Rio Cebolla

Stream Inventory Report

Santa Fe National Forest
Jemez Ranger District
Surveyed July to September 2001
Forest Fisheries Crew

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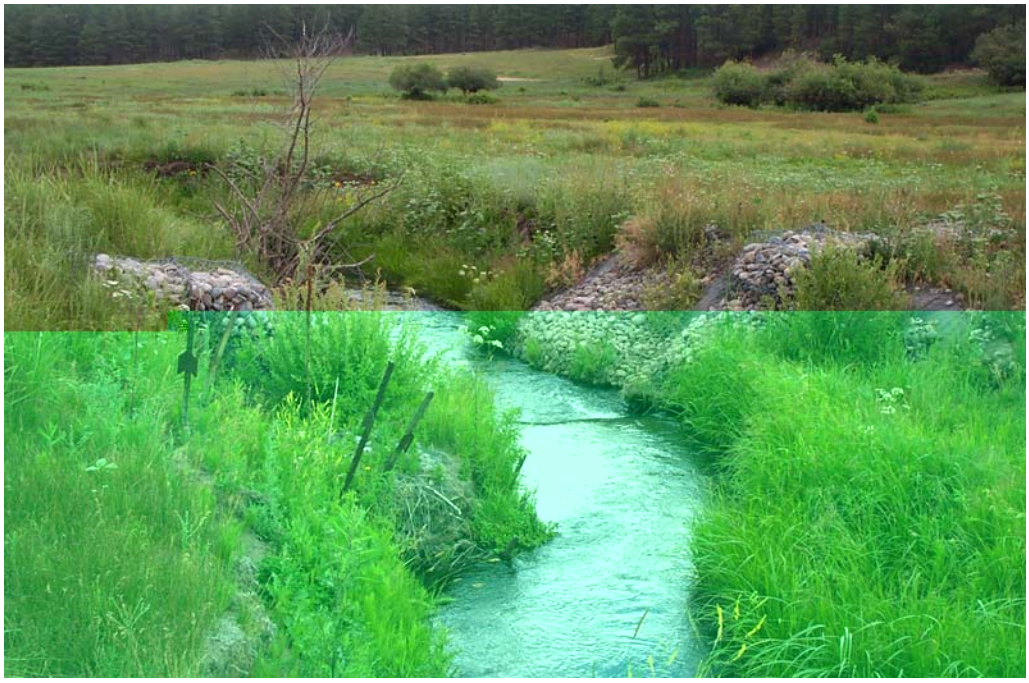

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Introduction
Rio Cebolla 2001 Stream Survey

The Santa Fe National Forest Fisheries Crew conducted a stream survey on Rio Cebolla during the summer of 2001. A total of 19.5 miles of stream were surveyed, from the mouth (T18N, R1E, Sec. 1 at 7190' elevation) to the terminus of fish presence (T20N, R2E, Sec. 5 at 8560' elevation) where Rio Cebolla flows over a large bedrock falls that prevents upstream fish migration. Rio Cebolla is a 4th order tributary to Rio Guadalupe. Rio Cebolla and Rio de las Vacas come together at Porter to form Rio Guadalupe (See map on page 1).

A modified Hankin/Reeves stream inventory methodology (Region 6) was adopted by Region 3 and was utilized for this survey. Stream habitats were broken up into riffles, pools, side channels, dry channels, culverts, and falls and given a Natural Sequence Order number (NSO). In addition, tributaries, such as streams, seeps and springs, were inventoried and given an NSO. The NSO that calculated stream length were riffles, pools, culverts, and falls. In addition, side channel NSO units were used to calculate available stream habitat, not stream length. This stream habitat survey specifically catalogues aquatic habitat. The PFC survey

Executive Summary

Rio Cebolla is a 4th order stream originating from spring sources near the northwest corner of the Valles Caldera National Preserve (VCNP), on the Coyote Ranger District of the Santa Fe National Forest. Fish use runs from the mouth at the confluence with Rio de las Vacas (T18N R1E S1), 7190' elevation, to a natural barrier upstream from Pipeline Road (T21N R3E S5), 8560' elevation. Rio Cebolla drains the area in between Rio de las Vacas and San Antonio Creek. The Rio Cebolla Watershed is comprised of over 42,000 acres, primarily on the Jemez and Coyote Ranger Districts (Santa Fe National Forest), in Sandoval County, New Mexico, except for New Mexico State lands at Seven Springs Fish Hatchery and Fenton Lake State Park, as well as private inholdings in the Seven Springs area and 40 acres (the Horn Property) just below Fenton Lake.

Rio Cebolla was broken into 12 different reaches (see Table 2), based on stream and valley morphology, dramatic changes in stream flow, impoundments, and private land boundaries. The survey began at the mouth of the river and worked its way upstream. The stream reaches were numbered in an upstream progressive order.

Table 2. Description and Length of Stream Reaches on Rio Cebolla.

Reach	River Miles	Landmark at Beginning and End	Land Owner
1	0-3.0	Mouth to Open Meadow in T19N R2E S30	Santa Fe National Forest
2	3.0-4.9	Open Meadow in T19N R2E S30 to Trail Canyon	Santa Fe National Forest and Private Property
3	4.9-7.7	Trail Canyon to Fenton lake	Santa Fe National Forest and New Mexico State Parks
4	7.7-8.0	Fenton Lake	New Mexico State Parks (Not Surveyed)
5	8.0-9.9	Fenton Lake to Private Land Boundary at Seven Springs Community	New Mexico State Parks and Santa Fe National Forest
6	9.9-11.9	Seven Springs Community	Private Property (Not Surveyed)
7	11.8-13.9	State Boundary Fence Below Lowest Hatchery Pond at Seven Springs Fish Hatchery to FS Gate at Seven Springs Campground	New Mexico Department of Game and Fish and Santa Fe National Forest
8	13.9-16.1	Seven Springs Campground to McKinney Pond	Santa Fe National Forest
9	16.1-16.2	McKinney Pond	Santa Fe National Forest (Not Surveyed)
10	16.2-17.4	McKinney Pond to Road Canyon	Santa Fe National Forest
11	17.4-20.2	Road Canyon to Unnamed Tributary on the Left Bank in SW1/4 of T20N R2E S5	Santa Fe National Forest
12	20.2-21.8	Tributary on the Left Bank in SW1/4 of T20N R2E S5 to Terminus of Fish Presence	Santa Fe National Forest

Overall, the gradient on Rio Cebolla is low, ranging from 0.7% to 1.6%. Much of Rio Cebolla runs through open meadow areas with very low gradient. Rio Cebolla is a spring-fed system that has very stable stream flows. Two man-made impoundments

(Fenton Lake and McKinney Pond) moderate flows as well. Indications of high seasonal flows, bankfull indicators, and above water-level sediment deposits (sand and gravel bars) are rare.

Geologically, Rio Cebolla flows through areas associated with the Jemez Mountains' volcanic origin. Rock in this area is igneous and includes pumice and tuff, which are very soft and form highly erosive soils. Excessive fine sediment loads and high turbidity are encountered in Rio Cebolla, exacerbated by grazing practices, human disturbance, and road runoff.

Stream flow appears to be stable. Several times during the summer of 2001 monsoon events, typical to the Jemez Mountains, were experienced. Stream flow showed no definitive increase. No irrigation withdrawals or active ditches were found during the survey. As of 1994, Rio Cebolla was found to have unacceptable pH, temperature, total phosphorous, siltation, and ammonia levels (NM Water Quality Control Commission 1994).

Habitat Characteristics

Table 3. Overall Stream Survey Summary for the Rio Cebolla.

ENTIRE STREAM					
Stream Length Surveyed:		102861 feet		19.5 miles	
Habitat Type	**Total Number**	**Total Feet of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	274	4,872	4.7	4.7	>30%
Riffle	319	97,756	95.0	94.0	-
Culvert	4	103	0.1	0.1	-
Tributary	22	-	-	-	-
Falls	2	130	0.1	0.1	-
Side Channel	13	1,112	NA	1.1	-
Total	634	103,973	100.0	100.0	-

Red: Not Properly Functioning

During the habitat survey conducted on Rio Cebolla, the river was broken up into 634 total NSOs (Habitat Units), which measured a total of 102,861 feet in length (19.5 stream miles). Of these 634 NSOs (see Table 3), there were 274 pools, 319 riffles, 4 culverts, 22 tributaries, 2 falls, and 13 side channels. There were no stream length measurements for tributaries, as they did not contribute to the habitat in the main stem of the river.

A matrix of factors and indicators was developed to tie to stream habitat information collected during this survey (see Table 4). The matrix originally was developed in Region 6 (Washington and Oregon), but was modified for mountain streams in the intermountain west and relates to regulations determined by New Mexico Environment Department (NMED). The matrix was further refined to incorporate geology of streams historically occupied by RGCT.

Rio Cebolla is **not properly functioning** (see Table 5) for all of the criteria in categories of water quality, habitat characteristics, and channel condition and dynamics (except pool quality), and **at risk** for State Standards for water temperature at two sites (above Seven Springs Fish Hatchery and Fenton Lake) and streambank condition.

Rio Cebolla was comprised almost entirely of riffle habitat. There is 20 times more riffle than pool habitat (4.7%). For a stream to be properly functioning it must have at least 30% pool habitat.

In all reaches there were limited amounts of pool habitat. This lack of pool habitat is mostly attributed to loss of undercut banks, downcut channel, decreased meander, depleted beaver activity, lack of LWD and sediment filling in pools. In a system like Rio Cebolla, pool habitat was likely created by stream meander and beaver activity. Rio Cebolla is a low gradient stream with stable stream flows. There are limited channel forming events below Fenton Lake, a man-made reservoir. These events are necessary to help flush out fine sediments, and form pools.

Table 4. Matrix of Factors and Indicators of Stream Health Condition for Historic and Occupied Rio Grande Cutthroat Trout Streams as Related to R3 Stream Habitat Inventory.

FACTORS	INDICATORS	Properly Functioning	At Risk	Not Properly Functioning
Water Quality	***Temperature – State of New Mexico Standards***	<20°C (68°F) (3 day avg. max)	Ó20°C (68°F) <23°C (73.4°F) (3 day avg. max)	Ó23°C (73.4°F) (3 day avg. max)
	Temperature – Salmonid Development	Ò17.8°C (64°F) (7 day avg. max)	>17.8º (64ºF) < 21.1º (70ºF) (7 day avg. max)	Ó21.1ºC (70ºF) (7 day avg. max)
Habitat Characteristics	**Sediment**	<20% fines (sand, silt, clay) in riffle habitat. Fine sediment within range of expected natural streambed conditions		Ó20% fines (sand, silt, clay) in riffle habitat. Fine sediment outside of expected natural streambed conditions.
	Large Woody Debris[1]	>30 pieces per mile, >12" diameter, >35 feet in length	20-30 pieces per mile, >12" diameter, >35 feet in length	<20 pieces per mile, >12" diameter, >35 feet in length
	Pool Development[2]	Ó30% pool habitat by area		<30% pool habitat by area
	Pool Quality	Average residual pool depth Ó1 foot		Average residual pool depth <1 foot
Channel Condition and Dynamics	**Width Depth Ratios by Channel Type** *(utilize Rosgen type and range given if applicable)*	Width/depth ratios and channel types within natural ranges and site potential		Width/depth ratios and channel types are well outside of historic ranges and/or site potential
		Expected range of bankfull width/depth ratios and channel type	***Rosgen Type*** A, E, G B, C, F D	***W/D Ratio*** <12 12-30 >40
	Streambank Condition[3]	<10% unstable banks (lineal streambank distance)	10-20% unstable banks (lineal streambank distance)	>20% unstable banks (lineal streambank distance)

[1] Large Woody Debris numeric are not applicable in meadow reaches
[2] Pool Development numeric are applicable to 3rd order or larger streams
[3] Streambank Condition numeric are not applicable in reaches with > 4% gradient

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are deeply undercut providing habitat for fish, and shading the water from the sun. Due to extensive meandering on the stream bends, deeper pools are found, also with deep undercut banks. However, in Rio Cebolla, the system has been altered by historic grazing practices and human disturbance, such as timber harvest, road construction and recreation. The undercut banks have sloughed off into the stream, forcing the stream to become wider and shallower. This bank erosion is removing the undercut bank habitat and adding fine sediments to the stream, as well as allowing elevated stream temperatures. The fine sediments are then transported downstream, and settle out in the slow moving pool habitats, filling in these deep pools with fine sediments, creating extremely long riffles.

Table 8. Habitat Characteristics for Rio Cebolla.

Reach	Pool:Riffle Ratio	Avg. Riffle Width:Avg. Riffle Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
Entire River	1:1.2	16:1	3.6[1]	21490 feet	10.4
Properly Functioning Indicators	-	-	>30	-	<10

[1] This numeric does not take into account Reaches 1,2,8, and 10, as they are meadow reaches.

Rio Cebolla had 10.4 % unstable banks throughout the entire river (see Table 8). The streambank condition of Rio Cebolla was **at risk**, as the percentage was above the indicator of <10%, but below 20%.

The amount of LWD per mile for the entire river was 3.6 pieces per mile (see Table 8). This amount of wood indicates that the river is **not properly functioning** for LWD. A properly functioning stream must have >30 pieces of LWD per mile. There are several factors involved in the low amount of LWD in Rio Cebolla. First, the geomorphology of the Rio Cebolla greatly affects the levels of LWD. Rio Cebolla does not have high gradient reaches in forested areas that add LWD to the stream. High gradient reaches are called transport reaches. The wood falls into the stream, and because it has a high gradient, the wood is transported downstream. Once the gradient decreases, the wood begins to settle into the riparian area or gets caught in bedrock features. These areas are called response reaches. Rio Cebolla geomorphology is such that the transport reaches are located in the headwaters, with the response reaches downstream. However, the stream size is so small, and the flow partially regulated, that LWD is unable to be transported throughout the river system. Fenton Lake also negates further transport of LWD into the lower reaches.

The second factor in the low amounts of LWD in the Rio Cebolla can be attributed to the lack of forested reaches. The majority of Rio Cebolla flows through open meadow areas. These areas by nature are not recruitment areas for LWD. The levels of LWD in Rio Cebolla may naturally be lower than most stream systems. However, the amount of LWD in Rio Cebolla is still well below natural levels. Since LWD recruitment is confined to local recruitment, only large disturbance events could increase the amount of LWD recruitment. In the forest type found in the Jemez Mountains, fires are one of the most common disturbance events. Fire suppression has hindered the extent of natural fires, which has reduced the amount of LWD recruitment.

Reach by Reach Comparison

Rio Cebolla was broken into twelve different reaches. Table 9 has summarized the habitat characteristics for each reach and the entire river.

Reaches 1-3, 11 and 12 have high amounts of unstable banks. These reaches had a higher amount of bank erosion due to heavy recreational use of this area and past grazing practices. The riparian areas in these lower reaches are well developed and in some cases limit bank erosion.

The reach with the highest amount of LWD is Reach 7. Reach 7 was likely the most forested reach in Rio Cebolla. However, during the survey, LWD was not accurately measured due to surveyor error (and was undercounted throughout the survey); nevertheless, it was obvious that LWD was inadequate as indicated by other factorTmMthe

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Stream Flow

Peak flows in Rio Cebolla are governed by snowmelt, typically spiking in the spring, usually late May to early June. These peak flows are effected by Fenton Lake, which allows only a certain amount of flow released from its outtake and only during extreme flood conditions allows flow over its spillway, thus moderating average to moderately above average peak flows. The river is spring fed. Low flow often persists from late summer until the snowmelt in the spring. However, Rio Cebolla typically receives monsoon events in July through September. During monsoon events small spikes in stream flow are observed. A flow measurement was taken at the beginning of the survey on July 30, 2001, near the confluence with Rio de las Vacas, measuring 5.4 CFS. Low stream flow measurements may be attributed to the 20-year drought conditions that New Mexico is currently experiencing.

There are 3 lakes or ponds on Rio Cebolla: Fenton Lake, the Ice Pond, and McKinney Pond. These three man-made impoundments moderate flow within Rio Cebolla. This flow modification reduces the channel forming events in Rio Cebolla. The reduction of flows also reduces the ability of the stream to flush out fine sediments. There may be a few scattered ponds. No irrigation withdrawals or active diversion ditches were observed during the survey, though these activities may occur on the private land in the Seven Springs community.

Water Temperature

Four thermograph tidbits were placed in Rio Cebolla from June to October 2001 to collect stream temperature data. Records were taken at 4-hour intervals during this time period. The first thermograph was placed in Reach 1 near the mouth and confluence with Rio de las Vacas. The second thermograph was placed in Reach 3 downstream of Fenton Lake. The third thermograph was placed in Reach 5 upstream of Fenton Lake. The fourth thermograph was placed in Reach 7 above Seven Springs State Fish Hatchery.

Table 11. Water temperature for Rio Cebolla from two thermograph stations from June 14-September 30, 2001.

	Water Quality Standards		**Rio Cebolla above Hatchery**		**Rio Cebolla @ Mouth**	
	NMED 3-Day Maximum	SFNF 7-Day Maximum	3-Day Max. Temps	7-Day Max Temps	3-Day Max. Temps	7-Day Max Temps
Conditions			**# Days**	**# Days**	**# Days**	**# Days**
Properly Functioning	< 68º F	Ò 64º F	68	27	60	41
At Risk	68-<73.4º F	64-70º F	41	55	46	19
Not properly Functioning	Ó 73.4º F					

shading to the stream, reducing stream temperature. Fenton Lake is having an adverse effect on stream temperatures in Rio Cebolla. Further studies should be conducted to determine if McKinney Pond is having an effect on downstream temperatures.

Table 12. Water temperature for Rio Cebolla from two thermograph stations from June 15-October 1, 2001.

	Water Quality Standards		**Rio Cebolla Above Fenton Lake**		**Rio Cebolla Below Fenton Lake**	
	NMED 3-Day Maximum	SFNF 7-Day Maximum	3-Day Max. Temps	7-Day Max Temps	3-Day Max. Temps	7-Day Max Temps
Conditions			**# Days**	**# Days**	**# Days**	**# Days**
Properly Functioning	< 68º F	Ò 64º F	94	56	45	33
At Risk	68-<73.4º F	64-70º F	15	45	38	21
Not properly Functioning	Ó 73.4º F	>70º F	0	8	26	55

The average daily maximum temperature for the site above Seven Springs State Fish hatchery was **at risk** for the State Standards and **not properly functioning** for standards for salmonid development (see Table 11). The average daily maximum temperature for the mouth of Rio Cebolla was **not properly functioning** for the State Standards and the standards for salmonid development. For a stream to meet the State Standards for a quality coldwater fishery, a stream must not have a 3-Day maximum temperature greater than 68ºF. For a stream to meet the standards for salmonid development, a stream must not have a 7-day maximum greater than 64ºF. Rio Cebolla did not meet these criteria at all sites.

The site above Seven Springs Fish Hatchery exceeded the State Standards 41 days out of 109 total days recorded; the temperatures spent 41 days between 68º and 73.4ºF (at risk). The site exceeded the standards for salmonid development 82 out of 109 days recorded; the temperatures spent 55 days between 64° and 70° (at risk), and 27 days >70°F (not properly functioning. The water temperatures reached levels where mortality in salmonids occurs 25% of the days recorded.

The mouth of Rio Cebolla exceeded the State Standards 49 days out of 109 days recorded; the temperatures spent 46 days between 68º and 73.4ºF (at risk) and 3 days >73.4ºF (not properly functioning). The site at the mouth exceeded the standards for salmonid development 68 days out of 109 days recorded; the temperatures spent 19 days between 64° and 70° (at risk), and 49 days >70°F (not properly functioning). The water temperatures reached levels where mortality in salmonids occurs 45% of the days recorded.

Table 13. Monthly temperatures for two Rio Cebolla thermograph sites.

	Rio Cebolla above Seven Springs			**Rio Cebolla @ Mouth**		
Month	**Max Temp**	**Min Temp**	**Avg Temp**	**Max Temp**	**Min Temp**	**Avg Temp**
June	71.98	43.34	58.09	73.02	46.21	62.25
July	72.28	52.24	60.63	74.54	56.24	64.98
August	68.42	49.73	58.21	69.13	55.69	62.05
September	64.93	41.66	52.67	62.46	50.11	56.12

The thermographs above and below Fenton Lake were used to determine the influence of Fenton Lake on stream temperatures (see Table 12). These two thermograph sites determined that Fenton Lake has a definite influence on stream temperatures. Fenton Lake is a surface drawn dam, meaning that the warmer surface waters flow out of the reservoir.

Figure 1. Monthly Water Temperatures in Rio Cebolla above Seven Springs State Fish Hatchery

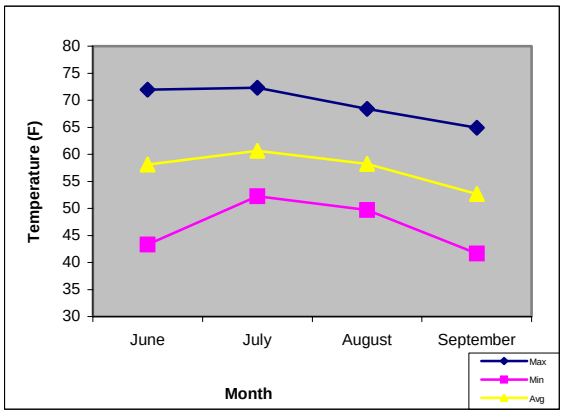
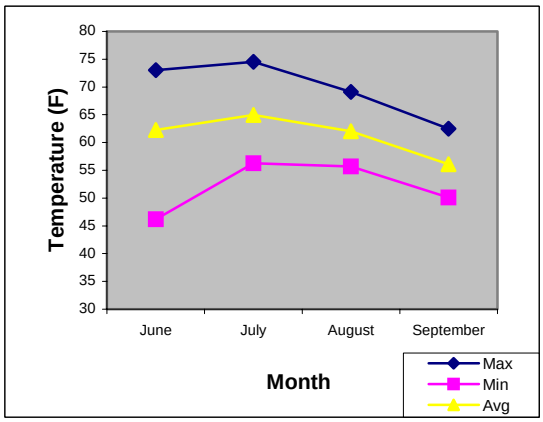


Figure 2. Monthly Water Temperatures in Rio Cebolla at the Mouth.



The average daily maximum temperature for the site above Fenton Lake was **at risk** for the State Standards, and **not properly functioning** for the standards of salmonid development. The average daily maximum temperature for the site below Fenton Lake was **not properly functioning** for both the State Standards and the standards of salmonid development.

The site above Fenton Lake exceeded the State Standards 15 out of 109 days recorded; the temperatures spent 15 days between 68º and 73.4ºF. The site exceeded the standards for salmonid development 53 out of 109 days recorded; the temperatures spent 45 days between 64° and 70° (at risk), and 8 days >70°F (not properly functioning). The water temperatures reached levels where mortality in salmonids occurs 7% of the days recorded.

The site below Fenton Lake exceeded the State Standards 64 out of 109 days recorded; the temperatures spent 38 days between 68º and 73.4ºF (at risk) and 26 days >73.4ºF (not properly functioning). The site exceeded the standards for salmonid development 76 out of 109 days recorded; the temperatures spent 21 days between 64° and 70° (at risk), and 55 days >70°F (not properly functioning). The water temperatures reached levels where mortality in salmonids occurs 50% of the days recorded.

Table 14. Monthly Temperatures for Two Rio Cebolla Thermograph Sites.

	Rio Cebolla Above Fenton Lake			Rio Cebolla Below Fenton Lake		
Month	**Max Temp**	**Min Temp**	**Avg Temp**	**Max Temp**	**Min Temp**	**Avg Temp**
June	69.6	45.56	57.50	74.83	52.51	63.18
July	70.79	53.07	59.82	75.46	58.4	64.64
August	65.52	50.0	57.09	71.49	57.55	63.07
September	62.07	41.93	51.95	63.84	50.84	57.20

On a randomly selected day (August 5, 2001) the temperature above Fenton Lake at 9:47 AM was 55.3°F while below Fenton Lake the temperature at 7:02 AM was 61.54°F and at 11:02 AM was 66.75°F. The temperature increases anywhere from 5-10°F passing through Fenton Lake.

A conclusion drawn from this data is that the water coming out of Fenton Lake is much warmer than the water entering it. This will have to be studied further to determine what effects this is having on fish populations downstream of Fenton Lake.

The diurnal difference of daily average temperatures in Rio Cebolla ranged from 1°F (above Fenton Lake) to 14°F (below Fenton Lake).

Figure 3. Monthly water temperatures for Rio Cebolla above Fenton Lake.

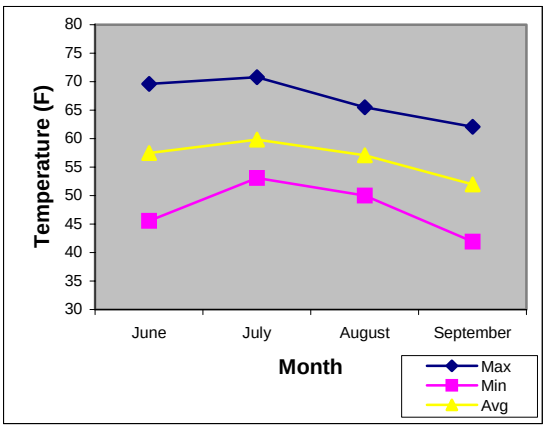
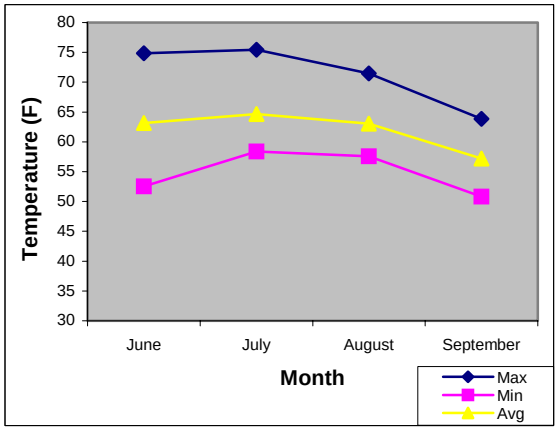


Figure 4. Monthly water temperature for Rio Cebolla Below Fenton Lake.



Riparian Vegetation

Throughout Rio Cebolla, alder and willow species dominate the riparian vegetation. Grasses are present throughout, which help stabilize the stream banks. Kentucky bluegrass is becoming a dominant species in some locations along streambanks, which has a smaller rootmass than native species it has replaced. This further limits bank stability. Conifers are present throughout the drainage, but the only forested reaches were Reaches 3, 5, 7, 11, and 12. The dominant conifer species in the floodplain is ponderosa pine (*Pinus ponderosa*).

Photo 2. Reach 3, NSO 194, T4. Lush riparian vegetation found in an ungrazed section of Rio Cebolla.

Heavy riparian grazing was observed in the upper reaches, above McKinney Pond. Willows appeared unhealthy and had evidence of heavy browsing.

No further information regarding riparian vegetation was documented during the survey.

Beaver Activity

There were no active beaver dams found during the 2001 survey. However, there were some active beaver chewings observed. In Reach 11, an old beaver dam was recorded. This dam had silted in long ago, and had been breached, forming a large productive meadow. The old lodge was still intact in the center of the meadow.

Many beaver dams located within the Rio Cebolla Watershed over the last 20 years have been removed using dynamite (Travis Moseley, personal communication 2001). Fortunately, some beaver dams still exist, as seen in Photo 3.

Photo 3. Reach 3, NSO 229, R113. Old beaver dam found in Rio Cebolla.

While the beaver's role in a watershed has been misunderstood by the public, land managers and biologists, studies over the last few decades conclude that beaver are a critical component to increasing stream integrity as well as biotic productivity within the stream and floodplain. Beaver dams were methodically removed from

Nitrogen and phosphorus containing sediments also settle, making beaver ponds a nutrient sink for a stream system. The storage of nutrient laden soil in sediment reduces eutrophication in nutrient rich systems. In low nutrient systems, such as headwater streams, the nutrient storage in pond sediment creates a time-release system increasing productivity. After the beaver leaves an area and the pond drains, the nutrient rich soil is utilized by riparian vegetation to produce dense riparian areas.

Decreased water velocity caused by beaver ponds alters the carbon cycle of streams. Reduced water velocity combined with increased water temperatures allows macroinvertebrates and bacteria to break down organic matter (leaves and wood) at a faster rate, creating dense macroinvertebrate populations. The breakdown converts organic matter to sediment and in some cases methane gas. The increased bacterial action reduces dissolved oxygen levels within the ponds and immediately downstream. The decreased velocity combined with increased width and overall surface area of the beaver ponds increases stream temperatures. The reduced concentration of dissolved oxygen and increased temperatures usually does not reach levels of concern for trout in Rocky Mountain streams (Gard 1961).

Beaver activity also has an affect on the riparian vegetation within proximity of the ponds, as well as the water table. Beaver activity increases the surface area of ponds by several hundred times, which is highly influential on the surrounding riparian vegetation. The increased surface area allows for storage of water in the banks and floodplain. The storage of water in the soil and floodplain increases the water table and stores water for times of low flow. During late summer low flow conditions water stored in the banks provides cool water to moderate flow and extreme temperatures (Parker et al. 1985).

While storing water, beaver dams also reduce extreme flows and related disturbance. The dams moderate flow during flood periods. This moderation reduces bank erosion related to flood events, improving bank stability in downstream areas (Olson 1994).

Beavers do consume large quantities of riparian vegetation or woody supplies in their diet, as well as for the construction and maintenance of their habitat. Consumption rates for beaver populations are higher than the regeneration rates of riparian vegetation. Beaver tend to occupy an area until the surrounding supplies are consumed and then move on to a new section of river within or outside of the watershed. Once a beaver leaves, high nutrient content in the area allows for fast regeneration of consumed riparian vegetation. Over time the area will regenerate and will be ready for a beaver to return in future years (DeByle 1985).

Beavers generally improve trout habitat. Cutthroat trout in Rocky Mountain streams tend to be most abundant in streams with beaver ponds, but are generally absent in streams with only abandoned ponds. Beavers do several things for fisheries habitat: provide a food source, moderate stream temperatures, as well as increase habitat volume and over wintering habitat. Trout biomass and individual size increases with the presence of beaver dams. One possible explanation is high density of macroinvertebrates involved in the decomposition of organic matter and consumption of bacteria. Macroinvertebrates

are a key food source for many trout, including RGCT. Increased pool volume, a vital habitat feature for trout, could also contribute to the correlation of healthy fish populations and beaver ponds. Over wintering habitat is also provided by the deep pools created by some ponds. The deeper pools become a refuge for fish when riffle habitat is frozen and can determine the carrying capacity of a stream. Flow and water temperature moderating affects that are caused by increased water tables provide cool water to the stream during low flow conditions. This could further increase the fish population carrying capacity of the stream (Olson 1994).

From an aquatic resource perspective, it is desirable to restore beavers to Rio Cebolla. However, focus should be placed on riparian restoration. First, riparian vegetation must be allowed to establish in the floodplain. There is a definite lack of woody species, such as willow, aspen, and alder. Once the riparian species return, then beavers can naturally recolonize Rio Cebolla.

Fisheries

Fish species found in Rio Cebolla (see Table 14) include the native species of Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), Rio Grande sucker *(Catastomus plebius)*, and Rio Grande chub *(Gila pandora).* These three (3) fish comprise the native fish assemblage in Rio Cebolla. Non-native species include German brown trout (*Salmo trutta)* and rainbow trout (*Oncorhynchus mykiss).* A hybrid cross between cutthroat trout and rainbow trout was assumed to inhabit the stream as well.

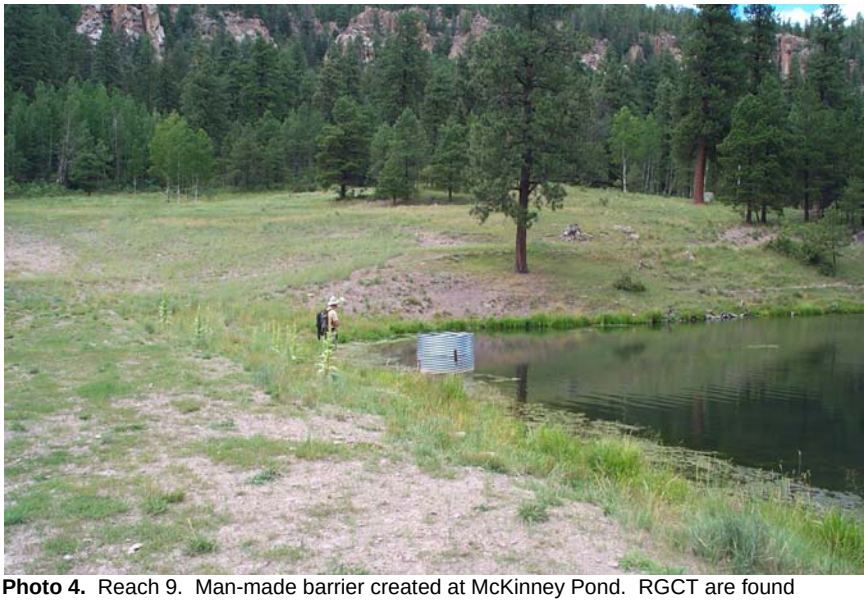


Photo 4. Reach 9. Man-made barrier created at McKinney Pond. RGCT are found above this dam.

McKinney Pond was constructed in 1992 to provide an upstream migration barrier to non-native brown and rainbow trout (see Photo 4). The pond was constructed 10 feet deep with a top-drain intake pipe installed. After the completion of the barrier, the

stream was chemically treated above McKinney Pond. Rio Grande cutthroat trout were then stocked in the upper 5.5 miles of Rio Cebolla (Reaches 9-12).

Rio Cebolla is recognized by the U.S. Fish and Wildlife Service as one of only 13 core populations (pure, stable and secure) of RGCT throughout its range. As stated by the USFWS, core populations need to be protected and expanded to assure success of the conservation of the species (USWFS 2002).

The introduction of brown and rainbow trout assisted in reducing the native range of RGCT in Rio Cebolla. RGCT is a species that needs high water quality to survive. Rio Grande cutthroat trout is the State Fish of New Mexico and has been placed on the regional forester's list of sensitive species. Range-wide, the numbers of RGCT have dropped dramatically over the last century. At one time, RGCT inhabited nearly all the cool, clear mountain lakes and streams of the Rio Grande Basin in Colorado and New Mexico. Now, there are small fragmented populations remaining in the headwaters of streams, less than 7% of their historic range. Some other causes of the decline of the RGCT are habitat degradation and dewatering of the streams for irrigation. The Jemez Mountains provides a stronghold for RGCT, as seen in San Pedro Parks Wilderness and the Cãnones Watershed (two other core populations).

Table 14. Fish Distribution for Rio Cebolla.

Fish Species	Native/Non-Native	Distribution	Reaches
Rio Grande Cutthroat	Native	Mile 16.1-21.8	9-12
Brown Trout	Non-Native	Mile 0- 16.1	1-8
Rainbow Trout	Non-Native	Mile 0-16.1	1-8
Rio Grande Sucker*	Native	Mile 0-7.7	1-3
Rio Grande Chub*	Native	Mile 0-7.7	1-3

*-Denotes need for further study

During 2001, 7,663 rainbow trout were stocked in Rio Cebolla. The stocking regime was at 50% its usual levels due to the closure of Seven Springs and Pecos Fish Hatcheries. Fish are stocked throughout the lower Rio Cebolla, including Fenton Lake, wherever access to the stream is provided.

The range of Rio Grande cutthroat trout in Rio Cebolla can be increased. The next barrier downstream from McKinney pond would be the concrete chute built at the Seven Springs State Fish Hatchery, which forms the Ice Pond. Beyond this location, Fenton Lake would provide an excellent migration barrier. The one draw back to this is that Rio Cebolla has tested positive for whirling disease around Seven Springs State Fish Hatchery, which is now producing Rio Grande cutthroat trout. Unfortunately, the entire Rio Cebolla is prime habitat for the carrier organism for whirling disease, tubifex worms. Whirling disease would limit productivity but not preclude Rio Grande cutthroat trout from repopulating this section of Rio Cebolla.

Photo 5. Reach 10, NSO 437, P187. Man-made V structure created in Rio Cebolla. Note: stream widening in foreground and dry structure in background.

Rio Cebolla is a candidate for LWD placements. However, in order for these projects to work, they must be done correctly. The entire stream is lacking LWD, but focus should be placed on forested reaches. Meadow reach restoration should involve re-establishing riparian hardwood species where they were historically. These meadow areas are capable of producing a variety of hardwood species; but with historic land management practices, many of these stands have disappeared. It was areas like these that would make ideal beaver habitat, and eventually excellent RGCT habitat.

Land Use

A variety of land use practices occur in the Rio Cebolla watershed.

Roads:

The Rio Cebolla Watershed has an extensive road system. There are approximately 2.73 miles of road per square mile within the watershed. While there is no factors and indicators related to road density, U.S Fish and Wildlife Service and National Marine Fisheries Service jointly recommend less than 2.5 miles of road per square mile in watersheds occupied by salmonids (Matrix of Factors and Indicators for bull trout and steelhead). This measurement does not account for State, County, or Private roads within the watershed. New Mexico Highway 126, FS Roads 376, 378, Pipeline Road and user created roads throughout the watershed are sources of sediment. Many of the roads located in the watershed are old roads that are not currently in use or maintained. Unmaintained roads were observed as sources of sediment delivery in the Rio Cebolla Watershed. During rain events, roads gully or wash out, inputting sediment into the stream. One road of major concern to the Rio Cebolla Watershed is NM Highway 126. This highway is currently a gravel road that runs through the lower watershed (Reaches 1-6), but is slated to have an improved drainage network and will be paved starting in 2003.

Photo 6. Reach 6. Calaveras Creek after a monsoon event. Note turbidity of stream and road runoff.

In Reach 6, Calaveras Creek enters the Rio Cebolla. NM Highway 126 runs along the stream and up a draw in this watershed. The sediment runoff from this stream is a serious

problem. During one monsoon event during 2001, Calaveras Creek was observed as a major source of sediment to Rio Cebolla (See Photo 6). Rio Cebolla above the confluence was clear, but below the confluence was too turbid to survey. The effects of Calaveras Creek are observed downstream to Fenton Lake.

Timber Harvest:

Forests in the Rio Cebolla Watershed consist primarily of ponderosa pine (*Pinus ponderosa)*. However, higher elevations produce Douglas-fir (*Pseudotsuga menziesii*) and a mix of spruce and fir. Timber harvesting has gone on for as long as people have inhabited the area. There is no record to show when the first timber harvest occurred in the Rio Cebolla Watershed. A railroad line was built in the 1920's to transport the timber from the logging camps to the sawmill, located just upstream of Virgin Canyon in the Rio Guadalupe Watershed. This included the blasting of Gilman Tunnels in the Rio Guadalupe Canyon to accommodate the railroad cars. During the 1940's the railroad trestles washed out during a flood, and were not rebuilt. Logs were then transported by truck, and the Gilman Tunnels were widened to accommodate the log trucks (Chris Jenkins, personal communication 2002).

There have only been two major timber sales in the Rio Cebolla Watershed within the last decade, Barley Canyon and Calaveras Timber Sales. Barley Canyon units are scattered to the east of Rio Cebolla in Reaches 4-8. Total acreage was unavailable, but 10 MMBF were removed in 1994. Calaveras Timber Sale units are on mesa top areas between Calaveras and Rio Cebolla Canyons. All sale units were up slope from the floodplain; none of which reached the stream.

For aquatic resource and floodplain protection, future recommendations for timber management in the Rio Cebolla watershed should be to manage riparian, floodplain and adjacent slopes as potential sources of LWD and to protect natural soil conditions. Harvesting of timber within 300' of live water should only occur to meet this objective. While this is a general statement, there are site specific opportunities to conduct riparian thinning inside this buffer.

Fires:

Fire has played an important role in the forests of northern New Mexico. All of these forests have adapted to a natural fire regime. However, with human intervention this natural fire regime has been severely altered. The fire suppression that has occurred for nearly a century has allowed fuels to build up in the forests. When a fire does occur, it now has the potential to become a catastrophic fire as was seen in the 2000 Cerro Grande Fire. There have been four major fires within the Rio Cebolla Watershed over the last 35 years. The earliest fire was the Cebollita Fire, which burned approximately 1600 acres in 1971 (Reach 2). The Lake Fork Fire burned approximately 218 acres in 1984 (Reaches 3 and 4). The Barley Fire burned approximately 55 acres in 1994 (Reach 4). The Schoolhouse Burn was a prescribed burn in 1999. Approximately 970 acres were burned (Reach 1) (See Rio Cebolla Map in File). These 4 fires were the only ones in the

watershed that would have had any significant effect on the soils and the river according to Phil Neff, Fire Management Officer for the Jemez Ranger District (Personal Communication, 2001).

In an October 2002 field review of Reaches 1 and 2, observations noted over 20 overland flow or ephemeral draw headcutting that is related to the Schoolhouse Burn area. Sediment flows were observed in Rio Cebolla throughout Reach 1, creating significant depositional loads and alluvial fan.

In August and September 2002 (after completion of the survey), a human-caused fire (abandoned campfire) called the Lakes Fire burned over 4,800 acres. It is unclear as to how much affect that burn will have on sediment and debris loading in Reaches 1-5.

Grazing:

Grazing has been a tradition in northern New Mexico since the settlement of this area. Public land grazing has occurred for nearly a century. Prior to the establishment of the Santa Fe National Forest, the watershed had likely been grazed for 50-100 years.

Table 15. San Diego Allotment Grazing Rotation.

Numbers of Cattle	Pasture	Reach Effected	Grazing Period
12 Bulls	Lake Fork Canyon	2	5/1-5/4
172 Pair & 9 Bulls	Lake Fork Canyon	2	4/29-5/19, 10/28-11/17
80 Pair & 3 Bulls	Cebolla	1	4/29-5/19, 10/28-11/17
252 Pair & 12 Bulls	Lake Fork Mesa	None	5/20-6/9
252 Pair & 12 Bulls	Cebollita/Virgin	None	6/10-7/14
252 Pair & 12 Bulls	Porter	None	7/15-8/25
252 Pair & 12 Bulls	Holiday	None	8/26-9/22
252 Pair & 12 Bulls	Schoolhouse	None	9/23-10/27
69 Pair	Guadalupe	None	11/18-11/30
69 Pair	Joaquin	None	12/1-12/29
69 Pair	Pajarito	None	12/30-4/30
47 Pair	Palomares	None	11/18-4/30
12 Bulls	Lobo	None	11/18-4/30

In the San Diego Allotment there are 368 cow/calf pairs and 12 bulls that utilize this allotment on an annual basis (see Table 15); 116 pair utilize the allotment year round. The Cebolla/San Antonio Allotment has 311 cow/calf pairs and 30 heifers that utilize this allotment on an annual basis (see Table 16); 116 pair utilize the allotment throughout the winter.

The Cebolla, Barley, and Cebolla Riparian pastures showed the most signs of heavy grazing use. The main pasture was up on top of the ridge, away from the stream. Cattle were not supposed to be grazing in the Cebolla Riparian and Barley pastures during the time of the survey. However, several times during the survey, cattle were seen in these pastures. The amount of use in these pastures appeared to exceed the desirable levels

(See Photo 7). This overuse caused damage to riparian vegetation and streambanks, further increasing detrimental effects to the fish populations in Rio Cebolla. For future management, cattle grazing should be managed to allow development of stable streambanks and healthy riparian vegetation.

Table 16. Cebolla/San Antonio Grazing Rotation.

Numbers of Cattle	Pasture	Reach Effected	Grazing Period
112 Pair, 30 Heifers	Calaveras	None	6/3-6/23
50 Pair	Cebolla Riparian	8-12	6/1-6/9
50 Pair	Road	11-12	6/10-6/23
162 Pair	Road	11-12	6/24-8/15
162 Pair	Barley	8	8/16-9/23
162 Pair	Cebolla Riparian	8-12	9/24-9/30
30 Heifers	Calaveras	None	6/24-9/30
149 Pair	Mushroom	None	6/7-7/31
149 Pair	San Antonio Riparian	None	8/1-8/15
149 Pair	Barley	8	8/16-9/30
116 Pair	126	None	10/1-10/31
33 Pair	Horseshoe	None	10/1-10/31

Photo 7. Reach 8, NSO 356, R181. Streamside utilization along Rio Cebolla below McKinney Pond (Cebolla Riparian). Notice stubble height.

Recreation:

Rio Cebolla has 2 developed recreational sites within the watershed: one campground, (Fenton Lake State Park), and one picnic area, (Seven Springs Picnic Area), which is currently closed. Portions of the Rio Cebolla are within the Jemez National Recreation Area (Reaches 1-2), which reportedly has 1.6 million annual visitors (JNRA EA 2002). This will likely increase with the opening of the Valles Caldera National Preserve.

In addition to these developed recreation sites there are many dispersed trails and campsites throughout the watershed. The heavy use of these areas has degraded riparian areas, as well as the stream itself (see Photo 8). The numerous dispersed trails, especially near the river, have created sediment inputs to the stream. The trails have also caused soil compaction, which prevents riparian vegetation from re-establishing in these areas as well as stream widening. Many of the dispersed campsites can be found in the floodplain, and have created similar problems to the riparian vegetation. The stream survey team and Forest Fish Biologist have observed the visiting public removing LWD from the stream and floodplain for firewood in these dispersed areas. These areas have been totally "browned out" (no vegetation in the campsites due to soil compaction).

Photo 8. Reach 1. Portable toilet found in Rio Cebolla along side a dispersed recreation site.

Forty-five (45) dispersed camping complexes were inventoried in 2001 along Rio Cebolla in Reaches 1 and 2 (FS Files), a stretch of 3 road miles. The inventory noted 120 active fire rings near the streambank or within the floodplain.

The Forest Recreation Staff has recognized the corridor as a high use dispersed recreation area and has taken measures to reduce the amount of dispersed recreation occurring in the area. The Santa Fe National Forest has constructed buck and pole fences near Seven Springs and places along Lake Fork Canyon to reduce areas where dispersed camping occurred next to streams. Dispersed roads have been closed to prevent further degradation to soils and vegetation. These recreational closures have affected over 3 miles of stream habitat.

Recreation should be managed to promote a healthy riparian and floodplain area. Possible practices to improve recreation management that have been identified through the Respect the Rio program include:

1. Moving and modifying dispersed campsites and trails along Rio Cebolla so that vehicle camping is 100' away from the stream banks;
2. Designating specific sections of stream as "Day Use Only" to protect natural and cultural resources;
3. Re-establishing riparian vegetation to restore natural functions to the riparian ecosystem;
4. Educating site users through signs placed at trailheads and modified campsites;
5. Inform the visiting public through a contact ranger program (set for implementation in 2003) about low-impact recreation and local regulations;
6. Designating a river access trail system in high use corridors.

Recommendation Summary

The following are general recommendations based on findings related to the survey as well as forest-wide recommendations from the fisheries program.

Education

Objective: To educate forest visitors regarding effects of their activities on the natural resources, inform them of ways of minimizing impacts and promote better use of the resource.

Concerns: Public education is clearly the most effect tool to promote change that must be made for any of the other recommendation to be successful. Programs can spend millions of dollars repairing damage that was done in the past, but if the public isn't properly informed about what you are doing and why you are doing it, then the money will have been spent needlessly. Without education the same activities will occur, and the damage will continue. Without education the same activities will occur, and the damage will continue.

Implementation methods:

1. Create a contact ranger program. A team of educators will contact forest users during intensive use times (summer), informing them of low-impact camping, fishing and other uses. The team will also be informing them of restoration and regulation changes occurring their dispersed campsites.
2. Members of the public as well as local and state decision makers will be invited to join Santa Fe National Forest fisheries staff in seminars focused on stream health, including snorkeling seminars. Special seminars will also be offered to teachers and college field courses.
3. Several K-12 schools are either currently or becoming interested in water quality and riparian monitoring on forest waterbodies. In-classroom riparian and stream health program and curriculum are being developed as well.

Riparian

Objective: To restore a natural riparian area with native vegetation and promote watershed health and function.

Concerns: A healthy riparian community in the Santa Fe National Forest is critical to help improve the water quality and function of all waterbodies.

Implementation Methods:

1. Augment current riparian areas by planting native species in the riparian areas. Willow plantings started in 2001 with the program expanding in future years to also include aspen planting.
2. Grazing practices should be managed to protect the riparian area. Possible practices include using a range rider, implementation or improvement of riparian

exclosures, or rotational grazing that would not allow grazing until the dormant season or minimize grazing during the growing season.

3. Another step that could be taken to restore riparian areas is to limit the use dispersed trails and campsites through relocation, designation and/or regulations.

Large Woody Debris

Objective: To increase the amount of LWD to natural levels and restore natural stream function.

Concerns: The amount of LWD present in Rio de las Vacas is well below natural levels in all forested reaches surveyed.

Implementation Methods:
Physically place LWD in the floodplain and stream enhancing the current fish habitat. The projects would utilize current research in LWD function and availability.

Native Fish Populations

Objective: To restore and protect populations of native Rio Grande cutthroat trout, Rio Grande chub and Rio Grande sucker.

Concerns: The current population of RGCT must be protected; furthermore, the population should eventually be expanded to include all fish-bearing waters in the Rio Cebolla Watershed in order to assure long-term survival of this native trout.

Implementation Methods:

1. In cooperation with partners, state and federal agencies, the native fish assemblage including RGCT could be expanded down to the Seven Springs Hatchery where a man-made barrier currently exists. Further expansion could be explored from this point downstream to Fenton Lake, which acts as a barrier. Even further, downstream expansion include Rio de las Vacas, forming an extensive population into Rio Guadalupe down to Gilman Tunnels.
2. A yearly monitoring program should be established to make sure that non-natives are not located above the barrier at McKinney Pond. If the monitoring program locates non-natives in this area, then they should be physically removed utilizing electrofishing equipment. However, if physical removal is not working, then chemical treatment should be utilized as well.
3. Further detailed field and literature studies should be conducted to determine whether or not the remaining native fish assemblage occupied waters above Fenton Lake. It is unclear if the waters above Fenton Lake were treated to remove “trash” fish or if other means of extirpation took place, such as from DDT spraying in the 60’s. DDT spraying of spruce budworm on other forests has been noted as extirpating full populations of fisheries in streams (Moore 1996). There are no natural barriers in the fish-bearing portion of Rio Cebolla and the waters are conducive to chub and sucker occupation.

Reach 1: Mouth at Porter to Meadow in T19N R2E S30

Reach 1 begins at the mouth, which is the confluence with Rio de las Vacas, near Porter (T 18N, R2E, Sec. 1) (see Photo 10). The survey of this reach started on July 4th, and ended on July 17, 2001. This reach starts at 7,190,' above sea level and continues upstream for 3.0 miles, where Rio Cebolla enters a big meadow at 7440'(T19N, R2E, Sec. 30). This reach has moderate gradient of 1.6%. A sand/silt substrate type dominates this reach. The Rosgen channel type for this reach is an E5 type channel.

Photo 10. Confluence of Rio de las Vacas and Rio Cebolla.

Reach 1 begins at Porter Landing, site of a historic logging camp and the junction of a spur rail line that came up the Rio Guadalupe through Gilman Tunnels. FS Road 376 parallels Rio Cebolla throughout Reach 1, allowing easy public access to dispersed recreation sites. Campsites are the main concern for water quality in this reach. During the survey, a portable toilet was found in the stream with human waste entering the water (see Photo 8). Other campsites in the area included latrine sites and unburied human waste within 1-3 feet of the stream. Large amounts of litter are evident as well as numerous dispersed foot and ATV trails fording the stream, contributing to bank destabilization. Some minor beaver activity was observed, but most pools (both natural and man-made) had filled in or were filling in with fine sediment. Numerous small rock and woody debris dams have been constructed in this reach. Most of these man-made structures were to provide swimming holes for recreationalists.

The riparian community consists mostly of woody species such as alder with some willow. Most of the ground was covered with various grass species, which are the

dominant riparian vegetation. Reach 1 is a meadow reach, with a wide-open valley floor, with some pockets of forested overstory. The majority of the overstory throughout this reach consisted of ponderosa pine, with some Douglas-fir and juniper.

Photo 11. Historic photo of Rio Cebolla one mile above Porter Landing in 1948. Notice lack of woody riparian vegetation.

Comparative photos of riparian and stream conditions from 1948 to 2002.

Photo 12. Rio Cebolla one mile above Porter Landing in 2002. Notice woody riparian species are present.

It is likely that the native fish assemblage minus the RGCT is found in this reach. Non-native salmonids are present which include brown and rainbow trout and cutbows (hybrid cross or rainbow and cutthroat trout). No snorkeling or electroshocking surveys were conducted in 2001. Further surveys need to be conducted to determine whether or not native fish reside in this reach.

Table 17. Water temperatures calculated from grab samples in Reach 1.

Reach	Max. Temp	Avg. Temp	Min. Temp
1	73	65.4	60

Water temperatures were also recorded with grab samples throughout the survey. The maximum temperature calculated from the grab data was 73º F, the average temperature for Reach 1 was 65.4º F, and the minimum temperature recorded during the survey was 60º F (see Table 17). The average and minimum temperatures fall within the tolerable range of RGCT (64-70º F), but the maximum temperature exceeds the tolerable range.

Table 18. Monthly temperatures for Rio Cebolla thermograph site.

Rio Cebolla @ Mouth			
Month	**Max Temp**	**Min Temp**	**Avg Temp**
June	73.02	46.21	62.25
July	74.54	56.24	64.98
August	69.13	55.69	62.05
September	62.46	50.11	56.12

The thermograph data collected at the mouth of Rio Cebolla, determined that it was **not properly functioning** exceeding the state standards 106 out of 109 days recorded (see Table 11). The site at the mouth exceeded the standards for salmonid development 60 out of 109 days recorded. The state water quality standards for a high quality cold water fishery, which includes Rio Cebolla, determine if the stream will be placed on the 303(d) list of impaired streams.

Habitat Characteristics

During the habitat survey conducted on Reach 1, the river was broken up into a total of 98 NSOs, measuring 15,724 feet in length. Of the 98 NSOs, almost 45% were pools. However, these 44 pools comprised only 7.5% of the stream habitat for Reach 1, 47 riffles accounted for 88.4% of the stream habitat (see Table 19). There is over 11 times more riffle habitat than pool habitat. While pool volume is moderately low, there is opportunity to increase pool formation with the introduction of LWD. The amount of side channel habitat is the highest of any reach in the entire river (3.9%), although an increase in side channel formation is suggested. The amount of side channel habitat is due to the low gradient meadow system, which typically is very sinuous with many side channels. However, a stream typically should have more side channel habitat. The lack of pool and side channel habitat can be attributed to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, extreme bank erosion, lack of LWD, and the deposition of sand and silt throughout the reach.

Table 19. Overall Stream Summary for Reach 1.

Reach 1					
Stream Length Surveyed:		15724 feet		3.0 miles	
Gradient:	1.6%		**Rosgen Channel Type:**		E5
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	44	1230	7.8	7.5	>30%
Riffle	47	14454	91.9	88.4	-
Culvert	1	40	0.3	0.3	-
Tributary	1	-	-	-	-
Falls	0	0	0	0	-
Side Channel	5	630	NA	3.9	-
Total	98	16354	100.0	100.0	-

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 1 is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except pool quality. Streambank condition is **at risk**. LWD is excluded from analysis in this reach as it is a meadow reach.

Table 20. Summary of Habitat and Substrate Percentages for Riffles in Reach 1.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
1	47	307.5	9.8	0.7	1.5	
Substrate Summary*						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
1	54.1	24.3	20.9	0.7	0.0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

* - substrate was recorded on 44 out of 47 riffles

Riffles in Reach 1 are **not properly functioning** for average sediment amounts, with 54.1% sand (sand, silt, clay, and fines), which is above the <20% criterion (see Table 20). This analysis only includes 44 of the 47 riffles in Reach 1, as 3 riffles did not have substrates recorded during the survey. Reach 1 is a low gradient reach, and is conducive for the settlement of fine substrates. Sand is typically collected in reaches with a gradient this low. However, the high amount of fine sediments in riffles in Reach 1 is well above natural levels.

Reach 1 was **properly functioning** for pool quality (see Table 21). The average residual pool depth was 1.2 feet, exceeding the properly functioning indicator of 1' (See Table 21). Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 1 was below acceptable levels. Reach 1 was **not properly functioning** for pool

quantity, with only 7.5%. The indicator for a properly functioning stream is ≥30% pool habitat. The lack of pool habitat is further accentuated by the lack of quality pools. There were no pools in the entire reach with a maximum depth greater than three feet. The average residual depth of the pools in Reach 1 was just above the minimum value of 1'. Pools appear to be filling in with sand. A stream with a "E" type channel should have more pools than is currently found in Reach 1. A typical E channel is a pool-riffle system where pools would typically be located on stream bends, and flows would scour out pools under the banks. However, this reach is lacking in pool formation. The substrate analysis for Reach 1 is only for 2 pools, as the observer did not estimate substrates for 42 of the pools.

Table 21. Summary of Pool Habitat and Substrate Percentages in Reach 1.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
1	44	28.0	15.1	1.9	0.7	1.2	14.8	23	7.7	0	0
Properly Functioning Indicators	-	-	-	-	-	<1'	-	-	-	-	-

Substrate Summary*							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
1	75.0	5.0	20.0	0	0	100.0	

*Substrate Summary for pools only includes 2 pools.

One reason for the lack of pool habitat in Reach 1 is siltation. The pools in Reach 1 have been filling in with fine sediment. Unfortunately, there are only 2 pools to base this analysis on. Sand was the dominant substrate composition (75%).

Table 22. Habitat Characteristics for the Reach 1.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
1	1:1.1	9:1	0.3[1]	3163	10.1
Properly Functioning Indicators	-	<12:1	>30	-	<10%

[1] LWD was removed from analysis as it is a meadow reach.

Although Reach 1 is defined as a meadow reach, the lack of LWD in Reach 1 may also be attributable to removal of LWD from fish-bearing streams. It was a common practice, in the middle part of this century, to remove LWD from streams. Logjams were seen as barriers to fish passage. However, LWD does not hinder fish movements. In fact LWD is an essential part of pool formation, and is critical in providing fish habitat. The accessibility of this reach may be another reason why the amount of LWD is so low. Recreationists have physically removed LWD for use in campfires, as was evident throughout Reach 1. Historic fire suppression practices may be another reason for the lack of LWD in this reach (as discussed in the Executive Summary).

The bankfull width-to-depth ratio for Reach 1 was 9:1. This ratio meets criteria for a typical "E"channel. Therefore Reach 1 is **properly functioning** for width-to-depth. Evidence of entrenchment, though, suggests that this needs to be further investigated. FS Road 376 and the old railroad bed affect the width-to-depth ratio in Reach 1. The road and railroad bed are adjacent to the stream channel and prohibits the stream from meandering naturally in its floodplain and reducing the width of the stream, causing the stream to degrade and forcing the stream to one side of the floodplain.

Photo 13. Reach 1. Dispersed campsite causing bank erosion. Note wood is being used to create stream crossing.

The streambank condition of Reach 1 is **at risk** with 10.1%, which exceeds the necessary amount of <10% for a properly functioning stream (see Table 22). The levels of bank instability are due to the heavy recreational use along the floodplain (see Photo 13), and are compounded by heavy grazing pressure.

Some of the causes for this reach not meeting the guidelines can be attributed to the heavy recreational use that occurs in this reach. Both sides of the river are riddled with dispersed trails and recreation sites. These dispersed sites are the main causes of the bank instability in this reach, further causing stream degradation. With some rehabilitation, such as planting willows and other native grasses, the bank stability could be increased dramatically.

Photo 14. Reach 1**,** NSO 98, R46. Entrenched channel showing bank erosion with willows growing at top of the slope.

Pool development was the other criterion that was not properly functioning, which has a relatively easy form of rehabilitation. Prior to LWD placement, the floodplain should be restored. Sections of the rail line are confining the stream channel and should be removed to allow natural movement of the stream bed as well as natural floodplain functions. Adding LWD to Reach 1 would benefit the stream, by increasing stream health, and would also benefit the recreational anglers by creating better fish habitat. LWD placement would also aid in creating more pool habitat for Reach 1. Unfortunately the forested area has been heavily logged in the early 20th century removing most of the large overstory from this area. Adding LWD would return the stream channel to its natural functioning condition, improving the bankfull width-to-depth ratio to natural levels.

The dispersed recreation areas should be relocated away from the streambanks and rehabilitated. These areas are causing sedimentation problems. Recreation levels will

likely increase with the opening of the Valles Caldera, rehabilitating and relocating these areas should occur before the visitation levels to the Jemez Mountains increase.

Beavers should be enticed into re-colonizing this area, since they had a historic presence. Replanting the riparian area with willow and aspen will attract beavers to this area. The beavers will create large pond complexes, which provide excellent fish habitat.

If this reach were to be rehabilitated, then personal contact with users and educational signs would be necessary in this area to ensure that the restoration would be effective. This area receives heavy recreational use from early spring to late fall.

Reach 2: From Meadow in T19N R2E S30 to Trail Canyon

Reach 2 begins at a large meadow in T19N, R2E, Sec. 30. The survey of this reach started on July 18 and continued through the July 24, 2001. This reach begins at 7,440' above sea level and continues up into the Jemez Mountains for 1.9 miles where it stops at the mouth of Trail Canyon at 7515' elevation (T19N, R2E, Sec. 20). This reach is moderately flat with a gradient of 0.7%. The Rosgen channel type for this reach is an E5 type channel. Reach 2 is dominated by fine sediment (sand, silt, clay), which is typical of low gradient streams.

A large cut bank begins Reach 2. While the valley here is nearly a mile wide and open, entrenched banks mostly obscure the actual stream. Cutbanks occur here and many past efforts to control erosion and downcutting were observed during the survey. These erosion control methods include log structures in and along the channel, rip-rap, gabions (both in-channel and along the banks; see Cover Photo), and "trash catcher" structures (see Photo 15). The purpose of trash collectors was to imitate beaver dams and large log structures. NMG&F conceived the idea of "an obstruction or a leaky dam made of hog-wire tied to the upstream side of a row of steel stakes as a possible solution to problems of high cost, difficulty of moving logs to stream in open areas, and streams lacking beaver habitat" (FS Files).

Photo 15. Reach 2, NSO 149, R71. Remnant trash structure in Rio Cebolla.

Lake Fork Canyon (Reach 2, NSO 123, T2) enters on the right, and is the major tributary to this reach. Due to limited flow from Lake Fork, no reach break was made. The

tributary mouth was flooded for over 100’ upstream, creating a major backwater refuge. Intact wetland areas with cattails and willows were noted here.

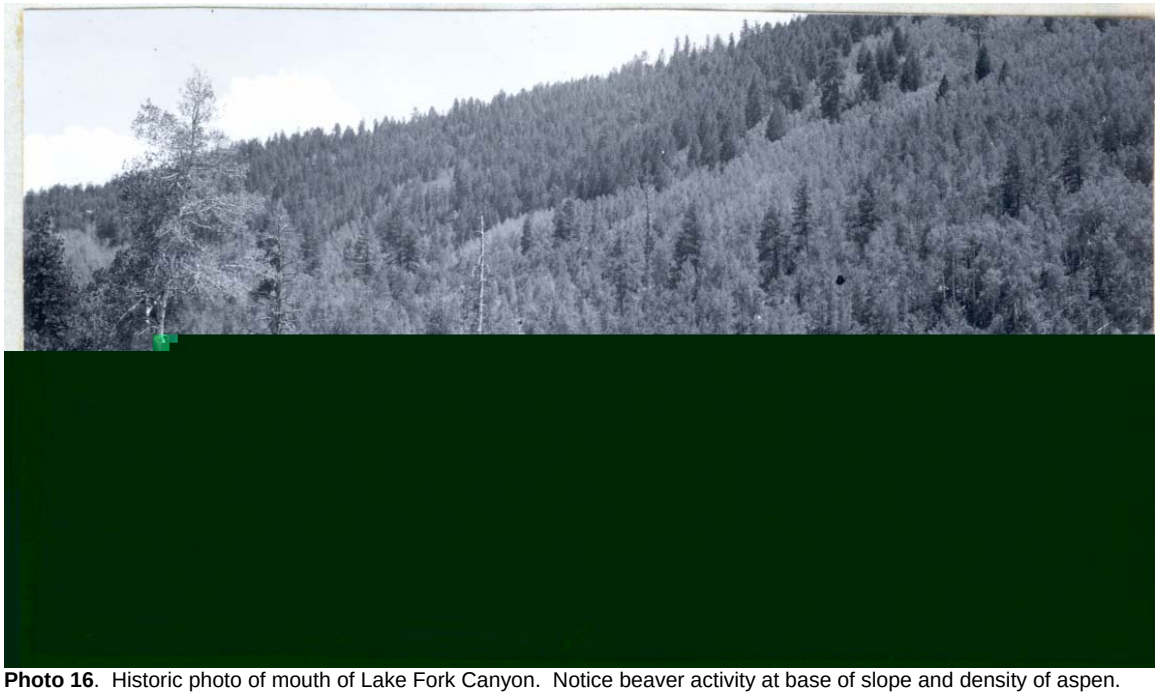


Photo 16. Historic photo of mouth of Lake Fork Canyon. Notice beaver activity at base of slope and density of aspen.

Comparative photos of historic and existing conditions of the resources around Lake Fork Canyon.

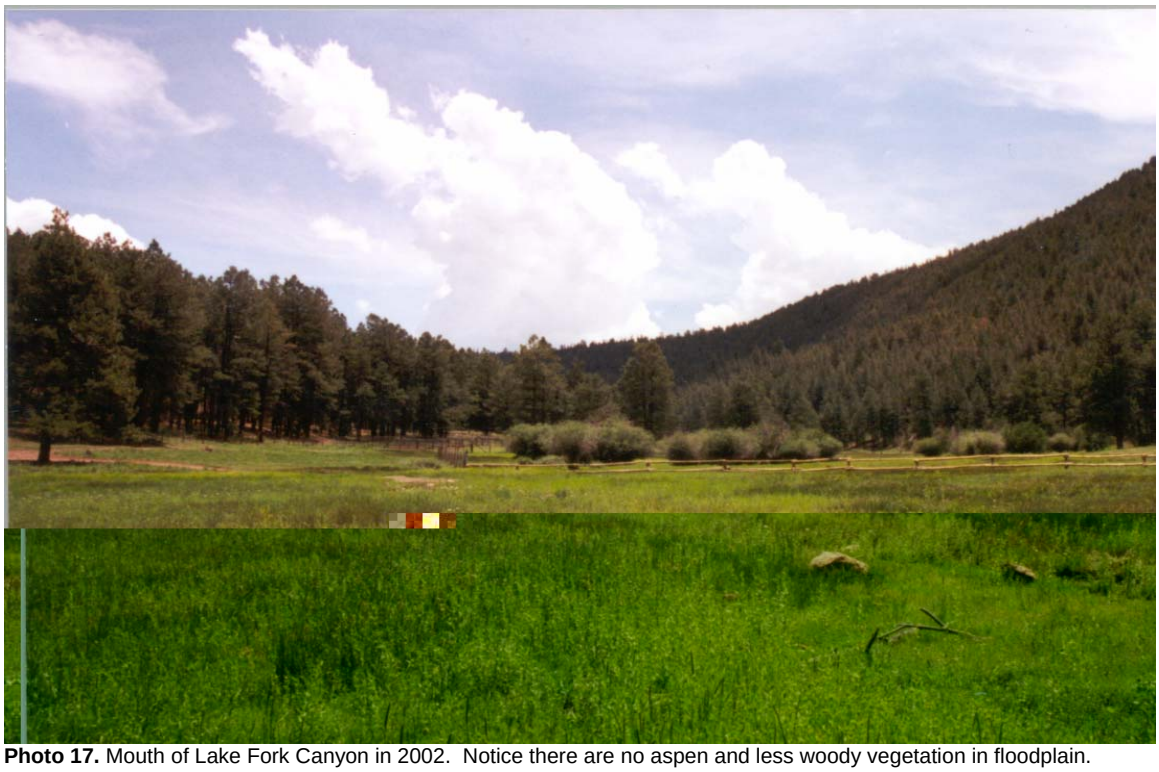


Photo 17. Mouth of Lake Fork Canyon in 2002. Notice there are no aspen and less woody vegetation in floodplain.

Much of this meadow system may have been created by beaver activity and deposition, although little current activity was observed. In the upper part of the meadows, near Lake Fork Canyon, and the FS Road 376 crossing, the stream has flows at or near natural grade, with banks lower than 3' in height. The lower portion of Reach 2 is highly entrenched, shaded by alders growing in the riparian terraces. In places, the old railroad bed and FS Road 376 forces the stream to one side of the floodplain causing this entrenchment. The headcutting creates some concern. If the channel continues to headcut, the entire reach would become heavily entrenched (see Photo 18).

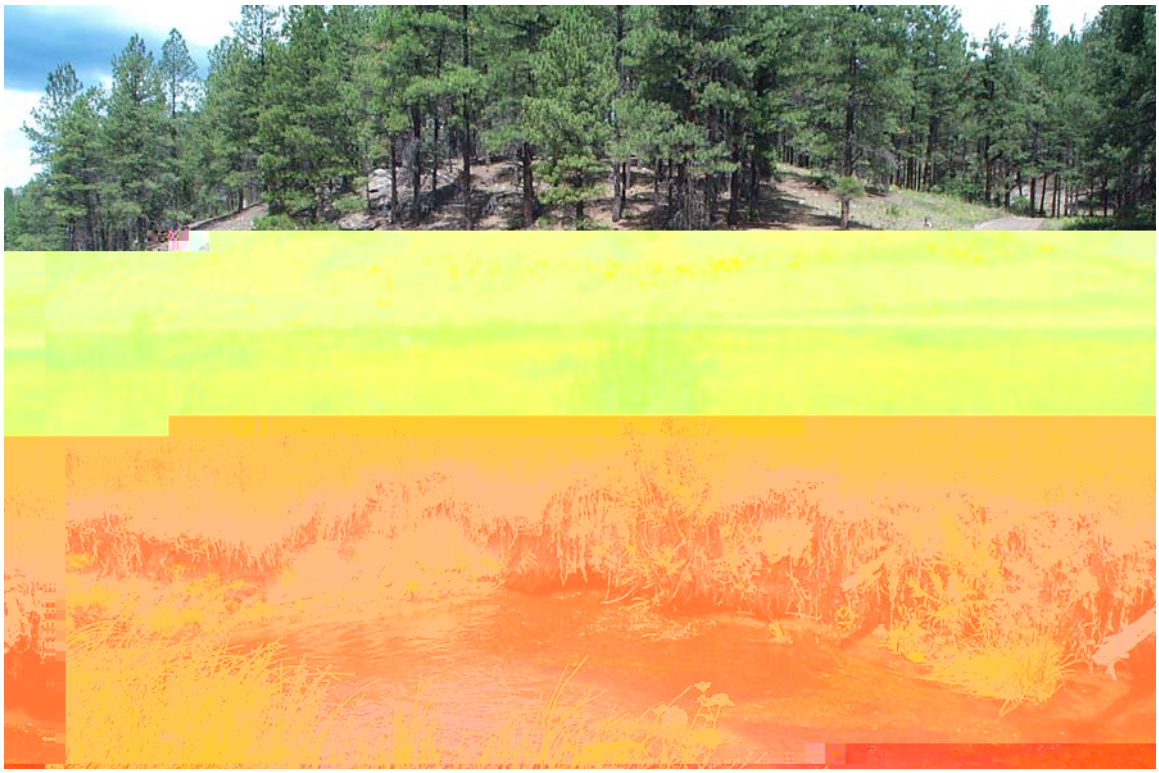


Photo 18. Reach 2, NSO 159, R76. Bank erosion along Rio Cebolla. Note amount of entrenchment and proximity to FS Road 376.

Reach 2 includes a section of private property, the Horn Property. The Horn Property was a homestead, 40 acres of which are still owned by the descendents of the original family. Grazing in the past was heavy, attested to by the large cutbanks and bare upland soils colonized by exotic vegetation such as thistle and mullen. Many of the riffles throughout the reach contained high quantities of macrophyte vegetation. This vegetation was observed to be stabilizing very large quantities of fine sediment.

The riparian community consists mostly of woody species such as alder with some willow. Most of the ground was covered with various grass species, which are the dominant riparian vegetation. Reach 2 is a meadow reach, with a wide-open valley bottom. This vegetation helped stabilize the banks. The stable banks were covered with grasses as well. The overstory outside of the riparian area was comprised mostly of ponderosa pine.

Non-native German brown trout were observed during the survey. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout. In addition, non-native salmonids, rainbow trout and cutbows, are likely present. Further surveys need to be conducted to determine whether or not native fish reside in this reach.

Table 23. Water temperatures calculated from grab samples in Reach 2.

Reach	Max. Temp	Avg. Temp	Min. Temp
2	68	64.4	60

No thermograph was placed in Reach 2, so there is no definitive temperature data associated with Reach 2 to be compared to State and Forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from the grab temperatures that the overall maximum temperature for Reach 2 was 68º F, the average temperature was 64.4º F, and the minimum was 60º F (see Table 23). The water temperatures for Reach 2 fall within the tolerable range for RGCT, which is <64-70º F.

Habitat Characteristics

During the habitat survey conducted on Reach 2, the river was broken up into a total of 67 NSOs, measuring 10,277 feet in length. Of the 67 NSOs, approximately 48% were pools. However, these 32 pools comprised only 7.1% of the stream habitat for the entire reach, 33 riffles accounted for 92.5% of the stream habitat (see Table 24). There is almost 13 times as much riffle habitat than pool habitat. The lack of pool and side channel habitat (0%) can be attributed to the entrenchment of the channel, decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, extreme bank erosion, lack of LWD, and the deposition of sand and silt throughout the reach. This entrenchment cuts the stream off from the floodplain, not allowing the channel to meander through its floodplain. The amount of fine sediment in the stream is also contributing to the lack of pool habitat

Table 24. Overall Stream Summary for Reach 2.

Reach 2					
Stream Length Surveyed:		10277 feet		1.9 miles	
Gradient:	0.7%		**Rosgen Channel Type:**		E5
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	32	734	7.1	7.1	>30%
Riffle	33	9508	92.5	92.5	-
Culvert	1	35	0.3	0.3	-
Tributary	1	-	-	-	-
Falls	0	0	0	0	-
Side Channel	0	0	-	0	-
Total	67	11011	100.0	100.0	-

below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical “E” type channel should have more pools than Reach 2 has. Typical “E” channel types are a riffle-pool system. In “E” channels, the pools would typically be located on stream bends, where flows would scour out pools under the banks. However, this reach is lacking in pool formation. This is likely due to the above normal fine sediment levels and decreased bank stability due to bank trampling and conversion of native grasses to a small root mass species like Kentucky bluegrass. It is clear from the data that the pools in Reach 2 are filling in with fine sediment. However, this data only represents 10 of the 32 pools, as the observer only recorded substrate for these 10 pools.

Table 27. Habitat Cha

instability are due to the heavy recreational use along the floodplain, and are compounded by heavy grazing pressure, mostly historic (see Photo 18).

Reach 3: Trail Canyon to Fenton Lake

Reach 3 begins at the mouth of Trail Canyon. The survey of this reach started on July 24th and continued through July 30, 2001. This reach begins at 7515' above sea level (T19N R2E S30) and continues upstream for 2.8 miles where it stops at Fenton Lake at 7645' elevation (T19N R2E S16). The average gradient for Reach 3 is 0.96%. The Rosgen channel type for this reach is a C5 type channel. The stream substrate is dominated by sand/silt.

A change in valley width from 1 mile to 0.5 miles and a change in gradient are what determine the reach break between Reaches 2 and 3.

Entrenchment was observed, where the stream meanders from cut banks on one side to a steep valley wall on the other (see Photo 19). There are currently no cattle grazing on Forest Service land in Reach 3 or in the Fenton Lake State Park Campground in the upper section of Reach 3.

Photo 19. Reach 3, NSO 227, R112. Typical stream habitat in Reach 3. Notice entrenchment occurring.

The riparian community consists mostly of woody species such as alder with some willow. Some conifer species were found in the riparian area as well. Most of the ground was covered with grasses. This vegetation helped stabilize the banks. This reach has a wide-open valley. The majority of the overstory throughout this reach consisted of ponderosa pine, with some Douglas-fir.

There were several old beaver dams found in Reach 3. Of the four recorded, only one remains active to this date.

New Mexico Department of Game & Fish was observed stocking 1200 rainbow trout in the lower campground area from July 25 through July 30, 2001. Many dead rainbow trout were observed during the next few days, which is likely due to stress caused by being placed in warmer water. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout. In addition, non-native salmonids, brown trout and cutbows, are likely present.

Table 28. Water temperatures calculated from grab samples in Reach 3.

Reach	Max. Temp	Avg. Temp	Min. Temp
3	70	67.8	65

It was determined from these grab samples that the overall maximum temperature for Reach 3 during the survey was 70º F, the average temperature was 67.8º F, and the minimum temperature was 65º F (see Table 28). The water temperatures for this reach meet the tolerable range of <64-70º F for RGCT.

Table 29. Monthly temperatures for Rio Cebolla thermograph site.

Rio Cebolla Below Fenton Lake			
Month	**Max Temp**	**Min Temp**	**Avg Temp**
June	74.83	52.51	63.18
July	75.46	58.4	64.64
August	71.49	57.55	63.07
September	63.84	50.84	57.20

The thermograph data collected determined that Rio Cebolla below Fenton Lake was **not properly functioning** exceeding the state standards 64 out of 109 days recorded. The site at the mouth exceeded the standards for salmonid development 76 out of 109 days recorded (see Table 12). The state water qualirds foa higher quatyha cdte wateliaad)ed

Table 30. Overall Stream Summary for Reach 3.

Reach 3					
Stream Length Surveyed:		14725 feet		2.8 miles	
Gradient:	0.9%		**Rosgen Channel Type:**		C5
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	26	586	4.0	4.0	>30%
Riffle	35	14139	96.0	95.3	-
Culvert	0	0	0	0	-
Tributary	3	-	-	-	-
Falls	0	0	0	0	-
Side Channel	3	110	-	0.7	-
Total	67	14835	100.0	100.0	-

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 3, is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition except pool quality and width-to-depth ratio.

Table 31. Summary of Habitat and Substrate Percentages for Riffles in Reach 3.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
3	35	404	8.1	0.8	1.7	
Substrate Summary*						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
3	55.8	36.8	7.4	0	0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

* - substrate was recorded on 34 out of 35 riffles

Riffles in Reach 3 are **not properly functioning** for average sediment amounts, with 55.8% fines (sand, silt, and clay,), which exceeds the <20% criteria (see Table 31). Reach 3 is a low gradient reach, and because of the velocity of the stream flow, this reach is conducive for the settlement of fine substrates. Sand is typically collected in reaches with a gradient as low as the gradient found in Reach 3.

Reach 3 was **properly functioning** for pool quality, with an average residual pool depth of 1.3', which exceeds the minimum of >1'(see Table 32). Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 3 was below acceptable levels. The pools are filling in with fine sediment, and the entrenchment has reduced the meander capability of the stream, which would create pools naturally. There are some significant pools in this reach created by beaver dams, yet the residual pool depth for the reach barely exceeds minimum standards.

Table 32. Summary of Pool Habitat and Substrate Percentages in Reach 3.

Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
3	26	22.5	11.6	2.0	0.7	1.3	9.3	19	6.8	1	0.4
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary*							
	Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
	3	68.8	30.8	0.4	0	0	100.0

* - substrate was recorded on 24 out of 26 pools

Reach 3 was **not properly functioning** for pool formation, with only 4.0% pool habitat, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "C" type channel should have more pools than Reach 3 has. It is concluded that a large portion of the pool habitat was lost in this reach due to siltation. Fine sediments are filling pools. Almost 70% of the substrate in pools is fine sediment (sand and silt), meaning that pools in this reach are likely filling in.

Table 33. Habitat Characteristics for the Reach 3.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
3	1:1.3	13:1	0.7	5089	17.3
Properly Functioning Indicators	-	12<30:1	>30	-	<10

Reach 3 is **not properly functioning** for LWD, with 0.7 pieces per mile (see Table 33), which is well below the necessary >30 pieces per mile necessary for a properly functioning stream. The lack of LWD in this reach can be attributed to several factors. First, Reach 3 is located below Fenton Lake. This man-made dam prevents LWD recruitment from upstream. Second, fire suppression practices have reduced the amount of LWD recruited into the stream channel (as discussed in the Executive Summary). Another possible factor is the removal of LWD from fish-bearing streams. It was a common practice, in the middle part of this century, to remove LWD from streams. Logjams were seen as barriers to fish passage. However, LWD does not hinder fish movements. In fact LWD is an essential part of pool formation, and is critical in providing fish habitat. The accessibility of this reach may be another reason why the amount of LWD is so low. Recreationists have likely physically removed LWD from streams or the floodplain for use in campfires.

The amount of unstable banks in Reach 3 was 17.3%, well above 10%. Therefore, reach 3 is **at risk** for streambank condition. Much of the bank instability found in this reach is

due to past management practices (dispersed and developed recreation and historic cattle grazing).

The bankfull width-to-depth ratio for Reach 3 is 13:1, within the necessary range of 12-30 for a "C" Type channel. Therefore, Reach 3 is **properly functioning** for the criterion for width-to-depth ratio.

One area of major concern in Reach 3 is the amount of fine sediment present in the stream. With the dam at Fenton Lake, there should be minimal sediment delivery in the reach. However, sediment levels are unnaturally high in Reach 3, especially directly below the reservoir dam. The US Forest Service should work cooperatively with New Mexico State Parks to manage the section of Rio Cebolla that flows through Fenton Lake State Park. This cooperative project would insure that dredged sediment would be removed from interaction with the downstream floodplain. Campsites that are hindering floodplain function should be redesigned or moved out of the floodplain to increase natural floodplain function.

LWD should be placed in the floodplain in Reach 3. The amount of LWD in Reach 3 is extremely low. The owners of the Horn Property are willing to work with the USFS to restore fish habitat on their land along Rio Cebolla. Another form of restoration that could be used to create more pool habitat is to restore woody riparian species, which in turn would promote re-colonization of beavers.

Photo 20. Reach 3, NSO 230, T5. User trail along the stream bank on Rio Cebolla. Notice increased bank instability.

Another recommendation is to re-design or implement angler trails that do not cause unstable banks, provide access at key points and limit stream crossings. The current angler and recreational user trails are increasing bank instability (See Photo 20).

Reach 4: Fenton Lake (Not Surveyed)

The survey was not conducted for Fenton Lake. This man-made reservoir is known to contain rainbow trout, brown trout, Rio Grande sucker, Rio Grande chub, and grass carp. It's maintained to keep a consistent pool level and there are excellent wetlands at the head of the reservoir. NM 126 creates a short dike across the head of the reservoir, creating more wetland features and a fluvial depositional area at the bottom end of Reach 5.

Figure 6. Monthly temperatures above Fenton Lake

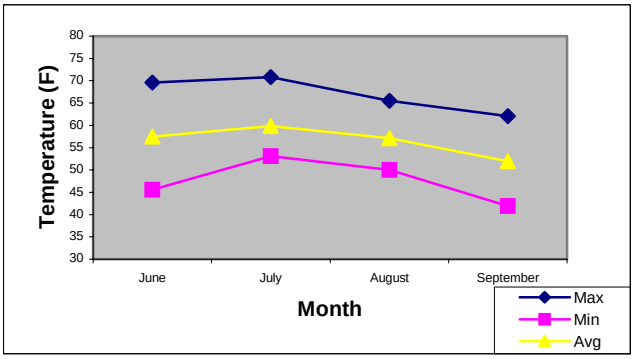
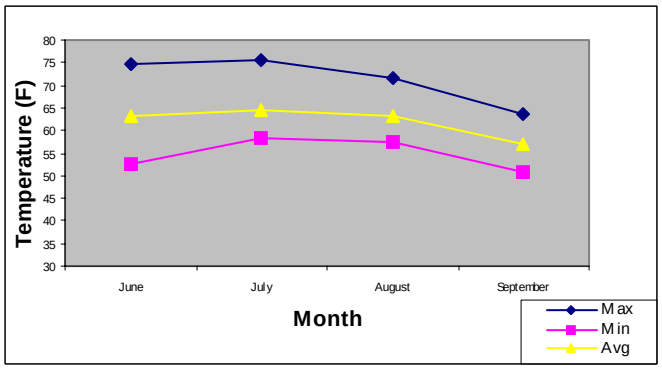


Figure 7. Monthly temperatures below Fenton Lake.



Fenton Lake is a man-made reservoir with a top draw dam. The warmer water is found in the upper layers of water. Therefore, Fenton Lake is warming the Rio Cebolla. The warm water enters the stream below the dam. It can be determined from our thermograph data that Fenton Lake is having a detrimental effect on Rio Cebolla water quality in terms of water temperatures. The water temperatures above and below show on average a 6°F difference from temperatures entering Fenton Lake to the water leaving Fenton Lake.

Photo 21. Reach 3, NSO 232, R114. Outflow of Fenton Lake. Thermograph location.

Reach 5: Fenton Lake to Seven Springs Community

Reach 5 begins at the NM Highway 126 crossing at Fenton Lake. The survey of this reach started on July 30, 2001 and continued through August 13, 2001. This reach begins at 7660' above sea level (T19N R2E S10) and continues up into the Jemez Mountains for 1.9 miles where it stops at the property line boundary at the Seven Springs community at 7760' elevation (T19N R2E S3). The average gradient for this reach is 1.0%. The Rosgen channel type for this reach is an "E5". The stream substrate is dominated by sand and silt.

This low gradient, highly sinuous reach contains some excellent wetlands and wet-meadow areas in the lower section of the reach. The lower meadow section is State Park land, designated as a wildlife refuge up to Barley Canyon, FS Road 378. The upper section of the reach above the road crossing is Forest Service land.

Sections of stream in the meadow were often completely obscured by overhanging sedge and cattail (see photos 21 and 22). Areas of flooded backwater and marsh caused the survey team to lose the main channel for 50-100 feet. Stable undercut banks were observed, with one side channel (NSO 263) actually traveling underground for 20-30 feet. No evidence of current grazing activity was observed in this reach.

Photo 21. Reach 5, NSO 282, R140. Bridge at Barley Canyon. Notice lush vegetation along streambanks and concrete And metal dam.

This reach receives heavy fishing pressure evidenced by regular stocking by New Mexico Game & Fish and resource damage. This area is also a heavy recreational use area. During the survey, several campsites were seen near the stream. Around these campsites

the vegetation had been destroyed leaving patches of bare ground or the entire area was "browned out".

The riparian community for Reach 5 consists mainly of various grass species. There were some willow and alder. The overstory is dominated by ponderosa pine, with some Douglas-fir.

Brown trout were observed during the survey as well as rainbow trout and cutbows. It is likely that the native fish assemblage once resided in this reach.

Table 34. Water temperatures calculated from grab samples in Reach 5.

Reach	Max. Temp	Avg. Temp	Min. Temp
5	64	59.6	56

During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 5 during the survey was 64º F, the average temperature was 59.6º F, and the minimum temperature was 56º F (see Table 34). All three temperatures meet the tolerable range of <64-70º F for RGCT.

Table 35. Monthly temperatures for Rio Cebolla thermograph site.

Rio Cebolla Above Fenton Lake			
Month	**Max Temp**	**Min Temp**	**Avg Temp**
June	69.6	45.56	58.09
July	70.79	53.07	59.82
August	65.52	50	57.09
September	62.07	41.93	51.95

The thermograph data collected determined that Rio Cebolla above Fenton Lake was **at risk** exceeding the state standards 15 out of 109 days recorded. The site at the mouth exceeded the standards for salmonid development 53 out of 109 days recorded (see Table 12). The state water quality standards for a high quality cold water fishery, which includes Rio Cebolla, determine if the stream will be placed on the 303(d) list of impaired streams.

Habitat Characteristics

During the habitat survey conducted on Reach 5, the river was broken up into a total of 66 NSOs, measuring 9892 feet in length. Of the 66 NSOs, approximately 41% were pools. However, these 27 pools comprised only 5.7% of the stream habitat for the entire reach, 35 riffles accounted for 93.6% of the stream habitat (see Table 36). There is over 16 times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 0.7%, of the stream habitat. The lack of pool and side channel habitat in the Forest Service portion of the reach can be attributed to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, extreme bank erosion, lack of LWD, and the deposition of sand and silt.

Table 36. Overall Stream Summary for Reach 5.

Reach 5					
Stream Length Surveyed:			9892 feet		1.9 miles
Gradient:	1.0%			**Rosgen Channel Type:**	C5
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning**

Table 38. Summary of Pool Habitat and Substrate Percentages in Reach 5.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
5	27	21.0	7.7	2.2	0.7	1.5	14.4	23	12.3	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary*							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
5	61.2	36.9	1.5	0.4	0	100.0	

* - substrate was recorded on 26 out of 27 pools

Reach 5 was **properly functioning** for pool quality, with an average residual pool depth of 1.5', which exceeds the minimum of >1' for a properly functioning stream (see Table 38). Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 5 was below acceptable levels. The dominant substrate in pools was sand, making up 61.2% of the substrate. Due to this observation, it can be determined that the pools within this reach have begun to fill in with fines. These fines are being transported from upstream sources. Reach 5 was **not properly functioning** for pool formation, with only 5.7% pool habitat, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "E" type channel should have more pools than Reach 5 has.

Table 39. Habitat Characteristics for the Reach 4.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
5	1:1.3	10:1	1.1	833	4.2
Properly Functioning Indicators	-	<12:1	>30	-	<10

Reach 5 is **not properly functioning** for LWD, with 1.1 pieces per mile, which is well below the necessary >30 pieces per mile necessary for a properly functioning stream (see Table 39). A contributor to the lack of LWD is the man-made controls at Seven Springs State Fish Hatchery and McKinney Pond. These control structures minimize the amount of LWD to be delivered to downstream areas during the region's infrequent delivery events, such as floods and extreme spring run-off. Therefore LWD recruitment is isolated to local delivery, which is already limited by the infrequent forested sections along Rio Cebolla. The lack of locally delivered LWD in this reach can be attributed to fire suppression practices (as discussed in the Executive Summary).

Another common practice of fuelwood and logjam removal may also be a cause in the reduced amounts of LWD in Reach 5.

The bankfull width-to-depth ratio for Reach 5 is 10:1, below the necessary range of <12 for an "E" Type channel. Therefore, Reach 5 is **properly functioning** for criterion for width-to-depth ratio.

Photo 22. Reach 5, NSO 267, P118. Lush wetlands area above Fenton Lake.

The stream bank condition for Reach 7 is **properly functioning**, with 4.2% unstable banks, below the necessary amount of <10% for a properly functioning stream.

Reach 5 is a candidate for restoration. The heavy recreational use has impacted the riparian areas, as well as the stream itself. The numerous dispersed trails, especially near the river, have created sediment inputs to the stream. The trails have also caused soil compaction, which prevents riparian vegetation from re-establishing in these areas as well as stream widening. Many of the dispersed campsites can be found in the floodplain, and have created similar problems to the riparian vegetation. These areas have been totally "browned out" (no vegetation in the campsites due to soil compaction).

Dispersed sites along Rio Cebolla should be redesigned and relocated away from streambanks. The hikers should be using one trail along the entire Rio Cebolla with an established alternative riverside trail in high use areas. Educational signs should be placed to inform people about the importance of riparian vegetation and healthy streams. This section of stream could be managed as day use only to allow for recovery. Riparian vegetation should be re-established to restore proper functions to the riparian ecosystem. An educational sign should be placed at trailheads, as well as the closed campsites. A person should patrol these areas informing the public about the proper practices necessary for low-impact recreation and keeping visitors informed as to the local regulations.

Reach 6: Seven Springs Community (Not Surveyed)

This reach is within the private property boundaries of the Seven Springs Homeowners' Association. Over forty landowners have may have stream frontage many of which are absentee. Individual express permission was not obtained at the time of the survey, so the reach was not surveyed. However, some observations of the area were made.

The stream flows through an area of mixed conifer forest and meadow. Gradient appears to be approximately 1% with low sinuosity. Many properties have driveways and culverts that cross the stream, probably with associated sediment delivery issues. The area was formerly the Fenton Ranch, and was likely heavily grazed in the past. Currently, many pastures have livestock including cattle and horses. The major concern in this reach is Calaveras Creek, a tributary that enters on the left bank. Sediment loads and turbidity levels are observed in Calaveras Creek that are far higher than other streams in the area (see Photo 23). Calaveras Creek drainage includes highly erosive soils and NM Highway 126 follows it for approximately one mile. Fine sediment loads in this creek are likely the main contributor of sediment to Rio Cebolla and Fenton Lake.

Photo 23. Sediment loads created by NM 126 through Calaveras Canyon on a morning after a monsoon event.

Hatchery staff and private citizens have repeatedly removed beaver dams currently in place on Calaveras Creek, near Seven Springs Fish Hatchery. These dams may be in a location to threaten road and building investments; however, some level of sediment holding structures in this area would be considered beneficial.

Reach 7: Seven Springs Fish Hatchery to Seven Springs Picnic Area

Reach 7 begins at the boundary line between the Seven Springs Community and Seven Springs State Fish Hatchery. The survey began on August 14, 2001. This reach begins at 7880' above sea level (T20N R2E S34) and continues upstream for 2.1 miles where it stops at Seven Springs Picnic Area (T20N R2E S26) at 8045' elevation. The average gradient for Reach 7 is 1.5%. The Rosgen channel type for this reach is an E5 channel type. The reach is dominated by sand and silt substrate.

Photo 24. Reach 7, NSO 310, F1. Concrete chute constructed at Seven Springs State Fish Hatchery.

Stream location and low sinuosity in this area are probably the result of past channel alteration in the original construction of the hatchery complex. At the time of this survey, the hatchery was being completely rebuilt and some influences on the stream reflect this. Perhaps 50% of the flow feed the hatchery, and flow into the main stream from pipes, overflows, seeps, and small streams. The flow source comes from natural springs. All flow eventually reaches Rio Cebolla which naturally/historically increased in flow at this springs complex. Above the hatchery, Rio Cebolla was observed to be a much smaller stream, roughly half the volume. A more thorough survey could include temperature and water quality monitoring of the water sources around Seven Springs hatchery. Heavy equipment activity at the time of the survey was intense, and some care had been taken to control erosion from areas of exposed soils by the use of net-fencing and straw bales. At the end of the hatchery complex is a man-made dam spillway (see Photo 24). The pool behind the dam is spring fed and the stream channel does not actually include the pond, skirting it through a wetlands area on the right bank. This reservoir is known as the "Ice Pond".

Photo 25. Reach 7, NSO 327, R166. Old beaver dam site located Above Seven Springs State Fish Hatchery.

The riparian community for Reach 7 consists mainly of grasses with a mixed conifer overstory.

Non-native brown trout were observed during the survey. RGCT once occupied this reach while Rio Grande chub and sucker possibly occupied this reach. It is unclear if the waters above Fenton Lake were treated to remove "trash" fish or if other means of extirpation took place, such as from DDT spraying in the 60's. DDT spraying of spruce budworm on other forests has been noted as extirpating full populations of fisheries in streams (Moore 1996). There are no natural barriers in the fish-bearing portion of Rio Cebolla and the waters are conducive to chub and sucker occupation._Non-native species such as rainbow and cutbows (rainbow cutthroat hybrids) are likely found within this reach.

Table 40. Water temperatures calculated from grab samples in Reach 7.

Reach	Max. Temp	Avg. Temp	Min. Temp
7	67	62.2	57

During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 7 during the

survey was 67º F, the average temperature was 62.2º F, and the minimum temperature was 57º F (see Table 40). All three temperatures are within the tolerable range of <64-70º F for RGCT.

Table 41. Monthly temperatures for Rio Cebolla thermograph site.

Rio Cebolla Above Seven Springs			
Month	**Max Temp**	**Min Temp**	**Avg Temp**
June	71.98	43.34	58.09
July	72.28	52.24	60.63
August	68.42	49.73	58.21
September	64.93	41.66	52.67

There was one thermograph site located in Reach 7. The thermograph data collected determined that Rio Cebolla above Seven Springs was **at risk** exceeding the state standards 41 out of 109 days recorded (see Table 11). The site above Seven Springs was **not properly functioning**, exceeding the standards for salmonid development 82 out of 109 days recorded. The state water quality standards for a high quality cold water fishery, which includes Rio Cebolla, determine if the stream will be placed on the 303(d) list of impaired streams.

Habitat Characteristics

Table 42. Overall Stream Summary for Reach 7.

Reach 7					
Stream Length Surveyed:		10968 feet		2.1 miles	
Gradient:	1.5%		**Rosgen Channel Type:**	C5	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	12	151	1.4	1.4	>30%
Riffle	21	10801	98.5	97.8	-
Culvert	1	16	0.1	0.1	-
Tributary	1	-	-	-	-
Falls	0	0	0	0	-
Side Channel	1	72	-	0.7	-
Total	36	11040	100.0	100.0	-

During the habitat survey conducted on Reach 7, the river was broken up into a total of 36 NSOs, measuring 10,968 feet in length. Of the 36 NSOs, approximately 33% were pools. However, these 12 pools comprised only 1.4% of the stream habitat for the entire reach, 21 riffles accounted for 97.8% of the stream habitat (see Table 42). There is over 69 times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 0.7%, of the stream habitat. The lack of pool and side channel habitat can be attributed to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, extreme bank erosion, lack of LWD, and the deposition of sand and silt throughout the reach.

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 7, is **not properly**

functioning for all criteria in the category of habitat characteristics and channel condition, except streambank condition and width-to-depth ratio.

Table 43. Summary of Habitat and Substrate Percentages for Riffles in Reach 7.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
7	21	514.3	5.0	0.5	1.2	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
7	50.9	36.2	12.9	0.0	0.0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

Riffles in Reach 7 are **not properly functioning** for average sediment amounts, with 50.9% fines (sand, silt, and clay), which exceeds the <20% criteria (see Table 43). The riffles are dominated by fine sediment. Reach 7 is a low gradient reach, and because of the velocity of the stream flow, this reach is conducive for the settlement of fine substrates. Sand is typically collected in reaches with a 1.5% gradient. However, the current amount of fine sediments is much higher than natural levels.

Table 44. Summary of Pool Habitat and Substrate Percentages in Reach 7.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
7	12	12.6	6.8	1.4	0.5	0.9	13.0	23	11.0	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-
Substrate Summary											
		Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total			
		7	53.4	35.0	3.3	0	8.3	100.0			

Reach 7 was **not properly functioning** for pool quality, with an average residual pool depth of 0.9', which is below the minimum of >1' for a properly functioning stream (see Table 44). The amount of pool habitat in Reach 7 was below acceptable levels. Reach 7 was **not properly functioning** for pool quantity, with only 1.4% pool habitat, which is below the necessary level of ≥30% pool habitat for a properly functioning stream. The lack of pool habitat within this reach can be attributed to deposition of fine sediments. Pools are filling in with fine sediments, as is shown by having 53.4% of the substrate in pools consisting of fines (sand and silt).

Reach 7 is **not properly functioning** for LWD, with 8.6 pieces per mile, which is well below the necessary >30 pieces per mile necessary for a properly functioning stream (see Table 45).

Photo 26. Reach 7,NSO 323, R164. Typical habitat in Reach 7 with a piece of LWD.

The bankfull width-to-depth ratio for Reach 7 is 9:1, within the range of <12 for an "E" channel. Therefore, Reach 7 is **properly functioning** for width-to-depth ratio.

The stream bank condition for Reach 7 is **properly functioning**, with 5.5% unstable banks, below the necessary amount of <10% for a properly functioning stream.

Table 45. Habitat Characteristics for the Reach 7.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
7	1:1.8	9:1	8.6	1199	5.5
Properly Functioning Indicators	-	<12:1	>30	-	<10

There are few recommendations for Reach 7. The first is to coordinate with NMG&F and hatchery personnel to ensure good habitat conditions are maintained or improved upon in the area of the hatchery complex. Consider water temperature and quality issues from pond and raceway outflows. Assessing the "Ice Pond" dam for possible enhancement and construction to form a true fish barrier was conducted in 1999. This barrier would allow for native fish recovery upstream and provide a buffer zone below

the McKinney Pond barrier. However, re-patriation has been postponed indefinitely due to the presence of whirling disease.

Of special note are the conditions of the streambanks throughout this reach. Much of Rio Cebolla throughout Reach 7, on Forest Service land, is within an exclosure. This exclosure has likely allowed riparian vegetation to grow and stabilize the streambanks. The recreation throughout this reach has also been greatly reduced due to the reconstruction of Seven Springs State Fish Hatchery and closure of Seven Springs Picnic Area, likely increa41ed p Ha

Reach 8: Seven Springs Picnic Area to McKinney Pond

Reach 8 begins at Seven Springs Picnic Area. This reach was created due to the change in gradient, increased sinuosity, and entrance to the meadow system in Reach 8. The survey of this reach started on August 21 and continued through August 22, 2001. This reach begins at 8045' above sea level (T20N R2E S26) and continues upstream through Forest Service land, into the Jemez Mountains for 2.2 miles, where it stops at McKinney Pond (T20N R2E S24) at 8125' elevation. The average gradient for this reach is 0.7%. The Rosgen channel type for this reach is an E5 channel type. The stream substrate is dominated by sand substrate.

Public vehicle access beyond Seven Springs Picnic Area has been closed since 1992. The closure was enacted by the Jemez District Ranger to specifically protect the stream and promote native fish recovery, though foot and horse traffic is allowed. The most popular point of access for anglers is Oat Canyon, from FS Road 380. Several anglers were encountered in the Rio Cebolla.

This reach has many quality pools, including some man-made pools. Old beaver activity was observed and historical data indicates heavy beaver use in this area, described as "stair stepped beaver ponds all the way up those meadows." (Travis Mosely, personal communication 2001) Oat and Hay Canyon did not contribute any flow during the time of the survey. An elk grazing exclosure at the mouth of Oat Canyon was observed to have cattle inside it at the time of a snorkel survey conducted on August 9, 2001.

Photo 27. Reach 8, NSO 393, T10. Small tributary entering Rio Cebolla on right bank. Notice lack of woody riparian vegetation.

The riparian vegetation was comprised of alder with some willow. Grasses were common along the banks and helped stabilize the stream banks. Reach 8 was a typical meadow reach.

Some stream improvement structures were found in Reach 8. The majority of these were installed in the late 1980's or early 1990's with help from New Mexico Trout. This restoration effort included the construction of McKinney Pond and the removal of non-native fish above the barrier.

A snorkel survey was conducted on August 9, 2001. Five 100 meter transects were snorkeled below McKinney Pond (NSO 408-413), and five 100 meter transects were snorkeled above the dam (NSO 414-421). Below McKinney Pond, brown trout dominated the fish assemblage, with diverse age classes. RGCT that were observed below the pond were stocked by NMG&F (Paroz, Personal Communication, 2001).

Table 46. Fish identified during a 500 meter snorkel survey in Reach 8 on August 9, 2001 (below McKinney Pond).

Species	Juvenile (<3')	Sub-Adult (3-6")	Adult (6-9")	Large Adult (9-12")	Big Fatty >12"	Total
Rio Grande Cutthroat	7	0	2	3	2	14
Brown Trout	32	77	69	16	2	196
Rainbow Trout	1	0	0	0	0	1
Cutbow	0	0	1	0	0	1
Unknown Trout	1	7	2	0	0	10

During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 8 during the survey was 70º F, the average temperature was 65º F, and the minimum temperature was 58º F (see Table 47). All three temperatures were within the tolerable range of <64-70º F for RGCT.

Table 47. Water temperatures calculated from grab samples in Reach 8.

Reach	Max. Temp	Avg. Temp	Min. Temp
8	70	65	58

Habitat Characteristics

During the habitat survey conducted on Reach 8, the river was broken up into a total of 78 NSOs, measuring 11,717 feet in length. Of the 68 NSOs, approximately 45% were pools. However, these 35 pools comprised only 4.4% of the stream habitat for the entire reach, 38 riffles accounted for 95.6% of the stream habitat (see Table 48). There is over 21 times as much riffle habitat in this reach as there is pool habitat. The lack of pool and side channel habitat can be attributed to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, extreme bank erosion, lack of LWD, and the deposition of sand and silt throughout the reach.

Table 48. Overall Stream Summary for Reach 6.

Reach 8					
Stream Length Surveyed:		11717 feet		2.2 miles	
Gradient:	0.7%		**Rosgen Channel Type:**		E5
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	35	510	4.4	4.4	>30%
Riffle	38	11207	95.6	95.6	-
Culvert	0	0	0	0	-
Tributary	5	-	-	-	-
Falls	0	0	0	0	-
Side Channel	0	0	-	0	-
Total	78	11717	100.0	100.0	-

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 8, is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except pool quality, streambank condition, and width-to-depth ratio.

Riffles in Reach 8 are **not properly functioning** for average sediment amounts, with 50.7% fines (sand, silt, and clay), which exceeds the <20% criteria (see Table 49). The riffles are dominated by sand. A large percent of the riffles in Reach 8 are long, deep, slow moving riffles, called glides. It is concluded that a large portion of the pool habitat was lost in this reach due to siltation. These glides were pools at one time, but due to the high amount of fines in the system, the pools have filled in to form glides. Reach 8 is a low gradient reach, and because of the velocity of the stream flow, this reach is conducive for the settlement of fine substrates. Sand is typically collected in reaches with a 0.7% gradient.

Table 49. Summary of Habitat and Substrate Percentages for Riffles in Reach 8

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
8	38	294.9	4.9	0.6	1.3	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
8	50.7	43.2	6.1	0.0	0.0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

The siltation problem is exacerbated by the closed road system along the stream that was never rehabilitated. Although closed, the existing and unmaintained road is a sediment source. Another factor in the exorbitant levels of sediment is runoff from the numerous

ephemeral draws located within the watershed. Large quantities of sediment are being washed out of these draws into the Rio Cebolla. In 2000, the Santa Fe National Forest implemented an erosion control project in Oat Canyon (Rio Grande Cutthroat Trout Candidate Status Review Response Paper 2002). This project, however, has not eliminated the runoff from Oat Canyon.

Table 50. Summary of Pool Habitat and Substrate Percentages in Reach 8.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
8	35	14.6	6.0	1.6	0.5	1.1	15.8	17	7.7	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
8	56.5	42.6	0.9	0.0	0.0	100.0	

Reach 8 was **properly functioning** for pool quality, with an average residual pool depth of 1.1', which barely exceeds the minimum of >1' for a properly functioning stream (see Table 50). This is consistent throughout the stream indicating that pools are filling in with fine sediments.

Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 8 was below acceptable levels. Reach 8 was **not properly functioning** for pool formation, with only 4.4% pool habitat, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "E" type channel should have more pools than Reach 8 has.

LWD was not analyzed for Reach 8, as it was a meadow reach.

Table 51. Habitat Characteristics for the Reach 8.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
8	1:1.1	9:1	0.5[1]	1889	8.1
Properly Functioning Indicators	-	<12:1	>30	-	<10

[1] LWD was excluded from analysis as Reach 8 was a meadow reach.

The bankfull width-to-depth ratio for Reach 8 is 9:1, well within the necessary range of <12 for an "E" Type channel (see Table 51). Therefore, Reach 8 is **properly functioning** for criterion for width-to-depth ratio.

The stream bank condition for Reach 8 is **properly functioning**, with 8.1% unstable banks, below the necessary amount of <10% for a properly functioning stream.

Photo 28. Reach 8, NSO 398, R197. Typical habitat in Reach 8. Notice browsed willow and erosion caused by cattle.

There are a few recommendations for Reach 8. The fisheries program recommends improvement to current riparian conditions. There are several ways to accomplish this, which may include but is not limited to: 1) planting and/or seeding of native vegetation; 2) incorporating prescribed fire through the meadows to promote growth of the dormant seed bank; 3) improved road management which would include properly decommissioning unneeded roads and improving road grade and crossings; and 4) further improving and developing upland water developments to spread out and further limit riparian utilization. Cattle were observed in this pasture during the survey period (August 21-22). According to the Annual Operating Instructions for this allotment, cattle were not designated to be utilizing this pasture at that time. Forest Service personnel should work closely with permittees to make sure regulations are followed in this allotment. In 2003, a 5-mile exclosure will be implemented throughout this reach from Seven Springs to the Pipeline Road, which will limit livestock grazing in the valley bottom to two weeks a year, allowing for riparian recovery.

Jemez Ranger District is also pursuing funding for an extensive willow and aspen planting project in Rio Cebolla. The planted species could be placed in protective tubes to prevent browsing from elk. In addition, oversaturation of plantings will allow a higher percentage of plants to successfully establish themselves. A healthy riparian area is necessary to keep water temperatures low, as well as stabilizing the stream banks. A healthy riparian area would also provide water storage, and an allocthonous source of nutrients for the stream invertebrates.

Reach 9: McKinney Pond (Not Surveyed)

McKinney pond was constructed in 1992 to provide a barrier to upstream movement of fish. It had a pool approximately 10' deep at the time of construction, with a top-drain intake pipe (vertical culvert) (see Photo 4). The Rio Cebolla above McKinney Pond was then chemically treated to remove brown and rainbow trout. Rio Gr thonallsalremnraianv a above McKinney

Reach 10: McKinney Pond to Road Canyon

Reach 10 begins at the head of McKinney Pond (T20N R2E S24). The survey of this reach began on August 22, 2001 and continued through August 28, 2001. This reach begins at 8145' above sea level and continues for 1.2 miles to the mouth of Road Canyon (T20N R2E S18) at 8485' elevation. The average gradient for Reach 10 is 1.4%. The Rosgen channel type for this reach is E4. The stream substrate is dominated by gravel.

This section is moderately entrenched and showed some shading by alders. Stability problems were common in Reach 10, and a project to improve bank stability and fish habitat was conducted in the early 1990's. Some of the log structures helped to create plunge pools; however, many failed (see Photo 30). Similar grazing conditions were observed in this reach as in Reaches 8, 11, and 12.

Photo 30. Reach 10, NSO 438, R222. Typical habitat in Reach 10. Notice heavy utilization in floodplain and failed stream restoration structure in foreground.

The riparian community for Reach 10 consists of grass species. The major woody species in the riparian area is alder. Reach 10 is a meadow reach with a wide-open valley bottom.

Rio Grande cutthroat trout were the only fish species located above McKinney Pond. A snorkel survey was conducted on August 9, 2001. Five 100 meter transects were snorkeled (NSO 414-421). Just above McKinney Pond, the snorkel survey confirmed that a diversified age class of RGCT resides above McKinney Pond

Table 52. Fish identified during a 500 meter snorkel survey in Reach 10 on August 9, 2001 (above McKinney Pond)

Species	Juvenile (<3')	Sub-Adult (3-6")	Adult (6-9")	Large Adult (9-12")	Big Fatty >12"	Total
Rio Grande Cutthroat	22	33	6	0	1	62
Unknown Trout	3	0	1	0	0	4

There is no thermograph data associated with Reach 10, so there is no definitive water temperature data to compare to State and Forest water quality guidelines. During the survey, grab temperatures were taken throughout the day.

Table 53. Water temperatures calculated from grab samples in Reach 10.

Reach	Max. Temp	Avg. Temp	Min. Temp
10	65	57.7	50

It was determined from these grab samples that the overall maximum temperature for Reach 7 during the survey was 65º F, the average temperature was 57.7º F, and the minimum temperature was 50º F (see Table 53). All three temperatures are within or are below the tolerable range of <64-70º F for RGCT.

Habitat Characteristics

Table 54. Overall Stream Summary for Reach 10.

Reach 10					
Stream Length Surveyed:		6583 feet		1.2 miles	
Gradient:	1.4%		**Rosgen Channel Type:**		E4
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	21	241	3.7	3.7	>30%
Riffle	22	6342	96.3	96.3	-
Culvert	0	0	0	0	-
Tributary	3	-	-	-	-
Falls	0	0	0	0	-
Side Channel	0	0	-	0	-
Total	46	6583	100.0	100.0	-

During the habitat survey conducted on Reach 10, the river was broken up into a total of 46 NSOs, measuring 6,583 feet in length. Of the 46 NSOs, approximately 46% were pools. However, these 21 pools comprised only 3.7% of the stream habitat for the entire reach, 22 riffles accounted for 96.3% of the stream habitat (see Table 54). There is over 26 times as much riffle habitat in this reach as there is pool habitat. There were no side channels found in this reach. The lack of pool and side channel habitat can be attributed to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, and the deposition of sand and silt throughout the reach.

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 10 is **not properly**

functioning for all criteria in the category of habitat characteristics and channel condition, except pool quality and stream bank condition.

Table 55. Summary of Habitat and Substrate Percentages for Riffles in Reach 10.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
10	22	288.3	4.2	0.5	1.2	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
10	45.9	52.7	1.4	0.0	0.0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

Riffles in Reach 10 are **not properly functioning** for average sediment amounts, with 45.9% fines (sand, silt, clay, and mud), which exceeds the <20% criteria (see Table 55). The riffles are dominated by gravels and fines (sand, silt, clay, and mud). A large percent of the riffles in Reach 10 are long, deep, slow moving riffles, called glides. It is concluded that a large portion of the pool habitat was lost in this reach due to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, and the deposition of sand and silt throughout the reach. Fine sediment loading is partly due to natural conditions but has been exacerbated by a network of maintained and unmaintained roads as well as other upland disturbances from historic grazing and recreational use.

Table 56. Summary of Pool Habitat and Substrate Percentages in Reach 10.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
10	21	11.5	5.0	1.5	0.4	1.1	16.8	12	9.6	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-
Substrate Summary*											
		Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total			
		10	54.0	45.0	1.0	0.0	0.0	100.0			

* - substrate recorded on 20 out of 21 pools

Meadow reaches, like Reach 10, typically have undercut banks on both sides or alternating sides of the stream. These undercut banks provide quality fish habitat, and shade the stream. Grazing along the stream banks has caused the undercut banks to slough off into the river, adding fine sediments to the stream, and widening the stream (see Photo 31). These fine sediments have filled the pools throughout this reach with silt, choking off quality fish habitat.

Reach 10 was **properly functioning** for pool quality, with an average residual pool depth of 1.1', which barely exceeds the minimum of >1' for a properly functioning stream (see Table 56), which alludes to pools filling in with fine sediment. This is an issue to stream productivity and limits the size of the RGCT population due to limited overwintering habitat.

Reach 10 was **not properly functioning** for pool formation, with only 3.7% pool habitat, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A similar meadow reach in reference condition in Rio de las Vacas had 50% pool volume (2002 survey in San Pedro Parks Wilderness). A typical "E" type channel should have more pools than Reach 10 has. However, due to the erosion occurring in the stream channel and loss of undercut banks, the pool habitat is greatly decreased.

The amount of LWD does not apply to Reach 10, as it is a meadow system. LWD would not occur in high quantities in this reach, as there is no local recruitment of wood falling into the channel. There are also limited sources of recruitment from upstream sources, as there are limited forested reaches above here. However, historically there may have been willows growing along the banks of the river. These willows would have provided some source of woody debris to the stream.

Table 57. Habitat Characteristics for the Reach 10.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
10	1:1	7:1	4.0[1]	873	6.6
Properly Functioning Indicators	-	<12:1	>30	-	<10

[1] LWD was omitted from analysis, as Reach 10 is a meadow reach.

The bankfull width-to-depth ratio for Reach 10 is 7:1, well within the necessary range of <12 for an "E" channel type (see Table 57). Therefore, Reach 10 is **properly functioning** for width-to-depth ratio.

The stream bank condition for Reach 10 is **properly functioning**, with 6.6% unstable banks, below the necessary amount of <10% for a properly functioning stream.

There are a few recommendations for Reach 10. The fisheries program recommends improvement to current riparian conditions. There are several ways to accomplish this, which may include but is not limited to: 1) planting and/or seeding of native vegetation; 2) incorporating prescribed fire through the meadows to promote growth of the dormant seed bank; 3) improved road management which would include properly decommissioning unneeded roads and improving road grade and crossings; and 4) further improving and developing upland water developments to spread out and further limit riparian utilization. Cattle were observed in this pasture during the survey period (August 21-22). According to the Annual Operating Instructions for this allotment, cattle were

not designated to be utilizing this pasture at that time. Forest Service personnel should work closely with permittees to make sure regulations are followed in this allotment. In 2003, a 5-mile exclosure will be implemented throughout this reach from Seven Springs to the Pipeline Road, which will limit livestock grazing in the valley bottom to two weeks a year, allowing for riparian recovery.

Jemez Ranger District is also pursuing funding for an extensive willow and aspen planting project in Rio Cebolla. The planted species could be placed in protective tubes to prevent browsing from elk. In addition, oversaturation of plantings will allow a higher percentage of plants to successfully establish themselves. A healthy riparian area is necessary to keep water temperatures low, as well as stabilizing the stream banks. A healthy riparian area would also provide water storage, and an allocthonous source of nutrients for the stream invertebrates.

Photo 31. Reach 10, NSO 446, R226. Cattle crossing along Rio Cebolla. Notice stream widening and unstable banks at this site.

Reach 11: Road Canyon to Tributary (SW ¼ of T20N R2E S25)

Reach 11 begins at the confluence with Road Canyon (T20N R2E S18). The survey of this reach started on August 28, 2001 and continued through August 30, 2001. This reach begins at 8240' above sea level and continues for 2.8 miles to an unnamed tributary on the left bank in T20N R2E S25 (SW ¼)at 8440' elevation. The average gradient for Reach 11 is 1.3%. The Rosgen channel type for this reach is an E4 channel. The stream substrate is dominated by gravel.

The dominant impact in Reach 11 is cattle grazing, with Reach 11 likely being the heaviest impacted reach in Rio Cebolla. Entrenchment was noted, along with unstable banks. The number of pools was high; with many natural scour pools as well as the highest number of man-made log plunge pools structures observed during the survey. USFS and New Mexico Trout created these structures in the early 1990's.

Photo 32. Reach 11, NSO 576, R288. Typical habitat in Reach 11. Notice extreme resource damage created by grazing.

The riparian community was comprised of willow and alder species. Stream banks were covered with grasses as well, helping in stabilizing the stream banks. Riparian area was heavily browsed, with some alder and willow clumps being in poor condition.

At least one beaver dam was observed, long ago silted in and breached, forming a meadow with an old lodge still evident in the center. Some floodplain areas here were strangely humped and furrowed, with more cobbles evident on the terraces and in the channel, likely evidence of old beaver meadows. Shading of the entire reach was

minimal, and the stream was easy to walk in, without thick brush cover seen in other reaches.

Table 58. Water temperatures calculated from grab samples in Reach 11.

Reach	Max. Temp	Avg. Temp	Min. Temp
11	64	53.6	50

There is no thermograph data associated with Reach 11, so there is no definitive water temperature data to compare to state and forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 11 during the survey was 64ºF, the average temperature was 53.6ºF, and the minimum temperature was 50ºF (see Table 58). All three temperatures were within or below the tolerable range of <64-70ºF for RGCT.

Habitat Characteristics

Table 59. Overall Stream Summary for Reach 11.

Reach 11					
Stream Length Surveyed:		14847 feet		2.8 miles	
Gradient:	1.3%		**Rosgen Channel Type:**		C4
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	66	743	5.0	4.9	>30%
Riffle	73	14104	95.0	93.5	-
Culvert	0	0	0	0	-
Tributary	5	-	-	-	-
Falls	0	0	0	0	-
Side Channel	2	230	-	1.5	-
Total	146	15077	100.0	100.0	-

During the habitat survey conducted on Reach 11, the river was broken up into a total of 146 NSOs, measuring 14,847 feet in length. Of the 146 NSOs, approximately 45% were pools. However, these 66 pools comprised only 4.9% of the stream habitat for the entire reach, 73 riffles accounted for 93.5% of the stream habitat (see Table 59). There is over 19 times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 1.5%, of the stream habitat. The lack of pool and side channel habitat can be attributed to decrease in meander, channel degradation, loss of undercut banks, stream widening and shallowing, extreme bank erosion, and the deposition of sand and silt throughout the reach.

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 11 is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition.

Table 60. Summary of Habitat and Substrate Percentages for Riffles in Reach 11.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
11	73	193.2	3.2	0.5	1.0	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
11	43.2	52.0	4.7	0.1	0.0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

Riffles in Reach 11 are **not properly functioning** for average sediment amounts, with 43.2% fines (sand, silt, and clay,), which exceeds the <20% criteria (see Table 60). This has limited spawning potential and productivity. A large percent of the riffles in Reach 11 are long, deep, slow moving riffles, called glides. These glides were likely pools that have filled in due to siltation. The high amount of fine sediments found in this reach is due to the bank erosion occurring throughout this reach and increased sediment inputs from upland sources. Reach 11 is a meadow reach with occasional forested overstory and would typically have more pools, likely created by LWD in the stream channel and undercut banks. These undercut banks provide quality fish habitat, and shade the stream. Grazing the vegetation along the stream banks has caused the undercut banks to slough off into the river, adding fine sediments to the stream. These fine sediments have filled the pools throughout this reach with silt, choking off quality fish habitat.

Table 61. Summary of Pool Habitat and Substrate Percentages in Reach 11.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
11	66	11.3	4.9	1.3	0.4	0.9	23.5	11	3.9	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-
Substrate Summary											
		Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total			
		11	58.3	39.2	1.4	1.1	0	100.0			

Reach 11 was **not properly functioning** for pool quality, with an average residual pool depth of 0.9', which does not meet the minimum requirement of >1' for a properly functioning stream (see Table 61). The amount of pool habitat in Reach 11 was below acceptable levels, indicating that pools are filling in due to bank erosion and sediment delivery from the poor road network and grazing practices in the upland areas. This

indicates that pools are filling in with fine sediment. This limits stream productivity and the size of the RGCT population due to minimal overwintering habitat.

Reach 11 was **not properly functioning** for pool formation, with only 4.9% pool habitat, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "E" type channel should have more pools than Reach 11 has. However, due to the erosion occurring in the stream channel, and lack of channel forming events the pool habitat is greatly decreased.

Reach 11 is a meadow reach and is therefore not analyzed for LWD.

Table 62. Habitat Characteristics for the Reach 11.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
11	1:1.1	10:1	1.1[1]	3769	12.7
Properly Functioning Indicators	-	<12:1	>30	-	<10

[1]LWD was removed from analysis as Reach 11 is a meadow reach.

The stream bank condition for Reach 11 is **at risk**, with 12.7% unstable banks, exceeding the necessary amount of <10% for a properly functioning stream.

The bankfull width-to-depth ratio for Reach 11 is 10:1. This is within the necessary range of <12 for a properly functioning "E" channel. Therefore Reach 11 is **properly functioning** for width-to-depth ratio.

There are a few recommendations for Reach 11. The fisheries program recommends improvement to current riparian conditions. There are several ways to accomplish this, which may include but is not limited to: 1) planting and/or seeding of native vegetation; 2) incorporating prescribed fire through the meadows to promote growth of the dormant seed bank; 3) improved road management which would include properly decommissioning unneeded roads and improving road grade and crossings; and 4) further improving and developing upland water developments to spread out and further limit riparian utilization. Cattle were observed in this pasture during the survey period (August 21-22). According to the Annual Operating Instructions for this allotment, cattle were not designated to be utilizing this pasture at that time. Forest Service personnel should work closely with permittees to make sure regulations are followed in this allotment. In 2003, a 5-mile exclosure will be implemented throughout this reach from Seven Springs to the Pipeline Road, which will limit livestock grazing in the valley bottom to two weeks a year, allowing for riparian recovery.

Jemez Ranger District is pursuing funding for an extensive willow and aspen planting project in Rio Cebolla. The planted species could be placed in protective tubes to prevent browsing from elk. In addition, oversaturation of plantings will allow a higher percentage of plants to successfully establish themselves. A healthy riparian area is necessary to keep water temperatures low, as well as stabilize streambanks and provide water storage.

Reach 12: Tributary in SW ¼ of T20N R2E S25 to Terminus of Fish Presence

Reach 12 begins at the confluence with an unnamed tributary on the left bank in the SW ¼ of T20N R2E S25. The survey of this reach started on August 30, 2001 and continued through September 4, 2001. This reach begins at 8440' elevation. Reach 11 continues for 1.5 miles until a large bedrock feature that is thought to be the terminus of fish presence in Rio Cebolla (T20N R2E S5) at 8560' elevation (see Photo 33). This bedrock feature is 2931' upstream from the Pipeline Road crossing. The average gradient for Reach 12 is 1.5%. The Rosgen channel type for this reach is an E4 channel. The stream substrate is dominated by gravel.

Photo 33. Reach 12, NSO 632, F2. Suspected barrier where fish presence ends.

Entrenchment is moderate, with a restricted valley floor width near the top of the reach, less than 300 feet. Aspen groves were observed in the lower meadow area of Reach 12, just below the FS Road 527 crossing. An area of mature dead alders was observed as well. The stream above FS Road 527 flows through conifer forested areas down to the

water's edge with correspondingly higher amounts of LWD. Two fords and several dispersed camping areas were observed around the 527 Road corridor (Pipeline Road) (see Photo 34).

Photo 34. Reach 12, NSO 617, C4. Pipeline Road crossing. Very inadequate for stream flow. Notice outhouse in floodplain.

The flow of the stream in this reach is so consistent from spring fed sources that bankfull level flows seemed constant. Few pools were observed above FS Road 527 and the source of the stream was soon found. A large bedrock outcrop forms a natural chute here, heavily grown with watercress and algae. The strata layer seems to force groundwater springs to the surface. A section of channel in bedrock above the steep part of the chute was mapped, and ends at a spring fed pool, the last habitat surveyed. A visual observation of the next half mile of stream showed no signs of fish presence.

The riparian community was comprised of willow and alder species. Stream banks were covered with grasses as well, helping to stabilize stream banks. The riparian area was heavily browsed, with some alder and willow clumps being in poor condition.

Anglers encountered here had been catching many small cutthroat, whose remains were observed in the stream bed. They indicated that they had not seen any other trout species.

Table 63. Water temperatures calculated from grab samples in Reach 12.

Reach	Max. Temp	Avg. Temp	Min. Temp
12	62	59.3	55

There is no thermograph data associated with Reach 12, so there is no definitive water temperature data to compare to State and Forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temp

Grazing along the stream banks has caused the undercut banks to slough off into the river, adding fine sediments to the stream. These fine sediments have filled the pools throughout this reach with silt, choking off quality fish habitat.

Table 65. Summary of Habitat and Substrate Percentages for Riffles in Reach 12.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
12	16	492.2	5.8	0.3	0.9	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
12	35.0	38.7	19.4	0.6	6.3	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

Reach 12 was **not properly functioning** for pool quality, with an average residual pool depth of 0.7', which does not meet the minimum requirement of >1' for a properly functioning stream (see Table 66). Reach 12 was **not properly functioning** for pool formation, with only 1.4% pool habitat, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream.

Table 66. Summary of Pool Habitat and Substrate Percentages in Reach 12.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
12	10	11.1	4.9	1.0	0.3	0.7	6.5	0	0	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-
Substrate Summary											
		Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total			
		12	52.0	38.0	9.0	1.0	0.0	100.0			

The amount of pool habitat in Reach 12 was below acceptable levels, indicating that pools are filling in due to bank erosion and sediment delivery from the poor road network and grazing practices in the upland areas, which alludes to pools filling in with fine sediment. This is an issue to stream productivity and limits the size of the RGCT population due to limited overwintering habitat. A typical "E" type channel should have more pools than Reach 12 has. However, due to the erosion occurring in the stream channel, and lack of channel forming events the pool habitat is greatly decreased.

Reach 12 is **not properly functioning** for amount LWD with 5.9 pieces per mile (see Table 67). Reach 12 is a forested reach, and should have more LWD. The lack of LWD in this reach can be attributed to two factors. First, fire suppression practices have

reduced the amount of LWD recruited into the stream channel. Fire ecology is an important part of the landscape in New Mexico. Large fires would remove the understory, and open up the canopy for the dominant species in this reach. Fires assist in LWD recruitment for stream in this region. The dying trees would eventually fall into the stream channel. The stream would then move the LWD during floods to places where the wood could create habitat. The lack of major fires over the last century has greatly diminished the amount of LWD in New Mexico streams.

Table 67. Habitat Characteristics for the Reach 12.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
12	1:1.6	9:1	5.9	1953	12.1
Properly Functioning Indicators	-	<12:1	>30	-	<10

Another factor is removal of LWD. Historically, LWD was considered a barrier to fish passage. However, LWD doesn't hinder fish movement and creates excellent fish habitat. LWD may be removed for firewood for campfires as well. Typically LWD is old, well-cured, easily accessible firewood. Many of the roads throughout the forest run along streams. This easy access to logjams makes them an easy source for fuelwood cutters.

The bankfull width-to-depth ratio for Reach 12 is 9:1, which is within the necessary range of <12:1 for a properly functioning "E" channel. Therefore Reach 12 is **properly functioning** for width-to-depth ratio.

The stream bank condition for Reach 12 is **at risk**, with 12.1% unstable banks, exceeding the necessary amount of <10% for a properly functioning stream.

There are a few recommendations for Reach 12. The fisheries program recommends improvement to current riparian conditions. There are several ways to accomplish this, which may include but is not limited to: 1) Grazing practices should be managed to protect the riparian area once it is re-established, either by using a range rider, riparian exclosures, or rotational grazing that would not allow grazing until the dormant season or limit grazing during the growing season; 2) planting and/or seeding of native vegetation; 3) incorporating prescribed fire through the meadows to promote growth of the dormant seed bank; 4) improved road management which would include properly decommissioning unneeded roads and improving road grade and crossings; and 5) further improving and developing upland water developments to spread out and further limit riparian utilization. Once the riparian area has been re-established, closely monitored grazing could occur for short periods each year. Forest Service personnel should work closely with permittees to make sure regulations are followed in this allotment.

In 2003, a 5-mile exclosure will be implemented for a majority of this reach from Seven Springs to the Pipeline Road, which will limit livestock grazing in the valley bottom to

two weeks a year, allowing for riparian recovery. The remaining section above the Pipeline Road will stay open to grazing.

Jemez Ranger District is pursuing funding for an extensive willow and aspen planting project in Rio Cebolla. The planted species could be placed in protective tubes to prevent browsing from elk. In addition, oversaturation of plantings will allow a higher percentage of plants to successfully establish themselves. A healthy riparian area is necessary to keep water temperatures low, as well as stabilize streambanks and provide water storage.

Photo 35. Reach 12, NSO 625, R315. Typical riffle in Reach 12.

LWD should be added to the stream floodplain within the first terrace. Placing the wood in this area would allow the stream to move the wood during bankfull flows, when most of the changes in stream morphology occur.

Angler awareness signs should be placed around the FS Road 527 road crossing, specifically at the dispersed campsites. Signs should explain the importance of native fish and to report any non-native fish caught to the NMG&F or the Santa Fe National Forest. An outhouse is located too close to the stream near this road crossing and should be moved out of the floodplain. Safety and stability of Pipeline Road should be assessed, the road crossing appears to be a hazard to the structural integrity of the culvert. This current design is inappropriate for floodplain function.

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