
WQCC APPROVED
TOTAL MAXIMUM DAILY LOADS
FOR THE
UPPER RIO GRANDE WATERSHED



OCTOBER 13, 2026

Prepared by

New Mexico Environment Department, Surface Water Quality Bureau

Monitoring, Assessments, and Standards Section

Public Draft Released: August 14, 2026

Water Quality Control Commission Approval Date: *October 13, 2026*

U.S. EPA Approval Date: *DATE*

Effective Date: *DATE*

Revision Date(s): _____

For Additional Information please visit:

<https://www.env.nm.gov/surface-water-quality/>

~or~

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Santa Fe, New Mexico 87505

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List of Abbreviations

4Q3	4-Day, 3-year low-flow frequency
6T3	Temperature not to be exceeded for 6 or more consecutive hours on more than 3 consecutive days
AU	Assessment Unit
BMP	Best management practices
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cfu	Colony forming units
CGP	Construction general storm water permit
CoolWAL	Cool Water Aquatic Life
CWA	Clean Water Act
°C	Degrees Celsius
DMR	Discharge Monitoring Report
HQCWAL	High Quality Coldwater Aquatic Life
°F	Degrees Fahrenheit
HUC	Hydrologic Unit Code
j/m ² /s	Joules per square meter per second
km ²	Square kilometers
LA	Load allocation
lb/day	Pounds per day
mgd	Million gallons per day
mg/L	Milligrams per Liter
mi ²	Square miles
mL	Milliliters
MOS	Margin of safety
MOU	Memorandum of Understanding
MS4	Municipal separate storm sewer system
MSGP	Multi-sector general storm water permit
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
QAPP	Quality Assurance Project Plan
SSTEMP	Stream Segment Temperature Model
SWPPP	Storm water pollution prevention plan
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
UAA	Use Attainability Analysis
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WBP	Watershed-based plan
WLA	Waste load allocation
WQCC	Water Quality Control Commission
WQS	Water quality standards (20.6.4 NMAC as amended through 8/14/2025)

EXECUTIVE SUMMARY

Section 303(d), or 33 U.S.C. § 1313(d), of the Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA), 33 U.S.C. § 1251 *et seq.*, requires states to develop Total Maximum Daily Load (TMDL) management plans for water bodies determined to be water quality limited. A TMDL is defined as *“a written plan and analysis established to ensure that a water body will attain and maintain water quality standards including consideration of existing pollutant loads and reasonably foreseeable increases in pollutant loads”* (USEPA, 1999). A TMDL defines the amount of a pollutant a water body can assimilate without violating a state’s water quality standards (WQS). It also allocates that load capacity to known point sources and nonpoint sources at a given flow. It further identifies potential methods, actions, or limitations that could be implemented to achieve water quality standards. TMDLs are defined in the Code of Federal Regulations at Title 40, Part 130 (40 C.F.R. § 130.2(i)) as the sum of individual Waste Load Allocations (WLAs) for point sources, and Load Allocations (LAs) for nonpoint source and background conditions, and a Margin of Safety (MOS) in acknowledgement of various sources of uncertainty in the analysis. 40 C.F.R. § 130.7(c).

The New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB) conducted a water quality survey of the Upper Rio Grande Watershed in 2017-2018 and 2025-2026. Water quality monitoring stations were located to evaluate the impact of tributary streams and ambient water quality conditions. Impairments addressed in this TMDL document, as well as existing approved TMDLs, are shown on Tables ES-1 to ES-9, below. Additional information regarding these impairments is available in the 2026-2028 Clean Water Act §303(d)/§305(b) Integrated Report and List (IR) (NMED/SWQB, 2026). This TMDL does not address all water quality impairments in the project area. Previous TMDLs were developed for other impairments in these watersheds; those TMDLs are available online at: <https://www.env.nm.gov/surface-water-quality/tmdl/>. Information regarding all impairments is available in the 2026-2028 Clean Water Act §303(d)/§305(b) Integrated Report and List (IR) (NMED/SWQB, 2026). The SWQB interactive Mapper (<https://gis.web.env.nm.gov/oem/?map=swqb>) provides a convenient interface to see where impairments exist, and to search for information about water bodies of interest using the Identify Features tool.

The next water quality monitoring survey of the Upper Rio Grande Watershed is scheduled for 2027, at which time TMDL targets will be re-examined and potentially revised, as this document is considered to be an evolving management plan. In the event that new data indicate that the targets used in this analysis are not appropriate and/or if new standards are adopted, the TMDL will be adjusted accordingly. When water quality standards have been achieved, the reaches will be moved to the appropriate category in the IR.

Table ES-1. Beaver Creek (Rio de los Pinos to headwaters)	
New Mexico Standard's Segment	20.6.4.123 NMAC
Assessment Unit Identifier	NM-2120.A_904
NPDES Permit(s)	None
Segment Length (miles)	8.13
Parameters of Concern	Temperature
Designated Uses Affected	HQCWAL
USGS Hydrologic Unit Code	13010005 - Conejos
Scope/Size of Watershed (mi ²)	25.90
Land Type	21h: Volcanic Mid-Elevation Forests (5.25%) 21g: Volcanic Subalpine Forests (94.75%)
Land Use/Cover	55.85% forest, 35.91% shrubland, 6.22% herbaceous, 2.02% wetlands, less than 0.01% developed
Land Ownership/Management	99.84% Forest Service, 0.16% private
Geology	29.53% igneous and sedimentary, 48.96% purely igneous, 2.53% purely metamorphic, 10.94% unconsolidated and sedimentary, 8.04% purely unconsolidated
Probable Sources*	Forest Roads, Grazing in Riparian Zone, Other Recreational Pollution Sources, Rangeland Grazing
IR Category	5/5A
Priority Ranking	High
Existing TMDLs	None
WLA + LA + MOS = TMDL	
Temperature	$0 + 1.72 \times 10^8 + 4.29 \times 10^7 = 2.14 \times 10^8$ kJ/day

*Probable Sources are a qualitative, alphabetical list.

Table ES-2. Canada Tio Grande (Rio San Antonio to headwaters)	
New Mexico Standard's Segment	20.6.4.123 NMAC
Assessment Unit Identifier	NM-2120.A_903
NPDES Permit(s)	None
Segment Length (miles)	10.58
Parameters of Concern	<i>E.coli</i> , temperature
Designated Uses Affected	HQCWAL
USGS Hydrologic Unit Code	13010005 - Conejos
Scope/Size of Watershed (mi ²)	11.03
Land Type	21d: Foothill Shrublands (7.00%) 21f: Sedimentary Mid-Elevation Forests (28.39%) 21e: Sedimentary Subalpine Forests (0.21%) 21g: Volcanic Subalpine Forests (64.40%)
Land Use/Cover	60.15% forest, 32.89% shrubland, 5.04% herbaceous, 1.91% wetlands, less than 0.10% developed
Land Ownership/Management	95.31% Forest Service, 4.69% private
Geology	41.24% purely igneous, 58.76% unconsolidated and sedimentary
Probable Sources*	Forest Roads, Grazing in Riparian Zone, Rangeland Grazing
IR Category	5/5A
Priority Ranking	High
Existing TMDLs	None
WLA + LA + MOS = TMDL	
<i>E.coli</i>	$0 + 1.13 \times 10^9 + 1.25 \times 10^8 = 1.25 \times 10^9$ cfu/day
Temperature	$0 + 4.28 \times 10^7 + 1.07 \times 10^7 = 5.35 \times 10^7$ kJ/day

*Probable Sources are a qualitative, alphabetical list.

Table ES-3. Embudo Creek (Rio Grande to Picuris Pueblo bnd)	
New Mexico Standard's Segment	20.6.4.114 NMAC
Assessment Unit Identifier	NM-2111_40 and NM-2111_41
NPDES Permit(s)	None
Segment Length (miles)	11.46
Parameters of Concern	Temperature
Designated Uses Affected	MCWAL
USGS Hydrologic Unit Code	13020101 – Upper Rio Grande
Scope/Size of Watershed (mi ²)	320.56
Land Type	21a: Alpine Zone (4.77%) 21c: Crystalline Mid-Elevation Forests (3.15%) 21b: Crystalline Subalpine Forests (5.13%) 21d: Foothill Shrublands (18.28%) 22h: North Central New Mexico Valleys and Mesas (4.70%) 21f: Sedimentary Mid-Elevation Forests (39.22%) 21e: Sedimentary Subalpine Forests (24.21%) 22f: Taos Plateau (0.54%)
Land Use/Cover	80.21% forest, 10.59% shrubland, 3.47% herbaceous, 2.18% hay/pasture, 1.39% developed, 1.34% barren, 0.77% wetlands, less than 0.10% each – open water and cultivated crops
Land Ownership/Management	7.77% Bureau of Land Management, 72.41% Forest Service, 8.22% Tribal, 10.12% private, 1.48% State
Geology	3.11% igneous and metamorphic, 2.41% purely igneous, 12.04% purely metamorphic, 49.36% purely sedimentary, 28.07% unconsolidated and sedimentary, 5.00% purely unconsolidated
Probable Sources*	Angling pressure, channelization, crop production, dams/diversions, flow alteration, highway/road/bridge runoff, impervious pavement, on-site treatment systems, rangeland grazing, residence/buildings, roads, streambank modifications
IR Category	5/5A and 5/5C
Priority Ranking	High
Existing TMDLs	NM-2111_41: Turbidity and sedimentation (2005)
WLA + LA + MOS = TMDL	
Temperature - NM-2111_40	$0 + 1.13 \times 10^9 + 2.83 \times 10^8 = 1.42 \times 10^9$ kJ/day
Temperature - NM-2111_41	$0 + 8.57 \times 10^8 + 2.14 \times 10^8 = 1.07 \times 10^9$ kJ/day

*Probable Sources are a qualitative, alphabetical list.

Table ES-4. Rio Fernando de Taos (Tienditas Creek to headwaters)	
New Mexico Standard's Segment	20.6.4.123 NMAC
Assessment Unit Identifier	NM-98.A_001
NPDES Permit(s)	None
Segment Length (miles)	6.84
Parameters of Concern	Temperature
Designated Uses Affected	HQCWAL
USGS Hydrologic Unit Code	13020101 – Upper Rio Grande
Scope/Size of Watershed (mi ²)	11.67
Land Type	21f: Sedimentary Mid-Elevation Forests (80.11%) 21e: Sedimentary Subalpine Forests (19.88%)
Land Use/Cover	90.70% forest, 5.82% shrubland, 2.04% developed, 1.34% wetlands, 0.10% herbaceous
Land Ownership/Management	82.50% Forest Service, 0.69% Tribal, 16.81% private
Geology	9.04% purely igneous, 6.80% purely metamorphic, 57.65% purely sedimentary, 26.50% unconsolidated and sedimentary
Probable Sources*	Channelization, crop production, dams/diversions, flow alteration, highway road/bridge runoff, hiking trails, impervious pavement, legacy logging, mass wasting, on-site treatment systems, rangeland grazing, residences/buildings, roads, waterfowl, wildlife other than waterfowl
IR Category	5/5A
Priority Ranking	High
Existing TMDLs	<i>E.coli</i> (2012), Specific conductance (2025)
WLA + LA + MOS = TMDL	
Temperature	$0 + 2.55 \times 10^7 + 6.39 \times 10^6 = 3.19 \times 10^7$ kJ/day

*Probable Sources are a qualitative, alphabetical list.

Table ES-5. Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	
New Mexico Standard's Segment	20.6.4.114 NMAC
Assessment Unit Identifier	NM-2111_00
NPDES Permit(s)	Los Alamos-White Rock WWTP (NM0020133) expires 2-28-2027 Buckman Direct Diversion Project (NM0030848) expires 4-30-2030 City of Santa Fe WWTP (NM0022292) ¹ expires 8-31-2026 Los Alamos National Laboratory Stormwater Individual Permit (NM0030759) expires 7-31-2027
Segment Length (miles)	18.2
Parameters of Concern	Aluminum, adjusted gross alpha, PCB, plant nutrients, temperature turbidity
Designated Uses Affected	MCWAL, LW
USGS Hydrologic Unit Code	13020201 –Rio Grande-Santa Fe
Scope/Size of Watershed (mi ²)	9801.77
Land Type	21a: Alpine Zone (1.98%) 21c: Crystalline Mid-Elevation Forests (3.41%) 21b: Crystalline Subalpine Forests (5.99%) 21e: Foothill Shrublands (19.32%) 21j: Grassland Parks (0.26%) 22h: North Central New Mexico Valleys and Mesas (8.72%) 22g: Rio Grande Floodplain (0.64%) 22b: San Luis Alluvial Flats and Wetlands (9.51%) 22a: San Luis Shrublands and Hills (9.55%) 21f: Sedimentary Mid-Elevation Forests (11.70%) 21e: Sedimentary Subalpine Forests (4.49%) 22f: Taos Plateau (8.56%) 21h: Volcanic Mid-Elevation Forests (3.77%) 21g: Volcanic Subalpine Forests (10.21%)
Land Use/Cover	47.01% shrubland, 37.86% forest, 5.49% herbaceous, 3.14% cultivated crops, 2.90% wetlands, 1.59% developed, 1.21% hay/pasture, 0.49% barren, 0.31% open water
Land Ownership/Management	11.87% Bureau of Land Management, 0.03% Bureau of Reclamation, 0.05% Department of Defense, 0.42% Department of Energy, 36.73% Forest Service, 0.39% Fish and Wildlife Service, 7.61% Tribal, 0.55% National Parks Service, 38.18% private, 4.02% State
Geology	2.10% igneous and metamorphic, 2.19% igneous and sedimentary, 29.46% purely igneous, 0.03% metamorphic and sedimentary, 5.69% purely metamorphic, 24.78% purely sedimentary, 13.06% unconsolidated and sedimentary, 22.63% purely unconsolidated, 0.06% water

Probable Sources*	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharges, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl
IR Category	5/5A and 5/5C
Priority Ranking	High
Existing TMDLs	None
WLA¹ + stormwater² + LA + MOS = TMDL	
Total Recoverable Aluminum	132.22 + 67.91 + 1597.47 + 199.73 = 1997.33 lbs/day
Adjusted gross alpha	$7.56 \times 10^8 + 3.81 \times 10^7 + 9.48 \times 10^9 + 1.14 \times 10^9 = 1.14 \times 10^{10}$ pCi/day
PCB	$7.11 \times 10^{-5} + 3.58 \times 10^{-6} + 8.92 \times 10^{-4} + 1.07 \times 10^{-4} = 1.07 \times 10^{-3}$ lbs/day
Total Nitrogen**	534.68 + 36.79 + 9159.69 + 1081.24 = 10812.39 lbs/day
Total Phosphorus**	98.60 + 0.01 + 1560.98 + 184.40 = 1843.97 lbs/day
Temperature	$5.27 \times 10^9 + 2.33 \times 10^8 + 5.81 \times 10^{10} + 1.59 \times 10^{10} = 7.95 \times 10^{10}$ kJ/day
Turbidity	(see table below)

*Probable Sources are a qualitative, alphabetical list.

**protective plant nutrient TMDL

¹ See Section 10.1.1.D for discussion about future discharge plans to this AU

² These WLAs include reserve WLA. See Implementation Section 10.1.1

Duration (consecutive days)	WLA (lbs/day)*	Stormwater (lbs/day)	MOS (15%)	LA (lbs/day)	TMDL (lbs/day)
3	3669.88	173.81	8315.91	43453.60	55439.38
4	2680.71	126.96	6074.46	31741.20	40496.37
5	2498.74	118.35	5662.12	29586.59	37747.44
6	2316.77	109.73	5249.78	27431.97	34998.52
7	2225.79	105.42	5043.61	26354.66	33624.06
14	1861.85	88.18	4218.93	22045.43	28126.21
30	1497.91	70.94	3394.25	17736.19	22628.36

Table ES-6. Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	
New Mexico Standard's Segment	20.6.4.129 NMAC
Assessment Unit Identifier	NM-2120.A_602
NPDES Permit(s)	Taos Ski Valley WWTP (NM0022101) expires 9-30-2028
Segment Length (miles)	3.97
Parameters of Concern	Plant nutrients
Designated Uses Affected	HQCWAL
USGS Hydrologic Unit Code	13020101 – Upper Rio Grande
Scope/Size of Watershed (mi ²)	21.14
Land Type	21a: Alpine Zone (25.86%) 21c: Crystalline Mid-Elevation Forests (3.90%) 21b: Crystalline Subalpine Forests (70.24%)
Land Use/Cover	80.81% forest, 10.05% herbaceous, 7.48% barren, 1.29% developed, 0.24% wetlands, 0.11% shrubland, less than 0.10% open water
Land Ownership/Management	87.24% Forest Service, 0.03% Tribal, 12.73% private
Geology	0.59% igneous and metamorphic, 41.49% purely igneous, 38.51% purely metamorphic, 19.41% purely unconsolidated
Probable Sources*	Angling pressure, camping, crop production, dams/diversions, fire suppression, flow alterations, highway/road/bridge runoff, hiking trails, impervious surfaces, logging, municipal point source discharge, on-site treatment systems, rangeland grazing, residences/buildings, roads, trash/litter, waste from pets, waterfowl, wildlife other than waterfowl
IR Category	1
Priority Ranking	High
Existing TMDLs	Plant nutrients (2005)
WLA + LA + MOS = TMDL	
Total nitrogen**	0.75 + 3.60 + 0.48 = 4.83 lbs/day
Total phosphorus**	0.25 + 1.20 + 0.16 = 1.61 lbs/day

*Probable Sources are a qualitative, alphabetical list.

**revised & protective plant nutrient TMDL

Table ES-7. Rio Nutritas (Rio San Antonio to headwaters)	
New Mexico Standard's Segment	20.6.4.123 NMAC
Assessment Unit Identifier	NM-2120.A_905
NPDES Permit(s)	None
Segment Length (miles)	7.99
Parameters of Concern	E.coli, temperature
Designated Uses Affected	HQCWAL, primary contact
USGS Hydrologic Unit Code	13010005 – Conejos
Scope/Size of Watershed (mi ²)	12.45
Land Type	21f: Sedimentary Mid-Elevation Forests (41.04%) 21g: Volcanic Subalpine Forests (58.96%)
Land Use/Cover	58.22% forest, 34.82% shrubland, 4.34% herbaceous, 2.62% wetlands, less than 0.10% developed
Land Ownership/Management	81.75% Forest Service, 18.25% private
Geology	15.87% purely igneous, 84.13% unconsolidated and sedimentary
Probable Sources*	Forest Roads, Grazing in Riparian Zone, Rangeland Grazing
IR Category	5/5A
Priority Ranking	High
Existing TMDLs	None
WLA + LA + MOS = TMDL	
E.coli	$0 + 1.19 \times 10^9 + 1.32 \times 10^8 = 1.32 \times 10^9$ cfu/day
Temperature	$0 + 4.58 \times 10^7 + 1.15 \times 10^7 = 5.73 \times 10^7$ kJ/day

*Probable Sources are a qualitative, alphabetical list.

Table ES-8. Rio de los Pinos (New Mexico reaches)	
New Mexico Standard's Segment	20.6.4.123 NMAC
Assessment Unit Identifier	NM-2120.A_900
NPDES Permit(s)	None
Segment Size (acres)	20.63
Parameters of Concern	Aluminum
Designated Uses Affected	HQCWAL
USGS Hydrologic Unit Code	13010005 – Conejos
Scope/Size of Watershed (mi ²)	154.34
Land Type	21a: Alpine Zone (2.11%) 21d: Foothill Shrublands (8.58%) 22a: San Luis Shrublands and Hills (5.12%) 22h: Volcanic Mid-Elevation Forests (14.50%) 22g: Volcanic Subalpine Forests (69.69%)
Land Use/Cover	50.38% forest, 38.38% shrubland, 6.57% herbaceous, 3.90% wetlands, 0.32% hay/pasture, 0.22% developed, 0.16% barren, less than 0.10% each – open water and cultivated crops
Land Ownership/Management	1.88% Bureau of Land Management, 90.41% Forest Service, 5.70% private, 1.99% State
Geology	19.71% igneous and sedimentary, 56.01% purely igneous, 0.43% purely metamorphic, 17.90% unconsolidated and sedimentary, 5.95% purely unconsolidated
Probable Sources*	Crop production, dams/diversions, flow alterations, rangeland grazing
IR Category	5/5A
Priority Ranking	High
Existing TMDLs	Temperature (2004)
WLA + LA + MOS = TMDL	
Aluminum, total recoverable	0 + 72.45 + 12.79 = 85.23 lbs/day

*Probable Sources are a qualitative, alphabetical list.

Table ES-9. Rio San Antonio (CO border to Montoya Canyon)	
New Mexico Standard's Segment	20.6.4.123 NMAC
Assessment Unit Identifier	NM-2120.A_902
NPDES Permit(s)	None
Segment Length (miles)	11.86
Parameters of Concern	Total Recoverable Aluminum, temperature
Designated Uses Affected	HQCWAL
USGS Hydrologic Unit Code	13010005 – Conejos
Scope/Size of Watershed (mi ²)	115.64
Land Type	21d: Foothill Shrublands (26.76%) 22a: San Luis Shrublands and Hills (14.78%) 21f: Sedimentary Mid-Elevation Forests (16.84%) 21e: Sedimentary Subalpine Forests (0.02%) 21h: Volcanic Mid-Elevation Forests (2.46%) 21g: Volcanic Subalpine Forests (39.13%)
Land Use/Cover	54.43% shrubland, 30.02% forest, 13.64% herbaceous, 1.86% wetlands, less than 0.10% each – open water and developed
Land Ownership/Management	8.41% Bureau of Land Management, 83.08% Forest Service, 7.28% private, 1.23% State
Geology	52.02% purely igneous, 47.98% unconsolidated and sedimentary
Probable Sources*	Agriculture, crop production, flow alterations, drought related, habitat modifications, rangeland grazing, low water crossing, roads, streambank erosion
IR Category	5/5A
Priority Ranking	High
Existing TMDLs	None
WLA + LA + MOS = TMDL	
Total Recoverable Aluminum	$0 + 187.15 + 33.03 = 220.18 \text{ lbs/day}$
Temperature	$0 + 3.93 \times 10^8 + 9.84 \times 10^7 = 4.92 \times 10^8 \text{ kJ/day}$

*Probable Sources are a qualitative, alphabetical list.

1.0 BACKGROUND

This document establishes TMDLs for 10 Assessment Units (AUs) in the Upper Rio Grande basin (**Figures 1.1 - 1.4**). Assessments of impairment were based on data collected during the 2017-2018 and 2025-2026 SWQB water quality surveys.

1.1 Watershed Description

This document establishes TMDLs for 10 Assessment Units (AUs) in the Conejos HUC 13010005, Upper Rio Grande HUC 13020101, and Upper Rio Grande-Santa Fe HUC 13020201 (**Figure 1.1, Table 1.1**). Impairment determinations were based on data collected during the 2017-2018 and 2025-2026 SWQB water quality surveys. Hydrologic Unit Code 13010005 (Conejos) is 767.11 square miles, almost entirely within Rio Arriba and Taos Counties, New Mexico, with the northern portions of the watershed extending into Colorado. The Upper Rio Grande HUC (13020101) is 3254 square miles and within Santa Fe, Rio Arriba, and Taos Counties. The Rio Grande-Santa Fe HUC (13020201) is 1872 square miles and within Sandoval, Los Alamos, Santa Fe, and Bernalillo Counties. The upper Rio Grande watershed includes lands of Pueblo de Cochiti, Nambé Pueblo, Ohkay Owingeh, Picuris Pueblo, Pueblo of Pojoaque, Pueblo of San Felipe, San Ildefonso Pueblo, Santa Ana Pueblo, Santa Clara Pueblo, Santo Domingo Pueblo, Taos Pueblo, and Pueblo of Tesuque.

In the Upper Rio Grande region, crust forming the North American tectonic plate is pulling apart, causing two more or less parallel faults. The section of land dropping down between them is called the Rio Grande Rift. The rift becomes wider from north to south. The geology of the Upper Rio Grande basin consists of a complex distribution of Precambrian metamorphic rocks, Paleozoic sedimentary rocks and Tertiary volcanics (**Figure 1.2**). Volcanic features include several shield volcanos north of Taos, and the Taos Plateau volcanic field, mostly west of the river (Bauer, 2011; Chronic, 1987). The Upper Rio Grande watershed is in the Sangre de Cristo and Rocky Mountains. Surface geology of HUC 13010005 is 9.0% sedimentary and igneous, 60% igneous, 11% unconsolidated and sedimentary, and 19% unconsolidated. Surface geology of HUC 13020201 is 30% igneous, 28% sedimentary, 30% unconsolidated and sedimentary, and 10% unconsolidated. Surface geology of HUC 13020101 is 6% igneous and metamorphic, 35% igneous, 8% metamorphic, 14% sedimentary, 18% unconsolidated and sedimentary, and 21% unconsolidated. (**Figure 1.2**).

Table 1.1 Assessment units and monitoring stations discussed in this TMDL

Map Point	Assessment Unit	Station Name	Station ID
1	Beaver Creek (Rio de los Pinos to headwaters)	Beaver Creek blw Diablo Creek	27Beaver004.6
2	Canada Tio Grande (Rio San Antonio to headwaters)	Canada Tio Grande abv Rio San Antonio	27CTGran000.7
3	Rio Nutritas (Rio San Antonio to headwaters)	Rio Nutritas abv Rio San Antonio	27RNutri002.0
4	Rio de los Pinos (New Mexico reaches)	Rio de los Pinos at gage - 27RPinos002.6	27RPinos002.6
5	Rio de los Pinos (New Mexico reaches)	Rio de los Pinos abv Beaver Cr	27RPinos024.9
6	Rio San Antonio (CO border to Montoya Canyon)	Rio San Antonio at NM-CO border in Ortiz	27RSanAn000.4
7	Embudo Creek (Rio Grande to Canada de Ojo Sarco)	Embudo Creek at Hwy 68 bridge nr Dixon at USGS gage 0827900	28Embudo000.8
8	Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	Embudo Creek above Canoncito	28Embudo010.1
9	Rio Fernando de Taos (Tienditas Creek to headwaters)	Rio Fernando de Taos above Apache Canyon	28RFerna028.7
10	Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	RIO HONDO 2.4 MILES BLW STP	28RHondo022.4
11	Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Rio Grande at Buckman Road	30RGrand586.5

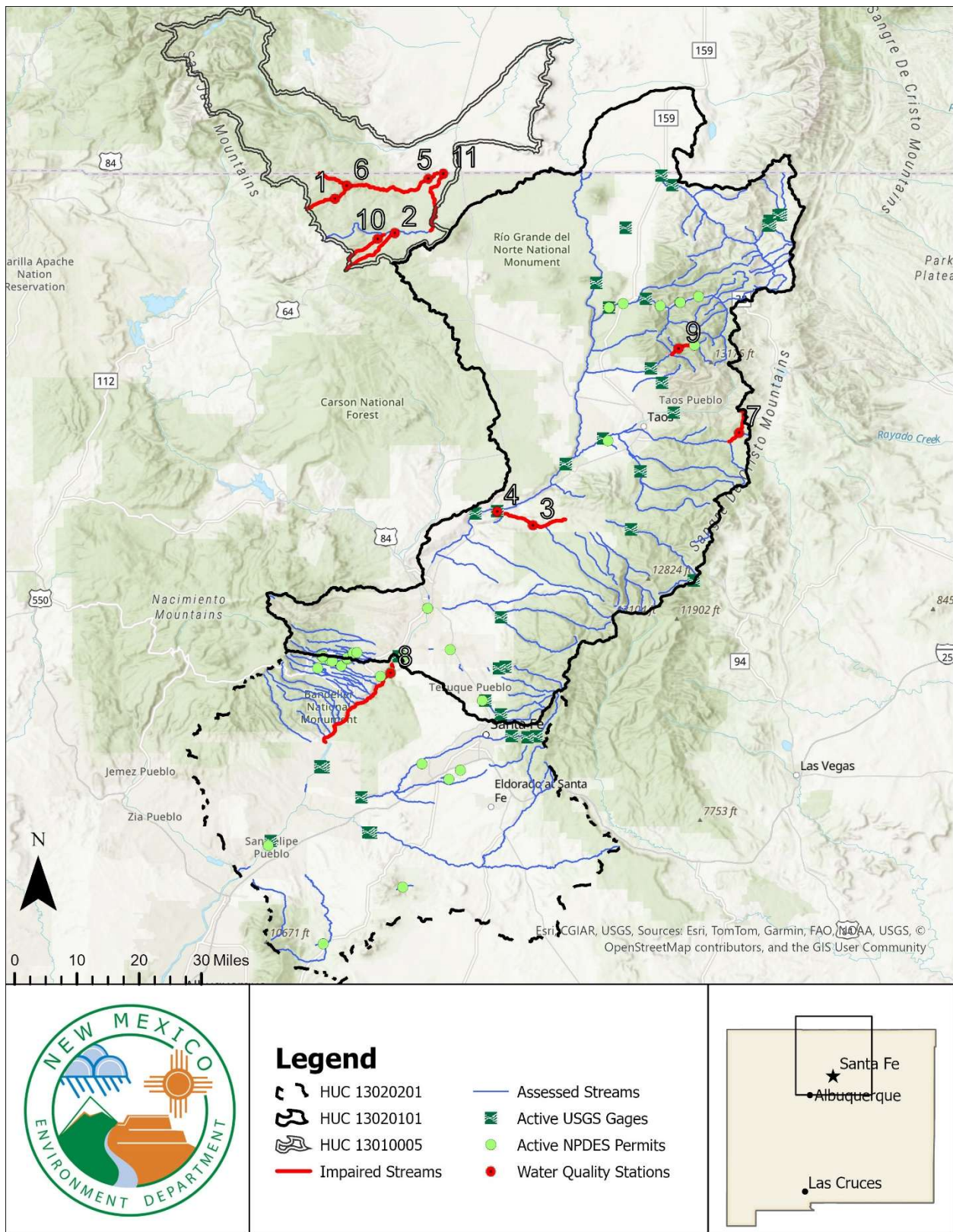


Figure 1.1 Overview of the new TMDLS for the Upper Rio Grande Watershed

Land cover in the 13010005 HUC is 36% shrub/scrub, 30% evergreen forest, 10% herbaceous, 8% deciduous forest, 4% hay/pasture, 3% woody wetlands, and 2% cultivated crops. Land cover in the 13020201 HUC is 60% shrub/scrub, 21% evergreen forest, 14% herbaceous, and 2% developed open space. Land cover in the 13020101 HUC is 47% shrub/scrub, 40% evergreen forest, 5% herbaceous, 2% deciduous forest, and 1% cultivated crops (**Figure 1.3**).

The primary landowners in the 13010005 HUC are the US Forest Service (66%), private (20%), BLM (11%), and 3% state. The primary landowners in the 13020201 HUC are private (46%), tribal nations (22%), U.S. Forest Service (18%), 5% BLM, 4% state, 3% National Park Service, and 2% Department of Energy. The primary landowners in the 13020101 HUC are the U.S. Forest Service (36%), private (30%), BLM (17%), tribal nations (13%), and state (4%). (**Figure 1.4**).

Outstanding National Resource Waters (ONRWs) are streams, lakes and wetlands that receive additional protection against degradation under the State of New Mexico's Standards for Interstate and Intrastate Surface Waters and the federal Clean Water Act. An ONRW designation is the highest level of protection against degradation that can be afforded a waterbody under the State of New Mexico's Water Quality Standards. Portions of waterbodies within the Upper Rio Grande watershed are designated as ONRW (20.6.4.9 D NMAC), including the following: Rio Santa Barbara (2005), USFS Wilderness (2013), Upper Rio Grande Streams (2023), and Special Designation Streams (2024).

Table 1.2 TMDL Assessment Units designated as Outstanding National Resource Waters

AU_ID	Assessment Unit	ONRW designation*
NM-2120.A_904	Beaver Creek (Rio de los Pinos to headwaters)	USFS Wilderness (2013)
NM-2120.A_903	Canada Tio Grande (Rio San Antonio to headwaters)	Special Designation Streams (2024)
NM-2111_40 NM-2111_41	Embudo Creek (Rio Grande to Picuris Pueblo bnd)	none
NM-98.A_001	Rio Fernando de Taos (Tienditas Creek to headwaters)	none
NM-2111_00	Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	none
NM-2120.A_602	Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	Upper Rio Grande Streams (2023)
NM-2120.A_905	Rio Nutritas (Rio San Antonio to headwaters)	none
NM-2120.A_900	Rio de los Pinos (New Mexico reaches)	Special Designation Streams (2024)
NM-2120.A_902	Rio San Antonio (CO border to Montoya Canyon)	Special Designation Streams (2024)

*<https://www.env.nm.gov/surface-water-quality/onrws/> and <https://www.env.nm.gov/surface-water-quality/wqs-amendments/>

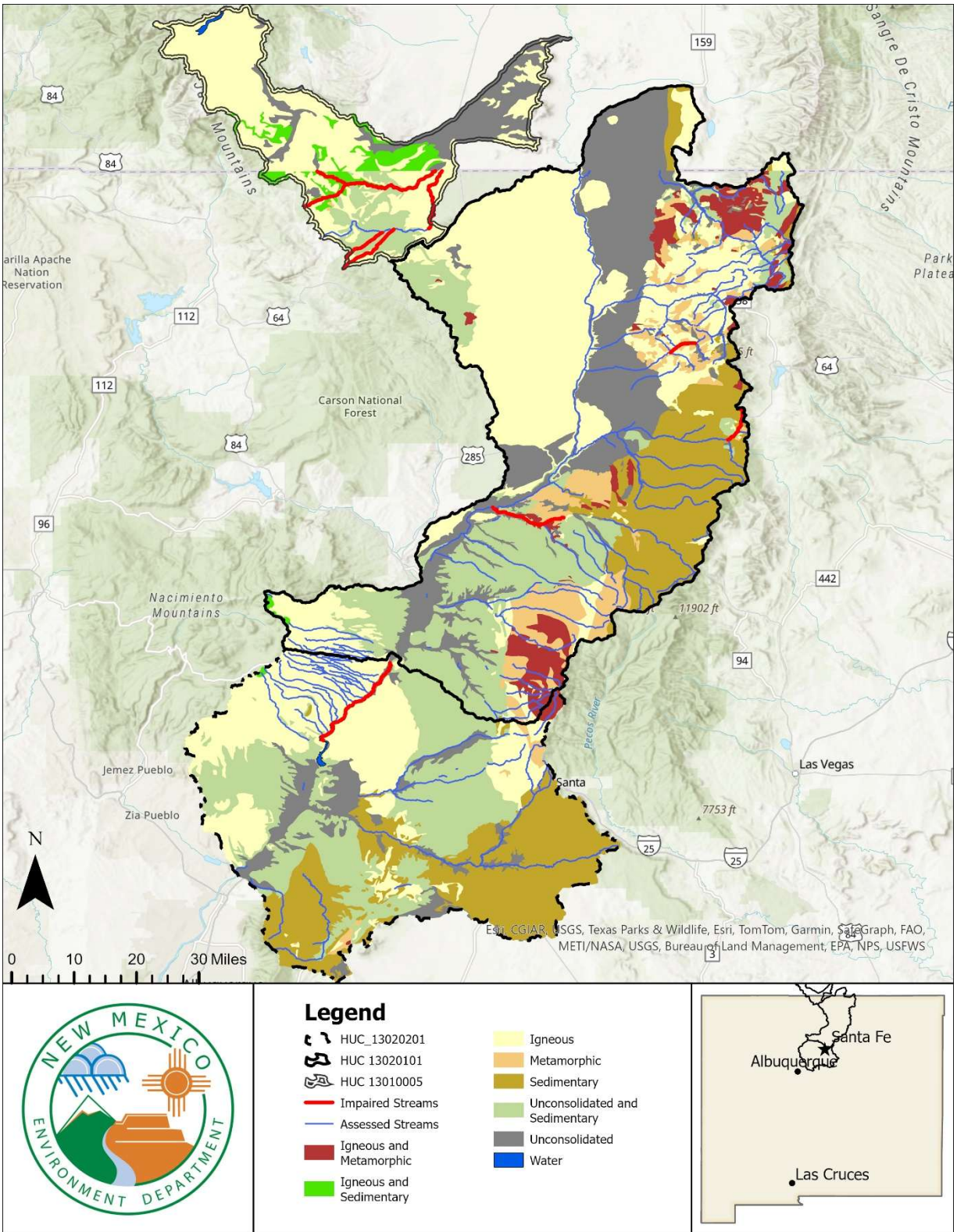


Figure 1.2 Surface geology of the Upper Rio Grande Watershed

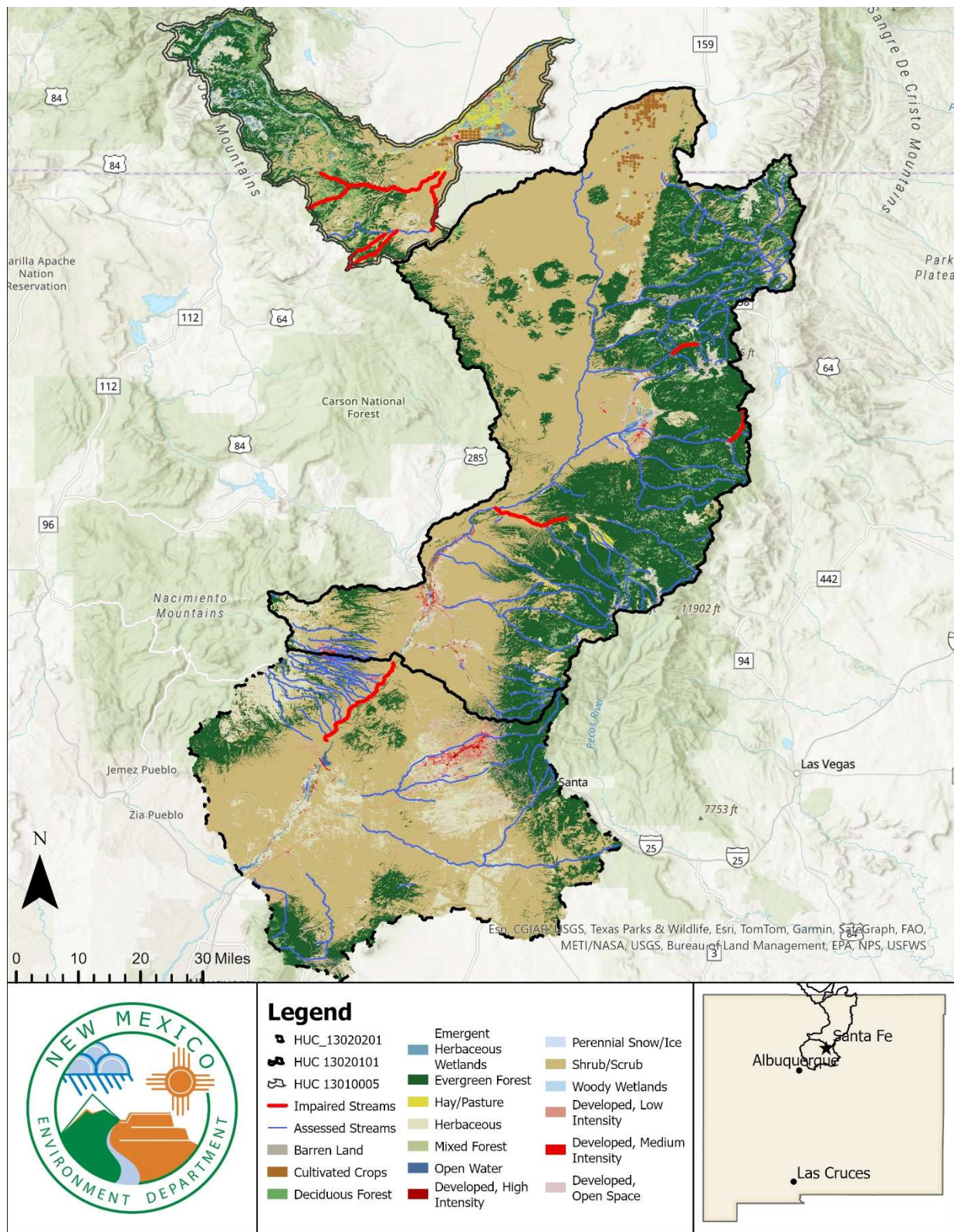


Figure 1.3 Land cover of the Upper Rio Grande Watershed

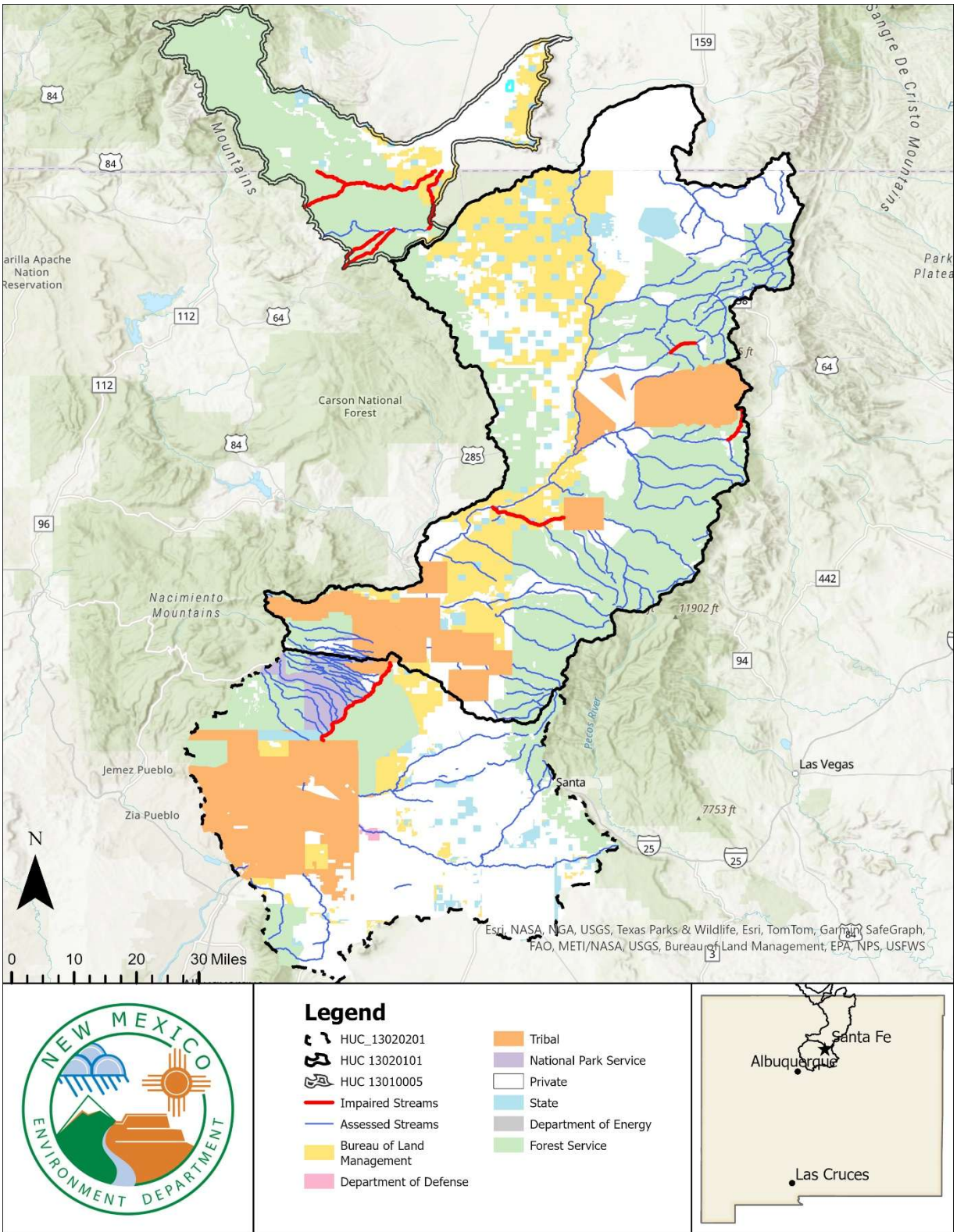


Figure 1.4 Land ownership of the Upper Rio Grande Watershed

1.2 Water Quality Standards

Water quality standards (WQS) for the assessment units **Embudo Creek and Rio Grande**, are set forth in the following sections of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 New Mexico Administrative Code [NMAC], 2025, <https://www.env.nm.gov/surface-water-quality/wqs/>):

20.6.4.114 RIO GRANDE BASIN: The main stem of the Rio Grande from the Cochiti pueblo boundary upstream to Rio Pueblo de Taos excluding waters on San Ildefonso, Santa Clara and Ohkay Owingeh pueblos, Embudo creek from its mouth on the Rio Grande upstream to the Picuris Pueblo boundary, the Santa Cruz river from the Santa Clara pueblo boundary upstream to the Santa Cruz dam, the Rio Tesuque except waters on the Tesuque and Pojoaque pueblos, and the Pojoaque river from the San Ildefonso pueblo boundary upstream to the Pojoaque pueblo boundary. Some Rio Grande waters in this segment are under the joint jurisdiction of the state and San Ildefonso pueblo.

A. Designated uses: irrigation, livestock watering, wildlife habitat, marginal coldwater aquatic life, primary contact and warmwater aquatic life; and public water supply on the main stem Rio Grande.

B. Criteria:

(1) The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: 6T3 temperature 22°C (71.6°F) and maximum temperature 25°C (78.8°F). In addition, the following criteria based on a 12-month rolling average are applicable to the public water supply use for monitoring and public disclosure purposes only:

Radionuclide	pCi/L
Americium-241	1.9
Cesium-137	6.4
Plutonium-238	1.5
Plutonium-239/240	1.5
Strontium-90	3.5
Tritium	4,000

(2) At mean monthly flows above 100 cfs, the monthly average concentration for: TDS 500 mg/L or less, sulfate 150 mg/L or less and chloride 25 mg/L or less.

[20.6.4.114 NMAC - Rp 20 NMAC 6.1.2111, 10/12/2000; A, 5/23/2005; A, 12/1/2010]

Water quality standards (WQS) for the following assessment units- **Beaver Creek, Canada Tio Grande, Rio Fernando de Taos, Rio Rio Nutritas, Rio de los Pinos, and Rio San Antonio** are set forth in the following sections of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 New Mexico Administrative Code [NMAC], 2025, <https://www.env.nm.gov/surface-water-quality/wqs/>):

20.6.4.123 RIO GRANDE BASIN: Perennial reaches of the Red river upstream of the mouth of Placer creek, all perennial reaches of tributaries to the Red river, and all other perennial reaches of tributaries

to the Rio Grande in Taos and Rio Arriba counties unless included in other segments and excluding waters on Santa Clara, Ohkay Owingeh, Picuris and Taos pueblos.

A. Designated uses: domestic water supply, high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat and primary contact; and public water supply on the Rio Pueblo and Rio Fernando de Taos.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: specific conductance 400 $\mu\text{S}/\text{cm}$ or less (500 $\mu\text{S}/\text{cm}$ or less for the Rio Fernando de Taos); the monthly geometric mean of *E. coli* bacteria 126 cfu/100 mL or less, single sample 235 cfu/100 mL or less; and phosphorus (unfiltered sample) less than 0.1 mg/L for the Red river.

[20.6.4.123 NMAC - Rp 20 NMAC 6.1.2120, 10/12/2000; A, 5/23/2005; A, 12/1/2010]

[**NOTE:** The segment covered by this section was divided effective 5/23/2005. The standards for the additional segment are under 20.6.4.129 NMAC.]

Water quality standards (WQS) for the assessment unit **Rio Hondo** are set forth in the following sections of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 New Mexico Administrative Code [NMAC], 2025, <https://www.env.nm.gov/surface-water-quality/wqs/>):

20.6.4.129 RIO GRANDE BASIN: Perennial reaches of the Rio Hondo.

A. Designated uses: domestic water supply, high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat and primary contact.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: specific conductance 400 $\mu\text{S}/\text{cm}$ or less and phosphorus (unfiltered sample) less than 0.1 mg/L.

[20.6.4.129 NMAC - N, 5/23/2005; A, 12/1/2010]

1.3 Antidegradation and TMDLs

New Mexico's antidegradation policy, found at 20.6.4.8(A) NMAC and required under 40 C.F.R. § 131.12, describes how waters are to be protected from degradation. At a minimum, the policy mandates that "the level of water quality necessary to protect the existing uses shall be maintained and protected in all surface waters of the state." Furthermore, the policy's requirements must be met whether or not a segment is impaired. TMDLs are consistent with this policy because implementation of a TMDL restores water quality so that existing uses (defined as the highest quality of water that has been attained since 1975) are protected and water quality criteria are achieved.

The Antidegradation Policy Implementation Procedure establishes the process for implementing the antidegradation policy (Appendix A of NMED/SWQB, 2020). However, certain specific requirements in the Antidegradation Policy Implementation Procedure do not apply to the Water Quality Control Commission's (WQCC) establishment of TMDLs because these types of water quality-related actions already are subject to extensive requirements for review and public participation, as well as various limitations on degradation imposed by state and federal law (NMED/SWQB, 2020).

1.4 Water Quality Monitoring Survey

In 2017-2018 and 2025-2026 SWQB surveyed the Upper Rio Grande and Middle Rio Grande. This document will only be discussing the survey of the Upper Rio Grande Watershed- Conejos HUC 13010005 Upper Rio Grande HUC 13020101 and Rio Grande-Santa Fe HUC 13020201 (**Figures 1.1-1.4**).

The SWQB divides rivers and streams into AUs based on differing geological and hydrological properties, and each AU was assessed individually using data from one or more monitoring sites located within the AU. Based on a variety of factors, selected monitoring locations were sampled for water quality constituents several times over the two years.

Geomorphology and continuously logged data were collected at least once for as many as possible of the perennial AUs. Geomorphology parameters were measured following the then-current revision of the SWQB Standard Operating Procedure 5.0, Physical Habitat Measurements (<https://www.env.nm.gov/surface-water-quality/sop/>). Data-logged parameters may include temperature, turbidity, dissolved oxygen, pH, and/or conductivity, and were measured following the then-current revision of the SWQB Standard Operating Procedures 6.1-6.4, Sondes and Thermographs (<https://www.env.nm.gov/surface-water-quality/sop/>). Impaired AUs addressed in this TMDL, and the associated monitoring stations, are shown on **Figure 1.1**.

Monitoring occurs during the non-winter months (March through November); focuses on physical, chemical, and biological conditions in perennial waters; and includes sampling for most pollutants that have numeric and/or narrative criteria in the WQS. More detail about the 2017-2018 water quality survey can be found in the survey summary reports (NMED/SWQB, 2020a) <https://www.env.nm.gov/surface-water-quality/water-quality-monitoring/>.

1.5 Hydrologic Conditions

Water chemistry and thermograph data on which these TMDLs are based were collected in the years 201-2026. In order to characterize streamflow conditions in which the data were collected, discharge records were obtained from USGS gage 08279000 – Embudo Creek at Dixon, NM and USGS gage 08313000 – Rio Grande at Otowi Bridge, NM (**Figures 1.5 & 1.6**). The discharge data show that flow in Embudo Creek and Rio Grande during the 2017-2026 water quality survey was generally lower than the median daily statistic over the 91-year and 55-year period of record, respectively.

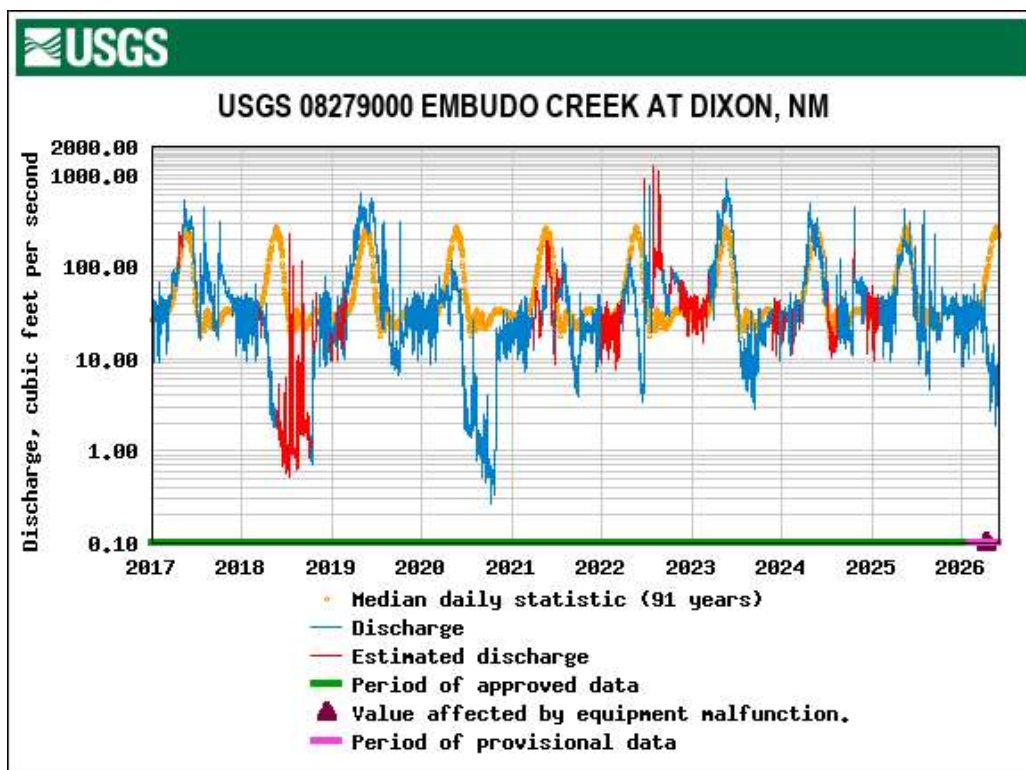


Figure 1.5 Daily discharge of the Embudo Creek at Dixon, NM gage for the years 2017-2026

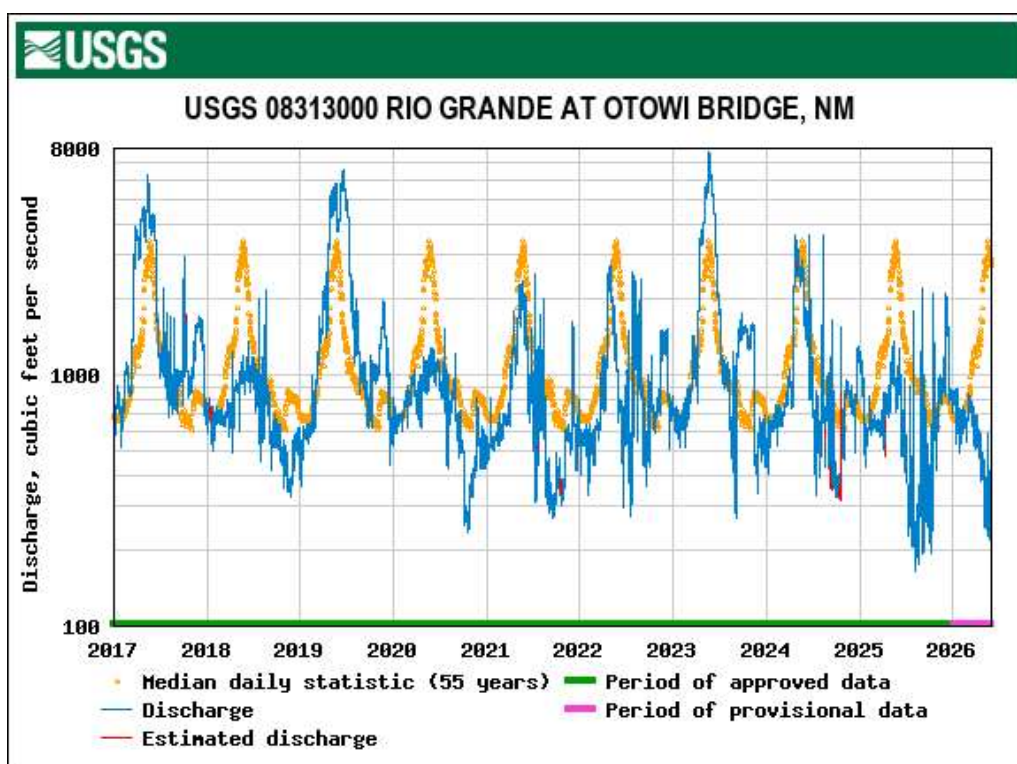


Figure 1.6 Daily discharge of the Rio Grande at Otowi Bridge, NM for the years 2017-2026

1.6 TMDL Uncertainties

Pursuant to EPA guidance (EPA, 2002), TMDLs “should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling.” Uncertainties and assumptions in the TMDL process are detailed in the individual Margin of Safety subsections for each TMDL parameter. Uncertainties and assumptions related to the size of the available datasets and/or flow are detailed in the Target Loading Capacity and Flow subsections for each TMDL parameter. When modeling is used to develop a TMDL, water quality modeling results are summarized in the individual TMDL parameter sections and detailed in an appendix to the TMDL. In general, weaknesses in the TMDL analytical process include the limited availability of water quality data during the assessment process, limited flow and habitat measurements for TMDL development, and limited flow and water quality long-term gaging sites to be used during both the assessment and TMDL processes. Strengths in the TMDL analytical process include the robust assessment processes outlined in the Comprehensive Assessment and Listing Methodology (CALM; NMED/SWQB, 2025) especially related to assessments of narrative water quality standards, such as nutrients, sedimentation, and turbidity. Additional strengths include the use of regression equations to calculate TMDLs such as turbidity and specific conductance as well as the collection and subsequent discussion of NPDES permit effluent data as part of the TMDL development process.

2.0 ALUMINUM

Chronic high levels of aluminum (Al) can be toxic to fish, benthic invertebrates, and some single-celled plants. Aluminum concentrations from 0.1 to 0.3 mg/L (100 to 300 ug/L) increase mortality and retard growth, gonadal development, and egg production of fish. Information on the toxic forms of aluminum in natural waters suggests that soluble trivalent aluminum (Al^{3+}) exerts a toxic effect on fish by binding to the negative charge of gill tissues, thereby disrupting ionoregulatory and respiratory balance (Exley et al., 1991; Gensemer and Playle, 1999). This charge interaction is complicated by subsequent polymerization of insoluble, positive-charged Al oxyhydroxides to fish gill tissues and thus both soluble and insoluble forms are implicated in the toxic response of fish to Al (Gensemer and Playle, 1999).

In 2010, the WQCC updated the aquatic life use (ALU) criteria for aluminum from dissolved aluminum to hardness-dependent total recoverable aluminum (TR Al). In 2012, USEPA approved the change for use in waters where the pH is 6.5-9.0. Aluminum-impaired waters of the Upper Rio Grande basin were within the applicable pH range during all of the 2017-2018 sampling events. The term “total recoverable” refers to the analytical method used in laboratory analysis. “Total recoverable” is used here to reflect the language in 20.6.4.900.I NMAC, specifically, “For aluminum, the criteria are based on analysis of total recoverable aluminum in a sample that is filtered to minimize the mineral phase as specified by the department.” Based on recommendations from an aluminum filtration study conducted by SWQB staff (NMED/SWQB, 2012), if the turbidity exceeds 30 NTU, samples that will be analyzed for TR Al are filtered using a filter of 10 μ m pore size that minimizes mineral-phase aluminum without restricting amorphous or colloidal phases. To be conservative, the TMDLs are calculated to protect against exceedance of the chronic criterion, which is more stringent than the acute criterion.

2.1 Target Loading Capacity

To meet aquatic life designated uses, the SWQB CALM (NMED SWQB, 2025) says that for any one chemical/physical pollutant, there shall be no more than one exceedance of the acute criterion, and no more than one exceedance of the chronic criterion in three years. Exceedances of the water quality standards (WQS) were identified in the Rio de los Pinos (New Mexico reaches) and Rio San Antonio (CO border to Montoya Canyon) by assessment of the data from the 2017-2018 SWQB Upper Rio Grande intensive water quality survey, as shown on **Table 2.1**. Consequently, this AU was listed on the 2020-2022 Integrated CWA §303(d)/§305(b) List (NMED/SWQB, 2020) for aluminum. Results of laboratory analyses of the samples are shown in **Appendix B**.

Table 2.1 Exceedances of the Hardness-based Total Recoverable Aluminum WQS

Assessment Unit	Exceedances (chronic)	Exceedances (acute)
Rio de los Pinos (New Mexico reaches)	2/5	2/5
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	2/7	0/7
Rio San Antonio (CO border to Montoya Canyon)	3/6	3/6

2.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

Total recoverable aluminum exceedances tend to occur at higher flows for a given water body. Total recoverable aluminum concentrations measured during the lowest flow conditions did not exceed the applicable water quality criteria for the Rio de los Pinos and Rio San Antonio during the 2017-2018 Upper Rio Grande survey. Therefore, a higher flow value that corresponds with a higher probability of water quality exceedances was selected as the critical flow for TR AI. Critical flow values were estimated by averaging concurrent flow measurements/estimates that were equal to or greater than the lowest flow at which an exceedance was documented for each water body. Critical flows calculated using the above method are presented in **Table 2.2**. The critical flow was converted from cubic feet per second (cfs) to million gallons per day (mgd) using a conversion factor of 0.646.

Gaged streamflow data are not available for Rio Grande above Cochiti Reservoir therefore flow was measured by the Rio Grande at Otowi Bridge gage (USGS 08313000) located at the bottom of the upstream AU, and critical flow was calculated using the USGS SW Toolbox version 1.1. The critical flow, calculated as 4Q3, was 312 cfs for the time period 2011 through June 2026, the period during which the Buckman Direct Diversion (BDD) has been operating. The following equation (Thomas 1997) was used to estimate flow downstream in the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit:

Equation 4.1

$$Q_u = Q_g \left(\frac{A_u}{A_g} \right)^{0.5}$$

where,

- Q_u = discharge at ungaged site, cfs
- Q_g = discharge at gaged site, cfs
- A_u = Drainage area at the ungaged site, (square miles [mi^2])
- A_g = Drainage area at the gaged site, (mi^2)

In this case, the discharge at the ungaged site (cfs) was calculated as the critical flow, or 4Q3, using the USGS gage Rio Grande at Otowi Bridge as the “discharge at gaged site” in this equation.

Using this equation, a flow of 315 cfs, or 204 mgd, was calculated for the Rio Grande at Cochiti reservoir, however this result does not account for the diversion of city of Santa Fe drinking water via the Buckman Direct Diversion (BDD). The BDD 3-year maximum diversion (7.822 mgd) was subtracted from this result, which yielded a critical flow of 195.75 mgd. The White Rock WWTP was also located in this AU, with a design flow of 0.5 mgd. According to correspondence with the City of Santa Fe, the City has future plans to divert a portion of the City of Santa Fe Paseo Real WWTP (NM0022292) effluent to this assessment unit, resulting in an additional 0-5 mgd flow. The maximum 5 mgd flow option was added onto the flow of this

assessment unit. This resulted in a final critical flow of 201.25 mgd or 311.4 cfs for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

Table 2.2 Critical Flow for Total Recoverable Aluminum TMDLs

Assessment Unit	Critical Flow (cfs)	Critical Flow (mgd)
Rio de los Pinos (New Mexico reaches)	113	73
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	311	201
Rio San Antonio (CO border to Montoya Canyon)	124	80

The TMDL itself is a value calculated at a defined critical condition as part of a planning process designed to achieve water quality standards. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve in-stream water quality is the goal of SWQB efforts.

2.3 TMDL Calculations

The TMDL is defined as the mass of pollutant that can be carried under critical flow conditions without violating the target concentration for that constituent. A conversion factor is used to correct the TMDL units to lb/day. The TMDL is calculated based on simple dilution using **Equation 2.1**:

Equation 2.1 $Critical\ flow\ (mgd) \times WQS\ (mg/L) \times Conversion\ Factor\ (8.34) = TMDL\ (lb/day)$

TMDLs are presented on **Table 2.3** for the critical flow condition. The chronic aluminum criterion was calculated at the average hardness value that was measured during the survey sampling events that resulted in exceedances of the WQS (data shown in **Appendix A**).

Table 2.3 Calculation of Target Loads

Assessment Unit	Chronic TR Al criterion (mg/l)	Critical Flow (mgd)	Conversion Factor	TMDL (lb/day)
Rio de los Pinos (New Mexico reaches)	0.24	73	8.34	146.12
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	1.19	201	8.34	1997.33
Rio San Antonio (CO border to Montoya Canyon)	0.33	80	8.34	220.18

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 at all times is the goal. The TMDL is further allocated to a MOS (margin of safety), WLA (waste-load allocation for permitted point sources), and LA (load allocation for non-point sources), according to **Equation 2.2**:

Equation 2.2 $WLA + LA + MOS = TMDL$.

2.3.1 Margin of Safety

The CWA requires that each TMDL be calculated with a MOS. 33 U.S.C. § 1313(d)(1). This statutory requirement that TMDLs incorporate a MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. A MOS may be expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions). The MOS may be implicit, utilizing conservative assumptions for calculation of the loading capacity, WLAs, and LAs. The MOS may also be explicitly stated as an added separate quantity in the TMDL calculation. For these aluminum TMDLs, the MOS was developed using a combination of conservative assumptions and explicit allocations. Therefore, this MOS is the sum of the following two elements:

- *Implicit Margin of Safety*

Treating aluminum as a conservative pollutant, meaning a pollutant that does not readily degrade in the environment, was used as a conservative assumption in developing these loading limits.

Calculating the TMDL based on chronic rather than acute WQS.

- *Explicit Margin of Safety*

An **explicit MOS of 15%** was assigned to the aluminum impaired AUs, to account for the inherent error in flow measurements and estimations.

2.3.2 Waste Load Allocation

There are no active individual National Pollutant Discharge Elimination System (NPDES) permits that discharge to the Rio de los Pinos or Rio San Antonio, therefore the WLA for these TMDLs is zero.

There are four active individual National Pollutant Discharge Elimination System (NPDES) permits that discharge to the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) AU.

The Los Alamos County White Rock WWTP (NM0020133), City of Santa Fe Buckman Direct Diversion (NM0030848), and Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) permits do not currently have monitoring requirements nor reporting limits for aluminum. The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to this AU but has plans to divert a portion of their permitted 13 mgd effluent to this AU beginning in 2028. Therefore, aluminum WLA were assigned for each of these permits, see Section 10 – Implementation of TMDLs for additional information.

Table 2.4 NPDES aluminum WLA

Permit	Chronic TR Al criterion (mg/l)	Critical Flow (mgd)	Conversion Factor	RWLA** (lbs/day)
Los Alamos-White Rock WWTP (NM0020133)	1.19	0.5	8.34	4.96
Santa Fe Buckman Direct Diversion (NM0030848)	1.19	7.82	8.34	77.63
Los Alamos National Labs Stormwater Individual Permit (NM0030759)*	1.19	n/a	8.34	67.91
City of Santa Fe WWTP (NM0022292)	1.19	5	8.34	49.62

*See Appendix F for MS4/stormwater jurisdictional area calculation

**These WLAs include reserve WLA. See Implementation Section 10.1.1

Sediment and associated contaminants are considered components of industrial storm water discharges covered under NPDES General Permits. Stormwater discharges from construction activities are transient, occurring mainly during the construction itself, and then only during storm events. Coverage under the NPDES Construction General Permit (CGP) for construction sites greater than one acre, or less than one acre if they are part of a common plan of development, 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. The 2022 CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, and managerial and structural solids, erosion, and sediment control Best Management Practices (BMPs), and/or other controls. The SWPPP must include site-specific interim and permanent stabilization, managerial, and structural solids, erosion and sediment control BMPs and/or other controls that are designed to prevent to the maximum extent practicable an increase in the sediment yield and flow velocity from pre-construction, pre-development conditions to assure that applicable standards in 20.6.4 NMAC, including the antidegradation policy, and TMDL WLAs are met. This requirement applies to discharges both during construction and after construction operations have been completed. Currently in the 2022 CGP, EPA defines "sediment-related parameter" as a pollutant parameter that is closely related to sediment such as turbidity, total suspended solids (TSS), total suspended sediment, transparency, sedimentation, and siltation. For discharge covered under the CGP to a water that is impaired for a parameter other than a sediment-related parameter or nutrients, EPA will inform the operator if any additional controls are necessary to meet water quality standards.

Stormwater discharges from industrial activities and facilities, based on industrial classification codes, may be eligible for coverage under the 2021 NPDES Multi-Sector General Permit (MSGP). The MSGP also requires preparation of a SWPPP. Based on the industrial sector, some of the industrial facilities and activities covered under the MSGP have technology based effluent limitation and/or benchmark monitoring for pollutants. The current MSGP includes state-specific requirements that the benchmark values reflect State of New Mexico WQS.

It is not possible to calculate individual WLAs for facilities covered by the General Permits at this time using the available tools. While these sources are not given individual allocations, they are addressed through

other means, including BMPs, and other stormwater pollution prevention conditions. Implementation of a SWPPP that meets the requirements of a General Permit is generally assumed to be consistent with this TMDL. Loads that are in compliance with the General Permits are therefore currently included as part of the LA.

2.3.3 Load Allocation

In order to calculate the LA, the WLA and the MOS were subtracted from the TMDL, as shown on **Table 2.5**. The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors (see Section 2.3.1 for details).

Table 2.5 TMDL Allocations for Total Recoverable Aluminum (all units in lbs/day)

Assessment Unit	RWLA*	Stormwater WLA	LA	15% MOS	TMDL
Rio de los Pinos (New Mexico reaches)	0	0	72.45	12.79	85.23
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	132.22	67.91	1597.47	199.73	1997.33
Rio San Antonio (CO border to Montoya Canyon)	0	0	187.15	33.03	220.18

* These WLAs include reserve WLA. See Implementation Section 10.1.1

2.3.4 Load Reduction

The extensive data collection and analysis necessary to determine background aluminum loads were beyond the resources available for this study. It is therefore assumed that a portion of the load allocation is made up of natural background loads.

Table 2.6 Load Reduction Estimate to meet WQS for Total Recoverable Aluminum

Assessment Unit	Target Load (lb/day) ^a	Measured Load (lb/day) ^b	Load Reduction ^c
Rio de los Pinos (New Mexico reaches)	72.45	626.70	88.44
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	1692.44	3692.54	54.17
Rio San Antonio (CO border to Montoya Canyon)	187.15	1265.92	85.22

(a) Target Load = TMDL – MOS. The MOS is not included in the load reduction calculations because it is a set aside value, which accounts for any uncertainty or variability in TMDL calculations and therefore should not be subtracted from the measured load.

(b) The measured load is the magnitude of point and nonpoint sources. It is calculated at the TMDL critical flow using the mean measured TR Al concentration from sampling events (**Appendix A**).

(c) Percent reduction is the percent the existing measured load must be reduced to achieve the target load and is calculated as follows: $((\text{Measured Load} - \text{Target Load}) / \text{Measured Load}) \times 100$.

2.4 Probable Pollutant Sources

SWQB conducted an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Revision 2, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; see also **Appendix B**). Probable Source Sheets are filled out by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant.

Table 2.7 displays probable pollutant sources that have the potential to contribute to aluminum impairment within each AU in the TMDL study areas, as determined by field reconnaissance and knowledge of watershed activities. The draft probable source list will be reviewed and modified as necessary, with watershed group/stakeholder input during the TMDL public meeting and comment period. Probable sources of impairment will be further evaluated, refined, and changed as necessary through the Watershed-Based Plan (WBP).

Table 2.7 Probable sources of excessive total recoverable aluminum

Assessment Unit	Probable Sources
Rio de los Pinos (New Mexico reaches)	Crop production, dams/diversions, flow alterations, rangeland grazing
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharges, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl
Rio San Antonio (CO border to Montoya Canyon)	Agriculture, crop production, flow alterations, drought related, habitat modifications, rangeland grazing, low water crossing, roads, streambank erosion

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 watershed geology. Aluminum (Al) is the third most common element in the Earth's crust and the most common metal. Aluminum is present in natural waters in a complex of chemical forms. There is an exchangeable fraction of Al with soils, sediments, and precipitated organic material. However the Geochemical Atlas of Europe (FOREGS, 2005) found that "[p]atterns in stream water (Al) data are markedly different from distributions in the solid sample media, indicating predominance of exogenic factors (topography, climate, vegetation) over bedrock geology control for Al in streams." Anthropogenic surface disturbance may be considered an exogenic factor. All of the AUs newly listed for TR Al impairment in 2020 are located in areas of surface geology which are high in aluminum oxide content, including mafic volcanic rocks (14-18% Al), felsic volcanic rocks (12-16% Al) (<https://opentextbc.ca/geology/chapter/3-3-crystallization-of-magma/>) , and alluvium derived from those sources (**Figure 1.1**).

Aluminum is relatively insoluble at pH 6 to 8, but the solubility of Al increases under more acidic and more alkaline conditions, in the presence of complexing ligands, and at lower temperatures (Gensemer and Playle, 1999). Therefore, in addition to sediment mobilized by overland flow, normal aqueous chemical processes enhanced by the slight natural acidity of snow and rain are capable of dissolving some of the abundant, naturally-occurring aluminum and delivering it into a river system. Aqueous Al is comprised of inorganic Al hydroxy species, of which gibbsite is the most abundant in the pH range (7.17-8.65) encountered at stations with aluminum impairments during the 2017-2018 Upper Rio Grande survey. At pH values greater than 7, aluminum concentration would be expected to increase with increasing pH. However, no correlation of TR Al with pH was apparent in the TMDL AUs (see monitoring data in **Appendix B**).

Wildfires can affect the physical, chemical, and biological quality of streams, rivers, and lakes. After a fire, increased runoff provides a pathway for the transport of chemical-laden sediment to surface water, which may have substantial water quality impacts. Forest fires can result in increased water temperature due to reduced infiltration and loss of shading vegetation. Potential wildfire impacts to water quality are discussed on the SWQB website at <https://www.env.nm.gov/surface-water-quality/wildfire-impacts-on-surface-water-quality/>. Most watershed effects will naturally recover within 5 to 10 years after the fire, but some aspects of watershed structure and function, as well as areas of most severe fire intensity, may continue to recover for 15-20 years (Bixby et al., 2015). Therefore, runoff following forest fire has been added to the Probable Source list (**Table 2.6**) for those TMDL AUs where fires occurred during the 20 years preceding the 2017-18 water quality survey.

2.5 Consideration of Seasonal Variation

Normal aqueous chemical processes, enhanced by the slight natural acidity of snow and rain, are capable of rendering some of the abundant, naturally-occurring aluminum available to a river system, and, as a result of snowmelt, one might expect to see higher aluminum concentrations during spring sampling events in mountainous AUs. For example, there were apparent seasonal pattern to the exceedances documented in both Rio de los Pinos (New Mexico reaches) and Rio San Antonio (CO border to Montoya Canyon), with all observed aluminum exceedances occurring during spring runoff during the months of April and May.

2.6 Future Growth

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth to the year 2050. Rio de los Pinos (New Mexico reaches) and Rio San Antonio (CO border to Montoya Canyon) are both in Rio Arriba county. Rio Grande is in Los Alamos and Sandoval counties. GPS projects that the populations of Rio Arriba county will decline while Los Alamos and Sandoval counties will increase before declining beyond 2035-2040, as detailed on **Table 2.8**.

Table 2.8 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Rio Arriba	40,359	40,266	40,247	40,217	40,185	40,156	40,130
Los Alamos	19,418	19,857	20,439	20,791	20,883	20,793	20,545
Sandoval	148,829	157,468	164,648	169,117	170,460	169,575	166,753

Estimates of future growth are not anticipated to lead to a significant increase in aluminum that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

3.0 *E. COLI*

Escherichia coli (*E. coli*) is a species of coliform bacteria that is present in the intestinal tracts and feces of warm-blooded animals. Most *E. coli* are harmless and are an important part of a healthy human intestinal tract. However, some strains of *E. coli* are pathogenic, meaning they can cause illness, either diarrhea or illness outside of the intestinal tract. It is also used as an indicator of the potential presence of other pathogens that may present human health concerns. In addition to human sources, there are many natural sources of *E. coli* including aquatic mammals, mammals grazing in or near the water, agricultural runoff, avian sources, and in some cases, bacterial regrowth in stream sediments.

Bacterial data collected from the impaired AUs during the 2017-2018 SWQB water quality survey are shown in **Appendix B** and summarized on **Table 3.1**, below. Samples were assessed by comparing the *E. coli* results to the applicable single sample criterion. Assessment of the data identified exceedances of the New Mexico water quality standards for *E. coli* bacteria. As a result, these AUs are listed on the Integrated CWA §303(d)/ §305(b) List with *E. coli* as an impairment of the primary contact designated use (NMED/SWQB, 2026).

Assessment Unit	Water Quality Criterion (single sample, cfu/100mL)	Number of Exceedances
Canada Tio Grande (Rio San Antonio to headwaters)	235	2/8
Rio Nutritas (Rio San Antonio to headwaters)	235	2/5

3.1 Target Loading Capacity

The TMDL is a value calculated at a defined critical flow condition as part of a planning process designed to achieve water quality standards. For these *E. coli* TMDLs, the appropriate critical flow condition is at low flow, to be protective when the assimilative capacity of a stream is at its lowest. This TMDL document uses the ≤ 126 cfu/100 mL monthly geometric mean numeric criterion as the target value for *E. coli* bacteria attainment, rather than the ≤ 235 cfu/100 mL single sample criterion, to provide a conservative protective value and to prevent cases in which the single sample criterion is used as the target and attained but the geometric mean criterion is not attained.

3.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

Because all AUs discussed in this section are ungaged, an analysis method developed by USGS in partnership with NMED, authored by Bell and Tillery (2023) was used to estimate the critical low flow. In the Bell and Tillery analysis, six regression equations for estimating 4Q3 were developed based on

physiographic regions of New Mexico and stream basin characteristics (i.e., statewide and mountainous regions above 8,000 ft in elevation, or basins with less than 75 square mile drainage areas). The average elevation of all AUs in the Upper Rio Grande watershed in this TMDL are above 8,000 ft, and none are the streams in the San Juan watershed, therefore the 4Q3-1a statewide regression equation was used. The following regression equation is based on data from 44 gaging stations with non-zero discharge (Bell, Tillery, 2023):

Equation 3.1: $4Q3 = DA^{1.08} \times E^{12.20} \times e^{-115.37}$

Where:

4Q3 = Four-day, three-year low-flow frequency (cfs)

DA = drainage area (mi²)

E = mean basin elevation (ft)

e = mathematical constant, Euler's number

The 4Q3 value calculated using the USGS Bell and Tillery method are presented in **Table 3.2**. Parameters used in the calculation were obtained using the StreamStats online GIS application developed by the USGS (<https://streamstats.usgs.gov/ss/>). The flow was converted from cfs to million gallons per day (mgd) using a conversion factor of 0.646. The TMDL itself is a value calculated at a defined critical condition as part of a planning process designed to achieve water quality standards. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve instream water quality is the goal of SWQB efforts.

Table 3.2 - Calculation of 4Q3 for E. coli TMDLs

Assessment Unit	Drainage Area (mi ²)	Average Elevation (ft)	4Q3 (cfs)	4Q3 (mgd)
Canada Tio Grande (Rio San Antonio to headwaters)	11.0	9607	0.405	0.262
Rio Nutritas (Rio San Antonio to headwaters)	12.4	9551	0.429	0.277

3.3 TMDL Calculations

The WQS for bacteria are expressed as colony forming units (cfu) per unit volume. TMDLs for bacteria (**Table 3.3**) were calculated based on critical flow values (**Table 3.2**), water quality standards, and a conversion factor, using **Equation 3.2**.

Equation 3.2 $C \text{ as } \frac{cfu}{100mL} * 1000 \frac{mL}{L} * \frac{L}{0.264 \text{ gallons}} * Q \text{ in } 1,000,000 \frac{\text{gallons}}{\text{day}} = cfu/\text{day}$

Where C = water quality criterion for bacteria

Q = the critical stream flow in million gallons per day (MGD)

Table 3.3 – TMDL calculations

Assessment Unit	Geometric Mean <i>E. coli</i> criterion (cfu/100 mL)	Critical Flow (mgd)	Conversion Factor	TMDL (cfu/day)
Canada Tio Grande (Rio San Antonio to headwaters)	126	0.262	3.79×10^7	1.25×10^9
Rio Nutritas (Rio San Antonio to headwaters)	126	0.277	3.79×10^7	1.32×10^9

3.3.1 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 these bacteria TMDLs, the MOS was developed using a combination of conservative assumptions and inputs and explicit recognition of potential errors in flow calculations. Therefore, the MOS is the sum of the following:

- *Conservative Assumptions:*

E. coli bacteria do not readily degrade in the environment; and,

Basing the target load capacity on the geometric mean criterion rather than the higher-concentration single sample criterion; and

- *Explicit recognition of potential errors:*

There is inherent error in all flow estimations; a conservative **explicit MOS for this element in gaged streams is 5%**; a conservative **explicit MOS for this element in ungaged streams is 10%**.

3.3.2 Waste Load Allocation

There are no National Pollutant Discharge Elimination System (NPDES) individual permits that discharge to the *E. coli* impaired TMDL drainages. Therefore, no WLA is assigned for this TMDL.

Stormwater discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the USEPA NPDES Construction General Permit (CGP) for construction sites of one or more acres, or smaller if part of a common plan of development, 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. The current CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, managerial, and structural solids, erosion, and sediment control Best Management Practices (BMPs), and/or other controls. BMPs are designed to prevent to the maximum extent practicable an increase in sediment load to the water body or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc. BMPs also include measures to reduce flow velocity during and after construction compared to pre-construction conditions to assure that waste load allocations and/or applicable water quality standards, including the antidegradation policy, are met. Compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Stormwater discharges from industrial activities and facilities, based on industrial classification codes, may be eligible for coverage under the current NPDES Multi-Sector General Permit (MSGP). The MSGP also requires preparation of a SWPPP. Some of the industrial facilities and activities covered under the MSGP have technology based effluent limitation and/or benchmark monitoring for pollutants. The current MSGP includes state-specific requirements that the benchmark values be protective of State of New Mexico WQS.

It is not possible to calculate individual WLAs for facilities covered by the General Permits at this time using the available tools. The discharges from these permits are typically transitory as the activities are temporary. Loads that are in compliance with the General Permits are therefore currently included as part of the Load Allocation (LA). While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

3.3.3 Load Allocation

In order to calculate the LA, the WLA and MOS are subtracted from the TMDL using the equation below.

$$WLA + LA + MOS = TMDL$$

Since there is no WLA, the LA is equal to the TMDL minus the MOS. Results of the load calculations are presented in **Table 3.4**. The extensive data collection and analyses necessary to determine background *E. coli* loads are beyond the resources available for this study. It is assumed that a portion of the LA is made up of natural background loads. It is important to note that WLAs and LAs are estimates based on a specific flow condition. Under differing hydrologic conditions, the loads will change. Successful implementation of this TMDL will be determined based on attainment of the *E. coli* standards under all flow conditions.

Table 3.4 – Load Allocations for *E. coli*

Assessment Unit	WLA	LA	MOS (10%)	TMDL
Canada Tio Grande (Rio San Antonio to headwaters)	0	1.13×10^9	1.25×10^8	1.25×10^9
Rio Nutritas (Rio San Antonio to headwaters)	0	1.19×10^9	1.32×10^8	1.32×10^9

E. coli impairment determinations were based on exceedances of the State's single sample criteria and the TMDL is written to address the monthly geometric mean standard. As such, a simple comparison of the numbers would not necessarily represent an amount of contaminant reduction that would result in removing the impairment and would instead result in an overestimation of the actual reduction necessary. Neither Section 303 of the Clean Water Act nor 40 C.F.R. Part 130.7 requires states to include discussions of percent reductions in TMDL documents. Although NMED believes that it is often useful to discuss the magnitude of water quality exceedances in the TMDL, the "percent reduction" value can be calculated in multiple ways and as a result is often misinterpreted. Therefore, a percent reduction value is not provided for *E. coli* TMDLs.

3.4 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; **Appendix C**). Probable Source Sheets are filled out by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant. Pollutant sources that may contribute to each impairment were determined by field reconnaissance and evaluation (**Table 3.5**). Probable sources of bacteria impairments will be evaluated, refined, and changed as necessary through the Watershed Based Plans.

Table 3.5 – Probable Sources

Assessment Unit	Probable Sources
Canada Tio Grande (Rio San Antonio to headwaters)	Forest Roads, Grazing in Riparian Zone, Rangeland Grazing
Rio Nutritas (Rio San Antonio to headwaters)	Forest Roads, Grazing in Riparian Zone, Rangeland Grazing

3.5 Consideration of Seasonal Variation

Federal regulations (40 C.F.R. § 130.7(c)(1)) require that TMDLs take into consideration seasonal variation in watershed conditions and pollutant loading. Data used in the calculation of these TMDLs were collected during the spring, summer, and fall of 2017 and 2018 in order to ensure coverage of potential seasonal variation in the system. In both AUs, exceedances of the WQS were documented only in summer and early fall (July, September and October). This pattern is consistent with the findings of Hulvey et al. (2021) that *E. coli* peaked in midsummer in Utah streams running through grazed or ungrazed grasslands, with higher peaks in the grazed meadows.

3.6 Future Growth

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth to the year 2050. Four out of the 5 current *E. coli* TMDL AUs fall within Taos County. The Rio Quemado (Santa Cruz R to headwaters) AU flows through Rio Arriba and Santa Fe Counties. GPS projects that the populations of Rio Arriba county will decline and Santa Fe and Taos counties will increase, as detailed on **Table 3.6**.

Table 3.6 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Rio Arriba	40,359	40,266	40,247	40,217	40,185	40,156	40,130
Santa Fe	154,823	160,347	164,745	167,424	168,148	167,499	165,656
Taos	34,488	35,367	35,949	36,300	36,391	36,299	36,048

Estimates of future growth are not anticipated to lead to a significant increase in bacteria that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

4.0 ADJUSTED GROSS ALPHA

A radionuclide is a radioactive form of an element with an unstable nucleus. Gross alpha is “the total amount of energy that is released from naturally-occurring radionuclides and some of the heaviest radioactive elements such as uranium, thorium, radium, lead, radon, and polonium as they breakdown or decay” (Know Your H₂O, 2025). Radionuclides can occur naturally in the environment and can also be from anthropogenic sources or produced as byproducts of nuclear reactions. According to the California Water Board (2026), gross alpha particles are “a type of radiation emitted by radionuclides. They consist of two protons and two neutrons...U-238, Ra-226 and Rd-222 are examples of alpha particle emitters. Alpha emitters are used to treat cancer, as a static eliminator in paper mills and other industries, and in smoke detectors.” Radionuclides are known carcinogens and target the bone, liver, and reproductive organs.

4.1 Target Loading Capacity

The New Mexico WQS include adjusted gross alpha criteria of 15 pCi/L for livestock watering as outlined in 20.6.4.900 NMAC. Specifically, adjusted gross alpha is defined as follows-

“total radioactivity due to alpha particle emission as inferred from measurements on a dry sample, including radium-226, but excluding radon-222 and uranium. Also excluded are source, special nuclear and by-product material as defined by the Atomic Energy Act of 1954.”
20.6.4.7(A)(6) NMAC

The assessment approach used to determine adjusted gross alpha impairments is described in detail in Section 3.6 of the SWQB Comprehensive Assessment and Listing Methodology (CALM; NMED/SWQB, 2025).

Table 4.1 Exceedances of the Adjusted Gross Alpha WQS

Assessment Unit	Water Quality Criterion	Number of Exceedances
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	15 pCi/L	8/15 (2012) 34/65 (2016) 5/17 (2020)

4.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

These TMDLs are calculated for each reach at specific flows. When available, USGS gages are used to estimate flow especially in assessment units (AUs) where collecting flow measurements are not possible. Where gages are absent, flows may be modeled. Gaged streamflow data are not available for Rio Grande above Cochiti Reservoir therefore flow was measured by the Rio Grande at Otowi Bridge gage (USGS 08313000) located at the bottom of the upstream AU, and critical flow was calculated using the USGS SW Toolbox version 1.1. The critical flow, calculated as 4Q3, was 312 cfs for the time period 2011 through June

2026, the period during which the Buckman Direct Diversion (BDD) has been operating. The following equation (Thomas 1997) was used to estimate flow downstream in the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit:

Equation 4.1

$$Q_u = Q_g \left(\frac{A_u}{A_g} \right)^{0.5}$$

where,

- Q_u = discharge at ungaged site, cfs
- Q_g = discharge at gaged site, cfs
- A_u = Drainage area at the ungaged site, (square miles [mi^2])
- A_g = Drainage area at the gaged site, (mi^2)

In this case, the discharge at the ungaged site (cfs) was calculated as the critical flow, or 4Q3, using the USGS gage Rio Grande at Otowi Bridge as the “discharge at gaged site” in this equation.

Using this equation, a flow of 315 cfs, or 204 mgd, was calculated for the Rio Grande at Cochiti reservoir, however this result does not account for the diversion of city of Santa Fe drinking water via the Buckman Direct Diversion (BDD). The BDD 3-year maximum diversion (7.822 mgd) was subtracted from this result, which yielded a critical flow of 195.75 mgd. The White Rock WWTP was also located in this AU, with a design flow of 0.5 mgd. According to correspondence with the City of Santa Fe, the City has future plans (2028) to divert a portion of the City of Santa Fe Paseo Real WWTP (NM0022292) effluent to this assessment unit, resulting in an additional 0-5 mgd flow. The maximum 5 mgd flow option was added onto the flow of this assessment unit. This resulted in a final critical flow of 201.25 mgd or 311.4 cfs for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

4.3 TMDL Calculations

The TMDL is defined as the mass of pollutant that can be carried under critical flow conditions without violating the target concentration for that constituent. The TMDL is calculated based on simple dilution using critical flow, the numeric target, and a conversion factor to correct the units of measure, according to the formula:

Equation 4.2 $WQS (pCi/L) \times Critical\ flow (4Q3) \times Conversion\ Factor (3.785 \times 10^6) = TMDL (pCi/day)$

Table 4.2 Adjusted Gross Alpha TMDL calculations

Assessment Unit	Adjusted Gross Alpha criteria (pCi/L)	Critical Flow (mgd)	Conversion Factor	TMDL (pCi/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	15	201.25	3.79×10^6	1.14×10^{10}

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 at all times is the goal. The TMDL is

further allocated to a MOS, WLA (permitted point sources), and LA (non-point sources), according to the formula:

$$\text{Equation 4.3: } WLA + LA + MOS = TMDL$$

4.3.1 Margin of Safety

The CWA requires that each TMDL be calculated with a MOS. 33 U.S.C. § 1313(d)(1). This statutory requirement that TMDLs incorporate a MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. A MOS may be expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions). The MOS may be implicit, utilizing conservative assumptions for calculation of the loading capacity, WLAs, and LAs. The MOS may also be explicitly stated as an added separate quantity in the TMDL calculation. For this sediment TMDL, the MOS was developed using explicit allocations. Therefore, this MOS is the sum of the following elements:

- *Explicit recognition of potential errors:*
 - There is inherent error in flow estimation, a conservative MOS for this element in is **10%**.

Total MOS for this TMDL is **10%**.

4.3.2 Waste Load Allocation

There are four active individual National Pollutant Discharge Elimination System (NPDES) permits that discharge to the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) AU.

The Los Alamos County White Rock WWTP (NM0020133) and City of Santa Fe Buckman Direct Diversion (NM0030848) permits do not currently have monitoring requirements nor reporting limits for adjusted gross alpha. The Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) includes monitoring requirements for adjusted gross alpha. The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to this AU but has plans to divert a portion of their permitted 13 mgd effluent to this AU in the future. Therefore, adjusted gross alpha WLA were assigned for each of these permits, see Section 10 – Implementation of TMDLs for additional information.

Table 4.3 NPDES adjusted gross alpha WLA

Permit	Adjusted Gross Alpha criteria (pCi/L)	Critical Flow (mgd)	Conversion Factor	WLA (pCi/day)**
Los Alamos-White Rock WWTP (NM0020133)	15	0.5	3.79×10^6	2.84×10^7
Santa Fe Buckman Direct Diversion (NM0030848)	15	7.82	3.79×10^6	4.44×10^8
Los Alamos National Labs Stormwater Individual Permit (NM0030759)*	15	n/a	n/a	3.81×10^7
City of Santa Fe WWTP (NM0022292)	15	5	3.79×10^6	2.84×10^8

*See Appendix F for MS4/stormwater jurisdictional area calculation

**These WLAs include reserve WLA. Traditional WLA for NM0030759. See Implementation Section 10.1.1

Stormwater discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the USEPA NPDES Construction General Permit (CGP) for construction sites of one or more acres, or smaller if part of a common plan of development, 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. The current CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, managerial, and structural solids, erosion, and sediment control Best Management Practices (BMPs), and/or other controls. BMPs are designed to prevent to the maximum extent practicable an increase in sediment load to the water body or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc. BMPs also include measures to reduce flow velocity during and after construction compared to pre-construction conditions to assure that waste load allocations and/or applicable water quality standards, including the antidegradation policy, are met. Compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Stormwater discharges from industrial activities and facilities, based on industrial classification codes, may be eligible for coverage under the current NPDES Multi-Sector General Permit (MSGP). The MSGP also requires preparation of a SWPPP. Some of the industrial facilities and activities covered under the MSGP have technology based effluent limitation and/or benchmark monitoring for pollutants. The current MSGP includes state-specific requirements that the benchmark values be protective of State of New Mexico WQS.

It is not possible to calculate individual WLAs for facilities covered by the General Permits at this time using the available tools. The discharges from these permits are typically transitory as the activities are temporary. Loads that are in compliance with the General Permits are therefore currently included as part of the Load Allocation (LA). While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

4.3.3 Load Allocation

Load Allocation is pollution from any nonpoint source(s) or natural background and is addressed through Best Management Practices (BMPs). To calculate the LA, the WLA and the MOS were subtracted from the TMDL using **Equation 4.3**, as shown on **Table 4.4**. The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors (see **Section 4.3.1** for details).

Table 4.4 TMDL allocations for Adjusted Gross Alpha

Assessment Unit	WLA* (pCi /day)	Stormwater WLA (pCi/day)	LA (pCi /day)	10% MOS	TMDL (pCi/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	7.56×10^8	3.81×10^7	9.48×10^9	1.14×10^9	1.14×10^{10}

*These WLAs include reserve WLA. Traditional WLA for NM0030759. See Implementation Section 10.1.1

4.4 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; **Appendix C**). Probable Source Sheets are filled out by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant. Pollutant sources that may contribute to each impairment were determined by field reconnaissance and evaluation (**Table 4.6**). Probable sources of bacteria impairments will be evaluated, refined, and changed as necessary through the Watershed Based Plans.

Table 4.6 – Probable Sources

Assessment Unit	Probable Sources
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharges, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl

4.5 Consideration of Seasonal Variation

Section 303(d)(1) of the CWA requires TMDLs to be “established at a level necessary to implement the applicable WQS with seasonal variation.” The critical condition used for calculating the TMDL is considered conservative and protective of the water quality standard under all flow conditions. Calculations made at the critical flow, in addition to using other conservative assumptions as described in the previous section on MOS, should be protective of the water quality standards designed to preserve aquatic life in the

stream. It was assumed that if critical conditions were met during this time, coverage of any potential seasonal variation would also be met.

4.6 Future Growth

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth until decreasing after 2035-2040. Rio Grande is in Los Alamos and Sandoval Counties. GPS projects that the populations of these counties will increase, as detailed on **Table 4.7**.

Table 4.7 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Los Alamos	19,418	19,857	20,439	20,791	20,883	20,793	20,545
Sandoval	148,829	157,468	164,648	169,117	170,460	169,575	166,753

Estimates of future growth are not anticipated to lead to a significant increase in adjusted gross alpha that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

5.0 PLANT NUTRIENTS

Phosphorus and nitrogen are essential for proper functioning of ecosystems. However, excess nutrients cause conditions unfavorable for the proper functioning of aquatic ecosystems. Nuisance levels of algae and other aquatic vegetation (macrophytes) can develop rapidly in response to nutrient enrichment when other factors (e.g., light, temperature, substrate) are not limiting (**Figure 5.1**). However, the magnitude of nutrient concentration that constitutes an “excess” is difficult to determine and varies by ecoregion.

Phosphorus and nitrogen generally drive the productivity of algae and macrophytes in aquatic ecosystems, therefore they are regarded as the primary limiting nutrients in freshwater. The main reservoirs of natural phosphorus are rocks and natural phosphate deposits. Weathering, leaching, and erosion are all processes that break down rock and mineral deposits allowing phosphorus to be transported to aquatic systems via water or wind. The breakdown of mineral phosphorus produces inorganic phosphate ions (H_2PO_4^- , HPO_4^{2-} , and PO_4^{3-}) that can be absorbed by plants from soil or water (USEPA, 1999). Phosphorus primarily moves through the food web as organic phosphorus (after it has been incorporated into plant or algal tissue) where it may be released as phosphate in urine or other waste by heterotrophic consumers and reabsorbed by plants or algae to start another cycle (Nebel and Wright, 2000).

The largest global reservoir of nitrogen is the atmosphere. About 80% of the atmosphere by volume consists of nitrogen gas (N_2). Although nitrogen is plentiful in the environment, it is not readily available for biological uptake. Nitrogen gas must be converted to other forms, such as ammonia (NH_3 and NH_4^+), nitrate (NO_3^-), or nitrite (NO_2^-) before plants and animals can use it. Conversion of gaseous nitrogen into usable mineral forms occurs through three biologically mediated processes of the nitrogen cycle: nitrogen fixation, nitrification, and ammonification (USEPA, 1999). Mineral forms of nitrogen can be taken up by plants and algae and incorporated into their tissue. Nitrogen follows the same pattern of food web incorporation as phosphorus and is released in waste primarily as ammonium compounds. The ammonium compounds are usually converted to nitrates by nitrifying bacteria, making it available again for uptake, starting the cycle anew (Nebel and Wright, 2000).

Rain, overland runoff, groundwater, drainage networks, and industrial and residential waste effluents transport nutrients to receiving waterbodies. Once nutrients have been transported into a waterbody they can be taken up by algae, macrophytes, and microorganisms either in the water column or in the benthos; they can sorb to organic or inorganic particles in the water column and/or sediment; they can accumulate or be recycled in the sediment; or they can be transformed and released as a gas from the waterbody (**Figure 5.1**).

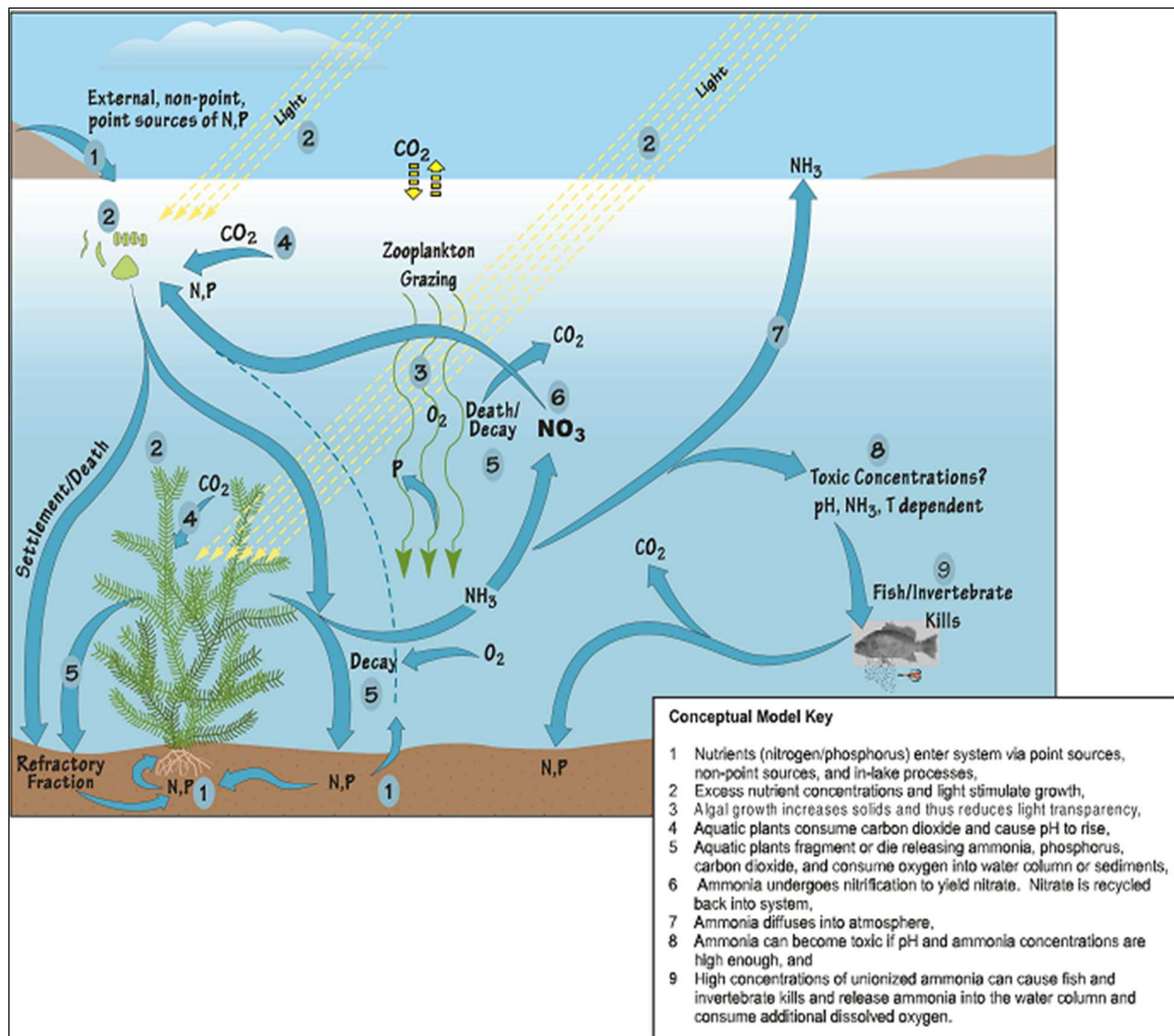


Figure 5.1 Nutrient conceptual model (USEPA 1999)

5.1 Target Loading Capacity

The intent of nutrient criteria, whether numeric or narrative, is to limit nutrient inputs to control the excessive growth of attached algae and higher aquatic plants. Controlling algae and plant growth preserves aesthetic and ecologic characteristics along the waterway. While conceptually there may be several possible combinations of total nitrogen (TN) and total phosphorus (TP) concentrations that are protective of water quality, the application of simple chemical limitation concepts to a complex biologic system to determine these combinations is challenging. One of the primary reasons for this is that different species of algae and higher aquatic plants will have different nutritional needs. Some species will thrive in nitrogen limited environments while others will thrive in phosphorous limited environments. Because of the diversity of nutritional needs amongst organisms, numeric thresholds for both TN and TP are required to preserve the aesthetic and ecologic characteristics along a waterway. Focusing on one

nutrient or trading a decrease in one for an increase in the other may simply favor a particular species without achieving water quality standards.

New Mexico has a narrative criterion for plant nutrients set forth in 20.6.4.13(E) NMAC:

Plant Nutrients: *Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in the dominance of nuisance species in surface waters of the state.*

This narrative criterion can be challenging to assess because the relationships between nutrient levels and impairment of designated uses are not defined, and distinguishing nutrients from “other than natural causes” is difficult. Numeric thresholds are necessary to establish targets for TMDLs, to develop water quality-based permit limits and source control plans, and to support designated uses within the watershed.

Excess nutrients are an ongoing water quality concern and priority nationally and for New Mexico. (EPA 2022). In 2015 and 2016, SWQB collaborated with Tetra Tech, Inc., the EPA Region 6, and EPA’s National Nutrient Criteria Program Nutrient Scientific Technical Exchange Partnership and Support (N-STEPS) program on a project to revise nutrient impairment thresholds for streams and rivers in New Mexico. This project follows EPA’s nutrient criteria guidance (EPA, 2010) and Empirical Approaches for Nutrient Criteria Derivation (EPA, 2009). Statistical analyses of available state and regional data were conducted to refine nutrient thresholds using defined reference conditions, relationships between cause and response variables and a verified classification system. TN and TP candidate thresholds were derived for each site class using frequency distributions of nutrient conditions, defined as the median site value (Jessup et al. 2015), in least disturbed sites. Comparing site medians rather than individual sampling events to numeric thresholds is better aligned with the intention of identifying chronic excessive nutrients conditions. The resultant candidate thresholds were evaluated by SWQB staff, and the selected thresholds were used to revise this nutrient listing methodology. The 100+ page report (Jessup et al., 2015) detailing the N-STEPS effort is available at <https://www.env.nm.gov/surface-water-quality/nutrients/>. SWQB also generated and posted a shorter document which summarizes the steps taken to determine the candidate thresholds, and SWQB’s logic regarding final threshold selection (NMED/SWQB, 2016). NMED is conducting the 2025-2026 Rio Grande Nutrients Monitoring Survey to support development of defensible, data-driven nutrient thresholds specific to the Rio Grande in New Mexico. Data collected during this survey will be part of an additional N-STEPS project resulting in nutrient thresholds for the Rio Grande to be included in the 2027 CALM.

Phosphorous is found in water primarily as orthophosphate. In contrast nitrogen may be found as several dissolved species, all of which must be considered in nutrient loading. Total nitrogen is defined by SWQB as the sum of nitrate+nitrite (N+N), and Total Kjeldahl Nitrogen (TKN) (NMED/SWQB, 2017). At the present time, there is no USEPA-approved method to test for total nitrogen, however adding the results of USEPA methods 351.2 (TKN) and 353.2 (N+N) is appropriate for estimating total nitrogen. While not an EPA-approved method, Method SM4500-N for Total Nitrogen using a persulfate digest, is an approved method in the SWQB QAPP (NMED/SWQB, 2020) and is used in cases where a lower detection limit is needed. Daily delta DO, a response variable, is defined as the difference between the maximum and minimum DO concentration within a 24-hour period. The applicable stream threshold values for the Rio Hondo stream TMDL are shown on **Table 5.1a**. These threshold values were used for water quality assessments and TMDL development in streams. NMED does not currently have nutrient thresholds for rivers, therefore,

nutrient thresholds for rivers in **Table 5.1b** are the Ecoregion 21 values listed in the Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion II (EPA, 2000).

Nutrient assessments were conducted on data collected during the 2017-2018 water quality survey. Data contributing to the impairment determination are shown in **Appendix B**. Neither assessment unit is currently impaired for nutrients. The TMDLs in this section are protective TMDLs.

Table 5.1a Causal and response variable thresholds for stream plant nutrients TMDL (NMED/SWQB, 2025)

Assessment Unit*	Site Class	TN (mg/L)	TP (mg/L)	Delta DO
Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	TN: Steep TP: Steep	0.30	0.03	1.79

*Protective TMDL

Table 5.1b Ecoregion 21 Ambient Water Quality Criteria Recommendations for river plant nutrients TMDL (EPA, 2000)

Assessment Unit*	TN (mg/L)	TP (mg/L)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	6.45	1.1

*Protective TMDL

5.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

Because all AUs discussed in this section are ungaged, an analysis method developed by USGS in partnership with NMED, authored by Bell and Tillery (2023) was used to estimate the critical low flow. In the Bell & Tillery analysis, six regression equations for estimating 4Q3 were developed based on physiographic regions of New Mexico and stream basin characteristics (i.e., statewide and mountainous regions above 8,000 ft in elevation, or basins with less than 75 square mile drainage areas). The average elevation of all impaired AUs in the Upper Rio Grande watershed are above 8,000 ft and are not the San Juan River nor tributaries to the San Juan, so the 4Q3-1a statewide regression equation was used. The following regression equation is based on data from 44 gaging stations with non-zero discharge (Bell, Tillery, 2002):

Equation 3.1: $4Q3 = DA^{1.08} \times E^{12.20} \times e^{-115.37}$

Where:

$4Q3$ = four-day, three-year low-flow frequency (cfs)

DA = drainage area (mi²)

E = mean basin elevation (ft)

e = mathematical constant, Euler's number

The 4Q3 values calculated using Bell & Tillery's method are presented in **Table 5.2**. Parameters used in the calculation were obtained using the StreamStats online GIS application developed by the USGS (<https://streamstats.usgs.gov/ss/>). The flow was converted from cfs to million gallons per day (mgd) using a conversion factor of 0.646. The TMDL itself is a value calculated at a defined critical condition as part of a planning process designed to achieve water quality standards. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve instream water quality is the goal of SWQB efforts.

When available, USGS gages are used to estimate flow especially in assessment units (AUs) where collecting flow measurements are not possible. Where gages are absent, flows may be modeled. Gaged streamflow data are not available for Rio Grande above Cochiti Reservoir therefore flow was measured by the Rio Grande at Otowi Bridge gage (USGS 08313000) located at the bottom of the upstream AU, and critical flow was calculated using the USGS SW Toolbox version 1.1. The critical flow, calculated as 4Q3, was 312 cfs for the time period 2011 through June 2026, the period during which the Buckman Direct Diversion (BDD) has been operating. The following equation (Thomas 1997) was used to estimate flow downstream in the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit:

Equation 5.2

$$Q_u = Q_g \left(\frac{A_u}{A_g} \right)^{0.5}$$

where,

Q_u = discharge at ungaged site, cfs

Q_g = discharge at gaged site, cfs

A_u = Drainage area at the ungaged site, (square miles [mi²])

A_g = Drainage area at the gaged site, (mi²)

In this case, the discharge at the ungaged site (cfs) was calculated as the critical flow, or 4Q3, using the USGS gage Rio Grande at Otowi Bridge as the "discharge at gaged site" in this equation.

Using this equation, a flow of 315 cfs, or 204 mgd, was calculated for the Rio Grande at Cochiti reservoir, however this result does not account for the diversion of city of Santa Fe drinking water via the Buckman Direct Diversion (BDD). The BDD 3-year maximum diversion (7.822 mgd) was subtracted from this result, which yielded a critical flow of 195.75 mgd. The White Rock WWTP was also located in this AU, with a design flow of 0.5 mgd. According to correspondence with the City of Santa Fe, the City has future plans to divert a portion of the City of Santa Fe Paseo Real WWTP (NM0022292) effluent to this assessment unit,

resulting in an additional 0-5 mgd flow. The maximum 5 mgd flow option was added onto the flow of this assessment unit. This resulted in a final critical flow of 201.25 mgd or 311.4 cfs for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

Table 5.2 Critical flow for nutrient TMDL AUs

Assessment Unit	Drainage Area (mi ²)	Average Elevation (ft)	4Q3 (cfs)	4Q3 (mgd)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	n/a	n/a	311	201
Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	21.1	10,682	2.99	1.93

5.3 TMDL Calculations

As a river flows downstream it has a specific loading capacity for nutrients. This loading capacity, or TMDL, is defined as the mass of pollutant that can be carried under critical flow conditions without violating the target concentration for that constituent. These TMDLs were developed based on simple dilution calculations using critical flows, the numeric target, and a conversion factor used to convert the resulting TMDL to lb/day units. The specific loading capacity of a receiving water for a given pollutant was estimated using **Equation 5.2**. The calculated daily loading capacities (i.e., TMDLs) for TP and TN are summarized in **Table 5.4**.

Every stream and river has a specific carrying capacity for nutrients based on applicable WQS. This carrying capacity, or TMDL, is defined as the concentration of pollutant that can be carried without violating the target concentration for that constituent. The specific carrying capacity of a receiving water for a given pollutant was estimated using **Equation 5.3**.

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 at all times is the goal. The TMDL is further allocated to a MOS, WLA (permitted point sources), and LA (non-point sources), according to the formula:

Equation 5.2: $Critical\ flow\ (4Q3) \times WQS\ (mg/L) \times Conversion\ Factor = TMDL\ (lbs/day)$

Equation 5.3: $WLA + LA + MOS = TMDL$

Table 5.3 Stream & River TMDL calculations for TN/TP

Assessment Unit	Parameter	Critical Flow (mgd)	In-Stream Target (mg/L)	Conversion Factor	TMDL (lbs/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)*	Total Nitrogen	201	6.45	8.34	10812.39
	Total Phosphorus		1.1		1843.97
Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)**	Total Nitrogen	1.93	0.30	8.34	4.83
	Total Phosphorus		0.1		1.61

* From EPA Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion II (EPA, 2000).

** CALM (NMED/SWQB, 2025) “steep” thresholds for TN and 20.6.4.129 NMAC segment-specific TP 0.1 mg/L criterion.

5.3.1 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. The MOS can be expressed either implicitly or explicitly. An implicit MOS is incorporated by making conservative assumptions in the TMDL analysis, such as allocating a conservative load to background sources. An explicit MOS is applied by reserving a portion of the TMDL and not allocating it to any other sources.

For this nutrient TMDL, the margin of safety was developed using a combination of conservative assumptions and explicit recognition of potential errors. Therefore, this margin of safety is the sum of the following elements:

- *Conservative assumptions*
 - Treating phosphorus and nitrogen as pollutants that do not readily degrade in the environment.
 - An implicit margin of safety is added by setting a TMDL that, if achieved, would not exceed the threshold at any time, whereas the WQS thresholds are based on the median measured concentration.
- *Explicit recognition of potential errors*
 - There is inherent error in flow estimation, a conservative MOS for this element in ungaged streams is **10%**.

The total MOS for this TMDL is **10%**.

5.3.2 Waste Load Allocation

There are four active individual National Pollutant Discharge Elimination System (NPDES) permits that have the potential to discharge to the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) AU. There is one NPDES permit that discharges to the Rio Hondo.

EPA (with NMED and City of Santa Fe staff) completed the Life Cycle Analysis project (EPA, 2023) to provide upgrade options for the Paseo Real WWTP. The report overall recommended Scenario 1-Sidestream Filtration with target effluent concentrations of 4.5 mg/L TN and 0.7 mg/L TP. These values are reflected in **Table 5.7**. The baseline values of 5 mg/L TN and 1 mg/L TP are reflected in **Tables 5.4-5.6**.

The Los Alamos County White Rock WWTP (NM0020133), City of Santa Fe Buckman Direct Diversion (NM0030848), and Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) do not currently have monitoring requirements nor reporting limits for plant nutrients. The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to this AU but has plans to divert a portion of their permitted 13 mgd effluent to this AU in 2028. Therefore, plant nutrient WLA were assigned for each of these permits, see Section 10 – Implementation of TMDLs for additional information

WLAs for Los Alamos County White Rock WWTP, City of Santa Fe Buckman Direct Diversion, Los Alamos National Laboratory Individual Stormwater Permit, and City of Santa Fe Paseo Real WWTP are presented in **Tables 5.4 – 5.8**.

Table 5.4 Wasteload Allocation for Los Alamos County White Rock WWTP (NM0020133)

Phase	Parameter	Target limit (mg/L)	WLA (lbs/day) ^(c)
1 st (a)	Total Nitrogen	5.0	20.85
	Total Phosphorus	1.0	4.17
2 nd (b)	Total Nitrogen	TBD	TBD
	Total Phosphorus	TBD	TBD
nth	Total Nitrogen	TBD*	TBD*
	Total Phosphorus	TBD*	TBD*

TBD = to be determined TBD* = pending finalization of large river nutrient threshold project

^(a) The target limits are based on the baseline values used in the EPA Life Cycle Assessment (USEPA, 2023)

^(b) To be evaluated next permit cycle and TMDL revised if necessary. See Section 10.

^(c) WLA calculated using Equation 5.2 and 0.5 mgd design flow.

Table 5.5 Wasteload Allocation for City of Santa Fe Buckman Direct Diversion (NM0030848)

Phase	Parameter	Target limit (mg/L)	RWLA (lbs/day) ^{(c)*}
1 st ^(a)	Total Nitrogen	5.0	326.18
	Total Phosphorus	1.0	65.24
2 nd ^(b)	Total Nitrogen	TBD	TBD
	Total Phosphorus	TBD	TBD
nth	Total Nitrogen	TBD*	TBD*
	Total Phosphorus	TBD*	TBD*

TBD = to be determined. TBD* = pending finalization of large river nutrient threshold project

^(a) The target limits are based on the baseline values used in the EPA Life Cycle Assessment (USEPA, 2023)

^(b) To be evaluated next permit cycle and TMDL revised if necessary. See Section 10.

^(c) WLA calculated using Equation 5.2 and 7.822 mgd design flow.

*These WLAs include reserve WLA. See Implementation Section 10.1.1

Table 5.6 Wasteload Allocation for LANL Stormwater Individual Permit (NM0030759)

Phase	Parameter	Target limit (mg/L)	RWLA (lbs/day) ^{(c)*}
1 st ^(a)	Total Nitrogen	5.0	36.79
	Total Phosphorus	1.0	0.01
2 nd ^(b)	Total Nitrogen	TBD	TBD
	Total Phosphorus	TBD	TBD
nth	Total Nitrogen	TBD*	TBD*
	Total Phosphorus	TBD*	TBD*

TBD = to be determined. TBD* = pending finalization of large river nutrient threshold project

^(a) The target limits are based on the baseline values used in the EPA Life Cycle Assessment (USEPA, 2023)

^(b) To be evaluated next permit cycle and TMDL revised if necessary. See Section 10.

^(c) WLA calculated using jurisdictional area approach outlined in Appendix F

*These WLAs include reserve WLA. See Implementation Section 10.1.1

Table 5.7 Wasteload Allocation for City of Santa Fe Paseo Real WWTP (NM0022292)

Phase	Parameter	Target limit (mg/L)	WLA (lbs/day) ^(d)
0 (current permit) ^(a)	Total Nitrogen	6.9	n/a
	Total Phosphorus	3.1	
1 st	Total Nitrogen	4.5 ^(b)	187.65
	Total Phosphorus	0.7 ^(b)	29.19
2 nd ^(c)	Total Nitrogen	TBD	TBD
	Total Phosphorus	TBD	TBD
nth	Total Nitrogen	TBD*	TBD*
	Total Phosphorus	TBD*	TBD*

TBD = to be determined. TBD* = pending finalization of large river nutrient threshold project

^(a) Current permit limits for 13 mgd discharge to Santa Fe River. Target limits are informational only and WLA is not applicable to this Rio Grande TMDL

^(b) The target limits are based on the Scenario 1 recommendations in the EPA Life Cycle Assessment

^(c) To be evaluated next permit cycle and TMDL revised if necessary. See Section 10.

^(d) WLA calculated using Equation 5.2 and 5 mgd design flow.

Table 5.8 Wasteload Allocation for NM0022101 (Taos Ski Valley)*

Phase	Parameter	Target limit (mg/L)	WLA (lbs/day) ^(e)
0 (current permit) ^(a)	Total Nitrogen	8.2-27.9	n/a
	Total Phosphorus	0.5-2.5	n/a
1 st ^(b)	Total Nitrogen	4.15 mg/L (TN-Season 1)	10.38
		2.60 mg/L (TN Season 2)	6.51
	Total Phosphorus	0.55 mg/L (TP-Season 1)	1.38
		0.15 mg/L (TP Season 2)	0.38
2 nd ^(c)	Total Nitrogen	TBD	TBD
	Total Phosphorus	TBD	TBD
nth ^(d)	Total Nitrogen	0.3	0.75
	Total Phosphorus	0.1	0.25

TBD = to be determined.

*Revision of 2005 Rio Hondo plant nutrient TMDL

^(a) The current permit limits are seasonal. The range of 30-day average limits is listed. Target limits are informational only and WLA is not applicable to this TMDL

^(b) Phase 1 Targets and WLA based on 85th percentile of TN and TP (30-day average) collected by the permittee from October 2023-May 2026. Season 1: November 1-April 30. Season 2: May 1-October 31.

^(c) To be evaluated next permit cycle and TMDL revised if necessary. See Section 10

^(d) Targets based on in-stream nutrient targets and segment-specific criteria discussed in Table 5.4

^(e) WLA calculated using Equation 5.2 and 0.3 mgd design flow.

Stormwater discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the USEPA NPDES Construction General Permit (CGP) for construction sites of one or more acres, or smaller if part of a common plan of development, 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. The current CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, managerial, and structural solids, erosion, and sediment control Best Management Practices (BMPs), and/or other controls. BMPs are designed to prevent to the maximum extent practicable an increase in sediment load to the water body or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc. BMPs also include measures to reduce flow velocity during and after construction compared to pre-construction conditions to assure that waste load allocations and/or applicable water quality standards, including the antidegradation policy, are met. Compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Stormwater discharges from industrial activities and facilities, based on industrial classification codes, may be eligible for coverage under the current NPDES Multi-Sector General Permit (MSGP). The MSGP also requires preparation of a SWPPP. Some of the industrial facilities and activities covered under the MSGP have technology based effluent limitation and/or benchmark monitoring for pollutants. The current MSGP includes state-specific requirements that the benchmark values be protective of State of New Mexico WQS.

It is not possible to calculate individual WLAs for facilities covered by the General Permits at this time using the available tools. The discharges from these permits are typically transitory as the activities are temporary. Loads that are in compliance with the General Permits are therefore currently included as part of the Load Allocation (LA). While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

5.3.3 Load Allocation

Load Allocation is pollution from any nonpoint source(s) or natural background and is addressed through Best Management Practices (BMPs). To calculate the LA, the WLA and the MOS were subtracted from the TMDL using **Equation 5.3**, as shown on **Table 5.4 – 5.8**. The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors (see **Section 5.3.1** for details).

Table 5.9 River and Stream TMDL allocations for TP and TN

Assessment Unit	Parameter	WLA* (lbs/day)	Stormwater (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Total Nitrogen	534.68	36.79	9159.69	1081.24	10812.39
	Total Phosphorus	98.60	0.01	1560.98	184.40	1843.97
Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	Total Nitrogen	0.75	0	3.60	0.48	4.83
	Total Phosphorus	0.25	0	1.20	0.16	1.61

$$[TMDL] - [MOS] - [WLA] = [LA]$$

*These WLAs include reserve WLA. See Implementation Section 10.1.1

5.4 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; **Appendix C**). Probable Source Sheets are filled out by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant. Pollutant sources that may contribute to each impairment were determined by field reconnaissance and evaluation (**Table 5.11**). Probable sources of bacteria impairments will be evaluated, refined, and changed as necessary through the Watershed Based Plans.

Table 5.10 – Probable Sources

Assessment Unit	Probable Sources
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharge, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl
Rio Hondo (South Fork Rio Hondo to Lake Fork Creek)	Angling pressure, camping, crop production, dams/diversions, fire suppression, flow alterations, highway/road/bridge runoff, hiking trails, impervious surfaces, logging, municipal point source discharge, on-site treatment systems, rangeland grazing, residences/buildings, roads, trash/litter, waste from pets, waterfowl, wildlife other than waterfowl

5.5 Consideration of Seasonal Variation

Section 303(d)(1) of the CWA requires TMDLs to be “established at a level necessary to implement the applicable WQS with seasonal variation.” The Rio Grande and Rio Hondo AUs are receiving protective TMDLs, and do not have any exceedances of the WQS during the 2017-2018 monitoring survey, and do not appear to have any seasonal trends in the data.

The critical condition used for calculating the TMDL is considered conservative and protective of the water quality standard under all flow conditions. Calculations made at the critical flow, in addition to using other conservative assumptions as described in the previous section on MOS, should be protective of the water quality standards designed to preserve aquatic life in the stream. It was assumed that if critical conditions were met during this time, coverage of any potential seasonal variation would also be met.

5.6 Future Growth

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth until a decline after 2035-2040. Rio Hondo is in Taos County and Rio Grande is in Los Alamos and Sandoval Counties. GPS projects that the populations of these counties will increase, as detailed on **Table 5.11**.

Table 5.11 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Los Alamos	19,418	19,857	20,439	20,791	20,883	20,793	20,545
Sandoval	148,829	157,468	164,648	169,117	170,460	169,575	166,753
Taos	34,488	35,367	35,949	36,300	36,391	36,299	36,048

Estimates of future growth are not anticipated to lead to a significant increase in plant nutrients that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

6.0 POLYCHLORINATED BIPHENYLS (PCBs)

Polychlorinated Biphenyls (PCBs) are a group of man-made chemicals that were manufactured from 1929 until their manufacture was banned in 1979. They are comprised of carbon, hydrogen, and chlorine atoms. According to EPA, “Due to their non-flammability, chemical stability, high boiling point and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications.” (USEPA 2025) There are 209 PCB congeners and the naming of each is determined by the number and placement of the chlorine atoms in the molecule.

PCBs do not readily break down in the environment and can move through soil, air, and water for years. They can accumulate in plants and bioaccumulate in fish. PCBs can have both carcinogenic and noncarcinogenic, such as neurological and reproductive, impacts on animals and humans.

6.1 Target Loading Capacity

The New Mexico WQS include PCB criteria outlined in 20.6.4.900 NMAC for drinking water supply, wildlife habitat, and aquatic life uses. Specifically, the aquatic life use of human health-organism only (HH-OO) criteria used in this TMDL is framed as follows-

“The criteria listed under human health-organism only (HH-OO) are intended to protect human health when aquatic organisms are consumed from waters containing pollutants. These criteria do not protect the aquatic life itself; rather, they protect the health of humans who ingest fish or other aquatic organisms.” 20.6.4.900(J)(2)(f) NMAC

The assessment approach used to determine PCB impairments is described in detail in Section 3.1.2.3 of the SWQB CALM (NMED/SWQB, 2025).

Table 6.1 Exceedances of the PCB WQS

Assessment Unit	Water Quality Criterion	Number of Exceedances
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	0.00064 µg/L 6.4 x 10 ⁻⁷ mg/L	12/23 (2012) 20/29 (2016) 6/23 (2020)

6.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

These TMDLs are calculated for each reach at specific flows. When available, USGS gages are used to estimate flow especially in assessment units (AUs) where collecting flow measurements are not possible. Where gages are absent, flows may be modeled. Gaged streamflow data are not available for Rio Grande above Cochiti Reservoir therefore flow was measured by the Rio Grande at Otowi Bridge gage (USGS 08313000) located at the bottom of the upstream AU, and critical flow was calculated using the USGS SW Toolbox version 1.1. The critical flow, calculated as 4Q3, was 312 cfs for the time period 2011 through June

2026, the period during which the Buckman Direct Diversion (BDD) has been operating. The following equation (Thomas 1997) was used to estimate flow downstream in the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit:

Equation 6.1

$$Q_u = Q_g \left(\frac{A_u}{A_g} \right)^{0.5}$$

where,

- Q_u = discharge at ungaged site, cfs
- Q_g = discharge at gaged site, cfs
- A_u = Drainage area at the ungaged site, (square miles [mi^2])
- A_g = Drainage area at the gaged site, (mi^2)

In this case, the discharge at the ungaged site (cfs) was calculated as the critical flow, or 4Q3, using the USGS gage Rio Grande at Otowi Bridge as the “discharge at gaged site” in this equation.

Using this equation, a flow of 315 cfs, or 204 mgd, was calculated for the Rio Grande at Cochiti reservoir, however this result does not account for the diversion of city of Santa Fe drinking water via the Buckman Direct Diversion (BDD). The BDD 3-year maximum diversion (7.822 mgd) was subtracted from this result, which yielded a critical flow of 195.75 mgd. The White Rock WWTP was also located in this AU, with a design flow of 0.5 mgd. According to correspondence with the City of Santa Fe, the City has future plans (2028) to divert a portion of the City of Santa Fe Paseo Real WWTP (NM0022292) effluent to this assessment unit, resulting in an additional 0-5 mgd flow. The maximum 5 mgd flow option was added onto the flow of this assessment unit. This resulted in a final critical flow of 201.25 mgd or 311.4 cfs for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

6.3 TMDL Calculations

The TMDL is defined as the mass of pollutant that can be carried under critical flow conditions without violating the target concentration for that constituent. The TMDL is calculated based on simple dilution using critical flow, the numeric target, and a conversion factor to correct the units of measure, according to the formula:

Equation 6.2 $WQS (mg/L) \times Critical\ flow\ (4Q3) \times Conversion\ Factor\ (8.34) = TMDL\ (lbs/day)$

Table 6.2 PCB TMDL calculations

Assessment Unit	PCB criteria (mg/L)	Critical Flow (mgd)	Conversion Factor	TMDL (lbs/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	6.4×10^{-7}	201.25	8.34	1.07×10^{-3}

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 at all times is the goal. The TMDL is

further allocated to a MOS, WLA (permitted point sources), and LA (non-point sources), according to the formula:

$$\text{Equation 6.3: } WLA + LA + MOS = TMDL$$

6.3.1 Margin of Safety

The CWA requires that each TMDL be calculated with a MOS. 33 U.S.C. § 1313(d)(1). This statutory requirement that TMDLs incorporate a MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. A MOS may be expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions). The MOS may be implicit, utilizing conservative assumptions for calculation of the loading capacity, WLAs, and LAs. The MOS may also be explicitly stated as an added separate quantity in the TMDL calculation. For this sediment TMDL, the MOS was developed using explicit allocations. Therefore, this MOS is the sum of the following elements:

- *Explicit recognition of potential errors:*
 - There is inherent error in flow estimation, a conservative MOS for this element in is **10%**.

Total MOS for this TMDL is **10%**.

6.3.2 Waste Load Allocation

There are four active individual National Pollutant Discharge Elimination System (NPDES) permits that have the potential to discharge to the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) AU.

The Los Alamos County White Rock WWTP (NM0020133) and City of Santa Fe Buckman Direct Diversion (NM0030848) permits do not currently have monitoring requirements nor reporting limits for PCBs. The Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) includes monitoring requirements for PCBs. The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to this AU but has plans to divert a portion (5 mgd) of their permitted 13 mgd effluent to this AU in 2028. Therefore, PCB WLA were assigned for each of these permits, see Section 10 – Implementation of TMDLs for additional information.

Table 6.3 NPDES PCB WLA

Permit	PCB criteria (mg/L)	Critical Flow (mgd)	Conversion Factor	RWLA** (lbs/day)
Los Alamos-White Rock WWTP (NM0020133)	6.4×10^{-7}	0.5	8.34	2.67×10^{-6}
Santa Fe Buckman Direct Diversion (NM0030848)	6.4×10^{-7}	7.82	8.34	4.18×10^{-5}
LANL Individual Stormwater Permit (NM0030759)*	6.4×10^{-7}	n/a	8.34	3.58×10^{-6}
City of Santa Fe WWTP (NM0022292)	6.4×10^{-7}	5	8.34	2.67×10^{-5}

*See Appendix F for MS4/stormwater jurisdictional area calculation

**These WLAs include reserve WLA. Traditional WLA for NM0030759. See Implementation Section 10.1.1

Stormwater discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the USEPA NPDES Construction General Permit (CGP) for construction sites of one or more acres, or smaller if part of a common plan of development, 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. The current CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, managerial, and structural solids, erosion, and sediment control Best Management Practices (BMPs), and/or other controls. BMPs are designed to prevent to the maximum extent practicable an increase in sediment load to the water body or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc. BMPs also include measures to reduce flow velocity during and after construction compared to pre-construction conditions to assure that waste load allocations and/or applicable water quality standards, including the antidegradation policy, are met. Compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Stormwater discharges from industrial activities and facilities, based on industrial classification codes, may be eligible for coverage under the current NPDES Multi-Sector General Permit (MSGP). The MSGP also requires preparation of a SWPPP. Some of the industrial facilities and activities covered under the MSGP have technology based effluent limitation and/or benchmark monitoring for pollutants. The current MSGP includes state-specific requirements that the benchmark values be protective of State of New Mexico WQS.

It is not possible to calculate individual WLAs for facilities covered by the General Permits at this time using the available tools. The discharges from these permits are typically transitory as the activities are temporary. Loads that are in compliance with the General Permits are therefore currently included as part of the Load Allocation (LA). While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

6.3.3 Load Allocation

Load Allocation is pollution from any nonpoint source(s) or natural background and is addressed through Best Management Practices (BMPs). To calculate the LA, the WLA and the MOS were subtracted from the TMDL using **Equation 6.3**, as shown on **Table 6.4**. The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors (see **Section 6.3.1** for details).

Table 6.4 TMDL allocations for PCB

Assessment Unit	RWLA* (lbs /day)	Stormwater (lbs/day)	LA (lbs /day)	10% MOS	TMDL (lbs/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	7.11×10^{-5}	3.58×10^{-6}	8.92×10^{-4}	1.07×10^{-4}	1.07×10^{-3}

*These WLAs include reserve WLA. Traditional WLA for NM0030759. See Implementation Section 10.1.1

6.4 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; **Appendix C**). Probable Source Sheets are filled out by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant. Pollutant sources that may contribute to each impairment were determined by field reconnaissance and evaluation (**Table 6.6**). Probable sources of bacteria impairments will be evaluated, refined, and changed as necessary through the Watershed Based Plans.

Table 6.6 – Probable Sources

Assessment Unit	Probable Sources
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharge, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl

6.5 Consideration of Seasonal Variation

Section 303(d)(1) of the CWA requires TMDLs to be “established at a level necessary to implement the applicable WQS with seasonal variation.” The critical condition used for calculating the TMDL is considered conservative and protective of the water quality standard under all flow conditions. Calculations made at the critical flow, in addition to using other conservative assumptions as described in the previous section on MOS, should be protective of the water quality standards designed to preserve aquatic life in the

stream. It was assumed that if critical conditions were met during this time, coverage of any potential seasonal variation would also be met.

6.6 Future Growth

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth until a decline after 2035-2040. Rio Grande is in Los Alamos and Sandoval Counties. GPS projects that the populations of these counties will increase, as detailed on **Table 6.7**.

Table 6.7 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Los Alamos	19,418	19,857	20,439	20,791	20,883	20,793	20,545
Sandoval	148,829	157,468	164,648	169,117	170,460	169,575	166,753

Estimates of future growth are not anticipated to lead to a significant increase in plant nutrients that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

7.0 TEMPERATURE

Water temperature influences the metabolism, behavior, and mortality of fish and other aquatic organisms. Natural temperatures of a water body fluctuate daily and seasonally. These natural fluctuations do not eliminate indigenous populations, but may affect existing community structure and geographical distribution of species. Anthropogenic impacts such as thermal pollution, deforestation, flow modification and climate change can modify these natural temperature cycles, often leading to deleterious impacts on aquatic life communities. Such modifications may contribute to changes in geographical distribution of species and their ability to persist in the presence of additional stressors such as introduced species. One mechanism by which temperature affects fish is that warmer water has a lower capacity for dissolved oxygen. Water temperature within the stream substrate can influence the growth of insects and salmon eggs. In addition to direct effects, the toxicity of many chemical contaminants increases with temperature (Caissie, 2006).

7.1 Target Loading Capacity

Fish and other aquatic organisms have specific ranges of temperature tolerance and preference. Cold water fish such as salmonids (salmon and trout) are especially vulnerable to increased water temperature. For that reason, coldwater criteria are typically designed primarily to support reproducing populations of salmonids. A coolwater Aquatic Life Use (ALU) was approved by the WQCC in October 2010, to support aquatic life whose physiologic tolerances are intermediate between those of warmwater and coldwater aquatic life (NMED/SWQB, 2009). Acute temperature criteria (such as New Mexico's T_{MAX}) are intended to protect aquatic life from lethal exposures, whereas chronic criteria (the 4T3 or 6T3) protect from sub-lethal exposures sufficient to cause long-term detrimental effects (Todd et al., 2008). The acute and chronic criteria are established to protect the most sensitive members of fish communities, based on laboratory studies of the upper thermal limits of individual species.

For this TMDL document, target values for temperature are based on the reduction in thermal loading necessary to achieve numeric criteria. Temperature criteria for ALUs in New Mexico are shown on **Table 7.1**. New Mexico's aquatic life temperature criteria are expressed as T_{MAX} , 4T3 and 6T3. T_{MAX} is the maximum recorded temperature, 4T3 means the temperature not to be exceeded for four or more consecutive hours in a 24-hour period on more than three consecutive days, and 6T3 means the temperature not to be exceeded for six or more consecutive hours in a 24-hour period on more than three consecutive days.

Table 7.1 Aquatic Life Use Temperature (°C) Water Quality Criteria

Criterion	High Quality Coldwater	Coldwater	Marginal Coldwater	Coolwater	Warmwater	Marginal Warmwater
4T3	20	---	---	---	---	---
6T3	---	20	25	---	---	---
T_{MAX}	23	24	29	29	32.2	32.2

TMDLs were calculated for four Upper Rio Grande watershed AUs that exceeded the T_{MAX} for their designated ALU. All of those which have chronic standards also exceeded the applicable chronic standard. Thermograph data are presented in **Appendix B**.

Table 7.2 Aquatic Life Use designations of the temperature TMDL AU

Assessment Unit	Designated ALU
Beaver Creek (Rio de los Pinos to headwaters)	High Quality Coldwater
Canada Tio Grande (Rio San Antonio to headwaters)	High Quality Coldwater
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	Marginal Coldwater
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	Marginal Coldwater
Rio Fernando de Taos (Tienditas Creek to headwaters)	High Quality Coldwater
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Marginal Coldwater
Rio Nutritas (Rio San Antonio to headwaters)	High Quality Coldwater
Rio San Antonio (CO border to Montoya Canyon)	High Quality Coldwater

7.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

These TMDLs are calculated for each reach at specific flows. When available, USGS gages are used to estimate flow especially in assessment units (AUs) where collecting flow measurements are not possible. Where gages are absent, flows may be modeled. Gaged streamflow data are not available for Rio Grande above Cochiti Reservoir therefore flow was measured by the Rio Grande at Otowi Bridge gage (USGS 08313000) located at the bottom of the upstream AU, and critical flow was calculated using the USGS SW Toolbox version 1.1. The critical flow, calculated as 4Q3, was 312 cfs for the time period 2011 through June 2026, the period during which the Buckman Direct Diversion (BDD) has been operating. The following equation (Thomas 1997) was used to estimate flow downstream in the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit:

Equation 7.1

$$Q_u = Q_g \left(\frac{A_u}{A_g} \right)^{0.5}$$

where,

- Q_u = discharge at ungaged site, cfs
- Q_g = discharge at gaged site, cfs
- A_u = Drainage area at the ungaged site, (square miles [mi^2])
- A_g = Drainage area at the gaged site, (mi^2)

In this case, the discharge at the ungaged site (cfs) was calculated as the critical flow, or 4Q3, using the USGS gage Rio Grande at Otowi Bridge as the “discharge at gaged site” in this equation.

Using this equation, a flow of 315 cfs, or 204 mgd, was calculated for the Rio Grande at Cochiti reservoir, however this result does not account for the diversion of city of Santa Fe drinking water via the Buckman Direct Diversion (BDD). The BDD 3-year maximum diversion (7.822 mgd) was subtracted from this result, which yielded a critical flow of 195.75 mgd. The White Rock WWTP was also located in this AU, with a design flow of 0.5 mgd. According to correspondence with the City of Santa Fe, the City has future plans to divert a portion of the City of Santa Fe Paseo Real WWTP (NM0022292) effluent to this assessment unit, resulting in an additional 0-5 mgd flow. The maximum 5 mgd flow option was added onto the flow of this assessment unit. This resulted in a final critical flow of 201.25 mgd or 311.4 cfs for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

Because all other AUs discussed in this section are ungaged, an analysis method developed by USGS in partnership with NMED, authored by Bell and Tillery (2023) was used to estimate the critical low flow. In the Bell & Tillery analysis, six regression equations for estimating 4Q3 were developed based on physiographic regions of New Mexico and stream basin characteristics (i.e., statewide and mountainous regions above 8,000 ft in elevation, or basins with less than 75 square mile drainage areas). The average elevation of all impaired AUs in the Upper Rio Grande watershed are above 8,000 ft and are not the San Juan River nor tributaries to the San Juan, so the 4Q3-1a statewide regression equation was used. The following regression equation is based on data from 44 gaging stations with non-zero discharge (Bell, Tillery, 2002):

$$\text{Equation 7.2: } 4Q3 = DA^{1.08} \times E^{12.20} \times e^{-115.37}$$

Where:

4Q3 = four-day, three-year low-flow frequency (cfs)

DA = drainage area (mi²)

E = mean basin elevation (ft)

e = mathematical constant, Euler’s number

The 4Q3 values calculated using Bell & Tillery’s method are presented in **Table 7.3**. Parameters used in the calculation were obtained using the StreamStats online GIS application developed by the USGS (<https://streamstats.usgs.gov/ss/>). The flow was converted from cfs to million gallons per day (mgd) using a conversion factor of 0.646.

The TMDL itself is a value calculated at a defined critical condition as part of a planning process designed to achieve water quality standards. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve instream water quality is the goal of SWQB efforts.

Table 7.3 Critical flow for temperature impaired AUs

Assessment Unit	Drainage Area (mi ²)	Average Elevation (ft)	4Q3 (cfs)	4Q3 (mgd)
Beaver Creek (Rio de los Pinos to headwaters)	25.9	9978	1.62	1.05
Canada Tio Grande (Rio San Antonio to headwaters)	11	9606	0.40	0.26
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	269	9395	9.75	6.30
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	321	9039	7.36	4.76
Rio Fernando de Taos (Tienditas Creek to headwaters)	11.7	9158	0.24	0.16
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	--	--	311	201
Rio Nutritas (Rio San Antonio to headwaters)	12.5	9551	0.43	0.28
Rio San Antonio (CO border to Montoya Canyon)	116	9353	3.72	2.40

7.3 TMDL Calculations

For temperature TMDLs, the WQS criterion is a temperature specified either by the designated ALU or segment-specific criteria, and it can be either a maximum temperature or time-duration temperature such as the 4T3 or 6T3. The 4Q3 low-flow is generally used for the critical flow unless another flow statistic or multiple flow conditions are more appropriate for the situation. The conversion factor is a variable needed to convert units used by SWQB for temperature (in Celsius) and flow (in cfs) to units needed to balance the thermal energy equation. Substituting the appropriate unit conversion factors, the equation used for temperature is the following:

$$\text{Equation 7.3} \quad WQS (^{\circ}C) \times \text{Critical Flow (cfs)} \times \text{Conversion Factor } (1.023 \times 10^7) = \text{TMDL (kJ/day)}$$

Details of the derivation of the temperature TMDL equation are presented in **Appendix D**. **Table 7.4** shows the TMDL calculation values for each TMDL AU.

Table 7.4 Temperature TMDL calculations

Assessment Unit Name	Target temperature (°C)	4Q3 critical flow (cfs)	Conversion factor	TMDL (kJ/day)
Beaver Creek (Rio de los Pinos to headwaters)	20	1.05	1.023×10^7	2.14×10^8
Canada Tio Grande (Rio San Antonio to headwaters)	20	0.26	1.023×10^7	5.35×10^7
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	25	6.30	1.023×10^7	1.61×10^9
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	25	4.76	1.023×10^7	1.22×10^9
Rio Fernando de Taos (Tienditas Creek to headwaters)	20	0.16	1.023×10^7	3.19×10^7
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	25	311	1.023×10^7	7.95×10^{10}
Rio Nutritas (Rio San Antonio to headwaters)	20	0.28	1.023×10^7	5.73×10^7
Rio San Antonio (CO border to Montoya Canyon)	20	2.40	1.023×10^7	4.92×10^8

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 at all times is the goal. The TMDL is further allocated to a MOS, WLA (permitted point sources), and LA (non-point sources), according to the formula:

$$\text{Equation 7.4: } WLA + LA + MOS = TMDL$$

7.3.1 Margin of Safety

The CWA requires that each TMDL be calculated with a MOS, intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. 33 U.S.C. § 1313(d)(1). A MOS may be expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions). The MOS may be implicit, utilizing conservative assumptions for calculation of the loading capacity, WLAs, and LAs. The MOS may also be explicitly stated as an added separate quantity in the TMDL calculation.

- An *implicit MOS* is introduced by using the chronic criteria as TMAX targets.
- *Explicit Recognition of Potential Errors:*
 - There is inherent error in flow estimation, a conservative MOS for this element in ungaged streams is **10 %**.
 - In recognition of the likelihood of future increases in air temperature and evaporative demand, an additional explicit **10%** MOS is added to each AU for climate change.

Total MOS for this TMDL is **20%**.

7.3.2 Waste Load Allocation

There are four active individual National Pollutant Discharge Elimination System (NPDES) permits that discharge to the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) AU.

The Los Alamos County White Rock WWTP (NM0020133) and City of Santa Fe Buckman Direct Diversion (NM0030848) permits do not currently have monitoring requirements nor reporting limits for temperature. The Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) includes monitoring requirements for temperature. The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to this AU but has plans to divert a portion (5 mgd) of their permitted 13 mgd effluent to this AU in 2028. Therefore, temperature WLA were assigned for each of these permits, see Section 10 – Implementation of TMDLs for additional information.

Table 7.5 NPDES temperature WLA

Permit	Temperature criteria (mg/L)	Critical Flow (cfs)	Conversion Factor	RWLA (kj/day)
Los Alamos-White Rock WWTP (NM0020133)	25	0.77	1.023×10^7	1.98×10^8
Santa Fe Buckman Direct Diversion (NM0030848)	25	12.10	1.023×10^7	3.10×10^9
LANL Individual Stormwater Permit (NM0030759)*	25	n/a	1.023×10^7	2.33×10^8 **
City of Santa Fe WWTP (NM0022292)	25	7.74	1.023×10^7	1.98×10^9

*See Appendix F for MS4/stormwater jurisdictional area calculation

**These WLAs include reserve WLA. Traditional WLA for NM0030759. See Implementation Section 10.1.1

There may be storm water discharges from industrial, including construction, activities covered under the National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) or Multi-Sector General Permit (MSGP). Excess temperature loading may be a component of some storm water discharges covered under general NPDES permits. Stormwater discharges from industrial, including construction, activities are generally considered transient because they occur mainly during the construction itself and/or only during storm events.

Coverage under the USEPA NPDES CGP for construction sites one acre or greater or smaller if part of a common plan of development require preparation of a Storm Water Pollution Prevention Plan (SWPPP) that includes identification and control of pollutants associated with the construction activities to minimize impacts to water quality. The current CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, managerial, and structural solids, erosion, and sediment control Best Management Practices (BMPs), and/or other controls. BMPs are designed to prevent to the maximum extent practicable an increase in sediment load to the water body or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc. BMPs

also include measures to reduce flow velocity during and after construction compared to pre-construction conditions. Stormwater discharges from industrial activities and facilities, based on industrial classification codes, may be eligible for coverage under the current NPDES MSGP. The MSGP also requires preparation of a SWPPP. Some of the industrial facilities and activities covered under the MSGP have technology based effluent limitation and/or benchmark monitoring for pollutants. The current MSGP includes state-specific requirements that the benchmark values reflect State of New Mexico WQS.

It is not possible to calculate individual WLAs for facilities covered by the General Permits at this time using the available tools. Loads that are in compliance with the General Permits are therefore currently included as part of the Load Allocation (LA). While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements. State certification of federal permits ensure that applicable water quality standards, including the antidegradation policy, are met. Compliance with a CGP or MSGP SWPPP that meets the requirements of the general permits is generally assumed to be consistent with this TMDL.

7.3.3 Load Allocation

Load Allocation is pollution from any nonpoint source(s) or natural background and is addressed through Best Management Practices (BMPs). To calculate the LA, the WLA and the MOS were subtracted from the TMDL using **Equation 7.4**, as shown on **Table 7.6**. The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors (see **Section 7.3.1** for details).

Table 7.6 Temperature TMDL load allocations (units are kJ/day)

Assessment Unit	RWLA/WLA	Stormwater	LA	20% MOS	TMDL
Beaver Creek (Rio de los Pinos to headwaters)	0	0	1.72×10^8	4.29×10^7	2.14×10^8
Canada Tio Grande (Rio San Antonio to headwaters)	0	0	4.28×10^7	1.07×10^7	5.35×10^7
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	0	0	1.13×10^9	2.83×10^8	1.42×10^9
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	0	0	8.57×10^8	2.14×10^8	1.07×10^9
Rio Fernando de Taos (Tienditas Creek to headwaters)	0	0	2.55×10^7	6.39×10^6	3.19×10^7
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	5.27×10^9	2.33×10^8	5.81×10^{10}	1.59×10^{10}	7.95×10^{10}
Rio Nutritas (Rio San Antonio to headwaters)	0	0	4.58×10^7	1.15×10^7	5.73×10^7
Rio San Antonio (CO border to Montoya Canyon)	0	0	3.93×10^8	9.84×10^7	4.92×10^8

7.4 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; **Appendix B**). Probable Source Sheets are filled out by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant. Pollutant sources that may contribute to each impairment were determined by field reconnaissance and evaluation (**Table 7.7**). Probable sources of bacteria impairments will be evaluated, refined, and changed as necessary through the Watershed Based Plans.

Table 7.7 – Probable Sources

Assessment Unit	Probable Sources
Beaver Creek (Rio de los Pinos to headwaters)	Forest Roads, Grazing in Riparian Zone, Other Recreational Pollution Sources, Rangeland Grazing
Canada Tio Grande (Rio San Antonio to headwaters)	Forest Roads, Grazing in Riparian Zone, Rangeland Grazing
Embudo Creek (Rio Grande to Picuris Pueblo bnd)	Angling pressure, channelization, crop production, dams/diversions, flow alteration, highway/road/bridge runoff, impervious pavement, on-site treatment systems, rangeland grazing, residence/buildings, roads, streambank modifications
Rio Fernando de Taos (Tienditas Creek to headwaters)	Channelization, crop production, dams/diversions, flow alteration, highway road/bridge runoff, hiking trails, impervious pavement, legacy logging, mass wasting, on-site treatment systems, rangeland grazing, residences/buildings, roads, waterfowl, wildlife other than waterfowl
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharges, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl
Rio Nutritas (Rio San Antonio to headwaters)	Forest Roads, Grazing in Riparian Zone, Rangeland Grazing
Rio San Antonio (CO border to Montoya Canyon)	Agriculture, crop production, flow alterations, drought related, habitat modifications, rangeland grazing, low water crossing, roads, streambank erosion

7.5 Consideration of Seasonal Variation

Section 303(d)(1) of the CWA requires TMDLs to be “established at a level necessary to implement the applicable WQS with seasonal variations.” Both stream temperature and flow vary seasonally and from year to year. Water temperatures are coolest in the winter and early spring months. Future climate change is expected to increase air temperatures and decrease streamflow, potentially causing increases in

maximum water temperature. The warmest stream temperatures correspond to prolonged solar radiation exposure, warmer air temperature, and low flow conditions.

7.6 Future Growth

SWQB acknowledges the projected impact of climate change on the state's water resources. Climate change will put additional stress on New Mexico's water resources and make attainment of water quality standards more difficult to achieve. In addition, shifting temperature and precipitation patterns affect vegetative composition and density and increase wildfire intensity and the propensity for wildfire in non-fire adapted ecosystems. In 2019, Governor Lujan Grisham signed Executive Order 2019-003 on Addressing Climate Change and Energy Waste Prevention. Executive Order 2019-003 directs all State agencies to evaluate the impacts of climate change on their programs and operations and integrate climate change mitigation and adaptation practices into their programs and operations.

In general, the strongest influence on in-stream water temperature is the ambient air temperature. Stakeholders should explore options to determine the most appropriate approach for each particular watershed or project, with the ultimate goal being that the stream meets the WQS. The SWQB encourages implementation practitioners to design projects to reduce water temperature well below the WQS, such that currently impaired AUs will be likely to meet WQS standards in the future with sufficient resiliency to warmer air temperatures and potentially lower flows.

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth until a decline after 2035-2040. GPS projects that the populations of these counties will increase, as detailed on **Table 7.8**.

Table 7.8 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Los Alamos	19,418	19,857	20,439	20,791	20,883	20,793	20,545
Sandoval	148,829	157,468	164,648	169,117	170,460	169,575	166,753
Taos	34,488	35,367	35,949	36,300	36,391	36,299	36,048

Estimates of future growth are not anticipated to lead to a significant increase in plant temperature that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

8.0 TURBIDITY

Turbidity is an expression of the optical property in water that causes incident light to be scattered and absorbed rather than transmitted in straight lines. It is a condition resulting from suspended solids in the water, including silts, clays, and plankton. Such particles absorb heat in the sunlight, thus raising water temperature, which in turn lowers dissolved oxygen levels. It also prevents sunlight from reaching plants below the surface. This decreases the rate of photosynthesis, so less oxygen is produced by plants. Turbidity may harm fish and their larvae.

The impacts of suspended sediment and turbidity are well documented in scientific literature. An EPA monitoring guideline report states that increased sediment load is often the most important adverse effect of human activities on streams (USEPA, 1991). An increase in suspended sediment concentration will reduce the penetration of light, decrease the ability of fish or fingerlings to capture prey, and reduce primary production (USEPA, 1991). As stated by Relyea et al. (2000), “increased turbidity by sediments can reduce stream primary production by reducing photosynthesis, physically abrading algae and other plants, and preventing attachment of autotrophs to substrate surfaces.”

8.1 Target Loading Capacity

The New Mexico WQS has general criteria applicable to all waters of the state. The general narrative standard at 20.6.4.13(J) NMAC for turbidity reads:

“Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function, or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water...”

The assessment approach used to determine impairments of the narrative turbidity standard is described in detail in the Comprehensive Assessment and Listing Methodology (NMED/SWQB, 2025). Target values for this TMDL were based on the turbidity thresholds identified in the CALM. It relies upon the use of biotranslators to derive numeric thresholds from the narrative standard above. A biotranslator is a physical or chemical water quality parameter that has been isolated and effects an impairment of a quantifiable attribute of an indicator organism. In some cases, the quantifiable attribute may be the lethal dose or concentration of the parameter. In the case of turbidity, the attribute is typically based upon observed behavior and the Severity of Ill Effects (“SEV”) index.

A SEV index of 3.5 was selected to develop thresholds for turbidity impairment in New Mexico. This SEV index value corresponds to the boundary between conditions that effect changes to feeding in aquatic organisms and conditions that have been found to reduce growth rate and habitat size. The relationship between turbidity, duration, and a SEV of 3.5 is given in **Equation 8.1**, where x is duration in hours and y is the turbidity in Nephelometric Turbidity Units (NTUs) for durations from 7 hours to 720 hours. Shorter-term turbidity excursions are unlikely to impair the growth, function, and reproduction of aquatic life as required by New Mexico’s narrative turbidity water quality standard, while thresholds for durations longer than 720 consecutive hours result in turbidity values that are lower than supported by literature available at the time of the assessment protocol development. The CALM provides a series of turbidity thresholds and durations which are listed in **Table 8.1**.

Equation 8.1: $x = 37,382y^{-1.9887}$

Where:

x = duration (hours)

y = turbidity (NTU)

Applicable for durations between 7 and 720 hours.

Table 8.1 Turbidity impairment thresholds and durations

Turbidity Threshold (NTU)	Allowable Duration (consecutive hours)	Allowable Duration (consecutive days)
23	72	3
20	96	4
18	120	5
16	144	6
15	168	7
11	336	14
7	720	30

NTU = Nephelometric Turbidity Units

8.2 Flow

According to the New Mexico Water Quality Standards, the low flow critical condition for numeric criteria (excluding human health-organism only criteria) set in 20.6.4.97 through 20.6.4.900 NMAC and 20.6.4.13(F) NMAC is defined as the 4-day, 3-year low-flow frequency (4Q3, 20.6.4.11(B)(2) NMAC). The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years.

These TMDLs are calculated for each reach at specific flows. When available, USGS gages are used to estimate flow especially in assessment units (AUs) where collecting flow measurements are not possible. Where gages are absent, flows may be modeled. Gaged streamflow data are not available for Rio Grande above Cochiti Reservoir therefore flow was measured by the Rio Grande at Otowi Bridge gage (USGS 08313000) located at the bottom of the upstream AU, and critical flow was calculated using the USGS SW Toolbox version 1.1. The critical flow, calculated as 4Q3, was 312 cfs for the time period 2011 through June 2026, the period during which the Buckman Direct Diversion (BDD) has been operating. The following equation (Thomas 1997) was used to estimate flow downstream in the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit:

Equation 6.1

$$Q_u = Q_g \left(\frac{A_u}{A_g} \right)^{0.5}$$

where,

- Q_u = discharge at ungaged site, cfs
- Q_g = discharge at gaged site, cfs
- A_u = Drainage area at the ungaged site, (square miles [mi^2])
- A_g = Drainage area at the gaged site, (mi^2)

In this case, the discharge at the ungaged site (cfs) was calculated as the critical flow, or 4Q3, using the USGS gage Rio Grande at Otowi Bridge as the “discharge at gaged site” in this equation.

Using this equation, a flow of 315 cfs, or 204 mgd, was calculated for the Rio Grande at Cochiti reservoir, however this result does not account for the diversion of city of Santa Fe drinking water via the Buckman Direct Diversion (BDD). The BDD 3-year maximum diversion (7.822 mgd) was subtracted from this result, which yielded a critical flow of 195.75 mgd. The White Rock WWTP was also located in this AU, with a design flow of 0.5 mgd. According to correspondence with the City of Santa Fe, the City has future plans to divert a portion of the City of Santa Fe Paseo Real WWTP (NM0022292) effluent to this assessment unit, resulting in an additional 0-5 mgd flow. The maximum 5 mgd flow option was added onto the flow of this assessment unit. This resulted in a final critical flow of 201.25 mgd or 311.4 cfs for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

8.3 TMDL Calculations

Because impairment of a waterbody is dependent on the duration of elevated turbidity, a separate TMDL has been determined for each NTU/duration threshold identified in the turbidity assessment protocol. These TMDLs were developed using the turbidity/duration thresholds identified in the SWQB turbidity assessment protocol (NMED/SWQB, 2025), the site-specific relationship between turbidity and TSS, the 4Q3 flow condition, and a unit conversion factor to correct the TMDL units into pounds per day (lb/day). First, using the regression equations shown in **Appendix B**, TSS concentrations for each turbidity threshold were calculated (**Table 8.2**). Then, the 4Q3 critical low flow from Section 8.2, above, and the TSS threshold values were substituted into **Equation 8.3** to determine the TMDL at each turbidity/duration threshold (**Table 8.2**). Note that each TMDL is for a particular turbidity/duration pairing. It should not be extrapolated to longer or shorter durations.

$$\text{Equation 8.3} \quad WQS \text{ (mg/L)} \times \text{Critical Flow (4Q3)} \times \text{Conversion Factor (8.34)} = \text{TMDL (lbs/day)}$$

Table 8.2 Turbidity TMDL calculations

Assessment Unit	Turbidity (NTU)	TSS (mg/L)	TSS TMDL (lbs/day)	Duration (consecutive days)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	23	33.03	55439.38	3
	20	24.13	40496.37	4
	18	22.49	37747.44	5
	16	20.85	34998.52	6
	15	20.03	33624.06	7
	11	16.76	28126.21	14
	7	13.48	22628.36	30

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 at all times is the goal. The TMDL is further allocated to a MOS, WLA (permitted point sources), and LA (non-point sources), according to the formula:

Equation 8.4: $WLA + LA + MOS = TMDL$

8.3.1 Margin of Safety

The CWA requires that each TMDL be calculated with a MOS. 33 U.S.C. § 1313(d)(1). This statutory requirement that TMDLs incorporate a MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. A MOS may be expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions). The MOS may be implicit, utilizing conservative assumptions for calculation of the loading capacity, WLAs, and LAs. The MOS may also be explicitly stated as an added separate quantity in the TMDL calculation. For this turbidity TMDL, the MOS was developed using a combination of conservative assumptions and explicit allocations. Therefore, this MOS is the sum of the following elements:

- *Conservative assumptions:*
 - TSS is a conservative parameter that does not settle out of the water column.
- *Explicit recognition of potential errors:*
 - Uncertainty exists in the relationship between TSS and turbidity. A conservative MOS for this element is **5%**.
 - There is inherent error in flow estimation, a conservative MOS for this element in calculated, gaged streams is **10 %**.

The total MOS for this TMDL is **15%**.

8.3.2 Waste Load Allocation

There are four National Pollutant Discharge Elimination System (NPDES) permitted facility on the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) AU. The Los Alamos County White Rock WWTP (NM0020133) and the City of Santa Fe Paseo Real WWTP (NM0022292) currently have 30-day and 7-day average TSS limits. The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to this AU but has plans to divert a portion of their permitted 13 mgd effluent to this AU in the future. The City of Santa Fe Buckman Direct Diversion (NM0030848) permit currently includes a monitoring requirement for turbidity. The Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) does not include monitoring or reporting requirements for either turbidity or TSS. Therefore, TSS WLA were assigned for each of these permits, see Section 10 – Implementation of TMDLs for additional information. The WLAs in **Table 8.4** are not expected to affect the TSS permit limits of 30 (30-day average) and 45 (daily max) mg/L in the current NM0020133 and NM0022292 permits.

Table 8.3 NPDES discharge limits for TSS

Permit	Design Flow (mgd)	TSS Permit Limit
Los Alamos-White Rock WWTP (NM0020133)	0.5	30 mg/L (30-day avg) 45 mg/L (7-day avg)
Santa Fe Buckman Direct Diversion (NM0030848)	7.822	None**
City of Santa Fe WWTP (NM0022292)	5	30 mg/L (30-day avg) 45 mg/L (7-day avg)
LANL Stormwater Individual Permit (NM0030759)*	n/a	None

*See Appendix F for MS4/stormwater jurisdictional area calculation

**Permit includes turbidity weekly reporting requirement

Table 8.4 TSS waste load allocations - Rio Grande (Cochiti Reservoir to San Ildefonso bnd)*

Assessment Unit	Duration (consecutive days)	TSS (mg/L)	TSS WLA (lb/day)*
Los Alamos-White Rock WWTP (NM0020133)	3	33.03	137.74
	4	24.13	100.61
	5	22.49	93.78
	6	20.85	86.95
	7	20.03	83.54
	14	16.76	69.88
	30	13.48	56.22
Santa Fe Buckman Direct Diversion (NM0030848)	3	33.03	2154.77
	4	24.13	1573.98
	5	22.49	1467.13
	6	20.85	1360.29
	7	20.03	1306.87
	14	16.76	1093.18
	30	13.48	879.50

City of Santa Fe WWTP (NM0022292)	3	33.03	1377.38
	4	24.13	1006.12
	5	22.49	937.82
	6	20.85	869.53
	7	20.03	835.38
	14	16.76	698.79
	30	13.48	562.20
LANL Stormwater Individual Permit (NM0030759)	3	33.03	173.81
	4	24.13	126.96
	5	22.49	118.35
	6	20.85	109.73
	7	20.03	105.42
	14	16.76	88.18
	30	13.48	70.94

*no RWLA for turbidity for any the permits discharging to the Rio Grande AU. See Implementation Section 10.1.1

8.3.3 Load Allocation

Load Allocation is pollution from any nonpoint source(s) or natural background and is addressed through Best Management Practices (BMPs). To calculate the LA, the WLA and the MOS were subtracted from the TMDL using **Equation 8.3**, as shown on **Table 8.5**. The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors (see **Section 8.3.1** for details).

Table 8.5 TSS load allocations for turbidity impaired AUs

Assessment Unit	Duration (consecutive days)	WLA (lbs/day)*	MS4** (lbs/day)	MOS (15%)	LA (lbs/day)	TMDL (lbs/day)
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	3	3669.88	173.81	8315.91	43453.60	55439.38
	4	2680.71	126.96	6074.46	31741.20	40496.37
	5	2498.74	118.35	5662.12	29586.59	37747.44
	6	2316.77	109.73	5249.78	27431.97	34998.52
	7	2225.79	105.42	5043.61	26354.66	33624.06
	14	1861.85	88.18	4218.93	22045.43	28126.21
	30	1497.91	70.94	3394.25	17736.19	22628.36

*No RWLA for turbidity for any the permits discharging to the Rio Grande AU. See Implementation Section 10.1.1

**LANL Stormwater Individual Permit (NM0030759)

8.4 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment in the AU drainage area, according to Standard Operating Procedure 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>; **Appendix B**). Probable Source Sheets are filled out

by SWQB monitoring staff during watershed surveys. The sheets are then reviewed by watershed protection staff familiar with the location, and the TMDL writer conducts a search of aerial imagery, GIS files, and other available resources. The list of probable sources is not intended to single out any particular landowner or land management activity and generally includes several sources per pollutant. Pollutant sources that may contribute to each impairment were determined by field reconnaissance and evaluation (**Table 8.6**). Probable sources of bacteria impairments will be evaluated, refined, and changed as necessary through the Watershed Based Plans.

Table 8.6 – Probable Sources

Assessment Unit	Probable Sources
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Angling pressure, bridges/roads, dams/diversions, dispersed camping, flow alterations, garbage/trash, hiking trails, impervious pavement, municipal point source discharge, rangeland grazing, residence/buildings, site clearance, stormwater, urban runoff, waste from pets, waterfowl, wildlife other than waterfowl

8.5 Consideration of Seasonal Variation

Federal regulations (40 CFR § 130.7(c)(1)) require that TMDLs take into consideration seasonal variation in watershed conditions and pollutant loading. Higher turbidity values are typically associated with higher flows. However, as precipitation events are infrequent and transitory in nature, the 4Q3 is considered a more conservative estimate of the long-term stream condition. Since the critical flow condition is set to estimate low flow discharge, it is assumed that if critical conditions are met, coverage of any potential seasonal variation will also be met.

8.6 Future Growth

Growth estimates by county are available from the University of New Mexico Geospatial and Population Studies (GPS) (<https://gps.unm.edu/pru/projections>). These estimates project growth until a decline after 2035-2040. Rio Grande is in Los Alamos, Sandoval, and Santa Fe Counties. GPS projects that the populations of these counties will increase, as detailed on **Table 8.7**.

Table 8.7 County Population Estimates

	2020 (Census)	2025	2030	2035	2040	2045	2050
Los Alamos	19,418	19,857	20,439	20,791	20,883	20,793	20,545
Sandoval	148,829	157,468	164,648	169,117	170,460	169,575	166,753
Santa Fe	154,823	160,347	164,745	167,424	168,148	167,499	165,656

Estimates of future growth are not anticipated to lead to a significant increase in plant nutrients that cannot be controlled with BMP implementation. BMPs should be utilized and improved upon while continuing to improve watershed conditions and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

9.0 MONITORING PLAN

Pursuant to CWA Section 106(e)(1), 33 U.S.C. Section 1256, the SWQB has established appropriate monitoring methods, systems and procedures in order to compile and analyze data on the quality of the surface waters of New Mexico. In accordance with the New Mexico Water Quality Act, NMSA 1978, Sections 74-6-1 to -17, the SWQB has developed and implemented a comprehensive water quality monitoring strategy for the surface waters of the State.

The monitoring strategy establishes the methods of identifying and prioritizing water quality data needs, specifies procedures for acquiring and managing water quality data, and describes how these data are used to progress toward three basic monitoring objectives: to develop water quality-based controls, to evaluate the effectiveness of such controls, and to conduct water quality assessments. The SWQB revised its 10-year monitoring and assessment strategy (NMED/SWQB, 2016a) and submitted it to USEPA Region 6 for review in June of 2016. The strategy details both the extent of monitoring that can be accomplished with existing resources plus expanded monitoring strategies that could be implemented given additional resources. The SWQB utilizes a rotating basin approach to water quality monitoring. In this approach, a select number of watersheds are intensively monitored each year with an established return frequency of approximately every six to eight years. The next scheduled monitoring date for the Upper Rio Grande watershed is 2027.

The SWQB maintains current quality assurance and quality control plans to cover all monitoring activities. This document, called the Quality Assurance Project Plan (NMED/SWQB, 2018b), is updated regularly and approved by USEPA Region 6. In addition, the SWQB identifies the data quality objectives required to provide information of sufficient quality to meet the established goals of the program. Current priorities for monitoring in the SWQB are driven by the CWA Section 303(d) list of streams requiring TMDLs or TMDL alternatives; water bodies identified as needing ALU verification; the need to monitor unassessed perennial waters; and water bodies receiving point source discharge(s).

Once assessment monitoring is completed, those reaches showing impairment and requiring a TMDL will be targeted for more intensive monitoring. The methods of data acquisition include fixed-station monitoring, intensive surveys of priority assessment units (including biological assessments), and compliance monitoring of industrial, federal, and municipal dischargers, as specified in the SWQB Standard Operating Procedures.

Long-term monitoring for assessments will be accomplished through the establishment of sampling sites that are representative of the water body and which can be revisited approximately every eight years. This information will provide time relevant information for use in CWA Section 303(d) listing and 305(b) report assessments and to support the need for developing TMDLs. The approach provides:

- a systematic, detailed review of water quality data which allows for a more efficient use of valuable monitoring resources;
- information at a scale where implementation of corrective activities is feasible;
- an established order of rotation and predictable sampling in each basin which allows for enhanced coordinated efforts with other programs; and
- program efficiency and improvements in the basis for management decisions.

A watershed would not be ignored during the years in between water quality surveys. The rotating basin program will be supplemented with other data collection efforts such as on-going studies being performed by the USGS and USEPA. Data will be analyzed and field studies will be conducted to further characterize acknowledged problems and TMDLs will be developed and implemented accordingly. Both long-term and intensive field studies can contribute to the State's Integrated § 303(d)/§ 305(b) listing process for waters requiring TMDLs.

10.0 IMPLEMENTATION OF TMDLs

When approving TMDL documents, USEPA takes action on the TMDL, LA, WLA, and other components of the TMDL as needed (e.g., MOS and future growth). USEPA does not take action on the implementation section of the TMDL, and USEPA is not bound to implement any recommendations found in this section, in particular if they are found to be inconsistent with CWA and NPDES regulations, guidance, or policy.

10.1 Point Sources

10.1.1 Individual NPDES Permits

There are five individual NPDES permits discussed in these TMDLs. Four are on the Rio Grande (Cochiti Reservoir to San Ildefonso bnd). There is one NPDES permit on the Rio Hondo AU. Discussion of these permits is separated into the following sections.

A reserve waste load allocation (RWLA) is calculated the same as a typical WLA but is held in reserve in the event that a given parameter is shown to contribute to the impairment of a receiving water. For permits discharging to the Rio Grande in this TMDL, future permit renewals should include monitoring and reporting requirements to evaluate the potential effect of the discharge on the receiving water. If monitoring data shows that the discharge does not cause or contribute to the impairments of the receiving water, no effluent limits or formal WLAs would be incorporated into the next permit. However, if monitoring demonstrates that the discharge does cause or contribute to an exceedance of the applicable aluminum, adjusted gross alpha, PCBs, temperature, and turbidity criteria and/or plant nutrient thresholds, the reserved capacity may be incorporated into the permit as the facility's WLA and used to establish appropriate effluent limitations.

10.1.1.A Los Alamos County White Rock WWTP (NM0020133)

WLA for the Los Alamos County White Rock WWTP (NM0020133) are included for aluminum (Section 2.3.2), adjusted gross alpha (4.3.2), plant nutrients (5.3.2), PCB (6.3.2), temperature (7.3.2), and turbidity (8.3.2). The current permit does not include monitoring requirements nor reporting limits for the parameters addressed in this TMDL. The current permit expires on February 28, 2027. NMED-SWQB recommends at least monitoring requirements for the parameters addressed in this TMDL, and ultimate TMDL implementation will be coordinated with NMED-SWQB Point Source Regulation Section staff and EPA Region 6. RWLA for aluminum, adjusted gross alpha, PCBs, and temperature are included in this TMDL and traditional WLAs for plant nutrients and turbidity are included in this TMDL.

10.1.1.B City of Santa Fe Buckman Direct Diversion (NM0030848)

WLA for the City of Santa Fe Buckman Direct Diversion (NM0030848) are included for aluminum (Section 2.3.2), adjusted gross alpha (4.3.2), plant nutrients (5.3.2), PCB (6.3.2), temperature (7.3.2), and turbidity (8.3.2). The current permit does not include monitoring requirements nor reporting limits for the parameters addressed in this TMDL, except for turbidity/TSS. The current permit expires on April 30, 2030. NMED-SWQB recommends at least monitoring requirements for the parameters addressed in this TMDL, and ultimate TMDL implementation will be coordinated with NMED-SWQB Point Source Regulation

Section staff and EPA Region 6. RWLA for aluminum, adjusted gross alpha, PCBs, plant nutrients, and temperature are included in this TMDL and a traditional WLA for turbidity are included in this TMDL.

10.1.1.C Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759)

WLA for the Los Alamos National Labs (LANL) Stormwater Individual Permit (NM0030759) are included for aluminum (Section 2.3.2), adjusted gross alpha (4.3.2), plant nutrients (5.3.2), PCB (6.3.2), temperature (7.3.2), and turbidity (8.3.2). The current permit does not include monitoring requirements nor reporting limits for the parameters addressed in this TMDL, except for gross alpha. The current permit expires on July 31, 2027. NMED-SWQB recommends at least monitoring requirements for the parameters addressed in this TMDL, and ultimate TMDL implementation will be coordinated with NMED-SWQB Point Source Regulation Section staff and EPA Region 6. RWLA for aluminum and plant nutrients are included in this TMDL and traditional WLA for adjusted gross alpha, PCBs, temperature and turbidity are included in this TMDL.

10.1.1.D City of Santa Fe Paseo Real WWTP (NM0022292)

The City of Santa Fe Paseo Real WWTP (NM0022292) does not currently discharge to the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit but the City has plans to divert a portion of their permitted 13 mgd effluent to this AU beginning in 2028. Therefore, WLA are included for aluminum (Section 2.3.2), adjusted gross alpha (4.3.2), plant nutrients (5.3.2), PCB (6.3.2), temperature (7.3.2), and turbidity (8.3.2). The current permit does not include monitoring requirements nor reporting limits for the parameters addressed in this TMDL, except for TSS (turbidity) and plant nutrients. The current permit expires on August 31, 2026. NMED-SWQB recommends at least monitoring requirements for the parameters addressed in this TMDL, and ultimate TMDL implementation will be coordinated with NMED-SWQB Point Source Regulation Section staff and EPA Region 6 once discharge to this AU is finalized. NMED recognizes that a new permit number may be assigned to the new outfall to the Rio Grande, and in that case, the new permit should use all WLA noted in this document associated with NM0022292. However, NMED also recognizes that the new outfall to the Rio Grande could be addressed as an additional outfall (instead of a new permit) under the original permit number, NM0022292. RWLA for aluminum, adjusted gross alpha, PCBs, and temperature are included in this TMDL and traditional WLA for plant nutrients and turbidity are included in this TMDL.

10.1.1.E Taos Ski Valley WWTP (NM0022101)

A WLA for the Taos Ski Valley WWTP (NM0022101) is included for plant nutrients (Section 5.3.2). This WLA is a revision of the 2005 Rio Hondo plant nutrient TMDL. The current permit includes reporting limits for total nitrogen and total phosphorus based on the WLAs established in the 2005 plant nutrient TMDL for the Rio Hondo (South Fork Rio Hondo to Lake Fork Creek). The current permit limits are listed in Table 5.9 as Phase 0 and Phase 1 WLA is based on the 85th percentile of recent data collected by the permittee. The current permit expires on September 30, 2028. NMED-SWQB recommends continuing total nitrogen and total phosphorus limits and ultimate TMDL implementation will be coordinated with NMED-SWQB Point Source Regulation Section staff and EPA Region 6.

10.2 Nonpoint Sources

10.2.1 WBP and BMP Coordination

Public awareness and involvement will be crucial to the successful implementation of these plans and improved water quality. A Watershed Based Plan (WBP) is a written plan intended to provide a long-range vision for various activities and management of resources in a watershed. It includes opportunities for private landowners and public agencies in reducing and preventing nonpoint source impacts to water quality. This long-range strategy will become instrumental in coordinating efforts to achieve water quality standards in the watershed. The WBP is essentially the Implementation Plan, or Phase Two of the TMDL process. The completion of the TMDLs and WBP leads directly to the development of on-the-ground projects to address surface water impairments in the watershed. BMPs to be considered as part of on-the-ground-projects to address temperature include establishment of additional woody riparian vegetation for shade and/or stream channel restoration work, particularly at road crossings. Additional information about the reduction of nonpoint source pollution can be found online at: <https://www.epa.gov/polluted-runoff-nonpoint-source-pollution>.

10.2.2 Clean Water Act Section 319(h) Funding

The Watershed Protection Section of the SWQB may potentially be able to provide USEPA Section 319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed as category 4 or 5 waters on the Integrated § 303(d)/§ 305(b) list. These monies are available to all private, for-profit, and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, federal agencies, or agencies of the state. Proposals are submitted through a Request for Proposal (RFP) process. Selected projects require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Funding is potentially available, generally annually, for both watershed-based planning and on-the-ground projects to improve surface water quality and associated habitat. Further information on funding from the CWA Section 319(h) can be found at the SWQB website: <https://www.env.nm.gov/surface-water-quality/>.

10.2.3 Other Funding Opportunities and Restoration Efforts

Several other sources of funding exist to address impairments discussed in this TMDL document. NMED's Construction Programs Bureau assists communities in need of funding for WWTP upgrades and improvements to septic tank configurations. They can also provide matching funds for appropriate CWA Section 319(h) projects using state revolving loan fund monies. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Environmental Quality Incentive Program (EQIP) program can provide assistance to private landowners in the basin. The USDA Forest Service aligns their mission to protect lands they manage with the TMDL process, and are another source of assistance. The US Bureau of Land Management (BLM) has several programs in place to provide assistance to improve unpaved roads and grazing allotments.

The SWQB annually makes available CWA Section 604(b) funds through a Request for Quotes (RFQ) process. The SWQB requests quotes from regional public comprehensive planning organizations to conduct water quality management planning as defined under Sections 205(j) and 303(e) of the CWA. The

SWQB seeks proposals to conduct water quality management planning with a focus on projects that clearly address the State's water quality goals to preserve, protect and improve the water quality in New Mexico. The SWQB encourages proposals focused on TMDLs and UAAs or other water quality management planning activities that will directly address identified water quality impairments. The SWQB 604(b) RFQ is released annually in September.

The NMED River Stewardship Program (RSP) has the overall goal of addressing the root causes of poor water quality and stream habitat in New Mexico. Objectives include: restoring or maintaining hydrology of streams and rivers to better handle overbank flows and thus reduce flooding downstream; enhancing economic benefits of healthy river systems such as improved opportunities to hunt, fish, float or view wildlife; and providing state matching funds required for federal Clean Water Act grants the SWQB receives each year.

The RSP awarded over \$10 Million across 28 projects in early 2025 and 2026. A competitive Request for Proposals was issued in the spring 2026, to award approximately \$10 Million to new projects. These projects are funded through the Land of Enchantment Legacy fund and appropriations by the New Mexico Legislature. Awards are anticipated to be announced in early 2027. Additional funding sources for watershed protection and improvement projects are listed in Appendix C of the New Mexico Nonpoint Source Management Plan, available at <https://www.env.nm.gov/surface-water-quality/nps-plan>.

Information on additional watershed restoration funding resources is available on the SWQB website at <https://www.env.nm.gov/surface-water-quality/watershed-protection-section/>.

10.3 Temperature Modeling

Freshwater systems have interrelated biotic and abiotic parameters that drive the temperature of the waterbody. For a stream, these parameters can be generalized into simple categories that include: vegetation and land cover, channel morphology, and hydrology. Parameters such as channel width, meteorological measurements and microclimates, and solar irradiance, can exhibit considerable spatial variability. Together these parameters affect heat transfer and mass transfer processes to varying degrees. Due to the complexity of these systems, temperature modeling techniques are useful to facilitate the computation and prediction of the extent to which different parameters can affect a freshwater system. Temperature models can also identify the sensitivity of water temperature to individual parameters, to inform understanding of actions most likely to succeed in TMDL implementation. BMPs to be considered as part of on-the ground-projects to address temperature include establishment of additional woody riparian vegetation for shade and/or stream channel restoration work, particularly at road crossings.

The SSTEMP Model, Version 2.0.8, developed by the USGS Biological Resource Division (Bartholow, 2002) was used to predict stream temperatures of the impaired AUs based on watershed geometry, hydrology, and meteorology. The model predicts mean, minimum, and maximum daily water temperatures throughout a stream reach by estimating the heat gained or lost from a parcel of water as it passes through a stream segment during a single day (Bartholow, 2002). Each AU was modeled on the date of the maximum recorded water temperature on the thermograph record which was used to assess impairment. The model is calibrated by comparing predicted temperature values with actual thermograph readings measured in the field. SSTEMP is useful to inform TMDL implementation practices for temperature impaired AUs. The model analysis focuses mainly on changes in the riparian shade percentage and/or

modification to channel dimensions. Total percent shade was chosen as a first-step analysis for TMDL implementation since it is easily translated into quantifiable management objectives.

SWQB collects physical habitat data using Standard Operating Procedure 5.0 (<https://www.env.nm.gov/surface-water-quality/sop/>). Sufficient physical habitat data was available to conduct SSTEMP modeling for the AUs Canada Tio Grande (Rio San Antonio to headwaters), Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd), and Embudo Creek (Rio Grande to Canada de Ojo Sarco).

SSTEMP Version 2.0.8

File View Help

Hydrology

Segment Inflow (cfs)	0.000
Inflow Temperature (°F)	55.000
Segment Outflow (cfs)	0.400
Accretion Temp. (°F)	42.600

Geometry

Latitude (degrees)	36.814
Dam at Head of Segment	☐
Segment Length (mi)	10.580
Upstream Elevation (ft)	10580.0
Downstream Elevation (ft)	8850.00
Width's A Term (s/ft²)	12.125
B Term where $W = A * Q^{**B}$	0.532
Manning's n	0.703

Meteorology

Air Temperature (°F)	62.400
☒ Maximum Air Temp (°F)	73.900
Relative Humidity (%)	49.000
Wind Speed (mph)	4.000
Ground Temperature (°F)	42.600
Thermal gradient (j/m²/s/C)	1.650
Possible Sun (%)	76.000
Dust Coefficient	5.000
Ground Reflectivity (%)	25.000
Solar Radiation (Langley's/d)	

Shade

Total Shade (%)	15.350
-----------------	--------

Time of Year

Month/day (mm/dd) 07/10

Intermediate Values

Day Length (hrs) = 14.372
Slope (ft/100 ft) = 3.097
Width (ft) = 5.151
Depth (ft) = 0.391

Mean Heat Fluxes at Inflow (j/m²/s)

Convect. = +18.10	Atmos. = +259.00
Conduct. = -11.37	Friction = +0.02
Evapor. = -54.28	Solar = +274.28
Back Rad. = -361.19	Vegetat. = +56.93
Net = +181.50	

Optional Shading Variables

Segment Azimuth (degrees) [Redacted]

	West Side	East Side
Topographic Altitude (degrees)	[Redacted]	[Redacted]
Vegetation Height (ft)	[Redacted]	[Redacted]
Vegetation Crown (ft)	[Redacted]	[Redacted]
Vegetation Offset (ft)	[Redacted]	[Redacted]
Vegetation Density (%)	[Redacted]	[Redacted]

Model Results - Outflow Temperature

Predicted Mean (°F) = 67.44
Estimated Maximum (°F) = 80.12
Approximate Minimum (°F) = 54.77

Mean Equilibrium (°F) = 69.15
Maximum Equilibrium (°F) = 83.29
Minimum Equilibrium (°F) = 55.01

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Figure 10.1 SSTEMP Example output for Canada Tio Grande (Rio San Antonio to headwaters)

A series of assumptions are associated with the SSTEMP model run conditions. Running the model outside of these assumptions may result in inaccuracies or model instability. The assumptions used in the development of SSTEMP that are most relevant to the present TMDLs are listed below. A complete list of assumptions and model deficiencies is presented in the SSTEMP user manual (Bartholow, 2002).

- Water in the system is instantaneously and thoroughly mixed at all times; there is no lateral temperature distribution across channel OR vertical gradients in pools.
- Stream geometry is characterized by mean conditions.
- Solar radiation and other meteorological and hydrological variables are 24-hour means.
- Distribution of lateral inflow is uniformly apportioned throughout the segment length
- Manning's n and travel time do not vary as functions of flow.
- Modeled/representative time periods must be long enough for water to flow the full length of the segment.
- SSTEMP is not able to model cumulative effects; for example, adding or deleting vegetation mathematically is not the same as in real life.

Water temperature can be expressed as heat energy per unit volume. SSTEMP provides an estimate of heat energy expressed in joules per square meter per second ($\text{J}/\text{m}^2/\text{s}$). The program will predict the minimum, mean, and maximum daily water temperature for the set of variables input into the model. The theoretical basis for the model is strongest for the mean daily temperature. The predicted maximum is largely an estimate and likely to vary widely with the maximum daily air temperature. The predicted minimum is computed by subtracting the difference between maximum and mean, from the mean; but the predicted minimum is always above 0 degrees Celsius (Bartholow, 2002).

Sources for the SSTEMP input variables are shown in **Appendix E**. The SSTEMP predicted maximum temperature was calibrated against thermograph data. **Table E.1** shows input values for the calibrated model. Percent total shade was then increased until the maximum 24-hour temperature decreased to the applicable temperature criterion. **Table 10.1** details model outputs for the TMDL AUs.

Table 10.1 SSTEMP model results for temperature impaired AUs

Assessment Unit	Estimated % Shade ^(a)	WQS % Shade ^(b)	Shade Increase (%) ^(c)
Canada Tio Grande (Rio San Antonio to headwaters)	15.35	40.74	165
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	30.82	45.65	48
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	18.82	57.25	204

^(a) Shade is collected via densitometer during SWQB habitat monitoring (see Appendix E).

^(b) % shade at which the SSTEMP predicted maximum temperature is held below the applicable WQS, all other variables being held the same.

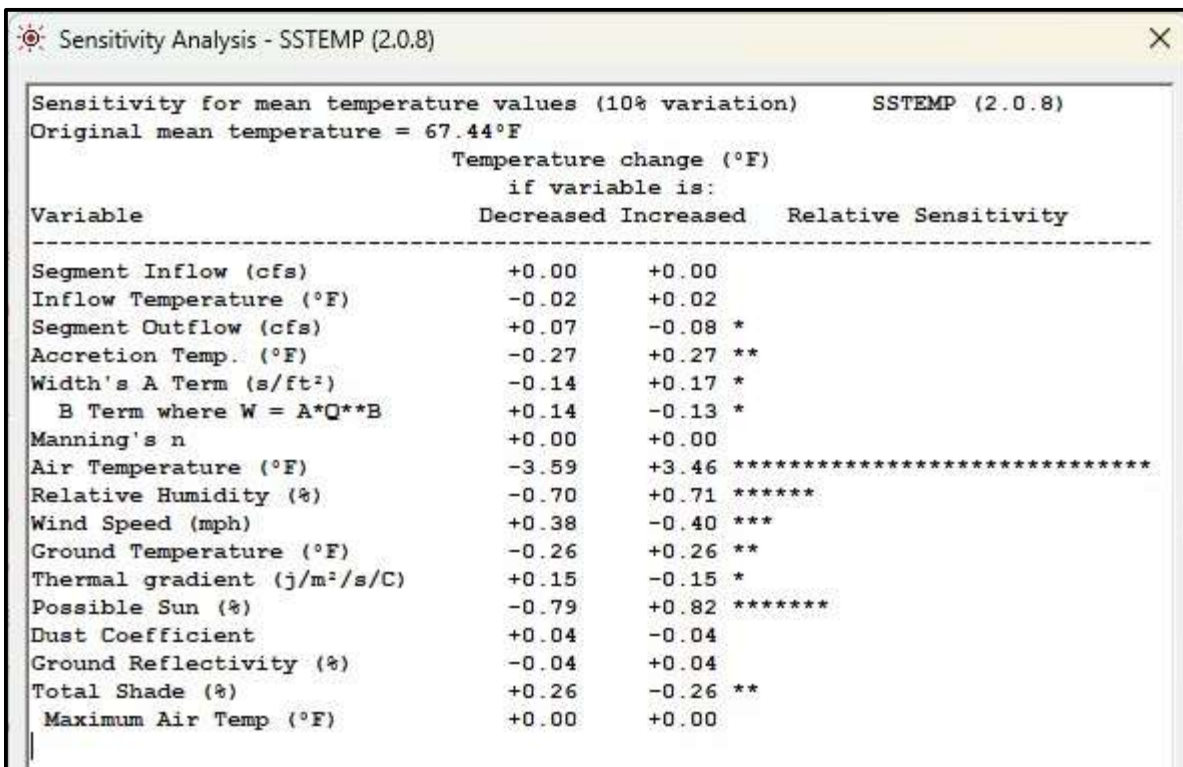
^(c) % by which SSTEMP predicts that shade must be increased to hold maximum water temperature below the applicable WQS, all other variables being held the same.

For the AU Canada Tio Grande (Rio San Antonio to headwaters), shade was increased from the densitometer recorded 2.35% to 15.35% This increase is justified by comparing the monitoring location to the full length of the AU. The monitoring location is exposed, with very little vegetation, but most of the AU is in a shallow sloped canyon with brush and other vegetation, 50 or more feet above the streambed.

Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd) measured shade is 18.8%. The monitoring location has little topographic shade, while the inflow and majority of AU is in a canyon with 200+ ft elevation difference. The percent shade was increased to 30.82% to compensate.

The SSTEMP model does not consider any impact of climate change. SWQB encourages implementation practitioners to design projects to decrease water temperatures beyond simply meeting the applicable WQS, such that currently impaired AUs will be likely to meet WQS standards well into the future with some resiliency to climate change. Another example of designing for resiliency would be the creation of habitat refugia wherein water temperatures would be expected to remain cooler than the average for that water body.

SSTEMP may be used to compute, one at a time, the sensitivity to input values. This analysis varies most active input by 10% in both directions and displays a screen showing the resulting changes to estimated maximum temperature. The "Relative Sensitivity" schematic graph that accompanies the display gives an indication of which variables most strongly influence the results (Bartholow, 2002). Sensitivity analysis outputs are shown in **Figure 10.2**. Meteorological variables will always have the greatest impact on predicted maximum temperature. For the San Francisco River, the sensitivity analysis indicates that maximum water temperature is relatively insensitive to variables other than the meteorological conditions.



Sensitivity Analysis - SSTEMP (2.0.8)

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 67.44°F

Variable	Temperature change (°F) if variable is:		Relative Sensitivity
	Decreased	Increased	
Segment Inflow (cfs)	+0.00	+0.00	
Inflow Temperature (°F)	-0.02	+0.02	
Segment Outflow (cfs)	+0.07	-0.08	*
Accretion Temp. (°F)	-0.27	+0.27	**
Width's A Term (s/ft ²)	-0.14	+0.17	*
B Term where W = A*Q**B	+0.14	-0.13	*
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-3.59	+3.46	*****
Relative Humidity (%)	-0.70	+0.71	*****
Wind Speed (mph)	+0.38	-0.40	***
Ground Temperature (°F)	-0.26	+0.26	**
Thermal gradient (j/m ² /s/C)	+0.15	-0.15	*
Possible Sun (%)	-0.79	+0.82	*****
Dust Coefficient	+0.04	-0.04	
Ground Reflectivity (%)	-0.04	+0.04	
Total Shade (%)	+0.26	-0.26	**
Maximum Air Temp (°F)	+0.00	+0.00	

A

Sensitivity Analysis - SSTEMP (2.0.8)			
Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)			
Original mean temperature = 69.95°F			
Variable	Temperature change (°F)		Relative Sensitivity
	Decreased	Increased	
Segment Inflow (cfs)	-0.46	+0.47 ***	
Inflow Temperature (°F)	-0.09	+0.10 *	
Segment Outflow (cfs)	+0.47	-0.52 ***	
Accretion Temp. (°F)	-0.18	+0.18 *	
Width's A Term (s/ft ²)	-0.04	+0.05	
B Term where $W = A*Q**B$	-0.02	+0.02	
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-4.89	+4.67 *****	
Relative Humidity (%)	-1.08	+1.11 *****	
Wind Speed (mph)	+0.35	-0.37 **	
Ground Temperature (°F)	-0.22	+0.22 *	
Thermal gradient (j/m ² /s/C)	+0.09	-0.09 *	
Possible Sun (%)	-0.44	+0.45 ***	
Dust Coefficient	+0.03	-0.03	
Ground Reflectivity (%)	-0.03	+0.03	
Total Shade (%)	+0.39	-0.38 **	
Maximum Air Temp (°F)	+0.00	+0.00	

B

Sensitivity Analysis - SSTEMP (2.0.8)			
Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)			
Original mean temperature = 76.74°F			
Variable	Temperature change (°F)		Relative Sensitivity
	Decreased	Increased	
Segment Inflow (cfs)	-0.32	+0.68 *****	
Inflow Temperature (°F)	-0.24	+0.27 **	
Segment Outflow (cfs)	+0.68	-0.35 *****	
Accretion Temp. (°F)	-0.07	+0.07	
Width's A Term (s/ft ²)	-0.07	+0.10 *	
B Term where $W = A*Q**B$	-0.04	+0.04	
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-4.34	+4.12 *****	
Relative Humidity (%)	-0.68	+0.70 *****	
Wind Speed (mph)	+0.14	-0.14 *	
Ground Temperature (°F)	-0.33	+0.34 **	
Thermal gradient (j/m ² /s/C)	+0.16	-0.16 *	
Possible Sun (%)	-0.71	+0.73 *****	
Dust Coefficient	+0.04	-0.04	
Ground Reflectivity (%)	-0.04	+0.04	
Total Shade (%)	+0.31	-0.31 **	
Maximum Air Temp (°F)	+0.00	+0.00	

C

Figure 10.2 SSTEMP Sensitivity outputs: A) Canada Tio Grande (Rio San Antonio to headwaters), B) Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd), C) Embudo Creek (Rio Grande to Canada de Ojo Sarco)

The SSTEMP model does not consider any impacts of climate change. SWQB encourages implementation practitioners to design projects to decrease water temperatures beyond simply meeting the applicable WQS, such that currently impaired AUs will be likely to meet WQS standards well into the future with some resiliency to climate change. An example of designing for resiliency would be the creation of habitat refugia wherein water temperatures would be expected to remain cooler than the average for that water body.

11.0 APPLICABLE REGULATIONS AND REASONABLE ASSURANCES

New Mexico's Water Quality Act, NMSA 1978, §§ 74-6-1 to -17 (Act), authorizes the WQCC to "adopt rules to prevent or abate water pollution in the state" and to require permits. The Act authorizes a constituent agency, such as NMED, to take enforcement action against any person who violates a water quality standard. Several statutory provisions on nuisance law could also be applied to NPS water pollution. The Act also states in Section 74-6-12(A):

The Water Quality Act does not grant to the commission or to any other entity the power to take away or modify the property rights in water, nor is it the intention of the Water Quality Act to take away or modify such rights.

In addition, the State of New Mexico Standards for Interstate and Intrastate Surface Waters at 20.6.4.6(C) NMAC state:

Pursuant to Subsection A of Section 74-6-12 NMSA 1978, this part does not grant to the water quality control commission or to any other entity the power to take away or modify property rights in water.

New Mexico policies are in accordance with the federal CWA Section 101(g):

It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall cooperate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

33 U.S.C. § 1251(g)

New Mexico's CWA Section 319 Program has been developed in a coordinated manner with the State's CWA Section 303(d) process. All watersheds that are targeted in the annual §319 request for proposal process coincide with the State's biennial impaired waters list as approved by USEPA. The State has given a high priority for funding, assessment, and restoration activities to these watersheds.

As a constituent agency, NMED has the authority under the Act, Section 74-6-10 to issue a compliance order or commence civil action in district court for appropriate relief if NMED determines that actions of a "person" (as defined in the Act) have resulted in a violation of a water quality standard including a violation caused by a NPS. The NMED NPS water quality management program has historically strived for and will continue to promote voluntary compliance to NPS water pollution concerns by utilizing a voluntary, cooperative approach. The State provides technical support and grant monies for implementation of BMPs and other NPS prevention mechanisms through Section 319 of the CWA. Since portions of this TMDL will be implemented through NPS control mechanisms, the New Mexico Watershed Protection Program will target efforts to this and other watersheds with TMDLs.

In order to obtain reasonable assurances for implementation in watersheds with multiple landowners, including federal, state, and private land, NMED has established Memoranda of Understanding (MOUs) with various federal agencies, in particular the U.S. Forest Service and the BLM. MOUs have also been

developed with other state agencies, such as the New Mexico Department of Transportation. These MOUs provide for coordination and consistency in dealing with NPS issues.

The time required to attain standards for all reaches is estimated to be approximately 10-20 years. This estimate is based on a five-year time frame implementing several watershed projects that may not be starting immediately or may be in response to earlier projects. Stakeholders in this process will include SWQB, and other parties identified in the WBP. The cooperation of watershed stakeholders will be pivotal in the implementation of these TMDLs as well.

12.0 PUBLIC PARTICIPATION

Public participation was solicited in development of this TMDL. Pursuant to 40 C.F.R. § 130.7(a), the public participation will be conducted in accordance with Section XIV of the WQMP/CPP (NMED/SWQB, 2020), and as outlined in Section IV.C of the WQMP/CPP. The draft TMDL was made available for a 30-day comment period beginning August 14, 2026, and ending on September 14, 2026. The draft document notice of availability included information on comment submittal and dates/times of the public meetings. It was advertised via email distribution lists and webpage postings. A public meeting will be held using virtual meeting technology on August 27, 2026 from 2-3:30pm. [#] sets of public comments were submitted. A response to public comments will be added to this TMDL document as **Appendix G**. The TMDL document was approved by the NM WQCC on [DATE] and EPA Region 6 on [DATE].

Following WQCC and EPA approval, the next step for public participation will be development of WBPs and watershed protection projects, including those that may be funded by CWA Section 319(h) grants managed by SWQB.

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APPENDIX A
THREATENED AND ENDANGERED SPECIES
KNOWN TO OCCUR IN THE PROJECT AREA

Common Name	Scientific Name	Federal Status	State Status
Conejos (13010005)			
Boreal Toad	Anaxyrus boreas	Partial Status [PS]	Endangered
Pacific Marten	Martes caurina		Threatened
Boreal Owl	Aegolius funereus		Threatened
Gray Vireo	Vireo vicinior		Threatened
New Mexican Meadow Jumping Mouse	Zapus hudsonius luteus	Listed Endangered [LE]	Endangered
Upper Rio Grande (13020101)			
Bald Eagle	Haliaeetus leucocephalus		Threatened
Taos Springsparsley	Cymopterus spellenbergii		Endangered
Santa Fe Cholla	Cylindropuntia viridiflora		Endangered
Pinyon Jay	Gymnorhinus cyanocephalus	Under Review [UR]	
Yellow-Billed Cuckoo	Coccyzus americanus	Listed Threatened [LT]	
Peregrine Falcon	Falco peregrinus		Threatened
American Peregrine Falcon	Falco peregrinus anatum		Threatened
Southern Pocket Gopher	Thomomys umbrinus		Threatened
Rio Grande Silvery Minnow	Hybognathus amarus	Listed Endangered [LE]	Endangered
Mountain Lily	Lilium philadelphicum var. andinum		Endangered
Pacific Marten	Martes caurina		Threatened
Monarch Butterfly	Danaus plexippus	Candidate for Listing [C]	
Great Plains Lady's Tresses	Spiranthes magnicamporum		Endangered
White-Tailed Ptarmigan	Lagopus leucura		Endangered
Jemez Mountains Salamander	Plethodon neomexicanus	Listed Endangered [LE]	Endangered
Lilljeborg's Pea-Clam	Pisidium lilljeborgi		Threatened
Sangre De Cristo Pea-Clam	Pisidium sanguinichristi		Threatened
Boreal Owl	Aegolius funereus		Threatened
Mexican Spotted Owl	Strix occidentalis lucida	Listed Threatened [LT]	
Southwestern Willow Flycatcher	Empidonax traillii extimus	Listed Endangered [LE]	Endangered
Spotted Bat	Euderma maculatum		Threatened
Gray Vireo	Vireo vicinior		Threatened
New Mexican Meadow Jumping Mouse	Zapus hudsonius luteus	Listed Endangered [LE]	Endangered

Source: <https://nhnm.unm.edu/nhnmsearch>

APPENDIX B
WATER QUALITY DATA

B.1. Total Recoverable Aluminum data

Exceedances of the applicable criteria are shown in **bold red font**. MDP indicates a missing data point.

Rio Grande (Cochiti Reservoir to San Ildefonso bnd) - 30RGrand586.5

Date	TR (mg/L)	Acute Criterion (mg/L)	Chronic Criterion (mg/L)
4/6/2017	2.9	3.51	1.41
5/18/2017	1.5	2.43	0.975
3/21/2018	0.72	3.28	1.31
5/15/2018	0.47	4.64	1.86
8/2/2018	1.6	4.54	1.82
10/17/2018	0.63	5.11	2.05
10/30/2018	0.36	5.11	2.05

Rio de los Pinos (New Mexico reaches) - 27RPinos002.6

Date	TR (mg/L)	Acute Criterion (mg/L)	Chronic Criterion (mg/L)	Flow (cfs)
4/4/2018	0.76	0.541	0.217	86.8
7/24/2018	0.19	0.975	0.391	10.4
9/19/2017	0.13	0.844	0.338	14.8
4/4/2017	1.3	0.658	0.263	124
10/9/2018	0.19	0.812	0.325	22.6

Rio San Antonio (CO border to Montoya Canyon) - 27RSanAn000.4

Date	TR (mg/L)	Acute Criterion (mg/L)	Chronic Criterion (mg/L)	Flow (cfs)
9/19/2017	0.24	2.56	1.03	0.75
4/4/2018	1.3	1.01	0.404	28.7
10/9/2018	0.08	3.05	1.22	0.55
9/12/2018	0.12	2.78	1.11	0.55
5/16/2017	2.1	0.43	0.172	254
4/4/2017	2.3	1.11	0.445	88.3

B.2. E.coli data

Exceedances of the applicable criteria are shown in **bold red** font. MDP indicates a missing data point.

Canada Tio Grande (Rio San Antonio to headwaters)

Date	Station ID	<i>E.coli</i> (mpn/100mL)
2017-05-16	27CTGran000.7	7.45
2017-09-18	27CTGran000.7	50.39
2017-10-30	27CTGran000.7	5.16
2018-05-22	27CTGran000.7	9.79
2018-04-04	27CTGran000.7	0
2018-07-24	27CTGran000.7	461.11
2018-09-11	27CTGran000.7	54.61
2018-10-09	27CTGran000.7	547.5

Rio Nutritas (Rio San Antonio to headwaters)

Date	Station ID	<i>E.coli</i> (mpn/100mL)
2017-09-18	27RNutri002.0	37.34
2017-10-30	27RNutri002.0	13.36
2018-05-22	27RNutri002.0	6.32
2018-09-11	27RNutri002.0	325.54
2018-09-25	27RNutri002.0	307.59

B.3. Adjusted gross alpha data

Exceedances of the applicable criteria are shown in **bold red** font. MDP indicates a missing data point.

Rio Grande (Cochiti Reservoir to San Ildefonso bnd)

Date	Station ID	Location ID	Adjusted Gross Alpha (pCi/L)
10-04-2018	CAWR-18-163204	Rio Grande above Frijoles	4.5
10-02-2018	CAWR-18-163205	Rio Grande at BDD Intake	1.9
08-08-2015	BDR080815C	Rio Grande at BDD Intake	18
08-08-2015	BDR080815E	Rio Grande at BDD Intake	84
07-30-2015	BDW073015BS	Rio Grande at BDD Intake	17
07-30-2015	BDW073015C	Rio Grande at BDD Intake	65
07-30-2015	BDW073015F	Rio Grande at BDD Intake	49
07-31-2015	BDW073115ES	Rio Grande at BDD Intake	14
07-31-2015	BDW073115F	Rio Grande at BDD Intake	77
07-31-2015	BDW073115M	Rio Grande at BDD Intake	20
08-08-2015	OTO080815C	Rio Grande at Otowi Upper bank	12
08-08-2015	OTO080815G	Rio Grande at Otowi Upper bank	210
10-21-2015	OTO102115BS	Rio Grande at Otowi Upper bank	5.6
10-21-2015	OTO102115C	Rio Grande at Otowi Upper bank	1000
10-21-2015	OTO102115E	Rio Grande at Otowi Upper bank	830
10-21-2015	OTO102115ES	Rio Grande at Otowi Upper bank	6.6
10-21-2015	OTO102115G	Rio Grande at Otowi Upper bank	490
10-21-2015	OTO102115GS	Rio Grande at Otowi Upper bank	8.6

B.4. Plant nutrient data

Both the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) and Rio Hondo (South Fork Rio Hondo to Lake Fork Creek) assessment units are not impaired for plant nutrients. The TMDLs in this document are protective TMDLs.

B.5. PCB data

Exceedances of the applicable criteria are shown in **bold red** font. MDP indicates a missing data point.

Rio Grande (Cochiti Reservoir to San Ildefonso bnd)

Date	Station ID	PCB (µg/L)
10-30-2018	30RGrand586.5	0.00001
10-17-2018	30RGrand586.5	0.000013
3-21-2018	30RGrand586.5	0.000014
07-02-2015	BDE070215D	0.00158
07-07-2015	BDE070715D	0.00174
07-07-2015	OTO070715A	0.000368
07-08-2015	OTO070815A	0.000207
07-20-2015	BDE072015A	0.000335
07-21-2015	BDE072015F	0.00542
07-27-2015	OTO072715A	0.000365
07-30-2015	BDE073015C	0.000231
07-31-2015	BDE073115A	0.00132
08-01-2015	OTO080115A	0.00021
08-08-2015	BDR080815A	0.000232
08-08-2015	OTO080815A	0.00045
08-15-2015	BDR081515A	0.000231
08-15-2015	OTO081515A	0.000456
10-21-2015	BDR102115A	0.00684
10-21-2015	OTO102115A	0.00596
10-22-2015	BDE102115E	0.000531
10-24-2015	BDE102415C	0.000589
10-02-2018	CAWR-18-163205	0.000174
10-04-2018	CAWR-18-163204	0.0000311

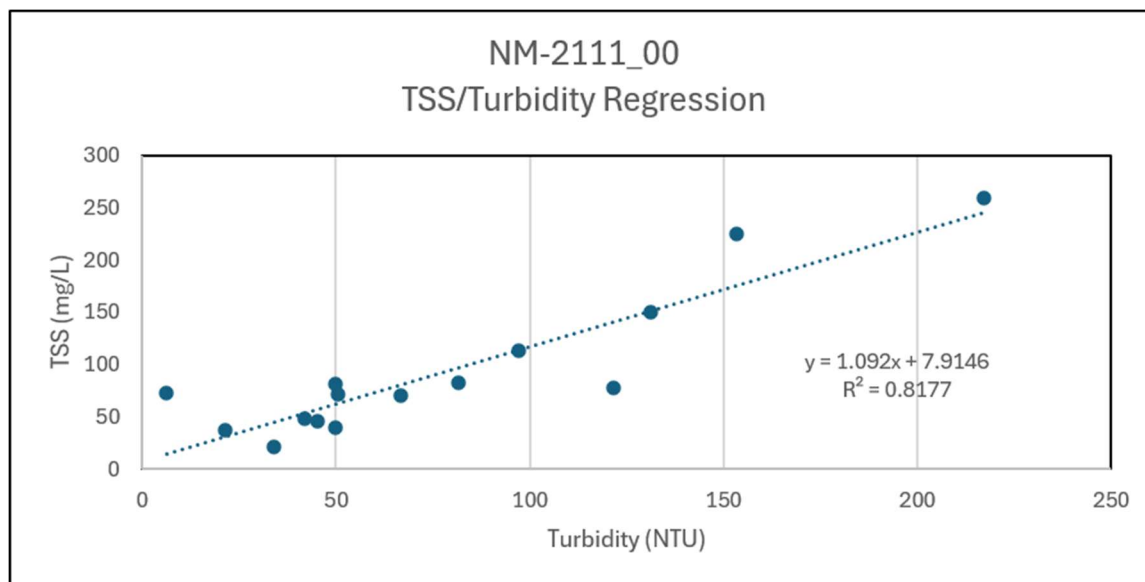
B.6. Temperature data

See Appendix E.

B.7. Turbidity data

Rio Grande (Cochiti Reservoir to San Ildefonso bnd) - 30RGrand586.5

Date	TSS (mg/L)	Turbidity (NTU)	Flow (cfs)
2017-08-31	259	217	921
2025-05-27	82	81.5	808
2025-07-21	225	153.2	372
2026-03-17	48	42	773
2026-04-07	46	45.4	669
2025-09-09	150	131.2	241
2017-04-06	73.00	6.3	3100
2017-05-18	70	66.7	5790
2017-07-17	71	50.5	1290
2017-10-17	81	50	973
2018-03-21	37	21.3	736
2018-05-15	78	121.5	1070
2018-08-02	113	97.2	888
2018-10-17	40	50	973
2018-10-30	21	34	362



APPENDIX C

SOURCE DOCUMENTATION

The approach for identifying probable sources of impairment is documented in SWQB Standard Operating Procedure (SOP) 4.1, Probable Source(s) Determination (<https://www.env.nm.gov/surface-water-quality/sop/>). “Sources” are defined as activities that may contribute pollutants or stressors to a water body (USEPA, 1997). The list of “Probable Sources of Impairment” in the Integrated § 303(d)/§ 305(b) List, Total Maximum Daily Load documents (TMDLs), and Watershed-Based Plans (WBPs) is intended to include any and all activities that could be contributing to the identified cause of impairment, which are supported by evidence strong enough to establish presumption but not proof. Probable Source categories are selected from Appendix A of SOP 4.1, which was adapted from the EPA ATTAINS database.

USEPA, through guidance documents, strongly encourages states to include a list of Probable Sources for each listed impairment. According to the 1998 Section 305(b) report guidance, “..., *states must always provide aggregate source category totals...*” in the biennial submittal that fulfills CWA Section 305(b)(1)(C) through (E) (USEPA, 1997). The list of “Probable Sources” is not intended to single out any particular landowner or single land management activity and has therefore been labeled “Probable” and generally includes several sources for each known impairment.

Any new impairment listing will be assigned a Probable Source of “Source Unknown.” During sampling events, Monitoring Team staff select applicable Probable Sources from a drop-down menu on the Stream/River Field Data Form. Information gathered by the Monitoring Team is used to generate a draft Probable Source list in consequent TMDL planning documents. The TMDL writer then revises the list using aerial imagery, Geographic Information System data, and other available records. The list is also reviewed by Watershed Protection Section staff with knowledge of the AU and watershed. These draft Probable Source lists will be finalized with watershed group/stakeholder input during the pre-survey public meeting, TMDL public meeting, WBP development, and various public comment periods. The Probable Source list in the approved TMDL will be used to update the subsequent Integrated List.

Data on Probable Sources gathered by Monitoring and Assessment Section staff and Watershed Protection Section staff during water quality surveys and watershed restoration projects is housed in the NMED Surface Water Quality Information Database (SQUID). More specific information on Probable Sources of Impairment is provided in individual watershed planning documents (e.g., TMDLs, WBPs, etc.) as they are prepared to address individual impairments by AU.

Literature Cited:

USEPA. 1997. Guidelines for preparation of the comprehensive state water quality assessments (305(b) reports) and electronic uptakes. [EPA-841-B-97-002A](#). Washington, D.C.

APPENDIX D
CALCULATION OF TEMPERATURE TMDL

Calculation of Temperature TMDL

Problem Statement: Convert Temperature Criteria into a Daily Load

Background

The temperature of water is essential for proper metabolic regulation in the aquatic community. Water at a given temperature has a thermal mass that can be represented in units of energy (thermal energy). There are a variety of sources of temperature loading to a waterbody, including air temperature, solar radiation and point source discharge (if present). In addition, how the temperature loading to a stream is translated to the thermal mass of the stream is dependent on its hydrologic characteristics and condition of riparian area (i.e., shading).

The calculation of a TMDL target is governed by the basic equation,

$$\text{Eq1. } WQS \text{ criterion} * \text{flow} * \text{conversion factor} = \text{TMDL target capacity}$$

For Temperature TMDLs, the WQS criterion is a temperature specified either by the designated Aquatic Life Use (ALU) or site-specific criteria and can be either a maximum temperature or time-duration temperature such as the 4T3 or 6T3.

Flow will generally use the 4Q3 low-flow for the critical flow unless another flow statistic or multiple flow conditions are more appropriate for the situation.

The conversion factor is a variable needed to 1) convert units used by SWQB for flow (in cfs) to cubic meters (m^3) and 2) convert change in water temperature (C) to a volumetric heat capacity ($\text{kJ}/(\text{m}^3 \cdot \text{C})$).

Calculation of Thermal Energy

The thermal loading capacity of a volume is governed by the following equation,

$$\text{Eq2. } \text{thermal energy} = \text{specific heat capacity} * \text{mass} * \text{change in temperature}$$

Specific heat capacity is the amount of energy needed to raise the temperature of one kilogram of a substance by 1 degree Celsius.

Mass can be replaced by volume via density.

Accepted Scientific Units for the variables above are:

thermal energy = kilojoule (kJ) (calories are less common and considered archaic)

specific heat capacity = $\text{kJ}/(\text{kg} \cdot \text{C})$

mass = kilograms (kg)

change in temperature = Celsius (C)

The specific heat capacity of water at $25^\circ\text{C} = 4.182 \text{ kJ}/(\text{kg} \cdot \text{C})$. This is the isobaric (under constant pressure) value for heat capacity at an absolute atmospheric pressure of 585 mmHg. Note: varying water temperature and absolute pressure to minimum and maximum ambient values has negligible effect on the resulting heat capacity.

Calculation of Conversion Factor

Flow (cfs) to (m³/day)

$$\text{Eq3. } 1 \text{ cf/s} * 86,400 \text{ s/day} * 0.0283 \text{ m}^3/\text{cf} = 2445.12 \text{ m}^3/\text{day}$$

Heat Capacity to Volumetric Heat Capacity

$$\text{Eq4. } 4.182 \text{ kJ}/(\text{kg}^{\circ}\text{C}) * 1000 \text{ kg}/\text{m}^3 = 4,182 \text{ kJ}/(\text{m}^3^{\circ}\text{C})$$

Note: water density varies with temperature but only by a fraction of a percent.

$$\text{Conversion Factor} = 2445.12 \text{ m}^3/\text{day} * 4,182 \text{ kJ}/(\text{m}^3^{\circ}\text{C}) = 1.023\text{E}+07 \text{ kJ}/(\text{day}^{\circ}\text{C})$$

Form of TMDL Equation

$$\text{Eq5. } \Delta [^{\circ}\text{C}] \times [\text{cfs}] \times 1.023\text{E}+07 = \text{TMDL (kJ/day)}$$

Input variables in **bold**, $\Delta^{\circ}\text{C} = (\text{WQC} - 0^{\circ}\text{C})$ and **cfs** = critical flow

The resulting value is the increase in kJ/day above 0° Celsius.

APPENDIX E

SSTEMP INPUT DATA

E 1.0 INTRODUCTION

This appendix provides site-specific hydrology, geometry, and meteorological data for input into the Stream Segment Temperature (SSTEMP) Model (Bartholow, 2002). Hydrology variables include segment inflow, inflow temperature, segment outflow, and accretion temperature. Geometry variables are latitude, segment length, upstream and downstream elevation, Width's A-term, Width's B-term, and Manning's n. Meteorological inputs to SSTEMP Model include maximum air temperature, air temperature, relative humidity, windspeed, ground temperature, thermal gradient, possible sun, dust coefficient, ground reflectivity, and solar radiation. In the following sections, data sources for these parameters are discussed in detail for each Assessment Unit (AU) to be modeled using SSTEMP Model. Each AU was modeled on the date of the maximum recorded water temperature on the thermograph record which was used to assess impairment, shown below in **Table E.1**. There were no habitat data available for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) assessment unit.

Table E.1 Assessment units and modeled dates

Assessment Unit	Assessment Unit ID	T _{MAX} Date (Modeled Date)
Canada Tio Grande (Rio San Antonio to headwaters)	NM-2120.A_903	7/10/2017
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	NM-2111_40	7/24/2018
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	NM-2111_41	8/6/2018
Rio San Antonio (CO border to Montoya Canyon)	NM-2120.A_902	6/10/2018

E 2.0 HYDROLOGY

E 2.1 Segment Inflow and Outflow

This parameter is the mean daily flow at the top and bottom of the stream segment. To be conservative, the lowest four-consecutive-day discharge that has a recurrence interval of three years, but that does not necessarily occur every three years (4Q3), was used instead of the mean daily flow. These critical low flows were used to reflect the decreased assimilative capacity of the stream to absorb and disperse solar energy.

Discharges for ungaged sites on gaged streams were estimated based on methods published by Thomes et. Al. (1997). If the drainage area of the ungaged site is between 50 and 150 percent of the drainage area of the gaged site, **Equation E.1** is used. Embudo Creek is split into two AUs, Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd) and Embudo Creek (Rio Grande to Canada de Ojo Sarco). The outflow of Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd) is the inflow of Embudo Creek (Rio Grande to Canada de Ojo Sarco). The AU Embudo Creek (Rio Grande to Canada de Ojo Sarco) has a USGS gage, EMBUDO CREEK AT DIXON, NM – 08279000, at the outflow. Gaged flow was determined using the USGS Hydrologic Toolbox software. Calculated 4Q3 at USGS gage 08279000 was used to calculate estimated inflow and outflow for both Embudo Creek AUs.

$$\text{Equation E.1: } Q_u = Q_g \times \left(\frac{A_u}{A_g}\right)^{0.5}$$

Where:

Q_u = area weighted 4Q3 at the ungaged site (cfs)

Q_g = 4Q3 at gaged site (cfs)

A_u = drainage area of ungaged site (mi²)

A_g = drainage area of gaged site (mi²)

Discharges for ungaged streams were determined using Bell & Tillery's statewide regression equations (2023). The 4Q3 inflow and outflow were determined for the AUs Rio San Antonio (CO border to Montoya Canyon) and Canada Tio Grande (Rio San Antonio to headwaters) using the 4Q3-1a, **Equation E.2**, statewide regression equation. For AUs who's inflow are headwaters, Canada Tio Grande (Rio San Antonio to headwaters), the inflow is equal to zero.

$$\text{Equation E.2: } 4Q3 = DA^{1.08} \times E^{12.20} \times e^{-115.37}$$

Where:

4Q3 = four-day, three-year low-flow frequency (cfs)

DA = drainage area (mi²)

E = mean basin elevation (ft)

e = mathematical constant, Euler's number

The 4Q3 values for inflow and outflow are presented in **Table E.2**. Parameters used in the calculations were obtained using the StreamStats online GIS application developed by the USGS (<https://streamstats.usgs.gov/ss/>). Inflow and outflow were determined by delineating basins at the top and bottom of the AUs, respectively.

Table E.2 4Q3 Inflow & outflow

Assessment Unit	Inflow 4Q3 (cfs)	Outflow 4Q3 (cfs)
Canada Tio Grande (Rio San Antonio to headwaters)	--	0.4
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	2.13	2.49
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	2.49	2.61
Rio San Antonio (CO border to Montoya Canyon)	3.25	3.72

E 2.2 Inflow Temperature

This parameter represents the mean water temperature at the top of the segment on the modeled date.

The inflow temperature for Embudo Creek (Rio Grande to Canada de Ojo Sarco) was determined with long term temperature data collected on the modeled date at the monitoring station Embudo Creek above

Canoncito – 28Embudo010.1. This monitoring site is located at the outflow of Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd).

Inflow for the AU Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd) lacks thermograph data, so an alternative method was used to estimate inflow temperatures. An assumption was made that the ratio between air temperature and surface water temperature is the same at the top of the AU and the monitoring location used for assessment of the AU. Mean daily air temperatures were acquired from New Mexico Climate Center website (<https://wrcc.dri.edu/wraws/nmF.html>). The adiabatic lapse rate was used to correct for elevational differences at both the monitoring station and the inflow location. Mean daily air temperature for the AU and the adiabatic lapse rate equation are presented later in section **E 4.1**.

The inflow temperature for Rio San Antonio (CO border to Montoya Canyon) was determined with thermograph data collected on the modeled date at the monitoring station Rio San Antonio at NM-CO border in Ortiz - 27RSanAn000.4. This monitoring location is located next to the Colorado border on the AU.

Table E.3 Mean daily inflow temperature

Assessment Unit	Inflow Temp (°C)	Inflow Temp (°F)
Canada Tio Grande (Rio San Antonio to headwaters)	--	--
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	21.0	69.8
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	21.9	71.4
Rio San Antonio (CO border to Montoya Canyon)	17.6	63.7

E 2.3 Accretion Temperature

The temperature of the lateral inflow, barring tributaries, generally should be the same as groundwater temperature. In turn, groundwater temperature may be approximated by the mean annual air temperature. Mean annual air temperatures were acquired from New Mexico Climate Center website (<https://wrcc.dri.edu/wraws/nmF.html>). The adiabatic lapse rate (**Equation E.4** – presented in section **E 4.1**) was used to correct for elevational differences between the AUs and weather stations. Weather stations were chosen by relative elevation and geographic area of the AUs.

Table E.4 Mean annual air temperature as estimates for accretion temperature

Assessment Unit	Mean Annual Air Temp (°C)	Mean Annual Air Temp (°F)
Canada Tio Grande (Rio San Antonio to headwaters)	5.9	42.6
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	9.7	49.4
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	10.9	51.7
Rio San Antonio (CO border to Montoya Canyon)	7.1	44.8

E 3.0 GEOMETRY

E 3.1 Latitude

Latitude refers to the position of the stream segment on the earth's surface. Latitude was obtained from the SWQB Mapper, a GIS application, by taking the mean average between the highest and lowest values for the stream corridor for each AU. Latitudes are presented in **Table E.5**.

E 3.2 Dam at Head of Segment

None of the AUs discussed in this appendix have a dam at the inflow.

E 3.3 Segment Length

Segment length was obtained from the SWQB Surface Water Quality Database. Segment lengths are presented in **Table E.5**.

E 3.4 Upstream and Downstream Elevation

Elevations were obtained from Google Earth. Elevations are presented in **Table E.5**.

Table E.5 Geometric parameters

Assessment Unit	Latitude	Segment Length (mi)	Upstream Elevation (ft)	Downstream Elevation (ft)
Canada Tio Grande (Rio San Antonio to headwaters)	36.814	10.58	10580	8850
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	36.455	5.16	7100	6225
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	36.198	6.3	6225	5840
Rio San Antonio (CO border to Montoya Canyon)	36.928	11.86	6226	5843

E 3.5 Width's A and Width's B Term

Field measurements of particle size distribution, water surface slope, and bankfull cross-section were collected following the SWQB Standard Operating Procedure for Physical Habitat Measurements (<https://www.env.nm.gov/surface-water-quality/sop/>). These field data were entered into the Windows-Based Stream Channel Cross-Section Analysis (WinXSPro 3.0) Program (USDA, 2005), to generate values for width, discharge, and Manning's n coefficient at various stages up to bankfull. Width's B Term was calculated as the slope of the regression of the natural log of width and the natural log of flow. Theoretically, the Width's A Term is the untransformed Y-intercept. However, because the width versus discharge relationship tends to break down at very low flows, Width's A Term was estimated by solving for the following equation:

$$\text{Equation E.3: } W = A \times Q^B$$

Where:

- W = Known width (feet)
 A = Width's A Term (seconds per square foot)
 Q = Known discharge (cfs)
 B = Width's B Term (unitless)

It should be noted that the site of physical habitat monitoring for the AUs Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd) and Embudo Creek (Rio Grande to Canada de Ojo Sarco) is the same site. Embudo Creek (Rio Grande to Canada de Ojo Sarco) lacked any physical habitat data on monitoring locations in the AU. The monitoring location is Embudo Creek above Canoncito – 28Embudo010.1, which is at the outflow of Embudo Creek (Rio Grande to Canada de Ojo Sarco) and the inflow of Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd). Since they are separate AUs of the same stream, it is assumed the physical properties are representative of both AUs. **Table E.6** summarizes width A & B terms for the temperature impaired assessment units. The following **Figures E.1 – E.4** presents the calculations for the width A term.

Table E.6 Width A & B terms

Assessment Unit	Width A Term	Width B Term
Canada Tio Grande (Rio San Antonio to headwaters)	12.125	0.532
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	8.532	0.478
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	8.532	0.478
Rio San Antonio (CO border to Montoya Canyon)	2.471	1.753

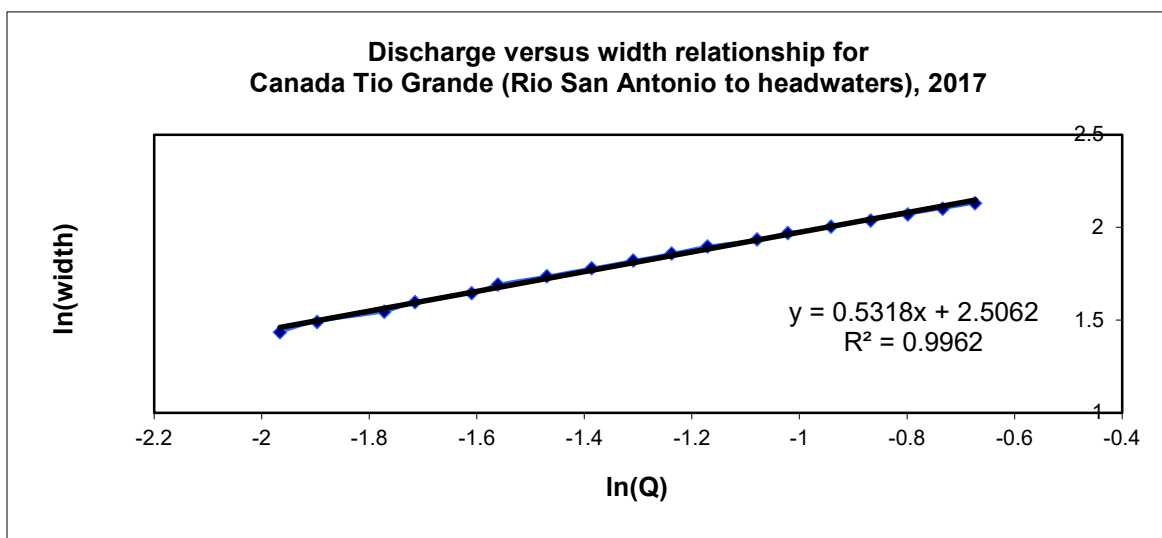


**Figure E.1 Discharge vs. Width Relationship
Canada Tio Grande (Rio San Antonio to headwaters)**

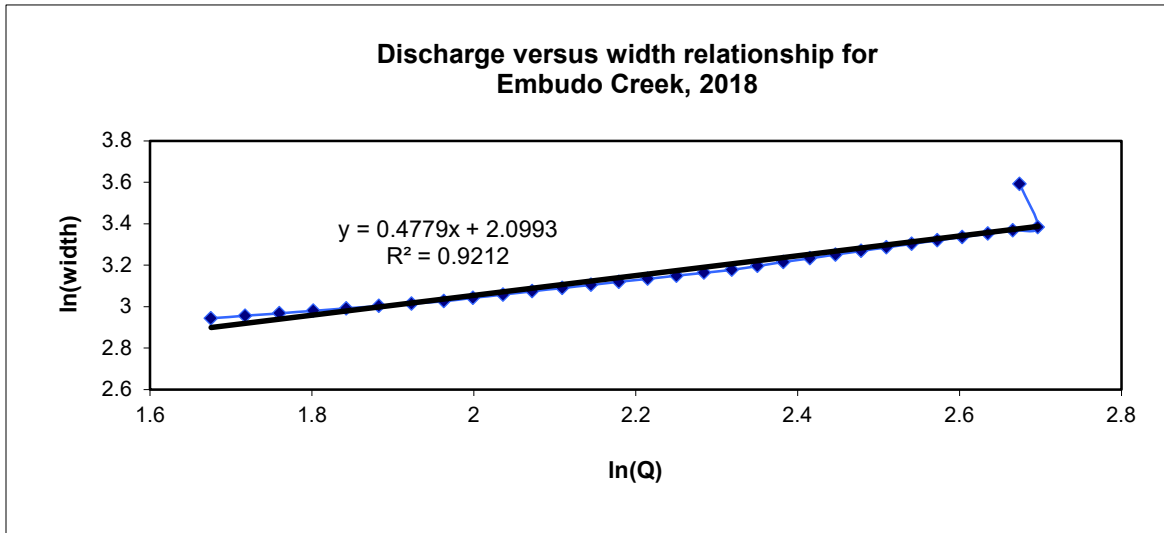


**Figure E.2 Discharge vs. Width Relationship
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)
& Embudo Creek (Rio Grande to Canada de Ojo Sarco)**

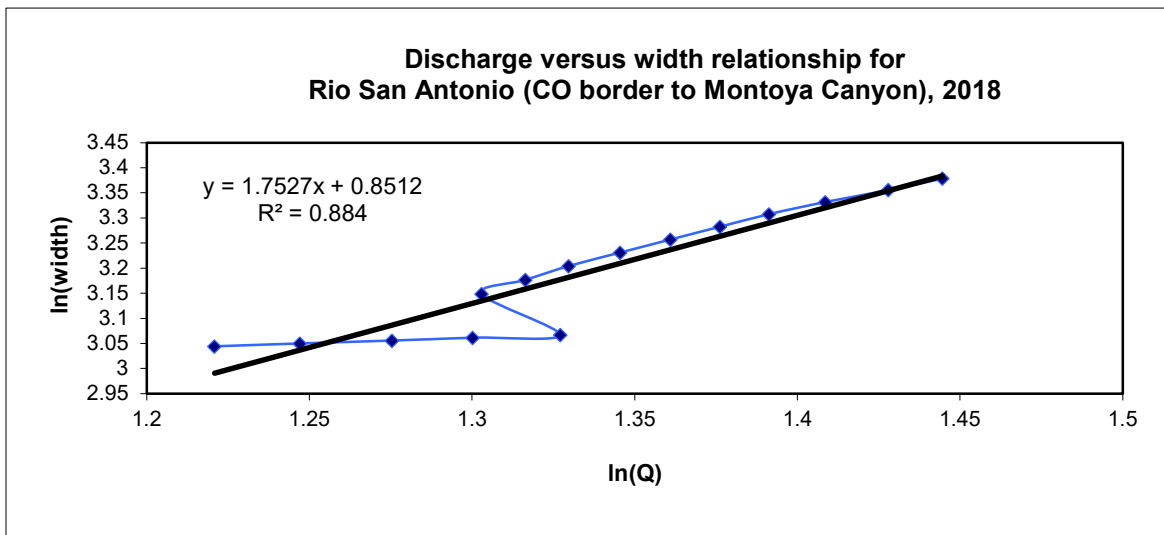


**Figure E.3 Discharge vs. Width Relationship
Rio San Antonio (CO border to Montoya Canyon)**

E 3.6 Manning's n or Travel Time

Site and stage-specific geometry were modeled by the WinXSPRO program described above. WinXSPRO uses Thorne and Zevenbergen's equation as the default Manning's n estimator, but also has an option for user supplied Manning's n. Manning's n is a measure of channel roughness which varies with depth of flow, increasing in value at shallower stages. The user supplied Manning's n was selected for modeling in all cases. Thorne and Zevenbergen's equation produced flow values that did not match measurements collected in the field.

Table E.7 Manning's n values

Assessment Unit	Manning's N Value
Canada Tio Grande (Rio San Antonio to headwaters)	0.703
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	0.357
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	0.357
Rio San Antonio (CO border to Montoya Canyon)	0.317

E 4.0 METEOROLOGICAL PARAMETERS

E 4.1 Air Temperature

In the absence of measured air temperature at the thermograph stations, 24 hour mean temperature on the modelled date was obtained from the nearest available weather station posted on the New Mexico Climate Center website (<https://wrcc.dri.edu/wraws/nmF.html>). Air temperature for the Canada Tio Grande AU was the temperature at the Remote Automatic Weather Station (RAWS) at Buckles Colorado. Air temperature for the Embudo Creek AUs was the RAWS station Mills Canyon New Mexico. Air temperature for the Rio San Antonio AU was the RAWS station Big Horn New Colorado. The adiabatic lapse rate (**Equation E.4**) was used to correct for elevational differences between the AUs and weather stations. Adjusted mean daily air temperatures for temperature impaired AUs are presented in **Table E.6**. Weather stations were chosen by relative elevation and geographic area of the AUs.

$$\text{Equation E.4: } T_a = T_o + C_t \times (Z - Z_o)$$

Where:

- T_a = air temperature at elevation E (°C)
- T_o = air temperature at elevation E_o (°C)
- C_t = moist-air adiabatic lapse rate (-0.00656 °C/m)
- Z = mean elevation of segment (m)
- Z_o = elevation of weather station (m)

Table E.8 Adjusted mean daily air temperature

Assessment Unit	Mean Elevation of AU (m)	Elevation of Weather Station (m)	Weather Station Mean Daily Air Temp (°C)	AU Adjusted Mean Daily Air Temp (°C)	AU Adjusted Mean Daily Air Temp (°F)
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Canada Tio Grande (Rio San Antonio to headwaters)	2956	2804	17.9	16.9	62.4
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	2027	1785	22.0	20.4	68.7
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	1838	1785	24.0	23.7	74.6
Rio San Antonio (CO border to Montoya Canyon)	2530	2540	18.2	18.3	64.9

E 4.2 Maximum Air Temperature

The maximum daily air temperature in SSTEMP overrides a calculated value only if the check box is checked. Since the WQS standard of concern is the T_{MAX} which is particularly sensitive to the maximum air temperature (Bartholow, 2002), an empirical value was entered in this field. In the absence of measured air temperature at the thermograph stations, maximum temperature on the modelled date was obtained from the same weather stations used for mean daily air temperature, above.

E 4.3 Relative Humidity

Mean relative humidity on the modelled date was obtained from the same weather stations used for mean and maximum daily air temperature, above. Data was corrected for elevation and temperature using Equation E.5:

$$\text{Equation E.5: } R_h = R_o \times (1.064^{(T_o - T_a)}) \times \left(\frac{T_a + 273.16}{T_o + 273.16} \right)$$

Where:

- T_a = air temperature at elevation E (°C)
- T_o = air temperature at elevation E_o (°C)
- C_t = moist-air adiabatic lapse rate (-0.00656 °C/m)
- Z = mean elevation of segment (m)
- Z_o = elevation of weather station (m)

E 4.4 Wind Speed

Mean wind speed on the modelled date was obtained from the same weather stations used for mean and maximum daily air temperature, above. Since wind can be variable, and the conditions of the weather stations are not equivalent to the AUs, and wind speed likely being lower at the water's surface compared to an exposed weather station, this parameter was adjusted for model calibration.

E 4.5 Ground Temperature

Same as Accretion Temperature, above.

E 4.6 Thermal Gradient

The software default value is 1.65 joules/meter²/second/°C.

E 4.7 Possible Sun

This variable is an indirect and inverse measure of cloud cover. Percent possible sun was obtained from the Western Regional Climate Center (<https://wrcc.dri.edu/cgi-bin/clilcd.pl?nm23050>). The nearest location with monthly possible sun data is Albuquerque. Bartholow (2002) recommends using possible sun as a calibration parameter. Maximum air temperature, relative humidity, wind speed, ground temperature and possible sun are presented in **Table E.7**:

Table E.9 Meteorological Parameters

Assessment Unit	Maximum Air Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Ground Temperature (°F)	Possible Sun (%)
Canada Tio Grande (Rio San Antonio to headwaters)	73.9	49	4.0	42.6	76
Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd)	82.9	65	9.4	49.4	76
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	86.0	40	10.7	51.7	76
Rio San Antonio (CO border to Montoya Canyon)	78.1	17	10.4	44.8	83

E 4.8 Dust Coefficient

The software default value of 5 was used.

E 4.9 Ground Reflectivity

The software default value of 25% was used.

E 4.10 Solar Radiation

SSTEMP calculates solar radiation internally when a dust coefficient is entered. Weather station values may not represent the on-site solar radiation since the stations are remote from the AU.

E 5.0 SHADE

Shade % data is collected during habitat surveys via densitometer. These values have been confirmed or adjusted by viewing google earth and ArcGIS maps.

Canada Tio Grande measured shade at the monitoring location used for assessment is 2.35%. The monitoring location is exposed, with very little vegetation, but most of the AU is in a shallow sloped canyon with brush and other vegetation, 50 or more feet above the streambed. The percent shade was increased by 13% to compensate.

Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd) measured shade is 18.82%. The monitoring location has little topographic shade, while the inflow and majority of AU is in a canyon with 200+ ft elevation differential. The percent shade was increased by 12% to compensate.

Embudo Creek (Rio Grande to Canada de Ojo Sarco) measured shade is 18.8%. It was determined this is an adequate representation of the AU.

Rio San Antonio measured shade is 29.4%.

E 6.0 REFERENCES

- Bartholow, J.M. 2002. SSTEMP for Windows: The Stream Segment Temperature Model (Version 2.0). U.S. Geological Survey computer model and documentation. Available on the internet at <https://www.sciencebase.gov/catalog/item/53ea4091e4b008eaa4f4c457>. Revised August 2002.
- Bell, Meghan T., Tillery, Anne C. 2023. Regression Equations for Estimating the 4-Dat, 3-Year Low-Flow Frequency and Adjusted Harmonic Mean Streamflow at Ungaged Sites for Unregulated, Perennial Streams in New Mexico. USGS Scientific Investigations Report 2023-5058.
- New Mexico Environment Department/Surface Water Quality Bureau (NMED/SWQB). 2013. Standard Operating Procedure for Physical Habitat Measurements, Revision 7. June 9, 2023.
- Thomas, Blakemore E., H.W. Hjalmarson, and S.D. Waltemeyer. 1997. Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States. USGS Water-Supply Paper 2433.
- U.S. Department of Agriculture (USDA). 2005. WinXSPRO 3.0. A Channel Cross Section Analyzer. WEST Consultants Inc. San Diego, CA & Utah State University.
- U.S. Geologic Survey (USGS). 2022. U.S. Geologic Survey Hydrologic Toolbox (Version 1.1.1). Available on the internet at: <https://www.usgs.gov/software/us-geological-survey-hydrologic-toolbox-software-archive>.

APPENDIX F
MS4/STORMWATER JURISDICTIONAL AREA APPROACH

EPA released a memo entitled “Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs” in November 2002 clarifying EPA regulations regarding Waste Load Allocations (WLA) and Municipal Separate Storm Sewer Systems (MS4s) in TMDLs; a revision to the memo was released in 2010. In November 2008, EPA released the draft TMDLs to Stormwater Handbook to provide guidance to states as to how to include WLAs for MS4s in TMDLs. The handbook provides a number of options for states to consider when developing TMDLs that include MS4 allocations. One of the waterbody-based approaches to TMDL development includes the jurisdictional area approach:

“Jurisdictional area: loading capacity is allocated to permitted stormwater sources (and other land-based sources) on the basis of the portion of the drainage area included within their physical boundary. Without knowing the specific area draining to a stormwater conveyance system, the stormwater source area can be represented by the jurisdictional or operational area of the source (e.g., urbanized area for an MS4). For example, if the loading capacity is 100 lbs/day and the urbanized area of an MS4 represents 30 percent of the area draining to the assessment location, the MS4 WLA is specified as 30 lbs/day.”

(TMDLs to Stormwater Permits Handbook, 2008, p. 80)

The excerpts from the TMDLs to Stormwater Handbook provide the framework from which SWQB developed the WLA for the MS4 permittee for the Rio Grande (Cochiti Reservoir to San Ildefonso bnd) Assessment Unit. The following explanation provides additional detail on these jurisdictional area calculations.

Determination of Contributing Watershed and Urbanized Areas

For the purposes of the MS4/stormwater WLA determination, the total watershed area for the Rio Grande AU was first determined via USGS StreamStats v.4.31.1, using the contributing HUCs to the most downstream point of the assessment unit (AU) as the watershed pour point. The contributing drainage includes the USGS HUCs displayed in **Figure F.1**, 13020201 (Rio Grande-Santa Fe) and 1302010113 (Santa Clara Creek-Rio Grande). The urbanized area was determined using the “Urban Areas and Designated Urban Areas - MS4” GIS coverage for the LANL Stormwater Individual Permit. Both watershed and urbanized area determinations for the Rio Grande AU are presented in **Table F.1** and **Figure F.1**. This determination process follows previous New Mexico TMDL- MS4 jurisdictional area WLA development.

MS4/Stormwater Jurisdictional Area Approach

The LANL Stormwater Individual Permit WLA are discussed in the following sections: **aluminum, adjusted gross alpha, plant nutrients, PCBs, temperature, and turbidity**. The individual stormwater permit (NM0030759) reads:

“Los Alamos National Laboratory (LANL), managed and owned by Permittees Newport News Nuclear BWXT-Los Alamos, LLC and U.S. Department of Energy is authorized to discharge storm water associated with industrial activities from specified solid waste management units (SWMUs) and areas of concern (AOCs)...from the facility located at Los Alamos, New Mexico, to receiving waters named: ...Water Body Segment No. 20.6.4.98, 20.6.4.126, 20.6.4.128 or 20.6.4.114 of the Rio Grande Basin”

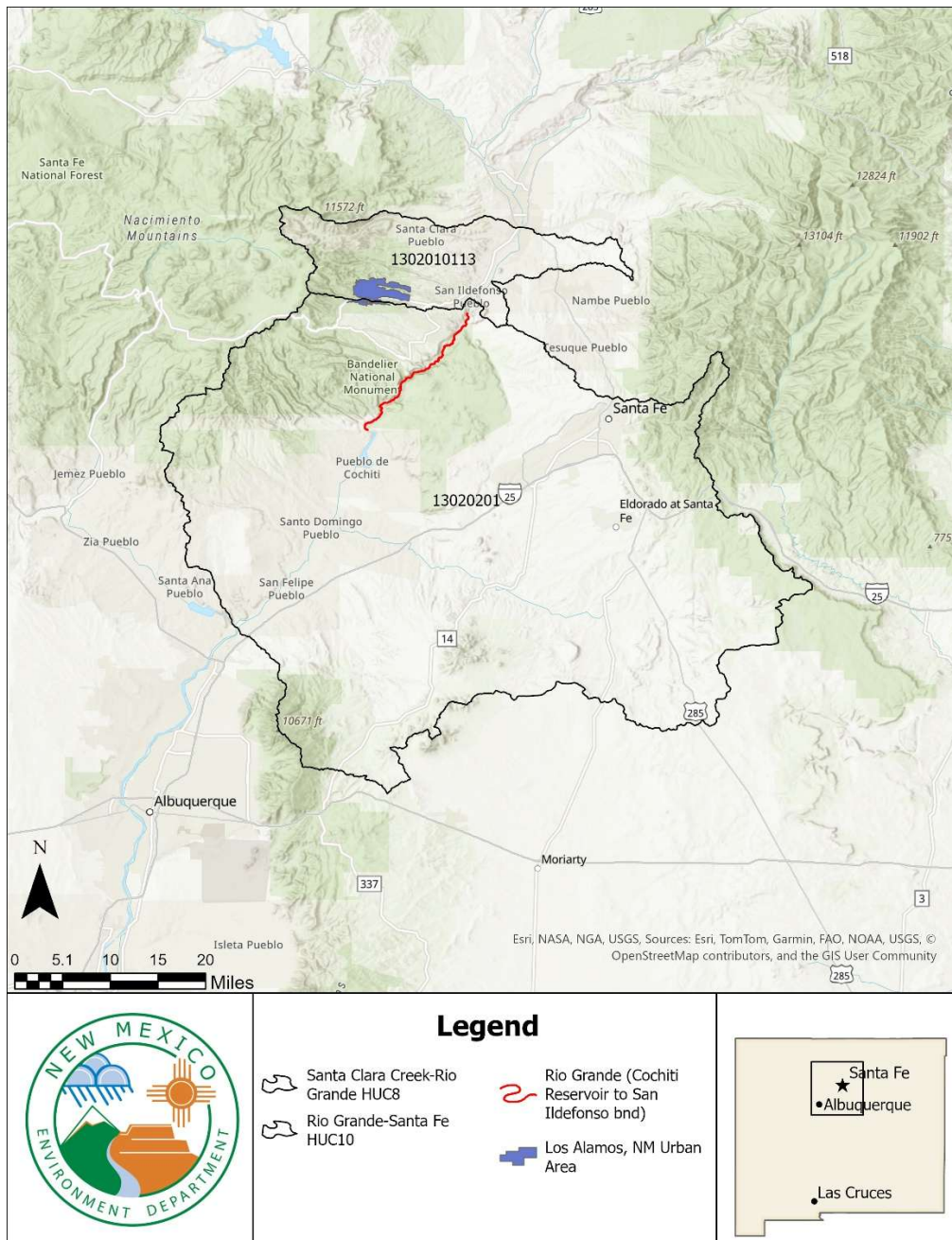
Percent Jurisdictional area per AU is determined as follows:

$$\text{Urbanized Area} \div \text{Contributing Watershed Area} = \% \text{ Jurisdictional Area}$$

Table F.1 MS4/Stormwater Jurisdictional Areas

Assessment Unit	Urbanized Area (mi ²)	Contributing Watershed Area (mi ²)*	Percent Jurisdictional Area
Rio Grande (Cochiti Reservoir to San Ildefonso bnd)	Los Alamos UA 8.52	1871.64566 + 201.22 = 2072.86566	0.4%

* 13020201 Rio Grande-Santa Fe
1302010113 Santa Clara Creek-Rio Grande



The LANL Stormwater Individual Permit WLA values used in the TMDL document were calculated using the percentage in **Table F.1**. The remaining percentage was designated for nonpoint sources and natural background as the load allocation. From this calculated TMDL value, the Margin of Safety (MOS) and the individual NPDES permits were subtracted. To calculate the LANL Stormwater Individual Permit permit WLA, the percentages derived using the jurisdictional area approach were applied to the remaining TMDL quantity. The WLA values for NM0030759 are listed in **Sections 2.3.24.3.2, 5.3.2, 6.3.2, 7.3.2, 8.3.2**.

The WLA for the Rio Grande (Cochiti Reservoir to San Ildefonso bend) AU was calculated as follows:

$$[\text{TMDL}] - [\text{MOS}] - [\text{Individual NPDES WLA}] = [\text{available for LA and MS4}]$$

The LANL individual stormwater WLA was assigned as a percentage of the LA.

LANL stormwater WLA = 0.4% (**Table F.1**), therefore;

$$\text{NM0030759 stormwater WLA} = 0.4\% \times \text{LA}$$

The remaining available load is allocated to the LA. The final TMDL allocations are therefore as follows:

$$[\text{TMDL}] - [\text{MOS}] - [\text{NPDES WLA}] - [\text{stormwater WLA}] = [\text{LA}]$$

If at some time in the future there is a change to the jurisdictional area of a stormwater permittee, the allocation between the WLA and LA presented in the associated TMDL can be adjusted using a per area loading. This adjustment maintains the overall TMDL and a consistent per area watershed loading and transfers load between the LA and WLA. As this change would be consistent with the overall goals of the TMDL, it would not require a formal revision in order to be implemented within an NPDES stormwater permit.

References:

- USEPA. 2014. Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs. Washington, D.C. Available online at <https://www.epa.gov/tmdl/establishing-total-maximum-daily-load-tmdl-wasteload-allocations-wlas-storm-water-sources-and>
- _____. 2008. TMDLs to Stormwater Permits Handbook (draft). Washington, D.C. Available online at <https://www.epa.gov/tmdl/tmdls-stormwater-permits-draft-handbook>.

APPENDIX G
RESPONSE TO COMMENTS

The public comment draft of the Upper Rio Grande Watershed TMDL was released for the 30-day public comment period on August 14, 2026.

A public announcement was sent via GovDelivery to 3,864 recipients on August 14, 2026, in both Spanish and English. Information about the public comment draft, public comment period, and public meetings were sent directly to staff members with the Pueblos of Cochiti, Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Felipe, San Ildefonso, Santa Ana, Santa Clara, Santo Domingo, Taos, and Tesuque. Information about the public comment draft, public comment period, and public meetings were also sent directly to contacts for the following NPDES permits: NM0020133 (Los Alamos-White Rock WWTP), NM0030848 (Buckman Direct Diversion Project), NM0030759 (Los Alamos National Laboratory Stormwater Individual Permit), NM0022292 (City of Santa Fe-Paseo Real WWTP), and NM0022101 (Taos Ski Valley WWTP).

SWQB hosted a virtual public meeting on August 27, 2026, from 2:00-3:30 pm. The public meeting was attended by seven NMED staff members and three stakeholders.

SWQB received two sets of public comments on the Upper Rio Grande Watershed TMDL:

1. Scott Murray on behalf of Snake Farm, LLC
2. Shannon Romeling, Amigos Bravos

Changes made to the TMDL based on public or additional staff comments include:

1. Based on public comments, probable sources in Table ES-9, Section 2.4, and Section 7.4 were updated for the Rio San Antonio assessment unit.
2. Based on public comments, Table 1.2 was added to Section 1.0 to list the ONRW status for reach AU discussed in the document
3. Based on public comment, the following text was removed from Section 2.0- “and is essentially interchangeable with the term “total”.
4. Based on staff comments, “municipal point source discharges” was added as a probable source to Table ES-5 and Sections 2.4, 4.4, 5.4, 6.4, 7.4, and 8.4 for the Rio Grande assessment unit.
5. Based on staff comments, clarifying language about the future City of Santa Fe Paseo Real WWTP outfall to the Rio Grande assessment unit was added to a footnote on Table ES-5.
6. Minor grammatical and spelling errors in TMDL.

PLEASE NOTE: When feasible, original typed letters that were not received electronically were scanned and converted to MSWord. Likewise, when feasible, letters received electronically were also converted to MSWord. All text was converted to Calibri font with standard page margins for ease of collation. All original letters of comment are on file at the SWQB office in Santa Fe, NM.

COMMENT SET 1

Help Us Identify Probable Sources of Impairment

1. Complete your contact information (optional) and site information
2. Check boxes next to the observed activities that you are concerned may be contributing to surface water quality impairment.
3. Return the form to NMED-SWQB in-person or using the contact information at the bottom of the form.

Name: Scott Murray - on behalf of Snake Farm LLC
Phone Number (optional): 7063024010
Email or Mailing Address (optional): scottmurray30@gmail.com
Date of observation: 04/15/2026
Waterbody or site description (example - Fish Creek near HWY 34 crossing): San Antonio - CO border to Montoya Canyon

✓	ACTIVITY
☐	Feedlots
☒	Livestock Grazing
☒	Agriculture - diversions
☒	Flow Alterations (water withdrawal)
☐	Stream/River Modification(s) / dredging
☐	Storm Water Runoff
☒	Drought Related
☐	Landfill(s)
☐	Industry or Wastewater Treatment Plant
☐	Inappropriate Waste Disposal
☐	Housing or Land Development
☒	Streambank erosion cattle related
☐	Waste from Pets
☐	Pavement and Other Impervious Surfaces
☐	Roads/Bridges/Culverts
☒	Habitat Modification(s)
☐	Mining/Resource Extraction
☐	Logging/Forestry Operations
☐	Improperly maintained septic systems
☐	Habitat Modification
☐	Waterfowl
☐	Wildlife other than Waterfowl
☐	Recreational Use
☐	Natural Sources
☐	Forest fire watershed runoff impacts
☐	Other: (please describe)

Comments/additional information: heavy presence of cattle in the riparian area. Significant upstream diversion of stream flow. Low flows result in die off of large and small riparian vegetation

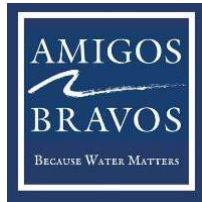


New Mexico Environment Department - Surface Water Quality Bureau
P.O. Box 5469, Santa Fe, NM 87502 (505) 827-0187 phone or (505) 827-0160 fax
heidi.henderson@state.nm.us

08/18/2020

SWQB response: Thank you for your comment. Probable sources in Table ES-9, Section 2.4, and Section 7.4 were updated for the Rio San Antonio assessment unit.

COMMENT SET 2



WATER IS LIFE.

It's Our Duty to Protect It.

September 14, 2026

Heidi Henderson
NMED SWQB
P.O. Box 5469,
Santa Fe, NM, 87502
voice: (505) 819-9986

Sent via the NMED Portal and Electronic Mail to heidi.henderson@env.nm.gov RE:

TMDLs for the Upper Rio Grande

Dear Ms. Henderson,

Amigos Bravos is a statewide river conservation organization whose mission is to protect and restore the waters of New Mexico. Amigos Bravos works locally, statewide, and nationally to ensure that the waters of New Mexico are protected by the best policy and regulations possible. In this capacity Amigos Bravos works to make sure that New Mexico's water quality standards are protective enough to support the diverse human and non-human uses of our state's water resources. A TMDL is the first and often most critical step in cleaning up a waterbody as all other steps in the restoration process such as watershed planning and restoration projects pivot off the information provided in the TMDL. Therefore, advocating for comprehensive and accurate TMDLs is a critical component of our work to protect clean water and the cultures that depend upon it here in New Mexico. We would like to communicate the following comments regarding the draft TMDLs for the upper Rio Grande.

Summary of Main Concerns:

- Potential increase in impairments and antidegradation of ONRW's in the upper Rio Grande.
- Lack of ONRW specific implementation protocols to prevent degradation of these outstanding waters.
- High loading from the Village of Taos Ski Valley wastewater treatment plant
- Infrequent monitoring every 8-10 years is not comprehensive of New Mexico waters nor frequent enough to properly assess water quality.
- Lack of increased monitor in waterways adjacent to recent fire activity, especially if the waterways were monitored prior to the fire activity.
- Lack of ephemeral and intermittent streams included in TMDL analysis and reports.
- Need for developing TMDL's using low flows that consider climate change and continued drought conditions.



Impairments on Outstanding National Resource Waters (ONRW) Streams

We appreciate the language on page 16 that explains Outstanding National Resource Waters. However, we would like to see a table and more details as done in the Upper Pecos River TMDL document currently out for review. In that document, Table 1.3 that explains which segments of the TMDL document are in ONRW's. That document also discusses rearranging assessment units so that the boundaries align with ONRW protected waters. We would like to see a discussion like that in this document if it makes sense.

The Upper Pecos River TMDL document is also starting to use a subwatershed approach (page 38 of the Upper Pecos TMDL draft) and we encourage the NMED to beginning using in the Upper Rio Grande as well.

Amigos Bravos is still concerned that there are numerous new impairments in ONRW streams in the upper Rio Grande, representing increased degradation since the time of ONRW designation in 2022. While we understand that the waters for this TMDL assessment were measured in 2017, 2018, 2025 and 2026, if the impairments were found after the designation, they represent antidegradation and need to be closely monitored and enforcement actions need to be taken.

As Amigos Bravos has suggested in numerous comments on other regulatory processes (Forest Plans, Water Quality Management Plans), there needs to be specific ONRW implementation protocols developed to outline what steps will be taken to address these impairments. Amigos Bravos suggests the following steps if degradation of water quality is detected in an ONRW:

- Where water quality was better than the applicable designated uses and criteria, and there is sufficient water quality data to establish a baseline, TMDLs for the newly impaired ONRW should be calculated to attain water quality **at the time** of designation and not for the assigned designated uses and criteria for that segment.
- NMED will reach out to the appropriate land owner(s), land manager(s), and other interested parties, including the original ONRW petitioners, and will conduct a meeting or meetings with the purpose of drafting an action plan that details potential sources of the degradation and actions to take to address and/or remedy the degradation.
- NMED, in collaboration with the land managers and owners associated with the ONRW, will increase water quality sampling frequency to at least once annually in the ONRW until degradation is improved to the baseline water quality levels in existence at the time of ONRW designation.

SWQB response:

Thank you for your comment. Section 1.1 of the URG TMDL lists the ONRW designations in the URG watershed. Based on your comment, a new table (Table 1.2) has been added to Section 1.1 to list each assessment unit and its individual ONRW status.

Subwatershed assessment units (AUs) were first introduced in the 2026-2026 CWA §303(d)/ §305(b) Integrated Report and an explanation about subwatersheds is

provided in Section II.C.3 of the Integrated Report. Subwatershed AUs are currently only developed for the Upper Pecos, Rio Chama, and Sacramento Mountains watersheds. Subwatershed AUs will be developed for other watersheds in New Mexico during the development of future Sampling and Analysis (SAP) development and water quality survey planning. Subwatershed AUs for the Upper Rio Grande survey area will be developed during Field Sampling Plan development in early 2027.

As you noted, many of the impairments addressed in this TMDL were documented before ONRW designation. SWQB updates the USFS during monthly and annual coordination meetings about the impairment and ONRW status of the waters in the Upper Rio Grande.

Outreach to landowners, land managers, and original petitioners is consistent with the Watershed Based Planning process described in Section 10.2.1, which is built on landowner and stakeholder participation. SWQB notes that the lands surrounding the ONRW AUs in the TMDL are predominantly managed by the U.S. Forest Service, so implementation authority for managing probable sources (through BMPs, etc.) rests with that agency. SWQB will continue to coordinate with the USFS and interested parties, including Amigos Bravos, through watershed planning.

Finally, monitoring frequency is set through the SWQB's current Monitoring and Assessment Strategy (available at <https://www.env.nm.gov/surface-water-quality/monitoring-assessment-and-standards-section/>, currently under revision) and constrained by resource limitations which fluctuate yearly. SWQB cannot commit to a fixed sampling frequency in a TMDL document. However, ONRW status is one of the factors used to prioritize monitoring in the Monitoring and Assessment Strategy and during survey planning, which includes a public meeting and comment period on the sampling and analysis plan for each upcoming survey year. The next scheduled survey of this watershed is 2027 (2026-2028 Integrated Report, Figure 4). SWQB MASS also has an active goal to expand volunteer monitoring, with a particular focus on ONRWs, including for example, a potential collaboration with New Mexico Wild to enhance ONRW monitoring during the Bureau's 2027 Upper Rio Grande ambient survey. Outside data meeting quality assurance requirements may be submitted at any time.

Rio Hondo (South Fork Rio Hondo to Lake Fork Creek) TMDL's (ONRW)

Amigos Bravos has continued concerns about the Village of Taos Ski Valley wastewater treatment plant, which is in this segment and should be considered for the creation of its TMDL. Below are two comments that we submitted on February 27th 2023 to the EPA in response to the Taos Ski Valley NPDES Permit # NM0022101. We believe these comments are relevant should be considered when calculation the total nitrogen and total phosphorous TMDL calculations in this document.

Proposed Loading vs TMDL Allocation: While we are pleased to see that loading has not increased from previous permits we have some concerns and questions about this existing loading amount. The 2005 TMDL for the Rio Hondo for Nitrogen lists the total waste load allocation (WLA) as ranging from 11–16.2 lb/day depending on the phase of capture of septic tanks outlined in the TMDL. Amigos Bravos is not aware which phase the treatment plant is currently in, but even if you assume we are in last phase, which has a 16.2 lbs/day WLA, the current and proposed permit far exceeds this with loads as high as 46.6 lbs/day during some times in the year and yearly average of 22.75 lbs/day. Even if you assume that the Village of Taos Ski Valley has been allocated the full growth allocation (GA) of .63 lbs/day in the TMDL, that only gets the WLA to 16.83 lbs/day, which is still far below the 22.75 lbs/day yearly average allowed in the current and draft permit.

Timing of Loading: The proposed (and current) permit loading timing appears to be based on old data like what was used in the development of the 2005 TMDL, which used monthly average streamflow from 1934-2002. With climate change we are seeing both earlier spring runoff times as well as less overall runoff. For example, in 2022 the highest flows in the Rio Hondo were observed in March, yet the draft permit uses WLA calculations that appear to be based on data that had the highest runoff periods in May and June. Amigos Bravos requests clarification of how the seasonal variations for WLA were determined for the draft permit and if they were based on old data, that these seasonal variations be calculated using more recent monthly average streamflow data.

Please refer to table 5.8 of this TMDL document, and NPDES Permit # NM0022101 to make sure that all the WLA's being used are correct and that our comment to the EPA about the permit are considered. This is an ONRW and requires increased attention and monitoring by the NMED.

SWQB response:

Thank you for your comments. The 2026 plant nutrient TMDL for the Rio Hondo (South Fork Rio Hondo to Lake Fork Creek) assessment unit and the WLA listed in Table 5.8 are revisions of the 2005 plant nutrient TMDL and WLA. The current permit (NM0022101) expires on September 30, 2028, and the new TMDL and WLA are anticipated to be incorporated into the permit renewal as outlined in Section 5.3.2 (specifically Table 5.8) and Section 10.1.1.E.

Upon consideration of Amigos Bravos public comments on the 2023 draft Taos Ski Valley permit (NM0022101), the State of New Mexico 401 certification included a request for EPA to:

- 1. include the annual average for the total nitrogen cannot exceed 13.6 lbs/day as listed in table F-3 in the 2005 TMDL, and*
- 2. include a compliance schedule for Taos Ski Valley WWTP to develop and implement a pollutant minimization plan to address total nitrogen and total phosphorus loads.*

2.0 Aluminum

Page 25 states: “The term “total recoverable” refers to the analytical method used in laboratory analysis, and is essentially interchangeable with the term “total”. Please modify this statement to be more accurate. “Total recoverable” is related to the analytical procedure, but it is not simply interchangeable with “total.” EPA distinguishes total recoverable from other measurements, including dissolved and total metals. For example, EPA Method 200.8 defines a total recoverable analyte as the concentration determined from an unfiltered sample, either directly under specified conditions or after digestion with hot dilute mineral acids. The distinction matters because:

- **Dissolved:** generally the fraction that passes through a 0.45-µm filter.
- **Total recoverable:** dissolved material plus particulate-associated material that is recovered through the specified acid digestion procedure.
- **Total:** can imply a more aggressive digestion intended to measure essentially all of the analyte, including metals strongly associated with particles. EPA notes that total and total recoverable procedures can differ in how much particulate-bound metal they measure.

SWQB response:

Thank you for your comment. Based on your feedback, the following text from Section 2 (page 25) of the TMDL was removed: “and is essentially interchangeable with the term “total”.

As mentioned in the TMDL, total recoverable aluminum is defined in 20.6.4.900.1 NMAC as, “For aluminum, the criteria are based on analysis of total recoverable aluminum in a sample that has a pH between 6.5 and 9.0 and is filtered to minimize mineral phases as specified by the department.” Sampling and filtration for total recoverable aluminum samples is addressed in SOP 8.2, Section 6.1.6- [https://www.env.nm.gov/surface-water- quality/sop/](https://www.env.nm.gov/surface-water-quality/sop/) and the 2012 Aluminum Filtration Study- <https://www.env.nm.gov/surface-water-quality/calm/>.

1.4 Water Quality Monitoring Survey

The report states that on page 22 that “monitoring occurs during the non-winter months; focuses on physical, chemical, and biological conditions in perennial waters; and includes sampling for most pollutants that have numeric and/or narrative criteria in the WQS.” Amigos Bravos feels that this selection of only perennial waters is not representative of the Upper Rio Grande watershed, nor the State of New Mexico, as the vast majority of waters are intermittent or ephemeral. These streams are vital to the health of the watershed and to our communities for irrigation, recreation, and drinking water supply. Non-perennial streams also serve as tributaries for other waterways and their degradation will significantly impact the entire watershed. Finally, as climate change and drought conditions worsen, many of these perennial streams could become intermittent or ephemeral and lose their TMDL priority if these types of streams are not included in the analysis. Amigos Bravos would like to see ephemeral and intermittent streams included in TMDL analysis and reports.

SWQB response:

Thank you for your comment. SWQB agrees that non-perennial waters are important and constitute most stream miles in New Mexico. The quoted sentence describes where assessment data can in practice be realistically obtained, not a decision to exclude these waters. Section 3.1 of the Antidegradation Policy Implementation Procedure states that lack of flow in ephemeral and intermittent waters makes characterizing baseline water quality difficult, and that these waters receive Tier 1 protection for all pollutants of concern, so they are not left unprotected. The definition of surface waters of New Mexico expressly includes both intermittent and ephemeral streams; Tier 1 applies categorically to all intermittent, ephemeral, and effluent-dependent waters and requires that water quality support existing and designated uses. Therefore, reduced flow does not remove a water from the program, nor are ephemeral or intermittent streams excluded from the assessment and TMDL development process. TMDLs and their implementation, through Watershed Based Plans or similar mechanisms, are developed at the watershed scale, so intermittent and ephemeral streams feeding perennial waterbodies are captured in both the analysis and the resulting restoration work.

1.6 TMDL Uncertainties

The report states weaknesses in the TMDL analytical process include the limited availability of water quality data during the assessment process. Amigos Bravos applauds the NMED's recognition of the weakness and understands the organization is limited in resources and tasked with monitoring the entire State of New Mexico. However, we would add to this stated weakness the lack of data during the 8-10 years between monitoring assessments. As New Mexico continues to experience changes in its water landscape due to climate change stressors and urban growth, the degradation of waterways can occur rapidly. Amigos Bravos would like to see the NMED utilize partnerships with local organizations, schools, hunters/anglers, and other conservationists to continue the monitoring of TMDL waterways in between assessment periods, particularly ones that are on the verge of failing WQS and/or have experienced a degradation event such as fire or extreme flooding that could impact stream health. This will help alert the NMED to falling water quality standards and will also build ownership with community stakeholders to help maintain and improve their local waterways.

Amigos Bravos believes the water community in New Mexico is a potential strength for the TMDL analytical process and should be developed accordingly to help with the monitoring and implementation stages of the TMDL process.

SWQB response:

Thank you for your comment. The interval between rotational surveys balances the need for sufficient sampling coverage for each waterbody in a watershed survey and obtaining sufficient data for assessment with the inability to sample more frequently. Competing priorities and resource limitations dictate trade-offs to shorten the monitoring rotation. SWQB plans to shorten the rotation to every six years in the Monitoring and Assessment Strategy revision (under development) by reverting to one year watershed surveys, targeting a max of n=4 for priority parameters, and reducing or removing sampling parameters that are not predominantly detected.

SWQB welcomes collaboration on community-based monitoring to build local stewardship in addition to producing data. SWQB also accepts data that meets the quality assurance requirements on a rolling basis and frequently obtains datasets from other agencies and outside data sources. Examples of these include CWA Section 319 project recipients reporting monitoring data, data pulled from the Water Quality Portal, permittees, USGS, and US EPA. Accordingly, the SWQB notes that the Bureau and Department are not solely internally reliant and assessments and TMDLs are often developed using a variety of data sources. As noted in the above Responses, SWQB plans to expand our volunteer monitoring program through dedicated grant funded staff assignments to develop and strengthen partner relationships.

2.1 Target Loading Capacity

The report states “the SWQB Comprehensive Assessment and Listing Methodology says that for any one chemical/physical pollutant, there shall be no more than one exceedance of the acute criterion, and no more than one exceedance of the chronic criterion in three years.” As the monitoring assessment period is only for two years, and then not again for 8-10 years, Amigos Bravos is unclear how a chronic criterion is being assessed to occur less than once in a three-year period. It seems likely that a chronic condition could occur again outside of the assessment period and not be properly considered as a violation to the water quality standard.

SWQB response:

Thank you for your comment. The assessment procedures are set out in the CALM. The exceedance thresholds are applied to the assessment dataset, and the three-year period referenced is the most recent three years within that dataset, counted on a rolling basis. “More than one exceedance” translates to two or more, so if least two exceedances of the chronic criterion are documented during a two-year survey (occurring during the rolling 3-year period), that supports a determination of non-support; the shorter survey period does not prevent a listing. SWQB also uses data from outside entities meeting the quality assurance requirements described above, which sometimes provide annual coverage between surveys or additional datapoints within a two or three-year period.

Impacts of Wildfires

Amigos Bravos was pleased to see the inclusion of wildfire activity in the consideration of increased pollutants due to runoff. The document states that watershed effects will naturally recover 5-10 years after the fire, and areas that have experienced severe fire will recover in 15-20 years. As some of the data collection for this report was conducted during 2017 and 2018, it seems the TMDL analysis will severely understate the impacts of the increased wildfire activity in New Mexico, especially in the Upper Rio Grande as seen this year. Amigos Bravos would like to see an effort be made to monitor waterways adjacent to fire activity, especially if the waterways have recently been assessed without the impacts of fire being considered. This is another opportunity to build a collaboration platform with local organizations and agencies to assess potential rapid changes in stream water quality.

SWQB response:

Thank you for your comment. The initiative described in Section 1.1 of the TMDL document is being developed with FEMA, USEPA, USGS, and the New Mexico Department of Homeland Security and Emergency Management, and its timing depends on the participating agencies, including those on the federal level, and on funding availability, rather than on SWQB alone. SWQB plans to return to the Upper Rio Grande watershed within the rotational monitoring survey timeline to collect data to inform assessments of the watershed in its new post-fire condition. SWQB continues to monitor and assess as resources allow and welcomes any outside data that meets our quality assurance requirements. SWQB is also aware of several local watershed groups and watershed restoration contractors active in the area, including Chama Peak Land Alliance, Rio Grande Return, Natural Channel Design Engineering, Ecotone Landscape Planning LLC, New Mexico State University Water Resources Research Institute, Rio Arriba Soil and Water Conservation District, River Source, Santa Fe – Pojoaque Soil and Water Conservation District, Santa Cruz Watershed Group, Taos Soil and Water Conservation District, Trout Unlimited, and Keystone Restoration Ecology. SWQB welcomes coordination with any organizations pursuing complementary restoration and planning efforts in the watershed.

Consideration of Seasonal Variation

This is a vital part of TMDL analysis, and we appreciate this section calling out effects on seasonal variation in all of the parameters analyzed. One more basic consideration for seasonal variation that we would like to see discussed is the fact that spring runoff is earlier in the season as climate change effects continue. How will this be worked into TMDL calculations?

SWQB response:

Thank you for your comment. The critical condition for these TMDLs is the 4Q3 low flow, the lowest four consecutive day flow expected once in three years. Because 4Q3 is an annual low-flow statistic with a three-year recurrence interval, it captures the low-flow condition regardless of when in the year it occurs, so a shift in the timing of spring runoff does not by itself invalidate the critical flow used. The 4Q3 statistic accounts for year-to-year variability in flow, so a shift in spring runoff timing is captured within that annual and inter-annual variation rather than treated as a separate seasonal input. Climate change is recognized in the Water Quality Standards at 20.6.4.6(D) NMAC, which provides that the standards serve to respond to its inherent threats and provide resiliency for continued protection of water quality.

Load Management

Amigos Bravos was encouraged by the report stating, "Management of the load to improve instream water quality is the goal of SWQB efforts" (Page 66), and by the detail in section 2.2 (Flow). However, we would like further clarification on how the SWQB anticipates achieving this goal as additional demands are placed on our watersheds in continued extreme drought conditions. Has the SWQB explored minimal base flows or environmental flows to ensure water quality standards and aquatic ecosystem health are maintained? How will the SWQB balance these necessary flows with domestic and irrigation demand if drought conditions continue to worsen? Are there designations or protections, such as Outstanding National Resource Waters, that could help maintain base flows to protect water quality?

SWQB response:

Thank you for your comment. The minimum flow incorporated into these TMDLs is the 4Q3 critical low flow; calculating the loading capacity at that condition is what keeps the allocation protective when flows are low. SWQB does not have authority to allocate water or establish minimum instream flows. Water rights administration rests with the Office of the State Engineer, particularly with regards to irrigation and domestic use. An ONRW designation is likewise a water quality protection rather than a flow protection; it constrains degradation but does not reserve a quantity of water.

SWQB does recognize hydrologic alteration as a form of pollution. Under Appendix J of the CALM, an AU impaired due to lack of adequate flow may be assigned to Integrated Report Category 4C and addressed through an Advance Restoration Plan or similar planning document. Where flow is a factor in the impairments addressed here it is also identified as a probable source; drought and water diversion both appear among the probable sources in Sections 2.4, 4.4, 5.4, 6.4, 7.4, and 8.4.

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Waste Load Allocation

In the description of Waste Load Allocations (WLA), the report states that it is not possible to calculate individual WLAs covered under general permits as these discharges are "typically transitory as the activities are temporary" (Page 43). Amigos Bravos would like to caution the SWQB in assuming these discharges are temporary in nature, and furthermore that the permittees are taking the necessary precautions to fulfill their management plans. As agencies throughout New Mexico are resource scarce, including enforcement personnel, violations and/or continued discharges are possible which would inhibit the Load Allocations and Margin of Safety to properly cover discharges to the system.

SWQB response:

Thank you for your comment. A discharge not in compliance with its general permit is not an authorized load and is not accounted for in the Load Allocation(s); it is a compliance and enforcement matter rather than a TMDL allocation to be adjusted. SWQB encourages Amigos Bravos and the public to report suspected violations at <https://www.env.nm.gov/general/report-an-environmental-issue-or-incident/>. We have forwarded your comment to the Point Source Regulation Section for review.

10.2.1 WBP and BMP Coordination (Page 124)

Amigos Bravos supports the SWQB's intent to utilize public awareness and involvement to achieve success in TMDL implementation, but we also want to be realistic about the time and resources needed to complete a watershed-based-plan. While the funding programs are a vital step in the right direction, additional resources, agency support, and the removal of required matching funds will be helpful to support the submission of these plans. Furthermore, the SWQB should understand the time required to not only develop the WBP but then to carry out project related discovery, development, and construction. Time is of the essence to protect our watersheds from further degradation and Amigos Bravos would like to see other avenues developed to support implementation of TMDL restoration projects.

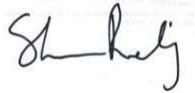
SWQB response:

Thank you for your comment. The non-federal match associated with CWA Section 319(h) funding is a requirement of federal law and USEPA grant conditions, and NMED must provide it. SWQB does work with applicants on the forms match may take, including in-kind contributions and partner labor, which can materially reduce the cash burden on a local organization. NMED recently reduced CWA Section 319(h) match requirements to 10% for projects to reduce this burden on local organizations since the state-funded River Stewardship Program has been amply funded to help cover federal match requirements. Developing a Watershed Based Plan and carrying a project through construction is a multi-year undertaking that should be understood at the outset. Project timelines also reflect a deliberate approach to design and review intended to ensure the best use of public funds; rushing implementation projects tends to reduce their effectiveness and longevity.

The Nonpoint Source Management Program administers additional opportunities beyond Section 319, described at <https://www.env.nm.gov/surface-water-quality/funding-opportunities/>. The River Stewardship Program and Watershed Protection Assistance Programs can be used to address water quality issues identified in the TMDL before or while a WBP is being developed. CWA Section 319(h) funds are also available to implement a demonstration project during WBP development to help accelerate the WBP implementation process and increase stakeholder participation in the process. Even though WBP development takes time and resources, investing in a WBP provides a holistic, community-driven approach to watershed management that provides lasting benefits.

Thank you for the opportunity to provide input in and comment on the draft TMDL. We look forward to further discussion about the concerns that we have raised in our comments. Please do not hesitate to contact me at 575-758-3874 or sromeling@amigosbravos.org if further clarification or discussion on the above comments is merited or needed.

Sincerely,

A handwritten signature in black ink, appearing to read "Shannon Romeling".

Shannon Romeling
Projects and Foundations Coordinator
Amigos Bravos
Sromeling@amigosbravos.org

SWQB response:

SWQB thanks Amigos Bravos for reviewing the draft document and submitting these comments. Several of the issues raised concern Bureau-wide methodology or other programs and have been forwarded to the Standards and Outreach Team, the Monitoring Team, the Watershed Protection Section (WPS) and the Point Source Regulation Section (PSRS) accordingly.