4.0 ALUMINUM

Assessment of the data from the 2004 SWQB intensive water quality survey in the Rio Puerco watershed identified several exceedences of the New Mexico water quality standards for dissolved aluminum in La Jara Creek and Rio Puerco. Consequently, these waterbodies were listed on the 2006-2008 Integrated CWA §303(d)/§305(b) (NMED/SWQB 2007) list for aluminum.

4.1 Target Loading Capacity

Target values for these aluminum TMDLs will be determined based on 1) the presence of numeric criteria or appropriate numeric translator to a narrative standard, 2) the degree of experience in applying the indicator, and 3) the ability to easily monitor and produce quantifiable and reproducible results. This TMDL is also consistent with New Mexico's antidegradation policy.

According to the New Mexico water quality standards (20.6.4.900 NMAC), the dissolved aluminum chronic criterion is 0.087 mg/L and the dissolved aluminum acute criterion is 0.75 mg/L for aquatic life uses. The chronic criterion was exceeded 3 of 7 times on La Jara Creek (perennial reaches above Arroyo San Jose) and 5 of 19 times on Rio Puerco (Arroyo Chijuilla to northern boundary Cuba). These exceedences are presented in Tables 4.1-4.2 and Figures 4.3-4.6.

High chronic levels of dissolved aluminum can be toxic to fish, benthic invertebrates, and some single-celled plants. Aluminum concentrations from 0.100-0.300 mg/L increase mortality, retard growth, gonadal development and egg production of fish (http://www.bae.ncsu.edu/programs/extension/wqg/). High acute levels of dissolved aluminum can be especially detrimental to aquatic life increasing mortality rates for many species of fish and macroinvertebrates.

Table 4.1 Dissolved aluminum and flow data for La Jara Creek

Sample Date	Dissolved Al (mg/L)	Flow (cfs)
La Jara above irrigation diversion (33LaJara009.7)		
3/30/04	0.26*	3.425
4/14/04	0.23*	4.23
5/25/04	0.4*	3.722
6/29/04	<0.01	1.42
7/27/04	<0.01	0.85
9/1/04	<0.01	n/a
11/18/04	<0.01	n/a

*denotes exceedence of dissolved aluminum chronic criterion
n/a = not available

Table 4.2 Dissolved aluminum and flow data for Rio Puerco (Arroyo Chijuilla to northern boundary Cuba)

Sample Date	Dissolved Al (mg/L)	Flow (cfs)
Rio Puerco @ Hwy 550 bridge (33RPuerc248.7)		
4/14/2004	0.12*	6.597
6/29/2004	<0.01	0.25
11/18/2004	<0.01	0.9
Rio Puerco above WWTP (33RPuerc244.0)		
3/30/2004	0.16*	3.73
4/14/2004	0.4*	27.969
5/25/2004	2*	6.684
6/29/2004	<0.01	1
7/27/2004	0.08	n/a
9/1/2004	<0.01	0.05
9/30/2004	<0.01	1
11/18/2004	0.02	1
Rio Puerco below WWTP @ Sanchez property (33RPuerc241.8)		
3/30/2004	<0.01	n/a
4/14/2004	0.19*	n/a
5/26/2004	0.02	5.5
6/29/2004	<0.01	1
7/27/2004	0.04	1
9/1/2004	0.01	0.1
9/30/2004	<0.01	0.02
11/18/2004	<0.01	1
Cuba WWTP outfall (NM 0024848) [a]		
3/30/2004	<0.01	0.05[b]
4/14/2004	<0.01	0.05 [b]
5/25/2004	<0.01	0.05 [b]
6/29/2004	<0.01	0.04 [b]
7/27/2004	<0.01	0.05 [b]
9/1/2004	<0.01	0.05 [b]
9/30/2004	<0.01	0.05 [b]
11/18/2004	<0.01	0.06 [b]

*denotes exceedence of dissolved aluminum chronic criterion
n/a = not available
[a] The design flow is 0.144 mgd (0.223 cfs)
[b] 30day reported average for given month in 2004 (originally reported in mgd)

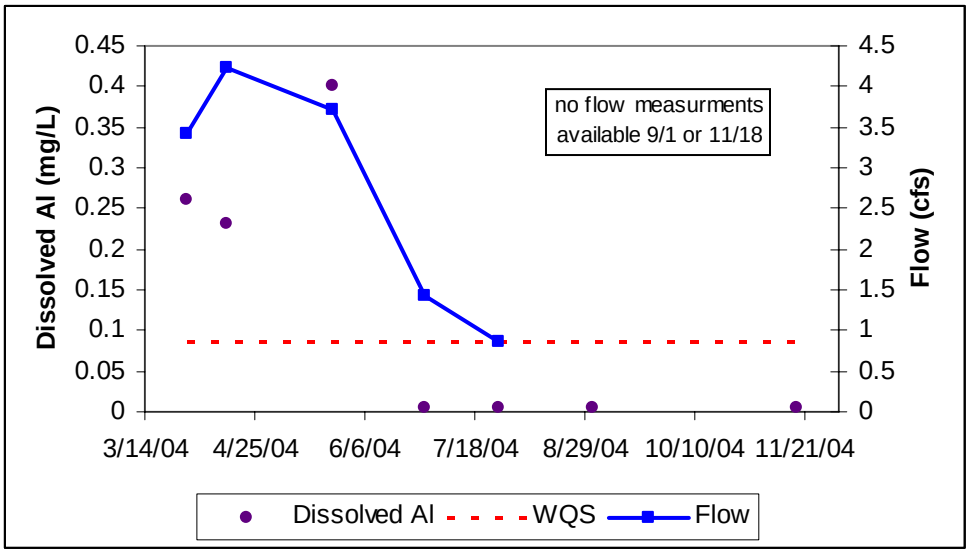

Figure 4.1 Dissolved aluminum chronic criterion exceedences at 33LaJara009.7

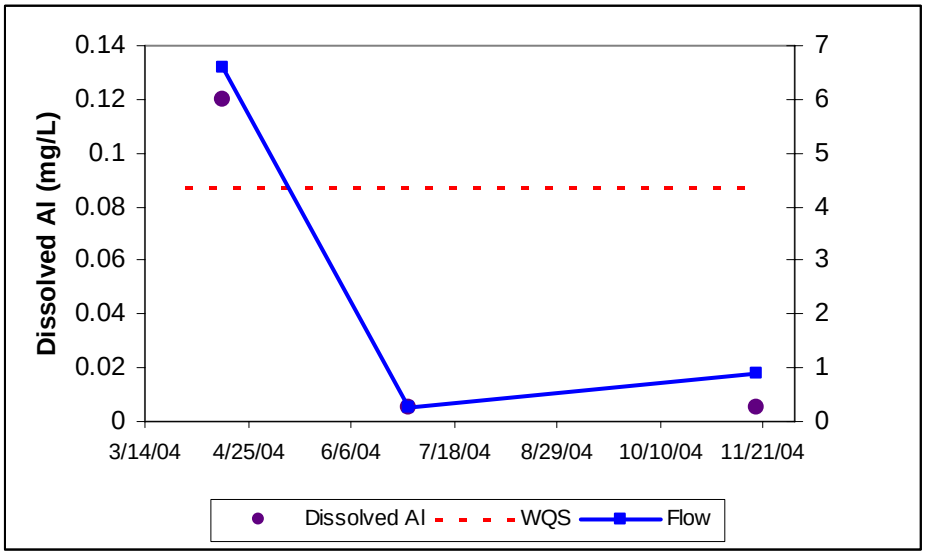

Figure 4.2 Dissolved aluminum chronic criterion exceedences at 33RPuerc248.7

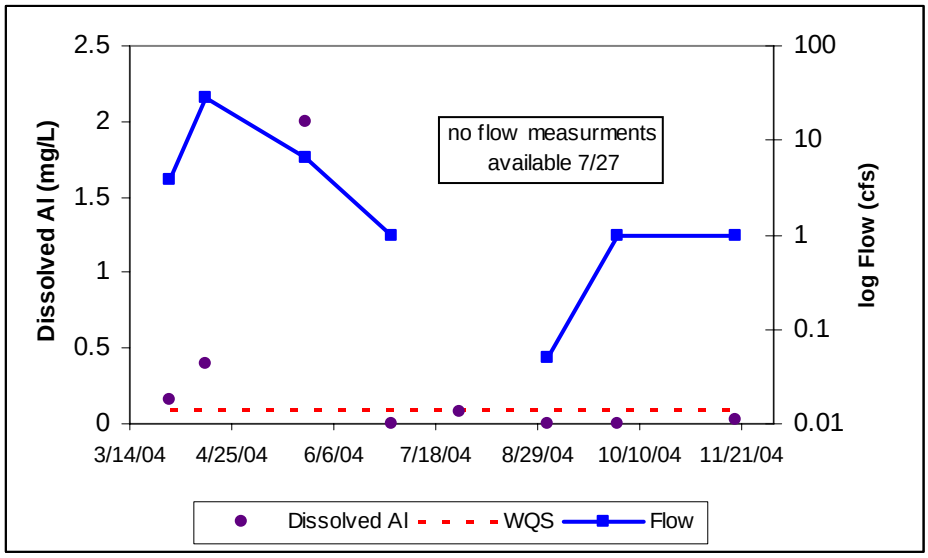

Figure 4.3 Dissolved aluminum chronic criterion exceedences at 33RPuerc244.0

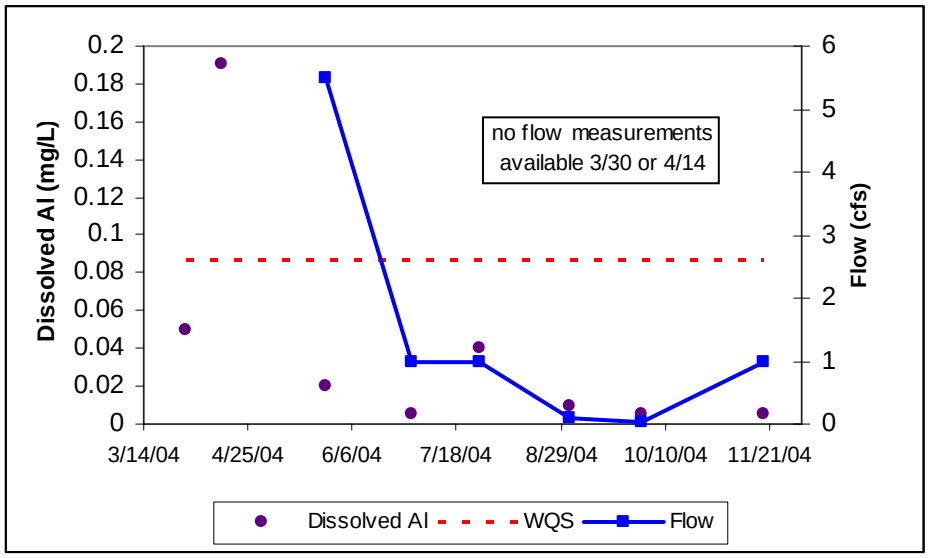

Figure 4.4 Dissolved aluminum chronic criterion exceedences at 33RPuerc241.8

4.2 Flow

TMDLs are calculated for te Rio Puerco and La Jara assessment units at a specific flow. Metal concentrations in a stream vary as a function of flow. As flow increases, the concentration of metals can increase. When available, USGS gages are used to estimate flow. Where gages are absent, geomorphologic cross section field data are collected at each site and actual flow measurements are taken. There are no active gages on La Jara Creek and no relevant active gages on the Rio Puerco (see Section 2.4.2), therefore, gage data was not available for these TMDL calculations and actual flow measurements were used. For these reaches, flow was measured by SWQB during the 2004 sampling runs using standard USGS procedures (NMED/SWQB 2001a).

Flows were measured at La Jara Creek above the irrigation diversion 5 times during the 2004 sampling season (Figure 4.3 and Table 4.1). WQS exceedences occurred only during high flows, so the critical flow was determined to be the average of the 3 high flows (3.425 cfs, 4.23 cfs, and 3.722 cfs) during the 2004 sampling year. Flow was measured 16 times at sites in the Rio Puerco (Arroyo Chijuilla to northern boundary Cuba) assessment unit during the 2004 sampling season (Table 4.2 and Figures 4.4-4.6). Given the available flow data, WQS exceeded only during high flows, so the critical flow was determined to be the average of the 4 available high flows (6.597 cfs, 3.73 cfs, 27.969 cfs, 6.684 cfs).

Therefore the critical flows for these TMDLs were:

- La Jara Creek (perennial reaches above Arroyo San Jose) = 3.79 cfs
- Rio Puerco (Arroyo Chijuilla to northern boundary Cuba) = 11.25 cfs

The flow value for La Jara Creek (perennial reaches above Arroyo San Jose) was converted from cfs to units of mgd as follows:

$$3.79\frac{ft^3}{\sec}\times 1{,}728\frac{in^3}{ft^3}\times 0.004329\frac{gal}{in^3}\times 86{,}400\frac{\sec}{day}\times 10^{-6}=2.44\,mgd$$

Using the above equation, the flow value for Rio Puerco (Arroyo Chijuilla to northern boundary Cuba) was converted from 11.25 cfs to 7.27 mgd.

4.3 Calculations

A target load for dissolved aluminum is calculated based on a flow, the current water quality criterion, and a conversion factor (8.34) that is used to convert mg/L units to lbs/day (see Appendix B for Conversion factor derivation). The target loading capacity is calculated using **Equation 1**. The results are shown in Table 4.3.

Critical flow (mgd) x Criterion (mg/L) x 8.34 = Target Loading Capacity (Eq. 1)

Table 4.3 Calculation of target loads for dissolved aluminum

Location	Flow (mgd)	Dissolved Aluminum (mg/L)	Conversion Factor	Target Load Capacity (lbs/day)
La Jara Creek (perennial reaches abv Arroyo San Jose)	2.44	0.087	8.34	1.77*
Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	7.27	0.087	8.34	5.27*

Notes: *values rounded to three significant figures

It is important to remember that the TMDL is a planning tool to be used to achieve water quality standards. Since flows vary throughout the year in these systems the target load will vary based

on the changing flow. Management of the load to improve stream water quality and meet water quality criteria should be a goal to be attained. Meeting the calculated TMDL may be a difficult objective.

The measured loads for dissolved aluminum were similarly calculated. The arithmetic mean of the data used to determine the impairment was substituted for the criterion in Equation 1. The same conversion factor of 8.34 was used. Results are presented in Table 4.4.

Table 4.4 Calculation of measured loads for dissolved aluminum

Location	Flow (mgd)	Dissolved Aluminum Arithmetic Mean (mg/L)	Conversion Factor	Measured Load (lbs/day)
La Jara Creek (perennial reaches abv Arroyo San Jose)	2.44	0.297	8.34	6.04*
Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	7.27	0.574	8.34	34.8*

Notes: *values rounded to three significant figures

4.4 Waste Load Allocations and Load Allocations

4.4.1 Waste Load Allocation

There are no individually permitted point source facilities on La Jara Creek. The Village of Cuba Wastewater Treatment Plant (WWTP) (NM0024848) is located within the impaired Río Puerco AU and discharges directly to the Río Puerco. The NPDES permit (NM0024848) does not have a limit for aluminum. Additionally, the 8 samples collected from the Cuba WWTP outfall during 2004 (Table 4.2) show results below the dissolved aluminum water quality criterion; therefore a WLA was not calculated for this facility.

There are no Municipal Separate Storm Sewer System (MS4) storm water permits in these Assessment Units. Sediment may be a component of some industrial and construction storm water discharges covered under General NPDES Permits, so the load from these discharges should be addressed. In contrast to discharges from other industrial storm water and individual process wastewater permitted facilities, storm water discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the NPDES construction general storm water permit (CGP) for construction sites greater than one acre requires preparation of a Storm Water Pollution Prevention Plan (SWPPP) that includes identification and control of all pollutants associated with the construction activities to minimize impacts to water quality. In addition, the current CGP also includes state specific requirements to implement best management practices (BMPs) that are designed to prevent to the maximum extent practicable, an increase in sediment, or a parameter that addresses sediment (e.g., TSS, turbidity, siltation, SBDs, etc.) and water velocity

during and after construction compared to pre-construction conditions. In this case, compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Other industrial storm water facilities are generally covered under the current NPDES Multi-Sector General Storm Water Permit (MSGP). This permit also requires preparation of an SWPPP that includes identification and control of all pollutants associated with the industrial activities to minimize impacts to water quality. In addition, the current MSGP also includes state specific requirements to further limit (or eliminate) pollutant loading to water quality impaired/water quality limited waters from facilities where there is a reasonable potential to contain pollutants for which the receiving water is impaired. In this case, compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

Individual wasteload allocations for the General Permits were not possible to calculate at this time in this watershed using available tools. Loads that are in compliance with the General Permits from facilities covered are therefore currently calculated as part of the watershed load allocation.

4.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity TMDL following **Equation 1**:

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 2)}$$

The MOS is estimated to be 25 percent of the target load calculated in Table 4.5. Results are presented in Table 4.5. Additional details on the MOS chosen are presented in Section 4.7.

Table 4.5 TMDL for dissolved aluminum

Location	WLA (lbs/day)	LA (lbs/day)	MOS (25%) (lbs/day)	TMDL (lbs/day)
La Jara Creek (perennial reaches abv Arroyo San Jose)	0	1.33	0.443	1.77*
Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	0	3.95	1.32	5.27*

Notes: *values rounded to three significant figures

The extensive data collection and analyses necessary to determine background dissolved aluminum loads for this AU was beyond the resources available for this study.

It is important to reiterate that TMDLs are planning documents that provide a framework for working towards the goal of achieving water quality criteria or appropriate numeric translators.

Management of the load to improve stream water quality is a goal to be attained, rather than a regulatory requirement.

4.5 Identification and Description of Pollutant Source(s)

Probable nonpoint sources that may be contributing to the observed load are displayed in Table 4.6:

Table 4.6 Pollutant source summary for Aluminum

Pollutant Sources	Magnitude[(a)]	Location	Probable Sources[(b)]
Point:			
Dissolved Aluminum	none	La Jara Creek (perennial reaches abv Arroyo San Jose)	0%
	none	Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	0%
Nonpoint:			
Dissoslved Aluminum	6.04	La Jara Creek (perennial reaches abv Arroyo San Jose)	100% Unknown Natural sources [(c)]
	34.8	Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	100% Highway/Road/Bridge Runoff (non-construction related) Loss of Riparian Habitat Rangeland Grazing Streambank Modification/destabilization Channelization Natural Sources Wildlife other than Waterfowl Drought-related Impacts

Notes:
(a) Measured Load.
(b) From the 2006-2008 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2007). This list of probable sources is based on staff observation and known land use activities in the watershed. These sources are not confirmed or quantified at this time.
(c) As noted in the "assessment unit comments" on the 2006-2008 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2007).

Probable sources of dissolved aluminum for this assessment unit will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process.

4.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the potential sources of impairment. The Pollutant Source(s) Documentation Summary included in Appendix A provides documentation of a visual analysis of probable sources along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Staff completing these forms identify probable sources of nonpoint source impairments along each reach as determined by field reconnaissance. It is important to consider not only the land directly adjacent to the stream, but also to consider upland and upstream areas in a more holistic watershed approach to implementing these TMDLs.

In general, increased metals in the water column can commonly be linked to sediment transport and accumulation, where the metals are a constituent part of the stream. This does not appear to be the case for either La Jara Creek or Rio Puerco as evidenced by the fact that there is a very weak relationship between the dissolved aluminum and TSS concentrations according to the data used to determine the impairment (Figures 4.7 and 4.8). However, the degree to which sediment delivery and transport in these watershed is a natural phenomenon, has been exacerbated by human activities, or is the result of a combination of both should be considered. Even though the highly erodible soils of the Río Puerco Watershed are the primary source of sediment transport, the anthropogenic influence of the highway construction, channelization, land development, and historical rangeland grazing practices could be contributing to impairment, particularly in the Río Puerco. The geology in the watershed contributes to the amount of sediment available for transport.

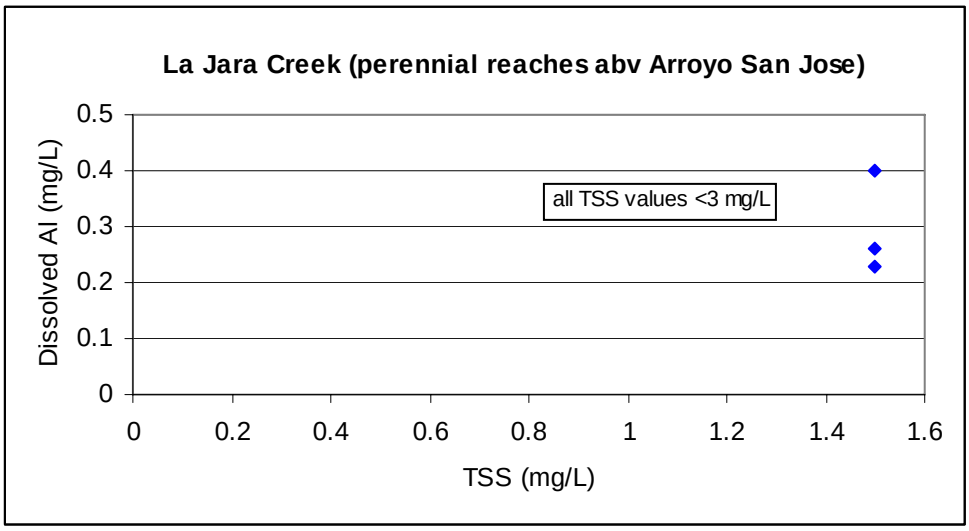

Figure 4.5 Relationship between dissolved aluminum and TSS in La Jara

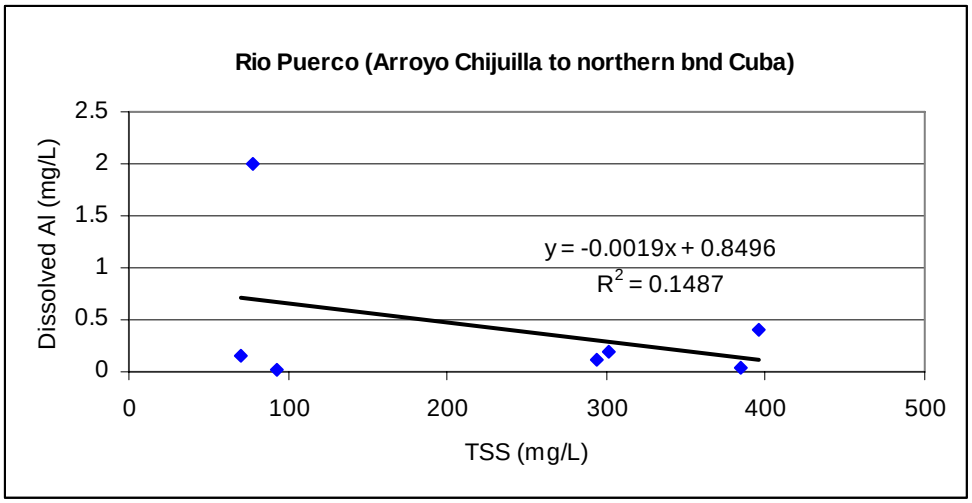

Figure 4.6 Relationship between dissolved aluminum and TSS in Rio Puerco

Higher aluminum is characteristic of the spring snowmelt/runoff period and is not pronounced during baseflow conditions in La Jara Creek or Rio Puerco. Exceedences occurred only during March-May in these assessment units. Normal aqueous chemical process, enhanced by the slight natural acidity of snow and rain, are capable of rendering any naturally occurring aluminum available to the stream system. The fact that dissolved aluminum concentrations above the chronic aluminum criterion were measured during the spring sampling runs as opposed to the lower concentrations found during fall sampling runs are indicative of a landscape source. Acidic anions as well as carbonic acid carried in snow are released into the soil as the snow melts and bring aluminum species into solution. Thus, aluminum concentrations are often high during spring runoff in many areas in New Mexico despite the expected diluting effects of high flow.

4.7 Margin of Safety

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL, there will be no MOS for point sources since none were accounted for in the TMDL calculation. However, the MOS is estimated to be 25% for dissolved aluminum. This MOS incorporates several factors:

- *Errors in calculating nonpoint source loads*

  A level of uncertainity exists in sampling nonpoint sources of pollution. Techniques used for measuring metals concentrations in stream water can lead to inaccuracies in the data. Therefore, a conservative MOS for metals increases the TMDL by **15%.**

- *Errors in calculating flow*

  Flow estimates were based on field measurements. There is a potential to have errors in measurements of flow due to equipment accuracy, time of

sampling, etc. To be conservative, an additional MOS of **10%** will be included to account for accuracy of flow computations.

4.8 Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during the spring, summer, and fall of 2004 in order to ensure coverage of any potential seasonal variation in the system. Critical condition was set to the flow estimate determined during snowmelt/runoff when exceedences occurred from March-May 2004.

4.9 Future Growth

Estimations of future growth are not anticipated to lead to a significant increase for dissolved aluminum that cannot be controlled with BMP implementation in the watershed, continued improvement of road conditions, and proper land management.