GEOLOGY 700 LANDSLIDES AND FLOODS
FIELD TRIP ROAD LOG

mileage	description
0.0	start at parking lot between Founders Hall and Van Matre Hall; head west to 101 and go south
2.5	cross Jacoby Creek; note corridor of riparian vegetation as it winds across its floodplain
5.0	cross Freshwater Creek
10.1	note shallow landslides on slope on E side of 101 north of Victoria Plaza; these are threatening houses above
11.8	Elk River road offramp; the lower parts of Elk River are apparently filling with fine sediment
15.6	turnoff to CR; the active Little Salmon Fault (thrust fault) runs beneath the campus; this fault is caused by NE-SW compression of Humboldt Co. related to the subduction of the Gorda Plate
16.3	note shallow debris slides on hillslopes to E of highway
18.0	vicinity of Hookton Rd -- more shallow slides on hillsides
18.7	begin climbing up the north slope of the Table Bluff - Tompkins Hill Anticline. This is a young (< 1.5 million yr old) and growing upfold related to the NE-SW compression of Humboldt Co.
19.7	crest of the Tompkins Hill Anticline
22.0	take Ferndale offramp
22.7	turn right at Fernbridge to cross the Eel River
22.8 - 23.2	cross the Eel River. Note the large point bar (Singley Bar) on the south side (left bank) of the river. This is a typical point bar built on the inside of a bend. This area is relatively frequently flooded. Upstream from Fernbridge on the outside of a bend there is obvious bank erosion. From here to Ferndale we will be crossing the meander belt of the Eel River. This floodplain area is marked by many old meander scars.
24.2, 24.4	Cross channel of Old River -- a former channel of the Eel. Not the standing water; the water table is very close to the surface at this time of the year. Runoff will be readliy generated by saturation overland flow.
25.5	Cross channel of Salt River. The channel is very shallow, and filled in with sediment. You can see standing water, but not really any appreciable flow.
25.9	Turn R onto Port Kenyon Road. Travel W to turnoff over Salt R. **Stop 1**: walk to bridge and look at the channel. Filling of this channel may be due to 1) excessive sediment yield from upstream and/or 2) subsidence and reduced stream gradient. Loop W through Arlynda Corners , down Market to Main.
27.2	Junction of Market and Main. Turn right onto Main, proceed toward Ferndale
27.3	Junction Van Ness Ave. Francis Creek, which runs through downtown Ferndale, turns away from Main St here to join Salt R. W of Arlynda Corners. Francis Cr. has caused persistent flooding problems in Ferndale.
27.4	**Stop2**: Look at Francis Creek in concrete ditch in front of Ferndale High School. Also note elswhere how it runs in channel under board sidewalk.
28.0	Turn right on Fern Ave. (corner w/ Public Library), cross narrow Francis Cr. Turn around.
	Stop 3: Look at Francis Cr. as it passes behind Main St. businesses. Note narrowness, encroachment on channel. Proceed back to Main St., turn right.
28.4	Turn right on Shaw Ave. Stop in front of Ferndale Museum.
	Stop 4: Look at Francis Cr. Return to Main St., turn right.
28.6	Turn right onto Ocean (Centerville Road).
28.7	Stop near Police Station. Look at clogged Francis Cr. Upstream of this point Francis Cr. is in grazing and timberland. Bedrock consists of easily erodible sediments of the Wildcat Group, much prone to landsliding.

28.8	Mattole Rd. on left --turnoff for road to capetown, Cape Mendocino and Petrolia. Road goes up the side of Wildcat Ridge, yielding good exposures of Wildcat Group rocks. We continue W on Centerville Road.
29.1	Dip -- cross old channel. Relatively fresh debris slide on W side of valley on left, showing good scarp. Bottom of valley filled with slope wash and landslide debris (colluvium). This is typical of all the small valleys that exit the hills to our S onto the Eel R terraces. Runoff in valley bottom generated by saturation overland flow.
30.6	Note gully incision on right. This is caused by concentration of flow onto devegetated ground. Probably mostly related to overgrazing, roading upslope. Note alluvial fan being built onto field to right of road where ditch empties.
30.9	Strongly colluviated valley on left
31.2	Fern Cottage
31.7, 32.0	More deeply colluviated valleys.
32.2	Note extreme overgrazing, trampling effects on slope on left (S of road). Runoff from these areas will be generated by Horton overland flow. Gullying is occurring.
32.6	Poole Rd. on left.
33.2	Cross channel dredged out by Humboldt Co. Sediment from small drainage (less than 0.5 sq mi) upslope has blocked culvert, road.
33.3	Centerville Beach; continue up hill to S toward abandoned naval station
33.4	Note unchanneled swales on left. These genrate runoff by saturation overland flow.
33.8	Small slump - earthflow is encroaching onto road from right.
33.9	Discontinuous gully headcuts can be seen in valley to left (east) of road. Saturation overland flow.
34.0	Centerville Beach Naval Station (abandoned)
34.3	**Stop 5**: Head of Centerville Beach landslide. This is a huge slump - debris slide/flow which occurred mostly in the winter of 1997-98. County road has been relocated several times to avoid growth of headscarp. Walk around and look at headscarp cracks, failure itself. Be careful of edges -- they are unstable and some overhang. Walk to S margin of slide, look S toward valley of Fleener Cr. Upstream you can see debris slides. Directly S lumpy topography marks old earthflow. Slides were reactivated here in 1997 (note large grey scarp).
42.8	Go back the way we came. Turn right at Fernbridge junction on N side of Eel R. Proceed S toward 101.
45.4	Enter Highway 101 southbound
48.5	Kenmar Road exit
49.2	Slides below houses on bluff on left
51.2	Cross Van Duzen R. This bridge was washed out by the 1964 floods. The Van Duzen has a high sediment load. It's a major contributor of gravel to the big bars, such as Sandy Prairie, just downstream on the Eel. Looking at the hills to SW, we can begin to see high old Pleistocene river terraces (flat surfaces) left behind as the Eel R downcut.
52.0	Good view of old high Eel R terraces on hills to R.
53.8	Cross Eel R north of Rio Dell. Note newer spans of northbound bridge. The north half of the bridge was destroyed by the 1964 floods. Note outstanding exposures of Scotia Bluffs sandstone on far side of river to left of highway downstream from here.
55.8	Cross Eel R.
56.1	Scotia exit

60.1 Stafford exit. Leave 101 here. At crossroads, turn the left, proceed about 0.2 mi W to wide turn-around near debris basin. Park.

Stop 6: Walk along margin of debris basin. Look upstream (to W) to see debris torrent track. Look downstream to see additional sediment catch-basin installed by Pacific Lumber.

Stafford is on a terrace of the Eel R. It was severely damaged by the 1964 floods. In winter 1996-97, a major debris torrent devestated Stafford. The debris torrent originated from a large debris slide or flow on logged land upslope. The slide, originating in a hillslope hollow, landed in the stream channel and, mixing with the streamflow became a highly mobile debris torrent. When the torrent hit Stafford Flat it spread out, engulfing and destroying several houses.

60.3 Return to 10. Head south

61.6 Vista point. Look E along river to see well-developed point bar of Elinor Flat

62.2 Cross channel of Jordan Creek. Downstream reach (to L) has been heavily alluviated in recent times, then stream has downcut, leaving obvious fill terraces. We may stop here on way back if time permits.

62.3 Avenue of the Giants off-ramp

66.2 - 66.8 Major slope stabilization efforts on R side of highway. Slope materials were removed, drains and rock emplaced and material re-compacted and recontoured.

72.2 Take Mattole (Honeydew) Road exit; proceed westward up South Fork of the Eel R to Bull Creek. Below us on the left is the site of Dyerville, which was destroyed by the floods of 1955 and 1964.

73.4 Looking to the left up the South Fork, you can glimpse the delta at the mouth of Bull Cr.

74.9 **Stop 7:** Stop at crossing over Cow Cr. This is a relatively undisturbed forest stream. Runoff is generated mostly by subsurface stormflow. Large alluvial flats along Bull Cr. provide ideal environment for large old-growth redwoods. At this stop we will look at how to estimate the bankfull stage. The drainage area of Cow Cr. Is 2.3 sq. mi.

75.7 Just upstream from Calf Cr. Bull Creek closely approaches the road.

76.0 **Stop 8**: The forest opens up here below Blue Slide and Luke Prairie. Park in the turnout on the left side of the road just before it re-enters forest. The grassy opening upslope on the north side of the road is an active earthflow in sheared Franciscan rocks. The earthflow has encroached on the road and narrowed it. Note the hummocky, bumpy topography typical of earthflows. It is grassy because it moves too rapidly for trees to be able to establish themselves. Note the tilted trees near the estern toe of the earthflow.

Bull Creek here shows the effects in bank erosion and bar formation.

76.5 **Stop 9:** Flatiron Tree and Tall Trees access road. We will cross Bull Cr. and walk downstream to look at channel of Squaw Cr., a relatively undisturbed forest stream. The drainage area of Squaw Cr. is 4.4 sq. mi.

77.1 Albee Creek

77.2 Main bridge over Bull Creek. USGS gaging station is just upstream. We will stop here on the way back.

78.3 Cross Bull Creek. The old Bull Cr townsite lay upstream and downstream of this point. The town and sawmill was severely damaged in 1955 and destroyed in 1964. Deep gravel deposits covered the area. We will stop here on the way back.

79.1 Earthflows across the creek upslope. Bank erosion along Bull Creek.

79.4 Cuneo Cr. bridge. Cuneo Creek has been choked with sediment since 1955 and has filled in, and then downcut near its junction with Bull Cr. We will stop here on the way back.

Continue uphill along Mattole Road.

82.0 **Stop 10**: Devil's Elbow Slide viewpoint. This huge debris slide complex was initiated in the storms of 1955 after logging and fire. Previously it was simply a forested slope. The slide enlarged further in 1964, and has continued to grow and gully. Its headward growth has caused relocation of the Mattole (Honeydew) Road. This slide complex is a major contributor of sediment to Cuneo Cr.

82.6 **Stop 11**: Devil's Elbow slide headscarp. Stop at turnout on left side of road where it re-enters forest. Burns Cr is to the S, Cuneo Cr. to the north. Walk back down road, cross to N side and climb up slope to reach main headscarp of Devils Elbow slide. Note slump scarps, cracks. What is the future here?

Turn around, head back downhill.

85.3 approx	Turnoff to Cuneo Cr. Horse/Group camp. Turn left onto road. Large flat area downslope is part of a huge fill terrace on Cuneo Cr.
	Stop 12 Proceed to campground, take trail to creek. Hike upstream to look at debris flow deposits from 1955 and 1964 floods. Go back downstream, Look at modern fill terraces, channel conditions. Tremendous fill has occurred, followed by downcutting since 1955. High terrace of Cuneo Ridge is fill deposited about 10,000 yr ago. The drainage area of Cuneo Cr is 4.2 sq mi.
	Return to Mattole (Honeydew) Road, head downhill. Note: mileage for Horse Camp side trip is not included in log.
85.6	Road to upper Bull Cr on right. This road has been abandoned due to extensive sliding and erosion in the past two years.
86.0	**Stop 13**: Cuneo Cr. bridge. Stop in pullout on right. Drop down to old Bull Cr. road, walk back to Cuneo Cr. Note 2nd Cuneo Cr. bridge just peeking out of the sediments. There has been a minimum of 7 meters (23 feet) of filling here since 1955. Cuneo Cr. has been intermittently re-excavating these deposits. Note extensive fill terraces along mainstem Bull Creek, and sediment input from erosion on its R bank.
86.9	Cross Bull Cr. Pull out on R side of road just beyond Baxter Environmental Camp road. This is general area of old Bull Cr. townsite. Walk back to Bull Cr. bridge. Look upstream and downstream. Note how vegetation on both sides, and bedrock outcrop on left bank downstream has stabilized banks andconstrained channel migration.
	Walk downstream. In this vicinity a sediment retention dam was built to try to reduce downstream sediment impacts. It filled rapidly. This is now a site of channel widening and braiding.
87.9	**Stop 14**: Bull Cr. bridge and gaging station. Look at gaging station, bankfull indicators. Discuss stream gaging. The drainage area of Bull Cr. here is 29.1 sq. mi.
	Continue back toward Highway 101.
93.3	Junction with US 101. Proceed under 101, turn right onto Avenue of the Giants.
93.4	**Pit stop**: Note 1964 high water marker on right. Turn left to go to Founders Tree bathrooms, access to river bars.
	Return to Avenue of the Giants, continue S
95.3	Good view of LB point bar on S Fork Eel. Note how forest continues right down to back of bar.
95.6	Junction with Lum Road into Weott. Note 1964 high water sign. Lower Weott was wiped out by the 1964 flood.
	Continue uphill to Highway 101.
96.3	Junction with 101. Take 101 north.
98.6	Take Dyerville Avenue of the Giants turnoff (this is same turnoff to go to Bull Cr.) Head north on Avenue of the Giants, paralleling Eel River.
102.7	Redcrest
103.8	Turnoff to Holmes. Holmes was completely flooded and badly damaged in both 1955 and 1964.
105.2 - 105.3	Shallow slides off bedding steeply dipping out of the hillside on the W (left) side of the road.
105.7	Bridge over Bear Cr. Note incised fill terraces behind debris jam near mouth.
107.4	Pepperwood. This small town was obliterated by the 1964 floods.
109.2	North end of Avenue of the Giants. If time permits we may stop and walk north to Jordan Cr. Return to 101 and head N.
113.2	If time permits, take south Scotia off-ramp. Head north through Scotia. Scotia was badly damaged in the 1964 floods.
115.0	**Stop 15 (if time permits)**: Take bridge over Eel R to Rio Dell. Cross Eagle Prairie Bridge and park on far side. Walk back onto upstream side of bridge about halfway across. Note heavy riparian forest with silt and sand highwater line on R bank, erosion into Wildcat group bedrock on L bank.
	Return to freeway and head back to Arcata.

From the Eureka Times-Standard, Sunday, August 11, 2002

The Old Salt

By John Driscoll The Times-Standard

Rebuilding the river that was

PORT KENYON -- At the end of Port Kenyon Road, dairyman John Vevoda pushed his way through the willows that crowd the banks of the Salt River. A trickle is the only evidence of a river.

If he stepped back 100 years, Vevoda's boots might have been lapped by the wake of a big schooner making its way upriver to the cannery or the creamery that once called Port Kenyon home.

The river has all but disappeared northwest of Ferndale. The flat topography of the area, and dirt shaken loose from the nearby Wildcat Mountains by earthquakes, has allowed the Salt River to fill in. Even in the winter it is impassable here by anything larger than a kayak -- where once there was a port just outside of Ferndale.

After several stalled attempts to resurrect the river, a new effort is under way. This time, key players like the U.S. Army Corps of Engineers are more involved, and more is at stake than a few hundred acres of pasture.

For years, it was Vevoda and a few other bottom-land owners who suffered the flooding that has resulted from the disconnected hydrology of the Salt River system. He is now the not-so-proud owner of the seasonal, so-called Lake Vevoda. His former dairy operation of 400 cows on Bertelsen Lane is under water half the year, and in the spring he has to pump the water off the land that now yields only one crop of corn.

"This used to be my dairy," Vevoda said, looking around at unrealized investments, buildings and equipment that stand idle now.

Other dairies failed before his. He pointed to them across the landscape. They were all victims of the flooding that has become endemic here, Vevoda said.

During the drought of 1977, Vevoda helped form the Eel River Resource Conservation District, which later became the Humboldt County Resource Conservation District. The agencies' aim was to restore the river that by then had well-known siltation problems.

But it was only a few landowners who were affected by the problem, and the districts failed to gain the interest of the U.S. Army Corps of Engineers.

So the river became more and more choked. The tidal water that pushed up the Salt from the mouth of the Eel River was pushed farther and farther downstream. Willows and other freshwater and upland vegetation grew where it once could not. The trees and plants trapped sediment, further filling the channel.

In 1992, a magnitude 7.1 earthquake jostled the fragile soils in the Wildcat. In 1995, storms pushed that dirt down into Francis Creek, Reas Creek and Williams Creek, all tributaries of the Salt River. Already lacking velocity due to the flat terrain, the water dropped sediment as the vegetation slowed it down.

Several feet of sediment dropped in a single day, Vevoda said. His barn on Port Kenyon Road flooded, and Vevoda dug a ditch to channel the water away from the building.

Still, the Corps held back because relatively few acres, and few people's livelihoods, were affected. Engineers from the Corps said it was a drainage problem, not a flooding problem, and didn't qualify as a Corps project.

Things have changed. Vevoda's old drive to get the Salt River functioning is being taken up as more are affected. Ferndale now has trouble meeting state water quality laws when it pumps its wastewater effluent into the Salt River. There isn't enough flow to dilute it. And the city's $4 million effort to restore Francis Creek and relieve flooding within city limits, has just moved that problem downstream.

Also, the fish that once spawned in Francis, Reas and Williams creeks that are now essentially cutoff from the Salt, are only a remnant of their once bountiful population.

"Fish have almost got to have legs to get to the streams themselves," said Bruce Slocum, a farmer and naturalist who has spent much of his life on the Salt River.

Slocum said restoring the salmon, steelhead and cutthroat trout that once used those streams is one of the main reasons for restoring the Salt River now.

The remnant Salt

Slocum, too, gets flooded out during the winter. But spending a couple of hours with him on the Salt River suggests he is interested in the restoration on a deeper level.

"If ever you're looking for him, you'll find him on the river," said his wife, Nancy Kaytis-Slocum.

The place is loaded with birds and other wildlife. White-tailed kites, a northern harrier, egrets, herons and resident mallards made their way around the Salt on their varied businesses Monday. Slocum easily has one of the most enviable territories in the yearly Christmas Bird Count.

Slocum rides the waters of the Salt River and the Eel River Delta, his aluminum boat propelled by a 65-horsepower outboard motor. When he first moved here 50 years ago, lots of things were different.

For one, he spent most of his time motoring around in a salvaged wooden boat with a 9/10-horsepower engine won by his dad in a Puget Sound fishing derby. He kept his boat at the mouth of Francis Creek, several miles upstream. There was good red surf perch fishing, and good duck hunting.

Camp Weott, a little village made up mainly of vacation homes on a pair of peninsulas thrusting out into the Eel River Delta had yet to meet its demise, though the river had begun threatening to cut the settlement off from the Eel's shores.

There was a lot of human activity during that time, Slocum said. Now there's almost none, save for a few hunters during the hunting season.

"All the way to there was the Salt River," Slocum said, pointing to a berm 75 yards away.

In the now-narrow channel, waving eel grass points in the direction of the rising tide. It's a relatively new phenomenon, brought on by a lack of tidal action.

Slocum said the channel would undoubtedly have to be dredged, and most likely more than once. Between levees put up by the Army Corps and the channelization of creeks by farmers, natural flushing action isn't likely to clean the Salt River out by itself, Slocum said.

Whether any of this is possible is in the hands of the Army Corps.

Watershed lost

"There's no natural system left here," said Humboldt County 1st District Supervisor Jimmy Smith.

During floods, steelhead and salmon waiting to move upstream to spawn can make it upstream, but often they fail to find the channel of the Salt River. They can end up in fields, where they may try fruitlessly to spawn in the clover, Smith said.

These fish need more certain passage up into Francis and other creeks, Smith said.

"We lost a whole watershed above the Salt," said Don Tuttle, deputy director of Humboldt County's Public Works Department. "Some of the drainage systems are running backward in winter."

Why is the river broken?

A 1993 plan prepared by the U.S. Department of Agriculture's Soil Conservation Service lines it out: Flooding drops sediment into the Salt River channel; the naturally erosive hillsides deposit more sediment; earthquakes trigger landslides; the Eel River delta area has experienced geological uplift; trees and plants have clogged the channel; timber harvesting, conversion of land to pasture, road construction and sand and gravel mining have caused siltation; streams have been channeled and levees, dikes, tide gates and dams have been built.

That's a lot of problems, and it will likely take a number of different solutions to get the Salt back on track. Some tides gates may need to be removed, and basins to catch sediment built.

Catch basins take up space, however, and Slocum understands that no one here wants to part with land they can keep animals on. That's something of an irony, because it's possible they may part with land by the very will of flood water, and the lack of the Salt River in winter.

Also, some of the flows that once spilled from the Eel River into the Salt during flood events may need to be restored.

Some of that floodwater may have to bypass the Leonardo Levee, a structure built by the Army Corps to protect landowners on the east side of town from flooding. It worked. But many also believe that it prevented floodwaters from scouring out the Salt River's channel, which may have led to flooding downstream.

"It is the frequency of flooding and the rate of sediment deposition that have been altered by land use activities," the USDA report reads.

Vevoda said the Corps of Engineers should have had the foresight to see what the Leonardo Levee would do to the Salt River, but he added that it undoubtedly helps the upstream landowners.

"You have a lot of volume but no velocity," Vevoda said.

The Corps' role in building the levee is part of the nexus for it to get involved now, Tuttle said. With a functioning system comes less flooding, always of interest to the Army Corps.

"Ecosystem restoration is a primary mission for the Corps," said Corps project leader Jim Howells.

It's tricky hydrology, though. From Ferndale to the mouth of the Salt River, there is almost no fall, and some quietly wonder if the mouth isn't higher than its tributary creeks. The way those creeks drain suggest the system is indeed running backwards, which may make it all the more difficult to right it.

Building a head of steam

Unlike past efforts to jump-start the restoration, there are more players and more at stake than ever before. Lots of that interest is due to Ferndale's wastewater problems, and from their huge project to stem flooding in town.

The city's wastewater treatment plant was built in 1975. At the time, its effluent drained into Francis Creek where it meets the Salt River.

As the aggradation got worse, the bed of Francis Creek and the Salt River eventually became higher than the drain pipe. In the winter, when it's not being used to irrigate fields, the effluent must now be pumped from the plant to Francis Creek.

But the Salt's slow demise creates a problem there, too.

Because there's little flow down the river even during the winter, and because the tides no longer reach into the upper channel, there isn't enough water to dilute the effluent to state standards. That has Ferndale struggling to avoid fines of up to $3,000 per day every time the effluent is not thoroughly diluted.

"If we get tidal water coming back up we would have the dilution factor," said wastewater plant operator Randy Jensen.

Mayor Jeff Farley, who grew up in Ferndale and watched as the Salt disappeared, said in five years the problem will be compounded.

"It'll never get anywhere, it will never heal, itself," Farley said.

Ferndale's restoration of Francis Creek, which runs through the front yards of Victorian homes on Main Street, was meant to alleviate flooding caused by siltation of the creek and by poorly functioning culverts. Really what it did was displace the problem -- to Lake Vevoda and surrounding areas.

Since much of the problem lies outside the city limits, Ferndale's involvement can really only be peripheral. Still, Farley has been to Sacramento to visit with state Sen. Wesley Chesbro, D-Arcata, and Assemblywoman Virginia Strom-Martin to rouse interest and funds.

"We didn't want to wait until the last minute," Farley said.

U.S. Rep. Mike Thompson has also taken an interest in recent years. The Napa Democrat urged the Army Corps to take another look at a problem he sees as critically important to the region. Thompson also sees the possibility that the Salt River restoration could be a model project with multiple beneficiaries, which means it has a much better shot at getting started than in the past.

"It's 2002, you can do just about anything," Thompson said. "You just have to figure out how to pay for it."

Restoring the river's namesake

The goal is really to put the salt back up the Salt River. A main part of the work will involve extensive dredging, which should allow the tides to once again reach up into Port Kenyon. The salt should keep the tenacious, fast-growing willows and other brush from choking the channel, slowing down floodwaters and tapping silt.

Tuttle suggested salt-tolerant trees like sitka spruce and big leaf maple be planted along the shores of the Salt River, mimicking to some degree the past vegetation.

All of the players know it's so much easier said than done.

"This is not going to be an easy fix," Vevoda said with certainty.

The Army Corps said it won't know if the project is feasible until after a thorough study is done.

It is also unlikely to remain fixed once it's done. Maintenance will almost definitely be part of the long-term solution.

"Wouldn't that be simpler than having a whole system fail?" asked Smith.

The bill for it all, not including the maintenance, has been estimated at around $5 million. The federal government would foot 65 percent of the bill, with state and local money making up the difference.

For that, the area should get less flooding and improved bottom lands. Ferndale should escape the wrath of the state over its wastewater problems. Francis Creek and Reas Creek, and perhaps Williams Creek should slowly see more fish.

Over the years, a number of piecemeal solutions have been suggested. Vevoda said the people that live here know that the only way to make the Salt River work is to fix it head to tail -- or don't bother.

From the Eureka Times-Standard, Thursday, September 18, 2003

Army Corps starts Salt River effort

By John Driscoll The Times-Standard

Marking a step toward restoration of the downtrodden Salt River outside Ferndale, a U.S. Army Corps of Engineers design team is meeting with local officials to start the ball rolling.

The Corps team will begin determining the feasibility of dredging and restoring the sediment- and vegetation-choked river.

On Wednesday, the group took a field trip of the Ferndale bottoms area the once-navigable river passes through. That follows a meeting with Humboldt County Supervisor Jimmy Smith, Ferndale Mayor Frank Taubitz, representatives of the state Coastal Conservancy and Department of Fish and Game, the Humboldt County Resource Conservation District and landowners affected by the regular flooding of the river.

"Oh, this is it," Smith said of the progress. "This is a great, great movement."

The feasibility study will take an estimated two years. It will consider the so-called environmental cost of the work compared with the environmental benefits. The Corps will consult with local experts on flora and fauna, fish life, geology and a host of other topics to make a final decision on whether to restore the river.

The Salt River runs a flat course from about 3 miles west of Fortuna to the lower Eel River. The Salt was once navigable by large steamers to Port Kenyon, which is now as landlocked as Ferndale itself. The river isn't even noticeable were it not for signs showing its location.

In short, the river doesn't work. It backs up onto dairy land -- in one case forming a huge lake -- during the winter and prohibits drainage from Ferndale's wastewater treatment plant. Its connection with Reas Creek, Francis Creek and Williams Creek is tenuous or nonexistent, so salmon and steelhead that once ran in modest numbers up the creeks to spawn no longer can make it.

The Corps, which had previously failed to garner interest in the concept, is now looking into the project as part of a shift toward ecological restoration as a Corps goal. It's likely that regular dredging and maintenance will be needed to keep the river from clogging again.

In the immediate future, the Corps will prepare a project management plan that will determine the studies necessary to kick off the effort.

Don Tuttle, former deputy director of public works for the county, said the Corps has enormous local resources available to them.

"I think they were impressed with the amount of talent we brought to the meeting," Tuttle said. "All they have to do is take advantage and ask for information."

From the Eureka Times-Standard, Sunday, May 28, 2006

Salt River effort keeps rolling

By John Driscoll The Times-Standard

Federal funding that would be secured for the Salt River if the U.S. Senate approves it would provide an important backup to a vital project for Ferndale, officials say.

The U.S. House of Representatives passed the measure with a bill this week. It authorizes $400,000 that can be used by the U.S. Army Corps of Engineers, which just recently jumped back on board the effort to restore the river and its fish and go along way toward fixing the chronic wastewater treatment problems in the city.

The Salt River, choked with silt and vegetation, essentially runs backwards. It's a drain for storm water and wastewater that doesn't function well, floods hundreds of acres every winter and is behind numerous water quality violations that have led to a sewer connection moratorium in the city.

The money would be on top of $450,000 from last year, which helped start the necessary studies for the project. Ferndale and Humboldt County have applied to the state for $1.17 million, some of which would go toward studies and some of which could be used for construction.

”If we get this slate of projects approved at the state level,” said 1st District Supervisor Jimmy Smith, “we will have a bank account to complete this work.”

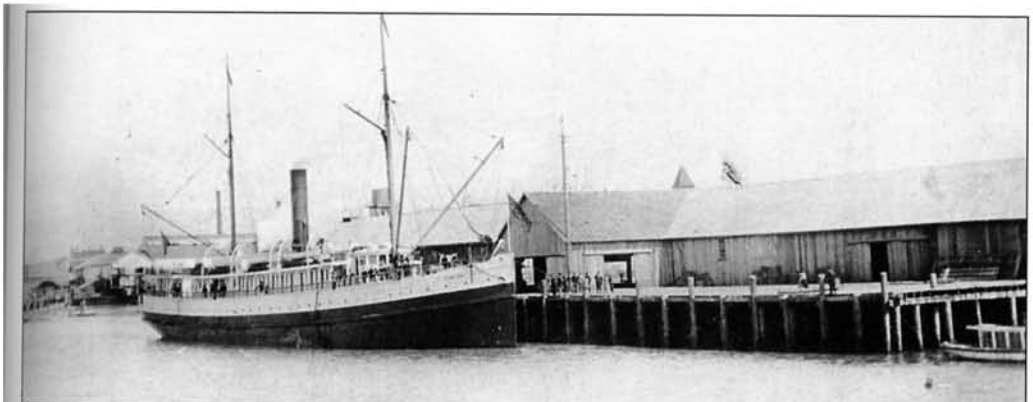
Part of the effort is dealing with the more than a dozen agencies whose goals must synergize.

But Ferndale City Manager Michael Powers said that with funding looking promising, and with the Army Corps on board again, things look good.

”Unfortunately money makes the world go round, especially when it comes to dredging a river,” Powers said. “We're confident it's going to happen.”

Port Kenyon and the Salt River, late 1800's

In 1876, John Gardner Kenyon built a wharf and warehouse on his holdings on the Salt River, establishing the first port in the valley. Salt River was navigable for five miles at that time, and steamships plying the Eureka to San Francisco route made it a regular port of call. Today the river is silted up, and little evidence of Port Kenyon's early importance remains but the name.



The steamer *Argo* served Port Kenyon from the late 1890s until 1908. She made weekly trips, transporting goods between Port Kenyon and San Francisco, a 24-hour run. The first steamer to serve Port Kenyon was the *Thomas Whitelaw*, commissioned by J.G. Kenyon in 1878. Some of the outgoing cargo from Port Kenyon included grain, potatoes, butter, hides, salmon, and wool. Incoming cargo included merchandise for local stores, household items, liquor, furniture, and other goods for Eel River Valley residents. J.M. Eddy, in the 1893 booklet *In the Redwood's Realm*, described Port Kenyon commerce by noting, "The golden butter flows out, and the golden coin flows in." Shipping finally ceased at Port Kenyon around 1908 due to delays at the mouth of the Eel River caused by shoaling. Goods spoiled during the long wait. As Humboldt Bay developed, it replaced Port Kenyon as the major port in the area. Below is an *Argo* invoice for the Waddington Store.

Source: Images of America -- Ferndale, Ferndale Museum 2004

Ocean going ships once tied up to this pier in Port Kenyon, California. Now, the Salt River channel here is full of sediment and willows.

Francis Creek flows through the City of Ferndale in Humboldt County. The Ferndale Drainage Committee and City of Ferndale sponsored a multiple-site project that used innovative bio-engineering techniques to stabilize the banks, reduce flooding and erosion, and restore the native vegetation. The project included the placement of rock clusters in the stream to create pools for improving fish habitat. The project was planned with cooperation, approval, and partial funding of OES/FEMA and California Department of Transportation.

NOTE: DETAILED GEOLOGIC MAPS OF CENTRAL AND SOUTHERN HUMBOLDT COUNTY HAVE BEEN RECENTLY (4 APRIL 2000) PUT ON LINE BY THE USGS AT http://geopubs.wr.usgs.gov/map-mf/mf2336/
THESE ARE IN ADOBE ACROBAT pdf FORMAT.

SIMPLIFIED GEOLOGY OF WILDCAT GROUP

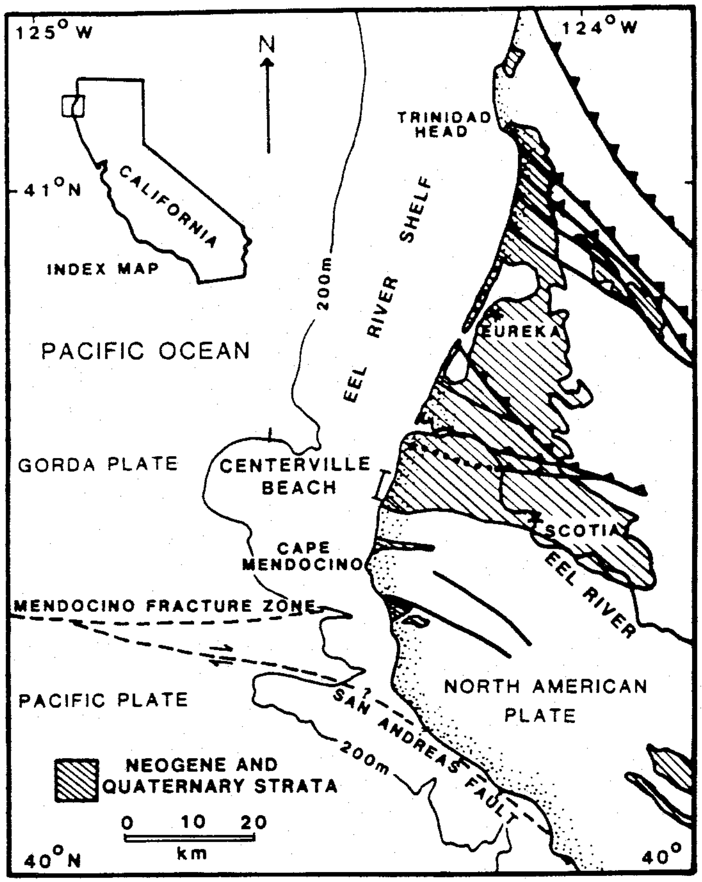


Figure 7. Location of the Neogene and Quaternary Wildcat Group in northern California, including shelf sediment of the upper Rio Dell Formation exposed at Centerville Beach.

= THRUST FAULT

STRATIGRAPHY OF WILDCAT GROUP ROCKS

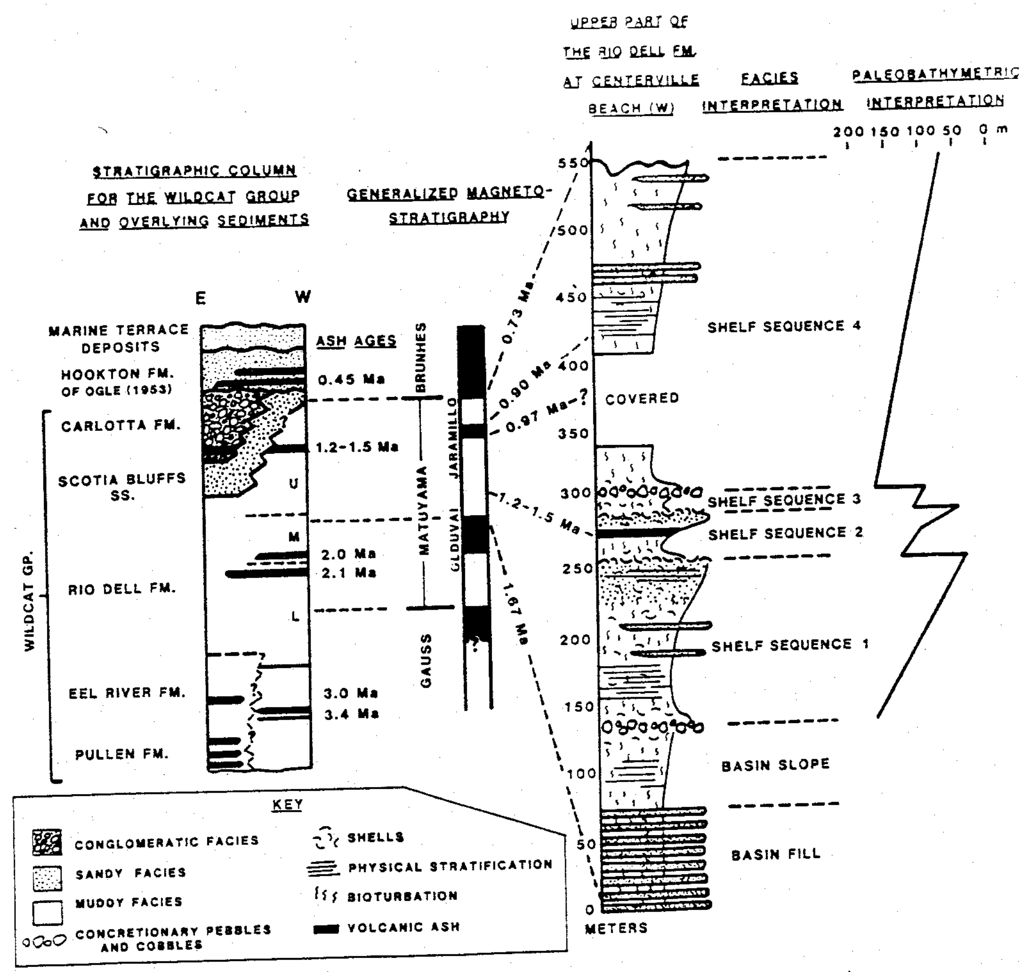
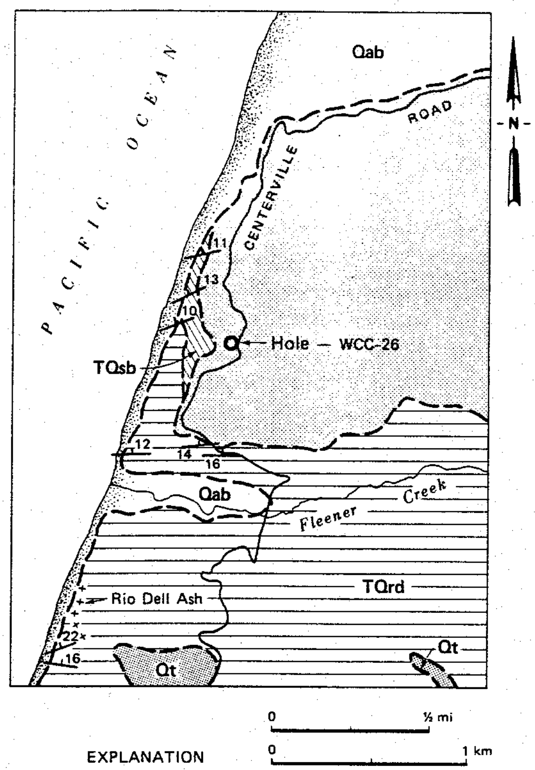


Figure 8. Stratigraphic columns for the Wildcat Group and the upper part of the Rio Dell Formation at Centerville Beach, showing age control, facies, and paleobathymetric interpretations. Column for the Wildcat Group shows outcrop relations along the Eel River, near the town of Scotia (E), and at the Centerville Beach locality (W) (modified from Sarna-Wojcicki and others, 1982). Lower formations (i.e., the Pullen and Eel River Formations) of the Wildcat Group have not been distinguished in the eastern section. Magnetostratigraphy is after Dodd and others (1977), Kodama (1979), and Woodward-Clyde Consultants (1980), using the time scale of Mankinen and Dalrymple (1979). Ash ages from Woodward-Clyde Consultants (1980) and Sarna-Wojcicki and others (1987, and this volume).

SOURCE: H.E. CLIFTON AND E.L. LEITHOLD, 1991, QUATERNARY COASTAL AND SHALLOW-MARINE FACIES SEQUENCES, NORTHERN CALIFORNIA, IN QUATERNARY NONGLACIAL GEOLOGY: CONTERMINOUS U.S., GEOLOGICAL SOCIETY OF AMERICA

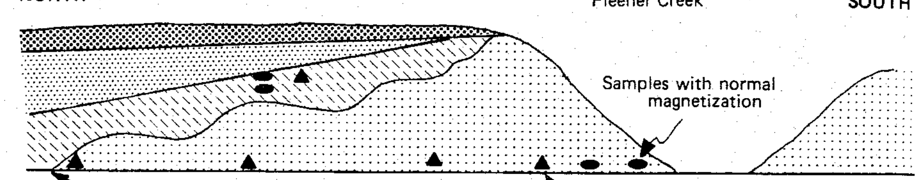
CENTERVILLE BEACH GEOLOGY



EXPLANATION

Qab	Quaternary alluvium and beach deposits
Qt	Marine terrace
Qh	Hookton(?) Formation
TQsb	Scotia Bluffs(?) Formation
TQrd	Rio Dell Formation
16	Dip of bedding

HUMBOLDT BAY POWER PLANT UNIT No. 3	GEOLOGIC MAP OF THE AREA AT THE NORTH END OF CENTERVILLE BEACH	13976G–6511 A-18
Woodward-Clyde Consultants		Figure A–13



EXPLANATION

- Hookton(?) Formation — sand and chert pebble gravel
- Scotia Bluffs(?) Formation — sand and chert pebble gravel
- Scotia Bluffs(?) Formation — silty sand, clay, and sand
- Rio Dell Formation — siltstone and minor sandstone

HUMBOLDT BAY POWER PLANT UNIT No. 3	DIAGRAMATIC CROSS SECTION AT THE NORTH END OF CENTERVILLE BEACH	13976G–6511 A-14
Woodward-Clyde Consultants		Figure A–12

SOURCE: WOODWARD-CLYDE CONSULTANTS

ROCK UNITS OF THE WILDCAT GROUP

SOURCE: WOODWARD-CLYDE CONSULTANTS

The late Tertiary and Quaternary Wildcat Group and younger formations were deposited unconformably on several older formations. South of the Eel River, the Wildcat Group was deposited in part on the Coastal Belt Franciscan, which consists predominantly of graywacke and siltstone, and includes intensely deformed shear zones (Nason, 1968). McLaughlin and others (1979) suggest the Coastal Belt Franciscan in the King Range, approximately 40 km south of the Eel River, ranges from early Eocene to middle Miocene in age. Evitt and Pierce (1975) suggest the Coastal Belt Franciscan is dominantly early Tertiary in age. To the east, the Wildcat Group rests primarily on the Yager Formation, which consists of graywacke and shale. Ogle (1953) reported tentative age assignments ranging from Cretaceous to Eocene for the Yager Formation. Evitt and Pierce (1975) report a probable Eocene age.

Ogle (1953) published what is currently the most comprehensive description of the stratigraphy of the Wildcat Group. He subdivided the Wildcat into five formations and defined a sixth, the Hookton Formation, which he inferred lay unconformably on top of the Wildcat. Ogle's (1953) subdivision of the Wildcat consisted, in ascending order, of the Pullen, Eel River, Rio Dell, Scotia Bluffs and Carlotta Formations.

Pullen Formation - Ogle (1953) reports the Pullen Formation consists predominantly of diatomaceous siltstone and mudstone, with some ferruginous limestone nodules and a few thin glauconitic sandstone beds.

Eel River Formation - Ogle (1953) describes the Eel River Formation as composed of a dark gray-black mudstone, siltstone, and sandstones. Most of the sandstones were reported to be glauconitic, as were some of the finer-grained sediments.

Rio Dell Formation - The Rio Dell Formation consists predominantly of massive marine siltstone, lesser amounts of claystone, and fine- to very fine grained, poorly sorted sandstone. Water depths, inferred from microfossils at Centerville Beach (Ingle, 1976), range from approximately 1800 m at the base of the formation to approximately 90 m at the top.

Scotia Bluffs Formation - On top of, and interfingering with, the Rio Dell Formation is the Scotia Bluffs Formation. This formation consists predominantly of massive fine- to medium-grained sandstones and lesser amounts of pebbly conglomerate and siltstone. The Scotia Bluffs Formation is at least partially marine, and megafossils from the lower part of this formation at its type section in the Scotia Bluffs suggest water depths of 30 m or less (Faustman, 1964).

Carlotta Formation - Resting on top of, and interfingering with, the Scotia Bluffs Formation is the Carlotta Formation. East of the Eel River and Fortuna, this unit consists of massive coarse conglomerate, poorly sorted sandstone, bedded and massive blue-gray siltstone, and blue-gray mudstone. The presence of coarse, poorly sorted conglomerate, the absence of marine fossils, and the presence locally of fossil redwood logs 7 to 9 m long suggest the Carlotta Formation was deposited in predominantly continental environments. South of Ferndale, along Wildcat Ridge, the Carlotta consists primarily of massive sandstone with thin pebbly conglomerate. Coarse, massive conglomerate is present only near the base of the Carlotta.

Hookton Formation

Ogle (1953) described the Hookton Formation as yellow-orange gravels, sands, silts, and clays that unconformably overlie the Wildcat Group. Ogle was aware that locally the Hookton was difficult to distinguish from the Carlotta Formation but felt that the yellow-orange color permitted the two units to be differentiated.

CENTERVILLE BEACH LANDSLIDE

1972

2002

CENTERVILLE BEACH LANDSLIDE

2005

coastal photos courtesy of California Coastal Records Project
http://www2.californiacoastline.org/

Fleener Cr Slide, 2002

Fleener Cr Slide, 2005

BACK GROUND INFORMATION ON THE STAFFORD SLIDE (FROM THE INTERNET)

Stafford is one freeway exit south of PL's headquarters in Scotia, CA. During the drought of the early 1990's PL clear-cut the mountain 1,400 feet directly above the village of Stafford, CA. The storms of New Years, 1997 brought down a 20-foot wall of mud and rock that wiped out seven homes. Just out of the path of the debris torrent was a logjam composed of sections of old growth trees. It helped protect several of the Stafford homes by slightly diverting the debris flow. Ten months after the slide, the California Division of Forestry tissued an emergency permit so PL could harvest the $100,000 worth of redwood timber in the logjam.

APPARENT CAUSE (source: “Whiskeytown Project” website)

Roads cause erosion and greatly increase the potential for slope failure during large and episodic storm events. Most gullies in mountainous watersheds are road related. Roads alter the natural drainage patterns, and cutslopes intercept sub-surface flow and convert it to surface runoff. Drainage ditches and berms channelize concentrated flows and efficiently deliver sediment to streams. Most importantly, roads are frequently constructed by placing roadfill material in drainage channels. That roadfill then becomes part of the drainage system and, given enough time, has a high probability of being delivered to downslope rivers and streams as sediment.

Poor road drainage and unstable fill can initiate landslides, especially with roads built on steep terrain in geologically unstable lands. During the winter of 1996-1997, many road-related landslides occured in the Pacific Northwest. Several lives were lost in Northern California and Oregon. The famous Stafford debris landslide, located on recently-harvested timberland in Northern California, was apparently initiated by skid roads and waterbars which concentrated and diverted overland flows into a swale area (Gray, 1997). s

EYEWITNESS ACCOUNT OF THE DEBRIS TORRENT
An Interview by Rebecca Grant

Ed. note: This information is taken from an interview with Mike O' Neal, a resident of Stafford, whose home was nearly demolished in the Dec. 31, 1996 landslides. The only question I asked in the interview was "What happened?"

"I had just put in a full season of transporting mobile homes and I was relaxing at home with my family after the holidays. On Dec. 31, I woke up to a terrible exploding, crashing sound, so I ran up to my daughter's room on the second floor of the house to look out the window. I saw trees, I mean big trees, second growth redwoods that were growing in a creek, snapping to the ground one at a time, snapping and slamming to the ground.

Now there's a 28-inch culvert beneath my home, which has been there for 30 years. The night before, there had been a lot of water flowing through, and I realized that if some debris were to clog it up, I could lose the foundation of my house.

So I ran out to my backyard. The creek that runs in the back of my house was basically trickling...I knew that a monster dam was up above somewhere. Then it swoll, and swoll, and swoll and broke and came down at me like molten lava. That's literally what it looked like. It was approximately 18 feet high of solid mud with an old growth stump floating on top.

I started running back and forth between my next door neighbor's driveway and my driveway, trying to figure out which way it was going to go. I got everyone evacuated to the frontage road before the slide reached and took out my next door neighbor's mobile home and mud surrounded about 4 houses, including mine.

Then it rained again, all night into the day on Jan.1, 1997. At 4:30 am the build-up broke again and exploded; it seemed like the entire mountain had come down, bringing with it 60-80 foot stumps. The slide travelled straight through town, filling it up like a big loaf of bread.

The next slide will just pour over the sides of last years mud and will probably take out the homes on the south side and will possibly pour over the highway. I've walked up on the mountain this summer to check things out; there are still at least 25 acres up there fractured with huge fissures, so big my dogs kept falling in."

Monday, Mar. 05, 2001

The Stafford landslide lawsuit jury trial that was set to begin today has been settled. The terms of the settlement were read into the Court's record earlier this morning.

The Stafford landslide lawsuit jury trial that was set to begin today has been settled. The terms of the settlement were read into the Court's record earlier this morning. As part of the settlement Maxxam and its wholly owned subsidiary Pacific Lumber Company along Barnum Timber agreed to pay the 26 residents of Stafford $3,300,000.00 (three million three hundred thousand dollars) in order to avoid the jury trial. Many of the residents of Stafford were current or former employees of Pacific Lumber and virtually all were long-time supporters of the timber industry.

The case arose out of a catastrophic landslide that occurred on December 31, 1996 and nearly buried the entire community of Stafford under hundreds of thousand of cubic yards of mud and debris. The landslide, which originated on the steep slopes above Stafford, had been recently clear-cut by Pacific Lumber and was alleged by the residents to have been the cause of the slide. The residents claimed that Pacific Lumber should have known that once they roaded and clear-cut an already unstable hillside, the residents' homes would be subject to slides.

"We are pleased that Maxxam and Pacific Lumber have finally come around and compensated us for the harms to our property and lives their logging practices caused. We all have suffered much," said long time resident and former PL employee Mary DelBiaggio. "It just makes me kind of mad that they didn't do right by us 4 years ago. But I guess they thought they could beat us with all their power and money. It looks like they were wrong. I hope now we can start some real healing," she said.

Mike O'Neal another resident of Stafford agreed. " If Maxxam/PL and Barnum had offered us half the amount of the settlement four years ago we never would have had to go to court and spend three and half years litigating this thing. I sure hope everyone learns some lessons from this tragedy. No one should ever have to go through what my neighbors and I had to go through. Especially when Pacific Lumber should have known better than to cut the hills the way they did in the first place," he said.

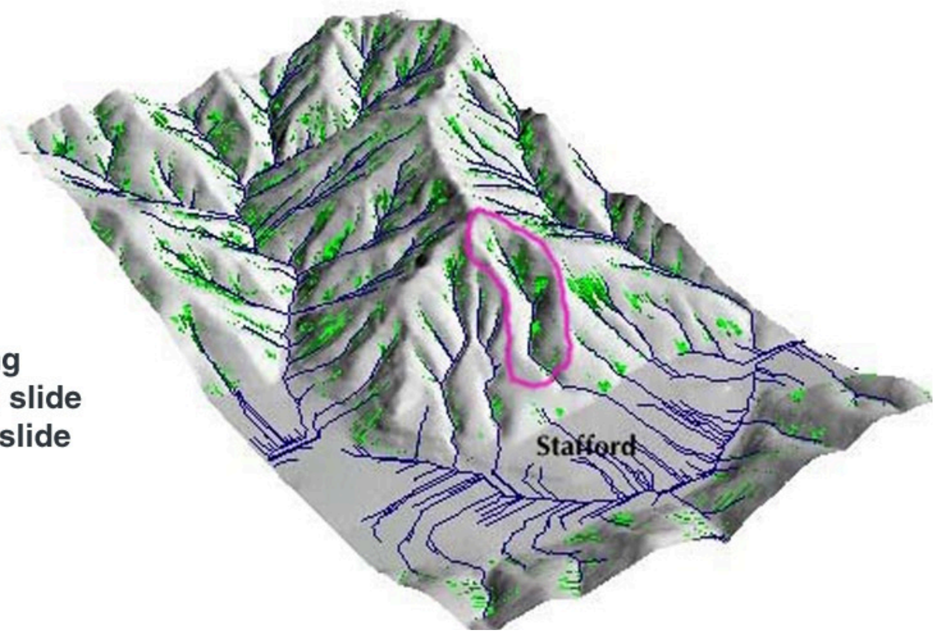
As part of the settlement, Maxxam and Pacific Lumber will install lights at the bottom of hill where basin were constructed that supposedly protect the residents of Stafford from the next big slide. The lights are being installed in order help better monitor the steep and still very unstable hills above the remaining homes at Stafford.

"I'm pleased that at least we will be better able to see the slide come before it gets here the next time." said Kim Rollins a former resident whose home was destroyed and whose grandfather used to be mill superintendent at Pacific Lumber. "But," he added, "I don't think my family and I are going to move back any time soon. I want to wait and see how Pacific Lumber puts the lessons that they learned from this case into practice. Then maybe there will be no more Staffords and we can be comfortable enough to move back."

Source area of Stafford debris torrent

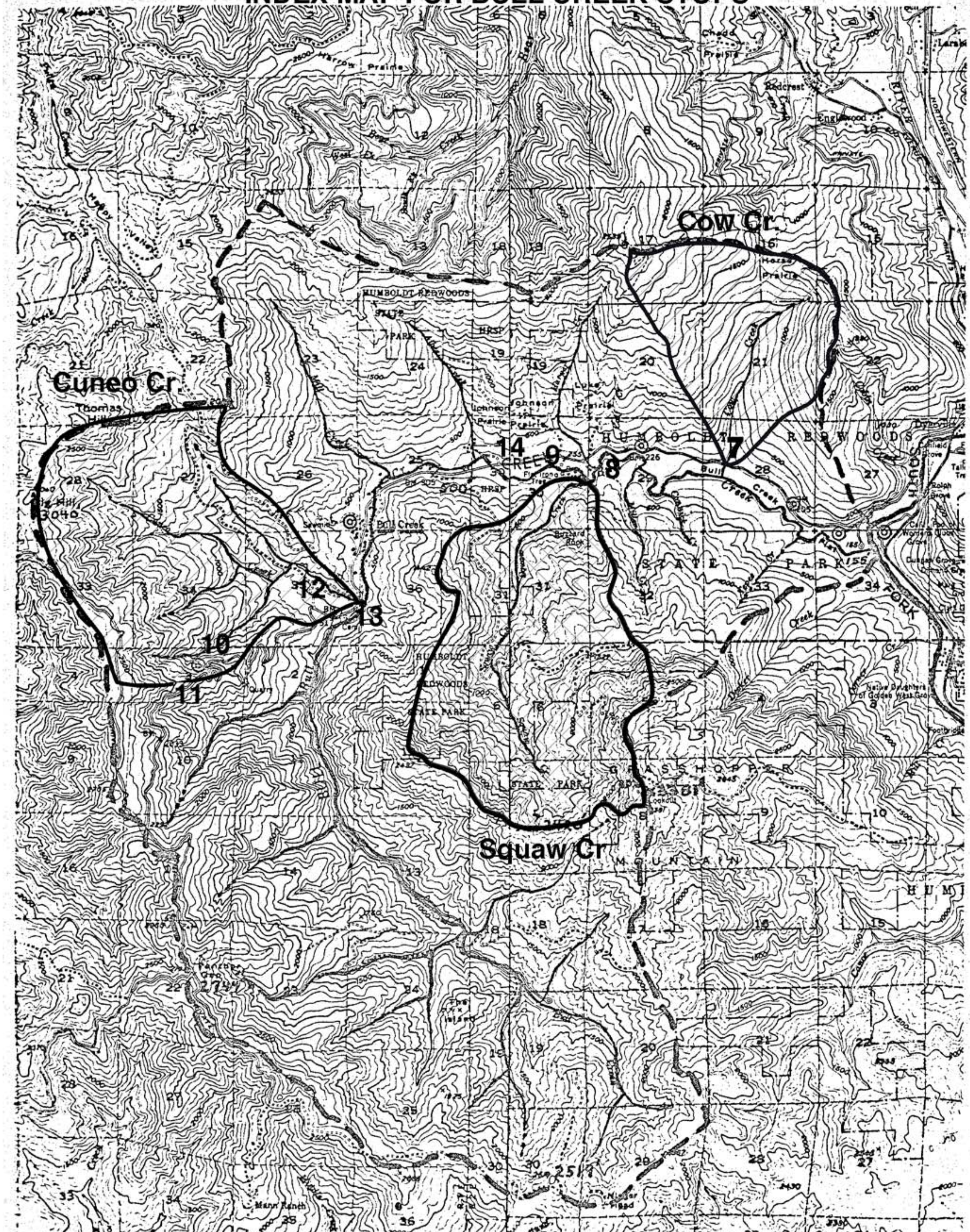
Effects of debris torrent on channel

Stafford Debris Torrent Effects



perspective diagram showing source drainage for Stafford slide green areas are SHALSTAB slide area predictions

INDEX MAP FOR BULL CREEK STOPS



Scale 1 : 78120

1 0 1 2 3 4 5 miles

7. Cow Creek
8. Turnout below Luke Prairie
9. Tall Trees access
10. Devil's Elbow Slide viewpoint
11. Devil's Elbow Slide headscarp
12. Cuneo Cr flood deposits
13. Cuneo Cr. bridge
14. Bull Cr bridge & gage

BANKFULL CHARACTERISTICS VS DRAINAGE AREA

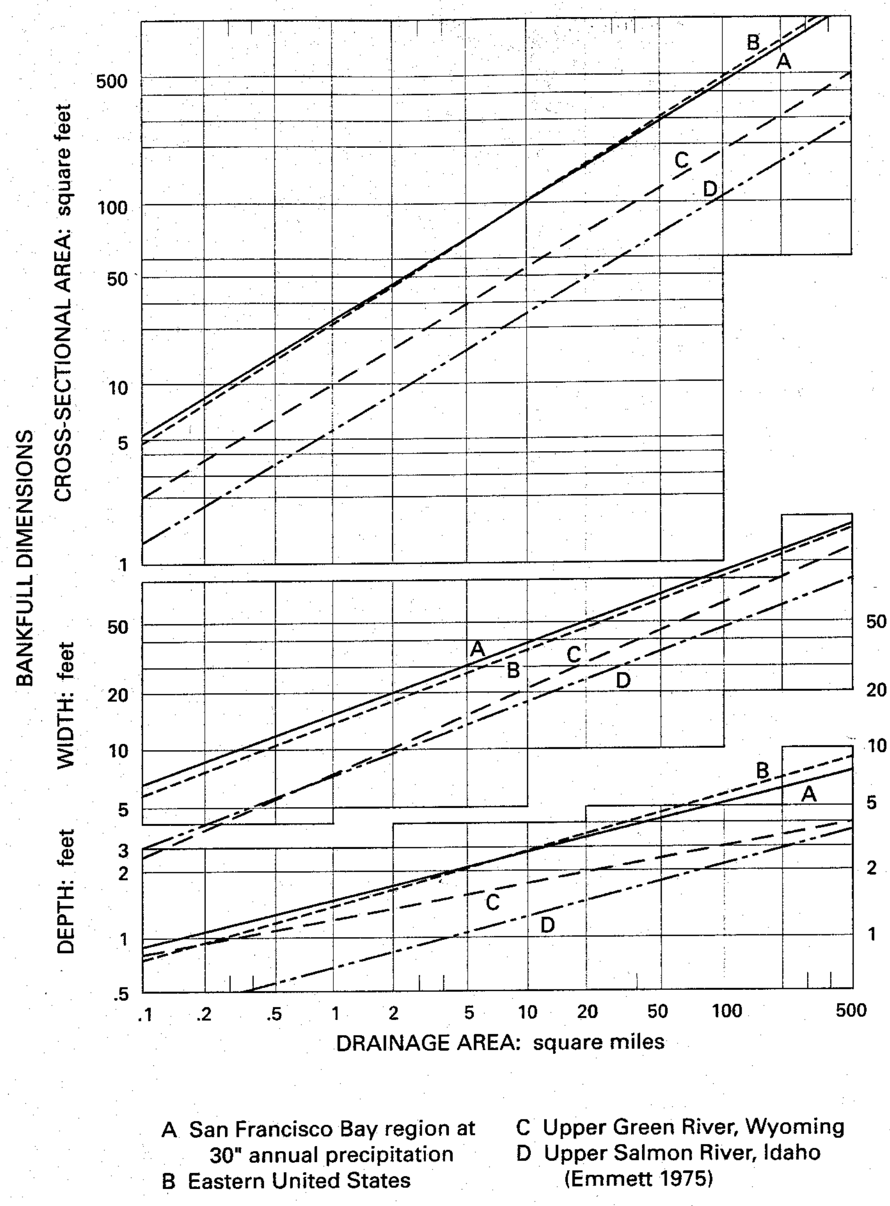


Figure 8.5 Average values of bankfull channel dimensions as a function of drainage area for four regions. (After Dunne and Leopold 1978.)

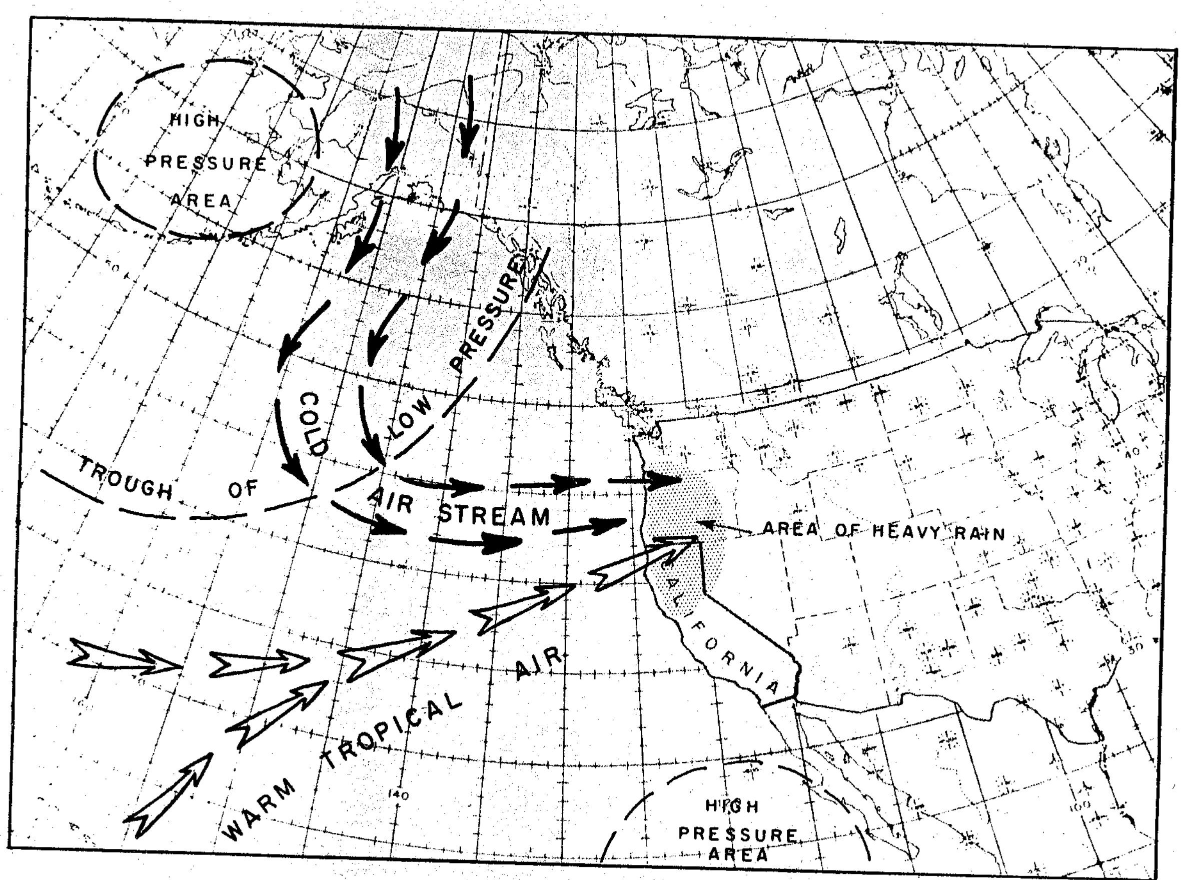
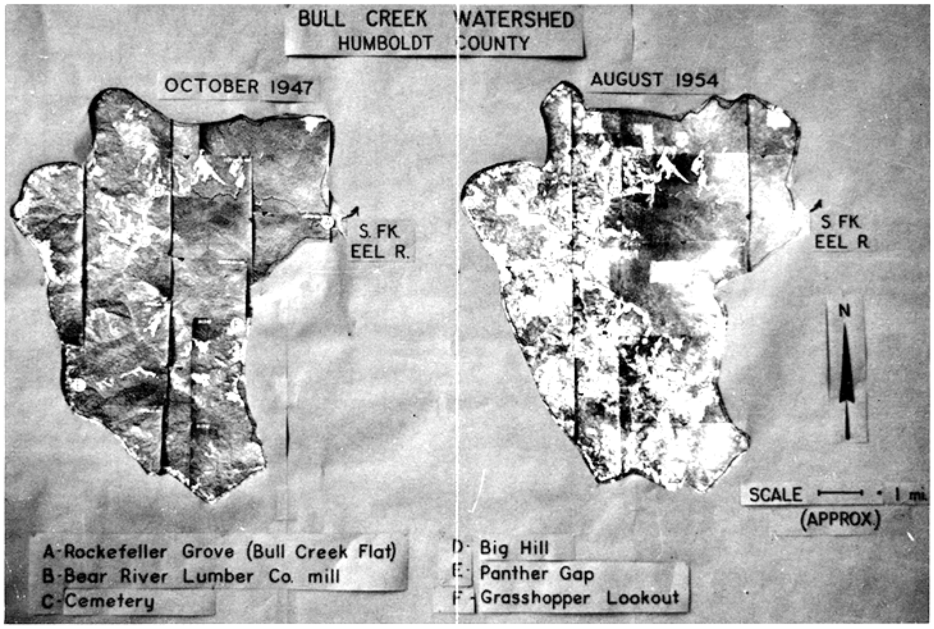


Fig. 8.

SCHEMATIC DIAGRAM OF WEATHER PATTERN
AT 500 MILLIBARS DECEMBER 22, 1964

SOURCE: W.L. HORN, 1966, CLIMATE AND HYDROLOGY, in A SYMPOSIUM ON MANAGEMENT FOR PARK PRESERVATION - A CASE STUDY AT BULL CREEK: SCHOOL OF FORESTRY, U.C. BERKELEY



Airphoto mosaics taken seven years apart show how the forest cover on the steep slopes of upper Bull Creek has been denuded.

Bull Creek channel, before and after sediment input

1947

1957

source: James P. Tryner, *Crisis on Bull Creek*, Save-the-Redwoods League Bulletin, 1961

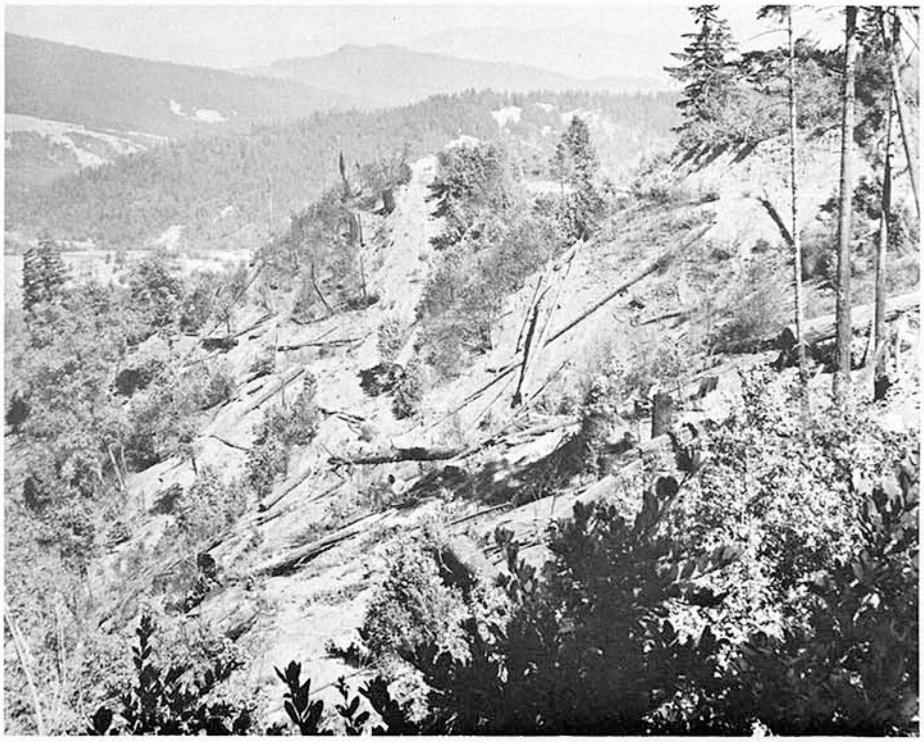
Channel of Bull Creek before logging in upper watershed. Average width no more than 60 ft.

2

Channel of Bull Cr circa 1960. Width about 300 ft.

source: Peggy Wayburn, *The Tragedy of Bull Creek,* Sierra Club Bulletin, January 1960

Bull Creek hillslopes after logging and storms



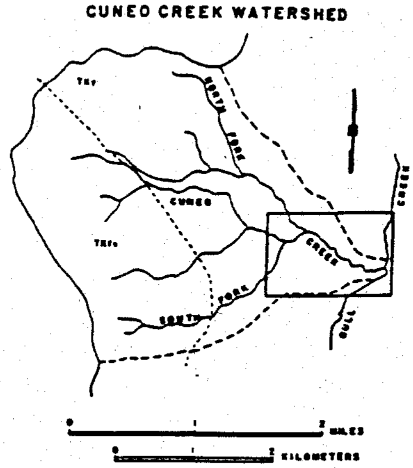
3

Slopes above Cuneo Creek, about 1960

4

Large landslide in Bull Cr watershed, circa 1960.
Possibly the beginning of the Devil's Elbow slide?

source: James P. Tryner, *Crisis on Bull Creek*,Save-the-Redwoods League Bulletin, 1961



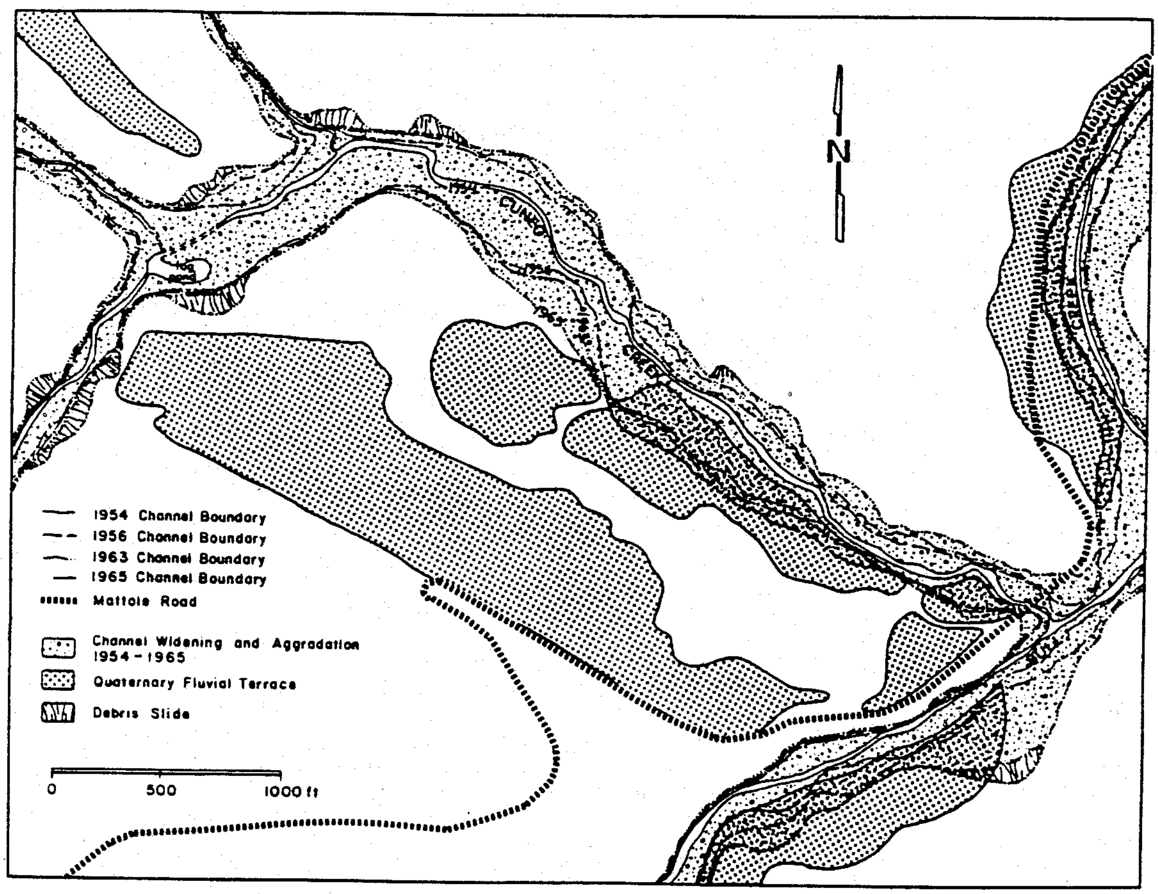


Figure 5. Progression of channel widening in the lowermost 1.8 km of Cuneo Creek mainstem (from Short, 1984).

SOURCE: D.A. SHORT HSU MASTERS THESIS, 1993

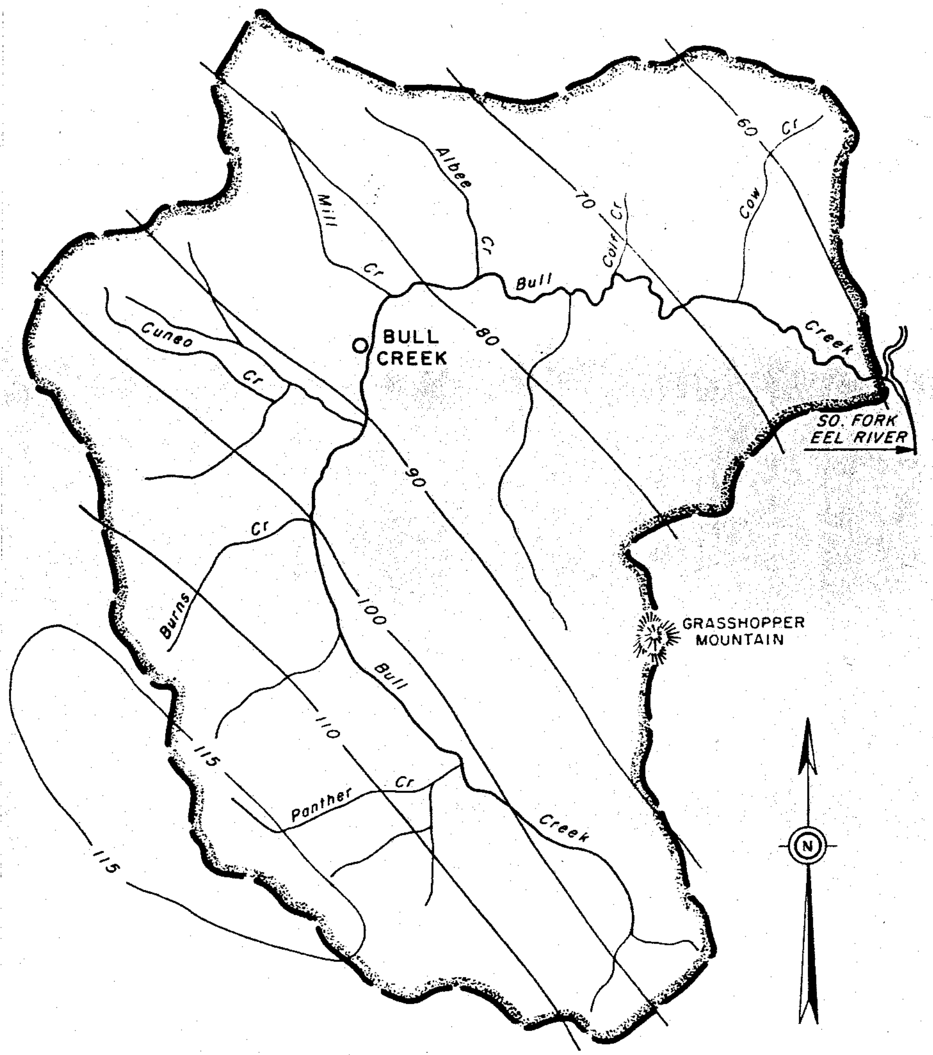
Bull and Cuneo Cr Photos, August 1968

View upstream along Bull Cr from junction with Cuneo Cr.
August 1968

View up Cuneo Cr. from its junction with Bull Cr. Slide taken from the road at N end of the bridge.   August 1968

View up Cuneo Cr from Pole Line Road, August 1968
Photos taken by A.K. Lehre

RAINFALL DISTRIBUTION (INCHES)



MEAN ANNUAL ISOHYETAL LINES
BULL CREEK WATERSHED

Fig. 7.

SOURCE: W.L. HORN, 1966

CUNEO CREEK BRIDGES

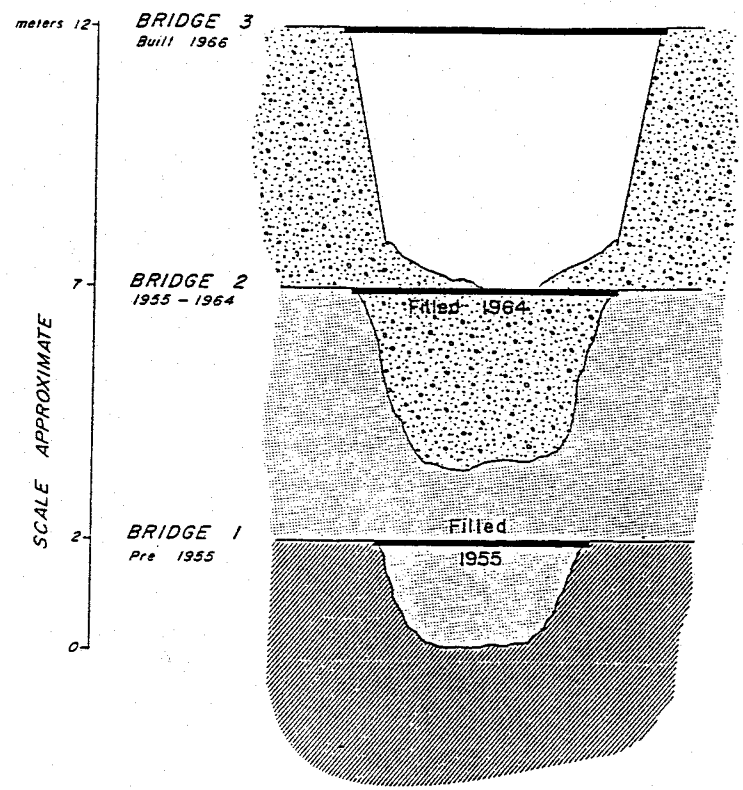
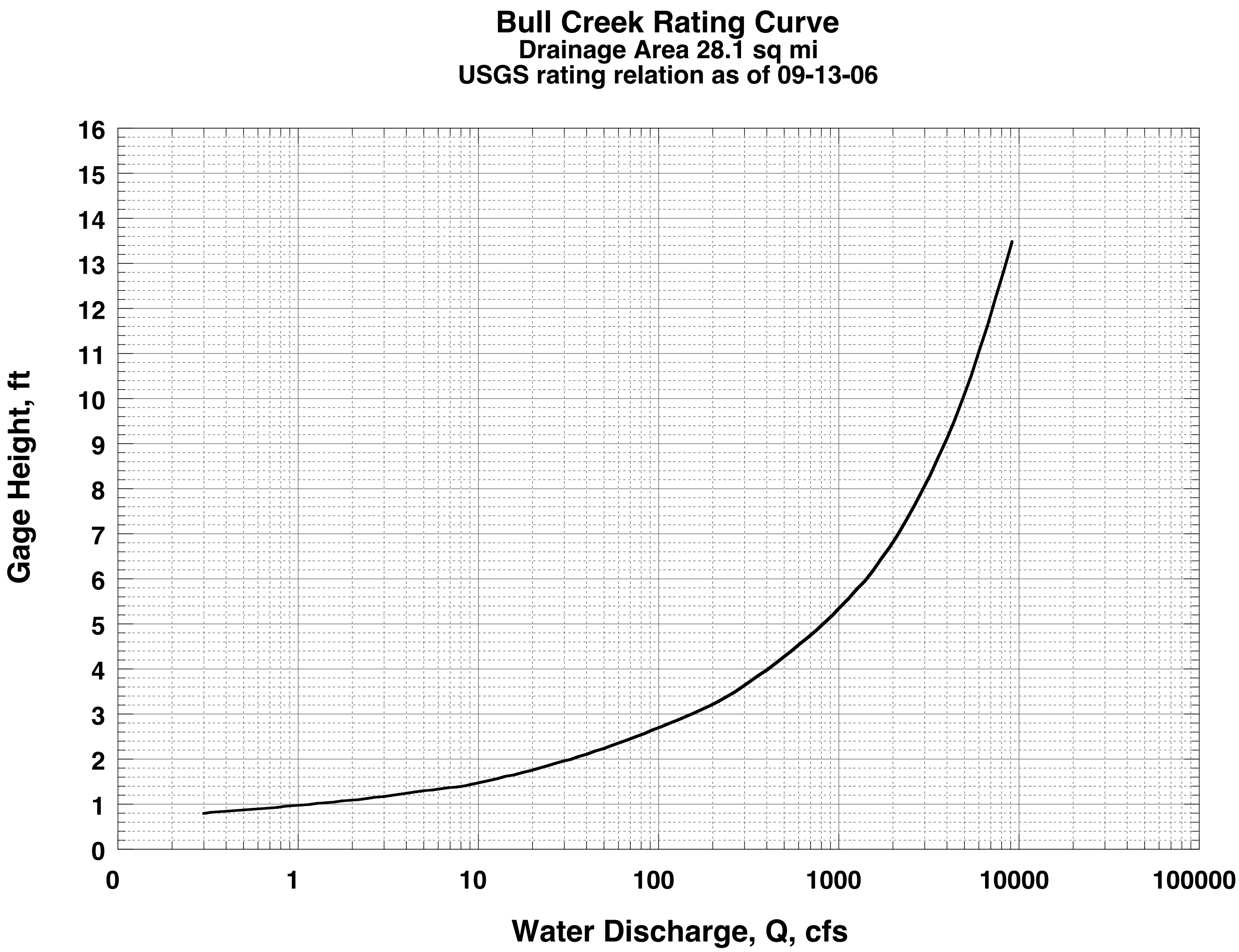
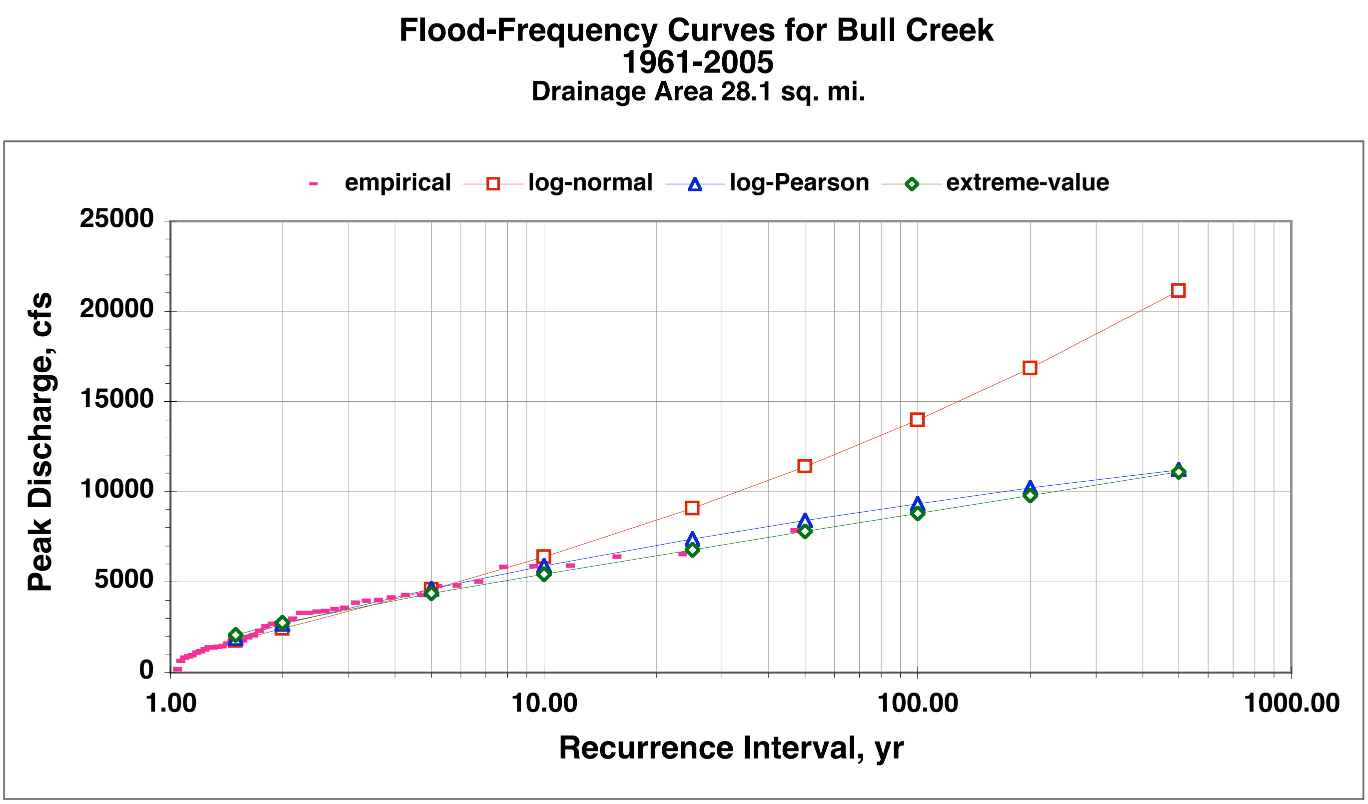


Figure 6. Succession of three bridges over mouth of Cuneo Creek (from Short, 1984).

SOURCE: D.A. SHORT, A SEDIMENT BUDGET FOR A SMALL NORTHCOAST DRAINAGE BASIN HUMBOLDT CO, CALIFORNIA
HSU MASTERS THESIS, 1993


Bull Creek Rating Curve
Drainage Area 28.1 sq mi
USGS rating relation as of 09-13-06
Gage Height, ft
Water Discharge, Q, cfs
0
1
10
100
1000
10000
100000
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0


Flood-Frequency Curves for Bull Creek
1961-2005
Drainage Area 28.1 sq. mi.
empirical
log-normal
log-Pearson
extreme-value
Peak Discharge, cfs
Recurrence Interval, yr
25000
20000
15000
10000
5000
0
1.00
10.00
100.00
1000.00

Annual Peak Discharges at Bull Creek 1961 - 2005
drainage area 28.1 sq, mi.

Water Year	Date of Peak	Peak Q, cfs	Rank
1961	10-Feb-61	3400	18
1962	9-Feb-62	1380	36
1963	31-Jan-63	4120	12
1964	20-Jan-64	1930	29
1965	22-Dec-64	6520	2
1966	4-Jan-66	5000	7
1967	5-Dec-66	4800	8
1968	14-Jan-68	2710	24
1969	24-Dec-68	3550	16
1970	26-Jan-70	4280	10
1971	3-Dec-70	2970	22
1972	22-Jan-72	4000	13
1973	16-Jan-73	1370	37
1974	16-Jan-74	5830	6
1975	18-Mar-75	3290	21
1976	26-Feb-76	1590	33
1977	19-Sep-77	173	45
1978	14-Dec-77	4260	11
1979	11-Jan-79	878	42
1980	14-Jan-80	2540	26
1981	27-Jan-81	1770	30
1982	16-Nov-81	3840	15
1983	16-Dec-82	5880	4
1984	10-Nov-83	2810	23
1985	12-Nov-84	3500	17
1986	17-Feb-86	4780	9
1987	5-Mar-87	1460	34
1988	6-Dec-87	2310	27
1989	22-Nov-88	1150	39
1990	8-Jan-90	806	43
1991	4-Mar-91	2040	28
1992	16-Feb-92	635	44
1993	20-Jan-93	3300	20
1994	23-Jan-94	1110	40
1995	9-Jan-95	6400	3
1996	12-Dec-95	3370	19
1997	31-Dec-96	7830	1
1998	23-Mar-98	1690	31
1999	30-Nov-98	1430	35
2000	14-Feb-00	2700	25
2001	22-Feb-01	970	41
2002	6-Jan-02	1680	32
2003	16-Dec-02	5860	5
2004	17-Feb-04	3950	14
2005	12-Dec-05	1270	38