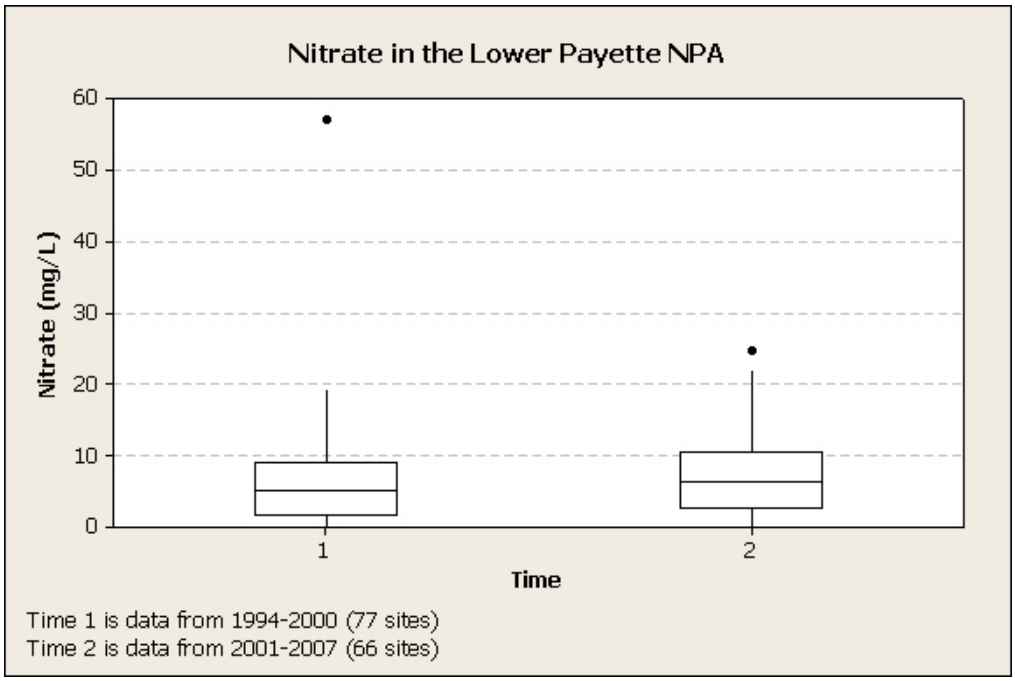


Figure 31. Nitrate boxplots for the Lower Payette NPA for Time 1 and 2.

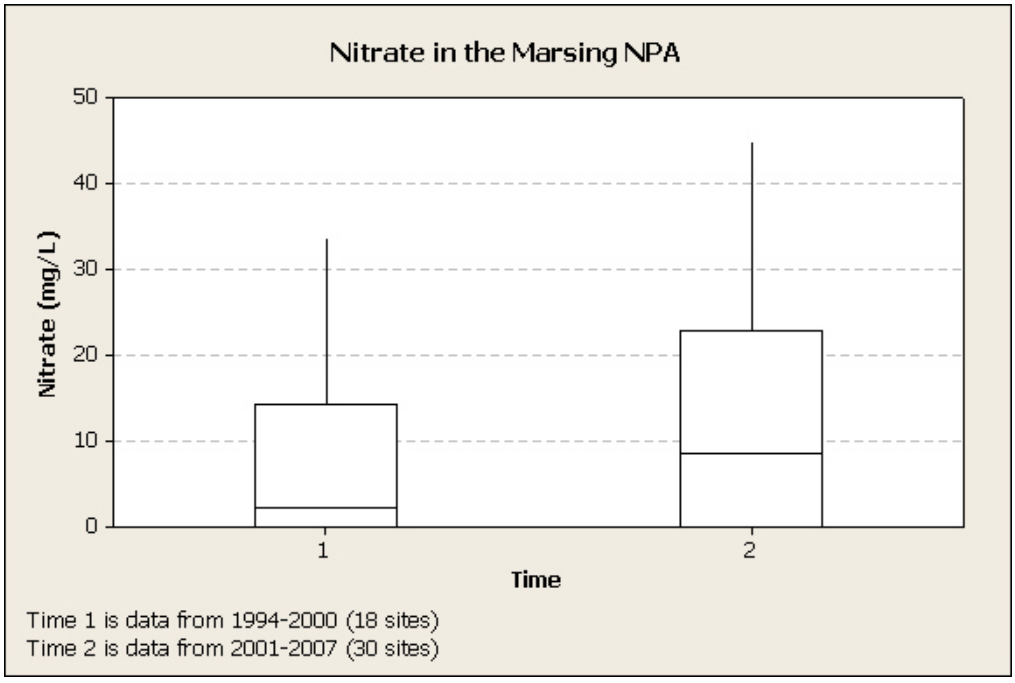


Figure 32. Nitrate boxplots for the Marsing NPA for Time 1 and 2.

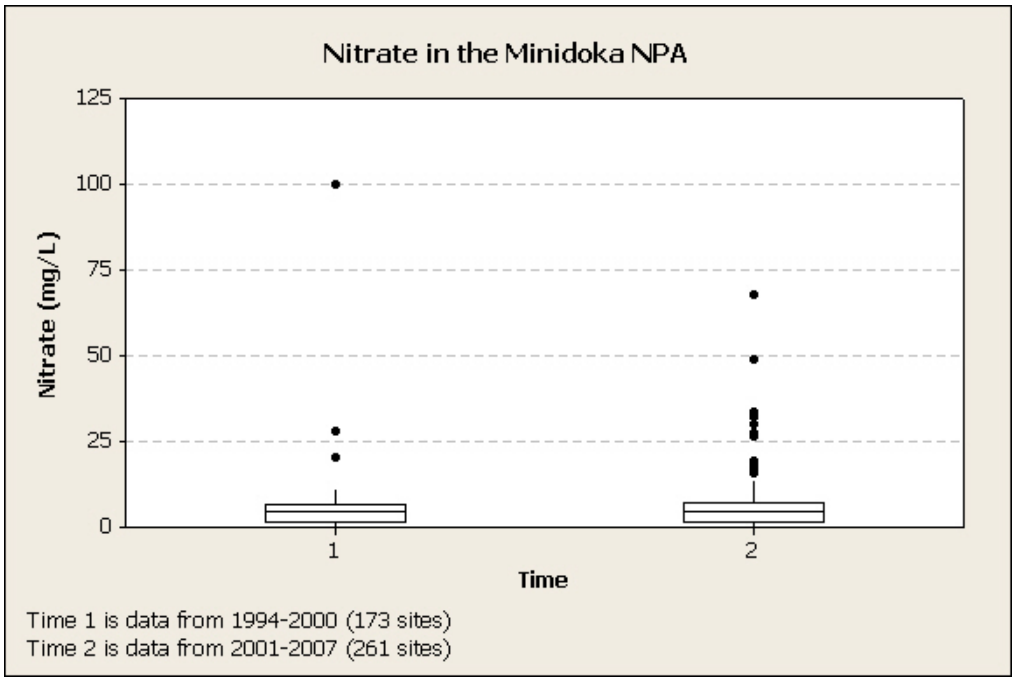


Figure 33. Nitrate boxplots for the Minidoka NPA for Time 1 and 2.

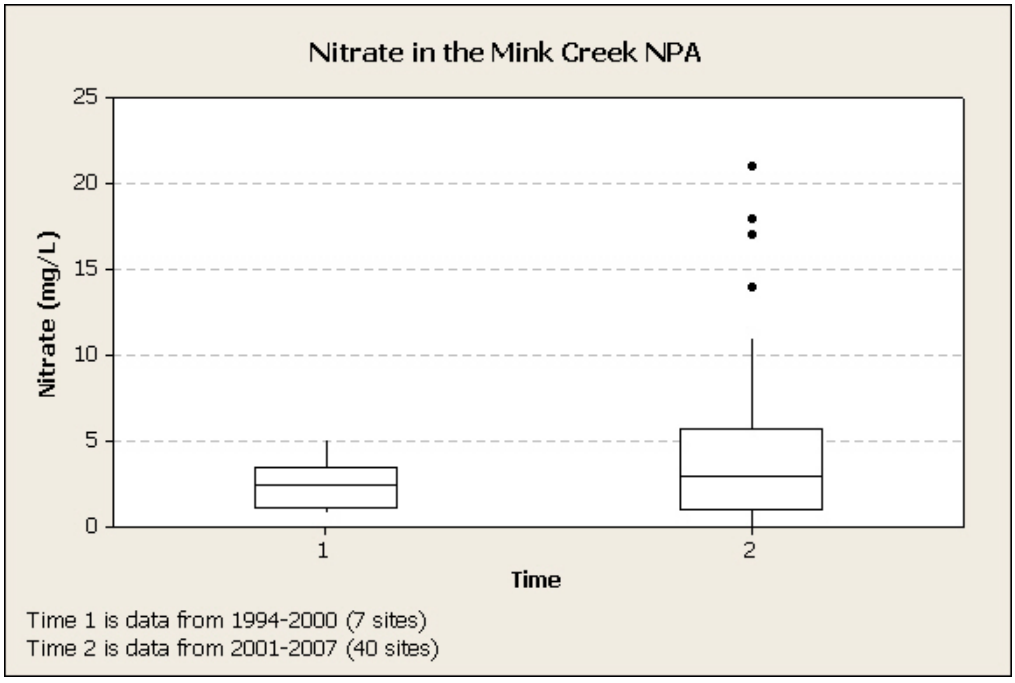


Figure 34. Nitrate boxplots for the Mink Creek NPA for Time 1 and 2.

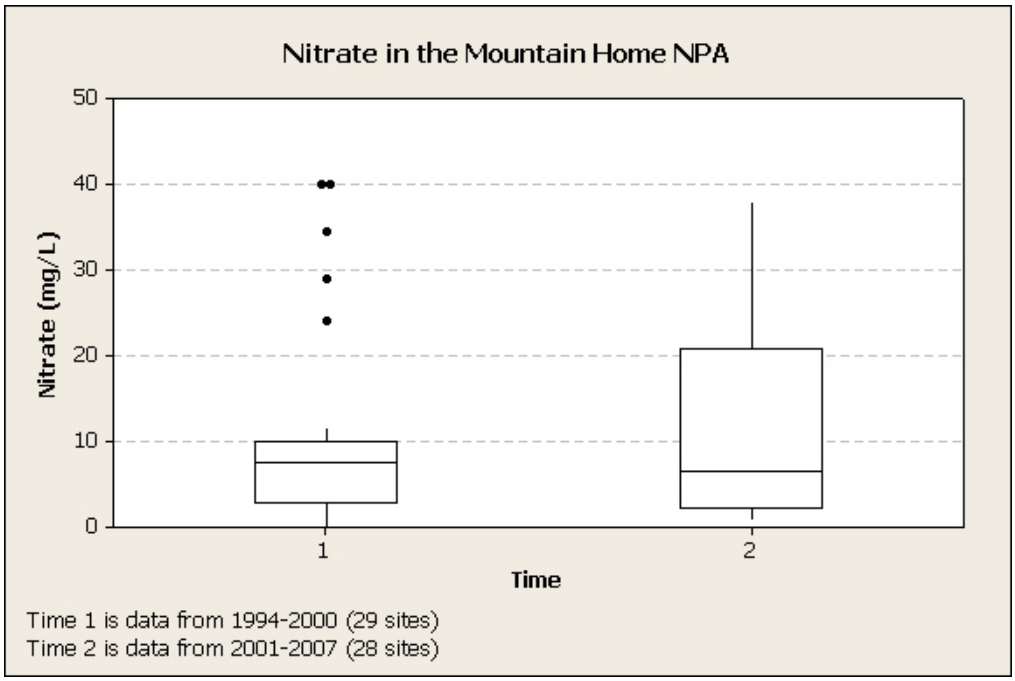


Figure 35. Nitrate boxplots for the Mountain Home NPA for Time 1 and 2.

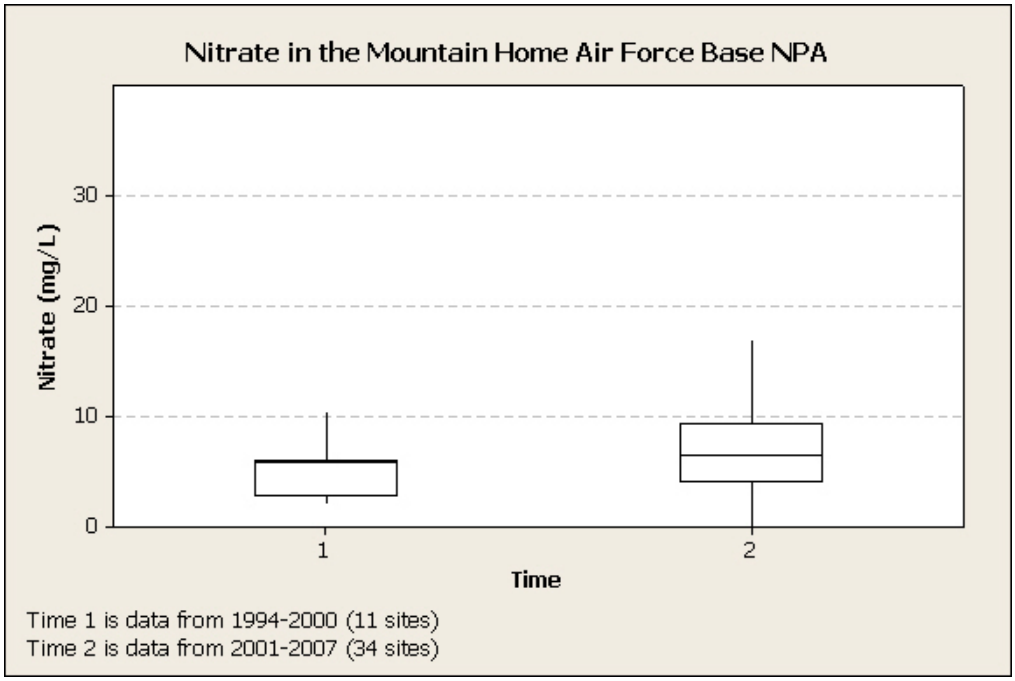


Figure 36. Nitrate boxplots for the Mountain Home AFB NPA for Time 1 and 2.

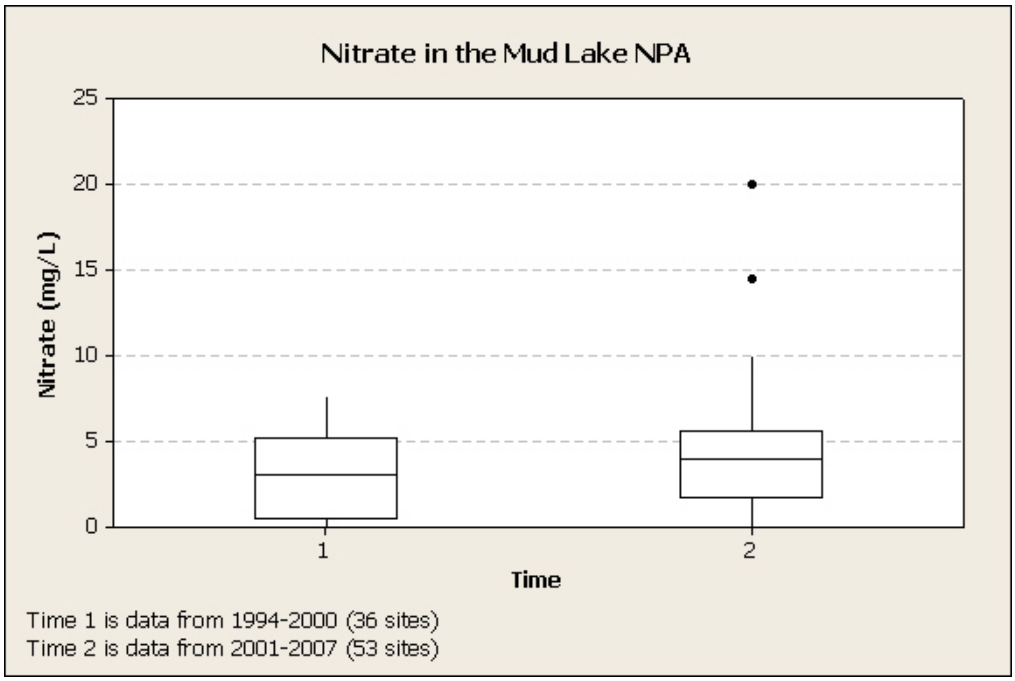


Figure 37. Nitrate boxplots for the Mud Lake NPA for Time 1 and 2.

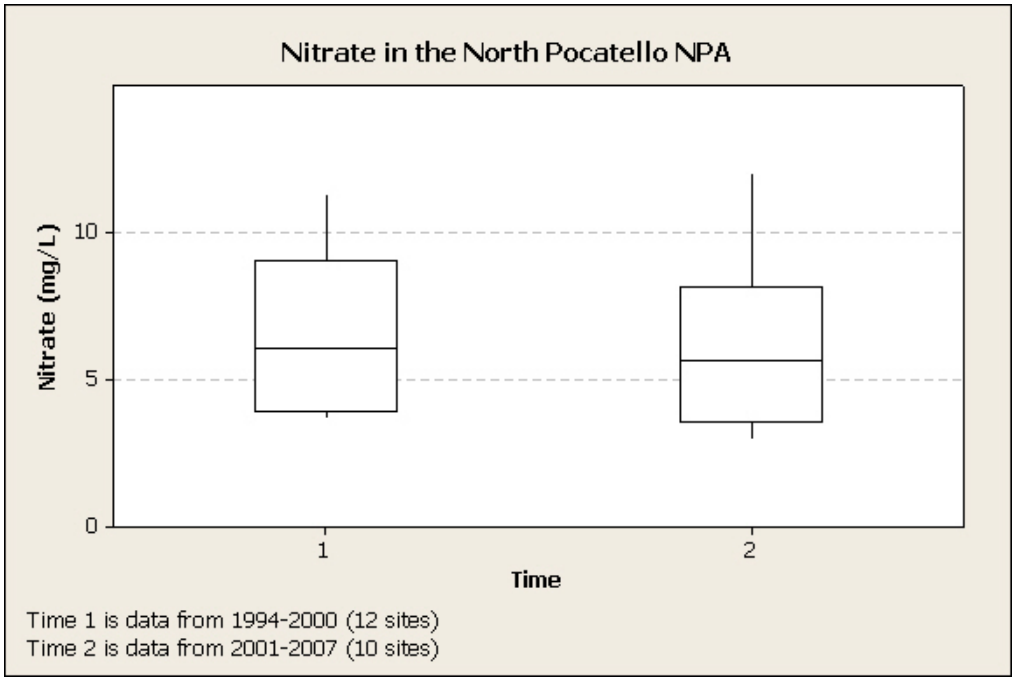


Figure 38. Nitrate boxplots for the North Pocatello NPA for Time 1 and 2.

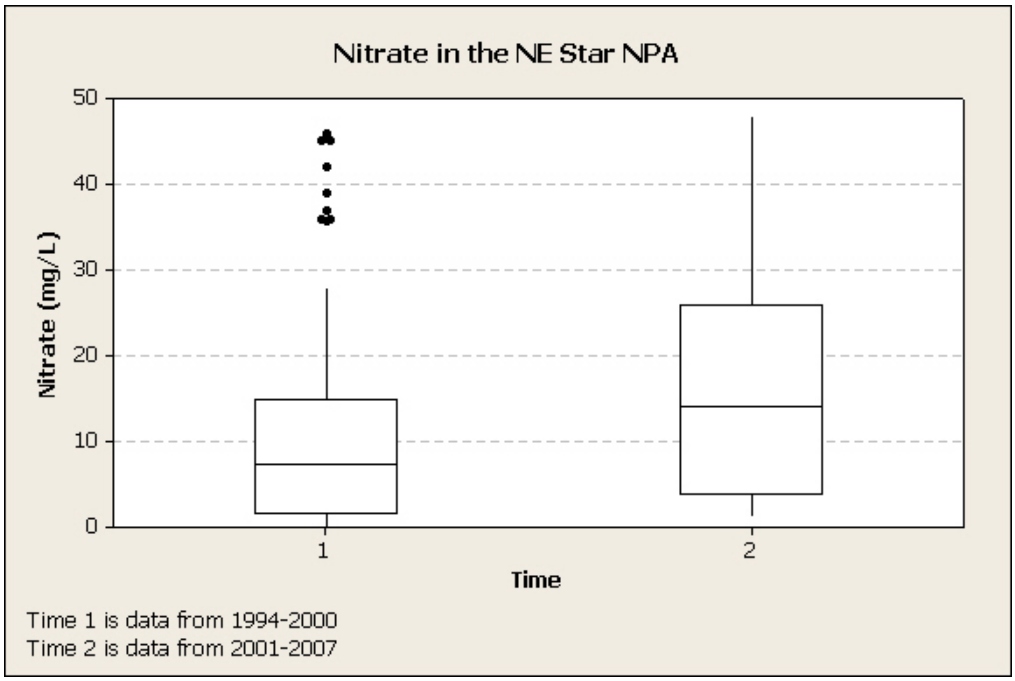


Figure 39. Nitrate boxplots for the Northeast Star NPA for Time 1 and 2.

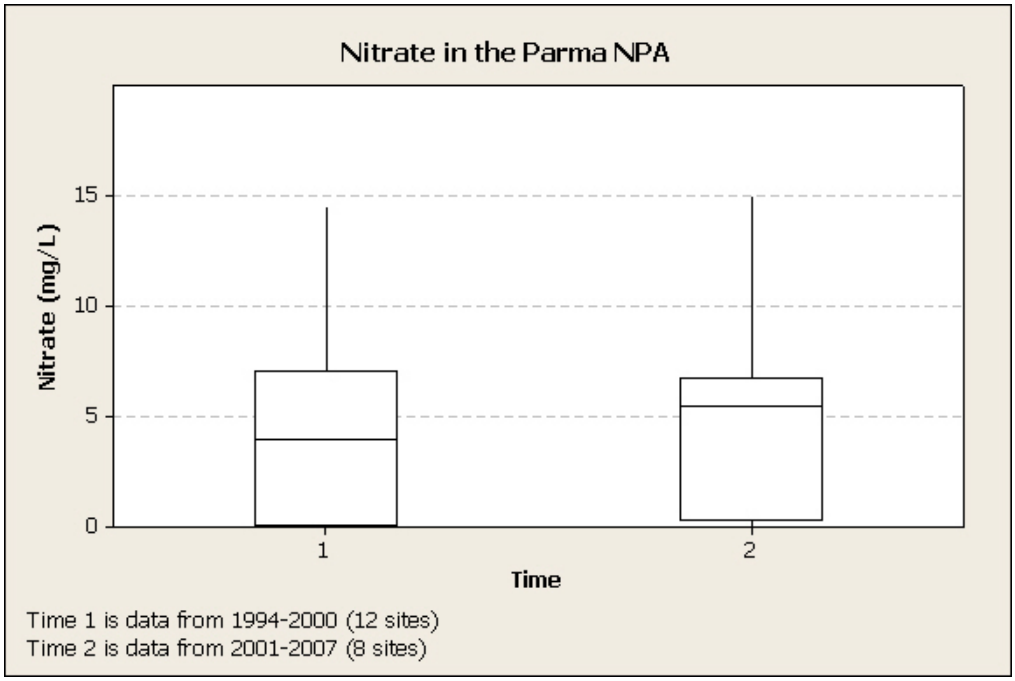


Figure 40. Nitrate boxplots for the Parma NPA for Time 1 and 2.

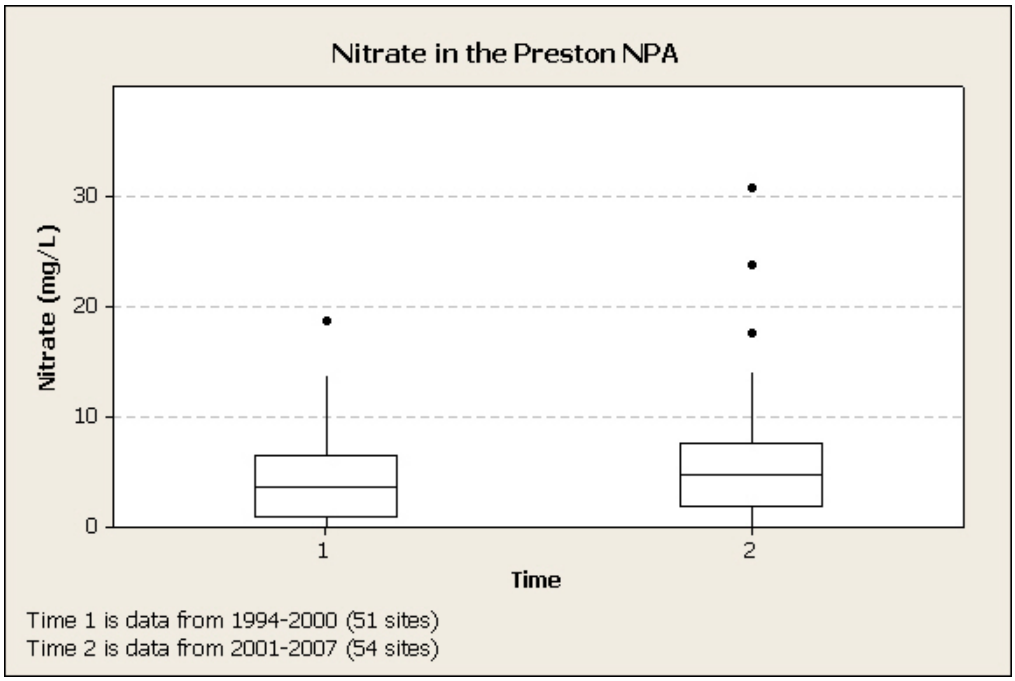


Figure 41. Nitrate boxplots for the Preston NPA for Time 1 and 2.

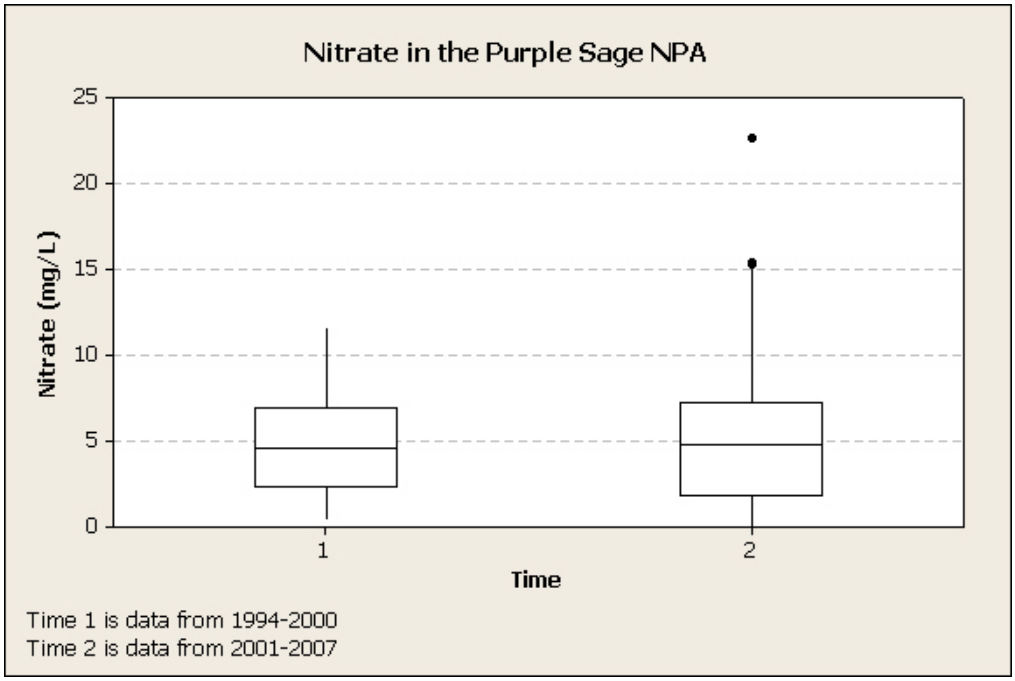


Figure 42. Nitrate boxplots for the Purple Sage NPA for Time 1 and 2.

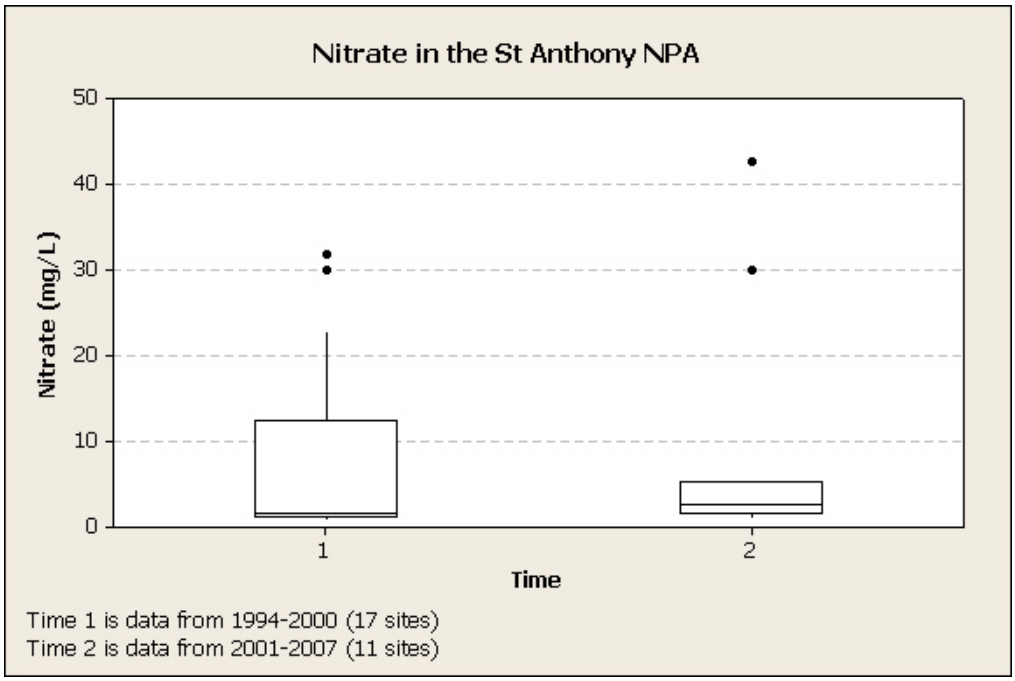


Figure 43. Nitrate boxplots for the St Anthony NPA for Time 1 and 2.

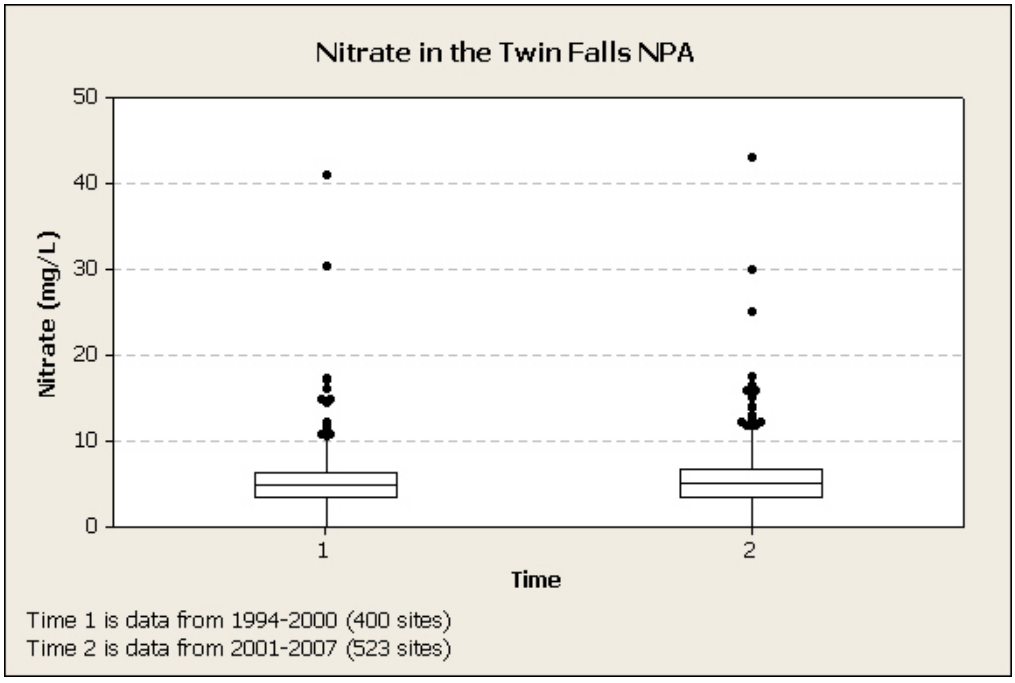


Figure 44. Nitrate boxplots for the Twin Falls NPA for Time 1 and 2.

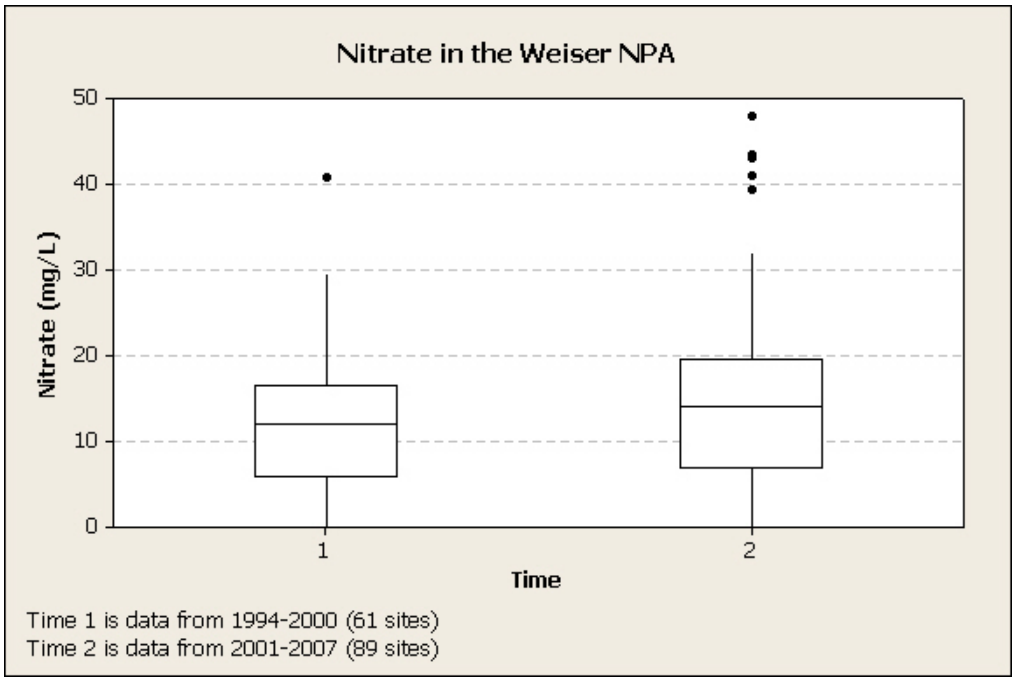


Figure 45. Nitrate boxplots for the Weiser NPA for Time 1 and 2.

References

Parliman, D.J., 2002, Analysis of nitrate (NO_3-N) concentration trends in 25 ground-water-quality management areas, Idaho, 1961-2001. U.S. Geological Survey Water-Resources Investigations Report 02-4056, 18 p.
http://id.water.usgs.gov/PDF/wri024056/trends.pdf