ROUND VALLEY INDIAN RESERVATION BOUNDARY

UPPER SEQUOIA RESERVOIR UNDER STUDY

Mill Creek

Middle Fork Eel River

EXISTING WILDERNESS AREA

20 MILES TO YOLLA BOLLY MIDDLE EEL WILDERNESS AREA

60 MI. TO INTERSTATE 5

PRIVATE ROAD (EASEMENT REQUIRED FOR USE)

Black Butte River

MENDOCINO

TO LAKE PILLSBURY 28 MILES

NATIONAL

FOREST

Eel River

N.W.P. RAILROAD

PROPOSED AIRSTRIP RELOCATED

DOS RIOS

DOS RIOS DAM

TUNNEL TO GRINDSTONE CREEK

POSSIBLE RELOCATED SITE OF COVELO

LAYTONVILLE

101

PRIVATE ROAD

Outlet Creek

Eel River

WILDLIFE AREA

Eel Creek

REDWOOD HIGHWAY

TO SAN FRANCISCO

TO BENBOW RIDGE RESERVOIR 6 MILES

EXISTING PRIVATE ROAD

LEGEND

- ADDITIONAL LANDS REQUIRED FOR RECREATION
- PRIVATE LANDS WITHIN PROJECT BOUNDARY
- LANDS TO BE ACQUIRED FOR RELOCATION OF ROUND VALLEY INDIAN COMMUNITY.
- BUREAU OF LAND MANAGEMENT LAND
- STATE — STATE LAND

(SOURCE OF DATA BLM MAP DATED: APRIL 1964)

- EXISTING INDIAN TRIBAL & ALLOTTED LAND (SOURCE OF DATA BY I.A. MAP DATED: 1954)
- EXISTING INDIAN LAND WITHIN APPROX. LAND ACQ. BOUNDARY (TO REMAIN UNDER B. of I.A. OWNERSHIP)
- APPROXIMATE LAND ACQUISITION BOUNDARY
- PROPOSED ACCESS ROAD
- PRIVATE ROAD
- RELOCATED ROAD
- STATE OR COUNTY ROAD
- US HIGHWAY
- INDIAN RESERVATION BOUNDARY
- NATIONAL FOREST BOUNDARY

N

EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
WATER RESOURCES DEVELOPMENT
MIDDLE FORK EEL RIVER
LAND ACQUISITION PLAN

DOS RIOS RESERVOIR

SCALE IN MILES 0 1 2 3

IN 3 SHEETS — SHEET NO. 3

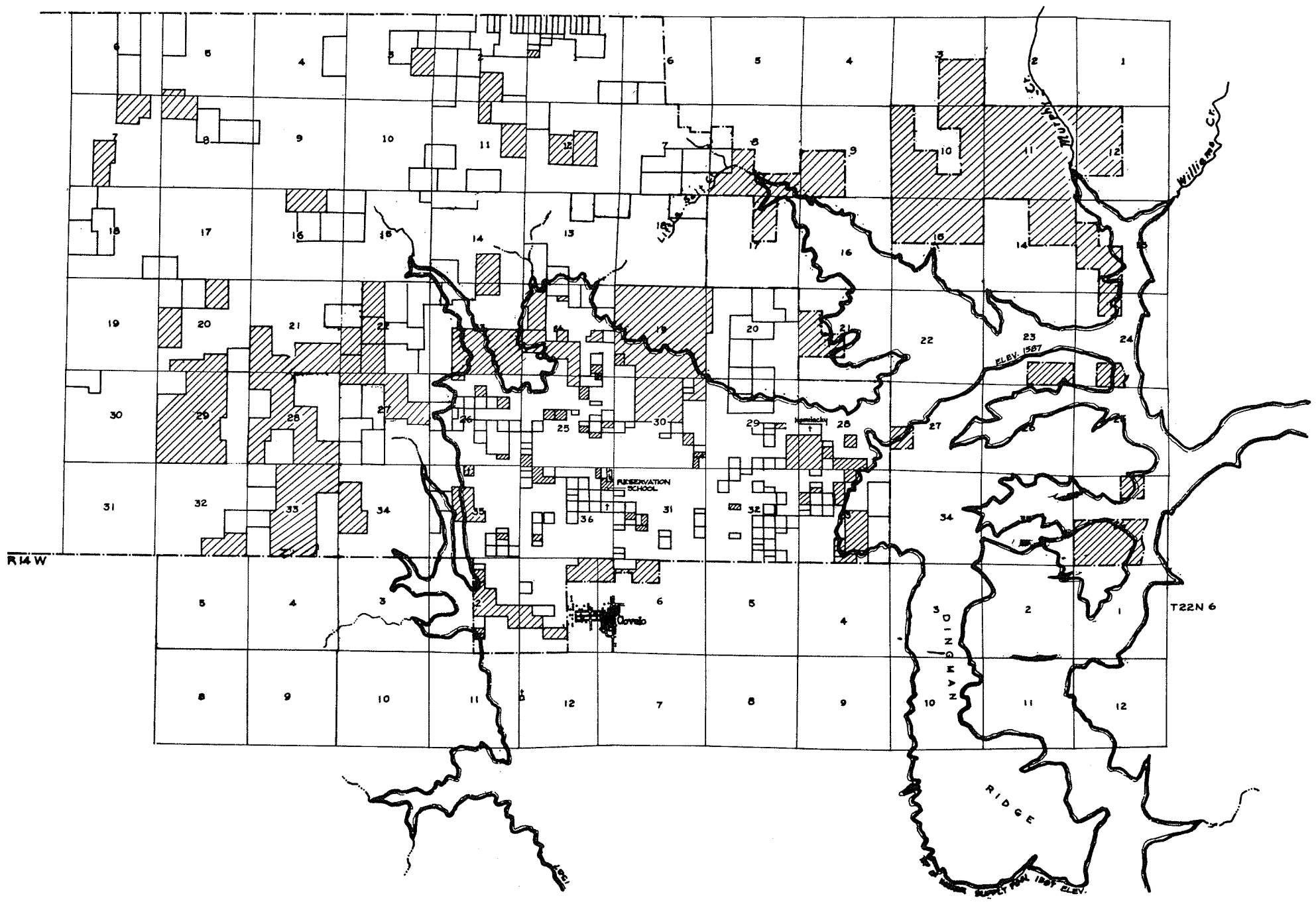
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS

DRAWN: C.H.
TRACED: A.G.
CHECKED: P.L.

TO ACCOMPANY REPORT DATED: APRIL 1968

FILE NO. 60-34-8

PLATE D-3



LEGEND

- TOP OF WATER SUPPLY POOL - 1587 ELEV.
- STREAMS
- SECTION LINE
- TRIBAL LANDS
- ALLOTTED LANDS
- ROUND VALLEY INDIAN RESERVATION BOUNDARY
- CEMETERY

N

0 ½ 1 mi

GRAPHIC SCALE

EEL RIVER BASIN
CALIFORNIA

INTERIM REPORT

WATER RESOURCES DEVELOPMENT

MIDDLE FORK EEL RIVER

DOS RIOS RESERVOIR

BUREAU OF INDIAN AFFAIRS LAND

IN 1 SHEET — SHEET NO. 1

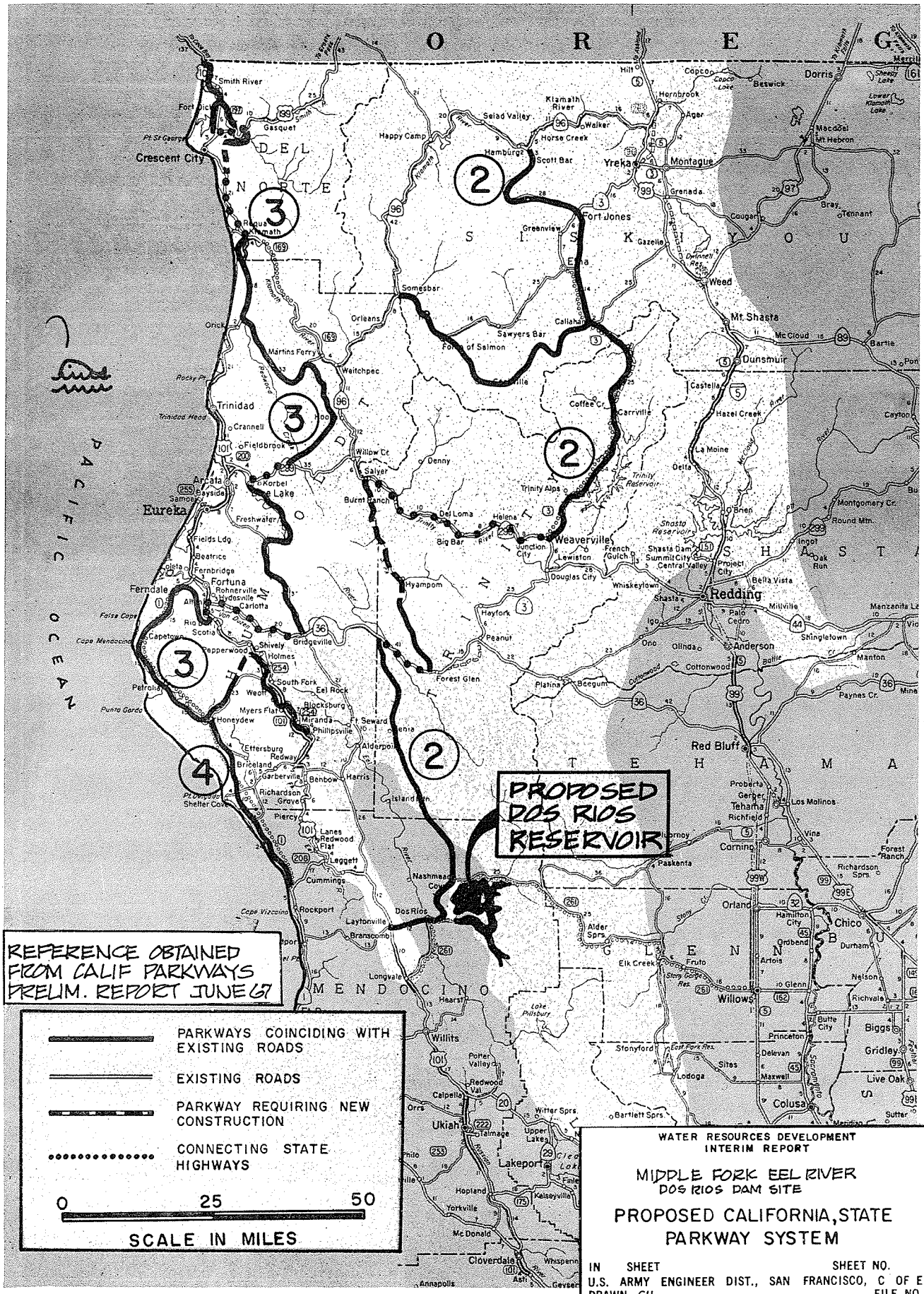
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS

DRAWN: C.K.
TRACED: C.K.
CHECKED: P.E.L.

TO ACCOMPANY REPORT
DATED: APRIL 1958

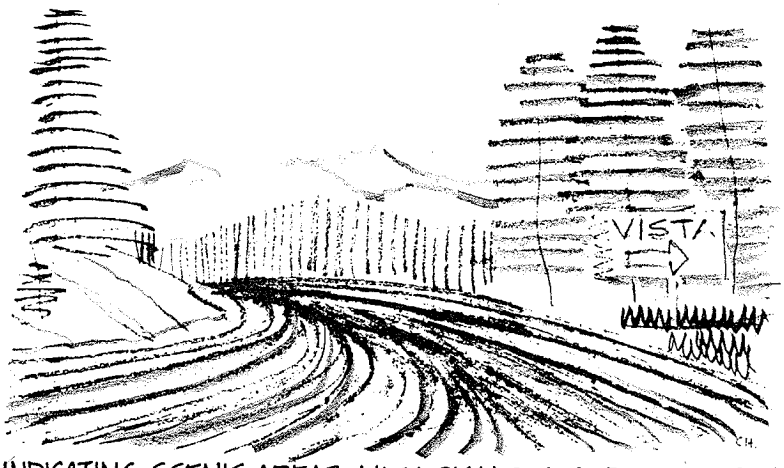
FILE NO.
60-34-8

PLATE D-4


PROPOSED
DOS RIOS
RESERVOIR
REFERENCE OBTAINED
FROM CALIF PARKWAYS
PRELIM. REPORT JUNE 67
PARKWAYS COINCIDING WITH EXISTING ROADS
EXISTING ROADS
PARKWAY REQUIRING NEW CONSTRUCTION
CONNECTING STATE HIGHWAYS
0 25 50
SCALE IN MILES
WATER RESOURCES DEVELOPMENT
INTERIM REPORT
MIDDLE FORK EEL RIVER
DOS RIOS DAM SITE
PROPOSED CALIFORNIA, STATE
PARKWAY SYSTEM
IN SHEET
SHEET NO.
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: CH
FILE NO.
TRACED: CH
TO ACCOMPANY REPORT
CHECKED: P.L.
DATED APRIL 1968
60-34-8
PLATE D-5

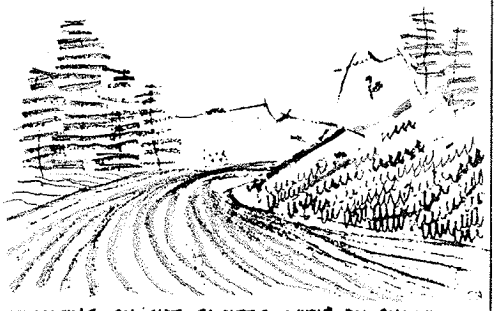
AESTHETIC CONSIDERATIONS IN ROAD ALIGNMENT

ALIGNMENT OF ROAD TO FIT EXISTING LANDFORM →



INDICATING SCENIC AREAS WITH SIGNS AND PULLOUTS.

SELECTIVE TREE CUTTING FOR OCCASIONAL VIEWS.



PLANTING ON CUT SLOPES - VIEW ON CURVE

WATER RESOURCES DEVELOPMENT
INTERIM REPORT
MIDDLE FORK, EEL RIVER
DOS RIOS DAM SITE

AESTHETIC CONSIDERATIONS IN ROAD ALIGNMENT

IN 2 SHEETS SHEET NO.

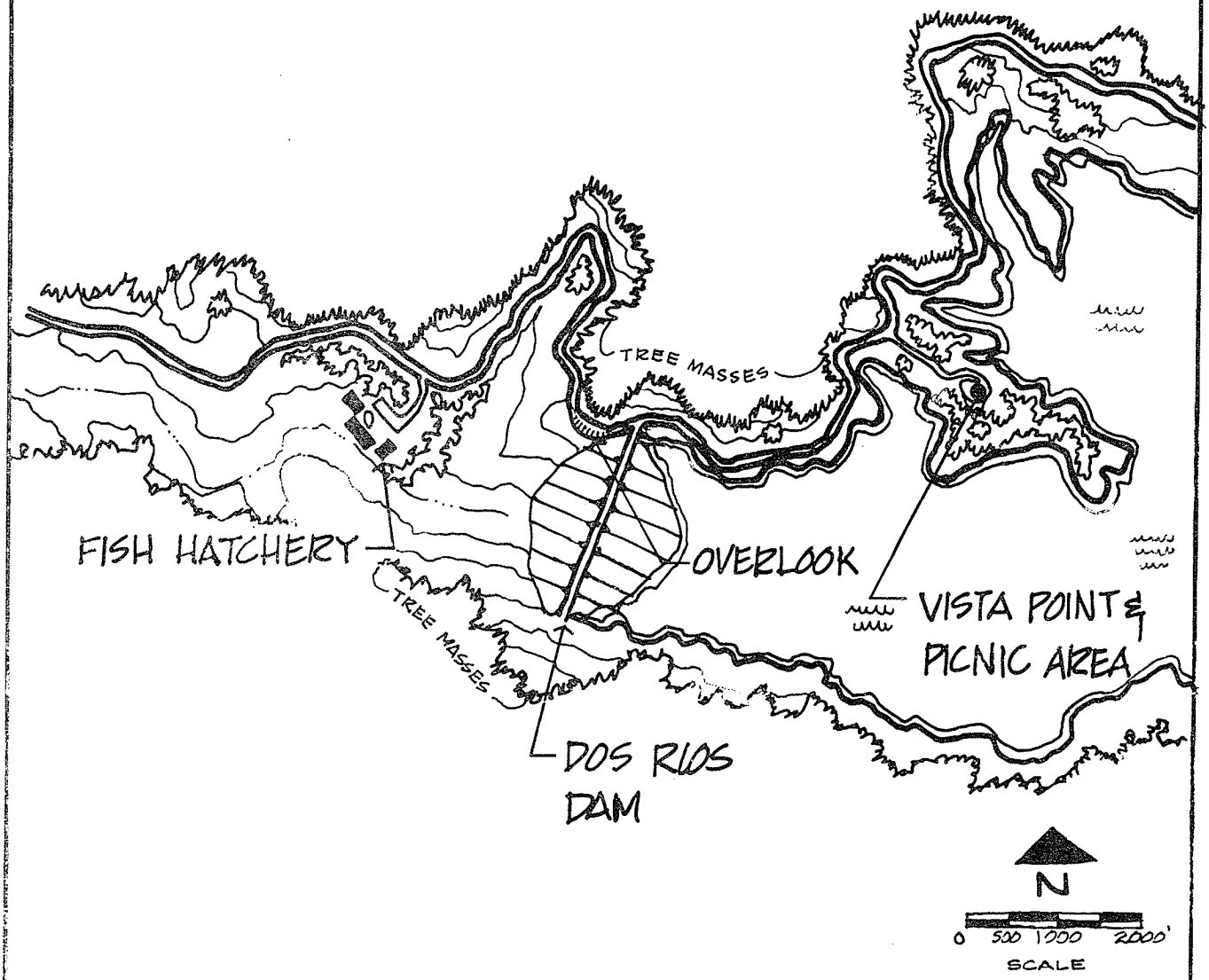
US ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS

DRAWN: C.H.
TRACED: C.H.
CHECKED: P.L.

TO ACCOMPANY REPORT
DATED: APRIL 1968

FILE NO. 60-34-8

PLATE D-6



WATER RESOURCES DEVELOPMENT
INTERIM REPORT

MIDDLE FORK, EEL RIVER

RECREATIONAL DEVELOPMENT IN DAM AREA

DOS RIOS DAM SITE

IN SHEET SHEET NO.

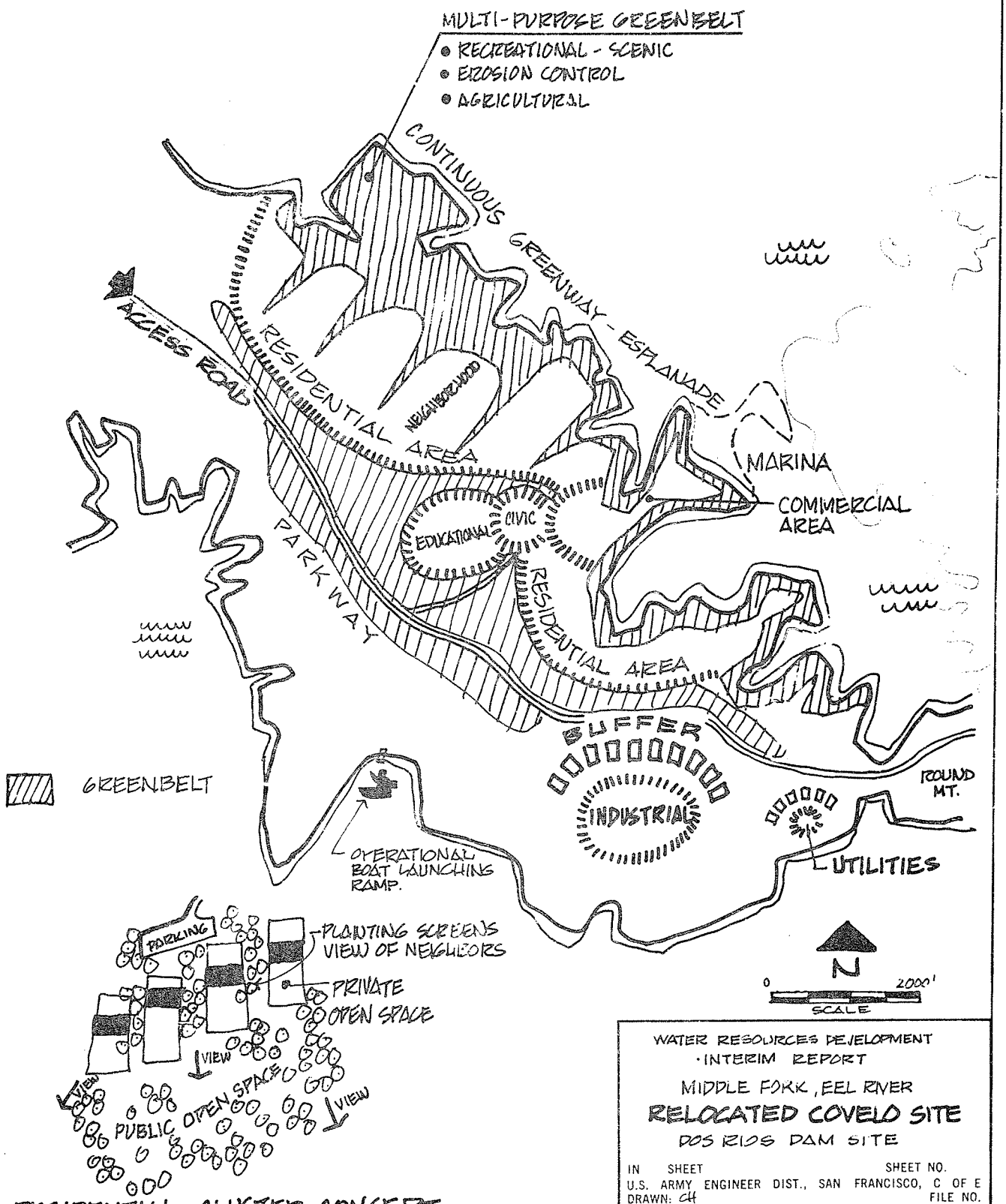
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E

DRAWN: CH FILE NO.

TRACED: CH TO ACCOMPANY REPORT

CHECKED: PL DATED APRIL, 1968 60-34-8

PLATE D-7



RESIDENTIAL CLUSTER CONCEPT

WATER RESOURCES DEVELOPMENT
· INTERIM REPORT

MIDDLE FORK, EEL RIVER

RELOCATED COVELO SITE

DOS RIOS DAM SITE

IN SHEET	SHEET NO.
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E	
DRAWN: CH	FILE NO.
TRACED: CH	TO ACCOMPANY REPORT
CHECKED: PL	DATED APRIL 1968 60-34-8

PLATE D-8

EEL RIVER BASIN, CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

APRIL 1968

APPENDIX E

PROJECT BENEFITS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLES

EEL RIVER BASIN, CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

APRIL 1968

APPENDIX E

PROJECT BENEFITS

GENERAL

E-1. PURPOSE

This appendix presents the procedures and projections used in determining benefits from a multiple-purpose reservoir on Middle Fork Eel River at Dos Rios. Tangible benefits from flood control, water supply, hydropower, recreation and other sources are considered first, followed by the impact of the proposed project on the national economy and a section on intangible benefits. The role of an authorized system of levees in the Delta Area of the Eel River is considered in conjunction with the proposed multiple-purpose reservoir.

E-2. SCOPE

Included in this appendix are a discussion of historical flood damages and their use in projecting future average annual damages without flood protection and the benefits expected from construction of planned improvements; derivation of land enhancement benefits; an analysis of the benefits from development of water supplies for export with recognition of the basin needs; consideration of benefits from a small hydropower plant at Dos Rios; and a discussion of future demands for outdoor recreation, the contribution of proposed improvements toward satisfying that demand, and the impact of proposed recreation improvements on the local economy. Project year one, or the first year the project will be in operation, has been forecast as the year 1980. Pursuant to Senate Resolution 148, as amended 28 January 1958, benefits have been estimated for periods of 50 and 100 years.

FLOOD DAMAGES

E-3. GENERAL

Only tangible flood damages are evaluated on a monetary basis. Floods may cause substantial damages of an intangible nature not

subject to monetary evaluation, which may become tangible by assignment of arbitrary values or by assumption of damages equivalent to marketable goods and services. Intangible damages include loss of human life and limb, impairment of health and living conditions, and human suffering.

E-4. FLOOD CHARACTERISTICS AND PROBLEMS

Flooding of the Eel River and its tributaries usually follows high intensity rainstorms which occur in the winter and early spring months. The floods are characterized by a very rapid rise of swiftly flowing water in volumes greatly exceeding channel capacities. The floods peak in twenty-four to forty-eight hours after the initial rise, and flows are seldom above bankfull stage for more than three days. Peak discharge at Ferndale in the Delta for the largest flood of record was an estimated 840,000 cubic feet per second in December 1964. The channel capacity in the Delta is about 120,000 cubic feet per second. Major floods are characterized by very rapid flow and much turbulence in the narrow canyon areas of the Eel and its tributaries upstream from the Delta. Average velocities during the catastrophic flood of December 1964 are estimated to have ranged from 10 to 25 feet per second. Velocities were even greater at the bends in the river.

E-5. When heavy flooding occurs, bridges and roads up to 50 feet above canyon streambeds have been washed out, whole communities destroyed, lumber mills severely damaged, and the Eel River Delta agricultural area devastated. Livestock losses have been high and transportation facilities have been thoroughly disrupted with many parts of the basin becoming isolated. Overbank flooding results in heavy damage to the lands from sheet erosion, scour, siltation and debris deposits. Even minor flooding erodes banks and shifts channels in the Delta, which is composed of unstable alluvial material. It is expected that hazards to life and health will increase as population expands. Intensified use and occupancy of flood plain land, such as increased density of residences, will result in increased damages from future floods unless preventive measures such as flood control projects or flood plain management are accomplished.

E-6. EXISTING AND AUTHORIZED DEVELOPMENTS

The Sandy Prairie Levee Project, completed in 1959 by the San Francisco District, protects an agricultural and industrial area including a section of U.S. Highway 101. This work consists of about four miles of levee on the north bank of the Eel River. Congress authorized the Eel River Delta Levee Project in the 1965 Flood Control Act which provides for construction of about 35 miles

of levees on the Eel and Salt Rivers in the lower Eel River flood plain. Preconstruction planning in this project is currently underway. The authorized project was designed to protect against a 100-year flood, equivalent to a 600,000 cubic feet per second discharge. The reduction in peak flow resulting from spillway surcharge storage from possible future upstream reservoirs under consideration was expected to approximate standard project flood protection. The December 1964 flood event reached a peak of 840,000 cubic feet per second and exceeded the December 1955 flood peak of about 600,000 cubic feet per second by a substantial amount. The modified frequency curves reflecting the inclusion of the December 1964 flood resulted in revising the frequency of the 600,000 cubic feet per second to a two percent chance of occurrence. Also, studies described in the main section and other appendices of the report indicate that any levee system in the Delta which would provide capacity in excess of 600,000 cubic feet per second would require extensive relocation of U.S. Highway 101 and the railroad bed of the Northwestern Pacific Railroad Company. It has been determined that the practical limit to which the levees should be designed without incurring excessive costs due to these relocations is in the magnitude of 600,000 cubic feet per second. In analyzing the benefits that might result from the proposed Dos Rios project and other related upstream projects, pre-project conditions were defined as the authorized levee system constructed to a capacity of 600,000 cubic feet per second, which corresponds to a two percent chance flood.

E-7. Flood protection in the Delta is presently afforded by individual landowners who have constructed levees at various locations along the Eel River. These unconnected levees do not constitute a continuous system of flood-protection works and are overtopped and breached by moderate rises in the river flow.

E-8. SURVEYS OF FLOOD DAMAGES

Damage surveys were made for the floods of 1937, 1943, 1945, 1953, 1955, 1960, 1963 and 1964. A detailed enumeration of the damages by category and value for the larger floods of 1953, 1955 and 1964 is shown in Table E-1. Flood plains were divided into flood-damage reaches for purposes of analysis. Flood plains and reaches are shown on Plates E-1, E-2 and E-3. Consideration was given to locations of gaging stations, channel crossings, confluence of important tributaries, and other geographic features which affect flood damage. All known sources were used by field personnel to determine damage to highways, utilities, urban and commercial areas, agricultural areas, bank-protection works and levees. Care was exercised in separating damages due to local conditions, such as side hill drainage, landslides, and drainage failures, from those resulting from floods on the Eel River and its tributaries.

E-9. TYPES OF FLOOD DAMAGES

Flood losses, or damages, were designated by classes and types of damage indicated in the following paragraphs and were developed in accordance with terminology contained in EM 1120-2-101, Examination and Surveys, General Procedures, and EM 1120-2-112, Secondary Benefits in Flood Control Evaluation. Tangible flood damages were considered as follows: (1) physical damages caused by inundation; (2) emergency losses or costs incurred in fighting or in anticipation of the flood, termed "flood-fighting costs" in this report; and (3) business and other financial losses resulting from decreased production, profits and wages, and increased cost of normal operations and living. The elimination of such damages constitutes primary benefits. Tangible damages were determined for the following classes or types of flood losses:

a. Residential which include inundation and destruction losses to non-farm residences and contents thereof, appurtenant buildings, and grounds.

b. Commercial which include losses to all properties used in commerce, business, trade, servicing or entertainment as distinguished from other properties used in industry, public administration, utility production and service, and transportation. Physical flood damages to commercial property and facilities include damages to land, buildings, equipment, supplies, merchandise and other items used in the conduct of the business. Loss of business sustained by commercial activities as a consequence of floods is the result of net losses of income including losses resulting from decreased production, loss of sales or services normally required by the consuming public, or the loss of a net profit to the owner of a business. Losses of wages to employees of a commercial establishment were considered when such losses were not compensated for by employment in emergency activities during the flood and rehabilitation period.

c. Industrial which include inundation losses and destruction to properties and facilities used in the extracting, producing, manufacturing and processing of commodities, and heavy warehousing and distribution facilities. Business losses to industry are essentially the same as those listed in the paragraph above for commercial establishments.

d. Public facilities which include inundation losses to public buildings, parks, and other facilities, including equipment and furnishings owned or operated by Federal, State, county or local government units. Public business losses include losses in sales or revenue, loss of wages, and increased cost of normal operations.

e. Public utilities which include losses to all utilities other than railroads, such as electric, water and telephone plants, transmission lines and other similar facilities.

f. Agricultural which include, in addition to inundation losses and destruction of growing crops and land, losses to farm dwellings, barns and other appurtenant buildings and their contents. Included are losses to equipment, stored crops and feed, poultry, fences, lands, bridges, private levees and other farm facilities and siltation, and cost of debris removal are also a part of tangible damages estimate. Livestock damages include loss of and injury to cattle used in beef and milk production.

g. Roads and bridges include inundation and destruction losses to roads, streets, pavement, sidewalks, bridges, and other highway structures, supplies and equipment.

h. Railroads include losses to tracks, roadbed, trestles, bridges, rights-of-way, supplies and equipment attributable to direct destruction of facilities by overflow. Loss due to bank erosion and monetary losses due to traffic delays are treated separately in the paragraph entitled "Common Carrier Railroad Damages."

i. Emergency aid (not covered in l and m below) includes the cost of protection and other work essential for the preservation of life and property, such as clearance of debris and wreckage, and emergency repair or temporary replacement of public facilities. Aid and relief activities include two general categories: (a) that furnished to the individuals and family units directly affected by a flood; and (b) that furnished for emergency rehabilitation of communities and cities rendered helpless by the flood. Aid to individuals and families is generally furnished by public and private social and welfare groups, and by national disaster relief organizations such as the Red Cross.

j. Public Law 99 assistance covers the cost of authorized Federal aid for flood fighting, flood emergency preparation, rescue operations and repair and restoration of damaged flood-control works.

k. Public Law 875 assistance covers the cost of authorized Federal assistance to States and local governments to accomplish channel clearing, debris removal and other emergency channel work on unimproved streams.

l. Bank erosion damages include loss of land and structures caused by erosion of river banks.

E-10. RECURRING AND NON-RECURRING DAMAGES

Recurring flood damages are those items of probable damages which are expected to result from future floods of similar magnitude. Non-recurring flood damages are those items previously lost and not restored or modified such as to be safe from damages from future floods. An example of this is the destruction and in-replacement of a bridge, or replacement with one at a higher level and wider waterway opening. Non-recurring flood damages are excluded from the primary flood damage compilations utilized to determine average annual damages from occurrence of future floods of a magnitude comparable to those which have occurred in the past.

E-11. DESIGNATION OF AREAS SUBJECT TO FLOODING

The principal areas of flooding affected by the proposed project are delineated on Plates E-1, E-2 and E-3. The flood-damage reaches and major types of damages sustained in historical floods are described below.

a. Reach I (Delta Area). From the mouth of the river to the confluence of the Van Duzen River. Major losses in this reach were to agriculture and agricultural products, farm equipment, buildings and farm animals. During the high-stage floods, roads, bridges and railroads were washed out and traffic delays were prolonged.

b. Reach III (Scotia Area). From the confluence of the Van Duzen River to the confluence of the South Fork. Damage in this reach was primarily to the lumber industry, urban developments, railroad property and roads and bridges. Substantial damages occurred in virtually all categories. Urban areas which suffered flood damage included Rio Dell, Alton, Scotia, Stafford, Elinor, Pepperwood, Shively, Holmes and Dyerville.

c. Reach V (Alderpoint Area). From confluence of the South Fork to the confluence of the North Fork. The principal damages in this area were to railroad property. Bank erosion caused roadbed subsidence, slides and washout of railroad tracks. Traffic delays were of major proportions.

d. Reach VI (Dos Rios Area). From confluence of the North Fork to confluence of the Middle Fork. Damages in this reach were comparable in kind to those in the Alderpoint area.

e. Reach - Round Valley. This area is located about seven miles northeast of the confluence of the Eel River and the Middle Fork. It was flooded by waters of several small creeks including Mill, Town, Short and Grist Creeks. Major damages were to agricultural and to industrial facilities about five miles northeast of Covelo. This reach will be inundated when the proposed Dos Rios Reservoir is in operation.

f. Other areas. The following areas within the Eel Basin are subject to flooding but are not affected by the proposed project: Van Duzen River (Reach II), South Fork Eel River (Reach IV), Outlet Creek, Little Lake Valley and the Eel River upstream from the confluence of the Middle Fork.

E-12. FLOOD PLAIN MANAGEMENT

A general plan designed to constitute a long-term general guide for future land use has been prepared for the Eel River Delta area. The preparation of the plan was financed in part through an urban planning grant from the Housing and Home Finance Agency under the provisions of Section 701 of the Housing Act of 1954. This plan was adopted by the Humboldt County Board of Supervisors, the Fortuna City Council, and the Ferndale City Council in early 1967. It is expected that this plan for physical growth and development of the Eel River Delta land area will be implemented by city and county zoning ordinances. This plan has provisions for an effective flood plain management program. The principal designation of land within the historical flood plain is for "Exclusive Agriculture" of "Conservation" for floodway or recreation purposes. The classification of "Exclusive Agriculture" provides for minimum parcels of 20 acres where soils are of good quality for agricultural production purposes and where protection and preservation of such use is desirable and in the public interest. "Conservation-Floodway" classification provides for designation of channels of rivers and streams, including the areas which carry normal flood waters or the areas between existing or planned levees, dykes or other flood control features. Agricultural and recreational uses are permissible in this classification. "Conservation-Recreation" classification is planned for areas of substantial acreage where natural scenic, historical, geological, vegetation or other features of a recreational nature prevail. Public interest would require preservation for recreational purposes or for passive private use. A study to provide a general plan for land use along the Eel River from the Delta to the Mendocino County boundary is expected to be completed by mid-1968. This General Plan is expected to provide similar classifications of land use as prepared for the Delta area to provide effective flood plain management. This study for a General Plan is expected to include the communities of Rio Dell, Scotia, Pepperwood, Weott, Myers Flat, Miranda, Redway and Garberville.

E-13. MONETARY VALUES IN STANDARD PROJECT FLOOD PLAIN

Based on the Mendocino County and Humboldt County 1967-68 tax rolls, and other information, estimates were made of the present monetary value of public and private land, improvements and personal property in the standard project flood plain. The standard project flood plain is described in Appendix B, "Hydrology, Hydraulics and

Water Resources Analysis." The monetary values in the standard project flood plain are as follows:

Reach I	$ 30,000,000
Reach III	42,000,000
Reach V	2,500,000
Reach VI	500,000
Round Valley	25,000,000
Total	$100,000,000

E-14. HISTORICAL FLOOD DAMAGES

The major recorded flood event along the Eel River for which damage data are available occurred in December 1964. The next large flood was December 1955 of somewhat lesser magnitude. Other floods occurred in 1937, 1943, 1945, 1953, 1960 and 1963.

a. December 1964 Flood. The storms of December 1964 produced record peak stage and discharges on many of the North Coastal streams of California. A description of these floods and damages is contained in a three-volume report entitled "Report on Floods of December 1964 in Northern California Coastal Streams," U.S. Army Engineer District, San Francisco, California, Corps of Engineers, December 1965. The Eel River and tributaries were probably the hardest hit from the point of view of the peak discharges being considerably higher than previously known historical peak discharges. The results were catastrophic, and damages far exceeded those previously estimated as capable of occurring from potential floods in the basin. Nineteen persons lost their lives due to flood conditions in the Eel River Basin. Entire communities were destroyed leaving little except demolished buildings and cars trapped in millions of tons of silt deposits. In other areas, damage to homes, house trailers, businesses, schools, levees, sewage systems and transportation facilities was widespread and tragic. In addition to damage in urban areas, agricultural lands, State parks, national forests, Federal, State and county property, industrial areas, highways, roads, bridges, railroads, public utilities and transportation companies also suffered severe damage. The rich agricultural area of the Eel River Delta was inundated with several feet of water, as well as silt and debris. About 3,400 head of livestock, many of them valuable dairy cattle, were lost. Thousands of dead cattle were washed into Humboldt Bay from the Eel Delta creating a potential health hazard. Lack of adequate transportation facilities for the remaining dairy production for a period of several months added to the losses suffered by the industry. Due to the destruction of highways and bridges all automobile traffic ceased for almost two weeks and for the next ten weeks was limited only to essential or emergency traffic. The Paul Mudgett Memorial Bridge just north of

Rio Dell, the Rio Dell Bridge at Rio Dell, and the new Dick Fleischer Memorial Bridge at Stafford were all washed out by the flood waters. Loss of standing timber was extensive in the basin. Practically all of the lumber mills in the flood plain sustained damage, cold decks were destroyed, and huge stockpiles of lumber were washed downstream. Most of the mills were either shut down completely or in partial operation for several months after the flood. Upper tributaries poured waters into the main Eel which roared through the canyon area from Rio Dell to Outlet Creek destroying everything in its path. It ripped out railroad tracks, communication lines, stations, living quarters and maintenance buildings. Rail transportation in the basin came to a complete halt with the shutdown of Northwestern Pacific Railroad Company operations. This railroad is the only line connecting northwestern California and the San Francisco Bay Area. The main line winds through the Eel River canyon for over 100 miles with the roadbed hugging the canyon walls for most of the distance. Service was interrupted for a 177-day period after which only limited traffic was permitted. The flood of December 1964 caused railroad damages that have required an expenditure of $10 million to repair. The Congress of the United States has approved a special appropriation to reimburse the Northwestern Pacific Railroad Company for part of the cost of restoration of the bank protection works. This funding is being administered by the U.S. Army Corps of Engineers.

b. Other floods. Description of other floods are found in the following reports of the Corps of Engineers:

(1) Interim Report for Water Resources Development, Eel River, California, Appendix C, "Flood Damages and Flood Control Benefits," January 1964;

(2) Floods of January - February 1963 in Northern California Coastal Streams, February 1964;

(3) Preliminary Report on Floods of December 1955 in Central and Northern California and Western Nevada, 9 January 1956;

(4) Report on Floods of 18 January 1953 in Northern California Coastal Streams, June 1953.

E-15. MONETARY DAMAGES FROM HISTORICAL FLOODS

Tables E-1, E-2 and E-3 present the recurring damages by reaches affected by the proposed reservoir and type of damage sustained during the floods of 1953, 1955 and 1964. Table E-1 represents values based on prices and economic conditions at the time of occurrence. Table E-2 represents the values based on 1964 prices and economic conditions which were used in the derivation of the flood damage relationship curves, Plates E-4 through E-8. Table E-3 represents

the values based on June 1967 prices and economic conditions and with damages of $367,000, $15,400,000 and $57,800,000 for the 1953, 1955 and 1964 floods, respectively.

E-16. Other floods occurred in 1937, 1943, 1945, 1960 and 1963. Most of the damages sustained in these flood events were to agricultural land in the Delta Area.

E-17. HISTORICAL DISCHARGES AND DAMAGES

Presented below, for ready reference, is the relationship between discharge at Scotia gaging station and total damages in Reaches I, III, V, VI and Round Valley which would be affected by the proposed Dos Rios Reservoir project for floods which have occurred during the past 30 years.

Year of Flood	Discharge (c.f.s.)	Total Damages (1967 Price levels 1/) (000)
1964	752,000	$57,800
1963	275,000	280
1960	343,000	850
1955	541,000	15,400
1953	215,000	367
1945	100,000	230
1943	315,000	380
1937	345,000	900

1/ Excludes railroad bank erosion damages and monetary losses.

E-18. DAMAGES IN OTHER AREAS OF THE EEL RIVER BASIN

Damages sustained in the December 1964 flood, excluding railroad bank erosion and monetary losses, in areas and along tributaries not affected by the proposed reservoir are summarized below in 1964 prices:

Area	Damages	Principal Types
Van Duzen	$ 4,000,000	Roads and bridges, agricultural, residential, and commercial
South Fork	11,000,000	Roads and bridges, commercial, residential
Outlet Creek	165,000	Railroad
Main Eel	165,000	Railroad
Little Lake Valley	100,000	Commercial and agricultural

The types and magnitudes of flood damages sustained in these areas for other historical floods are presented in Interim Report for Water Resources Development, Eel River, California and Appendix C, "Flood Damages and Flood Control Benefits," January 1964.

E-19. DERIVATION OF AVERAGE ANNUAL DAMAGES

In deriving the average annual damages it was assumed that the authorized Delta levee project has been constructed and the protection to the Delta Area has been provided to handle a peak flow of 600,000 cubic feet per second, corresponding to a two percent chance of flood. In addition, damages to the Northwestern Pacific Railroad Company facilities and revenues between Rio Dell and Dos Rios were separated for independent analysis in the following paragraphs. Average annual damages, excluding railroad damages were derived graphically by the following method:

a. Discharge-frequency relationship. Curves showing discharge frequencies were developed for each damage area affected by the proposed project. The curves were developed from existing records, historical reports, comparison of areas and runoff characteristics and correlation of recorded discharges. Details of these derivations are shown in Appendix B, "Hydrology and Hydraulic Design."

b. Discharge-damage relationship. Discharge-damage curves for each type of damage, such as residential, commercial, industrial and agriculture were prepared by plotting damages from past floods, adjusted to 1964 conditions against the corresponding flood discharges through the respective areas and fitting a curve to these points.

c. Damage-frequency relationship. Curves showing damage-frequency relationship were prepared by graphical correlation by quadrant plotting of the discharge damage and discharge-frequency curves for existing conditions and also for conditions of various plans of improvements and degree of protection.

d. Average annual damage. The area under the damage-frequency curve, converted to its equivalent value in dollars, is the average annual damage.

E-20. FLOOD DAMAGES UNDER EXISTING CONDITIONS AND PRICES

Plates E-4 through E-8, "Flood Damage Relationship," show the curves from which recurring flood damages were derived. The curves are based on 1964 prices and conditions. Railroad damages are excluded in Reaches III, V and VI. There were no railroad damages in Reach I or in Round Valley. The average annual flood damage for the five reaches affected by the proposed multi-purpose Dos Rios Reservoir project on the Middle Fork of the Eel River based on 1964 price levels are presented by category in Table E-4 and are summarized as follows:

Reach		Damages (1964 Price levels)	
I	Delta	$ 249,000	1/
III	Scotia	552,000	
V	Alderpoint	153,000	
VI	Dos Rios	18,000	
	Round Valley	28,000	
	Total	$1,000,000	2/

1/ The total average annual damages under existing conditions are $694,000. Pre-project conditions are conditions with the Delta levees constructed to contain a flow of 600,000 cubic feet per second which corresponds to a two percent chance flood. The residual damages under pre-project conditions would amount to $249,000.

2/ Excludes railroad damages, which are treated separately.

E-21. SUMMARY OF AVERAGE ANNUAL FLOOD DAMAGES EXCLUDING RAILROAD DAMAGES

Average Annual Flood. Damages were updated to June 1967 price levels. A listing by reach and category is provided in Tabel E-5. Railroad damages are excluded. A summary by reach is as follows:

Reach	Damages	
I	$ 270,000	
III	630,000	
V	170,000	
VI	19,000	
Round Valley	31,000	
Total	$1,120,000	1/

1/ Excludes railroad damages, which are treated separately.

E-22. COMMON CARRIER RAILROAD DAMAGES

The canyon area of the main Eel River from Rio Dell in Reach III to the confluence of the Middle Fork is subject to major flood damage. The principal damage, especially in Reaches V and VI, is to Northwestern Pacific Railroad Company property and consists of both inundation and bank erosion. Bank erosion causes roadbed subsidence, slides and washouts of roadbed and tracks. Inundation losses are those attributable to direct destruction of facilities

by overflow and usually are of substantial magnitude in large floods. In addition to physical loss, monetary losses due to traffic delays are of major proportions. Although overflow damages to trackage and equipment cause minor traffic delays, most monetary losses result from land subsidences, slides and washouts. Therefore bank erosion damages include the value of monetary losses for purposes of economic analysis.

E-23. Available records of the annual costs of railroad maintenance and rail service interruptions were correlated with available river discharges in order to estimate the average annual erosion damage for the canyon area. Details of this analysis are presented in "Report of Survey on Bank Protection Works Adjacent to the Railroad Along Eel River, California," U.S. Army Engineer District, San Francisco Corps of Engineers, August 1965.

E-24. Protective works, consisting of riprapping at crucial bends along Eel River were constructed by the railroad company in 1965. The difference between total erosion damages and benefits from railroad protection became existing damages for further analysis. Section 218 of Public Law 89-298, 89th Congress, 27 October 1965, provided that the Secretary of the Army reimburse any common carrier by railroad for expenses incurred to prevent recurrence of damage by floods or high water along Eel River including the area from Rio Dell to the confluence of Middle Fork.

E-25. Correlation analysis of inundation damage and river discharge was made. Total average annual railroad damages at 1967 prices from bank erosion and inundation are presented in the following tabulation:

	Erosion			Existing	
Reach	Existing Damage	Benefits from 1/	Residual Damage 2/	Inundation Damage 3/	Total
III	$100,000	$10,000	$ 90,000	$ 65,000	$155,000
V	220,000	21,000	199,000	51,000	250,000
VI	110,000	10,000	100,000	35,000	135,000
Total	$430,000	$41,000	$389,000	$151,000	$540,000

1/ Estimated to be about 10 percent effective
2/ Residual damages become existing damages for further economic analysis.
3/ Inundation damage consists of losses to physical equipment and real estate improvements.

E-26. SUMMARY OF TOTAL AVERAGE ANNUAL FLOOD DAMAGES UNDER EXISTING CONDITIONS

For ready reference the total average annual flood damages including railroad damages in reaches affected by the proposed reservoir project are presented in the following tabulation at 1967 price levels and conditions:

Reach	Railroad	Other	Total
I 1/	$ -	$ 270,000	$ 270,000
III	155,000	630,000	785,000
V	250,000	170,000	420,000
VI	135,000	19,000	154,000
Round Valley	-	31,000	31,000
Total	$540,000	$1,120,000	$1,660,000

1/ For Delta Area damages under pre-project conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

E-27. FLOOD DAMAGES UNDER FUTURE CONDITIONS

Flood damage studies indicate that future average annual flood damages may be expected to increase in proportion to the increase in economic activity in the flood plain area. The income associated with the total value of land and improvements as influenced by population growth, trends in farm income and land use was chosen as the most appropriate indicator of future growth. The expected future development of the flood plain, excluding development of the railroad, is as follows:

a. Delta. The Eel River Delta standard project flood plain is primarily an agricultural area with 1960 population of about 6,300 and an area of 26,000 acres. It is situated close to the rapidly expanding Eureka-Arcata-Fortuna area, the present population of which approximates 53,000. Economically the flood plain is tributary to the Eureka-Arcata-Fortuna area, and the indications are that this relationship will be intensified during the study period. In recent years, economic expansion of the Delta flood plain has been substantially below the potential indicated by its proximity to an area of major expansion. One of the principal reasons for this lag in economic development is the reality and threat of periodic flooding. Without flood protection the danger and severity of flooding are expected to

continue to limit economic growth in the Delta. However, population pressures and proximity to the Eureka-Arcata-Fortuna area, as well as growing demands of tourists, are expected to result in modest urbanization of the Delta area during the study period. The authorized but unconstructed Eel River Delta levee system in operation without upstream storage facilities is assumed to be capable of handling a peak flow of 600,000 cubic feet per second or a 50-year flood. Consequently, the protection provided by the levee system alone will probably not result in extensive change in land use in much of the flood plain. Most of the enhancement attributable to the levee system is expected to be in change in crop patterns to higher valued crops. Flood plain management practices by local and State governments are expected to limit changes in land use if adequate flood protection is not provided. Executive Order 11296, precluding as far as practicable uneconomic, hazardous or unnecessary use of flood plains in connection with the location of Federal or Federally-financed facilities (including buildings, roads and structures), would further limit urbanization of the Delta without adequate protection. Enhancement attributable to the Delta levees in this reach is discussed in later paragraphs.

b. Scotia. The 4,300-acre standard project flood plain in Reach III is a lumbering and agricultural area. Lumbering activities center around Scotia, a company town of the Pacific Lumber Company. Dairy farming is located in the metropolitan area, near the Van Duzen River, and at scattered points downstream. It is anticipated that future development will include the expansion of forest product manufacture and semi-manufacture near Scotia. The introduction of row-type agriculture is expected within the 100-year study period as increased population in the Eureka-Arcata area provides an expanding market for row crops. Climate and soils in Reach III are conducive to growing row crops of high quality. Some development of commercial facilities is expected in extreme southern portions of Reach III. These facilities would service tourists visiting nearby State parks. Effective flood plain management and local zoning ordinances, in addition to Executive Order No. 11296, will severely limit urban growth in upstream urban areas such as Pepperwood, Holmes, Shively and Stafford and in the metropolitan area.

c. Alderpoint. High V-shaped canyon walls surround the river at most points in Reach V. The Northwestern Pacific Railroad Company roadbed follows the river through the flood plain. Virtually all of the present 100 urban acres in the 3,200-acre standard project flood plain are groups of railroad employees' homes and railroad industrial installations. About 90 acres just upstream from the confluence of the South Fork are in agricultural use. Future development during the study period will consist primarily of the addition of 300 flood plain acres of irrigated pastureland. Flood plain management is expected to limit the construction of permanent improvements.

d. Dos Rios. Due to the extremely steep canyon walls surrounding the Eel River in Reach VI, the flood plain is very small, accounting for less than 200 acres. Urban land use is related to nearby lumbering, railroad and recreational activity. Some grazing land is located in the flood plain. Primary development expected in the flood plain and surrounding area is the replacement of agricultural lands by urban lands reflecting expansion of the tourist service and forest product manufacturing industries. Development is severely limited by mountainous terrain.

e. Round Valley. The Round Valley flood plain includes over 6,000 acres of agricultural land, mostly dry farmed. The major agricultural activity is cattle-raising for beef production. Urban development in the flood plain centers around the town of Covelo with an estimated population of 600. The major non-agricultural industry is a sawmill about 5 miles northeast of Covelo. The valley is somewhat isolated by hills and mountains which typify much of northwestern California. Existing land transportation into and out of the valley is inadequate. Agriculture will probably expand and remain the dominant land use during the study period. With adequate water supplies, interior drainage facilities, and an improved transportation system the flood plain could be expected ultimately to support about 13,000 acres of irrigated farmland. About 80 percent of all agricultural land would be devoted to the raising of field crops, orchard products and grains. The projected income from this increased agricultural production is discussed in Appendix A, "Economic Environment of the Eel River Basin." Increased urban use would occur on acres surrounding the town of Covelo.

E-28. The extent to which economic activity discussed generally in the preceding paragraph is expected to increase without a flood control project is indicated by the development factors presented in Table E-6.

E-29. The average annual flood damages under June 1967 prices and future conditions were obtained by applying the development factors without a project to flood damages under existing conditions of preproject conditions for Reach I. Results are shown in Tables E-7 and E-8 and are summarized below:

Reach	50-Year Study Period (000)	100-Year Study Period (000)
I	$ 324	$ 357
III	754	822
V	187	204
VI	21	21
Round Valley	34	36
Total	$1,320	$1,440

E-30. RAILROAD DAMAGES UNDER FUTURE CONDITIONS

Railroad damages are expected to increase in the future. However, the expected increase is not anticipated to be of significant magnitude to establish a discounted growth factor for a 50- or 100-year study period. Extensive growth is not expected because of present and anticipated leveling off of tonnage of lumber and lumber products shipped from northwestern California as well as more intense competition from truck and ship modes of transportation for lumber and other products. Therefore, no development factors were applied to existing railroad damages.

E-31. SUMMARY OF TOTAL AVERAGE ANNUAL FLOOD DAMAGES UNDER FUTURE CONDITIONS

Total average annual flood damages including railroad damages are presented in Table E-9 under future conditions and at 1967 prices and are summarized below:

Reach	50-Year Study Period (000)	100-Year Study Period (000)
I	$ 324	$ 357
III	909	977
V	437	454
VI	156	156
Round Valley	34	36
Total	$1,860	$1,980

FLOOD CONTROL BENEFITS

E-32 FLOOD DAMAGE REDUCTION BENEFITS UNDER EXISTING CONDITIONS AND PRICES

Damage-frequency curves under 1964 prices and conditions are shown on Plates E-4 through E-8. The average annual benefits from flood damage-reduction under 1964 prices and conditions were computed as the difference between the area under the damage-frequency curves, under existing conditions, or pre-project conditions for Reach I and under project conditions. The project condition assumes Dos Rios Reservoir, with 600,000 acre-feet of flood storage, constructed

after completion of the levee system. The reservoir affects the discharge-frequency curve but does not change the damage discharge relationship. Floods of the same discharge will cause the same damages under both existing and project conditions, but the frequency of occurrence for any given discharge is reduced. The residual damages under 1964 prices and conditions were computed as the area under the damage-frequency curves representing project conditions. The derivation of the frequency damage curves results in reducing the December 1964 flood to about 650,000 cubic feet per second or to approximately the assumed capacity of the Delta levees with three feet of freeboard. Damages, residual damages and benefits derived from Plates E-4 through E-8 were updated to June 1967 price levels and conditions by price indices. The results, which excludes benefits to the railroad, are shown in Table E-10 and are summarized below:

Reach	Benefits 1/ (000)
I	$ 178
III	433
V	130
VI	16
Round Valley	31
Total	$ 788

1/ Excludes railroad benefits.

E-33. FLOOD DAMAGE REDUCTION BENEFITS UNDER FUTURE CONDITIONS

The average annual benefits from flood-damage reduction under June 1967 prices and future conditions were obtained by applying the development factor without a project to flood-damage reduction benefits under existing conditions. The results, exclusive of the railroad benefits, are shown in Tables E-11 and E-12 and are summarized below:

Reach	50-Year 1/ Study Period (000)	100-Year 1/ Study Period (000)
I	$ 210	$ 235
III	515	565
V	143	156
VI	18	18
Round Valley	34	36
Total	$ 920	$1,010

1/ Excludes railroad benefits.

E-34. EFFECT OF ELIMINATION OF FLOOD HAZARD ON FUTURE DEVELOPMENT

This section considers the highest and best use of land assuming elimination, or substantial abatement, of the flood hazard along all reaches of the Eel River. Elimination of flood hazards would greatly affect future development of the Delta and Scotia reaches. Encroachment of urban use into agricultural and idle lands would be accelerated and expanded. Urban land use is expected to be in predominately residential use. Commercial land use will probably increase in order to meet the needs of an expanding population and increased tourism. Some of the lands remaining in agriculture are expected to be farmed more extensively and put to the highest value consistent with the physical limitations of the land. Such a trend is expected to promote the establishment of truck farming and livestock finishing in the flood plain.

E-35. Industrial uses will probably be based mainly on the raw materials available in the area. This will include the manufacturing of lumber and food processing. The Delta is well oriented to transportation networks and a source of labor supply. Provision for a high degree of protection of the flood hazard would appreciably encourage location of industry in the Delta Area.

E-36. EFFECT OF DELTA LEVEES ON FUTURE DEVELOPMENT

The authorized Delta levees, with an approximate capacity of 600,000 c.f.s. would provide protection against floods occurring about once every fifty years. The two percent protection is not considered sufficient to encourage urbanization of the Delta area. Breaches and destruction of the levees by floods of great magnitude, such as the December 1964 flood, would cause catastrophic damages to urbanized areas. However, protection against a two percent flood would result in an increased use of land for agricultural purposes, especially truck farming.

E-37. EFFECT OF PROPOSED PROJECT ON FUTURE DEVELOPMENT

The proposed reservoir project alone, without installation of the delta levees, would not reduce flood damages sufficiently to affect future development of the Eel River Delta flood plain. However, the proposed reservoir, with 600,000 acre-feet of storage, is expected to be constructed subsequent to the authorized Delta levees. The two projects would combine to provide protection against floods of greater than a one percent, or 100-year, chance of occurrence. This combined effect is assumed to provide, substantially, full protection against floods of the December 1964 flood. Such protection is adequate to encourage extensive urbanization of flood plain lands in the Delta area. After construction of the levee system in the Delta and the Dos Rios Reservoir project, standard project protection could be

provided by installation of additional upstream reservoirs such as the English Ridge project which is currently under study by the Bureau of Reclamation.

E-38. LAND ENHANCEMENT BENEFITS, 50-YEAR ANALYSIS

An analysis of the protection provided by Dos Rios Reservoir indicated that significant land enhancement is not expected to occur in reaches other than Reach I, the Delta Area. Therefore, land enhancement benefits were computed for only the Delta area. Only lands contained within the historical flood plain were considered in the computation of land enhancement benefits. Benefits from land enhancement were measured by the income associated with the difference between the value of comparable flood-free land developed to its highest and best use, less cost of raw land subject to flooding, development costs, value of applicable flood damages prevented and value of residual damages. Land value and land use were determined by field investigation, discussion with local interests, pertinent comparisons of values in other comparable areas and the opinions of professional real estate oriented organizations and individuals.

E-39. The total land enhancement benefit expected to occur in the Delta area as a result of both the authorized Delta levee project and the proposed Dos Rios Reservoir project was computed as a first step toward determining the enhancement benefit attributable to the Dos Rios Reservoir alone. The two projects, together, are expected to enable about 4,500 acres of pasture land to change to a higher land use. Of this, about 2,500 acres are expected to shift to urban use. Most of this acreage will be residential. Population pressures from the expanding Eureka-Arcata area will cause enhanced residential land to be developed to relatively high density use, namely, four to six lots per acre with scattered multi-unit structures. Commercial establishments are expected to develop to meet the needs of the expanding Delta population, to service the upstream population and to meet the demands of increasing numbers of tourists expected to travel along U.S. Highway 101 while visiting recreational sites in Humboldt and other northern California counties. Lumber products, manufacturing, food processing and miscellaneous industries, such as those not required to be near the source of raw materials or markets, are expected on lands enhanced to industrial uses. The proposed project is expected to enable about 2,000 additional acres of vacant or idle lands to be utilized for growing row crops. Nearby urban areas, such as Eureka, Arcata, Fortuna and Ferndale, will probably be the primary markets for the agricultural produce. In addition, regional and State markets will develop, especially for specialty-vegetable products such as artichokes. The value per acre of enhanced land, with and without the authorized Delta levees and the proposed reservoir, and the number of acres enhanced during

the 50-year study period are presented in Table E-13. The increase in value per acre by category of use is shown below:

Residential	$ 4,500
Industrial	10,000
Agriculture	1,500

E-40. Average annual benefits from land enhancement attributable to the Delta levees and Dos Rios Reservoir for the 50-year study period are presented by category of land use in Table E-14. The method used to determine land enhancement is consistent with EM 1120-2-111, "Relation of Flood Damage and Flood Control Benefits to Market Value of Land," 13 June 1957. Benefits from land enhancement attributable to the Dos Rios Reservoir were computed as the difference between combined project land enhancement and land enhancement from the Delta levees alone. Benefits from the levees alone were limited to the addition of 2,000 acres of agricultural lands because the degree of protection provided would not be sufficient to encourage extensive urbanization of the flood plain. The average annual benefit amounted to $40,000 after deduction of residual damages including loss of one crop every fifty years and losses to operating equipment. The average annual benefit attributable to the proposed project is $260,000 less $40,000, or $220,000, for the fifty-year economic life.

E-41. At present no land enhancement benefit is anticipated in other reaches because of the relatively low degree of flood protection from the Dos Rios project alone. However, considerable enhancement potential exists in the Eel River flood plain, particularly in the Scotia area. The combined effect of the proposed project and other complementary flood control projects may reduce flood damages sufficiently to enhance a large number of acres.

E-42. LAND ENHANCEMENT BENEFITS, 100-YEAR ANALYSIS

For the 100-year analysis, it was assumed that all creditable enhancement will have occurred in the first 50 years. The land enhancement benefit for the 100-year study period is $290,000. The average annual equivalent value of land enhancement benefits was computed at 3-1/4 percent rate of interest for a 100-year economic life in terms of June 1967 prices and conditions as follows:

Step 1: $220,000 1/ x .83 2/ (100-year average annual equivalent value of 50-year life benefit)

Step 2: $637,000 3/ x .168 4/ (Average annual equivalent of uniform benefit for second 50 years)

Step 3: $183,000 + $107,000 = $290,000.

1/ Average annual equivalent value of enhancement for 50-year life. Land enhancement benefit attributable to both the Delta levees and the proposed reservoir is $260,000, Table E-17 enhancement benefits from the levees alone is $40,000.

2/ $\frac{.0339 \text{ (100th year capital recovery factor)}}{.0407 \text{ (50th year capital recovery factor)}} = .83$

3/ Average annual income from net enhancement, 50th year.

4/ 29.513 (present worth factor uniform annual series for 100 years)
-24.552 (present worth factor uniform annual series for first 50 years)
4.961 x .0339 (100th year capital recovery factor) = .168

E-43. WINDFALL LAND ENHANCEMENT BENEFITS

A land ownership study based on the Humbodlt County 1967-68 property tax roll indicated that there are approximately 460 owners of property in the historical flood plain of the Delta Area. When the Delta levees are constructed it is estimated that the number of property owners will be reduced to 420. The large parcels of land over 300 acres are located near the Pacific Ocean and are composed of marsh and slough areas. Due to salt water intrusion and soil conditions it is expected that these areas will remain in low grade agriculture or fish and wildlife conservation. Even with construction of the levee system the rate of development of the balance of the flood plain is expected to be deferred during the first few years after completion of the Dos Rios Reservoir project.

E-44. The investigation for windfall benefits involved a site analysis of the large ownerships. In this analysis the average total benefits per owner were computed from the values of specific large parcels over 300 acres. For parcels under 300 acres average values were used. Generally the percentage increase in per acre values from pre-project to 15 years post-project ranges from 25 percent for the ownerships under 10 acres to 5 percent for the parcels in the 500- to 900-acre category. Table E-15 shows that there are no benefits of such magnitude as to constitute the basis for consideration of additional requirements for local cooperation.

E-45. COMMON CARRIER RAILROAD BENEFITS

The effectiveness of various reservoirs in preventing bank erosion and resulting flood damages is diminished by the necessity of releasing excess storage following heavy rainfall. This discharge is not expected to cause inundation damages but is expected to cause substantial bank erosion. Average annual benefits were computed separately for bank erosion losses and for inundation damages. As previously noted, no growth factor was applied to railroad damages. Therefore, benefits are the same for the 50- and 100-year analyses as for existing conditions. The total railroad benefit is as follows:

Reach	Railroad Benefit
III	$ 56,000
V	71,000
VI	83,000
Total	$210,000

E-46. SUMMARY AND TOTALS OF FLOOD CONTROL BENEFITS

Average annual equivalent benefits from flood damage reduction and from land enhancement for future conditions are summarized below and itemized by reach and type of benefit in Table E-17:

Reach	50-Year Project Life (000)	100-Year Project Life (000)
I	$ 430	$ 525
III	571	621
V	214	227
VI	101	101
Round Valley	34	36
Total	$1,350	$1,510

E-47. EFFECT OF DELTA LEVEES

Flood control benefits presented in Table E-17 were derived with the assumption that the pre-project conditions were defined as the authorized Delta levee system constructed to a capacity of about 600,000 cubic feet per second. These benefits were adopted for project formulation and justification. In order to determine the possible effect of the staging of levee construction relative to the reservoir, benefits were also computed for the proposed reservoir alone, assuming the Delta levees were not constructed. Only the Delta Reach is affected by this assumption. In this reach, benefits for the reservoir alone were found to be slightly higher for the 50-year study period than the benefits for the adopted condition of the reservoir with authorized levees assumed constructed in advance of the reservoir. Benefits attributable to the reservoir for the 100-year period were found to be practically the same for conditions with and without the levees. For both study periods, the category of flood control benefits shifts from combined land enhancement and flood reduction benefits to flood reduction benefits alone. Thus, whether or not the levees are constructed would not adversely affect the economic justification of including flood control as a purpose of the proposed Dos Rios project. The summary of average annual flood control benefits attributable to Dos Rios with and without the Delta levees is as follows for the Delta Reach:

	Without Delta Levees		With Delta Levees	
	50-Year	100-Year	50-Year	100-Year
Flood Damage Reduction	$490,000	$525,000	$210,000	$235,000
Land Enhancement	-	-	220,000	290,000
Total	$490,000	$525,000	$430,000	$525,000

WATER SUPPLY BENEFITS

E-48. GENERAL

Water export is one of the principal purposes of the proposed Dos Rios Reservoir. The combined yield of the basic State of California Central Valley Project and State Water Project will be insufficient to meet the water needs of the State by the mid-1980's. State deficiencies will increase to 6,000,000 acre-feet by 2020. Therefore, development of supplemental sources of water is envisioned. Details of the State's water needs are presented in Department of Water Resources Bulletin No. 160-66, "Implementation of the California Water Plan," March 1966.

E-49. The Eel River Basin and other North Coastal Area basins are water surplus areas and are expected to supply some of the necessary waters to other areas of the State. The Dos Rios Reservoir would export water through the Grindstone Diversion Tunnel into the Sacramento River and thence to the Sacramento-San Joaquin Delta for eventual statewide distribution with other waters "pooled" in the Delta. The Delta pooling concept recognizes the Sacramento-San Joaquin Delta as the focal point for export and distribution of surplus waters to water-deficient areas in the southerly portion of the State. It also provides a physical basis for coordinating the operation of the State Water Project with the Federal Central Valley Project. The Delta pooling concept is discussed in the main portion of this report. The firm annual export expected from Dos Rios, after deductions for fish mitigation and local basin requirements, is 900,000 acre-feet as measured at the Sacramento-San Joaquin Delta pool.

E-50. WATER SUPPLY BENEFITS

Benefits from developing water supplies are based on the least cost of producing an equivalent annual yield from an alternative source. Except for alternate sites on the Middle Fork, other potential water export sites in the Eel River Basin will be needed in the foreseeable future to supplement the basic California Water Plan. Such sites are not, therefore, true alternatives but rather priorities of construction. For cost allocation purposes, however, the least cost alternative would be a single purpose reservoir for water supply at Dos Rios. The total annual cost of such a project is estimated at $14,900,000, of which $5,870,000 is the specific cost of the Grindstone Diversion Tunnel and the remaining $9,030,000 is for the remainder of the project. Details are presented in Appendix F, "Project Formulation, Plan of Improvement, Costs, Cost Allocation and Apportionment of Costs."

E-51. The State Department of Water Resources has made an analysis of the probable value of water in the Sacramento-San Joaquin Delta based, in part, on obtaining water from the sea through desalinization processes, giving consideration to expected improvements in techniques in the future. The State also estimated the costs for delivering water from the Delta to the areas of utilization and adjusted the total benefit to arrive at a figure of $30 per acre-foot in the Delta. To allow for additional minor water conveyance works from the exit portal of Grindstone Tunnel to the Sacramento River and the Delta, a value of one dollar per acre-foot was assumed. The resulting net benefit of $29 per acre-foot was then adopted as the unit benefit for water supply for the Dos Rios Project at the exit portal. This value is considered conservative when compared to the probable price prudent consumers would be willing to pay for water. The reservoir pool is expected to fill to a usable level for water supply within a short period of time. Full use of available water is expected to be made almost immediately. Therefore, there would be little, if any, period for buildups of demand for the supplemental water, and for the estimated 900,000 acre-feet yield, the water supply benefits would amount to $26,100,000 annual for both the 50- and 100-year economic lives.

HYDROPOWER SUPPLY BENEFITS

E-52. HYDROPOWER BENEFITS

Studies were conducted to determine the benefits from a hydropower plant inserted into the fish water release system to utilize the available flow and head. Additional details on this power plant are covered in Appendix F, "Plan and Cost of Improvements and Allocation of Costs."

E-53. It is estimated that a base load plant operating under a fixed 200 c.f.s. discharge and a head of 340 feet is the optimum development that can be justified on an incremental basis to utilize fish releases. This would result in a plant capacity of 4,800 kilowatts operating at full capacity the year-round. Any plan for hydropower development which required use of reservoir storage to provide greater release would not be economically justified. Also, consideration of sufficient installed capacity to utilize the 350 c.f.s. fish releases made during part of the year showed only marginal justification. If the plant were to be operated on a daily peaking basis, the additional afterbay storage facility and increased tunnel and pipeline capacities required would result in added costs which would make that plan economically unfavorable.

E-54. Hydropower benefits expected to result from construction and operation of a 4,800-kilowatt hydropower plant at Dos Rios have been estimated based on data furnished by the Federal Power Commission for this study. The values, $9.28 per kilowatt for installed capacity and 3.06 mills per kilowatt-hour for energy, are representative at this time for the Pacific Northwest power network for a Federally-financed steam-electric plant and are adjusted to reflect "at-site" power values. The value of $9.28 for installed capacity was used in computing the alternative cost of producing power only. For computing benefits, the value for a privately-financed plant was used. The installed capacity benefit figure has been estimated as about $18.43 per kilowatt which is about double the Federally-financed figure. Energy values would remain the same. Total hydropower annual benefits for both the 50- and 100-year study periods are estimated to be:

Installed capacity - 4,800kw x $18.43	=	$ 85,000
Energy - 42,000,000 kwh x 0.00306	=	125,000
Total hydropower benefit		$210,000

RECREATION BENEFITS

E-55. RECREATION BENEFITS

The population of the San Francisco Bay Area is expected to overcrowd the potential outdoor recreation facilities of the area between the Bay and Eel River Basin by about 1985. Thereafter, the Bay Area demand for outdoor recreation such as camping, boating and hiking is expected to center on the Eel River Basin which has a moderate climate, scenic surroundings and outstanding Redwood groves. The proposed reservoir would be the largest in the basin and one of the largest in the State in terms of recreation pool and shoreline miles. It would be located about 20 miles from Highway 101, the major north-south interstate highway in Northern California. These factors indicate the possible interstate appeal of the reservoir. Access roads from major highways to the reservoir are currently severely limited. The State of California has plans for a two-lane access highway to Round Valley that is expected to be completed by 1985. This highway will connect United States Highway 99 at Orland with United States Highway 101 at Laytonville. The two-way capacity of this road would be 5,000 cars per day. The maximum annual attendance which this road can support is 2,000,000 people. About half of the recreation days are expected to be spent on lands owned by the proposed relocated Round Valley Indian Community. The 1,000,000 visitor days accruing to the Indian Community is not claimed as a project benefit, but is used as mitigation for losses

sustained by the Indian Community due to the disruption of the present economy. Recreation benefits were derived in Appendix D, "Recreation, Fish and Wildlife" and are presented for reference in Table E-18. The average annual project benefits after allowance for mitigation for the Indian Community is $1,170,000 for the 50-year study period and $1,210,000 for the 100-year study period. The impact of the proposed recreation reservoir on Covelo and surrounding area is discussed in Appendix A, "Economic Environment of the Eel River Basin."

SUMMARY OF BENEFITS

E-56. SUMMARY OF PRIMARY PROJECT BENEFITS

Project benefits for flood control, water supply and recreation are summarized and totaled for the 50- and 100-year study periods in the following tabulation:

PROJECT BENEFITS 1/
50- and 100-Year Study Periods

Type of Benefit	50-Year (1980-2030)	100-Year (1980-2080)
Flood Control 2/	$ 1,350,000	$ 1,510,000
Water Supply	26,100,000	26,100,000
Hydropower	210,000	210,000
Recreation	1,170,000	1,210,000 3/
Total	$28,830,000	$29,030,000

1/ Utilized for cost allocation purposes.
2/ Assumes authorized Delta levees installed with capacity of 600,000 c.f.s.
3/ The facilities for mitigating damage to the Indian economy would absorb 1,000,000 recreation days. Benefits accruing to visitation associated with Indian facilities total $1,200,000 and are excluded from the above tabulation.

E-57. SECONDARY BENEFITS

Previously, primary project benefits were determined and totaled. However, there are other types of benefits which may and should be considered in project planning. These types of benefits include secondary, employment and intangible benefits. Secondary benefits are of substantial magnitude. Lumber is the most important industry in northwestern California. The lumber products from this area are distributed on a national basis. The December 1964 flood disrupted the flow of lumber and lumber products to national markets by destroying lumber mills including machinery, raw materials, and finished products. In addition major lumber transportation facilities in the area, such as the Northwestern Pacific Railroad, were closed or were in limited operation for up to a year after the flood. A study initiated by the U.S. Army Engineer District, San Francisco, Corps of Engineers, indicated that the effect of the 1964 flood on the national economy was a loss that ranged from $22 to $31 million. This study made quantitative comparisons of the pre-flood lumber industry activity with the post-flood lumber industry activity and using various econometric models assessed the probable supply and demand equilibriums in national lumber markets in the absence of the 1964 floods. Comparisons were made of actual and probable shipments, prices, and production from all lumber producing areas in the nation. The study was made specifically for the lumber industry of a five-county area consisting of Mendocino, Humboldt, Trinity, Del Norte and Siskiyou Counties of northwestern California. An assumption was made that the five-county effect on the national economy was a $31 million loss. Based upon locations of sawmills and transportation facilities, it was estimated that the disruption of the lumber industry in Eel River Basin by the 1964 flood resulted in a loss of $9 million to the national economy. Estimates were made of the probable loss to the national economy of floods of various magnitudes and average annual damages were computed by the damage discharge method described previously in determining primary flood damage. The resulting estimate of average annual damages, adjusted to 1967 price levels, was $200,000 for the Eel River Basin. Development factors were not applied to secondary damages or benefits because the economic loss to the nation of future floods in northwestern California will also depend upon the economy of the United States. Analyses of such trends are beyond the scope of this Appendix. A substantial portion of the national loss caused by flooding in Eel River Basin would be eliminated by the proposed project. Average annual benefits attributable to Dos Rios for both the 50- and 100-year periods and at 1967 price levels are about $170,000.

E-58. TOTAL PROJECT BENEFITS INCLUDING SECONDARY BENEFITS

Project benefits, including secondary benefits, are summarized and totaled below:

Type of Benefit	50-Year (1980-2030)	100-Year (1980-2080)
Primary		
Flood Control 1/	$ 1,350,000	$ 1,510,000
Water Supply	26,100,000	26,100,000
Hydropower	210,000	210,000
Recreation	1,170,000	1,210,000
Total Primary Benefits	$28,830,000	$29,030,000
Secondary		
National Impact	170,000	170,000
Total Primary and Secondary Benefits	$29,000,000	$29,200,000

1/ Assumes authorized delta levees installed with capacity of 600,000 c.f.s.

E-59. EMPLOYMENT BENEFITS

The counties of Humboldt, Lake, Mendocino, Tehama and Trinity have been designated by the Economic Development Administration, Department of Commerce, as areas of persistent unemployment and in this connection are eligible for consideration in the award of Federal contracts under Title IV of the Public Works and Economic Development Act of 1965, Public Law 89-136, Senate Document No. 97, 87th Congress, and related programs. These counties form part of the basin or are immediately adjacent to the basin. An appreciable portion of the labor force required for proposed project construction would be residents of these counties. Alleviation of local unemployment would constitute a benefit to the local and national economies. Determination of this benefit has been based on analytically derived estimates for the seven-year construction period (a) that labor costs represent approximately 65 percent of total construction costs and (b) that 45 percent of the labor force will be made up of area residents. The computation of the benefit to the local economy based on the cost of construction is as follows:

Project Cost - $320,000,000 (Labor and materials only. Does not include land, design, and supervision)

(a) Estimated total labor cost:
$320,000,000 x 65 percent = $208,000,000

(b) Estimated labor cost paid to local unemployed labor:
$208,000,000 x 45 percent = $94,000,000

50-year total project average annual cost benefit: $3,800,000 1/
100-year total project average annual cost benefit: $3,200,000 1/

1/ Capital recovery factor at 3-1/4 percent rate of interest.

E-60. Relief of temporary unemployment would occur through employment of local residents in maintenance and operation of the proposed project. Determination of this benefit is based upon the estimates (a) that labor costs represent about 65 percent of total maintenance and operation costs, and (b) that 45 percent of the labor force will be made up of local residents. In accordance with ER 1165-2-6, "Water Resource Policies and Authorities, Evaluation of Redevelopment Effects," 1 February 1966, the effects of area employment in project operation and maintenance were based on a straight line reduction in potential project employables for maintenance to a zero level at the end of 20 years from the date of project evaluation. The average annual cost for maintenance and operation is $650,000. With a 3-1/4 percent rate of interest the average annual benefit is $200,000 for both the 50-year and 100-year periods. The total employment benefits are shown in the following tabulation:

	50-Year Project Life	100-Year Project Life
Construction	$3,800,000	$3,200,000
Maintenance and Operation	200,000	200,000
Total Employment Benefits	$4,000,000	$3,400,000

E-61. PROJECT BENEFITS INCLUDING EMPLOYMENT BENEFITS

Employment benefits are incidental benefits and may be added to the primary project benefits in project evaluation. Incidental

benefits are not normally used for project formulation, economic justification or cost allocation. The primary project benefits and the incidental employment benefits are shown below in the following summary:

Type of Benefit	50-Year (1980-2030)	100-Year (1980-2080)
Primary		
Flood Control 1/	$ 1,350,000	$ 1,510,000
Water Supply	26,100,000	26,100,000
Hydropower	210,000	210,000
Recreation	1,170,000	1,210,000
Total Primary Benefits	$28,830,000	$29,030,000
Secondary Benefits	170,000	170,000
Total Primary and Secondary Benefits	$29,000,000	$29,200,000
Incidental		
Employment	4,000,000	3,400,000
Total Benefits	$33,000,000	$32,600,000

1/ Assumes authorized delta levees installed with capacity of 600,000 c.f.s.

E-62. INTANGIBLE BENEFITS

Although not subject to monetary evaluation, intangible damages along the Eel are of substantial magnitude. Nineteen deaths resulted from the December 1964 flood. No deaths were reported for previous floods. Health hazards existing during floods, although no epidemics have been attributable to floods along the Eel. Chaos and isolation resulted from major floods. Human suffering was high as personal property, homes, animals and whole communities were devastated. The proposed flood protection would aid in elimination of these extremely severe intangible losses. By eliminating floods of the magnitude of the December 1964 flood, the project would greatly reduce the hazard to human life.

E-63. RECAPITULATION OF BENEFITS

For the 100-year economic life the totals for the preceding tabulations are as follows:

Primary Benefits	$29,030,000
Primary Benefits and Secondary Benefits	$29,200,000
Primary Benefits, Secondary Benefits and Incidental Employment Benefits	$32,600,000

TABLE E-1

SUMMARY OF HISTORICAL FLOOD DAMAGES
Prices and Conditions at Time of Occurrence
(In $1,000)

Date and Type and Damage	Reach I	Reach III	Reach V	Reach VI	Round Valley	Total
January 1953						
Agricultural	$ 70	$ 7	-	-	$138	$ 215
Roads and bridges	48	5	-	-	-	53
Bank erosion	20	2	-	-	-	22
Total	$138	$ 14			$138	$ 290
December 1955						
Residential	$ 384	$ 621	$ 215	-	-	$ 1,220
Commercial	339	834	537	-	-	1,710
Agricultural	2,970	315	36	-	29	3,350
Public utilities	95	170	85	-	-	350
Roads and bridges	725	487	578	-	-	1,790
Public facilities	-	-	20	-	-	20
Emergency aid	717	345	57	51	-	1,170
Railroad	-	748	742	-	-	1,490
Total	$5,230	$3,520	$2,270	$ 51	$ 29	$11,100
December 1964						
Residential	$ 382	$ 1,960	$ 266	$ 15	$ 27	$ 2,650
Commercial	281	908	381	44	16	1,630
Industrial	-	10,000	718	323	559	11,600
Agricultural	7,860	3,250	417	136	237	11,900
Livestock	1,210	170	-	-	-	1,380
Public utilities	102	1,010	128	-	-	1,240
Roads and bridges	834	3,940	736	-	-	5,510
Public facilities	23	82	15	1	1	122
Emergency aid	295	782	193	-	-	1,270
PL/99	307	-	-	-	-	307
PL/875	956	2,330	546	-	18	3,850
Bank erosion	50	68	20	1	2	141
Railroad	-	2,400	5,080	2,720	-	9,700
Total	$12,300	$26,900	$8,500	$2,740	$860	$51,300

TABLE E-2

SUMMARY OF HISTORICAL FLOOD DAMAGES
1964 Prices and Conditions
(In $1,000)

Date and Type of Damage	Reach I	Reach III	Reach V	Reach VI	Round Valley	Total
January 1953 1/						
Agricultural	$ 82	$. 9	-	-	$157	$ 248
Roads and bridges	57	7	-	-	-	64
Bank erosion	24	2			-	26
Total	$163	$18			$157	$ 338
December 1955 1/						
Residential	$ 459	$ 768	$ 273	-	-	$ 1,500
Commercial	395	1,060	685	-	-	2,140
Agricultural	3,520	390	50	-	30	3,990
Public utilities	112	210	114	-	-	436
Roads and bridges	866	604	730	-	-	2,200
Public facilities	-	-	24	-	-	24
Emergency aid	848	428	74	60	-	1,410
Railroad	-	910	890	-	-	1,800
Total	$6,200	$4,370	$2,840	$60	$ 30	$13,500
December 1964 1/						
Residential	$ 382	$ 1,960	$ 266	$ 15	$ 27	$ 2,650
Commercial	281	908	381	44	16	1,630
Industrial	-	10,000	718	323	559	11,600
Agricultural	7,860	3,250	417	136	237	11,900
Livestock	1,210	170	-	-	-	1,380
Public utilities	102	1,010	128	-	-	1,240
Roads and bridges	834	3,940	736	-	-	5,510
Public utilities	23	82	15	1	1	122
Emergency aid	295	782	193	-	-	1,270
PL/99	307	-	-	-	-	307
PL/875	956	2,330	546	-	18	3,850
Bank erosion	50	68	20	1	2	141
Railroad	-	2,400	5,080	2,220	-	9,700
Total	$12,300	$26,900	$8,500	$2,740	$860	$51,300

1/ Damages sustained during the 1953 and 1955 floods were brought to 1964 price levels by applying appropriate indices compiled by the U. S. Department of Commerce, U.S. Department of Labor, U.S. Department of Agriculture and Engineering News-Record. In addition, damages were brought to 1964 levels of development.

TABLE E-3

SUMMARY OF HISTORICAL FLOOD DAMAGES
1967 Prices and Conditions
(In $1,000)

Date and Type of Damage	Reach I	Reach III	Reach V	Reach VI	Round Valley	Total
January 1953						
Agricultural	$ 93	$ 10	-	-	$163	$ 266
Roads and bridges	64	7	-	-	-	71
Bank erosion	27	3	-	-	-	30
Total	$184	$ 20			$163	$ 367
December 1955						
Residential	$ 516	$ 902	$ 312	-	-	$ 1,730
Commercial	449	1,220	781	-	-	2,450
Agricultural	3,950	455	52	-	33	4,490
Public utilities	125	247	130	-	-	502
Roads and bridges	970	706	834	-	-	2,510
Public facilities	-	-	28	-	-	28
Emergency aid	950	500	83	67	-	1,600
Railroad	-	1,060	1,030	-	-	2,090
Total	$6,960	$5,090	$3,250	$67	$33	$15,400
December 1964						
Residential	$ 412	$ 2,220	$ 312	$ 17	$ 29	$ 2,990
Commercial	294	1,030	439	50	17	1,830
Industrial	-	11,500	814	378	608	13,300
Agricultural	8,520	3,690	483	153	254	13,100
Livestock	1,280	190	-	-	-	1,470
Public utilities	104	1,140	156	-	-	1,400
Roads and bridges	911	4,460	849	-	-	6,220
Public facilities	25	100	17	1	1	144
Emergency aid	321	893	216	-	-	1,430
PL/99	339	-	-	-	-	339
PL/875	1,040	2,630	631	-	19	4,320
Bank erosion	54	77	23	1	2	157
Railroad	-	2,770	5,830	2,500	-	11,100
Total	$13,300	$30,700	$9,770	$3,100	$930	$57,800

TABLE E-4

AVERAGE ANNUAL FLOOD DAMAGES 1/
1964 Prices and Conditions

Reach and Category	Existing Damages
I - Delta 2/	
Residential	$ 27,000
Commercial	18,000
Agricultural	147,000
Utilities	5,000
Other	52,000
Total, Delta	$249,000
III - Scotia	
Residential	$117,000
Commercial	61,000
Agricultural	72,000
Utilities	34,000
Other	268,000
Total, Scotia	$552,000
V - Alderpoint	
Residential	$. 24,000
Commercial	36,000
Agricultural	10,000
Utilities	14,000
Other	69,000
Total, Alderpoint	$153,000
VI - Dos Rios	
Commercial	$ 2,000
Industrial	10,000
Agricultural	5,000
Other	1,000
Total, Dos Rios	$ 18,000

TABLE E-4
(Cont'd)

AVERAGE ANNUAL FLOOD DAMAGES [1]
1964 Prices and Conditions

Reach and Category	Existing Damages
Round Valley	
Residential	$ 1,000
Commercial	1,000
Industrial	15,000
Agricultural	10,000
Other	1,000
Total, Round Valley	$ 28,000
Total, all Reaches [2]	
Residential	$ 169,000
Commercial	118,000
Industrial	25,000
Agricultural	244,000
Utilities	53,000
Other [3]	391,000
Total, all Reaches	$1,000,000

[1] Excludes railroad damages, which are treated separately.

[2] For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

[3] Includes mostly road and bridge losses, and Public Law 875 expenditures; also includes public facilities, emergency aid, bank erosion and Public Law 99 expenditures.

TABLE E-5

AVERAGE ANNUAL FLOOD DAMAGES
June 1967 Prices and Conditions [1]

Reach and Category	Existing Damages
I - Delta [2]	
Residential	$ 30,000
Commercial	20,000
Agricultural	155,000
Utilities	6,000
Other	59,000
Total, Delta	$270,000
III - Scotia	
Residential	$131,000
Commercial	68,000
Agricultural	77,000
Utilities	38,000
Other	316,000
Total, Scotia	$630,000
V - Alderpoint	
Residential	$ 27,000
Commercial	39,000
Agricultural	11,000
Utilities	16,000
Other	77,000
Total, Alderpoint	$170,000
VI - Dos Rios	
Commercial	$ 2,000
Industrial	11,000
Agricultural	5,000
Other	1,000
Total, Dos Rios	$ 19,000

TABLE E-5 (Cont'd)

AVERAGE ANNUAL FLOOD DAMAGES
June 1967 Prices and Conditions 1/

Reach and Category	Existing Damages
Round Valley	
Residential	$ 1,000
Commercial	1,000
Industrial	17,000
Agricultural	11,000
Other	1,000
Total, Round Valley	$31,000
Total, all Reaches 2/	
Residential	$ 189,000
Commercial	130,000
Industrial	28,000
Agricultural	259,000
Utilities	60,000
Other	454,000
Total, all Reaches	$1,120,000

1/ Excludes railroad damages, which are treated separately.

2/ For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

TABLE E-6

DEVELOPMENT FACTORS
AVERAGE ANNUAL EQUIVALENT VALUE 1/

Reach and Category	50-Year Study Period 1980-2030	100-Year Study Period 1980-2080
I Delta		
Residential	1.5	1.7
Commercial	1.5	1.7
Agricultural	1.1	1.2
Utilities	1.2	1.3
Other	1.2	1.3
III Scotia		
Residential	1.3	1.4
Commercial	1.2	1.4
Agricultural	1.0	1.0
Utilities	1.2	1.3
Other	1.2	1.3
V Alderpoint		
Residential	1.2	1.3
Commercial	1.2	1.3
Agricultural	1.0	1.0
Utilities	1.1	1.2
Other	1.1	1.2
VI Dos Rios		
Commercial	1.2	1.2
Industrial	1.2	1.2
Agricultural	1.0	1.0
Other	1.1	1.1
Round Valley		
Residential	1.2	1.5
Commercial	1.3	1.6
Industrial	1.0	1.0
Agricultural	1.3	1.3
Other	1.1	1.2

1/ Based on income associated with increased value per decade and deferred at an interest rate of 3-1/4 percent compounded annually.

TABLE E-7

AVERAGE ANNUAL FLOOD DAMAGES
Under Future Conditions and June 1967 Prices 1/

50-Year Study Period

Reach and Category	Existing Damages	Development Factor	Future Damages
I Delta 2/			
Residential	$ 30,000	1.5	$ 45,000
Commercial	20,000	1.5	30,000
Agricultural	155,000	1.1	171,000
Utilities	6,000	1.2	7,000
Other	59,000	1.2	71,000
Total, Delta	$270,000		$324,000
III Scotia			
Residential	$131,000	1.3	$170,000
Commercial	68,000	1.2	82,000
Agricultural	77,000	1.0	77,000
Utilities	38,000	1.2	46,000
Other	316,000	1.2	379,000
Total, Scotia	$630,000		$754,000
V Alderpoint			
Residential	$ 27,000	1.2	$ 31,000
Commercial	39,000	1.2	46,000
Agricultural	11,000	1.0	11,000
Utilities	16,000	1.1	17,000
Other	77,000	1.1	82,000
Total, Alderpoint	$170,000		$187,000
VI Dos Rios			
Commercial	$ 2,000	1.2	$ 2,000
Industrial	11,000	1.2	13,000
Agricultural	5,000	1.0	5,000
Other	1,000	1.1	1,000
Total, Dos Rios	$ 19,000		$ 21,000

TABLE E-7
(Cont'd)

AVERAGE ANNUAL FLOOD DAMAGES
Under Future Conditions and June 1967 Prices [1]

50-Year Study Period

Reach and Category	Existing Damages	Development Factor	Future Damages
Round Valley			
Residential	$ 1,000	1.2	$ 1,000
Commercial	1,000	1.3	1,000
Industrial	17,000	1.0	17,000
Agricultural	11,000	1.3	14,000
Other	1,000		1,000
Total, Round Valley	$ 31,000		$ 34,000
Total, all Reaches [2]			
Residential	$ 189,000		$ 247,000
Commercial	130,000		161,000
Industrial	28,000		30,000
Agricultural	259,000		278,000
Utilities	60,000		70,000
Other [3]	454,000		534,000
Total, all Reaches	$1,120,000		$1,320,000

[1] Excludes railroad damages, which are treated separately.

[2] For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

[3] Includes mostly road and bridge losses, and Public Law 875 expenditures; also includes public facilities, emergency aid, bank erosion and Public Law 99 expenditures.

TABLE E-8

AVERAGE ANNUAL FLOOD DAMAGES
Under Future Conditions and June 1967 Prices 1/

100-Year Study Period

Reach and Category	Existing Damages	Development Factor	Future Damages
I Delta 2/			
Residential	$ 30,000	1.7	$ 51,000
Commercial	20,000	1.7	34,000
Agricultural	155,000	1.2	186,000
Utilities	6,000	1.3	8,000
Other	59,000	1.3	78,000
Total, Delta	$270,000		$357,000
III Scotia			
Residential	$131,000	1.4	$185,000
Commercial	68,000	1.4	97,000
Agricultural	77,000	1.0	77,000
Utilities	38,000	1.3	50,000
Other	316,000	1.3	413,000
Total, Scotia	$630,000		$822,000
V Alderpoint			
Residential	$ 27,000	1.3	$ 34,000
Commercial	39,000	1.3	50,000
Agricultural	11,000	1.0	11,000
Utilities	16,000	1.2	18,000
Other	77,000	1.2	91,000
Total, Alderpoint	$170,000		$204,000
VI Dos Rios			
Commercial	$ 2,000	1.2	$ 2,000
Industrial	11,000	1.2	13,000
Agricultural	5,000	1.0	5,000
Other	1,000	1.1	1,000
Total, Dos Rios	$ 19,000		$ 21,000

TABLE E-8
(Cont'd)

AVERAGE ANNUAL FLOOD DAMAGES
Under Future Conditions and June 1967 Prices [1]

100-Year Study Period

Reach and Category	Existing Damages	Development Factor	Future Damages
Round Valley			
Residential	$ 1,000	1.5	$ 2,000
Commercial	1,000	1.6	2,000
Industrial	17,000	1.0	17,000
Agricultural	11,000	1.3	14,000
Other	1,000		1,000
Total, Round Valley	$ 31,000		$ 36,000
Total, all Reaches [2]			
Residential	$ 189,000		$ 272,000
Commercial	130,000		185,000
Industrial	28,000		30,000
Agricultural	259,000		293,000
Utilities	60,000		76,000
Other [3]	454,000		584,000
Total, all Reaches	$1,120,000		$1,440,000

[1] Excludes railroad damages, which are treated separately.

[2] For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

[3] Includes mostly road and bridge losses, and Public Law 875 expenditures; also includes public facilities, emergency aid, bank erosion and Public Law 99 expenditures.

TABLE E-9

TOTAL AVERAGE ANNUAL FLOOD DAMAGES
INCLUDING RAILROAD DAMAGES

50- and 100-year Study Periods
($1,000)

Reach	50-Year			100-Year		
	Railroad	Other	Total	Railroad	Other	Total
I 1/	$ -	$ 324	$ 324	$ -	$ 357	$ 357
III	155	754	909	155	822	977
V	250	187	437	250	204	454
VI	135	21	156	135	21	156
Round Valley	-	34	34	-	36	36
Total	$540	$1,320	$1,860	$540	$1,440	$1,980

1/ For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

TABLE E-10

AVERAGE ANNUAL FLOOD REDUCTION BENEFITS
June 1967 Prices and Conditions 1/

Reach and Category	Existing Damages	Residual Damages	Total Benefits
I Delta 3/			
Residential	$ 30,000	$ 10,000	$ 20,000
Commercial	20,000	7,000	13,000
Agricultural	155,000	53,000	102,000
Utilities	6,000	2,000	4,000
Other	59,000	20,000	39,000
Total, Delta	$270,000	$ 92,000	$178,000
III Scotia			
Residential	$131,000	$ 40,000	$ 91,000
Commercial	68,000	22,000	46,000
Agricultural	77,000	25,000	52,000
Utilities	38,000	12,000	26,000
Other	316,000	98,000	218,000
Total, Scotia	$630,000	$197,000	$433,000
V Alderpoint			
Residential	$ 27,000	$ 6,000	$ 21,000
Commercial	39,000	10,000	29,000
Agricultural	11,000	3,000	8,000
Utilities	16,000	4,000	12,000
Other	77,000	17,000	60,000
Total, Alderpoint	$170,000	$ 40,000	$130,000
VI Dos Rios			
Commercial	$ 2,000	NEG	$ 2,000
Industrial	11,000	2,000	9,000
Agricultural	5,000	1,000	4,000
Other	1,000	NEG	1,000
Total, Dos Rios	$ 19,000	$ 3,000	$ 16,000

TABLE E-10
(Cont'd)

AVERAGE ANNUAL FLOOD REDUCTION BENEFITS
June 1967 Prices and Conditions [1]

Reach and Category	Existing Damages	Residual Damages	Total Benefits
Round Valley [2]			
Residential	$ 1,000	-	$ 1,000
Commercial	1,000	-	1,000
Industrial	17,000	-	17,000
Agricultural	11,000	-	11,000
Other	1,000		1,000
Total, Round Valley	$31,000		$31,000
Total, all Reaches [3]			
Residential	$ 189,000	$ 56,000	$133,000
Commercial	130,000	39,000	91,000
Industrial	28,000	2,000	26,000
Agricultural	259,000	82,000	177,000
Utilities	60,000	18,000	42,000
Other [4]	454,000	135,000	319,000
Total, all Reaches	$1,120,000	$332,000	$788,000

[1] Excludes railroad damages and benefits which are treated separately.

[2] Round Valley would be inundated by the proposed project. Therefore, project is credited with elimination of flood damages.

[3] For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

[4] Includes mostly road and bridge losses, and Public Law 875 expenditures; also includes public facilities, emergency aid, bank erosion and Public Law 99 expenditures.

TABLE E-11

AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Under Future Conditions and June 1967 Prices 1/

50-Year Study Period

Reach and Category	Existing Benefit	Development Factor	Total Benefits
I Delta 2/			
Residential	$ 20,000	1.5	$ 30,000
Commercial	13,000	1.5	18,000
Agricultural	102,000	1.1	111,000
Utilities	4,000	1.2	5,000
Other	39,000	1.2	46,000
Total, Delta	$178,000		$210,000
III Scotia			
Residential	$ 91,000	1.3	$117,000
Commercial	46,000	1.2	55,000
Agricultural	52,000	1.0	52,000
Utilities	26,000	1.2	31,000
Other	218,000	1.2	260,000
Total, Scotia	$433,000		$515,000
V Alderpoint			
Residential	$ 21,000	1.2	$ 24,000
Commercial	29,000	1.2	34,000
Agricultural	8,000	1.0	8,000
Utilities	12,000	1.1	13,000
Other	60,000	1.1	64,000
Total, Alderpoint	$130,000		$143,000
VI Dos Rios			
Commercial	$ 2,000	1.2	$ 2,000
Industrial	9,000	1.2	11,000
Agricultural	4,000	1.0	4,000
Other	1,000	1.1	1,000
Total, Dos Rios	$ 16,000		$ 18,000

TABLE E-11
(Cont'd)

AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS 1/
Under Future Conditions and June 1967 Prices
50-Year Study Period

Reach and Category	Existing Benefit	Development Factor	Total Benefits
Round Valley			
Residential	$ 1,000	1.2	$ 1,000
Commercial	1,000	1.3	1,000
Industrial	17,000	1.0	17,000
Agricultural	11,000	1.3	14,000
Other	1,000	1.1	1,000
Total, Round Valley	$ 31,000		$ 34,000
Total, all Reaches 2/			
Residential	$133,000		$172,000
Commercial	91,000		110,000
Industrial	26,000		28,000
Agricultural	177,000		189,000
Utilities	42,000		49,000
Other 3/	319,000		372,000
Total, all Reaches	$788,000		$920,000

1/ Excludes railroad damages and benefits, which are treated separately.

2/ For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

3/ Includes mostly road and bridge losses, and Public Law 875 expenditures; also includes public facilities, emergency aid, bank erosion and Public Law 99 expenditures.

TABLE E-12

AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Under Future Conditions and June 1967 Prices 1/

100-Year Study Period

Reach and Category	Existing Benefit	Development Factor	Total Benefits
I Delta 2/			
Residential	$ 20,000	1.7	$ 35,000
Commercial	13,000	1.7	22,000
Agricultural	102,000	1.2	122,000
Utilities	4,000	1.3	5,000
Other	39,000	1.3	51,000
Total, Delta	$178,000		$235,000
III Scotia			
Residential	$ 91,000	1.4	$128,000
Commercial	46,000	1.4	65,000
Agricultural	52,000	1.0	52,000
Utilities	26,000	1.3	35,000
Other	218,000	1.3	285,000
Total, Scotia	$433,000		$565,000
IV Alderpoint			
Residential	$ 21,000	1.3	$ 26,000
Commercial	29,000	1.3	37,000
Agricultural	8,000	1.0	8,000
Utilities	12,000	1.2	14,000
Other	60,000	1.2	71,000
Total, Alderpoint	$130,000		$156,000
VI Dos Rios			
Commercial	$ 2,000	1.2	$ 2,000
Industrial	9,000	1.2	11,000
Agricultural	4,000	1.0	4,000
Other	1,000	1.1	1,000
Total, Dos Rios	$ 16,000		$ 18,000

TABLE E-12
(Cont'd)

AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Under Future Conditions and June 1967 Prices 1/

100-Year Study Period

Reach and Category	Existing Benefit	Development Factor	Total Benefits
Round Valley			
Residential	$ 1,000	1.5	$ 2,000
Commercial	1,000	1.6	2,000
Industrial	17,000	1.0	17,000
Agricultural	11,000	1.3	14,000
Other	1,000	1.2	1,000
Total, Round Valley	$ 31,000		$ 36,000
Total, all Reaches 2/			
Residential	$133,000		$191,000
Commercial	91,000		128,000
Industrial	26,000		28,000
Agricultural	177,000		200,000
Utilities	42,000		54,000
Other 3/	319,000		409,000
Total, all Reaches	$788,000		$1,010,000

1/ Excludes railroad damages and benefits, which are treated separately.

2/ For Delta area damages under preproject conditions (with authorized levee project assumed constructed to contain a 600,000 cubic feet per second flow).

3/ Includes mostly road and bridge losses, and Public Law 875 expenditures; also includes public facilities, emergency aid, bank erosion and Public Law 99 expenditures.

TABLE E-13

AVERAGE VALUE PER ACRE AND ACRES ENHANCED
50-Year Study Period

DELTA

Category	Value of Land 1/			Acres Enhanced
	With Project 2/	With Levees	Without Project 3/	
Residential	$ 6,500	$2,000	$1,200	2,100
Industrial	12,000	2,000	1,200	400
Agricultural	2,500	1,000	800	2,000

1/ Value in project year 50, net of improvements and development costs.

2/ With authorized delta levees and Dos Rios Reservoir installed.

3/ Without authorized delta levees or Dos Rios Reservoir.

TABLE E-14

AVERAGE ANNUAL LAND ENHANCEMENT BENEFITS
REACH I - DELTA 1/
(1967 Prices and Conditions)

50-Year Analysis

	Enhanced Acres	Value of Land Flood Free 2/ (000)	Value Without Project (000)	Value of Flood 3/ Damages Prevented (000)	3/ Value of Residual Damages (000)	50th Year Value of Enhancement (000)	50th Year Net Income From 4/ Enhancement	Land 5/ Enhancement Benefit
Residential 6/	2,100	$13,700	$2,500	$ 700	$2,000	$ 8,500	$425,000	$150,000
Industrial	400	4,800	500	200	600	3,500	175,000	60,000
Agricultural	2,000	5,000	800	800	900	2,500	125,000	50,000
Total	4,500	$23,500	$3,800	$1,700	$3,500	$14,500	$725,000	$260,000
Less land enhancement attributable to levee system -								40,000
Balance of land enhancement attributable to Dos Rios Reservoir - - - - - - - - - - - - - -								$220,000

1/ Benefits are those attributable to the combined effect of the Delta Levees and Dos Rios Reservoir.

2/ Land value net of improvements and development costs.

3/ Based as average annual damages and residual damages and related to enhanced areas.

4/ Enhancement benefits in project 50th year. Investigations indicate that project induced enhancement will continue to accrue over the 50-year period. Rate of return was computed at 5 percent.

5/ 50th year net income discounted at 3-1/4 percent. Average annual equivalent factors based on a normal growth curve. A normal growth curve was considered appropriate as reflecting economic development presented in the discussion and tables of land use and population presented in Appendix A, "Economic Environment of the Eel River Basin."

5/ Includes commercial land developed to serve the needs of the local population and tourists.

TABLE E-15

INVESTIGATION FOR WINDFALL LAND ENHANCEMENT BENEFITS
REACH I, EEL RIVER DELTA

Size of Parcels (Acres)	Number of Owners	Average Value Per Acre 1/		Average Total Benefit Per 3/ Owner	Average Ownership (Acres)	Land Use	
		Pre-Project	15 Years Post-2/ Project			1/ Pre-Project	15 Years Post-Project 1/
Under 10	160	$2,000	$2,500	$ 1,900	6	Low density residential	Moderate density residential
10 - 100	210	1,500	1,800	10,000	55	Very low density residential. Some native and irrigated pasture	Low density residential
100-300	40	1,000	1,200	18,600	150	Native and irrigated pasture. Few agricultural residences	Low density residential Some pasture and row type agricultural crops.
300-500	6	250	270	5,000	410	Vacant and unused with some native pasture	Vacant, unused with some native pasture and reserved for conservation use
500-900	4 4/	200	210	4,600	750	Unusable, vacant and native pasture	Unusable, native pasture and reserved for conservation use
Total	420						

1/ Delta levee system is assumed to be constructed.

2/ Adjusted for flood damages prevented.

3/ Present worth at project year one, discounted 15 years at 3-1/4 percent.

4/ The largest ownership in this reach consists of a marsh and slough area which totals to about 900 acres. The total benefit to this largest land owner is estimated at $5,600.

TABLE E-16

AVERAGE ANNUAL COMMON CARRIER RAILROAD BENEFITS
1967 Prices

Reach	1/ Erosion Damage	2/ Benefits in Percent	3/ Erosion Benefit	Inundation Damage	Residual Damage	3/ Inundation Benefit	3/ Total Railroad Benefit
III	$ 90,000	10	$ 9,000	$ 65,000	$18,000	$ 47,000	$ 56,000
V	200,000	21	41,000	50,000	21,000	30,000	71,000
VI	100,000	50	50,000	35,000	1,000	33,000	83,000
Total	$390,000		$100,000	$150,000	$40,000	$110,000	$210,000

1/ Excludes benefits from railroad protective works consisting of riprapping of crucial river bends.

2/ Estimated percent effectiveness of proposed Dos Rios Reservoir in reducing bank erosion.

3/ Benefits are the same under existing and future conditions.

TABLE E-17

SUMMARY OF AVERAGE ANNUAL FLOOD CONTROL BENEFITS
FUTURE CONDITIONS (1967 Prices)

Reach		Flood Damage Reduction	Railroad	Land Enhancement	Total
		50-Year Life			
I	Delta [1]	$210,000	-	$220,000	$ 430,000
III	Scotia	515,000	$ 56,000	-	571,000
V	Alderpoint	143,000	71,000	-	214,000
VI	Dos Rios	18,000	83,000	-	101,000
	Round Valley [2]	34,000	-	-	34,000
	Total	$920,000	$210,000	$220,000	$1,350,000
		100-Year Life			
I	Delta [1]	$ 235,000	-	$290,000	$ 525,000
III	Scotia	565,000	$ 56,000	-	621,000
V	Alderpoint	156,000	71,000	-	227,000
VI	Dos Rios	18,000	83,000	-	101,000
	Round Valley [2]	36,000	-	-	36,000
	Total	$1,010,000	$210,000	$290,000	$1,510,000

[1] Excludes railroad damages, which are treated separately.

[2] Round Valley would form part of reservoir of proposed project. Therefore, project can be credited with elimination of flood damages.

TABLE E-18

AVERAGE ANNUAL RECREATION BENEFITS

Years After Project Completion	Net Recreation-Days Due to Project	1/ Recreation Benefit (Total)	50-Year 2/ Average Annual Recreation Benefit	2/ 100-Year Analysis Average Annual Recreation Benefit
0				
10	1,000,000	$1,400,000	$ 417,000	$ 349,000
20 3/	1,000,000	1,400,000	303,000	252,000
30	1,000,000	1,400,000	220,000	183,000
40	1,000,000	1,400,000	160,000	133,000
50	1,000,000	1,400,000	70,000	96,000
60	1,000,000	1,400,000		70,000
70	1,000,000	1,400,000		51,000
80	1,000,000	1,400,000		37,000
90	1,000,000	1,400,000		27,000
100	1,000,000	1,400,000		12,000
	Total, average annual benefits		$1,170,000	$1,210,000

1/ Recreation-days times $1.40. The value of recreation day was determined by consideration of the variety of recreation activities, in addition to the quality and aesthetics of the site. The methodology for deviation of value of $1.40 per recreation day is presented in Appendix D, "Recreation, Fish and Wildlife."

2/ Average annual equivalent factors at 3-1/4 percent.

3/ Recreation-days are limited by the capacity of access roads, not by demand or capacity factors. If adequate roads are provided, the true potential of the reservoir could be reached, an estimated 7,000,000 recreation days.

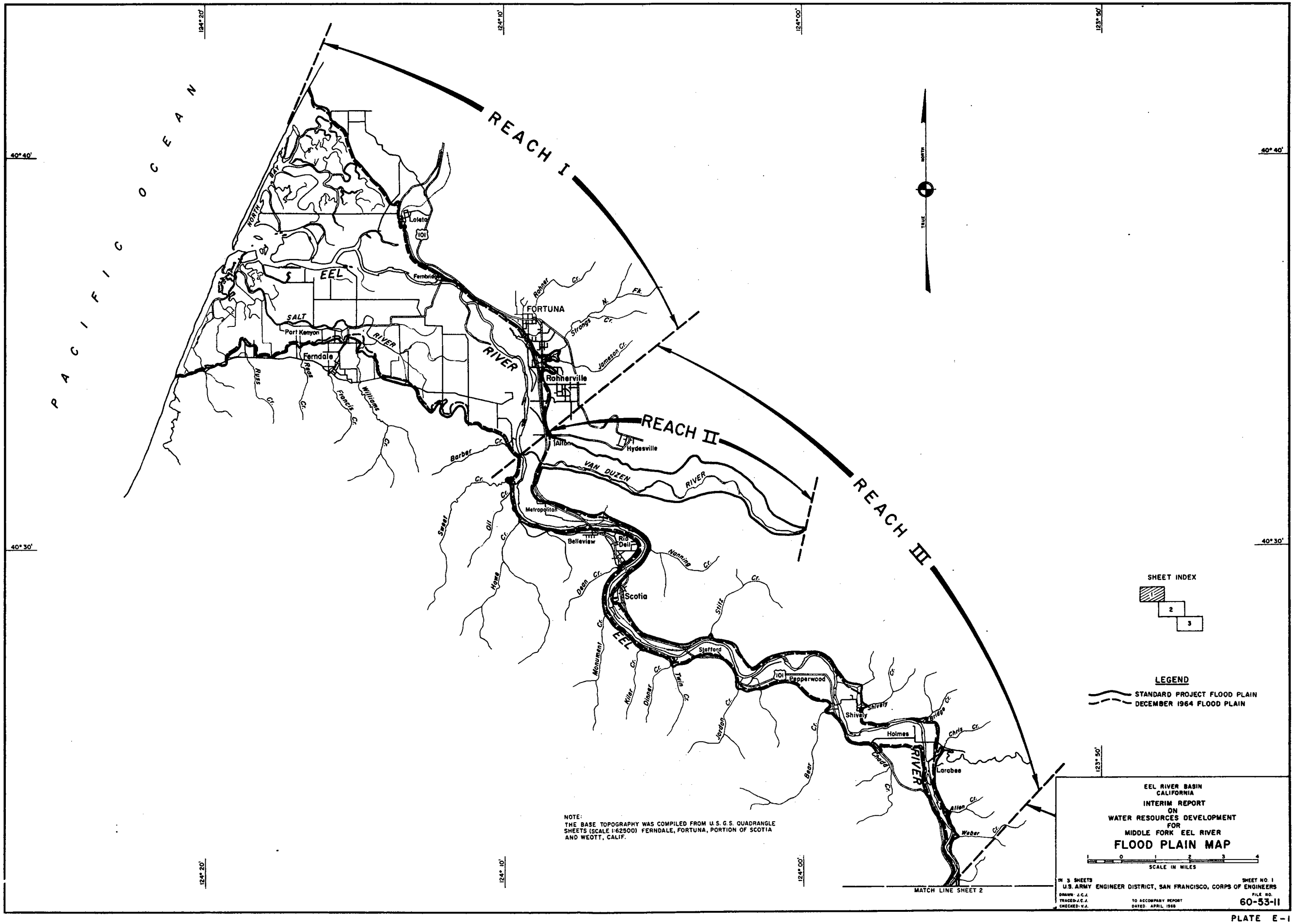

PACIFIC OCEAN
124° 20'
124° 10'
124° 00'
123° 50'
40° 40'
40° 30'
REACH I
REACH II
REACH III
NORTH
TRUE
NORTH BAY
EEL
RIVER
Loleta
101
Fernbridge
Rohner Cr.
FORTUNA
N. Fk.
Strongs Cr.
Jameson Cr.
SALT
Port Kenyon
Ferndale
Rohnerville
Eel
Francis Cr.
Williams Cr.
Berber Cr.
Cr.
Talton
Hydesville
VAN DUZEN
RIVER
Metropolitan
Sprar
Oil
Cr.
Belleview
Rio Dell
Hoaxe
Dean Cr.
Nanning Cr.
Scotia
Shitz
Monument Cr.
Stafford
Kiler
Dinner
Train Cr.
Jordan Cr.
Pepperwood
Shively
Bridge Cr.
Chris Cr.
Holmes
Bear
Eubrad Cr.
Larabee
Allen Cr.
Weber Cr.
MATCH LINE SHEET 2
SHEET INDEX
1
2
3
LEGEND
STANDARD PROJECT FLOOD PLAIN
DECEMBER 1964 FLOOD PLAIN
NOTE:
THE BASE TOPOGRAPHY WAS COMPILED FROM U.S.G.S. QUADRANGLE SHEETS (SCALE 1:62500) FERNDALE, FORTUNA, PORTION OF SCOTIA AND WEOTT, CALIF.
EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER
FLOOD PLAIN MAP
1 0 1 2 3 4
SCALE IN MILES
IN 3 SHEETS
SHEET NO. 1
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS
DRAWN- J.C.C.
TRACED-J.C.C.
CHECKED-V.A.
TO ACCOMPANY REPORT
DATED APRIL 1968
FILE NO.
60-53-11

PLATE E-1

MATCH LINE SHEET 1

40° 20'

40° 10'

40° 00'

123° 50'

123° 40'

123° 30'

123° 20'

Bull Cr.

Decker Cr.

South Fork

Camp Grant

Weott

101

Mc Cann

Elkhorn Cr.

Devils Cr.

Whitlow P.O.

Tanoak

Smith

Beatty Cr.

Stevens Cr.

EEL

Coleman Cr.

Eel Rock

Oak Glen

REACH IV

South Fork

Canoe Cr.

EEL

RIVER

Meyers Flat

NORTHWESTERN PACIFIC

Brock Creek

Basin Cr.

Conley Cr.

Dobbyn Cr.

Fort Seward

RIVER

REACH V

South Dobbyn Cr.

Blocksburg Ranger Sta.

Alderpoint

Carter Cr.

Steelhead

Steelhead Cr.

Mill Cr.

Cain Rock

Tichnor Cr.

Homann Cr.

EEL

NORTHWESTERN PACIFIC

Kekawaka

Kekawaka Cr.

Jewett Cr.

Pine Cr.

Boulder Cr.

Chamise Cr.

RIVER

Tunnel Cr.

Island Mountain

Pine Cr.

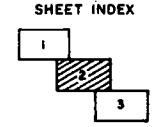
Willow Cr.

MATCH LINE SHEET 3

NOTE:
THE BASE TOPOGRAPHY WAS COMPILED FROM U.S.G.S. QUADRANGLE SHEETS (SCALE 1:62500) PORTION OF WEOTT AND BLOCKSBURG. ALDERPOINT AND KETTENPOM, CALIF.

NORTH
TRUE

SHEET INDEX



LEGEND

STANDARD PROJECT FLOOD PLAIN

DECEMBER 1964 FLOOD PLAIN

EEL RIVER BASIN
CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

FLOOD PLAIN MAP

SCALE IN MILES

IN 3 SHEETS

SHEET NO. 2

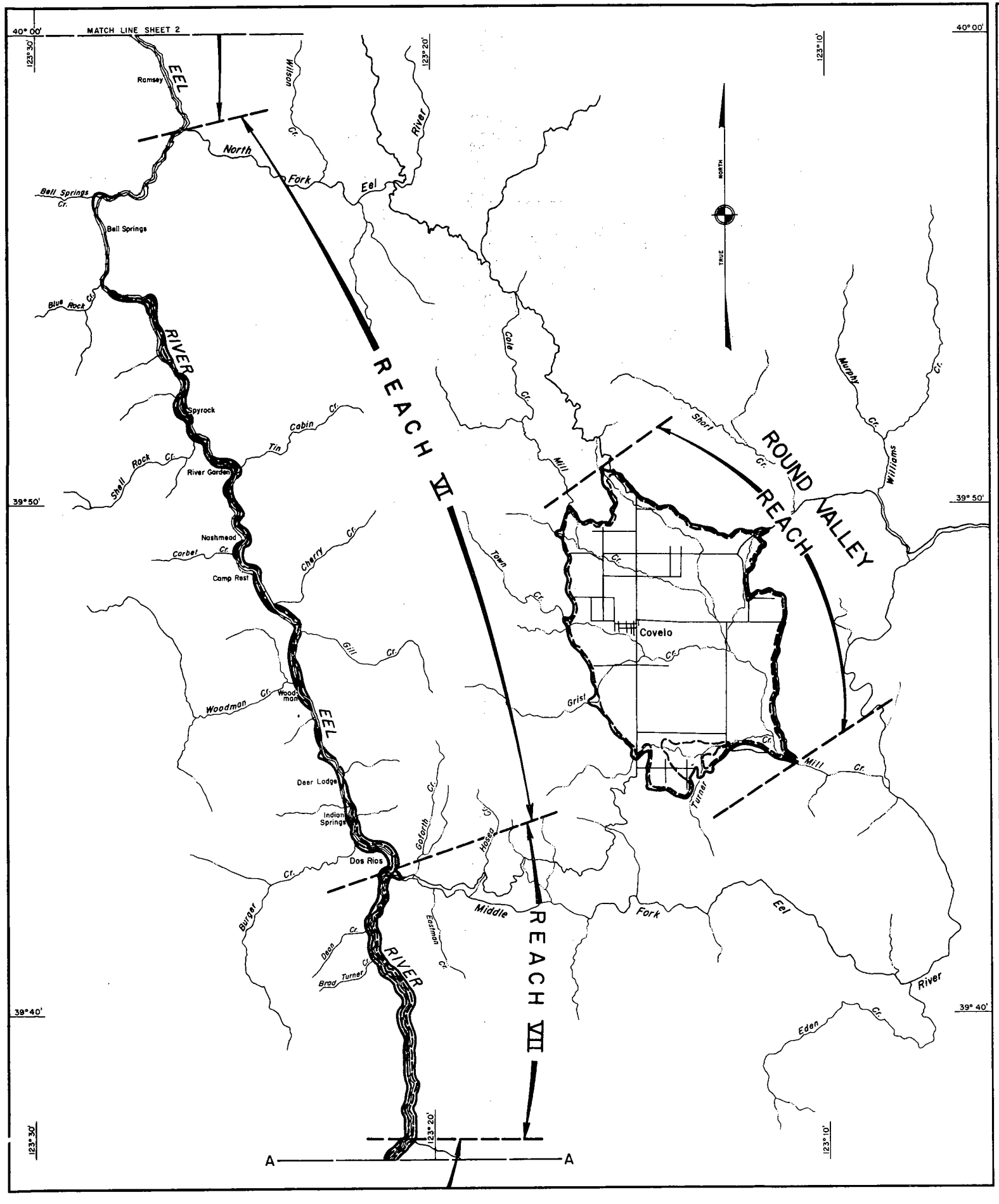
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS

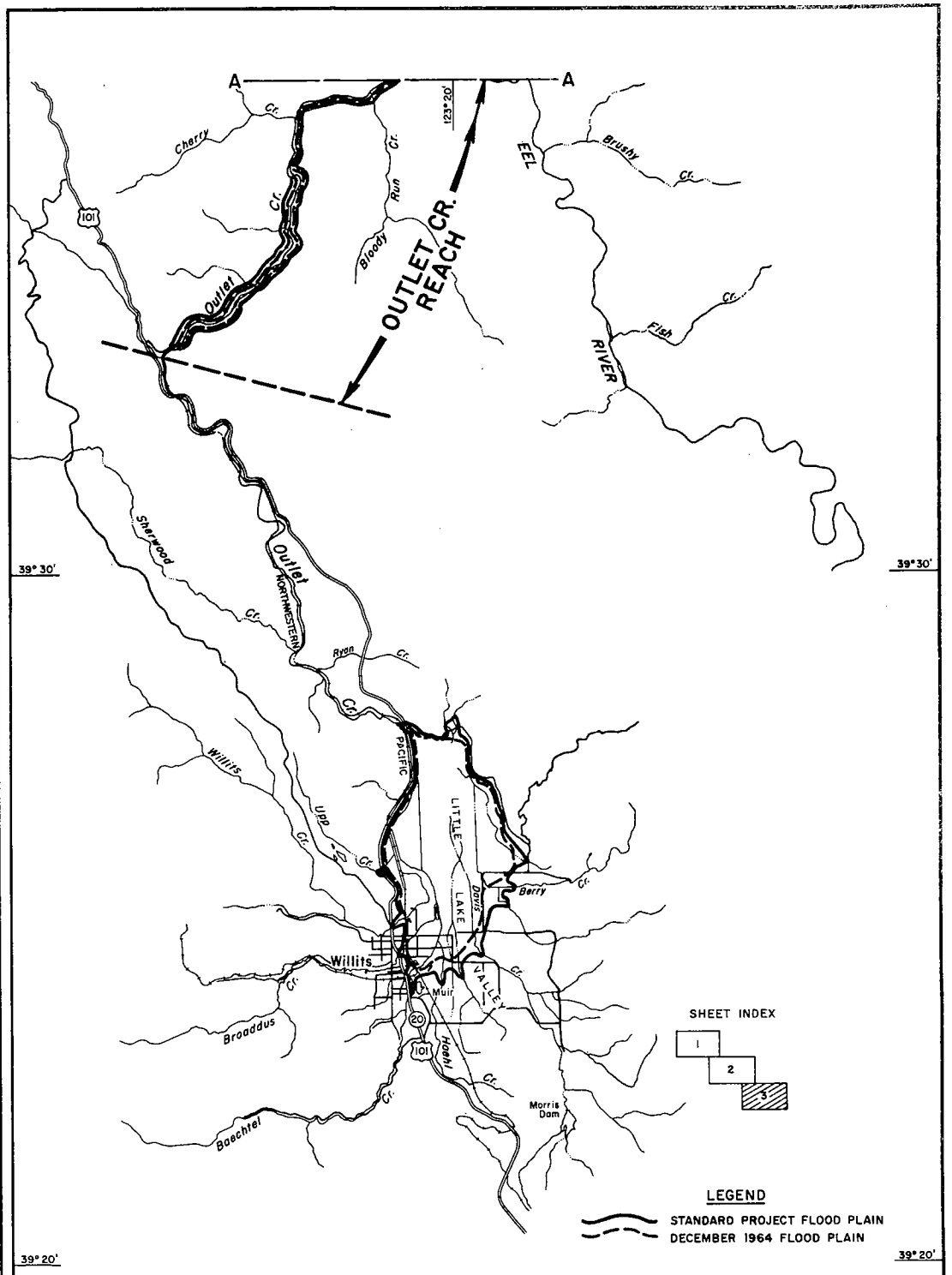
DRAWN: J.C.J.
TRACED: J.C.J.
CHECKED: V.L.

TO ACCOMPANY REPORT
DATED: APRIL 1965

FILE NO.
60-53-11

PLATE E-2





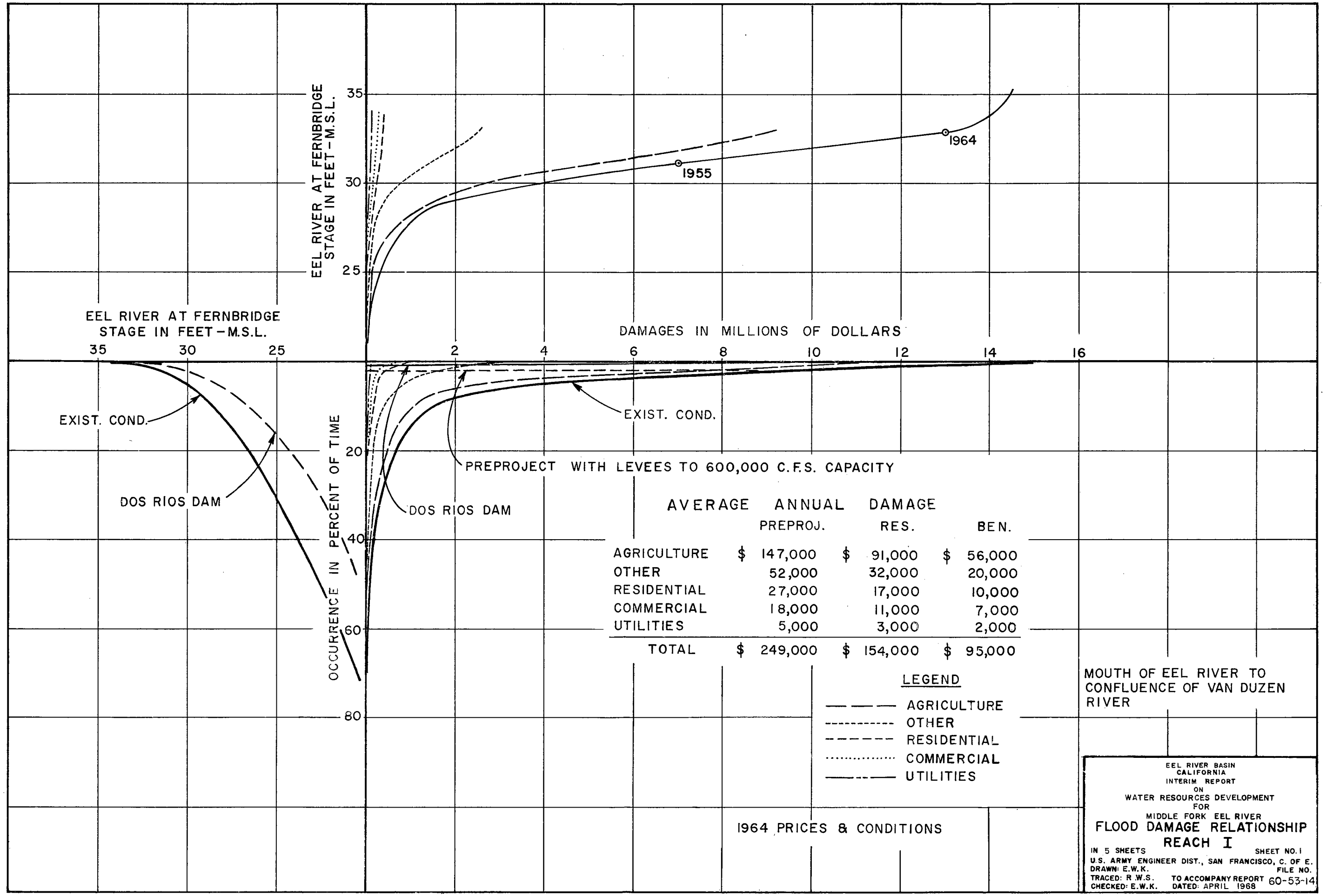
NOTE:
THE BASE TOPOGRAPHY WAS COMPILED FROM U.S.G.S. QUADRANGLE SHEETS (SCALE 1:62500) SPYROCK, COVELO, LAYTONVILLE, EDEN VALLEY AND WILLITS, CALIF.

EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER
FLOOD PLAIN MAP

SCALE IN MILES 0 1 2 3 4

IN 3 SHEETS
SHEET NO. 3
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS
DRAWN- J.C.J.
TRACED-J.C.J.
CHECKED-V.J.
TO ACCOMPANY REPORT DATED APRIL 1966
FILE NO. 60-53-11

PLATE E-3



AVERAGE ANNUAL DAMAGE

	PREPROJ.	RES.	BEN.
AGRICULTURE	$ 147,000	$ 91,000	$ 56,000
OTHER	52,000	32,000	20,000
RESIDENTIAL	27,000	17,000	10,000
COMMERCIAL	18,000	11,000	7,000
UTILITIES	5,000	3,000	2,000
TOTAL	$ 249,000	$ 154,000	$ 95,000

LEGEND

- AGRICULTURE
- OTHER
- RESIDENTIAL
- COMMERCIAL
- UTILITIES

1964 PRICES & CONDITIONS

MOUTH OF EEL RIVER TO CONFLUENCE OF VAN DUZEN RIVER

EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

FLOOD DAMAGE RELATIONSHIP REACH I

IN 5 SHEETS SHEET NO. 1
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C. OF E.
DRAWN: E.W.K. FILE NO.
TRACED: R.W.S. TO ACCOMPANY REPORT 60-53-14
CHECKED: E.W.K. DATED: APRIL 1968

PLATE E-4

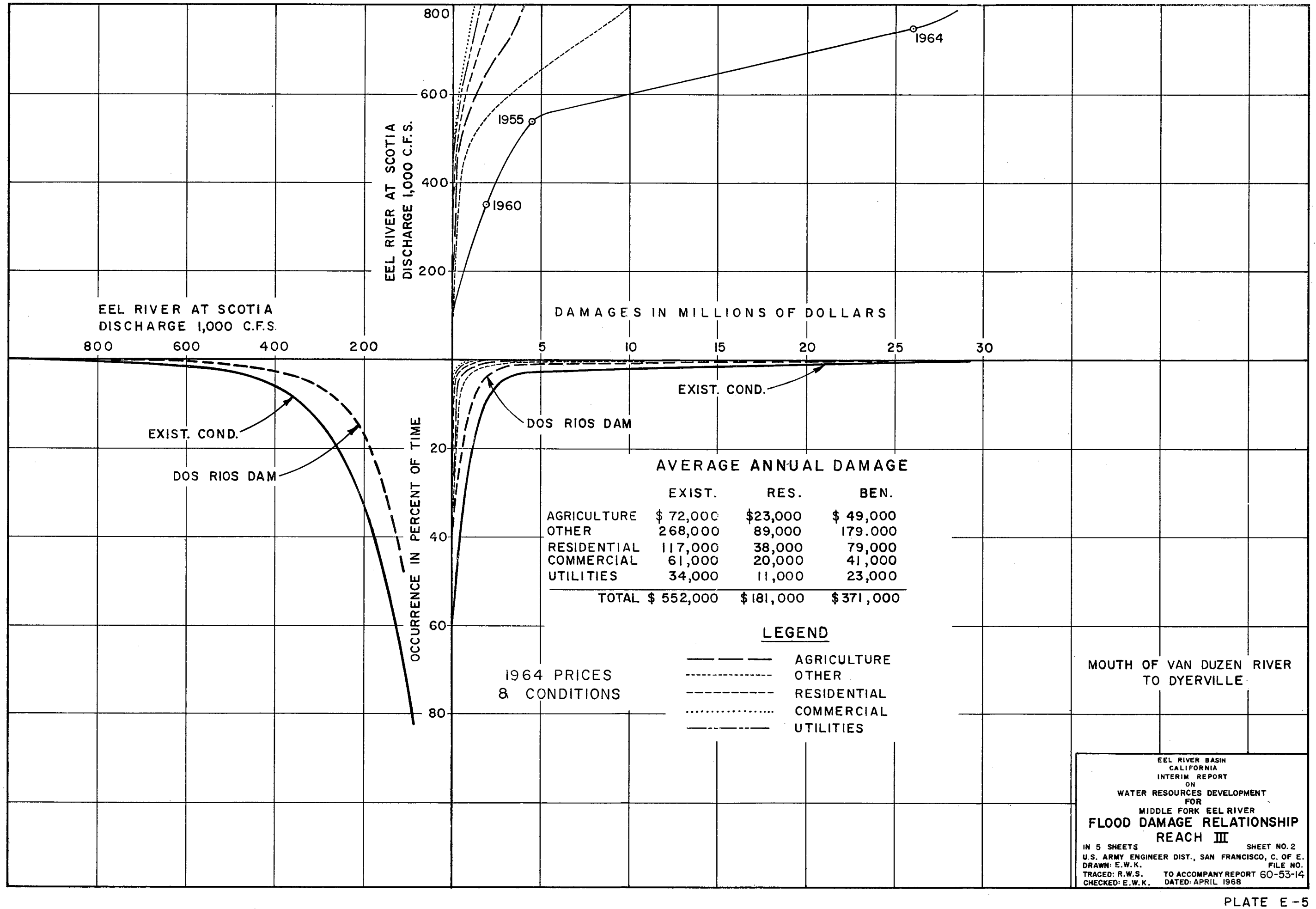
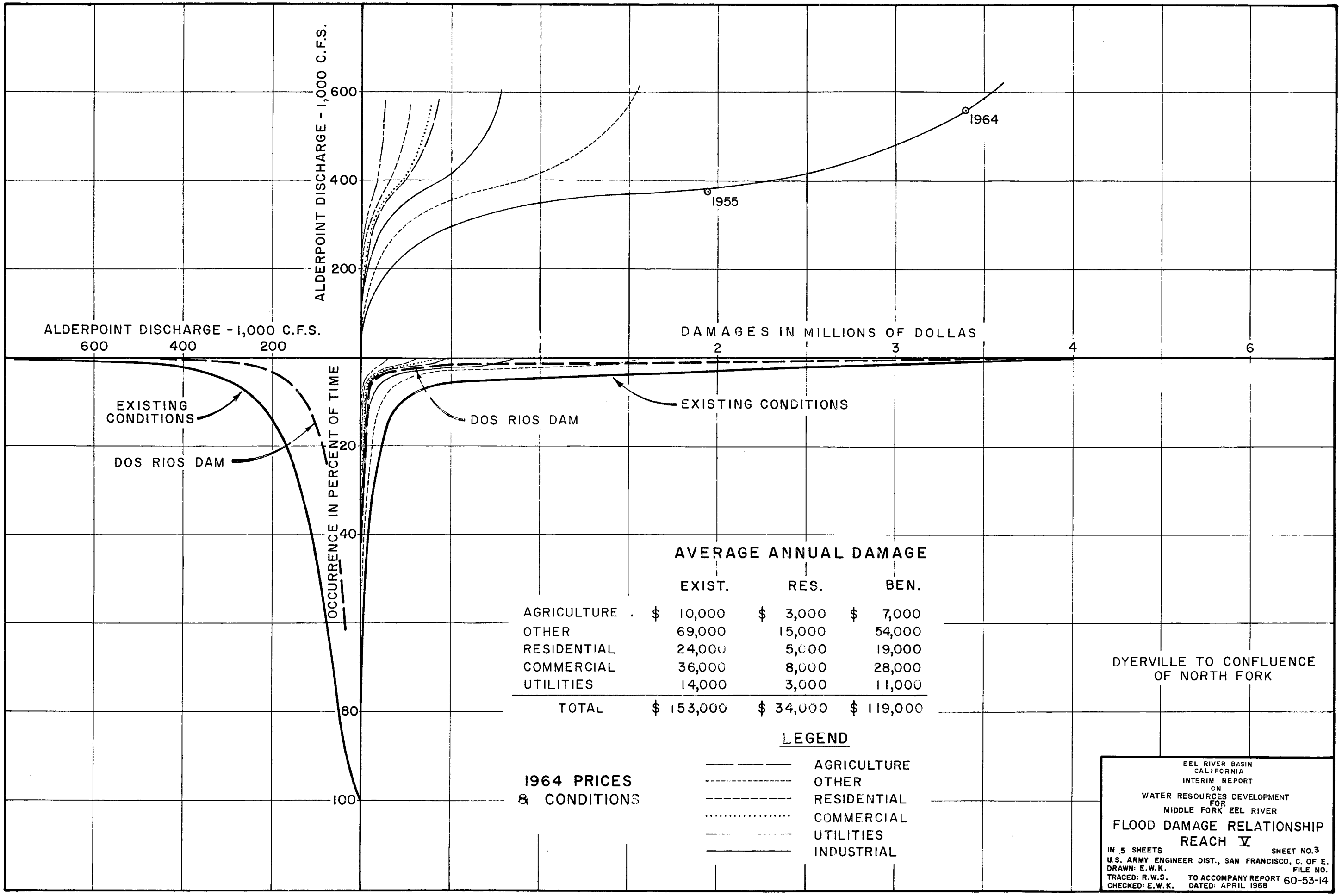

EEL RIVER AT SCOTIA
DISCHARGE 1,000 C.F.S.
800
600
400
200
1964
1955
1960
DAMAGES IN MILLIONS OF DOLLARS
5
10
15
20
25
30
EEL RIVER AT SCOTIA
DISCHARGE 1,000 C.F.S.
800
600
400
200
EXIST. COND.
DOS RIOS DAM
OCCURRENCE IN PERCENT OF TIME
20
40
60
80
EXIST. COND.
DOS RIOS DAM
AVERAGE ANNUAL DAMAGE
EXIST. RES. BEN.
AGRICULTURE $ 72,000 $23,000 $ 49,000
OTHER 268,000 89,000 179.000
RESIDENTIAL 117,000 38,000 79,000
COMMERCIAL 61,000 20,000 41,000
UTILITIES 34,000 11,000 23,000
TOTAL $ 552,000 $181,000 $371,000
LEGEND
AGRICULTURE
OTHER
RESIDENTIAL
COMMERCIAL
UTILITIES
1964 PRICES
& CONDITIONS
MOUTH OF VAN DUZEN RIVER
TO DYERVILLE
EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER
FLOOD DAMAGE RELATIONSHIP
REACH III
IN 5 SHEETS
SHEET NO. 2
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C. OF E.
DRAWN: E.W.K.
FILE NO.
TRACED: R.W.S.
TO ACCOMPANY REPORT 60-53-14
CHECKED: E.W.K.
DATED: APRIL 1968

PLATE E-5



AVERAGE ANNUAL DAMAGE

	EXIST.	RES.	BEN.
AGRICULTURE	$ 10,000	$ 3,000	$ 7,000
OTHER	69,000	15,000	54,000
RESIDENTIAL	24,000	5,000	19,000
COMMERCIAL	36,000	8,000	28,000
UTILITIES	14,000	3,000	11,000
TOTAL	$ 153,000	$ 34,000	$ 119,000

1964 PRICES
& CONDITIONS

LEGEND

- AGRICULTURE
- OTHER
- RESIDENTIAL
- COMMERCIAL
- UTILITIES
- INDUSTRIAL

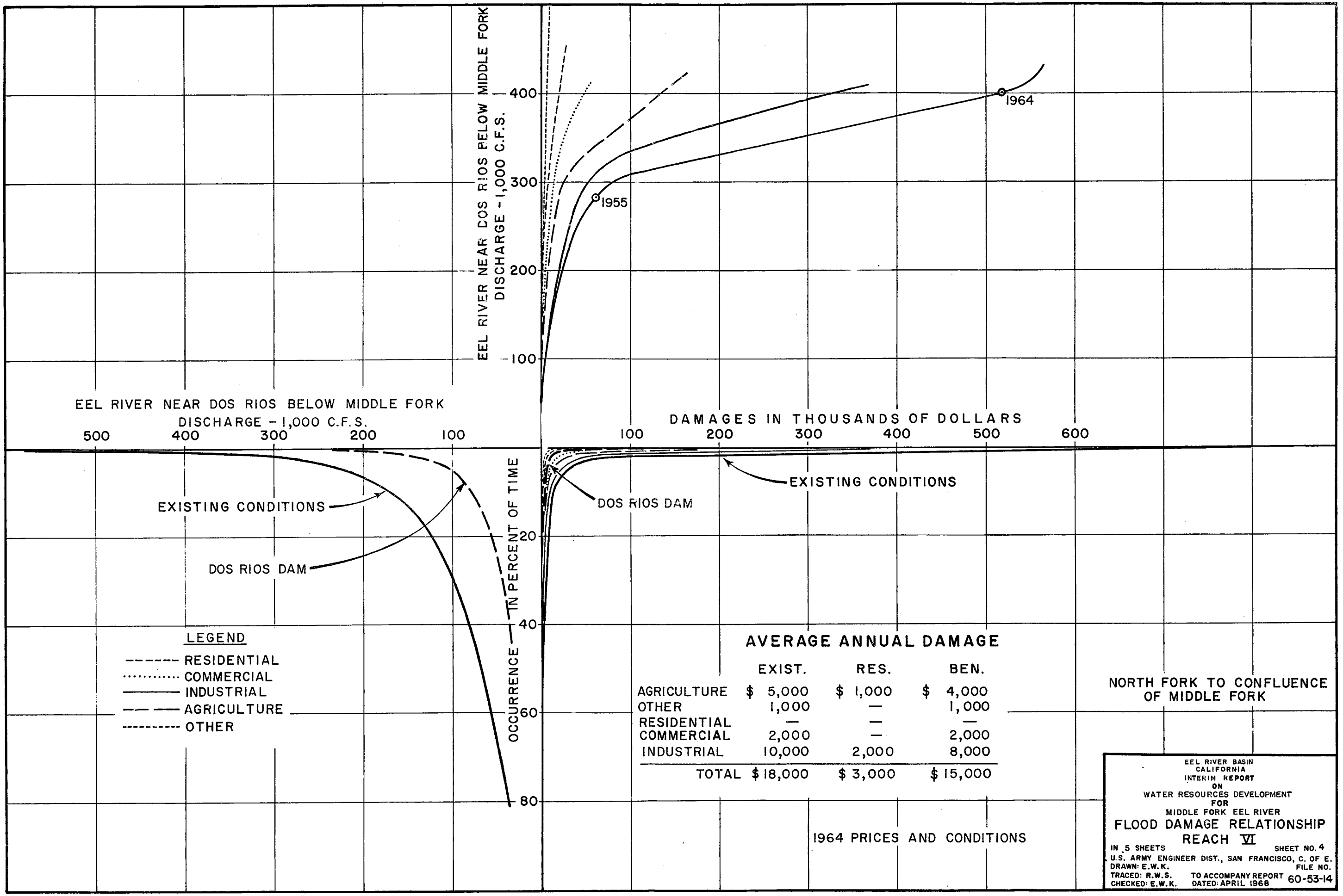
DYERVILLE TO CONFLUENCE OF NORTH FORK

EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

FLOOD DAMAGE RELATIONSHIP
REACH V

IN 5 SHEETS SHEET NO. 3
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C. OF E.
DRAWN: E.W.K. FILE NO.
TRACED: R.W.S. TO ACCOMPANY REPORT 60-53-14
CHECKED: E.W.K. DATED: APRIL 1968

PLATE E-6



AVERAGE ANNUAL DAMAGE

	EXIST.	RES.	BEN.
AGRICULTURE	$ 5,000	$ 1,000	$ 4,000
OTHER	1,000	—	1,000
RESIDENTIAL	—	—	—
COMMERCIAL	2,000	—	2,000
INDUSTRIAL	10,000	2,000	8,000
TOTAL	$ 18,000	$ 3,000	$ 15,000

NORTH FORK TO CONFLUENCE OF MIDDLE FORK

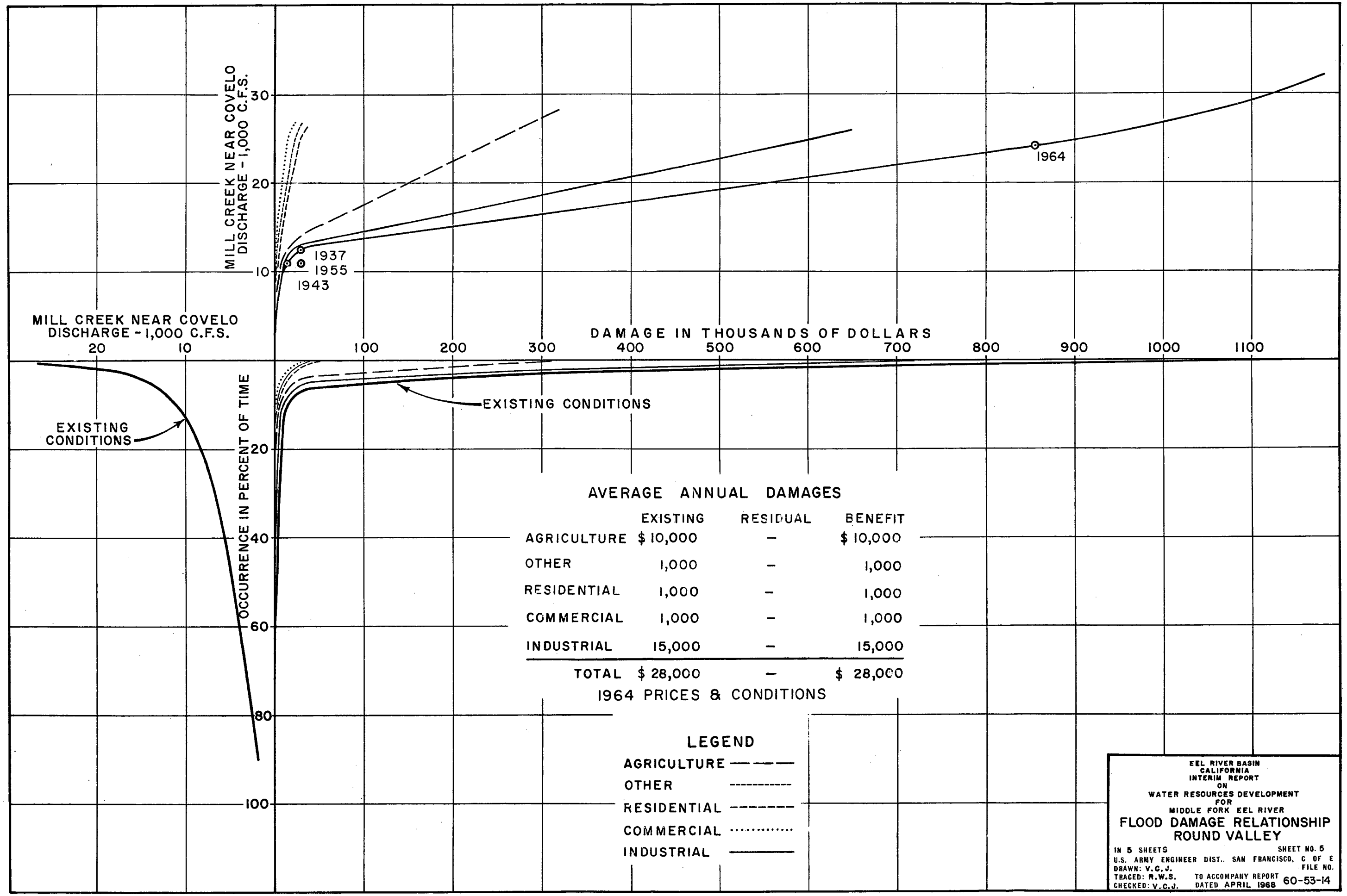
1964 PRICES AND CONDITIONS

EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

FLOOD DAMAGE RELATIONSHIP REACH VI

IN 5 SHEETS — SHEET NO. 4
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C. OF E.
DRAWN: E.W.K. — FILE NO.
TRACED: R.W.S. — TO ACCOMPANY REPORT
CHECKED: E.W.K. — DATED: APRIL 1968
60-53-14

PLATE E-7



AVERAGE ANNUAL DAMAGES

	EXISTING	RESIDUAL	BENEFIT
AGRICULTURE	$ 10,000	–	$ 10,000
OTHER	1,000	–	1,000
RESIDENTIAL	1,000	–	1,000
COMMERCIAL	1,000	–	1,000
INDUSTRIAL	15,000	–	15,000
TOTAL	$ 28,000	–	$ 28,000

1964 PRICES & CONDITIONS

LEGEND

AGRICULTURE — — —
OTHER ----------
RESIDENTIAL --------
COMMERCIAL ·····
INDUSTRIAL ———

EEL RIVER BASIN
CALIFORNIA
INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

FLOOD DAMAGE RELATIONSHIP ROUND VALLEY

IN 5 SHEETS — SHEET NO. 5
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: V.C.J. — FILE NO.
TRACED: R.W.S. — TO ACCOMPANY REPORT
CHECKED: V.C.J. — DATED APRIL 1968 — 60-53-14

PLATE E-8

EEL RIVER BASIN, CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

APRIL 1968

APPENDIX F

PROJECT FORMULATION
PLAN OF IMPROVEMENT, COSTS,
COST ALLOCATIONS AND APPORTIONMENT OF COSTS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLES

EEL RIVER BASIN, CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

APRIL 1968

APPENDIX F

PROJECT FORMULATION, PLAN OF IMPROVEMENT, COSTS, COST ALLOCATIONS AND APPORTIONMENT OF COSTS

INTRODUCTION

F-1. PURPOSE

The purpose of this appendix is to present the details of the plan of improvement, the estimated first costs and annual charges, the allocation of those costs to the several purposes for which the project is formulated, and apportionment of cost between Federal and non-Federal interests.

F-2. SCOPE

The scope of this appendix includes the general aspects of a number of alternative projects in the Eel River Basin which were studied in the formulation process of evolving a recommended plan of improvement. Formulation and sizing studies pertinent to the recommended plan of improvement are presented in the main report. This appendix also includes the details and cost estimates of the Dos Rios Dam and Reservoir and appurtenant works, including recreation facilities and conveyance works for exporting water out of the basin. Allocation of costs and apportionment of costs between Federal and non-Federal interests are limited to the recommended plan of improvement herein.

F-3. SPECIAL PROBLEMS

Areas inundated by the proposed reservoir include Indian tribal and allotted lands and the town of Covelo. They are interrelated as the town provides public and private service facilities for the Indian community. It is proposed that lands be exchanged on the Indian ownerships to provide residence adjacent to the reservoir. It is also proposed that the town of Covelo be resettled next to the reservoir to provide similar services to the Indian community and also provide supporting services to proposed recreation developments. The matters are discussed in subsequent paragraphs of this appendix.

POTENTIAL AND ALTERNATIVE PROJECTS

F-4. AUTHORIZED DELTA LEVEES

House Document No. 234, 89th Congress, 1st Session, summarizes information on potential projects for water resource development in the Eel River Basin. During the current investigation several changes in project concepts and consideration of additional projects developed. The authorized Delta levees of the lower Eel River, recommended for construction in House Document No. 234, were designed to provide a channel and floodway capacity of 600,000 cubic feet per second, which was approximately equal to the peak of the December 1955 flood, the maximum of record at that time, with an estimated one percent chance of occurrence. The related standard project flood peak was estimated as 710,000 cubic feet per second. It was considered that the effect of spillway surcharge storage at contemplated future reservoir projects in the upper Eel River would reduce the standard project flood peak in the Delta area to about 600,000 cubic feet per second. Under future conditions, therefore, the Delta levee project would have provided protection approaching the standard project flood. The December 1964 flood peak of 840,000 cubic feet per second exceeded the previously derived standard project flood by an appreciable amount. The standard project flood peak, as presently determined, is 920,000 cubic feet per second in the Delta. Advance planning studies to date for the authorized levee project indicate that it would not be prudent to provide flood protection for any flow less than the 1964 historical flood and that this degree of protection can be accomplished in the most economical manner by a combination of levees and flood control storage in a reservoir on the lower Eel River or in the proposed Dos Rios and potential English Ridge reservoirs, the latter presently under study by the U.S. Bureau of Reclamation. The Dos Rios project would reduce the December 1964 discharge of 840,000 cubic feet per second in the Delta to 650,000 cubic feet per second and the standard project flood from 920,000 to 710,000 cubic feet per second. In combination, Dos Rios and English Ridge projects would reduce the standard project flood to 640,000 cubic feet per second and December 1964 to 580,000 cubic feet per second in the Delta area. It was found, also, that the costs for levees in the Delta increased rapidly for discharges above 600,000 cubic feet per second because of relocation of a main highway and a railroad. In analyses made herein, it has been assumed that the Delta levees would be constructed to contain the flow of 600,000 cubic feet per second as a maximum, and benefits were evaluated accordingly. Location of authorized levees and potential reservoirs are shown on Plate 2 of the main report.

F-5. RESERVOIR SYSTEM

The basic reservoir system considered in House Document No. 234 consisted, starting downstream, of Sequoia, Bell Springs and English Ridge Reservoirs on the main Eel River. Water would he pumped upstream from Sequoia to Bell Springs to English Ridge. Dos Rios Reservoir or other reservoirs were proposed on the Middle Fork Eel River and these reservoirs were primarily alternatives to English Ridge Reservoir. Gravity tunnel conveyance of water from a Middle Fork Reservoir or English Ridge Reservoir into the Sacramento Valley Basin completed the basic system. Subsequent studies by State and other Federal agencies have been concurrent with investigations related to this report. Later paragraphs in this appendix reflect the findings of these studies. With the exception of those on Middle Fork, annual yield figures cited for Eel River projects reflect amounts resulting from runoff from incremental drainage areas between the projects and were estimated by the State of California.

F-6. SEQUOIA PROJECT

This multiple-purpose reservoir, as considered in House Document No. 234, would be located on the main stem of the Eel River about one mile upstream from the community of Sequoia. The dam would be about 610 feet in height, would control a drainage area of about 2,400 square miles, would have a storage capacity of 5,000,000 acre-feet, and would be capable of developing 800,000 acre-feet of annual firm yield. It would impound tributary runoff, and surplus waters would be pumped upstream into the Bell Springs Reservoir. In-basin water releases were assumed to be used to produce hydroelectric power. Current geologic studiesindicate a structure at this site would encounter unreasonable economic costs for heights above 500 feet. The reservoir formed by a 500-foot dam would have a gross capacity of about 3.2 acre-feet with a corresponding yield of about 500,000 acre-feet. It would be necessary to make a major relocation of about 100 miles of the Northwestern Pacific Railroad which traverses the main stem of the Eel. The relatively high cost for this relocation combined with the limited amount of storage which can be developed and the added pumping required would result in a cost of water for export out of the basin greater than that from other more suitable sites located further upstream.

F-7. BELL SPRINGS PROJECT

The Bell Springs Dam and multiple-purpose reservoir in House Document No. 234 was to be located on the main stem of the Eel River, about 5 miles south of the Mendocino-Humboldt County Line. It would impound runoff and serve as a means of transporting water pumped from Sequoia Reservoir to English Ridge. Surplus waters would be pumped into English Ridge Reservoir and the South Fork Eel River, the latter

for within-basin use. Transfer of water into English Ridge could be either direct or through Dos Rios Reservoir. Mandatory waters released downstream from Bell Springs were considered for usage as a producer of hydroelectric power within the basin. The Bell Springs Dam, about 550 feet high, with a storage capacity of 1.3 million acre-feet could develop 500,000 acre-feet of water supply yield and would also require major railroad relocation. Current geologic findings, conducted during the study phases of this report, indicate that it would be extremely doubtful that a structure, over 200 feet high could be developed economically at the Bell Springs site. An appraisal of the geology of Island Mountain and Willow damsites, alternatives to Bell Springs, revealed slide conditions of abutments of such magnitude that it would not be economically feasible to build a structure. No further study was thereafter undertaken.

F-8. THE YELLOW JACKET PROJECT

The Yellow Jacket damsite and Upper Sequoia Reservoir, designated in House Document No. 234 as the Brock Creek Reservoir, would be located about ten miles upstream from Sequoia damsite and about 2.5 miles downstream from the town of Fort Seward, and was considered as an alternative to the Sequoia project. In the foundation area of the dam, the river flows in an east-west direction through a narrow, steep-walled canyon, then makes a sharp bend to the north about 2,000 feet downstream from the dam axis. This affords a favorable offsite location for diversion and outlet tunnel and spillway. At the dam axis, the river channel is about 250 feet wide and both abutments rise on average slope of 25 to 30 degrees. The site appears to be capable of accommodating an earth or rock-fill dam up to a maximum height of 750 feet. This structure would create a reservoir with a gross capacity of about 10,000,000 acre-feet and a maximum water surface elevation of 1,000 feet. As in the case of the other main stem reservoirs a major relocation of the Northwestern Pacific Railroad would be required. Yield from the reservoir would approximate that obtainable at the Sequoia site. Based on available information, this damsite appears superior to the Sequoia damsite.

F-9. SOUTH FORK EEL RIVER PROJECTS

The Branscomb and Streeter projects located on the upper South Fork near Branscomb and on Ten Mile Creek near Laytonville, respectively, were considered in House Document No. 234 as likely developments for multiple-purpose use, particularly recreation. Recent studies conducted during this report investigation, which evaluated multiple-purpose projects at the above sites, other potential sites, and local protection works, have shown flood protection cannot be economically justified on the South Fork Eel River. The California Department of Water Resources in its reconnaissance study of recreation reservoirs in the Upper South

Fork Basin reports that economic justification could not be demonstrated for single-purpose recreation reservoirs. Evacuation and flood plain management are currently being investigated at Weott and Myers Flat on the South Fork and at Pepperwood on the Eel River below the South Fork, in cooperation with the California Department of Beaches and Parks. That agency is conducting real estate appraisals exploring the possibility of exchanging State lands for lands within the flood plains. However, to date, local interests and residents have expressed very little interest in this type of project.

F-10. ENGLISH RIDGE PROJECT

This multiple-purpose reservoir would be located on the upper main stem of the Eel River in Mendocino County, about 20 miles northeast of Willits. It would impound tributary runoff and also serve as a means of transportating stored runoff or water pumped from downstream reservoirs into conveyance tunnels for "out-of-basin" use. However, English Ridge could be a separate project as noted in the report prepared recently by the State on route selection for water conveyance facilities. Conservation water for export use would be diverted by gravity through the Garrett Tunnel for use in the Clear Lake area and Putah and Cache Creek Basins. The U.S. Bureau of Reclamation is presently studying the English Ridge site and its investigation is scheduled for completion in late 1969. Investigation has indicated that the English Ridge site is suitable for construction of a dam about 550 feet high with a reservoir capacity and a yield available for export of about 1,800,000 and 200,000 acre-feet, respectively. In the Bureau of Reclamation plan, delivery of water from English Ridge into the Central Valley would entail construction of extensive conveyance facilities to Clear Lake and Lake Berryessa and channelization of Putah Creek before introduction into the Central Valley could be effected. During the past 50 years, the Russian River Basin, adjacent and southerly, has received about 180,000 acre-feet of water annually from the English Ridge drainage basin via private power developments.

F-11. MIDDLE FORK EEL RIVER

Two basin concepts were considered for the development of the Middle Fork Eel River. One plan would include utilizing Round Valley and its tributary area for reservoir storage and the other plan considered protecting Round Valley from inundation. Projects considered in House Document No. 234 as having potential development capability on the Middle Fork were dams at the Spencer, Franciscan, Etsel, Dos Rios and Jarbow sites. In view of the complex and unstable nature of the geology of the area, the structural suitability of the damsites was of paramount importance in both structural and economic selection of a final proposed project plan. Geologic studies and explorations of potential Middle Fork sites were undertaken through a cooperative Corps of Engineers-California State Department of Water Resources exploration program.

F-12. THE SPENCER-FRANCISCAN PROJECT

The Spencer site is located on the Middle Fork about six miles east of Covelo. It is the furthermost upstream damsite for development of a major Middle Fork reservoir. Construction of Franciscan Dam on Short Creek at the entrance to Round Valley would be required to protect Round Valley and to develop additional reservoir storage. A dam 380 feet high at the Spencer site would impound a reservoir of limited capacity of about 850,000 acre-feet and would not flood Round Valley. Geologic investigations of the Spencer and Franciscan sites revealed that they are located in a major regional shear zone. The abutments have extensive slides and the foundation materials are of very poor structural character. Investigations indicated that construction of dams of sufficient height to provide reasonable reservoir storages, if geologically possible, would very likely be of prohibitive cost. An alternative to the Franciscan site, Wailaki, is situated in a low saddle between the Middle Fork Eel River and Short Creek Basins. Investigations of this site indicated poor geological conditions similar to the Franciscan site.

F-13. THE ETSEL-FRANCISCAN PROJECT

The two Etsel sites (lower and upper) are located on the Middle Fork Eel River about three miles downstream from of the Spencer damsite. The Etsel reservoir would be an alternative to Spencer reservoir and would likewise require construction of Franciscan or Wailaki Dam. Etsel reservoir would provide considerably more storage than Spencer reservoir. A dam 430 feet high at either of the Etsel sites would impound a reservoir of about 1,400,000 acre-feet. Extensive geological investigations at the upper Etsel site revealed equally poor foundation conditions similar to the Spencer or Franciscan sites. The major difficulty with this site is the presence of a massive landslide that occupies most of the left abutment area. Therefore, the Upper Etsel site was determined to be infeasible for construction of a large dam. The lower site was abandoned due to landslide conditions on both abutments. Development of a feasible damsite in the Etsel area, therefore, is considered noncompetitive economically in view of the geologic complexities involved.

F-14. THE JARBOW PROJECT

The Jarbow damsite is located on the Middle Fork Eel River about four miles upstream from the Dos Rios site. This project was initially considered as a possible alternative to Dos Rios. However, field investigations indicate a substantial portion of the foundation area is underlain by structurally incompetent material. Possible combinations of the Middle Fork projects included a low Dos Rios, or Jarbow, Dam, in combination with either Spencer or Etsel reservoirs and Franciscan or Wailaki reservoirs. The cost of development, however, showed that a high dam at Dos Rios with large storage would be more favorable when comparable benefits were produced.

F-15. THE DOS RIOS PROJECT - LOW DAM

This project was considered primarily in conjunction with other upstream reservoirs for full development of the Middle Fork Eel River without flooding the Round Valley area. Elimination of the feasibility of upstream reservoirs, in effect, preclude further consideration of this project. With other upstream developments, the project presented a potential for accomplishing one or more purposes: flood control, water supply, recreation and hydropower as an afterbay unit. Maximum reservoir water surface was about elevation 1,325 feet, controlled by Mill Creek exit from Round Valley. This provided potential control over about 320 square miles below both the Spencer-Franciscan Project and the Etsel-Franciscan Project. Thus, potential development of the incremental runoff, averaging about 300,000 acre-feet annually for water supply was possible. The dam would be about 400 feet high with gross reservoir storage of 550,000 acre-feet. After a minimum allowance of 150,000 acre-feet for sedimentation and slide potential, active storage would be 400,000 acre-feet. As a single Middle Fork Eel River development, the low dam would develop less than 100,000 acre-feet in excess of fishery and local requirements and, thus, would fail to optimize development of water resources for the tributary drainage area which involves, on the average, about one million acre-feet of runoff annually. During extremely high floods, such as that of December 1964, storm runoff has been as high as 800,000 acre-feet for the single flood, being equivalent to about 80 percent of the average annual runoff. Also, the transport system for export of water from the basin would require about 25 miles of tunnel, or a major pumping cost in conjunction with over 20 miles of tunnel. With the conclusion that the Dos Rios site offered the only feasible site on the Middle Fork, a low dam would fail significantly in optimizing the water resources potential of the basin for meeting Statewide needs for various purposes, further consideration of such a project was abandoned.

F-16. THE MAXIMUM DOS RIOS PROJECT - RESERVOIR EXCLUDING ROUND VALLEY AREA

Preliminary analyses indicated that this project could provide all the purposes of the adopted project but to a lesser extent. The potential for flood control, and hydropower would be about identical; much of the potential for future extensive recreation development would be eliminated; and, the water supply yield, which would be produced with Round Valley flooded, would be reduced by almost 50 percent. This project had the obvious advantages of not flooding about 18,000 acres of flat valley land, plus limited disturbance to Indian lands. The disadvantages were that major dams on Mill Creek and Short Creek plus a major valley drainage facility with a ponding area would be required to preserve Round Valley. The reduced water supply development could be duplicated at a greatly increased cost by transporting water from a downstream reservoir such as Yellow Jacket. Reservoir storage at the Sacramento Valley end of a greatly enlarged export tunnel from the Middle Fork also might permit increased water supply development.

F-17. The elevation of the maximum water surface in the reservoir would be essentially the same as the adopted project (elevation 1,602 feet) with liberal assumptions on engineering and geologic conditions at Mill Creek and Short Creek. The plan considered, therefore, had a 730-foot high main dam at Dos Rios, a 325 foot-high dam at Mill Creek and a 250-foot high dam at Short Creek. Gross reservoir storage would be about 3,400,000 acre-feet assigned as follows: flood control, 500,000 acre-feet; minimum pool, 1.5 million acre-feet; and water supply storage, 1,400,000 acre-feet. Annual yield for water supply measured at the reservoir site would be about 350,000 acre-feet. A 15-foot diameter transbasin export tunnel, about 20 miles long, would be required. Fishery releases and a hatchery would be the same as that required for the adopted project, but lands for mitigation of wildlife losses could be reduced to about 4,000 acres. Indian land exchange costs were estimated at 20 percent of those associated with flooding Round Valley.

F-18. The blocking of Mill Creek would require a drainage system from Round Valley to a point below Dos Rios damsite. Drainage from 85 square miles must be considered. The standard project flood with an estimated discharge of 26,000 cubic feet per second and with a related runoff volume of 75,000 acre-feet was adopted for the analysis. Designs based on floods of lesser peaks and volumes of runoff would pose substantial residual damage potential for the floods exceeding such designs and could result in damage claims if a "foreseen" flood occurred but was not provided for. The volume of runoff and topography dictated a ponding area with volume enlargement by excavation. Studies of costs for various combbinations of drain size and entrance sump areas resulted in the selection of a 10-foot diameter drain about five miles long with a sump and ponding area of about 4,000 acres. For tunnel sizes less than 10 feet in diameter, costs would not decrease appreciably while ponding area requirements would increase substantially.

F-19. Comparison of costs between the proposed reservoir project and the one to prevent flooding of Round Valley described above is as follows:

Item	Cost in $1,000 of project which Floods Round Valley	Does not flood Round Valley
FIRST COSTS		
Lands and damages 1/	$ 37,800	$ 21,900
Relocations	46,200	15,100
Reservoirs	7,000	3,700
Dams	136,100	177,000
Drainage facilities	0	20,400
Fish & wildlife facilities	4,300	4,300
Powerplant	2,000	2,000
Roads, railroads, bridges	3,000	3,000
Recreation facilities	3,800	3,800
Buildings, grounds, utilities	300	300
Perm. oper. equipment	500	500
Totals	$241,000	$252,000
ANNUAL COSTS		
Interest and amortization	$ 9,100	$ 9,520
Operation, maintenance and replacement	570	530
	$ 9,670	$ 10,050

1/ Excludes $4,000,000 for cost of lands to be acquired specifically for future recreation potential.

First costs include appropriate amounts for engineering, design, supervision and administration. Annual costs are computed based on an economic life of 100 years at 3-1/4 percent interest. It may be noted from the above that direct project construction and operation costs, when considered alone, favor the flooding of Round Valley.

F-20. Other economic costs also should be considered. If Round Valley were not to be used as a part of the reservoir, average annual flood damages of about $40,000 in Round Valley could be expected. This would, in effect, reduce the flood control benefits attributable to the alternative plan which would not flood Round Valley. On the other hand, flooding of Round Valley, in entirety or in part, would result in a loss of future income. However, since Covelo and the Indian interests in the valley would be relocated in a manner which would replace the present economy, the only future income which would be affected would be related to the agricultural economy of the valley. This is discussed in Appendix A wherein an annual value of $570,000 has been assigned to this particular segment of the economy with the valley entirely inundated. With the valley partially inundated, as would be the case with a ponding area provided in conjunction with the drainage tunnel, the loss in future income would be $110,000 annually.

F-21. Addition of these annual costs to those of the previous tabulation results in the following:

Item	Annual costs in $1,000 for a project which Floods Round Valley	Does not flood Round Valley
Construction and operation	$ 9,670	$10,050
Loss in flood control benefits	0	40
Loss in future income	570	110
Total economic costs	$10,240	$10,200

F-22. Analyses made in the previous paragraph indicate an almost identical annual economic cost for the project regardless of whether or not Round Valley is flooded. However, with Round Valley protected from inundation by the reservoir, the annual water supply yield of the project available for export would be reduced by about 310,000 acre-feet at the site and by probably 400,000 acre-feet as measured at the Sacramento-San Joaquin Delta Pool. For essentially the same annual economic costs, however, the benefits to water supply would be almost double and the potential for recreation development would be greatly increased for the plan in which Round Valley would be flooded. The most feasible plan of development of a project on the Middle Fork of the Eel River is a multiple-purpose reservoir which includes the Round Valley area.

F-23. HYDROPOWER

Sufficient analyses were made to determine the various means by which hydropower might be included as a project purpose. One possibility is utilizing the transbasin export water which would be discharged through the Grindstone Diversion Tunnel. Major rates of diversions, however, are expected to be made during only a part of each year. Depending upon the pattern of regulation to provide the estimated yield from the Dos Rios Project as measured in the Sacramento-San Joaquin Delta Pool, it is possible that in many years only minor amounts of water would need to be exported through the Grindstone Diversion Tunnel. The flow for power development, therefore, would not be dependable without the inclusion of a relatively large afterbay for reregulation for water supply requirements. Storage requirements in such an afterbay could extend over a period of several years. An entire system of large reservoirs in the afterbay area is currently under consideration by various Federal and State agencies. The scope of development as well as the time of need is yet to be established, but it is anticipated that a minimum of twenty years

will elapse after completion of the Dos Rios project before these other developments would be constructed. It is concluded, therefore, that potential hydropower development utilizing exportation flow should properly be a feature to be considered during the plan formulation of these possible future developments in the afterbay area.

F-24. It was determined, further, by these studies that, except for capacities which would utilize only the flow released for mitigation of fishery losses, the inclusion of hydropower as a project purpose could not be economically justified. The fish releases as presently established would amount to 200 cubic feet per second during the four-month period 1 June through 30 September, and 350 cubic feet per second the remainder of the year. The available gross head at the power house, based on the power plant being located at elevation 1050 feet above mean sea level, would range between about 375 and 540 feet. With an estimated loss of 35 feet, the minimum net head, for a discharge of 200 cubic feet per second, would be about 340 feet. This would result in an installed capacity of 4,800 kilowatts based on a firm (uniform) demand. It was determined, also, that the inclusion of additional capacity for peaking or for providing a dependable power yield in a system would result in incremental costs which would exceed the incremental benefits. The 4,800 kilowatt installed capacity, therefore, is the optimum hydropower development which can be justified.

F-25. The possibility of developing pumped storage hydroelectric power generation also was investigated. The high cost for constructing an afterbay in the main Eel River downstream from the junction with the Middle Fork for power, alone, would not make such a development economically feasible. As mentioned earlier, planning is continuing for possible development of other reservoir projects on the main Eel River for multiple-purposes, including exportation of water, flood control, recreation and power, but the determination of the timing of such development is still subject to detailed formulation studies. It is considered, therefore, that pumped storage hydroelectric generation is more closely allied with the main Eel River developments and should be evaluated in connection with the project formulation being made in connection therewith.

F-26. THE MAXIMUM DOS RIOS PROJECT - LARGE RESERVOIR INCLUDING ROUND VALLEY AREA

This is the proposed project and, therefore, details of formulation are presented in the main report. However, for purposes of continuity, the principal items of project formulation are summarized in the following paragraphs.

F-27. PROJECT FORMULATION

Evaluation of all available data on potential and alternative projects has shown that the development of the Middle Fork Eel River is considered to be the keystone of a regional and basinwide water resource development system by virtue of its capability to provide substantial amounts of export water to many areas of need in the State of California; alleviate flood problems within the basin; and, create recreation opportunities of local, State and national significance. In addition, it would make possible limited conventional hydropower and potential adaptation for pumped-storage hydroelectric power in combination with more distant future lower main-stem Eel River reservoirs; and, provide water supply and quality control releases in the basin, and maximum exportation flexibility toward regulating flows in the Sacramento-San Joaquin Delta. Initial planning by the California State-Federal Interagency Group, consisting of representatives of the Corps of Engineers, the Bureau of Reclamation, the Soil Conservation Service and the State Department of Water Resources, indicated that water developed in the Middle Fork could be exported from the basin most economically via the adopted tunnel to Grindstone Creek and thence into the Central Valley System. This export route was the main alternative consideration in previous planning and is still under consideration.

F-28. With all consideration pointing toward initial development of the Middle Fork and project formulation indicating Dos Rios as the most favorable project, the Dos Rios development evolved. In screening the selected basin units and basin unit combinations, it was determined that a multiple-purpose reservoir at Dos Rios would be the best plan by meeting all of the necessary criteria to a greater degree than any other reasonable plan considered for early construction. The selected plan of improvement would meet the most pressing foreseeable needs in the overall area. Pertinent features are described in the paragraphs which follow.

F-29. SUMMARY OF BASIN FORMULATION

Since the publication of House Document No. 234, 89th Congress, 1st Session, there has been extensive investigation of upstream reservoirs in the Eel River Basin and conveyance systems for export water into the Sacramento-San Joaquin River system. These investigations have been undertaken by the California State-Federal Interagency Group on a coordinated basis with the participating agencies, supported by special consultant agencies, undertaking specific areas of study. Pertinent to this report, the major study effort on conveyance routes to the Sacramento Valley was accomplished by the California Department of Water Resources, and reservoirs on the Middle Fork Eel River were jointly

investigated by that Department and the Corps of Engineers. The significance of the unprecedented December 1964 flood was evaluated by the Corps. Hydroelectric power, within-basin water supply, within-basin water quality, basin irrigation water and project recreation also were evaluated by the Corps based on latest available information from all agencies and historical records.

F-30. Conclusions resulting from investigations were:

a. Conveyance of export water from the Eel River Basin into the Sacramento Valley appears most likely via a gravity tunnel from the Middle Fork Eel River Basin to the Grindstone Creek area.

b. A large Dos Rios Reservoir on the Middle Fork Eel River should be developed, including the Round Valley area, with flood control, water supply, hydroelectric power and recreation as project purposes and with formulation to reflect export conveyance route considerations.

c. Development of the English Ridge Reservoir is not precluded by Dos Rios Reservoir development.

d. Investigation of Yellow Jacket damsite and Upper Sequoia Reservoir should continue with an early completion date to permit consideration of further meeting the near future water requirements of the State of California.

PLAN OF IMPROVEMENT

F-31. PROPOSED PLAN OF IMPROVEMENT

The selected plan of improvement consists of a dam and multiple-purpose reservoir located about three miles upstream from the town of Dos Rios on the Middle Fork Eel River. The dam would impound about 7.6 million acre-feet of water and would provide for flood control, water supply, recreation and hydropower. A 21-mile transbasin conveyance tunnel is planned to divert water eastward into the Sacramento Valley where it would be incorporated in the California State Water Project. A complex of recreational facilities including camping, picnicking, swimming, boat-launching facilities and historical Indian archive section, monuments, and other features are planned. Hydroelectric power generation utilizing releases for fisheries within the basin also is proposed. Where given herein, all elevations are in feet above mean sea level datum.

F-32. THE DOS RIOS RESERVOIR

The Dos Rios dam would form a reservoir on the Middle Fork Eel River with a surface area of about 40,000 acres and a capacity of 7.6 million acre-feet at elevation 1,602 feet, the top of the flood control

pool. The body of the reservoir would include the Round Valley and Williams Valley areas and arms of Middle Fork Eel tributaries extending up Salt Creek, Elk Creek, Thatcher Creek, Poor Mans Creek, Murphy Creek and Black Butte River. At the top of the water supply pool, the Round Valley reservoir section would be about 4.5 miles wide and seven miles long. The reservoir extending up the main stem of the Middle Fork Eel River would be over 26 miles in length. The main report explains the basis for storage distribution, which is as follows:

Flood control pool	600,000 acre-feet
Water supply, recreation and fishery release pool	5,000,000 acre-feet
Minimum pool including storage for sedimentation and slide potential	2,000,000 acre-feet
Total	7,600,000 acre-feet

F-33. CLEARING THE RESERVOIR AREA

The reservoir area would be cleared in accordance with established Corps of Engineers policies and guides. The reservoir contains three zones. Zone 1 would include all the land surface area from the bottom of the reservoir to the top of the minimum pool at elevation 1,425 feet mean sea level. Clearing in this zone would consist of removal of structures and topping of trees and brush so as not to extend above the lower limit of the water supply pool. Zone 2 comprises the land surface area between the minimum pool and the top of the water supply pool which is 1,587 feet above mean sea level. Trees, brush and structures would be removed from this zone. Clearing in zone 3, the flood control pool, would be accomplished in accordance with and compatible to its purpose and the recreation developments.

F-34. DAM AND APPURTENANT STRUCTURES

Except for an impervious core element, the dam would be constructed of various zones of rockfill, graded from finer rock near the core to a maximum size of 24 inches on the outer slopes. The immediate damsite area would be stripped of all overburden materials, allowing the dam to rest on a foundation of sound rock. The location of the axis of the dam was established on the basis of geologic and topographic considerations. The crest length would be approximately 2,100 feet and would be curved upstream on a radius of 4,000 feet. The crest elevation would be 1,650 feet for a dam height of 730 feet. This height would include 24 feet of freeboard allowance for wind and wave action and seismic effects. The top width of the dam would be 30 feet and the average upstream and downstream

slopes would be 1.0 vertical on 2.5 horizontal. A general layout of the dam is shown on Plate 4 of the main report. Further details on hydrology and hydraulics are presented in Appendix B and soils and geology in Appendix C. Pertinent project data are given in Table F-1.

a. Details of embankment zoning. Plate 4 of the main report shows the proposed embankment zoning, the upstream and downstream slopes, and the various rock zones of the dam. The central zone would contain the finer-grained materials from the impervious borrow areas. This material would be impervious when in place and would be constructed as a rolled, earthfill. The transition section would be comprised of filter-graded materials and would be placed adjacent to the central impervious core in both the upstream and downstream sections of the dam. The transition material would be compacted in 12-inch lifts and would be graded to prevent the finer-grained core material from washing into the rock zones. The zone adjacent to the transition zone would contain 6-inch maximum size stone and would be compacted in 18-inch lifts. The next zone would contain 18-inch maximum size stone and would be compacted in 24-inch lifts. The oversized rock zone would contain 24-inch maximum size stones and would be compacted in 36-inch lifts. All stone in the rock zones would be compacted with a 10-ton vibratory roller.

b. Seepage. The foundation of the dam would be grouted along the axis. The grout curtain would consist of three lines, 10 feet apart. The center line of holes would be grouted on five-foot centers with alternate holes 25 and 150 feet deep. The two outside lines would be grouted 25 feet deep on five-foot centers. Additional holes would be provided in areas of considerable grout take. Drainage tunnels would be provided for drainage of seepage passing through or around the grout curtain. The tunnels would be located in both abutments at about the third point of the maximum dam height (approximately elevation 1160) and these tunnels would be driven parallel to the dam axis just downstream from the downstream transition section of the embankment. They would extend horizontally from about the end of the axis a distance of 400 feet toward the river channel. Their inside diameter would be eight feet and they would be lined with concrete. Drain holes three inches in diameter would be drilled through the concrete lining at both the crown and the invert of the tunnel and would extend to within 25 feet of the abutment to the streambed level. The holes would be drilled approximately parallel to the downstream transition slope. Spacing of holes would be based on the arrangement of joint and fracture spacing of the bedrock as determined during excavation of the tunnel. Disposition of the seepage would be through access tunnels to the face of the abutment and by drains from the access tunnel portal to the streambed.

c. Spillway and stilling basin. The spillway location is proposed for the left abutment approximately 1,000 feet upstream from the dam axis. The spillway would consist of a gated, side-channel structure which would discharge into a sloping tunnel, 50 feet in diameter, and finally into the diversion tunnel. Downstream discharge would be from the diversion tunnel into a stilling basin located approximately 400 feet from the downstream toe of the dam. Flood control releases would be regulated through the spillway by three tainter gates, 30 feet wide and 44 feet high. The profile of the spillway is shown with sections and details in Appendix C on Plates C-8, C-9 and C-10. The approach channel elevation is planned at 1,581 feet. The elevation of the top of the regulating tainter gates would be 1,625 feet. The maximum cut required for the spillway excavation would be some 400 feet high and would place the spillway in sandstone. This material is sufficiently competent to allow cut slopes of 1 vertical on 0.5 horizontal with berms. The spillway side walls would be vertical and would be anchored to the sandstone bedrock with rockbolts. Three-inch diameter drain holes, located midway between rockbolts, would also be provided for drainage of the rock behind the walls. The tunnel portion of the spillway alignment would be approximately 700 feet long. It would slope at 45 degrees from an elevation of 1,525 feet to an elevation of 935 and would connect with the diversion tunnel approximately 2,100 feet downstream from the diversion tunnel inlet. The spillway tunnel would be structurally supported and lined with concrete. In addition, a protective steel lining would be provided at the intersection of the spillway tunnel and the diversion tunnel to protect against cavitation in the concrete lining. The steel lining would completely cover the inside periphery of the spillway-diversion tunnel elbow. The discharge at the downstream portal of the diversion tunnel would be at elevation 925. The bottom of the stilling basin would be at elevation 864 and this excavation for the stilling basin would require a maximum cut of some 300 feet. This would place the basin mostly in sandstone and chert with a minor amount of shale on the right abutment. Cut slopes would be 1 vertical on 0.5 horizontal. Stilling basin walls would be vertical and would be anchored to the bedrock in the same manner as the spillway walls.

d. Diversion tunnel and emergency outlet works. Diversion of the river during the construction period would be accomplished by means of a diversion tunnel, 50 feet in diameter, located in the left abutment. This tunnel would be approximately 4,500 feet long and would discharge into the spillway stilling basin downstream from the toe of the dam. Upstream invert would be at elevation 940 and downstream invert at elevation 925. The plan of the diversion tunnel and emergency outlet works is shown in Appendix C on Plate C-6. A profile of the tunnel is shown on Plate C-9 and a typical section on Plate C-8. For the majority of its length, the diversion tunnel would be excavated in hard sandstone, but it may penetrate a 200-foot-thick bed of thinly-bedded sandstone and shale. Light to moderate support would be needed in that portion of the

tunnel that penetrates the sandstone. Heavy support may be required in the 200-foot section of sandstone and shale. The entire length of the tunnel would be lined with concrete. Emergency drainage of the reservoir would be provided through three conduits penetrating the stop-plug in the diversion tunnel. These conduits, each eight feet in diameter, would discharge into the diversion tunnel. Flow would be controlled by three 8-foot diameter high pressure gates. Three similar gates would be provided for emergency use or closure during maintenance of the operating gates. Access to the gate chamber would be provided by an elevator shaft in the left abutment.

e. Outlet works. Water quantities and quality control for fishery releases would be provided for by means of the outlet works. These works would consist of a concrete inlet structure, a 6.5-foot diameter tunnel, and a 4-foot diameter pipe leading downstream to the fish hatchery, via the hydroelectric power plant. The plan of the outlet works is shown in Appendix C on Plate C-6, with details on Plate C-11. The concrete inlet structure would be constructed on the face of the left abutment. Four inlet valves located at elevations 1,565, 1,510, 1,440, and 1,364 would allow temperature control and flexibility of operation. Flow control would be accomplished by individual slide gates, with stop logs for emergency repairs. Water releases would flow through two pipes each 6.5 feet in diameter. The two pipes would combine releases from elevations 1,565 and 1,440 and from elevations 1,510 and 1,364 and would lead from the inlet structure through the abutment to a gate chamber containing the control gates. The combination of flow from two inlet elevations into one pipe would assure continuous operation of at least two of the four inlets. Access to the gate chamber would be provided by an elevator shaft in the left abutment. Downstream from the gate chamber, the two pipes would merge and transition into a 6.5-foot diameter tunnel. This tunnel would be approximately 4,700 feet in length, lined with concrete, and would emerge to the surface along the left abutment below the downstream toe of the dam. The tunnel would transition into a surface pipe, four feet in diameter leading to the powerhouse. Two pipes, each four feet in diameter, would lead from the powerhouse tailrace. One would lead to the fish hatchery, the second would discharge into the stream. Provision would be made to bypass fish water around the powerhouse in event of shutdown.

F-35. GRINDSTONE DIVERSION TUNNEL

Water from Dos Rios would be diverted to water conveyance facilities by means of a gravity tunnel 17 feet in diameter and approximately 21 miles long. The tunnel would be lined with concrete and would fall about 185 feet from the inlet to the outlet portals at Grindstone Creek. Flow through the tunnel would be regulated by a control tower and two

regulating gates, 8.5 feet by 15.5 feet. These would be located near the upstream portal. Two similar gates would also be provided for emergency. The intake structure would contain a trash rack and stoplog closure for repair of the control and emergency gates. Discharge from the tunnel would be into a stilling basin, located at the downstream portal, designed for flows up to 4,000 cubic feet per second. Profiles and sections of the tunnel are shown in Appendix C on Plate C-12. This facility is proposed for construction by the State of California with funds provided by the State. It is physically independent of other features necessary to create the reservoir, and, therefore, it can be treated as a specific cost for water supply in cost allocation computations.

F-36. HYDROPOWER FACILITIES

Hydropower facilities would consist of a 4,800 kilowatt turbine-generator unit, necessary buildings and control equipment, switchyard, a small afterbay structure for regulating short-period surges and for maintaining tailwater elevations for efficient turbine operating conditions, and a bypass line and necessary valve controls to regulate the flow to the fish hatchery. The plant would be located below the dam at approximately elevation 1050 and upstream from the fish hatchery. All, or a part, of the fishery releases would be utilized by the power plant. The location of the power facilities is shown on Plate 5 of the main report.

F-37. RECREATION FACILITIES

Facilities to be provided at the reservoir for recreation as a project purpose are based on accommodating approximately 1,000,000 annual recreation-day attendance. The basis for arriving at this figure is described in Appendix D, "Recreation and Fish and Wildlife". Although the reservoir would have the potential of accommodating 7,000,000 annual recreation days the gross inadequacy of existing roads from the two principal highways, U.S. 101 and Interstate No. 5, to the reservoir area present a definite constraint to the realization of this potential. A new State Route 261 currently is being planned from the Sacramento Valley westerly through the project area and thence to its junction with Highway U.S. No. 101. The road is scheduled for completion prior to the expected beginning of project operation, and it is estimated that the traffic capacity of this road will be such as to permit recreation attendance of two million recreation days annually. As a possible means of providing a substitute economy for the Indian community which is being proposed for relocation in areas abutting the reservoir, it has been assumed that recreation and related facilities will be included as part of the mitigative measures for the relocation. It is estimated that these recreation facilities would accommodate 1,000,000 annual recreation days leaving the remaining 1,000,000 to be provided for as a project purpose.

F-38. About 190 picnic sites, 500 camp sites, swimming areas, nine lanes of boat launching ramps and access roads are the recreation facilities to be provided for initial construction as a project purpose. The lands associated with the proposed recreational facilities total 800 acres. A description of the recreational facilities is given more detail in Appendix D. Additional boat launching ramp construction below the top of the water supply pool also would be included as a contingency factor in event boating trends exceeded the project use and to preserve the recreation potential of the reservoir. The inclusion of such a contingency is a practical, economical and relatively inexpensive expenditure since it would not be feasible to lower the water supply storage level for the ramp construction and since underwater placement could lead to many costly and unforeseen structural problems.

F-39. Although the access roads to the reservoir are expected to impose a constraint such as to be a major factor in limiting recreation attendance to what can be foreseen at this time, is is quite possible that other pressures and reasons, aside from recreation, may be instrumental in requiring the increase in traffic capacity of the road system. A much more precise and certain evaluation of projected conditions can be made at the time of project construction, or shortly thereafter, relative to the feasibility of providing additional recreational facilities. In order that the full recreation potential of the reservoir for recreational development can be preserved, and in accordance with the intent of Public Law 89-72 (Federal Projects Recreation Act of 1965) providing for such preservation, a total of 14,000 acres of land, in addition to other project requirements, would be purchased. Of the 14,000 acres 10,000 are in private ownership and the remainder is in Federal ownership. Public Law 89-72 outlines the methods of disposal of this type of lands, if after ten years they are determined to be in excess of any public need. Although the cost of these lands is included in the overall project cost estimate, no benefits have been assigned to it at this time nor does it form a part of the economic cost for allocations to project purposes.

F-40. If recreation were not included as a project purpose, the minimum facilities which would be provided for project operation and public health and safety would consist of a limited overlook area, four boat launching lands and related turn-around facilities at the end of the project access roads.

F-41. RELOCATIONS

Known relocations, that would be required as a consequence of project construction, consist of roads, power and telephone lines, the

community of Covelo, Covelo Airport, a portion of the Indian community, and three cemeteries. A discussion of these relocations is contained in the following paragraphs.

a. Roads. There is one principal county road which would require relocation if the project were to be constructed. This road, County Road 261, serves to provide access to Covelo via Dos Rios from U.S. Highway 101 to the west and to U.S. Highway 99W (Interstate Route 5), which traverses the Sacramento Valley, to the east. The road is known by various names. From U.S. Highway 101 to the vicinity of Covelo it is known as the Longvale Road; from Covelo to a junction with Alder Springs Road near the common corner of Mendocino, Glenn and Tehama Counties, it is called the Mendocino Pass Road; from that point to Paskenta in the Sacramento Valley, as the Round Valley Road; and as the Paskenta Road between Paskenta and Corning. About four miles west of Paskenta, a branch leads via Garland, Newville and Black Butte Roads to Orland. Both Orland and Corning are situated on U.S. Highway 99W. Also, at the western end, alternate access to U.S. Highway 101 is available over a rather poor road connecting Dos Rios with Laytonville. For those travelling north on U.S. Highway 101, some 14 miles of travel is eliminated over the route from Dos Rios to Longvale to Laytonville. However, because of the better quality road over the longer route, only a minor saving in time can be anticipated. From Covelo, a secondary road branches north, which connects with small communities along the eastern side of the Eel River Basin, and leads, via a network of similar roads, to U.S. Highway 101 in the vicinity of Eureka. This road would intersect the relocated main county road at the north end of the project area and would not need to be relocated. Physical relocation of the county road at the west would begin about 6.2 miles northeast from the damsite and would continue around the west and north sides of the reservoir and connect again with the existing road about 0.9 miles east from the confluence of Middle Fork of Eel River and Black Butte River. This section would require a relocation of 43.3 miles. From this point, a relocated road about 6.0 miles long would follow upstream along Black Butte River, cross at the lakehead, and turn downstream again to connect with an existing unnamed road serving private properties at the east side of the reservoir. It is expected that the existing unnamed road serving these properties would be improved and extended to provide access for construction of Grindstone Tunnel. Costs for the improvement and extension of the unnamed road would specifically apply to the Grindstone Tunnel feature of the project. Near the westerly terminous of the relocated county road, a road 2.0 miles long would be needed to serve the proposed relocated town of Covelo. All of these relocated roads are shown on Plate 3 included with the main report. Currently, the U.S. Forest Service is planning on upgrading standards of the County Road 261 through National Forest lands. Further, it is anticipated that the State will take over the road and improve the remainder from U.S. Highways 101 to 99W by the time the project is completed in 1980. Cost estimates for road relocations are

predicated on construction to the higher State standards. However, these cost estimates reflect the difference in road length, with and without the project, as chargeable to the project. The logical alignment for the relocated road is such as to provide access to recreation sites on the reservoir perimeter and for the Indian complex and, as noted earlier, will connect with the road leading north from Round Valley. The estimated cost of road relocations is about 12 million dollars exclusive of engineering, supervision and administration.

b. Utilities. The only known utility systems affected by project construction would be electric power and telephone lines. The operators of these utilities have been contacted and a determination has been made of the present systems. Round Valley is served by a 60 kilovolt transmission line from the vicinity of Laytonville. This line terminates at Covelo where voltage is reduced to 12 kilovolts for further local distribution. One 12 kilovolt line returns part way to the west to serve Dos Rios; a second follows the existing county road to the north and east to the vicinity of the confluence of Middle Fork Eel and Black Butte Rivers where it terminates. Telephone service is supplied over a two-wire line from Laytonville and Dos Rios. This line extends to the north and east to the same termination point as the 12 kilovolt powerline. Generally, these telephone lines are carried on the same poles as the power facility. The present 60 kilovolt powerline would be utilized to a point opposite the new townsite for Covelo. It would be necessary to provide an additional 1.4 miles of new line to reach the town. From there, after transforming to 12 kilovolts, new lines aggregating 31.4 miles would follow the relocated county road to the vicinity of the present termination point. A branch circuit also would connect with the existing line to Dos Rios. Telephone service would utilize the common poles as at present and would serve the same areas. Aggregate length of two-wire telephone lines would be 34.2 miles.

c. Cemeteries. There are at least three known cemeteries in Round Valley which, in the aggregate, contain about 1,000 graves. Two of these are Indian cemeteries and the third is a community cemetery for the valley. It is possible there may be additional scattered Indian graves which would be located during the more comprehensive investigations which would be made during preconstruction planning. However, the estimated total number of graves cited above is believed to be adequate to cover this contingency. Graves would be relocated either to other existing suitable cemeteries, Indian or general, or new cemetery sites would be provided in the vicinity. This choice would depend upon future negotiations with local officials and the Indian interests.

d. Covelo Airport. This is a small county airport bordering Town Creek just to the west of Covelo. A suitable site for relocating this airport appears possible at a higher elevation about two miles southwest from the present site. Relocation of the airport would require

site grading for a lighted airstrip 3,500 feet long and construction of necessary operation and storage buildings, utilities and an access road.

e. Covelo Townsite. Covelo is an unincorporated community situated in Round Valley, a part of the area required for Dos Rios Reservoir. Although unincorporated at present, it is expected the town will obtain corporate status prior to the time relocation would be necessary. Projections of population within the townsite and for the rural areas of Round Valley without proposed project consideration have been taken from reports by the State of California and the Corps of Engineers and are presented below:

Round Valley Population

Year	Town of Covelo	Rural Area	Total
1960	600	1,000	1,600
1970	800	1,600	2,400
1980	1,200	2,800	4,000
1990	2,000	4,600	6,600

In association with these population trends, land uses in the town of Covelo are projected as follows:

Land Usage - Acres

Year	Total	Industrial	Commerical	Residential
1960	700	100	70	530
1970	780	120	80	580
1980	900	130	90	780
1990	1,040	150	100	790

In the land tabulation above, industrial land has been estimated as about 15 percent of the total area, land used for commercial purposes as about 10 percent, and the remainder as residential land.

f. Covelo is presently a center for supplies and services, not only for the rural areas of Round Valley but also for surrounding areas as well. It provides school and church facilities for both the resident population of the valley and for residents in the Indian lands at the north. The nearest communities, where similar supplies and services are available, are Willits, which is 49 miles distant, and Laytonville, which is 26 miles distant. Laytonville, however, can be reached directly only over a poor secondary road from Dos Rios. Therefore, the concept has been taken that the town of Covelo should be relocated to an area contiguous to the lands to be acquired for the project so that a local service community would be retained.

g. It is estimated that resettlement of Covelo would take place probably by about 1980, prior to inundation of Round Valley by the reservoir. On the basis of a projected population of 1,200 by that date, it is estimated that about 400 residences would be needed each of which would require a site of about one-third acre, exclusive of streets but including easements for utilities. It is anticipated that streets would be designed to meet subdivision standards for Mendocino County and would include necessary street and intersection lighting adequate for public safety. Residential areas would be subdivided into normal block divisions as dictated by topography and would include continuous sidewalks on one side of each street. The area for commercial uses would be about 10 percent of the area required for residential use and would be concentrated in one location on a normal block pattern. Sidewalks would be provided on both sides of each street and continuous street lighting would be included in commercial areas. Two school sites of five acres each at separate locations, but related to residential areas, would be required. It is anticipated the townsite would be within a reasonable proximity to potential recreation developments. To meet suitable aesthetic considerations and to avoid undesirable traffic patterns, no lands would be proposed for industrial purposes. Sawmills now in Round Valley could be relocated outside the project area by owners, if desired, under normal real estate acquisition and resettlement practices. Utilities estimated to support the community consist of a collection system for sewage together with provisions for secondary treatment plus chlorination and a water supply capable of providing 150 gallons per day per capita for residential areas plus an additional 10 percent of the residential water requirement for commercial use. Eelctrical power and telephone services would be provided by the appropriate public utilities as with the present townsite.

h. Two areas were selected as basically suitable for re-siting Covelo. The first of these is the site preferred by many of the present population of Covelo. It would be situated on the ridge at the southwest corner of Round Valley which would separate the portion of the reservoir along the Middle Fork of Eel River from the portion in Round Valley. With the project reservoir as formulated, a peninsula would be formed in a northwest-southeast direction about 2.5 miles long and about one mile wide. Approximately 15 percent of the total area available on this peninsula would be needed for the townsite. Although topographic conditions preclude use of some portions of the area for townsite purposes, it is estimated that adequate land is available to relocate Covelo. The second site, not adopted, would be situated at the west side of Round Valley in the uplands above the reservoir and between Town and Grist Creeks. Here, topographic conditions are more adaptable to site location and it would be closer to the Indian lands to the north. However, during periods when the reservoir is operating at minimum conservation storage, reservoir lands proper would be exposed with a less favorable aesthetic impact. It is this consideration that has prompted

local preference for the first site discussed above. Although there might be some cost advantage in selecting the second site, it is believed this might be more than offset by intangible aesthetic considerations. Therefore, it is believed to be in the best public interest to assume that the town of Covelo would be relocated in the peninsula area at the southwest corner of Round Valley and that the Federal Government would undertake the construction of the necessary utilities, roads and streets. Costs for this relocation would become part of the project costs and would be treated as a mitigative measure. After site preparation and installation of utilities, it may be assumed for all practical purposes, that land values of the new site would approximate those at the existing one. It may be assumed, also, that future operation and maintenance costs for water and sanitary facilities would be provided in the normal incorporated community manner with these items not chargeable to the project. The same approach on maintenance and operation is logical on the relocated airport since this would be a replacement in kind with a value equal to the old. The only costs for this facility which would be chargeable to the project are those for acquisition of land and construction of the substitute facility and there would be no net cost to the project for acquiring the present facility.

i. Indian Community. The Round Valley Indian Reservation is an extensive area located to the north and northwest of the proposed project. The reservation lands extend into the reservoir area and include the northerly two miles of Round Valley as well as a portion of the valley directly west from Covelo. Indian service maps indicate that about 185 parcels of Indian lands would be disturbed by the project but whether each parcel is held by an individual owner has not been ascertained. Of the total disturbed parcels, about 170 would be completely inundated by the reservoir, including two cemeteries. Maps indicate that the 185 parcels are composed of: Tribal-40; "Allotted" Tribal-35; and "Allotted"-110. "Allotted" land can be purchased on an individual basis with approval of the owner, including guidance from the Indian Service of the Department of Interior, if desired. Most of the 170 parcels which would be completely inundated are composed of relatively flat land which could be farming developments. The Indian Service has indicated that many non-resident Indians are involved in land ownership and have expressed the opinion that some of these would want separate properties if new lands around the reservoir were to be exchanged for existing holdings.

j. The Indian Service has furnished some data on the present Indian economy. Present population (1967) of the Round Valley Indian Reservation is 346 persons. Of these, 94 are considered as an available labor force of which 43, or about 46 percent, are employed permanently or part time. Of the remaining 51 unemployed, about 75 percent are actively seeking work. Indian income is derived principally through sale of timber resources on Indian lands and from employment in local

lumber mills. The Indian Service estimates that individual family income ranges between $1,000 and $8,000 per year. If a substitute economy were to be developed, the Indian Service believes that $3,000 per year per family should be a minimum consideration and that family incomes, which currently are above that amount, should at least be equalled and the opportunity for a better potential offered. Non-resident tribal members, some with land interests, are estimated to total above 1,000 and are located throughout the United States.

k. Fullest consideration has been given to steps which might be taken to mitigate, to the greatest possible extent, any adverse impact on the Indian interests and economy. It is expected that the Bureau of Indian Affairs, in consultation with the Tribal Council, will develop appropriate plans for the relocation. As a means of arriving at a reasonable estimate of cost for the relocation, certain concepts of what such a plan might entail were adopted. Discussions were held with representatives of the Bureau of Indian Affairs during the formulation of the project in which it was indicated that the suggested approach was reasonable and workable. The basis for the cost estimate included the items as described in the remainder of this paragraph. To compensate for the loss of relatively flat land to be taken for the reservoir, it was assumed that there would be an exchange of two acres of hilly land for each acre of valley land taken. This ratio would not provide the same amount of similar terrain, which is not possible, but would tend to compensate for quality reduction in soil available for family food production to be used within the family group. Also, a new economy would be needed to replace that which was disturbed, to meet overall family requirements. It is believed this economy could be best developed around recreation. Accordingly, exchange lands would be obtained to provide a solid and continuous area of Indian development with about 24 miles of reservoir shoreline along the north edge of Round Valley. The western end of this development would be centered around recreation and Indian cultural history and industry. Exchange concept development is predicated upon providing facilities for one million visitor-days annually which is one-half of the estimated visitor pressure which could be expected considering project access limitations on present roads from the west and some improved access, by 1980, over the road from the east. For purposes of developing a basis for the cost estimate, the facilities were assumed to consist of: 190 picnic sites, 500 campsites, swimming areas, 10 lanes for boat-launching, and 1.75 miles of access roads. The costs of these facilities would be shared by all project purposes as with other mitigative measures. The facilities would be owned and operated by the Indians who would, in turn, receive the revenue therefrom in exchange for the economy foregone in Round Valley. Project relocations (roads, power, water, etc.) would be provided to all Indian lands bordering on the reservoir which are not subject to exchange concepts. Total lands in the Indian complex would amount to about 10,000 acres. Of these, about 5,200 acres would result from

land-exchange procedures and the remaining acres would be in present Indian lands which would not be disturbed by the project. Of the total, about 640 acres would be used for recreation purposes.

F-42. LANDS AND DAMAGES

a. Area requirements. Lands required for the adopted project total 103,000 acres of which 14,000 would be reserved for future recreation potential. About 21,000 acres are Federal properties (U.S. Bureau of Land Management) and 600 acres belong to the State of California. County holdings in the area consist of roadways and an airport. Major usage of required lands, in rounded figures, is given in the following tabulation:

Maximum Water Surface	- 42,000 acres
Islands	- 12,000
Wildlife Refuge	- 16,000
Indian Land Exchange	- 5,000
Relocations	- 1,000
Recreation (initial)	- 1,000
Recreation (reserved)	- 14,000
Public perimeter access buffer zone and "blocking out"	- 12,000
Total	103,000 acres

b. Estimated cost. The U.S. Army Engineer District, Sacramento, made a real estate survey in July 1967 of about 92,000 acres that would be affected by the adopted project. This survey covered 18,500 acres of valley land, including the Town of Covelo, and 73,000 acres of hillside land. It encompassed, therefore, the major portion of land values associated with the adopted project. An estimated 170 ownerships were involved. Public facilities and utilities which would be relocated were not evaluated. The information in the Real Estate Report expanded to encompass the area required for the adopted project and the costs adjusted accordingly.

F-43. MITIGATION OF FISH AND WILDLIFE LOSSES

Measures for mitigating losses to fish and wildlife have been coordinated with the U.S. Fish and Wildlife Service and the California State Division of Fish and Game. A discussion of cooperative efforts undertaken and of measures recommended to mitigate these losses, are discussed below:

a. Fish. During preparation of this report, numerous meetings were held with representatives of the Federal and State fish and wildlife agencies to establish the losses to this resource in the event of project construction, and of measures which might be taken to mitigate these losses. As a summary thereof, in a letter dated 7 September 1967, the U.S. Fish and Wildlife Service, advised that construction of Dos Rios Reservoir would effectively block existing runs of salmon and steelhead trout in the Middle Fork of Eel River. A further discussion of these losses and of mitigative measures required is contained in Appendix D which relates to recreation and the fish and wildlife resources of the basin. In this summary, features for mitigating losses to that portion of the Eel River fishery affected by the adopted project were recommended and are proposed as project features as follows:

(1) Construction of a fish hatchery and appurtenant features which includes a selective water level outlet structure and water conveyance system from the dam to the hatchery, The hatchery would have a capacity of 16,250,000 salmon eggs, 4,600,000 steelhead eggs, 13,000,000 salmon smolts (at 100 per pound) and 2,300,000 yearling steelhead trout (at 8 per pound).

(2) Maintaining certain minimum releases to be made from the reservoir to support and maintain fish runs in the main streams below the dam. These releases are specified as 350 cubic feet per second during the months of October through May and as 200 cubic feet per second, June through September. Water used to operate the hatchery would make up part of these flows.

(3) Strips of land along the three-mile reach between the dam and the confluence of the Middle Fork and the main Eel River would be acquired for fishery management and public access.

b. Wildlife. Existing wildlife resources of the Eel River Basin and the adverse effects expected to result from project construction also are discussed at length in Appendix D and reflect advice from the U.S. Fish and Wildlife Service. The principal forms which would be affected by project construction are the resident and migratory herds of deer and miscellaneous smaller game, and non-game fur animals and upland game birds which now utilize the reservoir area. The fish and wildlife agency estimates that if about 8,000 acres of substitute lands could be acquired and managed for wildlife purposes, the loss of game habitat in the reservoir area would be compensated. It is proposed to acquire an area suitable for this purpose at the southeast portion of the reservoir adjoining the east side of the Elk Creek arm. In total, about 10,000 acres would be acquired of which 1,600 acres would be private lands and the remainder in public lands under the jurisdiction of the U.S. Bureau of Land Management. It is considered necessary to acquire these 10,000 acres in order to assure that a net of 8,000 acres suitable for preparation and management of wildlife will be obtained. Preparation would consist

of fencing certain areas to preclude grazing by domestic and feral livestock, development of springs and construction of rudimentary access roads and trails.

COST ESTIMATES

F-44. GENERAL

Estimates of cost have been prepared for the proposed multiple-purpose plan of improvement discussed earlier in this appendix; for other potential alternatives considered; and for those other alternative projects for which cost data must be developed in order to accomplish the allocation of total project costs to the several purposes of the project. All costs are based on September 1967 price levels. Item costs include contingency allowances of about 20 percent except for recreation facilities for which a somewhat higher allowance was used. All economic costs and benefits are referred to the common base year of 1980, the time when it is estimated the project will have been completed and will be potentially capable of producing benefits. In any cases where project benefits or costs do not begin coincident with project completion, the value of the benefits or costs have been discounted to their present worth at the base year noted above. For all practical purposes, facilities required for mitigation of fish and wildlife damages will remain the same for the single and one-purpose-omitted projects at the Dos Rios site as for the multiple-purpose project. The costs for the Grindstone Diversion Tunnel are included separately from those for the dam and reservoir since these are specific costs entirely chargeable to water supply. This feature, therefore, does not enter directly into the calculation of cost allocations for the dam and reservoir except for adjustment of benefits to water supply by an amount equal to the specific costs for the Grindstone Diversion Tunnel. The costs for the additional 14,000 acres of recreational lands have been treated in a similar manner except that no adjustment of recreation benefits is required in this instance.

F-45. FIRST COST - MULTIPLE-PURPOSE PROJECT (ADOPTED)

A detailed estimate of cost for the proposed multiple-purpose project is presented in Table F-2. The added lands for potential future recreation facilities and the Grindstone Diversion Tunnel have been shown separately. The total project first cost, by major items which are classified as given in the Program and Accounting Manual, is given below:

Classification	Feature	Contract Cost	Distributed Engineering and Design and Supervision and Administration	Total Feature Cost
			(in $1,000's)	
DAM AND RESERVOIR 1/				
.01	Lands and damages	$ 37,800	---	$ 37,800
.02	Relocations			
	Indian Community	(21,500)	($2,500)	(24,000)
	Town of Covelo	(2,620)	(280)	(2,900)
	Airport	(2,560)	(240)	(2,800)
	Power and telephone lines	(520)	(80)	(600)
	Roads and bridges	(12,200)	(1,300)	(13,500)
	Ranger stations	(1,800)	(200)	(2,000)
	Cemeteries	(300)	(100)	(400)
	Total relocations	$ 41,500	$ 4,700	$ 46,200
.03	Reservoir clearing and archeological investigations	$ 6,300	$ 700	$ 7,000
.04	Dams	121,020	15,080	136,100
.06	Fish and wildlife facilities	4,000	300	4,300
.07	Power plant	1,800	200	2,000
.08	Road, railroads and bridges	2,500	500	3,000
.14	Recreation facilities	3,400	400	3,800
.19	Buildings, grounds and utilities	290	10	300
.20	Permanent operating equipment	490	10	500
	Subtotal	$219,100	$21,900	$241,000
.30	Engineering and design	$ 11,500	---	---
.31	Supervision and administration	10,400	---	---
	Total cost, dam and reservoir	$241,000		$241,000
ADDITIONAL LANDS FOR POTENTIAL FUTURE RECREATION		$ 4,000	---	$ 4,000
GRINDSTONE DIVERSION TUNNEL				
.04	Dams 2/	$137,000	$16,000	$153,000
.30	Engineering and design	8,400	---	---
.31	Supervision and administration	7,600	---	---
	Total cost, Grindstone diversion tunnel	$153,000		$153,000
	TOTAL PROJECT COST	$398,000		$398,000

1/ Excludes approximately $1,800,000 for lands required for relocations
2/ Includes, as well, costs for Lands and Damages (Item .01)

F-46. ANNUAL CHARGES - MULTIPLE PURPOSE PROJECT (ADOPTED)

Annual charges for the adopted multiple-purpose reservoir project were computed using the current rate of interest of 3-1/4 percent as determined by the Secretary of the Treasury and for economic lives of both 50 and 100 years as required by Senate Resolution 148. The adopted economic project life is 100 years. In addition to the interest on, and amoritization of, the first costs, annual charges and annual economic costs and investments include interest during construction, operation, maintenance and major replacement, and gain or loss of land productivity. These factors are discussed in the following subparagraphs.

a. Operation, maintenance and major replacements. Ordinary operation and maintenance factors have been developed by U.S. Army Engineer District, Sacramento, in its Engineering Division Memo No. 198 revised to October 1966. These are used exclusively for all construction items with the exception of recreation facilities for which the San Francisco District has developed its own factors. Factors used in computing annual operation and maintenance are given below:

Item	
Dam and reservoir	$39,000 plus $0.01 per acre-foot capacity in excess of 200,000 acre-feet
Concrete, misc. structural, bridges, conduits, tunnel lining, etc.	0.1 percent of first cost
Steel, trashracks, stoplogs, structural members, pipes, bridges, gates, valves, and gate hoists and operating equip.	1.5 percent of first cost
Misc. electrical and mechanical equipment	1.0 percent of first cost
Buildings, grounds and utilities	5.0 percent of first cost
Roads	2.0 percent of first cost
Fish hatchery	$190,000
Hydrologic and communications facilities	10.0 percent of first cost

On the basis of the above, the annual operation and matinenance costs are estimated at $535,000 comprised of the following major categories:

Dam and reservoir	$116,000
Concrete structures	29,000
Steel structures and gates	45,000
Fish hatchery	190,000
Recreational facilities	100,000
Power plant	55,000
Total	$535,000

The annual cost of major replacements depends on two factors: the expected physical life on an entire unit and the economic life of the project. Annual costs of major replacements are computed on the basis of amortizing the present worth of the cost of future replacements over the economic life of the project. Major replacement factors are given below:

Item	Physical life-yrs	Major replacement factor for economic life of: (3-1/4 percent interest)	
		100 yrs	50 yrs
Misc. mechanical and electrical equipment	40	0.012	0.011
Fish hatchery 1/	50	0.003	0
Recreation facilities 2/	25	0.008	0.009
Buildings	50	0.007	0

1/ On assumption that approximately 50 percent of the first cost of the hatchery will be composed of items with a 50-year physical life.

2/ On assumption that approximately 1/3 of the facilities for recreation, exclusive of roads will require replacement each 25 years.

Major replacement annual costs for the proposed project total $35,000 made up as follows:

Miscellaneous mechanical and electrical equipment and buildings	$ 4,000
Recreation facilities	7,000
Fish hatchery	10,000
Power plant	14,000
Total major replacement	$35,000

b. Gain or loss of present land productivity. An item to be considered in the overall economic analysis is the effect that construction of the project would have on the present land productivity of the area required for project purposes and whether this change in land use would constitute a net gain or loss to the area economy. If the present net income approximates the earnings represented by the investment in project lands, that is, the project interest rate, it can be considered there will be no gain or loss. If not, then the difference between the project interest rate and the equivalent rate represented by net earnings under present use will represent a gain or loss to the general economy of the area. The Town of Covelo and surrounding areas in Round Valley is the only significant area in which land-use returns may exceed 3-1/4 percent. However, a feature of project construction is relocation of the town and its income-producing properties. Thus, no significant gain or loss is expected to result from inundating this area. Estimated net loss prior to project operation in agricultural production in Round Valley is estimated as $180,000 annually. Other portions of the reservoir area and contiguous lands required for the project are mostly rugged and used primarily for primitive recreation and grazing and produce minor returns although some timber is produced in a continuing program. In the final analysis, based on uses for similar areas which were studied in conjunction with projects developed in the adjacent Russian River Basin, it is believed the average net return for the entire project area will not differ substantially from the project interest rate. In conclusion, therefore, it is believed that gain or loss in productivity on project lands might be only of minor significance and need not be a factor entering into the project economics except for the alternative of not flooding Round Valley which was treated earlier in this appendix.

c. Project investments and investment costs. The total investment in project construction is composed of the first cost plus interest on these costs until the project first costs produces benefits, that is, the "base year" discussed earlier. Since appropriations usually are made available only as required to meet a construction schedule, it is considered sufficient to assume that average interest on first costs would be equivalent to the amount represented by applying the interest rate to the full first cost over the number of years represented by one-half of the total construction period. It is estimated that the construction of the proposed Dos Rios Reservoir project will extend over a period of 7 years. This same construction period was adopted, also, for the alternative single purpose projects, and for the projects with one purpose omitted for use in the cost allocations. The product of one-half of the 7-year period and the interest rate of 3-1/4 percent results in a factor of 0.114, which is to be applied to the first cost to obtain interest during construction. This amount, plus the first cost, represents the project investment. Capital recovery factors,

which represent annual interest on and amortization of the project investment, for an interest rate of 3-1/4 percent are 0.0339 and 0.0407 for periods of 100 years and 50 years, respectively.

d. Annual charges. The annual charges for the proposed reservoir project would amount to $9,670,000 for the dam and reservoir and $5,870,000 for the Grindstone Diversion Tunnel to give a total of $1,554,000. These figures are exclusive of the $4,000,000 first cost of the added lands which would be acquired for the potential future increase in recreation facilities in keeping with the Federal Water Projects Recreation Act of 1965. The derivation of the annual charges, for an economic life of 100 years, is given below:

I	DAM AND RESERVOIR	
	A. First Cost and Investment	
	First cost	$241,000,000
	Interest during construction	27,500,000
	Total investment	$268,500,000
	B. Annual Charges	
	Interest and amortization (.0339 x $268,500,000)	$ 9,100,000
	Operation and maintenance	535,000
	Major replacements	35,000
	Total annual charges	$ 9,670,000
II	GRINDSTONE DIVERSION TUNNEL	
	A. First Cost and Investment	
	First cost	$153,000,000
	Interest during construction	17,000,000
	Total investment	$170,000,000
	B. Annual Charges	
	Interest and amortization (0.0339 x 170,000,000)	5,780,000
	Operation, maintenance and major replacements	90,000
	Total annual charges	$ 5,870,000
III	TOTAL PROJECT ANNUAL CHARGES	$ 15,540,000

ALTERNATIVE PROJECTS FOR COST ALLOCATIONS

F-47. GENERAL

For purposes of cost allocations it is necessary to develop a series of cost estimates for the least cost alternatives for single purpose projects producing the same benefit, in kind and in monetary evaluation, for that particular purpose as would the proposed multiple-purpose project. Where the cost of these single purpose least cost alternatives is less than the benefit, then this cost will govern, instead of the benefit, in the allocation procedures. In all cases, except for water supply, it was found that the least cost alternative exceeded the benefits by wide margins, and, therefore, did not prove to be pertinent in the subject instance. In addition, cost estimates were prepared for projects with one purpose omitted in order to arrive at the separable, or incremental, cost of adding that purpose.

F-48. SINGLE-PURPOSE PROJECTS

As discussed previously in this appendix, projects designed to serve a single-purpose and to produce benefits equivalent to those produced by the multiple-purpose projects have been considered. Through comparative analyses, it has been found that, with the exception of hydropower, single-purpose reservoir projects, situated at or near the site of the multiple-purpose project, provide the least expensive and most practical means of providing these equivalent benefits. The least expensive means of producing equivalent power is considered to be the cost of a steam plant. Each of these projects is designed specifically for the purpose to be served with all other purposes omitted except for those features needed for mitigation of damage to fish and wildlife. A summary of first costs for these projects is shown on Table F-3 and of annual charges in Table F-4. As indicated previously the specific costs for the Grindstone Diversion Tunnel and the added lands for recreation do not need to be included since they do not enter directly into the cost allocations for the dam and reservoir features of the project. A description of each of these projects is given in the following subparagraphs.

a. Single-purpose flood control. This project is based on construction of a dam and reservoir at about the same site as the multiple-purpose project. It would consist of a rockfill dam, spillway and outlet works similar to those employed for the multiple-purpose project and would include the hatchery and provision of minimum releases for fish damage mitigation. Such a project would require storage reservations of 150,000 acre-feet for sedimentation, 330,000 acre-feet for potential slides, 600,000 acre-feet for flood control and 100,000 acre-feet to provide releases of 200 and 350 cubic feet per second for 4 and 8 months of the year respectively, equivalent to about 214,000

acre-feet annually to operate the hatchery and maintain necessary minimum flows. This would result in a total reservoir storage capacity of 1,180,000 acre-feet and a dam 510 feet high with crest elevation of 1,430 feet mean sea level. No facilities for recreation would be included.

b. Single-purpose water supply. This project would be similar to the multiple-purpose project except that it would contain no provision for storing floods nor would recreation facilities be provided. A single-purpose water conservation project would have storage reservations of 2,000,000 acre-feet as a minimum pool which also would serve for sediment, potential slide storage and economical trans-basin tunnel costs, and 5,000,000 acre-feet for water conservation resulting in a total storage requirement of 7,000,000 acre-feet. A reservoir of this capacity would require a dam 715 feet high with its crest at elevation 1,635 feet mean sea level.

c. Single-purpose recreation. To provide recreation benefits similar to those resulting from the multiple-purpose project would require a project with the same scope of recreation facilities and a reservoir having the same long-term average water surface area, during the recreation season that would result through operation of the multiple-purpose project. It is estimated that the long-term mean elevation of the multiple-purpose reservoir will range between 1,540 feet in the spring and 1,520 feet in the fall. On the basis of an average elevation of about 1,530 feet, the reservoir surface area would be about 33,000 acres. However, it is estimated that an average water surface of about 27,000 acres, at elevation 1,465 feet, would suffice to produce the same recreation benefits as the multiple-purpose project as similar lands for development and water surface dimensions are comparable. It would be necessary, also, to provide for minimum fishery releases of about 214,000 acre-feet annually which would require 100,000 acre-feet of storage. A reservoir at elevation 1,465 feet would result in a gross storage capacity of about 2,970,000 acre-feet and this would be ample for sedimentation allowance for slides, for fishery releases, and for maintaining a reservoir fishery. For forming a lake at elevation 1,465 feet, a dam 595 feet high with its crest at elevation 1,515 feet mean sea level would be required. Outlet works and spillway would be of a similar construction to those in the multiple-purpose project. The single-purpose recreation project described above was formulated on the premise that for a project to be a true alternative, it must have the same capability and capacity for performing and satisfying the initial potential and forseeable future demands as provided for in the proposed project. The recreation function in the proposed multiple-purpose project has the capacity for ultimately satisfying 7.0 million recreation-days, and the potential for becoming a National Recreation Area. Therefore, as a true alternative, to be considered in the absence of the proposed project, the

alternative must possess similar capabilities. However, the proposed multiple-purpose project initially provided for 1.0 million recreation-days, and assuming that no future recreation facilities would be provided, it was necessary to formulate another single-purpose recreation alternative. The second considered recreation alternative, designed to accommodate 1.0 million recreation-days, consisted of two small reservoirs located at the Franciscan and Etsel damsites. In spite of the geologic conditions described for these sites in above paragraphs F-12 and F-13, small dams at these locations were selected simply for the reason that no other sites for water-based or water-oriented recreation were available within the zone of influence that could be developed for reasonable costs. The dams considered at the Franciscan and Etsel sites would be about 200 feet high with storages of 150,000 and 90,000 acre-feet and water surface areas of 2,200 and 1,500 acres, respectively. Recreation facilities would be the same as contained in the proposed project. No provisions were made for landslides, and fish release flows were reduced proportionately in respect to the proposed project. The estimated cost of this recreation alternative is $55.0 million. It was concluded that for cost allocation purposes the recreation benefits would be the controlling factor and further alternative formulation was not warranted.

d. Single-purpose hydropower. The costs of developing a hydropower plant of the scope considered herein for that purpose alone would be economically unfeasible by a wide margin. It is considered, therefore, that the alternative cost of power, produced in an equivalent Federally-financed steam plant, will definitely control allocations to hydropower. Therefore, no estimate has been prepared for a single-purpose hydropower project.

F-49. PROJECTS FOR DETERMINING SEPARABLE COSTS

For use in determining separable costs for cost allocations for each of the purposes in a multiple-purpose project, it is necessary to develop costs for alternative projects in each of which one of the primary project purposes is omitted. The difference in cost betweenthe adopted multiple-purpose project and each alternative project isthe separable cost of the purpose which was omitted from the particular alternative. First costs and annual charges excluding the specific costs for the Grindstone Diversion Tunnel and for the 14,000 acresof recreational lands are shown in Tables F-3 and F-4, respectively, for the four alternative projects needed to establish separable costs. A description of each is given in the following subparagraphs.

a. Project with water supply omitted. This project is basically the single-purpose recreation project with storage space of 600,000 acre-feet for flood control added. The resultant reservoir would have a gross storage capacity of about 3,570,000 acre-feet. The dam required with this storage would be about 615 feet high with its crest at about

elevation 1,535 feet mean sea level. Also, the cost of recreation lands and facilities, needed to generate the same recreation benefits as the multiple-purpose project, would be an added item. Since fishery releases would be made under conditions where adequate head would be available for the purpose, the hydropower facilities of the multiple-purpose project would be incorporated in this alternative.

b. Project with recreation omitted. Fundamentally, this project would be the same as the multiple-purpose project except that the cost of recreation lands and facilities would be deducted.

c. Project with flood control omitted. Basically, this project would be the same as the multiple-purpose project from which the 600,000 acre-feet of flood control storage would be deleted.

d. Project with hydropower omitted. This would be the basic multiple-purpose project except that the costs for the hydropower facilities would be omitted.

COST ALLOCATIONS AND APPORTIONMENTS

F-50. GENERAL

Project costs have been allocated to purposes in accordance with the "Separable Costs - Remaining Benefits" method in keeping with existing practices and policies of the Federal agencies. The mathematics of the cost allocation procedure is such that the order of certain of the calculations can be rearranged without affecting the results. In this instance, therefore, it was possible to omit the specific costs for the Grindstone Diversion Tunnel and for the 14,000 acres of additional recreational lands from all the computations involving the cost allocations with the exception of reducing the water supply benefit (which was not based on a single-purpose reservoir at Dos Rios) by the annual cost of the Grindstone Diversion Tunnel.

F-51. ALLOCATION OF COSTS

The computations for the cost allocations to project purposes, for a 100-year economic life, by the Separable Costs - Remaining Benefits method are given in Table F-5. Benefits shown in the table have been taken from Appendix E. For water supply, the estimated annual benefits of $26,100,000 have been reduced by $5,870,000, the estimated annual specific cost for the Grindstone Diversion Tunnel, to give $20,230,000. For information purposes allocations were made, also, to illustrate the effect of excluding recreation as a project purpose, the results of which are shown in Table F-7. For the adopted multiple-purpose project, the results of Table F-5 are summarized in the following tabulation:

Item	Purpose				
	Flood Control	Water Supply	Recreation	Hydro Power	Total
			(in $1,000's)		
FIRST COSTS					
A. DAM AND RESERVOIR					
Percent Joint-Use (remaining) Cost	12.9	79.0	7.8	0.3	100.0
Joint-Use (remaining) Cost	$30,400	$186,000	$18,000	$ 600	$235,000
Specific Costs	0	0	4,000	2,000	6,000
Totals	$30,400	$186,000	$22,000	$2,600	$241,000
B. GRINDSTONE DIVERSION TUNNEL					
Specific Cost	0	$153,000	0	0	$153,000
C. ADDED LANDS FOR FUTURE RECREATION POTENTIAL					
Specific Cost	0	0	$ 4,000	0	$ 4,000
D. TOTAL PROJECT	$30,400	$339,000	$26,000	$2,600	$398,000
ANNUAL CHARGES 1/					
A. DAM AND RESERVOIR					
Interest plus Amortization	$ 1,154	$ 7,010	$ 837	$ 99	$ 9,100
Operation, maintenance and major replacements	56	300	143	71	570
Totals	$ 1,210	$ 7,310	$ 980	$ 170	$ 9,670
B. GRINDSTONE DIVERSION TUNNEL					
Interest plus Amortization	-	$ 5,780	-	-	$ 5,780
Operation, maintenance and major replacements	-	90	-	-	90
Totals	-	$ 5,870	-	-	$ 5,870
C. TOTAL PROJECT	$ 1,210	$ 13,180	$ 980	$ 170	$ 15,540

1/ Annual costs are not included for the added recreation lands which would be acquired and held in reserve for possible additional development in the future. In accordance with the Federal Projects Recreation Act of 1965 these lands would be retained for a minimum period of 10 years after which time a determination would be made to the extent that they are excess to the needs, or potential, for further recreation improvements.

F-52. APPORTIONMENT OF COST TO INTERESTS

In accordance with existing laws and policies, definite guides have been established for sharing of project costs between the Federal Government and non-Federal interests. Federal portions of costs are considered non-reimbursable while non-Federal portions are reimbursable to the Federal Government by a State or local sponsoring agency. For the project considered herein, all costs allocated to flood control are Federal costs since benefits are considered to be of general and widespread nature and there are no known windfall benefits; all costs allocated to water supply are non-Federal; and, costs allocated to recreation as a definite project purpose follow a separate cost-sharing formula described below. In the event that recreation is not a project purpose because of the lack of desire, or of the inability, of non-Federal interests to share in recreation development, the minimum basic facilities for public health and safety only would be included. In accordance with Section 3 of Public Law 89-72, the costs allocated to recreation based upon minimum facilities and reduced benefits will be non-reimbursable. With recreation as a project purpose, the Federal Government would assume all of the related joint costs for construction and joint operation, maintenance and major replacements plus one-half of the separable first costs for including recreation as a purpose. Non-Federal interests must agree to pay, or repay, with interest, the remaining one-half of the separable first costs allocated to recreation, together with interest during construction, and agree to operate and maintain the recreation lands and facilities. These operation, maintenance and major replacement costs for recreation are specifically identifiable as those costs directly expended from year to year for operating and maintaining (including major replacements) the project recreation facilities. As previously noted, the specific costs associated with the Grindstone Tunnel are related to water supply and are non-Federal. Of the total first cost of $398,000,000, the net Federal cost would be $57,000,000 and non-Federal $341,000,000. Annual operation, maintenance costs of $660,000 would be apportioned $160,000 to the Federal Government and $500,000 including $90,000 for the Grindstone Diversion Tunnel, to non-Federal interests. A summary of the cost apportionment is given below:

Item	Purpose				
	Flood Control	Water Supply	Recreation	Hydro Power	Total
			(in $1,000's)		
FIRST COSTS					
A. DAM AND RESERVOIR					
Federal	$30,400	0	$20,000	$2,600	$ 53,000
Non-Federal	0	$186,000	2,000	0	188,000
Total	$30,400	$186,000	$22,000	$2,600	$241,000
B. GRINDSTONE DIVERSION TUNNEL					
Federal	0	0	0	0	0
Non-Federal	0	$153,000	0	0	$153,000
Total	0	$153,000	0	0	$153,000
C. ADDED LANDS FOR FUTURE RECREATION POTENTIAL					
Federal	0	0	$ 4,000	0	$ 4,000
Non-Federal	0	0	0	0	0
Total	0	0	$ 4,000	0	$ 4,000
D. TOTAL PROJECT					
Federal	$30,400	0	$24,000	$2,600	$ 57,000
Non-Federal	0	$339,000	2,000	0	341,000
Total	$30,400	$339,000	$26,000	$2,600	$398,000
ANNUAL CHARGES					
A. DAM AND RESERVOIR					
(1) Interest plus amortization					
Federal	$ 1,154	0	$ 761	$ 99	$ 2,014
Non-Federal	0	$ 7,010	76	0	7,086
Total	$ 1,154	$ 7,010	$ 837	$ 99	$ 9,100
(2) Operation, maintenance and major replacements					
Federal	$ 56	0	$ 33	$ 71	$ 160
Non-Federal	0	$ 300	110	0	410
Total	$ 56	$ 300	$ 143	$ 71	$ 570

Item	Purpose				
	Flood Control	Water Supply	Recreation	Hydro Power	Total
	(in $1,000's)				
(3) Total Project					
Federal	$ 1,210	0	$ 794	$ 170	$ 2,174
Non-Federal	0	$ 7,310	186	0	7,496
Total	$ 1,210	$ 7,310	$ 980	$ 170	$ 9,670
B. GRINDSTONE DIVERSION TUNNEL					
(1) Interest plus Amortization					
Federal	0	0	0	0	0
Non-Federal	0	$ 5,780	0	0	$ 5,780
Total	0	$ 5,780	0	0	$ 5,780
(2) Operation, maintenance and major replacements					
Federal	0	0	0	0	0
Non-Federal	0	$ 90	0	0	$ 90
Total	0	$ 90	0	0	$ 90
(3) Total project					
Federal	0	0	0	0	0
Non-Federal	0	$ 5,870	0	0	$ 5,870
Total	0	$ 5,870	0	0	$ 5,870
C. TOTAL PROJECT					
Federal	$ 1,210	$ 0	$ 794	$ 170	$ 2,174
Non-Federal	0	13,180	186	0	13,366
Total	$ 1,210	$ 13,180	$ 980	$ 170	$ 15,540

F-53. FINANCIAL REQUIREMENTS OF NON-FEDERAL INTERESTS

In addition to the normal legal requirements, local interests would be required to meet the following financial obligations:

a. In accordance with the principles of the Water Supply Act of 1958 and prior to construction of the project, execute a contract with the Federal Government providing for repayment with interest of

the total first cost of the reservoir project exclusive of specific costs for recreation, hydropower, and Grindstone Diversion Tunnel, currently estimated as $186,000,000 plus interest during construction, and 76.2 percent of the total project annual cost for maintenance, operation and major replacements of the reservoir project exclusive of specific annual costs for recreation, hydropower, and Grindstone Diversion Tunnel, currently estimated as $300,000, all of which are costs allocated to the water conservation purpose of the project.

b. In accordance with the provisions contained in the Federal Water Project Recreation Act of 1965, execute a contract with the Federal Government for repayment with interest of one-half of the separable first costs of the project which are allocated to recreation, now estimated at$2,000,000, and agree to operate and maintain the recreational lands and facilities, the cost of which is now estimated to be $107,000 annually.

c. Agree to construct under their own method of financing and operate and maintain the Grindstone Tunnel, now estimated at a first cost of $153,000,000 and annual operation and maintenance cost of $90,000 with completion such that expected overall project benefits are essentially preserved.

TABLE F-1

PERTINENT DATA - DOS RIOS DAM AND RESERVOIR

Item	Unit	Quantity
HYDROLOGIC DATA		
Location of dam	On Middle Fork Eel River about 3 miles upstream from Eel River	
Drainage Area	Square Miles	745
Standard Project Flood Inflow Peak	c.f.s.	275,000
Spillway Design Flood Inflow Peak	c.f.s.	470,000
Maximum Flood of Record Inflow Peak (December 1964)	c.f.s.	216,000
RESERVOIR STORAGE		
Sediment deposition reservation 1/	Acre-feet	See note
Minimum pool-recreation and fishery 2/	"	2,000,000
Water supply pool	"	5,000,000
Flood control pool	"	600,000
Gross storage (top of flood control pool)	"	7,600,000
Maximum induced surcharge of spillway design flood above flood pool	"	970,000
RESERVOIR ELEVATION		
Streambed	Ft. m.s.l.	920
Top of minimum pool	"	1,425
Average recreation pool (mid-season)	"	1,530
Top of water supply pool	"	1,587
Top of flood control pool	"	1,602
Water surface, spillway design flood	"	1,626
RESERVOIR AREA		
Top of minimum pool	Acres	22,500
Top of average recreation pool	"	33,000
Top of water supply pool	"	38,500
Top of flood control pool	"	40,000

1/ Included in minimum pool.
2/ Includes sedimentation and slide potential.

TABLE F-1
(Cont'd)
PERTINENT DATA - DOS RIOS DAM AND RESERVOIR

Item	Unit	Quantity
DAM		
Type - Rockfill impervious core		
Elevation at crest	Ft. m.s.l.	1,650
Length of crest	Feet	2,120
Height	"	730
Width of crest	"	30
SPILLWAY		
Type - Side channel with 50' diameter tunnel		
Gates (30' x 44')	Each	3
Elevation at crest	Ft. m.s.l.	1,581
At top of gate	"	1,625
Design discharge	c.f.s.	109,000
Tailwater elevation	Ft. m.s.l.	940
OUTLET WORKS (Bottom outlet for dewatering reservoir)		
Type - (Gated conduits in diversion tunnel plug)		
Conduits (8.0' diameter)	Each	3
Gates (8.0' diameter)		
Emergency	"	3
Service	"	3
OUTLET WORKS (fishery release outlet)		
Type - Multiple-level inlet gate chamber in tunnel in left abutment of dam		
Length of tunnel (6.5' diameter)	Feet	4,700
Steel pipeline to hatchery and return to stream (4.0' diameter)	"	10,600
Gates		
Quality control (mixing - 6.5'x6.5' slide gate)	Each	4
Emergency (6.5' x 6.5' slide gate)	"	2
Discharge control(6.5'x6.5' slide gate)	"	2
Capacity at minimum pool elevation	c.f.s.	400
Invert elevation (from highest to lowest intakes)	Ft. m.s.l.	1,565
	"	1,510
		1,440
		1,364

TABLE F-1
(Cont'd)
PERTINENT DATA - DOS RIOS DAM AND RESERVOIR

Item	Unit	Quantity
DIVERSION TUNNEL (Diversion during construction)		
Diameter (50' diameter)		
Approximate length	Feet	4,500
Invert elevation at entrance	Ft. m.s.l.	940
Maximum expected diversion requirement	c.f.s.	188,000
GRINDSTONE TUNNEL (Water Supply)		
Diameter (17 feet)		
Approximate length	Miles	21.0
Invert elevation at entrance	Ft. m.s.l.	1,405.0
Top of control tower	"	1,635.0
Maximum expected diversion requirement	c.f.s.	3,000
Gates (8.5' x 15.5' slide gates)		
Emergency	Each	2
Service	"	2
FISH HATCHERY		
Rearing capacity	No. of eggs annually	
Salmon	"	16,250,000
Steelhead		4,600,000
Total		20,850,000
RECREATIONAL FACILITIES		
Developed recreation areas	Acres	800
Campsites	Each	500
Picnic sites	"	190
Swimming beaches	Area	1
Boat-launching lanes	Each	9
GAME MANAGEMENT AREA		
Managed area	Acres	16,000

TABLE F-2

DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Class.	Man. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
		I - PRINCIPAL FEATURES, RESERVOIR PORTION OF PROPOSED PROJECT					
.01		LANDS AND DAMAGES					
		1. Reservoir lands					
		a. Round Valley	16,200	Ac.	750.00	$ 12,150	
		b. Hill land	49,400	"	250.00	12,350	
		c. Recreation (initial development) 1/	800	"	250.00	200	
		d. Wildlife refuge	16,000	"	250.00	4,000	
		e. Fish hatchery	50	"	250.00	13	
		f. Improvements		L.S.	7,820,000.	7,820	
		g. Mineral values		L.S.	100,000.00	100	
		2. Acquisition costs				1,167	
		Total, Item .01					$37,800
.02		RELOCATIONS					
		1. Covelo relocation					
		a. Preparation of townsite		L.S.	2,040,000.	2,040	
		2. Airport					
		a. Facility including Admin. Building and utilities		L.S.	2,100,000.	2,100	
		3. Power & telephone lines					
		a. Two-wire telephone	34.2	Mi.	1,295.00	44	
		b. 60 KV power line	1.4	"	16,120.00	23	
		c. 12 KV power line	32.8	"	10,980.00	360	
		4. Roads					
		a. County road (south from Black Butte Creek)	6	"	200,000.00	1,200	
		b. Covelo spur road	2	"	175,000.00	350	
		c. County road (net cost with credit for improvements deducted)	43.3	"	170,000.00	7,337	
		5. Bridge (650'L x 28'W)	1	L.S.	1,180,000.	1,180	
		6. Cemeteries	1,000	Graves	250.00	250	
		7. Ranger Stations					
		a. Eel River Station	Job	L.S.	749,000.00	749	
		b. Covelo Station	Job	L.S.	752,000.00	752	

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Man. Class. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.02	RELOCATIONS (Cont'd)					
	8. Indian relocation					
	a. Roads	Job	L.S.	7,900,000.	$ 7,900	
	b. Individual septic sewer system	Job	L.S.	440,000.00	440	
	c. Power and telephone service	Job	L.S.	400,000.00	400	
	d. Water supply	Job	L.S.	5,000,000.	5,000	
	9. Indian recreational facilities					
	a. Picnic sites	190	Ea.	1,500.	285	
	b. Camp sites	500	"	2,700.	1,350	
	c. Swimming areas	Job	L.S.	630,000.	630	
	d. Boat-launching areas	10	Lane	36,000.	360	
	e. Access roads	1.75	Mi.	150,000.00	263	
	10. Lands					
	a. Covelo relocation site	800	Ac.	250.00	200	
	b. Acquisition Covelo site		L.S.	12,000.00	12	
	c. Airport site	200	Ac.	250.0	50	
	d. Acquisition airport site		L.S.	2,000.00	2	
	e. County roads	350	Ac.	250.00	88	
	f. Acquisition county road right-of-way		L.S.	5,000.00	5	
	g. Indian relocation	4,560	Ac.	250.00	1,140	
	h. Indian recreation site	640	Ac.	250.00	160	
	i. Acquisition Indian land		L.S.	78,000.00	78	
	11. Contingencies				6,752	
	Total, Item .02					$41,500
.03	RESERVOIRS					
	1. Clearing	38,500	Ac.	125.00	$ 4,813	
	2. Archeological investigations		L.S.	415,000.00	415	
	3. Contingencies				1,072	
	Total, Item .03					$ 6,300

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Class.	Man. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.04		DAMS					
		1. Embankment					
		a. Diversion & control of water	Job	L.S.	200,000.00	$ 200	
		b. Clearing & grubbing	114	Ac.	500.00	57	
		c. Stripping	1,060,000	C.Y.	.40	424	
		d. Pressure grouting	58,000	L.F.	10.00	580	
		e. Embankment					
		Oversized rock (24" max. dia.)	5,590,000	C.Y.	.35	1,957	
		Compacted rock (18" max. dia.)	6,720,000	C.Y.	.30	2,016	
		Compacted rock (6" max. dia.)	15,500,000	C.Y.	.30	4,650	
		Transition material	3,780,000	C.Y.	.30	1,134	
		Impervious core	5,050,000	C.Y.	.35	1,768	
		f. Borrow					
		Oversized rock (24" max. dia.)	4,300,000	C.Y.	1.40	6,020	
		Compacted rock (18" max. dia.)	5,170,000	C.Y.	1.40	7,238	
		Compacted rock (6" max. dia.)	11,900,000	C.Y.	1.30	15,470	
		Transition material	300,000	C.Y.	.55	165	
		Impervious core	6,310,000	C.Y.	.55	3,470	
		g. Abutment drainage (includes drainage pipe, drain holes, excavation)	Job	L.S.	3,500,000	3,500	
		h. Instrumentation	Job	L.S.	250,000.00	250	
		i. Construction camp	Job	L.S.	35,000.00	35	
		j. Miscellaneous temporary facilities	Job	L.S.	15,000.00	15	
		2. Spillway					
		a. Clearing & grubbing	9.4	Ac.	500.00	5	
		b. Excavation					
		1. Rock	871,000	C.Y.	1.25	1,089	
		2. Rock tunnel - 45° slope	75,000	C.Y.	30.00	2,250	

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Man. Class. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.04	DAMS (Cont'd)					
	2. Spillway (Cont'd)					
	c. Concrete					
	1. Spillway					
	Ogee weir	2,550	C.Y.	60.00	$ 153	
	Walls	6,380	C.Y.	50.00	319	
	Floors	13,400	C.Y.	27.00	362	
	Baffle blocks	390	C.Y.	50.00	20	
	2. Tunnel 50' Ø - (45° slope)	26,800	C.Y.	135.00	3,618	
	d. Re-steel	1,800	Ton	300.00	540	
	e. Rock bolts, 50' long	7,360	Ea.	45.00	331	
	f. Drain holes (3" Ø - 50' long)	368,000	L.F.	3.00	1,104	
	g. Structural steel for tunnel	2,080	Ton	350.00	728	
	h. Timber for tunnel	82	MBM	220.00	18	
	i. Tainter gates (30'W x 44'H)	3	Ea.	336,600.00	1,010	
	j. Riprap	15,000	Ton	4.25	64	
	k. Pressure grouting	3,320	L.F.	10.00	33	
	l. Special stainless steel lining (1" thick)	600	Ton	1,340.00	804	
	3. Outlet works and Diversion Tunnel					
	a. Excavation					
	1. Tunnel (50' Ø horizontal)	465,000	C.Y.	25.00	11,625	
	2. 16' dia. access shaft	7,520	C.Y.	20.00	150	
	b. Concrete					
	1. 50' dia. tunnel	147,000	C.Y.	90.00	13,230	
	2. 8' dia. access shaft	2,220	C.Y.	90.00	200	
	3. Stop plug	20,800	C.Y.	175.00	3,640	
	4. Diversion tunnel inlet structure	2,750	C.Y.	60.00	165	
	c. Re-steel	8,400	Ton	300.00	2,520	
	d. Structural steel for tunnel	11,100	Ton	350.00	3,885	
	e. Timber for tunnel supports	520	MBM	220.00	114	
	f. Elevator (16' Ø shaft, 725' long)	Job	L.S.	100,000.00	100	

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Man. Class. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.04	DAMS (Cont'd)					
	3. Outlet Works and Diversion Tunnel (Cont'd)					
	g. Control house and miscellaneous equipment	Job	L.S.	300,000.00	$ 300	
	h. 8' Ø tunnel through stop plug	3	Ea.	411,700.00	1,235	
	i. Gates (5'W x 11'H)	6	Ea.	60,000.00	360	
	j. Gate chamber (40' dia. x 50')	1	L.S.	100,000.00	100	
	k. Trash rack (54' x 54')	1	Ea.	135,000.00	135	
	l. Stop log	1	Ea.	150,000.00	150	
	m. Pressure grouting	4,600	L.F.	10.00	46	
	4. Fish release outlet					
	a. Excavation					
	Tunnel rock (6.5 Ø)	10,600	C.Y.	25.00	265	
	Access shaft (16'Ø)	6,400	C.Y.	20.00	128	
	b. Concrete					
	Inlet structure	1,500	C.Y.	50.00	75	
	Access Shaft (16'Ø)	1,860	C.Y.	90.00	167	
	Tunnel	2,800	C.Y.	90.00	252	
	c. Reinforcing steel	235	Ton	300.00	71	
	d. Structural steel for tunnel	480	Ton	350.00	168	
	e. Timber for tunnel supports	75	MBM	220.00	17	
	f. Trash rack (9' x 9')	4	Ea.	4,000.00	16	
	g. Gate chamber (35' dia. x 50'H)	Job	L.S.	80,000.00	80	
	h. Control valve (48" gate, ball-type)	2	Ea.	14,000.00	28	
	i. Steel pipe (48" dia. 1/2" wall)	10,560	L.F.	78.00	824	
	j. Slide gates (6.5' x 6.5')	8	Ea.	24,000.00	192	
	k. Stop logs (7.5' x 7.5')	4	Ea.	1,500.00	6	
	l. Elevator (16' Ø shaft - 610' long)	Job	L.S.	60,000.00	60	
	m. Steel lining (6.5' dia. x 4,700' x 1/2" thick.)	978	Ton	1,000.00	978	
	n. Pressure grouting	4,500	L.F.	10.00	45	
	5. Contingencies				18,296	
	Total, Item .04					$121,020

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Man. Class. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.06	FISH AND WILDLIFE FACILITIES					
	1. Fish hatchery		L.S.	3,300,000.	$ 3,300	
	2. Preparation of game management area		L.S.	120,000.00	120	
	3. Contingencies				580	
	Total, Item .06					$ 4,000
.07	POWER PLANT					
	1. Excavation, bedding & gravel bedding	Job	L.S.	10,000.00	$ 10	
	2. Concrete (afterbay)					
	a. Walls	190	C.Y.	60.00	11	
	b. Slab	425	C.Y.	30.00	13	
	c. Transition weir	50	C.Y.	45.00	2	
	3. Reinforcing steel	30	Ton	300.00	9	
	4. Pipe (48" dia.) and miscellaneous fitting	Job	L.S.	13,000.00	13	
	5. Surge supressing valve (600' head-200 c.f.s.)	1	Ea.	12,000.00	12	
	6. Gate valve (Ball-type 4' dia.)	4	Ea.	14,000.00	56	
	7. Powerhouse (20'x40'x30' reinforced concrete)	800	S.F.	40.00	32	
	8. Generating turbine (4,800 KW)	Job	L.S.	936,000.00	936	
	9. Switching yard (4,800 KW)	Job	L.S.	190,000.00	190	
	10. Substation (60 KV)	Job	L.S.	200,000.00	200	
	11. Transmission line (60 KV)	1.23	Mi.	34,000.00	42	
	12. Contingencies				274	
	Total, Item .07					$ 1,800
.08	ROADS, RAILROADS AND BRIDGES					
	1. Improvement of Longvale-Dos Rios road for passage of construction equipment	Job	L.S.	2,300,000.	2,300	
	2. Overlook	Job	L.S.	200,000.	200	
	Total, Item .08					$ 2,500

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Man. Class. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.14	RECREATION FACILITIES 2/					
	1. Proposed initial development for 1,000,000 visitor days					
	a. Picnic sites	190	Ea.	1,500.00	$ 285	
	b. Campsites	500	Ea.	2,700.00	1,350	
	c. Swimming areas	Job	L.S.	532,000.00	532	
	d. Boat-launching areas	9	Lane	36,000.00	325	
	e. Access roads	2.2	Mi.	150,000.00	341	
	f. Contingencies				567	
	Total, Item .14					$ 3,400
.19	BUILDINGS, GROUNDS AND UTILITIES					
	1. Project laboratory	1	L.S.	45,000.00	45	
	2. Project office building	1	L.S.	50,000.00	50	
	3. Vehicle shelter	1	L.S.	20,000.00	20	
	4. Fuel storage	1	L.S.	5,000.00	5	
	5. Water system	1	L.S.	50,000.00	50	
	6. Sanitary system	1	L.S.	65,000.00	65	
	7. Landscaping	1	L.S.	5,000.00	5	
	8. Contingencies	1	L.S.		50	
	Total, Item .19					$ 290
.20	PERMANENT OPERATING EQUIPMENT					
	1. Monumentation	Job	L.S.	290,000.00	$ 290	
	2. Hydrologic facilities	Job	L.S.	75,000.00	75	
	3. Communications facilities	Job	L.S.	25,000.00	25	
	4. Miscellaneous equipment, etc.	Job	L.S.	15,000.00	15	
	5. Contingencies				85	
	Total, Item .20					$ 490

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Class.	Man. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
.30		ENGINEERING AND DESIGN					$ 11,500
.31		SUPERVISION AND ADMINISTRATION					10,400
		TOTAL, PROJECT FIRST COST - INITIAL CONSTRUCTION - ITEM I					$241,000

1/ Excludes 14,000 acres reserved for recreation potential not currently possible due to access to project area.

2/ Cost of the minimum basic facilities required for the public, health and safety is estimated at $520,000 and the lands required for the construction of these facilities as 200 acres at a cost of $50,000.

II - ADDED LANDS TO BE ACQUIRED FOR POSSIBLE FUTURE EXPANSION OF RECREATION FACILITIES

.01		LANDS AND DAMAGES					
	1.	Future recreation lands	14,000	Ac.	250.00	$ 3,500	
	2.	Acquisition costs				500	
		Total, Item .01					$ 4,000
		TOTAL, PROJECT FIRST COST - ITEM II					$ 4,000

III - GRINDSTONE TUNNEL

.01		LANDS AND DAMAGES					
	1.	Lands, easements and acquisition costs	Job	L.S.	100,000.00	$ 100	
		Total, Item .01					$ 100

TABLE F-2
(Cont'd)
DOS RIOS DAM AND RESERVOIR
Cost Estimate, Multiple-purpose Project

P&A Man. Class. No.	Item	Quantity	Unit	Unit Price (Dollars)	Amount Subtotal (000)	Amount Total (000)
	III - GRINDSTONE TUNNEL (Cont'd)					
.04	DAMS					
	1. Upstream portal (intake structure)					
	a. Excavation	100,000	C.Y.	.90	$ 90	
	b. Backfill	18,000	C.Y.	1.30	23	
	c. Concrete (including cement)	10,000	C.Y.	70.00	700	
	d. Re-steel	500	Ton	300.00	150	
	2. Upstream portal (control structure)					
	a. Access bridge	Job	L.S.	190,000.00	190	
	b. Concrete (including cement)	8,000	C.Y.	70.00	560	
	c. Re-steel	400	Ton	300.00	120	
	d. Control house	250	S.F.	125.00	31	
	e. Control gates (2 - 8.5' x 15.5' tandem)	2	Ea.	390,000.00	780	
	f. Stop logs	2	Ea.	12,000.00	24	
	g. Trash rack	2	Ea.	40,000.00	80	
	h. Operation equipment	Job	L.S.	200,000.00	200	
	i. Crane (20 tons)	1	Ea.	25,000.00	25	
	3. Tunnel, downstream portal and stilling basin					
	a. Rock tunneling	1,268,000	C.Y.	30.00	38,040	
	b. Structural steel (tunnel supports)	11,530	Ton	350.00	4,036	
	c. Timber logging and supports	2,800	MBM	220.00	616	
	d. Concrete (including cement for downstream tunnel & downstream stilling basin)	361,000	C.Y.	90.00	32,490	
	e. Re-steel	14,440	Ton	300.00	4,332	
	f. Grouting	218,000	L.F.	10.00	2,180	
	g. Wet headings	27,200	L.F.	1,000.00	27,200	
	4. Access road (tunnel portal)	11.2	Mi.	1,960,000.	2,195	
	5. Contingencies				22,838	
	Total, Item .01 + .04					$137,000
.30	ENGINEERING AND DESIGN					8,400
.31	SUPERVISION AND ADMINISTRATION					7,600
	TOTAL, PROJECT FIRST COST - ITEM III					$153,000
	TOTAL, PROJECT FIRST COST - ITEMS I, II, & III					$398,000

TABLE F-3

DOS RIOS DAM AND RESERVOIR
SUMMARY OF FIRST COSTS FOR MULTIPLE-PURPOSE AND SINGLE-PURPOSE PROJECTS
AND FOR PROJECTS NEEDED TO DETERMINE SEPARABLE COSTS
(EXCLUDES SPECIFIC COSTS OF GRINDSTONE DIVERSION TUNNEL AND ADDED RECREATION LANDS)

P&A Man. Code	Item	Costs in Thousands of Dollars							
			Single-Purpose Projects			Projects for Determining Separable Costs - Cost of Multi-Purpose Project Without:			
		Multiple-Purpose Project	Flood Control	Water Supply	Recreation	Flood Control	Water Supply	Recreation	Hydropower
.01	Lands and damages	37,800	29,600	37,000	33,000	37,000	33,500	37,600	37,800
.02	Relocations	46,200	39,900	45,100	41,500	45,400	40,400	46,200	46,200
.03	Reservoir	7,000	3,100	6,900	4,900	6,900	5,400	7,000	7,000
.04	Dams	136,100	86,300	131,900	102,700	131,900	101,800	136,100	136,100
.06	Fish and wildlife facilities	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300
.07	Powerplant	2,000	0	0	0	2,000	2,000	2,000	0
.08	Roads, railroads and bridges	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
.14	Recreation facilities (full development)	3,800	0	0	3,800	3,800	3,800	0	3,800
	(basic facilities only) 1/	(800)	(0)	(0)	(800)	(800)	(800)	(0)	(800)
.19	Buildings, grounds and utilities	300	300	300	300	300	300	300	300
.20	Permanent operating equipment	500	500	500	500	500	500	500	500
	Total, Project First costs with full Recreation Development	241,000	167,000	229,000	194,000	235,000	192,000	237,000	239,000
	Total, with only basic facilities	(238,000)	(NA)	(NA)	(191,000)	(232,000)	(189,000)	(237,000)	(236,000)

Note: Total project costs for E&D and S&A have been distributed to construction items but not to lands and damages.
1/ If basic facilities provided for the public health and safety only.

TABLE F-3
(Cont'd)
DOS RIOS DAM AND RESERVOIR
SUMMARY OF FIRST COSTS FOR MULTIPLE-PURPOSE AND SINGLE-PURPOSE PROJECTS
AND FOR PROJECTS NEEDED TO DETERMINE SEPARABLE COSTS
(EXCLUDES SPECIFIC COSTS OF GRINDSTONE DIVERSION TUNNEL AND ADDED RECREATION LANDS)

Item	Costs Allocated to Each Purpose in Thousands of Dollars				
	Flood Control	Water Supply	Recreation	Hydropower	Total
Specific costs included in multiple-purpose project	0	0	4,000	2,000	6,000
Separable costs included in multiple-purpose project	6,000	49,000	4,000	2,000	61,000
Note: The following items are related to a multiple-purpose project in which facilities for the public health and safety only are provided.					
Project first cost	-	-	-	-	238,000
Specific costs included in project	0	0	1,000 1/	2,000	3,000
Separable costs included in project	6,000	49,000	1,000 1/	2,000	58,000

1/ Public health and safety only.

TABLE F-4

DOS RIOS DAM AND RESERVOIR
SUMMARY OF PROJECT INVESTMENTS AND ANNUAL CHARGES FOR MULTIPLE-PURPOSE AND SINGLE-PURPOSE PROJECTS AND FOR PROJECTS NEEDED TO DETERMINE SEPARABLE COSTS
(EXCLUDES SPECIFIC COSTS OF GRINDSTONE DIVERSION TUNNEL AND ADDED RECREATION LANDS)

Item	Costs in Thousands of Dollars							
		Single-Purpose Projects			Projects for Determining Separable Costs - Cost of Multi-Purpose Project Without:			
	Multiple-Purpose Project	Flood Control	Water Supply	Recreation	Flood Control	Water Supply	Recreation	Hydropower
A. FOR 100-YEAR ECONOMIC LIFE								
1. PROJECT FIRST COST AND INVESTMENTS								
First costs	241,000	167,000	229,000	194,000	235,000	192,000	237,000	239,000
Interest during construction	27,500	19,000	26,100	22,100	26,800	25,000	27,000	27,200
Project investments	268,500	186,000	255,100	216,100	261,800	213,900	264,000	266,200
2. ANNUAL CHARGES								
Interest & amortization (0.0339)	9,100	6,310	8,650	7,330	8,880	7,250	8,950	9,020
Operation and maintenance:								
Dam and reservoir	116	48	105	69	108	70	115	116
Concrete structures	29	23	26	25	27	25	27	28
Access roads	0	0	0	0	0	0	0	0
Steel structures and gates	45	45	45	45	45	45	45	45
Fish hatchery	190	190	190	190	190	190	190	190
Recreational facilities	100	0	0	100	100	100	0	100
Powerplant	55	0	0	0	55	55	55	0
Subtotal, Operation and Maintenance	535	306	366	429	525	485	432	479

TABLE F-4
(Cont'd)
DOS RIOS DAM AND RESERVOIR
SUMMARY OF PROJECT INVESTMENTS AND ANNUAL CHARGES FOR MULTIPLE-PURPOSE AND SINGLE-PURPOSE PROJECTS AND FOR PROJECTS NEEDED TO DETERMINE SEPARABLE COSTS
(EXCLUDES SPECIFIC COSTS OF GRINDSTONE DIVERSION TUNNEL AND ADDED RECREATION LANDS)

Item	Cost in Thousands of Dollars							
		Single-Purpose Projects			Projects for Determining Separable Costs - Cost of Multi-Purpose Project Without:			
	Multiple-Purpose Project	Flood Control	Water Supply	Recreation	Flood Control	Water Supply	Recreation	Hydropower
2. ANNUAL CHARGES (Cont'd)								
Major Replacements:								
Miscellaneous mechanical and electrical equipment and buildings	4	4	4	4	4	4	4	4
Recreation facilities	7	0	0	7	7	7	0	7
Fish hatchery	10	10	10	10	10	10	10	10
Powerplant	14	0	0	0	14	14	14	0
Subtotal, Major Replacements	35	14	14	21	35	35	28	21
Total, Operation, Maintenance and Major Replacements	570	320	380	450	560	520	460	500
Total, Annual Charges	9,670	6,630	9,030	8,180	9,440	7,770	9,410	9,520
(If recreation not included as a purpose)								
(Interest plus amortization)	(8,990)	-	-	-	(8,770)	(7,140)	(NA)	(8,910)
(Operation, Maintenance and Major Replacement)	(480)				(470)	(430)		(410)
(Total)	(9,470)				(9,240)	(7,570)		(9,320)

TABLE F-4
(Cont'd)
DOS RIOS DAM AND RESERVOIR
SUMMARY OF PROJECT INVESTMENTS AND ANNUAL CHARGES FOR MULTIPLE-PURPOSE AND SINGLE-PURPOSE PROJECTS AND FOR PROJECTS NEEDED TO DETERMINE SEPARABLE COSTS
(EXCLUDES SPECIFIC COSTS OF GRINDSTONE DIVERSION TUNNEL AND ADDED RECREATION LANDS)

Item	Costs Allocated to Each Purpose in Thousands of Dollars				
	Flood Control	Water Supply	Recreation	Hydropower	Total
SEPARABLE ANNUAL COSTS					
Operation, maintenance and major replacements	10	50	110	70	240
Interest plus amortization	220	1,850	150	80	2,300
Total	230	1,900	260	150	2,540
Note: The following items are relative to a multiple-purpose project in which facilities for the public health and safety only are provided					
SEPARABLE ANNUAL COSTS					
Operation, maintenance and major replacements	10	50	20	70	150
Interest plus amortization	220	1,850	40	80	2,190
Total	230	1,900	60	150	2,340

TABLE F-5

DOS RIOS DAM AND RESERVOIR
ALLOCATION OF PROJECT COSTS
SEPARABLE COSTS - REMAINING BENEFITS METHOD
100-Year Economic Life
(All Monetary Values are in $1,000)
(Excludes Grindstone Diversion Tunnel and Added Recreation Lands)

Item	Project Purpose				
	Flood Control	Water Supply	Recrea-tion	Hydro-power	Total
1. ALLOCATION OF TOTAL ANNUAL COSTS					
Benefits 1/	1,510	20,230	1,210	210	23,160
Alternate costs	6,630	9,030	8,180	170	24,010
Benefits limited by alternate costs	1,510	9,030	1,210	170	11,920
Separable costs	230	1,900	260	150	2,540
Remaining benefits	1,280	7,130	950	20	9,380
Percent for allocation of joint costs	13.7	76.0	10.1	0.2	100.0
Allocation of joint costs	980	5,410	720	20	7,130
Allocation of total annual costs	1,210	7,310	980	170	9,670
2. ALLOCATION OF ANNUAL OPERATION, MAINTENANCE AND MAJOR REPLACEMENT COSTS					
Separable costs	10	50	110	70	240
Allocated joint costs	46	250	33	1	330
Allocation of annual operation, maintenance & major replacements	56	300	143	71	570
Specific costs	0	0	107	69	176
Joint-use (remaining) cost	56	300	36	2	394
Percent joint-use (remaining) cost	14.2	76.2	9.1	0.5	100.0
3. ALLOCATION OF PROJECT INVESTMENT COSTS AND PROJECT FIRST COSTS					
Allocation annual investment costs	1,154	7,010	837	99	9,100
Allocated project first costs	30,400	186,000	22,000	2,600	241,000
Percent of total project first costs	12.7	77.0	9.2	1.1	100.0
Specific first costs	0	0	4,000	2,000	6,000
Joint-use (remaining) cost	30,400	186,000	18,000	600	235,000
Percent joint-use (remaining) cost	12.9	79.0	7.8	0.3	100.0

1/ From Appendix E. For water supply equals $26,100,000 (total) - $5,870,000 (Grindstone Diversion Tunnel), or $20,230,000.

TABLE F-6

DOS RIOS DAM AND RESERVOIR
SUMMARY OF FIRST COSTS AND ANNUAL CHARGES
FOR GRINDSTONE DIVERSION TUNNEL
AND FUTURE RECREATION LANDS
100-Year Economic Life
(All Monetary Values are in $1,000)

Item	Grindstone Diversion Tunnel	Future Recreation Lands
1. Project first cost	$153,000	$4,000
2. Interest during construction	17,400	0
3. Project investment	$170,400	$4,000
4. Annual charges:		
a. Interest plus amortization (0.0339)	$ 5,780	a/
b. Operation and maintenance	88	0
c. Major replacements	2	0
Total, annual charges	$ 5,870	0

a/ These lands would be acquired for possible future expansion of initial recreation development contingent upon adequate access to the site being provided by others and the willingness of non-Federal interests to share in the cost of and to operate the added facilities. Lands would be held by the Federal Government for a minimum of 10 years after project completion. If, by that time, access and non-Federal cooperation were not provided, the excess lands would be subject to disposal. If all of the lands were disposed of, it is considered that, at the minimum, their original costs would be recaptured. The only economic cost would be the interest during an approximate 10-year period, or so. The possible income from leasing the land plus the intangible benefit of protecting the area from probable large price increase if purchased at later date should more than offset the interest. No net annual cost, therefore, is associated with these added lands.

TABLE F-7

DOS RIOS DAM AND RESERVOIR
COMPLETE ALLOCATION OF PROJECT COSTS
ASSUMING ONLY BASIC FACILITIES
FOR PUBLIC HEALTH AND SAFETY
100-Year Economic Life
Separable Costs - Remaining Benefits Method
(All Monetary Values in $1,000)

Item	Project Purpose			
	Flood Control	Water Supply	Hydro-power	Total
1. ALLOCATION OF TOTAL ANNUAL COSTS				
Benefits	1,510	20,230	210	21,950
Alternate costs	6,630	9,030	170	15,830
Benefits limited by alternate costs	1,510	9,030	170	10,710
Separable costs	230	1,900	150	2,280
Remaining benefits	1,280	7,130	20	8,430
Percent for allocation of joint costs	15.2	84.6	0.2	100.0
Allocation of joint costs	1,090	6,080	20	7,190
Allocation of total annual costs	1,320	7,980	170	9,470
2. ALLOCATION OF ANNUAL OPERATION, MAINTENANCE AND MAJOR REPLACEMENT COSTS				
Separable costs	10	50	70	130
Allocated joint costs	50	300	0	350
Allocation of annual operation, maintenance & major replacements	60	350	70	480
3. ALLOCATION OF PROJECT INVESTMENT COSTS AND PROJECT FIRST COSTS				
Allocation annual investment costs	1,260	7,630	100	8,990
Allocated project first costs	33,400	202,000	2,600	238,000

EEL RIVER BASIN, CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

APRIL 1968

APPENDIX G

COMMENTS OF OTHER AGENCIES

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

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EEL RIVER BASIN, CALIFORNIA

INTERIM REPORT
ON
WATER RESOURCES DEVELOPMENT
FOR
MIDDLE FORK EEL RIVER

APRIL 1968

APPENDIX G

COMMENTS OF OTHER AGENCIES

GENERAL

G-1. SCOPE

The purpose of this appendix is to present the views and comments of other Federal and non-Federal agencies with discussions thereof relative to the recommended plan of improvement on the Middle Fork Eel River.

G-2. COORDINATION

Coordination with other Federal, State and local agencies was maintained throughout this study. These agencies expressed their interest in the studies and, when applicable, have prepared supplemental reports relating to their specific interests. Preliminary comments of these agencies have been considered during the preparation of this interim report. Field level views and comments of these agencies, and reports when submitted, are included herein as exhibits.

COMMENTS OF FEDERAL AGENCIES

G-3. SOIL CONSERVATION SERVICE (EXHIBIT A)

This agency stated that it is interested in the investigation for the proposed project and its work in the basin is presently that of furnishing technical assistance to cooperators in the Elk Creek Soil Conservation District, Mendocino County Soil Conservation District, Trinity County Soil and Water Conservation District and Westlake Soil Conservation District. Most of this assistance pertains to the rehabilitation and permanent improvement

of agricultural lands. Also, this agency under Section 6, Public Law 566 is preparing a report on watershed management for the Eel River Basin. Basic soil and water conservation information pertaining to the area is available in its office in Sebastopol, California and is available for use.

G-4. FOREST SERVICE (EXHIBIT B)

The Forest Service states that the proposed improvements will have a major impact on the lands and management of the Mendocino National Forest since the reservoir closely borders, and in some cases, inundates portions of the forest. The project will have impacts on the recreational, fire, protection, transportation, wildlife, timber management, watershed management and range activities or improvements. The agency raised a number of comments on specific items in the report. These comments were reviewed and where applicable the necessary corrections were incorporated in the report. The agency recommended that the Corps work closely with the U.S. Bureau of Public Roads relative to relocation of the various roads because of the questionable soils and geology conditions in the area. Finally, the Forest Service stated that it has started work on preparation of an impact study and its report will be completed in a year which will set forth in detail the effects of the project on its activities.

G-5. BUREAU OF RECLAMATION (EXHIBIT C)

The Bureau of Reclamation requested further information relative to the flood control benefits from the coordinated operation of the Dos Rios project and the proposed English Ridge project under study by its agency. This information will be handled by separate communication. The Bureau also stated that further study of the power plant below the Dos Rios Dam may indicate the desirability of rearranging and enlarging the installation for optimum use of the water and power potential available and in the design of the facility, consideration should be given to the arrangements to facilitate additional power development in the future if conditions change. During the advanced engineering and design stage, consideration will be given to the above comments made by the Bureau of Reclamation. In addition, the Bureau added that arrangements for power marketing will require consultation between its office and this office and that reference to power marketing and transmission responsibilities of the Bureau of Reclamation under Federal law and policy and the Interagency agreement should be included in the findings and recommendation. This matter has been incorporated in the report.

G-6. BUREAU OF LAND MANAGEMENT (EXHIBIT D)

The Bureau stated that it was unable to comment on the report in detail at this time. However, it added that its

official comments will be provided by an impact report it is presently preparing and will be completed by 1 October 1968. The report will identify the effects that the proposed reservoir will have on Bureau of Land Management resources and programs and the reciprocal effects that its programs may have on the proposed reservoir. Its report will contain recommendations with regard to management of lands and resources within and adjoining the project. The Bureau also noted that public domain lands within the subject area were recently classified for retention in Federal ownership under the Classification and Multiple Use Act of 1964. Also, in accordance with the Federal Water Project Recreation Act of 1965, provision is made for this agency to assume recreation administration of Federal water projects where public lands classified for retention in Federal ownership are within a reservoir project.

a. Discussion. The State of California has indicated its intent to assume the responsibilities of local cooperation for recreational development. This would not preclude recreational development by the Bureau of Land Management under such agreement as would be mutually acceptable to the State of California and this bureau. Details of any Bureau of Land Management involvement in recreation could be resolved during the advanced planning study stage.

G-7. BUREAU OF INDIAN AFFAIRS (EXHIBIT E)

The Bureau of Indian Affairs does not interpose any objections to the project at this date providing it is in no way objectionable to the Council and members of the Round Valley tribe. The Bureau also stated that the Corps of Engineers should assume full responsibility for conducting negotiations with the tribe relevant to the project and the Bureau will render every assistance to tribal authorities in reviewing such plans and proposal as requested by the tribe. The Bureau agreed that the full understanding of the Indian people involved and the presentation of adequate detailed plans for its evaluation are essential in obtaining approval of the tribe and its subsequent cooperation in the project. It added since this is a Corps of Engineers' project, the Corps should fund any analytical or study efforts in which the Bureau is asked to participate. It asked to be kept informed of any plans, studies or proposals that will require its assistance. Coordination already has been established with the Bureau of Indian Affairs and the Tribal Council. Development of detailed plans and necessary negotiations will be continued during post-authorization studies and designs.

G-8. BUREAU OF PUBLIC ROADS (EXHIBIT F)

The Bureau of Public Roads noted the proposed road relocations required because of the dam and reservoir. It furnished this office with a copy of a recent road system map of the area prepared by the California Division of Highways. This map is on file in San Francisco District, Corps of Engineers.

G-9. BUREAU OF OUTDOOR RECREATION (EXHIBIT G)

This Bureau limited its review to the recommended recreation plan in the report which includes both the Indian recreation plan to accommodate 1,000,000 visitor-days annually by 1990 and the general recreation plan to accommodate 1,000,000 recreation days by 1990. They stated that these plans and the land acquisition program outlined in the report should provide for adequate recreation development of the reservoir. Also, it stated that the plan for recreation is in accordance with the California Public Outdoor Recreation Plan developed by the State. Although the Bureau noted that consideration was being given in the draft of the report to developing the area as a national recreation area and stated it would like to comment on this matter should it become a recommendation, the report in its final form dropped this aspect from further consideration. The Bureau raised questions relative to costs presented in the report for the recreation facilities, namely the boat-launching areas, and stated that these costs do not appear to be wholly adequate. Subsequently, costs relative to recreational facilities were reviewed and adjusted accordingly and incorporated in the report. The Bureau stated that the pool fluctuation may be misleading and that the degree of drawdown, though not a serious deterrent to recreation development, should be noted. The pool fluctuation is adequately discussed in paragraph D-35. The Bureau agreed to the proposal of mitigating loss to the Indian economy through development of recreation potential at project cost and it requested we keep it informed of our progress in the development of this program. During the advanced study stage, coordination will be continued with the Bureau.

G-10. FEDERAL WATER POLLUTION CONTROL ADMINISTRATION (EXHIBIT H)

This agency stated that a preliminary water quality control study prepared by the Public Health Service in November 1962, entitled "Preliminary Report on Future Municipal and Industrial Water Uses and Future Water Quality Control Flow, Eel River Basin, California," and presenting information relative to stream flow regulation to maintain a dissolved oxygen level for sustaining the fishery of the Eel River is presently being reevaluated to outline these needs with specific reference to the Dos Rios and English Ridge projects. It added that from its advance data, its project reevaluation indicates that stream flow regulation needs for maintenance of the oxygen levels would not significantly change from that shown in its 1962 study and that these flows are less than the requirement for the fishery, determined by the U.S. Fish and Wildlife Service. The agency also added that its current study will evaluate the impact of water quality of expanding the conservation yield of Dos Rios Dam and English Ridge Dam through the Clear Lake conveyance route. It further stated that preliminary results of its studies show that water quality improvements would result from the conveyance of water through Clear Lake, however, this matter will be evaluated in greater detail in their forthcoming report.

G-11. NATIONAL PARK SERVICE (EXHIBIT I)

The National Park Service stated that the entire Eel River Basin is a vast archeological area with a long history of Indian inhabitation and these archeological values have been fully considered in our report. It added that the funds allotted in the report for study and salvage of this resource appears to be adequate. The Service also mentioned the matter to developing the reservoir areas as a national recreation area. As previously stated in paragraph G-9 the Dos Rios Reservoir will not be recommended as a national recreation area. The comments pertaining to this feature, therefore, no longer apply.

G-12. U.S. FISH AND WILDLIFE SERVICE (EXHIBIT J)

The Fish and Wildlife Service furnished this office with an interim report relative to the effects the proposed Dos Rios Dam and Reservoir would have on the fish and wildlife. The agency made the following comments regarding the fish resources: the proposed dam would block anadromous fish access to about 150 miles of spawning area in the Middle Fork and tributaries and would result in average annual losses of 45,000 angler-days for upstream migrant salmon and steelhead trout and 1,500 angler-days for juvenile steelhead trout; the fish resources would be drastically reduced downstream from the dam without provisions of downriver flows; losses of anadromous and resident fish could occur during project construction, since physical and hydraulic characteristics of temporary structures in the streambed could delay upstream fish migration; diversion of unregulated flows of Sacramento River at the Sacramento-San Joaquin Delta as part of the project yield could significantly affect fish passage and habitat; and, without development of an intensive fishery management program, to include fish stocking, regulation of reservoir water levels, provision of public-use facilities, and a zoned reservoir-use plan, Dos Rios reservoir would not support a significant fishery. The agency made the following comments regarding the wildlife: the reservoir would inundate substantial habitat areas supporting significant members of deer and important populations of bears and the long-term project effects would be a reduction in annual harvest of these species; the reduction in hunting effort for upland game, as a result of habitat inundation would be about 2,500 hunting-days annually; the total wildlife losses cannot be fully evaluated until the location and size of borrow and spoil areas are determined and relocation of roads and other similar matters are determined; and the effects on wildlife habitat in the river area downstream of the damsite and the Sacramento-San Joaquin Delta have not been fully assessed. The Service then

made several recommendations which are summarized as follows: the report of the District Engineer should include the conservation, improvement and development of fish and wildlife resources; to compensate for blockage of anadromous fish on Middle Fork, the project should provide for (1) construction and operation of a hatchery and related structures at or near the damsite; (2) construction and operation of additional hatchery facilities if, following a reasonable period of operation and evaluations, average fish runs and harvest are not being maintained by the above hatchery; (3) construction and operation of interim hatchery facilities to be used during project construction and thereafter until the permanent hatchery becomes operational; (4) a firm water supply of suitable quality for both permanent and interim hatchery operation; (5) release into the Middle Fork of 350 cubic feet per second during October 1 through May 31 and 200 cubic feet per second June 1 through September 30, amounting to approximately 217,000 acre-feet annually; (6) funds for the seasonal removal of obstructions such as landslide debris and vegetative growth that would prevent passage of anadromous fish in the 25-mile reach of Middle Fork and main Eel River from the damsite to the confluence of North Fork; and (7) prior to construction, a plan to be developed by the Corps in cooperation with Fish and Wildlife and State Department of Fish and Game to develop methods for the prevention of excessive water pollution during construction period. As an enhancement measure, the project should provide for: (1) fish stocking and angler-use facilities for the reservoir; (2) the development of a reservoir zoning plan in connection with overall planning for the reservoir to insure that certain areas would be available for fishing, hunting and other wildlife purposes without conflicting with general recreation; (3) plans and specifications for clearing vegetation from the reservoir site be developed by the Corps in cooperation with their agency and State Department of Fish and Game; and (4) establishment of a 16,000 acre wildlife management area including habitat development on about 1,500 acres of land within this area as compensation for destruction of big game and upland game habitat. The Service recommended also that all capital, operation, maintenance and replacement costs of mitigation be treated in the same manner as other project joint costs and allocated among the beneficial purposes of the project; control programs employing herbicides or pesticides on project lands or waters be developed in cooperation with the U.S. Public Health Service, FWPCA, Fish and Wildlife Service and their State counterpart; and that project operation criteria established for the protection and development of fish and wildlife be adhered to by the Corps as long as it exercises direct operational control of project features. Furthermore, the Service made several lengthy recommendations, on pages 22 and 23 of their report (Exhibit J), requesting this language be incorporated verbatim in the recommendations of the District Engineer's report.

a. Discussion. The recommendations stated above by the U.S. Fish and Wildlife Service are generally concurred with by the Corps of Engineers, with a few exceptions discussed below. The mitigative features developed by the Service for the fish and wildlife of the area were determined in conjunction with the Corps of Engineers during the continuous coordination carried on by the two agencies during the study stage. Items of costs have been included in the report for all mitigative measures agreed upon and are considered to be adequate at this time. It is expected that during the advance design and engineering phase continuous coordination will be conducted with all the various fish and wildlife agencies to resolve all problems relative to fish and wildlife mitigation and to obtain solutions acceptable to all. The recommendations made by the Service that are not concurred with by the Corps are: (a) that the project provide for funds for the annual removal or control of obstructions such as landslide debris or vegetative growth that would prevent passage of anadromous fish in the 25-mile reach of Middle Fork and main Eel River from the damsite to the confluence of the North Fork; (b) as an enhancement measure, project plans provide for fish stocking and angler-use facilities at the reservoir; and (c) that the language presented on pages 22 and 23 of their report be incorporated verbatim in the recommendations of the report by the District Engineer. It is considered that in item (a) above, there is no basis for establishing an annual cost for control of channel obstructions because of the uncertainty of occurrence and the severity. Channel obstructions cleaning would be expected to be undertaken as an emergency measure if such unforeseen conditions do arise. For item (b) above, it is considered, and further recognized, that ultimate fishing visitation may possibly overtax the biological potential of the reservoir and management and stocking may be needed at some time in the future. Such matters can be readily resolved if, or when, it arises. In response to item (c), the report of the Corps does indicate that final planning and coordination with other interested agencies, including those interested in fish and wildlife resources, will be made. The recommendations stipulate that the Chief of Engineers may make such modifications as he may deem advisable. It is concluded therefore, that recommendations and wordings which specifically identify the coordinating agency which may derive certain emphasis on specific features are not necessary.

G-13. U.S. GEOLOGICAL SURVEY (EXHIBIT K)

The Geological Survey reviewed the report with respect to the hydrological aspects. The agency generally concurred in the hydrology of the report except for two minor matters regarding gages on the Eel River and a discrepancy caused by a typographical error. These matters were noted and the appropriate corrections made.

G-14. FEDERAL POWER COMMISSION (EXHIBIT L)

The Commission stated that in our study for a dam on the lower main Eel River (Yellow Jacket site) the possibility of developing pump storage power between the proposed Dos Rios and Yellow Jacket Reservoir should be investigated along the lines of previous considerations and if pumped storage is feasible the construction of Dos Rios Dam should include provisions for pumped storage. The agency also suggested that the authorizing document provide for the use of an alternative development if the Dos Rios damsite geology proves to be unsuitable for a dam. Further, they requested that they would like to review the power installations proposed for the Dos Rios Dam during the advanced planning stage. The Commission also requested that during the advanced planning stage of Dos Rios Dam project further studies should be given to the addition of power facilities in connection with the Grindstone Diversion Tunnel.

a. Discussion. The general investigation of a dam on the lower main Eel River, commonly considered at the Yellow Jacket site, will be undertaken as the next step in development of the Eel River Basin water resources. Thus, the study should be completed before the advanced engineering and design studies are completed on the Dos Rios Dam. Consequently, if pumped storage power is determined to be feasible between Dos Rios and Yellow Jacket Dams, the former will be designated accordingly. In regard to the concern expressed by the Commission on the geology of Dos Rios damsite, it is considered that the site is a valid site and was thus determined through the extensive exploration program conducted. Coordination will be conducted with the Power Commission during the advanced engineering and design phase regarding the power installation for the Dos Rios Dam and the inclusion of additional power facilities, if feasible, for the Grindstone Diversion Tunnel.

B-15. BUREAU OF MINES (EXHIBIT M)

The Bureau states that within the general area of the dam and reservoir there are outcrops of coal in the area generally consisting of sub-bituminous rock, and non-coking grade. They further state there is no present demand in California for coal of this quality and the outlook for demand in the foreseeable future is probably poor. They added that it may be advisable to conduct a reconnaissance survey of the quantity and grade of coal in the area and an economic appraisal of its potential market to confirm their opinion.

a. Discussion. The need for a survey appears to be unjustified since the Bureau at its own admittance states that the present and future market demands for this coal are poor.