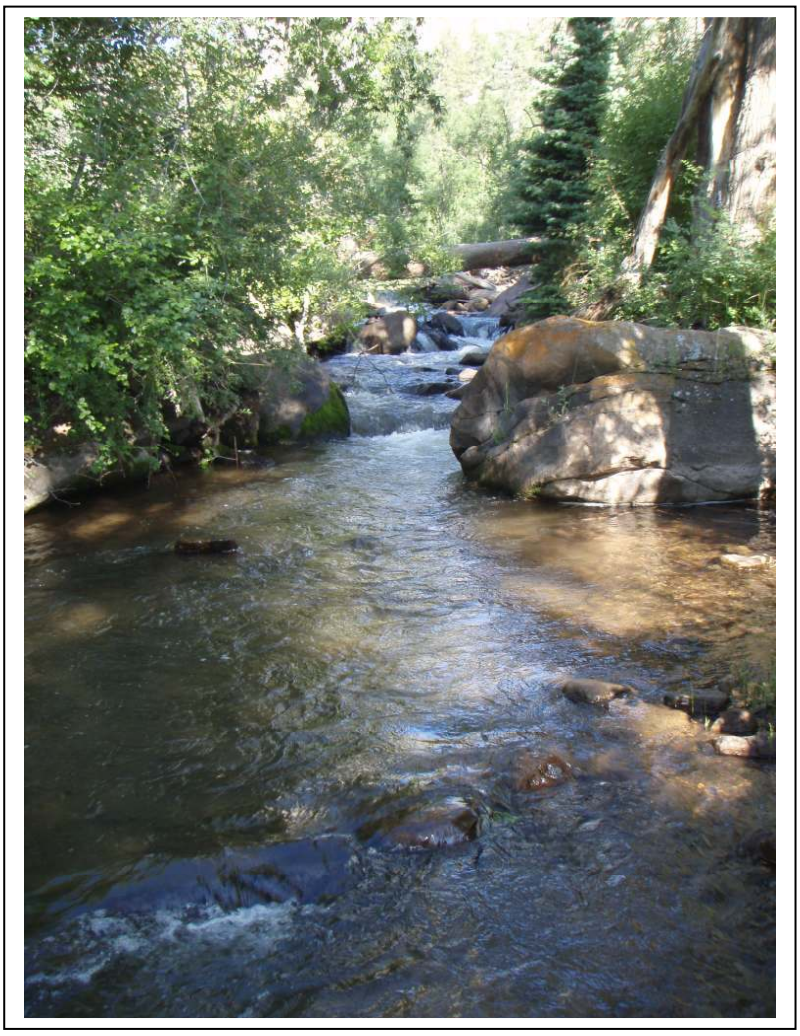
Aquatic Assessment & Habitat Enhancement Plan
The Cucharas River
Cuchara Valley Ranch
Huerfano County - Colorado



Prepared by

FIN-UP Habitat Consultants, Inc.

J. Peter Gallagher
220 Illinois Ave
Manitou Springs, CO 80829
(719) 685-9768 (Office)
(719) 332-2550 (Cell)
pete@fin-up.com

September 30, 2008

Table of Contents

In July 2008, FIN-UP Habitat Consultants, Inc. was contracted by Robert Taylor, owner of the Cuchara Valley Ranch, to conduct an aquatic assessment of the Cucharas River where it runs through the Cuchara Valley Ranch. The assessment included a study of existing habitat conditions for resident trout in the river, a condition assessment of previous structural work that had been attempted in the reach, and development of a restoration plan to improve habitat quality and complexity in the reach. This document summarizes the results of the assessment, and our recommendations for future enhancement work and management of the stream and adjacent riparian corridor.

Map 1: Location of project on the Cucharas River - Cuchara Valley Ranch, Huerfano County, CO.

The Cuchara Valley Ranch is located approximately 3 miles north of the town of Cuchara, in Huerfano County, CO. The ranch includes 2,296 feet of the Cucharas River, and the confluence with a major headwater tributary, White Creek, is also found on the property. For the purposes of this study, the stream through the property was delineated into two distinct reaches; one below the confluence with White Creek, extending downstream to the property boundary, and one above the confluence extending to the upstream boundary of the ranch.

Watershed and Hydrology

The headwaters of the Cucharas River drain the northeastern flanks of the Culebra Range and the northern and western aspects of the Spanish Peaks. The headwaters consist of several small tributaries, including Cucharas Creek, White Creek, Baker Creek, Dodgeton Creek and Chaparral Creek. The watershed extends downstream to the confluence with the Wahatoya Creek, approximately three miles downstream of the town of La Veta, CO. The aspect of the watershed is mostly a northern exposure, and the landscape is typically defined by steep hill slopes of dense spruce and mixed conifer. Riparian zones tend to be somewhat narrow in width, and consist of aspen, alder and native willow. The headwaters of the Cucharas River watershed upstream of the Cuchara Valley Ranch have a contributing drainage area of approximately 32.6 square miles, with White Creek contributing an additional 9 square miles of drainage area within the downstream reach on the ranch..

The US Geological Service (USGS) Hydrologic Unit of the watershed is 1102000604. The nearest automated stream gauge to the project area is located 2 miles downstream of the Cuchara Valley Ranch, and is maintained by Colorado Division of Water Resources. The location of this gauge is at Latitude 37°25'12",Longitude 105°03'08", in the SE¼ of the NE¼ of the SE¼ section of 24, T.30 S., R.69 W., Huerfano County, on left bank at Boyd Ranch. The gauge is 29 ft. downstream from a private bridge, 1.4 mi downstream from Chaparral Creek, and 6.5 mi southwest of La Veta. The watershed area upstream of this gauge is approximately 59 square miles. A 74 year record of flow data is available at this site. For the period of record, peak yearly flows have ranged from a minimum of 14 cubic feet per second (cfs) to 403 cfs. The median peak flow during the period of record was 95 cfs. The bank full stage (two year flood return interval) was determined for the study reaches using a combination of field observations and analysis of historic flow date. The bank full stage (BF) of the upstream reach was estimated to be 70 cfs, and the bank full stage of the downstream reach was estimated to be 90 cfs.

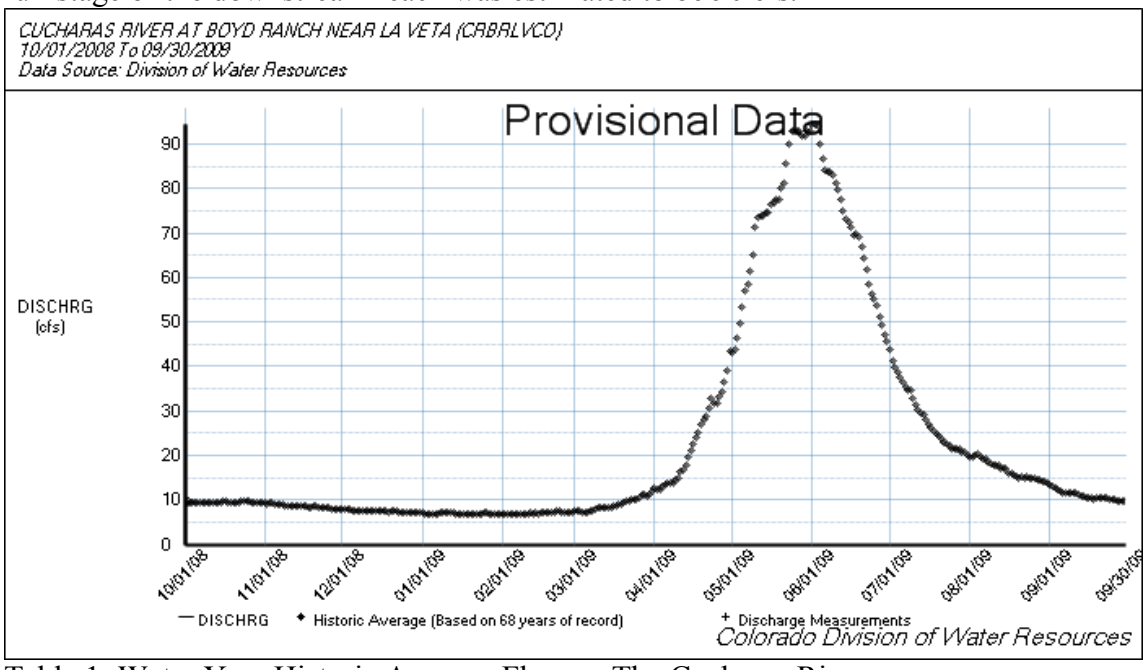


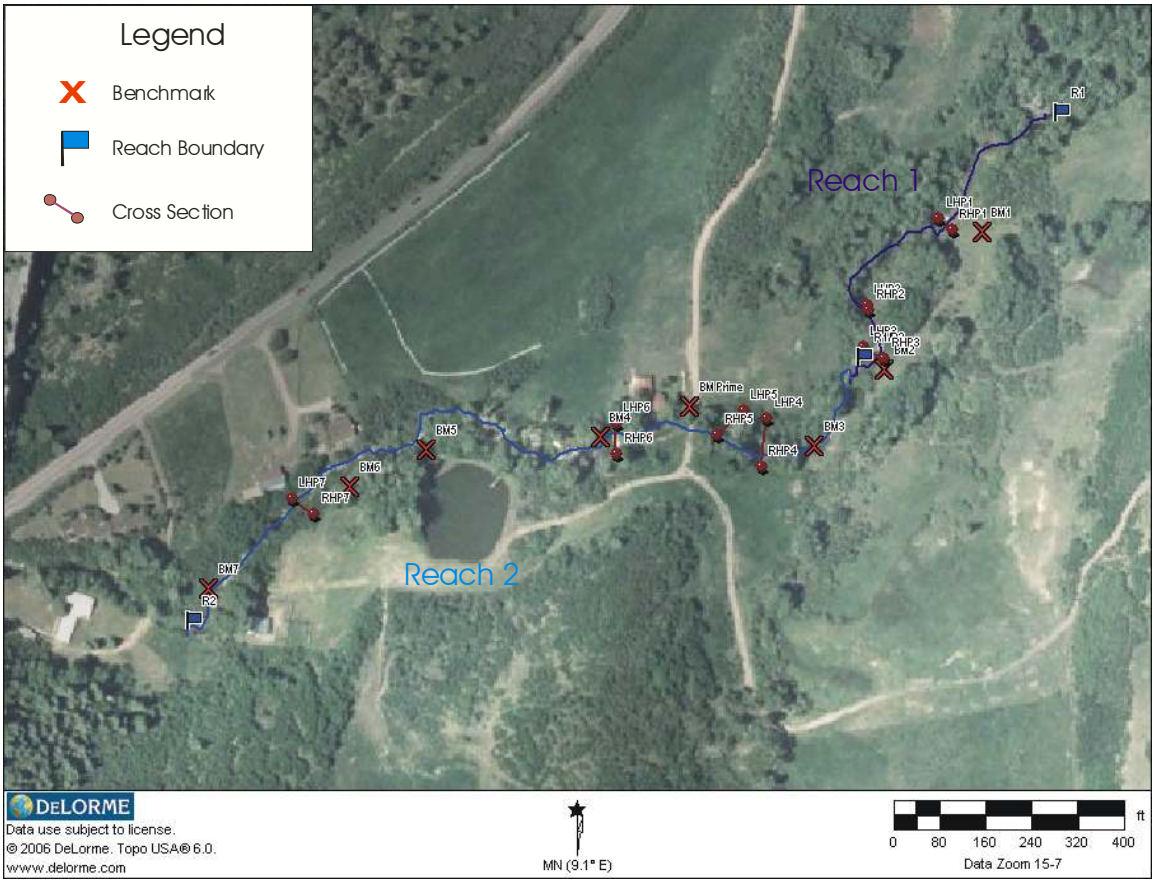
Table 1: Water Year Historic Average Flows – The Cucharas River.

Existing Fish Populations

The Cucharas River contains resident populations of both native and non-native fishes. The greenback cutthroat trout (*Oncorhynchus clarki stomias* - federal and state threatened), is not known to exist in the watershed. Brown trout (*Salmo Trutta*) and brook trout (*Salvelinus fontinalis*) are the most common non-native salmonids in the Cucharas River watershed, and have been observed in the project reach. Additionally, rainbow trout (*Oncorhynchus mykiss*) are occasionally stocked by private individuals, and may \remain resident in the watershed. No electrofishing data has been collected within the project area.

Stream Channel and Habitat Assessment Methods

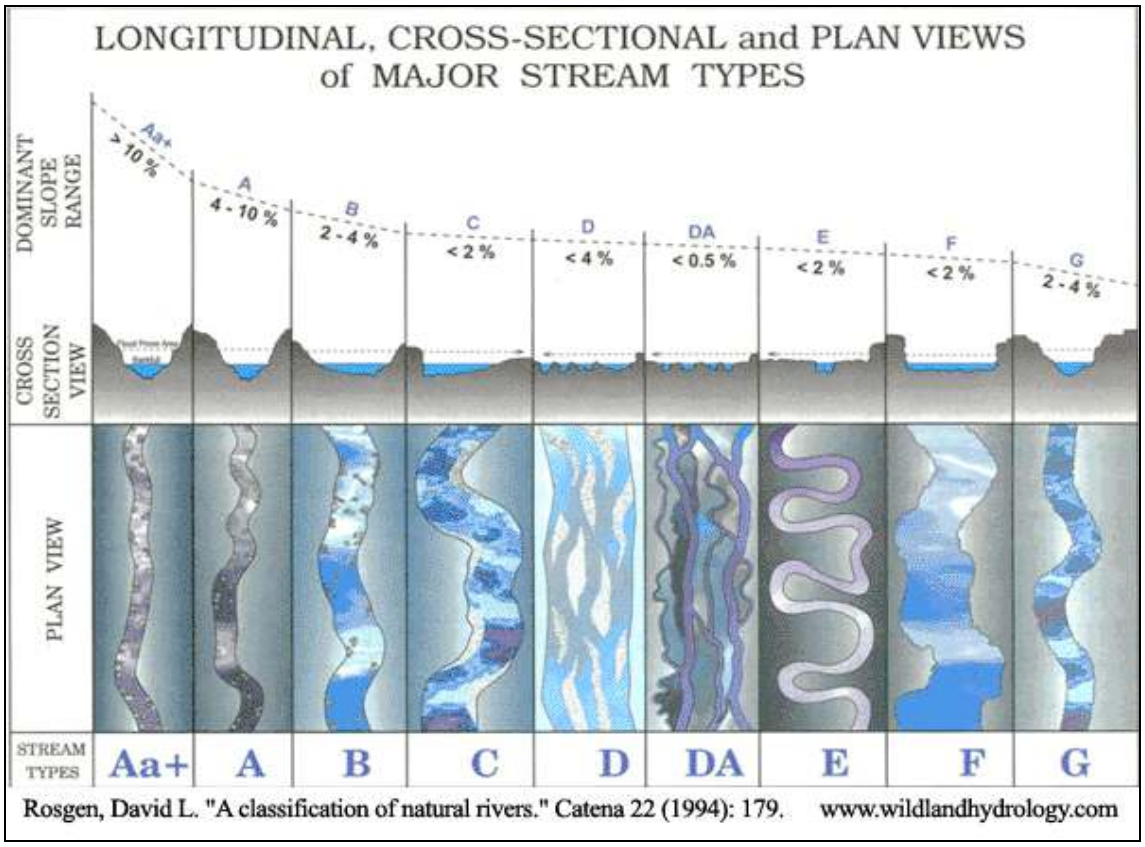
For the purposes of this assessment, The Cucharas River through the Cuchara Valley Ranch was delineated into distinct reaches, or segments, based on valley type, channel morphology, perennial vs. intermittent flows, and administrative or physical boundaries. Reaches were numbered consecutively, beginning at the furthermost downstream ranch boundary, and continuing upstream to the headwaters. Eight permanent benchmarks were established along the two study reaches, and seven cross-sections were located. The locations of the reaches, benchmarks and cross-sections is shown in the aerial photograph below.



Map 2: Locations of the study reaches, benchmarks, and cross-sections on the Cuchara Valley Ranch – The Cucharas River, Huerfano County, CO

Rosgen Stream Classification System

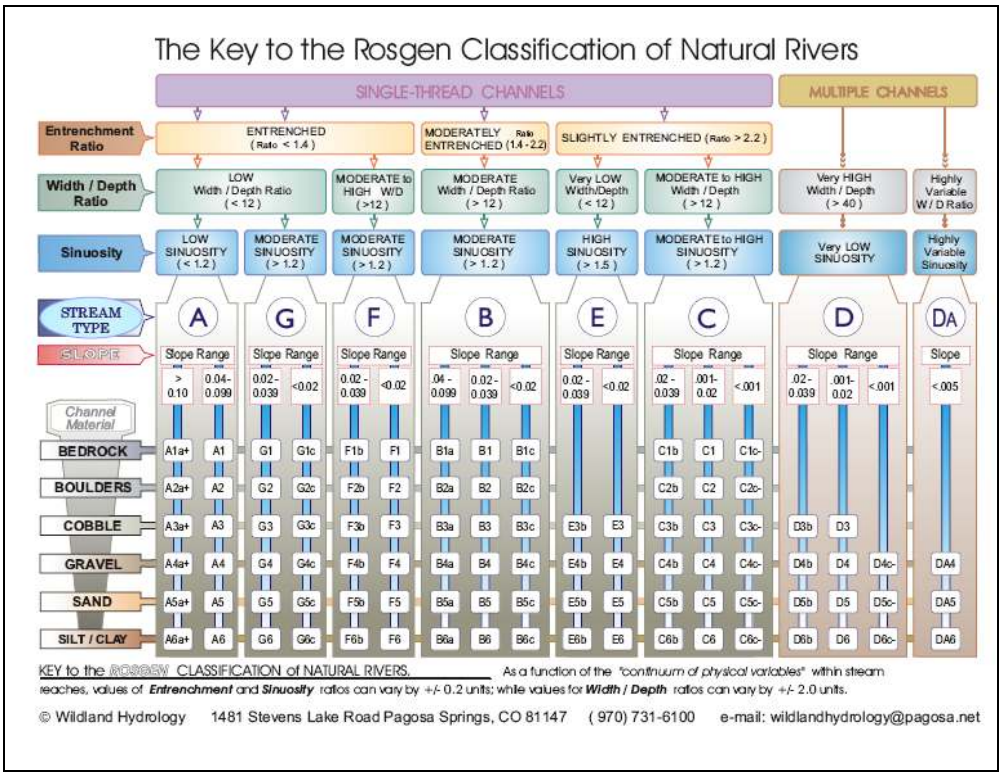
Stream reaches are classified using the Rosgen Stream Classification System (D.L. Rosgen, CATENA, 1994). The Rosgen classification system groups streams by similar channel geomorphology, gradient, sinuosity and function. The classification system is stratified into three progressive levels, based on channel form, dominant substrate, and gradient. A graphic depiction of the Level 1 classification is shown in the diagram below.



Generally, A type channels are typically found near the headwaters of mountain streams. Lower gradient B channels are characteristic of streams flowing though alluvial plains and broad mountain valleys below the headwaters. C and E channels tend to be found in lower elevation reaches with broad floodplains and low gradients. Each of these channel type supports different assemblages of aquatic habitats, and each can be important in providing habitat complexity for trout. F and G channels are typically found in areas that have been subjected to some disturbance, such as a flood or significant down-cutting of the stream channel. Frequently, in recovering F type channels, a new C channel will begin to form in the flat bottom of the F channel, establishing a new floodplain at a lower elevation.

The Level 2 classification stratifies dominant substrate composition, and ranges from 1, bedrock or native bed material, to 6, which represents fine particles of less than 1/4" diameter. A diagram of the Level 2 classification is shown on the following page. Level 3 of the Rosgen system includes more detailed gradient and sinuosity values. For

example, a Rosgen A3a channel would be a steep (<10%), deeply entrenched, and confined channel that exhibits low width/depth ratios and low sinuosity. Channel materials are typically unconsolidated, non-cohesive materials, dominated by cobbles, but also containing some boulders, gravel and sand. The A3a type is generally found in landforms associated with slump/earth-flow and debris torrent erosional processes, and would likely exhibit fluvial entrainments, mass wasting of steep adjacent slopes and debris scour. A detailed diagram of the Level 3 Rosgen classification system is shown below. The Rosgen classification system has been widely adopted by water professionals throughout the west, and is a useful tool for evaluation and comparative analysis of similar stream channels and habitat conditions.



Stream Channel Morphology:

For the purposes of the stream channel morphology study, seven cross-sections were established in representative channel types, and numbered consecutively beginning at the downstream boundary of the property and continuing upstream. Three of these cross-sections were established in Reach 1, downstream of the confluence with White Creek, and four were established in Reach 2 All directional references to stream banks and cross-sectional head pins for the channel geometry study are from a hydrologist's perspective, with left and right banks determined looking downstream along the channel.

Stream flow was measured at cross-section #3 for Reach 1, using a Marsh-McBirney FlowMate 2000 flow meter, and was calculated to be 19.7 cfs. Discharge for Reach 2 was collected near cross-section #5, and was measured at 17.2 cfs.

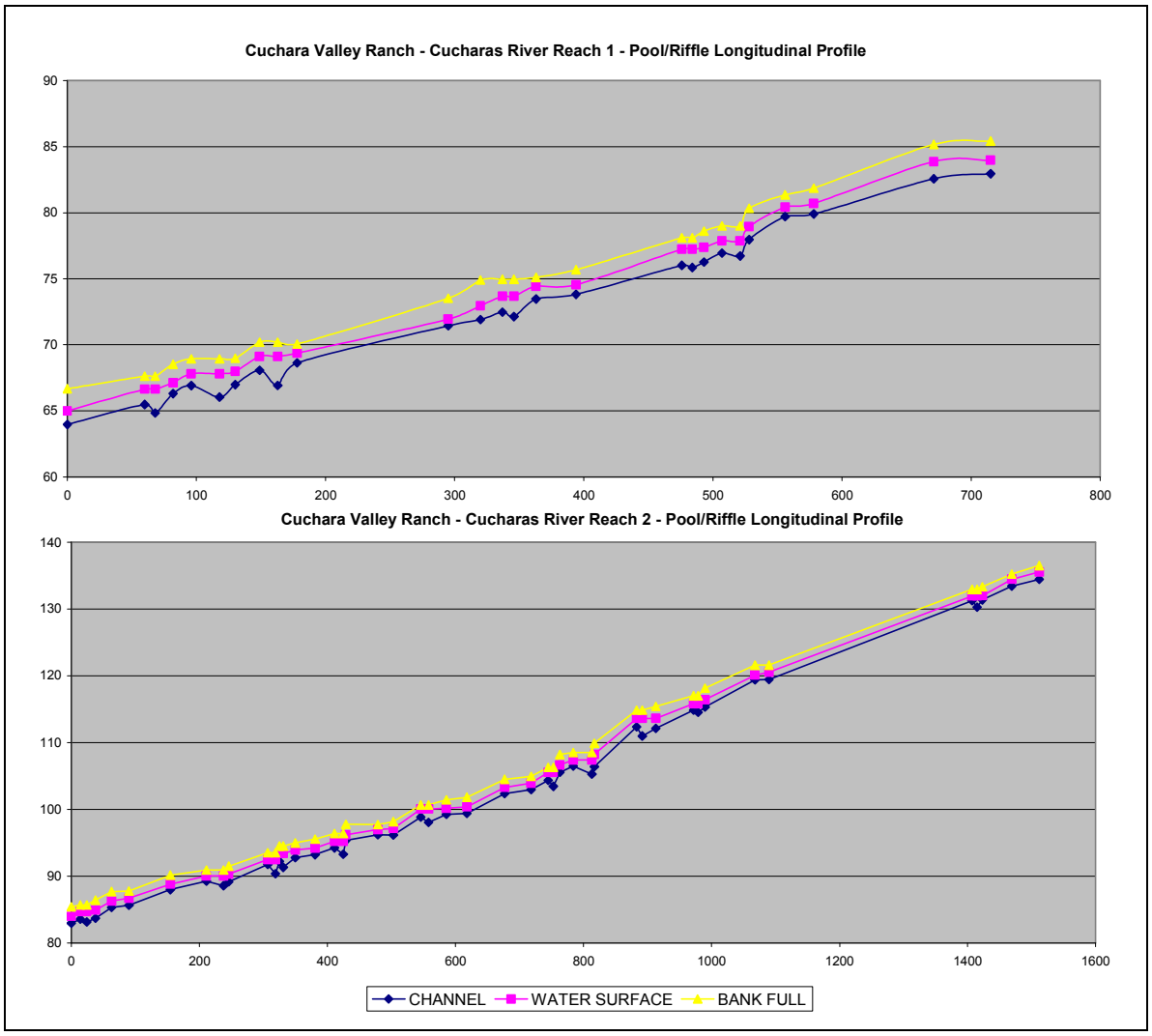


Chart 1: Longitudinal Profile of Reach 1 and Reach 2 on the Cucharas River.

Longitudinal profiles (Chart 1) of the stream channel were surveyed for both reaches. The longitudinal profiles are characterized by relatively high gradient, slight to moderate degrees of entrenchment, and relatively infrequent pool development. The average slope

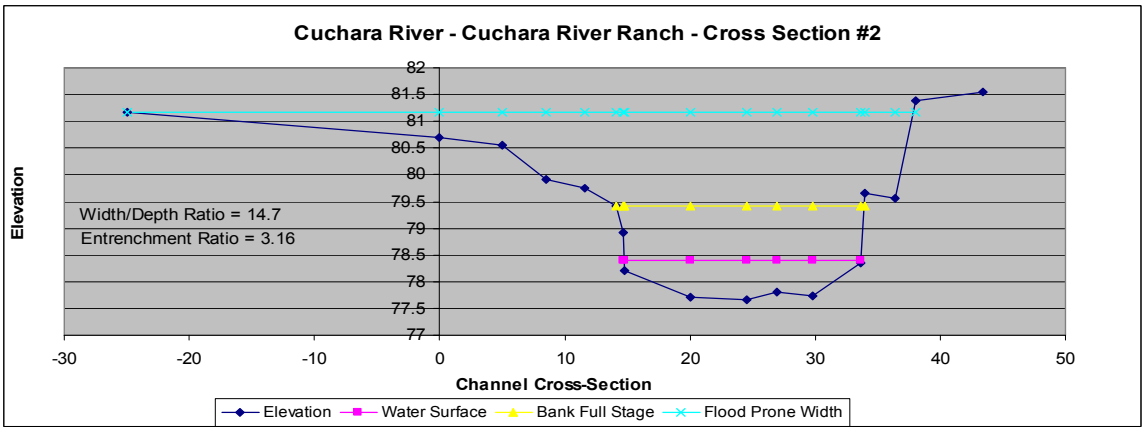


Chart 2: Cross Section #2 at Riffle #10 on Reach 1 of the Cucharas River.

of the channel, water surface and bank full elevation throughout the profile in Reach 1 was 2.7%, and in Reach 2 was 3.4%.. Riffle slopes ranged from 1% to 9%. Stream channel sinuosity was relatively low (<1.2) in Reach 2, and slightly greater in Reach 1.

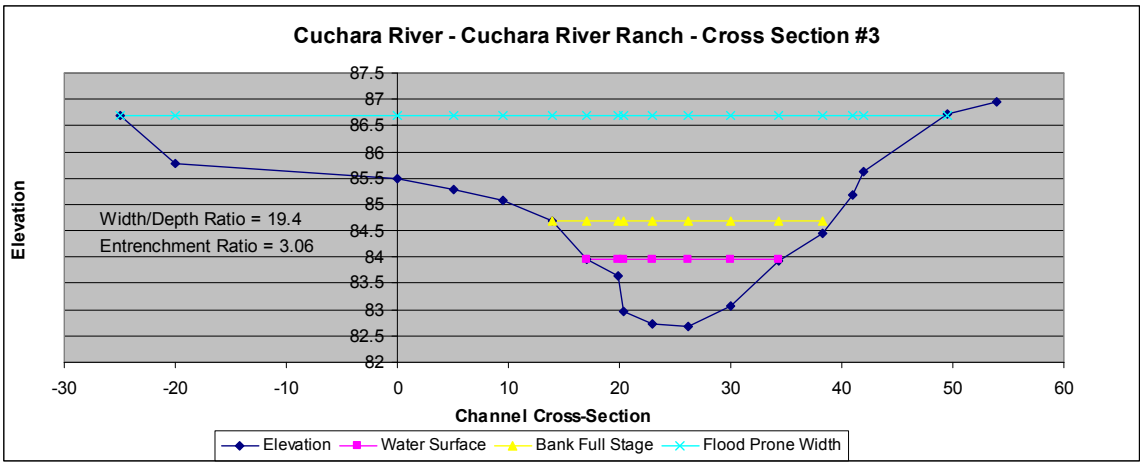


Chart 3: Cross-Section #3 at Glide #2 on Reach 1 of the Cucharas River.

Cross-sections #2 and #3 show representative profiles of a typical riffle and glide habitat within Reach 1. The riffle cross-section is dominated by larger substrate particle sizes, resulting in greater velocity complexity and surface turbulence. The glide cross-section exhibits some scour in the center of the channel, indicating that a pool could develop here with the removal of some channel armor. Each of the cross-sections exhibits slightly entrenched characteristics of the stream channel within the reach. Entrenchment ratios of greater than 3 were observed at the cross-sections. Width/depth ratios were calculated to be approximately 14 to 19. W/D ratios were similar to what would be expected to occur in a C channel.

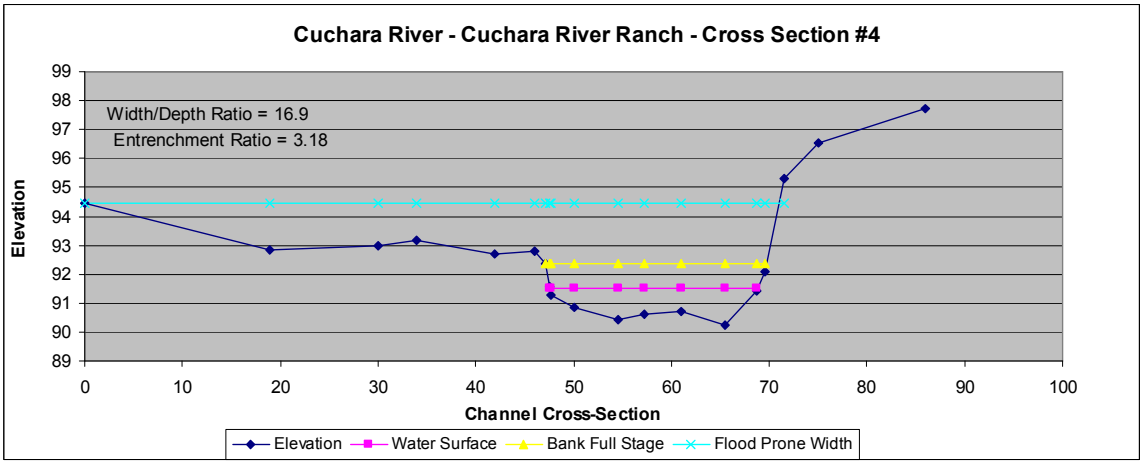


Chart 4: Cross-Section #4 at Riffle #6 on Reach 2 of the Cucharas River.

Cross-section #4, #5, and #7 show representative profiles of pool and riffle channels in Reach 2. The riffle in cross-section #4 is found in the lower portion of the reach, which exhibits geomorphic characteristics similar to Reach 1. Entrenchment in this cross-

section is similar to that found in Reach 1, and iss considered to be only slightly entrenched. The width/depth ratio is almost 17, consistent with a C type channel form. The slope of the stream channel through this cross-section is slightly greater than would be found in a pure C channel form, approaching 3.6%.

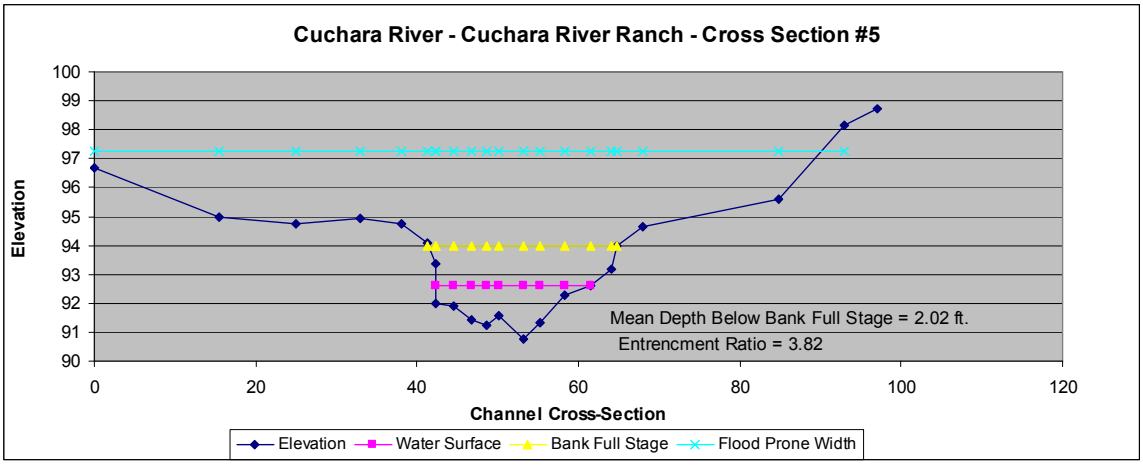


Chart 5: Cross-Section #5 at Pool #3 on Reach 2 of the Cucharas River.

The pool in cross-section #5 is also found near the downstream boundary of Reach 2, and exhibits similar characteristics with cross-section #4. The pool is characterized by deep scour in the center of the channel, with a mean depth below the bank full stage of the channel of greater than 2 feet. The entrenchment ratio is considered low in this channel unit, approaching a value of 4.

The riffle in cross-section #7 is found in the near the upstream boundary of Reach 2, along a nearly 400 ft long boulder dominated pocket-water riffle. This upstream segment of Reach 2 is considerably steeper (<4%), and exhibits less sinuosity than the lower segment. The entrenchment ratio in cross-section is considered to be moderate (1.95), and is more consistent with a steeper, straighter B channel type. The width/depth ratio of the cross-section is much lower than the values observed in the other cross-sections, and is also consistent with a B type channel form.

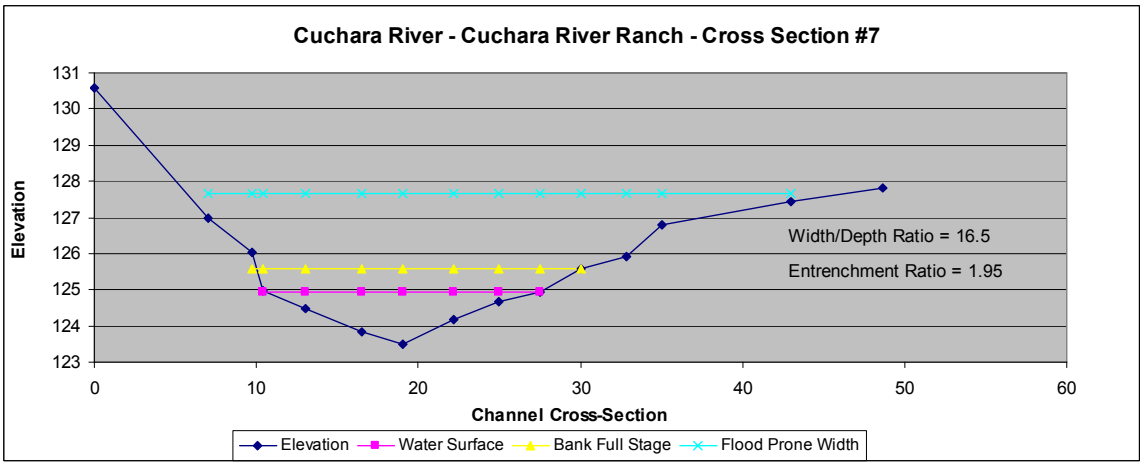


Chart 6: Cross-Section #7 at Riffle #18 on Reach 2 of the Cucharas River.

Within Reach 1, channel substrate composition was calculated using a Z-Walk pebble Count (Bevenger, 1997) and the results are shown in Table 2. A slight bi-modal distribution of smaller particles (fines), large gravel/small cobble, and small boulder is apparent in the pebble count data (Chart 7), and suggests that sediment inputs to the stream may exceed the capacity of the stream to move the material. The D50 (mean) particle size is estimated to be approximately 100mm, and the D84 particle size is estimated to be 125mm. Particle size ran from very fine sand to large boulders approaching 1 meter along the medial axis.

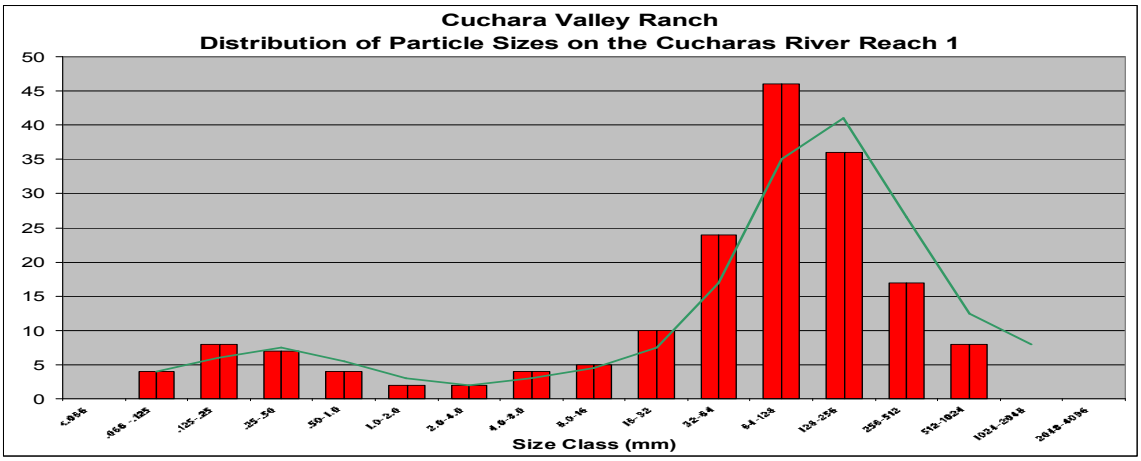


Chart 7: Distribution of substrate particle sizes in Reach 1 of the Cucharas River.

Z-Walk		Class		Total	% of	Cumulative
Metric - mm	Inches	Name		Number	Total	%
less .066		Silt/Clay			0.0%	0.0%
.062-.125		Very Fine		4	2.3%	2.3%
.125-.25		Fine		8	4.5%	6.8%
.25-.50		Medium		7	4.0%	10.7%
.50-1.0		Coarse		4	2.3%	13.0%
1.0-2.0		Very Coarse		2	1.1%	14.1%
2.0-4.0		Very Fine		2	1.1%	15.3%
4.0-8.0		Fine		4	2.3%	17.5%
8.0-16	.08-.6	Medium		5	2.8%	20.3%
16-32	.6-1.3	Coarse		10	5.6%	26.0%
32-64	1.3-2.5	Very Coarse		24	13.6%	39.5%
64-128	2.5-5.0	Small		46	26.0%	65.5%
128-256	5-10	Large		36	20.3%	85.9%
256-512	10-20	Small		17	9.6%	95.5%
512-1024	20-40	Medium		8	4.5%	100.0%
1024-2048	40-80	Large			0.0%	100.0%
2048-4096	80-160	Very Large			0.0%	100.0%

Table 2 - Results of the Z-Walk Pebble Count, showing distributions of substrate size classes in Reach 1 on the Cucharas River.

Due to time constraints, channel substrate composition in Reach 2 was estimated using the Wolman pebble count method at cross section #4. The results of this substrate sample are shown in Table 3. The sample site is representative of the most common riffle channel type in the reach, based on the aquatic habitat surveys conducted in conjunction with the channel geomorphic surveys. The sample site included all of Riffle #6 in Reach 2; a boulder/cobble dominated riffle pocket water riffle that is the most common habitat type in the reach.

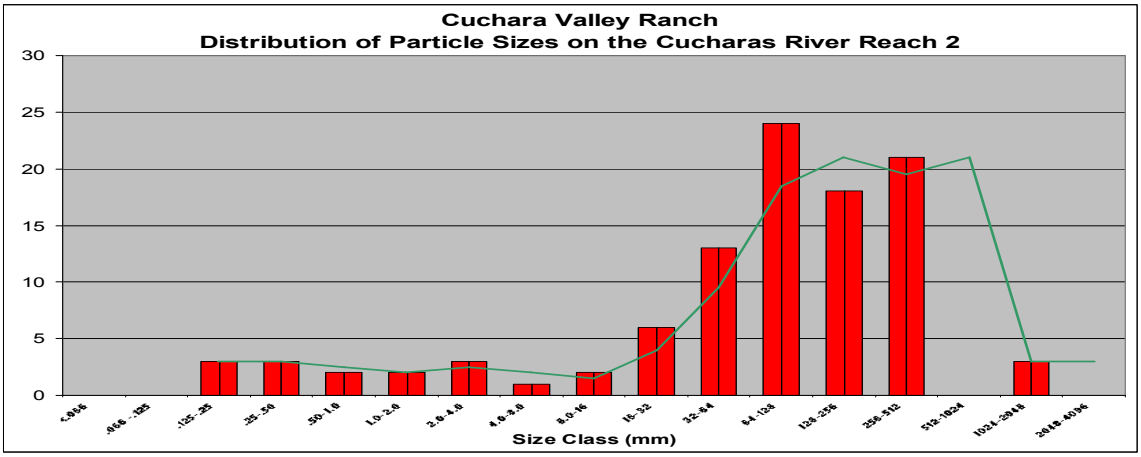


Chart 8 - Distribution of particle size classes distribution of sand and larger cobbles and boulder in Reach 2 on The Cucharas River.

Wolman Count		Class		Total	% of	Cumulative
Metric - mm	Inches	Name		Number	Total	%
less .066		Silt/Clay			0.0%	0.0%
.062-.125		Very Fine	SAND		0.0%	0.0%
.125-.25		Fine	SAND	3	3.0%	3.0%
.25-.50		Medium	SAND	3	3.0%	5.9%
.50-1.0		Coarse	SAND	2	2.0%	7.9%
1.0-2.0		Very Coarse	SAND	2	2.0%	9.9%
2.0-4.0		Very Fine	GRAVEL	3	3.0%	12.9%
4.0-8.0		Fine	GRAVEL	1	1.0%	13.9%
8.0-16	.08-.6	Medium	GRAVEL	2	2.0%	15.8%
16-32	.6-1.3	Coarse	GRAVEL	6	5.9%	21.8%
32-64	1.3-2.5	Very Coarse	GRAVEL	13	12.9%	34.7%
64-128	2.5-5.0	Small	COBBLE	24	23.8%	58.4%
128-256	5-10	Large	COBBLE	18	17.8%	76.2%
256-512	10-20	Small	BOULDERS	21	20.8%	97.0%
512-1024	20-40	Medium	BOULDERS		0.0%	97.0%
1024-2048	40-80	Large	BOULDERS	3	3.0%	100.0%
2048-4096	80-160	Very Large	BOULDERS		0.0%	100.0%

Table 3: Results of the Wolman Pebble Count, showing distributions of substrate size classes in Reach 1 on the Cucharas River.

There is less evidence of a bi-modal distribution pattern of smaller particles (fines) than in Reach 1(Chart 7), indicating that there is likely adequate energy in the reach to transport fine sediment through the system. Substrate size is dominated by small and large cobbles, with lesser amounts of channel armoring small boulder and larger gravels suitable for trout spawning. The D50 (mean) particle size is estimated to be approximately 100mm, and the D84 particle size is estimated to be 125mm, which is consistent with the values found in Reach 1. Particle size ran from very fine sand to large boulders in excess of 1 meter along the medial axis.

Based on the reach longitudinal profile survey, the channel cross-section analysis, and the stream substrate data, the channel in Reach 2 was determined to be a C3b, due, in part, to the higher gradient found in the reach. Reach 2 was found to exhibit two different geomorphic forms. The downstream segment of Reach 2, extending from the confluence of White Creek upstream to Pool #6 (just upstream of the ranch house) was determined to also be a C3b type, with many similar characteristics to the channel in Reach 1. Upstream of Pool #6, the gradient of the stream increases considerably, and the stream channel exhibits a form more similar to a B3 type. The channel throughout both reaches appears to be relatively stable at this time, but is affected by high flow shear forces eroding unstable and unvegetated stream banks in several segments of both reaches. Sediment from these eroding banks, and from sources upstream of the Ranch, appear to be accumulating in the pools and smaller velocity shelters in the channel in Reach 1, and may have a negative effect on the quantity and quality of useable habitat for resident trout.

Photo 1: Typical boulder/cobble dominated riffle in Reach 1 of the Cucharas River.

Aquatic and Riparian Habitat Assessment Protocols:
For the purposes of the stream and riparian habitat study, all directional references are from a fisheries biologist's perspective, with left and right banks determined looking upstream along the channel. Assessments characterize existing habitat conditions and evaluate current management and restoration potential. Stream reaches are analyzed using a basin-wide stream habitat survey protocol developed by the US Forest Service and Colorado Division of Wildlife for smaller streams in the Rocky Mountain Region (Winters and Gallagher, 1997). This protocol is a modified basin-scale aquatic habitat inventory based on the Hankin & Reeves survey method. All meso-habitat types within a delineated reach are measured for multiple attributes, including physical dimension, morphic form, bank condition and composition, substrate class, and cover for salmonids. The advantage of the Winters protocol is that it is a repeatable method, and therefore can be used to quantify changes in habitat resulting from management, habitat enhancement, or natural events. A copy of the Winters Protocol is provided as a separate document under this contract.

Aquatic Habitat Survey Results:
The project reaches for this study are located in on the Cucharas River on the Cuchara Valley Ranch in Huerfano County, Colorado (Map 1). Reach 1on the Cucharas River begins at a fence crossing the stream the eastern, downstream boundary of the ranch, and extends upstream to the confluence of White Creek. Reach 2 begins immediately upstream of the confluence with White Creek, and extends upstream to a fence crossing the stream at the western, upstream boundary of the Ranch. A rapid assessment of aquatic habitat was undertaken within both reaches, and a detailed stream habitat inventory was conducted in July, 2008 within the project area. Discharge was measured prior to the aquatic habitat surveys on both reaches, and is discussed in detail in the previous section describing channel morphology. Flows in Reach 1 were measured at 19.7 cfs, and 17.2 cfs in Reach 2. These flows are within the high side of the estimated base flow range for the stream.

Reach 1:
Reach 1 is characterized by a slightly entrenched channel meandering through relatively stable depositional material composed mostly of larger gravel and small cobble. The stream is mostly well connected with the adjacent flood plain, and exhibits and moderate (2.7%) gradient. Habitat for trout appears to be somewhat limited in the reach due to the infrequent occurrence of pools, and relatively poor pool scour and depth. Habitat in the riffles is also limited due to a lack of velocity shelter and pocket water. Minor sedimentation from local erosion sources may also be negatively impacting aquatic habitat within the reach. There is evidence of previous attempts to create pools and other habitat in the reach. Several failed boulder drop structures were observed during the survey. These structures, initially constructed in a straight line perpendicular to the direction of flow in the channel, have resulted in failed stream banks and over-widening of the stream downstream of these structures in several segments along Reach 1.

There were 21 individual meso-habitats measured in the reach (7 pools, 12 riffles and 2 glides), along a length of 758 feet of stream, and comprising a total wetted area of

13,474ft^2. The total area of the reach consisted of 71% riffles and 19% pools, with the remaining 10% consisting of glide habitat (Chart 9). The average wetted width of the stream was 17 feet throughout the reach. Stream bank stability throughout much of the reach was generally good, with alder, willow and cottonwood comprising most of the riparian vegetation. Several areas of bank degradation and instability are found within the reach. The causes of stream bank instability in these areas include bank failure from failure of in stream structures and shear at high flows. There were 180 feet of actively eroding stream banks contributing sediment directly into the stream. This accounted for slightly more than 12% of the total length of banks in the study reach.

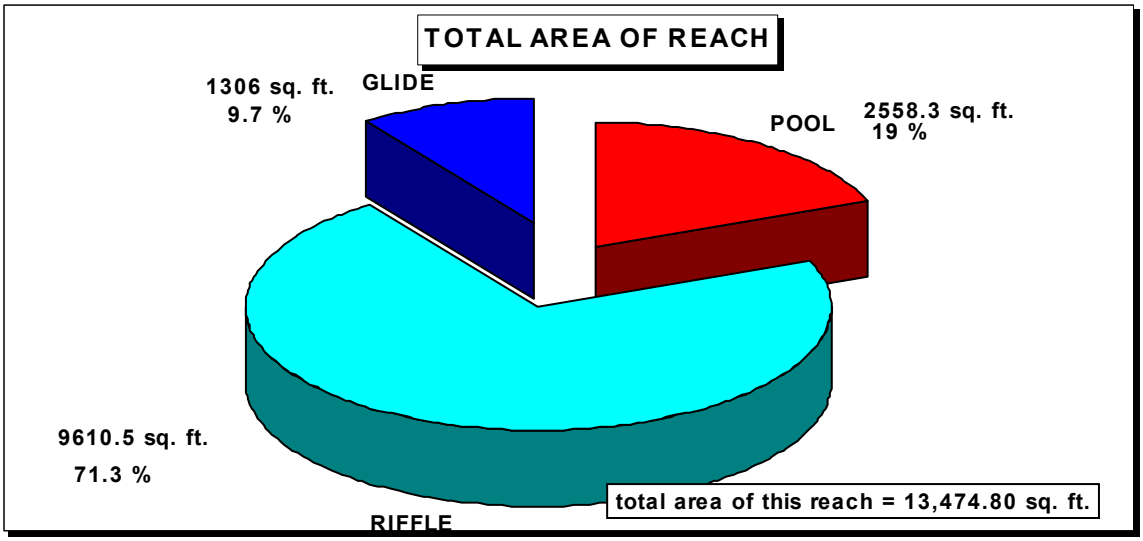


Chart 9 - Distribution of Pool, Riffle and Glide habitats in Reach 1 of the Cucharas River.

Higher gradient boulder dominated riffles exhibiting pocket water characteristics were the most common habitat type in terms wetted area, accounting for 47% of the total reach area (Chart 10). Lower gradient, cobble dominated riffles were the next most common habitat, accounting for 24% of the wetted area of the reach. Low gradient riffles can provide good spawning habitat, but are somewhat limited in terms of cover from high flows and predators. Generally, a good mix of higher gradient pocket water riffles providing cover and velocity shelter, combined with lower gradient cobble and gravel riffles for spawning habitat, should provide excellent habitat conditions for resident trout. One secondary channel riffle (Type 8) was observed in the reach, comprising 1% of the wetted area. Secondary channel riffles may provide important rearing habitat for young-of-the-year and juvenile trout, particularly during periods of higher flows. Overall, very little cover for trout was observed in these riffles, amounting to less than 1.5% (142 ft^2) of the total wetted area of these habitat types. The average width of all the riffles observed in the reach was 18.5 feet.

Pool development is quite limited in the reach, with only seven of these habitats observed during the survey. Lateral scour pools were the most abundant, comprising 8% of the total wetted area of the reach (Chart 10). The lateral scour pools were mostly associated with root-wad constrictions in the stream channel created by cottonwood and other tree root systems, and meanders along the stream channel. Trench pools and plunge pools were also observed in the reach, accounting for somewhat less wetted area than the lateral

scour pools. The plunge pool was associated with a failed boulder-drop structure. Trench pools and plunge pools comprised 6% and 4% of the total wetted area of the reach.

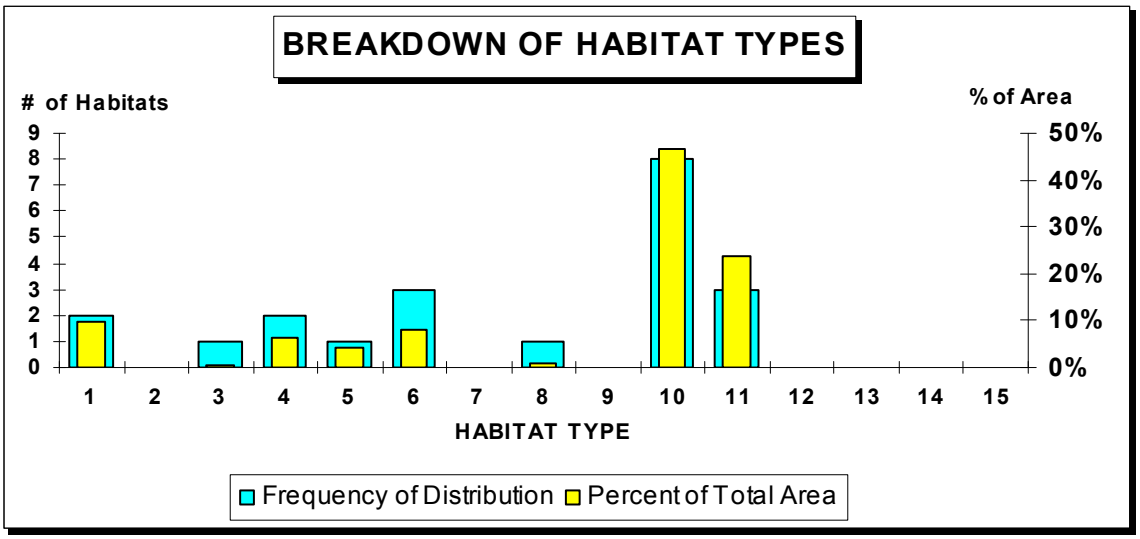


Chart 10 - Distribution of Meso-Habitat Types as a percentage of # of habitats and as a percentage of wetted perimeter of Reach 1 on the Cucharas River.

All of the pools exhibited generally poor scour depth, in part due to well armored substrates of cobble and boulder. The average pool depth in Reach 1 was 1.14 feet. Residual pool depth (RPD) in Reach 1 was found to range from 0.3 to 1.1 feet, with an average of 0.7 foot throughout the reach. RPD in Reach 1 is considered to be very poor, and may limit adequate over-wintering habitat for salmonids in this segment of the Cucharas River. Cover for trout accounted for less than 5% of the total wetted area of the pools, which is very poor for a stream of this size. The average wetted width of all pool types found within the reach was 15.2 feet.

Two glides were observed in the reach, comprising 10% of the wetted perimeter of the stream. Glide habitat appeared to be the result of poor scour due to substrate armoring and to a lesser extent form sediment inputs upstream. Cover for trout was extremely limited in the glides, which are characterized by laminar flow profiles and little velocity shelter or protection from predators. The average width of the glides observed in Reach 1 was 17.5 feet.

All forms of cover for adult trout accounted for only 2.1% of Reach 1 (Chart 11). Available cover is considered to be relatively poor in the reach, and may be a significant limiting factor to the health of the fishery. Creating additional cover will be an important component in the Habitat Enhancement Plan. Instream object cover (Cover Type 2 - >1' deep) was the dominant type observed in the reach, but was limited mostly to the pool habitats. Pool cover (Cover Type 5 - >1.5'deep) was very limited in the reach, and comprised only 1.3% of the wetted area of the pools and 0.25% of the total reach area. Pool cover is an important indicator for determining the available over-wintering capacity of the stream reach, and appeared to be severely limited in this segment of the Cucharas River. Combination and overhead cover were observed, but were limited in part due to

the lack of velocity shelter along the stream bank. In-stream and overhead cover could be enhanced in the riffle habitats by adding structure and velocity shelters along the stream banks with strategically placed boulders and large wood. Pool cover may be increased by improving scour in existing pools by removing some of the cobble/boulder armor, as well as by creating new pool habitats, particularly in the segments of the stream currently exhibiting glide characteristics. Combination cover may be improved throughout the reach through stabilizing and re-vegetating the eroding stream banks using large wood toe-slope stabilization techniques.

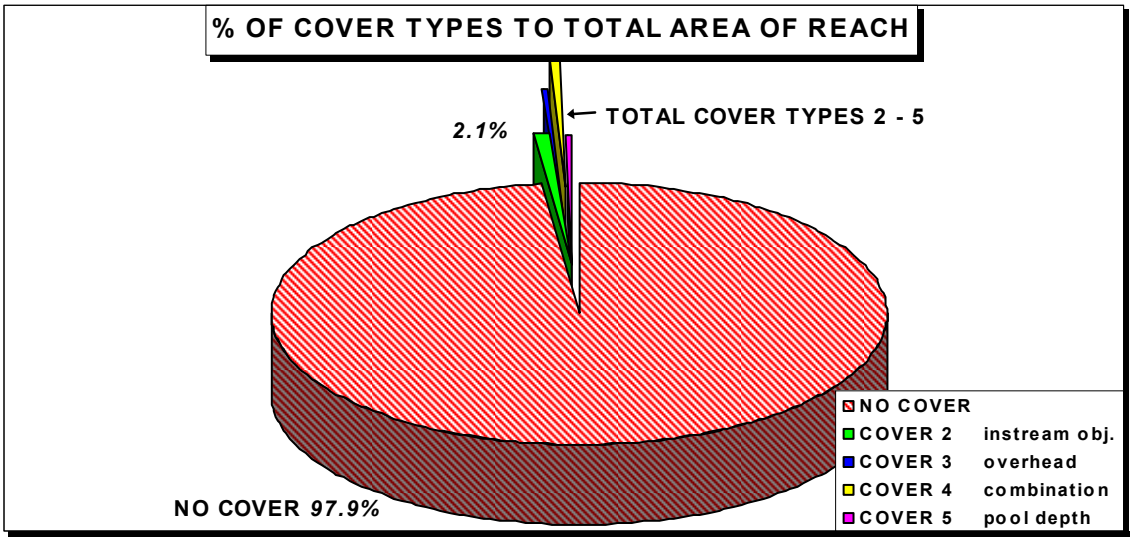


Chart 11 - Percentage of cover for trout to the total wetted perimeter Reach 1 on the Cucharas River.

Stream bank stability was generally good in the reach. Only a few areas of actively eroding stream banks were observed. Ninety percent of the left bank and 95% of the right bank were found to be stable. The remaining 5% of the left bank and 10% of the right bank were found to be generally unstable and at risk of failure due to high flow shear forces on the banks (Chart 12).

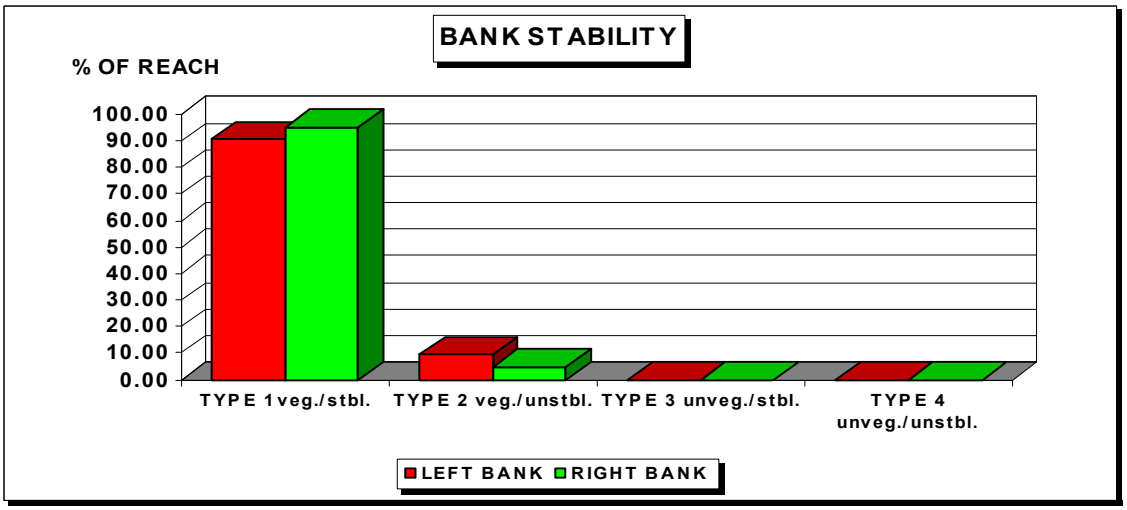


Chart 12 - Percentage of stable banks to unstable banks in Reach 1.

Bank rock content in the reach is shown in Chart 13, and consisted principally of large and small cobble fragments (Type 5 & 6). Smaller fragments of less than 1/8" were observed along the stream banks, but mostly along the point bars forming the inside of meander bends. Large wood (>4" diameter and > 3' long) is present in the reach, with eighteen pieces being observed. Large wood is an important habitat forming component for rivers in the Rocky Mountains, and provides cover and complexity to the aquatic ecosystem.

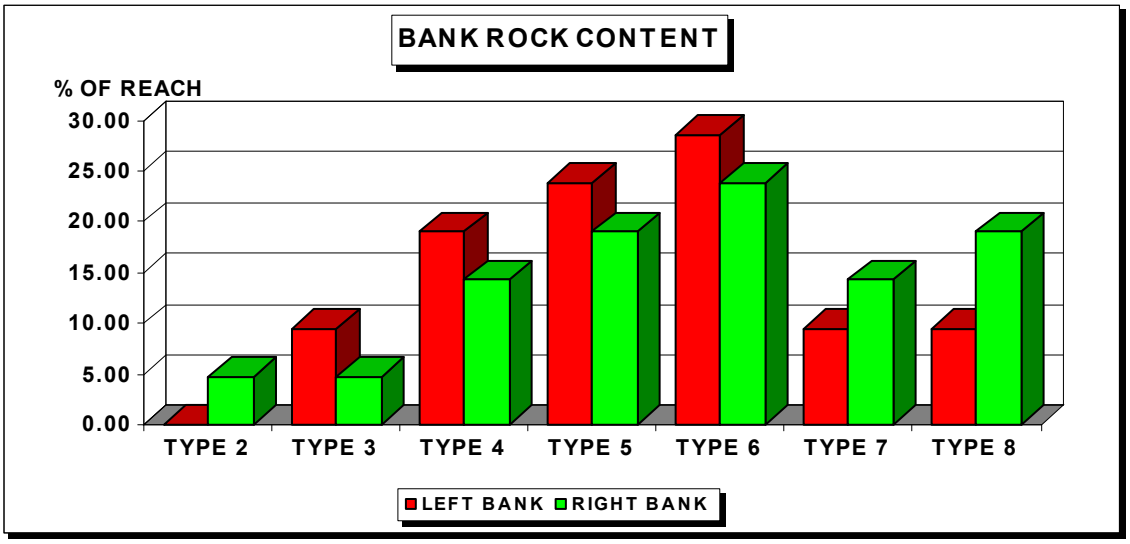


Chart 13 - Percentage of bank rock content sizes in Reach 1 on the Cucharas River.

Aquatic habitat conditions throughout Reach 1 were generally poor. Limiting factors to the fishery appear to be poor quality pool habitat, and limited in-channel object cover in both the low gradient and pocket water riffles. Several blown out in channel structures were identified during the course of the inventory that should be addressed in order to alleviate potential worsening problems and loss of habitat, as well as to help the river achieve its full potential as a cold water fishery.

Reach 2:

Aquatic habitat quality and quantity in Reach 2 is similar to that found in Reach 1. The stream is mostly well connected with the adjacent flood plain, and exhibits a slightly higher (3.4%) gradient. As is the case in Reach 1, habitat for trout appears to be somewhat limited in the reach due to the infrequent occurrence of pools, and relatively poor pool scour and depth. Pocket water velocity shelter in the riffles is slightly better quality than in Reach 1, but is still considered to be somewhat limited in the Reach. Several structures constructed to create pools and other habitat are found in the reach. For the most part, these structures are either providing limited function, or have completely failed, resulting in unanticipated negative effects to habitat in the reach. These structures consist mostly of straight boulder drops, perpendicular to the direction of flow, and are currently creating additional shear along stream banks and over-widening of the stream downstream of these structures.

There were 35 individual habitat units measured in the reach (11 pools, 21 riffles and 3 glides), along a length of 1,548 feet of stream, and comprising a total wetted area of 29,413ft^2. The total area of the reach consisted of 76% riffles and 18% pools, with the remaining 6% consisting of glide habitat (Chart 14). The average wetted width of the stream was 19.7 feet throughout the reach. It is interesting to note that stream channel width in Reach 2 was greater than in Reach 1, although flow regimes for Reach 2 are slightly less than in Reach 1, due to the inflow from White Creek. This would appear to indicate that width/depth ratios within Reach 2 are generally poorer than in Reach 1, and this does appear to be the case, particularly in the lower portion of the reach. Stream bank stability throughout the reach was generally good, with similar riparian vegetation found in Reach 1. A few areas of bank degradation and instability are found within the reach, mostly due to bank failures from poorly aligned in stream structures and shear at high flows. There were 152 feet of actively eroding stream banks contributing sediment directly into the stream. This accounted for approximately 5% of the total length of banks in Reach 2.

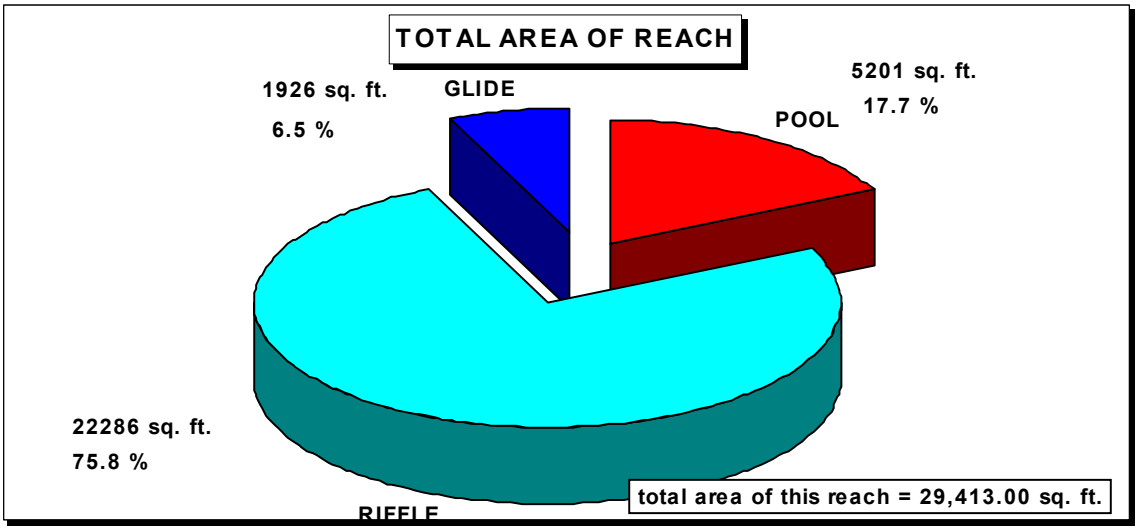


Chart 14 - Distribution of Pool, Riffle and Glide habitats in Reach 2 of the Cucharas River.

As is the case in Reach 1, higher gradient boulder dominated riffles exhibiting pocket water characteristics are the most common habitat type in terms wetted area, accounting for 50% of the total reach area (Chart 15). Indeed, one long pocket water boulder riffle occupies nearly 400 feet of the upper portion of the reach. Lower gradient, cobble dominated riffles were the next most common habitat, accounting for 21% of the wetted area of the reach. Generally, a good mix of higher gradient pocket water riffles providing cover and velocity shelter, combined with lower gradient cobble and gravel riffles for spawning habitat, should provide excellent habitat conditions for resident trout. One secondary channel riffle (Type 8) was found near the upstream boundary of Reach 2, comprising 1% of the wetted area. Overall, very little cover for trout was observed in these riffles, amounting to less than 1% (192 ft^2) of the total wetted area of these habitat types. The average width of all the riffles observed in the reach was 18.25 feet.

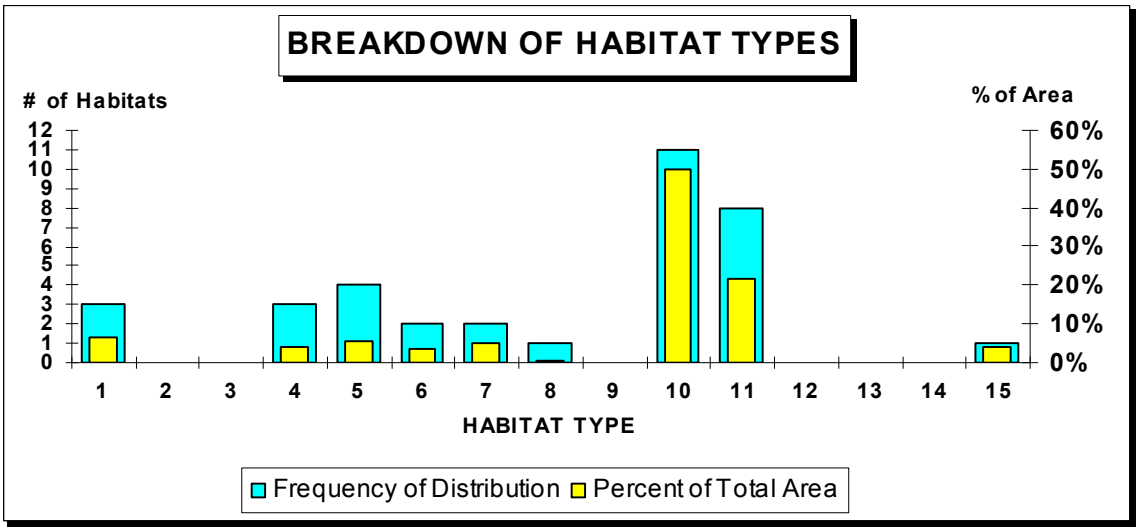


Chart 15 - Distribution of Meso-Habitat Types as a percentage of # of habitats and as a percentage of wetted perimeter of Reach 2 on the Cucharas River.

Pool development is as limited in this reach as in Reach 1, with only eleven pools measured during the survey. Plunge pools and Dam Pools were the most abundant, each comprising approximately 5% of the total wetted area of the reach (Chart 15). All but one of these plunge and dam pools was created by previously constructed in-stream structures. Trench pools and lateral scour pools were also observed in the reach. The trench pools tended to occur in the steeper upstream segment of the reach. Trench pools and lateral scour pools comprised 4% and 3% of the total wetted area of the reach respectively.

The overall quality of pool habitat in Reach 2 was considerably improved from that found in Reach 1, but still far less than would be expected to be the full potential for this segment of the Cucharas River. Pools in Reach 2 tended to exhibit generally poor scour depth, but less so than in Reach 1. The average pool depth in Reach 2 was 1.3 feet. Residual pool depth (RPD) in Reach 2 was found to range from 0.6 to 1.5 feet, with an average of 0.82 foot throughout the reach. RPD in Reach 2 is considered to be generally poor, and may limit adequate over-wintering habitat. Cover for trout was considerably better in terms of quantity and quality in the Reach 2 pools, accounting for approximately 15% of the total wetted area of the pools. The average wetted width of all pool types found within the reach was 19 feet, which, on face value, would appear to be somewhat wider than would be expected for this river, and is due, in no small part, to the over-widening effects of the poorly aligned drop structures that form many of the pool habitats in the reach.

Three glides were observed in the reach, comprising 10% of the wetted perimeter of the stream. Glide habitat was associated with the drop structures in the reach. Pools formed by these structures tended to scour for only a brief length along the longitudinal axis of the channel, resulting in shallow transitional areas exhibiting glide characteristics extending downstream to the riffle crest. Cover for trout was extremely limited in the glides, accounting for less than 1% of the total wetted area of these habitats. The average

width of the glides observed in Reach 2 was 22 feet, also indicating that these structures are having an undesirable widening effect on the stream channel in these areas..

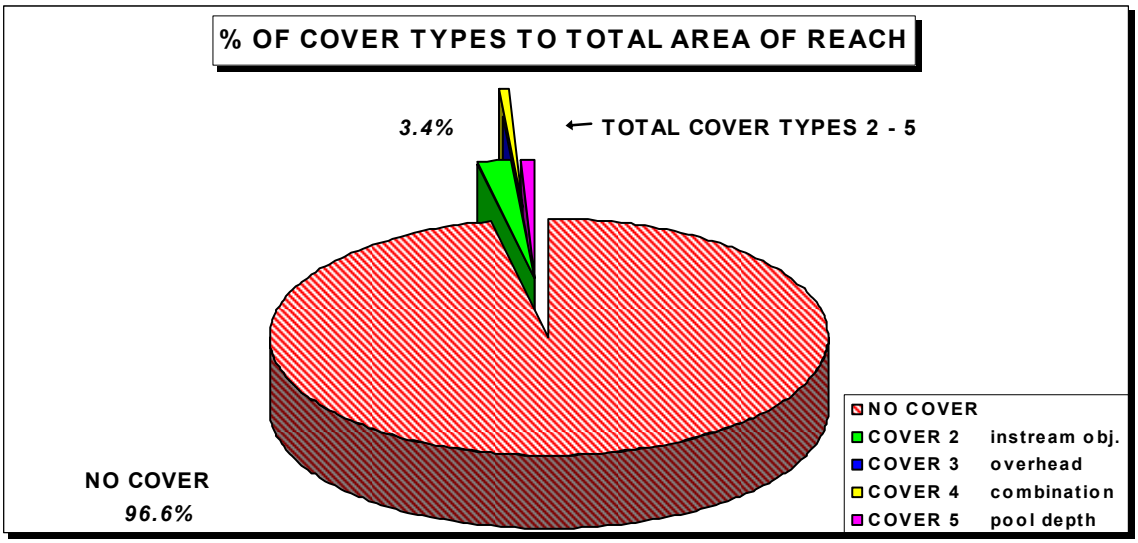


Chart 16 - Percentage of cover for trout to the total wetted perimeter Reach 2 on the Cucharas River.

On a percentage basis, cover for trout in Reach 2 was 60% greater than that found in Reach 1. All forms of cover for adult trout accounted for 3.4% of Reach 2 (Chart 16), and is closer to what would be expected in a C3b/B3 stream channel of this size. Available cover is considered to be fair in the reach. In-stream object cover (Cover Type 2 - >1' deep) was the dominant type observed in the reach, and was observed mostly to the pool habitats. Pool cover (Cover Type 5 - >1.5'deep) was much less limited in this reach, comprised 5% of the wetted area of the pools and 1% of the total reach area. Pool cover, as a percentage of the overall pool area and stream reach area, was four times greater in Reach 2 than in Reach 1, indicating that over-wintering habitat is likely less limited in this reach. A very small amount of combination and overhead cover were observed, but were limited in part due to the lack of velocity shelter along the stream banks.

As was the case in Reach 1, stream bank stability was generally good in this reach. Only a few areas of actively eroding stream banks were observed. Eighty-nine percent of the left bank and 97% of the right bank were found to be stable. The remaining stream bank was found to be generally unstable and at risk of failure due to high flow shear forces on the banks (Chart 17).

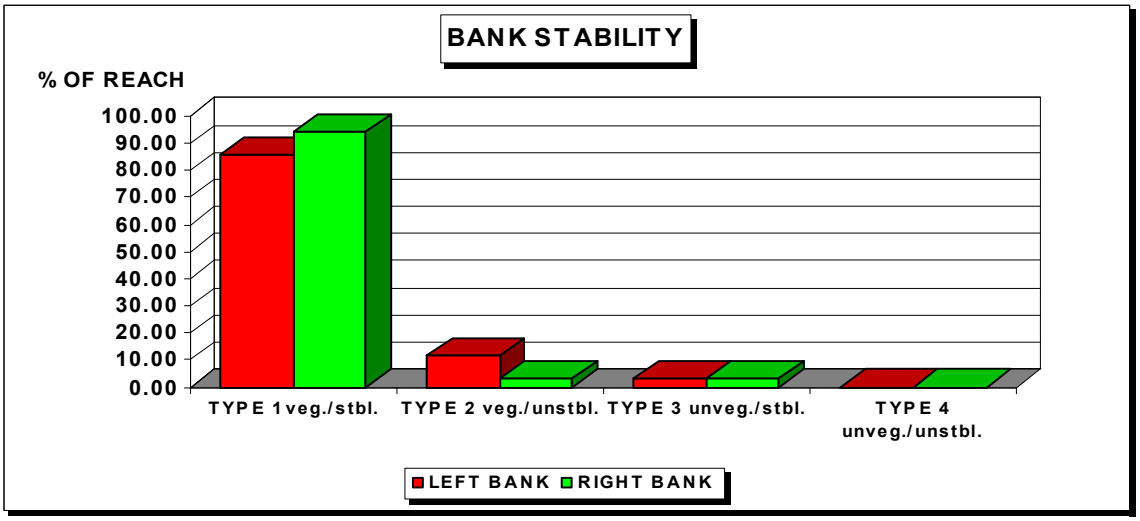


Chart 17 - Percentage of stable banks to unstable banks in Reach 2.

Bank rock content was similar to that found in Reach 1, and is shown in Chart 18. Bank rock content is a good measure of how resistant the stream banks are to high flow induced shear stress, in Reach 2 consisted principally of large cobble fragments (Type 5). Large wood (>4" diameter and > 3' long) is abundant in the reach, particularly in the upstream segment. Thirty-six pieces of wood were counted in the reach, and were creating additional scour and cover in the channel.

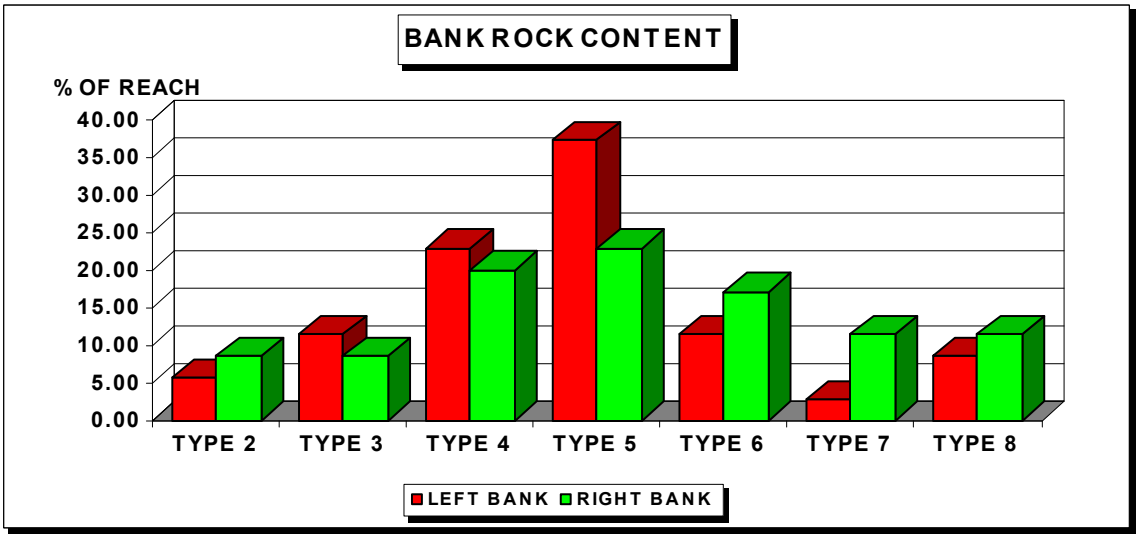


Chart 18 - Percentage of bank rock content sizes in Reach 2 on the Cucharas River.

Aquatic habitat conditions throughout Reach 2 were less limited than that found in Reach 1, but still below the full potential for the river. Limiting factors to the fishery appear to lack of quality pool habitat, and limited in-channel object cover in both the low gradient and pocket water riffles. The existing in channel structures identified during the course of the inventory appear to be further degrading the overall quality of habitat in the reach, and should be addressed in order limit further widening of the stream and loss of habitat.

Map 3: Locations of Treatment Sites on Reach 1 of the Cucharas River.

Map 4: Locations of Treatment Sites on Reach 2 of the Cucharas River.

Cuchara Valley Ranch – Cucharas River Aquatic Habitat Enhancement Plan

The reaches of the Cucharas River flowing through the Cuchara Valley Ranch may benefit from efforts to restore of the channel, stream banks, and associated aquatic and riparian habitats. There are opportunities for significant enhancement to the cold water fishery that may improve both hydrologic and habitat function, and benefit esthetic values within each reach.

The following Enhancement Plan is based on immediate restoration needs, maximization of in-channel habitat improvements, feasibility of implementation, and budgetary requirements for completing the work. Priorities include repair and/or reconfiguration of existing structures, stabilization of actively eroding stream banks, and increased in-channel stream habitat through placement of additional boulder and large wood features in the river. Each reach is described separately, with proposed treatments outlined beginning at the downstream boundary of each reach and extending upstream. Treatment sites are referenced back to the aquatic habitat survey described in the previous chapter, with specific recommendations to improve aquatic and riparian habitat conditions at each channel habitat unit along the reach. Individual treatments within each reach have been ranked in order of priority, so that the land-owner may implement the plan in stages, as funding is available.

Reach 1 Enhancement Plan

Four failed in-stream structures will be re-built and re-aligned within Reach 1. Natural river restoration techniques will be utilized to enhance existing habitat, and to create new holding areas and cover for trout. Pool scour will be enhanced by strategically removing some of the substrate armor in the existing pools, and by adjusting boulders to optimize the river's capacity to move sediment. Enhancing pool scour will increase average pool depth and residual pool depth in the channel, providing additional cover and over-wintering capacity for resident trout. Actively eroding stream banks will be stabilized and revegetated, using native willow and sedge harvested from areas near the stream. An aerial photo of Reach 1, showing the locations of the proposed treatment areas, is shown on page 22, and in the Appendix.

The following enhancements are proposed for Reach 1 of the Cucharas River on the Cuchara Valley Ranch, beginning at the downstream boundary of the ranch, and extending upstream to the confluence with White Creek:

- Approximately 1 yd^3 of cobble/boulder armor will be removed from Pool 2 to improve scour depth and residual pool depth, as well as increase pool cover in this habitat. All spoils will be completely removed from the water influence zone.

- Ten feet of log toe-slope bank full bench, planted with native willow, will be installed along the right bank of Pool 4, a backwater eddy pool, to eliminate an eroding bank. The estimated amount of fill per linear foot of treated bank is not expected to exceed 0.15 yd^3.


Backwater Eddy Pool 4 –Reach 1.


Left Bank of Riffle 4 - Reach 1.

- One hundred feet of log toe-slope bank full bench, planted with native willow, will be installed along the left bank of Riffle 4 to eliminate an actively eroding bank. Additionally, up to four small rock vanes / groins will be installed at intervals along the treated bank to provide for additional velocity shelter / pocket water for trout in this riffle. Three large cottonwood trees and approximately 14 boulders (0.5 yd^3 each) will be required for this work. The estimated amount of fill per linear foot of treated bank is not expected to exceed 0.2 yd^3.

- The failed boulder drop structure at Riffle 6 will be removed from the river, and the boulders will be re-used to create a small J-Hook Vane on the left stream bank at this site to reduce shear forces and erosion. No additional fill should be necessary to construct this feature.


Failed Structure at Riffle 6 –Reach 1.


Over-wide channel at Riffle 7 - Reach 1.

- Riffle 7 (Cross-section #1) will be narrowed using log toe-slope and bank full bench structures on both sides of the channel. Thirty-four feet of log toe-slope structure will be installed to reduce the bank-full width of this habitat to 20 feet.

- Construct a new pool by installing a boulder cross-vane at the top of the brief, low gradient transition near the Riffle 10 / Riffle 11 boundary. Some minor excavation of the larger armoring cobble from this new habitat will be necessary to improve scour. This material will be completely removed from the water influence zone. The cross vane will require 25 – 30 boulders, consisting of an estimated additional fill below the ordinary high water mark of the Cucharas River of 15 yd^3.

Site of new pool at Riffle 10 – Reach 1.

Eroding left bank at Riffle 11 - Reach 1.

- Forty feet of log toe-slope bank full bench, planted with native willow, will be installed along the left bank of Riffle 11 near the upstream boundary of this habitat unit to protect the outside of the meander bend in this area. One large cottonwood tree and approximately 4 boulders (0.5 yd^3 each) will be required for this work. The estimated amount of fill per linear foot of treated bank is not expected to exceed 0.15 yd^3.

- The failed structure at the transition between Riffle 11 and Glide 2 will be removed, and a large boulder J-Hook Vane installed in it's place to direct the river thalweg into the center of the channel and reduce shear forces on the eroding stream bank on the outside bend immediately downstream of the existing structure. An additional small rock vane should be installed 30 feet downstream of the J-Hook Vane described above. Total additional fill below the ordinary high water mark of the river for both of these structures is not expected to exceed 7 yd^3.

- Convert Glide 2 into a new pool by installing a boulder cross-vane immediately downstream of the confluence of White Creek and the Cucharas River. Some minor excavation of the larger armoring cobble from this new habitat will be necessary to provide depth and improve scour. This material will be completely removed from the water influence zone. The cross vane will require 20 boulders, consisting of an estimated additional fill below the ordinary high water mark of the Cucharas River of 10 – 12 yd^3.

Reach 2 Enhancement Plan

Six existing boulder drop structures will be re-built and re-aligned within Reach 2. Additional restoration and enhancement in the reach will include improving existing micro habitats, as well as creating new holding areas and cover for trout. Similar techniques used in Reach 1 will be employed, including improving pool scour by strategically removing some of the substrate armor in the existing pools, and by adjusting boulders to optimize the river's capacity to move sediment. Actively eroding stream banks will be stabilized and revegetated, using native willow and sedge harvested from areas near the stream. An aerial photo of Reach 2, showing the locations of the proposed treatment areas, is shown on page 22, and in the Appendix.

The following enhancements are proposed for Reach 2 of the Cucharas River on the Cuchara Valley Ranch, beginning at the confluence with White Creek, and extending upstream to the western boundary of the ranch:

- The failed boulder drop structure at the transition between Riffle 4 and Riffle 5 will be removed from the river, and the boulders will be re-used to create two small J-Hook Vanes along the outside of the meander forming the left stream bank at this site. These vanes will reduce shear stress along this actively eroding bank, as well as providing in-channel velocity shelter and holding areas for trout. The existing boulders in this failed structure should be adequate to construct the two J-Hook Vanes, requiring no additional fill to construct these features.

Failed Structure at Riffle 4 –Reach 2.

Eroding left bank at Riffle 6 and Pool 2.

- 162 feet of log toe-slope bank full bench, planted with native willow, will be installed along the left bank of Riffles 4 and 5, Pool 2, and Riffle 6 to treat this severely eroding bank. Additionally, up to six small rock vanes / groins will be installed at intervals along the treated bank to provide for additional velocity shelter / pocket water for trout along this segment of the reach. 5 large cottonwood trees and approximately 20 boulders (0.5 yd^3 each) will be required for this work. The estimated amount of fill per linear foot of treated bank is not expected to exceed 0.2 yd^3.

- Construct a double log cross-vane at Pool 2. Some minor excavation of the larger armoring cobble from this pool will be necessary to provide depth and improve scour. This material will be completely removed from the water influence zone. The cross vane will require two large cottonwoods, and approximately 10 boulders, consisting of an estimated additional fill below the ordinary high water mark 12 – 15 yd^3.

Site of the proposed double log/boulder cross vane at Pool 3 – Reach 2.

Existing boulders in Riffle 6 that will be adjusted to create pocket water vortices.

- Adjust the existing boulders in Riffle 6 to improve the quality and quantity of pocket water and in channel object cover in this riffle. Adjust and anchor the existing downed cottonwood tree on the right stream bank to provide for additional undercut bank combination cover in the riffle. Install a log/boulder J-Hook Vane at the transition between Riffle 6 and Pool 3 to reduce erosion occurring on the left stream bank, and to better define and maintain the riffle crest between these two habitats.

- Reconfigure the existing boulder drop structure forming Pool 3 into a full channel boulder cross vane. Reduce the elevation at the center of the structure to no greater than ½ of the bank full stage to enhance pool development and scour in this habitat. Some additional boulder (up to 4 yd^3) may be necessary to reconfigure this structure. Total fill for this feature is not expected to exceed 15- 16yd^3.

- Remove the existing boulder drop structure in Pool 4, and construct a double log cross-vane at this site, extending approximately 12 feet upstream into Glide 1. Boulders from the existing drop structure should be adequate to complete this

structure. New fill will consist of the two large cottonwoods necessary to form the left and right vanes of this structure. Total fill for this feature is not expected to exceed 15- 16yd^3.

Failed Structure at Pool 3 – Reach 2.

Failed Structure at Pool 4 and Glide 1.

- Glide 1 will be narrowed using a log toe-slope and bank full bench structure on the right stream bank, and a "Lunker" structure (see drawings and photos in the appendix) on the left bank. Twenty five feet of log toe-slope structure will be installed to reduce the bank-full width of this habitat to 20 feet. The "Lunker" structure is expected to provide approximately 40 ft^2 of additional under-cut bank combination cover in this habitat.

- Reconfigure the existing boulder drop structure forming Pool 5, immediately upstream of the bridge, into a full channel boulder cross vane. The legs of the cross vane will be tied into the existing bridge abutments to protect the features from erosion during high flows Reduce the elevation at the center of the structure to no greater than ½ of the bank full stage to enhance pool development and scour in this habitat. Some additional boulder (up to 4 yd^3) may be necessary to reconfigure this structure. Total fill for this feature is not expected to exceed 15- 16yd^3.

Existing structure at Pool 5 – Reach 2.

Site of proposed "Lunker" Structure @ R8.

- A "Lunker" structure will be installed on the left stream bank of Riffle 8, and will be tied into the boulder cross vane previously described in Pool 5, and the previously restored stream bank in Riffle 8. This feature will require 5 cottonwood trees and will provide approximately 60 ft^2 of additional combination cover in this habitat.

Existing structure at Pool 6 – Reach 2.

Existing Structure at P6 looking upstream.

- The boulder drop structure forming the dam pool at Pool 6 will require significant reconfiguration to reduce erosion and the over-widening of the channel downstream while still preserving the quality pool habitat found in this pool. The existing drop structure was constructed in a "reverse V" configuration, which has dramatically altered the river and stream banks below this feature. We propose to leave the existing structure "as is", and will install new boulder vanes on either side of the river downstream of the existing structure. These vanes will be tied into the existing structure, converting it into a standard cross vane feature. Once these new vanes are installed, the boulders forming the stream bank edges of the existing structure will be either lowered, or completely removed. The river banks between the new vanes and the existing structure will be re-defined using large wood to create new bank full benches on either side of the river. Additionally, "Lunker" undercut bank structures may be installed to create additional combination cover. An additional 12 yd^3 of boulder fill will be required to reconfigure this drop structure as described above. A diagram of the reconfiguration of the structure and stream bank treatments at Pool 6 is included in the appendix.

- Twenty feet of log toe-slope bank full bench, planted with native willow, will be installed along the right bank of Glide 3. One large cottonwood tree and approximately 4 boulders (0.5 yd3 each) will be required for this work. The estimated amount of fill per linear foot of treated bank is not expected to exceed 0.15 yd^3.

- A boulder J-Hook Vane will be installed near the transition of Pool 6 and Glide 3 to further enhance pool depth and cover in Pool 6, and to protect the left stream bank from erosion during peak flows. Approximately 10 -12 boulders will be required for this structure, which is not expected to exceed 7 yds^3.

- Riffle 17 is immediately adjacent to a home that was constructed on the north side of the river. The fill slope immediately below this structure exhibits relatively poor vegetative cover, and is actively eroding sediment directly into the river. 70 feet of log toe-slope bank full bench, planted with native willow, will be installed along the right bank of Riffle 17 to create a depositional zone between the eroding fill slope and the river. Three large cottonwood trees and approximately 12 boulders will be required for this work. The estimated amount of fill per linear foot of treated bank is not expected to exceed 0.15 yd^3.

Eroding fill slope at Riffle 17 – Reach 2.

Hardened water site at Pool 11 – Reach 2.

- A boulder cross vane will be installed at Pool 11, where there currently exists a hardened watering site in the stream channel adjacent to one of the barns on the ranch. This hardened watering site is no longer required, and will be decommissioned, including removal of the permanent fence extending into the stream within this habitat . Minor excavation of the larger armoring cobble armoring this hardened site will be necessary to provide depth and improve scour. This material will be completely removed from the water influence zone. The cross vane will require 15 boulders, consisting of an estimated additional fill below the ordinary high water mark of the Cucharas River of 8–10 yd^3.

Prioritization:

The work described in the previous section may be accomplished all at once, or may be divided into multiple projects. Table 4, on the following page, lists each of the treatment sites in Reach 1 and Reach 2, and prioritizes each treatment as critical (A) or non-critical (B). A single project, incorporating all of the restoration recommendations, is preferred, as it will reduce the construction related disturbance to the stream channel and adjacent riparian areas, and reduce the post project clean-up and re-vegetation requirements. The landowner may choose to implement the project over a two year period, depending on budget and restoration priority. If the landowner chooses to implement the work over a series of years, it is strongly recommended that Priority A treatments, consisting mostly of addressing impacts from existing structures, be accomplished as soon as possible. Priority B treatments, including construction of new habitats and treatment of unstable stream banks, may be implemented as time and budgets allow.

Reach 1				
Site	Treatment	Priority	Legnth/ Volume	New Fill (yd^3)
Pool 2	Remove Substrate Armor	B	1 yd^3	N/A
Pool 4	Log Toe Slope / Bank Full Bench	B	10 ft	1.5
Riffle 4	Log Toe Slope / Bank Full Bench	B	100 ft	20
Riffle 6	Reconstruct J-Hook Vane at Failed Structure	A	N/A	<1
Riffle 7	Log Toe Slope / Bank Full Bench	B	34 ft	5.1
Riffle 10	New Cross Vane Structure and Pool	B	N/A	15
Riffle 11	Log Toe Slope / Bank Full Bench	B	40 ft	6
Riffle 11	New J-Hook Vane	B	N/A	6
Riffle 11	Reconstruct J-Hook Vane at Failed Structure	A	N/A	<1
Glide 2	New Cross Vane Structure and Pool	B	N/A	12

Reach 2				
Site	Treatment	Priority	Legnth/ Volume	New Fill (yd^3)
Riffle 4	Reconstruct 2 J-Hook Vanes @ Failed Structure	A	N/A	<1
Riffle 5	Log Toe Slope / Bank Full Bench	B	162 ft	24.3
Pool 2	Construct 2X Log Boulder Cross Vane & Pool	B	N/A	15
Riffle 6	Adjust Existing Boulders to Increase Object Cover	A	N/A	<1
Pool 3	Reconstruct Cross Vane at Failed Structure	A	N/A	4
Pool 4	Remove Existing Str. & Replace w/ 2X Log X-Vane	A	N/A	9
Pool 5	Reconstruct Existing Structure into Cross Vane	A	N/A	4
Riffle 8	"Lunker" Stream Bank Structure	B	20 ft	4
Pool 6	Reconstruct Existing Structure into Cross Vane	A	N/A	12
Pool 6	Two "Lunker" Structures	A	40	8
Glide 3	Log Toe Slope / Bank Full Bench	B	20 ft	3
Glide 3	Construct New J-Hook Vane	B	N/A	7
Riffle 17	Log Toe Slope / Bank Full Bench	B	70 ft	10.5
Pool 11	New Cross Vane Structure and Pool	B	N/A	10

Table 4: List of Treatment Sites on the Cucharas River, with Priority Ranking and Estimated New Fill Below the Ordinary High Water Mark of the River.

- **Glossary of Terms:**

Benthic Zone - The benthic zone is the lowest level of a body of water. It is inhabited mostly by organisms that tolerate cool temperatures and low oxygen levels, called benthos or benthic organisms.

Cascade - A meso-habitat type. Cascades are the steepest riffle habitat types, in terms of gradient, in streams. These riffles consist of alternating small waterfalls and shallow pools. These habitats may appear to have the characteristics of a Step-pool system. Cascades are characterized by swift current flows and often have exposed rocks and boulders above the water surface, which creates considerable turbulence and surface agitation. The substrate normally found in cascades is bedrock or accumulations of boulders.

Cover - Locations where fish prefer to rest, hide and feed are called cover. Cover serves to visually isolate fish, which increases the number of territories in the same space. Additionally, cover can create areas of reduced velocities providing critical resting and feeding stations for fish. The amount of cover available in a stream can influence the production of a number of fish and invertebrate species.

Cross-Vane - A structure spanning the entire width of the channel, constructed of large boulders and/or large wood, that provides vertical stability, increased scour, increased stage upstream, and reduced stream power. This structure type is commonly used as a diversion structure for irrigation ditches, as well as for treating active down cutting and head cuts in the stream channel.

Embeddedness - The degree to which the interstitial spaces between larger substrate particles are filled with finer sediments. Embeddedness tends to armor the substrate, thus limiting available habitat for benthic dwelling macroinvertebrates and spawning habitat for salmonids.

Glide - A meso-habitat type. Glides are those portions of streams which have relatively wide uniform bottoms, low to moderate velocity flows, lack pronounced turbulence, and have substrates usually consisting of either cobble, gravel or sand. Glides are usually described as stream habitat with characteristics intermediate between those of pools and riffles. These habitats are commonly found in the transition between a pool and the head of a riffle, however they are occasionally found in low gradient stream reaches with stable banks and no major flow obstructions.

Green Line - A narrow band of riparian plant species immediately adjacent to the stream bank in deeply entrenched streams. These are typically streams that have no identifiable flood plains.

Head-Cut - An area of active down-cutting in the channel where a river or stream is eroding down to a new, lower flood plain.

Intermittent - An intermittent stream is one that only flows for part of the year.

Lotic - Of, relating to, or living in moving water such as streams and rivers.

Meso-Habitat - A channel scale habitat form. Typically a pool, riffle, rapid, cascade or glide habitat. A meso-habitat occupies the entire width of the stream channel, and with few exceptions (most notably plunge pools in high gradient step-pool systems) is at least as long as the channel is wide.

Micro-Habitat - Micro habitats are small, site specific habitats within a meso-habitat form, and may include spawning redds, in-stream or overhead cover, and velocity shelters.

Micro-Vortex - A small rock cluster structure that replicates pocket water habitat in riffles, rapids and cascades.

Over-Wintering Habitat - Areas of a stream or water body exhibiting depths that may sustain a population through the winter months.

Perennial - A perennial stream is one that flows year round.

Pocket Water - A micro-habitat type. Pocket water habitats are typically found in higher gradient riffles, rapids, and cascades with large cobble, boulder, and large woody debris. These pocket water habitats provide small areas for velocity shelter and cover within these fast-water habitat forms.

Pool - A meso-habitat type. Pools are channel segments exhibiting areas of scour and deposition where the water is deeper and slower moving.

Primary Producers - Primary producers are those organisms in an ecosystem that produce biomass from inorganic compounds. In almost all cases these are photosynthetically active organisms.

Rapid - A meso-habitat type. Rapids are riffles associated with high gradients (greater than 4%) with swiftly flowing (greater than 1.5 ft/sec), moderately deep, and highly turbulent waters. These riffles are generally associated with boulder substrates, which protrude through the surface of the water.

Residual Pool Depth (RPD) - Residual pool depth is estimated as the depth of water which would be retained in a pool under highly reduced flows or the stoppage of flows in the stream. This area of pools would be utilized by fish in low flow conditions. Residual pools would also provide habitat for overwintering of fish when ice buildup restricts movement in riffles or glides between pools. Residual pool depth is calculated by locating and measuring the greatest depth of the pool at the riffle crest (deepest point of the downstream boundary cross-section of the pool), and subtracting this value from the greatest measured depth of the pool habitat. The difference in these measurements is described as the RPD. RPD may be difficult to determine in some habitats, particularly dam pools with woody debris structural associations. In many of these habitat units, the RPD may actually be a very low value or zero due to water flowing through these debris dams.

Riffle - A meso-habitat type. Riffles are those areas of the stream in which turbulence in the water column is the major identifying characteristic, as a result of relatively high gradients. These units contain moderately deep to shallow, swift flowing water, and are characterized by boulder or cobble substrates. Riffles are very important for macroinvertebrate production, due to the availability of light and oxygen, and the corresponding vegetative growth on the bottom substrate. The quality of riffles, including low sediment deposition and resulting embeddedness can have a direct impact on fish populations. The cleaner and healthier the vegetative growth and benthic macroinvertebrate community, the more food there is for the fish population.

Salmonids - Salmonidae is a family of ray-finned fish, the only family of order Salmoniformes. It includes the well-known salmons and trouts; the Atlantic salmons and trouts of genus Salmo give the family and order their names.

Subfamily - Salmoninae
Brachymystax - lenoks
Oncorhynchus - Pacific salmon and trout
Salmo - Atlantic salmon and trout
Salvelinus - Char and trout (Brook trout, Lake trout)

Substrate - Stream substrate (sediment) is the material that rests at the bottom of a stream.

Thermal Refugia - Micro habitats found in streams and lakes that provide thermal protection for cold water species such as trout. These may include shaded areas, cool water springs, and deep water habitats.

Toe-Slope - The foot, or bottom, of the sloping bank of a stream. This is the area of the highest sheer stress and erosion potential on a stream bank, and is typically the point of failure leading to mass wasting and collapse.

References:

Azuma, David and David Fuller, 1994. Repeatability of the USFS Pacific SW Region Habitat Classification Procedure. USFS Pacific Southwest Experiment Station, Berkely, CA. Presentation Paper for the 1994 National American Fisheries Society Meeting.

Bevenger, Gregory S and Rudy M. King, 1995. A Pebble Count Procedure for assessing Watershed Cumulative Effects. U.S. Department of Agriculture - Forest Service, Rockey Mountain Forest and Range Experiment Station, Fort Collins CO. Research Paper #RM-RP-319 17pp.

Bisson, P.A., J.L. Nielson, R.A. Palmason, and L.E. Grove. 1981. A system for mapping habitat types in small streams, with examples of habitat utilization by salmonids during low stream flow. p. 62-73. In: N.B. Armantrout (ed.). Acquisition and utilization of aquatic habitat. Western Div. Amer. Fish. Soc., Portland, OR 376pp.

Bovee, K.D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Information Paper '12. U.S. Fish and Wildlife Service. FWS/OBS-82/26.

Gallagher, J. Peter. 2007. Aquatic Habitat Survey & Habitat Enhancement Plan for The Cucharas River – Samuel N Knight Property, La Veta, Huefano County, Colorado. FIN-UP Habitat Consultants, Inc. 15pp.

Gibbons, D.R., W.R. Meehan, M.D. Bryant, M.L. Murphy, S.T. Elliot. 1990. Fish in the Forest. Large Woody Debris in Streams, A New Management Approach to Fish Habitat. USDA-Forest Service, R10-MB-86. 21pp.

Hamilton, K. and E.P. Bergersen. 1984. Methods to Estimate Habitat Variables. CSU, CO Coop. Fish. Res. Unit, Environ. Eval., BOR Project No. DPTS-35-9.

Hankin, D.G. and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based upon visual estimation methods. Can. J. Fish. Aquat. Sci,, 45: 834-S44.

Helm, W.T., P. Brouha, M. Aceituno, C. Armour, P. Bisson, J. Hall, G. Holton, and M. Shaw. 1983. Aquatic habitat inventory. Glossary and Standard Methods. West.. Div. A.F.S., Portland, OR. 34pp.

Lisle, T.E. 1987. Using residual depths to monitor pool depths independently of discharge. USDA-FS Rsch. Note, PSW-394. 4pp.

McCain, Mike, David Fuller, Lynn Decker and Kerry Overton. 1990. Stream Habitat Classification and Inventory Procedures for Northern California. Region 5 FHR Currents Technical Bulletin #1, USDA-Forest Service, Pacific Southwest Region. Arcata CA. 15pp.

Ohlander, Coryell A. 1996. Clean Water Act - Monitoring and Evaluation, Part 7. Stream Reach Monitoring - T-Walk Training - Syllabus to Establish Background and Rationale. USDA Forest Service, Rocky Mountain Region, Denver, CO. 141pp.

Pacific Southwest Region Habitat Typing Field Guide (USDA-USFS)

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. USDA-FS Northern Region Rl-75-002. 22pp.

Platts, W.S. 1974. Geomorphic and aquatic conditions influencing salmonids and stream classification. USDA-FS, Surface Environment and Mining Report, Washington, D.C.

Platts, W. S., W.F. Megahan and G.W. Minshall. 1983. Methods for evaluating stream riparian and biotic conditions. USDA-FS Forest Range Exp. Stn., Gen. Tech. Rept. INT-13S. 70 pp.

Rosgen, D.L. 1985. A stream classification system. IN: Riparian ecosystems and their management; reconciling conflicting uses. Proceedings of the First North American Riparian Conference, April 16-18, Tucson, AZ. GTR-RM120, pp. 91-95.

Schmal, R.N., S.J. Kozel, and S.S. Marsh. 1988. A Basin-Wide Inventory Approach Using a Channel Type and Habitat Type Classification System for Resident Trout. USDA-FS. Medicine Bow National Forest, 16pp with illustrations.

USDA-Forest Service. 1975. Stream Reach Inventory and Channel Stability Evaluation: A Watershed Management Procedure. USDA-Forest Service, Northern Region. Rl-75-002. 26pp.

Winters, D.S. and J.P.Gallagher. - USDA-Forest Service. 1997. Basinwide Stream Habitat Inventory - A Protocol for the Pike and San Isabel National Forests and the Cimarron and Comanche National Grasslands. 41pp.

Ariel Photography used with permission: Topographical maps created using USGS and Delorme TOPO 6.0

APPENDIX

Project Area & Reach 4 Restoration Treatment Maps

Longitudinal Profiles of Reach 1 and Reach 2

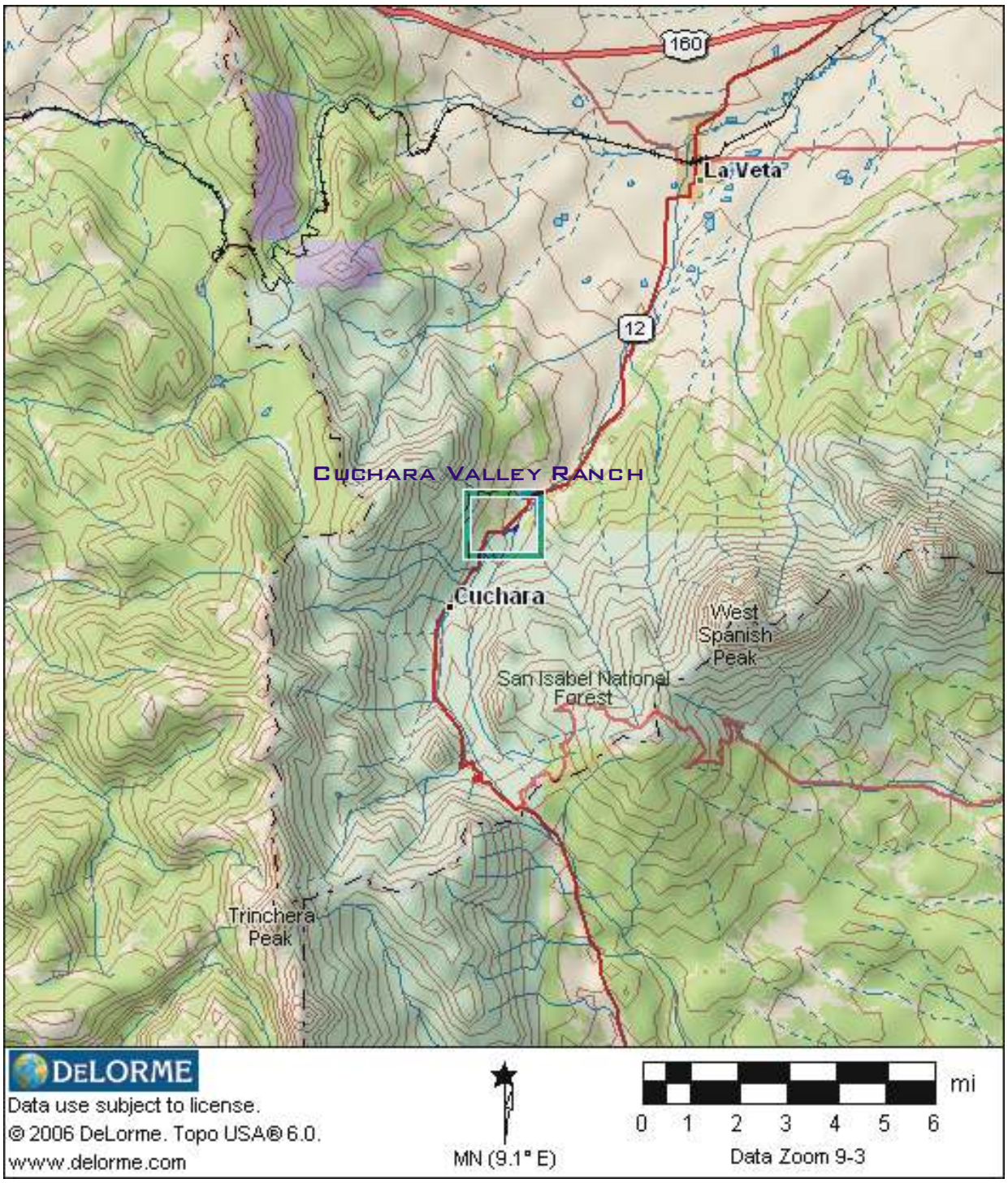
Cross - Sections

Proposed Treatments Designs and Conceptual Drawings

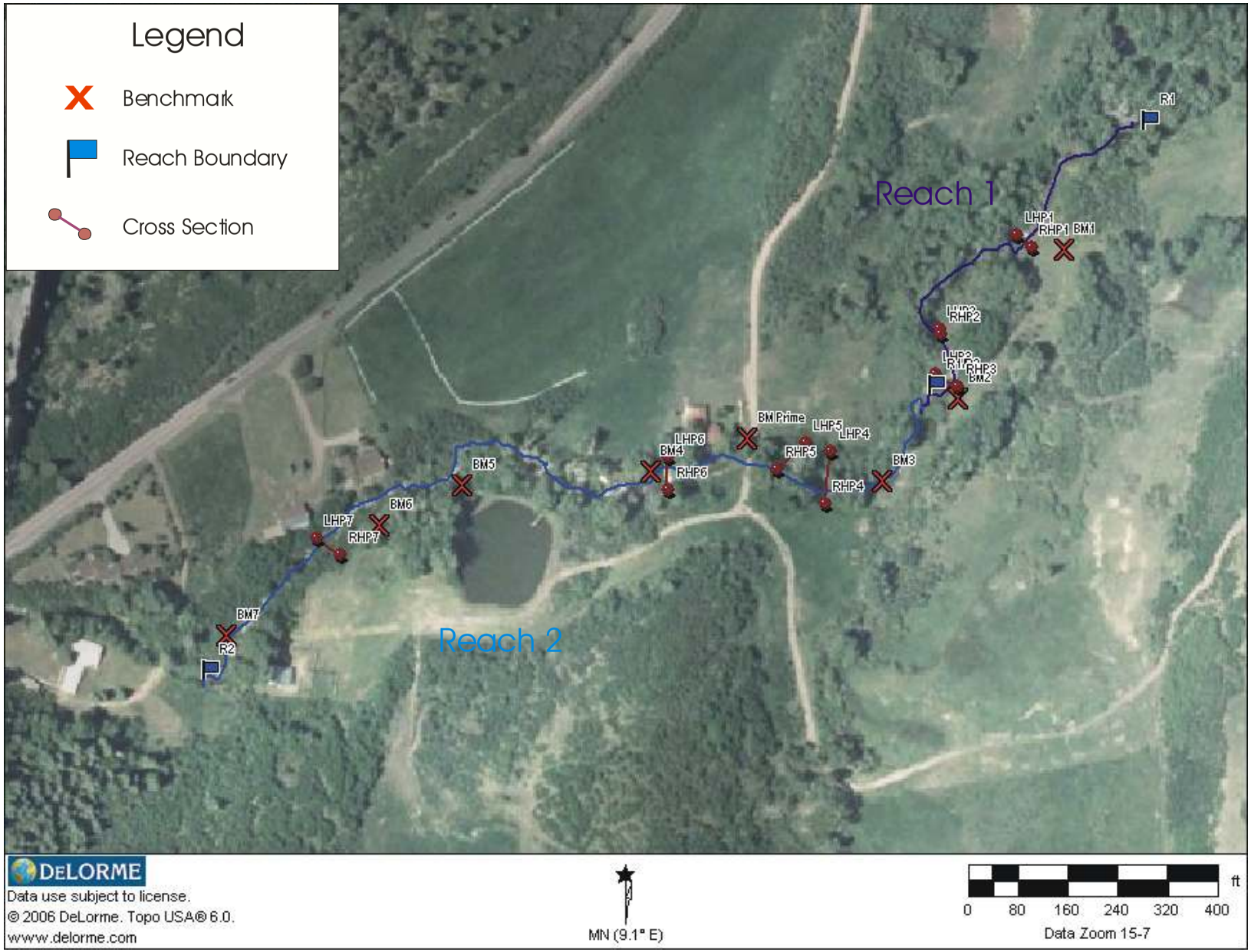
Photographs of Proposed Treatment Types

Stream Inventory BWSHI Data Sheets and Summaries

Vicinity, Project Reach & Restoration Treatment Maps

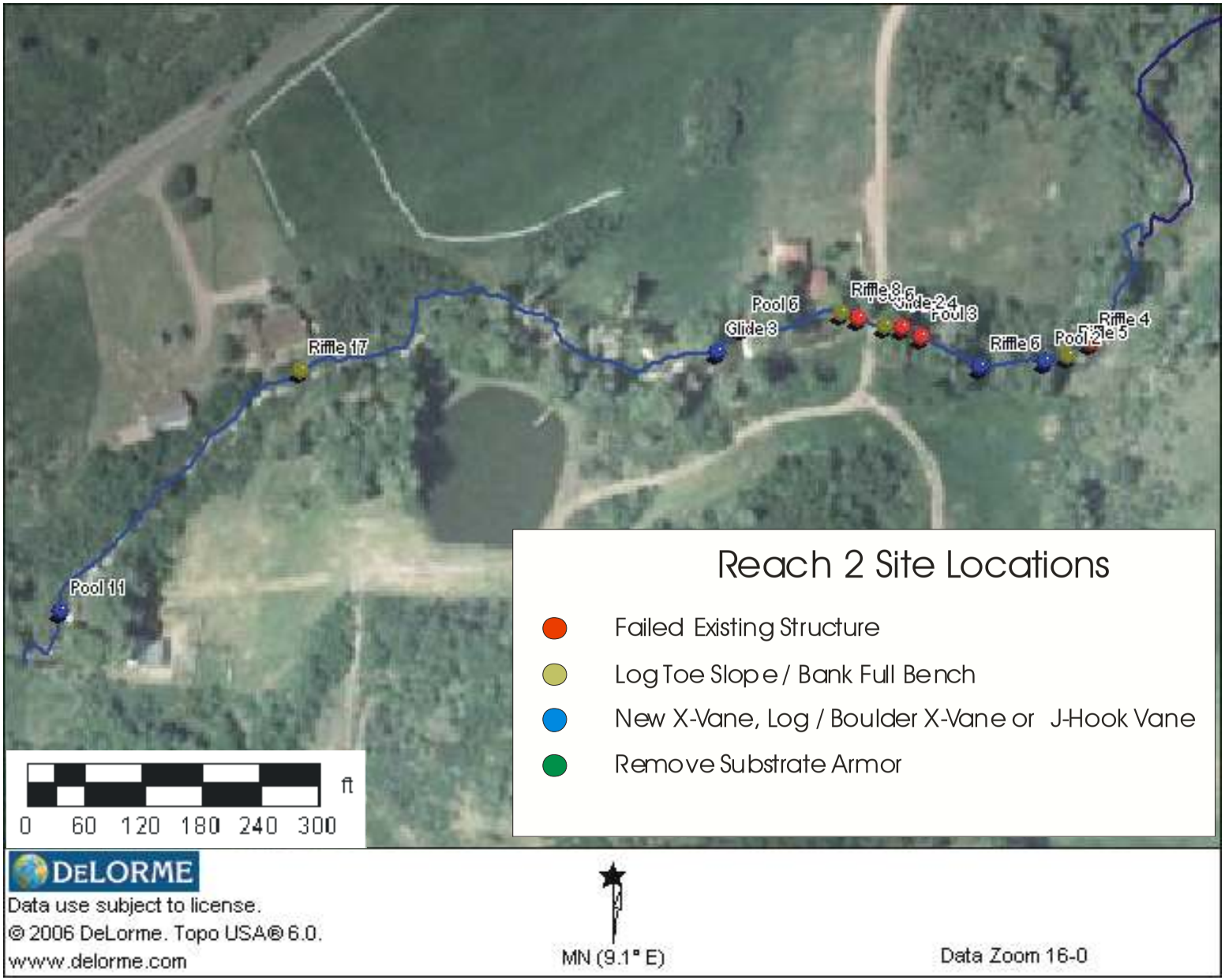


Project Vicinity and Location Map.



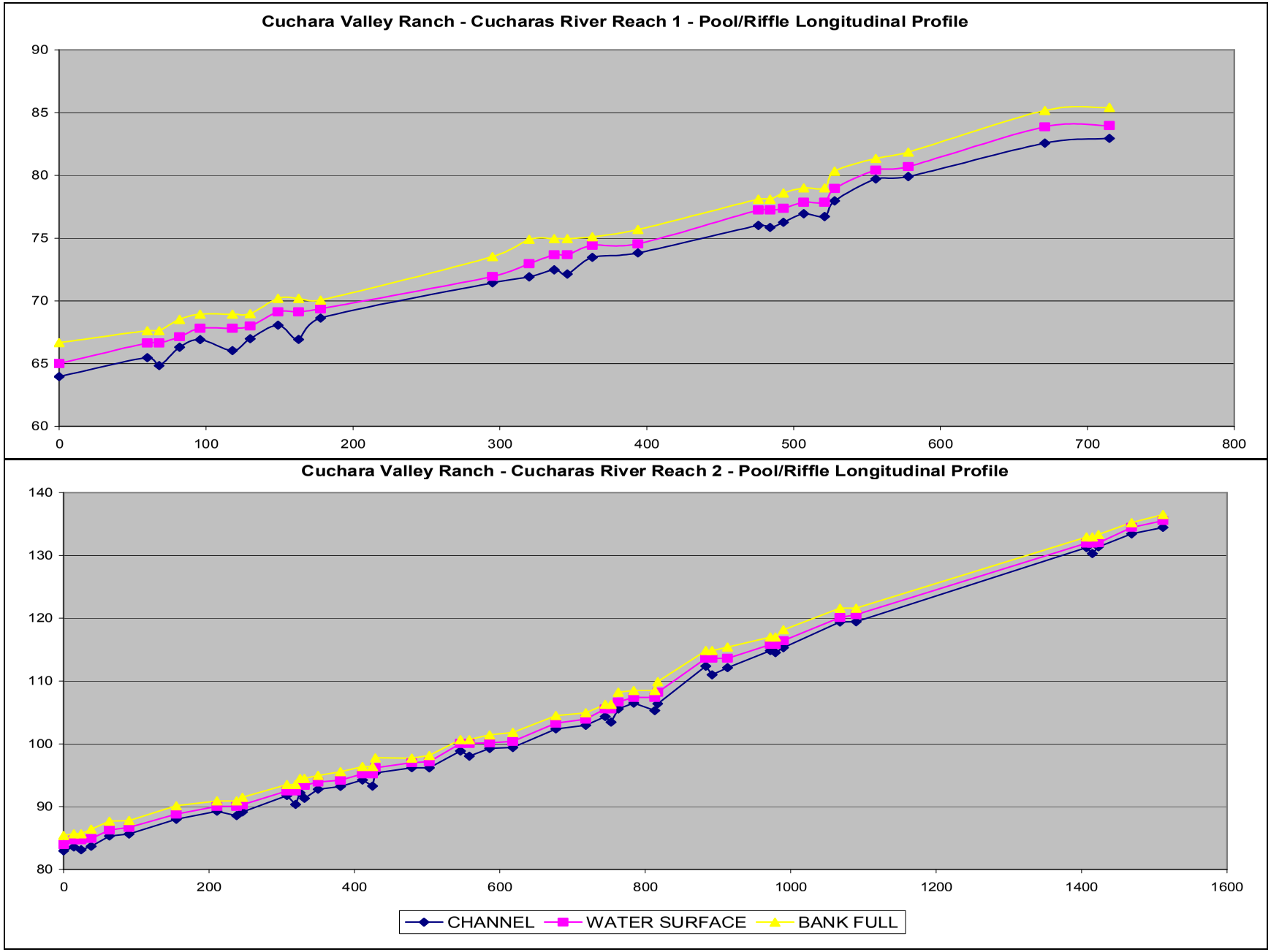
Cuchara Valley Ranch - Cucharas River – Stream Reach Delineation, Permanent Benchmark, and Cross-Section Locations

Cuchara Valley Ranch - Cucharas River – Reach 1 Restoration Site Locations, Defined by Treatment Type



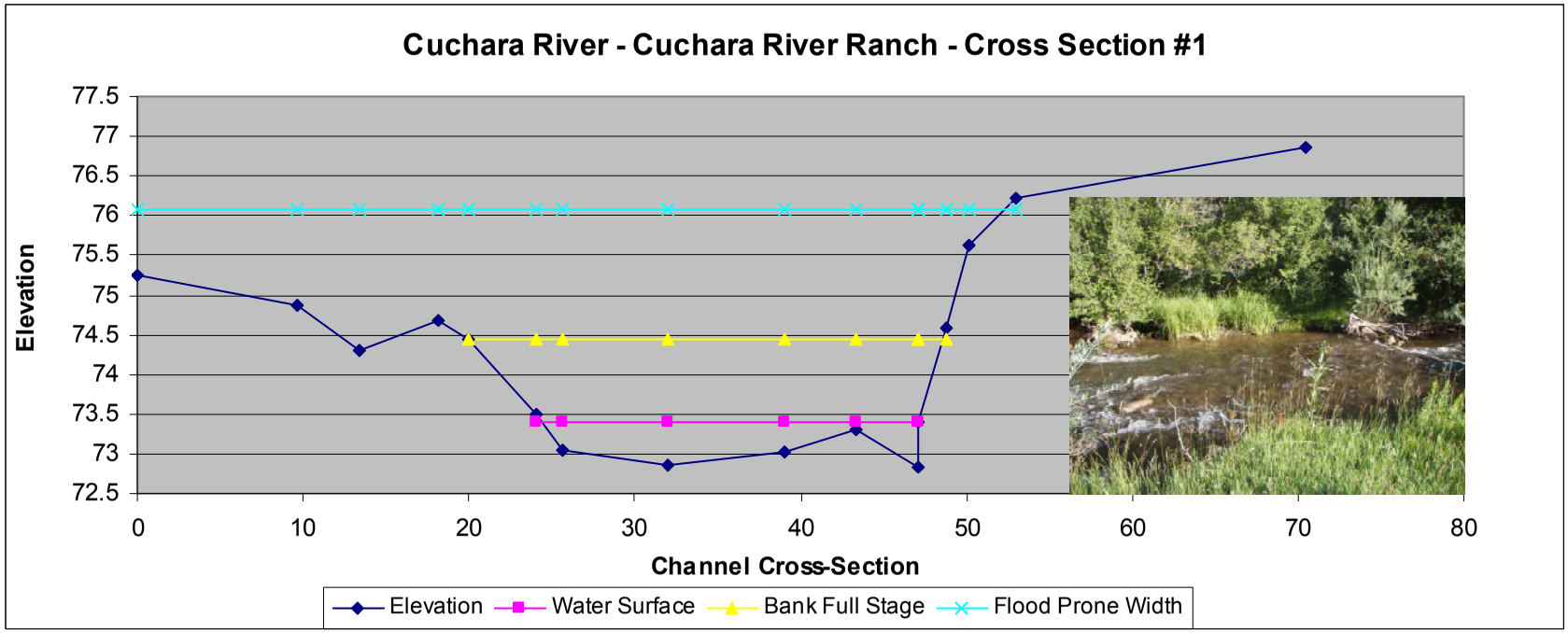
Cuchara Valley Ranch - Cucharas River – Reach 1 Restoration Site Locations, Defined by Treatment Type

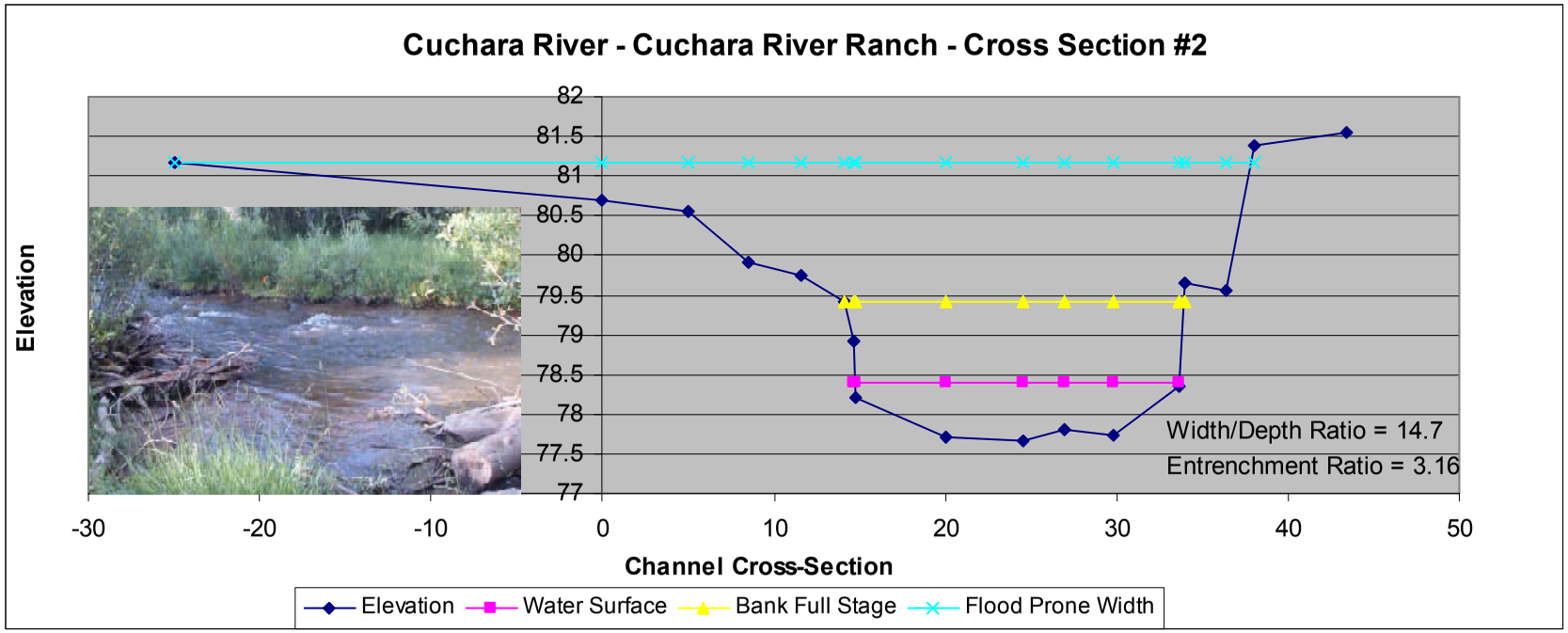
Longitudinal Profiles of Reach 1 and Reach 2

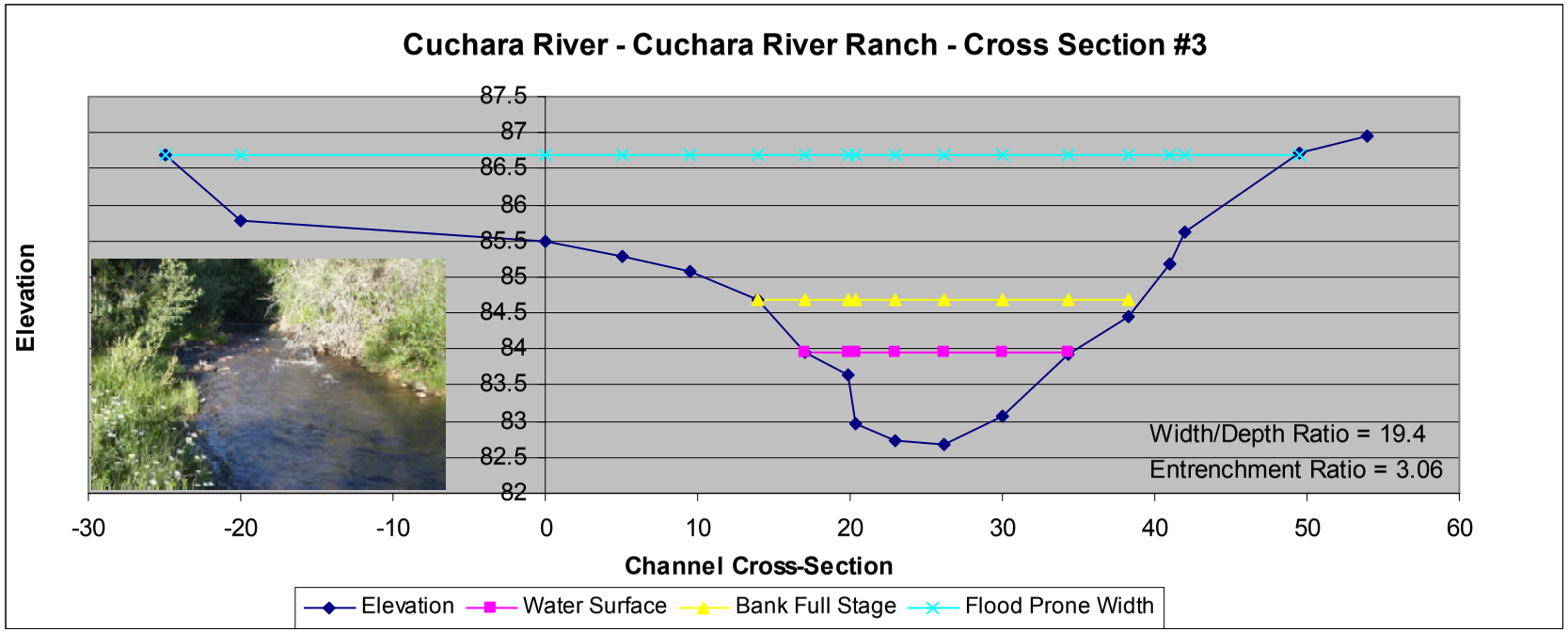


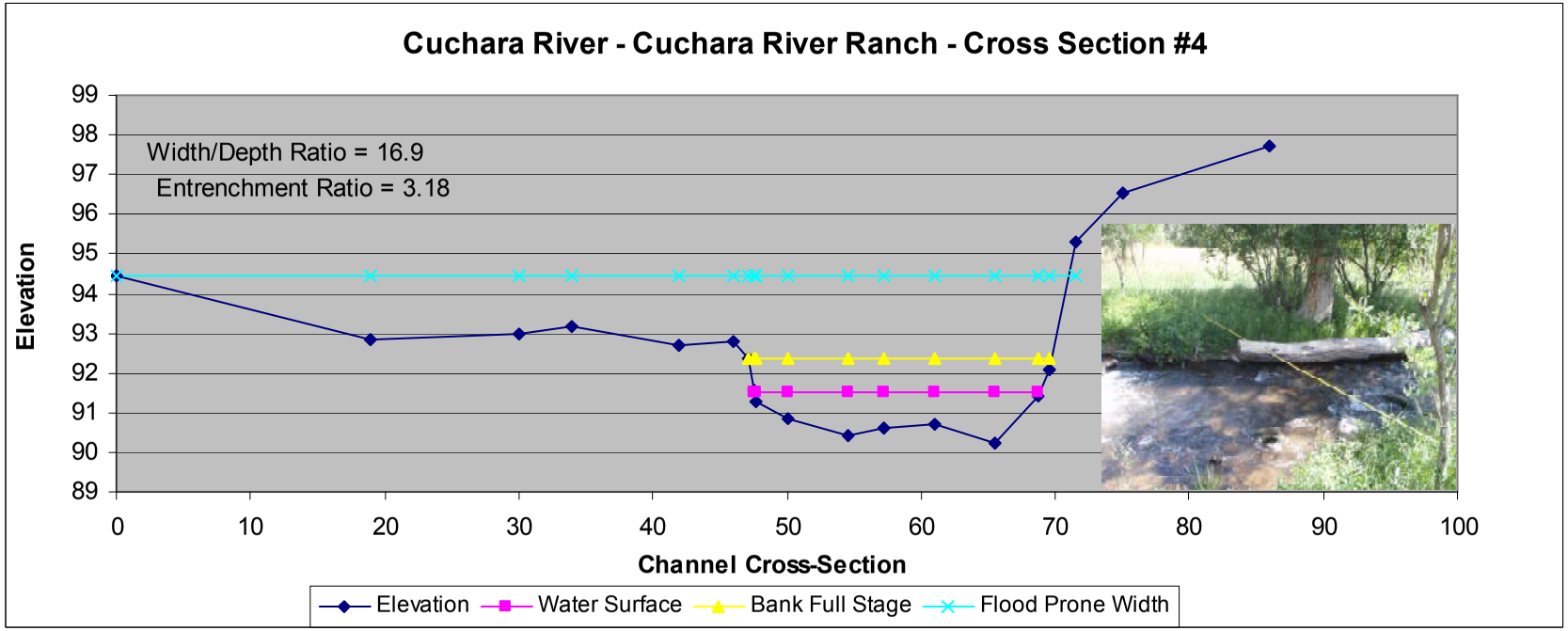
Longitudinal Profiles ofReach 1 & 2 on the Cucharas River - Cuchara Valley Ranch – Huerfano County, CO.

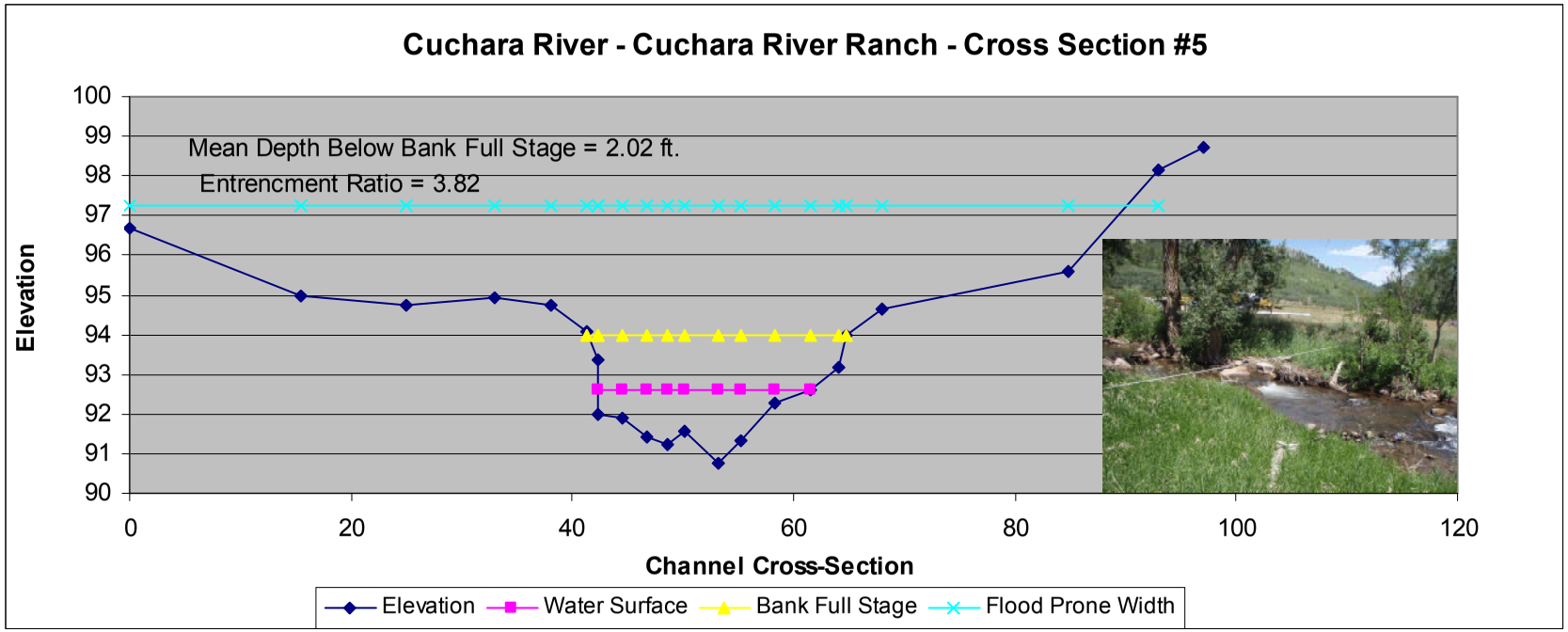
Cuchara Valley Ranch
Cucharas River Cross - Sections

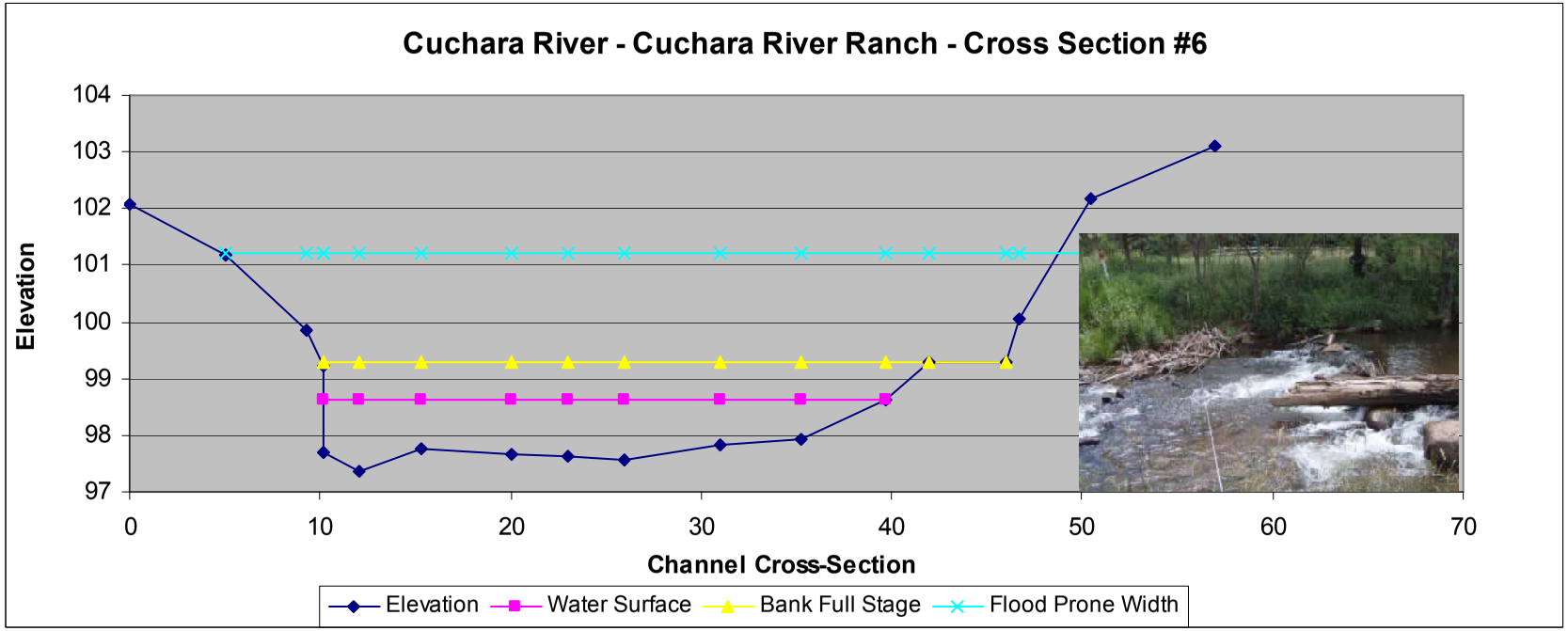

Cuchara River - Cuchara River Ranch - Cross Section #1
Elevation
77.5
77
76.5
76
75.5
75
74.5
74
73.5
73
72.5
0
10
20
30
40
50
60
70
80
Channel Cross-Section
Elevation
Water Surface
Bank Full Stage
Flood Prone Width

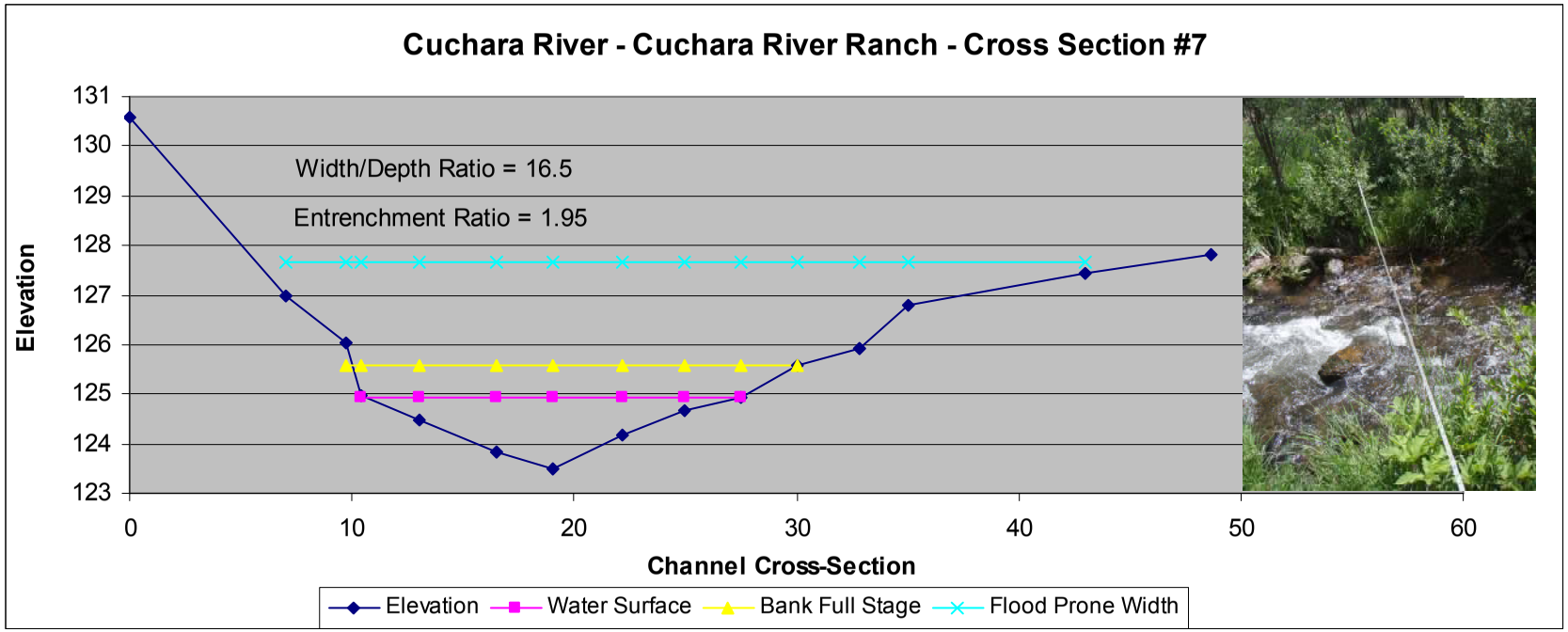

Cuchara River - Cuchara River Ranch - Cross Section #2
Elevation
82
81.5
81
80.5
80
79.5
79
78.5
78
77.5
77
-30
-20
-10
0
10
20
30
40
50
Channel Cross-Section
Width/Depth Ratio = 14.7
Entrenchment Ratio = 3.16
Elevation
Water Surface
Bank Full Stage
Flood Prone Width


Cuchara River - Cuchara River Ranch - Cross Section #3
Elevation
87.5
87
86.5
86
85.5
85
84.5
84
83.5
83
82.5
82
-30
-20
-10
0
10
20
30
40
50
60
Channel Cross-Section
Width/Depth Ratio = 19.4
Entrenchment Ratio = 3.06
Elevation
Water Surface
Bank Full Stage
Flood Prone Width

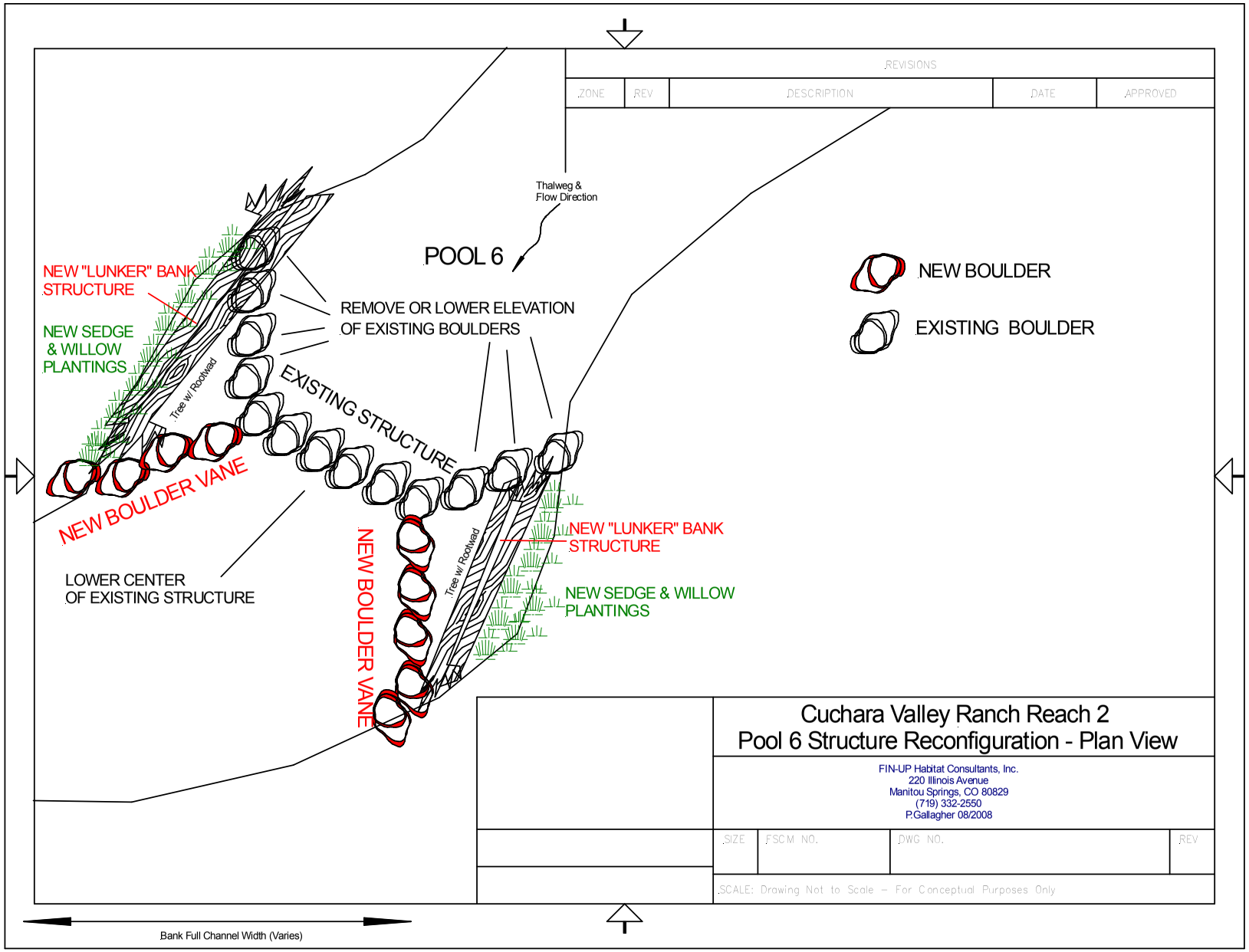

Cuchara River - Cuchara River Ranch - Cross Section #4
Elevation
99
98
97
96
95
94
93
92
91
90
89
0
10
20
30
40
50
60
70
80
90
100
Channel Cross-Section
Width/Depth Ratio = 16.9
Entrenchment Ratio = 3.18
Elevation
Water Surface
Bank Full Stage
Flood Prone Width


Cuchara River - Cuchara River Ranch - Cross Section #5
Mean Depth Below Bank Full Stage = 2.02 ft.
Entrencment Ratio = 3.82
Elevation
100
99
98
97
96
95
94
93
92
91
90
0
20
40
60
80
100
120
Channel Cross-Section
Elevation
Water Surface
Bank Full Stage
Flood Prone Width

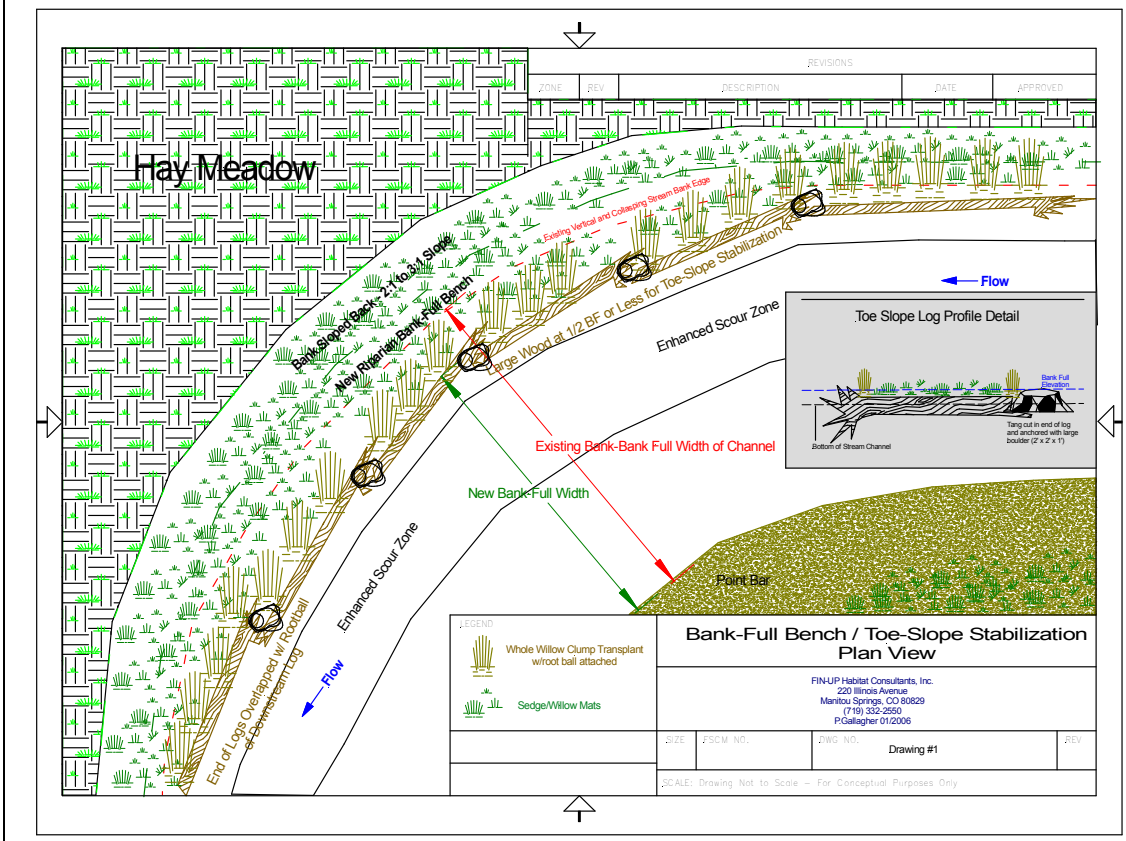

Cuchara River - Cuchara River Ranch - Cross Section #6
Elevation
104
103
102
101
100
99
98
97
0
10
20
30
40
50
60
70
Channel Cross-Section
Elevation
Water Surface
Bank Full Stage
Flood Prone Width

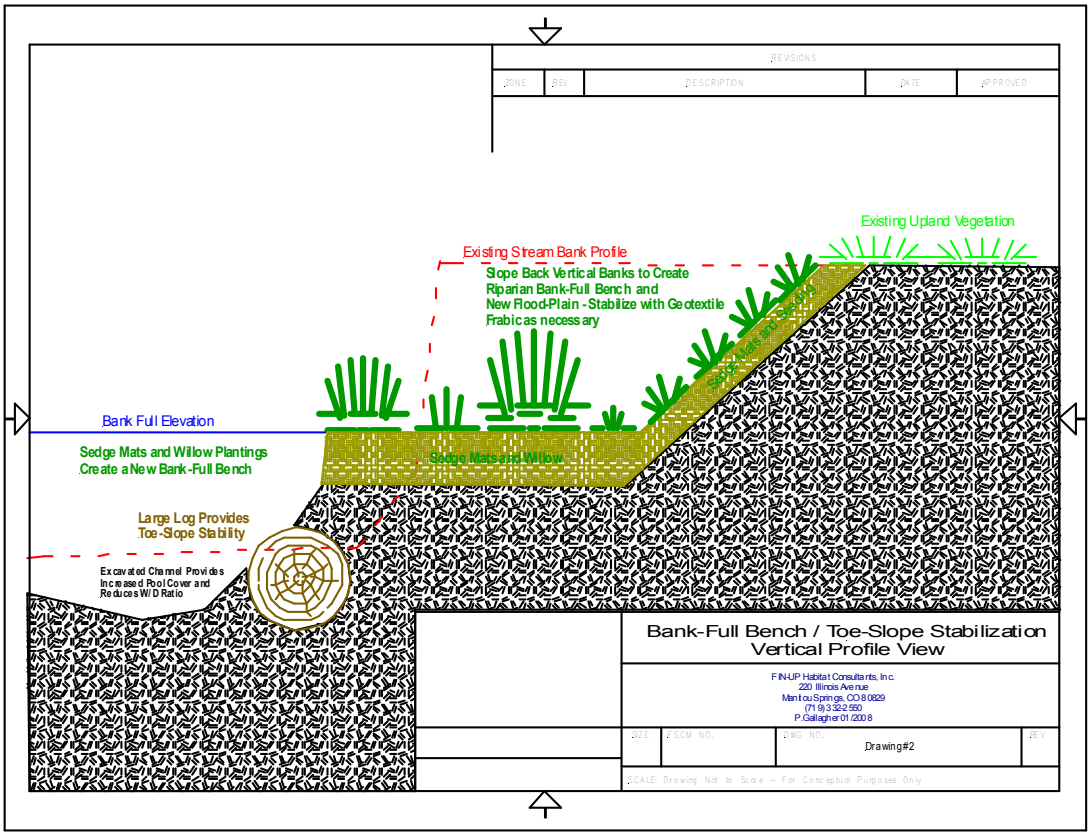

Cuchara River - Cuchara River Ranch - Cross Section #7
Width/Depth Ratio = 16.5
Entrenchment Ratio = 1.95
Elevation
131
130
129
128
127
126
125
124
123
0
10
20
30
40
50
60
Channel Cross-Section
Elevation
Water Surface
Bank Full Stage
Flood Prone Width

Proposed Treatments Designs and Conceptual Drawings


REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Thalweg &
Flow Direction
POOL 6
NEW "LUNKER" BANK
STRUCTURE
NEW SEDGE
& WILLOW
PLANTINGS
REMOVE OR LOWER ELEVATION
OF EXISTING BOULDERS
EXISTING STRUCTURE
Tree w/ Rootwad
NEW BOULDER VANE
LOWER CENTER
OF EXISTING STRUCTURE
NEW BOULDER VANE
NEW "LUNKER" BANK
STRUCTURE
Tree w/ Rootwad
NEW SEDGE & WILLOW
PLANTINGS
NEW BOULDER
EXISTING BOULDER
Cuchara Valley Ranch Reach 2
Pool 6 Structure Reconfiguration - Plan View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 08/2008
SIZE
FSCM NO.
DWG NO.
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only
Bank Full Channel Width (Varies)

Drawings and Photos of Treatment Types

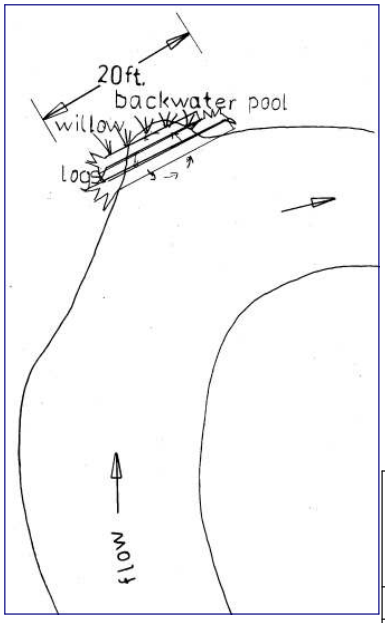




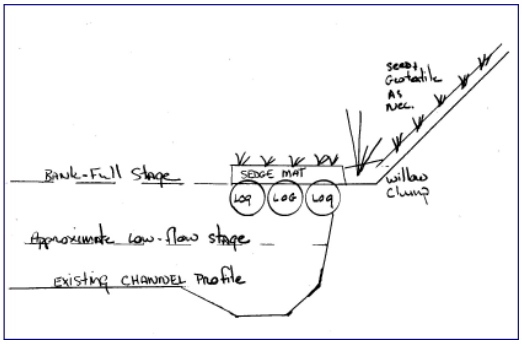
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

Plan View



Profile View



LUNKER Bench / Bank Stabilization
Plan and Profile View

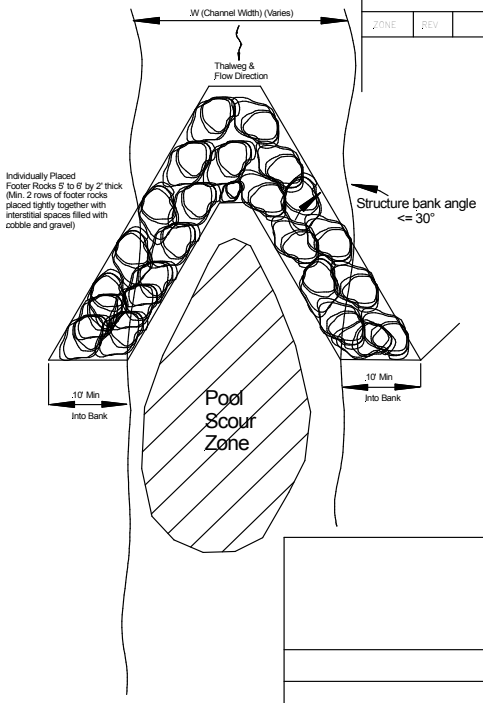
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 01/2008

SIZE	FSCM NO.	DWG NO.	REV
		Drawing #1	

SCALE: Drawing Not to Scale – For Conceptual Purposes Only

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

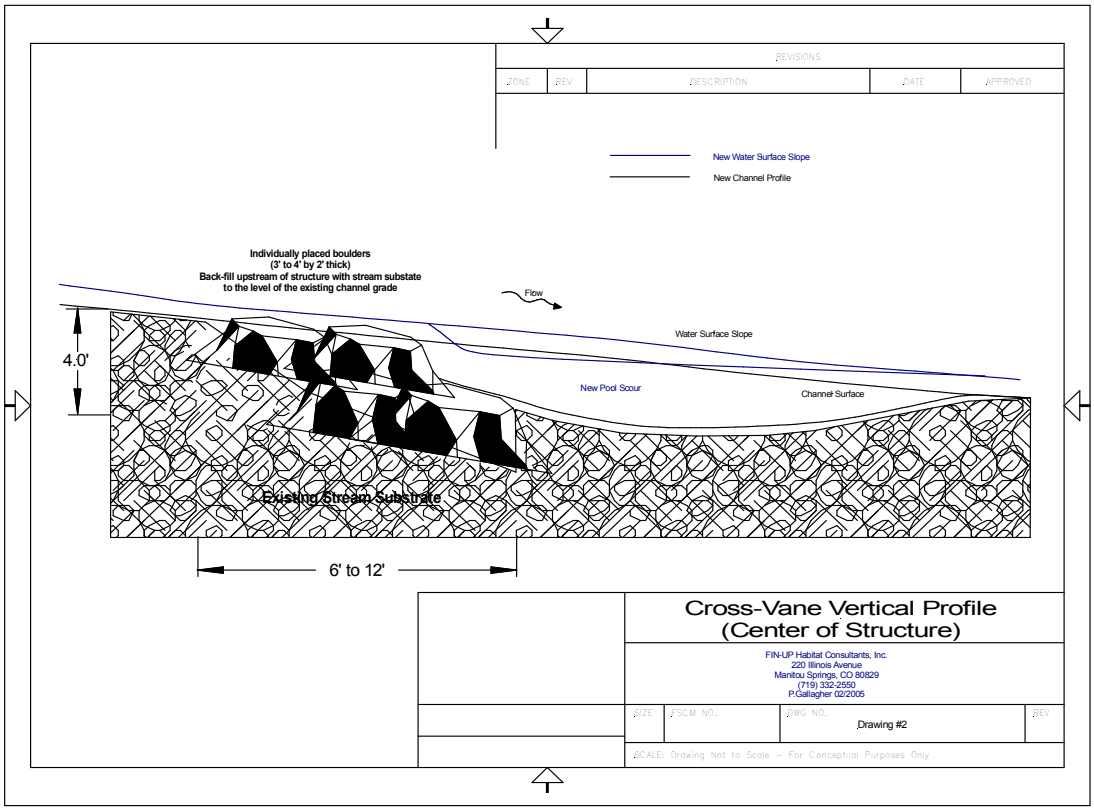


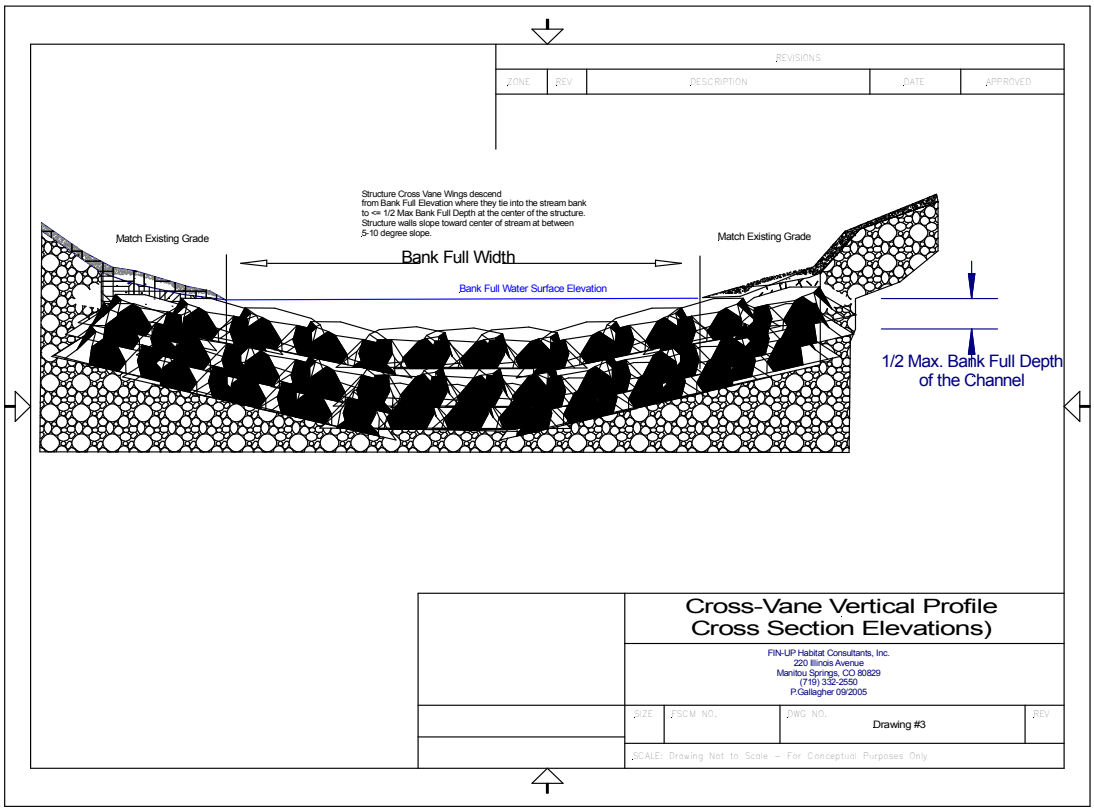
Generic Cross Vane - Plan View

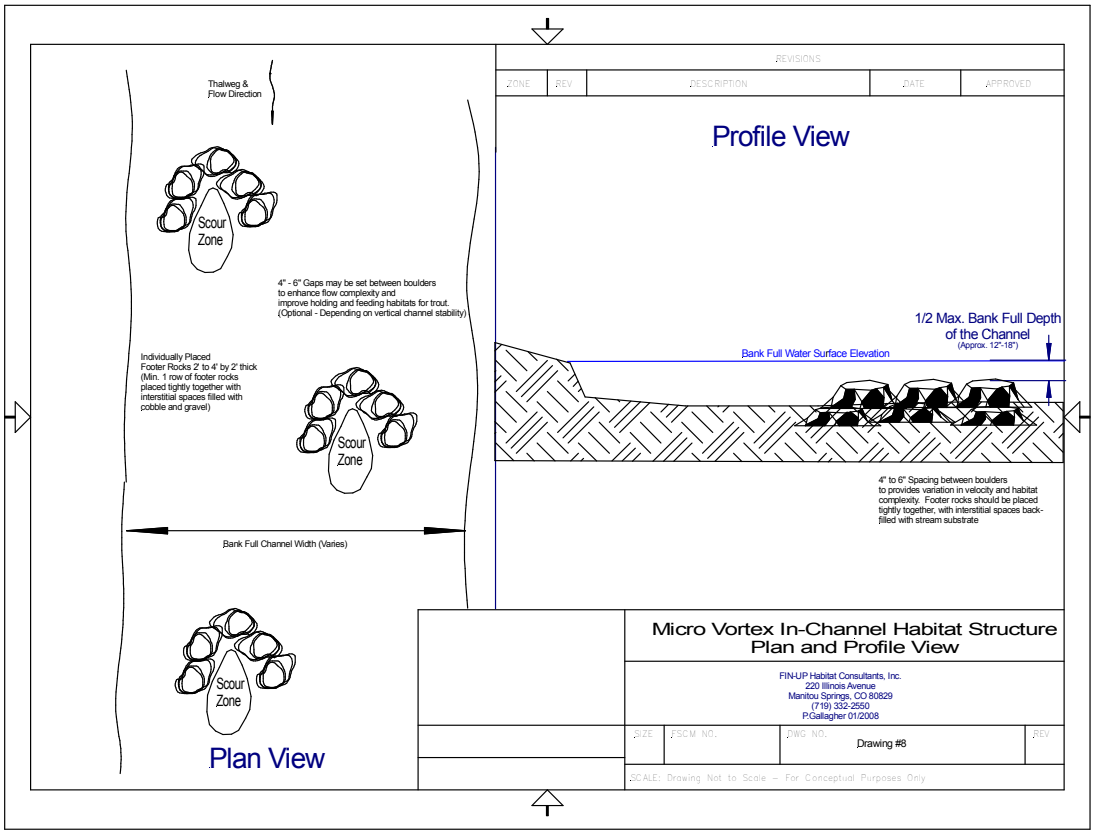
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 02/2005

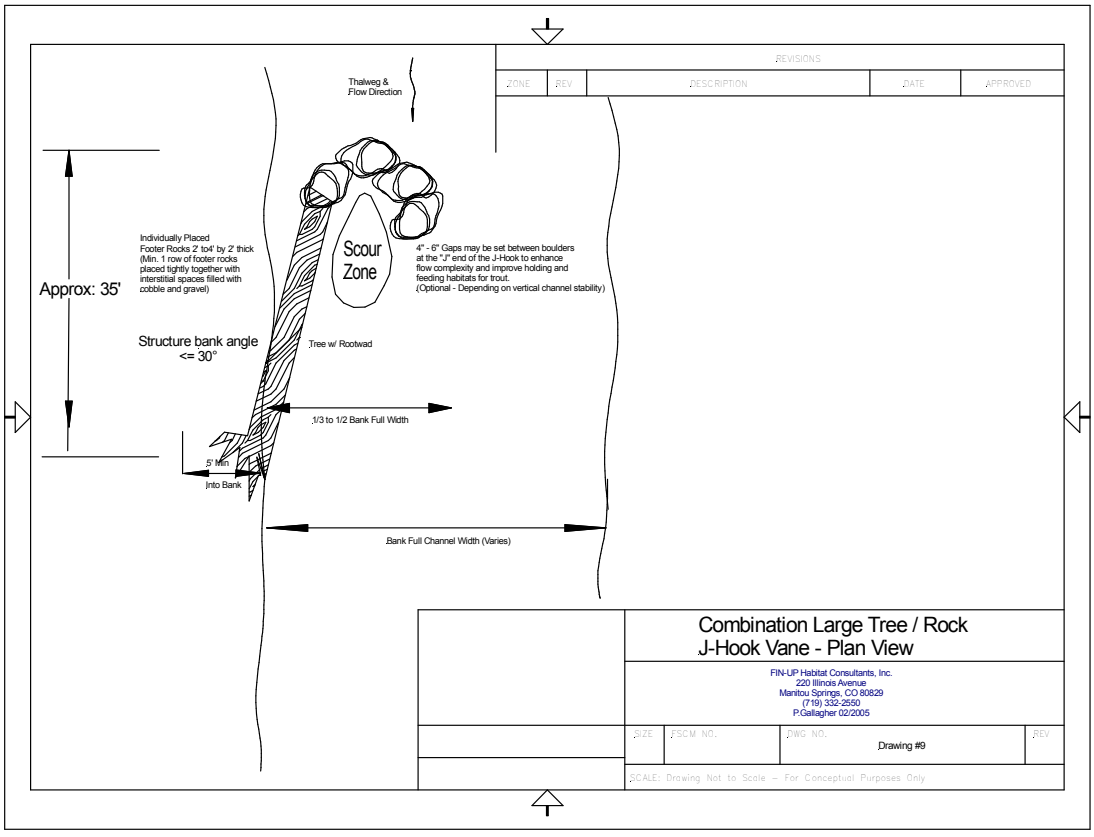
SIZE	FSCM NO.	DWG NO.	REV
		Drawing #5	

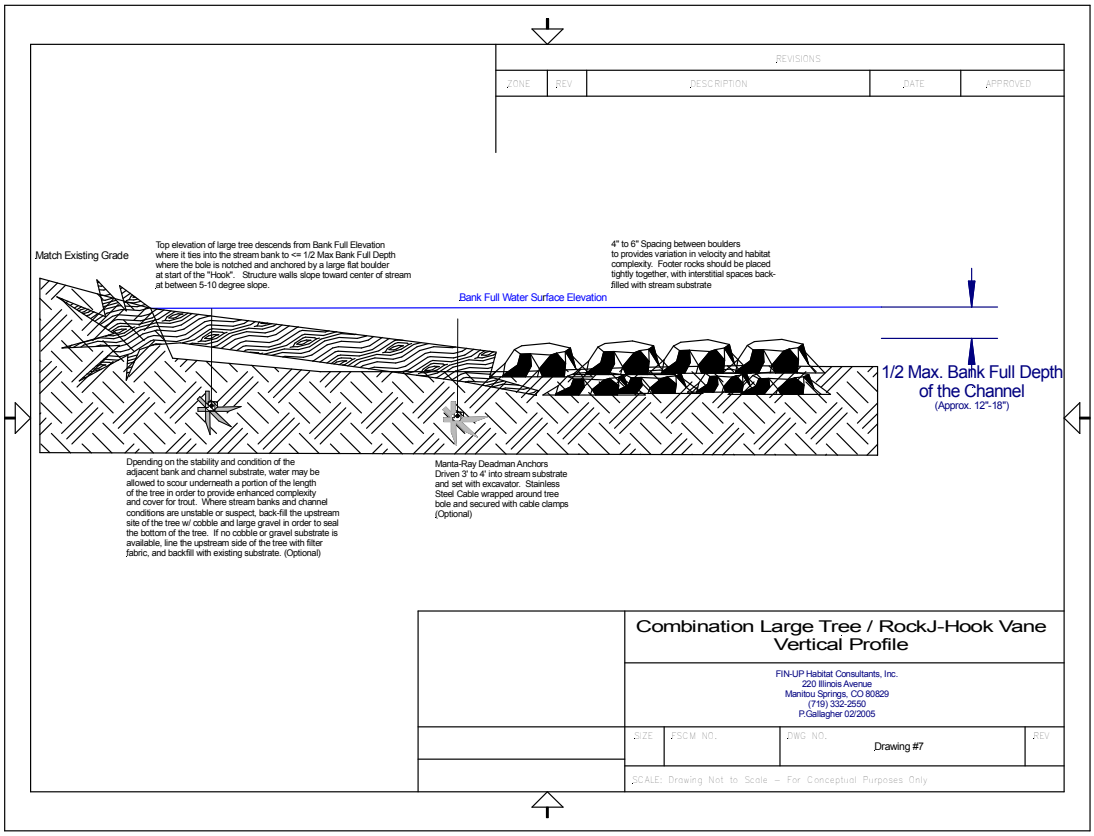
SCALE: Drawing Not to Scale – For Conceptual Purposes Only

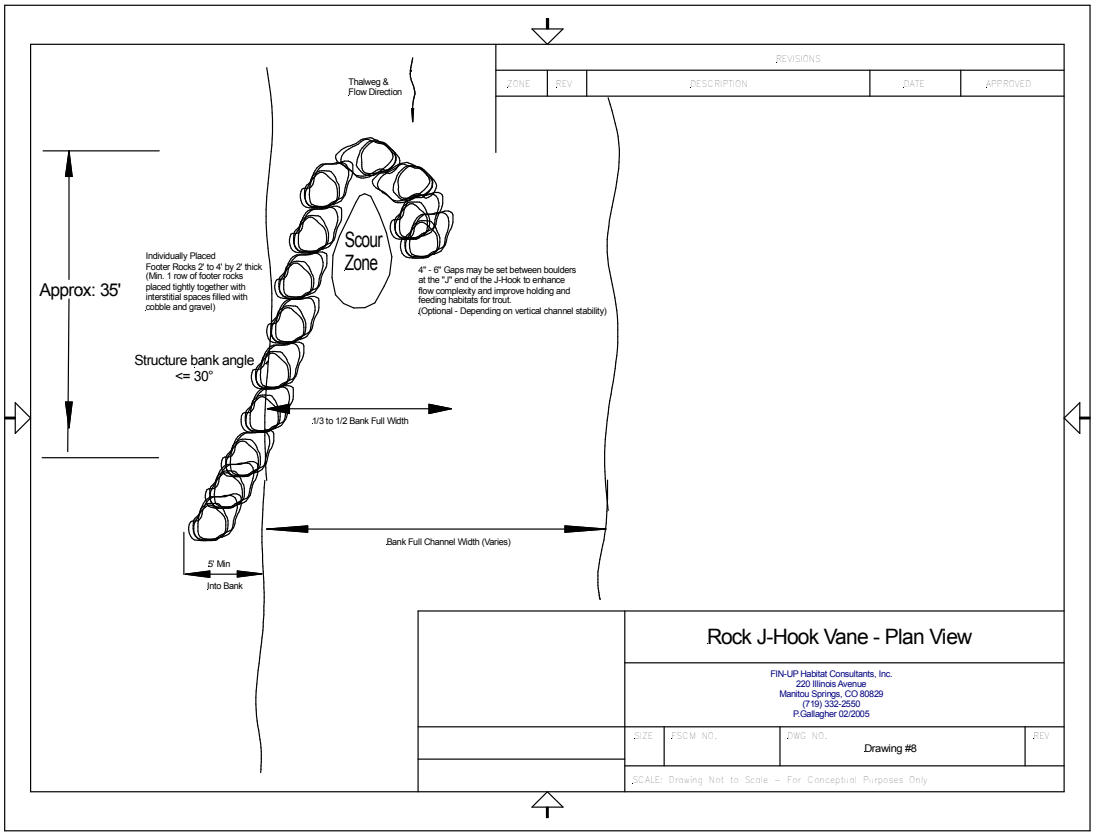

REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
New Water Surface Slope
New Channel Profile
Individually placed boulders
(3' to 4' by 2' thick)
Back-fill upstream of structure with stream substate
to the level of the existing channel grade
Flow
Water Surface Slope
4.0'
New Pool Scour
Channel Surface
Existing Stream Substrate
6' to 12'
Cross-Vane Vertical Profile
(Center of Structure)
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 02/2005
SIZE
FSCM NO:
DWG NO:
Drawing #2
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only

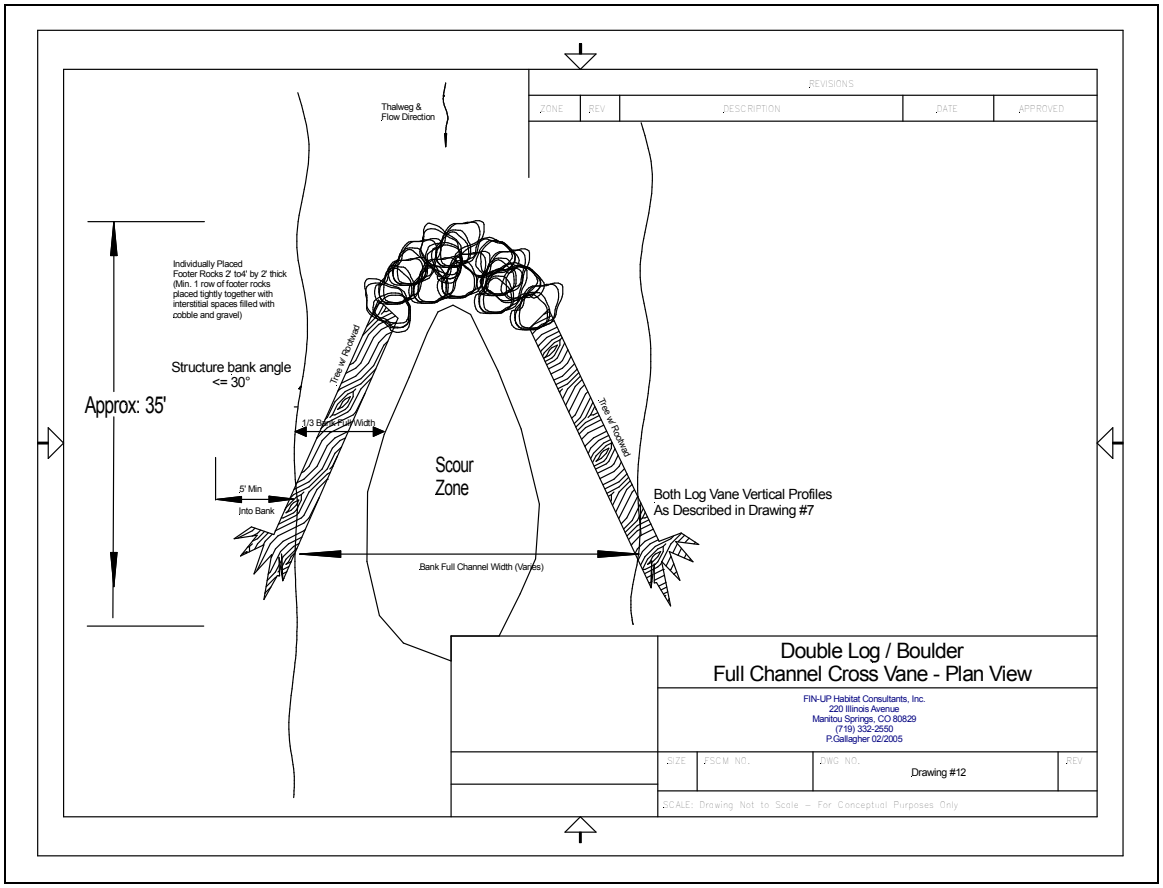

REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Structure Cross Vane Wings descend
from Bank Full Elevation where they tie into the stream bank
to <= 1/2 Max Bank Full Depth at the center of the structure.
Structure walls slope toward center of stream at between
5-10 degree slope.
Match Existing Grade
Bank Full Width
Match Existing Grade
Bank Full Water Surface Elevation
1/2 Max. Bank Full Depth
of the Channel
Cross-Vane Vertical Profile
Cross Section Elevations)
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 09/2005
SIZE
FSCM NO:
DWG NO:
Drawing #3
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only


REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Thalweg & Flow Direction
Scour Zone
4" - 6" Gaps may be set between boulders to enhance flow complexity and improve holding and feeding habitats for trout. (Optional - Depending on vertical channel stability)
Individually Placed Footer Rocks 2' to 4' by 2' thick (Min. 1 row of footer rocks placed tightly together with interstitial spaces filled with cobble and gravel)
Bank Full Channel Width (Varies)
Plan View
Profile View
1/2 Max. Bank Full Depth of the Channel
(Approx. 12"-18")
Bank Full Water Surface Elevation
4" to 6" Spacing between boulders to provides variation in velocity and habitat complexity. Footer rocks should be placed tightly together, with interstitial spaces back-filled with stream substrate
Micro Vortex In-Channel Habitat Structure
Plan and Profile View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 01/2008
SIZE
FSCM NO:
DWG NO:
Drawing #8
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only


REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Thalweg & Flow Direction
Scour Zone
Individually Placed Footer Rocks 2' to4' by 2' thick (Min. 1 row of footer rocks placed tightly together with interstitial spaces filled with cobble and gravel)
4" - 6" Gaps may be set between boulders at the "J" end of the J-Hook to enhance flow complexity and improve holding and feeding habitats for trout. (Optional - Depending on vertical channel stability)
Approx: 35'
Structure bank angle <= 30°
Tree w/ Rootwad
1/3 to 1/2 Bank Full Width
5' Min
Into Bank
Bank Full Channel Width (Varies)
Combination Large Tree / Rock
J-Hook Vane - Plan View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 02/2005
SIZE
FSCM NO:
DWG NO:
Drawing #9
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only


REVISIONS
ZONE
REV.
DESCRIPTION
DATE
APPROVED
Match Existing Grade
Top elevation of large tree descends from Bank Full Elevation where it ties into the stream bank to <= 1/2 Max Bank Full Depth where the bole is notched and anchored by a large flat boulder at start of the "Hook". Structure walls slope toward center of stream at between 5-10 degree slope.
4" to 6" Spacing between boulders to provides variation in velocity and habitat complexity. Footer rocks should be placed tightly together, with interstitial spaces back-filled with stream substrate
Bank Full Water Surface Elevation
1/2 Max. Bank Full Depth of the Channel
(Approx. 12"-18")
Depending on the stability and condition of the adjacent bank and channel substrate, water may be allowed to scour underneath a portion of the length of the tree in order to provide enhanced complexity and cover for trout. Where stream banks and channel conditions are unstable or suspect, back-fill the upstream site of the tree w/ cobble and large gravel in order to seal the bottom of the tree. If no cobble or gravel substrate is available, line the upstream side of the tree with filter fabric, and backfill with existing substrate. (Optional)
Manta-Ray Deadman Anchors Driven 3' to 4' into stream substrate and set with excavator. Stainless Steel Cable wrapped around tree bole and secured with cable clamps (Optional)
Combination Large Tree / RockJ-Hook Vane Vertical Profile
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 02/2005
SIZE
FSCM NO.
DWG NO.
Drawing #7
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only


REVISIONS
ZONE
REV.
DESCRIPTION
DATE
APPROVED
Thalweg & Flow Direction
Approx: 35'
Individually Placed Footer Rocks 2' to 4' by 2' thick (Min. 1 row of footer rocks placed tightly together with interstitial spaces filled with cobble and gravel)
Scour Zone
4" - 6" Gaps may be set between boulders at the "J" end of the J-Hook to enhance flow complexity and improve holding and feeding habitats for trout. (Optional - Depending on vertical channel stability)
Structure bank angle <= 30°
1/3 to 1/2 Bank Full Width
Bank Full Channel Width (Varies)
5' Min Into Bank
Rock J-Hook Vane - Plan View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 02/2005
SIZE
FSCM NO.
DWG NO.
Drawing #8
REV
SCALE: Drawing Not to Scale – For Conceptual Purposes Only



Cross Vane Structure on Fountain Creek below 21st Street Bridge, El Paso County, CO.

Double Log /Boulder Cross Vane Structure - Eagle Rock Ranch, Tarryall River, Park County, CO

Installing Bank Full Bench & Log Toe Slope Structure - South Platte River, Camp Alexander, Park County, CO

Installing a Log Vane - Camp Alexander, Elevenmile Canyon.

Elevenmile Picnic Ground Channel Reconfiguration Project.

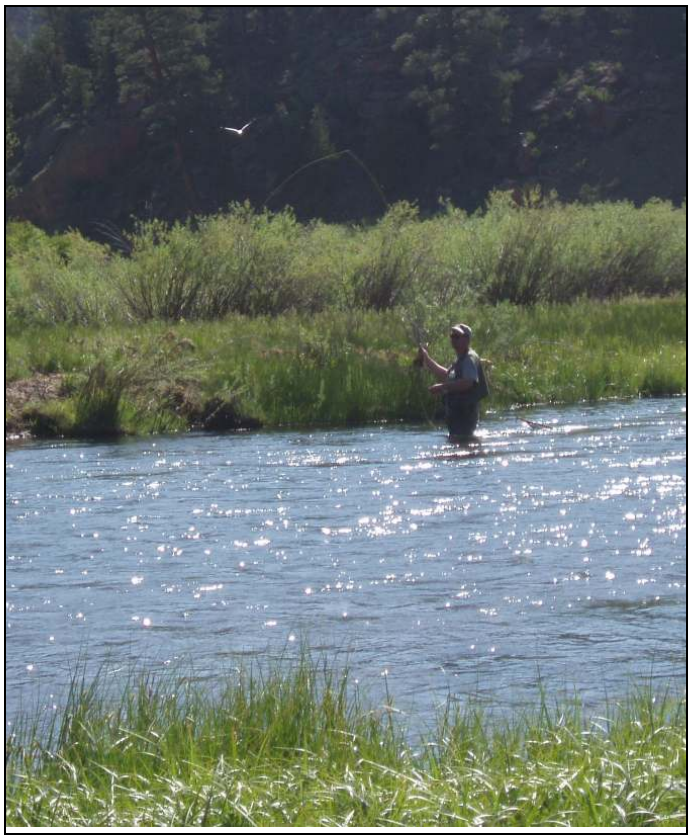
Removing the Mid-Channel Island - Elevenmile Picnic Ground Channel Reconfiguration Project - South Platte River.

Riparian Bench / Log Toe Slope Structures, one year after construction - Cucharas River, Huerfano County, CO.

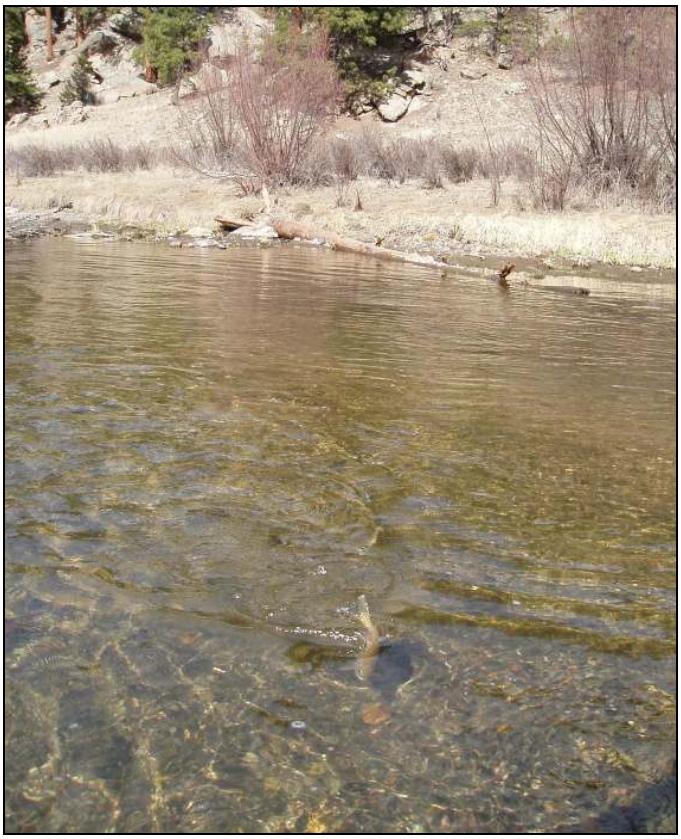
Double Log /Boulder Cross Vane with Restored Stream Bank Upstream - Beaver Creek Wildlife Area, CO.

Newly Constructed Step-Pool System in a Greenback Cutthroat Stream - S. Prong of Hayden Creek, Freemont County, CO.

Constructing a LUNKER Stream Bank and Riparian Bench Structure - Elevenmile Canyon Trees for Trout Centennial Project.

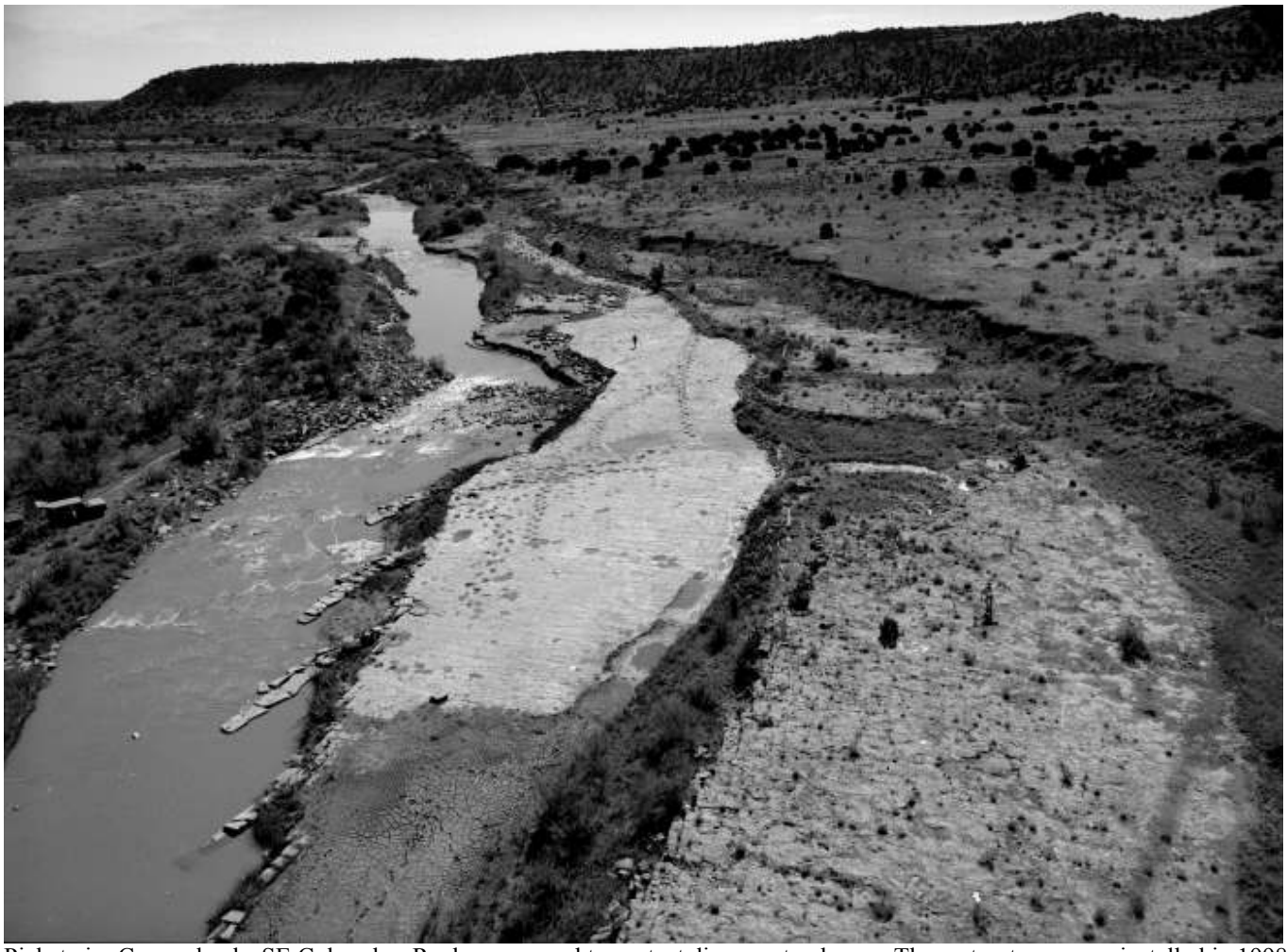


Fisherman & Restored Stream Bank - Camp Alexander



Coaxing a Rainbow from one of the many Trees for Trout.

Forest Service Biologist Stephanie Shively holds a 27" Brown Trout electrofished from a T4T structure in 11Mile Canyon.



Picketwire Canyonlands, SE Colorado - Rock vanes used to protect dinosaur trackway. These structures were installed in 1998, and survived a 100 year event the following spring. Note the deposition and new willow vegetation taking hold in between the structures.

Aerial of Dinosaur Tracks along Purgatoire River
Picket Wire Canyonlands, Comanche National Grassland, southeastern Colorado

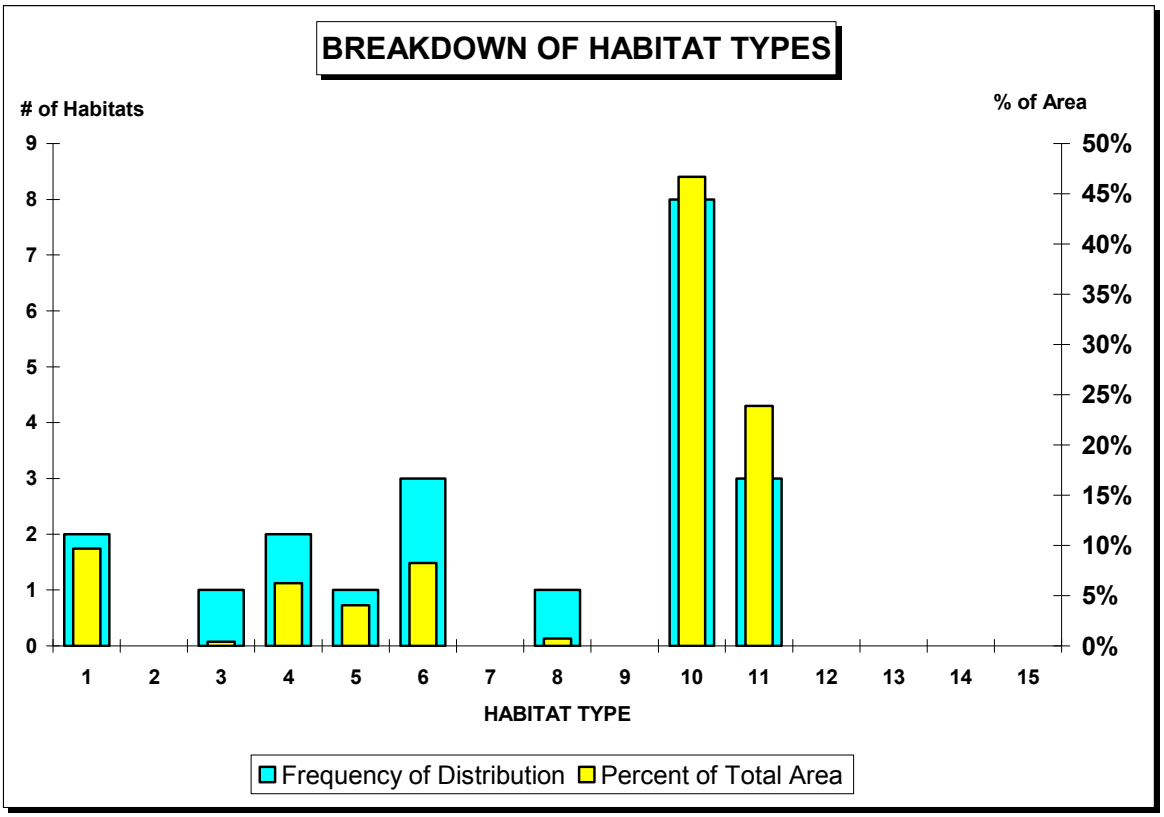
Stream inventory BWSHI data sheets and summaries

CUCHARA RIVER - REACH 1

JUY 28, 2008

	POOL	RIFFLE	GLIDE	REACH TOTAL		POOL	RIFFLE	GLIDE	REACH TOTAL
TOTAL LENGTH OF HABITAT (	159.00	524.00	75.00	758.00	TOTAL AREA OF HABITAT (sc	2558.30	9610.50	1306.00	13474.80
AVERAGE WIDTH OF HABITAT	15.17	18.50	17.50	17.06	% OF TOTAL NUM. OF HABIT/	33.33	57.14	9.52	100.00
AVERAGE RESIDUAL DEPTH (	0.71	0.00	0.00	0.71	HABITAT TYPE	18.99	71.32	9.69	100.00
					AS A % OF TOTAL AREA				
AVERAGE DEPTH (ft.)	1.14	0.00	0.00	1.14					
					% OF TOTAL COVERS 2 - 5	4.85	1.48	0.92	2.06
TOTAL COVER TYPE 2 (sq. ft.)	44.00	65.00	3.00	112.00	TO TOTAL HABITAT				
AVE. TYPE 2 COVER PER UNI	6.29	5.42	1.50	0.83					
					% OF CVR 2 TO TOTAL AREA	1.72	0.68	0.23	0.83
TOTAL COVER TYPE 3 (sq. ft.)	12.00	25.00	7.00	44.00	% OF CVR 3 TO TOTAL AREA	0.47	0.26	0.54	0.33
AVE. TYPE 3 COVER PER UNI	1.71	2.08	3.50	0.33					
TOTAL COVER TYPE 4 (sq. ft.)	34.00	52.00	2.00	88.00	% OF CVR 4 TO TOTAL AREA	1.33	0.54	0.15	0.65
AVE. TYPE 4 COVER PER UNI	4.86	4.33	1.00	0.65					
TOTAL COVER TYPE 5 (sq. ft.	34.00	0.00	0.00	34.00	% OF CVR 5 TO TOTAL AREA	1.33	0.00	0.00	0.25
AVE. TYPE 5 COVER PER UNI	4.86	0.00	0.00	0.25					
					% BANK ROCK CONTENT				
% BANK STABILITY TYPE 1					TYPE 2				
LEFT BANK	100.00	83.33	100.00	90.48	LEFT BANK	0.00	0.00	0.00	0.00
RIGHT BANK	85.71	100.00	100.00	95.24	RIGHT BANK	14.29	0.00	0.00	4.76
% BANK STABILITY TYPE 2					TYPE 3				
LEFT BANK	0.00	16.67	0.00	9.52	LEFT BANK	0.00	16.67	0.00	9.52
RIGHT BANK	14.29	0.00	0.00	4.76	RIGHT BANK	14.29	0.00	0.00	4.76
% BANK STABILITY TYPE 3					TYPE 4				
LEFT BANK	0.00	0.00	0.00	0.00	LEFT BANK	28.57	16.67	0.00	19.05
RIGHT BANK	0.00	0.00	0.00	0.00	RIGHT BANK	0.00	25.00	0.00	14.29
% BANK STABILITY TYPE 4					TYPE 5				
LEFT BANK	0.00	0.00	0.00	0.00	LEFT BANK	14.29	25.00	50.00	23.81
RIGHT BANK	0.00	0.00	0.00	0.00	RIGHT BANK	14.29	25.00	0.00	19.05
					TYPE 6				
					LEFT BANK	42.86	25.00	0.00	28.57
					RIGHT BANK	28.57	16.67	50.00	23.81
TOTAL OF ERODING BANKS (	15.00	165.00	0.00	180.00					
					TYPE 7				
					LEFT BANK	14.29	8.33	0.00	9.52
					RIGHT BANK	0.00	25.00	0.00	14.29
TOTAL LRG. ORGANIC DEBRIS	2.00	14.00	2.00	18	TYPE 8				
					LEFT BANK	0.00	8.33	50.00	9.52
					RIGHT BANK	28.57	8.33	50.00	19.05
AVERAGE OF SUBSTRATA TYPE FOR HABITAT ON THIS REACH									
PLANT DEBRIS	0.00	0.00	0.00	0.00	SAND\SILT	0.00	0.00	0.00	0.00
GRAVEL	0.00	0.00	0.00	0.00	RUBBLE	0.00	0.00	0.00	0.00
BOULDER	0.00	0.00	0.00	0.00	BEDROCK	0.00	0.00	0.00	0.00

HABITAT TYPE ANALYSIS									
				TOTAL					TOTAL
NUMBER OF TYPE 2 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 9 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 3 HABITAT	1.00	0.00	0.00	1.00	NUMBER OF TYPE 10 HABITAT	0.00	8.00	0	8.00
% OF HABITAT	2.35	0.00	0.00	4.76	% OF HABITAT	0.00	65.46	0	38.10
NUMBER OF TYPE 4 HABITAT	2.00	0.00	0.00	2.00	NUMBER OF TYPE 11 HABITAT	0.00	3.00	0	3.00
% OF HABITAT	32.83	0.00	0.00	9.52	% OF HABITAT	0.00	33.51	0	14.29
NUMBER OF TYPE 5 HABITAT	1.00	0.00	0.00	1.00	NUMBER OF TYPE 12 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	21.34	0.00	0.00	4.76	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 6 HABITAT	3.00	0.00	0.00	3.00	NUMBER OF TYPE 13 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	43.49	0.00	0.00	14.29	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 7 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 14 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 8 HABITAT	0.00	1.00	0.00	1.00	NUMBER OF TYPE 15 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	1.03	0.00	4.76	% OF HABITAT	0.00	0.00	0	0.00
TOTAL NUMBER OF HABITAT	7.00	12.00	2.00	21.00	NUMBER OF GLIDES	0.00	0.00	2	2.00
TOTAL % OF HABITAT	100.00	100.00	100.00	100.00		0.00	0.00	100.00	9.52



CUCHARA RIVER REACH 1 page 1	POOLS						RIFFLES								GLIDES
	TYPE 2	TYPE 3	TYPE4	TYPE5	TYPE 6	TYPE 7	TYPE 8	TYPE 9	TYPE 10	TYPE 11	TYPE 12	TYPE 13	TYPE 14	TYPE 15	TYPE 1
TOTAL LENGTH OF HABITAT TYPES	0.00	10.00	51.00	26.00	72.00	0.00	33.00	0.00	335.00	156.00	0.00	0.00	0.00	0.00	75.00
AVERAGE WIDTH OF HABITAT (ft.)	0.00	6.00	16.35	21.00	15.50	0.00	3.00	0.00	18.63	23.33	0.00	0.00	0.00	0.00	17.50
AVERAGE DEPTH (ft.)	0.00	0.80	1.21	0.90	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDUAL DEPTH (ft.)	0.00	0.30	0.65	0.60	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL AREA OF HABITAT (sq. ft.)	0.00	60.00	839.80	546.00	1112.50	0.00	99.00	0.00	6291.50	3220.00	0.00	0.00	0.00	0.00	1306.00
% OF TTL # OF HABITATS	0.00	0.05	0.10	0.05	0.14	0.00	0.05	0.00	0.38	0.14	0.00	0.00	0.00	0.00	0.10
HAB. TYPE AS A PERCENTAGE OF TOTAL AREA OF REACH	0.00	0.00	0.06	0.04	0.08	0.00	0.01	0.00	0.47	0.24	0.00	0.00	0.00	0.00	0.10
COVER															
TOTAL COVER TYPE 2 (sq.ft.)	0.00	6.00	12.00	10.00	16.00	0.00	0.00	0.00	63.00	2.00	0.00	0.00	0.00	0.00	3.00
AVE. COVER 2 per UNIT	0.00	6.00	6.00	10.00	5.33	0.00	0.00	0.00	15.75	2.00	0.00	0.00	0.00	0.00	3.00
% OF COVER 2 TO TTL AREA	0.00	10.00	1.43	1.83	1.44	0.00	0.00	0.00	1.00	0.06	0.00	0.00	0.00	0.00	0.23
TOTAL COVER TYPE 3 (sq.ft.)	0.00	0.00	3.00	4.00	5.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	7.00
AVE. COVER 3 per UNIT	0.00	0.00	1.50	4.00	5.00	0.00	0.00	0.00	4.17	0.00	0.00	0.00	0.00	0.00	7.00
% OF COVER 3 TO TTL AREA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL COVER TYPE 4 (sq.ft.)	0.00	10.00	4.00	0.00	20.00	0.00	0.00	0.00	52.00	0.00	0.00	0.00	0.00	0.00	2.00
AVE. COVER 4 per UNIT	0.00	10.00	4.00	0.00	6.67	0.00	0.00	0.00	10.40	0.00	0.00	0.00	0.00	0.00	2.00
% OF COVER 4 TO TTL AREA	0.00	16.67	0.48	0.00	1.80	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.15
TOTAL COVER TYPE 5 (sq.ft.)	0.00	6.00	6.00	2.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVE. COVER 5 per UNIT	0.00	6.00	3.00	2.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% OF COVER 5 TO TTL AREA	0.00	10.00	0.71	0.37	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBSTRATA															
PLANT DEBRIS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAND \ SILT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GRAVEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUBBLE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOULDERS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEDROCK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CUCHARA RIVER REACH 1 page 2	POOLS						RIFFLES								GLIDES
	TYPE 2	TYPE 3	TYPE4	TYPE5	TYPE 6	TYPE 7	TYPE 8	TYPE 9	TYPE 10	TYPE 11	TYPE 12	TYPE 13	TYPE 14	TYPE 15	TYPE 1
BANK STABILITY															
% OF BANK STABILITY TYPE 1															
LEFT BANK	0.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	87.50	66.67	0.00	0.00	0.00	0.00	100.00
RIGHT BANK	0.00	0.00	100.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	100.00
% OF BANK STABILITY TYPE 2															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	33.33	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% OF BANK STABILITY TYPE 3															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% OF BANK STABILITY TYPE 4															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BANK ROCK CONTENT															
TYPE 2															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TYPE 3															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	33.33	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TYPE 4															
LEFT BANK	0.00	0.00	50.00	0.00	33.33	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.50	0.00	0.00	0.00	0.00	0.00	0.00
TYPE5															
LEFT BANK	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	37.50	0.00	0.00	0.00	0.00	0.00	50.00
RIGHT BANK	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	25.00	33.33	0.00	0.00	0.00	0.00	0.00
TYPE 6															
LEFT BANK	0.00	100.00	0.00	100.00	33.33	0.00	0.00	0.00	25.00	33.33	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	100.00	33.33	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	50.00
TYPE7															
LEFT BANK	0.00	0.00	0.00	0.00	33.33	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	12.50	33.33	0.00	0.00	0.00	0.00	0.00
TYPE 8															
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00	0.00	50.00
LEFT BANK	0.00	100.00	0.00	0.00	33.33	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00	0.00	50.00
OTHER															
TOTAL OF ERODING BANKS (ft.)	0.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	100.00	0.00	0.00	0.00	0.00	0.00
TOTAL LRG. ORG. DEBRIS	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	10.00	4.00	0.00	0.00	0.00	0.00	2.00

Z-Walk		Class		Dot & Dash Count	Total	% of	Cumulative
Metric - mm	Inches	Name		: . = 3, ▭ : = 9	Number	Total	%
less .066		Silt/Clay				0.0%	0.0%
.062-.125		Very Fine	SAND		4	2.3%	2.3%
.125-.25		Fine	SAND		8	4.5%	6.8%
.25-.50		Medium	SAND		7	4.0%	10.7%
.50-1.0		Coarse	SAND		4	2.3%	13.0%
1.0-2.0		Very Coarse	SAND		2	1.1%	14.1%
2.0-4.0		Very Fine	GRAVEL		2	1.1%	15.3%
4.0-8.0		Fine	GRAVEL		4	2.3%	17.5%
8.0-16	.08-.6	Medium	GRAVEL		5	2.8%	20.3%
16-32	.6-1.3	Coarse	GRAVEL		10	5.6%	26.0%
32-64	1.3-2.5	Very Coarse	GRAVEL		24	13.6%	39.5%
64-128	2.5-5.0	Small	COBBLE		46	26.0%	65.5%
128-256	5-10	Large	COBBLE		36	20.3%	85.9%
256-512	10-20	Small	BOULDERS		17	9.6%	95.5%
512-1024	20-40	Medium	BOULDERS		8	4.5%	100.0%
1024-2048	40-80	Large	BOULDERS			0.0%	100.0%
2048-4096	80-160	Very Large	BOULDERS			0.0%	100.0%
					177		

Left/Right	Station	Willow Size
	0 + 0 ft	
	0 + 50 ft	
	0 + 100 ft	
	0 + 150 ft	
	0 + 200 ft	
	0 + 250 ft	
	0 + 300 ft	
	0 + 350 ft	
	0 + 400 ft	
	0 + 450 ft	
	0 + 500 ft	
	0 + 550 ft	
	0 + 600 ft	
	0 + 650 ft	
	0 + 700 ft	
	0 + 750 ft	
	0 + 800 ft	
	0 + 850 ft	
	0 + 900 ft	
	0 + 950 ft	
	0 + 1,000 ft	

Bankside Willow Growth & Regeneration

(Largest Willow within a 1 square meter area along side stream is measured every 50 feet, switching between right and left banks. If no willow within 1 square meter of bank at station interval, mearsurement is entered as Zero)

Other Comments:

Discharge

Stream Name: CUCHARA RIVER Reach #: 1

Date: JULY 28, 2008 Personnel: GALLAGHER

Discription: Calibration: 1.07

CUCHARA RIVER RANCH

Station	Width	Depth	Area	Velocity	Q	Sum(Q)
14.5	0.5	0	0	0	0	0
15.5	0.75	0.2	0.15	0	0	0
16	0.75	0.3	0.225	0.21	0.04725	0.04725
17	1	0.45	0.45	0.58	0.261	0.30825
18	1	0.65	0.65	0.84	0.546	0.85425
19	1	0.75	0.75	1.69	1.2675	2.12175
20	1	0.9	0.9	1.67	1.503	3.62475
21	1	1	1	2.16	2.16	5.78475
22	1	0.8	0.8	2.18	1.744	7.52875
23	1	1.1	1.1	1.69	1.859	9.38775
24	1	1.3	1.3	2.04	2.652	12.03975
25	1	1.1	1.1	2.08	2.288	14.32775
26	1	1	1	1.99	1.99	16.31775
27	1	0.85	0.85	2.37	2.0145	18.33225
28	1	0.9	0.9	1.28	1.152	19.48425
29	1	0.9	0.9	0.3	0.27	19.75425
30	1.35	0.5	0.675	0	0	19.75425
31.7	0.85	0	0	0	0	19.75425

Width = 17.2 Ft. Discharge = 19.75425 CFS

Mean Depth = 0.79 Ft. Total Area = 12.75 Sq. Ft.

Averge Velocity = 1.41 ft/sec.

STREAMNAME	CUCHARA RIVER	CHANNEL TYPE	B
REACH NO.	1	MIN. TEMP.	
DATE	JUY 28, 2008	MAX. TEMP	
PERSONNEL	P. GALLAGHER	DISTRICT	CUCHARA VALLEY RANCH
DESCRIPTION	START: PVT PROPERTY BOUNDARY FENCE		
	STOP: CONFLUENCE WITH WHITE CREEK		

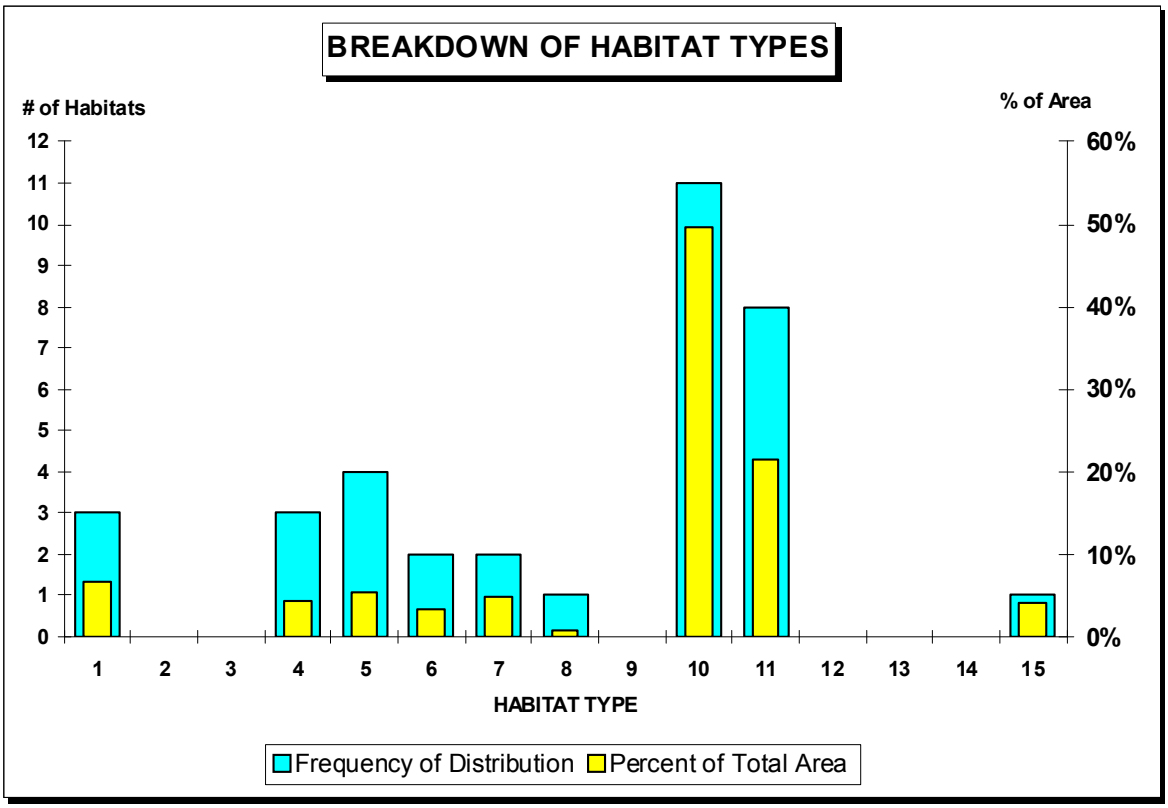
	HABITAT UNIT TYPE				RESIDUAL	AVE.	MAX.	COVER TYPES				BANK STABILITY		BANK ROCK CONTENT		ERODING BANKS		
NO.	TYPE	SA	LENGTH (FT.)	WIDTH (FT.)	DEPTH (FT.)	DEPTH (FT.)	DEPTH (FT.)	2	3	4	5	LEFT	RIGHT	LEFT	RIGHT	(FT.)	LOD	COMMENTS
R1	10	P	60.00	20.00				31	6	6		1	1	5	4		1	
P1	6	R	22.00	16.00	1.00	1.15	2.10	3	5	8	6	1	1	7	6			
R2	10	O	14.00	20.00					3			1	1	6	6			
P2	4	R	34.00	16.70	1.00	1.26	2.20	7	2	4	3	1	1	5	5		1	REMOVE SOME EXISTING ARMOR
R3	10	P	19.00	16.50								1	1	5	5			
P3	6	M	29.00	15.00	1.10	1.63	2.30	10		8	11	1	1	6	8			
P4	3	M	10.00	6.00	0.30	0.80	1.50	6		10	6	1	2	6	8	15.00		BAD BACKWATER HYDRAULIC - FIX WITH LOG TOE SLOPE
R4	11	O	117.00	19.00								2	1	8	5	100.00		TOE SLOPE ALONG LEFT BANK - CREATE P-WATER
R5	8	O	33.00	3.00								1	1	7	7			
R6	10	P	25.00	20.00				5	4	10		2	1	6	6	25.00		BLOWN STR @ 315' / REMOVE AND USE BLDR FOR P5
R7	11	O	17.00	25.00				2				1	1	6	8		2	OVER-WIDE / NARROW WITH WOOD
P5	5	S	26.00	21.00	0.60	0.90	1.60	10	4		2	1	1	6	6			BLOWN OUT - REBUILD X-VANE 10' UPSTREAM
G1	1	S	31.00	18.00					7	2		1	1	5	6		1	
R8	10	P	82.00	20.00				14	3	8		1	1	5	5		2	NICE P-WATER
P6	4	B	17.00	16.00	0.30	1.15	1.50	5	1		3	1	1	4	2		1	LITTLE V-SHELTER
R9	10	P	14.00	15.50					1			1	1	4	4		1	
P7	6	R	21.00	15.50	0.70	1.06	1.80	3		4	3	1	1	4	3			
R10	10	P	28.00	20.00						20		1	1	4	4		3	BLOWN STR @ 547' - ON BEND - DO NOT REBUILD - ADJUST BLDRS
R11	11	O	22.00	26.00								1	1	3	7		2	BUILD X-VANE 30' U/S BOTTOM
R12	10	P	93.00	17.00				13	8	8		1	1	3	7	40.00	3	TOE SLOPE AT TOP LEFT BANK - BLOWN STR AT TOP
G2	1	S	44.00	17.00				3				1	1	8	8		1	END OF REACH @ WHITE CREEK

CUCHARA RIVER - REACH 2

JULY 28,2008

	POOL	RIFFLE	GLIDE	REACH TOTAL		POOL	RIFFLE	GLIDE	REACH TOTAL
TOTAL LENGTH OF HABITAT (	275.00	1186.00	87.00	1548.00	TOTAL AREA OF HABITAT (sc	5201.00	22286.00	1926.00	29413.00
AVERAGE WIDTH OF HABITAT	18.91	18.24	22.00	19.72	% OF TOTAL NUM. OF HABIT/	31.43	60.00	8.57	100.00
AVERAGE RESIDUAL DEPTH	0.82	0.00	0.00	0.82	HABITAT TYPE	17.68	75.77	6.55	100.00
					AS A % OF TOTAL AREA				
AVERAGE DEPTH (ft)	1.28	0.00	0.00	1.28					
					% OF TOTAL COVERS 2 - 5	15.27	0.86	0.31	3.37
TOTAL COVER TYPE 2 (sq. ft.)	455.00	96.00	6.00	557.00	TO TOTAL HABITAT				
AVE. TYPE 2 COVER PER UN	41.36	4.57	2.00	1.89					
					% OF CVR 2 TO TOTAL AREA	8.75	0.43	0.31	1.89
TOTAL COVER TYPE 3 (sq. ft.)	7.00	41.00	0.00	48.00	% OF CVR 3 TO TOTAL AREA	0.13	0.18	0.00	0.16
AVE. TYPE 3 COVER PER UN	0.64	1.95	0.00	0.16					
TOTAL COVER TYPE 4 (sq. ft.)	67.00	55.00	0.00	122.00	% OF CVR 4 TO TOTAL AREA	1.29	0.25	0.00	0.41
AVE. TYPE 4 COVER PER UN	6.09	2.62	0.00	0.41					
TOTAL COVER TYPE 5 (sq. ft.	265.00	0.00	0.00	265.00	% OF CVR 5 TO TOTAL AREA	5.10	0.00	0.00	0.90
AVE. TYPE 5 COVER PER UN	24.09	0.00	0.00	0.90					
					% BANK ROCK CONTENT				
% BANK STABILITY TYPE 1					TYPE 2				
LEFT BANK	90.91	80.95	100.00	85.71	LEFT BANK	9.09	4.76	0.00	5.71
RIGHT BANK	100.00	90.48	100.00	94.29	RIGHT BANK	9.09	9.52	0.00	8.57
% BANK STABILITY TYPE 2					TYPE 3				
LEFT BANK	9.09	14.29	0.00	11.43	LEFT BANK	9.09	9.52	33.33	11.43
RIGHT BANK	0.00	4.76	0.00	2.86	RIGHT BANK	9.09	9.52	0.00	8.57
% BANK STABILITY TYPE 3					TYPE 4				
LEFT BANK	0.00	4.76	0.00	2.86	LEFT BANK	9.09	33.33	0.00	22.86
RIGHT BANK	0.00	4.76	0.00	2.86	RIGHT BANK	18.18	23.81	0.00	20.00
% BANK STABILITY TYPE 4					TYPE 5				
LEFT BANK	0.00	0.00	0.00	0.00	LEFT BANK	45.45	33.33	33.33	37.14
RIGHT BANK	0.00	0.00	0.00	0.00	RIGHT BANK	36.36	14.29	33.33	22.86
					TYPE 6				
					LEFT BANK	18.18	9.52	0.00	11.43
					RIGHT BANK	9.09	19.05	33.33	17.14
TOTAL OF ERODING BANKS (	35.00	117.00	0.00	152.00					
					TYPE 7				
					LEFT BANK	0.00	0.00	33.33	2.86
					RIGHT BANK	0.00	14.29	33.33	11.43
TOTAL LRG. ORGANIC DEBRIS	12.00	24.00	0.00	36	TYPE 8				
					LEFT BANK	9.09	9.52	0.00	8.57
					RIGHT BANK	18.18	9.52	0.00	11.43
AVERAGE OF SUBSTRATA TYPE FOR HABITAT ON THIS REACH									
PLANT DEBRIS	0.00	0.00	0.00	0.00	SAND\SILT	0.00	0.00	0.00	0.00
GRAVEL	0.00	0.00	0.00	0.00	RUBBLE	0.00	0.00	0.00	0.00
BOULDER	0.00	0.00	0.00	0.00	BEDROCK	0.00	0.00	0.00	0.00

HABITAT TYPE ANALYSIS									
				TOTAL					TOTAL
NUMBER OF TYPE 2 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 9 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 3 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 10 HABITAT	0.00	11.00	0	11.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	65.56	0	31.43
NUMBER OF TYPE 4 HABITAT	3.00	0.00	0.00	3.00	NUMBER OF TYPE 11 HABITAT	0.00	8.00	0	8.00
% OF HABITAT	23.88	0.00	0.00	8.57	% OF HABITAT	0.00	28.30	0	22.86
NUMBER OF TYPE 5 HABITAT	4.00	0.00	0.00	4.00	NUMBER OF TYPE 12 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	29.99	0.00	0.00	11.43	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 6 HABITAT	2.00	0.00	0.00	2.00	NUMBER OF TYPE 13 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	18.82	0.00	0.00	5.71	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 7 HABITAT	2.00	0.00	0.00	2.00	NUMBER OF TYPE 14 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	27.30	0.00	0.00	5.71	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 8 HABITAT	0.00	1.00	0.00	1.00	NUMBER OF TYPE 15 HABITAT	0.00	1.00	0	1.00
% OF HABITAT	0.00	0.81	0.00	2.86	% OF HABITAT	0.00	5.33	0	2.86
TOTAL NUMBER OF HABITAT	11.00	21.00	3.00	35.00	NUMBER OF GLIDES	0.00	0.00	3	3.00
TOTAL % OF HABITAT	100.00	100.00	100.00	100.00		0.00	0.00	100.00	8.57



CUCHARA RIVER REACH 2 page 1	POOLS						RIFFLES								GLIDES
	TYPE 2	TYPE 3	TYPE4	TYPE5	TYPE 6	TYPE 7	TYPE 8	TYPE 9	TYPE 10	TYPE 11	TYPE 12	TYPE 13	TYPE 14	TYPE 15	TYPE 1
TOTAL LENGTH OF HABITAT TYPES	0.00	0.00	75.00	79.00	51.00	70.00	36.00	0.00	763.00	321.00	0.00	0.00	0.00	66.00	87.00
AVERAGE WIDTH OF HABITAT (ft.)	0.00	0.00	16.17	19.63	20.50	20.00	5.00	0.00	18.55	19.50	0.00	0.00	0.00	18.00	22.00
AVERAGE DEPTH (ft.)	0.00	0.00	1.29	1.23	1.02	1.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDUAL DEPTH (ft.)	0.00	0.00	1.07	1.05	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL AREA OF HABITAT (sq. ft.)	0.00	0.00	1242.00	1560.00	979.00	1420.00	180.00	0.00	14611.50	6306.50	0.00	0.00	0.00	1188.00	1926.00
% OF TTL # OF HABITATS	0.00	0.00	0.09	0.11	0.06	0.06	0.03	0.00	0.31	0.23	0.00	0.00	0.00	0.03	0.09
HAB. TYPE AS A PERCENTAGE OF TOTAL AREA OF REACH	0.00	0.00	0.04	0.05	0.03	0.05	0.01	0.00	0.50	0.21	0.00	0.00	0.00	0.04	0.07
COVER															
TOTAL COVER TYPE 2 (sq.ft.)	0.00	0.00	33.00	41.00	11.00	370.00	0.00	0.00	78.00	18.00	0.00	0.00	0.00	0.00	6.00
AVE. COVER 2 per UNIT	0.00	0.00	11.00	13.67	5.50	185.00	0.00	0.00	8.67	6.00	0.00	0.00	0.00	0.00	6.00
% OF COVER 2 TO TTL AREA	0.00	0.00	2.66	2.63	1.12	26.06	0.00	0.00	0.53	0.29	0.00	0.00	0.00	0.00	0.31
TOTAL COVER TYPE 3 (sq.ft.)	0.00	0.00	3.00	0.00	4.00	0.00	0.00	0.00	31.00	10.00	0.00	0.00	0.00	0.00	0.00
AVE. COVER 3 per UNIT	0.00	0.00	1.50	0.00	2.00	0.00	0.00	0.00	5.17	3.33	0.00	0.00	0.00	0.00	0.00
% OF COVER 3 TO TTL AREA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL COVER TYPE 4 (sq.ft.)	0.00	0.00	15.00	27.00	5.00	20.00	0.00	0.00	30.00	7.00	0.00	0.00	0.00	18.00	0.00
AVE. COVER 4 per UNIT	0.00	0.00	5.00	6.75	5.00	20.00	0.00	0.00	5.00	3.50	0.00	0.00	0.00	18.00	0.00
% OF COVER 4 TO TTL AREA	0.00	0.00	1.21	1.73	0.51	1.41	0.00	0.00	0.21	0.11	0.00	0.00	0.00	1.52	0.00
TOTAL COVER TYPE 5 (sq.ft.)	0.00	0.00	23.00	35.00	2.00	205.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVE. COVER 5 per UNIT	0.00	0.00	7.67	8.75	2.00	102.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% OF COVER 5 TO TTL AREA	0.00	0.00	1.85	2.24	0.20	14.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBSTRATA															
PLANT DEBRIS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAND \ SILT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GRAVEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUBBLE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOULDERS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEDROCK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CUCHARA RIVER REACH 2 page 2	POOLS						RIFFLES								GLIDES
	TYPE 2	TYPE 3	TYPE4	TYPE5	TYPE 6	TYPE 7	TYPE 8	TYPE 9	TYPE 10	TYPE 11	TYPE 12	TYPE 13	TYPE 14	TYPE 15	TYPE 1
BANK STABILITY															
% OF BANK STABILITY TYPE 1															
LEFT BANK	0.00	0.00	100.00	100.00	50.00	100.00	100.00	0.00	81.82	75.00	0.00	0.00	0.00	100.00	100.00
RIGHT BANK	0.00	0.00	100.00	100.00	100.00	100.00	100.00	0.00	90.91	87.50	0.00	0.00	0.00	100.00	100.00
% OF BANK STABILITY TYPE 2															
LEFT BANK	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	9.09	25.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	0.00	0.00	0.00	0.00	0.00
% OF BANK STABILITY TYPE 3															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00	0.00	0.00	0.00	0.00
% OF BANK STABILITY TYPE 4															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BANK ROCK CONTENT															
TYPE 2															
LEFT BANK	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00	0.00	0.00	100.00	0.00
TYPE 3															
LEFT BANK	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	9.09	12.50	0.00	0.00	0.00	0.00	33.33
RIGHT BANK	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	18.18	0.00	0.00	0.00	0.00	0.00	0.00
TYPE 4															
LEFT BANK	0.00	0.00	0.00	25.00	0.00	0.00	100.00	0.00	45.45	12.50	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	66.67	0.00	0.00	0.00	100.00	0.00	36.36	0.00	0.00	0.00	0.00	0.00	0.00
TYPE5															
LEFT BANK	0.00	0.00	33.33	50.00	50.00	50.00	0.00	0.00	18.18	50.00	0.00	0.00	0.00	100.00	33.33
RIGHT BANK	0.00	0.00	0.00	50.00	50.00	50.00	0.00	0.00	9.09	25.00	0.00	0.00	0.00	0.00	33.33
TYPE 6															
LEFT BANK	0.00	0.00	0.00	0.00	50.00	50.00	0.00	0.00	9.09	12.50	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	33.33
TYPE7															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.18	12.50	0.00	0.00	0.00	0.00	33.33
TYPE 8															
RIGHT BANK	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	9.09	12.50	0.00	0.00	0.00	0.00	0.00
LEFT BANK	0.00	0.00	0.00	0.00	50.00	50.00	0.00	0.00	9.09	12.50	0.00	0.00	0.00	0.00	0.00
OTHER															
TOTAL OF ERODING BANKS (ft.)	0.00	0.00	0.00	0.00	35.00	0.00	0.00	0.00	45.00	72.00	0.00	0.00	0.00	0.00	0.00
TOTAL LRG. ORG. DEBRIS	0.00	0.00	1.00	4.00	4.00	3.00	0.00	0.00	6.00	6.00	0.00	0.00	0.00	12.00	0.00

Wolman Count		Class		Dot & Dash Count	Total	% of	Cumulative
Metric - mm	Inches	Name		: . = 3, ▭ : = 9	Number	Total	%
less .066		Silt/Clay				0.0%	0.0%
.062-.125		Very Fine	SAND	Wolman Pebble Count		0.0%	0.0%
.125-.25		Fine	SAND	Performed in Riffle 6	3	3.0%	3.0%
.25-.50		Medium	SAND	Type 10 Pocketwater Riffle	3	3.0%	5.9%
.50-1.0		Coarse	SAND	(Most Common Type)	2	2.0%	7.9%
1.0-2.0		Very Coarse	SAND		2	2.0%	9.9%
2.0-4.0		Very Fine	GRAVEL		3	3.0%	12.9%
4.0-8.0		Fine	GRAVEL		1	1.0%	13.9%
8.0-16	.08-.6	Medium	GRAVEL		2	2.0%	15.8%
16-32	.6-1.3	Coarse	GRAVEL		6	5.9%	21.8%
32-64	1.3-2.5	Very Coarse	GRAVEL		13	12.9%	34.7%
64-128	2.5-5.0	Small	COBBLE		24	23.8%	58.4%
128-256	5-10	Large	COBBLE		18	17.8%	76.2%
256-512	10-20	Small	BOULDERS		21	20.8%	97.0%
512-1024	20-40	Medium	BOULDERS			0.0%	97.0%
1024-2048	40-80	Large	BOULDERS		3	3.0%	100.0%
2048-4096	80-160	Very Large	BOULDERS			0.0%	100.0%
					101		

Left/Right	Station	Willow Size
	0 + 0 ft	
	0 + 50 ft	
	0 + 100 ft	
	0 + 150 ft	
	0 + 200 ft	
	0 + 250 ft	
	0 + 300 ft	
	0 + 350 ft	
	0 + 400 ft	
	0 + 450 ft	
	0 + 500 ft	
	0 + 550 ft	
	0 + 600 ft	
	0 + 650 ft	
	0 + 700 ft	
	0 + 750 ft	
	0 + 800 ft	
	0 + 850 ft	
	0 + 900 ft	
	0 + 950 ft	
	0 + 1,000 ft	

Bankside Willow Growth & Regeneration

(Largest Willow within a 1 square meter area along side stream is measured every 50 feet, switching between right and left banks. If no willow within 1 square meter of bank at station interval, mearsurement is entered as Zero)

Other Comments:

Discharge

Stream Name: Cuchara River Reach #: 2

Date: July 28, 2008 Personnel: P. Gallagher

Discription: Calibration: 1.07

Cuchara Valley Ranch - Discharge taken at Glide 3

Station	Width	Depth	Area	Velocity	Q	Sum(Q)
7.4	0.8	0	0	0	0	0
9	1.3	0.5	0.65	0.77	0.5005	0.5005
10	1	0.4	0.4	0.9	0.36	0.8605
11	1	0.5	0.5	0.98	0.49	1.3505
12	1	0.4	0.4	1.6	0.64	1.9905
13	1	0.5	0.5	1.61	0.805	2.7955
14	1	0.6	0.6	1.75	1.05	3.8455
15	1	0.6	0.6	0.25	0.15	3.9955
16	1	0.7	0.7	1.96	1.372	5.3675
17	1	0.75	0.75	1.79	1.3425	6.71
18	1	0.95	0.95	1.26	1.197	7.907
19	1	1	1	1.31	1.31	9.217
20	1	0.9	0.9	1.52	1.368	10.585
21	1	0.9	0.9	1.83	1.647	12.232
22	1	1	1	1.54	1.54	13.772
23	1	1	1	2.45	2.45	16.222
24	1	0.5	0.5	1.46	0.73	16.952
25	1	0.5	0.5	0.53	0.265	17.217
26	0.75	0.1	0.075	0.08	0.006	17.223
26.5	0.25	0	0	0	0	17.223

Width = 19.1 Ft. Discharge = 17.223 CFS

Mean Depth = 0.66 Ft. Total Area = 11.925 Sq. Ft.

Averge Velocity = 1.31 ft/sec.

STREAMNAME	CUCHARA RIVER										CHANNEL TYPE	B						
REACH NO.	2										MIN. TEMP.							
DATE	JULY 28,2008										MAX. TEMP							
PERSONNEL	P. GALLAGHER										DISTRICT	CUCHARA VALLEY RANCH						
DESCRIPTION	BEGIN @ THE CONFLUENCE OF CUCHARA AND WHITE CREEKS																	
	END @ PRIVATE PROPERTY FENCELINE																	
	HABITAT UNIT TYPE		LENGTH	WIDTH	RESIDUAL DEPTH	AVE. DEPTH	MAX. DEPTH	COVER TYPES				BANK STABILITY		BANK ROCK CONTENT		ERODING BANKS		
NO.	TYPE	SA	(FT.)	(FT.)	(FT.)	(FT.)	(FT.)	2	3	4	5	LEFT	RIGHT	LEFT	RIGHT	(FT.)	LOD	COMMENTS
R1	10	O	14.00	13.50					1	2		1	1	5	3		1	
P1	4	B	24.00	14.00	0.70	1.14	1.80	4	1	3	3	1	1	5	4			
R2	10	P	25.00	15.00				2	3			1	1	8	8			
R3	11	O	27.00	15.50					3			1	1	6	6			
R4	10	P	65.00	20.00				3	6			2	1	4	4	45.00		FAILED STR @145', TOE SLOPE WORK LEFT
R5	11	O	56.00	18.50								2	1	5	7	57.00		FENCE AT 186'
P2	6	R	35.00	17.00	0.60	0.91	1.40	6	2	5		2	1	5	8	35.00	1	POOR POOL
R6	11	P	61.00	20.00					3			1	1	5	8		1	CONSTRUCT ADDITIONAL POCKET WATER
P3	5	S	18.00	19.00	1.10	1.38	2.30	10		8	15	1	1	5	5		1	RECONFIGURE BOULDERS AND DREDGE
P4	5	S	25.00	21.00	1.20	1.26	2.40	25		12	4	1	1	8	5		2	BLOWN OUT - RECONFIGURE BOULDERS AND DREDGE
G1	1		31.00	26.00				6				1	1	5	5			BELOW BRIDGE - OVER WIDE - NARROW WITH BF BENCHES ON BOTH SIDES
R7	10	P	30.00	18.00						2		3	3	2	2			UNDER BRIDGE
P5	5	SA	18.00	20.50	0.80	1.03	2.00	6		2	6	1	1	4	3			RECONFIGURE TO PROTECT BRIDGE ABUTMENTS
R8	11	O	50.00	23.00						3		2	1	3	6	15.00		LUNKER STR ON LEFT
G2	1		24.00	20.00								1	1	3	6			
R9	10	P	43.00	28.00				17		4		1	1	5	7		1	STR AT TOP IS REVERSED - SEE RESTORATION NOTES
P6	7	S	40.00	22.00		1.47	2.00	350			150	1	1	6	8		1	BEST POOL IN THE REACH
G3	1		32.00	20.00								1	1	7	7			
R10	10	P	59.00	23.00				5				1	1	6	7		1	
R11	11	O	41.00	16.00								1	1	5	5		1	CONFLUENCE W/ POND OUTLET CHANNEL
R12	10	P	27.00	17.00				2				1	1	4	3			
P7	5	S	18.00	18.00	1.10	1.23	2.40			5	10	1	1	5	6		1	NO CHANGES RECOMMENDED
R13	11	O	21.00	22.00				8				1	1	5	6		2	
P8	4	B	33.00	19.00	1.50	1.43	2.30	25		10	15	1	1	2	2		1	2ND NICEST POOL - START OF STEEP "CANYON" SECTION
R14	15	B	66.00	18.00						18		1	1	5	2		12	STEEP CANYON SECTION
P9	7	L/W	30.00	18.00		1.85	2.80	20		20	55	1	1	5	5		2	MANUALLY REMOVED BEAVER DAM - END OF STEEP CANYON
R15	10	P	59.00	15.50				9		3		1	1	4	5			
P10	4	B	18.00	15.50	1.00	1.30	1.80	4	2	2	5	1	1	3	4			
R16	10	P	78.00	20.00				9	2			1	1	4	4		1	FENCE AT 1,040' - BLOWN OUT STRUCTURE AT TOP
R17	11	O	22.00	19.00				7		4		1	2	4	6			LOG T/S & BF BENCH ALONG RIGHT BANK - INLET DIVERSION FOR POND
R18	10	P	317.00	19.00				19	17	2		1	1	4	4			FAILED STR @1177' & 1341 - BRIDGE @ 1373
P11	6	M	16.00	24.00	1.00	1.13	1.80	5	2		2	1	1	6	5		3	HARDEND WATER SITE - REMOVE AND INSTALL CROSSVANE
R19	10	P	46.00	15.00				12	2	17		1	1	3	4		2	
R20	8	P	36.00	5.00								1	1	4	4			
R21	11	O	43.00	22.00				3	4			1	1	8	5		2	END OF REACH @ FENCE