EPA-Approved

TOTAL MAXIMUM DAILY LOAD (TMDL)

FOR

TECOLOTE CREEK (I-25 TO BLUE CREEK)

SEPTEMBER 13, 2018

Prepared by

New Mexico Environment Department, Surface Water Quality Bureau

Monitoring, Assessment, and Standards Section

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For Additional Information please visit:

www.env.nm.gov/swqb/index.html

~or~

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Cover photo: Tecolote Creek at San Geronimo, New Mexico, June 24, 2016.
Photo credit: SWQB staff.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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
CWAL	Cold Water Aquatic Life
^{o}C	Degrees Celsius
^{o}F	Degrees Fahrenheit
HUC	Hydrologic unit code
$j/m^2/s$	Joules per square meter per second
km^2	Square kilometers
LA	Load allocation
lbs/day	Pounds per day
mgd	Million gallons per day
mg/L	Milligrams per Liter
mi^2	Square miles
mL	Milliliters
MCWAL	Marginal Coldwater Aquatic Life
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
RFP	Request for proposal
SEE	Standard Error of the Estimate
SLO	State Land Office
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 2/28/18)

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act, 33 U.S.C. § 1313[1](CWA), 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. 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 40 Code of Federal Regulations Part 130 (40 C.F.R. § 130.2(i)[2]) 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.

The High Quality Coldwater (HQCW) aquatic life use (ALU) for a portion of Tecolote Creek (I-25 to Blue Creek) was first listed as impaired due to temperature in 1998. A Use Attainability Analysis[3] (UAA) was completed in 2018 to determine the most appropriate and protective ALU for Tecolote Creek. The UAA concluded that Coolwater is the most protective potentially attainable ALU. New Mexico Environment Department (NMED) recommended a change of ALU from HQCW to Coolwater for Tecolote Creek (I-25 to Blue Creek). Subsequently, the ALU change was approved by the Water Quality Control Commission and adopted into New Mexico's water quality standards. US Environmental Protection Agency (USEPA) approval is pending. This TMDL cannot be approved by USEPA until the UAA has been approved.

The NMED Surface Water Quality Bureau (SWQB) conducted a water quality survey of the upper Pecos River and its tributaries in 2010 and additional temperature data was collected on Tecolote Creek in 2016. Water quality monitoring stations were located within the Tecolote Creek watershed to evaluate the impact of tributary streams and ambient water quality conditions. Assessment of data generated during the 2010 and 2016 monitoring efforts confirmed exceedence of the Coolwater temperature criterion. This TMDL document addresses the impairment as summarized in Table ES-1, below. Perennial reaches of Tecolote Creek were previously also listed as impaired due to a segment-specific specific conductance (SC) criterion. The SC criterion was part of the HQCW ALU designation. The SC criterion no longer applies since the Coolwater ALU does not have an associated SC criterion. Additional information regarding these impairments can be reviewed in the current Clean Water Act §303(d)/§305(b) Integrated Report and List (IR)[4]. SWQB has not previously prepared any TMDL documents for Tecolote Creek.

The next scheduled water quality monitoring date for the upper Pecos River and its tributaries is 2019-20, 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 load capacity will be adjusted accordingly. When water quality standards have been achieved, the reach will be moved to the appropriate category in the IR.

1 http://www.epw.senate.gov/water.pdf
2 http://www.gpo.gov/fdsys/pkg/CFR-2002-title40-vol18/pdf/CFR-2002-title40-vol18-part130.pdf
3 https://www.env.nm.gov/surface-water-quality/wqs-historical/
4 https://www.env.nm.gov/swqb/303d-305b/

Table ES-1. Total Maximum Daily Load for Tecolote Creek (I-25 to Blue Creek)

New Mexico Standards Segment	20.6.4.230
Water body Identifier	NM-2212_10
Segment Length	22.0 miles
Parameters of Concern	Temperature
Uses Affected	Coolwater Aquatic Life
Geographic Location	Pecos Headwaters USGS Hydrologic Unit Code 13060001
Scope/size of Watershed	120 mi^2
Land Type	Southern Rockies (Ecoregion 21d and 21f) and Southwestern Tablelands (Ecoregion 26h)
Land Use/Cover	50% Evergreen Forest, 27% Shrub/Scrub, 21% Grassland/Herbaceous
Probable Sources	Rangeland grazing; bridges/culverts/RR crossing; low water crossing; gravel or dirt roads; channelization; stream channel incision; paved roads; forest fire; drought-related impacts
Land Management	71% private, 28% Forest Service, and 1% State
IR Category	5/5B
Priority Ranking	High
TMDL for: Temperature	WLA + LA + MOS = TMDL 0 + 9.081E+7 + 1.009E+7 = 1.009E+8 kJ/day

1.0 BACKGROUND

1.1 Watershed Description

Tecolote Creek is located within the Pecos Headwaters watershed (HUC 13060001) in northern New Mexico. Tecolote Creek has a total reach of 54 miles. It arises from the southeast slope of Elk Mountain in the southernmost portion of the Rocky Mountain Range in the Sangre de Cristo Mountains, flowing downstream to its confluence with the Pecos River at Tecolotito, New Mexico. The creek originates in sub-alpine forest above 9400 feet (ft) in elevation, then descends into mid-elevation mixed conifer and ponderosa pine forest. Tecolote Creek continues to flow through piñon-juniper woodlands and savannas, crossing I-25, where it becomes non-perennial for 26 miles until joining the Pecos River at an elevation of 5340 ft. Tributaries to Tecolote Creek include Falls Creek, Blue Creek and Wright Canyon Creek. The Tecolote Creek watershed area above I-25 is 120 square miles (mi^2).

Figure 1.1. Location of the Tecolote Creek watershed in New Mexico.

During the formation of the present Rocky Mountains (55–80 million years ago), rocks in northwestern parts of San Miguel County were uplifted; these uplifted rocks now form the southern and eastern flanks of the Sangre de Cristo mountains. With increased uplift in western parts of the county, surficial rocks were eroded, and older rocks were exposed at land. Precambrian metamorphic and igneous rocks form the cores of two southern Rocky Mountain ridges that bound the upper Pecos River Valley (Matherne and Stewart, 2012). Precambrian crystalline rocks are exposed at land surface, in the upper reaches of Tecolote Creek headwaters (Figure 1.2). The area of upper Tecolote Creek contains surficial carbonate or calcareous rocks, probably of the Permian San Andres Formation (Matherne and Stewart, 2012).

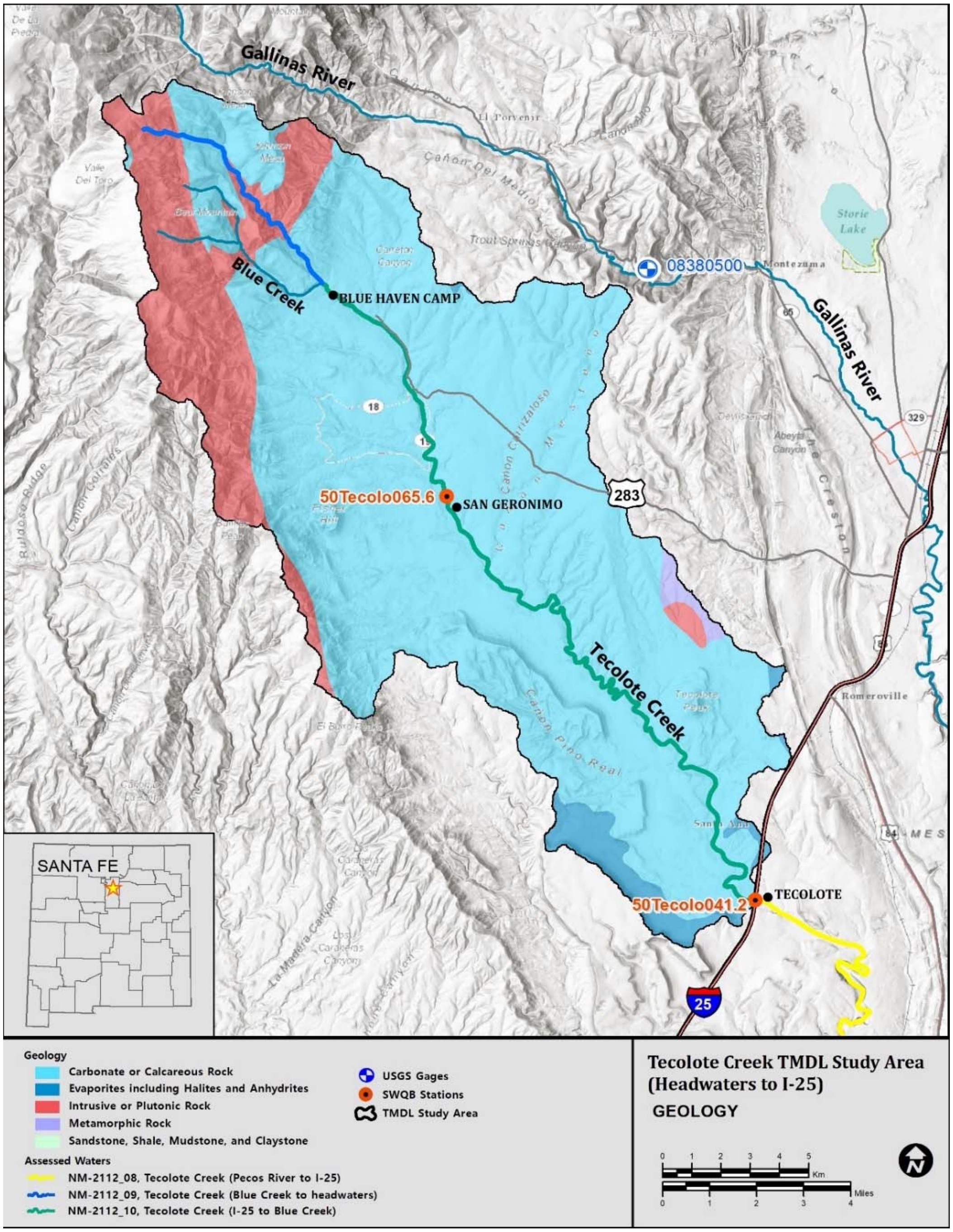


Figure 1.2 Geology of the upper Tecolote Creek Watershed

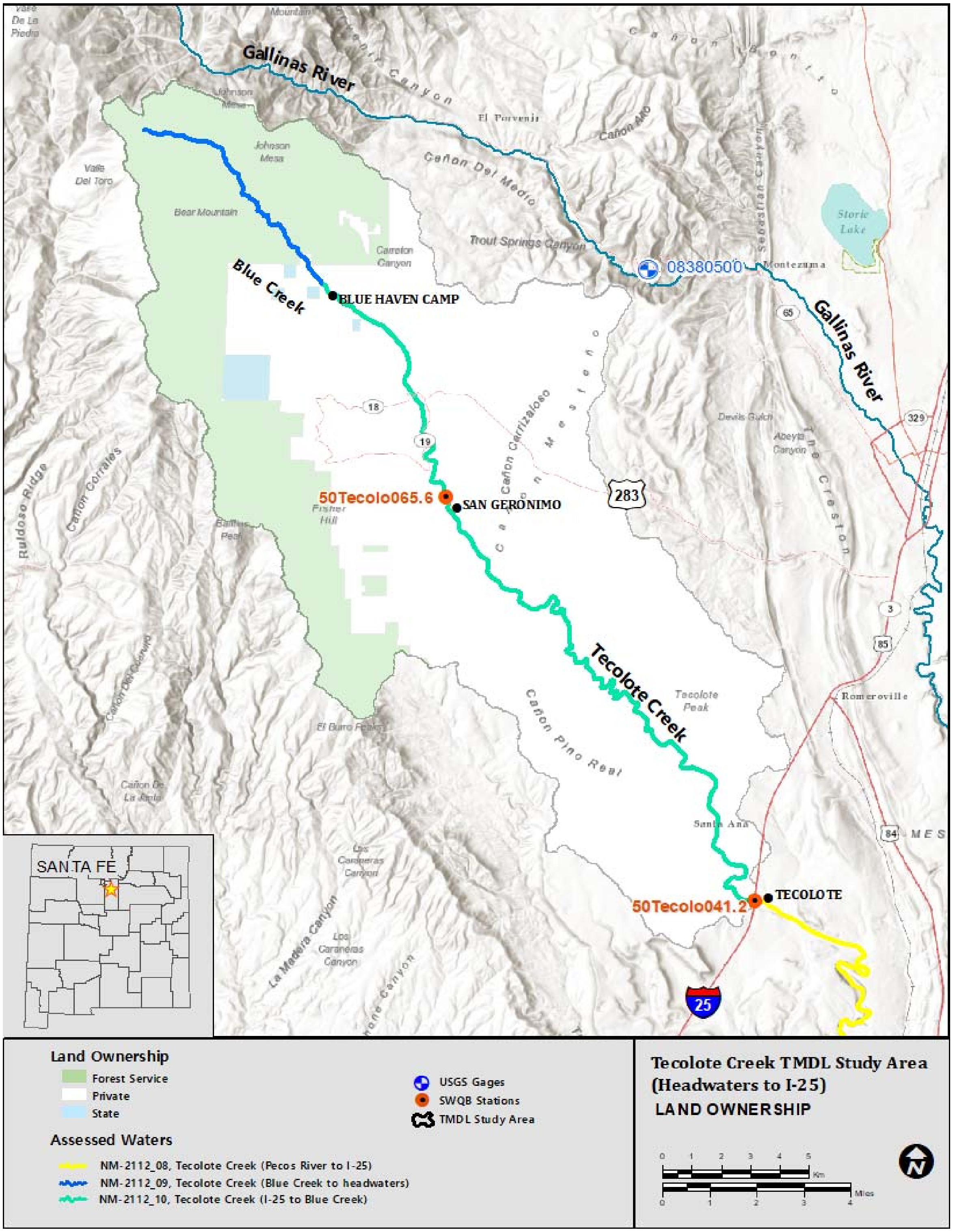


Figure 1.3. Land Ownership in the Tecolote Creek watershed.

Settlement, and presumably irrigation diversion, began on Tecolote Creek in 1824, with the submission and approval of an application to establish the Tecolote Land Grant (Bowden, undated). The Tecolote Land Grant includes land on both sides of what is now the I-25 corridor. Higher up in the watershed, the Las Vegas Land Grant (issued in 1835) includes the Tecolote Creek channel from the north boundary of the Tecolote Land Grant upstream to the village of Geronimo. Current land cover in the watershed includes 50% Evergreen Forest, 27% Shrub/Scrub, 21% Grassland/Herbaceous, and less than 1% each of several other cover types (Figure 1.4). Land ownership is 71% private, 28% Forest Service, and 1% State. Tecolote Creek headwaters and its tributaries above Blue Creek are within the Santa Fe National Forest (Figure 1.3).

The 2010 survey report notes that Tecolote Creek "watershed and riparian conditions appear degraded," (NMED/SWQB, 2010). The creek is impacted by both the clearing of riparian vegetation and stream diversion for irrigation. There are no USEPA National Pollutant Discharge Elimination System (NPDES) Individual Permits with discharges to Tecolote Creek. Mining activities with stormwater discharges to Tecolote Creek may be eligible for coverage under NPDES Multi Sector General Permit (MSGP); however, currently there is only one industrial facility with MSGP coverage in the watershed, Howard's Sand and Gravel, located just downstream of I-25 and outside of the TMDL Assessment Unit. The MSGP requires preparation of a stormwater pollution prevention plan, which includes specific conditions to limit or eliminate pollutants associated with the industrial activities to minimize impact to water quality. Water rights in the Tecolote watershed have not been abstracted by the New Mexico Office of the State Engineer. Additional impacts to the creek include the Tecolote wildfire, which burned 812 acres in the upper Blue Creek watershed from June 6 to June 21, 2010.

Table 1.1 Tecolote Creek Watershed Sampling Stations and USGS Gage used in TMDL Development

Station ID	**Station Name**
50Tecolo065.6	Tecolote Cr at Bridge Near San Geronimo
50Tecolo041.2	Tecolote Creek at I-25 Near Tecolote
Gage ID	**Gage Name**
USGS 08380500	Gallinas Creek near Montezuma, NM

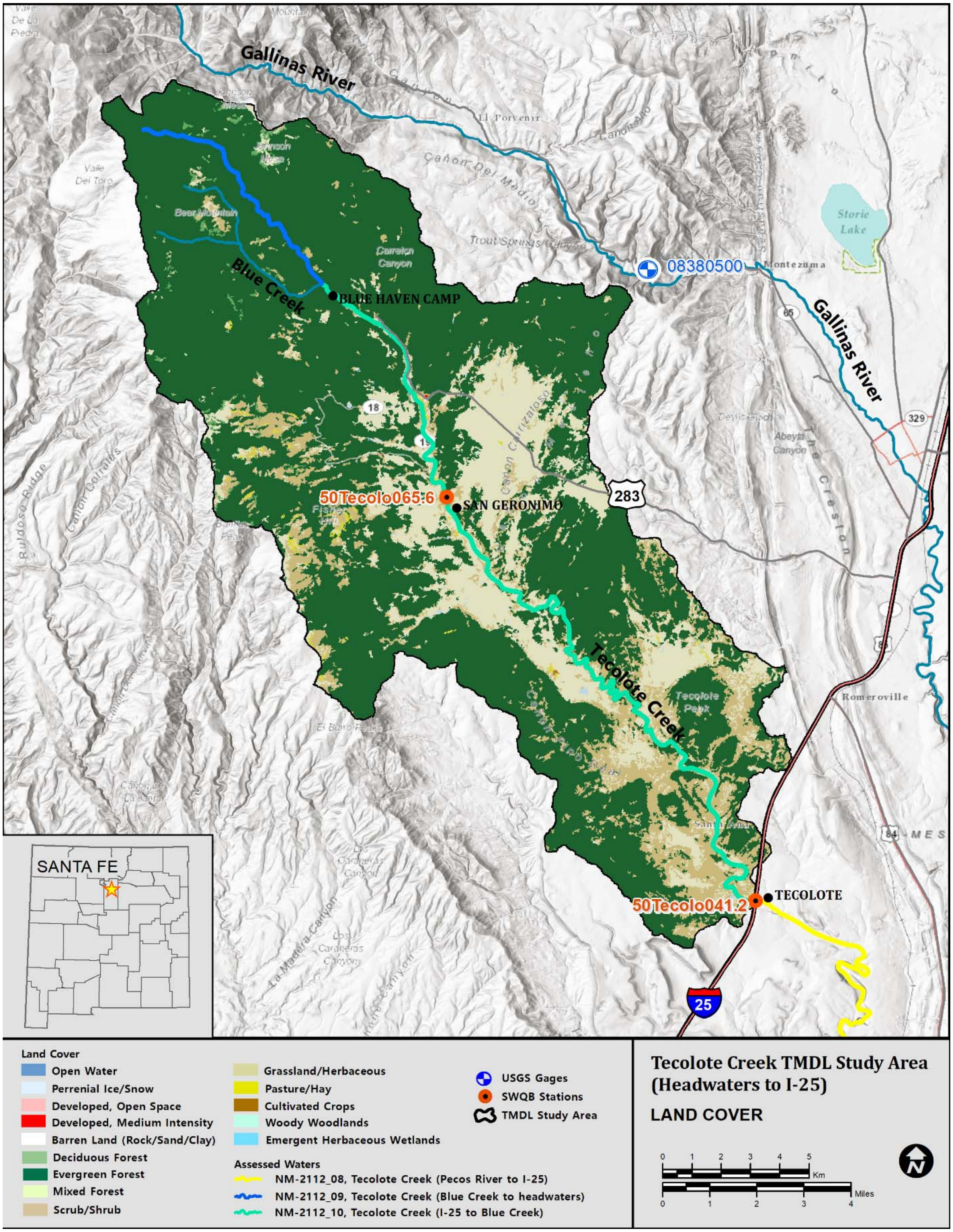


Figure 1.4. Land Use in the Tecolote Creek watershed.

1.2 Water Quality Standards

Water quality standards (WQS) for all assessment units (AU) in this document 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]) (NMAC, 2018):

20.6.4.230 PECOS RIVER BASIN - Tecolote Creek from I-25 to Blue Creek.

A. **Designated Uses:** domestic water supply, coolwater 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: the monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less, single sample 235 cfu/100 mL or less.

Segment 20.6.4.230 was newly created for this AU as a result of the 2018 UAA. The AU was previously part of Segment 20.6.4.215, with a designated HQCW ALU. 20.6.4.900 NMAC provides criteria applicable to existing, attainable or designated uses unless otherwise specified in an AU's specific segment. 20.6.4.13 NMAC lists general criteria that apply to all surface waters of the state at all times, unless a specified standard is provided elsewhere in the NMAC.

1.3 Antidegradation and TMDLs

New Mexico's antidegradation policy, which is based on the requirements of 40 C.F.R. § 131.12, describes how waters are to be protected from degradation (20.6.4.8.A NMAC). 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 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, 2011). However, 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, 2011).

1.4 Field Survey

Temperature data were collected at the SWQB San Geronimo and I-25 monitoring stations (50Tecolo065.6 and 50Tecolo041.2, respectively) and at the Blue Haven Camp, approximately 2 kilometers (km) downstream from Blue Creek, as part of regularly scheduled water quality surveys in 2001 and 2010, with additional data collection in 2016 to support the Use Attainability Analysis. Additional physical habitat data were obtained on Tecolote Creek in 2017, in order to provide input variables for the Stream Segment Temperature (SSTEMP) model.

Table 1.2 Available Thermograph Records from Tecolote Creek (I-25 to Blue Creek)

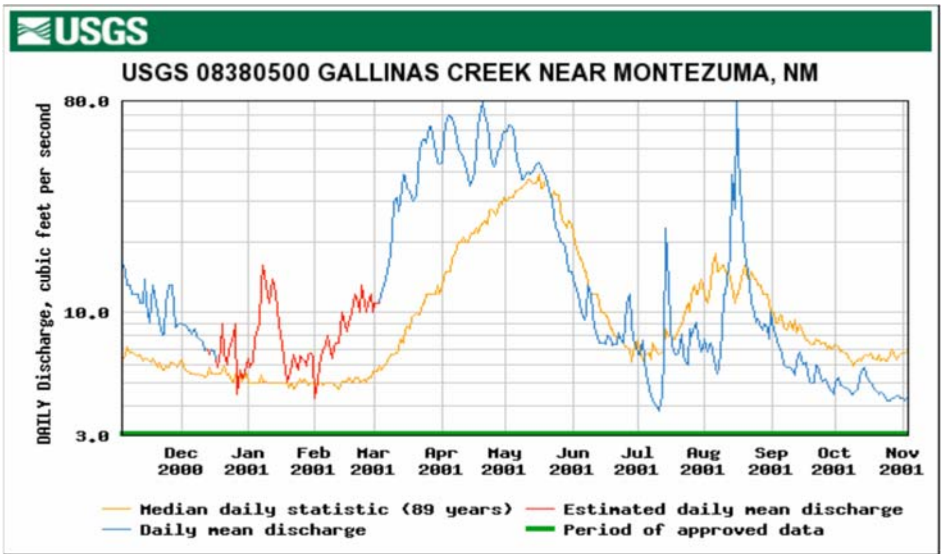
Station ID	Location	Deployment Dates	T_{MAX} (°C) **
NA *	Blue Haven Camp	2016	18.9
50Tecolo065.6	San Geronimo	2001	27.4
		2016	26.9
50Tecolo041.2	@ I-25	2010	29.6
		2016	31.1

* Blue Haven is not a designated SWQB monitoring station; it is located approximately 2 km below the confluence with Blue Creek. ** Maximum recorded temperature.

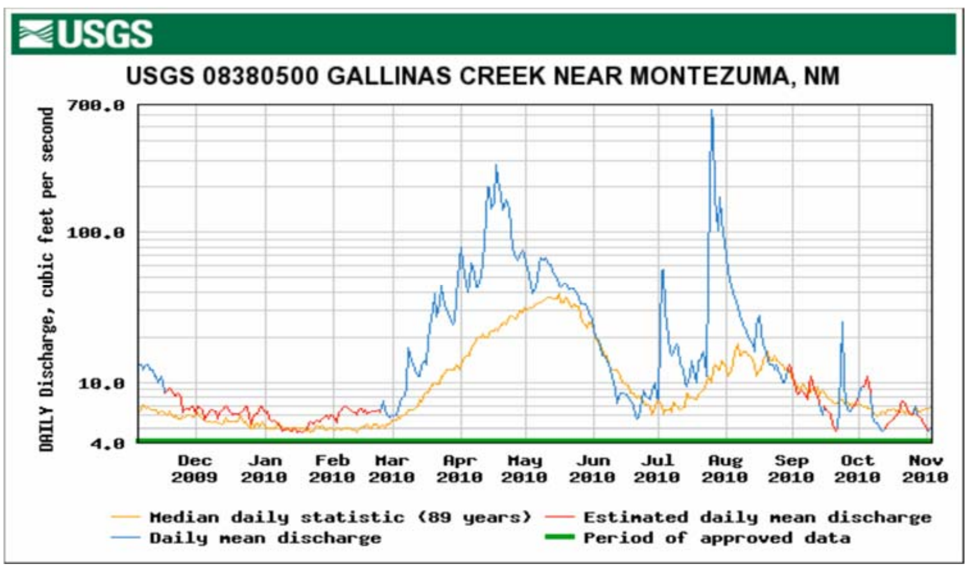
Monitoring of Tecolote Creek for temperature was conducted by SWQB in 2001, 2010 and 2016, in accordance with SWQB Standard Operating Procedure (SOP) 6.3. Thermograph data were assessed using the SWQB assessment protocols in place at the time (NMED/SWQB, 2000; NMED/SWQB, 2008; and NMED/SWQB, 2017).

1.5 Hydrologic Conditions

Tecolote Creek is not gaged for continuous stream discharge. In order to characterize streamflow conditions in which the thermograph data were collected, discharge data were obtained from the closest U.S. Geological Survey (USGS) gage, 08380500 – Gallinas Creek near Montezuma, NM. The Gallinas watershed has similar characteristics of watershed size, drainage area, and elevation. This gage is located 9 km from the nearest point on Tecolote Creek, at a similar latitude and elevation as Tecolote Creek between Blue Creek and San Geronimo (see Figures 1.2 through 1.4). The three years of available thermograph data (2001, 2010 and 2016) all had greater than average spring snowmelt runoff (Figure 1.5). The summer of 2001 appears to have had less than average flow, while summer 2010 included two large storm events resulting in greater than average flow, and summer 2016 included a dryer-than-normal spell of approximately three weeks duration followed by approximately six weeks of high flows.


USGS
USGS 08380500 GALLINAS CREEK NEAR MONTEZUMA, NM
DAILY Discharge, cubic feet per second
80.0
10.0
3.0
Dec 2000
Jan 2001
Feb 2001
Mar 2001
Apr 2001
May 2001
Jun 2001
Jul 2001
Aug 2001
Sep 2001
Oct 2001
Nov 2001
Median daily statistic (89 years)
Estimated daily mean discharge
Daily mean discharge
Period of approved data

A


USGS
USGS 08380500 GALLINAS CREEK NEAR MONTEZUMA, NM
DAILY Discharge, cubic feet per second
700.0
100.0
10.0
4.0
Dec 2009
Jan 2010
Feb 2010
Mar 2010
Apr 2010
May 2010
Jun 2010
Jul 2010
Aug 2010
Sep 2010
Oct 2010
Nov 2010
Median daily statistic (89 years)
Estimated daily mean discharge
Daily mean discharge
Period of approved data

B

C

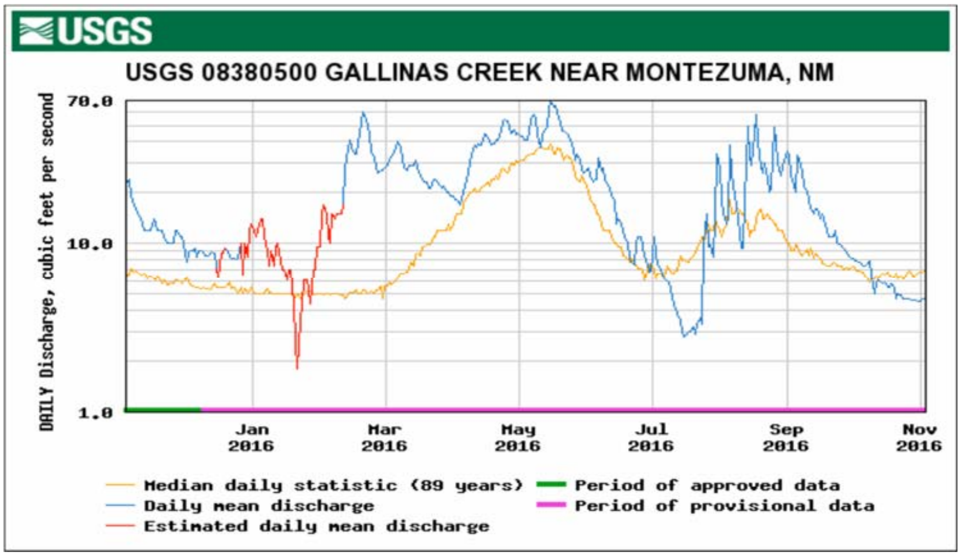


Figure 1.5 Discharge from the nearest USGS gauge, compared with median daily statistics, for water years (A) 2001, (B) 2010 and (C) 2016.

2.0 TEMPERATURE TOTAL MAXIMUM DAILY LOAD

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 in 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).

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 ALU was approved by the WQCC in October 2010, to support aquatic life whose physiologic tolerances are intermediate between those of warm 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.

2.1 Target Loading Capacity

For this TMDL document, target values for temperature are based on the reduction in thermal loading necessary to achieve numeric criteria. Increases in thermal loading in a given AU can often be correlated to changes in shade and/or canopy cover. Tecolote Creek (I-25 to Blue Creek) has a designated Coolwater aquatic life use. Temperature criteria for aquatic life uses in New Mexico are shown on Table 2.1. New Mexico's aquatic life temperature criteria are expressed as 4T3, 6T3 and T_{MAX}. 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. The Coolwater designation has a T_{MAX} criterion of 29 °C and no specified 4T3 or 6T3 limit.

Table 2.1 Aquatic Life Use Temperature Criteria (°C)

Criterion	*High Quality Coldwater*	*Coldwater*	*Marginal Coldwater*	*Coolwater*	*Warmwater*	*Marginal warmwater*
4T3	20	-	-	-	-	-
6T3	-	20	25	-	-	-
TMAX	23	24	29	29	32.2	32.2

The target load (TMDL) is further allocated to a Margin of Safety (MOS), Waste Load Allocation (WLA; permitted point sources), and Load Allocation (LA; non-point sources), according to the formula:

$$WLA + LA + MOS = TMDL$$

2.2 Flow

40 C.F.R. § 130.7(c)(1) requires states to calculate a TMDL using critical conditions for stream flow. The highest in-stream water temperatures typically occur during the hottest times of the year when the daytime is at its longest and solar radiation is at its highest. For New Mexico, the beginning of summer (before the monsoon season) is the hottest time of the year and coincides with the dry season, and consequently the lowest stream flows. Flow measured by SWQB staff during the 2010 monitoring survey ranged from 1 to 39.8 cfs. When available, USGS gages are used to estimate flow. However continuous gage data is not available for Tecolote Creek. Therefore, the critical flow condition used to calculate these temperature TMDLs was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the minimum average four consecutive day flow that occurs with a frequency of once every three years.

Because the available gage data are not available to calculate the critical low flow, an analysis method developed by Waltemeyer (2002) was used to estimate the 4Q3. In Waltemeyer's analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of NM (i.e., statewide and mountainous regions above 7,500 ft in elevation). The average elevation of the Tecolote Creek watershed above I-25 is less than 7,500 ft, so the statewide regression equation was used for the AU. The following regression equation is based on data from 50 gaging stations with non-zero discharge (Waltemeyer 2002):

$$4Q3 = 1.2856 \times 10^{-4}\, DA^{0.42}\, Pw^{3.16}$$

Where:

- 4Q3 = Four-day, three-year low-flow frequency (cfs)
- DA = drainage area (mi^2)
- Pw = average basin mean winter precipitation (inches)

The values used to calculate 4Q3 using Waltemeyer's method are presented in Table 2.2. Parameters used in the calculation were determined using Basins, an in-house NMED GIS application, and the USGS Stream Stats application, Version 3 (http://water.usgs.gov/osw/streamstats/new_mexico.html).

Table 2.2 Critical Flow Variables for Tecolote Creek (I-25 to Blue Creek)

Drainage Area (mi^2)	Average Mean Winter Precipitation (inches)	4Q3 Flow (cfs)
120	6.41	0.34

It is important to remember that the TMDL 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 stream water quality is the goal.

2.3 TMDL Calculations

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

WQS criterion x flow x conversion factor = 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 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 becomes:

$$\Delta^{o}C \text{ x } cfs \text{ x } 1.023E{+}7 = TMDL\ (kJ/day)$$

Details of the derivation of the TMDL equation are presented in Appendix A. TMDL variables for the Coolwater ALU T_{MAX} are shown on Table 2.3.

Table 2.3 Temperature TMDL Calculation for Tecolote Creek (I-25 to Blue Creek)

Condition	T_{MAX} (°C)	4Q3 Critical Flow (cfs)	Conversion Factor	Daily Load (kJ/day)
TMDL	29	0.34	1.023E+7	1.009E+8 (TMDL)
Measured condition	31.1	0.34	1.023E+7	1.082E+8 (Actual)

According to the values calculated on Table 2.3, a load reduction of 6.7% would result in Tecolote Creek (I-25 to Blue Creek) meeting the Coolwater ALU criterion.

WLA	+	LA	+	MOS	=	TMDL
0	+	9.081E+7	+	1.009E+7	=	1.009E+8 kJ/day

The MOS, WLA and LA components of the TMDL are described below in Sections 2.4 – 2.6.

2.4 Margin of Safety (MOS)

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. 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.

In order to develop this temperature TMDL, data from the warmest time of the year were used as a conservative assumption, in order to capture the seasonality of temperature exceedences. Because of the uncertainty in determining critical low flow, an explicit MOS of 10%, or 1.009E+7 kJ/day, is assigned to this TMDL.

2.5 Waste Load Allocation

Waste Load Allocation (WLA) is from a known point source and is controlled through NPDES permits. There is no active NPDES permitted point source in the watershed; therefore, no WLA is assigned.

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 of all pollutants associated with the construction activities and controls to minimize impacts to water quality. The current 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. BMPs and other controls are designed to prevent to the maximum extent practicable an increase in sediment load and flow velocity during and after construction compared to pre-construction conditions to the water body, or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc., in order to assure that waste load allocations and/or applicable water quality standards, including the antidegradation policy, are met. This requirement applies both during and after construction operations.

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 reflect State of New Mexico WQS. The only active MSGP on Tecolote Creek is located downstream of the I-25 to Blue Creek AU, and hence would not affect the temperature impairment.

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. Therefore WLA for this TMDL is zero.

2.6 Load Allocation

Load Allocation (LA) is pollution from any non-point source(s) or background and is addressed through Best Management Practices (BMPs). Since there is no WLA for this AU, the LA is equal to the TMDL value minus the MOS:

1.009E+8 - 1.009E+7= 9.081E+7 kJ/day

2.7 Identification and Description of Pollutant Source(s)

SWQB fieldwork includes an assessment of the probable sources of impairment (Appendix C). Probable Source Sheets are filled out by SWQB staff during watershed surveys and watershed restoration activities. The list of

“Probable Sources” is not intended to single out any single land owner or particular land management activity and generally includes several sources per pollutant. Table 2.4 displays probable pollutant sources that have the possibility to contribute to increased temperature in Tecolote Creek (I-25 to Blue Creek) 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 temperature impairments will be further evaluated, refined, and changed as necessary through the Watershed-Based Plan (WBP).

Table 2.4 Probable Source Summary for Temperature NM-2212_10, Tecolote Creek (I-25 to Blue Creek)

Channelization	Bridges/culverts/RR crossing
Stream channel incision	Paved roads
Gravel or dirt roads	Rangeland grazing
Low water crossing	Forest fire
Drought-related impacts	

A variety of factors can impact stream temperature (Figure 2.1). Decreased effective shade levels may result from reduction of riparian vegetation. When canopy densities are reduced, thermal loading increases in response to the increase in incident solar radiation. Likewise, it is well documented that past hydromodification activities have led to channel incision and widening. Wider stream channels also increase the stream surface area exposed to sunlight, thereby increasing heat transfer. Riparian area and channel morphology disturbances may also be attributed to past, and to some extent current, rangeland grazing practices that have resulted in reduction of riparian vegetation and streambank destabilization. These nonpoint sources of pollution primarily affect the water temperature through increased solar loading by: (1) increasing stream surface solar radiation influx, and (2) increasing stream surface area exposed to solar radiation.

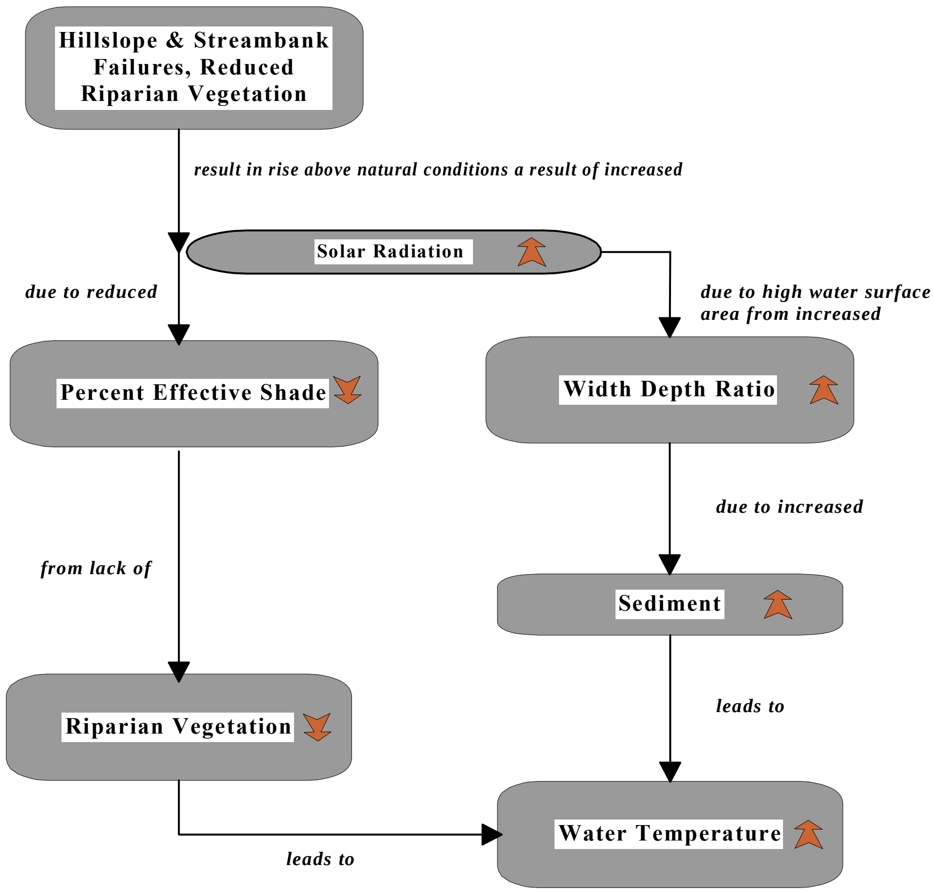


Figure 2.1 Factors Impacting Stream Temperature

Riparian vegetation, stream morphology, hydrology, climate, geographic location, and aspect all influence stream temperature. Although climate, geographic location, and aspect are outside of human control, the condition of the riparian area, channel morphology, and hydrology can be affected by land use activities. Specifically, the elevated summertime stream temperatures attributable to anthropogenic causes in the Tecolote Creek watershed above I-25 result from the following conditions:

1. Channel widening (i.e., increased width to depth ratios) that has increased the stream surface area exposed to incident solar radiation;
2. Riparian vegetation disturbance that has reduced stream surface shading, riparian vegetation height and density;
3. Reduced summertime base flows that result from instream impoundments and withdrawals and/or inadequate riparian vegetation; and,
4. Inflow from heated surfaces, such as road pavement, buildings, bare land, etc. and the flow of water over hardened channel bottoms and walls.

Base flows are maintained with a functioning riparian system so that loss of a functioning riparian system may lower and sometimes eliminate baseflows. Although removal of upland vegetation has been shown, in some cases, to increase water yield, studies show that removal of riparian vegetation along the stream channel subjects the water surface and adjacent soil surfaces to wind and solar radiation, partially offsetting the reduction in transpiration with evaporation. In losing reaches, where the stream loses water through infiltration to the surrounding ground as it flows downstream, increased temperatures can result in increased streambed infiltration, which can result in lower base flow (Constrantz et al. 1994).

Vegetation density increases will provide necessary shading, as well as encourage bank-building processes in severe hydrologic events. However shade is only one avenue which may be pursued to decrease water temperature and ultimately meet WQS. Changes in geomorphological parameters might also prove useful. For example, unstable channels may be characterized by excess sedimentation. Many aquatic organisms respond to high temperature by seeking thermal refuge, moving into cooler tributaries or small cold patches within the stream. Creation of thermal refuges, or enhanced connectivity, may mitigate the effects of increased water temperature (Caissie, 2006). SWQB encourages stakeholders to 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.

2.8 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.

The warmest stream temperatures correspond to prolonged solar radiation exposure, warmer air temperature, and low flow conditions. These conditions occur during late summer and early fall and promote the warmest seasonal instream temperatures. It is assumed that if critical conditions are met, coverage of any potential seasonal variation will also be met.

2.9 Future Growth

The Tecolote drainage is part of the San Miguel/Mora/Guadalupe Water Planning Region (WPR), which includes the entirety of those three counties. The TMDL AU is in San Miguel county, which includes approximately 75% of the WPR population.

The University of New Mexico Bureau of Business and Economic Research (BBER) projects that the population of San Miguel County will grow slowly from 33,137 people in 2015 to 39,202 in 2060. Projected aging of the population is likely to result in a decrease of average household size (more housing units per individual) (BBER, 2008). Future growth in San Miguel County is unlikely to contribute to increased water temperatures in the Tecolote watershed that could not be controlled with best management practices (BMPs). BMPs should continue to be utilized in this watershed to improve road conditions and grazing allotments and adhere to SWPPP requirements related to construction and industrial activities covered under the general permit. Any future growth would be considered part of the existing load allocation, assuming persistence of the present hydrologic conditions.

3.0 MONITORING PLAN

Pursuant to CWA Section 106(e)(1), 33 U.S.C. Section 1251, 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. SWQB revised its 10-year monitoring and assessment strategy (NMED/SWQB, 2016a) and submitted it to USEPA Region 6 for review in June, 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 eight years. The next scheduled monitoring date for the Upper Pecos basin is 2019-2020.

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, 2016b), 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). Short-term efforts were directed toward those waters that are on the USEPA TMDL consent decree list (U.S. District Court for the District of New Mexico 1997), however NMED/SWQB completed the final remaining TMDL on the consent decree in December 2006 and USEPA approved this TMDL in August 2007. The U.S. District Court terminated the Consent Decree on April 21, 2009.

Once assessment monitoring is completed, those reaches showing impacts 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.

It should be noted that 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.

4.0 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.

4.1 Point Sources – NPDES permitting

There are no individual NPDES permits that discharge to the assessment unit addressed in this document.

4.2 Nonpoint Sources

4.2.1 WBP and BMP Coordination

Public awareness and involvement will be crucial to the successful implementation of these plans and improved water quality. A 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 non-point source pollution can be found online at: https://www.epa.gov/polluted-runoff-nonpoint-source-pollution.

SWQB staff will continue to provide technical assistance such as selection and application of BMPs needed to meet WBP goals. Stakeholder public outreach and involvement in the implementation of this TMDL will be ongoing.

4.2.2 Temperature Modeling

The SSTEMP Model, Version 2.0.8, developed by the USGS Biological Resource Division (Bartholow 2002) was used to predict stream temperatures 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 (Bartholow 2002). The predicted temperature values are compared to actual thermograph readings measured in the field in order to calibrate the model. The SSTEMP model identifies current stream and/or watershed characteristics that influence stream temperatures. The model also quantifies the maximum loading capacity of the stream to meet water quality criteria for temperature (Figure 4.1). The model is important for estimating the effects of changes to the parameters influencing stream temperature. It can also be used to identify possible implementation activities which may be of use for reducing the water temperature, by identifying which parameters are most influential to the impairment.

Physical habitat data were collected in 2010 and 2017 to generate stream geometry variables for input to the SSTEMP. Physical habitat data were collected according to SWQB SOP 5.0, available online at https://www.env.nm.gov/surface-water-quality/sop/. Specific SSTEMP input values are discussed in Appendix B.

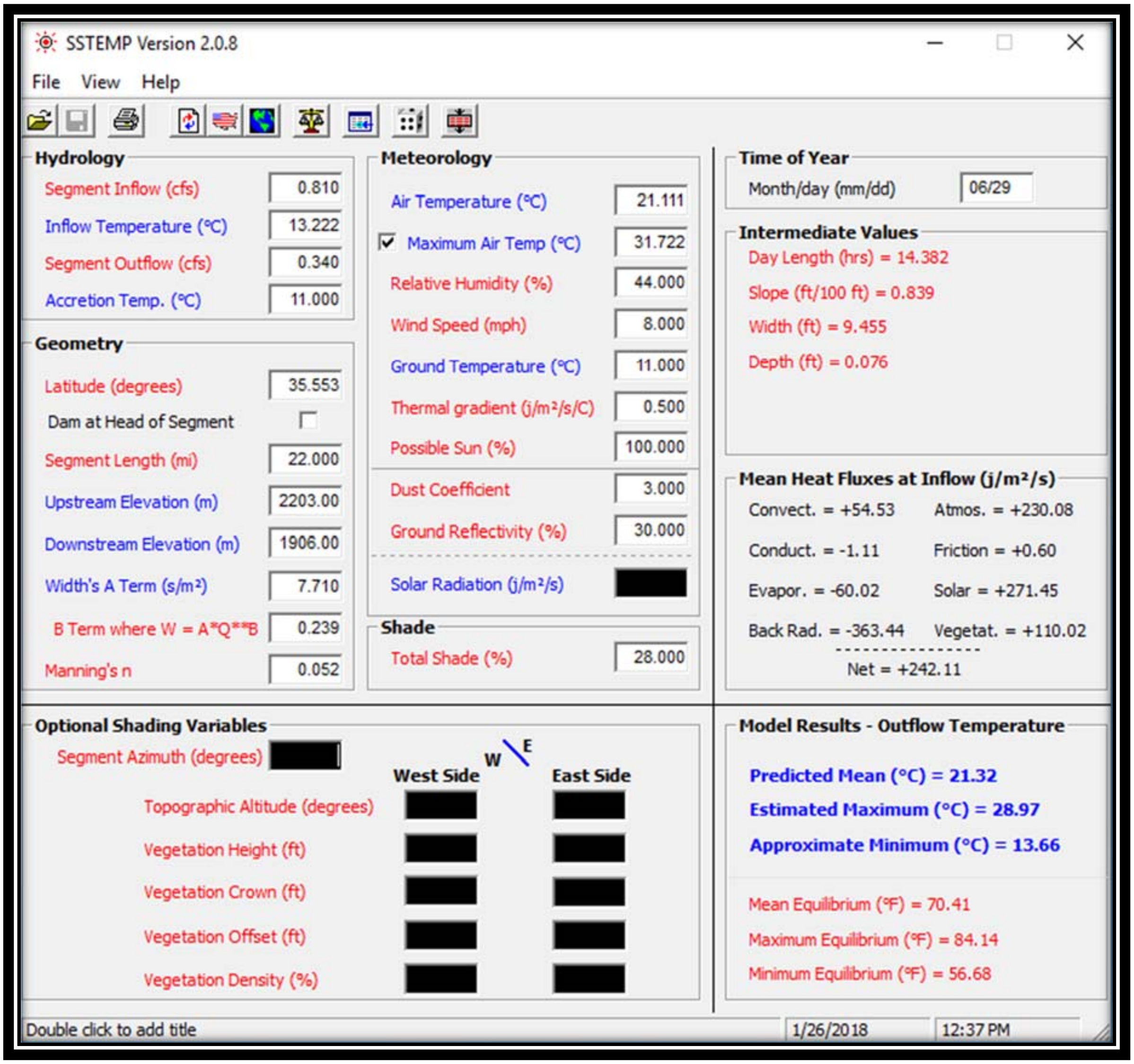


Figure 4.1 Example of SSTEMP output for Tecolote Creek (I-25 to Blue Creek).

A series of assumptions are associated with the SSTEMP run conditions. Running the model outside of these assumptions will often result in inaccuracies or model instability. The assumptions used in the development of SSTEMP that are most relevant to the development of the present TMDL are listed below. For a complete list of assumptions and model deficiencies, please see 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 ($j/m^2/s$). 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 positive (Bartholow 2002).

Table 4.1 details model outputs for Tecolote Creek (I-25 to Blue Creek). SSTEMP was first calibrated against thermograph data. Initial conditions were determined. As the percent total shade was increased, the maximum 24-hour temperature decreased until the appropriate temperature criterion was achieved. For Tecolote Creek (I-25 to Blue Creek), the Coolwater WQS for maximum water temperature of 29˚C is achieved when the percent total shade is increased from 14.6% to 28%. According to the SSTEMP model, the target maximum temperature, which includes the LA plus a 10% MOS, is achieved when the shade is further increased to 52% (Table 4.1).

Table 4.1 SSTEMP model results for Tecolote Creek (I-25 to Blue Creek) – Coolwater

Model run	Temperature target	Solar radiation component per 24-hours ($j/m^2/s$)	% total shade	Modeled temperature (˚C)
Current condition	31	321.97	14.6	Minimum: 14.48 Mean: 22.45 Maximum: 30.43
Meeting WQS	29	271.45	28	Minimum: 13.66 Mean: 21.32 Maximum: 28.97
WQS plus MOS	26.1	180.97	52	Minimum: 12.19 Mean: 19.13 Maximum: 26.08

SSTEMP may be used to compute, one at a time, the sensitivity to input values. This analysis varies the most active input by 10% in both directions, and displays a screen for resulting changes to mean and maximum temperatures. 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 for Tecolote Creek (I-25 to Blue Creek) are shown in Appendix B. The sensitivity analysis indicates that mean air temperature has the most influence on the estimated maximum stream temperatures in Tecolote Creek (I-25 to Blue Creek), with relative humidity, wind speed and possible sun having a secondary level of influence.

4.3 Clean Water Act Section 319(h) Funding

The Watershed Protection Section of the SWQB can potentially 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 by applicants 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: http://www.nmenv.state.nm.us/swqb/.

There is currently no approved WBP or active watershed group working on Tecolote Creek. SWQB staff will continue to conduct outreach related to the CWA Section 319(h) funding program which could lead to the formation of a watershed group in the area.

4.4 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 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 land owners 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 Bureau of Land Management (BLM) has several programs in place to provide assistance to improve unpaved roads and grazing allotments.

SWQB annually makes available CWA Section 604(b) funds through a Request for Quotes (RFQ) process. SWQB requests quotes from regional public comprehensive planning organizations to conduct water quality management planning as defined under Sections 205(j) and 303(e) and the CWA. 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. 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 New Mexico Legislature appropriated $2.3 million in state funds for the River Stewardship Program during the 2014 Legislative Session, $1 million during the 2015 Special Session, and $1.5 million during the 2016 Legislative Session. The River Stewardship Program has the overall goal of addressing the root causes of poor water quality and stream habitat. Objectives of the River Stewardship Program 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 CWA grants." A competitive request for proposals was conducted for 2014 funding and twelve projects located throughout the state were selected. Responsibility for the program is assigned to NMED, and SWQB staff administer the projects. SWQB issued a competitive request for proposals for the 2015-2016 funding in early 2016. Submitted project proposals have been reviewed, funding has been approved, and contracts are currently in development.

Information on additional watershed restoration funding resources is available on the SWQB website at- https://www.env.nm.gov/swqb/Watershed_Protection/FundingSourcesforWatershedProtection.pdf.

5.0 APPLICABLE REGULATIONS AND REASONABLE ASSURANCES

New Mexico's Water Quality Act, NMSA 1978 §§ 74-6-1 to -17 (Act), authorizes the WQCC to "promulgate and publish regulation to prevent or abate water pollution in the state" and to require permits. The Act authorizes a constituent agency 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 (this article) 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 Surface Water Quality Standards (20.6.4.6.C NMAC) states:

> *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 co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.*

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 NMSA 1978, 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.

6.0 PUBLIC PARTICIPATON

Public participation was solicited in development of this TMDL. A Public Comment Draft Tecolote Creek TMDL report was made available for a 30-day comment period beginning on June 4, 2018, and a public meeting was held on June 12, 2018, at the Highlands University campus in Las Vegas, New Mexico, from 5:30 to 7:30 pm. Three sets of written comments were received in response to the public comment period. SWQB response to public comments are included as Appendix D of the final TMDL report. The TMDL was approved by the WQCC on August 15, 2018 and EPA Region 6 on September 13, 2018.

Once the TMDL is approved by the WQCC and USEPA Region 6, the next step for public participation is development or revision of the WBP and implementation of watershed improvement projects including those that may be funded by CWA Section 319(h) grants. The WBP development and revision process is open to any member of the public who wants to participate.

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APPENDIX A
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,

Eq1. *WQS criterion * flow * conversion factor = 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 ($kJ/(m^3*C)$).

Calculation of Thermal Energy

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

Eq2. *thermal energy = specific heat capacity * mass * 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 = kJ/(kg*C)

mass = kilograms (kg)

change in temperature = Celsius (C)

The specific heat capacity of water at 25^{o}C = 4.182 kJ/(kg*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 (m^3/day)

Eq3. 1 cf/s * 86,400 s/day * 0.0283 m^3/cf = 2445.12 m^3/day

Heat Capacity to Volumetric Heat Capacity

Eq4. 4.182 kJ/(kg*C) * 1000 kg/m^3 = 4,182 kJ/(m^3*C)

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

Conversion Factor = 2445.12 m^3/day * 4,182 kJ/(m^3*C) = 1.023E+07 kJ/(day*C)

Form of TMDL Equation

Eq5. Δ [**^{o}C**] x [**cfs]** x 1.023E+07 = TMDL (kJ/day)

Input variables in **bold**, Δ**^{o}C** = (WQC - 0**^{o}C)** and **cfs** = critical flow

The resulting value is the increase in kJ/day above 0^{o} Celsius.

APPENDIX B
SSTEMP INPUT DATA AND SENSITIVITY ANALYSIS

B 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, these parameters are discussed in detail. The Assessment Unit was modeled on the date of the maximum recorded water temperature on the 2016 thermograph records from the monitoring station at I-25. The modeled date is June 29, 2016.

B 2.0 HYDROLOGY

B 2.1 Segment Inflow and Outflow

This parameter is the streamflow at the top or 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. Variables used to calculate the 4Q3 flows were obtained using the US Geological Survey's online tool StreamStats, Version 3.0 (https://water.usgs.gov/osw/streamstats/new_mexico.html).

B 2.2 Inflow Temperature

This parameter represents the mean daily water temperature at the top of the segment. The mean temperature recorded on the modelled date by the thermograph deployed in 2016 at Blue Haven Camp was used as the inflow temperature for the Assessment Unit.

B 2.4 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 temperature for 2016, at the approximate middle of the Assessment Unit, obtained from the PRISM database (http://www.prism.oregonstate.edu/), was used in the absence of measured data.

Table B.1 Hydrology variables used in the SSTEMP model for Assessment Unit Tecolote Creek (I-25 to Blue Creek)

Parameter	Model Value
Critical Inflow	0.81 cfs
Critical Outflow	0.34 cfs
Inflow Temperature	13.2 °C
Accretion Temperature	11.0 °C*

* PRISM Climate Group, Oregon State University,http://prism.oregonstate.edu, accessed 8 Nov 2017

B 3.0 GEOMETRY

B 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 average between the highest and lowest values for the stream corridor within the AU.

B 3.2 Dam at Head of Segment

There is no dam at the upstream end of the segment.

B 3.3 Segment Length

Segment length was obtained from the SWQB Mapper, a GIS application (https://gis.web.env.nm.gov/SWQB/).

B 3.4 Upstream and Downstream Elevation

The upstream and downstream elevations were determined using a USGS topographic map.

B 3.6 Width's A and Width's B Term

Width versus flow regression analyses were prepared by entering bankfull cross-section field data into a Windows-Based Stream Channel Cross-Section Analysis (WINXSPRO 3.0) Program (USDA, 2005). Field measurements were collected following the SWQB Standard Operating Procedure for Physical Habitat Measurements. 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, the Width's B Term was first calculated as the slope, and Width's A Term was estimated by solving for the following equation:

$$W = A \times Q^B$$

Where,

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

The following figure presents the regression of natural log of width and natural log of flow just above the I-25 monitoring station:

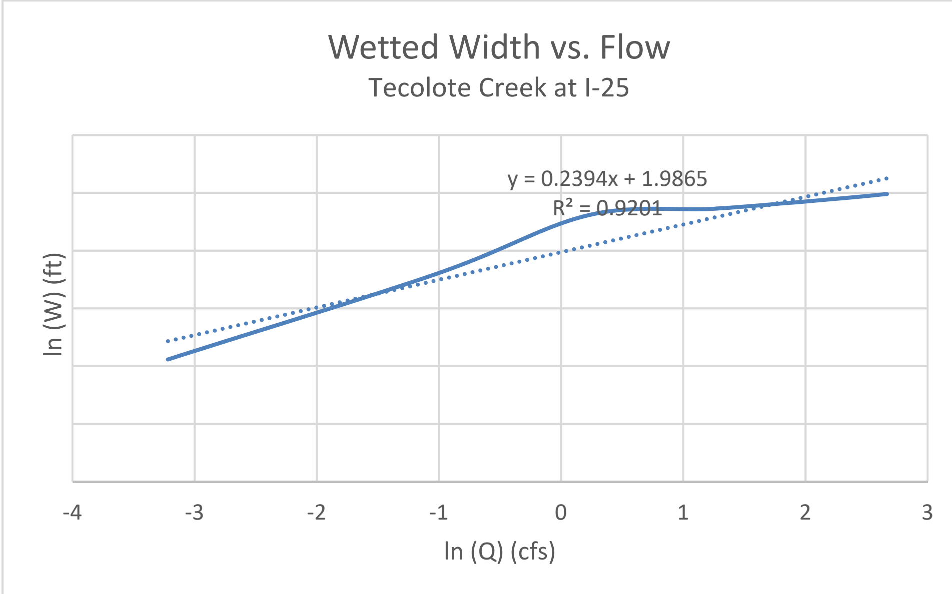

Figure B1. Wetted Width versus Flow in Tecolote Creek (I-25 to Blue Creek)

B 3.7 Manning's n or Travel Time

A site-specific value was generated by the WINXSPRO program described above. Manning's n is a measure of channel roughness which varies with depth of flow, increasing in value at shallower stages. The Manning's n coefficient associated with the 4Q3 flow being modelled was selected.

Table B.2 Stream geometry variables used in the SSTEMP model for Assessment Unit Tecolote Creek (I-25 to Blue Creek)

Parameter	Model Value
Average Latitude	35.553 degrees
Dam at Head of Segment	No
Segment Length	22 miles
Upstream Elevation	2203 meters
Downstream Elevation	1906 meters
Width's A Term	7.71 s/ft^2
Width's B Term	0.239 (dimensionless)
Manning's n	0.052 (dimensionless)

B 4.0 METEOROLOGY

B 4.1 Air Temperature

Air temperature is usually the single most important factor in determining mean daily water temperatures. In the absence of measured air temperature at the thermograph station, 24 hour mean temperature on the modelled date at the nearest available weather station (Las Vegas, New Mexico, airport) was obtained from the Weather Underground website (https://www.wunderground.com/). This weather station is located at the same latitude and elevation as the modelled Assessment Unit.

B 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 station, maximum temperature on the modelled date at the nearest available weather station was obtained from the Weather Underground website.

B 4.3 Relative Humidity

In the absence of measured data at the thermograph stations, 24 hour mean relative humidity on the modelled date at the nearest available weather station was obtained from the Weather Underground website.

B 4.4 Wind Speed

In the absence of measured data at the thermograph stations, 24 hour mean wind speed on the modelled date at the nearest available weather station was obtained from the Weather Underground website.

B 4.5 Ground Temperature

Same as Accretion Temperature, above.

B 4.6 Thermal Gradient

Thermal gradient is a measure of rate of thermal input (or outgo) from the streambed to the water. In the absence of measured data, the thermal gradient was used as a calibration variable, as suggested by Bartholow (2002), and set at 0.5.

B 4.7 Possible Sun

This variable is an indirect and inverse measure of cloud cover. In the absence of measured data, the possible sun was used as a calibration variable, as suggested by Bartholow (2002), and set at 100%.

B 4.8 Dust Coefficient

This value represents the amount of dust in the air. If you enter a value for the dust coefficient, SSTEMP will calculate the solar radiation. In the absence of measured data, the dust coefficient was set at 3, which is at the low end of the range of summer values provided by Bartholow (2002).

B 4.9 Ground Reflectivity

The ground reflectivity is a measure of the amount of short-wave radiation reflected back from the earth into the atmosphere. If you enter a value for the ground reflectivity, SSTEMP will calculate the solar radiation. In the absence of measured data, the ground reflectivity was set at 30%, which is within the range of values provided by Bartholow (2002) for “flat ground, grass covered”.

B 4.10 Solar Radiation

If a value is entered for solar radiation, SSTEMP Model will ignore the dust coefficient and ground reflectivity and “override” the internal calculation of solar radiation. In this case, no value was entered for solar radiation and this value was internally calculated from SSTEMP using the other meteorological variables.

Table B.3 Meteorological variables used in the SSTEMP model for Assessment Unit Tecolote Creek (I-25 to Blue Creek)

Parameter	Model Value
Mean Air Temperature	21.1 °C
Maximum Air Temperature	31.7 °C
Relative Humidity	44%
Wind Speed	8 mph
Ground Temperature	11.0 °C
Thermal Gradient	0.5 Joules/Meter^2/Second/°C
Possible Sun	100%
Dust Coefficient	3
Ground Reflectivity	30%
Mean Solar Radiation	not entered

B 5.0 SHADE

An estimate of average vegetative canopy for the AU was generated using the USDA NorWest Modeled Stream Temperature Scenario map for New Mexico (https://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html). The estimated value was 14.6%. To find the target load, shade was increased by integer percent values until the WQS was achieved.

B 7.0 SENSITIVITY ANALYSIS

Sensitivity Analysis - SSTEMP (2.0.8)

```
Sensitivity for mean temperature values (10% variation)     SSTEMP (2.0.8)
Original mean temperature = 22.45°C
                              Temperature change (°C)
                                  if variable is:
Variable                        Decreased Increased   Relative Sensitivity
--------------------------------------------------------------------------------
Segment Inflow (cfs)              0.00      +0.00
Inflow Temperature (°C)           0.00      +0.00
Segment Outflow (cfs)            +0.00      +0.00
Accretion Temp. (°C)             +0.00      +0.00
Width's A Term (s/m²)            +0.00       0.00
  B Term where W = A*Q**B         0.00      +0.00
Manning's n                      +0.00      +0.00
Air Temperature (°C)             -1.26      +1.25 ******************************
Relative Humidity (%)            -0.45      +0.46 ***********
Wind Speed (mph)                 +0.35      -0.38 *********
Ground Temperature (°C)          -0.02      +0.02
Thermal gradient (j/m²/s/C)      +0.02      -0.02
Possible Sun (%)                 +0.00      +0.34 ********
Dust Coefficient                 +0.01      -0.01
Ground Reflectivity (%)          -0.02      +0.02 *
Total Shade (%)                  +0.12      -0.12 ***
 Maximum Air Temp (°C)           +0.00      +0.00
```

Figure B.3 SSTEMP Maximum Temperature Sensitivity Analysis for Tecolote Creek (I-25 to Blue Creek)

B 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 http://www.fort.usgs.gov. Revised August 2002.

New Mexico Environment Department/Surface Water Quality Bureau (NMED/SWQB). 2016. *State of New Mexico Standard Operating Procedures*. Available on the internet at http://www.nmenv.state.nm.us/swqb/SOP/.

U.S. Department of Agriculture (USDA). 2005. WinXSPRO 3.0. A Channel Cross Section Analyzer. WEST Consultants Inc. San Diego, CA & Utah State University.

APPENDIX C

SOURCE DOCUMENTATION

“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. Data on Probable Sources is routinely gathered by Monitoring and Assessment Section staff and Watershed Protection Section staff during water quality surveys and watershed restoration projects and is housed in the Assessment Database (ADB version 2). ADB was developed by USEPA to help states manage information on surface water impairment and to generate §303(d)/§305(b) reports and statistics. 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.

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 land owner or single land management activity and has therefore been labeled “Probable” and generally includes several sources for each known impairment.

The approach for identifying “Probable Sources of Impairment” was recently modified by SWQB. Any new impairment listing will be assigned a Probable Source of “Source Unknown.” Probable Source Sheets will continue to be filled out during watershed surveys and watershed restoration activities by SWQB staff. Information gathered from the Probable Source Sheets will be used to generate a draft Probable Source list in consequent TMDL planning documents. 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 final Probable Source list in the approved TMDL will be used to update the subsequent Integrated List.

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.

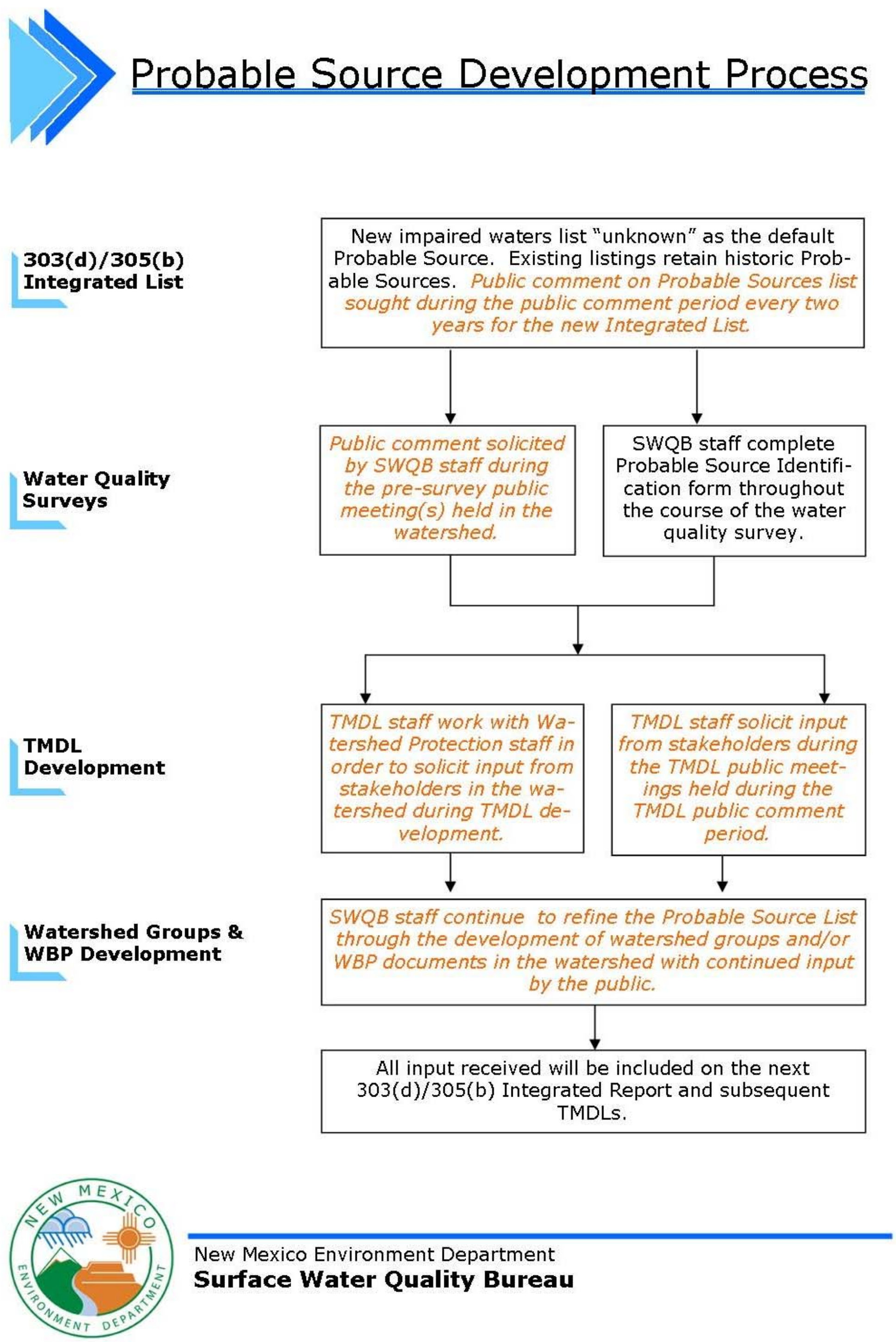

Figure C1. Probable Source Development Process and Public Participation Flowchart

Probable Source(s) & Site Condition Class Field Form

Station ID:	Station Name/Description:
AU ID:	AU Description:
Field Crew:	Comments:
Date:	Watershed protection staff reviewer: Date of WPS review:

Score the proximity, intensity and/or certainty of occurrence of the following activities in the AU upstream of the site. Consult with the appropriate staff at NMED and other agencies to score "*" cells if needed.

Activity Checklist

Hydromodifications				
Channelization	0	1	3	5
Dams/Diversions	0	1	3	5
Draining/Filling Wetlands	0	1	3	5
Dredging	0	1	3	5
Irrigation Return Drains	0	1	3	5
Riprap/Wall/Dike/Jetty Jack -- circle	0	1	3	5
Flow Alteration (from Water Diversions/Dam Ops – circle)	0	1	3	5
Highway/Road/Bridge Runoff	0	1	3	5
Other:	0	1	3	5
Habitat Modification				
Active Exotics Removal	0	1	3	5
Stream Channel Incision	0	1	3	5
Mass Wasting	0	1	3	5
Active Restoration	0	1	3	5
Other:	0	1	3	5
Industrial/ Municipal				
Storm Water Runoff due to Construction	0	1	3	5
Landfill	0	1	3	5
On-Site Treatment Systems (Septic, etc.)	0	1	3	5
Pavement/Impervious Surfaces	0	1	3	5
Inappropriate Waste Disposal	0	1	3	5
Residences/Buildings	0	1	3	5
Site Clearance (Land Development)	0	1	3	5
Urban Runoff/Storm Sewers	0	1	3	5
Power Plants	0	1	3	5
* Industrial Storm Water Discharge (permitted)	0	1	3	5
* Industrial Point Source Discharge	0	1	3	5
* Municipal Point Source Discharge	0	1	3	5
* RCRA/Superfund Site	0	1	3	5
Other:	0	1	3	5
Resource Extraction				
* Abandoned Mines (Inactive)/Tailings	0	1	3	5
* Acid Mine Drainage	0	1	3	5
* Active Mines (Placer/Potash/Other -- circle)	0	1	3	5
* Oil/Gas Activities (Permitted/Legacy – circle)	0	1	3	5
* Active Mine Reclamation	0	1	3	5
Other:	0	1	3	5

Silviculture				
* Logging Ops – Active Harvesting	0	1	3	5
* Logging Ops – Legacy	0	1	3	5
* Fire Suppression (Thinning/Chemicals)	0	1	3	5
Other:	0	1	3	5
Rangeland				
Livestock Grazing or Feeding Operation	0	1	3	5
Rangeland Grazing (dispersed)	0	1	3	5
Other:	0	1	3	5
Roads				
Bridges/Culverts/RR Crossings	0	1	3	5
Low Water Crossing	0	1	3	5
Paved Roads	0	1	3	5
Gravel or Dirt Roads	0	1	3	5
Agriculture				
Crop Production (Cropland or Dry Land)	0	1	3	5
Irrigated Crop Production (Irrigation Equip)	0	1	3	5
* Permitted CAFOs	0	1	3	5
* Permitted Aquaculture	0	1	3	5
Other:	0	1	3	5
Miscellaneous				
Angling Pressure	0	1	3	5
Dumping/Garbage/Trash/Litter	0	1	3	5
Exotic Species (describe in comments)	0	1	3	5
Hiking Trails	0	1	3	5
Campgrounds (Dispersed/Defined – circle)	0	1	3	5
Surface Films/Odors	0	1	3	5
Pesticide Application (Algaecide/Insecticide)	0	1	3	5
Waste From Pets (high concentration)	0	1	3	5
* Fish Stocking	0	1	3	5
Other:	0	1	3	5
Natural Disturbance or Occurrence				
Waterfowl	0	1	3	5
Drought-related Impacts	0	1	3	5
Watershed Runoff Following Forest Fire	0	1	3	5
Recent Bankfull or Overbank Flows	0	1	3	5
Wildlife other than Waterfowl	0	1	3	5
Other Natural Sources (describe in comments)	0	1	3	5

Legend – Proximity Score

Activity not known occur within AU upstream of station (includes unknown)	0	Activity observed or known to be present near station (1 km or less) or is known to occur in moderate frequency/intensity within the AU upstream of station	3
Activity observed or known to be present but not near the station and at low frequency/intensity within AU upstream of station	1	Activity observed or known to be present at station or known to occur in high frequency/intensity within the AU upstream of station	5

Figure C2. Probable Source & Site Condition Field Sheet for SWQB Staff

APPENDIX D

RESPONSE TO COMMENTS

SWQB hosted a public meeting on June 12, 2018 at the Highlands University campus in Las Vegas, New Mexico, from 5:30 to 7:30 pm. Notes from the public meeting are available in the SWQB TMDL files in Santa Fe.

SWQB received the following public comments on the Tijeras Arroyo TMDL:

A. Dr. Jim Morgan, Springer, NM
B. Sally Witters, landowner
C. New Mexico Department of Agriculture

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

1. Equations in Appendix A were updated in response to Dr. Morgan's comments.
3. Minor editorial corrections were made throughout the document.
4. Section 6 (Public Participation) was updated.

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 Times New Roman 12 font with standard page margins for ease of collation. Contact information such as phone number, street addresses, and e-mail addresses from private citizens were removed for privacy reasons. All original letters of comment are on file at the SWQB office in Santa Fe, NM.

COMMENT SET A

To: Rachel Jankowitz
NMED SWQB
Topic: Public Comment Temperature TMDL Tecolote Creek
Date: 20 June 19, 2018

Rachel,

Having had the opportunity to participate in the discussion at the Public Meeting held at NM Highlands University on 12 June 19, 2018 regarding the proposed temperature TMDL by NMED SWQB for the assessment unit (AU) of Tecolote Creek, I feel that I could contribute further written comment. I have had no particular experience in the establishment of a TMDL; however, I have had considerable experience as a teacher and scientist in the basic physical sciences, chemistry and physics-which directly relate to the matter.

BASIC PHYSICS
It is important to consider the physical relationship of heat and temperature within a system containing a material such as liquid water. The relationship, found in any text of the physical sciences, is:

$$H=cm(T_2-T_1)$$

Where:

H is an amount of thermal energy change-induced by an outside of the system source-that causes the initially thermally equilibrated system to change to a new thermally equilibrated state, with a new total thermal energy or heat.

c is the specific heat constant for the material in the system.

m is the mass of the system.

T_1 is the temperature of the system before a change in the total thermal energy.

T_2 is the temperature of the system after the change in the total thermal energy.

(Temperature can be considered to be an" indication of" the average thermal/kinetic energy found in any part of a thermally equilibrated system as indicated by a suitable measuring device. It is an intensive characteristic/property of the system which does not depend on the size of the system, unlike heat which is size of the system dependent-an extensive characteristic/property.)

The appropriate metric units are used in the relationship.

This relationship governs the calculation of a temperature TMDL for the Tecolote AU-when modified to incorporate time and flow considerations.

It does require that the Calculation of Thermal Energy equation listed on page 32 of the TMDL have temperature change in ^{0}C as the final term-not simply temperature. The thermal loading capacity refers to the thermal loading taking place from: the flow at the temperature at the top of the AU, until the flow reaches the lower point of the AU at the temperature there.

This also means that the Form of TMDL Equation listed on p. 33 be modified accordingly.

<u>NMED Response</u>: Thank you for your review of the temperature TMDL calculation. The TMDL calculation is based on multiplying the water quality criteria (in this case 29°C) times a critical flow value (a flow determined to be representative of low flow conditions, in this case the 4Q3) times a conversion factor to convert to a daily value (further explained in Appendix A). The calculation is not intended to generate a result for the increase in thermal loading from the beginning of the AU to the end. You are correct in that the equation for thermal energy uses a temperature differential (in your notation, T_2-T_1). As stated in the note for Eq. 5 in Appendix A, the TMDL value is the increase in kJ/day above 0°C. The use of the freezing point of water provides a fixed reference point for comparison of load reduction and calculation of waste load allocation (although there are no WLAs in this AU). In effect, 0°C is being used for the T_1 value. Equations 2 and 5 in Appendix A have been updated to indicate the temperature component is a differential value.

TIME DEPENDANCE
As stated above, implicit in the general heat vs. temperature effect is that some time interval would occur; however, in the TMDL case there is an explicit time-dependent element involved, that being the time of a mass of water to transit the AU, while being heated from the upper point of the AU, at a temperature T_1, to a temperatureT_2 at the termination of the AU. That time period must be within 24 hours.

<u>NMED Response</u>: While not needed for the TMDL calculation – as stated previously, the TMDL value is not the allowable increase in thermal load from the beginning of the AU to the end – travel time is an important consideration in the implementation section of the TMDL report. The SSTEMP model, discussed in the implementation section, uses stream distance and roughness to estimate a travel time, among other variables, used to calculate the heat fluxes for the stream reach. The model will also allow you to enter the travel time directly, if known.

TEMPERATURE RESTRICTONS
The temperatures T_1 & T_2 obtained must be of the same nature: maximum, mean or minimum. A mean temperature determination is likely to be more reliable. However, it is a requirement of the temperature water quality standard that the maximum temperature, T_1 or T_2, not be >= than 29 ^{0}C.

<u>NMED Response</u>: The Coolwater ALU temperature criterion is a maximum of 29°C, meaning that a temperature equal to 29 ^{0}C, but not above, would be meet the criterion.

FLOW DATA

While the temperature measurements are relatively easy to obtain with a fair degree of accuracy using current instrumentation, the remaining factor, m or mass, needed to calculate the heat change-if that is of interest to determine-is much more problematic. The mass of water moving down the AU, related to the flow rate during the required time interval, must be known with some accuracy as well. In the Tecolote situation, there being no USGS flow station located anywhere on the stream, there was a calculated low-flow for the terminal endpoint of the AU at I-25. This calculation, based on a regression equation developed by Waltemeyer (2002) used geophysical and climate data for the analysis.

Unfortunately, there was not included in the low-flow calculation any man-caused flow alterations - such as impoundments, or diversions for irrigation. These factors could be significant or even dominant.

Additionally, casual observations of the Tecolote flow at I-25 indicate periods of zero-flow!

Another attempt to estimate a low-flow value was to compare recorded flow values in the adjacent Gallinas Creek to possible low-flow values in Tecolote Creek. Unfortunately, the elevation of USGS gauge on the Gallinas was quite different than the elevation of I-25 termination point of the Tecolote. And, no consideration was given for man-made flow alterations that might have been present on the Gallinas, as well.

From the above discussion, it is evident that reliable flow data for the Tecolote is not available. This is very problematic for an attempted TMDL calculation. Some real-time flow data is needed. This flow data can be obtained with a reasonable degree of accuracy at a point in a stream by a simple method. That done by the stream cross section area times flow velocity method- which is described in USGS publications. It only requires a measuring stick and a portable stream velocity meter as equipment.

<u>NMED Response</u>: While the SWQB is experienced in both instantaneous discharge measurement and operation of continuous discharge monitoring stations, it is not needed in this case as the 4Q3 is an appropriate low flow statistic that can be used to calculate a conservative TMDL value. You are correct that the USGS 4Q3 calculation for ungauged streams does not provide for diversions or flow modifications. In part due to uncertainty in the critical flow value, a margin of safety is included in the TMDL calculation. During the 2010 survey, SWQB staff measured instantaneous flow five times just upstream of I-25 under both moderate and low flow conditions and observed a dry channel once.

It could be that the current AU should be shortened, located further upstream, in order to be perennial.

<u>NMED Response</u>: The Tecolote Creek AU references "Perennial reaches of Tecolote Creek from I-25 to Blue Creek."

SSTEMP

Because the downstream temperature, at times, exceeds acceptable value of 29ºC for a cool water aquatic life usage designation, the Stream Segment Temperature Model, SSTEMP, software package developed by Bartholow (2002), and available from the USGS Science Center, Fort Collins, CO, was used by NMED SWQB to find what remediation efforts might result in the lowering of the maximum temperature at the lower end of the stream segment to an acceptable value.

Basically, the Model uses the physical heat vs. temperature relationship in its construction and usage.

$$H=cm(T_2-T_1)$$

Because the relationship is expressed as a single equation, there can only be: one independent variable, and one dependent variable, in usage.

The independent variable is the H/thermal loading resulting by changing one of severable heating factors. The dependent variable is T_2, the calculated terminal temperature resulting from the thermal loading change H.

T_1, c and m are required to be fixed, or constant, values for the calculation. T_1 =known temperature at the top of the stream segment. The specific heat value, c, remains as a constant. The mass/flow mass is constant under a steady-state flow requirement.

It is the steady-state flow requirement that seems to indicate that the SSTEMP modelling may not be appropriate for a free-flowing stream, such as the Tecolote. To see if the model has a free-flowing modification available, there is a contact person listed by USGS for SSTEMP referencing. That person is:

John Risley
USGS Oregon Water Science Center
503 251-3279
jrisley@usgs.gov

NMED Response: Correct, SSTEMP is a steady-state model and, as such, only provides a snapshot of conditions based on static input variables. There is no option for dynamic modeling with SSTEMP. A number of software models are available that are capable of more complex and dynamic simulations. However, they exceed the needs and data availability for this TMDL.

Thanks for considering my comment.
See if there is anything of use or relevance.

Jim Morgan
heydoc@q.com
575 483-2890
Box 897, Springer, NM 87747

COMMENT SET B

RECEIVED
JUN 29 2018
SURFACE WATER
QUALITY BUREAU

Surface Water Quality Bureau
NEW MEXICO ENVIRONMENT DEPARTMENT

Public Comment Card

Meeting Date: JUNE 12, 2018

Comments Regarding: TOTAL MAXIMUM DAILY LOAD FOR TECOLOTE CREEK (I-25-BLUE CREEK)

*OPTIONAL INFORMATION :

*Name: SALLY WITTERS *Affiliation: COMMUNITY RESIDENT

*E-Mail:

*Mailing Address:

Comments must be submitted in writing in order to be included in the public record. Please provide comments in the space below (use back if necessary):

I AM A COMMUNITY RESIDENT OF THE TECOLOTE CREEK WATERSHED. I ENTHUSIASTICALLY SUPPORT RESTORATION/REHABILITATION OF TECOLOTE CREEK. I BELIEVE TECOLOTE CREEK IS AN IMPAIRED STREAM, AND THERE IS A LOT THAT COMMUNITY MEMBERS CAN DO TO IMPROVE THE WATER QUALITY.

THE NEIGHBORS ARE TALKING TOGETHER ABOUT IMPROVED WATER AND WATERSHED FOR LIVESTOCK AND WILDLIFE. THEY ARE EXCITED ABOUT HELPING TO AGAIN HAVE THE FISHING HOLE AND SWIMMING HOLE FOR MULTIPLE FAMILY GENERATIONS TO USE.

I AND MY NEIGHBORS ARE WILLING TO WORK TOGETHER WITH HERMITS PEAK WATERSHED ALLIANCE.

THANK YOU FOR THE WORK TMDL AND SWQB ARE DOING TOWARD DEVELOPING A WATERSHED PLAN.

Turn comment card in tonight or mail / fax:

TMDL Coordinator 5469
Surface Water Quality Bureau, P. O. Box ~~26110~~ Santa Fe, NM 87502
Phone: (505) 827-0187; Fax: (505) 827-0160

<u>NMED Response</u>: Thank you for your support for the Clean Water Act TMDL process, and for your willingness to working with the watershed group on improving aquatic habitat in Tecolote Creek.

COMMENT SET C

NEW MEXICO DEPARTMENT OF AGRICULTURE
Office of the Director/Secretary
MSC 3189
New Mexico State University
P.O. Box 30005
Las Cruces, NM 88003-8005 Phone:
(575) 646-3007

July 3, 2018

Ms. Rachel Jankowitz
New Mexico Environment Department Surface
Water Quality Bureau
P.O. Box 5469 Santa
Fe, NM 87502

RE: Public Comment Draft Total Maximum Daily Load (TMDL) for Tecolote Creek Dear

Ms. Jankowitz:

New Mexico Department of Agriculture (NMDA) submits the following comments regarding the Draft Total Maximum Daily Load (Draft TMDL) document for Tecolote Creek recently published by New Mexico Environment Department Surface Water Quality Bureau (SWQB).

NMDA maintains a strategic goal to promote responsible and effective use and management of natural resources in support of agriculture. Our comments are specific to our mission within state government – dedication to the promotion and enhancement of New Mexico's agriculture, natural resources, and quality of life.

Section 2.7 of the Draft TMDL presents information on how the SWQB assesses the probable sources of impairment. Based on the description of the development of the list of probable sources, it appears that SWQB staff diligently work with stakeholders to identify problems. While it is commendable to work with the public to develop these lists, the lists do not appear to be subject to scientific analysis.

In assessing the probable sources of temperature impairment, one of the nonpoint source contributions to the Draft TMDL mentioned is rangeland grazing. The Draft TMDL states there are no nutrient loads from nonpoint sources for this assessment. The relative contribution of different potential sources contributing to temperature impairment cannot be determined, and the list of probable sources is only a hypothesis unless performing an extensive data collection and analyses of the nutrient loads. As currently written, there are no safeguards preventing a popular opinion from causing one or several categories being overrepresented. NMDA requests that SWQB provide the specific scientifically valid sources for temperature impairment in order for the public and end users of the forthcoming final TMDL to have accurate information.

NMDA appreciates the opportunity to provide comments on the Draft TMDL for Tecolote Creek. We request to be kept informed of future comment opportunities such as this one. Please contact Ms. Kathryn Kruthaupt at (575) 646-2006 or kkruthaupt@nmda.nmsu.edu with questions regarding these comments.

Sincerely,

Jeff M. Witte
Director JM/kk/ya

NMED Response:

The inclusion of livestock grazing on the list of probable sources is supported by a large body of peer-reviewed literature documenting potential adverse effects on water quality (see examples below). While it would be ideal to have site-specific monitoring data for a number of variables, including grazing, it is beyond the available resources of the SWQB to do so. NMED does not state or imply that grazing is the primary source of temperature impacts in the watershed. As stated in Section 2.7 of the TMDL document, the probable sources list is a starting point to be refined or revised in the process of Watershed Based Plan (WBP) development, and does not single out any particular source or land owner. It is outside the scope of the TMDL to address probable sources in greater detail. The completion of a TMDL can lead to opportunities for subsequent monitoring, planning and restoration activities to address watershed conditions that contribute to the temperature impairment, through an approved WBP and application for grant funding. If the NM Dept. of Agriculture has additional information regarding "specific scientifically valid sources", NMED will consider any information that is submitted during the public comment period. We are not aware of possible "safeguards preventing a popular opinion from causing one or several categories being overrepresented". Again, if the NM Dept. of Agriculture has any specific suggestions for such safeguards, NMED will consider them.

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