PECOS WILD AND SCENIC RIVER INSTREAM FLOW REPORT

by

Esteban Muldavin, Bruce Sims and Lee Johnson

New Mexico Natural Heritage Program
University of New Mexico
Albuquerque

and

Santa Fe National Forest
Santa Fe, New Mexico

December 1993

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INTRODUCTION

In 1968, the United States Congress passed the Wild and Scenic Rivers Act as a means of protecting selected remaining free-flowing rivers of the U.S., preserving them and their immediate environments for the use and enjoyment of present and future generations (Public Law 90-542, October 2, 1968, as amended through Public Law 96-580, December 23, 1980). On June 6, 1990, Congress amended the Wild and Scenic Rivers act to add a 20.5 mile section of the Pecos River in New Mexico as a component of the National Wild and Scenic Rivers System. The Bill designated Segment 1, a 13.5 mile reach from the headwaters of the Pecos River in the Pecos Wilderness to the Wilderness Boundary, as a wild river. It combined Segment 2 (a four-mile reach from the Wilderness Boundary to the confluence of the Pecos River and Rio Mora) and Segment 3 (a three-mile portion from the river's confluence to Terrero), and designated these seven miles as a recreational river (Public Law 101-306, Appendix B).

To ensure the free-flowing character of the river, the USDA Forest Service is conducting this instream flow study to make flow recommendations for riparian vegetation community maintenance and fisheries habitat, with an emphasis on the recreational segment of the river, the seven miles from the Wilderness Boundary to Terrero. Recommended flow volumes will be submitted to the State of New Mexico for their approval as non-consumptive water rights.

SETTING

Landscape

The study area is located in the Santa Fe National Forest of northern New Mexico, and includes the upper reaches of the Pecos River above Terrero (Figure 1). There are three major tributary watersheds above Terrero that contribute flow to the main stem: Mora River, Panchuela Creek and Jacks Creek (Figure 2). The total watershed area is approximately 260 square miles. Elevation ranges in the watershed from 7,700 ft near Terrero to over 13,000 ft at Truchas Peak. Within the watershed, the

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[1] E. Muldavin is the ecologist for the New Mexico Natural Heritage Program, University of New Mexico. B. Sims is the Forest Hydrologist and L. Johnson is the Forest Fishery Biologist of the Santa Fe National Forest.

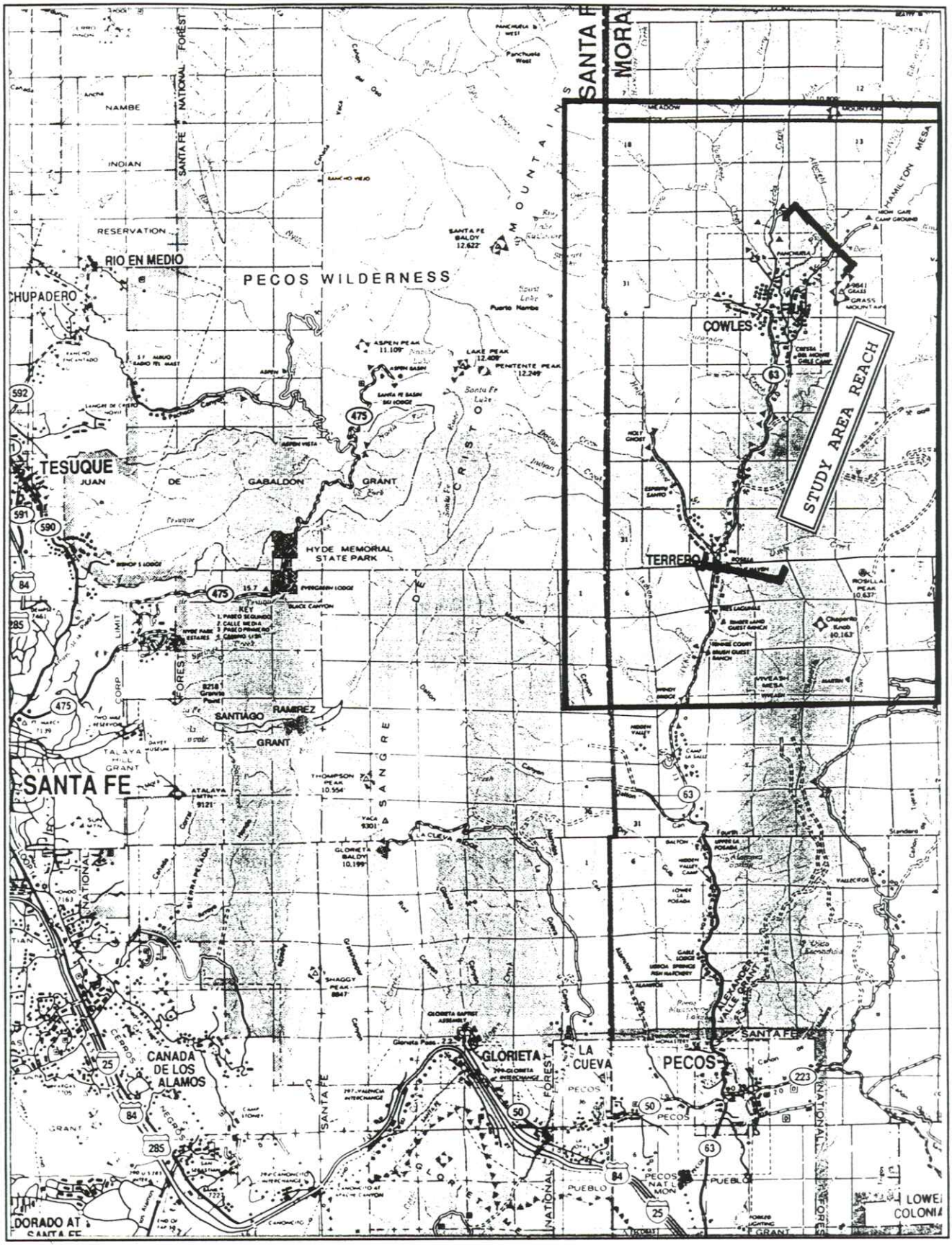


Figure 1. General location of the Pecos Wild and Scenic River reach under consideration.

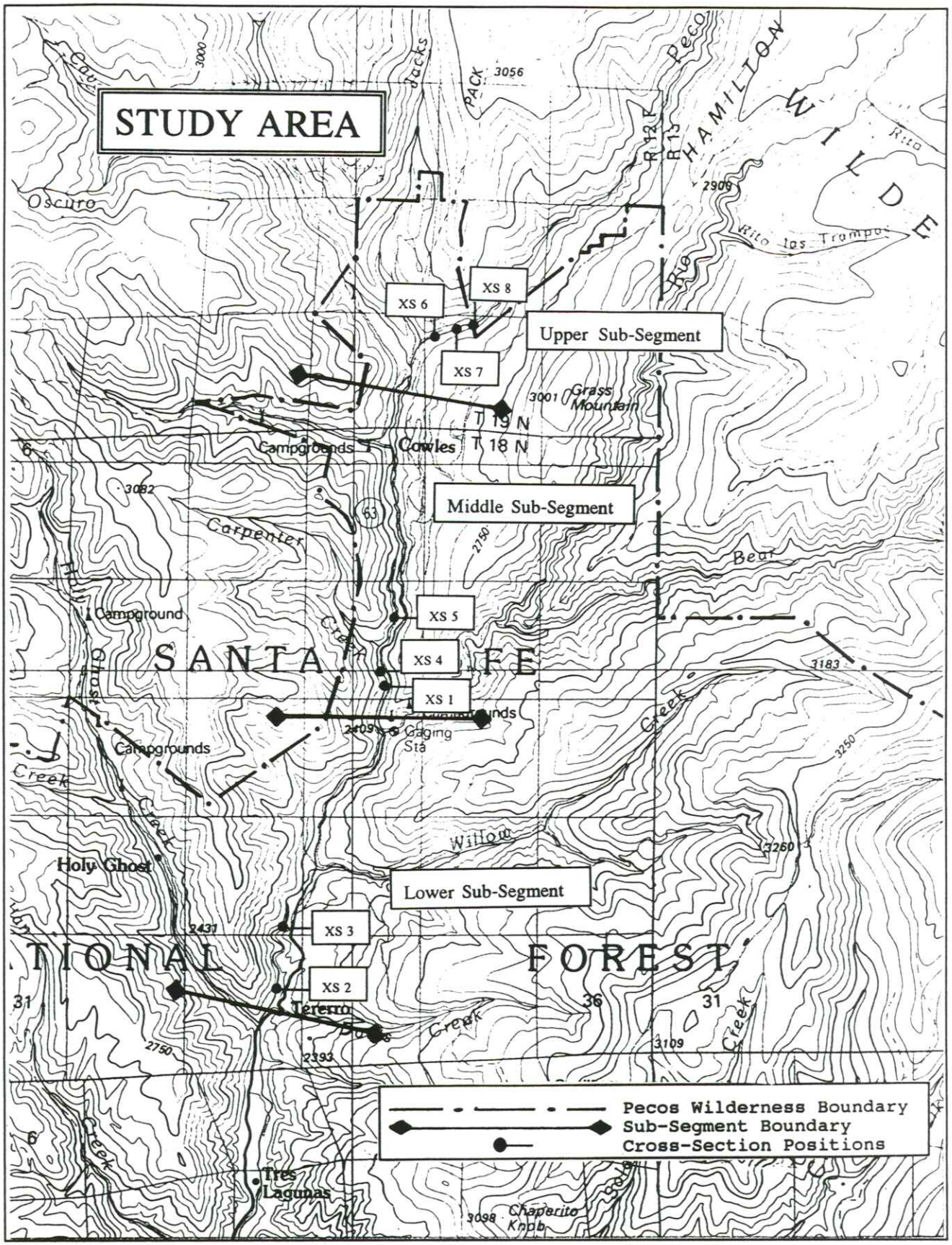


Figure 2. Map of the Wild and Scenic River Recreation Segment of the Pecos River delineating the Upper, Middle and Lower Sub-segments, along with transect locations.

mainstem of the Pecos flows from alpine grasslands down through old growth sub-alpine forest of Engelmann spruce and subalpine fir, to mixed coniferous forests of Douglas-fir,white fir and ponderosa pine. Blue spruces and alder grow adjacent to the channels grow, and at lower elevations, narrowleaf cottonwoods and willows become more prevalent.

Climate

Average annual temperatures range from 12 degrees C at lower elevation to -2 degrees C at higher elevations. Winters are very cold and summers are mild. Average annual precipitation ranges from 32 cm at lower elevations to 88 cm at upper elevations. Approximately 50% of the precipitation comes in the form of mid and late summer rainfall, with the remainder coming as winter snow (70-200 cm). The average number of frost-free days ranges from 165 at low elevations to less than 30 at the highest points in the watershed (Miller et al. 1993). Approximately 120 frost-free days occur within the seven mile study reach.

Geology

The river runs through geologically complex terrain composed primarily of Mesozoic sedimentary limestones and sands, underlain by Cambrian and Precambrian igneous rocks. Metamorphic substrates occur on occasion, but volcanics are absent (Moench, Grambling & Robertson 1988). The overall landscape is one of deep and narrow mountain valleys interspersed among high, rugged mountains.

Hydrology and Watershed Conditions

General Channel Morphology

The Pecos River channel morphology can be characterized by two general stream types. In one type, the river is confined in narrow, steep canyons where the river morphology is strongly controlled by the underlying bedrock (Figure 3). In these portions, the river tends to be narrow and straight, with a relatively steep gradient (1-2%), and the banks are armored by large stones and boulders. There are long runs with occasional deep pools, but riffles are uncommon. Depositional floodplains are very narrow. Obligate riparian vegetation develops in among the boulders and cobbles along the channel (Figure 4). This stream morphology generally falls within the Stream Type B1 of the Rosgen (1992) stream classification and will be referred to as Type B.

In contrast, a second stream type develops where the river is only moderately confined and the gradient lower ($<1.0\%$). Sinuosity is increased, and limited mid and side channel bars develop within the active floodplain (Figure 5). These depositional landforms are commonly stabilized by debris and obligate riparian vegetation (Figure 6). Reaches with long riffles are common, while pools are less common and runs are shorter. Where present, pools are often shallow and short in length.

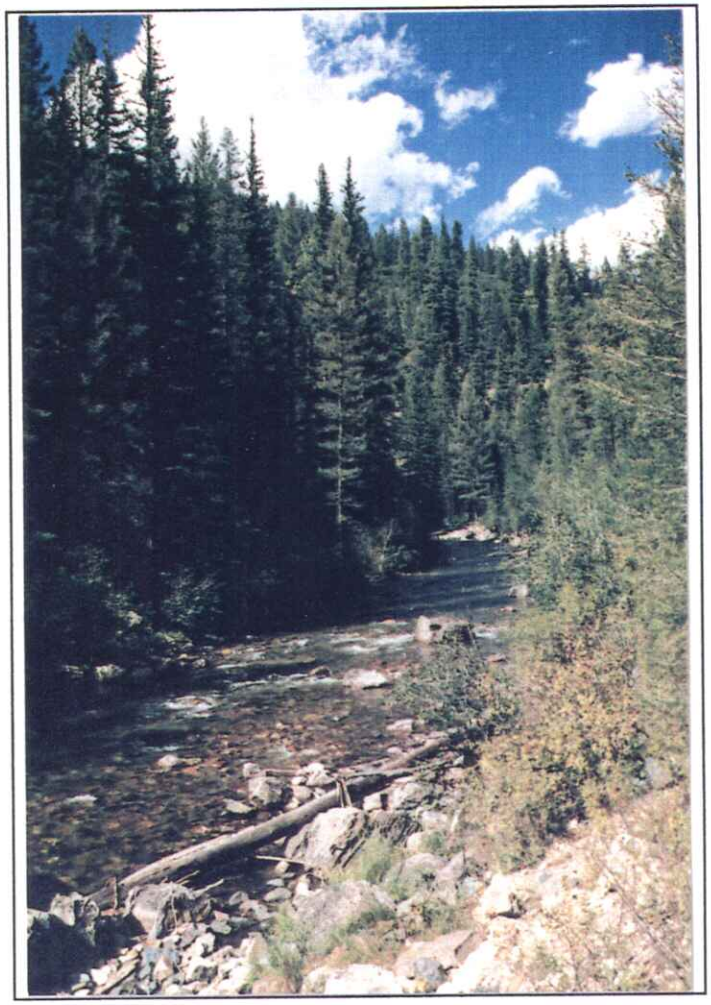


Figure 3. A confined reach of the Pecos River representing Type B channel morphology.

Figure 4. An armored cobble and stone bank typical of Type B channel morphology.

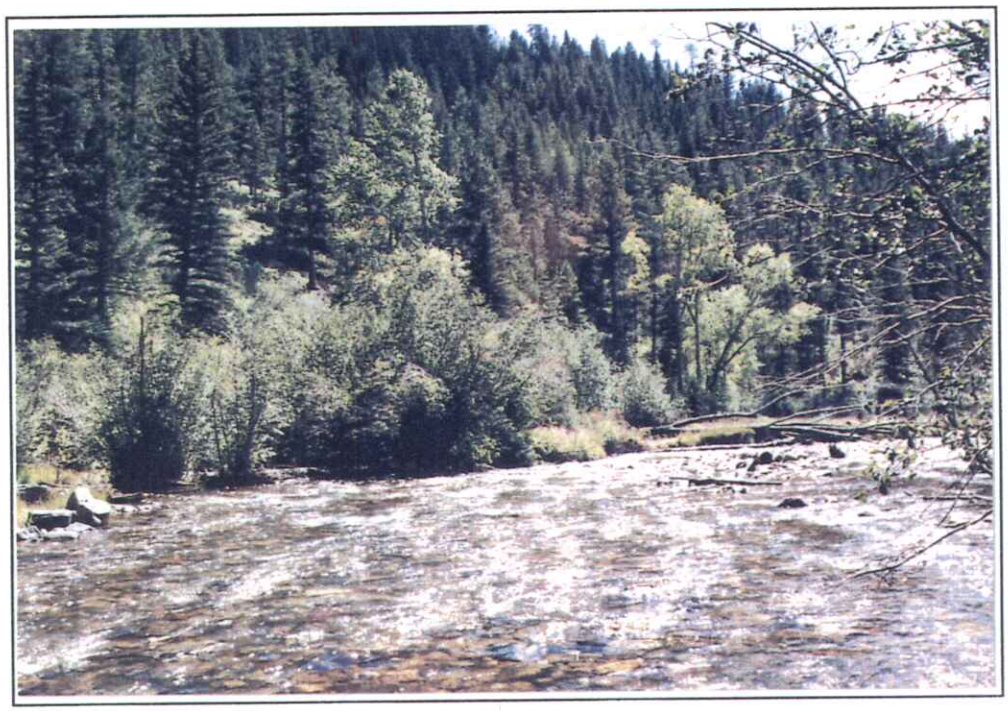


Figure 5. A moderately unconfined reach of the Pecos River representing Type C channel morphology with multiple channels and alluvial bars and terraces.

Figure 6. A young bar developing behind large woody debris which is being further stabilized by vegetation. This is a typical fluvial landform associated with Type C channel morphology.

Channel beds are generally composed of large gravels and cobbles. Smaller size sediments (fine gravel, sand and finer) are uncommon, while, at the other extreme, boulders and stones are infrequent. This type of morphology falls within the Stream Type C2 of Rosgen (1992), and it will be referred to as Type C. Gradations occur between the two stream types, with some transitional reaches exhibiting facets of both on opposite banks.

Water Uses

There are two small ponds within the Pecos River floodplain at Cowles. These ponds are fed by Windsor Creek. Water is diverted from the Pecos River into irrigation ditches and a small pond on private land just north of Terrero. These diversions are considered insignificant with respect to the overall hydrological regime of the river.

Water Quality

Standards promulgated by the New Mexico Water Quality Control Commission designate uses for the section of the upper Pecos River and its tributaries contained within the Wild and Scenic river corridor as domestic water supply, fish culture, high quality cold water fishery, irrigation, livestock and wildlife watering, and secondary contact recreation. Water quality upstream from Willow Creek and Terrero Mine is generally considered good. Water quality below Willow Creek does not fully support designated or attainable uses as defined by the state. Zinc, lead and aluminum have been measured at levels of concern in the Pecos River downstream from Willow Creek (Water Quality and Water Pollution Control in New Mexico, 1992. p. 202).

Watershed Condition

Ground cover in meadow areas in the upper watershed has greatly increased over the past 90 years as evidenced by a photo record compiled by the USFS (per. com. Jerry Elson). Likewise a dense forest understory has grown up over the past 50 years. These increases in vegetative cover are likely due to improved grazing practices, fire suppression, and the establishment of the Pecos Wilderness in 1964, which ended timber harvest activities.

Generally snags and large old trees are rare along the river, particularly outside of the Wilderness Boundary. Riparian area trees may have been logged for mine timbers and local housing during the first third of the 20th century.

Fisheries

Fish Resource

The Pecos River is one of the most productive fisheries streams on the Santa Fe National Forest. The upper river, above Pecos Falls, supports a population of Rio Grande cutthroat trout. The river downstream of Pecos Falls to the Wilderness Boundary is primarily a wild brown trout fishery. This river reach also supports small numbers of wild rainbow and/or cutthroat trout hybrids. Below the Wilderness boundary, through the recreational segment of the river, to the town of Terrero the river contains a large population of wild brown trout and provides habitat for hatchery raised and stocked rainbow trout.

Non-game fish comprise a small component of the total fish population within the reach from Terrero to the Wilderness Boundary. The river supports the upper extent of the white sucker population, and may also support the longnose dace and fathead minnow. No Threatened or Endangered fish species occupy the river in this area.

Fishing Use

Trout in the Pecos River provide an important and heavily used fishery. It is the most heavily fished river in the Santa Fe National Forest, and among the most used rivers in New Mexico. Most of the fishing occurs between the Wilderness boundary and the Forest boundary at the town of Pecos. The harvested fish are primarily rainbow and brown trout. The rainbows are generally hatchery-raised fish that are released as "catchables". The brown trout are wild fish. Based on the Operation Plan for the Aquatic Management of New Mexico Wildlife, approximately 2/3 of the fishery is provided by catchable rainbows and the 1/3 is provided by other species of trout.

Riparian Resources

The river is lined along most of its length by a narrow band (10-50 meters wide) of forest and shrublands dominated by obligate riparian species. Herbaceous dominated wetlands are relatively small in extent and uncommon. With respect to the U.S. Fish and Wildlife Service's National Wetlands Classification (Cowardin et al. 1979), these communities would be classified as Palustrine Forested, Palustrine Scrub-Shrub and Palustrine Persistent Emergent Wetlands, respectively. The New Mexico Natural Heritage Program statewide classification would place these communities within the Montane Riparian Forest, Woodlands and Shrublands, and as Herbaceous Wetlands (NMNHP 1993). The common dominants are narrowleaf cottonwood (*Populus angustifolia*), New Mexico alder (*Alnus oblongifolia*), bluestem willow (*Salix irrorata*), coyote willow (*Salix exigua*) and redosier dogwood (*Cornus stolonifera*), along with blue spruce (*Picea pungens),* and occasionally other conifers such as Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*).

METHODS

General Sampling Design

Sampling was confined to the recreation designated segment of the river from the Wilderness boundary to Terrero (Figure 2). This segment was divided into three sub-segments -- Upper, Middle, and Lower. These sub-segments represent different degrees of tributary contribution. The Upper Sub-segment represents mostly flow from the main stem of the Pecos. The Middle Sub-segment receives additional flow from Panchuela, Jacks and Winsor Creeks. The Lower Sub-segment is below the confluence with the Rio Mora and Willow Creek. Within each sub-segment, explicit representative reaches containing significant riparian vegetation were identified through aerial photo interpretation of color 1:24,000 scale photography. Sample reaches were then chosen representing a range of conditions found along the study reach. A total of eight cross-sections were established with three in both the Upper and Middle sub-segments, and two in the Lower Sub-section (Figure 2). These cross-sections formed the foundation for the collection of hydrological, fisheries and vegetation data. Precise cross-section locations were set to be representative of the physical configuration of the reach, and to concurrently maximize data acquisition on vegetation communities.

Hydrology

Flow Measurements

The river within the study area does not have an official flow gaging station. In order to evaluate the flow dynamics at the cross-sections, a correlation was made between flow levels at the only nearby a U.S.G.S. gage on the Mora River (Station No. 83777900) and three cross-sections on the Pecos, one each from the Upper, Middle and Lower Sub-segments (Cross-sections 8, 1, and 2 respectively in Figure 2). Flow was measured at these sites on six different days. Both low and moderately high flows were measured. Linear regression analysis was used to relate Mora flows to each of the three Pecos sites.

Cross-section Modeling of Flows on the Pecos

Each of the channel cross-sections extended across the entire floodplain of the Pecos, and were surveyed using a transit level and stadia rod. The active channel bottom was measured at every meter. Landforms higher than the active channel were described at significant topographical breaks in slope and substrate type. Water surface heights were measured along with stream gradients and channel substrate character. Root crown heights of significant riparian species were also noted.

Cross-section profiles were then computed, and flows at various stages modeled using the program XSPRO (Grant et al. 1992). This program requires as input stream cross-sectional area, stream gradient and a user imputed Manning's "n" channel roughness coefficient. The cross-section models were calibrated by first estimating the actual flow on the day of the cross-section survey using the Mora River gauge regression equations described above. Then Manning's "n" was adjusted to match actual flows to the modeled flows. Manning's "n" were initially estimated using Barnes (1967), and were kept within a range acceptable for natural channels expected in the study area as defined by Lindsey, Kohlert and Paulhus (1975).

Flow Frequency Analysis

The stream gage record from the Mora River was used to evaluate the flow regime over the past 29 years on the Pecos. Monthly mean flows along with low and high peaks on each Pecos River sub-segment were estimated using the Mora River regression equations. Growing season (April-September), non-growing season (October-March), and yearly mean minimums, maximums and averages were calculated over the period of record. Flows were also estimated for specific return intervals using the recurrence probabilities calculated at the Mora River gage by Waltemeyer (1986).

Vegetation

Riparian Community Characterization

Vegetation sampling was designed to describe the riparian vegetation communities present in the study area, and to evaluate their relationship to the hydrological regime. Plots were established on the surveyed stream cross-sections in representative stands of homogeneous vegetation as they occurred in various fluvial landform positions above the current channel (river wash, side and mid channel bars, terraces, etc.). Because riparian vegetation commonly occurs in long linear stands matching discrete fluvial landforms, plots were correspondingly shaped as long rectangles of 10x10 meter sampling quadrats placed end to end through the stand following the landform configuration. Plot size ranged from 100 to 400 square meters.

Within each plot a complete list of vascular plants was compiled and percent aerial cover estimated for each species. Vegetation was stratified by tree, shrub, graminoid (grass and grasslike plants) and forb layers with independent cover estimates for each layer. Trees were also counted by 2" diameter breast height (DBH) classes, and selected trees were aged and measured for height and DBH. Plot location along the cross-section was noted along with a description of the fluvial landform, surface soil characteristics, landscape position, occurrence size (stand size), elevation, aspect, slope, adjacent communities, and any other significant site characteristics. A complete soil

profile description was made on each plot using recommended Soil Conservation Service guidelines, and the soil classified to the family level of the Soil Taxonomy (Soil Survey Staff, 1992).

Using the floristic composition complemented by site characteristics, vegetation types were defined through iterative stand table sorting techniques (Mueller-Dombois and Ellenberg 1974) in combination with cluster analysis techniques (Ludwig and Reynolds 1989). Types were designated according to the New Mexico Natural Heritage Program (NMNHP) statewide vegetation community classification database protocols and procedures. Types were also classified according to the U.S. Fish and Wildlife wetlands classification (Cowardin et al. 1979).

Vegetation Community Fluvial Position and Hydraulic Analysis

Plot positions and major boundaries between vegetation types were delineated along the cross-sections. Also, the elevation and position of root crowns of major riparian species individuals were measured. Using the hydraulic flow models constructed for each cross-section, the flows required to sub-irrigate and flood specific communities were calculated, along with volumes necessary to reach root crown positions and various vegetation type boundaries.

Fisheries

The Physical Habitat Simulation System (U.S. Fish and Wildlife Service 1989) was used to model the habitat available for various life stages of brown trout in relation to flow. Three cross-sections were evaluated, one each from the Upper, Middle, and Lower Sub-segments. The model estimated the useable habitat available for brown trout at the life stages of incubation, fry, juvenile and adult based on water depth, water velocity and substrate type data gathered directly at the cross-sections under different flow conditions (the model estimates the habitat available during the measured flows).

RESULTS -- INSTREAM FLOW ANALYSIS

Hydrology

Flow Regime

Flows at the Pecos sites were found to be highly correlated to the Mora gage with R^2 values of 0.93 to 0.98 (Table 1). The calculated regression equations allowed extrapolation of water at the Pecos cross-section sites on any given day using the flow records from the Mora River. In Figure 7a-d the yearly average flow, yearly peak flow, growing season average flows, and non-growing season average flows are presented as estimated for each Sub-segment over the period of record of the Mora gage (1964-1992). Note that the Rio Mora and the estimates for the Upper Sub-segment of the Pecos show similar discharges. The Middle Sub-segment had somewhat higher discharges, and the Lower Sub-segment had the highest, reflecting the greater drainage area for each sub-segment. Growing season flows generally exceed non-growing season flows, except in exceptionally dry years such as 1964, 1971, 1975 and 1989. This is a reflection of the combination of spring runoff and summer "monsoon" rain events. Modulation in winter flow primarily reflects unseasonably warm weather in March leading to early runoff, or from extension of the monsoon season into October.

The spring runoff and summer monsoon effects are evident when the monthly mean minimum, maximum and average flows are examined. In Figure 8 these values have been estimated for the Pecos sub-segments from the Mora gage 29 year period of record. The mean maximum discharges occur in May following snowmelt and decline into the dry period of June, followed by a secondary peak during the height of the summer monsoon in August. Tables 2, 3, and 4 provide month by month breakdowns for each sub-segment of mean flows, along with the peak and low flows that occurred in each month over the entire period of record. The highest recorded flows correspond to the May, 1991, flood. The growing season and non-growing season values are also presented. Growing season values are viewed as being important in flow requirement analysis for riparian vegetation and fisheries. Winter flows can also be critical for particular fish species.

Knowing the recurrence intervals for various flows is helpful in developing in-stream flow recommendations. In Table 5 the flood flows are presented for specific recurrence intervals on each sub-segment as estimated by regression using Waltemeyer's (1986) return interval flow values for the Rio Mora. Peak flows exceeding 500 cubic feet per second (cfs) on the Rio Mora occurred only 3 times over the 29 year period of record (Figure 7b), corresponding to the 10 year recurrence interval flow calculated by Waltemeyer (1986). The calculated 10 year return interval flows appear to track fairly closely the estimations over the period of record. Note that the highest flow on record in May of 1991 represents only a 20-25 year event.

Table 1. Stream flow regression equations between the Rio Mora and the Upper, Middle and Lower Sub-Segments of the Pecos River study area.

Sub-Segment	Intercept	Slope	R^2
Upper	6.3078	0.6938	.98
Middle	22.7823	1.2248	.93
Lower	18.3629	2.3419	.98

Cross-section Hydraulic Analysis

The eight survey cross-section diagrams are presented by stream reach in Figures 9-16. Indicated are the flows for various modeled stage heights, along with the actual stage height and flow on the day of cross-section measurement. Note that the figures each have different scales corresponding to the maximum width and height of each cross-section. Complete hydraulic modeling results for each cross-section are presented in Appendix A.

Cross-section No. 8 occurs at the highest position in the Upper Sub-segment near the Wilderness Boundary (Figure 9). This cross-section combines the characteristics of both Type B and C stream morphologies. It is fairly well confined, but occurs just as the river valley begins to open up upon leaving the Wilderness, providing a small area for a floodplain and the development of a small island bar in the middle of the cross-section and associated dual channels (Type C). The bar is flooded yearly. The right side of the larger channel is armored with large cobbles and boulders, and bedrock is at or near the surface and reflects the transition to Type B morphology further up the river.

Cross-section No.7 shown in Figure 10 is also from the Upper Sub-segment, and represents a more pronounced Type C stream structure with an extended floodplain. Although the channel is slightly entrenched, it is not confined by the bedrock or associated large cobbles and boulders. A small island bar has developed which is flooded every 3-4 years. The left side of the cross-section indicates an elevated terrace that is rarely flooded (50 year return interval).

Cross-section No.6 occurs below No.7 in an even broader floodplain (Figure 11). Once again the channel is slightly entrenched, but flooding does occur along the side bars every 3-4 years. There were also indications of older channels to the right that were blocked and filled by debris.

In the Middle Sub-segment the river is once again confined for a significant distance within a steep sided canyon (Figure 3). This is represented by Cross-section 5 with its narrow channel bounded by steep banks that are armored with large boulders, cobbles and bedrock (Figure 12). It also cuts through a typical pool along this reach. The 25 year flow of 800 cfs would nearly fill the channel to the limit of the measured riparian zone.

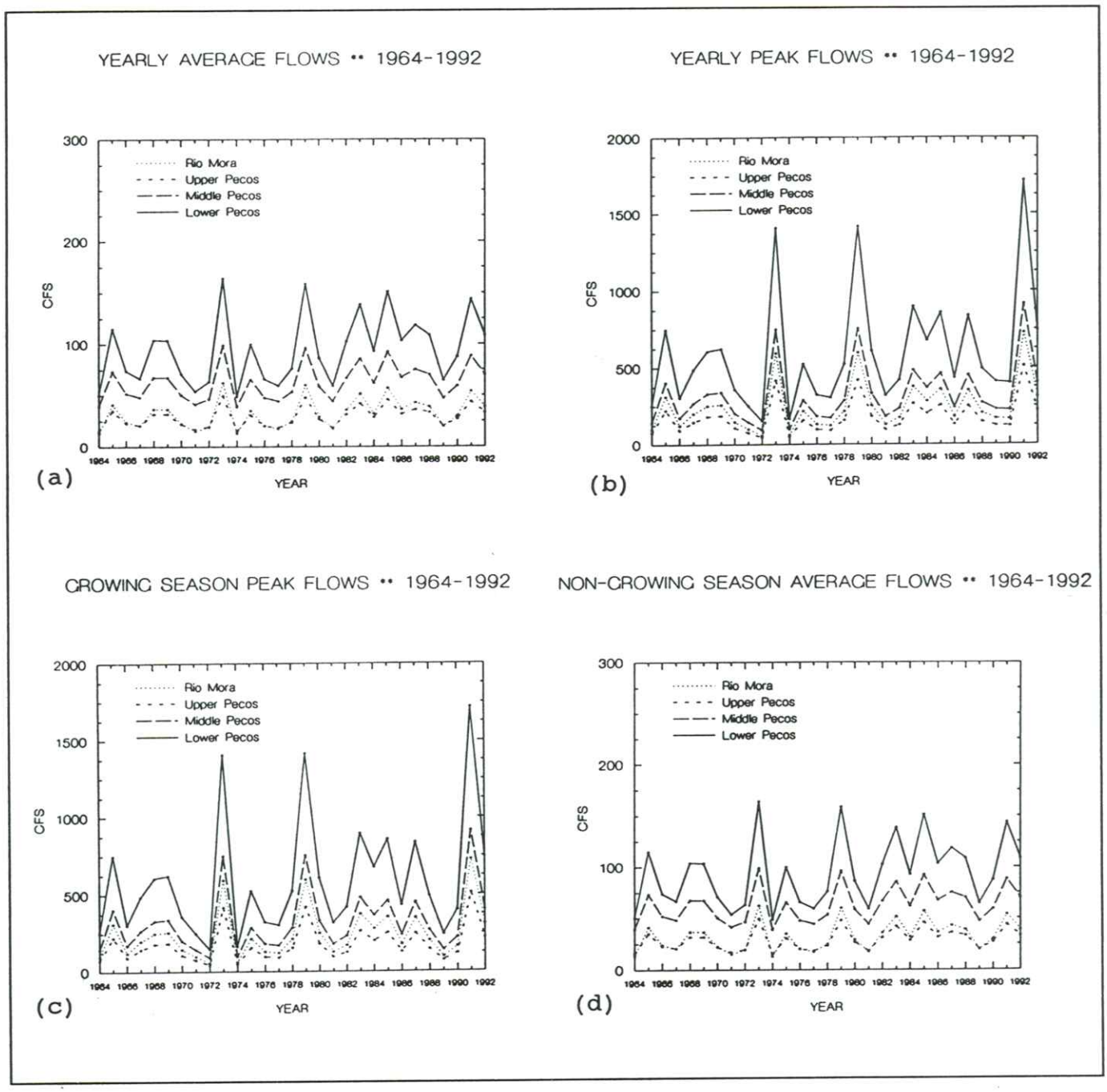


Figure 7. a) Yearly average flows over the period of record for the Rio Mora and Upper, Middle and Lower Sub-segments as calculated by regression from the Rio Mora values; b) Yearly maximum peaks recorded; c) average flows for the growing season (April-September) over the period of record; d) average flows for the non-growing season (October-March) over the period of record.

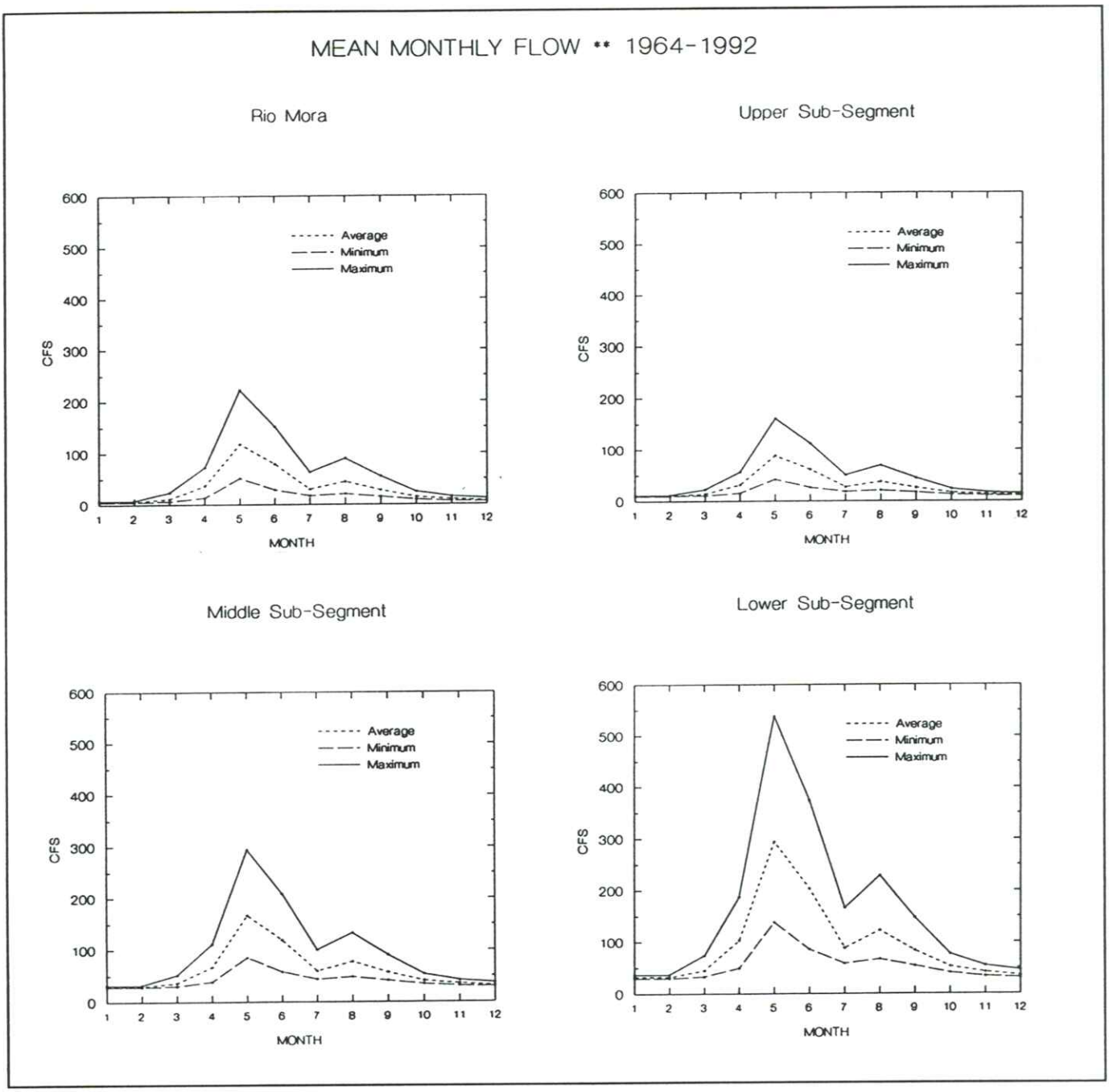


Figure 8. Means of monthly minimums, maximums and averages over the period of record for the Rio Mora gage (1964-1992) along with values calculated by regression for the Upper, Middle and Lower Sub-segments of the Pecos River.

TABLE 2. Upper Sub-Segment flow estimates: mean monthly maximums, minimums and averages, and highest recorded peak and low; growing season (April-September) mean monthly maximums, minimums and averages, and highest recorded peak and low; non-growing season (October-March) mean maximum, minimum and average, and highest recorded peak and low; yearly mean maximum, minimum and average, and highest recorded peak and low for the 1964-1992 period of record. Values in parenthesis are standard deviations.

	Monthly Maximum (St.Dev.)	Monthly Minimum (St.Dev.)	Monthly Average (St.Dev.)	Peak	Low
January	11.6 (2.4)	9.6 (1.4)	10.4 (1.4)	20.1	6.9
February	11.8 (2.5)	9.7 (1.3)	10.4 (1.5)	18.7	7.4
March	22.6 (20.4)	10.6 (1.8)	14.1 (5.2)	122.1	7.8
April	56.4 (31.3)	15.4 (4.9)	31.3 (13.9)	134.6	9.7
May	160.3 (117.7)	41.7 (24.9)	88.0 (52.6)	510.0	14.6
June	111.6 (93.2)	26.2 (14.6)	61.1 (47.6)	420.5	9.0
July	50.1 (42.6)	18.1 (8.1)	26.9 (13.6)	191.5	8.6
August	68.7 (55.0)	20.6 (9.1)	37.1 (24.7)	222.7	10.0
September	44.3 (33.5)	16.7 (6.7)	25.4 (14.4)	142.9	9.6
October	23.4 (10.9)	12.7 (2.4)	16.3 (4.7)	45.8	9.4
November	16.8 (5.6)	10.7 (2.3)	13.2 (3.1)	33.3	7.2
December	14.3 (5.6)	10.0 (1.6)	11.2 (1.8)	36.8	7.1
Growing Season	81.9 (80.6)	23.1 (15.9)	45.0 (39.1)	510.0	8.7
Non-Growing Season	18.2 (8.6)	11.2 (2.4)	13.6 (4.0)	122.1	7.1
Yearly	49.2 (66.0)	16.8 (12.9)	28.7 (32.1)	510.0	6.9

TABLE 3. Middle Sub-Segment flow estimates: mean monthly maximums, minimums and averages, and highest recorded peak and low; growing season (April-September) mean monthly maximums, minimums and averages, and highest recorded peak and low; non-growing season (October-March) mean maximum, minimum and average, and highest recorded peak and low; yearly mean maximum, minimum and average, and highest recorded peak and low for the 1964-1992 period of record. Values in parenthesis are standard deviations.

	Monthly Maximum (St.Dev.)	Monthly Minimum (St.Dev.)	Monthly Average (St.Dev.)	Peak	Low
January	32.2 (4.3)	28.6 (2.4)	30.1 (2.5)	47.2	23.8
February	32.5 (4.5)	28.7 (2.3)	30.1 (2.6)	44.8	24.7
March	51.6 (36.0)	30.4 (3.2)	36.6 (9.1)	227.3	25.4
April	111.2 (55.2)	38.9 (8.5)	66.9 (24.7)	249.3	28.9
May	294.6 (207.8)	85.4 (43.9)	167.0 (93.1)	911.9	37.4
June	208.7 (164.7)	57.9 (25.7)	119.6 (84.0)	753.9	27.6
July	100.1 (75.2)	43.6 (14.4)	59.2 (24.1)	349.8	26.9
August	132.9 (97.2)	48.0 (16.0)	77.2 (43.7)	404.9	29.3
September	90.0 (59.2)	41.1 (11.7)	56.6 (25.4)	264.0	28.6
October	53.0 (19.3)	34.2 (4.2)	40.4 (8.3)	92.5	28.4
November	41.4 (9.9)	30.6 (4.0)	35.0 (5.6)	70.5	24.3
December	36.9 (10.0)	29.3 (2.7)	31.5 (3.1)	76.6	24.2
Growing Season	156.2 (142.3)	52.5 (28.0)	91.1 (69.0)	911.9	26.9
Non-Growing Season	43.8 (15.2)	31.4 (4.2)	35.6 (7.1)	227.3	24.2
Yearly	98.6 (116.5)	41.4 (22.8)	62.4 (56.6)	911.9	23.8

TABLE 4. Lower Sub-Segment flow estimates: mean monthly maximums, minimums and averages, and highest recorded peak and low; growing season (April-September) mean monthly maximums, minimums and averages, and highest recorded peak and low; non-growing season (October-March) mean maximum, minimum and average, and highest recorded peak and low; yearly mean maximum, minimum and average, and highest recorded peak and low for the 1964-1992 period of record. Values in parenthesis are standard deviations.

	Monthly Maximum (St.Dev.)	Monthly Minimum (St.Dev.)	Monthly Average (St.Dev.)	Peak	Low
January	36.4 (8.3)	20.4 (4.7)	32.3 (4.8)	65.2	20.4
February	37.0 (8.5)	29.8 (4.4)	32.4 (5.0)	60.5	22.1
March	73.6 (68.9)	33.0 (6.1)	44.8 (17.4)	409.4	23.5
April	187.4 (105.7)	49.2 (16.4)	102.8 (47.1)	451.6	30.0
May	538.2 (397.4)	138.1 (84.0)	294.2 (177.8)	1718.5	46.4
June	374.0 (314.8)	85.5 (49.3)	203.5 (160.7)	1416.4	27.7
July	166.2 (143.9)	58.2 (27.5)	88.0 (46.1)	643.6	26.3
August	228.9 (185.9)	66.6 (30.6)	122.5 (83.6)	749.0	31.0
September	146.9 (113.3)	53.5 (22.4)	83.0 (48.6)	479.7	29.6
October	76.2 (36.9)	40.2 (8.1)	52.1 (16.0)	151.8	29.1
November	109.6 (19.04)	33.5 (7.6)	41.8 (10.7)	109.7	21.4
December	45.4 (19.2)	30.9 (5.2)	35.0 (5.9)	121.4	21.1
Growing Season	273.6 (272.2)	75.2 (53.6)	149.1 (131.8)	1718.5	26.3
Non-Growing Season	58.6 (29.1)	34.9 (8.1)	43.0 (13.5)	409.4	20.4
Yearly	163.3 (222.8)	53.9 (43.6)	94.2 (108.3)	1718.5	20.4

Table 5. Flood flows in cubic feet per second (cfs) for specific recurrence intervals in the Upper, Middle, and Lower sub-segments of the Pecos River as calculated by regression from the Mora River Gage intervals estimated by Waltemeyer (1989).

Interval Segment	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	Area Sq Mi
Upper	154	265	325	476	578	689	45.2
Middle	285	481	634	853	1,033	1,221	86.6
Lower	520	894	1,187	1,606	1,950	2,323	132.7
Rio Mora	214	374	499	678	825	984	53.2

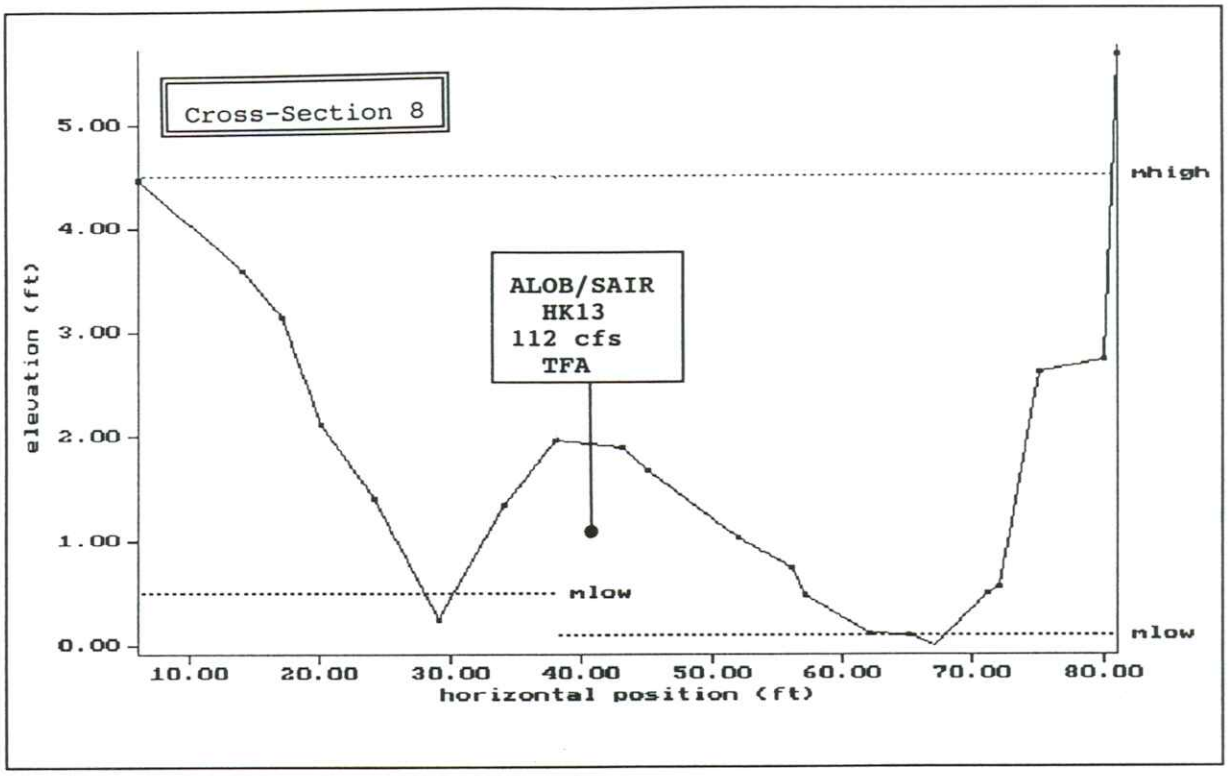


Figure 9. Cross-section 8 in the Upper Sub-segment at the Wilderness boundary showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

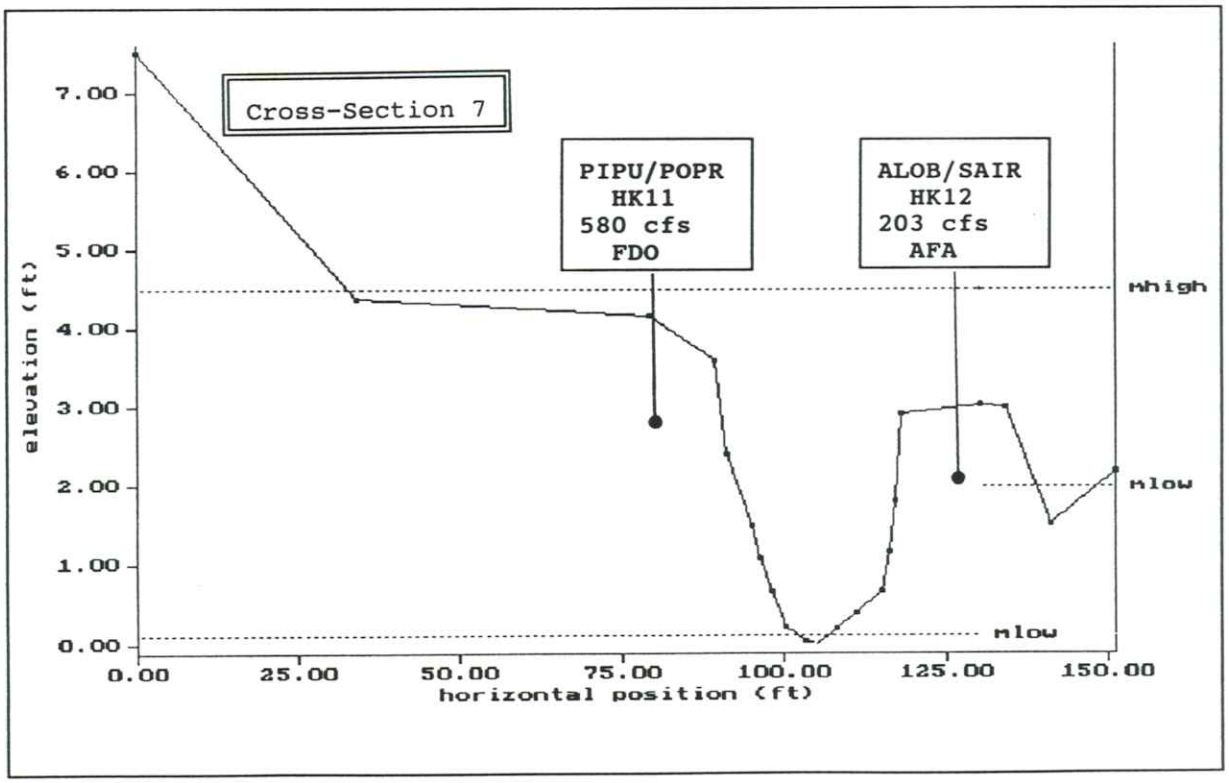


Figure19. Cross-section 7 in the Upper Sub-segment showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym(See Table 6 for acronym definitions).

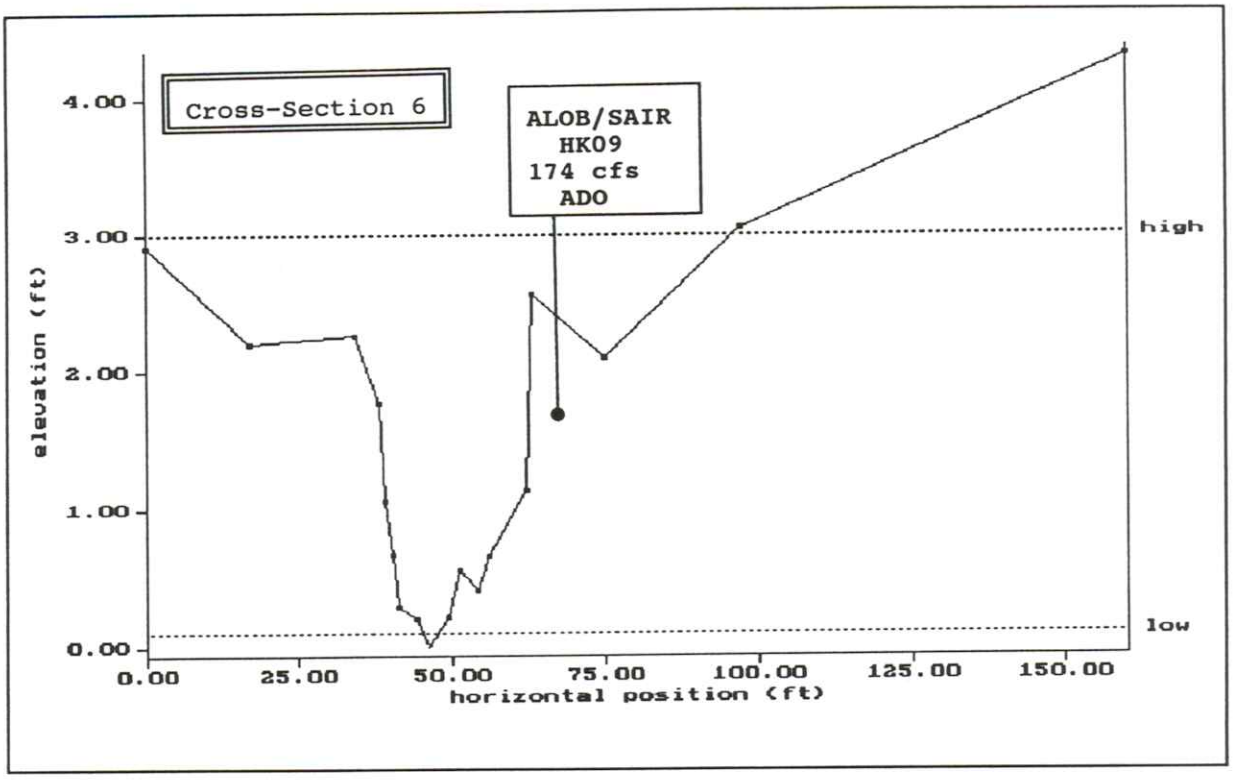


Figure 11. Cross-section 6 in the Upper Sub-segment at the Wilderness boundary showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

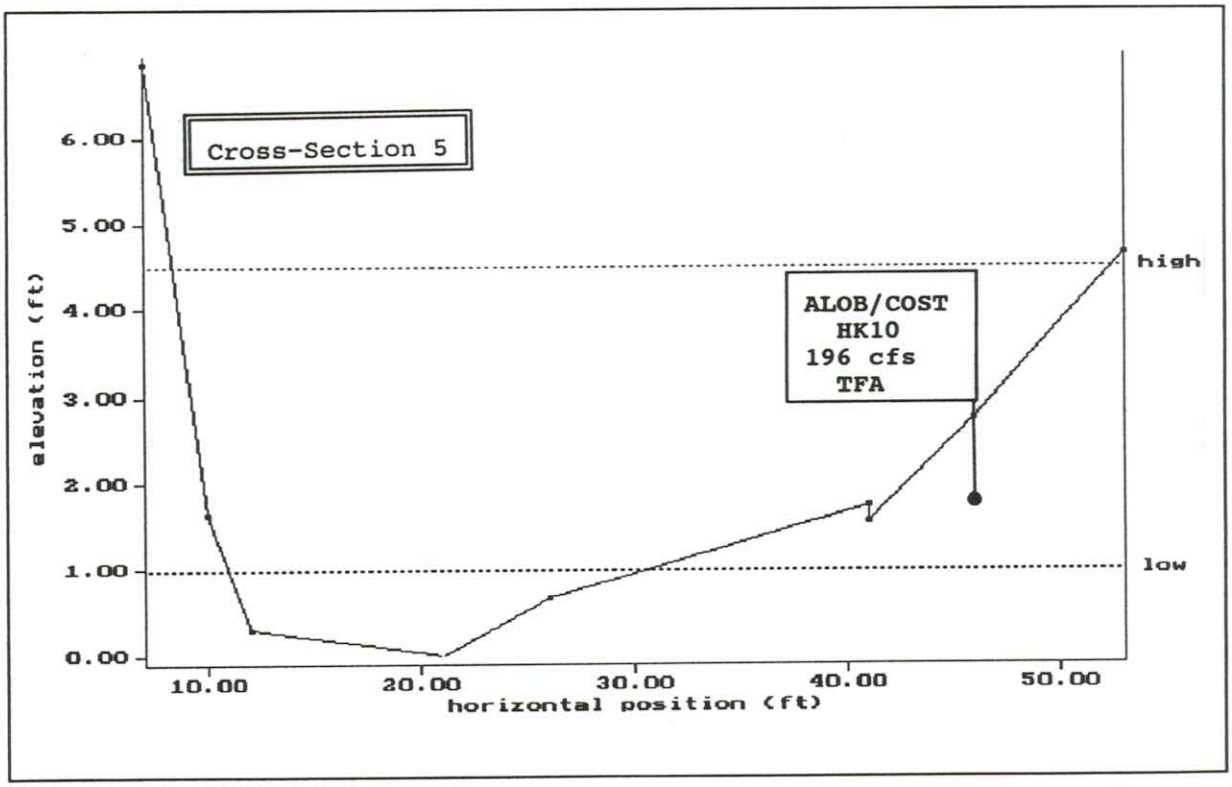


Figure 12. Cross-section 5 in the Middle Sub-segment showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

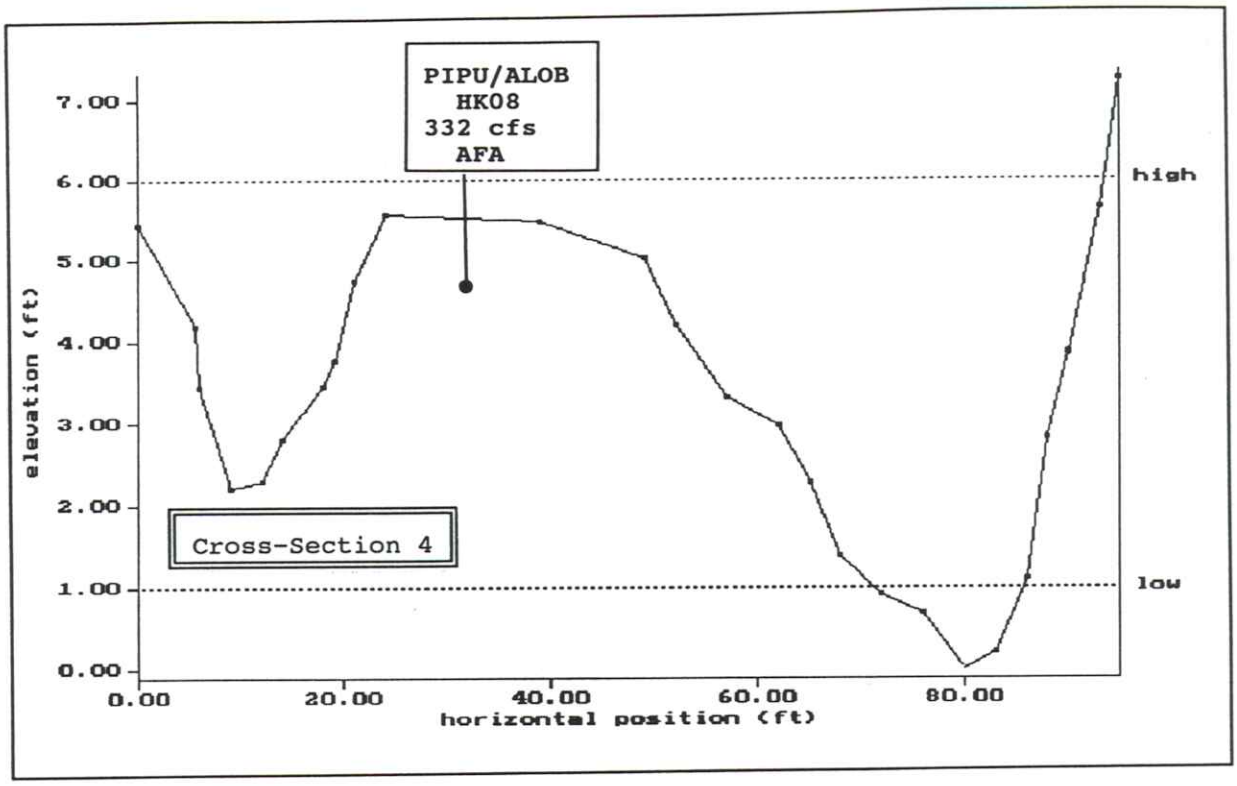


Figure 13. Cross-section 4 in the Middle Sub-segment at the Wilderness boundary showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

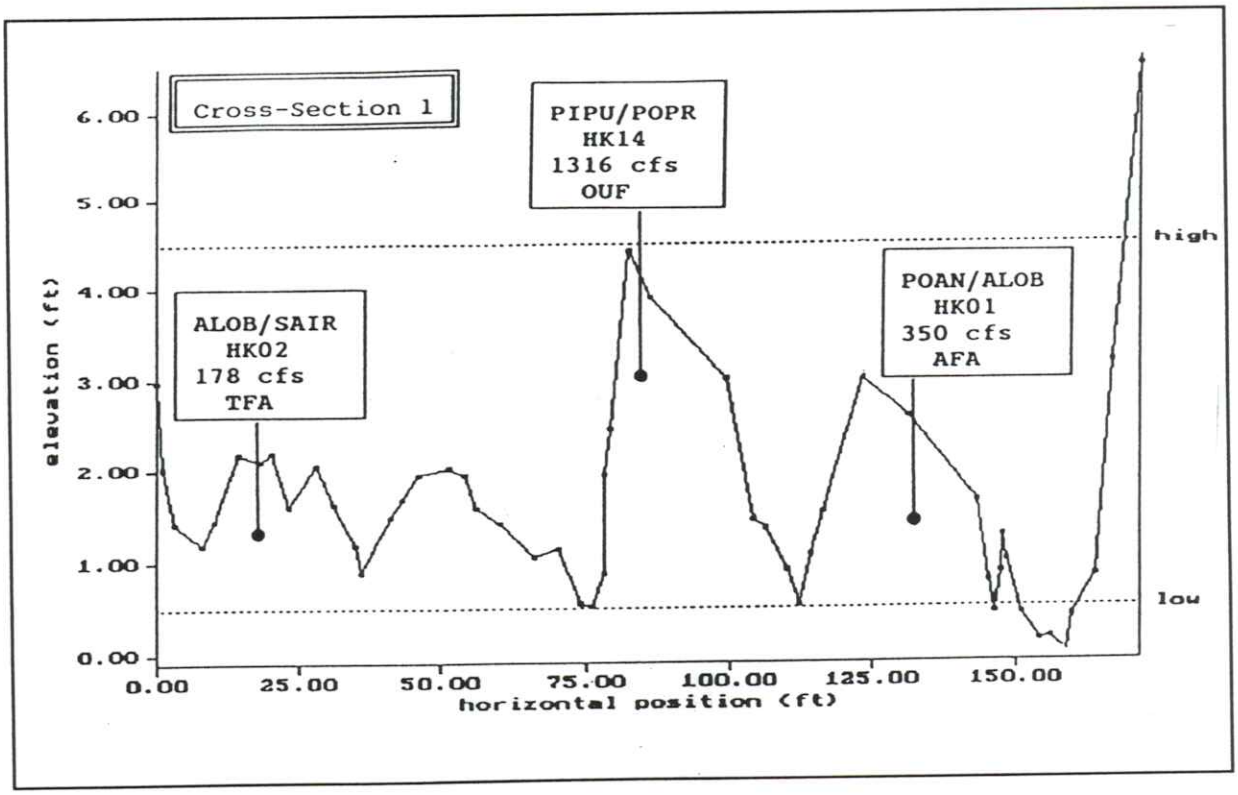


Figure 14. Cross-section 1 in the Middle Sub-segment showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

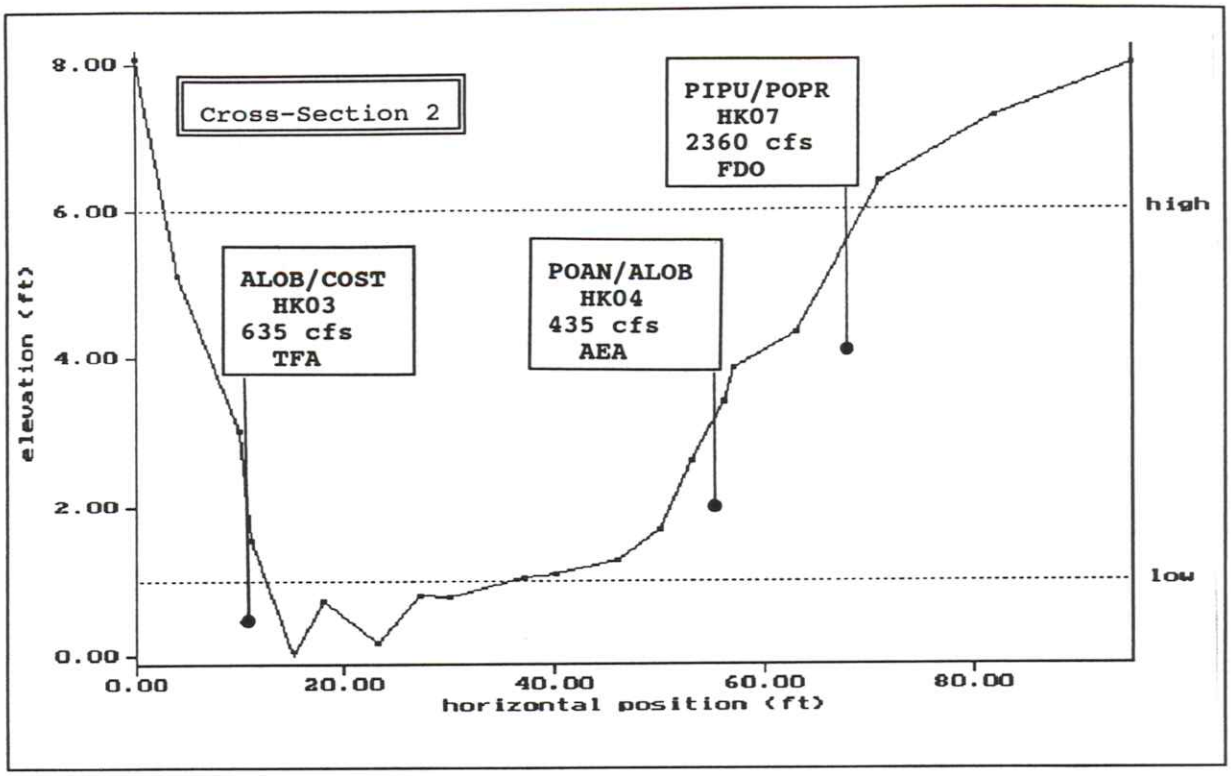


Figure 15. Cross-section 2 in the Lower Sub-segment at the Wilderness boundary showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

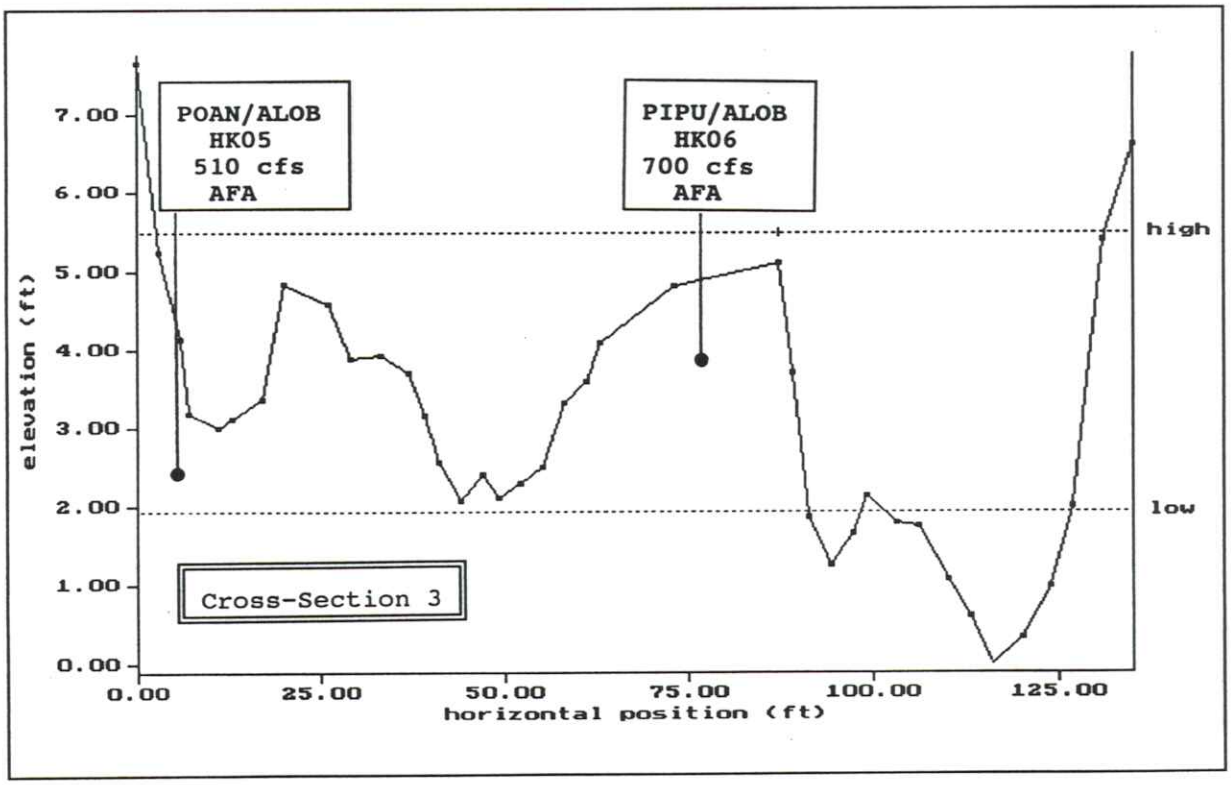


Figure 16. Cross-section 3 in the Lower Sub-segment showing plot position, vegetation community acronym, the cubic feet per second (cfs) required to inundate the site, and the soil taxon acronym (see Table 6 for acronym definitions).

Table 6. Vegetation communities and soils identified in the Scenic Segment of the Pecos River.

	Vegetation Community	Soil Taxon (Subgroup, Family)	Acronym
1	New Mexico Alder/Redosier Dogwood *Alnus oblongifolia/Cornus stolonifera*] (ALOB/COST)	Typic Fluvaquent, loamy skeletal	TFA-ls
2.	New Mexico Alder/Bluestem Willow [*Alnus oblongifolia/Salix irrorata*] (ALOB/SAIR)	Typic Fluvaquent, sandy skeletal loamy skeletal Aquic Dystrochrepts, coarse loamy Aeric Fluvaquent, loamy skeletal	TFA-ss TFA-ls ADO--cl AFA--ls
3	Narrowleaf Cottonwood/New Mexico Alder [*Populus angustifolia/Alnus oblongifolia*] (POAN/ALOB)	Aeric Fluvaquent, coarse loamy over sandy skeletal sandy skeletal Aeric Endoaquept, coarse loamy over sandy skeletal	AFA-cl/ss AFA-ss AEA-cl/ss
4.	Blue Spruce/New Mexico Alder [*Picea pungens/Alnus oblongifolia*] (PIPU/ALOB)	Aeric Fluvaquent, sandy skeletal loamy over sandy skeletal	AFA-ss AFA-l/ss
5.	Blue Spruce/Blue Grass [*Picea pungens/Poa pratensis*] (PIPU/POPR)	Fluventic Dystrochrepts, loamy Oxyaquic Udifluvents, coarse loamy	FDO-l OUF-cl

Nearer the lower end of the Middle Sub-segment, the channel begins to open slightly and we get the development of a limited floodplain as shown by Cross-section No.4 (Figure 13). An island bar is present which is flooded every 2-3 years. The main channel contains a deep pool, and the right side of this channel remains well armored with boulders and cobbles. This cross-section represents a transition from B to C stream types.

Just above the confluence with the Rio Mora, the valley further opens with the development of a relatively broad floodplain (Figure 5). Multi-channel complexes typical of the Type C morphology have formed as shown in Cross-section No.1 (Figure 14). The left most bar has been recently stabilized by vegetation and debris, but is flooded yearly. The right side bar is flooded less frequently, but is still inundated every 3-4 years. In contrast, the central terrace is rarely flooded (>100 years).

In the Lower Sub-segment the channel once again becomes somewhat confined in a narrow canyon. There is a small floodplain represented on the right side in Cross-section No.2 (Figure 15), but the left side remains steep banked and armored. The estimated 25 year flow would probably fill the active channel bottom of the historic floodplain and to the upper limit of the current riparian zone.

The Last cross-section, No. 3, again represents a somewhat wider floodplain complex where island bars have developed which are flooded every 3-4 years (Figure 16). The far right channel remains well armored and steep.

Riparian Vegetation Communities

Five riparian vegetation communities were described in detail for the study area on the basis of 14 vegetation plots (Table 6). An ordered stand table of these plots is presented in Appendix B which provides the quantitative foundation for the community descriptions. The family level soil taxons associated with each community are also given on Table 6. Complete soil profile descriptions are presented in Appendix C. The positions of each plot are illustrated along each of the stream cross-sections in Figures 11-16. Each plot is labeled with the plot number corresponding to that found in Appendix B, along with the community type acronym and soil taxon acronym from Table 6, and the estimated cubic feet per second required to flood the position of the plot. Table 7 presents the flows necessary to inundate a community and the estimated recurrence intervals for those flows.

Community descriptions

1. New Mexico Alder/Redosier Dogwood
[*Alnus oblongifolia/Cornus stolonifera*]
(ALOB/COST)

Vegetation: This community is dominated by shrub forms of New Mexico alder and redosier dogwood, along with wood rose (*Rosa woodsii*), bearberry honeysuckle (*Lonicera involucrata*), trumpet gooseberry (*Ribes leptanthum*), whitebark raspberry (*Rubus leucodermis*), New Mexico thimbleberry (*Rubus neomexicanus*), and an occasional willow (*Salix irrorata, S. caudata* and others). There can be a sparse canopy of blue spruce (*Picea pungens*), or Douglas-fir (*Pseudotsuga menziesii*), but the alder seldom achieves tree height (Figure 17). Although the type is predominantly shrubby, rich and luxuriant undergrowth can occur dominated by forbs such as meadow rue (*Thalictrum fendleri*), Richardson's geranium (*Geranium richardsonii*), cow parsnip (*Heracleum lanatum*), and horsetail (*Equisetum arvense*) (Figure 18). This is classified as a Palustrine Shrub Wetland following Cowardin (1979), or Montane Riparian Shrubland by NMNHP.

Environment: This community is associated with the Type B channel morphology where the stream is well confined within banks lined by large cobbles and boulders. Little or no depositional floodplain exists, although there can be small narrow beaches. These channels are well armored, and even under high flows there probably is little alteration of channel bed and bank materials. These conditions are typified in Cross-sections No. 5 and 2 (Figures 12 & 15), but also occur along at least one bank in No.'s 8, 4 & 3 (Figures 9, 13 & 16). Based on the hydraulic modeling of these cross-sections, the community is inundated at least partially every year (Table 7). This inundation is reflected in the hydric character soils. These soils show evidence of oxygen poor, reduced conditions at lower depths as a function of the close proximity and fluctuation of the water table and the wetted perimeter of the channel. Hence, the soils are classified as loamy skeletal Aeric Fluvaquents of mixed mineralogy and frigid temperature regime. Cobbles and stones make up 60% or more of the soil profile. Vegetation grows in among the cobbles and stones, reaching up the steep banks and grading into upland forest.

Figure 17. The New Mexico Alder/Redosier Dogwood community growing along a rocky bank in the Lower Sub-segment.

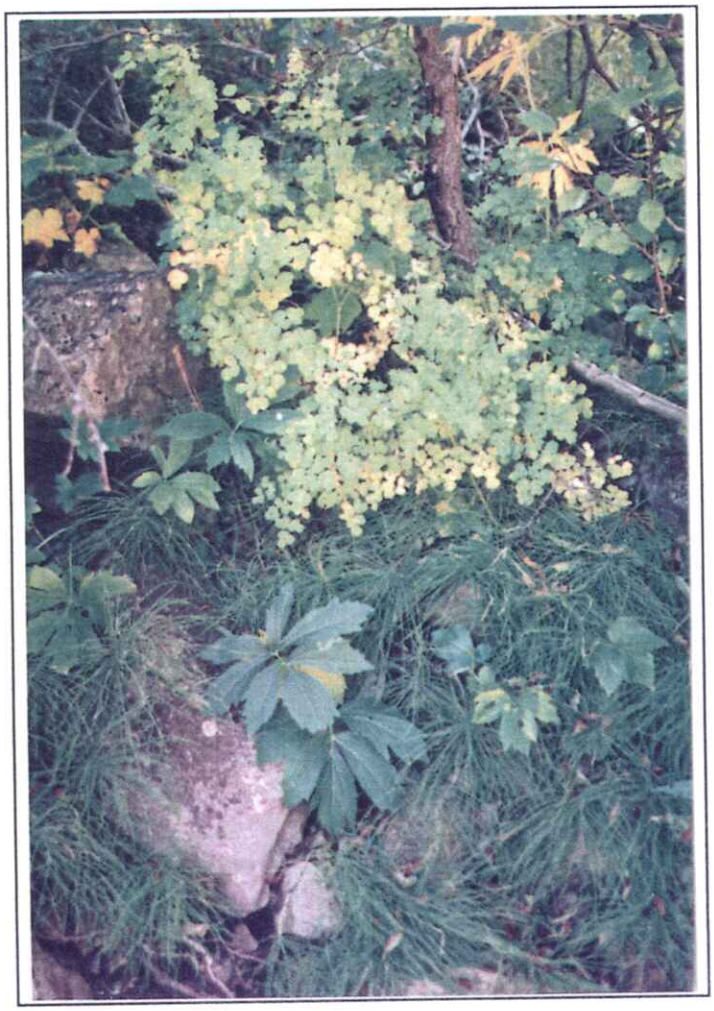


Figure 18. An example of the luxuriant herbaceous undergrowth than can occur in the New Mexico Alder/Redosier Dogwood community

Table 7. Range of flows required to inundate the plant communities identified along the Upper, Middle and Lower Sub-segments along with estimated return intervals for the flows.

Sub-Segment Community	Upper Sub-Segment	Return Interval	Middle Sub-Segment	Return Interval	Lower Sub-Segment	Return Interval
Alder/Dogwood	115-177	<2 yr	123-196	<2 yr	400-635	<3 yr
Alder/Bluestem Willow	112-201	<2 yr	178	<2 yr	510	2 yr
Blue Spruce/ Alder	--	--	393	4 yr	811	5 yr
Cottonwood/ Alder	--	--	350	3 yr	782	4 yr
Blue Spruce/ Blue Grass	580-873	50-100 yr	1,316	100 yr	2,129	75 yr

2. New Mexico Alder/Bluestem Willow
[*Alnus oblongifolia/Salix irrorata*]
(ALOB/SAIR)

Vegetation: This community is dominated by shrub forms of New Mexico alder and willows -- bluestem willow (*Salix irrorata*), coyote willow (*Salix exigua)* and whiplash willow (*Salix caudata*) (Figure 19). New Mexico alder occasionally reaches tree height (> 5 meters). Young shrub form reproduction of narrowleaf cottonwood can also occur (*Populus angustifolia*). The undergrowth is commonly dominated by mesic and hydric graminoid species such slender hairgrass (*Deschampsia caespitosa*), stink grass (*Eragrostis cilianensis*), redtop (*Agrostis gigantea*), sedges (*Carex spp.*) and rushes (*Juncus balticus, J. effusus*). The forb component can also be rich (15+ species) and abundant (>25% cover) and characterized by the presence of fireweed (*Epilobium angustifolium*), horsetail (*Equisetum arvense*), cutleaf coneflower (*Rudbeckia lacinata*), cow parsnip (*Heracleum lanatum*), Fendler cowbane (*Oxypolis fendleri*), horse cinquefoil (*Potentilla hippiana*), and selfheal (*Prunella vulgaris*). This is classified as a Palustrine Shrub/Scrub wetland following, Cowardin et al. (1979) and as a Montane Riparian Shrublands by the NMNHP classification.

Environment: This community is found on young depositional island or side bars associated with the Type C channel morphology (Figures 9, 10, 11 & 14). The stream may be moderately incised or confined, but movement still occurs within the floodplain allowing for the development of these sites. The lowest bars are flooded repeatedly during the year, the older more aggregated sites may be flooded only every other year (Table 7). The debris in combination with vegetation enhances sediment aggradation and leads to stabilization of the bars. The soils are commonly loamy-skeletal Typic Fluvaquents and Aquic dystrochrepts which have the water table within at least 50 cm of the surface sometime during the year, or evidence of prolonged reduced conditions (gley). Occasionally, the community will occur on somewhat drier soils such as Aeric Fluvaquents. They can have sandy or loamy surface horizons that overlay a cobbly matrix of the original channel bottom.

Figure 19. The New Mexico Alder/Bluestem Willow type developing on a recently stabilized island bar in the Middle Sub-segment. Young cottonwood reproduction is also present among the willows.

Figure 20. The Narrowleaf Cottonwood/New Mexico Alder community growing along an island bar and along a back channel in the Middle Sub-segment. The open, grassy terrace in the foreground is representative of the Blue Spruce/Blue Grass community that forms in the highest fluvial landforms (the blue spruce is out of view).

3. Narrowleaf Cottonwood/New Mexico Alder
[*Populus angustifolia/Alnus oblongifolia*]
(POAN/ALOB)

Vegetation: This riparian forest community type is dominated by a moderately open to very open overstory canopy of narrowleaf cottonwood (*Populus angustifolia*) which is usually even aged (Figure 20). New Mexico alder (*Alnus oblongifolia)* is the dominant shrub and occasionally a sub-canopy tree, but cottonwood reproduction is absent (Figure 21). Bearberry honeysuckle (*Lonicera invulcrata*), yellow willow (*Salix lutea*) and redosier dogwood (*Cornus stolonifera*) may also be common in the shrub layer. The herb layer can be luxuriant (>50% cover) and very diverse (30+ species). Common forbs include cow parsnip (*Heracleum lanatum*), cutleaf coneflower (*Rudbeckia lacinata*), Porter's lovage (*Ligusticum porteri*), meadow rue (*Thalictrum fendleri*), bedstraw (*Galium aparine*), false solomon seal (*Smilacina racemosa*) along with the grasses water bent (*Agrostis semiverticillata*), and bluegrass (*Poa pratensis*). This community has been classified as a Palustrine Forested Wetland following Cowardin (1979), or Montane Riparian Forest following the NMNHP classification.

Environment: This community is located on a moderate elevation island and on narrow side bars associated with the Type C channel morphology (Figure 14 & 15). Aggradation of sediments and/or limited downcutting has occurred to elevate the surface significantly above the water table to allow some aeration of the soil. This corresponds to the classification of the soils as Aeric Fluvaquents and Aeric Endoaquepts (hydric conditions at deeper than 50 cm). The lower position sites are flooded every 3-4 years, extending up to 20 years for the highest positions (Table 7).

4. Blue Spruce/New Mexico Alder
[*Picea pungens/Alnus oblongifolia*]
(PIPU/ALOb)

Vegetation: This riparian forest community is dominated by blue spruce (*Picea pungens*) with Douglas-fir (*Pseudotsuga menziesii*) as an occasional co-dominant (Figure 22). The understory is characterized by shrubby and small tree New Mexico alder (*Alnus oblongifolia*). The herbaceous layer is diverse and abundant in cover with cow parsnip (*Heracleum lanatum*), cutleaf coneflower (*Rudbeckia lacinata*), poison hemlock (*Conium maculatum*), meadow rue (*Thalictrum fendleri*), bedstraw (*Galium aparine*), false solomon seal (*Smilacina stellata*), and monkshood (*Aconitum columbianum*) as common forb dominants, along with the grasses red bent (*Agrostis gigantea*), and bluegrass (*Poa pratensis*), (Figure 23). This community has been classified as a Palustrine Forested Wetland following Cowardin et al. (1979), or Montane Riparian Forest following the NMNHP classification.

Environment: This community occupies small island bars within a limited floodplain (Figures 13 & 16). The river is moderately confined, preventing the development of large bars and terraces. Aggradation and downcutting continues to occur, elevating the sites somewhat above the water table and leading to the development of loamy-skeletal Aeric Fluvaquent soils (the matrix may be upwards of 80% coarse gravels, cobbles and stones). The lower position sites are flooded every 4-5 years, and older, higher sites are probably flooded every 20 years.

5. Blue Spruce/Blue Grass
[*Picea pungens/Poa pratensis*]
(PIPU/POPR)

Vegetation: This is a senescent riparian forest type where most of the overstory is represented by a few scattered blue spruce (*Picea pungens*). Narrowleaf cottonwoods (*Populus angustifolia*) are absent, or represented by a few senescent individuals. Obligate riparian species reproduction is absent. Ponderosa pine (*Pinus ponderosa*) or Douglas-fir (*Pseudotsuga menziesii*) may also be present. The undergrowth is dominated by meadow type grasses and forbs as shown in the foreground of Figure 20. The species that occur are adapted to open sun exposures and include bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), yarrow (*Achillea lanulosa*), pineywoods geranium (*Geranium caespitosum*), plantain (*Plantago major*), black-eyed susan (*Rudbeckia hirta*), and clovers (*Trifolium* spp.)

Environment: This community occupies the highest depositional bars and terraces in the floodplain landscape with Type C channel morphology (foreground of Figure 12). The sites are infrequently flooded (>25 years) and the water table is usually beyond 100 cm in depth. Aggradation of new materials on the top of the bars and terraces is uncommon and the soils show greater development than other sites in the riparian zone. Hence, they have been classified as Oxyaquic Udifluvents and the drier Fluventic Dystrochrepts. The surface layers are commonly fine textured loams developed from deposition of fines during high flows, with the coarse fragments occurring deep in the profiles, representing earlier aggradation of coarse sediments.

Figure 21. The shrubby aspect of theNarrowleaf Cottonwood/New Mexico Alder community is evident on this island bar. A rich herbaceous flora is also present beneath the shrubs.

Figure 22. The Blue Spruce/New Mexico Alder community growing on a small island bar in the Middle Sub-segment. Note the debris collecting at the point of the bars.

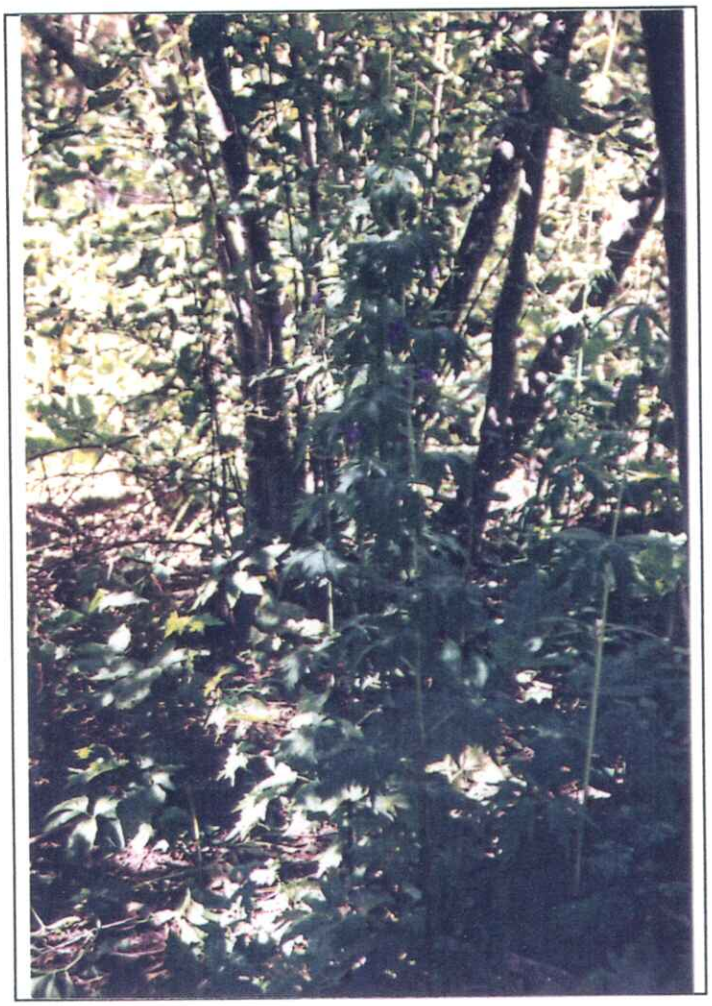


Figure 23. The undergrowth of the Blue Spruce/New Mexico Alder community can be rich and luxurious. Shown here in the foreground is monks hood (*Aconitum columbianum*).

Riparian Ecosystem Dynamics and Instream Flow

The two general channel morphologies (Type B and C) and their associated hydrological characteristics are correlated with two different types of riparian ecosystem dynamics. The confined, armored channel of Type B with its lack of a depositional flood plain, restricts the diversity of riparian communities that can be found there. These channels are lined essentially with only the New Mexico Alder/Redosier Dogwood community. The alder root crowns are generally established above the mean growing season maximum flow level, with roots extending down to the water table or approximately to the average growing season stage height (Figure 24). This position of the root crown allows for the roots to get at moisture for maintenance and growth, while avoiding continuous inundation and associated physical damage and low oxygen content soils. Alder under these conditions can grow into moderate sized trees. Blue spruce are occasionally found in this community but tend to be rooted at somewhat higher positions (Figure 25). High flows in this type of channel can lead to the removal of large trees and scouring of herbaceous vegetation. The community is seldom removed entirely. Alder appears to resprout quickly from the root crowns and maintains itself on the sites along with dogwood and honeysuckle. Repeated high flows will prevent the development of a significant tree canopy and keep the community as a whole in a low statured condition.

The depositional, less confined conditions of a Type C channel morphology lead to a more complex picture of ecosystem development (Figure 26). Channel migration or high sediment flow events can lead to the development of unconsolidated river bars. With repeated flooding and deposition (1 & 2 year events), the bars continue to develop. Coarse woody debris dams accelerate this developmental process. Perennial vegetation of the New Mexico Alder/Bluestem Willow community becomes rooted (particularly the reproduction of riparian trees), the bars become somewhat stabilized in the channel, and soils begin to develop (Figure 6).

Continued sediment accumulation on the point bars under higher flows (2-20 year floods) leads to further development of the bars and eventually the growth of a riparian forest of the Narrowleaf Cottonwood or Blue Spruce/New Mexico Alder communities. The soils become more aerated (Aeric Fluvaquents) and the species composition of the undergrowth changes in response. Reproduction of obligate riparian tree species on these higher, drier bars is usually unsuccessful. Hence, as the trees age and die, the bars become open and dominated by meadow grasses and forbs (Blue Spruce/blue grass community). These sites are seldom flooded (>25 years), and when they are, the force may be such as to scour the bars and terraces and remove them, returning the site to exposed non-vegetated river bar and the re-initiation of the cycle. This re-initiation is required for the sexual reproduction of cottonwoods. Without it, cottonwood is dependent on asexual suckering for maintenance on a site. Flows equivalent to the 100 year flood may be required to reset some sites in the floodplain. This complex process of riparian ecosystem development has been referred to as "site progression" by Leonard et al. (1992), and it is a critical process in the maintenance and growth of these communities.

Figure 24. New Mexico alder rooting along a rocky streambank during a typical September flow.

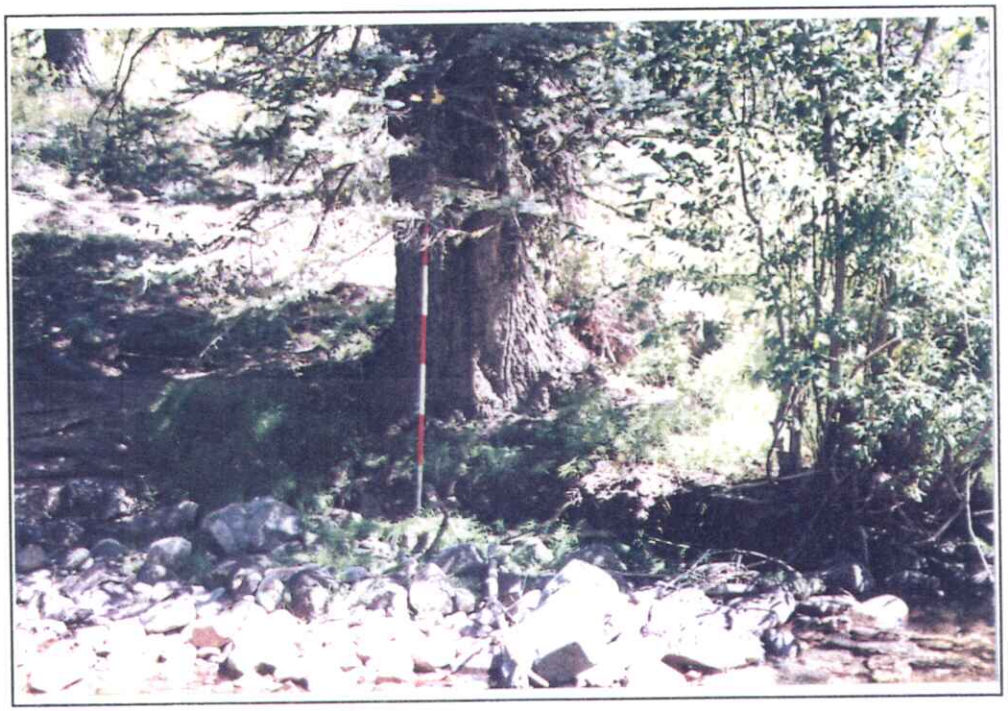
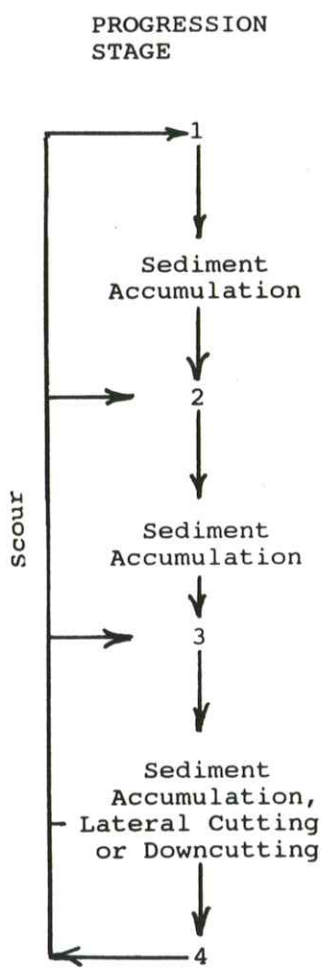


Figure 25. Blue Spruce rooting along a rocky stream bank. Note that the spruce root crown is established somewhat higher that the alder to the right. The flow is typical of September in this reach.



PROGRESSION STAGE	LANDFORM	VEGETATION COMMUNITY	SOIL TYPE	FLOOD RETURN INTERVAL
1	Exposed River Bar	Non-vegetated Annual Herbs	Riverwash	Yearly
2	Stabilized River Bar	Alder/Bluestem Willow	Typic Fluvaquent	1-2 yr
3	Aggregated River Bar	Cottonwood-Blue Spruce/ Alder	Aeric Fluvaquent	3-25 yr
4	River Terrace	Blue Spruce/ Blue Grass	Fluventic Dystochrepts Typic Udifluvents Oxyaquic Udifluvents	25-100+ yr

Figure 26. Schematic representation of site progression dynamics of montane riparian communities in the floodplain.

Fisheries

Fish Habitat Characteristics

In a broad sense fish productivity in a stream is controlled by factors such as geology, climate, vegetation, and soils, as well as the hydrology of the watershed. Given these broad constraints, fish production is also influenced on a smaller scale by habitat factors such as pool:riffle ratios, availability of quality spawning gravel, undercut banks, and large woody material.

On the average, the Pecos River appears to be dominated by riffle habitat. Riffles occupy 60-70 % of the available habitat, while pools occupy 30-40%. With respect to substrate, the stream bed is primarily composed of large gravels and cobbles -- very fine sediments are usually found in low amounts (usually associated with low gradients and flows in side channels), and are not considered to be a problem. There are relatively low levels of gravel less than five centimeters in size, but adequate amounts of spawning gravel appear to be currently available. It appears that the stream is either lacking inputs of this size gravel, or it is being transported downstream and out of the system.

Large woody debris occurs on occasion in the stream, particularly in depositional reaches of lower gradient (Figure 27). These materials, which are derived from upstream riparian vegetation communities, play an important role in this stream by creating aquatic habitat diversity. Much of the spawning gravel in the river is directly associated with these material, or is found in adjacent low gradient areas. Woody debris also provides cover and escape areas for fish.

Habitat Availability and Stream Flow

Levels of instream flow are important in creating available habitat for fish production. If the broad climatic and geologic constraints can be thought of as a bottle, then stream flow would be representative of the large part of the bottle, and the fine grain habitat variables such as debris and spawning gravels would represent the bottleneck. The amount of water in the stream controls the amount of space available for fish. High flow periods shape the channel and can strongly determine substrate conditions.

Figure 27. Large woody debris pictured above are important in aquatic systems, providing important additions to the structure of fish habitat.

The effect various types of flows may also depend on what life stage a fish is in at the time of the flow. The approximate times that the various life stages of brown trout are present in the river are presented in Table 8. The incubation period occurs primarily over the winter months. Fry are evident during the spring, and develop into juveniles on into the rest of the year.

The results from the Physical Habitat Simulation model and observations made on the river during various flows indicate that the key factor for maintaining the current productivity for trout is space. In Figure 28, habitat availability for each major life stage is related to flow in the Upper, Middle and Lower Sub-segments (cross-sections in Figures 9, 14 & 15, respectively). The amount of space available is primarily related to the width and depth of the stream channel, and the water flow within the channel. Until the entire width of the channel is filled, additional increments of water add significant amounts of area which is available for fish use. After the stream width is filled, additional increments of water add volume, but little usable area. This added water depth increases fish habitat to a point. However, at very high flows both the water depth and average water velocity increase. In more confined channels (Type B), the useable fish habitat within the channels at these high flows remains fairly constant (Upper Sub-segment), or could actually decrease due to high velocities (Lower Sub-segment). Where the stream is less confined (Type C morphology), such as in the Middle Sub-segment, high flows access side channels and/or lower level floodplains, and additional fish habitat is made available.

Higher stream flows creating habitat for brown trout are most prevalent during the spring snowmelt, and correspond to the prevalence of the fry life stage of the fish. Such added available habitat at this time may be important in overall productivity of the fishery.

Habitat area was not modeled for other fish species that are present in the river, but in general, habitat requirements for other trout species would be similar to brown trout. However, the seasons of use would not be the same for incubation and fry life stages. Cutthroat and rainbow trout are spring spawners and rely on habitat provided during the spring snowmelt on into summer for incubation, and on the summer monsoon seasons for fry development.

Table 8. River presence of Brown trout by life stage.

Life Stage / Month	Incubation	Fry	Juvenile	Adult
January	X		X	X
February	X		X	X
March	X	X	X	X
April		X	X	X
May		X	X	X
June			X	X
July			X	X
August			X	X
September			X	X
October	X		X	X
November	X		X	X
December	X		X	X

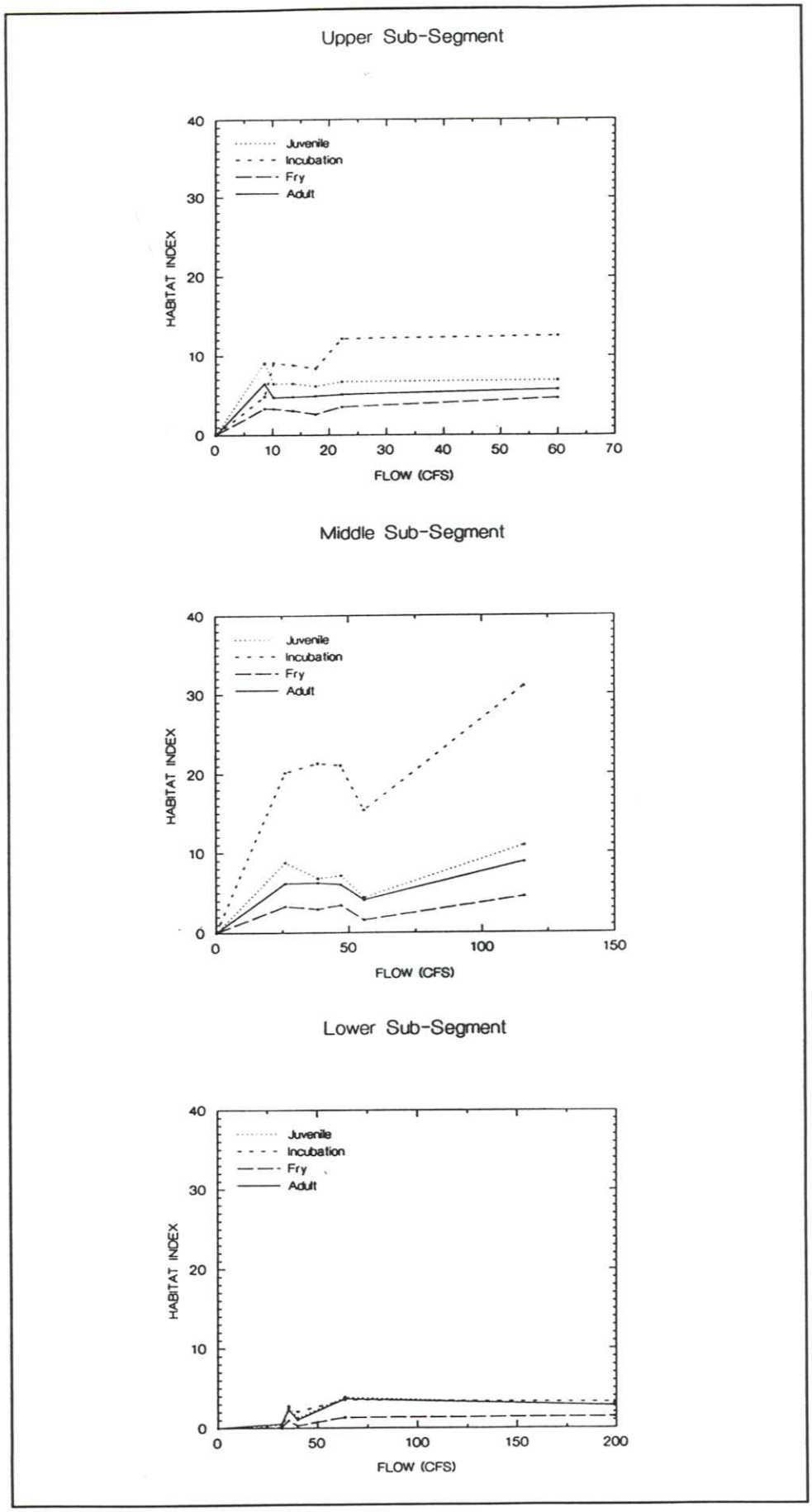


Figure 28. Results from the Physical Habitat Simulation System modeling showing the relationship between flows and available habitat for the incubation, fry, juvenile and adult life stages of brown trout in the Upper, Middle and Lower Sub-segments.

INSTREAM FLOW RECOMMENDATIONS

Riparian Communities

Riparian vegetation communities are dominated by species that depend directly on hydrological factors such as flooding and water table heights for maintenance, growth and reproduction. Hence, riparian ecosystems require sufficient base flows and certain periodic high flows to ensure proper functioning. Recommended flows for each vegetation community per Sub-segment are presented in Table 9. To maintain various obligate riparian species, a growing season average monthly flow must be maintained. Sustained low flows can lead to desiccation and death of obligate riparian species. Thus, a minimum flow must be maintained through the non-growing season, and daily flows should not be allowed to fall below a certain level at any time during the year for a duration of seven days or more (minimum daily/7 day period). Recommendations must also take into consideration site progression and riparian community development. Moderate to high flows are required to ensure channel migration and re-initiation of the progression cycle, as well as ongoing aggradation and development of the site and communities. This is particularly important for the reproduction and maintenance of narrowleaf cottonwood in the ecosystem. We recommend allowing moderate flows corresponding to the 2, 5 and 10 year recurrence interval peak flows on each sub-segment, along with a high, flow corresponding to the 25 year or greater flood.

In contrast, if flows are increased and sustained over a long-term (higher than the current mean monthly flows), they may have a negative effect on vegetation along the lower margin of the riparian zone. Sustained inundation and associated low oxygen content soils, plus physical damage, will lead to a die off of lower margin vegetation, and in effect, a migration upward of the communities in the floodplain. Thus to maintain the vegetation in its current positions in the channel, flows should not be increased to the point where the growing season mean average flow is significantly increased.

Fisheries

We provide in Table 10 the recommended monthly instream flows which will maintain the present fish fauna and productivity in each sub-segment. Flows within a given month correspond to the mean seasonal average flows for Winter, or the non-growing season (October-March), Spring (April- June), and Summer Monsoon (July-September). If the stream should fall below these average values, physical space for the fish populations will be significantly reduced (particularly in winter). Also high peaks in flow following the guidelines for riparian communities will lead to a reshaping of the channels, debris transport and deposition, and the overall development of more complex habitat for the fishery (along with re-initiation and development of the adjacent riparian zone).

Table 9. Instream flow recommendations for riparian communities along each sub-segment reach of the upper Pecos River Recreation Segment from Tererro to the Pecos Wilderness Boundary.

Sub-Segment Interval	Upper (cfs)	Middle (cfs)	Lower (cfs)
Growing Season Monthly Average	45	91	149
Non-Growing Season Monthly Average	11	31	43
Minimum Daily/7 Day Period	9	26	26
Yearly Peak	49	99	163
Once in 2 Years	154	285	520
Once in 5 Years	265	481	894
Once in 10 Years	325	634	1,187
Once in 25 Years	475	853	1,606

Table 10. Pecos Wild and Scenic River fisheries instream flow recommendations by month and Sub-segment.

Sub-Segment Month	Upper	Middle	Lower
January	13	34	40
February	13	34	40
March	13	34	40
April	60	118	200
May	60	118	200
June	60	118	200
July	30	64	98
August	30	64	98
September	30	64	98
October	13	34	40
November	13	34	40
December	13	34	40

DISCUSSION

The instream flow recommendations provided Tables 9 & 10 are based on instream flow modeling, the historical flow regime (as reflected in a 29 year stream gage period of record), and recent direct measurement of the fishery and riparian zone conditions. This is a limited window of quantitative observation and may not be sufficient to evaluate the current status of the system in a larger historical setting. For example, it is possible that the period of record for the gage data does not represent the flow regime as it existed earlier in the century. Flow volumes may have decreased over time due to increased vegetative cover in the upper watershed and an associated lower available snow contributing to the spring runoff. Today, only the largest floods are able to inundate the adjacent floodplains. Little inundation of stream floodplains was observed in the study area during a 20-25 year flood that occurred on May 22, 1991.

It is also possible that the stream has downcut slightly and has become more armored as a result of lowered sediment contributions from the upland. Even if flows have remained fairly consistent, the amount of sediment load appears to be lower. The armored channel bed observed at many of the study sites is similar to channels observed within the first few miles downstream of reservoirs. Such channels are sediment starved because all bedload is trapped behind the dams. Over time, only particles too large to transport remain downstream, creating an armored channel similar to that found here. The increased vegetative density since the cessation of timber harvest and control of wildfire may be responsible for the lower sediment contributions leading to the channel armoring and/or channel downcutting.

Debris in the aquatic and riparian systems is important. Where large logs are found in the stream, turbulent flow conditions are created which scour deep pools. These pools provide important fish habitat for rearing both young and adult trout. The large logs can also create conditions for the deposition of smaller gravels suitable for trout spawning. Debris also plays an important role in the development of fluvial landforms and the site progression of riparian communities. As with sediment, woody debris conditions in the stream may be below historical levels as a function of the lowered disturbance in the upper watershed during recent years. Large trees are present in the riparian corridor, but few large conifer snags are observed, and larger trees appear to be relatively young. Beaver activity is currently low. The lack of dam and lodge building may also lead to lower effective debris contribution to the aquatic ecosystems. Few log jams or other woody debris are present. Overall, the Pecos River lacks significant complexity along most reaches of this study, and this is considered a major limiting factor in controlling fish productivity and the development of a more extensive riparian zone. The lack of development of riparian vegetation then negatively feeds back on woody debris contributions and further reduces available habitat.

Changes in watershed conditions probably have significantly impacted the flow regime, and will continue to do so. For example, if fire in the Wilderness is allowed to burn, and a natural fire regime is re-established, this may have a significant impact on water flow, sediment yield and transport and woody debris contributions. Hence, the flow recommendations provided above need to be considered within the context of the current management strategies of the watershed.

ACKNOWLEDGMENTS.

We would like thank Beth Puschel and Holly Kirchner for collecting field data. Roby Wallace and Elizabeth Milford of the New Mexico Natural Heritage Program made significant contributions to the field work and analysis. Also, we wish to thank Brian Hansen of the U.S. Fish and Wildlife Service for his efforts in conducting the fish habitat model simulations. Special thanks to Pete Tatchel of the Santa Fe National Forest, Pecos District and now retired.

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APPENDIX A.
Pecos Wild and Scenic River Instream Flow Report

Tables of results from the hydraulic modeling of flows through the surveyed cross-sections. Each table reports the estimated velocity in feet per second (Ft/s) and flow in cubic feet per second (CFS) through each cross-section based on the measured stream gradient (slope), a user's supplied Mannings "n" and the cross-sectional area of the stream as output by XSPRO (Grant et al. 1992).

Table A1. Cross-section 1 at Middle Sub-segment.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
0.92	-1	9.2	18.5	18.1	0.5	0.5	0.0068	0.062	1.2	11.54
0.92	-2	1.7	6.5	6.4	0.3	0.3	0.0068	0.065	0.8	1.25
0.92	-3	0.7	3.6	3.5	0.2	0.2	0.0068	0.063	0.6	0.43
0.92	-4	0.0	0.2	0.2	0.0	0.0	0.0068	0.064	0.1	0.00
0.92	4	11.6	28.8	28.2	0.4	0.4	0.0068	0.063	1.1	13.22
1.02	-1	11.1	19.5	19.0	0.6	0.6	0.0068	0.062	1.4	15.16
1.02	-2	2.3	7.3	7.1	0.3	0.3	0.0068	0.065	0.9	2.07
1.02	-3	1.1	4.8	4.7	0.2	0.2	0.0068	0.063	0.7	0.78
1.02	-4	0.1	1.4	1.4	0.1	0.1	0.0068	0.064	0.3	0.02
1.02	4	14.6	33.1	32.2	0.4	0.5	0.0068	0.062	1.1	18.02
1.12	-1	13.0	20.3	19.7	0.6	0.7	0.0068	0.062	1.5	19.37
1.12	-2	3.2	11.8	11.5	0.3	0.3	0.0068	0.065	0.8	2.54
1.12	-3	1.6	6.1	6.0	0.3	0.3	0.0068	0.063	0.8	1.30
1.12	-4	0.3	2.6	2.6	0.1	0.1	0.0068	0.063	0.4	0.12
1.12	4	18.1	40.8	39.7	0.4	0.5	0.0068	0.062	1.1	23.33
1.22	-1	15.0	21.1	20.3	0.7	0.7	0.0068	0.061	1.6	24.04
1.22	-2	4.6	15.1	14.7	0.3	0.3	0.0068	0.064	0.9	3.91
1.22	-3	2.3	7.4	7.3	0.3	0.3	0.0068	0.063	0.9	2.03
1.22	-4	0.6	4.0	3.9	0.2	0.2	0.0068	0.063	0.6	0.33
1.22	-5	0.0	0.6	0.6	0.0	0.0	0.0068	0.063	0.1	0.00
1.22	5	22.5	48.1	46.8	0.5	0.5	0.0068	0.062	1.2	30.32
1.32	-1	17.1	21.7	20.9	0.8	0.8	0.0068	0.061	1.7	29.35
1.32	-2	6.1	16.9	16.3	0.4	0.4	0.0068	0.064	1.0	5.95
1.32	-3	3.1	8.8	8.6	0.4	0.4	0.0068	0.062	1.0	3.01
1.32	-4	1.1	5.7	5.6	0.2	0.2	0.0068	0.063	0.6	0.69
1.32	-5	0.2	3.6	3.6	0.1	0.1	0.0068	0.062	0.3	0.07
1.32	5	27.6	56.6	55.0	0.5	0.5	0.0068	0.062	1.2	39.07
1.42	-1	19.2	22.1	21.2	0.9	0.9	0.0068	0.061	1.8	35.30
1.42	-2	7.8	18.6	18.0	0.4	0.4	0.0068	0.064	1.1	8.46
1.42	-3	4.0	10.7	10.5	0.4	0.4	0.0068	0.062	1.0	4.14
1.42	-4	1.7	7.4	7.3	0.2	0.2	0.0068	0.063	0.7	1.27
1.42	-5	0.7	6.6	6.6	0.1	0.1	0.0068	0.062	0.5	0.33
1.42	5	33.5	65.4	63.7	0.5	0.5	0.0068	0.062	1.3	49.50
1.52	-1	21.3	22.5	21.6	0.9	1.0	0.0068	0.061	2.0	41.73
1.52	-2	9.7	21.0	20.2	0.5	0.5	0.0068	0.063	1.2	11.32
1.52	-3	5.2	12.3	12.1	0.4	0.4	0.0068	0.062	1.1	5.75
1.52	-4	2.5	9.1	9.0	0.3	0.3	0.0068	0.062	0.8	2.12
1.52	-5	1.4	7.6	7.6	0.2	0.2	0.0068	0.062	0.7	0.94
1.52	5	40.2	72.5	70.6	0.6	0.6	0.0068	0.062	1.3	61.87
1.62	-1	23.5	22.9	21.9	1.0	1.1	0.0068	0.060	2.1	48.65
1.62	-2	11.9	22.9	22.1	0.5	0.5	0.0068	0.063	1.3	14.89
1.62	-3	6.4	13.1	12.9	0.5	0.5	0.0068	0.062	1.2	7.94
1.62	-4	3.5	11.2	11.0	0.3	0.3	0.0068	0.062	0.9	3.26
1.62	-5	2.2	8.6	8.5	0.3	0.3	0.0068	0.062	0.8	1.84
1.62	5	47.6	78.7	76.5	0.6	0.6	0.0068	0.061	1.4	76.58
1.72	-1	25.8	24.1	23.0	1.1	1.1	0.0068	0.060	2.1	54.99
1.72	-2	14.1	23.6	22.7	0.6	0.6	0.0068	0.063	1.4	19.58
1.72	-3	7.7	14.0	13.7	0.6	0.6	0.0068	0.061	1.4	10.49
1.72	-4	4.8	14.7	14.5	0.3	0.3	0.0068	0.062	0.9	4.56
1.72	-5	3.1	9.5	9.4	0.3	0.3	0.0068	0.061	1.0	3.02
1.72	5	55.6	85.8	83.3	0.6	0.7	0.0068	0.061	1.5	92.64
1.82	-1	28.1	25.5	24.4	1.1	1.2	0.0068	0.060	2.2	61.48
1.82	-2	16.4	24.3	23.3	0.7	0.7	0.0068	0.062	1.5	24.83
1.82	-3	9.2	14.8	14.5	0.6	0.6	0.0068	0.061	1.5	13.40
1.82	-4	6.4	18.1	18.0	0.4	0.4	0.0068	0.062	1.0	6.46
1.82	-5	4.1	10.4	10.3	0.4	0.4	0.0068	0.061	1.1	4.49
1.82	5	64.2	93.1	90.4	0.7	0.7	0.0068	0.061	1.6	110.66
1.92	-1	30.6	27.0	25.9	1.1	1.2	0.0068	0.060	2.2	68.60

Table A1 (Continued). Cross-section 1 .

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
1.92	-2	18.8	25.0	23.8	0.8	0.8	0.0068	0.062	1.6	30.64
1.92	-3	10.7	15.6	15.3	0.7	0.7	0.0068	0.061	1.6	16.69
1.92	-4	8.4	21.6	21.4	0.4	0.4	0.0068	0.061	1.1	9.00
1.92	-5	5.2	11.3	11.1	0.5	0.5	0.0068	0.061	1.2	6.26
1.92	5	73.6	100.4	97.5	0.7	0.8	0.0068	0.061	1.6	131.19
2.02	-1	33.3	28.4	27.3	1.2	1.2	0.0068	0.060	2.3	76.37
2.02	-2	21.2	28.0	26.8	0.8	0.8	0.0068	0.062	1.7	35.18
2.02	-3	12.2	16.4	16.1	0.7	0.8	0.0068	0.061	1.7	20.37
2.02	-4	10.8	28.7	28.5	0.4	0.4	0.0068	0.061	1.1	11.41
2.02	-5	6.4	12.2	12.0	0.5	0.5	0.0068	0.061	1.3	8.35
2.02	5	83.9	113.7	110.6	0.7	0.8	0.0068	0.061	1.7	151.67
2.12	-1	36.1	29.9	28.7	1.2	1.3	0.0068	0.059	2.3	84.82
2.12	-2	24.0	28.6	27.3	0.8	0.9	0.0068	0.061	1.8	42.62
2.12	-3	13.9	17.3	16.9	0.8	0.8	0.0068	0.060	1.8	24.46
2.12	-4	13.8	31.2	31.0	0.4	0.4	0.0068	0.061	1.2	16.30
2.12	-5	7.6	13.8	13.6	0.6	0.6	0.0068	0.060	1.4	10.41
2.12	5	95.4	120.7	117.5	0.8	0.8	0.0068	0.060	1.7	178.60
2.22	-1	39.0	31.3	30.1	1.2	1.3	0.0068	0.059	2.4	93.98
2.22	-2	26.7	28.8	27.5	0.9	1.0	0.0068	0.061	1.9	51.05
2.22	-3	15.6	18.1	17.7	0.9	0.9	0.0068	0.060	1.9	28.97
2.22	-4	17.1	33.2	33.0	0.5	0.5	0.0068	0.060	1.3	22.25
2.22	-5	9.2	17.5	17.2	0.5	0.5	0.0068	0.060	1.3	12.27
2.22	5	107.6	128.9	125.6	0.8	0.9	0.0068	0.060	1.8	208.53
2.32	-1	42.1	32.8	31.5	1.3	1.3	0.0068	0.059	2.5	103.89
2.32	-2	29.5	29.0	27.7	1.0	1.1	0.0068	0.061	2.0	60.16
2.32	-3	17.4	18.9	18.5	0.9	0.9	0.0068	0.060	1.9	33.92
2.32	-4	20.4	33.2	33.0	0.6	0.6	0.0068	0.060	1.5	30.02
2.32	-5	10.9	17.6	17.3	0.6	0.6	0.0068	0.060	1.5	16.33
2.32	5	120.3	131.6	128.1	0.9	0.9	0.0068	0.060	1.9	244.31
2.42	-1	45.3	34.2	33.0	1.3	1.4	0.0068	0.059	2.5	114.56
2.42	-2	32.3	29.2	27.9	1.1	1.2	0.0068	0.061	2.2	69.93
2.42	-3	19.3	19.7	19.3	1.0	1.0	0.0068	0.059	2.0	39.32
2.42	-4	23.7	33.2	33.0	0.7	0.7	0.0068	0.060	1.6	38.74
2.42	-5	12.6	17.7	17.4	0.7	0.7	0.0068	0.059	1.6	20.86
2.42	5	133.2	134.2	130.6	1.0	1.0	0.0068	0.060	2.1	283.40
2.52	-1	48.7	35.7	34.4	1.4	1.4	0.0068	0.058	2.6	126.03
2.52	-2	35.1	29.4	28.1	1.2	1.2	0.0068	0.060	2.3	80.39
2.52	-3	21.3	20.6	20.1	1.0	1.1	0.0068	0.059	2.1	45.19
2.52	-4	27.0	33.2	33.0	0.8	0.8	0.0068	0.060	1.8	48.38
2.52	-5	14.4	17.9	17.5	0.8	0.8	0.0068	0.059	1.8	25.85
2.52	5	146.4	136.8	133.1	1.1	1.1	0.0068	0.059	2.2	325.84
2.62	-1	52.2	37.4	36.0	1.4	1.4	0.0068	0.058	2.6	137.74
2.62	-2	37.9	29.6	28.3	1.3	1.3	0.0068	0.060	2.4	91.54
2.62	-3	23.3	21.4	20.9	1.1	1.1	0.0068	0.059	2.2	51.55
2.62	-4	30.3	33.2	33.0	0.9	0.9	0.0068	0.059	1.9	58.92
2.62	-5	16.2	18.0	17.6	0.9	0.9	0.0068	0.059	1.9	31.29
2.62	5	159.9	139.7	135.8	1.1	1.2	0.0068	0.059	2.3	371.04
2.72	-1	55.9	39.5	38.1	1.4	1.5	0.0068	0.058	2.7	149.54
2.72	-2	40.7	29.8	28.4	1.4	1.4	0.0068	0.060	2.5	103.34
2.72	-3	25.5	22.2	21.7	1.1	1.2	0.0068	0.059	2.3	58.41
2.72	-4	33.6	33.2	33.0	1.0	1.0	0.0068	0.059	2.1	70.35
2.72	-5	17.9	18.2	17.7	1.0	1.0	0.0068	0.059	2.1	37.17
2.72	5	173.6	142.9	138.9	1.2	1.2	0.0068	0.059	2.4	418.81
2.82	-1	59.8	41.5	40.1	1.4	1.5	0.0068	0.058	2.7	162.38
2.82	-2	43.6	30.0	28.6	1.5	1.5	0.0068	0.059	2.7	115.80
2.82	-3	27.7	23.1	22.5	1.2	1.2	0.0068	0.058	2.4	65.79

Table A1 (Continued). Cross-section 1

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
2.82	-4	36.9	33.2	33.0	1.1	1.1	0.0068	0.059	2.2	82.65
2.82	-5	19.7	18.3	17.8	1.1	1.1	0.0068	0.058	2.2	43.48
2.82	5	187.6	146.1	142.0	1.3	1.3	0.0068	0.058	2.5	470.10
2.92	-1	64.0	43.6	42.1	1.5	1.5	0.0068	0.058	2.8	176.30
2.92	-2	46.4	30.2	28.7	1.5	1.6	0.0068	0.059	2.8	128.92
2.92	-3	30.0	23.9	23.3	1.3	1.3	0.0068	0.058	2.5	73.70
2.92	-4	40.2	33.2	33.0	1.2	1.2	0.0068	0.058	2.4	95.80
2.92	-5	21.5	18.5	17.9	1.2	1.2	0.0068	0.058	2.3	50.22
2.92	5	202.0	149.4	145.1	1.4	1.4	0.0068	0.058	2.6	524.95
3.02	-1	68.3	45.3	43.8	1.5	1.6	0.0068	0.057	2.8	192.39
3.02	-2	49.3	30.4	28.9	1.6	1.7	0.0068	0.059	2.9	142.71
3.02	-3	32.3	24.7	24.1	1.3	1.3	0.0068	0.058	2.5	82.26
3.02	-4	43.5	33.2	33.0	1.3	1.3	0.0068	0.058	2.5	109.81
3.02	-5	23.3	18.6	18.0	1.3	1.3	0.0068	0.058	2.5	57.40*
3.02	5	216.7	152.2	147.8	1.4	1.5	0.0068	0.058	2.7	584.56*
3.12	-1	72.7	45.5	43.9	1.6	1.7	0.0068	0.057	2.9	213.75
3.12	-2	52.2	30.5	29.0	1.7	1.8	0.0068	0.058	3.0	157.15
3.12	-3	34.8	25.6	25.0	1.4	1.4	0.0068	0.058	2.6	91.10
3.12	-4	46.8	33.2	33.0	1.4	1.4	0.0068	0.058	2.7	124.65
3.12	-5	25.1	18.7	18.0	1.3	1.4	0.0068	0.058	2.6	65.05*
3.12	5	231.5	153.5	149.0	1.5	1.6	0.0068	0.058	2.8	651.70*
3.22	-1	77.1	45.6	44.1	1.7	1.7	0.0068	0.057	3.1	236.08
3.22	-2	55.1	30.7	29.2	1.8	1.9	0.0068	0.058	3.1	172.26
3.22	-3	37.3	26.5	25.9	1.4	1.4	0.0068	0.057	2.7	100.54
3.22	-4	50.1	33.2	33.0	1.5	1.5	0.0068	0.058	2.8	140.34
3.22	-5	26.9	18.8	18.0	1.4	1.5	0.0068	0.057	2.7	73.09*
3.22	5	246.5	154.9	150.2	1.6	1.6	0.0068	0.057	2.9	722.32*
3.32	-1	81.5	45.8	44.2	1.8	1.8	0.0068	0.057	3.2	259.38
3.32	-2	58.0	30.9	29.4	1.9	2.0	0.0068	0.058	3.2	188.04
3.32	-3	40.0	27.4	26.8	1.5	1.5	0.0068	0.057	2.8	110.63
3.32	-4	53.4	33.2	33.0	1.6	1.6	0.0068	0.057	2.9	156.86
3.32	-5	28.7	18.9	18.0	1.5	1.6	0.0068	0.057	2.8	81.51*
3.32	5	261.5	156.3	151.4	1.7	1.7	0.0068	0.057	3.0	796.42*
3.42	-1	85.9	46.0	44.4	1.9	1.9	0.0068	0.056	3.3	283.67
3.42	-2	61.0	31.1	29.5	2.0	2.1	0.0068	0.057	3.4	204.50
3.42	-3	42.7	28.3	27.8	1.5	1.5	0.0068	0.057	2.8	121.37
3.42	-4	56.7	33.2	33.0	1.7	1.7	0.0068	0.057	3.1	174.21
3.42	-5	30.5	19.0	18.0	1.6	1.7	0.0068	0.057	3.0	90.32*
3.42	5	276.7	157.7	152.6	1.8	1.8	0.0068	0.057	3.1	874.06*
3.52	-1	90.3	46.2	44.5	2.0	2.0	0.0068	0.056	3.4	308.96
3.52	-2	63.9	31.3	29.7	2.0	2.2	0.0068	0.057	3.5	221.63
3.52	-3	45.5	29.3	28.7	1.6	1.6	0.0068	0.057	2.9	132.78
3.52	-4	60.0	33.2	33.0	1.8	1.8	0.0068	0.057	3.2	192.39
3.52	-5	32.3	19.1	18.0	1.7	1.8	0.0068	0.057	3.1	99.49*
3.52	5	292.1	159.1	153.9	1.8	1.9	0.0068	0.057	3.3	955.27*
3.62	-1	94.8	46.4	44.7	2.0	2.1	0.0068	0.056	3.5	335.25
3.62	-2	66.9	31.5	29.8	2.1	2.2	0.0068	0.057	3.6	239.45
3.62	-3	48.4	30.2	29.6	1.6	1.6	0.0068	0.056	3.0	144.90
3.62	-4	63.3	33.2	33.0	1.9	1.9	0.0068	0.056	3.3	211.41
3.62	-5	34.1	19.2	18.0	1.8	1.9	0.0068	0.056	3.2	109.04*
3.62	5	307.5	160.5	155.1	1.9	2.0	0.0068	0.056	3.4	1040.05*
3.72	-1	99.3	46.6	44.8	2.1	2.2	0.0068	0.056	3.7	362.54
3.72	-2	69.9	31.7	30.0	2.2	2.3	0.0068	0.056	3.7	257.97
3.72	-3	51.5	31.1	30.5	1.7	1.7	0.0068	0.056	3.1	157.74
3.72	-4	66.6	33.2	33.0	2.0	2.0	0.0068	0.056	3.5	231.26
3.72	-5	35.9	19.3	18.0	1.9	2.0	0.0068	0.056	3.3	118.95*

Table A1 (Continued). Cross-section 1

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
3.72	5	323.1	161.9	156.3	2.0	2.1	0.0068	0.056	3.5	1128.45*
3.82	-1	103.8	46.7	45.0	2.2	2.3	0.0068	0.056	3.8	390.83
3.82	-2	72.9	31.9	30.1	2.3	2.4	0.0068	0.056	3.8	277.18
3.82	-3	54.5	32.0	31.4	1.7	1.7	0.0068	0.056	3.1	171.33
3.82	-4	69.9	33.2	33.0	2.1	2.1	0.0068	0.056	3.6	251.94
3.82	-5	37.7	19.4	18.0	1.9	2.1	0.0068	0.056	3.4	129.22*
3.82	5	338.8	163.3	157.5	2.1	2.2	0.0068	0.056	3.6	1220.49*
3.92	-1	108.3	46.9	45.1	2.3	2.4	0.0068	0.055	3.9	420.12
3.92	-2	75.9	32.0	30.3	2.4	2.5	0.0068	0.056	3.9	297.10
3.92	-3	57.7	33.0	32.3	1.8	1.8	0.0068	0.056	3.2	185.69
3.92	-4	73.2	33.2	33.0	2.2	2.2	0.0068	0.056	3.7	273.46
3.92	-5	39.5	19.5	18.0	2.0	2.2	0.0068	0.056	3.5	139.85*
3.92	5	354.6	164.6	158.8	2.2	2.2	0.0068	0.056	3.7	1316.21*
4.02	-1	112.8	47.1	45.3	2.4	2.5	0.0068	0.055	4.0	450.41
4.02	-2	79.0	32.2	30.5	2.5	2.6	0.0068	0.056	4.0	317.73
4.02	-3	61.0	33.9	33.2	1.8	1.8	0.0068	0.055	3.3	200.83
4.02	-4	76.5	33.2	33.0	2.3	2.3	0.0068	0.055	3.9	295.81
4.02	-5	41.3	19.6	18.0	2.1	2.3	0.0068	0.055	3.7	150.83*
4.02	5	370.5	166.0	160.0	2.2	2.3	0.0068	0.055	3.8	1415.63*
4.12	-1	117.3	47.3	45.4	2.5	2.6	0.0068	0.055	4.1	481.72
4.12	-2	82.0	32.4	30.6	2.5	2.7	0.0068	0.055	4.1	339.09
4.12	-3	64.4	34.8	34.2	1.9	1.9	0.0068	0.055	3.4	216.80
4.12	-4	79.8	33.2	33.0	2.4	2.4	0.0068	0.055	4.0	319.02
4.12	-5	43.1	19.7	18.0	2.2	2.4	0.0068	0.055	3.8	162.18*
4.12	5	386.6	167.4	161.2	2.3	2.4	0.0068	0.055	3.9	1518.80*
4.22	-1	121.9	47.5	45.6	2.6	2.7	0.0068	0.055	4.2	514.04
4.22	-2	85.1	32.6	30.8	2.6	2.8	0.0068	0.055	4.2	361.17
4.22	-3	67.8	35.7	35.1	1.9	1.9	0.0068	0.055	3.4	233.60
4.22	-4	83.1	33.2	33.0	2.5	2.5	0.0068	0.055	4.1	343.07
4.22	-5	44.9	19.8	18.0	2.3	2.5	0.0068	0.055	3.9	173.87*
4.22	5	402.8	168.8	162.4	2.4	2.5	0.0068	0.055	4.0	1625.76*
4.32	-1	126.4	47.7	45.7	2.7	2.8	0.0068	0.054	4.3	547.39
4.32	-2	88.2	32.8	30.9	2.7	2.9	0.0068	0.055	4.4	384.00
4.32	-3	71.4	36.6	36.0	1.9	2.0	0.0068	0.054	3.5	251.27
4.32	-4	86.4	33.2	33.0	2.6	2.6	0.0068	0.055	4.3	367.97
4.32	-5	46.7	19.9	18.0	2.3	2.6	0.0068	0.054	4.0	185.92*
4.32	5	419.1	170.2	163.7	2.5	2.6	0.0068	0.054	4.1	1736.54*
4.42	-1	131.0	47.8	45.9	2.7	2.9	0.0068	0.054	4.4	581.75
4.42	-2	91.3	33.0	31.1	2.8	2.9	0.0068	0.054	4.5	407.58
4.42	-3	75.0	37.6	36.9	2.0	2.0	0.0068	0.054	3.6	269.83
4.42	-4	89.7	33.2	33.0	2.7	2.7	0.0068	0.054	4.4	393.73
4.42	-5	48.5	20.0	18.0	2.4	2.7	0.0068	0.054	4.1	198.31*
4.42	5	435.5	171.6	164.9	2.5	2.6	0.0068	0.054	4.2	1851.20*
4.50	-1	134.7	48.0	46.0	2.8	2.9	0.0068	0.054	4.5	609.99
4.50	-2	93.8	33.0	31.1	2.8	3.0	0.0068	0.054	4.6	428.08
4.50	-3	78.0	37.7	37.0	2.1	2.1	0.0068	0.054	3.7	288.45
4.50	-4	92.3	33.2	33.0	2.8	2.8	0.0068	0.054	4.5	414.96
4.50	-5	49.9	20.1	18.0	2.5	2.8	0.0068	0.054	4.2	208.48*
4.50	5	448.7	171.9	165.1	2.6	2.7	0.0068	0.054	4.3	1949.95*

Table A2. Cross-section 2.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
1.45	1	23.4	36.9	36.4	0.6	0.6	0.0168	0.046	3.1	72.45
1.55	1	27.1	38.1	37.6	0.7	0.7	0.0168	0.046	3.4	91.03
1.65	1	30.9	39.2	38.7	0.8	0.8	0.0168	0.046	3.6	111.85
1.75	1	34.8	40.0	39.3	0.9	0.9	0.0168	0.045	3.9	135.50
1.85	1	38.8	40.4	39.7	1.0	1.0	0.0168	0.045	4.2	161.74
1.95	1	42.8	40.9	40.1	1.0	1.1	0.0168	0.045	4.4	190.03
2.05	1	46.8	41.3	40.5	1.1	1.2	0.0168	0.045	4.7	220.38
2.15	1	50.9	41.8	40.9	1.2	1.2	0.0168	0.044	5.0	252.76
2.25	1	55.0	42.2	41.3	1.3	1.3	0.0168	0.044	5.2	287.19
2.35	1	59.1	42.7	41.7	1.4	1.4	0.0168	0.044	5.5	323.66
2.45	1	63.3	43.1	42.0	1.5	1.5	0.0168	0.044	5.7	362.18
2.55	1	67.5	43.6	42.4	1.5	1.6	0.0168	0.043	6.0	402.77
2.65	1	71.8	44.1	42.8	1.6	1.7	0.0168	0.043	6.2	445.35
2.75	1	76.1	44.6	43.3	1.7	1.8	0.0168	0.043	6.4	489.72
2.85	1	80.4	45.1	43.7	1.8	1.8	0.0168	0.043	6.7	536.20
2.95	1	84.8	45.6	44.2	1.9	1.9	0.0168	0.042	6.9	584.81
3.05	1	89.3	46.1	44.7	1.9	2.0	0.0168	0.042	7.1	635.26
3.15	1	93.8	46.8	45.3	2.0	2.1	0.0168	0.042	7.3	686.61
3.25	1	98.3	47.5	46.0	2.1	2.1	0.0168	0.042	7.5	740.23
3.35	1	103.0	48.2	46.6	2.1	2.2	0.0168	0.041	7.7	796.17
3.45	1	107.7	48.9	47.3	2.2	2.3	0.0168	0.041	7.9	854.95
3.55	1	112.4	49.4	47.8	2.3	2.4	0.0168	0.041	8.2	917.27
3.65	1	117.2	50.0	48.3	2.3	2.4	0.0168	0.041	8.4	982.04
3.75	1	122.1	50.6	48.8	2.4	2.5	0.0168	0.040	8.6	1049.30
3.85	1	127.0	51.1	49.3	2.5	2.6	0.0168	0.040	8.8	1119.11
3.95	1	132.0	52.6	50.9	2.5	2.6	0.0168	0.040	8.9	1177.48
4.05	1	137.2	54.2	52.4	2.5	2.6	0.0168	0.040	9.0	1238.94
4.15	1	142.5	55.7	53.9	2.6	2.6	0.0168	0.039	9.2	1303.57
4.25	1	147.9	57.2	55.4	2.6	2.7	0.0168	0.039	9.3	1371.48
4.35	1	153.5	58.7	56.8	2.6	2.7	0.0168	0.039	9.4	1444.09
4.45	1	159.3	59.4	57.5	2.7	2.8	0.0168	0.039	9.6	1532.07
4.55	1	165.0	60.1	58.2	2.7	2.8	0.0168	0.039	9.8	1623.25
4.65	1	170.9	60.8	58.8	2.8	2.9	0.0168	0.038	10.1	1717.70
4.75	1	176.8	61.5	59.5	2.9	3.0	0.0168	0.038	10.3	1815.49
4.85	1	182.8	62.2	60.2	2.9	3.0	0.0168	0.038	10.5	1916.70
4.95	1	188.8	62.9	60.9	3.0	3.1	0.0168	0.038	10.7	2021.41
5.05	1	195.0	63.6	61.6	3.1	3.2	0.0168	0.037	10.9	2129.68
5.15	1	201.2	64.3	62.2	3.1	3.2	0.0168	0.037	11.1	2242.22
5.25	1	207.4	64.9	62.7	3.2	3.3	0.0168	0.037	11.4	2360.96
5.35	1	213.7	65.5	63.3	3.3	3.4	0.0168	0.037	11.6	2483.48
5.45	1	220.1	66.0	63.8	3.3	3.4	0.0168	0.036	11.9	2609.88
5.55	1	226.5	66.6	64.3	3.4	3.5	0.0168	0.036	12.1	2740.21
5.65	1	232.9	67.2	64.8	3.5	3.6	0.0168	0.036	12.3	2874.58
5.75	1	239.4	67.8	65.4	3.5	3.7	0.0168	0.036	12.6	3013.07
5.85	1	246.0	68.3	65.9	3.6	3.7	0.0168	0.035	12.8	3155.76
5.95	1	252.6	68.9	66.4	3.7	3.8	0.0168	0.035	13.1	3302.75
6.00	1	255.9	69.2	66.7	3.7	3.8	0.0168	0.035	13.2	3377.88

Table A3. Cross-section 3.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
1.95	1	27.3	33.2	32.7	0.8	0.8	0.0026	0.041	1.6	44.27
2.05	1	30.6	35.2	34.5	0.9	0.9	0.0026	0.041	1.7	51.89
2.15	-1	34.2	37.0	36.3	0.9	0.9	0.0026	0.041	1.8	60.36
2.15	-2	0.0	1.5	1.5	0.0	0.0	0.0026	0.043	0.2	0.01
2.15	2	34.2	38.5	37.8	0.9	0.9	0.0026	0.041	1.7	60.37
2.25	-1	37.8	37.5	36.7	1.0	1.0	0.0026	0.041	1.9	71.13
2.25	-2	0.4	5.3	5.3	0.1	0.1	0.0026	0.043	0.3	0.12
2.25	2	38.2	42.8	42.0	0.9	0.9	0.0026	0.041	1.7	71.25
2.35	-1	41.5	37.8	36.9	1.1	1.1	0.0026	0.041	2.0	82.83
2.35	-2	1.1	9.1	9.0	0.1	0.1	0.0026	0.042	0.4	0.48
2.35	2	42.6	46.8	45.9	0.9	0.9	0.0026	0.041	1.8	83.32
2.45	-1	45.2	38.1	37.1	1.2	1.2	0.0026	0.040	2.1	95.29
2.45	-2	2.2	12.3	12.3	0.2	0.2	0.0026	0.042	0.6	1.23
2.45	2	47.4	50.4	49.4	0.9	1.0	0.0026	0.040	1.8	96.51
2.55	-1	48.9	38.4	37.4	1.3	1.3	0.0026	0.040	2.2	108.48
2.55	-2	3.5	14.1	14.0	0.2	0.3	0.0026	0.042	0.7	2.49
2.55	2	52.4	52.5	51.4	1.0	1.0	0.0026	0.040	1.9	110.97
2.65	-1	52.7	38.7	37.6	1.4	1.4	0.0026	0.040	2.3	122.40
2.65	-2	4.9	14.9	14.7	0.3	0.3	0.0026	0.042	0.9	4.29
2.65	2	57.6	53.6	52.3	1.1	1.1	0.0026	0.040	2.0	126.68
2.75	-1	56.4	39.0	37.8	1.4	1.5	0.0026	0.040	2.4	137.04
2.75	-2	6.4	15.6	15.5	0.4	0.4	0.0026	0.042	1.0	6.50
2.75	2	62.9	54.6	53.3	1.2	1.2	0.0026	0.040	2.1	143.54
2.85	-1	60.2	39.3	38.0	1.5	1.6	0.0026	0.040	2.5	152.40
2.85	-2	8.0	16.3	16.2	0.5	0.5	0.0026	0.042	1.1	9.12
2.85	2	68.3	55.6	54.2	1.2	1.3	0.0026	0.040	2.2	161.52
2.95	-1	64.1	39.6	38.3	1.6	1.7	0.0026	0.040	2.6	168.46
2.95	-2	9.7	17.1	16.9	0.6	0.6	0.0026	0.041	1.3	12.14
2.95	2	73.7	56.7	55.1	1.3	1.3	0.0026	0.040	2.3	180.61
3.05	-1	67.9	39.9	38.5	1.7	1.8	0.0026	0.040	2.7	185.24
3.05	-2	11.4	19.4	19.2	0.6	0.6	0.0026	0.041	1.3	14.77
3.05	2	79.3	59.3	57.7	1.3	1.4	0.0026	0.040	2.3	200.01
3.15	-1	71.8	40.2	38.7	1.8	1.9	0.0026	0.040	2.8	202.71
3.15	-2	13.6	24.2	23.9	0.6	0.6	0.0026	0.041	1.3	17.08
3.15	2	85.3	64.4	62.6	1.3	1.4	0.0026	0.040	2.3	219.79
3.25	-1	75.6	40.5	38.9	1.9	1.9	0.0026	0.039	2.9	220.89
3.25	-2	16.2	27.4	27.1	0.6	0.6	0.0026	0.041	1.3	21.05
3.25	2	91.8	67.9	66.0	1.4	1.4	0.0026	0.040	2.3	241.94
3.35	-1	79.5	40.8	39.2	1.9	2.0	0.0026	0.039	3.0	239.76
3.35	-2	19.0	30.1	29.7	0.6	0.6	0.0026	0.041	1.4	25.97
3.35	2	98.5	70.9	68.9	1.4	1.4	0.0026	0.040	2.4	265.73
3.45	-1	83.5	41.1	39.4	2.0	2.1	0.0026	0.039	3.1	259.33
3.45	-2	22.1	32.3	31.8	0.7	0.7	0.0026	0.041	1.4	32.01
3.45	2	105.5	73.4	71.2	1.4	1.5	0.0026	0.040	2.4	291.33
3.55	-1	87.4	41.4	39.6	2.1	2.2	0.0026	0.039	3.2	279.59
3.55	-2	25.4	34.2	33.6	0.7	0.8	0.0026	0.041	1.5	38.96
3.55	2	112.8	75.6	73.2	1.5	1.5	0.0026	0.039	2.5	318.55
3.65	-1	91.4	41.7	39.9	2.2	2.3	0.0026	0.039	3.3	300.55
3.65	-2	28.8	35.7	35.0	0.8	0.8	0.0026	0.040	1.6	46.98
3.65	2	120.2	77.4	74.9	1.6	1.6	0.0026	0.039	2.6	347.52
3.75	-1	95.4	42.0	40.1	2.3	2.4	0.0026	0.039	3.4	322.16
3.75	-2	32.4	37.4	36.7	0.9	0.9	0.0026	0.040	1.7	55.51
3.75	2	127.8	79.4	76.8	1.6	1.7	0.0026	0.039	2.7	377.67
3.85	-1	99.4	42.3	40.4	2.3	2.5	0.0026	0.039	3.5	344.38
3.85	-2	36.2	40.0	39.2	0.9	0.9	0.0026	0.040	1.8	64.10
3.85	2	135.6	82.4	79.6	1.6	1.7	0.0026	0.039	2.7	408.48
3.95	-1	103.5	42.7	40.6	2.4	2.5	0.0026	0.039	3.6	367.30
3.95	-2	40.4	46.6	45.7	0.9	0.9	0.0026	0.040	1.7	69.95

Table A3 (Continued). Cross-section 3

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
3.95	2	143.8	89.2	86.3	1.6	1.7	0.0026	0.039	2.7	437.25
4.05	-1	107.5	43.0	40.9	2.5	2.6	0.0026	0.039	3.6	390.92
4.05	-2	45.0	47.8	46.8	0.9	1.0	0.0026	0.040	1.8	82.70
4.05	2	152.5	90.8	87.7	1.7	1.7	0.0026	0.039	2.8	473.62
4.15	-1	111.6	43.3	41.1	2.6	2.7	0.0026	0.038	3.7	415.25
4.15	-2	49.8	49.6	48.6	1.0	1.0	0.0026	0.040	1.9	95.73
4.15	2	161.4	92.9	89.7	1.7	1.8	0.0026	0.039	2.8	510.98
4.25	-1	115.8	43.7	41.4	2.7	2.8	0.0026	0.038	3.8	440.29
4.25	-2	54.7	52.0	50.8	1.1	1.1	0.0026	0.039	2.0	109.25
4.25	2	170.5	95.6	92.2	1.8	1.8	0.0026	0.039	2.9	549.53
4.35	-1	119.9	44.0	41.7	2.7	2.9	0.0026	0.038	3.9	466.04
4.35	-2	59.9	54.3	53.1	1.1	1.1	0.0026	0.039	2.1	123.92
4.35	2	179.8	98.3	94.8	1.8	1.9	0.0026	0.039	3.0	589.95
4.45	-1	124.1	44.3	41.9	2.8	3.0	0.0026	0.038	4.0	492.51
4.45	-2	65.4	56.6	55.4	1.2	1.2	0.0026	0.039	2.1	139.78
4.45	2	189.4	100.9	97.3	1.9	1.9	0.0026	0.038	3.0	632.29
4.55	-1	128.3	44.6	42.2	2.9	3.0	0.0026	0.038	4.1	519.69
4.55	-2	71.0	59.0	57.7	1.2	1.2	0.0026	0.039	2.2	156.89
4.55	2	199.3	103.6	99.9	1.9	2.0	0.0026	0.038	3.1	676.58
4.65	-1	132.5	45.0	42.4	2.9	3.1	0.0026	0.038	4.1	547.60
4.65	-2	76.9	62.3	61.0	1.2	1.3	0.0026	0.039	2.3	173.53
4.65	2	209.4	107.3	103.4	2.0	2.0	0.0026	0.038	3.1	721.13
4.75	-1	136.8	45.3	42.7	3.0	3.2	0.0026	0.038	4.2	576.25
4.75	-2	83.2	66.6	65.2	1.2	1.3	0.0026	0.039	2.3	190.05
4.75	2	220.0	111.9	107.9	2.0	2.0	0.0026	0.038	3.1	766.30
4.85	-1	141.1	45.6	43.0	3.1	3.3	0.0026	0.038	4.3	605.62
4.85	-2	90.0	72.1	70.7	1.2	1.3	0.0026	0.038	2.3	206.06
4.85	2	231.0	117.8	113.7	2.0	2.0	0.0026	0.038	3.1	811.68
4.95	-1	145.4	46.0	43.2	3.2	3.4	0.0026	0.037	4.4	635.73
4.95	-2	97.3	76.9	75.5	1.3	1.3	0.0026	0.038	2.3	225.79
4.95	2	242.7	122.9	118.7	2.0	2.0	0.0026	0.038	3.2	861.52
5.05	-1	149.7	46.3	43.5	3.2	3.4	0.0026	0.037	4.5	666.59
5.05	-2	105.1	81.7	80.3	1.3	1.3	0.0026	0.038	2.4	247.60
5.05	2	254.8	128.0	123.8	2.0	2.1	0.0026	0.038	3.2	914.18
5.15	-1	154.1	46.6	43.7	3.3	3.5	0.0026	0.037	4.5	698.71
5.15	-2	113.3	85.2	83.7	1.3	1.4	0.0026	0.038	2.4	274.35
5.15	2	267.4	131.8	127.4	2.0	2.1	0.0026	0.038	3.2	973.06
5.25	-1	158.5	46.7	43.8	3.4	3.6	0.0026	0.037	4.6	732.82
5.25	-2	121.7	85.5	84.0	1.4	1.4	0.0026	0.038	2.5	309.62
5.25	2	280.2	132.2	127.8	2.1	2.2	0.0026	0.037	3.4	1042.45
5.35	-1	162.8	46.9	43.9	3.5	3.7	0.0026	0.037	4.7	767.73
5.35	-2	130.1	85.6	84.1	1.5	1.5	0.0026	0.038	2.7	347.08
5.35	2	293.0	132.5	128.1	2.2	2.3	0.0026	0.037	3.5	1114.81
5.45	-1	167.2	47.1	44.2	3.5	3.8	0.0026	0.037	4.8	802.41
5.45	-2	138.5	85.8	84.2	1.6	1.6	0.0026	0.037	2.8	386.47
5.45	2	305.8	132.9	128.4	2.3	2.4	0.0026	0.037	3.6	1188.88
5.55	-1	171.7	47.5	44.5	3.6	3.9	0.0026	0.037	4.9	836.89
5.55	-2	147.0	86.0	84.4	1.7	1.7	0.0026	0.037	2.9	427.75
5.55	2	318.6	133.4	128.8	2.4	2.5	0.0026	0.037	3.7	1264.64
5.65	-1	176.1	47.8	44.8	3.7	3.9	0.0026	0.037	5.0	872.18
5.65	-2	155.4	86.1	84.5	1.8	1.8	0.0026	0.037	3.0	470.92
5.65	2	331.5	133.9	129.3	2.5	2.6	0.0026	0.037	3.8	1343.10
5.75	-1	180.6	48.1	45.1	3.8	4.0	0.0026	0.036	5.0	908.29
5.75	-2	163.9	86.3	84.6	1.9	1.9	0.0026	0.037	3.1	515.98
5.75	2	344.5	134.4	129.7	2.6	2.7	0.0026	0.037	3.9	1424.27
5.85	-1	185.2	48.5	45.5	3.8	4.1	0.0026	0.036	5.1	945.24

Table A3 (Continued). Cross-section 3

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
5.85	-2	172.3	86.4	84.7	2.0	2.0	0.0026	0.037	3.3	562.92
5.85	2	357.5	134.9	130.2	2.6	2.7	0.0026	0.037	4.0	1508.16
5.95	-1	189.7	48.8	45.8	3.9	4.1	0.0026	0.036	5.2	983.03
5.95	-2	180.8	86.6	84.9	2.1	2.1	0.0026	0.037	3.4	611.75
5.95	2	370.5	135.4	130.6	2.7	2.8	0.0026	0.036	4.1	1594.78
6.05	-1	194.3	49.2	46.1	4.0	4.2	0.0026	0.036	5.3	1021.67
6.05	-2	189.3	86.8	85.0	2.2	2.2	0.0026	0.037	3.5	662.46
6.05	2	383.6	135.9	131.1	2.8	2.9	0.0026	0.036	4.2	1684.14
6.15	-1	198.9	49.5	46.4	4.0	4.3	0.0026	0.036	5.3	1061.18
6.15	-2	197.8	86.9	85.1	2.3	2.3	0.0026	0.036	3.6	715.07
6.15	2	396.7	136.4	131.5	2.9	3.0	0.0026	0.036	4.3	1776.25
6.25	-1	203.6	49.8	46.7	4.1	4.4	0.0026	0.036	5.4	1101.56
6.25	-2	206.3	87.1	85.2	2.4	2.4	0.0026	0.036	3.7	769.56
6.25	2	409.9	136.9	132.0	3.0	3.1	0.0026	0.036	4.4	1871.12
6.35	-1	208.3	50.2	47.1	4.2	4.4	0.0026	0.036	5.5	1142.82
6.35	-2	214.8	87.2	85.4	2.5	2.5	0.0026	0.036	3.8	825.96
6.35	2	423.1	137.4	132.4	3.1	3.2	0.0026	0.036	4.5	1968.78
6.45	-1	213.0	50.5	47.4	4.2	4.5	0.0026	0.036	5.6	1184.97
6.45	-2	223.4	87.4	85.5	2.6	2.6	0.0026	0.036	4.0	884.26
6.45	2	436.4	137.9	132.9	3.2	3.3	0.0026	0.036	4.6	2069.23
6.55	-1	217.8	50.8	47.7	4.3	4.6	0.0026	0.036	5.6	1228.02
6.55	-2	231.9	87.6	85.6	2.6	2.7	0.0026	0.036	4.1	944.48
6.55	2	449.7	138.4	133.3	3.2	3.4	0.0026	0.036	4.7	2172.50
6.65	-1	222.6	51.2	48.0	4.4	4.6	0.0026	0.035	5.7	1272.38*
6.65	-2	240.5	87.7	85.7	2.7	2.8	0.0026	0.036	4.2	1006.63
6.65	2	463.1	138.9	133.7	3.3	3.5	0.0026	0.035	4.8	2279.01*
6.75	-1	227.4	51.3	48.0	4.4	4.7	0.0026	0.035	5.8	1321.16*
6.75	-2	249.1	87.9	85.9	2.8	2.9	0.0026	0.035	4.3	1070.71
6.75	2	476.5	139.1	133.9	3.4	3.6	0.0026	0.035	4.9	2391.86*
6.85	-1	232.2	51.4	48.0	4.5	4.8	0.0026	0.035	5.9	1370.81*
6.85	-2	257.7	88.0	86.0	2.9	3.0	0.0026	0.035	4.4	1136.73
6.85	2	489.8	139.4	134.0	3.5	3.7	0.0026	0.035	5.0	2507.54*
6.95	-1	237.0	51.5	48.0	4.6	4.9	0.0026	0.035	6.0	1421.33*
6.95	-2	266.3	88.2	86.1	3.0	3.1	0.0026	0.035	4.5	1204.71
6.95	2	503.2	139.7	134.1	3.6	3.8	0.0026	0.035	5.1	2626.04*
7.00	-1	239.4	51.5	48.0	4.6	5.0	0.0026	0.035	6.0	1446.93*
7.00	-2	270.6	88.3	86.2	3.1	3.1	0.0026	0.035	4.6	1239.44
7.00	2	510.0	139.8	134.2	3.6	3.8	0.0026	0.035	5.1	2686.37*

Table A4. Cross-section 4.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
2.90	-1	46.5	26.8	25.7	1.7	1.8	0.0014	0.070	1.2	53.54
2.90	-2	3.2	7.4	7.2	0.4	0.4	0.0014	0.086	0.4	1.16
2.90	2	49.7	34.2	32.9	1.5	1.5	0.0014	0.071	1.0	54.71
3.00	-1	49.1	27.4	26.3	1.8	1.9	0.0014	0.069	1.2	58.50
3.00	-2	3.9	8.3	8.0	0.5	0.5	0.0014	0.085	0.4	1.57
3.00	2	53.1	35.7	34.3	1.5	1.5	0.0014	0.070	1.0	60.07
3.10	-1	51.8	29.2	28.0	1.8	1.9	0.0014	0.068	1.2	62.30
3.10	-2	4.8	9.1	8.9	0.5	0.5	0.0014	0.084	0.4	2.06
3.10	2	56.6	38.3	36.9	1.5	1.5	0.0014	0.069	1.0	64.36
3.20	-1	54.7	30.9	29.7	1.8	1.8	0.0014	0.067	1.2	66.56
3.20	-2	5.7	10.0	9.7	0.6	0.6	0.0014	0.083	0.5	2.64
3.20	2	60.4	40.9	39.4	1.5	1.5	0.0014	0.069	1.1	69.20
3.30	-1	57.8	32.6	31.4	1.8	1.8	0.0014	0.066	1.2	71.30
3.30	-2	6.7	10.9	10.6	0.6	0.6	0.0014	0.082	0.5	3.33
3.30	2	64.5	43.5	42.0	1.5	1.5	0.0014	0.068	1.1	74.63
3.40	-1	61.0	33.7	32.5	1.8	1.9	0.0014	0.065	1.3	77.48
3.40	-2	7.8	11.7	11.4	0.7	0.7	0.0014	0.081	0.5	4.13
3.40	2	68.8	45.5	43.9	1.5	1.6	0.0014	0.067	1.1	81.61
3.50	-1	64.3	34.5	33.2	1.9	1.9	0.0014	0.064	1.3	84.53
3.50	-2	9.0	12.5	12.1	0.7	0.7	0.0014	0.079	0.6	5.08
3.50	2	73.3	47.0	45.3	1.6	1.6	0.0014	0.066	1.1	89.61
3.60	-1	67.6	35.3	34.0	1.9	2.0	0.0014	0.063	1.4	92.03
3.60	-2	10.2	13.0	12.5	0.8	0.8	0.0014	0.078	0.6	6.23
3.60	2	77.9	48.3	46.5	1.6	1.7	0.0014	0.065	1.2	98.26
3.70	-1	71.1	36.1	34.7	2.0	2.0	0.0014	0.062	1.4	100.02
3.70	-2	11.5	13.5	12.9	0.9	0.9	0.0014	0.077	0.7	7.50
3.70	2	82.6	49.5	47.6	1.7	1.7	0.0014	0.064	1.2	107.52
3.80	-1	74.6	36.9	35.5	2.0	2.1	0.0014	0.061	1.5	108.53
3.80	-2	12.8	13.9	13.3	0.9	1.0	0.0014	0.076	0.7	8.93
3.80	2	87.4	50.7	48.8	1.7	1.8	0.0014	0.063	1.3	117.46
3.90	-1	78.2	37.6	36.2	2.1	2.2	0.0014	0.060	1.5	117.59
3.90	-2	14.2	14.2	13.6	1.0	1.0	0.0014	0.075	0.7	10.53
3.90	2	92.3	51.9	49.8	1.8	1.9	0.0014	0.063	1.3	128.12
4.00	-1	81.8	38.4	36.9	2.1	2.2	0.0014	0.059	1.6	127.25
4.00	-2	15.5	14.6	13.8	1.1	1.1	0.0014	0.074	0.8	12.28
4.00	2	97.3	53.0	50.8	1.8	1.9	0.0014	0.062	1.4	139.53
4.10	-1	85.6	39.2	37.7	2.2	2.3	0.0014	0.058	1.6	137.51
4.10	-2	16.9	14.9	14.1	1.1	1.2	0.0014	0.072	0.8	14.18
4.10	2	102.5	54.1	51.8	1.9	2.0	0.0014	0.061	1.4	151.70
4.20	-1	89.4	39.9	38.4	2.2	2.3	0.0014	0.057	1.7	148.42
4.20	-2	18.3	15.3	14.4	1.2	1.3	0.0014	0.071	0.9	16.24
4.20	2	107.7	55.2	52.8	2.0	2.0	0.0014	0.060	1.5	164.66
4.30	-1	93.2	40.5	39.0	2.3	2.4	0.0014	0.056	1.7	160.39
4.30	-2	19.8	15.9	15.0	1.2	1.3	0.0014	0.070	0.9	18.26
4.30	2	113.0	56.5	53.9	2.0	2.1	0.0014	0.059	1.5	178.65
4.40	-1	97.2	41.1	39.5	2.4	2.5	0.0014	0.055	1.8	173.17
4.40	-2	21.3	16.6	15.6	1.3	1.4	0.0014	0.069	1.0	20.45
4.40	2	118.5	57.7	55.1	2.1	2.1	0.0014	0.058	1.6	193.62
4.50	-1	101.1	41.7	40.0	2.4	2.5	0.0014	0.055	1.8	186.71
4.50	-2	22.9	17.3	16.2	1.3	1.4	0.0014	0.068	1.0	22.83
4.50	2	124.1	59.0	56.3	2.1	2.2	0.0014	0.057	1.6	209.55
4.60	-1	105.2	42.3	40.6	2.5	2.6	0.0014	0.054	1.9	201.05
4.60	-2	24.6	17.9	16.9	1.4	1.5	0.0014	0.066	1.0	25.44
4.60	2	129.7	60.2	57.5	2.2	2.3	0.0014	0.056	1.7	226.49
4.70	-1	109.2	42.8	41.1	2.6	2.7	0.0014	0.053	2.0	216.23
4.70	-2	26.3	18.6	17.5	1.4	1.5	0.0014	0.065	1.1	28.28
4.70	2	135.6	61.5	58.6	2.2	2.3	0.0014	0.055	1.7	244.51
4.80	-1	113.4	43.4	41.6	2.6	2.7	0.0014	0.052	2.0	232.30

Table A4 (Continued). Cross-section 4.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
4.80	-2	28.1	19.3	18.2	1.5	1.5	0.0014	0.064	1.1	31.33
4.80	2	141.5	62.7	59.9	2.3	2.4	0.0014	0.054	1.8	263.62
4.90	-1	117.6	44.0	42.2	2.7	2.8	0.0014	0.051	2.1	249.31
4.90	-2	30.0	20.2	19.0	1.5	1.6	0.0014	0.063	1.2	34.53
4.90	2	147.5	64.2	61.2	2.3	2.4	0.0014	0.053	1.8	283.84
5.00	-1	121.8	44.5	42.7	2.7	2.9	0.0014	0.050	2.2	267.33
5.00	-2	31.9	21.0	19.9	1.5	1.6	0.0014	0.062	1.2	38.03
5.00	2	153.7	65.6	62.5	2.3	2.5	0.0014	0.052	1.9	305.36
5.10	-1	126.1	46.1	44.2	2.7	2.9	0.0014	0.049	2.2	282.44
5.10	-2	33.9	21.9	20.7	1.6	1.6	0.0014	0.061	1.2	41.85
5.10	2	160.1	68.0	64.9	2.4	2.5	0.0014	0.051	1.9	324.29
5.20	-1	130.7	48.6	46.7	2.7	2.8	0.0014	0.048	2.3	295.01
5.20	-2	36.0	22.7	21.5	1.6	1.7	0.0014	0.059	1.3	46.02
5.20	2	166.7	71.3	68.2	2.3	2.4	0.0014	0.050	2.0	341.03
5.30	-1	135.5	51.1	49.2	2.6	2.8	0.0014	0.047	2.3	309.14
5.30	-2	38.2	23.5	22.3	1.6	1.7	0.0014	0.058	1.3	50.56
5.30	2	173.7	74.7	71.5	2.3	2.4	0.0014	0.049	2.0	359.70
5.40	-1	140.5	53.7	51.7	2.6	2.7	0.0014	0.046	2.3	324.90
5.40	-2	40.5	24.4	23.1	1.7	1.8	0.0014	0.057	1.4	55.50
5.40	2	181.0	78.0	74.8	2.3	2.4	0.0014	0.048	2.0	380.40
5.50	-1	145.8	58.7	56.7	2.5	2.6	0.0014	0.045	2.3	332.53
5.50	-2	42.8	25.0	23.7	1.7	1.8	0.0014	0.056	1.4	61.15*
5.50	2	188.7	83.8	80.4	2.3	2.3	0.0014	0.047	2.0	393.68*
5.60	-1	152.2	70.9	68.9	2.1	2.2	0.0014	0.044	2.1	321.93
5.60	-2	45.2	25.4	24.0	1.8	1.9	0.0014	0.055	1.5	67.64*
5.60	2	197.5	96.4	92.9	2.0	2.1	0.0014	0.046	1.9	389.57*
5.70	-1	159.1	71.1	69.0	2.2	2.3	0.0014	0.043	2.2	353.80
5.70	-2	47.6	25.5	24.0	1.9	2.0	0.0014	0.054	1.6	75.15*
5.70	2	206.8	96.6	93.0	2.1	2.2	0.0014	0.045	2.0	428.95*
5.80	-1	166.0	71.3	69.2	2.3	2.4	0.0014	0.042	2.3	387.95
5.80	-2	50.0	25.6	24.0	2.0	2.1	0.0014	0.052	1.7	83.18*
5.80	2	216.1	96.9	93.2	2.2	2.3	0.0014	0.044	2.1	471.13*
5.90	-1	173.0	71.4	69.3	2.4	2.5	0.0014	0.041	2.5	424.45
5.90	-2	52.4	25.7	24.0	2.0	2.2	0.0014	0.051	1.8	91.77*
5.90	2	225.4	97.2	93.3	2.3	2.4	0.0014	0.043	2.3	516.22*
6.00	-1	179.9	71.6	69.4	2.5	2.6	0.0014	0.040	2.6	463.46
6.00	-2	54.8	25.8	24.0	2.1	2.3	0.0014	0.050	1.8	100.94*
6.00	2	234.7	97.4	93.4	2.4	2.5	0.0014	0.042	2.4	564.40*

Table A5. Cross-section 5.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
1.70	1	29.7	31.6	30.9	0.9	1.0	0.0060	0.060	1.8	54.91
1.80	1	32.9	32.9	32.1	1.0	1.0	0.0060	0.059	1.9	64.06
1.90	1	36.1	33.4	32.6	1.1	1.1	0.0060	0.059	2.1	74.97
2.00	1	39.4	34.0	33.0	1.2	1.2	0.0060	0.058	2.2	86.78
2.10	1	42.7	34.5	33.5	1.2	1.3	0.0060	0.057	2.3	99.52
2.20	1	46.1	35.1	34.0	1.3	1.4	0.0060	0.056	2.5	113.20
2.30	1	49.5	35.6	34.5	1.4	1.4	0.0060	0.056	2.6	127.86
2.40	1	53.0	36.2	35.0	1.5	1.5	0.0060	0.055	2.7	143.53
2.50	1	56.5	36.7	35.4	1.5	1.6	0.0060	0.054	2.8	160.25
2.60	1	60.1	37.3	35.9	1.6	1.7	0.0060	0.054	3.0	178.06
2.70	1	63.7	37.8	36.4	1.7	1.8	0.0060	0.053	3.1	196.99
2.80	1	67.4	38.3	36.8	1.8	1.8	0.0060	0.052	3.2	217.19
2.90	1	71.1	38.8	37.3	1.8	1.9	0.0060	0.051	3.4	238.71
3.00	1	74.8	39.3	37.7	1.9	2.0	0.0060	0.051	3.5	261.50
3.10	1	78.6	39.8	38.1	2.0	2.1	0.0060	0.050	3.6	285.60
3.20	1	82.5	40.3	38.5	2.0	2.1	0.0060	0.049	3.8	311.09
3.30	1	86.3	40.8	39.0	2.1	2.2	0.0060	0.049	3.9	338.01
3.40	1	90.3	41.3	39.4	2.2	2.3	0.0060	0.048	4.1	366.43
3.50	1	94.2	41.8	39.8	2.3	2.4	0.0060	0.047	4.2	396.42
3.60	1	98.2	42.3	40.2	2.3	2.4	0.0060	0.046	4.4	428.05
3.70	1	102.3	42.8	40.7	2.4	2.5	0.0060	0.046	4.5	461.39
3.80	1	106.3	43.3	41.1	2.5	2.6	0.0060	0.045	4.7	496.53
3.90	1	110.5	43.8	41.5	2.5	2.7	0.0060	0.044	4.8	533.55
4.00	1	114.6	44.3	41.9	2.6	2.7	0.0060	0.044	5.0	572.54
4.10	1	118.9	44.8	42.4	2.7	2.8	0.0060	0.043	5.2	613.61
4.20	1	123.1	45.3	42.8	2.7	2.9	0.0060	0.042	5.3	656.87
4.30	1	127.4	45.8	43.2	2.8	2.9	0.0060	0.041	5.5	702.42
4.40	1	131.8	46.3	43.6	2.8	3.0	0.0060	0.041	5.7	750.38
4.50	1	136.1	46.8	44.0	2.9	3.1	0.0060	0.040	5.9	800.90

Table A6. Cross-section 6.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
1.10	1	14.0	22.8	22.6	0.6	0.6	0.0164	0.060	2.3	32.25
1.20	1	16.3	23.5	23.2	0.7	0.7	0.0164	0.059	2.5	41.24
1.30	1	18.7	23.8	23.4	0.8	0.8	0.0164	0.058	2.8	51.84
1.40	1	21.0	24.1	23.7	0.9	0.9	0.0164	0.058	3.0	63.59
1.50	1	23.4	24.4	23.9	1.0	1.0	0.0164	0.057	3.3	76.52
1.60	1	25.8	24.7	24.1	1.0	1.1	0.0164	0.056	3.5	90.65
1.70	1	28.2	25.0	24.3	1.1	1.2	0.0164	0.055	3.8	106.01
1.80	1	30.6	25.4	24.6	1.2	1.2	0.0164	0.054	4.0	122.23
1.90	1	33.2	26.4	25.5	1.3	1.3	0.0164	0.053	4.2	138.12
2.00	1	35.7	27.3	26.4	1.3	1.4	0.0164	0.053	4.3	155.41
2.10	1	38.4	28.3	27.3	1.4	1.4	0.0164	0.052	4.5	174.18
2.20	1	41.4	34.1	33.0	1.2	1.3	0.0164	0.051	4.3	177.32
2.30	1	46.1	58.8	57.7	0.8	0.8	0.0164	0.050	3.2	149.90
2.40	1	52.3	66.1	65.0	0.8	0.8	0.0164	0.049	3.3	173.46
2.50	1	59.1	73.5	72.3	0.8	0.8	0.0164	0.048	3.4	201.98
2.60	1	66.7	80.1	78.8	0.8	0.8	0.0164	0.048	3.6	237.35
2.70	1	74.8	84.8	83.5	0.9	0.9	0.0164	0.047	3.8	281.62
2.80	1	83.4	89.4	88.2	0.9	0.9	0.0164	0.046	4.0	331.50
2.90	1	92.5	94.1	92.9	1.0	1.0	0.0164	0.045	4.2	387.45
3.00	1	101.9	97.0	95.6	1.1	1.1	0.0164	0.044	4.5	455.06*
3.10	1	111.6	100.5	99.0	1.1	1.1	0.0164	0.043	4.7	527.06*
3.20	1	121.8	105.7	104.1	1.2	1.2	0.0164	0.043	4.9	600.87*
3.30	1	132.4	110.9	109.2	1.2	1.2	0.0164	0.042	5.2	682.81*
3.40	1	143.6	116.0	114.3	1.2	1.3	0.0164	0.041	5.4	773.53*
3.50	1	155.3	121.2	119.4	1.3	1.3	0.0164	0.040	5.6	873.75*

Table A7. Cross-section 7.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
0.10	1	0.2	4.3	4.3	0.1	0.1	0.0015	0.047	0.2	0.04
0.20	1	0.8	7.5	7.5	0.1	0.1	0.0017	0.047	0.3	0.25
0.30	1	1.7	9.8	9.7	0.2	0.2	0.0019	0.047	0.4	0.75
0.40	1	2.8	11.7	11.6	0.2	0.2	0.0021	0.046	0.6	1.57
0.50	1	4.0	13.7	13.7	0.3	0.3	0.0023	0.046	0.7	2.76
0.60	1	5.5	15.8	15.7	0.3	0.4	0.0025	0.046	0.8	4.41
0.70	1	7.2	17.3	17.2	0.4	0.4	0.0027	0.046	0.9	6.72
0.80	1	8.9	18.0	17.9	0.5	0.5	0.0029	0.045	1.1	9.81
0.90	1	10.8	18.7	18.6	0.6	0.6	0.0030	0.045	1.3	13.53
1.00	1	12.6	19.4	19.2	0.7	0.7	0.0032	0.045	1.4	17.92
1.10	1	14.6	20.1	19.9	0.7	0.7	0.0034	0.045	1.6	23.03
1.20	1	16.6	20.6	20.3	0.8	0.8	0.0036	0.044	1.7	29.04
1.30	1	18.7	21.0	20.7	0.9	0.9	0.0038	0.044	1.9	35.86
1.40	1	20.8	21.5	21.1	1.0	1.0	0.0040	0.044	2.1	43.48
1.50	1	22.9	21.9	21.5	1.0	1.1	0.0042	0.044	2.3	51.95
1.60	-1	25.1	22.5	22.1	1.1	1.1	0.0044	0.044	2.4	61.00
1.60	-2	0.0	1.2	1.2	0.0	0.0	0.0044	0.048	0.2	0.01
1.60	2	25.1	23.7	23.3	1.1	1.1	0.0044	0.044	2.4	61.01
1.70	-1	27.3	23.2	22.7	1.2	1.2	0.0046	0.043	2.6	70.91
1.70	-2	0.3	3.2	3.2	0.1	0.1	0.0046	0.048	0.4	0.10
1.70	2	27.6	26.4	25.9	1.0	1.1	0.0046	0.043	2.4	71.01
1.80	-1	29.6	23.8	23.2	1.2	1.3	0.0048	0.043	2.8	81.76
1.80	-2	0.7	5.3	5.2	0.1	0.1	0.0048	0.048	0.6	0.38
1.80	2	30.3	29.1	28.5	1.0	1.1	0.0048	0.043	2.4	82.14
1.90	-1	31.9	24.4	23.8	1.3	1.3	0.0050	0.043	2.9	93.68
1.90	-2	1.3	7.3	7.3	0.2	0.2	0.0050	0.047	0.7	0.92
1.90	2	33.2	31.7	31.0	1.0	1.1	0.0050	0.043	2.5	94.60
2.00	-1	34.3	25.0	24.3	1.4	1.4	0.0052	0.043	3.1	106.64
2.00	-2	2.1	9.3	9.3	0.2	0.2	0.0052	0.047	0.9	1.82
2.00	2	36.5	34.3	33.6	1.1	1.1	0.0052	0.043	2.6	108.45
2.10	-1	36.8	25.6	24.8	1.4	1.5	0.0054	0.042	3.3	120.65
2.10	-2	3.2	11.4	11.3	0.3	0.3	0.0054	0.047	1.0	3.14
2.10	2	40.0	36.9	36.1	1.1	1.1	0.0054	0.043	2.7	123.79
2.20	-1	39.3	26.1	25.4	1.5	1.5	0.0056	0.042	3.5	135.75
2.20	-2	4.4	13.2	13.1	0.3	0.3	0.0056	0.046	1.1	5.02*
2.20	2	43.7	39.4	38.5	1.1	1.1	0.0056	0.043	2.8	140.77*
2.30	-1	41.9	26.7	25.9	1.6	1.6	0.0058	0.042	3.6	151.99
2.30	-2	5.7	13.8	13.6	0.4	0.4	0.0058	0.046	1.4	7.78*
2.30	2	47.6	40.6	39.5	1.2	1.2	0.0058	0.043	3.0	159.78*
2.40	-1	44.5	27.3	26.4	1.6	1.7	0.0059	0.042	3.8	169.41
2.40	-2	7.1	14.4	14.1	0.5	0.5	0.0059	0.046	1.6	11.11*
2.40	2	51.6	41.7	40.5	1.2	1.3	0.0059	0.042	3.1	180.53*
2.50	-1	47.2	27.7	26.8	1.7	1.8	0.0061	0.042	4.0	188.93
2.50	-2	8.5	15.0	14.6	0.6	0.6	0.0061	0.046	1.8	15.03*
2.50	2	55.7	42.7	41.3	1.3	1.3	0.0061	0.042	3.3	203.96*
2.60	-1	49.8	28.0	27.0	1.8	1.8	0.0063	0.041	4.2	209.95
2.60	-2	10.0	15.6	15.0	0.6	0.7	0.0063	0.045	1.9	19.54*
2.60	2	59.9	43.6	42.1	1.4	1.4	0.0063	0.042	3.5	229.49*
2.70	-1	52.6	28.4	27.3	1.9	1.9	0.0065	0.041	4.4	232.29
2.70	-2	11.6	16.2	15.5	0.7	0.7	0.0065	0.045	2.1	24.67*
2.70	2	64.1	44.5	42.8	1.4	1.5	0.0065	0.042	3.7	256.96*
2.80	-1	55.3	28.7	27.5	1.9	2.0	0.0067	0.041	4.6	255.98
2.80	-2	13.1	16.8	16.0	0.8	0.8	0.0067	0.045	2.3	30.44*
2.80	2	68.4	45.4	43.5	1.5	1.6	0.0067	0.042	3.9	286.42*
2.90	-1	58.1	29.0	27.8	2.0	2.1	0.0069	0.041	4.8	281.06
2.90	-2	14.8	17.3	16.5	0.9	0.9	0.0069	0.044	2.5	36.88*
2.90	2	72.8	46.4	44.3	1.6	1.6	0.0069	0.041	4.0	317.93*

Table A7 (Continued). Cross-section 7

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
3.00	-1	61.2	36.6	35.4	1.7	1.7	0.0071	0.040	4.4	267.46
3.00	-2	16.4	17.9	17.0	0.9	1.0	0.0071	0.044	2.7	44.01*
3.00	2	77.6	54.6	52.3	1.4	1.5	0.0071	0.041	3.9	311.47*
3.10	-1	65.0	41.4	40.1	1.6	1.6	0.0073	0.040	4.3	278.26
3.10	-2	18.4	22.1	21.0	0.8	0.9	0.0073	0.044	2.6	47.23*
3.10	2	83.4	63.5	61.1	1.3	1.4	0.0073	0.041	3.7	325.49*
3.20	-1	69.1	41.6	40.3	1.7	1.7	0.0075	0.040	4.5	312.36
3.20	-2	20.5	22.2	21.0	0.9	1.0	0.0075	0.044	2.8	57.49*
3.20	2	89.6	63.8	61.3	1.4	1.5	0.0075	0.041	4.0	369.85*
3.30	-1	73.1	41.8	40.5	1.7	1.8	0.0077	0.040	4.8	348.70
3.30	-2	22.6	22.3	21.0	1.0	1.1	0.0077	0.043	3.0	68.73*
3.30	2	95.7	64.1	61.5	1.5	1.6	0.0077	0.041	4.2	417.43*
3.40	-1	77.2	42.0	40.6	1.8	1.9	0.0079	0.039	5.0	387.32
3.40	-2	24.7	22.4	21.0	1.1	1.2	0.0079	0.043	3.3	80.98*
3.40	2	101.9	64.4	61.6	1.6	1.7	0.0079	0.040	4.4	468.30*
3.50	-1	81.2	42.2	40.8	1.9	2.0	0.0081	0.039	5.3	428.28
3.50	-2	26.8	22.5	21.0	1.2	1.3	0.0081	0.043	3.5	94.24*
3.50	2	108.0	64.7	61.8	1.7	1.7	0.0081	0.040	4.7	522.52*
3.60	-1	85.3	42.4	41.0	2.0	2.1	0.0083	0.039	5.5	471.62
3.60	-2	28.9	22.6	21.0	1.3	1.4	0.0083	0.043	3.8	108.53*
3.60	2	114.2	65.0	62.0	1.8	1.8	0.0083	0.040	4.9	580.15*
3.70	-1	89.5	43.9	42.5	2.0	2.1	0.0085	0.039	5.7	507.44
3.70	-2	31.0	22.7	21.0	1.4	1.5	0.0085	0.042	4.0	123.86*
3.70	2	120.5	66.6	63.5	1.8	1.9	0.0085	0.040	5.1	631.30*
3.80	-1	93.8	45.8	44.3	2.0	2.1	0.0086	0.039	5.8	543.45
3.80	-2	33.1	22.8	21.0	1.5	1.6	0.0086	0.042	4.2	140.24*
3.80	2	126.9	68.6	65.3	1.9	1.9	0.0086	0.039	5.3	683.69*
3.90	-1	98.3	47.6	46.2	2.1	2.1	0.0088	0.038	5.9	582.28
3.90	-2	35.2	22.9	21.0	1.5	1.7	0.0088	0.042	4.5	157.70*
3.90	2	133.5	70.5	67.2	1.9	2.0	0.0088	0.039	5.5	739.98*
4.00	-1	103.1	49.5	48.0	2.1	2.1	0.0090	0.038	6.1	624.04
4.00	-2	37.3	23.0	21.0	1.6	1.8	0.0090	0.041	4.7	176.25*
4.00	2	140.4	72.5	69.0	1.9	2.0	0.0090	0.039	5.6	800.29*
4.10	-1	107.9	51.3	49.9	2.1	2.2	0.0092	0.038	6.2	668.89
4.10	-2	39.4	23.1	21.0	1.7	1.9	0.0092	0.041	5.0	195.91*
4.10	2	147.4	74.4	70.9	2.0	2.1	0.0092	0.039	5.8	864.79*
4.20	-1	113.2	60.0	58.5	1.9	1.9	0.0094	0.038	5.9	663.32
4.20	-2	41.5	23.2	21.0	1.8	2.0	0.0094	0.041	5.2	216.69*
4.20	2	154.7	83.1	79.5	1.9	1.9	0.0094	0.039	5.7	880.01*
4.30	-1	120.0	78.7	77.3	1.5	1.6	0.0096	0.037	5.2	619.63
4.30	-2	43.6	23.3	21.0	1.9	2.1	0.0096	0.041	5.5	238.63*
4.30	2	163.6	102.0	98.3	1.6	1.7	0.0096	0.038	5.2	858.26*
4.40	-1	128.6	97.5	96.0	1.3	1.3	0.0098	0.037	4.8	613.34
4.40	-2	45.7	23.4	21.0	2.0	2.2	0.0098	0.040	5.7	261.73*
4.40	2	174.3	120.8	117.0	1.4	1.5	0.0098	0.038	5.0	875.07*
4.50	-1	138.3	98.6	97.1	1.4	1.4	0.0100	0.037	5.0	697.84
4.50	-2	47.8	23.5	21.0	2.0	2.3	0.0100	0.040	6.0	286.02*
4.50	2	186.1	122.0	118.1	1.5	1.6	0.0100	0.038	5.2	983.86*

Table A8. Cross-section 8

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
0.25	1	1.2	8.9	8.9	0.1	0.1	0.0035	0.040	0.6	0.71
0.35	-1	2.2	11.1	11.0	0.2	0.2	0.0035	0.040	0.8	1.67
0.35	-2	0.0	0.9	0.9	0.0	0.1	0.0035	0.047	0.3	0.01
0.35	2	2.3	12.0	11.9	0.2	0.2	0.0035	0.040	0.7	1.68
0.45	-1	3.4	13.2	13.2	0.3	0.3	0.0035	0.040	0.9	3.08
0.45	-2	0.2	1.8	1.8	0.1	0.1	0.0035	0.046	0.4	0.07
0.45	2	3.6	15.0	15.0	0.2	0.2	0.0035	0.040	0.8	3.15
0.55	-1	4.8	15.0	15.0	0.3	0.3	0.0035	0.040	1.0	5.05
0.55	-2	0.4	2.7	2.6	0.1	0.2	0.0035	0.046	0.5	0.21
0.55	2	5.2	17.7	17.6	0.3	0.3	0.0035	0.040	1.0	5.25
0.65	-1	6.4	15.8	15.7	0.4	0.4	0.0035	0.040	1.2	7.76
0.65	-2	0.7	3.6	3.5	0.2	0.2	0.0035	0.046	0.6	0.45
0.65	2	7.1	19.4	19.3	0.4	0.4	0.0035	0.040	1.1	8.21
0.75	-1	8.0	16.4	16.3	0.5	0.5	0.0035	0.039	1.4	11.03
0.75	-2	1.1	4.5	4.4	0.2	0.3	0.0035	0.046	0.8	0.83
0.75	2	9.1	20.9	20.7	0.4	0.4	0.0035	0.040	1.3	11.86
0.85	-1	9.7	18.0	17.8	0.5	0.5	0.0035	0.039	1.5	14.37
0.85	-2	1.6	5.4	5.3	0.3	0.3	0.0035	0.045	0.9	1.35
0.85	2	11.3	23.4	23.1	0.5	0.5	0.0035	0.040	1.3	15.72
0.95	-1	11.5	19.5	19.3	0.6	0.6	0.0035	0.039	1.6	18.25
0.95	-2	2.2	6.3	6.1	0.3	0.4	0.0035	0.045	1.0	2.05
0.95	2	13.7	25.8	25.5	0.5	0.5	0.0035	0.040	1.4	20.30
1.05	-1	13.5	21.1	20.8	0.6	0.7	0.0035	0.039	1.7	22.73
1.05	-2	2.8	7.2	7.0	0.4	0.4	0.0035	0.045	1.0	2.94
1.05	2	16.4	28.3	27.8	0.6	0.6	0.0035	0.040	1.5	25.67
1.15	-1	15.7	22.3	22.1	0.7	0.7	0.0035	0.039	1.8	28.00
1.15	-2	3.6	8.1	7.9	0.4	0.5	0.0035	0.045	1.1	4.05
1.15	2	19.2	30.4	30.0	0.6	0.6	0.0035	0.040	1.6	32.04
1.25	-1	18.0	23.6	23.3	0.8	0.8	0.0035	0.039	1.9	33.87
1.25	-2	4.4	9.0	8.8	0.5	0.5	0.0035	0.044	1.2	5.39
1.25	2	22.3	32.6	32.1	0.7	0.7	0.0035	0.040	1.7	39.26
1.35	-1	20.4	24.9	24.5	0.8	0.8	0.0035	0.039	2.0	40.39
1.35	-2	5.3	9.9	9.7	0.5	0.6	0.0035	0.044	1.3	6.99
1.35	2	25.7	34.8	34.2	0.7	0.8	0.0035	0.040	1.8	47.38
1.45	-1	22.9	26.2	25.8	0.9	0.9	0.0035	0.039	2.1	47.57
1.45	-2	6.3	11.0	10.8	0.6	0.6	0.0035	0.044	1.4	8.76
1.45	2	29.2	37.2	36.5	0.8	0.8	0.0035	0.040	1.9	56.33
1.55	-1	25.5	27.4	27.0	0.9	0.9	0.0035	0.039	2.2	55.44
1.55	-2	7.5	12.3	12.0	0.6	0.6	0.0035	0.044	1.4	10.81
1.55	2	33.0	39.7	39.0	0.8	0.8	0.0035	0.040	2.0	66.25
1.65	-1	28.3	28.7	28.3	1.0	1.0	0.0035	0.039	2.3	64.01
1.65	-2	8.7	13.5	13.2	0.6	0.7	0.0035	0.043	1.5	13.22
1.65	2	37.0	42.2	41.5	0.9	0.9	0.0035	0.040	2.0	77.24
1.75	-1	31.2	29.9	29.4	1.0	1.1	0.0035	0.038	2.4	73.52
1.75	-2	10.1	14.8	14.4	0.7	0.7	0.0035	0.043	1.6	16.03
1.75	2	41.3	44.6	43.8	0.9	0.9	0.0035	0.040	2.1	89.55
1.85	-1	34.1	30.9	30.4	1.1	1.1	0.0035	0.038	2.5	83.85
1.85	-2	11.6	16.0	15.7	0.7	0.7	0.0035	0.043	1.7	19.25
1.85	2	45.8	47.0	46.1	1.0	1.0	0.0035	0.039	2.2	103.11
1.95	-1	37.3	35.2	34.6	1.1	1.1	0.0035	0.038	2.4	89.57
1.95	-2	13.2	17.2	16.9	0.8	0.8	0.0035	0.043	1.7	22.93
1.95	2	50.6	52.4	51.5	1.0	1.0	0.0035	0.039	2.2	112.49
2.05	-1	40.9	36.8	36.2	1.1	1.1	0.0035	0.038	2.5	101.62
2.05	-2	15.0	18.0	17.6	0.8	0.9	0.0035	0.042	1.8	27.55
2.05	2	55.9	54.7	53.8	1.0	1.0	0.0035	0.039	2.3	129.17
2.15	-1	44.5	36.9	36.3	1.2	1.2	0.0035	0.038	2.6	117.01

Table A8 (Continued). Cross-section 8.

STAGE Ft	#SEC	AREA Ft^2	PERIM Ft	WIDTH Ft	R Ft	DAVG Ft	SLOPE	n	VAVG Ft/s	Q CFS
2.15	-2	16.8	18.5	18.1	0.9	0.9	0.0035	0.042	2.0	32.83
2.15	2	61.3	55.4	54.4	1.1	1.1	0.0035	0.039	2.4	149.85
2.25	-1	48.2	37.1	36.5	1.3	1.3	0.0035	0.038	2.8	133.32
2.25	-2	18.6	18.8	18.4	1.0	1.0	0.0035	0.042	2.1	38.81
2.25	2	66.8	55.9	54.8	1.2	1.2	0.0035	0.039	2.5	172.13
2.35	-1	51.8	37.3	36.6	1.4	1.4	0.0035	0.038	2.9	150.54
2.35	-2	20.4	19.1	18.7	1.1	1.1	0.0035	0.042	2.2	45.25
2.35	2	72.3	56.4	55.3	1.3	1.3	0.0035	0.039	2.7	195.78
2.45	-1	55.5	37.5	36.8	1.5	1.5	0.0035	0.038	3.0	168.65
2.45	-2	22.3	19.4	19.0	1.2	1.2	0.0035	0.041	2.3	52.16
2.45	2	77.8	56.9	55.7	1.4	1.4	0.0035	0.039	2.8	220.81
2.55	-1	59.2	37.6	36.9	1.6	1.6	0.0035	0.038	3.2	187.64
2.55	-2	24.2	19.7	19.3	1.2	1.3	0.0035	0.041	2.5	59.55
2.55	2	83.4	57.3	56.2	1.5	1.5	0.0035	0.039	2.9	247.19
2.65	-1	62.9	39.1	38.4	1.6	1.6	0.0035	0.037	3.2	202.97
2.65	-2	26.2	20.0	19.5	1.3	1.3	0.0035	0.041	2.6	67.42
2.65	2	89.1	59.1	57.9	1.5	1.5	0.0035	0.038	3.0	270.39
2.75	-1	66.9	42.8	42.0	1.6	1.6	0.0035	0.037	3.2	212.81
2.75	-2	28.1	20.3	19.8	1.4	1.4	0.0035	0.041	2.7	75.78
2.75	2	95.1	63.1	61.8	1.5	1.5	0.0035	0.038	3.0	288.60
2.85	-1	71.1	42.9	42.0	1.7	1.7	0.0035	0.037	3.3	235.82
2.85	-2	30.1	20.6	20.1	1.5	1.5	0.0035	0.040	2.8	84.64
2.85	2	101.3	63.5	62.2	1.6	1.6	0.0035	0.038	3.1	320.46
2.95	-1	75.4	43.0	42.1	1.8	1.8	0.0035	0.037	3.4	259.81
2.95	-2	32.2	20.9	20.4	1.5	1.6	0.0035	0.040	2.9	94.00
2.95	2	107.5	63.9	62.5	1.7	1.7	0.0035	0.038	3.3	353.81
3.05	-1	79.6	43.1	42.1	1.8	1.9	0.0035	0.037	3.6	284.79
3.05	-2	34.2	21.2	20.7	1.6	1.7	0.0035	0.040	3.0	103.87
3.05	2	113.8	64.3	62.8	1.8	1.8	0.0035	0.038	3.4	388.66
3.15	-1	83.8	43.2	42.1	1.9	2.0	0.0035	0.037	3.7	310.74
3.15	-2	36.3	21.5	21.0	1.7	1.7	0.0035	0.040	3.1	114.26
3.15	2	120.1	64.8	63.1	1.9	1.9	0.0035	0.038	3.5	425.00
3.25	-1	88.0	43.3	42.2	2.0	2.1	0.0035	0.037	3.8	337.65
3.25	-2	38.4	22.2	21.7	1.7	1.8	0.0035	0.039	3.2	123.95
3.25	2	126.4	65.5	63.8	1.9	2.0	0.0035	0.038	3.6	461.60
3.35	-1	92.2	43.4	42.2	2.1	2.2	0.0035	0.037	4.0	365.52
3.35	-2	40.6	22.9	22.3	1.8	1.8	0.0035	0.039	3.3	134.22
3.35	2	132.8	66.3	64.5	2.0	2.1	0.0035	0.037	3.7	499.74
3.45	-1	96.4	43.5	42.2	2.2	2.3	0.0035	0.037	4.1	394.34
3.45	-2	42.9	23.5	23.0	1.8	1.9	0.0035	0.039	3.4	145.08
3.45	2	139.3	67.0	65.2	2.1	2.1	0.0035	0.037	3.8	539.41
3.55	-1	100.7	43.6	42.3	2.3	2.4	0.0035	0.037	4.2	424.09
3.55	-2	45.2	24.2	23.6	1.9	1.9	0.0035	0.039	3.5	156.56
3.55	2	145.9	67.8	65.9	2.2	2.2	0.0035	0.037	4.0	580.65
3.65	-1	104.9	43.7	42.3	2.4	2.5	0.0035	0.036	4.3	454.79
3.65	-2	47.6	24.9	24.4	1.9	2.0	0.0035	0.038	3.5	168.19
3.65	2	152.5	68.7	66.7	2.2	2.3	0.0035	0.037	4.1	622.98
3.75	-1	109.1	43.9	42.3	2.5	2.6	0.0035	0.036	4.5	486.41
3.75	-2	50.1	25.9	25.3	1.9	2.0	0.0035	0.038	3.6	179.81
3.75	2	159.2	69.7	67.7	2.3	2.4	0.0035	0.037	4.1	666.22
3.85	-1	113.4	44.0	42.4	2.6	2.7	0.0035	0.036	4.6	518.96
3.85	-2	52.7	26.8	26.2	2.0	2.0	0.0035	0.038	3.6	192.18
3.85	2	166.0	70.8	68.6	2.3	2.4	0.0035	0.037	4.2	711.14
3.95	-1	117.6	44.1	42.4	2.7	2.8	0.0035	0.036	4.7	552.44
3.95	-2	55.4	27.8	27.2	2.0	2.0	0.0035	0.038	3.7	205.34
3.95	2	173.0	71.8	69.6	2.4	2.5	0.0035	0.037	4.3	757.78

APPENDIX B.

VEGETATION COMMUNITY STAND TABLE (Continued)
Pecos Wild and Scenic River Instream Flow Report
December 1993

Plant Community No.:	00000000000000 33344112222555	Plant Community No. :	00000000000000 33344112222555
Year:	99999999999999 22222222222222	Year:	99999999999999 22222222222222
Principal Investigator:	HHHHHHHHHHHHHH KKKKKKKKKKKKKK	Principal Investigator:	HHHHHHHHHHHHHH KKKKKKKKKKKKKK
Plot Number:	1 11 11 41568039232741	Plot Number:	1 11 11 41568039232741
Abies concolor - mature	...3..2....1..	Agrostis stolonifera	3.....3..
Acer negundo - adv regen	.....3.....	Bouteloua curtipendula	.....+....
Alnus oblongifolia - adv regen	8.3.6.75.47...	Bromus carinatus	3..1.....+..
Alnus oblongifolia - mature	.8.4.5..7.....	Bromus ciliatus	..+.1+22.2+..3
Picea pungens - mature	...6341.....PP	Bromus inermis	..3+.....2.
Pinus ponderosa - mature	......+....3..	Calamagrostis canadensis	.....2.....
Populus angustifolia - adv reg	..3.....	Carex festivella	...1.....+...
Populus angustifolia - mature	54P.....	Carex rossii	.....+.....
Pseudotsuga menziesii - mature	...5.....	Carex stipata	..+.....3....
Acer negundo	...3.....	Elymus glaucus	1...1..1.....
Berberis fendleri	3...1.....	Eragrostis spp.	.....3.....
Berberis repens	.....2.....	Festuca pratensis	.....3...3.
Cercocarpus montanus	..2.....1..	Glyceria striata	....1....2....
Cornus stolonifera	3.14..85.....	Juncus balticus	.....3....
Jamesia americana	...3...1.....	Juncus saximontanus	.....34....
Juniperus communis	...1.....	Muhlenbergia wrightii	.....1..
Lonicera involucrata	.4.3.3541.5...	Phleum alpinum	.5.....
Parthenocissus inserta	...1.....	Phleum pratensis	3..1122153.333
Potentilla fruticosa	.....1.....3	Poa spp.	.....3....
Quercus gambelii	...3.....	Poa compressa	.....5..
Ribes inerme	43.133...333..	Poa fendleriana	..+.....
Ribes leptanthum	.....5.....	Poa pratensis	.6+311217.1.93
Ribes mescalerium	...1.3.....	Schizachyrium scoparium	..+.....
Rosa woodsii	3333325..2...+	Stipa robusta	.....1..
Rubus deliciosus	.....5.....	Trisetum montanum	.....1.....
Rubus leucodermis	.+..32.2.2...+	Achillea millefolium	.++1.+1+...323
Rubus neomexicanus	4.....	Aconitum columbianum	23..33.31.3...
Rubus strigosus	.....5.....	Actaea arguta	.....1...
Salix bebbiana	.....333....	Agrimonia striata	33.1..2....+..
Salix caudata	...+.....	Allium cernuum	..+.....1..
Sidalcea candida	..13.1....3...	Allium spp.	.1.....+
Salix exigua	..1.....	Ambrosia psilostachya	..+.....
Salix interior	.....1.3.....	Anemone cylindrica	.....1....2..
Salix irrorata	.....3.....	Antennaria umbrinella	..+.....
Salix lutea	..3+.3..34....	Arabis drummondii	.....+....
Salix monticola	.....4.....	Artemisia franserioides	.....2.....
Salix spp.	2	Artemisia frigida	..3.....
Salix subcoerulea	.1...3..334...	Artemisia ludoviciana	.....+.....3.3
Symphoricarpos oreophilus	.3..1.....3..3	Artemesia spp.	.....1.....
Agropyron smithii	3	Aster foliaceus	31..11.3133.12
Agropyron trachycaulum	1.+..121..1...	Aster spp.	.....1.....
Agrostis alba	....1...332.2.	Barbarea orthocerus	1.....
Agrostis scabra	.....1...3..	Besseya plantaginea	.....+.....
Agrostis semiverticillata	.7.....		

APPENDIX B.

VEGETATION COMMUNITY STAND TABLE

Pecos Wild and Scenic River Instream Flow Report

December 1993

NO.	PLANT COMMUNITY TYPE
01	New Mexico Alder/Redoiser Dogwood
02	New Mexico Alder/Bluestem Willow
03	Narrowleaf Cottonwood/New Mexico Alder
04	Blue Spruce/New Mexico Alder
05	Blue Spruce/Bluegrass

Percent Cover Conversions For The
Domin-Krajina Scale Output On Table

P =	+0	(Present in the stand)
+ =	<0.1 %	(Solitary, insignificant cover)
1 =	0.1 TO 0.4%	(Seldom, insignificant cover)
2 =	0.5 TO 0.9%	(Very scattered, small cover)
3 =	1 TO 4%	(Scattered cover)
4 =	5 TO 9%	
5 =	10 TO 24%	
6 =	25 TO 32%	
7 =	33 TO 49%	
8 =	50 TO 74%	
9 =	75% OR GREATER	

VEGETATION COMMUNITY STAND TABLE (Continued)
Pecos Wild and Scenic River Instream Flow Report
December 1993

Plant Community No.:	00000000000000 33344112222555	Plant Community No.:	00000000000000 33344112222555
Year:	99999999999999 22222222222222	Year:	99999999999999 22222222222222
Principal Investigator:	HHHHHHHHHHHHHH KKKKKKKKKKKKKK	Principal Investigator:	HHHHHHHHHHHHHH KKKKKKKKKKKKKK
Plot Number:	1 11 11 41568039232741	Plot Number:	1 11 11 41568039232741
Campanula rotundifolia	...1.+.....+.+	Oxypolis fendleri	23.1++.23+3...
Capsella bursa-pastoris	..........+.	Penstemon barbatus	..+.....+..
Cerastium nutans	11.....+....	Plantago major	...1.....3.
Chenopodium album	..........+..	Polemonium foliosissimum	.....2...
Chrysanthemum leucanthemum	...1.....1..	Potentilla hippiana	1....11....1.2
Chrysopsis canescens	..3.....	Potentilla pulcherrima	1....+.....+..
Cinna latifolia	....1+.....	Potentilla thurberi	....+.....
Circaea alpina	....+.....	Prunella vulgaris	11.1...3.....
Cirsium neomexicanum	.....1..	Pseudocymopteris montana	.....+.....
Cirsium pallidum	.....2..1	Ranunculus spp.	.1.....
Cirsium spp	1....1....1...	Ranunculus uncinatus	.....+.....
Cystopteris fragilis	.....1.....	Rudbeckia hirta	.....+1....3.2
Deschampsia caespitosa	.....+..5.....	Rudbeckia laciniata	53233223.33..2
Epilobium hornemannii	....+.....	Senecio fendleri	..1.....
Epilobium paniculatum	..+.....1.....	Senecio sanguisorboides	21.....1..2...
Epilobium spp.	.1...+...11...	Senecio spp.	.....1.....
Equisetum arvense	31+31423853..2	Sisymbrium linearifolium	.....+..
Erigeron flagellaris	.....1....1.+	Smilacina stellata	33..32.2..3...
Erigeron formosissimus	1.+..11.....3	Solidago rigida	..+.....1..
Erigeron speciosus v speciosus	.....2..	Solidago spp.	...3.....
Erigeron spp.	...1.....	Solidago wrightii	..+.....
Eupatorium herbaceum	.....1.....	Sonchus oleraceus	1.....+1...
Fragaria americana	.....1.3..1...	Taraxacum officinale	13+1++1+1.1232
Galium aparine	.1.1+....11...	Thalictrum fendleri	43.1.143..3..+
Galium boreale	.....+1.....+	Thlaspi alpestre	.....1.....
Geranium caespitosum	..1.....2.2	Thermopsis pinetorum	.....1..
Geranium richarsonii	.1.1.132.12+12	Townsendia eximia	..+.....
Geum macrophyllum	23..2+.1.23..3	Tragopogon dubius	..+.....3..
Heracleum lanatum	55.353333.3..3	Tragopogon pratensis	.....+.
Hypericum formosum	1.+.....	Trifolium pratense	...1.....3.
Hymenopappus newberryi	..1.....	Trifolium repens	...1.+21.1.332
Ipomopsis aggregata	..+.....	Urtica gracilenta	.....2.....
Iris missouriensis	.1.1.1..1....+	Verbascum thapsus	.....2..
Lathyrus graminifolius	..+1.....	Verbena macdougalii	.....+.+
Ligusticum porteri	21.1+1.31+3...	Veronica americana	.....P....
Linum lewisii	.....+	Vicia americana	1.....+.3
Medicago lupulina	.....33.	Viguiera multiflora	1.....1..
Mertensia franciscana	21..11.2.33..+	Viola canadensis	23.1+...1.1...
Oenothera hookeri	..2.....1++		

APPENDIX C

Soil Profile Descriptions

Pecos Wild and Scenic River Instream Flow Report

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Plot No. 92HK001
Location: Middle Sub-segment
Community Type: Narrowleaf Cottonwood/New Mexico Alder

Soil Taxon: Aeric Fluvaquent, mixed, frigid, coarse loamy over sandy skeletal

O 1 to 0 cm; little humus; grass, alder litter.

A1 0 to 12 cm; dark grayish brown (10YR 4/2 ped and crush/dry), black (10YR 2/1 ped and rub moist); silt loam (10% clay); weak, fine subangular blocky; slightly hard (dry); many very fine, common fine, few medium and coarse roots; 5% gravel; pH 6.4; no effervescence; smooth abrupt boundary.

2B1 12 to 29 cm; dark grayish brown (10YR 4/2 crush/dry), very dark brown (10YR 2/2 ped and rub/moist); loamy sand (5% clay); weak, medium crumb; nonsticky (wet), very friable (moist); few very fine, common fine, many medium, and few coarse roots; 60% gravel, 10% cobble; pH 7.2; no effervescence; smooth clear boundary.

2B2 29 to 70+ cm; dark grayish brown (10YR 4/2 crush/dry), black (10YR 2/1 rub/moist); sand loam (11% clay); fine granular to massive; nonsticky (wet), very friable (moist); few medium and coarse roots; 35% gravel, 50% cobble, 5% stone; pH 7.6; no effervescence.

Plot No.: 92HK002
Cross-section: 1
Location: Middle Sub-segment
Community Type: New Mexico Alder/Bluestem Willow

Soil Taxon: Typic Fluvaquent, sandy skeletal, mixed frigid

A1 0 to 5 cm; dark brown (10YR 3/3 crush/dry and 7.5YR 3/2 rub/moist); silt loam (10% clay); massive; nonsticky (wet), very friable (moist); many very fine, many fine, common medium, and few coarse roots; common very fine, common fine, few medium and coarse pores; pH 7.6; no effervescence; smooth clear boundary.

2B1 5 to 13 cm; grayish brown (10YR 5/2 crush/dry), dark brown (10YR 3/3 rub/moist); sand (3% clay); common, distinct, medium to coarse, strong brown to reddish yellow (7.5YR 5.5/8) mottles; single grain; nonsticky (wet), very friable (moist); many very fine, many fine, common medium, and few coarse roots; common very fine, common fine, few medium and coarse pores; 5% gravel, 8% cobble; pH 7.2; no effervescence; wavy clear boundary.

3B2 13 to 23 cm; dark grayish brown (10YR 4/2 crush/dry), dark brown (7.5YR 3/2 rub/moist); silt loam (15% clay); massive; nonsticky (wet), friable (moist); many very fine, many fine, common medium and coarse roots; common very fine, common fine, few medium and coarse pores; 15% gravel, 25% cobble; pH 7.6; no effervescence; smooth clear boundary.

4C1 23 to 34+ cm; dark grayish brown (10YR 4/2 crush/dry), dark brown (10YR 3/3 rub/moist); sand (2% clay); common, distinct, medium to coarse, strong brown to reddish yellow (7.5YR 5.5/8) mottles; single grain; nonsticky (wet), very friable (moist); many very fine, many fine, common medium, and common coarse roots; common very fine, common fine, common medium and few coarse pores; 32% gravel, 50% cobble; pH 7.4; no effervescence.

Water at 34 cm.

A1 has abundant roots and organic material; roots very dense; coarse alluvial organic material (tree bark).

2B1 has very dense roots; coarse alluvial organic material (tree bark).

4C1 has roots in the upper few cm.

Plot No.: 92HK003
Cross-section: 2
Location: Lower Sub-segment
Community Type: New Mexico Alder/Redosier Dogwood

Soil Taxon: Typic Fluvaquent, loamy skeletal, mixed, frigid

Oi 7 to 0 cm; coarse organic material (rotting wood); 95% coarse organic material.

A 0 to 23 cm; very dark grayish brown (10YR 3/2 rub/moist); loam (12% clay, 48% silt); few, distinct, medium to coarse, dark yellowish brown to yellowish brown (10YR 4.5/6) mottles; weak to moderate, medium crumb; nonsticky (wet), friable (moist); common roots of all sizes; common very fine, common fine, few medium and coarse pores; 10% gravel, 30% cobble, 30% stone; pH 7.2; no effervescence; smooth clear boundary.

Cg1 23 to 41 cm; very dark gray (10YR 3/1 rub/moist); silt loam (17% clay, 58% silt); common, distinct, medium to coarse, dark yellowish brown to yellowish brown (10YR 4.5/6) mottles; weak, medium crumb; slightly sticky (wet), friable (moist); common roots of all sizes; common very fine, common fine, few medium and coarse pores; 10% gravel, 30% cobble, 30% stone; pH 6.8; no effervescence; smooth clear boundary.

Cg2 41 to 61 cm; black (7.5YR 2.5/1 rub/moist); loam (12% clay, 48% silt); massive; nonsticky (wet), friable (moist); few roots of all sizes; common very fine, few fine, medium and coarse pores; 10% gravel, 30% cobble, 30% stone; pH 6.4; no effervescence; smooth clear boundary.

Cg3 61 to 83+ cm; dark gray to very dark gray (5Y 3.5/1 rub/moist); sandy loam (7% clay, 20% silt); massive; nonsticky (wet), friable (moist); few roots of all sizes; common very fine, few fine, medium and coarse pores; 10% gravel, 30% cobble, 30% stone; pH 7.2; no effervescence.

Pecos river left bank is 85 cm from pit.

A has coarse organic material (40% of soil) on in upper 5 cm; mottles are in the lower 4cm of the horizon.

Plot No.: 92HK004
Cross-Section: 2
Location: Lower Sub-segment North of Tererro
Community Type: Narrowleaf Cottonwood/New Mexico Alder

Soil Taxon: Aeric Endoaquept, coarse loamy over loamy skeletal, mixed frigid

A1 0 to 6 cm; very dark grayish brown (10YR 2.5/2) sandy loam; weak moderate crumb; very friable, non-sticky; many very fine, common fine, few medium roots; 1 percent gravel, 5 percent stones; slightly acid (pH 6.6); clear wavy boundary.

AB 6 to 24 cm; very dark grayish brown (10YR 2.5/2) sandy loam; weak fine subangular blocky; very friable, non-sticky; common medium pores; common very fine, fine, medium and coarse roots; 5 percent gravel, 10 percent cobble, 5 percent stone; slightly acid (pH 7.4); gradual smooth boundary.

Bw1 24 to 44 cm; very dark grayish brown (10YR 2.5/2) cobbly sandy loam; weak moderate subangular blocky; very friable, non-sticky; common medium pores; common very fine and fine, many medium and coarse roots; 15 gravel, 20 percent cobbles, 5 percent stone; slightly alkaline (pH 7.4); abrupt smooth boundary.

C1 44 to 60+ cm; dark brown (10YR 3/2.5) gravelly sandy clay loam; weak medium crumb; friable, slightly sticky; few fine, medium and coarse roots; 40 percent gravel, 20 percent cobbles, 10 percent stone.

Plot No.: 92HK005
Cross-section: 2
Location: Lower Sub-segment
Community Type: Narrowleaf Cottonwood/New Mexico Alder

Soil Taxon: Aeric Fluvaquent, sandy skeletal, mixed, frigid

A1 0 to 8 cm; dark grayish brown (10YR 4/2 crush/dry), very dark grayish brown (10YR 3/2 rub/moist); loamy sand to sandy loam; weak, medium crumb to single grain; nonsticky (wet), to very friable (moist); common roots of all sizes; common very fine, common fine, few medium and coarse pores; 30% gravel, 20% cobble; pH 7.6; no effervescence.

B1 8 to 35 cm; dark grayish brown (10YR 4/2 crush/dry), dark brown (10YR 3/3 rub/moist); loamy sand (5% clay, 15% silt); weak, medium crumb to single grain; nonsticky (wet), to very friable (moist); common roots of all sizes; common very fine, common fine, few medium and coarse pores; 25% gravel, 20% cobble, 30% stone; pH 7.6; no effervescence.

B2 35 to 70 cm; yellowish brown (10YR 5/4 crush/dry), dark brown (10YR 3/3 rub/moist); sand (3% clay, 7% silt); weak, medium crumb to single grain; nonsticky (wet), to very friable (moist); common very fine, fine, medium, and few coarse roots; common very fine, common fine, few medium and coarse pores; 25% gravel, 20% cobble, 30% stone; pH 7.6; no effervescence.

C 70 to >73 cm; dark reddish brown (5YR 3/2 crush/dry and rub/moist); loamy sand (5% clay, 15% silt); single grain; nonsticky (wet), to very friable (moist); common very fine, fine, medium, and few coarse roots; common very fine, common fine, few medium and coarse pores; 25% gravel, 20% cobble, 30% stone; pH 7.6; no effervescence.

Water at 73 cm.

A1 has coarse organic material (15%).

Plot No.: 92HK006
Cross-section: 3
Location: Lower Sub-segment
Community Type: Blue Spruce/New Mexico Alder

Soil Taxon: Aeric Fluvaquent, sandy skeletal, mixed, frigid

A1 0 to 20 cm; dark brown (10YR 3/3 crush/dry), very dark grayish brown (10YR 3/2 rub/moist); loam (15% clay, 45% silt); moderate to strong, medium crumb; nonsticky (wet), very friable (moist); many very fine, common fine, common medium, and few coarse roots; common very fine, common fine, few medium and ayerza pores; 10% gravel, 5% cobble; pH 7.6; no effervescence; smooth clear boundary.

2B1 20 to 35 cm; dark brown (10YR 3/3 crush/dry), very dark grayish brown (10YR 3/2 rub/moist); loam (15% clay, 45% silt); moderate to strong, medium crumb; nonsticky (wet), very friable (moist); many very fine, common fine, few medium and coarse; common very fine, common fine, few medium and coarse pores; 30% gravel, 25% cobble, 10% stone, 5% boulder; pH 7.6; no effervescence; smooth clear boundary.

2B2 35 to 99cm; dark grayish brown (10YR 4/2 crush/dry), very dark grayish brown to dark brown (10YR 3/2.5 rub/moist); loamy sand (5% clay, 10% silt); weak, medium crumb; nonsticky (wet), very friable (moist); few to common very fine, few to common fine, few medium and coarse roots; common very fine, common fine, few medium and coarse pores; 15% gravel, 15% cobble, 30% stone, 20% boulder; pH 7.8; no effervescence; smooth abrupt boundary.

2C1 99 to 102 cm; grayish brown (10YR 5/2 crush/dry), very dark grayish brown to dark brown (10YR 3/2 rub/moist); silty loam (20% clay, 60% silt); massive; slightly sticky (wet), very friable (moist); few roots and pores of all sizes; 10% gravel, 10% cobble, 40% stone, 30% boulder; pH 7.8; no effervescence.

Water at 102 cm.

Plot No.: 92HK07
Cross-Section: 2
Location: Lower Sub-segment.
Community Type: Blue Spruce/Blue Grass

Soil Taxon: Fluventic Dystrochrept, loamy, mixed, frigid.

A1 0 to 26 cm; very dark brown (10YR 3/2) silt loam; strong coarse subangular block; very friable; common fine and very fine, few medium and coarse pores; common fine and very fine, few medium and coarse roots; 2 percent gravel; slightly acid (pH 6.4); clear smooth boundary.

Bw1 26 to 51 cm; very dark brown (10YR 3/2) loam; moderate medium subangular blocky; very friable; common fine and very fine, few medium and coarse pores; common very fine, fine, medium and coarse roots; 3 percent gravel; slightly acid (pH 6.6); clear smooth boundary.

Bw2 51 to 76 cm; very dark brown (10YR 3/2) cobbly loam; moderate medium subangular blocky; very friable; common fine and very fine, few medium and coarse pores; common very fine, fine, medium and coarse roots; 3 percent gravel, 10 percent cobbles; clear smooth boundary.

C1 76 to 100+ cm; dark brown (10YR 3/3) cobbly sandy loam; weak fine crumb; common fine and very fine, few medium and coarse pores; few very fine and fine , common medium and coarse roots; slightly alkaline (pH 7.4).

Plot No: 92HK008
Cross to section: 4
Location: Middle Sub-segment
Community Type: Blue Spruce/New Mexico Alder

Soil Taxon: Aeric Fluvaquent, loamy over sandy skeletal, mixed, frigid

O 4 to 0 cm; weakly decomposed litter

A1 0 to 40 cm; very dark grayish brown (10YR 3/2 rub/moist); silty loam (20% clay, 70% silt); strong, medium to coarse crumb and few fine subangular blocky; sticky (wet), friable (moist); common roots and pores of all sizes; 2% gravel; pH 7.0; no effervescence.

C1 40 to 60 cm; very dark grayish brown (10YR 3/2 rub/moist); silty loam (15% clay, 55% silt); common, distinct, medium to coarse, yellowish brown to brownish yellow (10YR 5.5/8) mottles; massive; slightly sticky (wet), very friable (moist); common very fine, few fine, medium and coarse roots; common very fine, few fine, medium and coarse pores; 5% gravel, 5% cobble; pH 7.0; no effervescence.

C2 60 to 69 cm; black to very dark gray (10YR 2.5/1 rub/moist); silty loam(15% clay, 55% silt); few, distinct, medium to coarse, yellowish brown to brownish yellow (10YR 5.5/8) mottles; massive; slightly sticky (wet), very friable (moist); common very fine, few fine, medium and coarse roots; common very fine, few fine, medium and coarse pores; 5% gravel, 10% cobble; pH 7.0; no effervescence.

2C3 73 to 86cm; dark yellowish brown (10YR 4/4 crush/dry), dark brown (10YR 3/3 rub/moist); sand (5% clay, 5% silt); many, prominent, coarse, yellowish brown to brownish yellow (10YR 5.5/8) mottles, areas of soil are orange; single grain; nonsticky (wet), very friable (moist); few roots of all sizes; common very fine, common fine, few medium and coarse pores; 30% gravel, 55% cobble; pH 7.4; no effervescence.

Water at 86 cm.

Little biological activity below 44 cm.

A horizon has few small sand lenses.

C1 and C2 horizons have occasional to common sand lenses, few square to several square cm; occasional coarse alluvial organic matter (tree shoots).

Plot No.:92HK009
Cross-Section: 6
Location: Upper Sub-segment
Community Type: New Mexico Alder/Bluestem Willow

Soil Taxon: Aquic Dystrochrept, coarse loamy over sandy skeletal, mixed, frigid

A1 0 to 3 cm; grayish brown (10YR 5/2 ped and crush/dry), very dark grayish brown (10YR 3/2 ped and rub/moist); fine loamy sand (5% clay); fine granular; nonsticky (wet), very friable (moist); common very fine and fine roots; pH 7.2; no effervescence; wavy clear boundary.

Bw1 3 to 27 cm; dark grayish brown (10YR 4/2 ped and crush/dry), dark brown to very dark grayish brown (8.75YR 3/2 ped and rub/moist); loam (15% clay) fine strong angular blocky; nonsticky (wet), firm (moist) slightly hard (dry); many very fine, common fine, few medium roots; common fine pores; 1% gravel; pH 7.0; no effervescence; smooth clear boundary.

Bw2 27 to 48 cm; dark grayish brown (10YR 4/2 ped and crush/dry), dark brown to very dark grayish brown (8.75YR 3/2 ped and rub/moist); sandy loam (20% clay) fine strong angular blocky, amalgamated to medium, weak subangular blocky; slightly sticky (wet), firm (moist) slightly hard (dry); few very fine, few fine, many medium and coarse roots; common fine, medium filled pores; 1% gravel, 1% cobble, 1% stone, 1% boulder; pH 7.0; no effervescence; smooth abrupt boundary.

C1 48 to 100 cm; brown (10YR 4/3 ped and crush/dry), very dark grayish brown (10YR 3/2 ped and rub/moist); coarse loamy sand (5% clay); medium subangular blocky; nonsticky (wet), friable (moist); few very fine roots; 30% gravel, 50% cobble, 10% stone; pH 7.4; no effervescence.

A1 is intermittent over Bw1.

Plot No.:92HK010
Cross-Section: 5
Location: Middle Sub-segment
Community Type: New Mexico Alder/Redosier Dogwood

Soil Taxon: Typic Fluvaquent, loamy skeletal, mixed, frigid

A1 1 to 13 cm; very dark brown (10YR 2.5/2); gravelly loam; weak coarse subangular blocky; very friable, slightly sticky; few fine, common fine roots; 30 percent gravel, 20 percent cobble, 15 percent stone; neutral (pH 7.0); abrupt smooth boundary.

Cg1 13 to 16cm; very dark grayish brown (10YR 3/2); gravelly sandy clay loam; 10 percent very dark gray mottles (10YR 3/1); massive; very friable, sticky; few fine roots; 20 percent gravel, 10 percent cobble, 15 percent stone; neutral (pH 7.0); abrupt smooth boundary.

Cg2 26 to 46 cm; dark brown (10YR 3/3); cobbly sandy loam; 30 percent dark gray mottles (10YR 3/1); massive; very friable, slightly sticky; few fine roots; 10 percent gravel, 20 percent cobbles, 15 percent stone; slightly acid (pH 6.8); clear smooth boundary.

2Cg3 46 to 62+cm; very dark gray (10YR 3/1); clay; 20 percent dark yellowish brown mottles (10YR 4/4); massive; firm; few fine roots; five percent gravel, fiver percent cobble, 5 percent stone; slightly acid.

Plot No: 92HK011
Cross-section: 7
Location: Upper Sub-segment
Community Type: Blue Spruce/Blue Grass

Soil Taxon: Fluventic Dystrochrept, loamy skeletal, mixed, frigid

A1 0 to 6 cm; dark grayish brown (10YR 4/2 crush/dry), dark brown (7.5YR 3/2 rub/moist); silt loam (20% clay, 70% silt); strong, medium crumb; slightly sticky (wet), very friable (moist); many very fine, many fine, few medium and coarse roots; common very fine, common fine, few medium and coarse pores; pH 6.4; no effervescence; smooth abrupt boundary.

A2 6 to 33 cm; dark grayish brown (10YR 4/2 crush/dry), dark brown to very dark grayish brown (8.75YR 3/2 rub/moist); silt loam (20% clay, 70% silt); strong, medium crumb; slightly sticky (wet), very friable (moist); common very fine, common fine, common medium, and few coarse roots; common very fine, common fine, few medium and coarse pores; 5% gravel, 12% cobble; pH 6.6; no effervescence; smooth clear boundary.

2B1 33 to 73 cm; dark grayish brown (10YR 4/2 crush/dry), dark brown to very dark grayish brown (8.75YR 3/2 rub/moist); silt loam (15% clay, 55% silt); strong, very fine subangular blocky to strong, medium crumb; slightly sticky (wet), very friable (moist); few very fine, few fine, common medium, and few coarse roots; common very fine, common fine, few medium and coarse pores; 30% gravel, 50% cobble, 5% stone; pH 6.6; no effervescence; smooth clear boundary.

3C1 73 to 85+ cm; dark brown (10YR 3/3 crush/dry), dark brown (7.5YR 3/2 rub/moist); sandy loam (10% clay, 15% silt); moderate, fine crumb; nonsticky (wet), very friable (moist); few roots of all sizes; common very fine, common fine, common medium and few coarse pores; 5% gravel, 20% cobble, 60% stone; pH 7.0; no effervescence.

Plot No.: 92HK012
Cross-section: 7
Location: Upper Sub-segment
Community Type: New Mexico Alder/Bluestem Willow

Soil Taxon: Aeric Fluvaquent, loamy skeletal, mixed, frigid

A1 0 to 10 cm; very dark grayish brown (10YR 3/2 crush/dry), very dark gray to very dark grayish brown (10YR 3/1.5 rub/moist); silty loam (15% clay, 80% silt); strong medium crumb; slightly sticky (wet), friable (moist); many very fine, common fine, few medium and coarse roots; common very fine, common fine, few medium and coarse pores; pH 6.2; no effervescence; wavy abrupt boundary.

B1 10 to 39 cm; dark grayish brown (10YR 4/2 crush/dry), very dark grayish brown (10YR 3/2 rub/moist); sand (3% clay, 9% silt); moderate, medium crumb; nonsticky (wet), very friable (moist); common roots of all sizes; common very fine, common fine, few medium and coarse pores; 50% gravel, 20% cobble; pH 6.6; no effervescence; smooth clear boundary.

B2 39 to 64 cm; dark grayish brown (10YR 4/2 crush/dry), to very dark grayish brown to dark brown (10YR 3/2.5 rub/moist); sand (3% clay, 6% silt); moderate, fine to medium crumb; nonsticky (wet), very friable (moist); common very fine, common fine, few medium and coarse roots; common very fine, common fine, few medium and coarse pores; 30% gravel, 40% cobble, 10% stone; pH 7.0; no effervescence; smooth clear boundary.

C1 64 to 98 cm; dark grayish brown (10YR 4/2 crush/dry), to very dark grayish brown to dark brown (10YR 3/2.5 rub/moist); sand (2% clay, 5% silt); single grain; nonsticky (wet), very friable (moist); few roots of all sizes; common very fine, common fine, few medium and coarse pores; 10% gravel, 15% cobble, 65% stone; pH 7.6; no effervescence.

Water at 98 cm.

Plot No.: 92HK013
Cross-section: 8
Location: Upper Sub-segment
Community Type: New Mexico Alder/Bluestem Willow

Soil Taxon: Typic Fluvaquent, loamy skeletal, mixed

A1 1 to 13 cm; dark gray (10YR 4/2) sandy loam, very dark gary (10YR 2.5/1) moist; weak medium crumb; very friable, non-sticky; many fine and very fine roots, 1 percent gravel; neutral (pH 7.0); smooth, abrupt boundary.

Bg1 13 to 27 cm; very dark grayish brown (10YR 3/1.5) loam; weak fine subangular blocky; friable, non-sticky; common very fine and fine roots; 1 percent gravel; slightly acid (pH 6.0); clear smooth bound.

Bg2 17 to 33 cm; very dark gray (10YR 3/1) loam; weak medium subangular blocky; friable, non-sticky; no roots; 1 percent gravel; abrupt wavy boundary.

2Cg1 33 to 55+ cm; very dark gray (10YR 3/1) stony loam; massive; no roots; 5 percent gravel, 30 percent cobbles, 40 percent stones.

Plot No.: 92HK014
Cross-section: 1
Location: Middle Sub-segment
Community Type: Blue Spruce/Blue Grass

Soil Taxon: Oxyaquic Udifluvent, coarse silty, mixed, frigid

A1 0 to 8 cm; very dark grayish brown (10YR 3/2 rub/moist); silt loam (20% clay, 70% silt); few, distinct, medium to coarse, brownish yellow to yellowish brown (10YR 5.5/8) mottles; strong, medium to coarse granular to few, fine to strong subangular blocky; sticky (wet), friable (moist); many very fine, many fine, few medium and coarse roots; common very fine, common fine, few medium and coarse pores; pH 7.8; no effervescence; smooth clear boundary.

A2 8 to 25 cm; very dark grayish brown (10YR 3/2 rub/moist); silt loam (20% clay, 70% silt); few, distinct, medium to coarse, brownish yellow to yellowish brown (10YR 5.5/8) mottles; strong, medium to coarse granular to few, fine to strong subangular blocky; sticky (wet), friable (moist); many very fine, common fine, few medium and coarse roots; common very fine, common fine, few medium and coarse pores; pH 7.8; no effervescence; smooth clear boundary.

Bw1 25 to 54 cm; very dark grayish brown (10YR 3/2 rub/moist); silt loam (15% clay, 55% silt); moderate, fine to medium crumb; slightly sticky (wet), very friable (moist); common very fine, common fine, few medium and coarse roots; common very fine, few fine, medium and coarse pores; pH 7.8; no effervescence; smooth gradual boundary.

Bw2 54 to 100 cm; very dark grayish brown (10YR 3/2 rub/moist); silt loam (15% clay, 55% silt); moderate, fine to medium crumb; slightly sticky (wet), very friable (moist); common very fine, few fine, medium and coarse roots; common very fine, few fine, medium and coarse pores; pH 7.8; no effervescence; smooth abrupt boundary.

2Cg1 100 to 108 cm; very dark grayish brown (10YR 3/2 rub/moist); loamy sand (5% clay, 10% silt); many, faint, medium, strong brown to reddish yellow (7.5YR 5.5/8) mottles; weak, medium crumb; nonsticky (wet), very friable (moist); few roots of all sizes; common very fine, common fine, few medium and coarse pores; 25% gravel, 50% cobble; pH 7.4; no effervescence.

A1 is dry; coarse alluvial (non-root wood) organic material common.
A2 is moist at 10 cm; coarse alluvial (non-root wood) organic material common.
Bw2 has few small (5 by 2 cm) sand pockets.