SUPERSEDED BY SAC141.1, SAC145, & SAC146

Office Copy

0023

SACRAMENTO RIVER FLOOD CONTROL PROJECT

OPERATION AND MAINTENANCE MANUAL

BEAR RIVER LEVEE SYSTEM CONSTRUCTED IN VICINITY OF RIO OSO, SUTTER COUNTY, CALIFORNIA, APPROX. 28 MILES NORTHERLY OF SACRAMENTO, CALIFORNIA

MANUAL NO. 5

SACRAMENTO DISTRICT

CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY

SACRAMENTO, CALIFORNIA

FILE COPY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

SACRAMENTO RIVER
FLOOD CONTROL PROJECT

OPERATION AND MAINTENANCE MANUAL

Bear River Levee System Constructed in the Vicinity of
Rio Oso, Sutter County, California, Approximately
28 Miles Northerly of Sacramento, California

MANUAL NO. 5

Revised April 1948

OPERATION AND MAINTENANCE MANUAL NO. 5

Bear River Levee System in the vicinity of Rio Oso, Sutter County, California, approximately 28 miles northerly of Sacramento, California.

TABLE OF CONTENTS

Paragraph		Page
	I. - Introduction	
1-01	Authority of Existing Project	1
1-02	Sacramento River Flood Control Project	1
1-03	Protection Provided	1
	II - Local Cooperation	
2-01	Federal Requirements	2
2-02	State Legislation	2
2-03	Maintenance and Operation of the Unit of Levee covered by this Manual	3
	III - Maintenance & Operation General Procedure	
3-01	Regulations	4
3-02	Provisions	4
3-03	Duties of the Superintendent	5
	IV - Features of the Project Subject to Flood Control Regulations	
4-01	Levees	7
4-02	Drainage Structures	11
	V - Suggested Methods of Combatting Flood Conditions	
5-01	Mission	14
5-02	Methods Suggested	14
5-03	Earthen Levees	14
5-04	Premeditated Damage	15
5-05	Security	15
5-06	Human Element	15
5-07	Inspection of Flood Control Works	15
5-08	Preliminary Repair Work	16
5-09	Disaster Relief	17
5-10	Flood Fight	17
5-11	Topping	18
5-12	Transportation	19
5-13	Check Lists	19
5-14	Use of Government Plant	19

EXHIBIT INDEX

MANUAL NO. 5

Exhibit	Description
A	Flood Control Regulations, Maintenance and Operation of Flood Control Works.
B	"As constructed", Construction Drawings entitled, "Proposed Levee Enlargement, Bear River Levees from W.P.R.R. upstream 4 Miles, South Dry Creek Levees upstream from mouth 2 miles, East Levee W.P.R.R. Intercepting channel and South Levee of North Dry Creek". Drawing No. 2-4-106 in 6 sheets.
C	Control of Sand Boils, Movable and fixed wave wash protection, Caving bank protection, and Lumber and sack topping, Plates 1 to 5.
D	Check List No. 1.
E	Check List No. 2, Drainage structure.
F	Resolution adopted by the Reclamation Board of the State of California, 6 February 1946.

OPERATION AND MAINTENANCE MANUAL SACRAMENTO RIVER FLOOD CONTROL PROJECT

SECTION I

INTRODUCTION

1-01. Authority of Existing Project. The Sacramento River Flood Control Project was adopted by the Flood Control Act of 1 March 1917, Public 367 - 64th Congress, (H. Doc. 81, 62nd Congress, 1st Session, as modified by Rivers and Harbors Committee Doc. No. 5, 63rd Congress, 1st Session), and modified by the Flood Control Act of 15 May 1928, Public No. 391-70th Congress, (S.Doc. No. 23, 69th Congress, 1st Session), the River and Harbor Act of 26 August 1937, Public 392, 75th Congress, 1st Session, (Senate Committee Print 75th Congress, 1st Session), and the Flood Control Act of 18 August 1941, Public 228, 77th Congress, 1st Session), (H.Doc. No. 205, 77th Congress, 1st Session).

1-02. Sacramento River Flood Control Project. The Sacramento River has its source in northern California, flows generally south, and enters Suisun Bay, a waterway of the San Francisco Bay System. The river is approximately 320 miles long and drains an area of about 27,000 square miles. After emerging from the foothills it flows through a broad alluvial valley some 30 miles wide. The river is under improvement for navigation, to provide a channel 10 feet deep to Sacramento, 59 miles from the mouth, with lesser depths upstream. The flood control system of the Sacramento River embraces the following principal features:

a. Levees along the banks of the river and its tributaries.

b. Weirs and floodways or by-passes to carry off flood waters in excess of the capacity of the leveed river channels.

c. Enlargement of the river channel below Cache Slough to carry the entire flood flow.

1-03. Protection Provided. The Sacramento River Flood Control Project, when completed, will afford protection against flood damages to approximately 1,000,000 acres of land in the Sacramento Valley. The project is designed to provide protection against all floods of record and should not fail oftener than about once in 80 years on the average.

SECTION II

LOCAL COOPERATION

2-01. Federal Requirements. The Act of 18 August 1941, provides that "The projects for the control of floods and other purposes in the Sacramento River, California, adopted by the Acts approved March 1, 1917, May 15, 1928, and August 26, 1937, Public 392 (Senate Committee Print, 75th Congress, 1st Session), are hereby modified substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 205, Seventy-seventh Congress, first session."

The recommendation of the Chief of Engineers contained in House Document 205, 77th Congress, 1st Session, provides for the "completion of the Sacramento Valley Flood Control Project at an estimated additional first cost to the United States of $10,500,000; subject to the provisions that the State of California or responsible local agencies give assurances satisfactory to the Secretary of War that they will provide, without cost to the United States, all lands, easements and rights-of-way necessary for the completion of the project; bear the expense of necessary highway, railroad, and bridge alterations; hold and save the United States free from claims for damages resulting from construction of the works; and maintain and operate all works, after completion, in accordance with regulations prescribed by the Secretary of War."

The Act of 18 August 1941 further provides "That the authorization for any flood control project heretofore or herein adopted requiring local cooperation shall expire five years from the date on which local interests are notified in writing by the War Department of the requirements of local cooperation, unless said interests shall within said time furnish assurances satisfactory to the Secretary of War that the required cooperation will be furnished."

2-02. State Legislation. a. Adoption of Federal Policy. Enactment of Chapter 1528, Statutes of 1947, which amends Article 2 and added Articles 4, 5, and 6 to Chapter 3, Part 2, Division 5 of the State Water Code, provides for the adoption by and on behalf of the State of California of the conditions, plans, construction and mode of maintenance and operation of works within the Sacramento River Flood Control Project set forth in Senate Committee Print, 75th Congress, 1st Session, as authorized and approved by the Act of Congress, Public No. 392, 75th Congress, approved 26 August 1937, including the holding and saving the United States from damages due to construction works are continued in effect.

b. Powers and Duties of Department of Public Works and Reclamation Districts includes the following:

"8360. On behalf of the State the Department of Public Works, acting by and through the State Engineer, has supervisory powers over the maintenance and operation of the flood control works of the Sacramento River Flood Control Project.

8361. The department, acting by and through the State Engineer, shall maintain and operate on behalf of the State the following units or portions of the works of the Sacramento River Flood Control Project, and the cost of such maintenance and operation shall be defrayed by the State.

(a) The east levee of the Sutter By-pass north of Nelson Slough.

(b) The levees and channels of the Wadsworth Canal, the intercepting canals draining into it, and all structures incidental thereto.

(c) The collecting canals, sumps, pumps and structures of the drainage system of Project No. 6 east of the Sutter By-pass.

(d) The by-pass channels of the Butte Slough By-pass, the Sutter By-pass, the Tisdale By-pass, the Yolo By-pass and the Sacramento By-pass with all cuts, canals, bridges, dams, and other structures and improvements contained therein and in the borrow pits thereof.

(e) The levees of the Sacramento By-pass.

(f) The channels and overflow channels of the Sacramento River and its tributaries within the Sacramento and San Joaquin Drainage District.

(g) The Knights Landing ridge cut flowage area.

(h) The flood relief channels controlled by the Moulton and Colusa Weirs and the training levees thereof.

(i) The levee on the left bank of the Sacramento River adjoining Butte Basin, from the Butte Slough outfall gates upstream to a point four miles northerly from the Moulton Weir, after completion.

(j) All weirs and relief structures.

(k) The west levee of the Yolo By-pass, extending from the west end of the Fremont Weir southerly to the Cache Creek Settling Basin and the east levee of the Yolo By-pass from the Fremont Weir southerly two miles.

(l) The levee on the west bank of Feather River extending a distance of about two miles southerly from the Sutter-Butte Canal headgate.

(m) The levees of Cache Creek and the easterly and westerly levees of Cache Creek settling basin.

8370. It is the responsibility, liability and duty of the reclamation districts, levee districts, protection districts, drainage districts, municipalities, and other public agencies within the Sacramento River Flood Control Project limits, to maintain and operate the works of the project within the boundaries or jurisdiction of such agencies, excepting only those works enumerated in Section 8361 and those for which provision for maintenance and operation is made by federal law."

2-03. Maintenance and Operation of the Unit of Levee Covered by this Manual. The responsibility for the maintenance and operation of the unit of levee covered by this manual, described in paragraph 4-01, was accepted by the Reclamation Board of the State of California, as shown under attached resolution, Exhibit "F".

SECTION III

MAINTENANCE AND OPERATION

GENERAL PROCEDURE

3-01. Regulations. The purpose of this manual is to assist the local interests in the maintenance and operation of Flood Control Works constructed by the United States in accordance with the Flood Control Regulations contained under Section 208.10, Title 33 of the Code of Federal Regulations, approved by the Acting Secretary of War on 9 August 1944 under the authority covered by Section 3 of the Flood Control Act of 22 June 1936, as amended and supplemented. A copy of the approved regulations is bound at the back of this volume as Exhibit "A". Compliance with these regulations is one of the requirements of local cooperation.

3-02. Provisions. The general provisions under the Flood Control Regulations are listed below:

"1. The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

2. The State political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

3. A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

4. No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities.

5. No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be

made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer, or if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

6. It shall be the duty of the superintendent to submit a semi-annual report to the District Engineer covering inspection, maintenance and operation of the protective works.

7. The District Engineer or his authorized representative shall have access at all times to all portions of the protective works.

8. Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

9. Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

10. The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations."

3-03. Duties of the Superintendent. In line with the provisions covered by the regulations, the general duties of the Superintendent should include the following:

a. Training of Key Personnel. Key personnel should be trained in order that regular maintenance work may be performed efficiently and to insure that unexpected problems related to flood control may be handled in an expeditious and orderly manner. The superintendent should have available the names, addresses and telephone numbers of all his key men and a reasonable number of substitutes. These key men should in turn have similar data on all of the men that will be necessary for assistance in the discharge of their duties. The organization of key men should include the

following:

1. An assistant to act in the place of the Superintendent in case of his absence or indisposition.

2. Sector foremen in sufficient number to lead maintenance patrol work of the entire levee during flood fights. High qualities of leadership and responsibility are necessary for these positions.

b. Stream flow stages. Permanent arrangements should be made by the Superintendent with the Corps of Engineers at Sacramento, California, to secure stream flow stages and forecasts of stream flow stages and weather conditions of effective streams and drainage areas to properly plan adequate measures of protection.

c. Semi-annual Report. The semi-annual reports required under Paragraph 208.10 (a)(6) of the regulations should be submitted within a ten day period prior to 1 June and 1 December of each year and should include all dated copies of reports of inspections made during the period of report. Also, the nature, date of construction, and date of removal of all temporary repairs and the dates of permanent repairs should be included in this report. Other items and suggestions relative to public cooperation, public sentiment on the protection obtained, and other allied subjects are considered pertinent and desirable data for inclusion in the report, but are not required.

d. Check lists. The check lists shown in Exhibit "D" and "E", should be used in each inspection to insure that no features of the protective system are overlooked. Items requiring maintenance should be noted thereon; if items are satisfactory they should be so indicated by a check.

e. Proposed improvements or alterations. Drawings or prints of proposed improvements or alterations to the existing Flood Control Works must be submitted for approval to the District Engineer, Sacramento District, Corps of Engineers, Sacramento, California, sufficiently in advance of the proposed construction to permit adequate study and consideration of the work. Drawings or prints, in duplicate, showing any improvements or alterations as finally constructed should be furnished to the Corps of Engineers after completion of the work.

SECTION IV

Features of the Project Subject to Flood Control Regulations

4-01. Levees.

a. Construction Features.

(1) Description. The flood control works covered by this Manual form an integral part of the Sacramento River Flood Control Project. They consist of three units of levees, a part of the Bear River Levee System, as shown on attached drawing No. 2-4-106 in six (6) sheets, dated July 1944.

(2) Location. The Bear River Levee System is located within the boundaries of Reclamation Districts Nos. 784 and 817 and approximately along the North boundary of Reclamation District 1001, in the vicinity of Rio Oso, Sutter County, California, approximately 28 miles northerly of Sacramento, California. The Three units of Levees referred to above extend for a distance of approximately four miles upstream from the Western Pacific Railroad, and are listed below as follows:

(a) Unit No. 1. South Levee of Bear River from Station 55+00 to Station 260+00		20,500 ft.
(b) Unit No. 2. North Levee of Bear River from Station 166+88 to Station 280+00	11,312 ft.	
South Levee of Dry Creek from Station 0+00 to Station 98+45	9,845 ft.	21,157 ft.
(c) Unit No. 3. North Levee, Bear River from Station 74+21 to Station 148+00	7,379 ft.	
North Levee, South Dry Creek from Station 0+00 to Station 90+09	9,009 ft.	
East Levee of W.P.R.R. Intercepting Canal from Station 20+93 to Station 135+72	11,479 ft.	
South Levee of North Dry Creek from Station 0+00 to Station 105+22	10,522 ft.	38,389 ft.
GRAND TOTAL		80,046 ft.

Under the program provided by the Sacramento River Flood Control Project these three units of levees have been enlarged to form a crown 20 feet wide, a landside slope of one vertical on two horizontal and a riverside slope of one vertical to three horizontal. Construction also included a gravel road surfacing 12 feet wide on top of the levee with turnouts at 1,000-foot intervals, 50 feet long and 18 feet wide, and the necessary drainage structures, road approaches and appurtenances. All the drainage structures are listed in Exhibit "E".

This levee system provides direct protection to Reclamation Districts Nos. 784, 817, and 1001 against high water of the Bear River and its tributaries in this area. The grade of the adopted flood plane along the main channel of the Bear River varies from Elevation 59.0 at the lower end to 81.4 at the upper end. (All elevations are referred to U.S.E.D. Datum). The levee grade provides a freeboard of three feet above the flood plane. It is estimated that a flood flow of 18,500 second-feet in the main channel of the Bear River in this area will produce the adopted flood plane. Such a flow is not expected to occur oftener than once in six years, on the average.

(3) Contractor. The enlargement of the levee described above was performed by H. Earl Parker, contractor, under Contract W-04-167-eng-633, copy of which is on file in the U.S. Corps of Engineers' Office, Sacramento District, Sacramento, California.

(4) Beginning and Completion of Construction. Construction was started on 8 October 1944, and completed on 6 October 1945.

(5) Outstanding Construction Features. In general, all construction features are based on Standard plans and specifications, and the details are fully covered in the attached drawings listed below (See Exhibit "B").

File No.	Title
2-4-106	Proposed Levee Enlargement, Bear River Levees, from W.P.R.R. upstream 4 miles, South Dry Creek Levees upstream from Mouth 2 miles, East Levees W.P.R.R. Intercepting Channel and South Levee of North Dry Creek.

b. Pertinent Requirements of Section 208.10, Title 33, of Code of Federal Regulations.

"1. Maintenance. The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and further, to be certain that:

(I) No unusual settlement, sloughing or material loss of grade or levee cross-section has taken place;

(II) No caving has occurred on either the landside or the riverside of the levee which might affect the stability of the levee section.

(III) No seepage, saturated areas or sand boils are occurring;

(IV) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(V) Drains through the levees and gates on said drains are in good working condition;

(VI) No revetment work or riprap has been displaced, washed out, or removed;

(VII) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(VIII) Access rodds to and on the levee are being properly maintained;

(IX) Cattle guards and gates are in good condition;

(X) Crown of levee is shaped so as to drain readily, and roadway thereon if any is well shaped and maintained;

(XI) There is no unauthorized grazing or vehicular traffic on the levees;

(XII) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

2. Operation. During flood periods the levee shall be patrolled continuously to locate possible and boils or unusual wetness of the landward slope and to be certain that:

(I) There are no indications of slides or sloughs developing;

(II) Wave wash or scouring action is not occurring;

(III) No low reaches of levee exist which may be overtopped;

(IV) No other conditions exist which might endanger the structure. Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section."

Compliance with the provisions prescribed above is very essential for the efficient maintenance of the levee system covered by this manual and for the successful operation of the entire Flood Control Project of the Sacramento River.

c. Additional Requirements.

(1) A vigorous sod which covers the entire levee and protective berm is one of the most effective means of protecting an earth levee against erosion and wave wash. Large weeds and brush should not be permitted to grow on the levee as they smother grass, thereby encouraging erosion, and interfere with future maintenance. Mowing to keep weeds and brush under control should be accomplished in May and August, or more often if necessary, to assure a good sod cover. Grass clippings should be left on the levee. If large weeds and brush become established because of lack of proper maintenance, these should be cut and removed from the levee for disposal and no cuttings should be burned on the levee as sod is destroyed by fire thus leaving bare spots vulnerable to destructive erosion. Infertile bare areas require special treatment to produce a protective sod growth and may be treated by mulching with manure containing straw or straw alone plus seeding or sodding. If straw mulch is used, a suitable commercial fertilizer will greatly hasten the establishment of a protective sod cover. It is recommended that the county agricultural agent be consulted for detailed information on local planting practices.

(2) Dens and runways formed within the levee by burrowing animals are frequently the cause of levee failures furing flood stages. Burrowing animals such as muskrats, ground hogs, ground squirrels, moles and gophers found in the levee should be exterminated. The dens and runways should be opened up then thoroughly compacted as they are back filled. Levees kept properly cleared are not seriously menaced by burrowing animals as they prefer areas where the protection of cover such as high grass, weeds, and brush is found. Several methods of extermination are found effective such as trapping, baiting, and poison gases depending upon the type of animal present and the time of the year the work is done. Advice concerning the best methods in each locality can be obtained from the county agricultural agent.

(3) Check lists suggested under Exhibits "D" and "E" should be used in each inspection to insure that no features of the protective works are overlooked. Items requiring maintenance should be noted thereon; if items are found satisfactory they should be so indicated by a check.

(4) Periodic inspections as required by the Regulations should be made by the Superintendent at the following times:

(a) Immediately prior to the beginning of the major flood season, preferably within the ten day period prior to the months of June and November of each year. (The flood season is considered to include the period between the months of December and May).

(b) Immediately following each major high water period. (For definition of high water period see Exhibit "E").

(c) Otherwise at periods not exceeding 90 days.

(5) Suggestions as to methods of combating flood conditions are given in Section V of this manual. The methods presented therein have been developed during many years of experience during floods on large streams. These methods are not mandatory, but should prove useful in Sacramento Valley, where floods of large magnitude are of common occurrence.

4-02. Drainage Structures.

a. Description. The drainage structures covered by this manual form a part of the levee described in paragraph 4-01 a. These structures consist of drainage pipe or/and concrete culverts crossing the levee at approximately the elevation of the natural ground and are provided with automatic or hand operated gates as described in Check List No. 2, Exhibit "E".

b. Pertinent Requirements of Section 208.10, Title 33, of the Code of Federal Regulations.

"1. Maintenance. Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on drainage structures shall be examined, oiled and trial operated at least once every 90 days. Periodic inspections shall be made by the Superintendent to be certain that:

(I) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(II) Inlet and outlet channels are open;

(III) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(IV) Erosion is not occurring adjacent to the structures which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspection.

2. Operation. Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition."

Compliance with the provisions prescribed above pertaining to drainage structures is essential for proper maintenance of the levee system covered by this manual. Levee failures caused by neglected drainage structures are of common occurrence; it is therefore of utmost importance that this structure always be kept in perfect working condition in accordance with the regulations.

c. Additional Requirements.

1. Inspections. Periodic inspections should be made as follows:

(a) The outlets of pipes crossing under the levee inundate at relatively low river stages; therefore all pipes crossing under the levee should be inspected considerably in advance of the beginning of the flood season. The gates on these pipes should be checked at the same time.

(b) Inspection of all drainage structures should also be made following each major high water period.

(c) Otherwise at periods not exceeding 90 days.

2. Check Lists of Drainage Structures.
Check lists suggested under Exhibit "E" should be used in each inspection to insure that structures are kept in working condition at all times.

SECTION V

SUGGESTED METHODS OF COMBATING FLOOD CONDITIONS

5-01. Mission. The primary mission of the Corps of Engineers is to maintain the integrity of Flood Control Works. All other matters become secondary in a flood emergency and will yield precedence to the accomplishment of the primary mission. During periods of emergency, close liaison will be maintained with local interests, normally through the responsible State Agency such as the Reclamation Board of the State of California, since the main objective will be attained by supporting local interests in their efforts or by assuming full charge for the flood fight when the problem is beyond the capabilities of local interest.

5-02. Methods Suggested. Most of the methods described herein have been developed during years of experience with the various problems that often come up during periods of high water, and they are not intended to restrict the Superintendent, or others concerned, to a rigid set of rules for every condition that may arise. The remarks are primarily concerned with the earthen portions of the levee system. If problems not covered by these suggestions arise, where the Superintendent is in doubt as to the procedure to be taken, he will be expected to consult the District Engineer, Corps of Engineers, Sacramento, California, and follow standard engineering practices in meeting the situation. It should be noted that it is much better to be over-prepared for a "flood fight" than to find at the last moment that preparations were incomplete or unsatisfactory. Confidence of the protected persons and firms is a valuable asset that should not be carelessly lost through inefficient operation of the protection system in time of emergency.

5-03. Earthen Levees. An earthen levee is in danger whenever there is water against it. This danger is directly proportional to the height of the water, the duration of the flood stage, and the intensity of either the current or wave action. The danger is inversely proportional to the cross-sectional area of the levee, the levee's heights, and the degree of maintenance. A well-constructed levee of proper section should, if maintained and not overtopped, hold throughout any major flood. However, a serious accident may result in a break. Foundation troubles result in sand boils or a sinking levee, and the local use of unsatisfactory materials causes slides and sloughs. However, such threatened failures can be met if prompt action is taken and proper methods of treatment are used. Wave wash is to be expected whenever the levee is exposed to a wide stretch of open water and is serious if permitted to continue over a considerable length of time.

5-04. Premeditated Damage. The Superintendent should continually guard against premeditated damage to the levee. In the event of an extraordinary flood requiring a fight over long stretches of levee on both sides of the river, there is a natural temptation to relieve the strain by premeditated breaking of the opposite line.

5-05. Security. Personnel of the Corps of Engineers, whether military or civilian, are not vested with any civil police authority in the performance of their engineering duties, and they will not attempt to exercise any such authority. The responsibility for protecting flood control works against sabotage, acts of depredation, or other unlawful acts rests with the local interests through local and State Governmental agencies. In the event local law enforcement agencies prove inadequate, local interests can request the aid of State Forces, and if additional support becomes necessary, Federal troops can be requested as provided by law.

5-06. Human Element. Panic does not directly endanger the levee, but psychological fear due to ignorance of actual conditions may seriously affect the high-water fight during a critical moment. This fact may be considered in organization for emergency work. Confidence, engendered by an efficient organization, free from local jealousies, is the best guard against panic.

5-07. Inspection of Flood Control Works. Immediately upon receipt of information that a high water is imminent, the Reclamation Districts through their Superintendents, should form a skeleton organization, capable of quick expansion, and assign individuals (Sector Foremen) to have charge of definite sections of levees. As his initial activity, each Sector Foreman should go over his entire sector and parts of adjacent sectors, making a detailed inspection, particularly with reference to the following matters:

a. Sector limits; ascertain that the dividing line between sectors is plainly determined and, if necessary, marked.

b. Condition of new levees and recent repairs.

c. Condition of culverts, flap gates, and sluice gates.

d. Transportation facilities; roads, rail and water communications.

e. Material supply; quantity, location, and condition.

f. Communications; locate and check all necessary telephones in the sector.

5-08. Preliminary Repair Work. After the initial inspection has been made, each Sector Foreman should recruit a labor crew and provide it with tools such as shovels, axes, wheelbarrows, etc. In addition, bulldozers, scrapers, trucks, etc., should be located and made ready for use in case of emergency. Then immediate action should be taken to perform the following work:

a. Fill up holes or washes in the levee crown, slopes, and landslide berms. Where new construction has been completed during the year, rain washes and deep gullies may have developed. While the levee is new, preparations should be made in advance to combat wave wash along the exposed reaches.

b. Repair gaps where road crossings have been worn down and the levee is below grade. In filling the road crossings, it may be necessary to obtain material from landside borrow pits, in which case excavation for the material should be kept at least 50 feet from the toe of levee. Any filling done in this connection should be tamped in place and, if in an exposed reach, subject to wave wash, the new section should be faced with bags of sand.

c. Repair and close all flap gates on culverts and see that they are seated properly before they are covered with flood waters.

d. Ascertain that all roads to and along the levee are in a good state of repair. The Superintendent should obtain assistance from the county road forces to have all roads put in first-class condition.

e. Locate necessary tools and materials (sacks, sandbags, brush, lumber, lights, etc.), and distribute and store the same at points where active maintenance is anticipated.

f. Check and obtain repair of all telephone lines necessary for operation, obtain lists of all team forces, motorboats, motor cars, and truck transportation that can be made available.

g. Make thorough arrangements with reliable citizens of the community for the supply, transportation, subsistence, and shelter for the necessary labor.

h. Communicate directly with owners of all stock pastured on the levee and direct that all stock be removed from the levee right-of-way. Cut all fences crossing the levee that do not have gates provided.

i. Investigate all drainage ditches on the landside of the levee and open these drains when obstructions exist. Prepare to cut the necessary seep drainage ditches; however, no attempt should be made to drain the levee slope until actual seepage takes place.

j. Remove all dynamite and explosives of any kind from the vicinity of the levee.

5-09. Disaster Relief. It is the responsibility of local, state, municipal authorities, supported by and/or working in connection with the American Red Cross to adopt measures for the relief of flood disaster victims. Relief measures can be undertaken by the Department of the Army through its Army Area Commander under existing Army Regulations, but such measures will be undertaken only as a last resort, in extreme cases and under compelling circumstances where local resources are clearly inadequate to cope with the situation.

5-10. Flood Fight. After the above preliminary organization and precautions have been completed, the "Flood Fight" itself commences. The methods of combatting various defects in the earthen levee described in the following paragraphs have been proved effective during many years of use by the War Department.

a. Drainage of slopes. This work can be done economically while awaiting developments and will serve to make the levees more efficient. Crews should be organized to cut seep drains at all places on the levee and berm when seepage appears. The drains should be V-shaped, no deeper than necessary, and never more than 6" deep. Care must be taken not to cut the sod unnecessarily. In all instances, drains should be cut straight down the levee slope or nearly so. Near the toe of the slope the small drains should be Y'd together and led into larger drains, which, in general should lead straight across the landside berm into the landside pits or nearest natural or artificial drain.

b. Sandboils. These danger spots are serious if discharging material. The common method of controlling sand boils consists of walling up a watertight sack ring around the boil up to a height necessary to reduce the velocity of flow to a point at which material is no longer discharged from the boil. See Exhibit "C" Plate 1. The sack ring around the boil should be large enough to protect the defective area immediately surrounding the boil. If several boils of sufficient force to displace sand are observed a sack sublevee may be built around the entire nest of boils, rising to such a height that none of the boils will discharge with enough force to displace sand.

c. Wave Wash. The Superintendent and Sector Foremen should study the levee beforehand to determine the possibility of wave wash. All such reaches will be located well in advance and for use in emergency, a reserve supply of filled sacks and rolls of cotton bagging will be kept on board flats. If the slope is well sodded, a storm of an hour's duration should cause very little damage. During periods of high wind and high water, ample labor should stand by and experienced personnel should observe where the washouts are beginning by sounding or by actually wading along the

submerged slope. Sections of cotton bagging should be placed over the washed areas, as shown on Exhibit "C", Plate 3. As an alternative, filled sacks should be placed in the cut in an effective manner and as soon as possible. The filled sacks should be laid in sections of sufficient length to give protection well above the anticipated rise. Bagging so laid must be thoroughly weighted down to be effective. Plate 2, Exhibit "C" shows a movable type of wave wash protection, also used with good results. Its advantage is that it can rapidly be built at any convenient place and easily set in place on the job.

d. Scours. A careful observation should be made of the river side of the levee at all localities where a current of more than two feet per second is observed, or where the profiles show a high water slope of two feet per mile or greater. Trouble may be looked for at the ends of old levee dikes, road-crossing ramps, old traverses, and places where pipes, sewers and other structures penetrate the levee. If any sign of scour is observed in the pits or at the ends of the dikes, soundings should be taken to observe the amount and progress of the scour. The approved method of construction to check scour in the pits, on the slopes, or at the ends of dikes will be to construct deflection dikes using brush, treetops, or lumber, driving stakes and wiring together, and filling in between with brush and filled sacks or stone.

e. Caving bank protection. As protection against active caving of riverbanks, rock-filled cribs are very effective if properly placed. Cribs are usually 14 by 14 feet in plan by 10 to 14 inches in inside depth. The cribs are constructed on a double thickness of 1" x 4" x 14' lumber, equivalent to 2" x 4" pieces, lapped rail fence fashion at all corners and intersections. They are divided into four compartments of about equal area by two perpendicular cross walls constructed in the same manner as the side walls. The floors and covers are built up of double 1" x 4" boards spaced about 9" center-to-center. Under the floor and perpendicular to the direction of the floor boards are five equally spaced pairs of 1" x 4" boards about 3 feet center-to-center. On top of the cover, perpendicular to the direction of the cover boards, are three pairs of top boards, one over each of the side walls and one over the central division wall. All intersections are nailed with one 20d nail. The compartments are filled with rock before covering. Each wall intersection of the fabricated cribs is securely fastened by a loop of No. 9 wire. See Exhibit "C", Plate 4.

5-11. Topping. Immediate consideration should be given the grade line of each levee section by comparison of existing grades with those shown on the drawings, Exhibit "B", Plates 1 to 5. If any reaches show

a grade below the previous highest water, emergency topping should be undertaken at once to such a grade as may be established by the District Engineer, Corps of Engineers, Sacramento, California, as follows:

a. Sack topping. Sack topping may be used to raise the crown of the levee about three feet. The sacks should be laid stretcherwise or along the levee for the first layer, crosswise for the second layer, and so on. Sacks should be lapped at least 1/3 either way and well mauled into place. When properly sacked and tamped, one sack will give about three to four inches of topping. If gravel is available, it should be used for the front facing so as to avoid washing out.

b. Lumber and sack topping. This is the most commonly used method of raising low reaches in emergencies. In putting on this topping, as well as other topping, a careful line of levels should be run and grade stakes set in advance. 2" x 4" x 6' stakes should then be driven on the riverside of the crown six feet apart, and 1" x 12" boards nailed to the landside of the stakes. This wall, backed with a single tier of sacks, will hold out at least one foot of water. If a second foot is necessary, the layers of sacks will have to be increased in number and reinforced. The stakes should be driven three feet in the ground, and should project out three feet, thus providing, in extreme cases, a three-foot topping if properly braced behind with sacks and earth. In some instances, it may be practicable to back up the planking with tamped earth obtained in the vicinity in lieu of the sacks shown in the drawing, Exhibit "C", Plate 5.

5-12. Transportation. In instances where it is necessary to send equipment over roads that are impassable due to mud or sand, their passage may be provided by the use of a plank road or by means of steel or wire mats. Telephone communication should be provided along dangerous stretches of the levee when travel or other satisfactory means of communication cannot be maintained.

5-13. Check lists. The check lists shown in Exhibits "D" and "E" are furnished for reproduction and use by the local interests. These lists should be used in each inspection to insure that no features of the protective system are overlooked. Items requiring repairs should be noted thereon; if items are satisfactory, they should be indicated by a check mark.

5-14. Use of Government Plant. The District Engineer is authorized to use or loan Government property and plant in cases of emergency where life is in danger and there is no opportunity to secure prior authority for such use. The authority also extends to saving of property where no suitable private equipment is available, provided that such use is without detriment to the Government.

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

Chapter II—Corps of Engineers, War Department

PART 208—FLOOD CONTROL REGULATIONS

MAINTENANCE AND OPERATION OF FLOOD CONTROL WORKS

Pursuant to the provisions of section 3 of the Act of Congress approved June 22, 1936, as amended and supplemented (49 Stat. 1571; 50 Stat. 877; and 55 Stat. 638; 33 U. S. C. 701c; 701c-1), the following regulations are hereby prescribed to govern the maintenance and operation of flood control works:

§ 208.10 *Local flood protection works; maintenance and operation of structures and facilities*—(a) *General.* (1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations.

(b) *Levees*—(1) *Maintenance.* The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning durin times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) *Operation.* During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) *Flood walls.*—(1) *Maintenance.* Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) *Operation.* Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) *Drainage structures*—(1) *Maintenance.* Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on

drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Where drainage structures are provided with stop log or other emergency closures, the condition of the equipment and its housing shall be inspected regularly and a trial installation of the emergency closure shall be made at least once each year. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) *Operation.* Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition.

(e) *Closure structures*—(1) *Maintenance.* Closure structures for traffic openings shall be inspected by the superintendent every 90 days to be certain that:

(i) No parts are missing;

(ii) Metal parts are adequately covered with paint;

(iii) All movable parts are in satisfactory working order,

(iv) Proper closure can be made promptly when necessary;

(v) Sufficient materials are on hand for the erection of sand bag closures and that the location of such materials will be readily accessible in times of emergency.

Tools and parts shall not be removed for other use. Trial erections of one or more closure structures shall be made once each year, alternating the structures chosen so that each gate will be erected at least once in each 3-year period. Trial erection of all closure structures shall be made whenever a change is made in key operating personnel. Where railroad operation makes trial erection of a closure structure infeasible, rigorous inspection and drill of operating personnel may be substituted therefor. Trial erection of sand bag closures is not required. Closure materials will be carefully checked prior to and following flood periods, and damaged or missing parts shall be repaired or replaced immediately.

(2) *Operation.* Erection of each movable closure shall be started in sufficient time to permit completion before flood waters reach the top of the structure sill. Information regarding the proper method of erecting each individual closure structure, together with an estimate of the time required by an experienced crew to complete its erection will be given in the Operation and Maintenance Manual which will be furnished local interests upon completion of the project. Closure structures will be inspected frequently during flood periods to ascertain that no undue leakage is occurring and that drains provided to care for ordinary leakage are functioning properly. Boats or floating plant shall not be allowed to tie up to closure structures or to discharge passengers or cargo over them.

(f) *Pumping plants*—(1) *Maintenance.* Pumping plants shall be inspected by the Superintendent at intervals not to exceed 30 days during flood seasons and 90 days during off-flood seasons to insure that all equipment is in order for instant use. At regular intervals, proper measures shall be taken to provide for cleaning plant, buildings, and equipment, repainting as necessary, and lubricating all machinery Adequate supplies of lubricants for all types of machines, fuel for gasoline or diesel powered equipment, and flash lights or lanterns for emergency lighting shall be kept on hand at all times. Telephone service shall be maintained at pumping plants. All equipment, including switch gear, transformers, motors, pumps, valves, and gates shall be trial operated and checked at least once every 90 days. Megger tests of all insulation shall be made whenever wiring has been subjected to undue dampness and otherwise at intervals not to exceed one year. A record shall be kept showing the results of such tests. Wiring disclosed to be in an unsatisfactory condition by such tests shall be brought to a satisfactory condition or shall be promptly replaced. Diesel and gasoline engines shall be started at such intervals and allowed to run for such length of time as may be necessary to insure their serviceability in times of emergency. Only skilled electricians and mechanics shall be employed on tests and repairs. Operating personnel for the plant shall be present during tests. Any equipment removed from the station for repair or replacement shall be returned or replaced as soon as practicable and shall be trial operated after reinstallation. Repairs requiring removal of equipment from the plant shall be made during off-flood seasons insofar as practicable.

(2) *Operation.* Competent operators shall be on duty at pumping plants whenever it appears that necessity for pump operation is imminent. The operator shall thoroughly inspect, trial operate, and place in readiness all plant equipment. The operator shall be familiar with the equipment manufacturers' instructions and drawings and with the "Operating Instructions" for each station. The equipment shall be operated in accordance with the above-mentioned "Operating Instructions" and care shall be exercised that proper lubrication is being supplied all equipment, and that no overheating, undue vibration or noise is occurring. Immediately upon final recession of flood waters, the pumping station shall be thoroughly cleaned, pump house sumps flushed, and equipment thoroughly inspected, oiled and greased. A record or log of pumping plant operation shall be kept for each station, a copy of which shall be furnished the District Engineer following each flood.

(g) *Channels and floodways* — (1) *Maintenance.* Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds, and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections and deflection dikes and walls are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary.

(2) *Operation.* Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

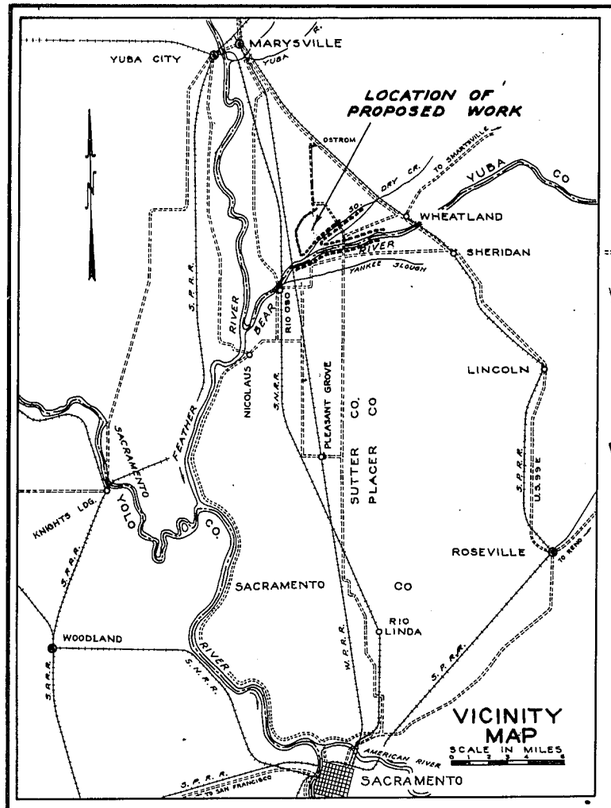
(h) *Miscellaneous facilities* — (1) *Maintenance.* Miscellaneous structures and facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. Areas used for ponding in connection with pumping plants or for temporary storage of interior run-off during flood periods shall not be allowed to become filled with silt, debris, or dumped material. The Superintendent shall take proper steps to prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) *Operation.* Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor. (49 Stat. 1571, 50 Stat. 877; and 55 Stat. 638; 33 U.S.C. 701c; 701c-1) (Regs. 9 August 1944, CE SPEWF)

[SEAL] J. A. ULIO,
Major General,
The Adjutant General.

[F. R. Doc. 44-12285; Filed, August 16, 1944; 9:44 a.m.]

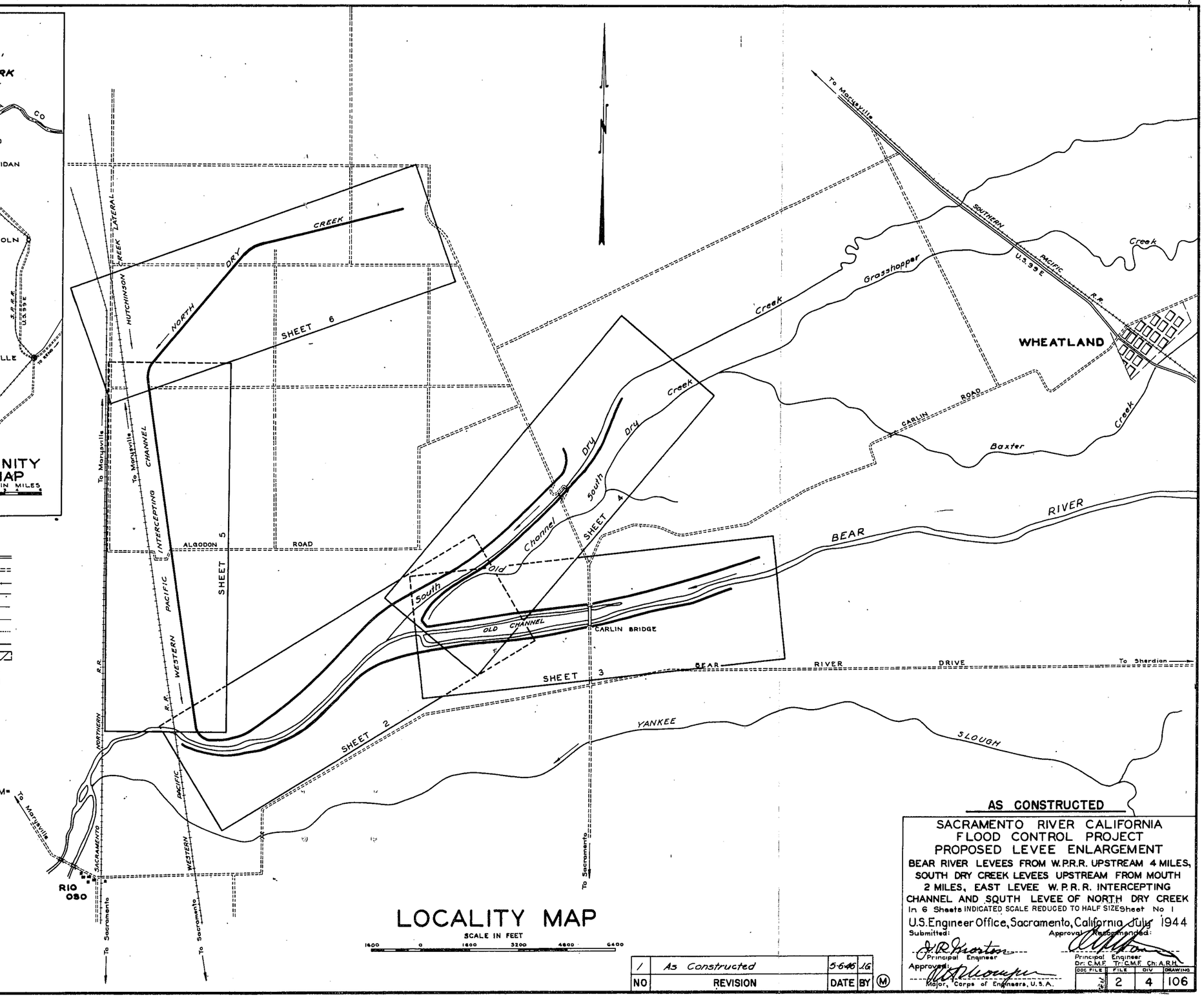
EXHIBIT "A" Sheet 2 of 2



LEGEND

- U.S. HIGHWAY ROUTE
- OTHER HIGHWAYS AND ROADS
- RAILROADS
- TELEPHONE OR TELEGRAPH LINE
- POWER TRANSMISSION LINE
- FENCE
- TOE OF EXISTING LEVEE
- CENTER LINE OF PROPOSED LEVEE
- AREAS AVAILABLE FOR BORROW
- S - INDICATES STANDARD TYPE ROAD APPROACH
- H - INDICATES HEAD-ON TYPE ROAD APPROACH
- R.S. - INDICATES RIVERSIDE OF LEVEE
- L.S. - INDICATES LANDSIDE OF LEVEE

NOTE:
ALL ELEVATIONS ARE REFERRED TO U.S.E.D. DATUM= MEAN LOWER LOW WATER SUISUN BAY= 3.6 FT BELOW MEAN SEA LEVEL.



LOCALITY MAP

SCALE IN FEET
1600 0 1600 3200 4800 6400

AS CONSTRUCTED

SACRAMENTO RIVER CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE ENLARGEMENT
BEAR RIVER LEVEES FROM W.P.R.R. UPSTREAM 4 MILES, SOUTH DRY CREEK LEVEES UPSTREAM FROM MOUTH 2 MILES, EAST LEVEE W.P.R.R. INTERCEPTING CHANNEL AND SOUTH LEVEE OF NORTH DRY CREEK
In 6 Sheets INDICATED SCALE REDUCED TO HALF SIZE Sheet No 1
U.S. Engineer Office, Sacramento, California July 1944

Submitted: J.R. Morton, Principal Engineer
Approval Recommended: Principal Engineer, Dr: C.M.F. Tr: C.M.F. Ch: A.R.H.
Approved: Major, Corps of Engineers, U.S.A.

NO	REVISION	DATE	BY
1	As Constructed	5-6-46	JG

DOC FILE	FILE	DIV	DRAWING
	2	4	106

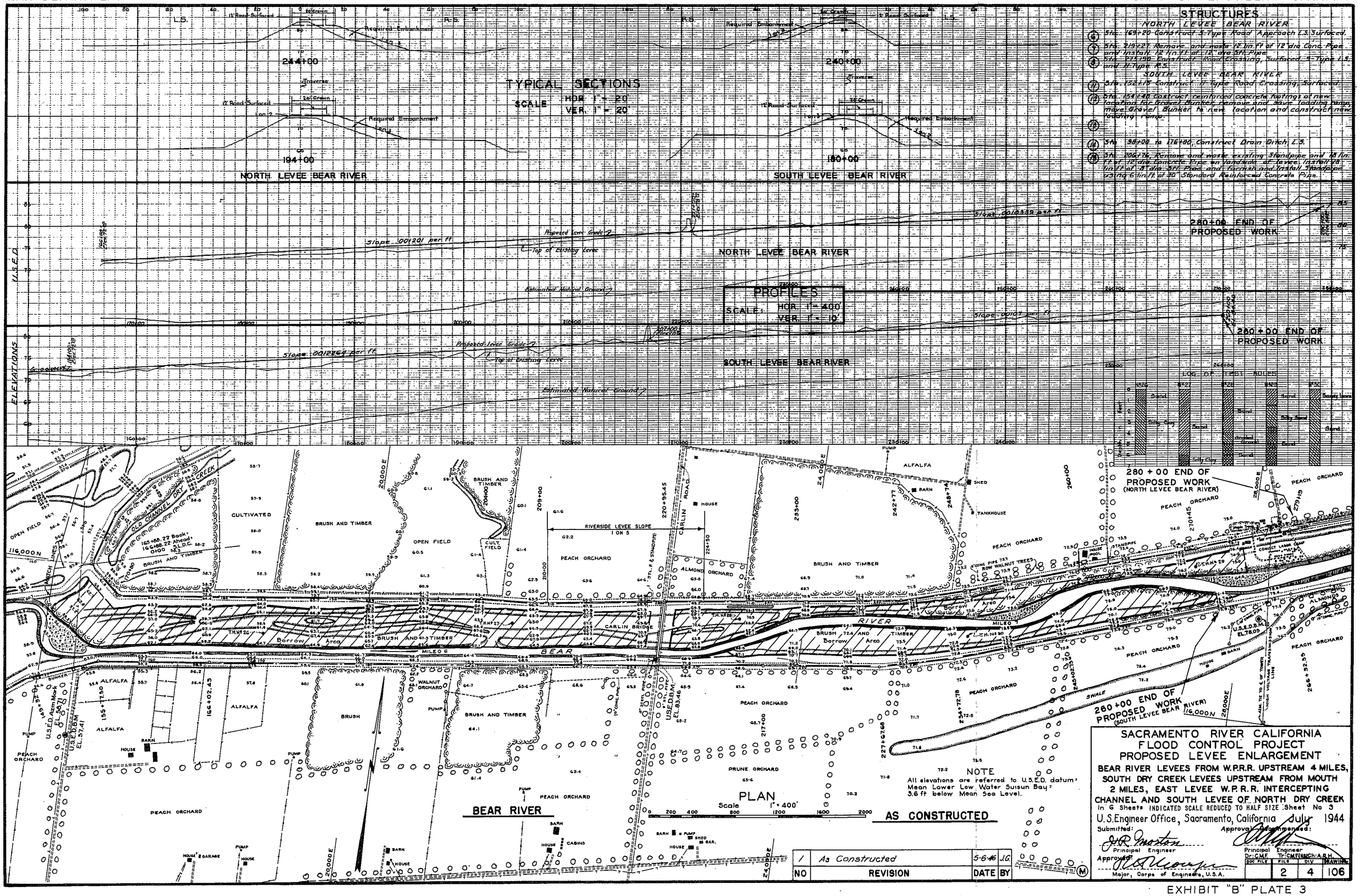


EXHIBIT "B" PLATE 3

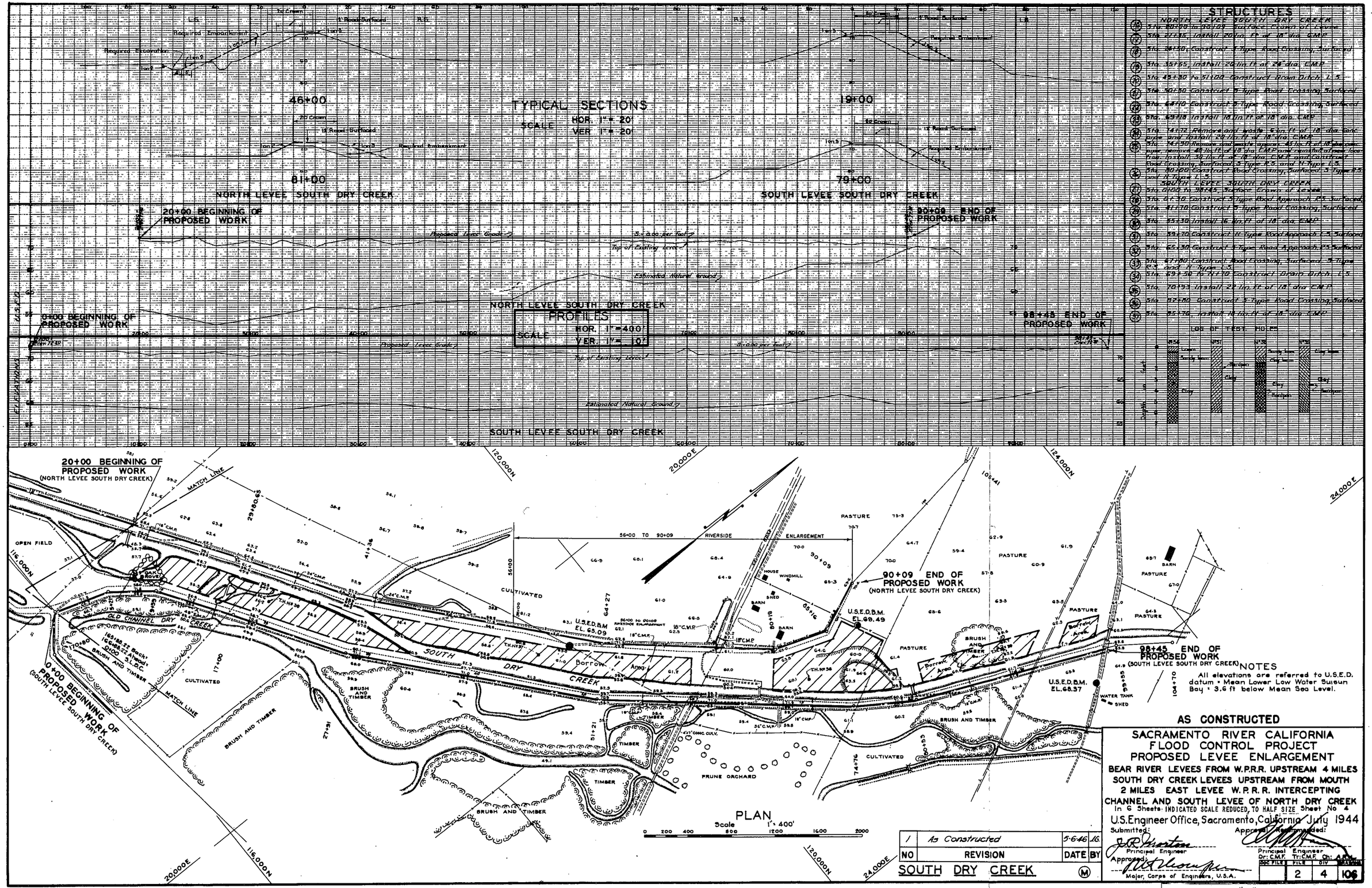


EXHIBIT "B" PLATE 4

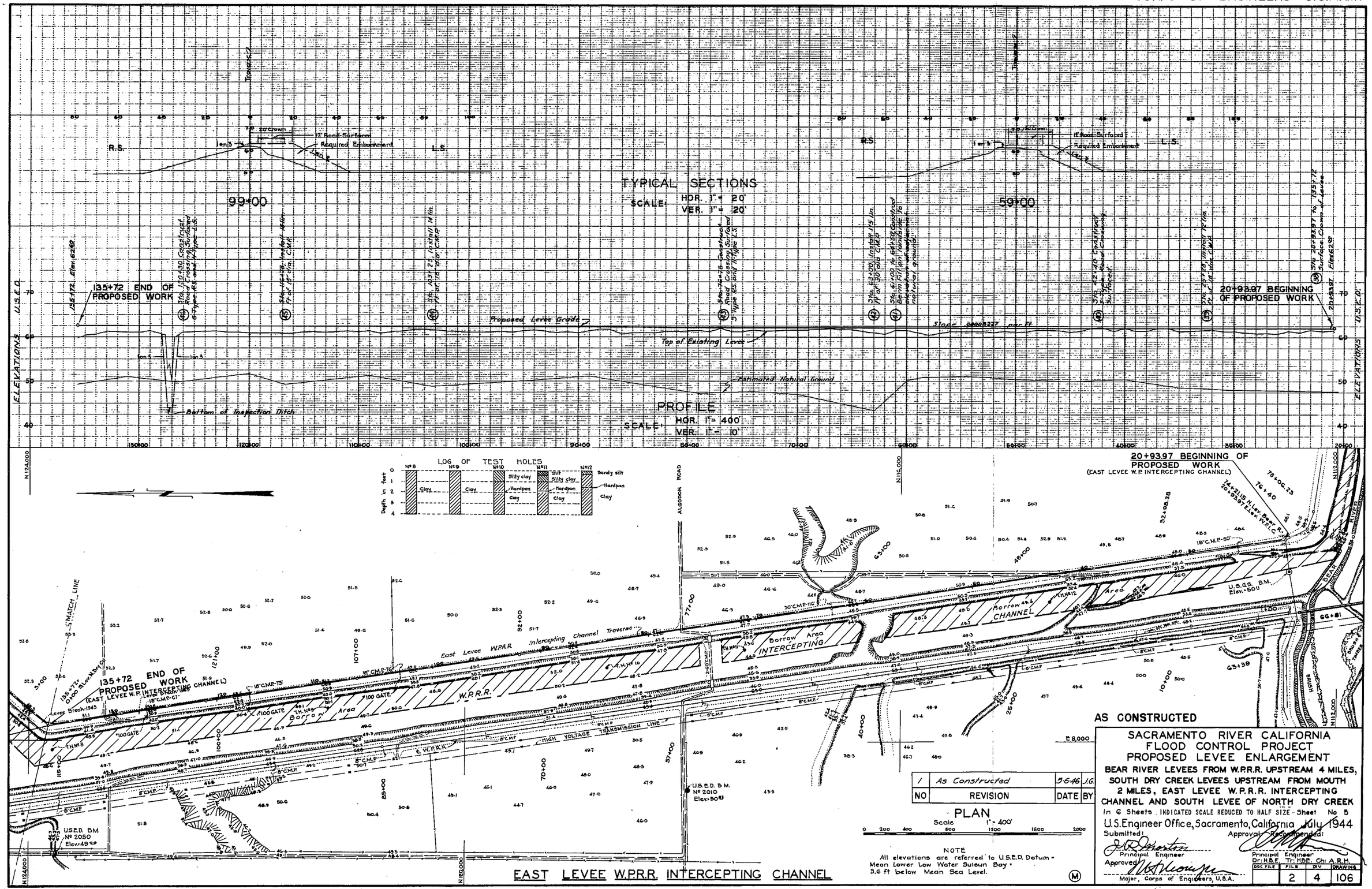


EXHIBIT "B" PLATE 5

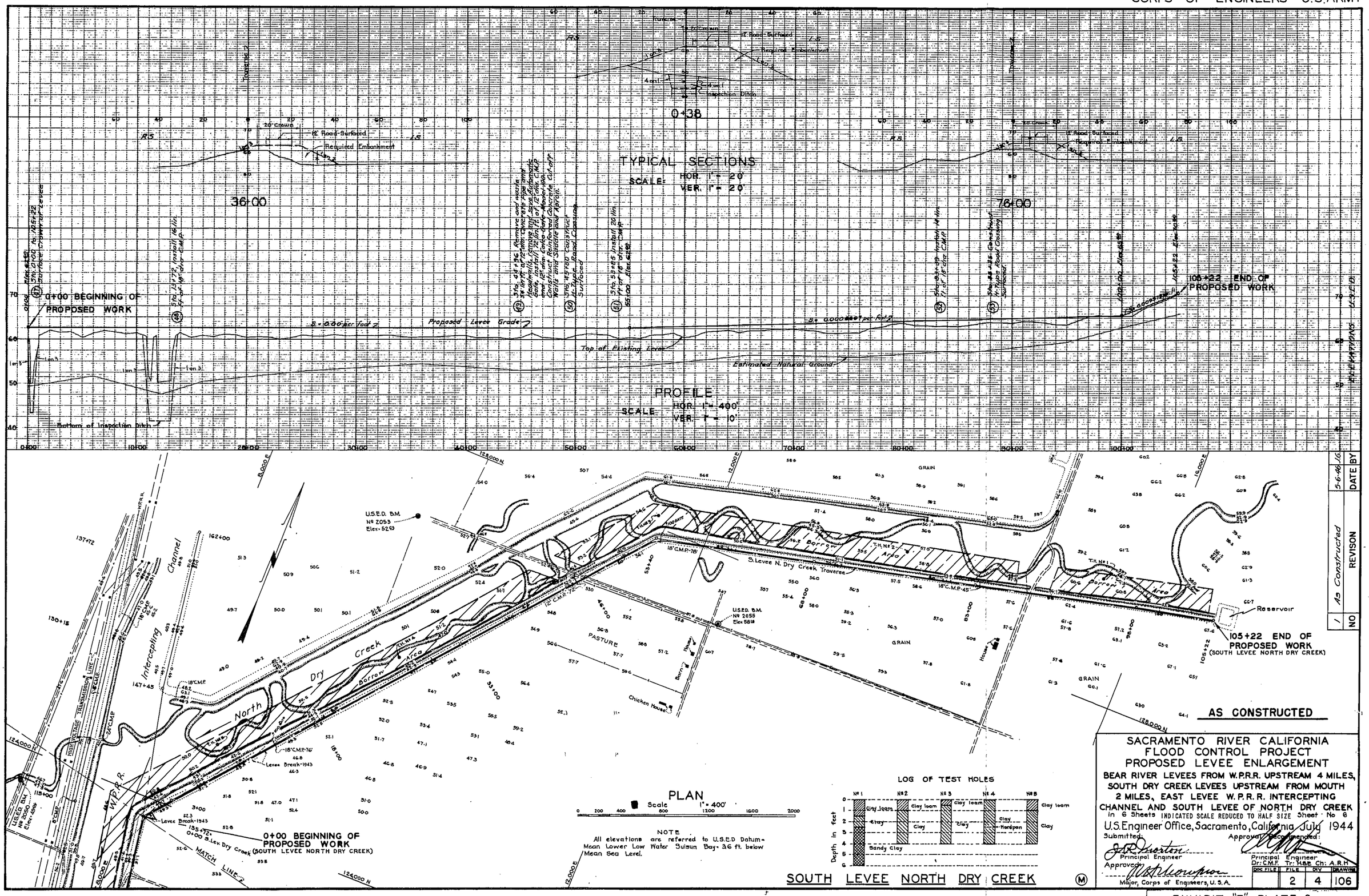
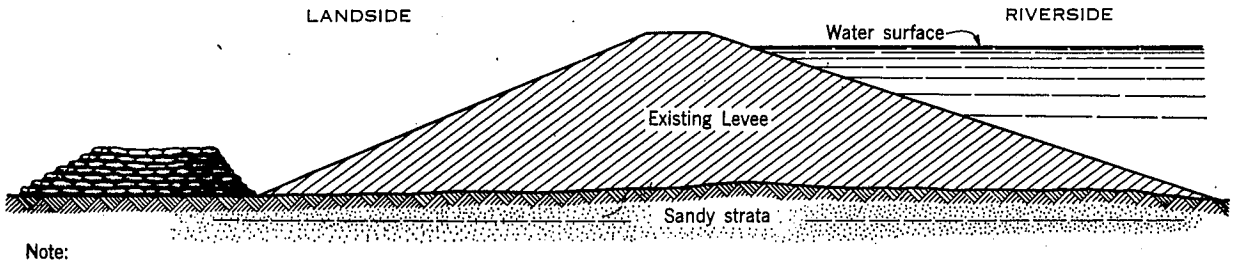


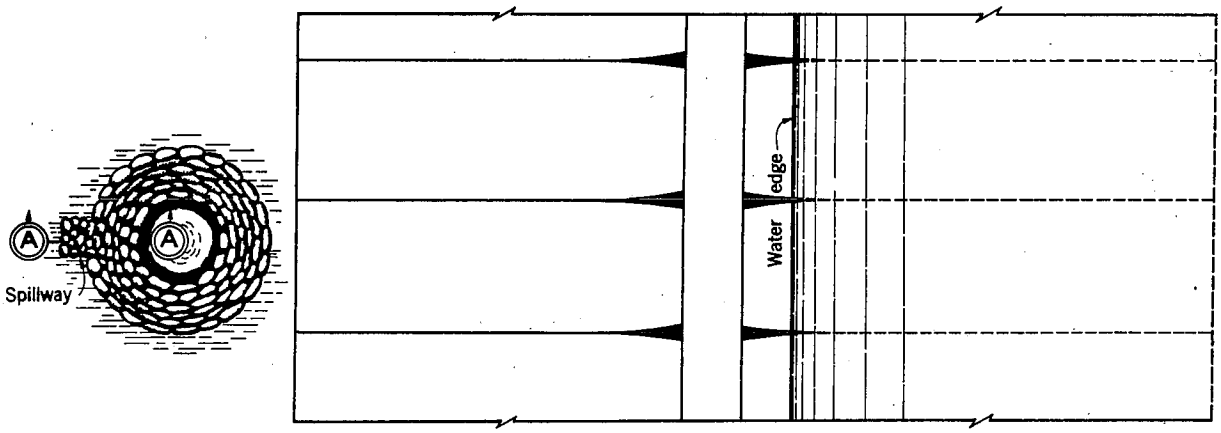
EXHIBIT "B" PLATE 6



Note:
Bottom width to be no less than 1½ times height.
Be sure to clear sand discharge.
Tie into levee if boil is near toe.

ELEVATION

SECTION A-A



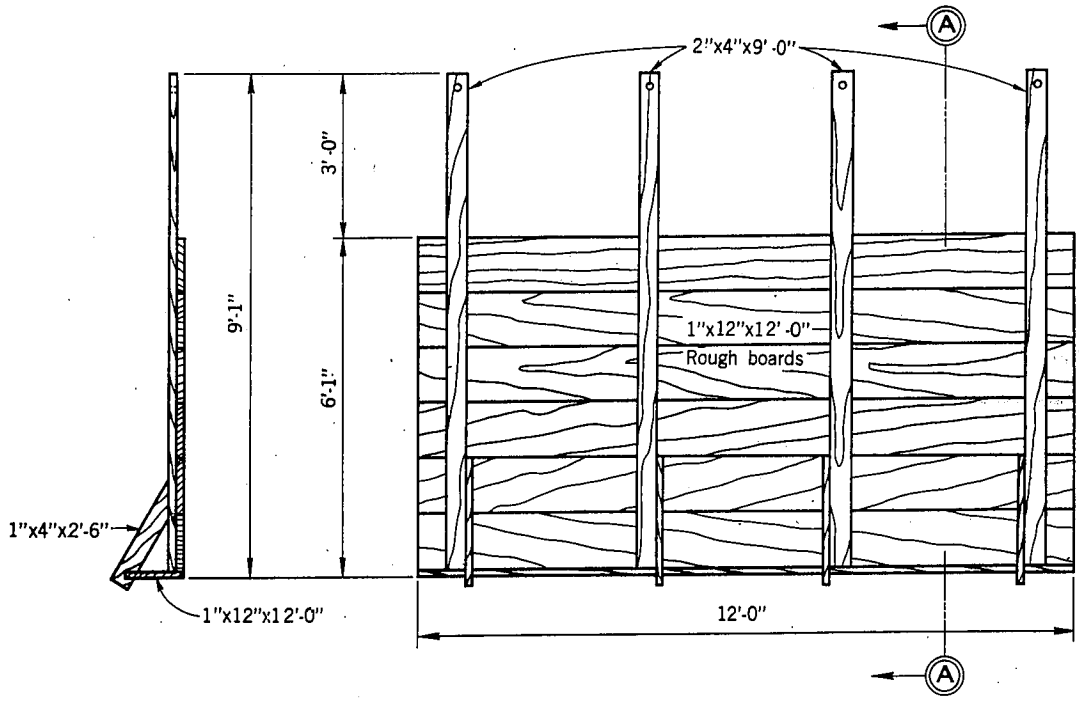
PLAN

Note:
Do not sack boil which does not put out material.
Height of sack loop or ring should be only sufficient to create enough head to slow down flow through boil so that no more material is displaced and boil runs clear.
Never attempt to completely stop flow through boil.

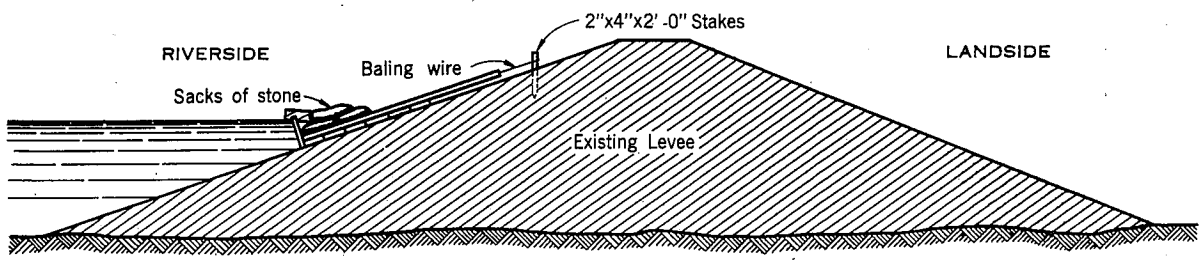
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT

CONTROL OF SAND BOILS

U.S. ENGINEER OFFICE, SACRAMENTO, CALIF.
MAY, 1946



SECTION A-A PLAN



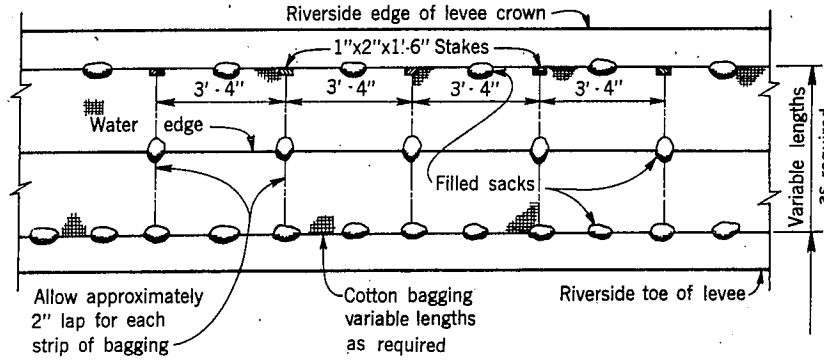
SECTION

BILL OF MATERIAL FOR 100 FEET
LUMBER
56 pieces 1"x12"x12'-0" 32 pieces 1"x4"x2'-6" 32 pieces 2"x4"x9'-0" * 32 pieces 2"x4"x2'-0" * (Sharpened)
WIRE
200' baling wire
NAILS
4½ lbs.-8d nails

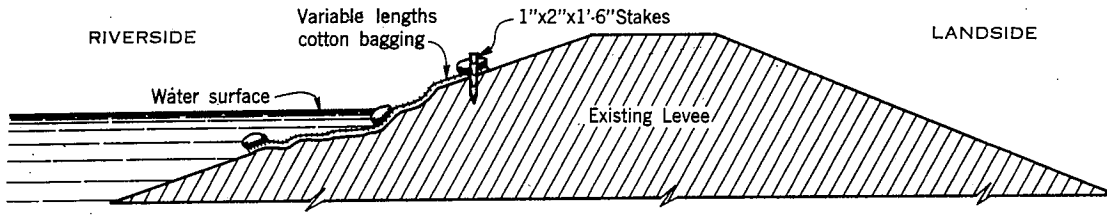
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT

MOVABLE WAVE WASH PROTECTION

U.S. ENGINEER OFFICE, SACRAMENTO, CALIF.
MAY, 1946



PLAN



SECTION

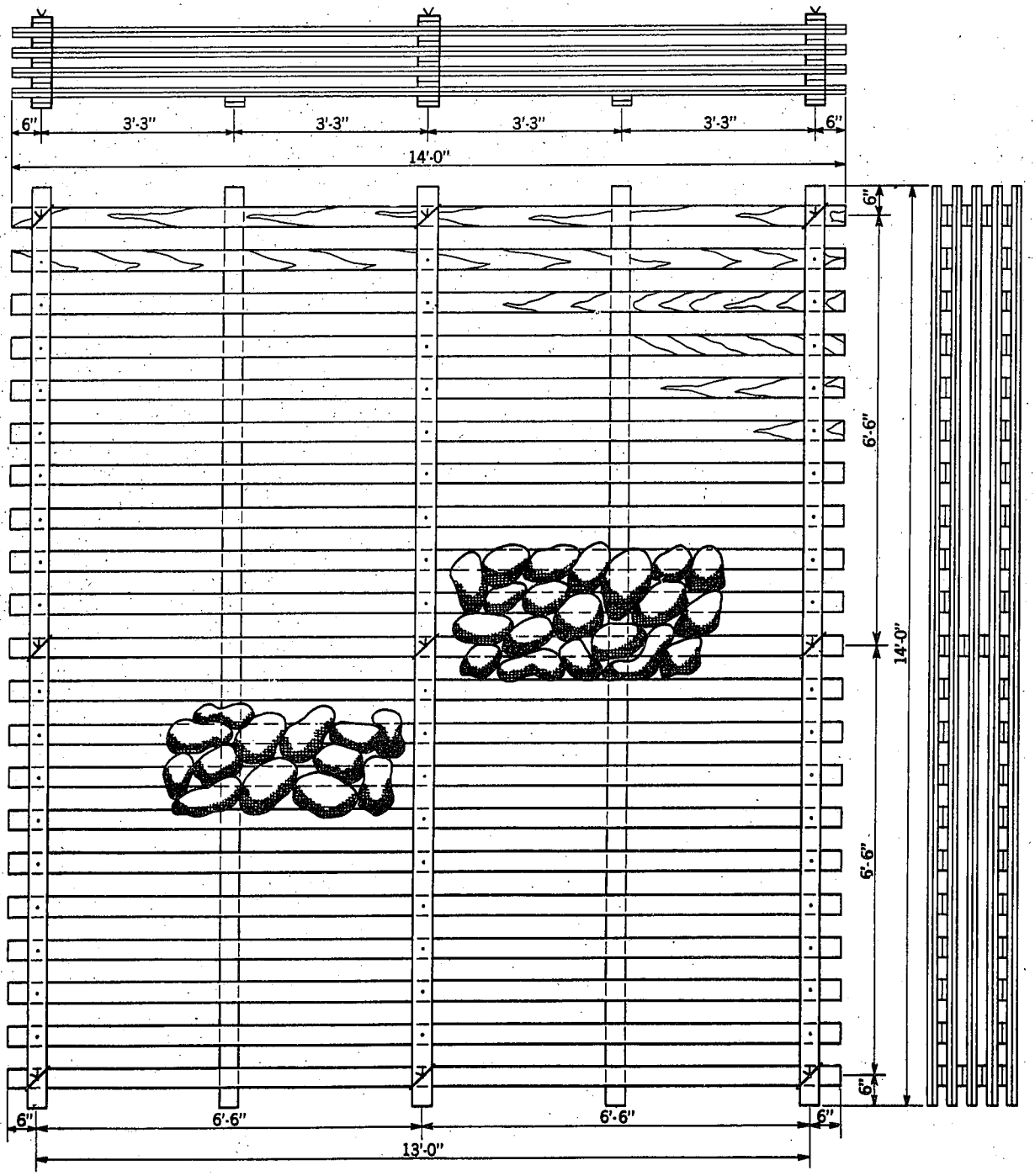
Note:
Lay lengths as required of cotton bagging approximately parallel with levee slope and across damaged section. Weight top and edges of bagging with filled sacks as shown above. The filled sacks should be wired or tied to each strip before laying in place. Stake the corners of each strip above water surface. Where cotton bagging is not available burlap sacking may be substituted.

MATERIAL REQUIRED FOR 100 LINEAR FEET OF LEVEE
LUMBER
* 30 Stakes 1"x2"x1'-6" * (Sharpened)
SANDBAGS
120 sand bags Cotton bagging as required

SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT

WAVE WASH PROTECTION

U.S. ENGINEER OFFICE, SACRAMENTO, CALIF.
MAY, 1946



Note:

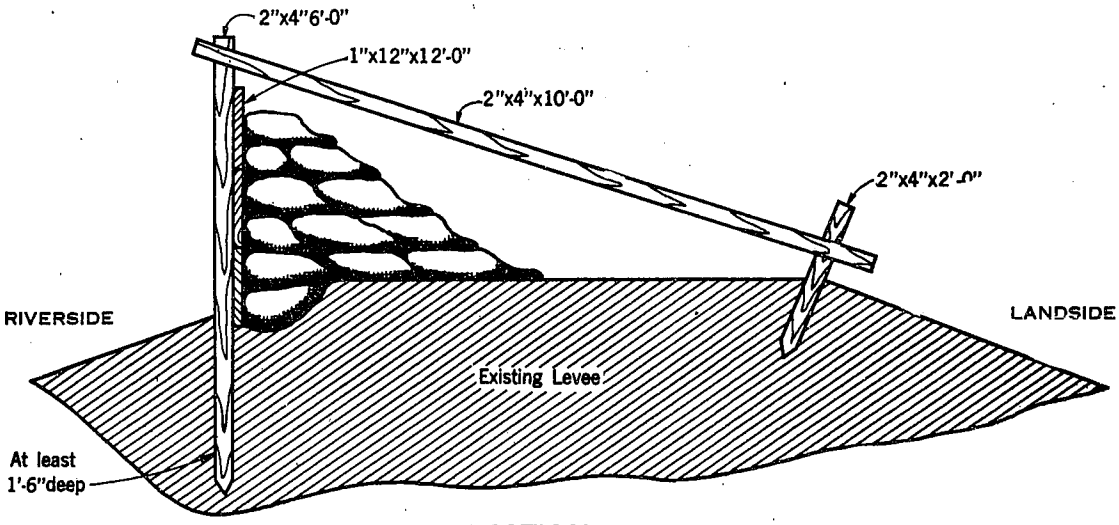
Cribs constructed of double thickness of 1"x4"x14'-0" lumber. Nail all intersections with 1-20d nail. Each intersection of walls securely fastened by a loop of No. 9 wire, tightly twisted.

BILL OF MATERIAL FOR ONE CRIB 13'-0"
LUMBER
130 pieces 1"x4"x14'-0"
WIRE
30' No. 9 wire
NAILS
12¼ lbs.-20d nails

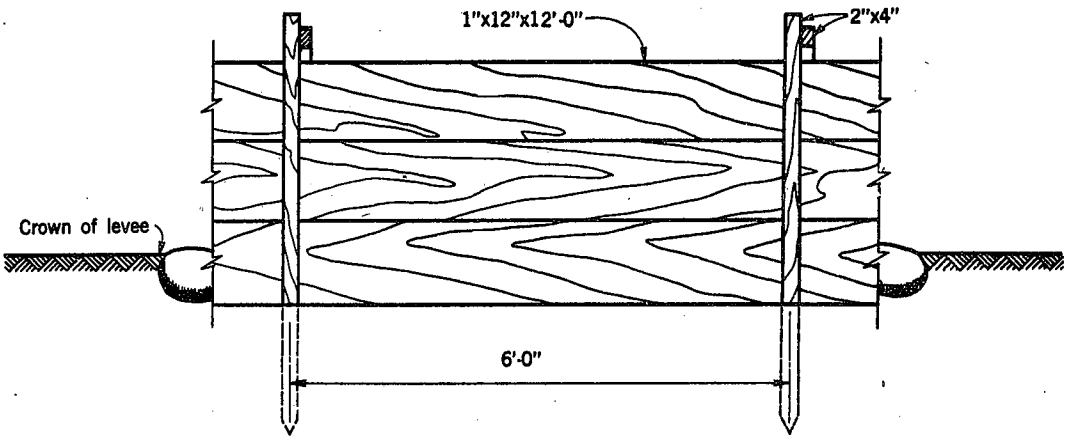
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT

CAVING BANK PROTECTION

U.S. ENGINEER OFFICE, SACRAMENTO, CALIF.
MAY, 1946



SECTION



FRONT ELEVATION

BILL OF MATERIAL FOR 100 LINEAR FEET OF LEVEE
LUMBER
25 pieces 1"x12"x12'-0" 17 pieces 2"x4"x10'-0" * 17 pieces 2"x4"x6'-0" * 17 pieces 2"x4"x2'-0" * (Sharpened)
NAILS
1 lb. -8d nails 2 lbs.-16d nails
SANDBAGS
1100 bags

SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT

LUMBER AND SACK TOPPING

U. S. ENGINEER OFFICE, SACRAMENTO, CALIF.
MAY, 1946

CHECK LIST NO. 1

LEVEE INSPECTION REPORT

Date _____

Inspected by _____

Report number of places requiring maintenance work opposite each item listed below. A separate report should be submitted describing the necessary maintenance work for each location.

Reference Manual No. _____

Item No.	Description	Number of Places
1	Settlement, sloughing, or loss of grade	
2	Caving, (either side of levee)	
3	Seepage, saturated	
4	Rip-rap	
5	Sod	
6	Access roads and road ramps	
7	Cattle guards and gates	
8	Crown of levee	
9	Unauthorized grazing or traffic	
10	Unauthorized encroachment on rights-of-way	
11	Unauthorized excavation and loose backfill	
12	Accumulations of drift, trash or debris	
13	Weeds or undesirable vegetation	
14	Miscellaneous pipe crossings	
15	Inappropriate burning of grass	
16	Other items not included above	

Inspected by _____

Exhibit "D"

CHECK LIST NO. 2

Drainage Structures located along the Bear River Levee System in the vicinity of Rio Oso, Sutter County, approximately 28 miles northerly of Sacramento, Calif., as shown on Drawing No. 2-4-106 in 6 sheets.

HIGHWATER PERIOD. This term is used under Paragraph 4-01(3)(b) of this Manual; it applies to floods rising above the reading of 18.0 on the U.S. Geological Survey gage located on the right bank of Bear River, 100 feet downstream from U.S. Highway 99E at Wheatland, Calif. Zero on this gage is set to Elev. 85.0 U.S.G.S. datum. The reading of 18.0 at Wheatland corresponds to a reading of 12.0 on the U.S. Weather Bureau gage "Wolf" near Auburn, Calif.

Structure No. as shown on Constr. Drawing	Station	Calif. Corr. Culvert Co. Structures Corr. Metal Pipe	Gate Model No.	Other Structures	Elevation of Invert U.S.C.E. Datum	Gage reading at Wheatland for structures to be closed	Recommended Maintenance Work
	North Levee - Bear River						
3	92+88	30"	100		46.9	13	
-	143+15	18"	100		53.5	13	
7	219+27			12" steel pipe, river end is plugged.	66.0	13	
	South Levee - Bear River						
15	206+76			8" steel pipe, river end is covered up.	68.0	13	
	North Levee - South Dry Creek						
-	4+96	18"	100		51.2	13	
-	9+85	18"	100		50.9	13	
17	21+35	18"	100		54.3	13	
19	35+57	24"	100		52.2	13	
-	43+17	24"	100		49.6	13	
23	69+17	18"	100		56.3	13	
24	74+71.5	18"	100		57.3	13	
	South Levee - South Dry Creek						
-	15+23.5	48"	100		49.5	13	
30	55+30	18"	101		57.7	13	
35	70+93	18"	101		58.6	13	
37	85+70	18"	101		59.0	13	

(EXHIBIT "E", Sheet 1 of 2 sheets)

CHECK LIST NO. 2

Manual No. 5

Bear River Levee System, Cont'd.

Structure No. as shown on Constr. Drawing	Station	Calif. Corr. Culvert Co. Structures Corr. Metal Pipe	Gate Model No.	Other Structures	Elevation of Invert U.S.C.E. Datum	Gage reading at Wheatland for structures to be closed	Recommended Maintenance Work
	East Levee, W.P.R.R. Intercepting Channel						
39	25+28	18"	100		46.8	13	
42	63+00	30"	100		39.8	13	
44	103+23	18"	100		47.7	13	
45	116+78	18"	100		48.7	13	
-	126+53	18"	100		49.1	13	
	South Levee - North Dry Creek						
48	13+72	18"	100		47.6	13	
49	44+96	12"	100		52.0	13	
51	53+85.5	18"	100		48.4	13	
-	83+39	18"	100		56.3	13	
-	91+50	18"	100		56.0	13	

Inspected by _____

Date _____

EXHIBIT "E"
Sheet 2 of 2 sheets.

R E S O L U T I O N

ADOPTED BY THE RECLAMATION BOARD

FEBRUARY 6, 1946

- - - - - - -

WHEREAS The Reclamation Board on February 6, 1946, did approve a certain item of "new construction", said work consisting of the construction of the Bear River levees from Western Pacific Railroad upstream four miles, South Dry Creek levees upstream from its mouth two miles, East Levee, Western Pacific Intercepting Canal and South Levee of North Dry Creek; and

WHEREAS the War Department, U.S. Engineer Office, District Engineer, under date of January 25, 1946, has notified the Reclamation Board of the completion of such work of "new construction", and its desire to turn over to The Reclamation Board such work as completed, for maintenance by the proper local interests; and

WHEREAS the Chief Engineer of The Reclamation Board has caused to be made inspection on the ground of such work of "new construction", and has found and determined that such work, as completed, has been prosecuted and carried out in conformance with the plans and specifications therefor; now, therefore, be it

RESOLVED AND ORDERED, That the Reclamation Board does hereby accept, for the State of California, the said item of "new construction" as aforesaid, which has, on the date hereinabove set forth, been turned over to said Board by the War Department, U.S. Engineer Office; and be it further

RESOLVED AND ORDERED, That the south levee of Bear River, together with the channel of said river, be turned over to Reclamation District No. 1001 for maintenance and operation, as the legally authorized function of said District; and be it further

RESOLVED AND ORDERED, That the north levee of Bear River upstream from the mouth of South Dry Creek, together with the channel of said river in that vicinity and the levees of South Dry Creek, together with the channel of said creek, be turned over to Reclamation District No. 817 for maintenance and operation, as the legally authorized function of said District, and be it further

RESOLVED AND ORDERED That the north levee of Bear River downstream from the mouth of Dry Creek, the east levee of the Western Pacific Intercepting Canal and the south levee of North Dry Creek, together with the channels adjacent to said levees, be turned over to Reclamation District No. 784, for maintenance and operation, as the legally authorized function of said District.

STATE OF CALIFORNIA)
COUNTY OF SACRAMENTO) SS
Office of The Reclamation Board)

I, GEORGE H. HOLMES, Secretary of The Reclamation Board, do hereby certify that the above and foregoing is a true and correct copy of a resolution duly passed and adopted by said Board at its meeting held February 6, 1946.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of The Reclamation Board this 15th day of February, 1946.

/s/ George H. Holmes
GEORGE H. HOLMES
Secretary
The Reclamation Board

EXHIBIT "F"