GRASS VALLEY CREEK

SEDIMENT YIELD STUDY

Trinity County

California

SEDIMENT YIELD STUDY
GRASS VALLEY CREEK WATERSHED
TRINITY COUNTY, CALIFORNIA

By
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September 1980

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Davis, California

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NEED FOR THE STUDY

Sand-sized and finer sediments are adversely affecting gravel spawning beds in the Trinity River below the mouth of Grass Valley Creek. The Water and Power Resources Service requested that the Soil Conservation Service (SCS) provide them with information on source areas of these type sediments within the Grass Valley Creek Watershed. Their particular interest is the effectiveness of the proposed Buckhorn Debris Basin.

METHOD OF STUDY

Numerous erosion and sediment studies were made in the past on the Grass Valley Creek Watershed. These studies were made by the now nonexistent State Department of Soil Conservation, the Soil Conservation Service, and the Trinity River Basin Fish and Wildlife Task Force. Suspended sediment data was available from a gage located on Grass Valley Creek at Fawn Lodge. The past sediment studies along with the suspended gage data were evaluated.

The watershed was divided into nine subwatersheds to delineate the problem areas. The watershed boundaries are shown on PLATE 1. The watersheds descriptions follow:

Subarea	Location	Drainage Areas Ac.	Sq. Mi.	Hectares	Sq. Kilo.
1	Mouth of Grass Valley Creek upstream to sawmill site	537	0.84	217.4	2.17
2	Sawmill site upstream to confluence of Grass Valley Creek and Phillips Gulch - Fawn Lodge	1992	3.11	805.5	8.06
2A	Phillips Gulch Drainage Area	1491	2.33	603.6	6.03
3	Fawn Lodge upstream to confluence of Grass Valley Creek and Little Grass Valley Creek - south of 299	1177	1.84	476.5	4.77
3A	North of 299	474	0.74	191.9	1.92
4	Confluence of Grass Valley Creek and Little Grass Valley Creek upstream to Buckhorn Site - south of 299	6690	10.45	2706.5	27.06
4A	North of 299	3965	6.20	1605.3	16.06
4B	Little Grass Valley Creek from 0.6 mile downstream from Shingle Shanty upstream to head of watershed	1432	2.24	580.8	5.80
5	Buckhorn Site on Grass Valley Creek upstream to top of watershed	6242	9.75	2527.1	25.27
	Totals	24000	37.5	9714.6	97.14

Soil Conservation Service methods were used to determine erosion and sediment yields from various sources in the subwatersheds.

CONCLUSIONS

1. Location of a debris basin at the Buckhorn Site will control 53 percent of the annual sediment to the Trinity River from Grass Valley Creek.

2. Location of a debris basin at the Sawmill Site will control 99 percent of the annual sediment to the Trinity River from Grass Valley Creek.

3. The source of 89 percent of the annual sediment to the Buckhorn Site is sheet and rill and streambank erosion. It is estimated that 20 percent of the erosion is a natural geologic process that cannot be altered.

4. The remaining erosion could be reduced appreciably by the installation of land treament measures.

5. Erosion will continue at the present rate until land treatment measures take effect.

OBJECTIVES OF THE STUDY

The major objective of the study is to determine the percent of the total sediment yield that will be controlled by the Buckhorn Site. Erosion and sediment yields were also determined for the various subwatersheds.

DESCRIPTION OF THE STUDY AREA

General

Grass Valley Creek Watershed is situated in East-Central Trinity County, California. U.S. Highway 299 traverses the watershed from east to west. The Shasta-Trinity County lines form the eastern boundary of the watershed. Weaverville, the county seat of Trinity County, is located about 5 miles northwest of the confluence of Grass Valley Creek and the Trinity River. Grass Valley Creek heads on the western slopes of Shoemaker Bally and flows in a northwesterly direction for about 15 miles entering the Trinity River three miles southwest of Lewiston, California. Little Grass Valley Creek is a major tributary of Grass Valley Creek. The headwaters of Little Grass Valley Creek are on the western slopes of Buckhorn Bally and its confluence with Grass Valley Creek is along U.S. Highway 299 about one-half mile west of Lewiston Road. Grass Valley Creek Watershed comprises an area of 24,000 acres or 37.5 square miles.

Topography

The Grass Valley Creek watershed is mountainous with steep slopes and narrow V-shaped valleys. The drainage pattern is dendritic. Total relief of the watershed is 4,350 feet measured from the summit of Shoemaker Bally (EL. 5,950 ft.) to the mouth of Grass Valley Creek (EL. 1,600 ft.).

UPPER GRASS VALLEY CREEK WATERSHED
VIEW FROM COUNTY LINE ROAD

CONFLUENCE OF GRASS VALLEY CREEK
AND TRINITY RIVER

Geology

Three-fourths of the watershed area is underlain by granite of the Shasta Bally Batholith (PLATE 3). The batholith is deeply weathered and few hard outcrops occur. Deep mechanical weathering produces great quantities of coarse to medium grained sand with few fines. The decomposed granite area extends from the head of the watershed (Shoemaker Bally) downstream to its contact with metamorphosed sediments near the confluence of Grass Valley and Little Grass Valley Creeks. The lower one-fourth of the watershed area consists of metamorphic rocks, landslide and terrace deposits. Recent alluvium is present along the narrow floodplains.

Soils

The soils over the upper three-fourths of the watershed area are classed as coarse sandy loam derived from granitic rocks. These soils have rapid to moderately rapid percolation rates and high to extremely high erosion rates. Soils over the lower one-fourth of the watershed area are gravelly loams derived from metamorphic sedimentary and steep metavolcanic rock uplands. These soils have moderate erosion rates.

Climate

The watershed enjoys a moderate climate. Summer temperatures reach 100° in the canyons and narrow valleys but the higher ridges are appreciably cooler. Freezing temperatures occur during the winter.

Average annual precipitation including rainfall and snow ranges from 60 inches in the lower watershed to 70 inches at the higher elevations.

Watershed Cover

About 75 percent of the watershed area is covered by hardwoods, brush, grass and second-growth conifers, such as Douglas Fir and Ponderosa Pine. The remaining watershed areas are open, building sites, and roads and trails. Overall the watershed cover is fairly good.

SOURCES OF SEDIMENT

Sediment in the Grass Valley Watershed is from erosion caused by direct rainfall and runoff. Four major sources of sediment in the watershed are sheet and rill erosion, erosion on streambanks, erosion on roads and roadbanks, and erosion caused by concentrated runoff from roads-roadside gullies. Man-caused accelerated erosion occurs on watershed slopes, streambanks, roads and roadbanks and roadsides. Natural geologic erosion also occurs on watershed slopes and on streambanks. The Grass Valley Watershed is unique because of the clear division between soils with low or medium erodibility and highly erodible decomposed granitic soils. Even under natural geologic conditions, bedload would be relatively high in Grass Valley Creek. Mans' activity has accelerated the erosion, especially on the highly erodible soils.

Sheet and Rill Erosion

Sheet erosion is the removal of a fairly uniform layer of soil from the land surface by runoff water. Rills are small eroded channels less than a foot in depth. Sheet and rill erosion occurs over most of the watershed and is the largest source of sediment and also the least visible.

Sheet and rill erosion rates were determined using the Universal Soil Loss Equation (USLE)(5). The USLE was developed by the USDA - Agricultural Research Service. The Universal Soil Loss Equation is comprised of the following factors:

$$A = RK(LS)CP$$

Where:

- R = Rainfall and Runoff Erosion Index
- K = Soil Erodibility Factor
- LS = Factor which combines the effects of slope length and steepness
- C = Cover and Crop Management Factor
- A = Predicted annual soil loss in tons per acre based on an average dry density of 90 pounds per cubic ft. (1.44 G/CC)

Numerical values for each equation factor were determined using rainfall data from the National Weather Service, soils information from SCS Soil Scientists, slope data by studying aerial photographs and taking random field measurements, and "Guides for Erosion and Sediment Control."

Sheet and rill erosion by subwatersheds is listed in the table below:

TABLE 1.

Subarea	Tons	Acres	Tons Per Acre
1	1,796	537	3.3
2	9,960	1,992	5.0
2A	4,175	1,491	4.0
3	4,002	1,177	3.4
3A	1,611	474	3.4
4	28,767	6,690	4.3
4A	17,049	3,965	4.3
4B	7,733	1,432	5.4
5	41,821	6,242	6.7
Totals	116,914	24,000	4.9 average

Streambank Erosion

There are approximately 270 miles of perennial and intermittent streams in the Grass Valley Creek Watershed. Stream miles were based on expansion of the Shasta Bally and Phillips Gulch 7½ minute quadrangle sheets. Sample reaches on the streams were observed in the field and studied on aerial photographs. Length, height and annual recession rate of the eroding stream

STREAMBANK EROSION ON GRASS VALLEY CREEK
ABOVE BUCKHORN DAMSITE

IMPROPER ROAD DRAINAGE CAUSING GULLY IN
DECOMPOSED GRANITE ABOVE BUCKHORN DAMSITE

banks were noted. The recession rate over a period of years was determined by physical features on ground including tree roots, fence lines, etc. Approximately 65 percent of the banks are eroding to various degrees. The average erosion rate per stream mile is 35 tons. About 90 percent of the erosion is in areas with granitic soils.

Streambank erosion by subwatersheds is listed in the following table:

TABLE 2.

Subarea	Tons	Stream Miles	Tons Per Mile/Yr.
1	25	7.5	3.5
2	90	23.0	4.0
2A	1400	16.0	85
3	70	14.5	5
3A	515	5.5	95
4	3465	76.5	45
4A	3665	42.5	85
4B	1280	15.0	85
5	7920	70	115
Totals	18430	270.5	70 average

Road and Roadbank Erosion

There are approximately 42 miles of various types of roads in the Grass Valley Creek Watershed. Approximately 26 miles of the roads are being used intensively including Highway 299, Lewiston Road and the Watershed Divide Road from Buckhorn Summit to Shoemaker Bally. The remaining roads are relatively unused miscellaneous and old logging roads.

Most of the road miles were driven or walked and erosion was observed in sample reaches. The method used and the data obtained by the State Division of Soil Conservation in 1968 was used primarily with some revisions. Various degrees of erosion are occurring on the roads and roadbanks. Roadbanks situated in the granitic materials are eroding at a fairly high rate. The exposed weathered granite slides down the steep banks and is deposited at the toe. This material is either removed by flows in the ditches or hauled away to disposal areas and then removed. Sheet and rill erosion caused by runoff flows is occurring on bare road surfaces in many cases.

Road and roadbank erosion by subwatersheds is listed on the following table:

ROADBANK IN DECOMPOSED GRANITE
BUCKHORN DAMSITE WATERSHED

ROADBANK IN METAMORPHOSED SEDIMENTS
ALONG HIGHWAY 299 BELOW FAWN LODGE

TABLE 3.

Subarea	Tons	Road Miles	Tons Per Mile/Yr.
1	75	2.8	25
2	220	4.7	45
2A	450	1.5	300
3	510	4.6	110
3A	330	0.9	365
4	270	3.8	70
4A	1950	4.1	475
4B	1330	2.8	475
5	4940	16.4	300
Totals	10075	41.6	240 average

Erosion From Roadside Gullies

Considerable gully erosion is occurring over the watershed caused by concentrated runoff from improper drainage facilities. The erosion is evident on all types of roads where drainage facilities are not long enough to reach natural stream channels or where the outlet was placed too high in the fill. Numerous gullies are also present in old logging roads were no drainage facilities were provided.

Observations were made in the field and on aerial photographs and estimates were made of the number of gullies present in each subwatershed and the amount of erosion from each.

TABLE 4.

Subarea	Number of Gullys	Erosion (Tons)	Tons Per Gully/Yr.
1	2	100	50
2	3	200	65
2A	1	110	110
3	1	50	50
3A	2	100	50
4	5	250	50
4A	5	250	50
4B	20	500	25
5	50	1250	25
Totals	89	2810	30 avg.

Geologic Erosion

An estimated 25,000 tons of erosion occurs annually by the natural geologic process. The erosion would occur over the watershed even without mans' acceleration of the erosion process. Erosion under natural conditions is included in sheet and rill and streambank erosion.

SEDIMENT YIELDS

Sediment yield is dependent on gross erosion in the watershed and on the transport of eroded material out of the watershed. Only a part of the eroded materials is carried out of the watershed. Varying proportions of the eroded materials are deposited as colluvium at the base of slopes and in swales or as alluvium in natural or artificial lakes, on floodplains and in channels within the watershed. Therefore, the magnitude of yield usually varies for different parts of a watershed.

Method of Determining Sediment Yield

There are several ways to determine the sediment yield of a watershed. In this study the gross erosion and sediment delivery method was used along with suspended load data from the USGS Gage located at Fawn Lodge. Sediment yield is a percentage of the gross erosion on the watershed. The gross erosion is the summation of all the erosion taking place in the watershed, including sheet and rill, streambanks, roads, gullies, etc.

Delivery Ratio

The Watershed Relief-Length Ratio has been shown as a significant indicator of the Sediment Delivery Ratio (6). The effect of the R/L Ratio may not be as pronounced in some areas as in others; but it seems to be a reasonable expression of several measureable watershed factors. In this study this was the method used to determine the percentage of eroded material moved out of the watershed.

Sediment yields from subwatershed are listed in Table 5 (page 9).

SEDIMENT STORAGE IN BUCKHORN SITE

Trap Efficiency

An estimated 75 percent of the eroded materials on the watershed is course material larger than 0.074 mm. Based on curves in SCS Technical Release 12 and intended function of the basin, the estimated trap efficiency of the basin is 96 percent.

Sediment Storage

An estimated 24.2 acre-feet (29.85 cubic dekameters) of material will reach the reservoir area. Some of the finer material will pass the reservoir during certain flows. It is estimated that 23.2 acre-feet (28.54 cubic dekameters) will be trapped in the reservoir annually.

TABLE 5. TOTAL SEDIMENT YIELD

Sub-area	Gross Erosion-Tons						Sediment Yield-Tons
	Sheet and Rill	Streambanks	Roads and Roadbanks	Roadside Gullys	Total	Delivery Ratio (%)	Total
1	1796	25	75	100	1996	30	600
2	6972	90	220	200	7482	55	4115
2A	5964	1400	450	110	7924	95	7525
3	4002	70	510	50	4632	70	3240
3A	1611	515	330	100	2556	70	1790
4	28767	3465	270	250	32752	25	8190
4A	17049	3665	1950	250	22914	30	6875
4B	7733	1280	1330	500	10843	85	9215
5	41821	7920	4940	1250	55831	85	47455
Totals	115715	18430	10085	2810	146930	60.5*	89005

*Average Delivery Ratio on Watershed

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1. California Department of Water Resources - Northern District, 1978, Sediment Control Study, Grass Valley Creek: Red Bluff, CA 73 p.

2. USDA-Soil Conservation Service, 1967, Report for General Soil Map, Trinity County, California: Soil Section, Davis, CA.

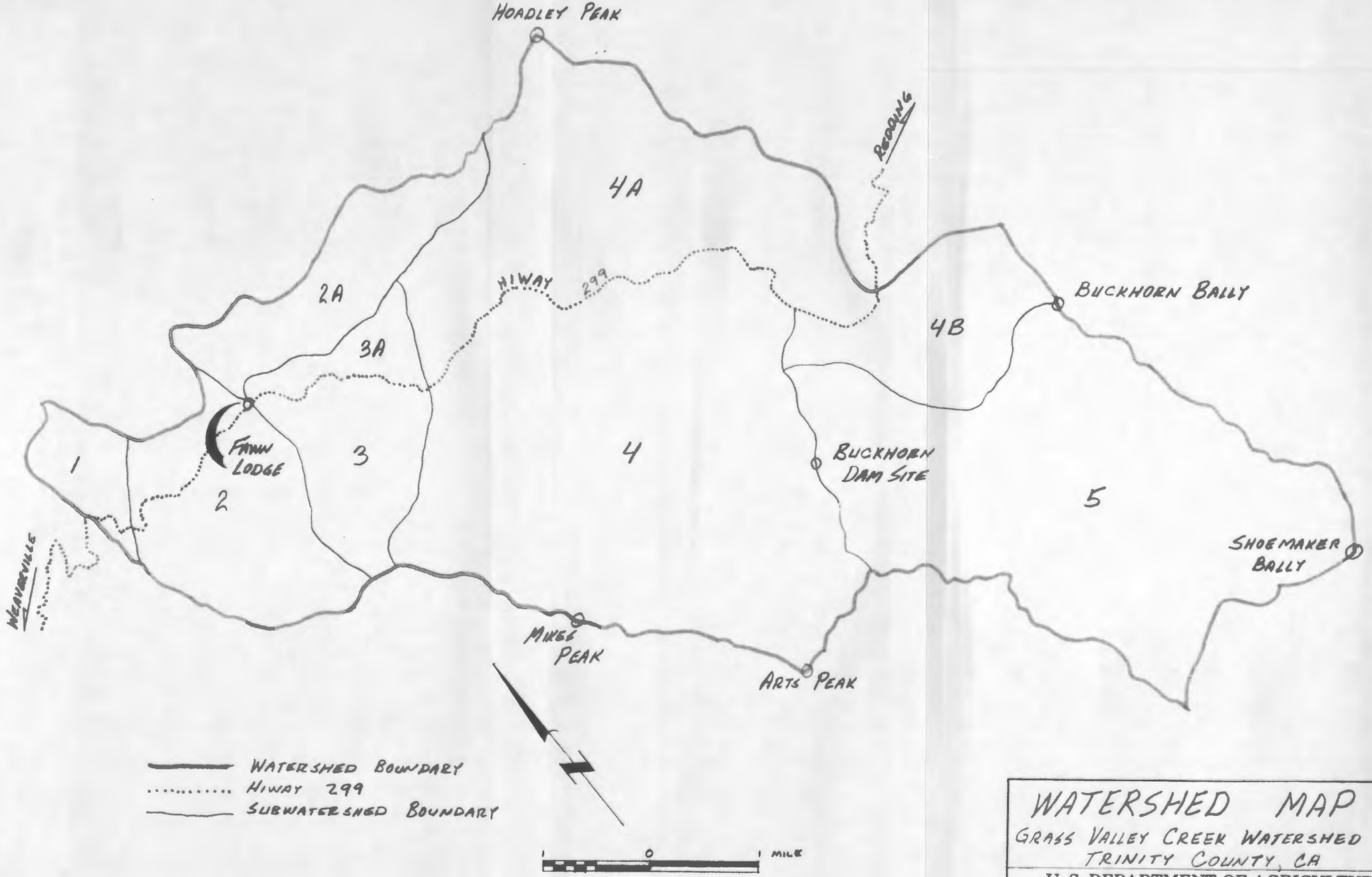
3. USDA-Soil Conservation Service, 1979, Sources of Sediment Mini-Report, Red Bank Creek Pilot Study Area, Tehama County, California: Red Bluff, CA.

4. State of California - Resources Agency, 1968, Grass Valley Creek Watershed Investigation: Sacramento, CA.

5. USDA-Soil Conservation Service, Guides for Erosion and Sediment Control: Davis, California 32 p.

6. John W. Roehl, Soil Conservation Service, Sediment Source Areas, Delivery Ratios and influencing Morphological Factors, Presented at the Symposium on Land Erosion, October, 1962.

7. USDA-Soil Conservation Service, National Engineering Handbook, Section 3, Sedimentation: Washington, D.C.



WATERSHED MAP

GRASS VALLEY CREEK WATERSHED
TRINITY COUNTY, CA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed		Approved by	
Drawn		Title	
Traced A.R.W.	4/80	Title	
Checked		Sheet No. of	Drawing No. PLATE 1

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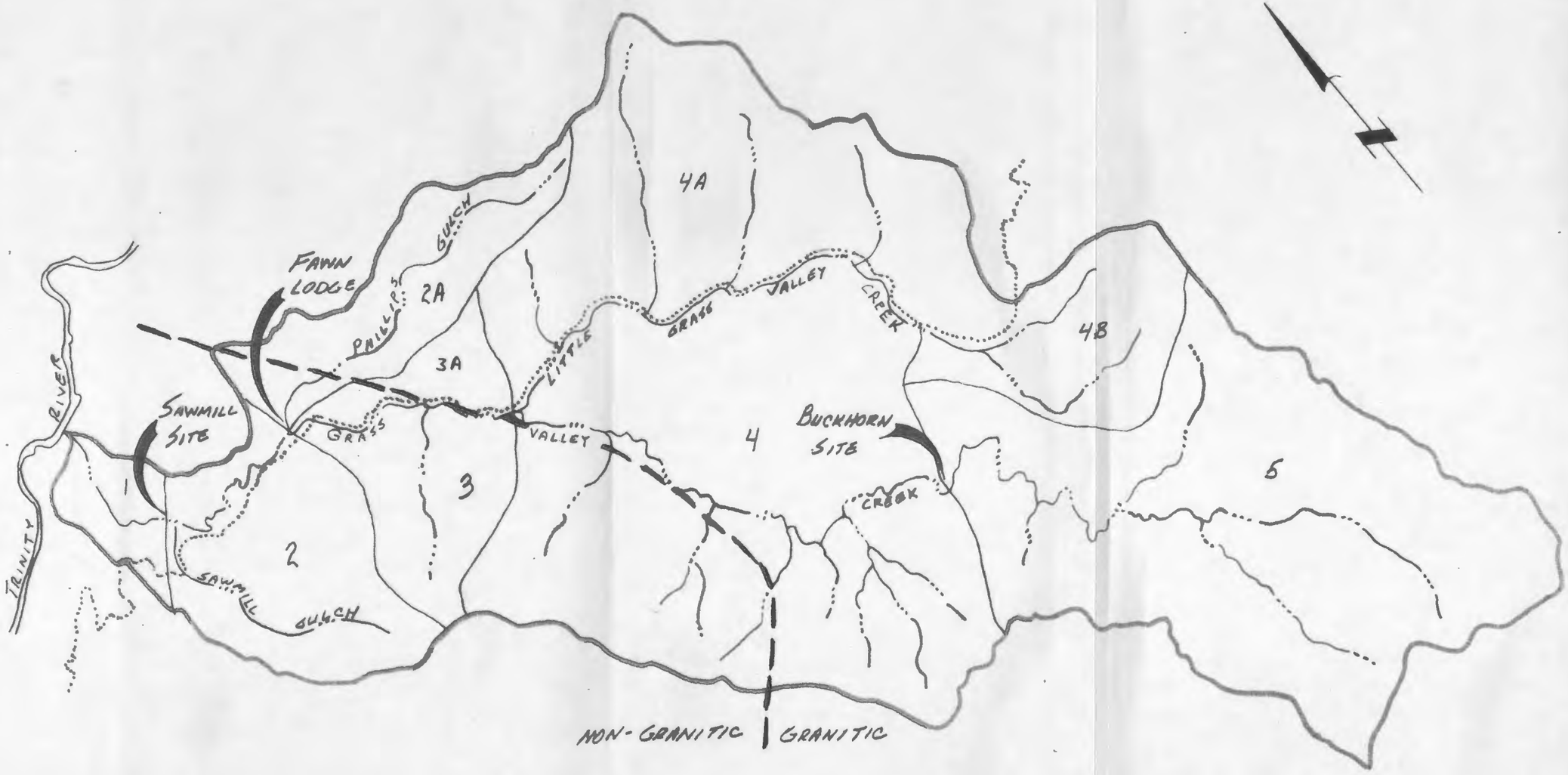

WATERSHED BOUNDARY
..... HIWAY 299
SUBWATERSHED BOUNDARY
STREAM, AS SHOWN ON 15' QUAD
GRANITIC SOILS BOUNDARY

0 MILE

STREAM MAP

GRASS VALLEY CREEK WATERSHED
TRINITY COUNTY, CA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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SCS-ENG 313A REV 8 75

① IRWIN, W.P., 1963, PRELIMINARY GEOLOGIC MAP OF THE WEAVERVILLE QUADRANGLE, CALIFORNIA, U.S.G.S. MISC. FIELD INVEST. MAP MF-275.

② ALBERS, J.P., ET AL., 1964, GEOLOGY OF THE FRENCH GULCH QUADRANGLE, CALIFORNIA, U.S.G.S. GEOL. QUAD. MAP GQ-336.

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——— CONTACT; ALL CONTACTS DRAWN AS SOLID LINES - CONFIDENCE LEVEL NOT IMPLIED.

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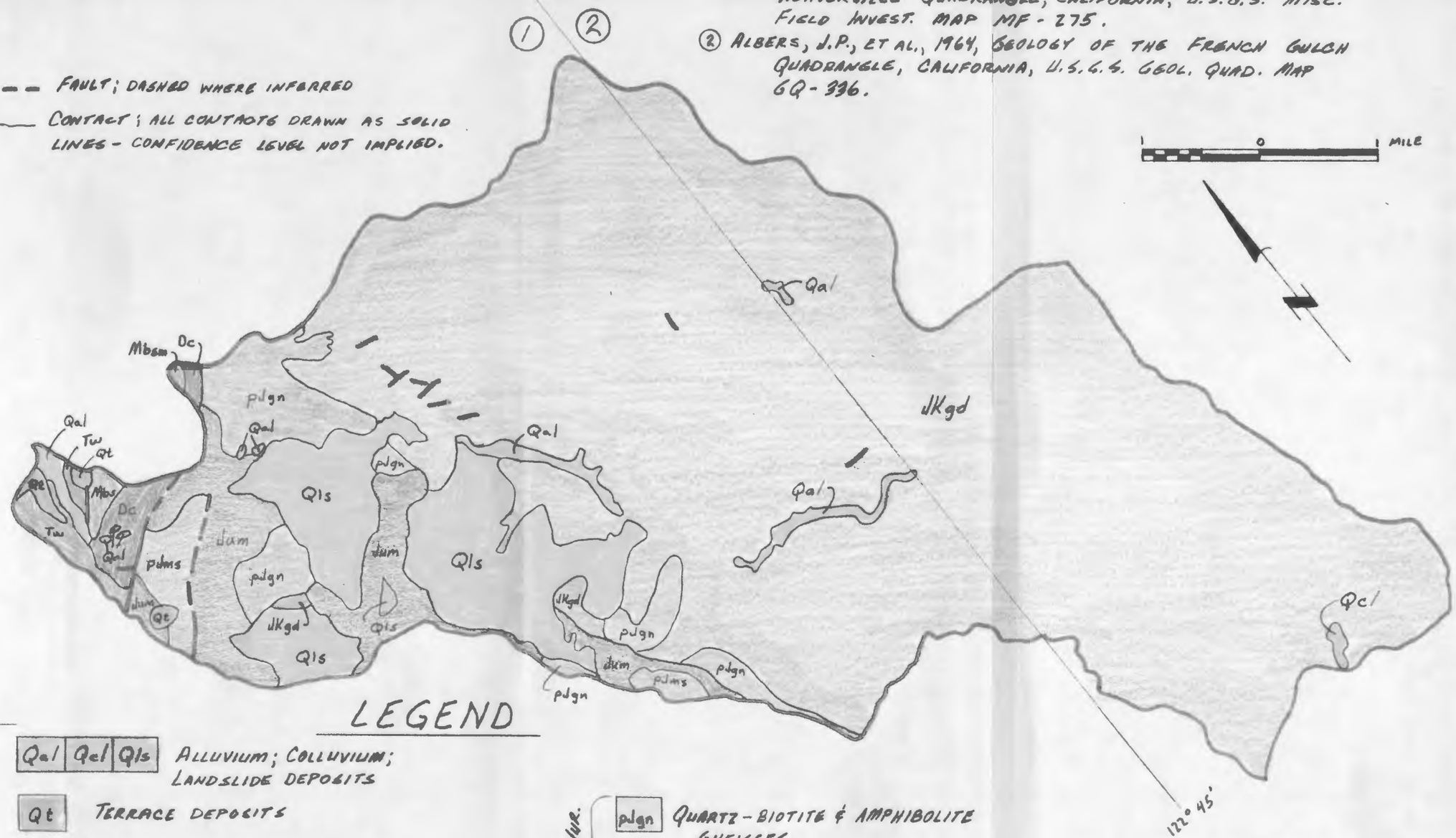

LEGEND

CENOZOIC — TERTIARY QUATERNARY

- Qal | Qcl | Qls — ALLUVIUM; COLLUVIUM; LANDSLIDE DEPOSITS
- Qt — TERRACE DEPOSITS

CENOZOIC — TERTIARY — OLIGO.

- Tw — WEAVERVILLE FM.; CONT. SEDS.

MESOZOIC — JUR. — CRET.

- JKgd — BIOTITE-HORNBLENDE GRANODIORITE
- JUM — PERIDOTITE; MOSTLY SERPENTINIZED

pre-JUR.

- pJgn — QUARTZ-BIOTITE & AMPHIBOLITE GNEISSES
- pJms — ABRAMS MICA SCHIST

PALEOZOIC — DEV.? — MISS.

- Mbs | Mbsm — BRAGDON FM., DARK SLATY MUDSTONE; CONTACT METAMORPHOSED Mbs
- Dc — COPLEY GREENSTONE, ALTERED PILLOW LAVA, AGGLOMERATE, AND TUFF

GEOLOGIC MAP

GRASS VALLEY CREEK WATERSHED
TRINITY COUNTY, CA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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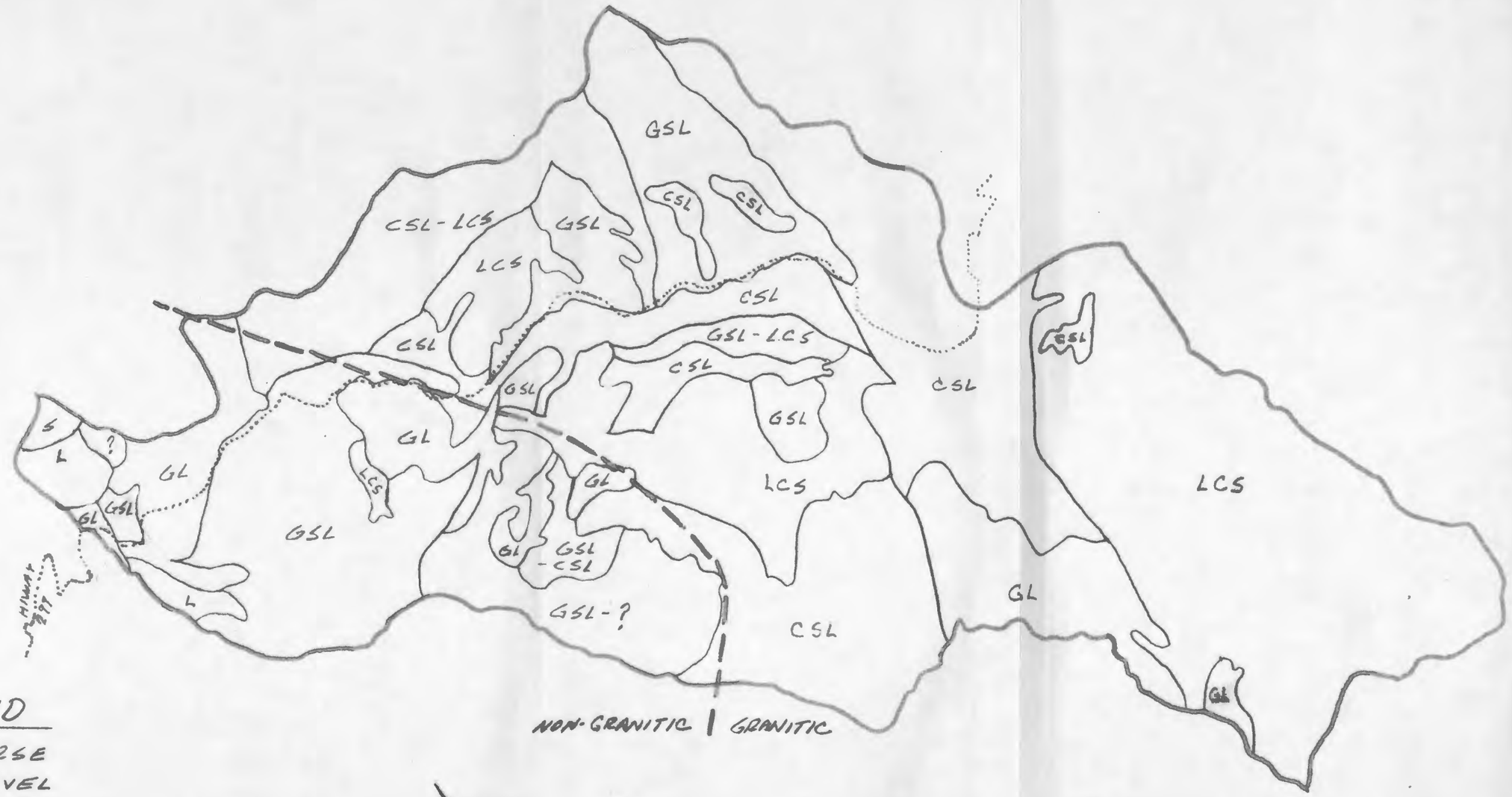

LEGEND

C - COARSE
G - GRAVEL
L - LOAM
S - SAND

e.g. GSL = GRAVELLY SANDY LOAM

~ SOIL BOUNDARY
..... HIWAY 299
——— WATERSHED BOUNDARY
- - - GRANITIC SOILS BOUNDARY

0 MILE

SOIL MAP

GRASS VALLEY CREEK WATERSHED
TRINITY COUNTY, CA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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SCS-ENG-313A REV 8-75

SUPPLEMENT TO ORIGINAL

SEDIMENT YIELD STUDY

GRASS VALLEY CREEK WATERSHED

TRINITY COUNTY, CALIFORNIA

OCTOBER 1980

The original study done in September 1980 determined the total amount of sediment that could be expected from each subarea under present conditions. It was later requested that a determination be made of the percentage of decomposed granite that reaches Grass Valley Creek from each subarea. These estimated percentages based on field observations and grain-size distribution data are listed below.

Subarea	Percentage of Total Sediment Yield (89,005 tons)	Percentage of Decomposed Granite (53,080 tons)
1	< 1	0
2	5	0
2A	8	7
3	4	2
3A	2	1
4	9	6
4A	8	9
4B	10	12
5	53	63

Subarea 5 comprises the Buckhorn Site Watershed.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

3179 Bechelli Lane #107
Redding, CA 96002
(916) 246-5252

SUBJECT: Percent of Erosion Controlled on the Grass Valley Creek Watershed

DATE: October 30, 1980

TO: Bill Webb, Area Conservationist

The Grass Valley Creek Watershed is comprised of 24,000 acres. It is estimated that 20 percent of the erosion occuring on the watershed is a natural geologic process. The remaining (80%) accelerated erosion is due to practices associated with logging and private land development.

The Soil Conservation Service has treated approximately 178 acres of this watershed with conservation practices. These practices include road surfacing, culverts, hydroseeding, mulching, tree planting, and several others. Using the premise that the areas treated with conservation practices were six times as erosive as the typical watershed, approximately five percent of the accelerated erosion has been stopped.

5% of the 80%

Sincerely,

Pam Hubbard

Pam Hubbard
Soil Conservationist

PH:djr

$700-$800,000 has been spent to halt erosion to date by SCS

11/18/80

SUPPLEMENT TO ORIGINAL

SEDIMENT YIELD STUDY

GRASS VALLEY CREEK WATERSHED

TRINITY COUNTY, CALIFORNIA

OCTOBER 1980

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5	53	63

Subarea 5 comprises the Buckhorn Site Watershed.

RANDALL F. REEVES
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