

**TMDL FOR NITRATE FOR
DAYS CREEK, AR**

(REACH 11140302-003)

**FINAL
December 23, 2005**

TMDL FOR NITRATE FOR DAYS CREEK, AR
(REACH 11140302-003)

Prepared for

EPA Region VI
Water Quality Protection Division
Permits, Oversight, and TMDL Team
Dallas, TX 75202

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be allocated to point sources and nonpoint sources discharging to the waterbody.

This report presents a TMDL for nitrate for Days Creek (reach 11140302-003) in southwestern Arkansas. Days Creek starts in Texas, drains most of the Texarkana metropolitan area, and flows into Arkansas before emptying into the Sulphur River. Days Creek is located within the Gulf Coastal Plain ecoregion and has a drainage area of approximately 144 mi² at its mouth. There are a total of six point source discharges in the Days Creek watershed, including two City of Texarkana wastewater treatment facilities with design flows of 2 MGD and 18 MGD, respectively. Reach 11140302-003 includes the entire portion of Days Creek in Arkansas, which is approximately 11 miles.

This stream reach was included on the 2002 Arkansas 303(d) list as not supporting its designated use of domestic, industrial, and agricultural water supply. Based on the 303(d) listing, the primary cause of impairment is nitrate nitrogen and the primary source of contamination is municipal point source. The Arkansas Department of Environmental Quality (ADEQ) has no numeric water quality standard for nitrate but uses the Safe Drinking Water Act maximum contaminant level (MCL) for nitrate of 10 mg/L as a criterion for streams with a designated use of drinking water supply. Therefore, this TMDL used a nitrate nitrogen concentration of 10 mg/L as the target concentration (endpoint).

Days Creek was not included on the 2002 Texas 303(d) list because domestic water supply is not a designated use for the portion of Days Creek in Texas.

Historical monitoring data for nitrate have been collected in Days Creek at the Texas/Arkansas state line by TCEQ (Texas Commission on Environmental Quality) and several miles downstream of the state line by ADEQ. These data were analyzed for long term trends,

seasonal patterns, and relationships between concentration and hydrologic conditions. These analyses showed that most of the exceedances occur in the late summer and early fall and that most of the exceedances occur during dry weather conditions.

The TMDL in this report was developed on an annual basis rather than for individual seasons. Based on the analyses of historical data and the 303(d) listing (which identified the primary source of nitrate causing impairment as municipal point source), critical conditions were determined to occur during low stream flows. During critical low flow conditions (i.e., 7Q10 conditions), both the stream flow upstream of the point sources and inflows downstream of the point sources were estimated to be zero. Therefore the load allocation (LA) for nonpoint sources was zero.

Wasteload allocations (WLAs) were developed for the two point source facilities that have sources of nitrate above typical ambient concentrations. Because both of these two facilities have sources of ammonia (which is gradually transformed into nitrate in the stream), the WLAs were expressed as allowable loads of both ammonia and nitrate. Assuming that all ammonia nitrogen is transformed into nitrate nitrogen within reach 11140302-003, the allowable point source loads were based on the design flow for each facility and concentrations of 2 mg/L of ammonia nitrogen (City of Texarkana permit limits) and 8 mg/L of nitrate nitrogen.

An implicit margin of safety (MOS) was incorporated by using several conservative assumptions. Because the LA was zero and the MOS was implicit, the TMDL was equal to the WLA. The TMDL is summarized in Table ES.1.

Table ES.1. Summary of nitrate TMDL for Days Creek.

	Design flow (MGD)	Allowable loads (lbs/day) of:	
		Ammonia nitrogen	Nitrate nitrogen
WLA for City of Texarkana Wagner Creek facility (TX0099287)	2.0	33	133
WLA for City of Texarkana Days Creek facility (TX0101800)	18.0	300	1,201
LA for nonpoint sources	n.a.	0	0
MOS	n.a.	implicit	implicit
TMDL	n.a.	333	1,334

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1.0 INTRODUCTION

This report presents a total maximum daily load (TMDL) for Days Creek in southwestern Arkansas near Texarkana. This stream reach was included on the 2002 Arkansas 303(d) list (ADEQ 2002a) as not supporting its designated use of drinking water supply. The sources of contamination and causes of impairment from the 303(d) listing are shown in Table 1.1. The TMDL in this report was developed in accordance with Section 303(d) of the Federal Clean Water Act and the Environmental Protection Agency's (EPA) regulations in 40 CFR 130.7.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern. The LA is the load allocated to nonpoint sources (NPS), including natural background. The MOS is a percentage of the TMDL that takes into account any lack of knowledge concerning the relationship between pollutant loadings and water quality.

Table 1.1. 303(d) listing for Days Creek.

Reach No.	Stream Name	Source	Cause	Priority
11140302-003	Days Creek	Municipal point source	Nitrate	Medium

2.0 BACKGROUND INFORMATION

2.1 General Information

The TMDL in this report is for Days Creek (reach 11140302-003), which is located in southwestern Arkansas near Texarkana (see Figure A.1 located in Appendix A). Days Creek starts in Texas, drains most of the Texarkana metropolitan area, and flows into the Sulphur River in Arkansas. Days Creek is located in the Gulf Coastal Plain ecoregion and has a drainage area of approximately 144 mi² at its mouth (USGS 1978). The portion of Days Creek that is in Arkansas is part of Arkansas Department of Environmental Quality (ADEQ) Planning Segment 1B. Reach 11140302-003 includes the entire portion of Days Creek in Arkansas, which is approximately 11 miles. The portion of Days Creek in Texas is identified by the Texas Commission on Environmental Quality (TCEQ) as segment 0304.

2.2 Land Use

Land uses for the Days Creek watershed were determined from the USGS National Land Cover Data (NLCD) (USGS 1992a). The spatial distribution of these land uses is shown on Figure A.2 (located in Appendix A) and land use percentages are shown in Table 2.1. These data indicate that the predominant land uses in the Days Creek watershed are forest, pasture/hay, and urban.

2.3 Hydrologic Data

There are no USGS flow gages on Days Creek. The nearest site for which the USGS has published a 7Q10 flow is McKinney Bayou near Garland, AR (USGS gage number 07342350; location is shown on Figure A.1 in Appendix A). This site is a USGS partial record station with a drainage area of 175 mi². The published annual 7Q10 flow for this site is 0 cfs (USGS 1992b). Because the size of the drainage area for this site is larger than for Days Creek, the annual 7Q10 flow for Days Creek (excluding contributions from point sources) is assumed to be 0 cfs. No seasonal 7Q10 values are available for this site.

Table 2.1. Land use percentages for the study area.

Land use	Percentage of study area
Water	0.8%
Wetland	4.5%
Low intensity residential	8.1%
High intensity residential	2.4%
Commercial/industrial/transportation	3.4%
Urban/recreational grasses	0.4%
Barren	1.4%
Shrubland	0.0%
Deciduous forest	22.4%
Evergreen forest	9.4%
Mixed forest	19.7%
Pasture/hay	27.0%
Row crops	0.5%
Small grains	0.0%
Fallow	0.0%
Total	100.0%

2.4 Water Quality Standards

Water quality criteria for Arkansas waterbodies are listed by ecoregion in Regulation No. 2 (ADEQ 2002b). Designated uses for the portion of Days Creek in Arkansas include primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial Gulf Coastal fishery. The designated uses for the portion of Days Creek in Texas include contact recreation, intermediate aquatic life, fish consumption use, and general use, but not domestic water supply (TCEQ 2002). Although water supply is a designated use for Days Creek in Arkansas, the Arkansas Department of Health records indicate that Days Creek in Arkansas is not used for any public water supply (ADH 2004).

There is no numeric water quality criterion for nitrate in Arkansas, but ADEQ uses the Safe Drinking Water Act maximum contaminant level (MCL) for nitrate of 10 mg/L as a criterion for streams with a designated use of drinking water supply (ADEQ 2000; p. D-10).

As specified in EPA's regulations at 40 CFR 130.7(b)(2), applicable water quality criterion include antidegradation requirements. Arkansas' antidegradation policy is listed in

Sections 2.201-2.204 of Regulation No. 2. The TMDL in this report is consistent with the Arkansas antidegradation policy.

2.5 Nonpoint Sources

In the 303(d) listing for Days Creek, nonpoint sources were not identified as a significant source of nitrate causing impairment. During storms, though, runoff from urban areas and from pastures probably contributes some nitrate loading above background levels.

2.6 Point Sources

Information for point source discharges in the Days Creek watershed was obtained by searching the Permit Compliance System (PCS) on the EPA web site (PCS 2004) and by directly contacting TCEQ and ADEQ personnel. This yielded a total of six facilities, four in Texas and two in Arkansas, with point source discharges in the Days Creek watershed. These point source discharges are listed in Table 2.2 and their locations are shown on Figure A.3 (in Appendix A). None of the facilities has a permit limit for nitrate, although two of the facilities have permit limits for ammonia nitrogen (which is gradually transformed into nitrate in streams). Of the six point sources listed in Table 2.2, only two facilities have sources of nitrate above typical ambient concentrations.

2.7 Previous Water Quality Studies

Listed below are relevant water quality studies that were identified for the Days Creek watershed. These previous studies were focused primarily on issues other than nitrate levels in Days Creek.

1. Synoptic water quality survey conducted by Texas Water Commission (a predecessor of TCEQ) on Days Creek on December 2, 1980, which included data for numerous water quality parameters including nitrate at a total of 9 stations. These data are in the STORET database (STORET 2004).
2. "Waste Load Evaluation for Days Creek in the Sulphur River Basin, Segment 0304" (TCEQ 1987). This study included water quality modeling to evaluate the

impact of point sources on dissolved oxygen in Days Creek. TCEQ has kept this modeling up to date to include current point source effluent characteristics.

3. “A Survey of the Sediment Chemistry, Instream Toxicity, and Aquatic Life Use within the Days Creek Watershed during 1994” (TCEQ 1995).

Table 2.2. Inventory of point source dischargers.

NPDES Permit Number	Facility Name	Type of Discharge	Permit Flow Rate (MGD)	Receiving Stream	Monthly Average Ammonia N Limit (mg/L)	Source of Nitrate? *
AR0038822	COOPER TIRE & RUBBER CO-TEXARKANA	STORMWATER	0.201	DITCH TO NIX CREEK TO DAYS CREEK	-	No
AR0046671	DOW CHEMICAL COMPANY	STORMWATER	0.067	TRIBUTARY TO OAK CREEK TO NIX CREEK TO DAYS CREEK	-	No
TX0099287	TEXARKANA CITY OF	TREATED MUNICIPAL WASTEWATER	2.000	WAGNER CREEK	2 (Mar-Nov); no limit for Dec-Feb	Yes
TX0102822	PAPER CHEMICALS INC.	NON-CONTACT COOLING WATER	0.040	INTO DRAINAGE DITCH TO WAGNER CREEK TO DAYS CREEK	-	No
TX0097055	ALUMAX MILL PRODUCTS	TREATED PROCESS WASTEWATER, UTILITY WASTEWATER, INGOT COOLING WATER	0.127	TRIBUTARY TO WAGNER CREEK	-	No
TX0101800	TEXARKANA CITY OF	TREATED MUNICIPAL WASTEWATER	18.000	DAYS CREEK ABOUT 4.5 KM UPSTREAM OF STATE LINE	2 (year round)	Yes

* above typical ambient concentrations

3.0 EXISTING WATER QUALITY FOR NITRATE

3.1 General Description of Data

Two water quality stations were identified with long term monitoring data for Days Creek. Data have been collected by ADEQ at the RED0004A station (several miles downstream of the state line) and by TCEQ at station 10226 (at the state line). Locations of these sampling sites are shown on Figure A.3 (in Appendix A). A summary of the nitrate data collected at these stations is provided in Table 3.1 and long term plots of the data are presented in Figures B.1 and B.2 (located in Appendix B).

Table 3.1. Summary of nitrate data for Days Creek.

Station ID	Station description	Period of record for analysis	No. of values	Min.	Median	Max.	No. of values above 10 mg/L	% of values above 10 mg/L
RED0004A	Days Creek southeast of Texarkana	9/04/90 – 3/30/04	157	0.5	4.6	14.5	25	16%
10226	Days Creek at State Line Road south of Texarkana	1/30/90 – 3/02/04	46	< 0.1	6.0	17.8	17	37%

3.2 Seasonal Patterns

Even though the water quality criterion for nitrate does not vary seasonally, the data were plotted seasonally to determine if existing water quality varies seasonally and to provide additional insight concerning causes of water quality problems. As shown in Figures B.3 and B.4 (in Appendix B), most of the exceedances of the 10 mg/L drinking water criterion occur in the late summer and early fall. For station RED0004A, 20 out of 25 exceedances occurred during August through November. For station 10226, 14 out of 17 exceedances occurred during July through October. Because low flow conditions for streams in this area typically occur during late summer and early fall (and point source impacts are most noticeable when stream flow is low), the seasonal pattern of nitrate concentrations in Days Creek is consistent with the 303(d) listing, which identifies the primary source of elevated nitrate concentrations as municipal point source.

3.3 Relationships Between Precipitation and Nitrate

Relationships between hydrologic conditions and nitrate concentrations in Days Creek were investigated by plotting measured nitrate values versus precipitation on the sampling day (Figures B.5 and B.6). The nitrate values were plotted against precipitation (NCDC 2004) because no data were available for stream flow in Days Creek. Although these figures do not show a consistent relationship between precipitation and nitrate concentration, 39 of the 42 recorded exceedances of the 10 mg/L drinking water criterion occurred on days with less than 0.25 inches of precipitation. In general, the results of this analysis between precipitation and nitrate are considered to be consistent with the 303(d) listing for Days Creek, which identifies the primary source of elevated nitrate concentrations as municipal point source.

4.0 TMDL DEVELOPMENT

4.1 Seasonality and Critical Conditions

EPA's regulations at 40 CFR 130.7 requires the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Also, both Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 require TMDLs to consider seasonal variations for meeting water quality criteria. Therefore, the historical data and analyses discussed in Section 3.0 were used to evaluate whether there were certain flow conditions or certain periods of the year that could be used to characterize critical conditions.

The 303(d) listing for Days Creek identifies the primary source of elevated nitrate concentrations as municipal point source, and the analyses of ambient water quality in Days Creek are consistent with the 303(d) listing. When the primary source of water quality exceedances is continuous point source discharges, critical conditions are characterized by minimum upstream flow for dilution. In the Arkansas water quality standards (ADEQ 2002b), critical low flow is defined as the 7Q10 flow for all situations except protecting a seasonal fishery, for human health criteria (i.e., carcinogenic or bioaccumulative pollutants), and for dissolved minerals (e.g., chloride, sulfate, and TDS). Therefore, the critical low flow for this TMDL is the 7Q10 flow.

This TMDL was developed on an annual basis rather than for individual seasons because: 1) the drinking water criterion for nitrate does not vary seasonally, 2) the largest point source discharge does not have seasonal permit limits, and 3) no seasonal 7Q10 information was available for Days Creek.

4.2 Water Quality Target

As mentioned in Section 2.4, there is no numeric water quality criterion for nitrate in Arkansas, but ADEQ uses the Safe Drinking Water Act MCL for nitrate of 10 mg/L as a criterion for streams with a designated use of drinking water supply (ADEQ 2000; p. D-10). Therefore this TMDL uses a nitrate concentration of 10 mg/L as the target concentration (endpoint).

4.3 Wasteload Allocation

WLAs were developed for the two point sources in Table 2.2 that have sources of nitrate above typical ambient concentrations. Because both of these two facilities have sources of ammonia (which is gradually transformed into nitrate in the stream), the WLAs were expressed as both ammonia and nitrate. To be conservative, it was assumed that all of the effluent ammonia would be transformed into nitrate within reach 11140302-003. During critical low flow conditions in late summer or early fall, nitrification rates will likely be high (due to warm temperatures) and travel times may be long (which allows more time for nitrification to occur). Because these two facilities have permit limits of 2 mg/L of ammonia nitrogen, the allowable effluent concentration for nitrate nitrogen was set to 8 mg/L. These concentrations of 2 mg/L ammonia nitrogen and 8 mg/L of nitrate nitrogen were multiplied by the design flow of each facility to obtain the WLAs. The four point sources in Table 2.2 that do not have sources of nitrate were not included in the WLAs because their contributions of nitrate to Days Creek are expected to be negligible.

4.4 Load Allocation

During critical low flow conditions (i.e., 7Q10 conditions), the flow upstream of the point source discharges is estimated to be zero (see Section 2.3). It is also assumed that nonpoint source inflow to Days Creek downstream of the point sources is negligible under 7Q10 conditions. Therefore, the nonpoint source loading of nitrate to Days Creek during critical low flow conditions is negligible, so the LA for nonpoint sources was set to zero.

4.5 Margin of Safety

Both Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 require TMDLs to include a MOS to account for lack of knowledge concerning the relationship between pollutant loadings and water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly through conservative assumptions used in establishing the TMDL. For this TMDL, an implicit MOS was incorporated through the use of the following conservative assumptions:

- Both point sources with WLAs were assumed to be simultaneously discharging at design flow during dry weather.
- All ammonia nitrogen discharged by the point sources was assumed to be transformed into nitrate nitrogen within reach 11140302-003.
- Uptake of nitrate nitrogen by algae and macrophytes was neglected.

4.6 TMDL

Because the LA was zero and the MOS was implicit, the TMDL was equal to the WLA. The TMDL is summarized in Table 4.1.

Table 4.1. Summary of nitrate TMDL for Days Creek.

	Design flow (MGD)	Allowable loads (lbs/day) of:	
		Ammonia nitrogen	Nitrate nitrogen
WLA for City of Texarkana Wagner Creek facility (TX0099287)	2.0	33	133
WLA for City of Texarkana Days Creek facility (TX0101800)	18.0	300	1,201
LA for nonpoint sources	n.a.	0	0
MOS	n.a.	implicit	implicit
TMDL	n.a.	333	1,334

4.7 Future Growth

Because the assimilative capacity of the stream for nitrate is calculated as concentration (i.e., the criterion of 10 mg/L) multiplied by the flow rate in the stream, the assimilative capacity will increase as the amount of flow in the stream increases. Under critical low flow conditions, the flow in the stream consists entirely of effluent from point sources, so that point sources are required to meet the instream criterion at their discharge location (i.e., at the “end of the pipe”). Therefore, future growth for the point sources discharging to Days Creek is not limited by this TMDL as long as the effluent concentrations of nitrate nitrogen and ammonia nitrogen combined do not exceed the criterion of 10 mg/L.

5.0 MONITORING AND IMPLEMENTATION

In accordance with Section 106 of the Federal Clean Water Act and under its own authority, ADEQ has established a comprehensive program for monitoring the quality of the State's surface waters. ADEQ collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for long term trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) and the 303(d) list of impaired waters.

Point source reductions for this TMDL will be implemented through the NPDES program, which is administered by TCEQ in Texas and by ADEQ in Arkansas.

6.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, federal regulations require EPA to publicly notice and seek comment concerning the TMDL. Pursuant to a May 2000 consent decree, this TMDL was prepared under contract to EPA. After development of this final TMDL, EPA prepared a notice seeking comments, information, and data from the general public and affected public. No comments were received during the public comment period. EPA transmitted this TMDL to ADEQ for incorporation into ADEQ's current water quality management plan.

7.0 REFERENCES

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APPENDIX A

Maps

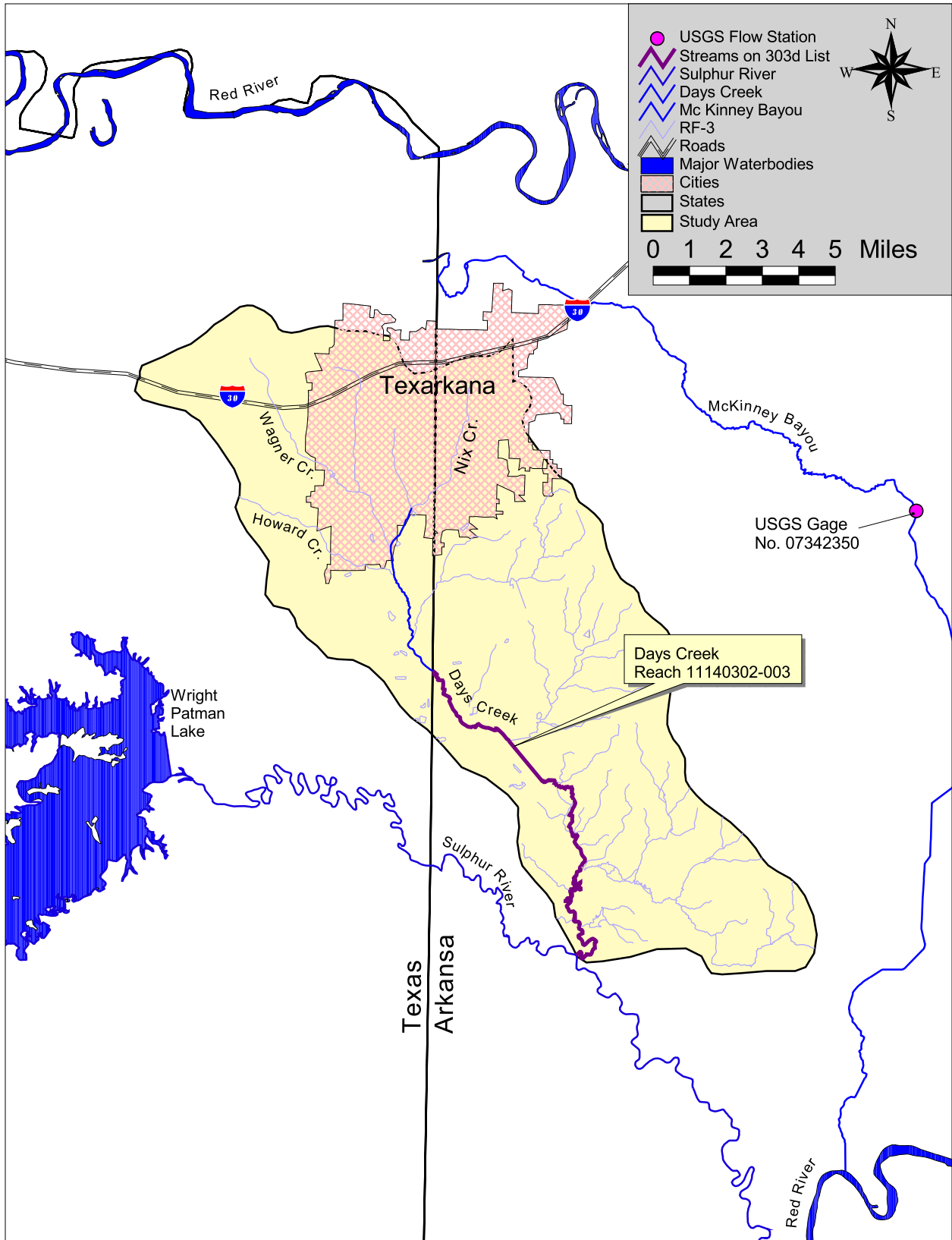


Figure A.1. Map of study area.

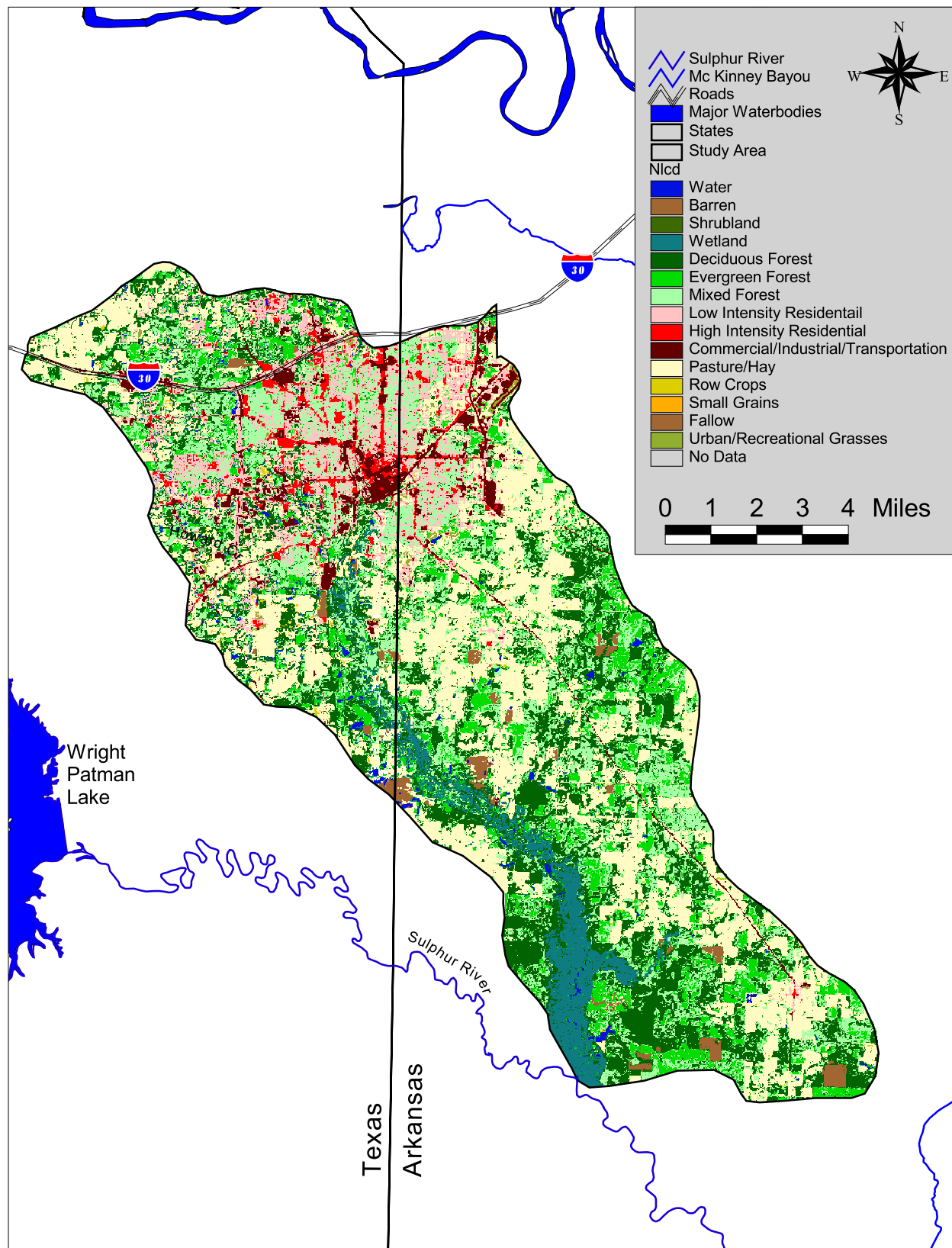


Figure A.2. Land use map.

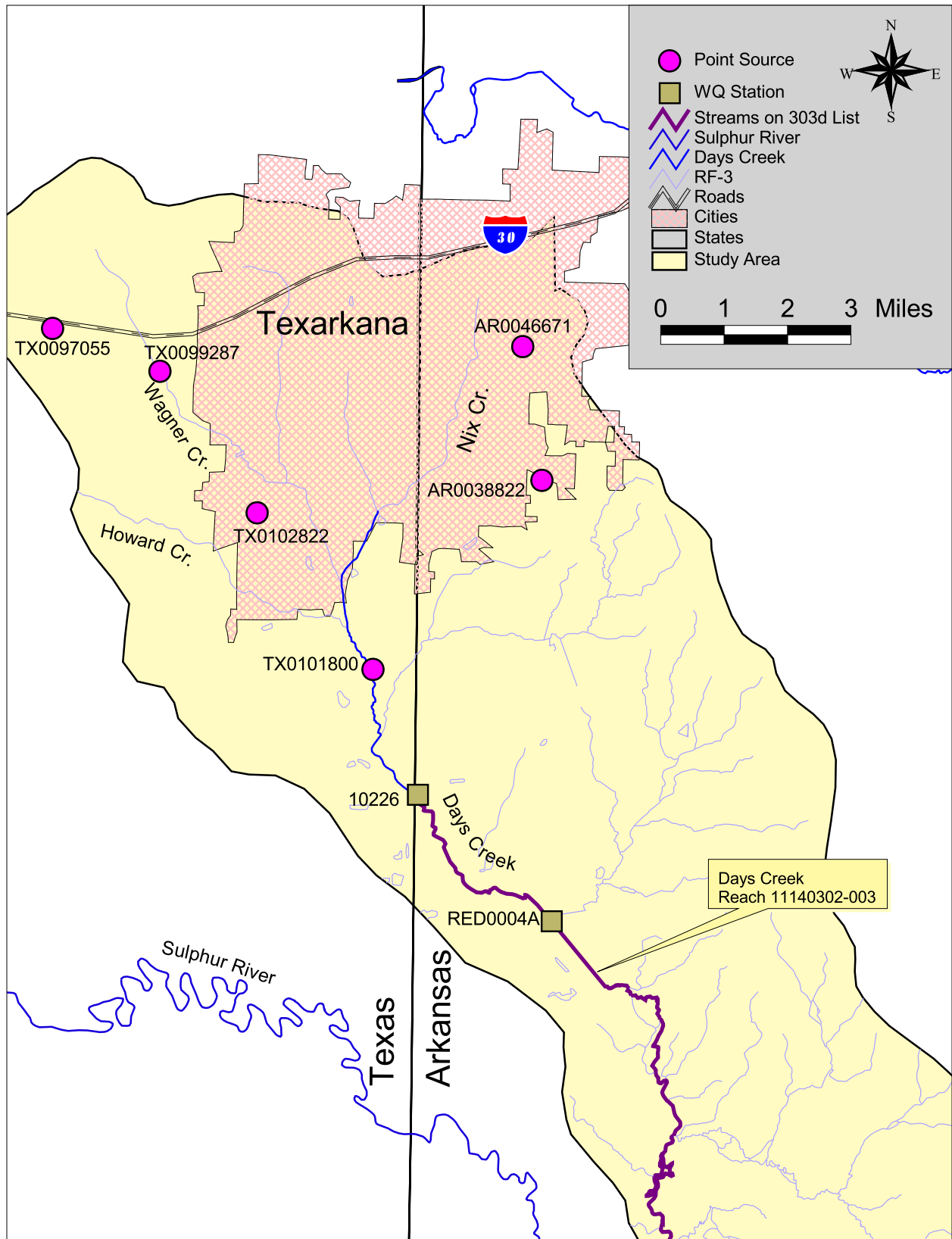


Figure A.3. Map of point source locations and water quality stations.

APPENDIX B

Water Quality Data

Figure B.1. Long Term Plot of Nitrate for Days Creek at RED0004A

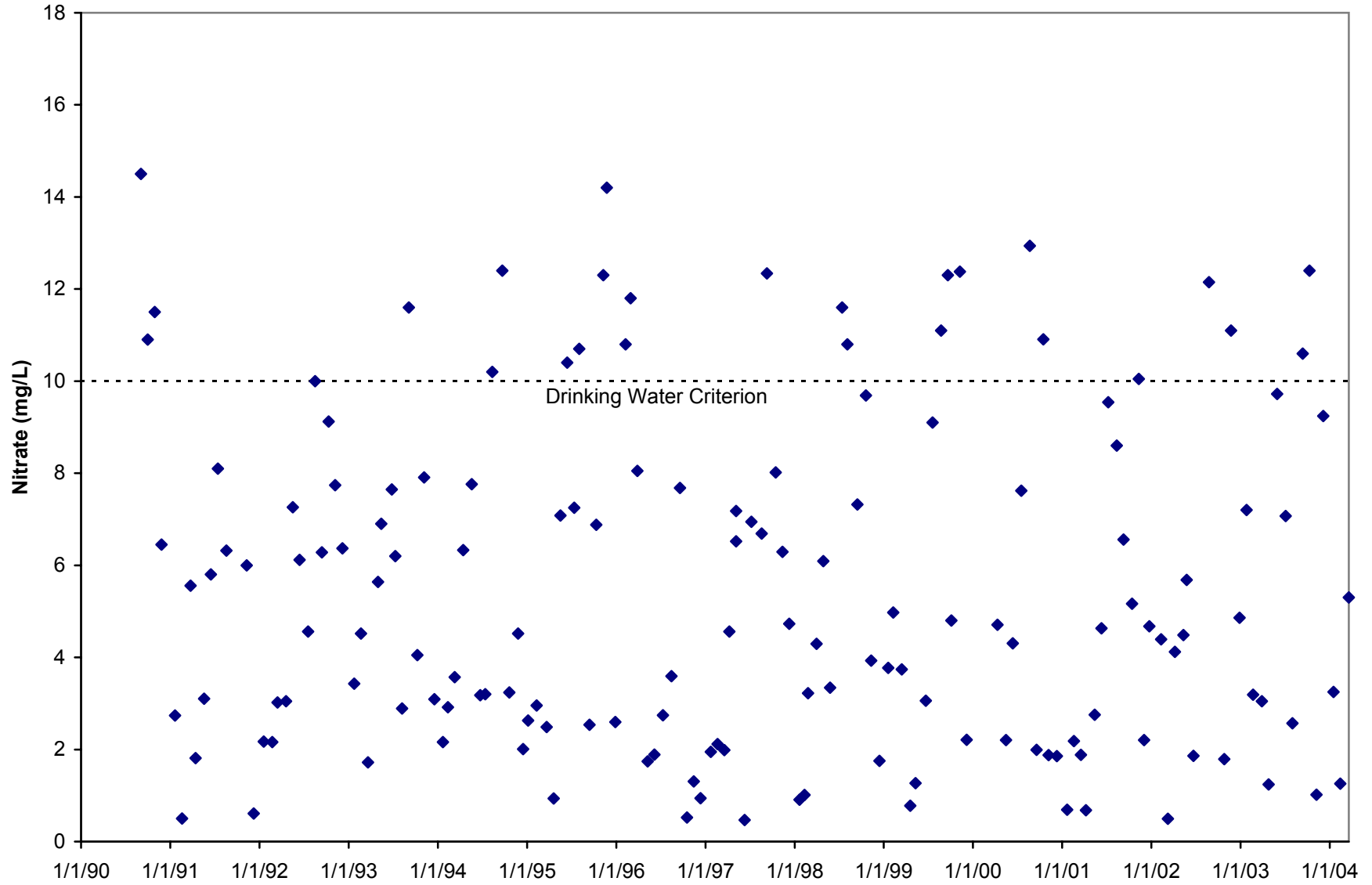


Figure B.2. Long Term Plot of Nitrate for Days Creek at Station 10226

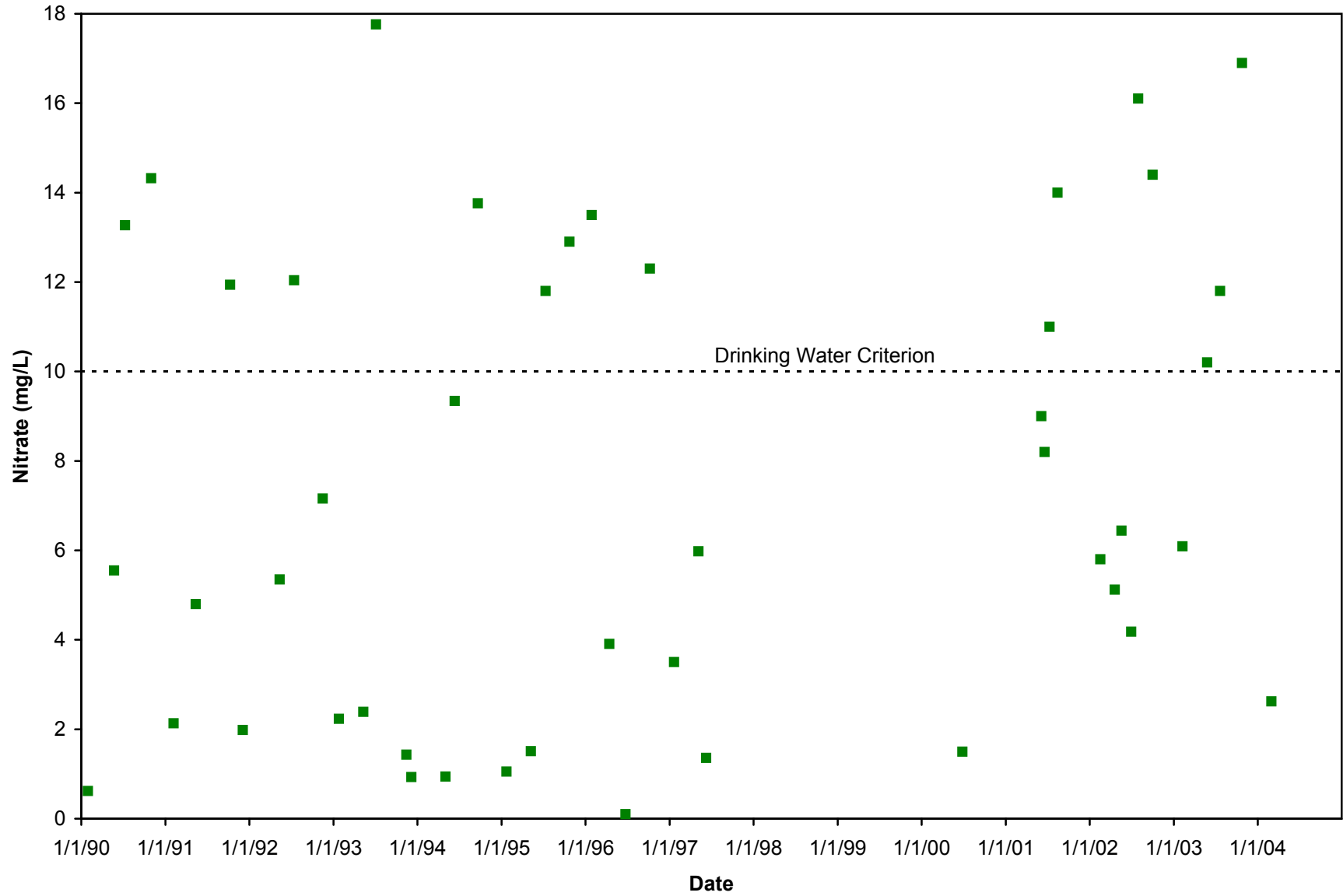


Figure B.3. Seasonal Plot of Nitrate for Days Creek at RED0004A

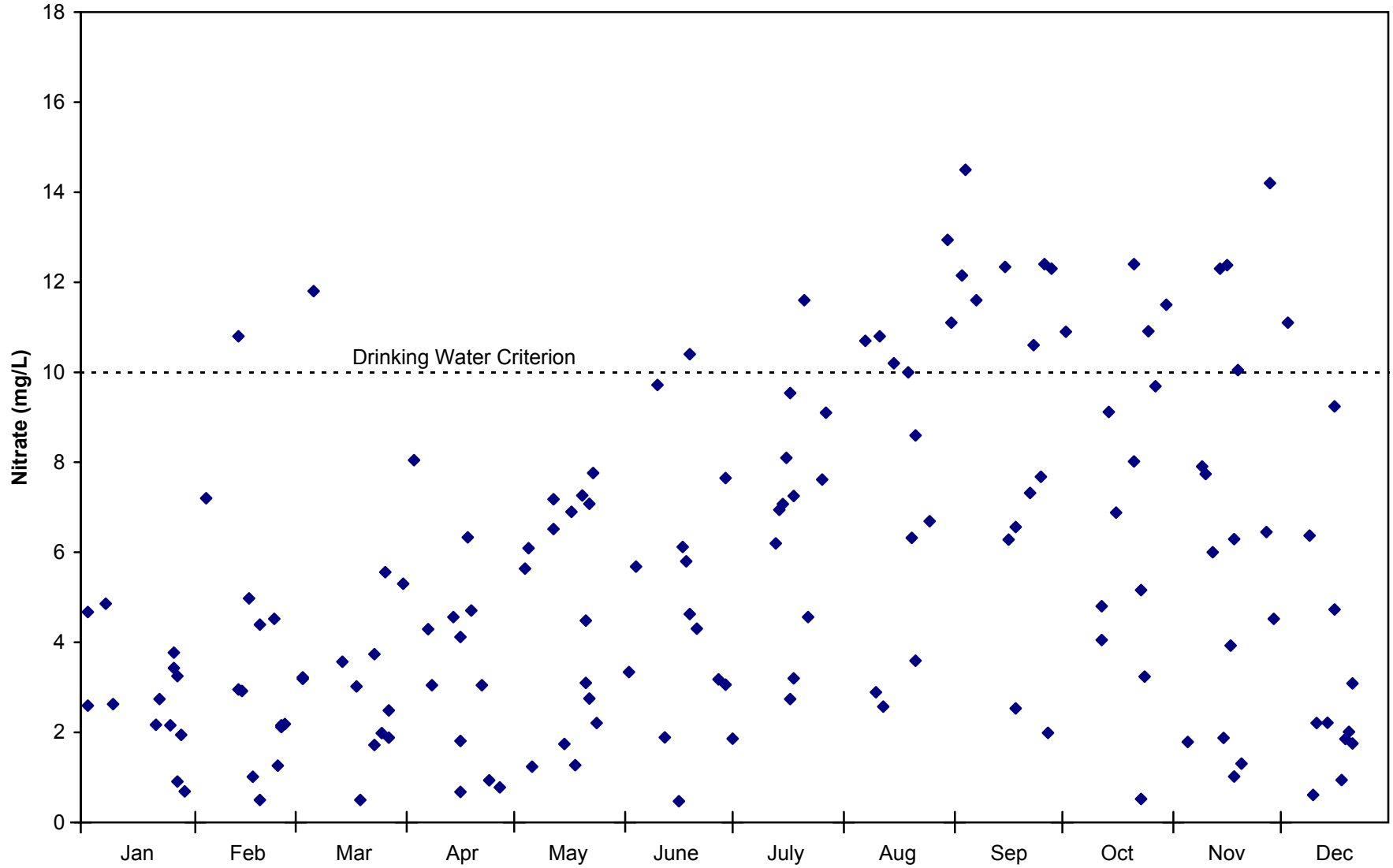


Figure B.4. Seasonal Plot of Nitrate for Days Creek at Station 10226

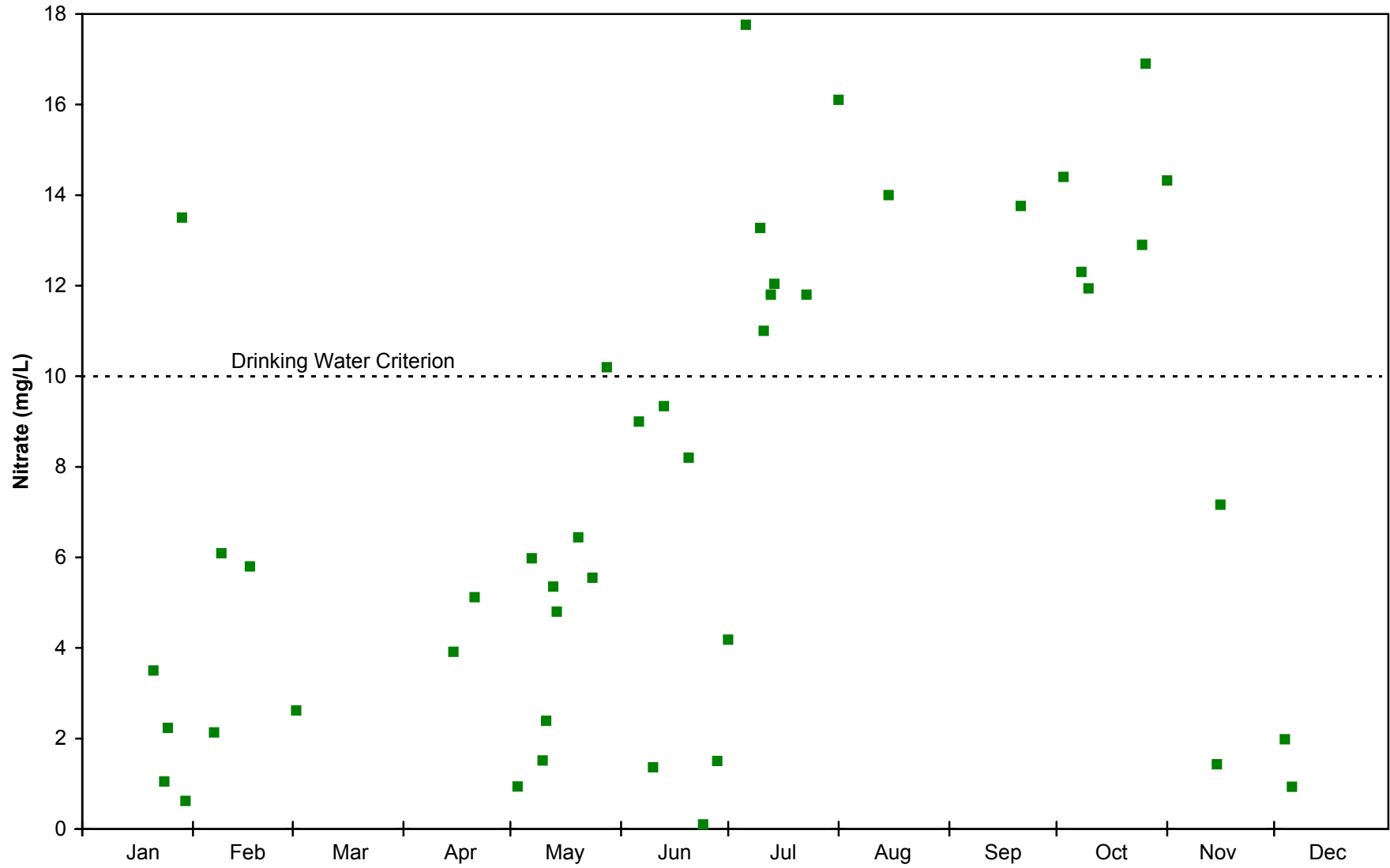


Figure B.5. Nitrate at Station RED0004A vs. Precipitation on Sampling Day

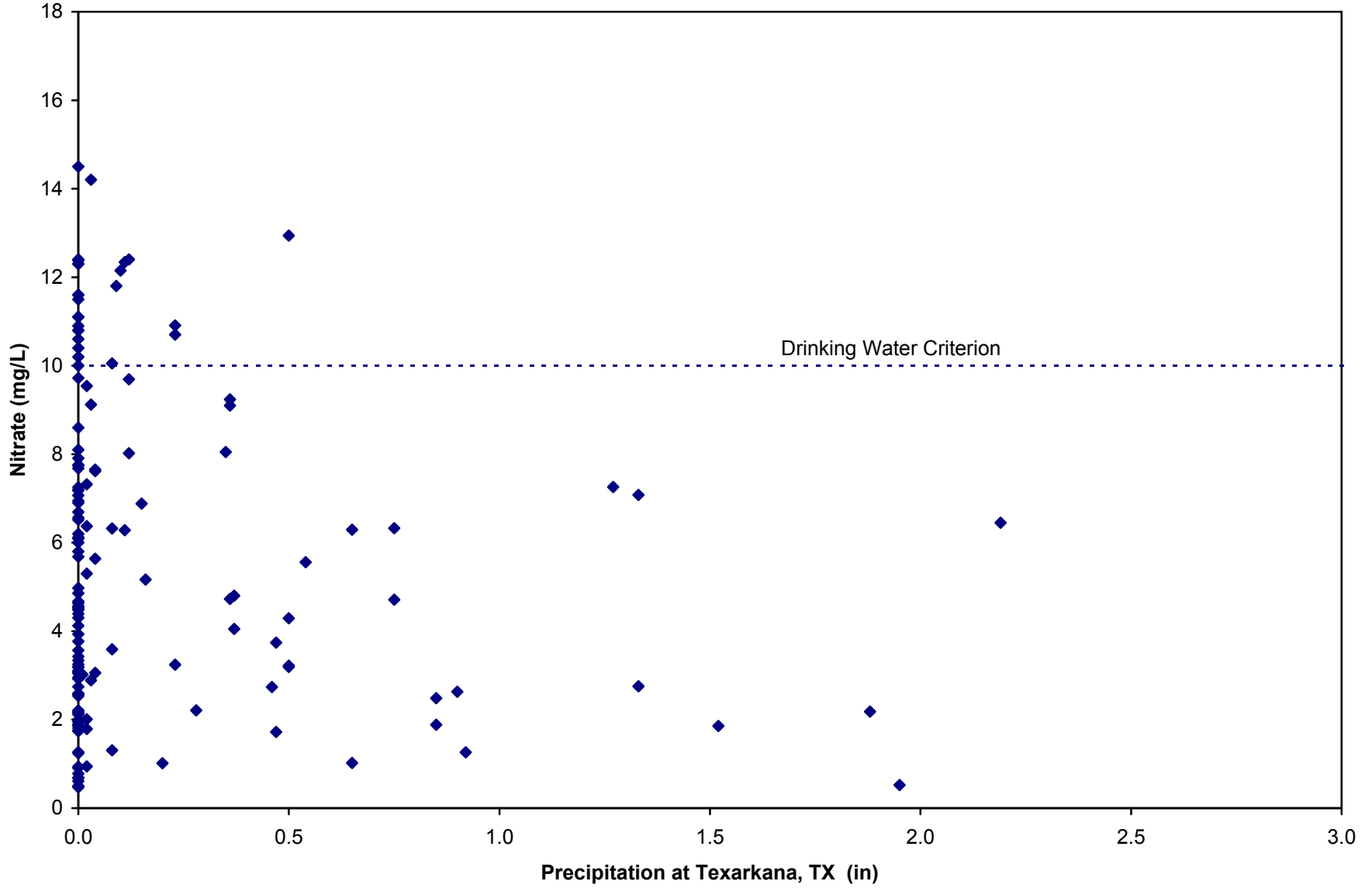


Figure B.6. Nitrate at Station 10226 vs. Precipitation on Sampling Day

