APPENDIX E
HYDROLOGY, GEOMETRY, AND METEROLOGICAL INPUT DATA FOR SSTEMP

This page left intentionally blank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

4Q3	Four-consecutive day discharge that has a recurrence interval of three years
cfs	Cubic Feet per Second
GIS	Geographic Information Systems
GPS	Global Positioning System
IOWDM	Input and Output for Watershed Data Management
mi^2	Square Miles
^oC	Degrees Celcius
SEE	Standard Error of Estimate
SSTEMP	Stream Segment Temperature
SWSTAT	Surface-Water Statistics
TMDL	Total Maximum Daily Load
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WinXSPRO	Windows-Based Stream Channel Cross-Section Analysis

This page left intentionally blank.

E1.0 INTRODUCTION

This appendix provides site-specific hydrology, geometry, and meterological 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. Meterological inputs to SSTEMP Model include 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 for each assessment unit to be modeled using SSTEMP Model. The assessment units and modeled dates are defined as follows:

Table E.1 Assessment Units and Modeled Dates

Assessment Unit ID	Assessment Unit Description	Modeled Date
NM-2120.A_827	= Comanche Creek (Costilla Creek to Little Costilla Creek)	8-4-2003
NM-2120.A_820	= Costilla Creek (Diversion above Costilla to Comanche Creek)	7-31-2002
NM-2120.A_900	= Rio de los Pinos (Colorado border to headwaters)	7-31-2000
NM-2120.A_512	= Rio Fernando de Taos (Rio Pueblo de Taos to headwaters)	7-5-2003
NM-2119_05	= Rio Grande (Red River to New Mexico-Colorado border)	7-8-2003
NM-2120.A_600	= Rio Hondo (Rio Grande to US Forest Service boundary)	7-3-2003
NM-2119_20	= Rio Pueblo de Taos (Rio Grande to Arroyo del Alamo)	7-10-2003
NM-2119_30	= Rio Pueblo de Taos (Arroyo del Alamo to Rio Grande del Rancho)	7-10-2003
NM-2120.A_511	= Rio Pueblo de Taos (Rio Grande del Rancho to Taos Pueblo boundary)	7-31-2000
NM-2120.A_901	= Rio San Antonio (Montoya Canyon to headwaters)	7-3-2003

E2.0 HYDROLOGY

E2.1 Segment Inflow

This parameter is the *mean daily* flow at the top of the stream segment. If the segment begins at an effective headwater, the flow is entered into SSTEMP Model as zero. Flow data from USGS gages were used when available. 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 as the inflow instead of the mean daily flow. These critical low flows were used to decrease assimilative capacity of the stream to adsorb and disperse solar energy. The 4Q3 was determined for gaged sites using a log Pearson Type III distribution through "*Input and Output for Watershed Data Management*" (IOWDM) software, Version 4.1 (USGS 2002a) and "*Surface-Water Statistics*" (SWSTAT) software, Version 4.1 (USGS 2002b).

Discharges for ungaged sites on gaged streams were estimated based on methods published by Thomas and others (1997). If the drainage area of the ungaged site is between 50 and 150 percent of the drainage area of the gaged site, the following equation is used:

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

where,

Q_u = Area weighted 4Q3 at the ungaged site (cubic feet per second [cfs])
Q_g = 4Q3 at the gaged site (cfs)
A_u = Drainage area at the ungaged site (square miles [mi^2])
A_g = Drainage area at the gaged site (mi^2)

Drainage areas for assessment units to which this method was applied are summarized in the following table:

Table E.2 Drainage Areas for Estimating Flow by Drainage Area Ratios

Assessment Unit	USGS Gage	Drainage Area from Gage (mi^2)	Drainage Area from Top of AU (mi^2)	Drainage Area from Bottom of AU (mi^2)	Ratio of DA of Ungaged (upstream) to Gaged Site	Ratio of DA of Ungaged (downstream) to Gaged Site
NM-2120.A_827	—[(a)]	—	0.119	42.147	—	—
NM-2120.A_820	08255500	215	115	216	53%	100%
NM-2120.A_512	—[(a)]	—	—	67.914	—	—
NM-2119_05	08263500	8,440	7,465	8,720	88%	103%
NM-2120.A_600	08267500	36	40	68	111%	***189%***[(b)]
NM-2120.A_900	08248000	155	—[(c)]	165	—[(c)]	106%
NM-2119_20	08246300	384	402	417	106%	109%
NM-2119_30	08276300	384	359	402	94%	105%
NM-2120.A_511	08276300	384	111	201	***289%***[(b)]	52%
NM-2120.A_901	—[(d)]	—	—[(c)]	67.29	—[(c)]	—[(d)]

Notes:
[(a)] Regression method developed by Waltemeyer (2002) was used to estimate flows since USGS this is an ungaged stream.
[(b)] The method developed by Thomas et al. (1997) is not applicable because the drainage area of the ungaged site is greater than 150 percent of the drainage area of the gaged site. Therefore, the method developed by Waltemeyer (2002) was used to estimate flows for these assessment units.
[(c)] Assessment unit begins at headwaters.
[(d)] USGS gage location is downstream of the lower boundary of the assessment unit. The section of the river where the gage is located typically goes dry. The method developed by Thomas et al. (1997) was not used because the only available gage data do not reflect natural flow conditions. Instead, the regression method developed by Waltemeyer (2002) was used.
mi^2 = Square miles
USGS = U.S. Geological Survey
AU = Assessment Unit

4Q3 derivations for ungaged streams were based on analysis methods described by Waltemeyer (2002). In this analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of New Mexico (i.e., statewide and mountainous regions above 7,500 feet

in elevation). The following statewide regression equation is based on data from 50 gaging stations with non-zero discharge (Waltemeyer 2002):

$$4Q3 = 1.2856 \times 10^{-4} \; DA^{0.42} \; P_w^{3.16}$$

where,

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

The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively, for this regression equation (Waltemeyer 2002). The following regression equation for mountainous regions above 7,500 feet in elevation is based on data from 40 gaging stations with non-zero discharge (Waltemeyer 2002):

$$4Q3 = 7.3287 \times 10^{-5} \; DA^{0.70} \; P_w^{3.58} \; S^{1.35}$$

where,

S = Average basin slope (percent)

The average SEE and coefficient of determination are 94 and 66 percent, respectively, for this regression equation (Waltemeyer 2002). The drainage areas, average basin mean winter precipitation, and average basin slope for assessment units where this regression method was used are presented in the following table:

Table E.3 Parameters for Estimating Flow using USGS Regression Model

Assessment Unit	Regression Model[(a)]	Average Elevation for Assessment Unit (feet)	Mean Basin Winter Precipitation (inches)	Average Basin Slope (unitless)
NM-2120.A_827	Mountainous	9,090	12.1	0.248
NM-2120.A_512	Mountainous	7,634	9.3	0.268
NM-2120.A_511	Statewide	6,761	10.9	0.271
NM-2120.A_600	Statewide	7,051	10.4	0.378
NM-2120.A_901	Mountainous	8,775	17.1	0.136

Notes:
mi^2 = Square miles
[(a)] Waltemeyer (2002)

Based on the methods described above, the following values were estimated for inflow:

Table E.4 Inflow

Assessment Unit	Ref.	4Q3[1] (cfs)	DAt (mi^2)	DAg (mi^2)	Pw (in)	S unitless	Inflow (cfs)
NM-2120.A_827	(a)	—	0.119	—	12.1	0.248	0.019
NM-2120.A_820	(b)	4.059	115	215	—	—	2.967
NM-2120.A_512	N/A	—	—	—	9.3	0.268	0.000[2]
NM-2119_05	(b)	66.324	7,465	8,440	—	—	62.376
NM-2120.A_600	(b)	—	40.0	36.2	10.4	0.378	0.990
NM-2120.A_900	N/A	9.283	—	155	—	—	0.000[2]
NM-2119_20	(b)	7.202	402	380	—	—	7.408
NM-2119_30	(b)	7.202	359	380	—	—	7.000
NM-2120.A_511	(a)	7.202	111	384	10.9	0.271	1.762
NM-2120.A_901	N/A	—	—	—	17.1	0.136	0.000[2]

Notes:
N/A = Not applicable, assessment unit begins at headwaters.
Ref. = Reference
(a) Waltemeyer 2002
(b) Thomas et al. 1997
cfs = cubic feet per second
mi^2 = Square miles
in = Inches
Pw = Mean winter precipitation
DAt = Drainage area from top of segment
DAb = Drainage area from bottom of segment
DAg = Drainage area from USGS gage
S = Average basin slope
[1] Based on period of record for USGS gage.
[2] Inflow is zero because assessment unit begins at headwaters.

E2.2 Inflow Temperature

This parameter represents the *mean daily* water temperature at the top of the segment. 2003 data from thermographs positioned at the top of the assessment unit were used when possible. If the segment began at a true headwater, the temperature entered was zero degrees Celcius (^oC) (zero flow has zero heat). The following inflow temperatures for impaired assessment units were modeled in SSTEMP:

Table E.5 Mean Daily Water Temperature

Assessment Unit	Upstream Thermograph Location	Inflow Temp. (^oC)	Inflow Temp. (^oF)
NM-2120.A_827	Comanche below Little Costilla Creek	15.4	59.7
NM-2120.A_820	Costilla Creek below Comanche Creek[a]	16.6[b]	61.9
NM-2120.A_512	None (headwaters)	0	32.0
NM-2119_05	R. Grande at NM-CO Border	21.7	71.0
NM-2120.A_600	R. Hondo at USGS gage above Valdez	10.5	50.8
NM-2120.A_900	None (headwaters)	0	32.0
NM-2119_20	R. Pueblo de Taos at Highway 240 [c]	22.5	72.4
NM-2119_30	R. Pueblo de Taos at Highway 240 [c]	22.5	72.4
NM-2120.A_511	R. Pueblo de Taos at USGS Gage [d]	20.6[b]	69.1

Assessment Unit	Upstream Thermograph Location	Inflow Temp. (ºC)	Inflow Temp. (ºF)
NM-2120.A_901	None (headwaters)	0	32.0

Notes:
ºC = Degrees Celcius
ºF = Degrees Farenheit
[(a)] Data from 2002 were used for this assessment unit.
[(b)] Single field measurement – not average daily temperature.
[(c)]The Rio Pueblo de Taos at Arroyo del Alamo was not accessible at the time of thermograph deployment. Therefore, the inflow temperature for the "Arroyo del Alamo to Rio Grande del Rancho" assessment unit is also used as the inflow temperature for the "Rio Grande to Arroyo del Alamo" assessment unit.
[(d)] Data from 2000 were used for this assessment unit.

E2.3 Segment Outflow

Flow data from USGS gages were used when available. To be conservative, the 4Q3 was used as the segment outflow. These critical low flows were used to decrease assimilative capacity of the stream to adsorb and disperse solar energy. Outflow was estimated using the methods described in Section 2.1. The following table summarizes 4Q3s used in the SSTEMP Model:

Table E.6 Segment Outflow

Assessment Unit	Ref.	4Q3[(1)] (cfs)	DAb (mi^2)	DAg (mi^2)	Pw (in)	S unitless	Outflow (cfs)
NM-2120.A_827	(a)	—	42.15	—	12.1	0.248	1.151
NM-2120.A_820	(b)	4.059	216	215	—	—	4.064
NM-2120.A_512	N/A	—	67.91	—	9.3	0.268	0.696
NM-2119_05	(b)	66.324	8,720	8,440	—	—	67.415
NM-2120.A_600	(b)	—	67.59	36.2	10.4	0.378	1.234
NM-2120.A_900	(c)	9.283	165	155	—	—	9.283
NM-2119_20	(b)	7.202	417	380	—	—	7.544
NM-2119_30	(b)	7.202	402	380	—	—	7.408
NM-2120.A_511	(a)	7.202	201	384	10.9	0.271	2.262
NM-2120.A_901	N/A	—	67.29	—	17.1	0.136	2.449

Notes:
N/A = Not applicable, assessment unit begins at headwaters.
Ref. = Reference
(a) Waltemeyer 2002
(b) Thomas et al. 1997
(c) From USGS gage data
cfs = cubic feet per second
mi^2 = Square miles
in = Inches
Pw = Mean winter precipitation
DAt = Drainage area from top of segment
DAb = Drainage area from bottom of segment
DAg = Drainage area from USGS gage
S = Average basin slope
[(1)] Based on period of record for USGS gage.
[(2)] Inflow is zero because assessment unit begins at headwaters.

E2.4 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 2003 was used in the absence of measured data. The following table presents the mean annual air temperature for each assessment unit:

Table E.7 Mean Annual Air Temperature as an Estimate for Accretion Temperature

Assessment Unit	Ref.	Mean Annual Air Temperature for 2003 (^oC)	Mean Annual Air Temperature for 2003 (^oF)
NM-2120.A_827	(a)	8.157	46.683
NM-2120.A_820	(a)	7.508[(1)]	45.514[(1)]
NM-2120.A_512	(b)	11.432 [(2)]	52.577 [(2)]
NM-2119_05	(c)	10.543	50.540
NM-2120.A_600	(c)	10.543	50.540
NM-2120.A_900	(d)	5.216	41.389
NM-2119_20	(c)	10.543	50.540
NM-2119_30	(c)	10.543	50.540
NM-2120.A_511	(b)	11.432[(2)]	52.577[(2)]
NM-2120.A_901	(d)	5.216	41.389

Notes:
Ref. = References for Weather Station Data are as follows:

(a) New Mexico State University Climate Network (Costilla Station, Elevation 2,120 meters; Latitude 36°59'N, Longitude 105°33'W)

(b) New Mexico State University Climate Network (Alcalde Station, Elevation 1,745 meters; Latitude 36°05'N, Longitude 106°03'W)

(c) New Mexico State University Climate Network (Taos Station, Elevation 2,161 meters; Latitude 36°27'N, Longitude 105°40'W)

(d) New Mexico State University Climate Network (Chamita Station, Elevation 2,560 meters; Latitude 36°57'N, Longitude 106°39'W)

[(1)] Mean annual temperature for 2002.
[(2)] Mean annual temperature for 2000
ºF = Degrees Farenheit
ºC = Degrees Celcius

E3.0 GEOMETRY

E3.1 Latitude

Latitude refers to the position of the stream segment on the earth's surface. Latitude is generally determined in the field with a global positioning system (GPS) unit. Latitude for each assessment unit is summarized below:

Table E.8 Assessment Unit Latitude

Assessment Unit	Latitude (decimal degrees)
NM-2120.A_827	36.80
NM-2120.A_820	36.91
NM-2120.A_512	36.40
NM-2119_05	37.00
NM-2120.A_600	36.54
NM-2120.A_900	36.97
NM-2119_20	36.34
NM-2119_30	36.38
NM-2120.A_511	36.39
NM-2120.A_901	36.86

E3.2 Dam at Head of Segment

The following assessment units have a dam at the upstream end of the segment with a constant, or nearly constant diel release temperature:

Table E.9 Presence of Dam at Head of Segment

Assessment Unit	Dam?
NM-2120.A_827	No
NM-2120.A_820	No
NM-2120.A_512	No
NM-2119_05	No
NM-2120.A_600	No
NM-2120.A_900	No
NM-2119_20	No
NM-2119_30	No
NM-2120.A_511	No
NM-2120.A_901	No

E3.3 Segment Length

Segment length was determined with National Hydrographic Dataset Reach Indexing GIS tool. The segment lengths are as follows:

Table E.10 Segment Length

Assessment Unit	Length (miles)
NM-2120.A_827	10.3
NM-2120.A_820	18.0
NM-2120.A_512	21.6
NM-2119_05	27.8
NM-2120.A_600	8.5
NM-2120.A_900	20.9
NM-2119_20	6.4
NM-2119_30	1.2
NM-2120.A_511	2.8
NM-2120.A_901	9.1

E3.4 Upstream Elevation

The following upstream elevations were determined in the field with a GPS unit:

Table E.11 Upstream Elevations

Assessment Unit	Upstream Elevation (feet)
NM-2120.A_827	9,222
NM-2120.A_820	8,963
NM-2120.A_512	8,960
NM-2119_05	7,485
NM-2120.A_600	7,650
NM-2120.A_900	9,624
NM-2119_20	6,670
NM-2119_30	6,730
NM-2120.A_511	6,859
NM-2120.A_901	8,809

E3.5 Downstream Elevation

The following downstream elevations were determined in the field with a GPS unit:

Table E.12 Downstream Elevations

Assessment Unit	Downstream Elevation (feet)
NM-2120.A_827	8,963
NM-2120.A_820	7,953
NM-2120.A_512	5,489
NM-2119_05	6,616
NM-2120.A_600	6,453
NM-2120.A_900	8,120
NM-2119_20	6,099
NM-2119_30	6,670
NM-2120.A_511	6,730
NM-2120.A_901	8,750

E3.6 Width's A and Width's B Term

Width's B Term was calculated as the slope of the regression of the natural log of width and the natural log of flow. Width-versus-flow regression analyses were prepared by entering cross-section field data into a Windows-Based Stream Channel Cross-Section Analysis (WINXSPRO) Program (U.S. Department of Agriculture [USDA] 1998). 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 table summarizes Width's A- and B-Terms for assessment units requiring temperature TMDLs:

Table E.13 Width's A and Width's B Terms

Assessment Unit	Width's B-Term	Width's A-Term[(1)]
NM-2120.A_827	0.157[(2)]	6.681[(2)]
NM-2120.A_820	0.230[(2)]	9.474[(2)]
NM-2120.A_512	0.224[(2)]	3.624[(2)]

Assessment Unit	Width's B-Term	Width's A-Term[(1)]
NM-2119_05	0.336[(2)]	16.410[(2)]
NM-2120.A_600	0.222	10.862
NM-2120.A_900	0.275[(2)]	14.463[(2)]
NM-2119_20	0.253	6.482
NM-2119_30	0.241	10.437
NM-2120.A_511	0.185	7.436
NM-2120.A_901	0.158	14.570

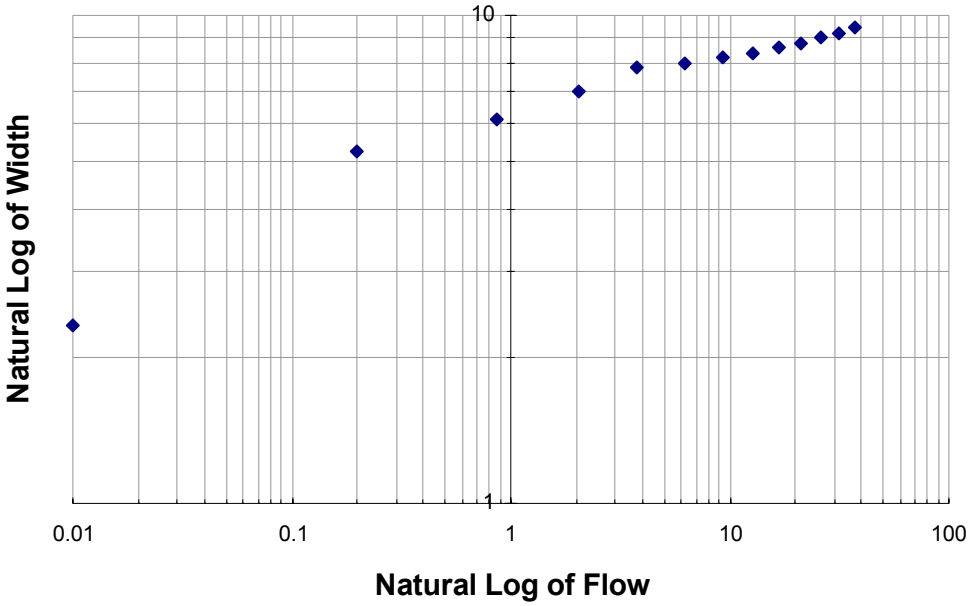
[(1)] A = e^constant from regression.
[(2)] Average of upstream and downstream measurements.

The following subsections present the detailed calculations for the Width's B-Term.

3.6.1 Width's B-Term for Assessment Unit NM-2120.A_827

Measurements were collected from upstream (below upper exclosure) and downstream (above mouth on Rio Costilla) locations within this assessment unit. The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.1 Wetted Width versus Flow for Assessment Unit NM-2120.A_827, Downstream



Comanche Creek above the mouth on Rio Costilla (downstream)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9690169
R Square	0.9389939
Adjusted R Square	0.9334479
Standard Error	0.0980035
Observations	13

Regression Equation
y = 0.1551x + 1.747
y = LN Width, x = LN Flow

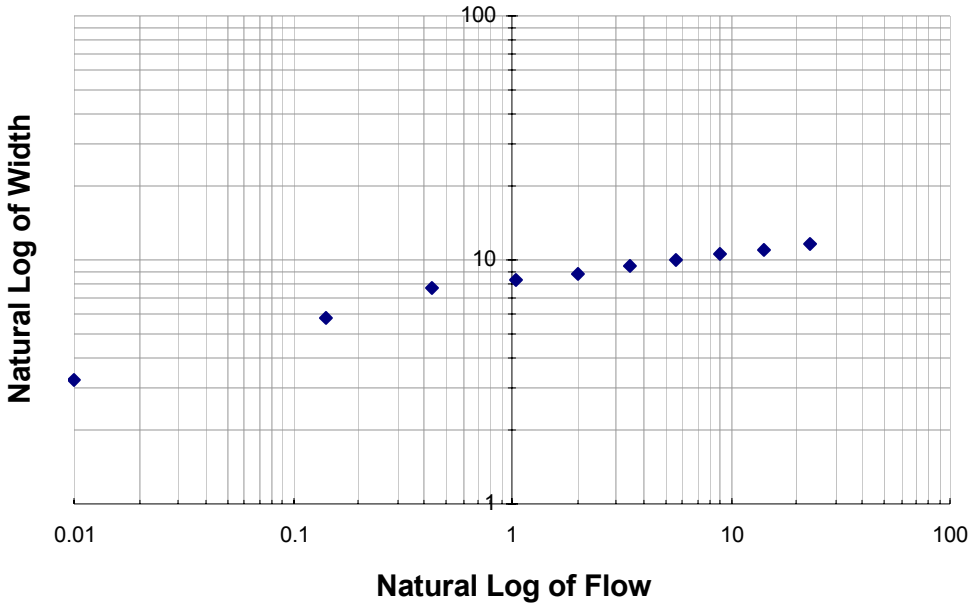
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.6261690	1.6261690	169.30988	5.0403E-08
Residual	11	0.1056516	0.0096046		
Total	12	1.7318206			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.7477121	0.0320431	54.542510	9.70113E-15	1.6771856	1.8182386	1.6771856	1.8182386
X Variable 1	**0.1550752**	0.0119179	13.011913	5.04034E-08	0.1288440	0.1813064	0.1288440	0.1813064

Width's B-Term is equal to the slope of the regression line, which is 0.155.

Figure E.2 Wetted Width versus Flow for Assessment Unit NM-2120.A_827, Upstream



Comanche Creek below the Upper Exclosure (upstream)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.97924148
R Square	0.95891387
Adjusted R Square	0.95377811
Standard Error	0.08305505
Observations	10

Regression Equation
y = 0.1596x + 2.0308
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.28797250	1.28797250	186.712940	7.9232E-07
Residual	8	0.05518514	0.00689814		
Total	9	1.34315764			

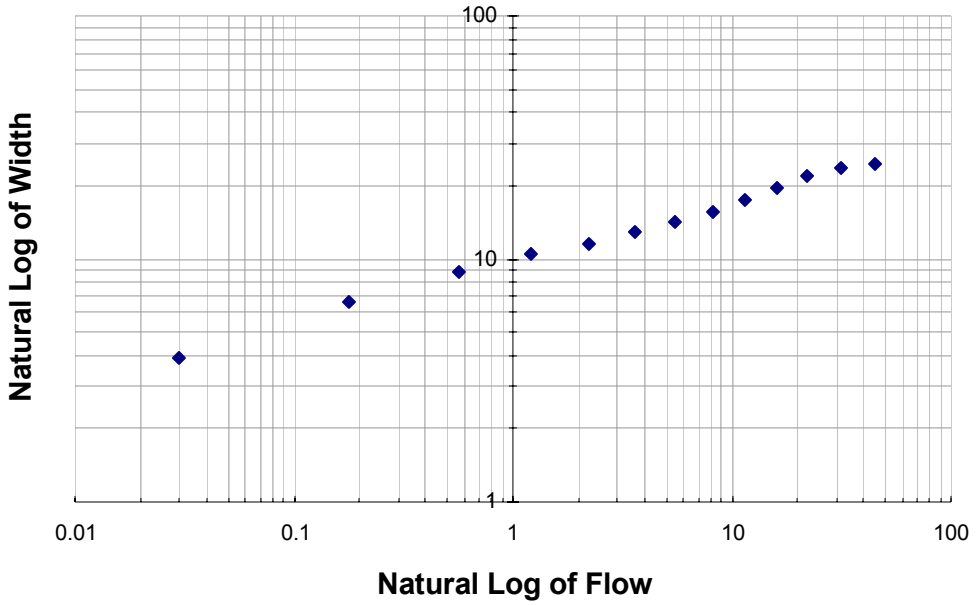
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.0308199	0.0267335	75.965182	1.0049E-12	1.9691721	2.0924676	1.9691721	2.0924676
X Variable 1	**0.1596353**	0.0116826	13.664294	7.9232E-07	0.1326950	0.1865756	0.1326950	0.1865756

Width's B-Term is equal to the slope of the regression line, which is 0.160.

3.6.2 Width's B-Term for Assessment Unit NM-2120.A_820

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.3 Wetted Width versus Flow for Assessment Unit NM-2120.A_820, Downstream



Costilla Creek above Costilla @ Hwy 196 bridge
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9953032
R Square	0.9906284
Adjusted R Square	0.9899590
Standard Error	0.0560299
Observations	16

Regression Equation
y = 0.2361x + 2.2731
y = LN Width, x = LN Flow

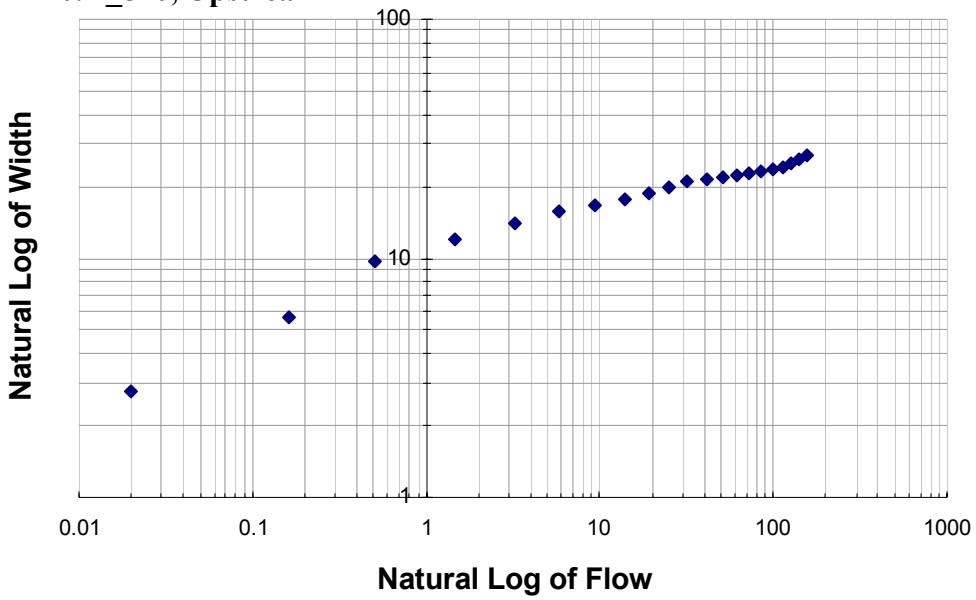
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.6458841	4.6458841	1479.8872	1.3353E-15
Residual	14	0.0439509	0.0031393		
Total	15	4.6898350			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.27306126	0.01803272	126.052010	8.5865E-23	2.23438488	2.3117376	2.23438488	2.3117376
X Variable 1	**0.23611555**	0.00613776	38.4693031	1.3353E-15	0.22295134	0.2492797	0.22295134	0.2492797

Width's B-Term is equal to the slope of the regression line, which is 0.236.

Figure E.4 Wetted Width versus Flow for Assessment Unit NM-2120.A_820, Upstream



Costilla Creek below Comanche Creek

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.97585927
R Square	0.95230131
Adjusted R Square	0.94979085
Standard Error	0.12473998
Observations	21

Regression Equation
y = 0.2235x + 2.2235
y = LN Width, x = LN Flow

ANOVA

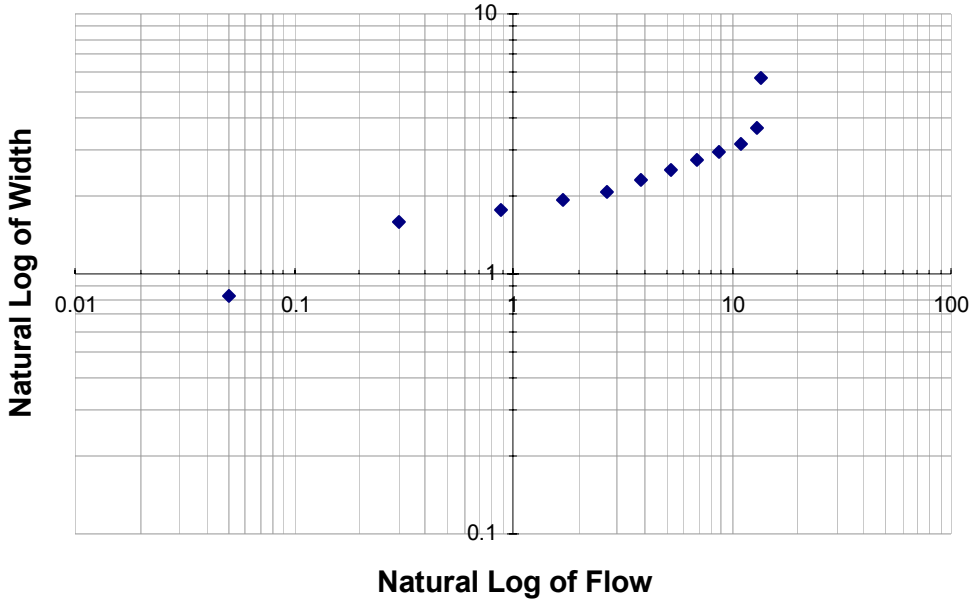
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.90245866	5.90245866	379.333826	5.1551E-14
Residual	19	0.29564121	0.01556006		
Total	20	6.19809988			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.22349578	0.04096512	54.2777765	2.6419E-22	2.13775477	2.30923680	2.13775477	2.30923680
X Variable 1	0.22346966	0.01147381	19.4764942	5.1551E-14	0.19945468	0.24748463	0.19945468	0.24748463

3.6.3 Width's B-Term for Assessment Unit NM-2120.A_512

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.5 Wetted Width versus Flow for Assessment Unit NM-2120.A_512, Upstream



Rio Fernando de Taos at Highway 64 Bridge

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93710378
R Square	0.87816350
Adjusted R Square	0.86597985
Standard Error	0.17492203
Observations	12

Regression Equation
y = 0.2622x + 0.5932
y = LN Width, x = LN Flow

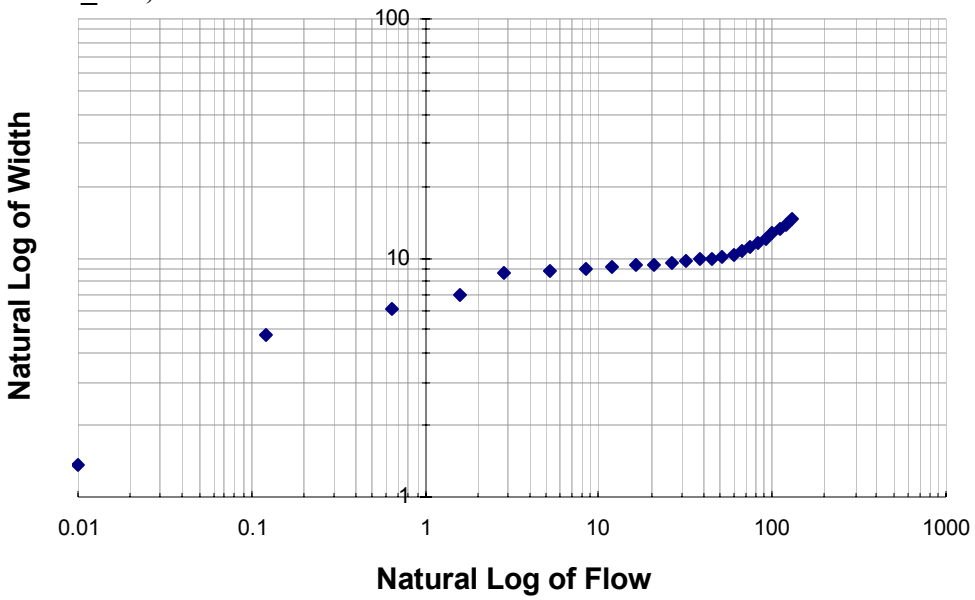
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2.20539821	2.2053982	72.077210	6.9709E-06
Residual	10	0.30597718	0.0305977		
Total	11	2.51137539			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.59321579	0.05898935	10.0563200	1.5097E-06	0.46177930	0.72465228	0.46177930	0.72465228
X Variable 1	**0.26218065**	0.03088173	8.48982984	6.9709E-06	0.19337185	0.33098945	0.19337185	0.33098945

Width's B-Term is equal to the slope of the regression line, which is 0.262.

Figure E.6 Wetted Width versus Flow for Assessment Unit NM-2120.A_512, Downstream



Rio Fernando de Taos at El Nogal Campground

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93904521
R Square	0.88180590
Adjusted R Square	0.87643345
Standard Error	0.16615627
Observations	24

Regression Equation
y = 0.1868x + 1.6933
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.53141044	4.53141044	164.134517	1.1201E-11
Residual	22	0.60737394	0.02760790		
Total	23	5.13878439			

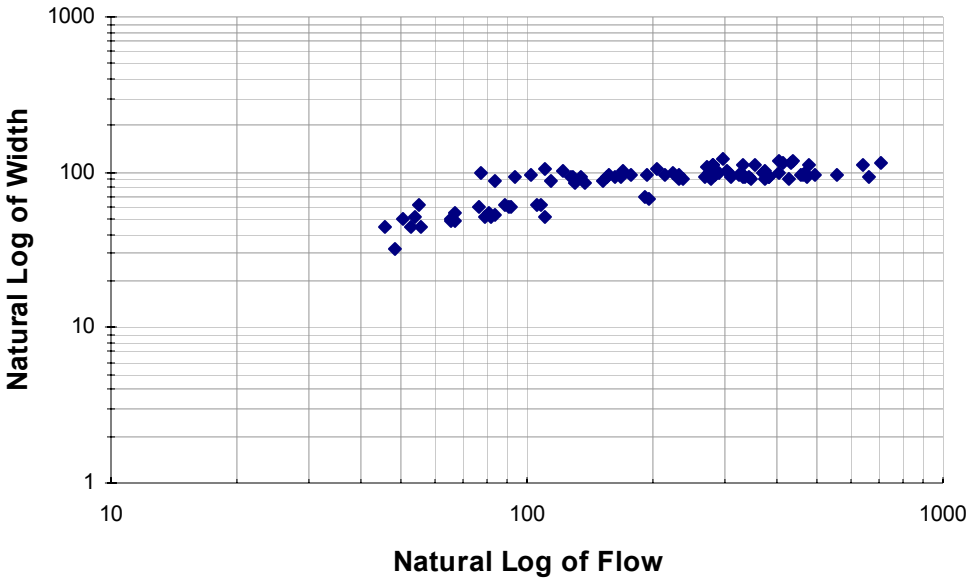
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.69330471	0.05205986	32.5261065	4.2570E-20	1.58533904	1.80127038	1.585339	1.80127
X Variable 1	**0.18675872**	0.01457742	12.8114994	1.1201E-11	0.15652695	0.21699049	0.156527	0.21699

Width's B-Term is equal to the slope of the regression line, which is 0.187.

3.6.4 Width's B-Term for Assessment Unit NM-2119_05

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.7 Wetted Width versus Flow for Assessment Unit NM-2119_05, Upstream



Rio Grande near Cerro, NM (upstream)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.79541615
R Square	0.63268686
Adjusted R Square	0.62865045
Standard Error	0.17734398
Observations	93

Regression Equation
y = 0.3174x + 2.7597
y = LN Width, x = LN Flow

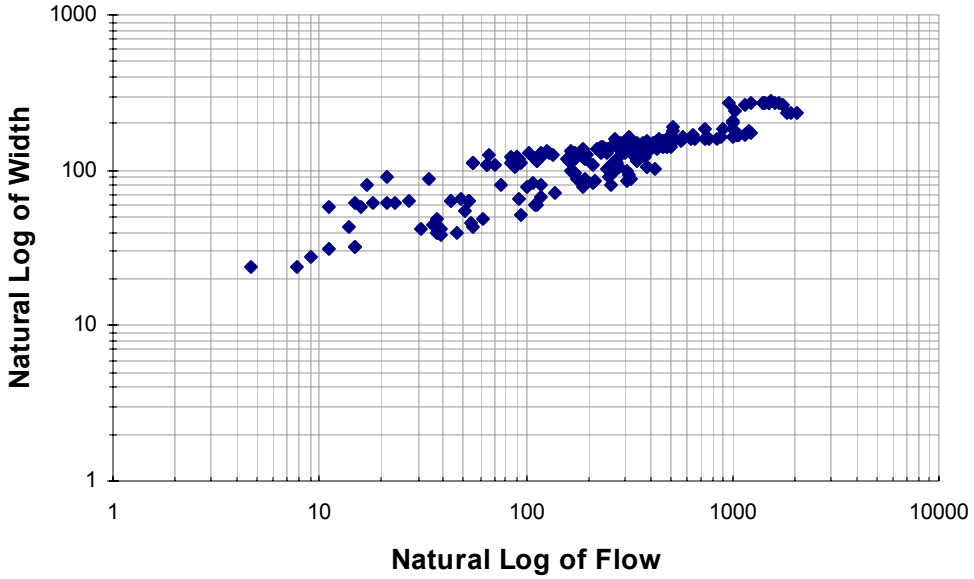
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.92977023	4.92977023	156.745020	1.6870E-21
Residual	91	2.86203090	0.03145088		
Total	92	7.79180114			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.75974246	0.13454647	20.5114443	6.8893E-36	2.49248240	3.02700253	2.492482	3.027003
X Variable 1	**0.31735631**	0.02534838	12.5197851	1.6870E-21	0.26700485	0.36770776	0.267005	0.367708

Width's B-Term is equal to the slope of the regression line, which is 0.317.

Figure E.8 Wetted Width versus Flow for Assessment Unit NM-2119_05, Downstream



Rio Grande at Lobotos (downstream)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.886801046
R Square	0.786416095
Adjusted R Square	0.785422682
Standard Error	0.233241416
Observations	217

Regression Equation
y = 0.355x + 2.8347
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	43.0659139	43.0659139	791.630158	5.1935E-74
Residual	215	11.6963349	0.05440155		
Total	216	54.7622489			

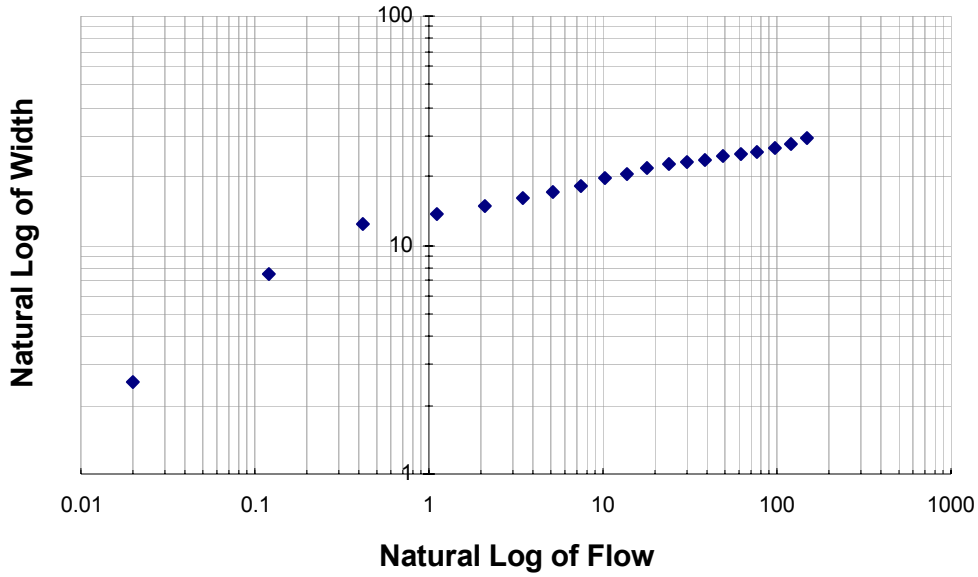
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.8346909	0.06933189	40.8858108	2.299E-103	2.69803378	2.97134801	2.69803	2.971348
X Variable 1	**0.35500156**	0.01261737	28.1359229	5.1935E-74	0.33013199	0.37987113	0.33013	0.379871

Width's B-Term is equal to the slope of the regression line, which is 0.355.

3.6.5 Width's B-Term for Assessment Unit NM-2120.A_600

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.9 Wetted Width versus Flow for Assessment Unit NM-2120.A_600



Rio Hondo at Valdez Gage

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.946864978
R Square	0.896553286
Adjusted R Square	0.890806246
Standard Error	0.186298077
Observations	20

Regression Equation
y = 0.222x + 2.3853
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.41437903	5.41437903	156.002627	2.6421E-10
Residual	18	0.62472552	0.03470697		
Total	19	6.03910455			

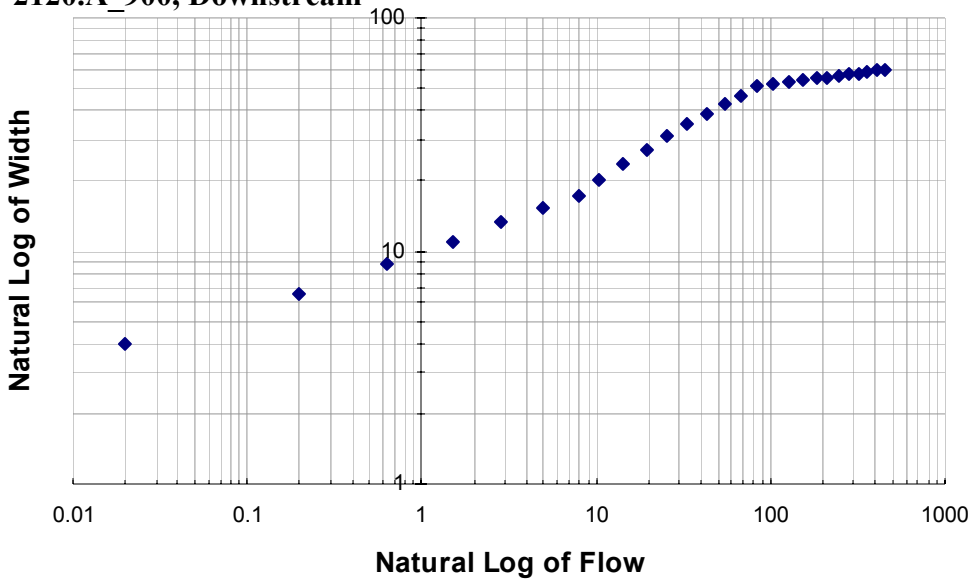
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.38525757	0.05693060	41.8976354	2.1302E-19	2.26565072	2.50486441	2.265651	2.504864
X Variable 1	**0.22202704**	0.01777624	12.4901011	2.6421E-10	0.18468051	0.25937356	0.184681	0.259374

Width's B-Term is equal to the slope of the regression line, which is 0.222.

3.6.6 Width's B Term for Assessment Unit NM-2120.A_900

Measurements were collected from upstream (at USFS boundary) and downstream (at USGS gage) locations within this assessment unit. The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.10 Wetted Width versus Flow at Assessment Unit NM-2120.A_900, Downstream



Rio de los Pinos at USGS Gage

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.988534462
R Square	0.977200382
Adjusted R Square	0.976288398
Standard Error	0.119746332
Observations	27

Regression Equation
y = 0.3047x + 2.3868
y = LN Width, x = LN Flow

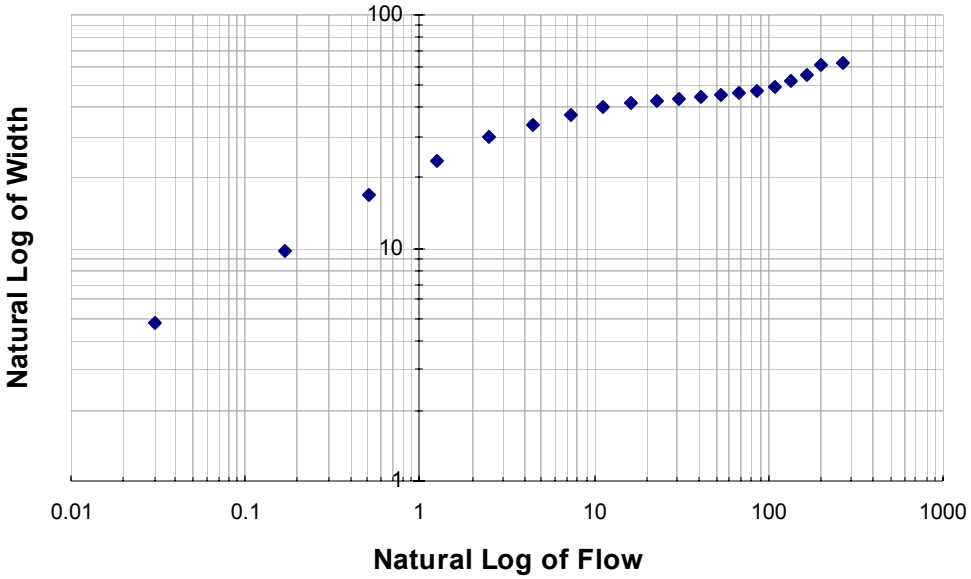
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	15.3645736	15.3645736	1071.50961	4.7572E-22
Residual	25	0.35847960	0.01433918		
Total	26	15.7230532			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.38679706	0.03871642	61.6481794	7.7731E-29	2.30705915	2.46653497	2.307059	2.466535
X Variable 1	**0.30467286**	0.00930755	32.7339214	4.7572E-22	0.28550359	0.32384212	0.285504	0.323842

Width's B-Term is equal to the slope of the regression line, which is 0.305.

Figure E.11 Wetted Width versus Flow at Assessment Unit NM-2120.A_900, Upstream



Rio de los Pinos above NM Game and Fish Area @ Forest Service bridge

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.954013288
R Square	0.910141354
Adjusted R Square	0.905149207
Standard Error	0.198899686
Observations	20

Regression Equation
y = 0.2456x + 2.893
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	7.21256397	7.21256397	182.314614	7.3899E-11
Residual	18	0.71209953	0.03956108		
Total	19	7.92466350			

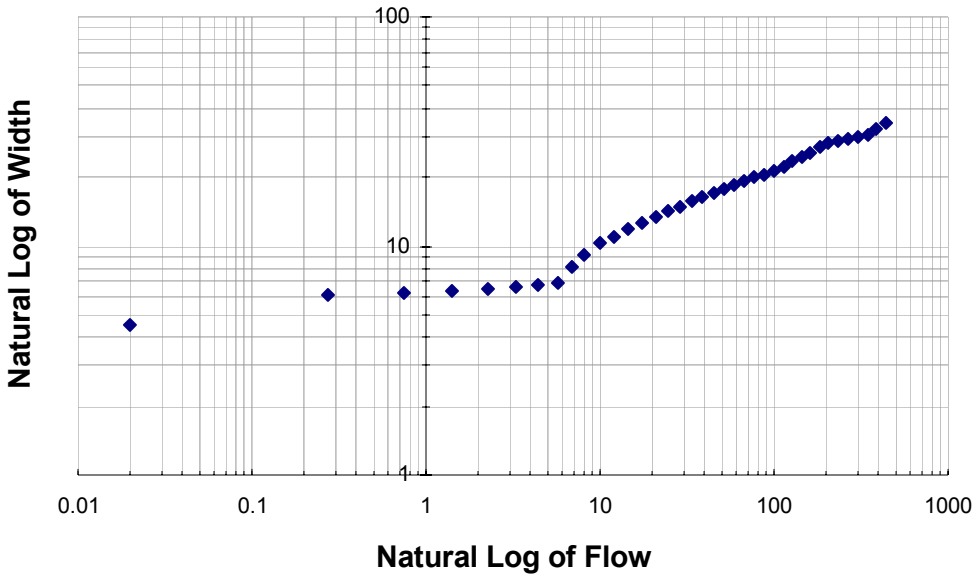
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.89303756	0.06515871	44.3998530	7.5702E-20	2.75614407	3.02993106	2.756144	3.029931
X Variable 1	**0.24558921**	0.01818857	13.5023929	7.3899E-11	0.20737641	0.28380201	0.207376	0.283802

Width's B-Term is equal to the slope of the regression line, which is 0.246.

3.6.7 Width's B-Term for Assessment Unit NM-2119_20

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.12 Wetted Width versus Flow for Assessment Unit NM-2119_20



Rio Pueblo de Taos at Rio Grande

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.955184036
R Square	0.912376542
Adjusted R Square	0.909942557
Standard Error	0.174517968
Observations	38

Regression Equation
y = 0.2527x + 1.8691
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	11.41659307	11.41659307	374.8488866	1.27868E-20
Residual	36	1.096434764	0.030456521		
Total	37	12.51302783			

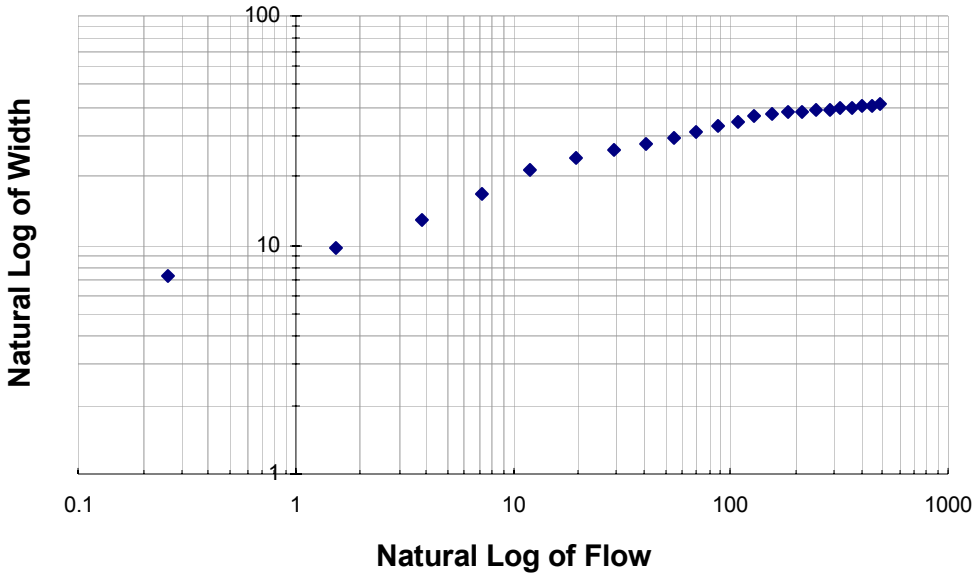
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.86906706	0.05157413	36.2403953	6.2724E-30	1.76447001	1.97366412	1.76447	1.973664
X Variable 1	**0.25273289**	0.01305370	19.3610146	1.2786E-20	0.22625879	0.27920698	0.226259	0.279207

Width's B-Term is equal to the slope of the regression line, which is 0.253.

3.6.8 Width's B-Term for Assessment Unit NM-2119_30

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.13 Wetted Width versus Flow for Assessment Unit NM-2119_30



Rio Pueblo de Taos at Los Cordovas Gage

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.983093535
R Square	0.966472899
Adjusted R Square	0.964876371
Standard Error	0.091507737
Observations	23

Regression Equation
y = 0.2414x + 2.3454
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.06907368	5.06907368	605.358960	5.7421E-17
Residual	21	0.17584698	0.00837366		
Total	22	5.24492067			

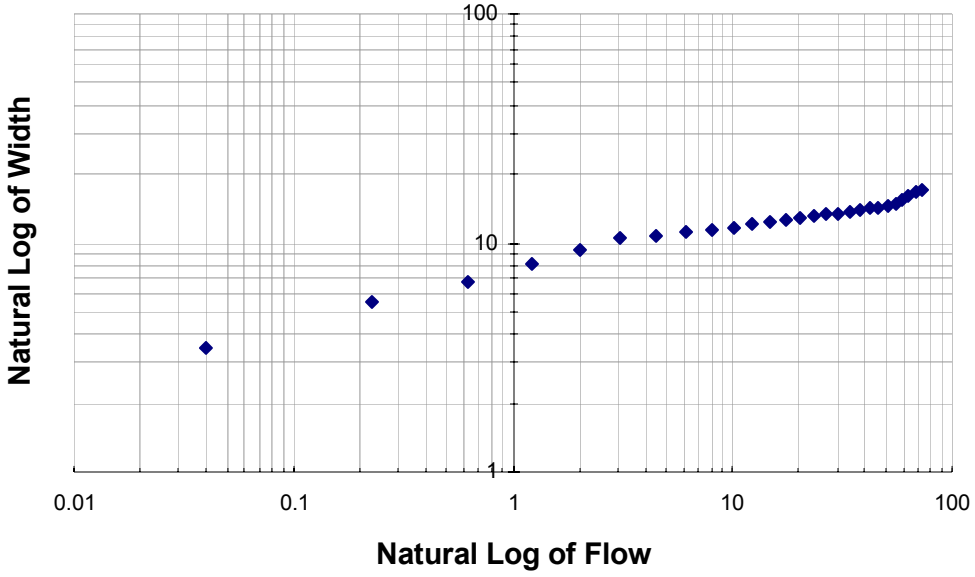
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.34535658	0.0443613	52.8693545	7.9256E-24	2.25310206	2.43761110	2.253102	2.437611
X Variable 1	**0.24135089**	0.0098094	24.6040435	5.7421E-17	0.22095113	0.26175066	0.220951	0.261751

Width's B-Term is equal to the slope of the regression line, which is 0.241.

3.6.9 Width's B-Term for Assessment Unit NM-2120.A_511

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.14 Wetted Width versus Flow for Assessment Unit NM-2120.A_511



Rio Pueblo de Taos at Gage at Pueblo

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.985936204
R Square	0.972070199
Adjusted R Square	0.970953007
Standard Error	0.060394655
Observations	27

Regression Equation
y = 0.1849x + 2.0063
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3.17370677	3.17370677	870.101254	6.0279E-21
Residual	25	0.09118785	0.00364751		
Total	26	3.26489463			

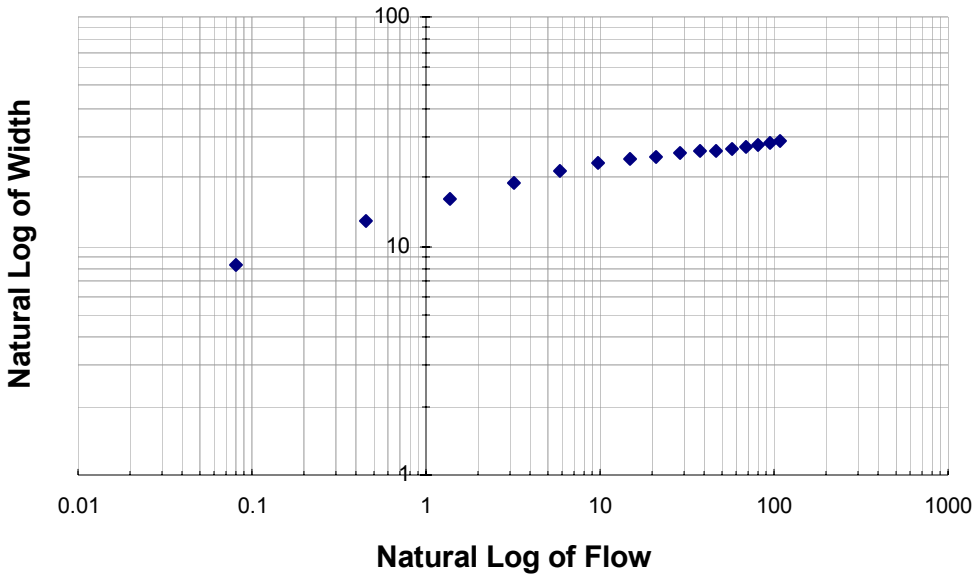
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.00627531	0.01902772	105.439592	1.2191E-34	1.96708701	2.04546361	1.967087	2.045464
X Variable 1	**0.18485494**	0.00626680	29.4974787	6.0279E-21	0.17194822	0.19776165	0.171948	0.197762

Width's B-Term is equal to the slope of the regression line, which is 0.185.

3.6.10 Width's B-Term for Assessment Unit NM-2120.A_901

The regression of natural log of width and natural log of flow for each location is as follows:

Figure E.15 Wetted Width versus Flow for Assessment Unit NM-2120.A_901



Rio San Antonio at Midpoint between Headwaters and Colorado Border

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.97768250
R Square	0.95586307
Adjusted R Square	0.95271044
Standard Error	0.07351574
Observations	16

Regression Equation
y = 0.1583x + 2.679
y = LN Width, x = LN Flow

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.63863560	1.63863560	303.194744	6.9710E-11
Residual	14	0.07566390	0.00540456		
Total	15	1.71429951			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.67898572	0.02952883	90.7243878	8.5318E-21	2.61565261	2.74231884	2.615653	2.742319
X Variable 1	**0.15828033**	0.00909004	17.4124881	6.9710E-11	0.13878410	0.17777656	0.138784	0.177777

Width's B-Term is equal to the slope of the regression line, which is 0.158.

E3.7 Manning's n or Travel Time

Site-specific values generated from WINXSPRO were used for Manning's n. The following table summarizes the input values:

Table E.14 Manning's n Values

Assessment Unit	Manning's n
NM-2120.A_827	0.031
NM-2120.A_820	0.037
NM-2120.A_512	0.036
NM-2119_05	0.035
NM-2120.A_600	0.060
NM-2120.A_900	0.040
NM-2119_20	0.062
NM-2119_30	0.018
NM-2120.A_511	0.078
NM-2120.A_901	0.039

E4.0 METEOROLOGICAL PARAMETERS

E4.1 Air Temperature

This parameter is the mean daily air temperature for the assessment unit (or average daily temperature at the mean elevation of the assessment unit). Air temperature will usually be the single most important factor in determining mean daily water temperature. Air temperature was measured directly (in the shade) using air thermographs and adjusted to what the temperature would be at the mean elevation of the assessment unit. The following table summarizes mean daily air temperatures for each assessment unit requiring a temperature Total Maximum Daily Load (TMDL):

Table E.15 Mean Daily Air Temperature

Assessment Unit	Elevation at Air Thermograph Location (meters)	Measured Mean Daily Air Temperature (°C)	Mean Elevation for Assessment Unit (meters)	Adjusted Mean Daily Air Temperature (°C)	Adjusted Mean Daily Air Temperature (°F)
NM-2120.A_827	2,811	15.683	2,771	15.942	60.695
NM-2120.A_820	2,120[(a)]	21.806[(a)]	2,578	18.802	65.843
NM-2120.A_512	1,745[(b)]	21.066[(b)]	1,979	19.532	67.158
NM-2119_05	2,161[(c)]	23.000	2,149	23.079	73.542
NM-2120.A_600	1,967	23.380	2,123	22.358	72.244
NM-2120.A_900	2,560[(d)]	17.900[(d)]	2,590	17.703	63.865
NM-2119_20	1,854	25.954	1,946	25.352	77.634
NM-2119_30	1,854	25.954	2,042	24.721	76.498
NM-2120.A_511	1,745[(b)]	21.066[(b)]	2,071	18.927	66.069
NM-2120.A_901	2,560[(d)]	17.900[(d)]	2,675	17.148	62.867

Notes:
[(a)] Mean daily temperature for **July 31, 2002** from New Mexico State University Climate Network (Costilla Station at 2,120 meters elevation).
[(b)] Mean daily temperature for **July 31, 2000** from New Mexico State University Climate Network (Alcalde Station at 1,745 meters elevation).
[(c)] Mean daily temperature for **July 5, 2003** from New Mexico State University Climate Network (Taos METAR Station at 2,161 meters elevation
[(d)] Mean daily temperature for **July 3, 2003** from New Mexico State University Climate Network (Chamita Station at 2,560 meters elevation).
ºF = Degrees Farenheit
ºC = Degrees Celcius

For the Rio de los Pinos, the adiabatic lapse rate was used to correct for elevational differences from the met station:

$$T_a = T_o + C_t \times (Z - Z_o)$$

where,

T_a = air temperature at elevation E (°C)

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

E4.2 Maximum Air Temperature

Unlike the other variables, the maximum daily air temperature overrides only if the check box is checked. If the box is not checked, the SSTEMP Model estimates the maximum daily air temperature from a set of empirical coefficients (Theurer et al., 1984 as cited in Bartholow 2002) and will print the result in the grayed data entry box. A value cannot be entered unless the box is checked.

E4.3 Relative Humidity

Relative humidity data were obtained from the Western Regional Climate Center web site (www.wrcc.dri.edu) or the New Mexico State University Climate Network (http://weather.nmsu.edu/data/data.htm). The data were corrected for elevation and temperature using the following equation:

$$R_h = R_o \times \left(1.0640^{(To-Ta)}\right) \times \left(\frac{T_a + 273.16}{T_o + 273.16}\right)$$

where,

R_h = relative humidity for temperature T_a (decimal)
R_o = relative humidity at station (decimal)
T_a = air temperature at segment (°C)
T_o = air temperature at station (°C)

The following table presents the adjusted mean daily relative humidity for each assessment unit:

Table E.16 Mean Daily Relative Humidity

Assessment Unit	Ref.	Mean Daily Air Temp. at Weather Station (°C)	Mean Daily Air Temperature at AU (°C)	Mean Daily Relative Humidity at Weather Station (percent)	Mean Daily Relative Humidity for AU (percent)
NM-2120.A_827	(a)	20.889	15.942	43.408	58.007
NM-2120.A_820	(a)	21.806	18.802	58.487	69.752
NM-2120.A_512	(b)	21.066	19.532	59.177	64.744
NM-2119_05	(c)	23.000	23.079	21.998	21.897
NM-2120.A_600	(c)	23.333	22.358	30.604	32.407
NM-2120.A_900	(b)	24.741	17.703	26.823	40.527

Assessment Unit	Ref.	Mean Daily Air Temp. at Weather Station (°C)	Mean Daily Air Temperature at AU (°C)	Mean Daily Relative Humidity at Weather Station (percent)	Mean Daily Relative Humidity for AU (percent)
NM-2119_20	(c)	24.493	25.352	24.002	22.822
NM-2119_30	(c)	24.493	24.721	24.002	23.682
NM-2120.A_511	(b)	21.066	18.927	59.177	67.080
NM-2120.A_901	(b)	24.741	17.148	26.823	41.866

Notes:
Ref. = References for Weather Station Data are as follows:
(a) New Mexico State University Climate Network (Costilla Station, Elevation 2,120 meters; Latitude 36°59'N, Longitude 105°33'W)
(b) New Mexico State University Climate Network (Alcalde Station, Elevation 1,745 meters; Latitude 36°05'N, Longitude 106°03'W)
(c) New Mexico State University Climate Network (Taos Station, Elevation 2,161 meters; Latitude 36°27'N, Longitude 105°40'W)
AU = Assessment Unit
ºC = Degrees Celcius

E4.4 Wind Speed

Average daily wind speed data were obtained from the New Mexico State University Climate Network (http://weather.nmsu.edu/data/data.htm). The following table presents the mean daily wind speed for each assessment unit:

Table E.17 Mean Daily Wind Speed

Assessment Unit	Ref.	Mean Daily Wind Speed (miles per hour)
NM-2120.A_827	(a)	5.226
NM-2120.A_820	(b)	3.508
NM-2120.A_512	(b)	1.846
NM-2119_05	(b)	1.831
NM-2120.A_600	(a)	5.514
NM-2120.A_900	(b)	1.734
NM-2119_20	(a)	8.119
NM-2119_30	(a)	8.119
NM-2120.A_511	(b)	1.846
NM-2120.A_901	(b)	1.734

Notes:
Ref. = References for Weather Station Data are as follows:
(a) New Mexico State University Climate Network (Taos Station, Elevation 2,161 meters; Latitude 36°27'N, Longitude 105°40'W)
(b) New Mexico State University Climate Network (Alcalde Station, Elevation 1,745 meters; Latitude 36°05'N, Longitude 106°03'W)

E4.5 Ground Temperature

Mean annual air temperature for 2003 was used in the absence of measured data. The following table presents the mean annual air temperature for each assessment unit:

Table E.18 Mean Annual Air Temperature as an Estimate for Ground Temperature

Assessment Unit	Ref.	Mean Annual Air Temperature for 2003 (^{o}C)	Mean Annual Air Temperature for 2003 (^{o}F)
NM-2120.A_827	(a)	8.157	46.683
NM-2120.A_820	(a)	7.508[(1)]	45.514[(1)]
NM-2120.A_512	(b)	11.432 [(2)]	52.577 [(2)]
NM-2119_05	(c)	10.543	50.540
NM-2120.A_600	(c)	10.543	50.540
NM-2120.A_900	(d)	5.216	41.389
NM-2119_20	(c)	10.543	50.540
NM-2119_30	(c)	10.543	50.540
NM-2120.A_511	(b)	11.432[(2)]	52.577[(2)]
NM-2120.A_901	(d)	5.216	41.389

Notes:
Ref. = References for Weather Station Data are as follows:

(a) New Mexico State University Climate Network (Costilla Station, Elevation 2,120 meters; Latitude 36^{o}59'N, Longitude 105^{o}33'W)

(b) New Mexico State University Climate Network (Alcalde Station, Elevation 1,745 meters; Latitude 36^{o}05'N, Longitude 106^{o}03'W)

(c) New Mexico State University Climate Network (Taos Station, Elevation 2,161 meters; Latitude 36^{o}27'N, Longitude 105^{o}40'W)

(d) New Mexico State University Climate Network (Chamita Station, Elevation 2,560 meters; Latitude 36^{o}57'N, Longitude 106^{o}39'W)

[(1)] Mean annual temperature for 2002.
[(2)] Mean annual temperature for 2000
ºF = Degrees Farenheit
ºC = Degrees Celcius

E4.6 Thermal Gradient

The default value of 1.65 was used in the absence of measured data.

E4.7 Possible Sun

Percent possible sun for Albuquerque is found at the Western Regional Climate Center web site http://www.wrcc.dri.edu/cgi-bin/clilcd.pl?nm23050. The percent possible sun is 76 percent for both July and August.

E4.8 Dust Coefficient

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. Solar radiation data are available from the New Mexico State University Climate Network (see Section 4.10).

E4.9 Ground Reflectivity

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. Solar radiation data are available from the New Mexico State University Climate Network (see Section 4.10).

E4.10 Solar Radiation

Because solar radiation data were obtained from an external source of ground level radiation, it was assumed that about 90% of the ground-level solar radiation actually enters the water. Thus, the recorded solar measurements were multiplied by 0.90 to get the number to be entered into the SSTEMP Model. The following table presents the measured solar radiation at weather stations representing each assessment unit:

Table E.19 Mean Daily Solar Radiation

Assessment Unit	Ref.	Mean Solar Radiation (L/day)	Mean Solar Radiation x 0.90 (L/day)
NM-2120.A_827	(a)	611.2	550.1
NM-2120.A_820	(b)	600.8	540.7
NM-2120.A_512	(a)	651.9	586.7
NM-2119_05	(c)	736.0	662.4
NM-2120.A_600	(a)	683.6	615.2
NM-2120.A_900	(b)	752.0	676.8
NM-2119_20	(a)	737.0	663.3
NM-2119_30	(a)	737.0	663.3
NM-2120.A_511	(a)	651.9	586.7
NM-2120.A_901	(b)	752.0	676.8

Ref. = References for Weather Station Data are as follows:

(a) New Mexico State University Climate Network (Alcalde Station, Elevation 1,745 meters; Latitude 36°05'N, Longitude 106°03'W)

(b) New Mexico State University Climate Network (Costilla Station, Elevation 2,120 meters; Latitude 36°59'N, Longitude 105°33'W)

(c) New Mexico State University Climate Network (Taos Station, Elevation 2,161 meters; Latitude 36°27'N, Longitude 105°40'W)

E5.0 SHADE

Percent shade was estimated for the assessment unit using densiometer readings taken upstream and downstream. The measurements were averaged along with estimates made at locations between the densiometer readings using aerial photographs downloaded from TerraServer, Version 5.0 (online at http://www.terraserver.microsoft.com/). This parameter refers to how much of the segment is shaded by vegetation, cliffs, etc. The following table summarizes percent shade for each assessment unit:

Table E.20 Percent Shade

Assessment Unit	Percent Shade
NM-2120.A_827	4.5%
NM-2120.A_820	37%
NM-2120.A_512	50%
NM-2119_05	50%
NM-2120.A_600	43%
NM-2120.A_900	20%
NM-2119_20	16%
NM-2119_30	5%
NM-2120.A_511	7%
NM-2120.A_901	16%

E6.0 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.

U.S. Department of Agriculture (USDA). 1998. WinXSPRO A Channel Cross Section Analyzer. West Consultants Inc. San Diego, CA.

U.S. Geological Survey (USGS). 2002a. Input and Output to a Watershed Data Management File (Version 4.1). Hydrologic Analysis Software Support Program. Available on the internet at http://water.usgs.gov/software/surface_water.html .

U.S. Geological Survey (USGS). 2002b. Surface-Water Statistics (Version 4.1). Hydrologic Analysis Software Support Program. Available on the internet at http://water.usgs.gov/software/surface_water.html .

Theurer, Fred D., Kenneth A. Voos, and William J. Miller. 1984. Instream Water Temperature Model. Instream Flow Inf. Pap. 16 Coop. Instream Flow and Aquatic System Group. U.S. Fish & Wildlife Service, Fort Collins, CO.

Thomas, Blakemore E., H.W. Hjalmarson, and S.D. Waltemeyer. 1997. Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States. USGS Water-Supply Paper 2433.

Viger, R.J., S.L. Markstrom, G.H. Leavesley and D.W. Stewart. 2000. The GIS Weasel: An Interface for the Development of Spatial Parameters for Physical Process Modeling. Lakewood, CO. Available on the internet at http://wwwbrr.cr.usgs.gov/weasel/.

Waltemeyer, Scott D. 2002. Analysis of the Magnitude and Frequency of the 4-Day Annual Low Flow and Regression Equations for Estimating the 4-Day, 3-Year Low-Flow Frequency at Ungaged Sites on Unregulated Streams in New Mexico. USGS Water-Resources Investigations Report 01-4271. Albuquerque, New Mexico.