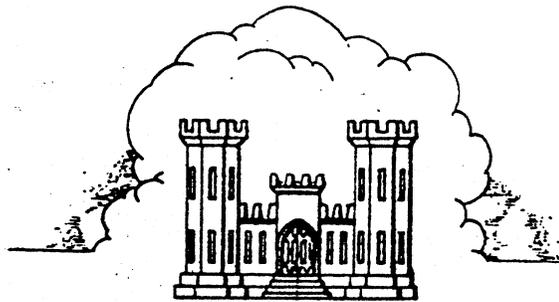


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27 OCT 1969

DESIGN MANUAL
FOR
LEVEE CONSTRUCTION



DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGN MANUAL
FOR
LEVEE CONSTRUCTION

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(Revised January 1973)

SECTION I

INTRODUCTION

1-01. General. This manual is only for the use of personnel in the Levees & Channels Section, an organizational unit of the Design Branch, Engineering Division, Sacramento District Engineer Office. The purpose of the manual is to guide new personnel and serve as a ready reference to engineers in the unit on the procedures to be followed in the development of construction plans for flood control works and navigation channel dredging. Requirements for other functions of the section such as studies in connection with Survey Reports, emergency flood control procedures and operation and maintenance manuals are not a part of this manual.

SECTION II

DESIGN MEMORANDA

2-01. General. Prior to initiation of work on contract plans and specifications for authorized levees and channel projects, which is the basic function of the Levees and Channels Section, regulations require the completion of definite project studies except when the project is authorized under the provisions of PL 685. Definite project studies are prepared and published as design memoranda and require the approval by the Division Engineer or OCE. ER 1110-2-1150 contains the requirements for these definite project studies.

2-02. Definite project studies. Usually definite project studies for levees and channels projects are contained in a single memorandum designated "General Design". The determination of number of Memoranda for authorized projects is made by the Chief of Engineering Division. An outline of the text on a memorandum shall be prepared, utilizing previously prepared memoranda as a guide. Approval of the outline shall be obtained from the Section Chief, Levees & Channels.

2-03. Surveys and explorations. The same procedure is used during definite project studies as is used in preparation of contract plans for obtaining survey and exploration data except the scope of the work will be more limited. For definite project studies controlled aerial photography might be considered in lieu of making a detailed topographic survey. Also cross-sections should be taken at 500-foot or 1000-foot intervals in lieu of the 100-foot 200-foot interval usually used during contract plan preparation. Fund limitations will control the number and type of exploration holes. All surveys and explorations made for design memoranda shall be so planned that they can be supplemented and refined for later use in the preparation of plans and specifications.

2-04. Drawings or plates. Drawings for the design memoranda shall be developed from the basic survey tracings provided by the Survey Section of the Foundation and Materials Branch in the same manner as for contract plans. Plates for design memoranda shall be reduced to a 10-1/2-inch vertical height x 16 inches maximum width for binding purposes.

2-05. District review. Design Memoranda shall be reviewed in draft form by the pertinent organizational elements of the District office and by the local sponsor. However, prior to issuance for review, a preliminary review will be made by the Chief, Levees and Channels, the Chief, Design Branch and by the Chief of Engineering Division if he desires. After District Office review is completed and the memorandum is assembled in final form, it shall be submitted to the Division Engineer as provided for in DR 1110-2-3. Upon approval of the Memoranda, copies together with pertinent correspondence will be distributed as provided for in Engineering Division Memo 211.

SECTION III

PLANS AND SPECIFICATIONS

3-01. Plans. Plans will be prepared by using "Cronaflex" or other approved transparencies taken from the basic survey tracings provided by the Foundation and Materials Branch. The basic survey tracings will not be used and will be placed on file (Map Files) as basic data. Plans will be prepared using methods and materials which will permit reduction to half size. In order to insure good prints and reduction, the following will be strictly observed:

- a. Lettering shall be a minimum of 1/10-inch in height.
- b. Shading shall be eliminated. In lieu thereof, cross hatching or symbols may be used.
- c. No lettering or printing shall be placed on the back of the tracings, except for profile and cross section grids.
- d. Appropriate scales will be used to permit reduction without crowding.
- e. Ozalid transparencies will not be used as original tracings. They may be used as record drawings when modification of an original tracing is about to be made and a reproducible must be made for record purposes.

3-02. Standard language and titles. Standard language will be used in the preparation of plans. The names and nomenclature should be the same as those used in the applicable OCE Guide Specifications. The drawing titles will be standardized and shall be the same as the titles and descriptions used in the design memorandums, specifications and PB 2-A Detailed Project Schedules. The use of abbreviations will be avoided to the maximum extent possible. Title blocks shall be in accordance with instructions contained in the current issue of EDM 210 and District Drawing 80-25-617.

3-03. Preparation. Issuance of the contract plans in preliminary form will be required intermittently during their preparation. It will be necessary to use them for right-of-way requests and other local interest actions. For these preliminary actions an ozalid transparency shall be used appropriately titled and dated, reserving the basic tracing for final development after right-of-way agreements are consummated.

- a. The drawings of the contract plans must include the following:

- (1) Each sheet of the plan must have coordinates and a suitable Bench Mark plainly marked. The Date of Surveys should also be shown. Each must have a north arrow, show direction of flow of the stream and have reference to river mileage when applicable.

(2) The borrow areas on the drawings, and particularly the cross sections, must be labelled either "Uniform" or "Progressive" Borrow.

(3) Location of all test holes, pits, or borings for soil and foundation investigation, together with sufficient pertinent data to indicate the soil classification and a note inviting attention to the fact that all data pertaining to the soils investigation which was conducted by the Sacramento District are available for inspection. Date of explorations must be shown on drawings.

(4) Structure notes should indicate the disposition of any and all structures passing through, under or over the levees within the limits of the work. These notes will indicate that the designer is aware of the presence of these structures.

(5) Where conduits are to be placed through new levees for drainage purposes, a traverse or centerline station will be given with suitable structure notes to indicate that the location and the elevations are flexible to a certain extent and can be adjusted in the field to suit conditions.

(6) All contract drawings (both plans and structure sections as necessary) which show the lengths of pipe to be furnished by the contractor, will contain the following note: "The lengths of pipe shown are for bidding purposes only and are approximate. Actual lengths to be fabricated or installed may vary slightly due to field conditions."

(7) Where work will be accomplished on or adjacent to a railroad right-of-way, place on the contract drawing a detail showing the relationship of our work to the railroad facilities.

b. Contract plans must conform with the right-of-way agreements. A careful check must be made to insure that no disagreement exists. All rights-of-way must be available and clearance must be given in writing by the Reclamation Board or other responsible local interests before the work may be advertised for bids in accordance with instructions contained in paragraph 3 of District Engineer's Memo to Chief of the Engineering Division dated 25 April 1951 (Exhibit B).

c. The Reclamation Board will be notified six weeks in advance of the scheduled advertising date whether the advertising date will be met as originally scheduled.

d. Cross sections. The original tracings of the cross sections used in development of the plans will be kept in the Levee Section until a definite alignment and layout is determined. All computations and preliminary work will be performed on prints of the cross section tracings. After the final alignment has been determined, the final templates will be shown on the cross section tracings. Three sets of prints of these tracings

will then be procured and sent to the Resident Engineer Office together with 10 sets of the earthwork yardage and other computations. This shall be done at least two days prior to advertising. Prospective bidders use this information in their studies and the Field Office uses the data in connection with "Before Construction" surveys and in making detail layouts. The cross section tracings will be sent to the map files.

3-04. Specifications. Review and processing of levee specifications will be in accordance with Engineering Division Memorandum No. 221. Construction time will be coordinated with Construction-Operations Division by DF.

3-05. Signatures. After the specifications have been written (subsequent to the District Review) and prior to submittal to the Division for review, all required signatures, except the signature of the Chief of the Engineering Division and the District Engineer which is required only on sheet 1 of the set (all other sheets will have the District Engineer's name lettered in the title block), will be affixed to the contract plans. The Chief of Engineering Division and the District Engineer will affix their signatures at the time "Advance Notice to Bidders" is issued approximately two weeks prior to advertising. Where Division approval is not required, all signatures will be obtained prior to the advertising for bids.

3-06. Revisions.

a. After the drawings have been completed, revisions or changes can be made without securing ozalid transparencies or recording the changes in the revision block up to the time the Chief of the Engineering Division and District Engineer affix their signatures to the drawings. After these signatures, revisions due to omissions, corrections, or other modifying changes will be made only after a transparency has been secured and placed in the District Files. The changes are then made on the original contract plan transparencies and appropriately recorded on the revision block in the title which then must be initialed.

b. In the interval between furnishing plans and quantities to the Specifications Section for specification preparation and advertising for bids, changes to the original "Cronaflex" transparencies will not be made on a continuing basis. Instead, any changes, whether due to the rights-of-way agreements or other causes, will be made at two separate and distinct stages in the development of the plans and specifications.

c. The drawings, quantities and technical specifications will be as complete as possible when they are submitted to the Specifications Section for initial preparation of the specifications. At this stage the tracings will be signed by the Section Chief. Immediately after signature, the Unit Chief will obtain a set of prints which will be a control or master set. Any changes to the drawings between the time of

submittal of the signed tracings to the Specifications Section and the completion of the District Review will be marked in red on the master set of prints. Changes will not be made on the tracings. After completion of the District Review, changes to the tracings will be made by taking them from the master set of prints. When the corrected tracings are forwarded to the Specifications Section, the master set should be loaned to them so that they will be sure that all changes necessary to the specifications will be caught and corrected prior to submitting the plans and specifications to the Division for review and approval.

d. The Unit Chief should secure a set of prints of the drawings as they go to the Division Engineer and again make a master set of prints. This master set should be kept current by making changes in color. After receipt of comments from the Division Engineer, any changes necessary to the drawings will also be made on the master set of prints. The tracings should then be corrected and, together with the master set of prints, again forwarded to the Specifications Section. This will help them to make sure that all the changes to the drawings are reflected in the specifications. Half size drawings shall be used for advertising purposes in accordance with instructions contained in Exhibit A.

3-07. Revisions by word description.

a. Sometimes it becomes necessary to revise the contract drawings during the advertising period by "word description" in lieu of reissuance of the drawings. Such "word descriptions" in lieu of issuance of a revised drawing will be made only when (1) bid opening date cannot be postponed to allow time to reissue drawings, (2) time does not permit reproduction and issuance of revised drawings, or (3) revisions are minor in nature. In such cases, the matter will be brought to the attention of the Chief of the Design Branch by the section chief.

b. When "word description" changes to the drawings are approved by the Chief, Design Branch, the amendment will include the following:

"The following revisions will be made to the drawings listed herein. These drawings are not being reissued with this amendment, but will be reissued to the successful bidder at time of contract award."

c. It shall be the responsibility of the chief of the section to revise the tracing within two days of issuance date of amendment, and it shall be the responsibility of the Specifications Section to furnish Construction-Operations Division with the required number of sets of the revised drawings not later than 3 days prior to award of contract.

SECTION IV

ASSURANCES, RIGHTS-OF-WAY AND ACCEPTANCE OF CONTRIBUTED FUNDS

4-01. Procedure for acquisition of assurances. Responsible local interests are required by law to provide the assurances of local cooperation. As soon as definite plans have been formulated and the first request for construction money is submitted to the Congress, definite assurances of local cooperation should be sought from local interests and a determination made of the legal and financial responsibility of the local interests to meet the terms of local cooperation. The Levees and Channels Section is responsible for obtaining these assurances from local interests. If the general design memorandum has been approved, formal request for assurances of local cooperation will be made when construction funds are first included in the budget (submission to Congress). If construction funds for a project are included in the budget prior to approval of the general design memorandum or are added by the Appropriations Committee, formal assurances will be requested as soon as planning has advanced to the point that local interests can be informed of specific details of the responsibilities which they must assume. The formal request will inform local interests of the legislative authority for the required conditions of local cooperation and will present sufficient information to clearly define what local interests must do to meet those conditions. On flood control projects the request will quote the legislative provision for expiration of the project authorization if assurances are not received within five years from the date of notice and will state that the 5-year period begins with the date of the formal request. Acknowledgement of receipt of the letter will be requested. If no acknowledgement is received or if the reply indicates any misunderstanding regarding local cooperation requirements or the 5-year limitation, the Levee Section will follow up with appropriate supplementary or explanatory letters. Formal requests will be sent by registered mail and receipts therefor maintained as a part of the record. Copies of correspondence to and from local interests on the subject will be furnished the Division Engineer and the Chief of Engineers. After receipt of the assurances, they are formally turned over to the Real Estate Division for a determination of legal sufficiency. The procedures for processing the assurances are outlined in District Circular 62-20 (see Exhibit K). On projects accomplished under special continuing authorizations (Emergency Jobs), the Construction-Operations Division obtains the assurances of cooperation from local interests.

4-02. Procedure for acquisition of rights-of-way. No construction will be undertaken until satisfactory assurances of local cooperation have been received and until all lands, easements, and rights-of-way required for at least a complete unit of the project have been provided by the responsible local interests. A District policy has been established requiring all necessary rights-of-way to be acquired before advertising for bids (Exhibit B). On projects which consist of a single unit which will require several years for construction, consideration will be given to

breaking the project into reaches. Such reaches may be considered as units if a full showing of financial and legal ability of local interests indicates such action to be warranted. A full discussion of this subject will be submitted to the Chief of Engineers in the general design memorandum or in separate correspondence prior to making any commitment to local interests on the schedule of rights-of-way requirements. On projects for which the State Reclamation Board furnishes rights-of-way for construction, the Sacramento District and the Board have mutually agreed to a schedule of timing and a sequence of actions. There are two schedules, one for projects in the Central Valley of California and one for the Sacramento River Bank Protection Project. They are attached as Exhibit L. It is the responsibility of the Levees Section to make sure that these schedules are met.

Real Estate requirements for local cooperation projects are established in ER 405-2-680 and ER 1150-2-301. When requests are made to local interests for rights-of-way for flood control projects, a map will be furnished showing the areas over which fee title or permanent easement must be acquired (land occupied by levees, channels and appurtenant structures) and areas over which permits or temporary easements must be acquired (borrow, spoil, work and temporary access areas). The procedure for furnishing the foregoing information is as follows:

a. Mark up preliminary drawings, outlining the minimum limits of the permanent easement lands and the temporary easement lands required. The required permanent easement for proposed levees will be shown as extending either five or ten feet beyond the levee toe on the landside to a point either five or ten feet beyond the levee toe on the waterside through the entire length of the contract work. The distance from the levee toe to the easement line shall be established by the local sponsor. Where projections or irregularities in the levee toe alignment are encountered, such as those due to irregularities in the ground surface, or where berm fills are to be constructed across old sloughs, channels or other depressions, the easement line should be adjusted as necessary in order that the work area will fall well within the easement or right-of-way line. The permanent easement for channel work where no levees are required will generally include the entire width of channel plus a 20-foot wide strip for dry weather maintenance on both sides of the channel. If levees are included, the right-of-way will extend either five or ten feet landward of one levee to either five or ten feet landward of the opposite levee. Temporary easements are required for spoil and borrow areas used during initial construction. They are also required where right of access will be needed, such as: (1) Between public roads and the job site; (2) Between the job site and borrow and spoil areas; (3) On the job itself. These access rights are especially important on jobs where a 12-foot crown width levee is involved. As the job nears completion, there may be insufficient room for construction equipment to pass unless additional right-of-way adjacent to the levee is secured. The right-of-way problems

on each job will be discussed with a representative of the Resident Office involved. The recommended routes for access to the work sites, borrow areas, and the job itself will be worked out jointly by the Levee Section in collaboration with the Resident Office and the local sponsor who acquires the right-of-way.

b. Furnish local interests copies of the marked-up drawings showing the limits of the rights-of-way to be furnished by a certain date. Local interests shall prepare property acquisition maps and documents and when they have obtained the required real estate, they will furnish in writing a statement that all rights-of-way have been secured together with copies of all right-of-way documents and maps. Clearance is then given to proceed with the work. If requested by local interests, it may be necessary to furnish offsets or descriptions of access roads for the temporary easement lands.

c. A project map will be furnished to the Real Estate Division to aid in review of the rights-of-way documents. As the individual rights-of-way are received, a copy will be sent to the Real Estate Division for a determination of its legal sufficiency. The Levee Section shall determine that rights-of-way are satisfactory from an engineering and construction standpoint.

d. When all rights-of-way have been acquired and clearance for construction has been obtained, the contract plans will be completed in accordance with the rights-of-way requirements. The completed plans will then be furnished the Specifications Section for final preparation of the specifications and advertising for construction.

e. On emergency flood control projects and maintenance dredging of navigation projects, the Construction-Operations Division obtains the rights-of-way and furnishes the rights-of-way documents to the Real Estate Division for determination of legal sufficiency.

4-03. Procedure for acceptance of contributed funds. Frequently the non-Federal work items can most economically be accomplished in conjunction with the Federal contract work. If the local sponsors determine that it is to their advantage to include such items in the Federal contract they should formally request this office to include the work. The work items must be listed and a cost estimate included. Authority for this office to accept the funds and do the work shall then be obtained from OCE. Paragraph 9 of ER 1140-2-301, subject: "Acceptance and Return of Contributed or Advance Funds" sets forth the requirements for this action.

SECTION V

SOIL AND FOUNDATION INVESTIGATIONS

NEW CONSTRUCTION

5-01. General. An investigation of foundation conditions and properties of embankment soils should be included in all levee projects. The purpose for such investigation is to supply in the contract documents a sufficiently clear and conclusive description of conditions to be encountered during construction as to eliminate any basis for a contractor's claim of changed conditions. To accomplish this objective, sufficient underground information should be available, and it should be interpreted and presented in the contract documents by qualified geologists and engineers.

5-02. Inspection and requests for investigation. On the basis of the general requirements described in paragraph 5-01, the Embankment Section will make an inspection of the levee alignment and/or any appurtenant structure locations. Following the investigation, the Embankment section will recommend what soils investigation work, if any, will be required, and, upon approval by the Levee Section chief, will make the necessary requests for such work. Determination of the number of borings, tests, and other soils or geologic investigative measures are matters for establishment by the engineer responsible for the design of a structure working with the soils engineer or geologist.

5-03. Soils and investigations notes on drawings. The location of all test holes, pits, or borings will be indicated on the contract drawings. Logs of each hole or pit will also be shown with the laboratory classification of the material, if available; otherwise the field classification will be given, together with depth of hole, reasons why hole was not driven to requested depth (in some cases), depth to water, etc. No interpretation of the soil data will be given; however, the data should be presented in sufficient detail as to give a clear and conclusive description of existing conditions. The specifications will state under Physical Data in the Special Conditions that other data pertaining to the soil investigation are available for the contractor's inspection. The basic idea is to present on the contract drawings the facts of the investigation without giving an interpretation.

CONSTRUCTION INVOLVING LEVEE MODIFICATION OR SET-BACK

5-04. General. In levee projects involving existing levees which are to be modified, enlarged, or set back, an investigation of the soil properties and foundation conditions will be made. It may develop that reconnaissance only is necessary. If explorations are found necessary, proceed as above.

SECTION VI

LEVEES

6-01. Inspection ditches. Inspection ditches will be included on all contract work where levees over 6 feet in height are constructed. The purpose of the inspection ditch is to determine foundation conditions, to provide a cut-off to reduce seepage, and to intercept all pipes or similar structures which may exist underground and which cannot be detected from a surface inspection. See Standard Drawing No. 4488/1, Exhibit D.

6-02. Patrol roads. Patrol roads are for the purpose of providing access along the top of the levee for inspection and maintenance of the levees. Generally all project levees will be provided with a patrol road by the Sacramento District. At all locations where any levee construction or stone protection work is being performed the possibility of including patrol road construction on adjacent reaches (which are to standard grade and section, and which do not have a patrol road) should be considered for inclusion in the contract.

a. Surfacing for patrol roads shall consist of 4 inches of compacted stabilized aggregate as shown on Drawing 4488/2, Exhibit D.

b. At locations where local interests desire an asphalt-treated surface, the Sacramento District will, at the written request of the Local Sponsor, provide 3 inches of compacted stabilized aggregate treated with asphaltic materials (seal-coat).

c. For levees with a crown width of 20 feet, the patrol road will be 12 feet wide. Levees with a crown width of 12 feet will be provided with a patrol road 10 feet in width.

d. On levees where county roads or State highways occupy the crown and which may be modified by our construction, the plans will include any type surfacing in any width Local interests request. (Agreement will be reached between the District and local interests as to the division of costs for such work.) The Sacramento District will request information from the local sponsor in writing at the time of submission of preliminary plans and the local sponsor will reply in writing, indicating the type and specifications of surfacing.

6-03. Access ramps. Access ramps shall be provided, where required, for access by vehicular traffic to all portions of the levee crown so that it may be traversed for patrol purposes. Special consideration shall be given to surface drainage at access ramps. Asphalt curbs and slope drains shall be provided as required. Standard access ramps are shown on Drawing No. 4488/2, Exhibit D.

6-04. Turnouts and turnarounds. To provide a means for the passing of two motor vehicles on a narrow levee crown, turnouts will be provided on levees with a crown width of 12 feet. Such turnouts will be placed at intervals of approximately 2,500 feet provided there are no ramps or

passing in the reach. The exact locations will be dependent upon various factors such as sight distance, property lines, levee alignment, desires of Local interests, and other considerations. A standard turnout is shown on Standard Drawing No. 4488/1, Exhibit D. Turnarounds will be provided on all levees where the levee deadends and there is no access road. Standard turnarounds for levees with 12 and 20-foot crown widths are shown on Standard Drawing No. 4488/1, Exhibit D.

6-05. Estimated quantities of materials of construction. To assist the designers in determining the quantities of materials needed for levee construction, a drawing, a table and a guide format are attached as Exhibit C. The drawing shows the shrinkage factors to apply for levee embankment; the table contains conversion factors to provide a uniform guide for converting quantities of construction materials from one unit to another and the guide format is an aid in assembling earthwork quantities.

6-06. Levee slopes. The adopted levee slopes for standard conditions are 1 on 3 on the waterside and 1 on 2 on the landside, (see Standard Drawing 4488/1, Exhibit D). The side slopes of standard side approach ramps will be the same as the slopes of the levee they serve. (See Standard Drawing 4488/2). These adopted slopes for standard conditions will be used whenever possible. However, modifications of these standards are permissible under certain conditions when economic or other considerations warrant.

6-07. Berm fills. Where the levee crosses over sloughs or overflow channels, berm fills shall be made when the depth of the slough or overflow channel below the adjacent natural ground exceeds a depth of 3 feet. Berm fills are required where the levee crosses an old channel. Special treatment for these fills must be developed in collaboration with the Soils Engineer.

6-08. Stone protection. Stone protection, meeting requirements of Drawing 4488/4, shall be used at locations where erosion is a problem or where further caving will endanger the levee. At locations where a berm is provided, the stone protection should extend from the toe of the bank slope up the bank to the top of the berm. If no berm is provided, the stone protection should extend up the slope to the elevation of the project design flood plane, unless conditions warrant a lower or higher elevation. Where a lower or higher elevation is indicated, the applicable design memorandum should be followed. The design flood planes for various streams in the Sacramento Valley are shown on Drawing No. 50-10-3334 which is on file in the Levees and Channels Section. The stone protection shall be placed on the slope which has been previously prepared for the purpose. In reaches where channel velocities are low the rock will be extended riverward from the junction of the bank slope and the bed of the river as shown on Drawing 4488/4. Where conditions require, a rock toe wall may be placed at the

underwater edge of the bank protection as a key for the rock revetment on the bank. The thickness of the stone protection shall be according to Drawing 4488/4. Bedding material, if required, shall be placed under the stone protection beginning at the low water line and shall extend to the top of the stone protection. Where the streambed is composed of sand or other easily eroded materials, the streambed will be excavated in such a manner and for a distance sufficient to allow extension of the stone protection below low waterline on a 1 on 3 slope to a point below the thalweg of the stream (see Standard Drawing No. 4488/4). This should be done to provide adequate protection against undercutting. The slope of the bank when provided with stone protection shall not be steeper than 1 on 2 except in special cases. However, cobbles will not be used on slopes steeper than 1 on 3. In preparing jobs where bank protection is involved, at least one section should be secured at each site by sounding all the way across the stream. This is for the purpose of determining the thalweg location and the method of terminating the stone protection at the toe of the bank. ETL 1110-2-60, "Criteria For Riprap Channel Protection" prescribed guidance and criteria for riprap protection, is attached as Exhibit E. -

6-09. Bedding material. Bedding material will be provided under stone protection only at locations that experience a wide range of tidal fluctuations or where there is a wide stretch of open water conducive to the building up of waves or where the levee embankment requires such material for stabilization. No bedding material will be placed at other locations unless specifically recommended by the Embankment Design Section of the Foundations and Materials Branch. Where bedding material is provided, it shall consist of a layer 6 inches in thickness above Mean Lower Low Water Line and 9 inches in thickness below and shall be placed under the stone protection beginning 10 feet below the Mean Lower Low Water Line and extending to the top of the stone protection (see Standard Drawing No. 4488/4, Exhibit D).

6-10. Stone protection alternatives. The stone protection material used for slope protection on streams in the Sacramento District may consist of either cobbles or quarry stone. Alternates for cobbles will be deleted from the specifications where slopes are steeper than 1 on 3. Alternate cobble specifications will also be deleted on the upper Sacramento River and tributary streams where velocities 10 feet from the bank exceed 8 feet per second.

6-11. Stone protection for high velocity streams. The specified gradations will be modified in accordance with ETL 1110-2-60 "Criteria For Graded Stone Riprap, Channel Protection". Where velocities against the bank exceed 18 feet per second, other types of slope protection should be considered, such as groins, grouted cobbles, concrete slab, drop structure, slope paving or derrick stone.

a. In designing waterway areas for flood channels, especially in reaches where steep gradients exist, special attention will be given to a comparison of the economics of increasing flow areas to reduce velocities so that a nominal amount of slope protection is required versus providing extensive slope protection for the higher velocities.

b. If design studies lead to the conclusion that locations of possible future erosion cannot be determined, and no slope protection, or only a nominal amount is to be placed, the cost estimates should reflect the cost of future slope protection as a maintenance cost.

6-12 Clearing. Where trees, shrubs and other wild growth must be removed in order to construct, reconstruct, or modify the levee, to place stone protection on the bank or levee, or to provide a patrol road only, the extent of the clearing will be clearly shown on the typical sections of the contract drawings. The various conditions encountered where clearing is required is shown on the drawings of Exhibit F. On projects which involve channel clearing to improve the hydraulic characteristics of the stream, growth will be removed as close to the ground as practicable, but no grubbing will be undertaken. Brush and trees with trunks smaller than 6 inches in diameter will be cut off no higher than 6 inches above the ground line. Trees larger than 6 inches will be cut off no higher than the diameter of the tree above the ground line; however, no trees will be cut off higher than 24 inches above the ground, regardless of diameter. The policy for "no grubbing" was established by correspondence with the Division Engineer, subject: "Channel Clearing, Sacramento River Project" basic SPDGT letter dated 30 August 1956 to Sacramento District.

6-13. Seeding of levee slopes.

a. The Levee Section representative, present during the turnover inspection, will carefully inspect both slopes of the levee, the crown and the berms to observe existing vegetative cover. He will observe the material in the levee, determine its source, and decide whether a natural protective cover will develop in time to minimize slope erosion. Our representative should talk to the project engineer on this subject. He will write a Memo for Record of his findings and will include a recommendation if he can make a determination at that time. If he cannot determine during the inspection that seeding is necessary he will arrange for a subsequent inspection between 1 November and 15 November at which time he will prepare a Memo containing his recommendation. Copies of all Memos will be furnished the Design Branch and Levee Section.

b. After the inspection and completion of the Memo, the Levee Section Unit Chief responsible for design of the contract work will write a letter to the State Reclamation Board advising them of our decision that the planting of a cover crop will or will not be undertaken.

c. If a cover crop is required, the Unit Chief responsible for design of the contract will prepare a disposition form, directed to the Chief of the Resident Office, through channels, requesting that seeding be done and giving specifications and other pertinent data necessary to perform the work. Seeding will not be undertaken prior to 15 November or later than 15 January.

d. If the job of seeding cannot be done by change order or purchase order, plans and specifications will be produced in the usual routine manner. (The Chief of the Levee Section will check with Construction-Operations Division and will advise the Unit Chief as to how the work is to be accomplished. On occasion the State Department of Water Resources has made arrangements to place or has arranged with local interests to place seed and fertilizer furnished by the Sacramento District).

e. The Resident Office will see that the planting of the cover crop is accomplished.

f. Results of all seeding undertaken since 15 January of the preceding year will be inspected by a representative of the Levee Section between 1 and 15 February of each year. He will prepare a Memo for Record of his findings furnishing a copy to Construction-Operations Division, Design and Levees.

6-14. Fencing and gates. Normally, where the fencing of the landowner is disturbed by the project work, it will be rebuilt at local interest expense after completion of the levee work as follows:

a. Where agreements stipulate an exact description of the right-of-way boundaries, or where lands have been condemned for levee purposes, the fences are to be relocated on the right-of-way line as staked or monumented by engineers of the Local Sponsor. The distance between the levee toe and the right-of-way line may be 5 or 10 feet. In no case should the levee toe fall outside the right-of-way line except on approach fills or berm fills.

b. Where no definite right-of-way has been acquired the relocated fence should be placed at an average distance of five (5.0) feet from the completed toe of the slope. If there is no fence along the toe of an existing levee and it is decided by the Local Sponsor that a fence is necessary, it will be built according to the rights-of-way agreement with the landowner.

c. Where gates are required across the levee crown to control grazing and to prevent unauthorized vehicular traffic, they shall be a swing gate type as shown on Figure 5 and 6 of Standard Drawing No. 4488/3. The wire mesh swing gate shall be used to prevent grazing on the levee and a cable gate shall be used to prevent unauthorized vehicular traffic on the levee crown.

SECTION VII

INTERIOR DRAINAGE

7-01. Criteria for provision of interior drainage. On levee projects undertaken by the Sacramento District, provisions will be made for interior drainage when the natural drainage is obstructed by project works. Interior drainage is classified generally as follows:

- a. Gravity outlets through levees.
- b. Pumping plants with discharge lines over or through the levees.
- c. Interior drainage works (collection systems).

New gravity outlets and pumping plants are generally built and paid for by the Federal Government. Interior drainage works (collection systems) are built and paid for by local interests. There have been exceptions to this general procedure in the past; however, unless instructed otherwise, this procedure will be followed. Such matters as economic justification and cost sharing arrangements are given consideration on the basis of the discussion in letter to SPD dated 20 September 1955, see Exhibit G. Also included in the exhibit is a tabulation showing division of costs for various interior drainage provisions on various projects constructed in the past. TM 5-820-4 and EM 110-2-1410 shall be followed.

SECTION VIII

IRRIGATION AND DRAINAGE PIPES AND STRUCTURES

8-01. General. Levees are one of the primary means by which lives and property along the river channels are protected from floodwaters. In view of the intensive development taking place along the river channels in the Central Valley, any construction which affects the safety of the levee must be given careful consideration. The installation of new or the modification of existing irrigation or drainage pipes through a levee presents an extreme hazard. The following standards, which have been developed to be used as a guide, will be followed by the Sacramento District in project construction and will be the basis for review by the Federal Government and the State for all pipe applications submitted to the Reclamation Board for approval. These standards apply to new installations as well as to the modification of existing installations.

In the interest of safety the objective, to the extent possible, is for all pipes through the project levees to have their invert above project design flood plane. All new installations should meet this criteria. Existing installations requiring modification must be given special considerations, as to require the owner to reinstall the pipe with the invert above the project design flood plane, would deprive him of an established prior right. A change in pipe size shall constitute a new installation.

Pipes for the passage of irrigation and drainage flow through the project levees can be divided into two general classes and the policy to be followed for each class is set forth in the following paragraphs:

8-02. New installations.

a. Invert of pipes above project design flood plane (either pressure or gravity flow).

(1) There is no restriction on pipe size for pressure flow. The minimum diameter pipe for gravity flow is 12 inches. Pipes through the levee shall be new steel, welded or riveted, and be soil proofed, except for threaded sizes, which shall be galvanized. Consideration can be given to pipes of composition other than steel if the strength is comparable. Joints shall be butt-welded, flange connected, or have mechanical couplings. No flange connections or mechanical couplings shall be used in the portion of the pipe which is buried in the levee slope or crown. Such joints will be in locations where they can be readily inspected at any time. The minimum gages for steel pipes are as follows:

(a) No. 10 gage (0.1345-inch thickness) up to and including 12 inches in diameter.

(b) No. 7 gage (0.1793-inch thickness) for pipes over 12 inches in diameter.

c. No. 3 gage (0.2391-inch thickness) for pipes over 30 inches in diameter.

(2) Cutoff wall. In levees constructed of homogeneous impervious fill 2 cutoff walls are required on all pipes 6 inches and over in diameter. The cutoff walls shall be either poured-in-place reinforced concrete or plate steel and shall be placed around the pipe at the crown-lines of the levee or at least 20 feet apart. (See Exhibit D, Drawing No. 4488/6). Drainage fill with annular thickness of 18 inches all around the pipe shall be provided on the landside third of the pipe.

(3) When siphon action is possible. Some means must be provided to break the siphon action on irrigation pumps or siphon pipelines 12" in diameter or less, and on drainage pump pipelines a Harris siphon breaker is required.

(4) Gates and valves. A flap gate will be required on all drainage pipes which pass through the levee above flood plane. A gate valve will be required on all irrigation pipes over 12" in diameter and shall be readily accessible and shall be on the waterside of the levee.

(5) Pipe coverage. Pipes shall have a minimum coverage of 24 inches to withstand vehicular traffic on the crown. If necessary the levee grade shall be raised to get the required cover over the pipe; the longitudinal slope along the levee shall not be steeper than 1 on 10. The pipes shall be installed in excavated trenches of the following widths: for pipes up to and including 12 inches in diameter, one diameter plus one foot on each side of the pipe; for pipes over 12 inches in diameter, one diameter plus one diameter on each side of the pipe up to 36-inch diameter. For pipe over 36-inch diameter trench shall be 72 inches plus diameter of pipe in width. (See Standard Drawing 4488/6). When two or more pipes are installed in a levee there shall be a minimum space between the pipes of 12 inches or the diameter of the larger pipe whichever is greater, up to a maximum of 36 inches. In the case of pipe arches the minimum spacing shall be 1/3 of the span of the pipe arch. Pipes or pipe arches need not be spaced more than 36 inches apart. The trench shall be excavated a minimum of 12 inches wider than the pipes or arches for small size pipes up to 12-inch diameter. For larger size pipes and arches a minimum distance of 36 inches shall be provided between the outside of the pipe or arch and the trench. The trench shall be backfilled in 4-inch layers and compacted to the same density as the undisturbed levee. Under certain conditions, such as when a railroad or highway is located on the levee crown, the jacking of the pipe through the levee above flood plane will be permitted. If a sleeve pipe is first jacked through the levee, the sleeve pipe shall have a minimum inside diameter 2 inches greater than the outside diameter of the pipe carrying the flow. The entire annular space between the sleeve and the pipe shall be pressure grouted with portland cement grout. On all installations where the pipe passes through the levee above flood plane, no portion of the pipe above the point of entry

and exit shall be exposed on the landside or riverside slope. The pipe shall be placed in the levee slope in a trench, backfilled as indicated above, and shall have a minimum coverage of 12 inches.

(6) Spillboxes or standpipes. Spillbox or standpipe installations on the landside of the levee shall be a minimum distance of 5 feet from the landside toe of the levee, measured from the nearest face of the spillbox or standpipe.

(7) Rock protection around pipes. Rock revetment shall be placed on the riverside slope of the bank and/or the levee upstream and downstream from the pipe as required to prevent erosion.

b. Invert of pipes below project design flood plane (either pressure or gravity flow). Normally no installation will be permitted through the levee with the invert below flood plane. However, there will be instances when public entities such as the State, counties, cities, reclamation and/or drainage districts, or responsible individuals must provide for the passage of relatively large volumes of water (100 cfs or more) from the landside to the stream channel. In this event the agency must present an engineering study to establish the need for the gravity structure, and to show adequate responsibility to construct and maintain the gravity structure. In each case both the District Engineer and the Local Sponsoring agency must give approval. A reinforced-concrete, cast in place box culvert built in accordance with standard drawing 4488/8 or precast reinforced concrete pipe with concrete collars conforming to Corps criteria at the joints and meeting ASTM specification C-76 may be used. The minimum size structure permitted will be 30 inches inside dimension.

8-03. Modifications to existing installations.

a. Invert of pipes above project design flood plane (either pressure or gravity flow).

(1) The same requirements govern as outlined in paragraph 8-02a for new installations.

b. Invert of pipe below project design flood plane (either pressure or gravity flow).

(1) The minimum size pipe permitted through the levee below the flood plane is 12 inches in diameter. Pipes shall be new, smooth steel pipe, ASTM-A382-66 or equal. The minimum gage for steel pipes 12 inches to 24 inches in diameter shall be 10 gage (.1345-inch in thickness) and 7 gage (.1793-inch in thickness) for pipes 24 inches to 28 inches in diameter.

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Where larger than 28-inch diameter pipe sizes are required, the minimum installation will consist of a 30-inch reinforced concrete, cast in place box culvert meeting the requirements and details shown on standard drawing 4488/8.

(2) Encasement and cutoff walls. Pipes 12 inches to 28 inches in diameter shall be encased with reinforced concrete, 6 inches thick in accordance with drawing 4488/6; the encasement shall extend from the water side levee toe to the landside levee toe. In levees constructed of homogeneous impervious fill two poured-in-place reinforced concrete cutoff walls shall be placed around the pipe at the levee crownlines or minimum 20 feet apart.

(3) Gates or valves. All irrigation pipes passing through the levee below flood plane shall have a positive closure device on the waterside of the levee that is accessible during high water. Drainage pipes passing through the levee below flood plane shall have a flap gate.

(4) Pipe excavation and backfill. Pipes shall be placed in an open cut with side slope of 1 on 3. The bottom width of the cut shall be equal to the outside diameter of encasement plus one foot each side of the encasement. The pipe installation shall be backfilled in 4-inch layers and compacted around the pipe to a distance of 4 feet above the pipe with mechanical tampers. Details shall be as shown on Standard Drawing No. 4488/6. From this point to levee grade the backfill shall be placed and compacted by the levee construction equipment. There may be special instances where the above procedure may not be practical. Such cases require special consideration.

(5) Concrete headwalls. Standard reinforced concrete headwalls shall be used on both the waterside and landside of the levee when the installation is used for either irrigation or drainage. A typical section of a gravity drainage system is shown on Standard Drawing 4488/6. Details for the adopted "U" headwall is shown on Standard Drawing 4488/7.

8-04. Sealing of abandoned pipes. Where abandoned pipes are encountered passing through the levee, and where modification of the levee is to be undertaken by the Sacramento District, that part of the pipe within the levee section should be completely removed during construction if practical. In the event that it is not practical to remove the pipe it should be sealed as follows: all abandoned pipes where the invert is at or below flood plane should be filled with concrete under pressure applied in such a manner as to insure that the pipe will be completely filled with concrete. Prior to filling the abandoned pipe with concrete the levee section shall be excavated so that the pipe can be cut off at each end approximately 10 feet from the slope of the levee. After filling the pipe the levee section shall be restored to its original section. All abandoned pipes, where the invert is above the flood plane, should be sealed by plugging with concrete. The plug should extend from the face of the

levee back into the pipe 2 feet, the distance being measured from the intersection of the top of the pipe with the levee slope. Such a plug is required only on the riverside. All structures requiring modification, removal or change by local interests will be modified, removed, plugged or changed by local interests before construction work is undertaken at a given location by the Corps of Engineers.

8-05. Sealing abandoned wells. All abandoned wells near or within the project improvements should be destroyed so they will not produce water, act as a channel for the movement of water or contaminate domestic water supply. The destruction of water wells shall be done in accordance with State of California Bulletin No. 74, Water Well Standards; State of California, Chapter V.

SECTION IX

STANDARDS FOR UTILITY LINES CROSSING LEVEES

9-01. General. Included in this section are underground power and communication lines, overhead utility lines and electrical pump service lines, pressure flow water pipes, force mains or gravity flow sewer lines and pressure gas mains. Large aqueduct crossings of levees and channels, such as Hetch Hetchy and EBMUD, require special study and are not a part of this section.

9-02. Underground power and communication cables. Underground power and communication cables shall pass through levees over the flood plane. Cables shall be installed in excavated trenches and backfilled so that the density of the fill will not be less than the undisturbed levee section. A minimum coverage of 12 inches is required and no portion of the cable shall be exposed in the levee section. Installation of cables in the levee crown or slopes in a longitudinal direction will not be permitted.

9-03. Overhead power and communication lines. Power and communication poles, guy wires and anchors will not be permitted on the levee crown or levee slopes. Preferably such facilities will be located a minimum of 10 feet from the levee toe. All overhead wire crossings of the levee as well as the crossing of designated levee access ramps must be installed with a minimum vertical clearance of 20 feet for low voltage lines (under 750 volts) and a vertical clearance of 25 feet for higher voltages. In addition clearances must conform with regulations set forth in State and County Codes. If power service is required for any facility on the riverside of the levee and no waterside berm exists, the service will be brought from the landside power source in an underground cable installed as outlined in paragraph 9-02. Any other services placed underground at local interest request shall be placed at no cost to the Federal government. This policy was established with the State Reclamation Board by SPKED-DL letter to the State dated 21 October 1968.

9-04. Pressure lines. These lines include water distribution lines, sewage force mains and gas lines generally installed by utility companies.

a. The invert of pressure lines shall be installed above flood plane, there shall be no restriction on pipe size. Generally the composition of the pipe meeting design requirements of the Utility Company is acceptable for installation through the levee. If steel pipe is used, it shall be soil proofed except that threaded sizes may be galvanized. Flanged connections and Dresser couplings are acceptable but they shall not be buried in the levee slope or crown. The minimum gages for steel pipe will be as follows:

(1) No. 10 gage (0.1345-inch thickness) up to and including 12 inches in diameter.

(2) No. 7 gage (0.1793-inch thickness) for pipes over 12 inches in diameter to 30 inches in diameter.

(3) No. 3 gage (0.2391-inch thickness) for pipes over 30 inches in diameter.

b. In levees constructed of impervious homogeneous fill cutoff walls (except as noted below) shall be placed around the pipe at the crownlines of the levee. These cutoff walls shall be poured-in-place reinforced concrete or plate steel as shown on standard drawing 4488/6. Where conditions are adverse to the installation of cutoff walls, such as the existence of a railroad or highway in the levee crown, and if there are no embankment shoulders, or if the pipe is well above the design flood plane, the cutoff walls may be deleted.

c. Pipes shall have a minimum coverage of 24 inches, to withstand vehicular traffic on the levee crown. If necessary the levee grade shall be raised to get the required cover over the pipe; the longitudinal slope along the levee shall not be steeper than 1 on 10. The pipes shall be installed in excavated trenches of the following widths: For pipes up to and including 12 inches in diameter, one diameter plus one foot on each side of the pipe; for pipes over 12 inches in diameter, one diameter plus one diameter on each side of the pipe up to 36 inch diameter (see standard drawing 4488/6). For pipe over 36 inch diameter trench shall be 72 inches + diameter of pipe in width. The trench shall be backfilled in 4-inch layers and compacted to the same density as the undisturbed levee. Under certain conditions, such as when a railroad or highway is located on the levee crown, the jacking of the pipe through the levee above the flood plane will be permitted. If a sleeve pipe is utilized the sleeve shall have a minimum inside diameter 2 inches greater than the outside diameter of the pressure line. The entire annular space between the pipe sleeve and the utility line shall be pressure grouted with Portland cement grout. On all installations where the pipe passes through the levee above flood plane, no portion of the pipe above the point of entry and exit shall be exposed on the landside or waterside slope. The pipe installed in the levee slope shall be placed in a trench, backfilled as described above, and shall have a minimum coverage of 12 inches.

9-05. Gravity lines. In rare instances a gravity sewer or other utility will cross under a levee usually below the base of the levee. In such cases the utility line shall be encased with reinforced concrete, 6 inches thick in accordance with drawing 4488/6, the encasement shall extend from the waterside levee toe to the landside levee toe. In levees constructed of impervious homogeneous fill poured-in-place reinforced concrete cutoff walls shall be placed around the pipe at the levee crownlines or at least 20' apart. The size of the cutoff walls shall be in accordance with drawing 4488/6. Excavation for the pipe encasement shall be by open cut with side slopes of 1 on 3. The bottom width of the cut shall be equal to the outside diameter of encasement plus one foot on each side up to 36 inch diameter pipe. For pipe over 36 inch diameter, the trench

shall be 72 inches plus diameter of pipe in width. The backfill shall be placed in 4-inch layers and compacted around the pipe encasement to a depth of 4 feet above the pipe with mechanical hand tampers as indicated on standard drawing 4488/6. From this point to levee grade the backfill shall be placed and compacted with levee construction equipment. Special consideration shall be given to installations when foundation conditions are poor such as in organic materials.

SECTION X

POLICIES REGARDING PAYMENT
FOR
INCIDENTAL ITEMS INCLUDED IN LEVEE
CONTRACTS

10-01. Abandoned structures.

a. Any abandoned (or to be abandoned) buildings or other improvements such as irrigation or drainage pipes, pump sumps, standpipes, distribution boxes, piers, piles, headwalls or structures of a like nature which are within the limits of the levee or its foundation shall be removed by the Government contractor at Government expense.

b. Buildings, improvements or other property which fall within the limits of the levee work area, bank sloping area, borrow area and spoil area which local interests desire to save, shall be removed by the local sponsor at his expense.

10-02. Modifications or removals requested by local sponsor. Any buildings which are not abandoned such as residences, sheds, warehouses, barns, tankhouses, windmills, etc., which are within the limits of the work and which the local sponsor requests we remove and save as a part of our contract shall be removed at local sponsor expense.

10-03. Modification of irrigation and drainage structures.

a. Any modification or replacement of an existing irrigation structure is to be at local interest expense.

b. All new irrigation structures are to be at local interest expense.

c. All new drainage structures (including the enlargement or modification of existing drainage structure) necessary because the Federal flood control structure would intercept natural local drainage, will be built and paid for by the Federal Government. This does not include any drainage collection works, if necessary.

10-04. Modification of miscellaneous structures.

a. All removal and replacement of fences and gates and the construction of any new fences and gates except gates at accesses to levee crown shall be done at local interest expense, unless otherwise authorized in the project document.

b. The construction of all road ramps and turnarounds in excess of those needed for operation and maintenance of the flood control works can be included in the Government contract, but if they are included, they will be paid for by local interest. This includes the replacement of existing private ramps.

c. The construction of any retaining wall or similar type structure to protect improvements and to eliminate the necessity of their being removed or relocated shall be done at local interest expense.

d. The construction of any flashboard or gated structures at locations where railroads and highways cross the flood control structure at less than project grade shall be built at local interest expense.

SECTION XI

CHANNELS

11-01. Channel excavation. In channel improvement and channel rectification projects, channel excavation will be performed in strict accordance with the contract plans and specifications. The contract plans and specifications must, therefore, indicate the depth and width of excavation and the proposed invert grade line. Great care must be exercised where channels are excavated under bridges. The channel invert must not be lower than the footing of the piers or abutments nor should the excavation be performed in such a way as to cause erosion or scour under a bridge to endanger the safety of the piers or abutments.

11-02. Dredging. Where computations are being made to determine dredging quantities to be removed from channels, the computations may be simplified by taking average depths across the sections and adding a certain amount for side slopes. Criteria on Dredging Policies and Practices is contained in EM 1130-2-307.

SECTION XII

JOB OR PROJECT COORDINATORS

12-01. General. For each separate job assignment performed by the Levees and Channels Section, a coordinator (usually the Unit Chief) will be assigned who will be responsible for the adequate and timely completion of the plans and specifications. It will be his duty to coordinate all phases of the design and preparation of the specifications. In order to perform his duties efficiently, it will be necessary for the coordinator to properly supervise and follow-up the work assigned to him.

12-02. Responsibilities.

a. Scheduling of control dates. - The scheduling of target dates for the completion of certain phases of the work or completion of the entire job will be done with the best judgment and knowledge of the coordinator. However, when the follow-up on the job indicates that a reconsideration and change of the scheduled date is necessary after criteria are firmly established, rescheduling of the work as justified and necessary will also be the responsibility of the coordinator. Such rescheduling will be done well in advance of the rescheduled control date in order that no control date will be reached before the job is completed. If for any reason a conflict occurs in the establishing of a control date, it shall be resolved at the next supervisory level or higher as necessary. Where a firm control date is established by a Branch Head or other higher supervisor on the basis of limited information, it may develop that such control date is erroneous due to lack of sufficient knowledge on his part. The coordinator should invite to the attention of his supervisor the unrealistic nature of such a control date when the follow-up reveals the control date is not realistic and may not be met.

b. Correspondence. - The coordinator must see and initial correspondence relating to his job which involves design matters, schedules, and timing for which he has responsibility. He must follow this procedure even though the correspondence might be prepared in another unit of the Branch, or even in another Branch. The Chief of the Design Branch has been instructed to see that this condition is rigidly complied with.

c. Adequacy of plans. - The responsibility for the adequacy of the plans and specifications rests in the coordinator. In no event will plans and specifications be sent out of the Engineering Division without being initialed and reviewed by the coordinator. This is especially true of specifications relating to change orders which are sent to the Project Engineer for compliance.

d. Request for surveys and exploration. - The coordinator will be responsible for seeing that both survey and exploration requests are made on time and that the Survey and Explorations Branches programs fit into the overall design schedule.

e. Field reconnaissance. - Prior to the initiation of final design, a field reconnaissance will be made by the responsible designer (usually the Coordinator) and a representative of the Soils Section to appraise the overall design problem with specific reference to foundation or soils problems. If geologic advice is needed, the coordinator will see that a representative of the Geology Section is present on the reconnaissance. The result of such reconnaissance will be incorporated in a "Memo for Record," signed by all participants.

f. Field check. Upon completion of the plans and specifications, and normally during the District review, a field check will be made of the completed design by the "Coordinator." The Project Office will be requested to assign a qualified man to accompany the coordinator on the field check so that all matters of mutual concern can be jointly considered at that time. (If for any reason the Project Office does not have a qualified man available at that time for the check, the Chief, Engineering Division should be advised immediately so that alternate arrangements can be made with the Chief of the Construction-Operations Division.)

g. Conflicting comments resulting from district review. - There may be confusion in the minds of some coordinators regarding the method of coordinating conflicting comments received during District review. After these comments have been screened and a decision reached on which one to use, all persons whose comments do not agree with the final decision should be informed of the decision. They should also be given an explanation as to the reason for the choice. If, after the explanation, agreement cannot be reached, the controversy should be referred to the next higher supervisor for resolution. If the controversy involves a Branch other than the Design Branch, it should be referred to the Chief, Design Branch. It is not intended that preliminaries be submitted to SPD for approval or plans and specifications be advertised which contain controversial items that have not been resolved in the District Office.

h. Coordination with Fish and Wildlife and Water Quality Agencies. During District review the project coordinator, in cooperation with Environmental Resources Section, Project Planning Branch, will transmit project plans and specifications to interested Federal and State Fish and Wildlife and Water Quality Agencies. On projects sponsored by the State all contact with interested State agencies will be coordinated with the State Reclamation Board. During planning and design of levee and channel projects, a Memo for Record will be made of all contacts with other agencies concerning fish and wildlife, environmental aspects, and water quality. The project coordinator will assemble one set of all such Memos for Record to be transmitted to Construction-Operations Division, Construction Branch. During advertising of the project, the coordinator will prepare a disposition form to Chief, Construction-Operations Division outlining all coordination that has been effected during planning and design of the project and will attach copies of the Memos for Record as references. The disposition form will highlight any agreements and/or understandings that have been reached during preparation of the contract documents.

i. Potential layout conflicts. - In "tight" situations, where there may be a conflict with other improvements or where distance limitations may be controlling, the coordinator will provide for the paper location to be checked in the field by "centerline" or "toe" stakes as considered necessary or desirable. Such check is particularly important where new or modified levees and channels are to be tied into existing facilities; where potential conflicts exist with buildings or other improvements; where the alignment or elevation is to be coordinated with railroads, highways, or bridges; where an accurate determination has to be made of the rights-of-way requirements prior to the completion of the plans and specifications; etc.

j. Letter to local interests regarding removal of public utilities. It will be the responsibility of the coordinator to write a letter to the State Reclamation Board, or other local interests as applicable, as soon as the development of the contract plans permit, inviting attention to any public utilities which are affected by the work. A list of the utilities involved should be given. The letter will request local interests to make arrangements to have these utilities moved from the work site on or before a given date. The date shown will usually be six weeks after the date of the advertising. This procedure is necessary in order not to delay initiation of construction by the contractor.

SECTION XIII

MISCELLANEOUS

13-01. Review of plans and specifications. After completion of the contract plans by the Levees Section, the plans together with bid items, are furnished to the Specifications Section for preparation of the specifications. The plans and specifications are reviewed by the following District elements. Construction-Operations Division, Resident or Field Office, Estimating Section, Design Branch, Foundation and Materials Branch, Embankment Section and Levees Section. During the District review, the Levees Section will make a final review of the plans and specifications, using as a guide the attached check list. (Exhibit J).

After plans and specifications have been reviewed by the District, the Levees Section will assemble and coordinate the comments of the various District elements. Any conflicting comments will be treated as outlined in paragraph 12-02g or a conference will be called to resolve differences. The plans and specifications will then be forwarded to the Division Engineer for approval. Where the contract cost of a job is estimated to be less than \$100,000, no Division prior approval will be necessary.

There shall be no concurrent review of the plans and specifications by the District and Division without approval of the Chief of the Engineering Division.

The transmittal of plans and specifications for approval will be accomplished by the Specifications Section.

13-02. Tabulation of local interest costs. On projects for which local interests contribute funds for non-Federal work items, the coordinator, during the design stage of the work, will complete SPK Form No. 306 as far as column 2. Columns 3 and 4 will be completed after the bids are opened. The coordinator will then secure six copies of the form and complete the form through column 4. One copy will be retained in the Levees Section; the remainder will be sent to Construction-Operations Division, Attention: Program Branch. Construction-Operations Division will immediately send two copies to the Reclamation Board and three copies to the Resident Office. After completion of the construction contract when final contract quantities are known, the Resident Office will complete columns 5 and 6, and return two copies to the Program Branch, Construction-Operations Division, who will in turn transmit them to the Reclamation Board. This procedure was adopted to better account to the State Reclamation Board for the local interest costs. For projects sponsored by agencies other than the State Reclamation Board the same general procedure will be followed when non-Federal work is included in the Corps contract.

13-03. Provision for portable office. The requirements for a field office used in the performance of inspection of construction shall be coordinated

with Construction-Operations and the Specifications Section. On levee project construction contracts where the work is continuous and/or is situated in a location such that a field office is essential to the performance of the inspection duties, a portable office will be provided by the contractor for the use of Government Inspectors. Field offices will not be required for projects when the bank protection and levee construction sites are scattered, and none shall be called for. In order to make a determination whether a portable office will be necessary on a given project, the Specifications Section will clear with the Construction-Operations Division. The portable office, when used, shall be a minimum of 12 feet long by 6 feet wide, 6 feet 6 inches in heights and be properly heated, lighted and ventilated. It shall contain the following features; a portable or built-in table with a top at least 3 feet by 5 feet suitable for drafting, a stool, 2 chairs, a stick file, a map rack capable of holding six sets of the contract drawings and a lockable storage receptacle with a minimum size of 1' x 2' x 4'. The office shall be located where directed; however, the contracting officer may require that the office be relocated at not more than two additional locations. Upon completion of the work the office shall be removed from the premises. The cost of furnishing, locating, relocating and removing the office shall be considered a subsidiary obligation of the contractor and no separate payment will be made therefor.

13-04. Change orders. The Levees Section, on channel and levee contracts, will initiate applicable change orders that originate within the Engineering Division. However, once a contract is advertised all change order action in connection with requests from local interests will be a responsibility of Construction-Operations Division. The Field or Project Office will initiate those change orders which originate in the field. Those originated by the project office are routed through the Levees Section for comment and concurrence during their preparation.

13-05. Wage rates. The Specifications Section will request wage rates for labor on construction projects. The wage rates must be requested at least six weeks before the advertised date. In special instances where the time is not available, wage rates may be obtained by telephonic request. In either case, the Specifications Section will furnish the Legal Branch the pertinent information regarding classification of worker, etc., and they will process the request with the Department of Labor in Washington.

13-06. Project transfer inspection. An inspection will be made of all completed contractual units prior to transfer to the local sponsor for maintenance and operation purposes. A representative of the Construction-Operations Division, a representative of the Levees Section, a representative of the field office together with representatives of the local sponsor will participate. The purpose of this inspection is to familiarize the participants with the work and to determine if there are any construction deficiencies. The representative of the Levees Section will only participate in questions pertaining to the design.

EXHIBIT A

OFFICE MEMORANDUM - UNITED STATES GOVERNMENT

Memo to All Section Heads

8 January 1960

SUBJECT: Use of Half-Size Drawings

1. Half-size drawings will be used for advertising purposes on all military and civil work, unless the use of such drawings is not practicable, or when five or less sheets are involved.
2. For work on the shelf or underway, half-size drawings will be used, if the drawings can be made satisfactory for reduction with a minimum of drafting effort. Otherwise, full-sized drawings will be used.
3. On future work, an effort will be made to prepare all drawings on military and civil work, and to use reproduction methods that will permit reduction to one-half size. When reduction to half size is not practicable, the use of full-size drawings will be cleared with the Chief, Design Branch.
4. The Chief, Drafting Section, will arrange for procuring printed tracings for the covers for one-half size drawing folios.
5. All Section Chiefs responsible for preparation of drawings will take steps to orient their employees in the new procedures required to insure the use of half-size drawings, such as:
 - a. Use of minimum 1/10 inch height of lettering.
 - b. Elimination of shading which results in a black area when reduced. Cross-hatching or symbols should be used in place of shading.
 - c. Elimination of printing or lettering on the back of tracings, except for profile and cross-section grids.
 - d. Use of scales that permit reduction without crowding.
 - e. Elimination of the use of ozalids, as original tracings. They can be used as record drawings when modification of an original tracing is about to be made and a reproducible must be made for record purposes.
6. When the use of half-size drawings is not practicable, bidders will be charged \$0.10 per sheet for full-size drawings.
7. This memo supersedes one on the same subject dated 6 January 1960.

HARRY DETTMER
Chief, Design Branch

EXHIBIT A

EXHIBIT B

OFFICE MEMORANDUM - UNITED STATES GOVERNMENT

TO: Chief, Engineering Division
Chief, Supply Branch

DATE: 25 April 1951

FROM:

SUBJECT: Rights-of-Way for Construction Work on Sacramento River, Old Project and Major and Minor Tributaries.

1. Reference is made to our letter to the State Reclamation Board dated 16 April and to reply from State Reclamation Board, dated 17 April, both on the above subject.
2. Our letter of 16 April stated that it will be the policy of this office not to advertise for bids until all rights-of-way have been acquired. It is also requested that when the State Reclamation Board transmits the last right-of-way for any job they include a statement to the effect that all rights-of-way for the job have been acquired, and that upon receipt of such a letter this office would then advertise the work. In their reply of 17 April, the State Reclamation Board went on record as being in hearty accord with the above policy and stated they have time and again advocated this procedure both by correspondence and by expression of the Board to our representatives.
3. Accordingly, as a standing policy, no work on the subject projects will be advertised until the rights-of-way have been acquired and we have been so advised by letter.
4. The successful application of this policy will mean that our plans and specifications must be prepared a sufficient time in advance to allow the Reclamation Board a reasonable time prior to our scheduled advertising date to acquire the necessary rights-of-way.
5. In addition to the above, careful planning and scheduling, it will be necessary to follow up informally, and formally as often as necessary, our requests for right-of-way action for each job, in order to keep advised as far in advance as possible on whether we will or will not be able to meet our originally scheduled advertising dates.

C. C. HAUG
Lt. Colonel, Corps of Engineers
District Engineer

EXHIBIT B
1 Sheet

EXHIBIT C

CONVERSION FACTORS FOR ESTIMATING QUANTITIES

1. Graded Aggregate (148.5#/Cu.Ft.) $2.373 \frac{\text{M. TON}}{\text{m}^3}$ =2.00 Tons/Cu.Yd.
2. Pit or Bank Run (140#/Cu.Ft.) =1.89 Tons/Cu.Yd.
3. Select Fill (135#/Cu.Ft.) =1.82 Tons/Cu.Yd.
- AC. — 4. Plant Mix (144#/Cu.Ft.) $2.306 \frac{\text{M. TON}}{\text{m}^3}$ =1.944 Tons/Cu.Yd.
 $1 \text{ Sq.Yd.} \times 1" = \frac{1.944}{36}$ =.054. Tons/Sq.Yd.
5. Sand (100#/Cu.Ft.) =1.35 Tons/Cu.Yd.
- 6. Paving Asphalt for Plant Mix =6% by weight of Plant Mix
7. Liquid Asphalt for Prime Coat or Liquid Asphalt Application (1/4 Gallon/Sq.Yd.) $\frac{1.13 \text{ liter}}{\text{m}^2}$ =.001 Ton/Sq.Yd.
8. Liquid Asphalt for Seal Coat 3/8 Gallon/Sq.Yd. =.0015 Ton/Sq.Yd.
" " " Tack " " " " " =.0015 Ton/Sq.Yd.
9. Liquid Asphalt for Road Mix =6% by weight of Road Mix Material (Binder)
10. Liquid Asphalt for Dust Palliative (1/4 Gallon/Sq.Yd.) =.001 Ton/Sq.Yd.
11. Cover Aggregate for Type "A" Seal Coat 15#/Sq.Yd. =.0075 Ton/Sq.Yd.
12. Cover Aggregate for Type "C" Seal Coat 25#/Sq.Yd. =.0125 Ton/Sq.Yd.
13. Water for Compaction Crushed Mineral Aggregate $\frac{15 \text{ gals.} \times \text{Ton}}{1000} = \text{M. gals.}$
14. Water for Compaction Embankment $\frac{40 \text{ gals.} \times \text{Cu.Yd.}}{1000} = \text{M. gals.}$
(Add to above for dust control)
15. Filter Material =1.6 Tons/Cu.Yd.
16. Cobbles =1.7 Tons/Cu.Yd.
17. Quarry Stone =1.6 Tons/Cu.Yd.
18. Net Embankment (Cu.Yd.) $\times 1.43 (30\%)$ =Req'd. gross excavation
/ .33

19. (Class "A" Concrete: 5.5 Sacks Cement/Cu.Yd.)
(Class "C" Concrete: 3.5 Sacks Cement/Cu.Yd.)
(1 Sack Cement = 1 Cu.Ft.)
(4 Sacks Cement = 1 Barrel)
(250 Gals. Asphalt = 1 Ton)

RWB
21 May 64

LEEVE SECTION STANDARDS
QUANTITY COMPUTATIONS

On levee and channel work embankment material must come from either required excavation, borrow or a combination. Required excavation is either utilized in embankment or disposed of in spoil areas or a combination thereof.

<u>RESPONSIBLE SECTION</u>	<u>SYMBOL</u>	<u>DERIVATION OF QUANTITY ESTIMATE</u>
		<u>TO DETERMINE NET EMBANKMENT</u>
Levee	A	Compute quantity in the net section (measured between nat.grd. & template)
Levee	B	Compute miscellaneous embankment such as inspection ditch, pads, ramps, berms, etc.
Levee	C	Compute stripping under embankment (plus 5 feet outside)
Levee	D	Net Embankment (A+B+C+)(Bid Item)
		<u>TO DETERMINE THE REQUIRED GROSS EXCAVATION</u>
Levee	E	Compute quantity between natural ground & template
Levee	F	Compute inspection ditch quantities
Levee	G	Compute ditch exc. (irrigation and/or drainage)
Levee	H	Total gross excavation quantity (E+F+G)
		<u>TO DETERMINE TOTAL EXCAVATION TO CONSTRUCT REQUIRED EMBANKMENT WHERE GROSS EXCAVATION IS IN EXCESS OF EMBANKMENT AND MATERIAL MUST BE SPOILED</u>
Levee	D	Net Embankment
Levee	I	Overbuilding percentage of A
Soils	J	Shrinkage percentage of D

RWB
21 May 64

LEVEE SECTION STANDARDS
QUANTITY COMPUTATIONS

<u>RESPONSIBLE SECTION</u>	<u>SYMBOL</u>	<u>DERIVATION OF QUANTITY ESTIMATE</u>
Soils	K	Foundation settlement percentage of A
Levee	L	Total excavation to constr. required embankment (D+I+J+K)
<u>TO DETERMINE NEXT EXCAVATION SUITABLE FOR LEVEE CONSTRUCTION</u>		
Levee	H	Total gross excavation
Levee	M	Compute stripping from required excavation
Soils	N	Compute unsuitable material
Levee	O	Estimated spillage
		Subtotal
		Minus _____
Levee	P	Net excavation suitable for levee construction (H-M-N-O)
<u>TO DETERMINE MATERIAL TO BE PLACED IN ZONE B SPOIL AREA</u>		
Levee	P	Net excavation suitable for levee construction
Levee	L	Total exc. to construct req'd embank.
		Minus _____
Levee	R	Amt. of excess suitable embankment material (P-L) (Bid Item)
NOTE: To determine volume for Zone B material multiply R by a factor (from Soils)		
<u>TO DETERMINE MATERIAL TO BE PLACED IN SPOIL AREAS OTHER THAN ZONE B</u>		
Levee	R	Amount of excess suitable embankment material
Levee	C	Stripping under embankment

RWB
21 May 64

LEVEE SECTION STANDARDS
QUANTITY COMPUTATIONS

<u>RESPONSIBLE SECTION</u>	<u>SYMBOL</u>	<u>DERIVATION OF QUANTITY ESTIMATE</u>
Levee	M	Stripping from req'd excavation
Soils	N	Unsuitable material
Levee	S	Amt. of excess matl. to spoil areas (R+C+M+N) (Bid Item)
<u>TO DETERMINE BORROW QUANTITY WHERE GROSS EXCAVATION IS NOT SUFFICIENT TO CONSTRUCT EMBANKMENT AND BORROW MUST BE SECURED</u>		
Levee	L	Total exc. to constr. req'd embankment.
Levee	P	Net exc. suitable for levee construction construction Minus _____
Levee	T	Amt. req'd from borrow area (L-P)

NOTE: Multiply T by a factor (secured from Soils) to get the quantity to be taken from the borrow area.

VALUE ENGINEERING PAYS

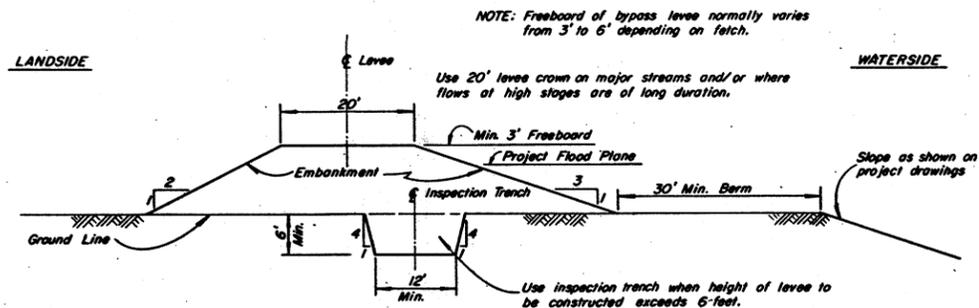


FIGURE 1
LEVEE SECTION WITH 20 FOOT CROWN
Scale: 1" = 10'-0"

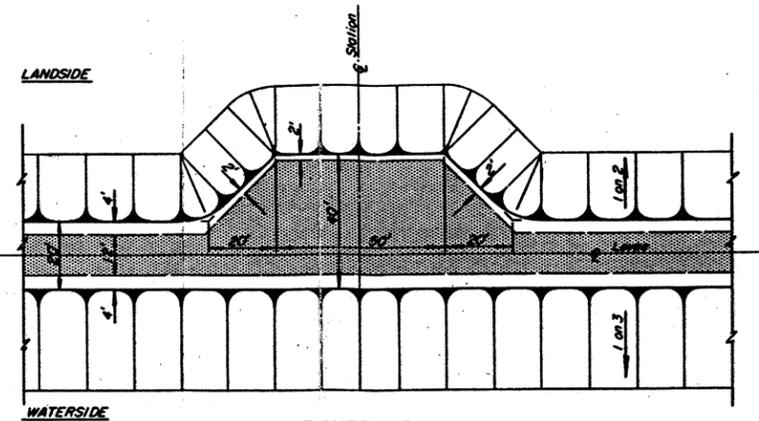
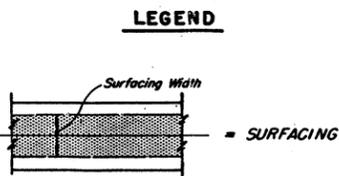


FIGURE 6
TURNAROUND ON 20 FOOT LEVEE CROWN
Scale: 1" = 20'-0"

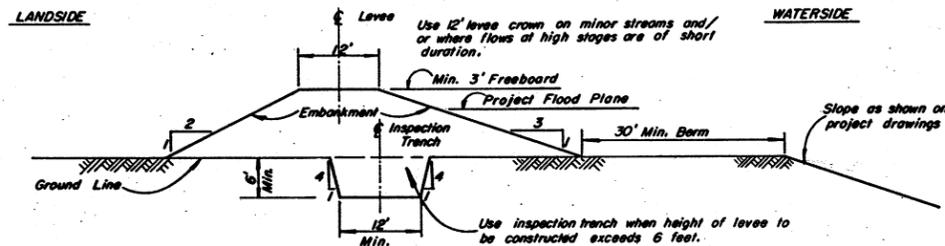


FIGURE 2
LEVEE SECTION WITH 12 FOOT CROWN
Scale: 1" = 10'-0"

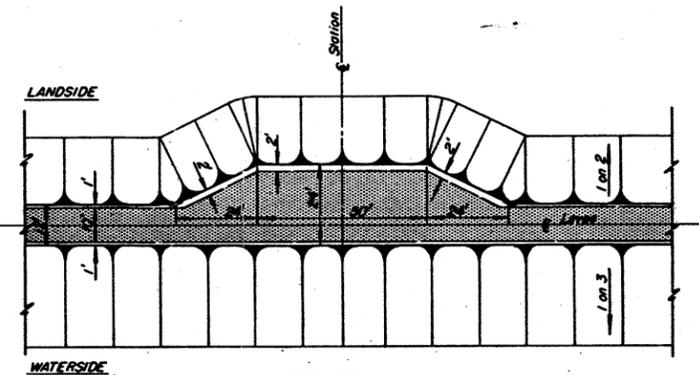


FIGURE 5
TURNOUT ON 12 FOOT LEVEE CROWN
Scale: 1" = 20'-0"

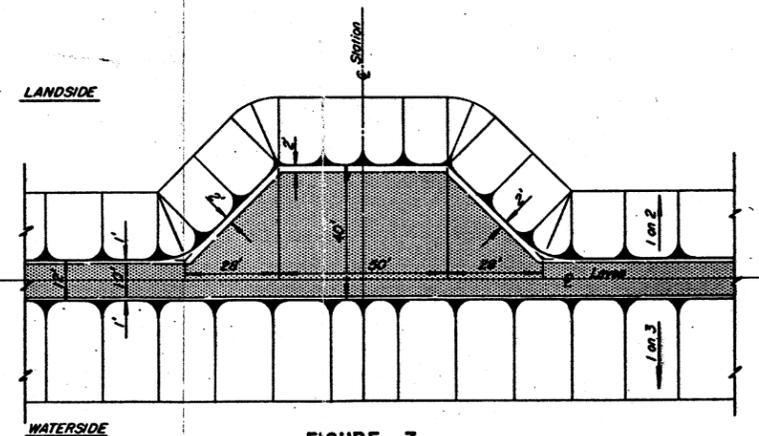


FIGURE 7
TURNAROUND ON 12 FOOT LEVEE CROWN
Scale: 1" = 20'-0"

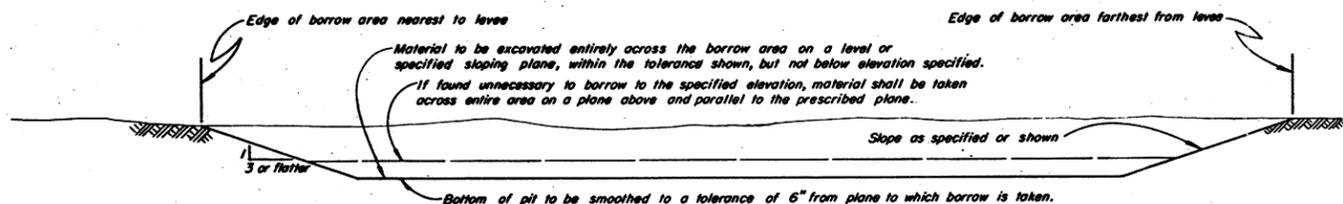


FIGURE 3
UNIFORM BORROW
Not To Scale

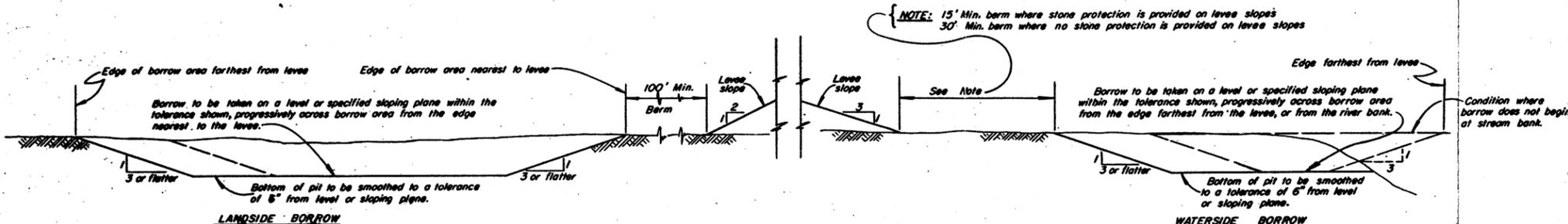
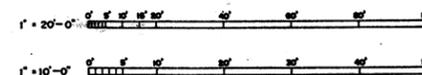


FIGURE 4
PROGRESSIVE BORROW
Not To Scale

GRAPHIC SCALES



REVISION	DATE	DESCRIPTION	BY	CHK

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

**STANDARD DRAWING
LEVEE SECTIONS
BORROW SECTIONS
TURNOUT & TURNAROUNDS**

DESIGNED BY: E. GARCIA
CHECKED BY: A. SMITH
PREPARED BY: R. CLARKE
DATE: 29 September 1969

SCALE AS SHOWN
FILE NO. 50-4-4488
SHEET NO. 4488/1 TO 4488/3 4488/1

NOTE: This sheet supersedes sheet numbers 3674/1 & 2, File No. 50-4-3674, Dtd. 29 Aug. 1960.

VALUE ENGINEERING PAYS

VOLUME IN CUBIC YARDS OF HEAD-ON RAMP

HEIGHT OF LEVEE IN FEET	W ₂ = 14'				W ₂ = 22'			
	P = .08		P = .06		P = .08		P = .06	
	M = 3	M = 2	M = 3	M = 2	M = 3	M = 2	M = 3	M = 2
1	2	3	4	4	4	4	6	6
2	11	12	16	17	16	18	24	26
3	26	28	38	40	39	43	56	60
4	48	54	70	76	71	78	102	111
5	79	88	115	125	114	127	165	179
6	118	133	173	189	168	189	245	267
7	167	189	245	268	236	266	344	375
8	226	258	333	365	316	358	462	504
9	297	339	438	482	410	466	602	658
10	380	435	562	619	521	591	765	837
11	476	546	705	778	646	735	950	1041
12	586	674	869	960	788	898	1161	1273
13	710	819	1055	1168	948	1082	1397	1535
14	850	982	1263	1401	1126	1286	1660	1827
15	1005	1163	1497	1662	1322	1514	1953	2151
16	1179	1366	1757	1952	1539	1764	2275	2509
17	1369	1589	2043	2273	1775	2038	2628	2901
18	1578	1834	2358	2626	2034	2338	3014	3330
19	1806	2103	2702	3012	2314	2664	3433	3796
20	2055	2395	3077	3433	2618	3017	3887	4302

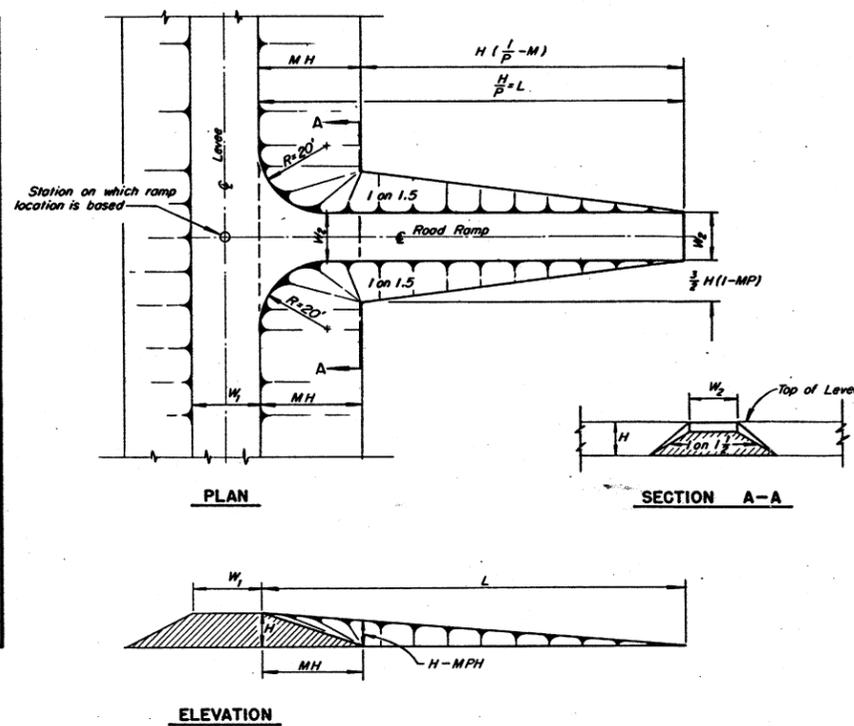


FIGURE 1
HEAD-ON APPROACH ROAD RAMP
Scale: 1" = 20'-0"

VALUES OF "K" FOR KW₂

"M"	P = .08	P = .06
= 3	1.0301	1.0166
= 2	1.0131	1.0073

FORMULAS

$L = H/P$
 $K = 1/\sqrt{1-M^2P^2}$
 $KW_2 = W_2/\sqrt{1-M^2P^2}$
 $A = (H/P)\sqrt{1-M^2P^2}$
 $B = W_2/PM$

Volume in cubic yards for head-on approach road ramp

$$V = \frac{H^2(1-PM)}{54P} \times [W_2 + H(1-PM)]$$

Volume in cubic yards for side approach road ramp

$$V = \frac{W_2 H^2}{54P} + \frac{W_2^2 H}{54PM\sqrt{1-M^2P^2}}$$

DEFINITIONS

- W₁ = Crown width of levee
- W₂ = Width of road ramp
- L = Horizontal projection of road ramp length
- H = Height of levee above natural ground
- P = Grade of Ramp
- M = Reciprocal of slope of levee, i.e., slope = 1 on 3, M = 3
- A = Length of road ramp measured parallel to ξ of levee
- B = Length of road ramp platform measured parallel to ξ of levee
- KW₂ = Width of road ramp measured perpendicular to ξ of levee
- V = Volume of road ramp in cubic yards

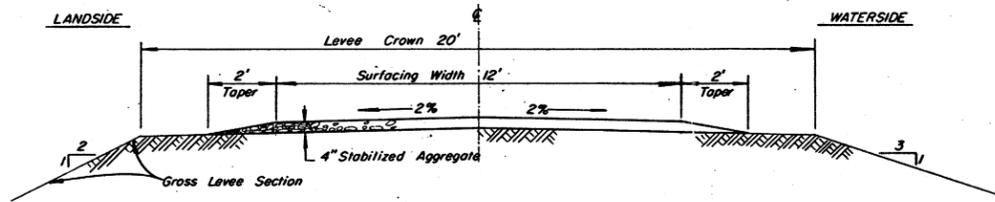


FIGURE 3
LEVEE SURFACING FOR 20' PATROL ROAD
Scale: 1" = 2'-0"

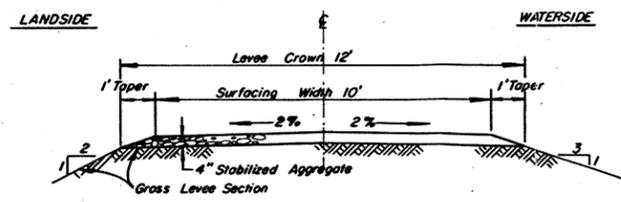


FIGURE 4
LEVEE SURFACING FOR 12' PATROL ROAD
Scale: 1" = 2'-0"

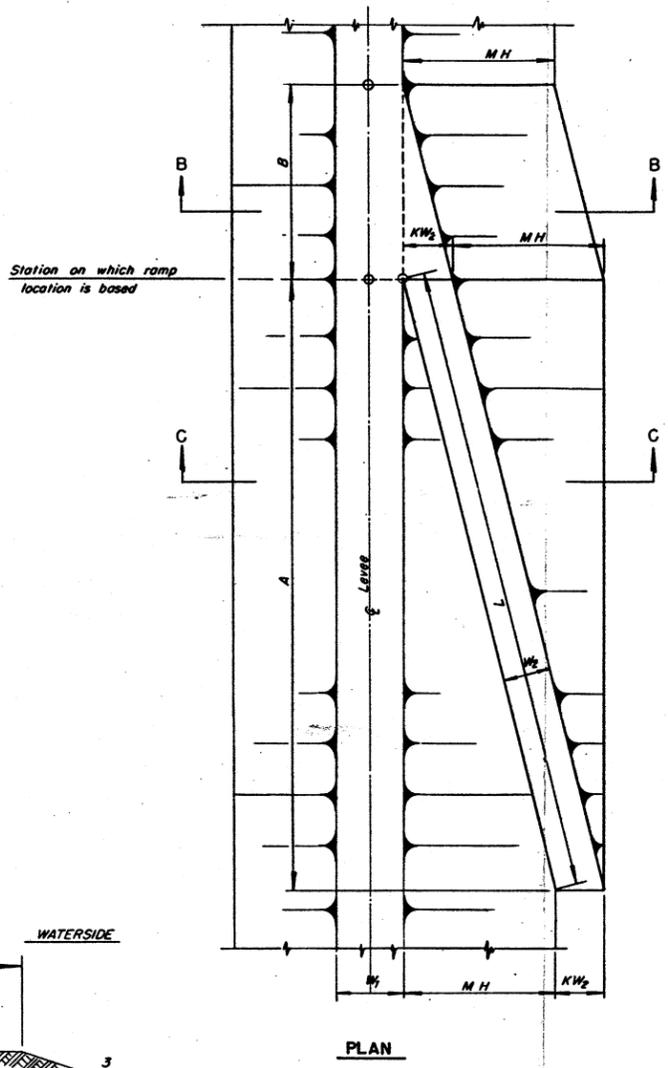
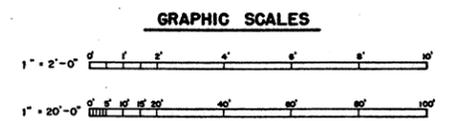
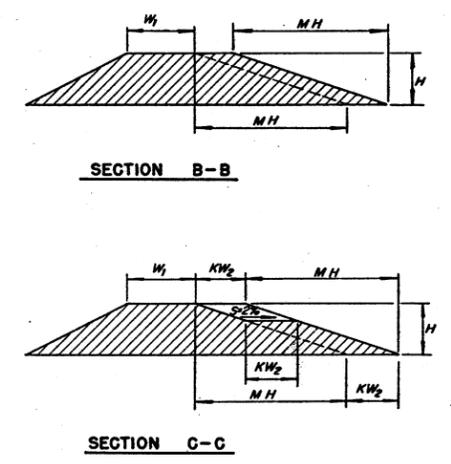


FIGURE 2
SIDE APPROACH ROAD RAMP
Scale: 1" = 20'-0"

VOLUME IN CUBIC YARDS OF SIDE RAMP

HEIGHT OF LEVEE IN FEET	W ₂ = 14'				W ₂ = 22'			
	P = .08		P = .06		P = .08		P = .06	
	M = 3	M = 2	M = 3	M = 2	M = 3	M = 2	M = 3	M = 2
1	19	26	25	35	44	62	57	82
2	44	59	58	78	97	134	128	176
3	76	98	100	130	161	216	213	287
4	114	144	151	191	235	308	311	410
5	159	196	211	260	320	411	423	546
6	210	255	279	338	414	524	548	696
7	268	320	355	425	519	647	687	859
8	332	391	441	520	634	780	840	1036
9	403	469	534	624	759	923	1006	1227
10	480	554	637	737	894	1077	1185	1431
11	564	645	748	858	1039	1241	1378	1649
12	654	742	868	988	1195	1414	1585	1881
13	750	846	997	1126	1361	1598	1806	2126
14	835	957	1134	1273	1537	1793	2040	2384
15	963	1074	1280	1429	1723	1997	2287	2656
16	1079	1197	1434	1594	1919	2212	2548	2942
17	1201	1327	1597	1767	2126	2437	2823	3241
18	1331	1464	1769	1948	2343	2672	3111	3554
19	1466	1607	1949	2139	2570	2917	3413	3881
20	1608	1756	2138	2332	2807	3172	3728	4221



U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

**STANDARD DRAWING
APPROACH ROAD RAMP
&
LEVEE SURFACING**

DATE: 23 September 1969

FILE NO. 50-4-4488
SHEET NO. 4488/1 TO 4488/8 4488/2

NOTE: This sheet supersedes sheet numbers 3674/1 & 2, File No. 50-4-3674, Dtd. 29 Aug. 1960

VALUE ENGINEERING PAYS

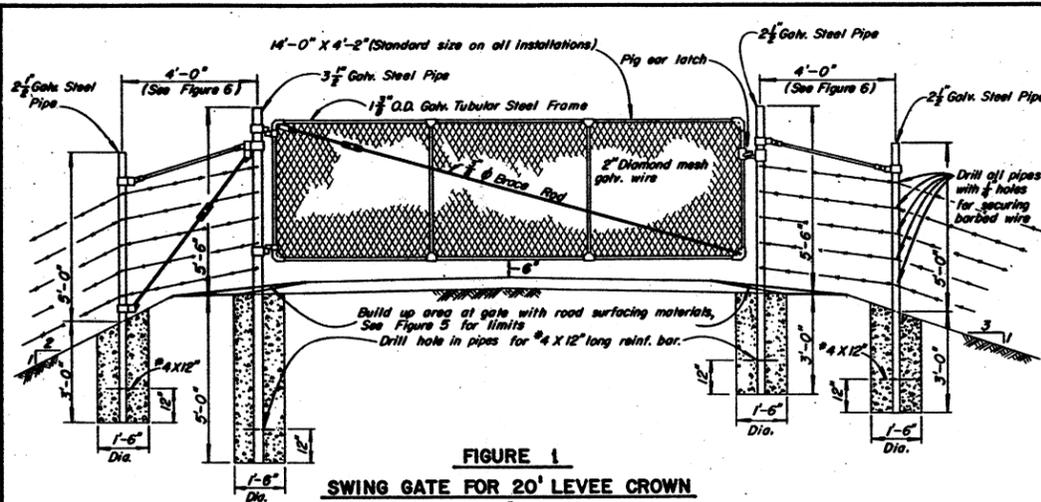


FIGURE 1
SWING GATE FOR 20' LEVEE CROWN
Scale: 1/2" = 1'-0"

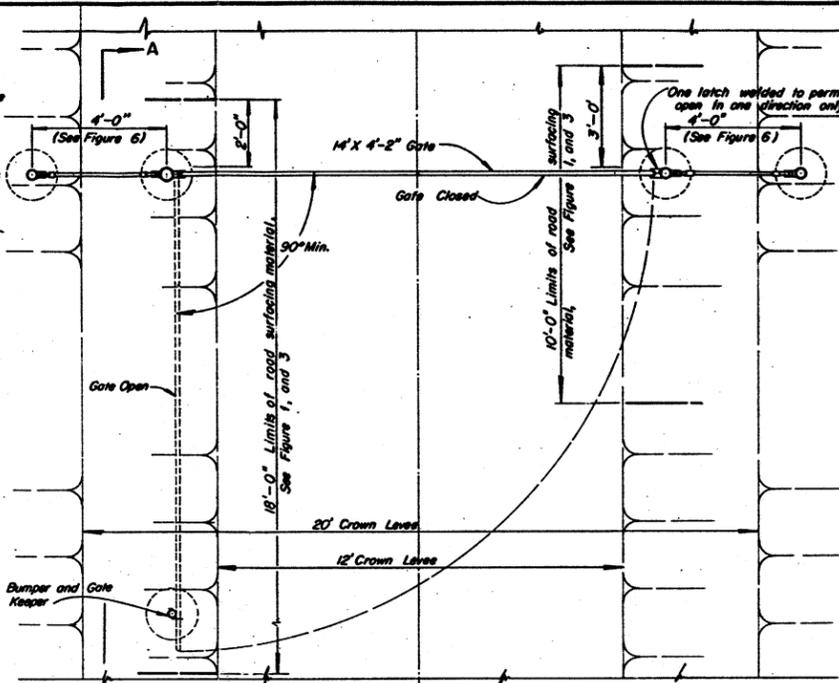


FIGURE 5
PLAN-SWING GATE INSTALLATION
Scale: 1/2" = 1'-0"

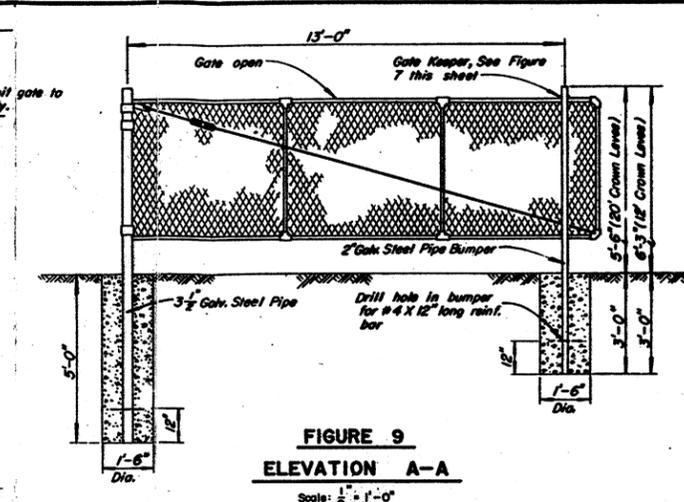


FIGURE 9
ELEVATION A-A
Scale: 1/2" = 1'-0"

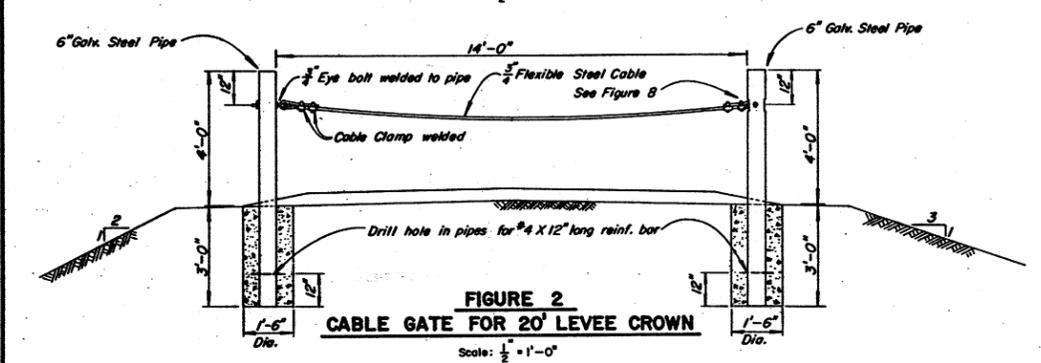


FIGURE 2
CABLE GATE FOR 20' LEVEE CROWN
Scale: 1/2" = 1'-0"

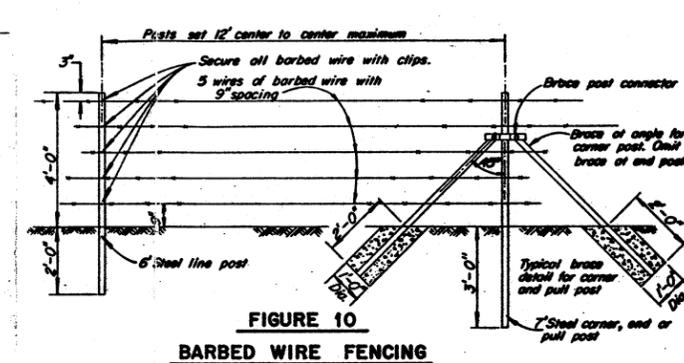


FIGURE 10
BARBED WIRE FENCING
Scale: 1/2" = 1'-0"

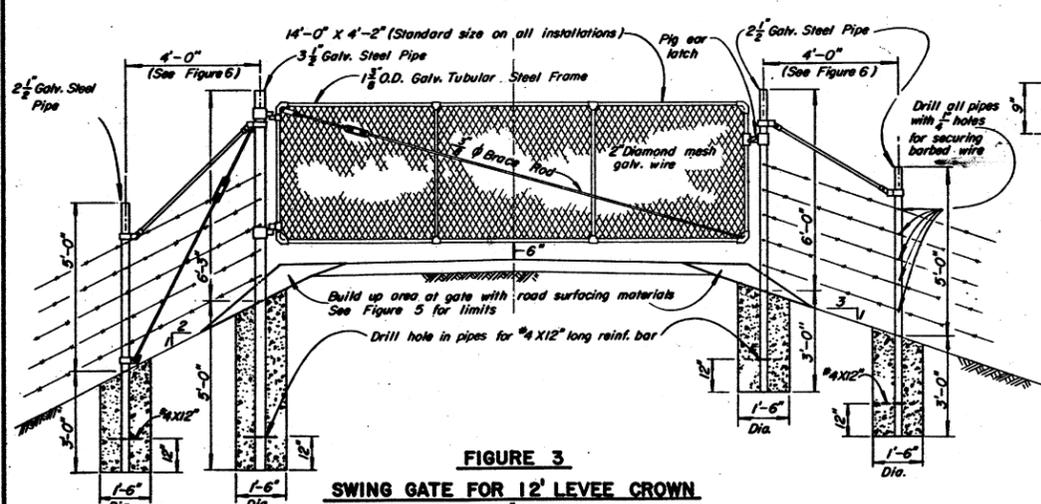


FIGURE 3
SWING GATE FOR 12' LEVEE CROWN
Scale: 1/2" = 1'-0"

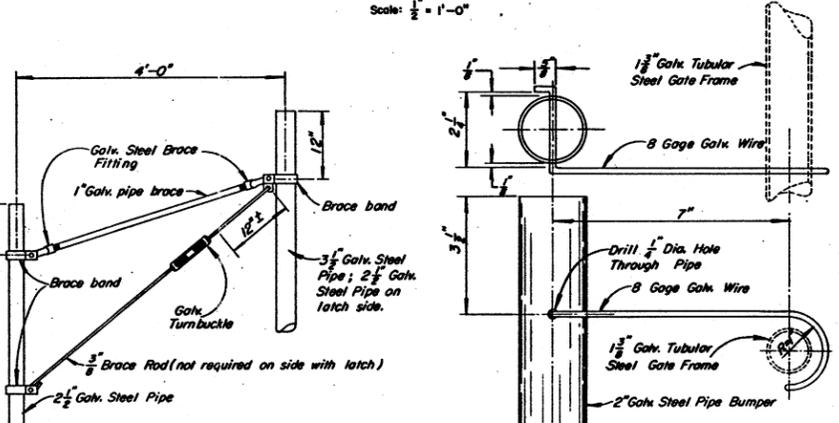


FIGURE 6
TENSION BRACING
Scale: 1" = 1'-0"

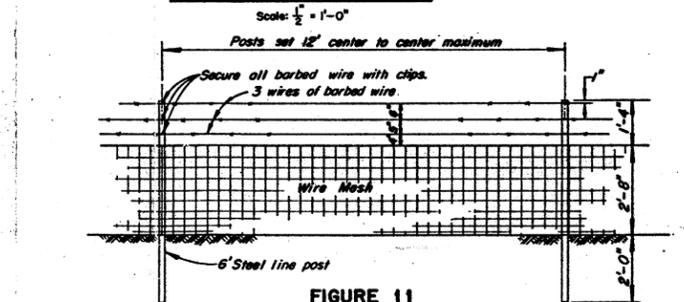


FIGURE 11
WIRE MESH & BARBED WIRE FENCING
Scale: 1/2" = 1'-0"

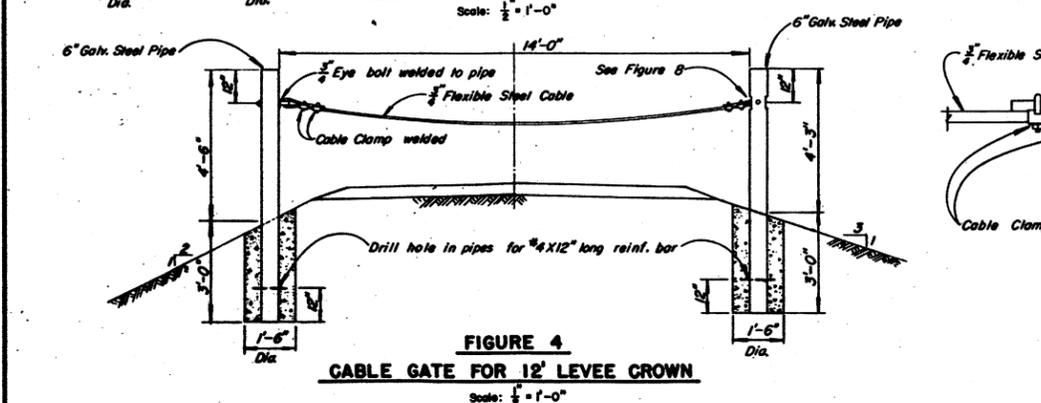


FIGURE 4
CABLE GATE FOR 12' LEVEE CROWN
Scale: 1/2" = 1'-0"

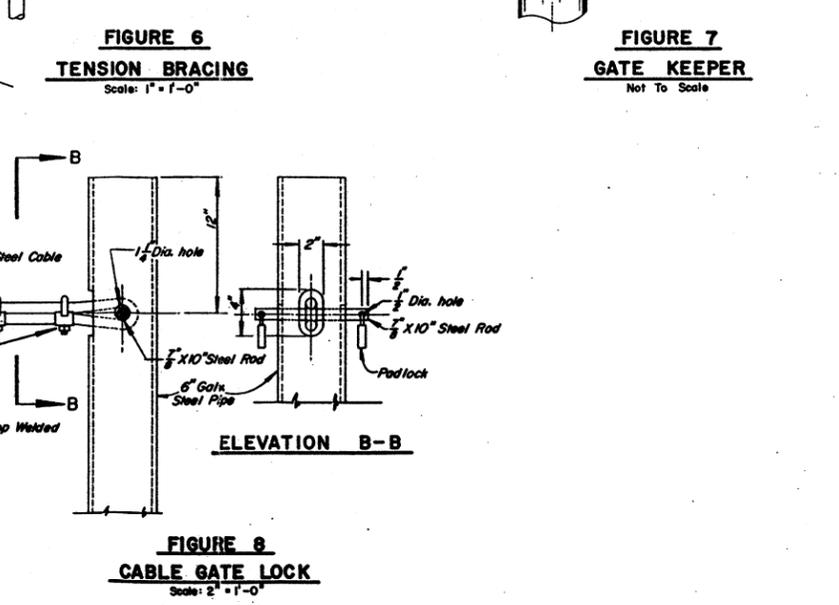
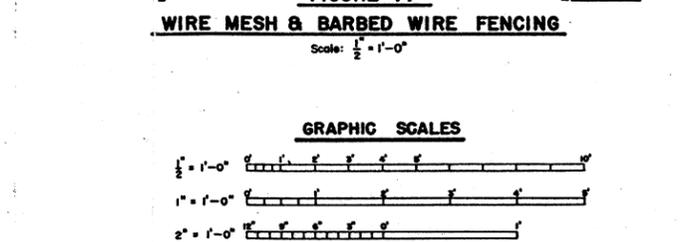


FIGURE 8
CABLE GATE LOCK
Scale: 2" = 1'-0"



GRAPHIC SCALES

DESIGNED BY:	DATE:	DESCRIPTION:	BY:	WT:
U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA				
DRAWN BY:	STANDARD DRAWING			
CHECKED BY:	GATES & FENCING FOR			
FORWARDED BY:	PATROL ROADS			
APPROVED BY:	DATE: 25 September 1969			
FORWARDED UNDER THE DIRECTOR'S SIGNATURE:		SCALE AS SHOWN:	SHEET NO.	
George B. Hanner		FILE NO. 50-4-4488	4488/1 TO 4488/8 4488/3	

NOTE: This sheet supersedes sheet number 3674/3, File No. 50-4-3674, Dtd. 29 Aug. 1960.

VALUE ENGINEERING PAYS

NOTE: Figs 1 & 2 used for dry channel construction

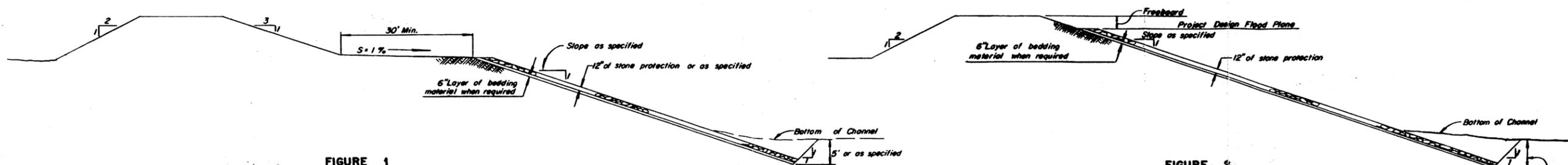


FIGURE 1
STONE PROTECTION WHEN BERM IS PROVIDED Δ
Scale: 1" = 10'-0"

FIGURE 2
STONE PROTECTION WHEN NO BERM IS PROVIDED Δ
Scale: 1" = 10'-0"

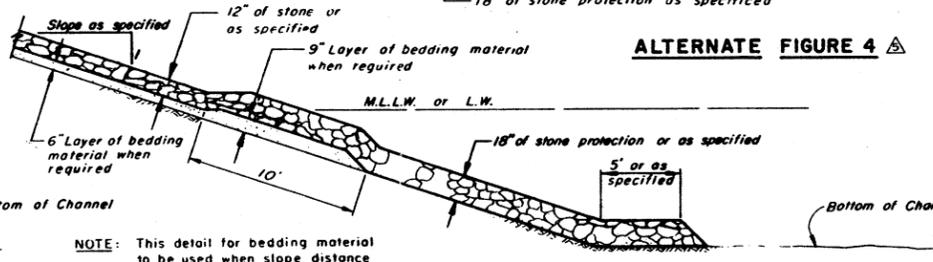
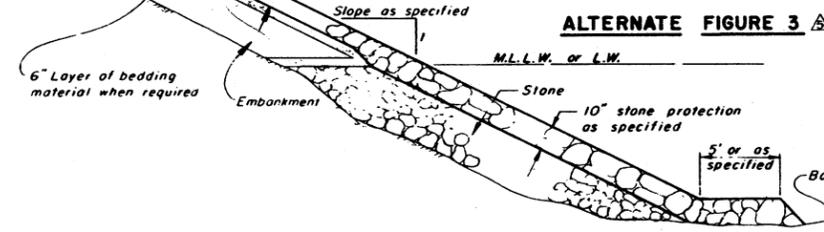
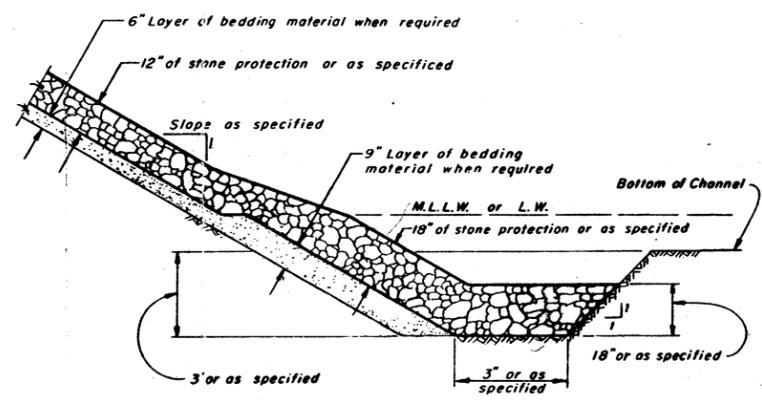
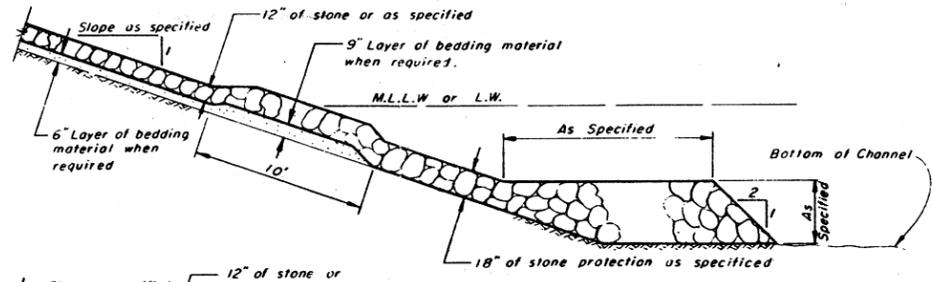
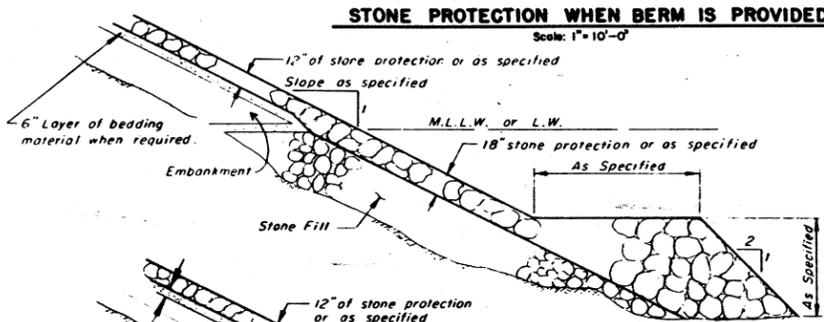


FIGURE 3
STONE PROTECTION WITH STONE FILL $\Delta \Delta \Delta$
Scale: 1" = 4'-0"

FIGURE 4 $\Delta \Delta \Delta$
Scale: 1" = 4'-0"

FIGURE 5 $\Delta \Delta \Delta$
Scale: 1" = 2'-0"

STONE PROTECTION AT BOTTOM OF CHANNEL

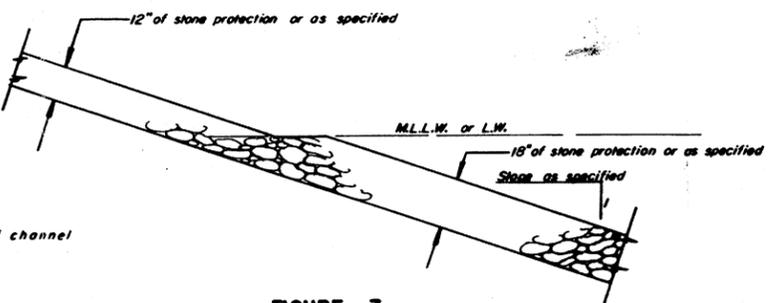
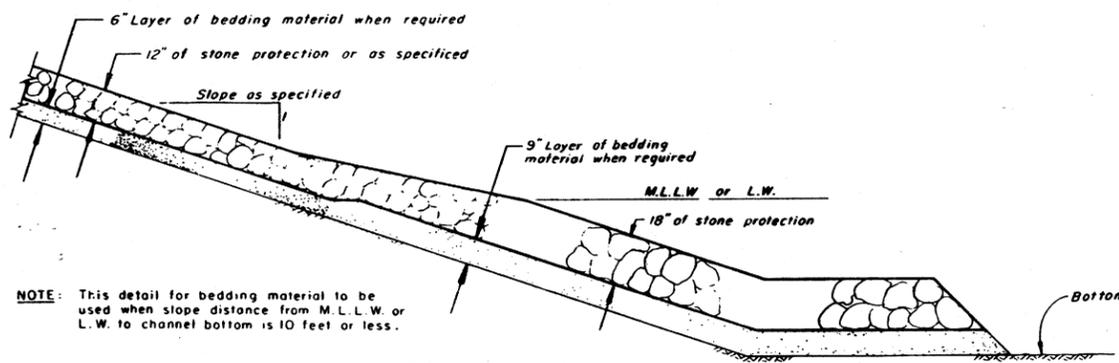
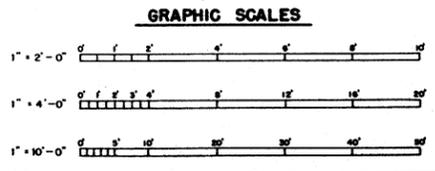


FIGURE 6
STONE PROTECTION WITH BEDDING MATERIAL $\Delta \Delta$
Scale: 1" = 2'-0"

FIGURE 7
STONE PROTECTION WITHOUT BEDDING MATERIAL
Scale: 1" = 2'-0"

NOTE: This detail for bedding material to be used when slope distance from M.L.L.W. or L.W. to channel bottom is greater than 10 feet.

NOTE: This detail for bedding material to be used when slope distance from M.L.L.W. or L.W. to channel bottom is 10 feet or less.



DATE	DESCRIPTION	BY	CHK
28 Aug 72	Change according to SPD comments (Unit 24)		
26 Aug 72	Change according to SPD comments (RD1602)		
18 Feb 71	Change according to SPD comments (Unit 21)		
26 Aug 70	Change according to SPD comments (Unit 20)		
16 Jun 70	Change according to SPD comments (Unit 19)		

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

STANDARD DRAWING
STONE PROTECTION

DATE: 29 September 1969

DESIGNED BY: E. GARCIA	DRAWN AS SHOWN FILE NO. 50-4-4488 SHEETS SHEET NO. 4488/1 TO 4488/8 4488/4,6
CHECKED BY: A. SMITH	
APPROVED BY: R. CLARKE	
DATE: 29 September 1969	

NOTE: This sheet supersedes sheet number 3674/4, File No. 50-4-3674, Dtd. 29 Aug 1960

2 Nov 72 Change according to SPD comments (Unit 24)

VALUE ENGINEERING PAYS

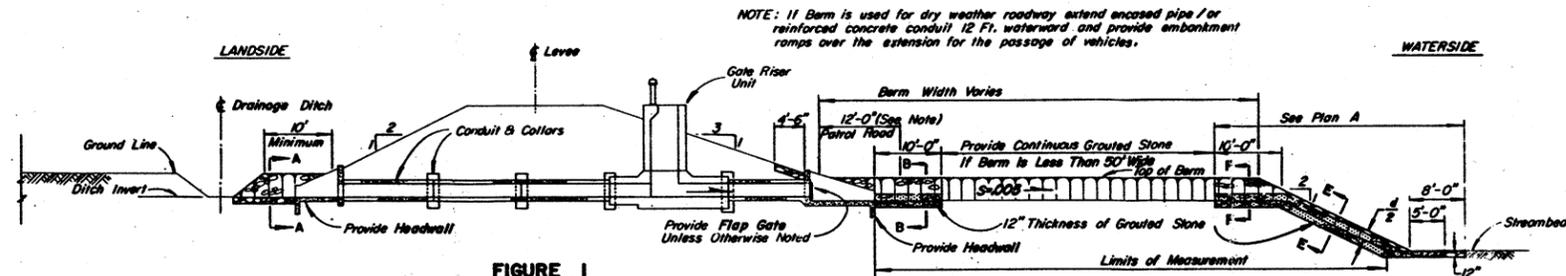
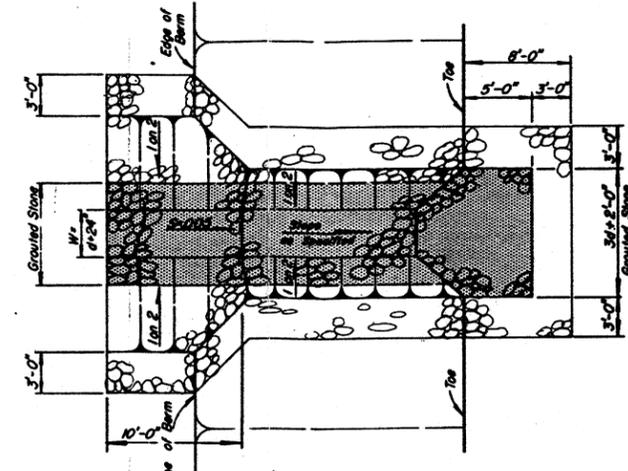


FIGURE 1
TYPICAL GRAVITY DRAINAGE STRUCTURE THROUGH
LEVEE SECTION
Scale: 1" = 10'-0"



PLAN A
Scale: 1" = 5'-0"

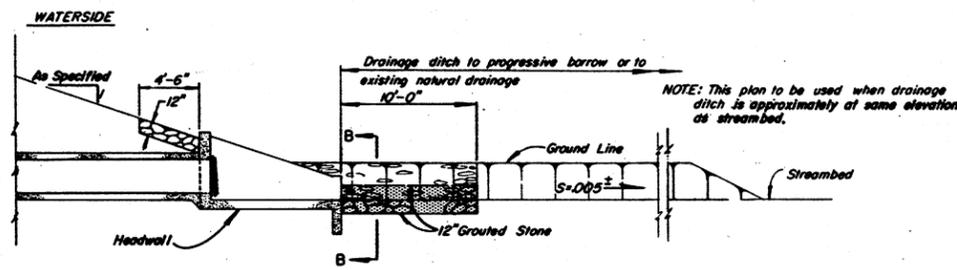
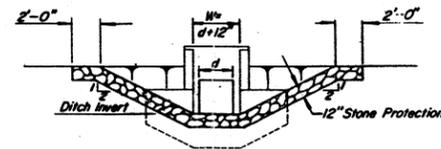
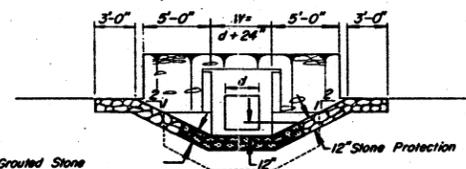


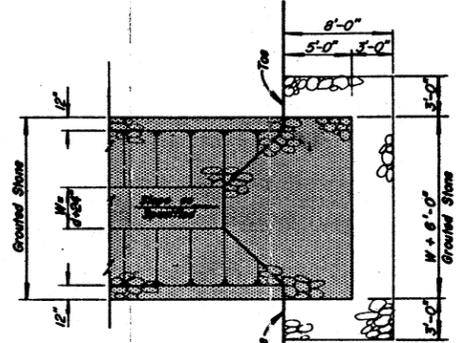
FIGURE 2
Scale: 1" = 5'-0"



SECTION A-A
Scale: 1" = 5'-0"



SECTION B-B
Scale: 1" = 5'-0"



PLAN B
Scale: 1" = 5'-0"

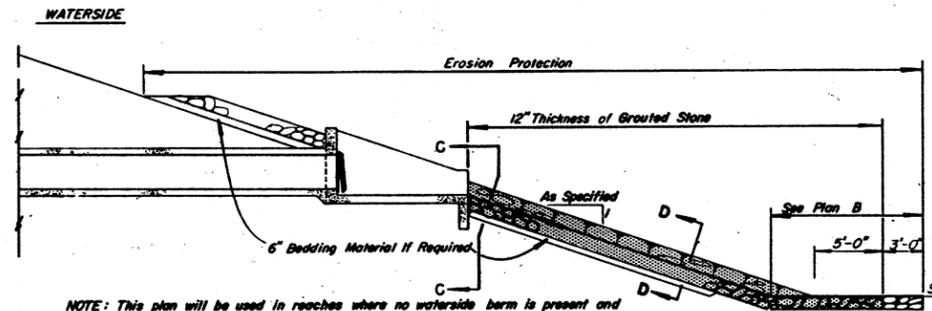
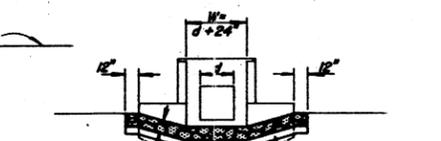


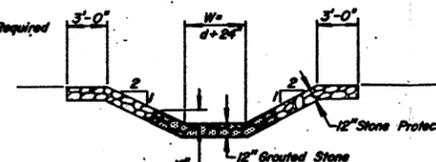
FIGURE 3
Scale: 1" = 5'-0"



SECTION E-E
Scale: 1" = 5'-0"



SECTION C-C
Scale: 1" = 5'-0"



SECTION F-F
Scale: 1" = 5'-0"

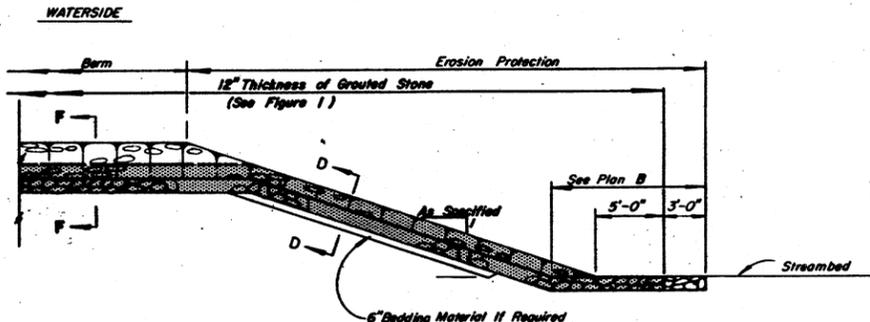
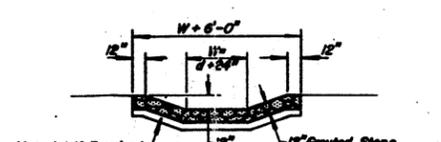
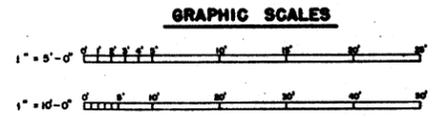


FIGURE 4
Scale: 1" = 5'-0"



SECTION D-D
Scale: 1" = 5'-0"



REVISION	DATE	DESCRIPTION	BY	CHK
U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA				
STANDARD DRAWING				
IRRIGATION & DRAINAGE STRUCTURE				
EROSION PROTECTION DETAILS				
DESIGNED BY: E. GARCIA				
CHECKED BY: A. SMITH				
APPROVED BY: R. CLARKE				
DATE: 22 September 1969				
SCALE AS SHOWN	FILE NO.			
4488/1 TO 4488/3	60-4-4488			
	SHEETS			
	4488/1 TO 4488/3			

NOTE: This sheet supersedes sheet number 3674/6, File No. 60-4-3674, Dtd. 13 Oct. 1960

VALUE ENGINEERING PAYS

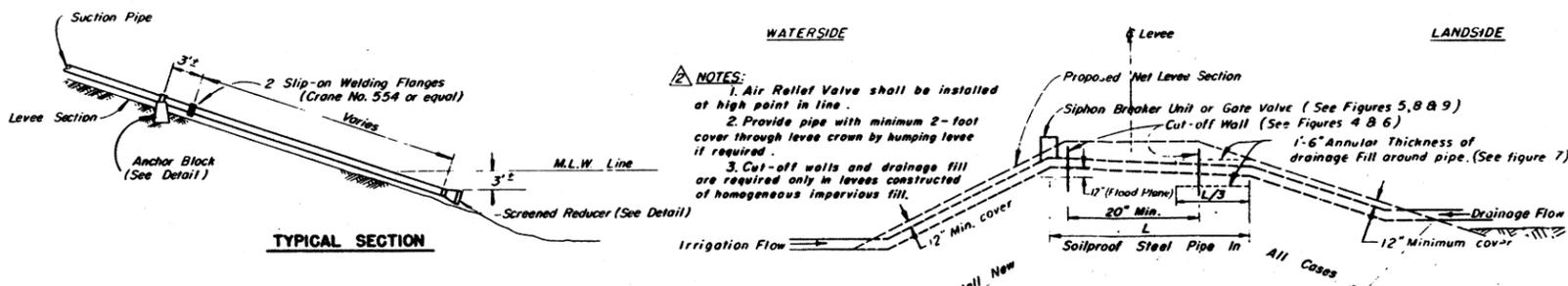
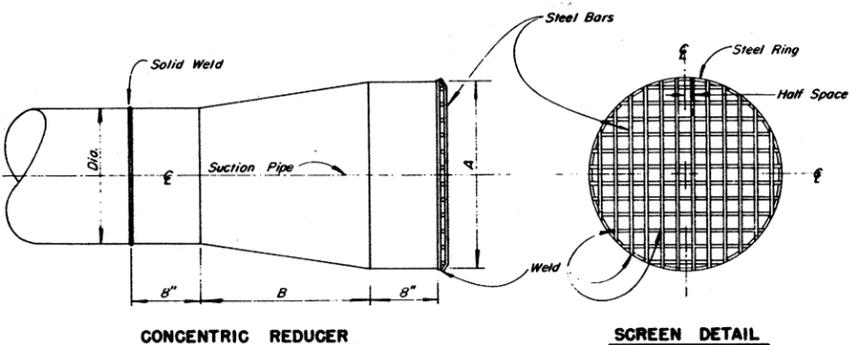


FIGURE 3
WELDED PIPE PRESSURE LINE INSTALLATION
Not To Scale



CONCENTRIC REDUCER

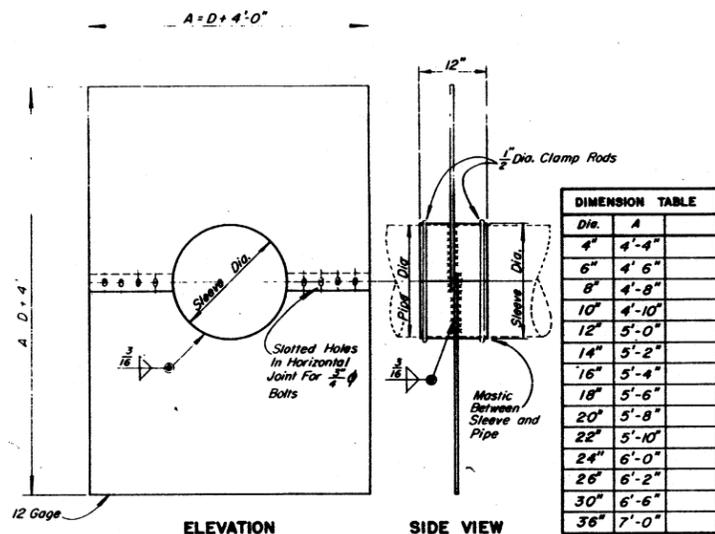
SCREEN DETAIL

REDUCER AND SCREEN DATA				
Pipe Dia.	A	B	Bar No.	Spacing
4"	6"	18"	2	1 1/2" C. to C.
6"	8"	18"	"	"
8"	10"	18"	"	"
10"	12"	18"	"	1 1/2" C. to C.
12"	16"	18"	"	"
14"	18"	20"	"	"
16"	22"	20"	3	1 1/2" C. to C.
18"	24"	20"	"	"

FIGURE 1

SUCTION PIPE INSTALLATION AND SCREEN DETAILS

Not To Scale



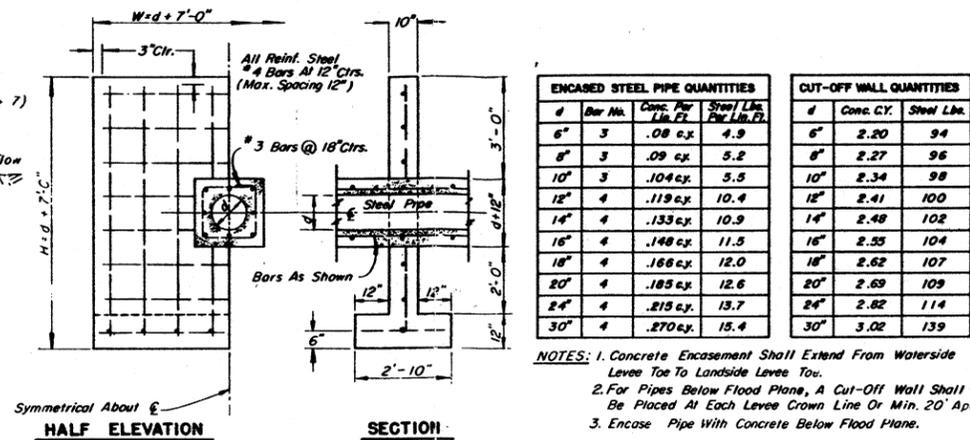
ELEVATION

SIDE VIEW

DIMENSION TABLE	
Dia.	A
4"	4'-4"
6"	4'-6"
8"	4'-8"
10"	4'-10"
12"	5'-0"
14"	5'-2"
16"	5'-4"
18"	5'-6"
20"	5'-8"
22"	5'-10"
24"	6'-0"
26"	6'-2"
30"	6'-6"
36"	7'-0"

FIGURE 4
PLATE STEEL CUT-OFF WALL FOR WELDED STEEL PIPE

Not To Scale



HALF ELEVATION

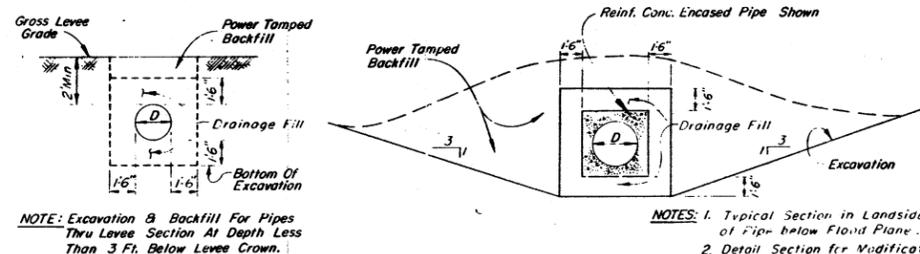
SECTION

ENCASED STEEL PIPE QUANTITIES				CUT-OFF WALL QUANTITIES		
d	Bar No.	Conc. Per Lin. Ft.	Steel Lin. Ft.	d	Conc. Cy.	Steel Lbs.
6"	3	.08 cu.	4.9	6"	2.20	94
8"	3	.09 cu.	5.2	8"	2.27	96
10"	3	.104 cu.	5.5	10"	2.34	98
12"	4	.119 cu.	10.4	12"	2.41	100
14"	4	.133 cu.	10.9	14"	2.48	102
16"	4	.148 cu.	11.5	16"	2.55	104
18"	4	.166 cu.	12.0	18"	2.62	107
20"	4	.185 cu.	12.6	20"	2.69	109
24"	4	.219 cu.	13.7	24"	2.82	114
30"	4	.270 cu.	15.4	30"	3.02	139

NOTES: 1. Concrete Encasement Shall Extend From Waterside Levee Top To Landside Levee Top.
2. For Pipes Below Flood Plane, A Cut-Off Wall Shall Be Placed At Each Levee Crown Line Or Min. 20' Apart.
3. Encase Pipe With Concrete Below Flood Plane.
4. Detail Shown For Modification Of Existing Pipe Structures.

FIGURE 6
CONCRETE CUT-OFF WALL AND ENCASED STEEL PIPE

Not To Scale

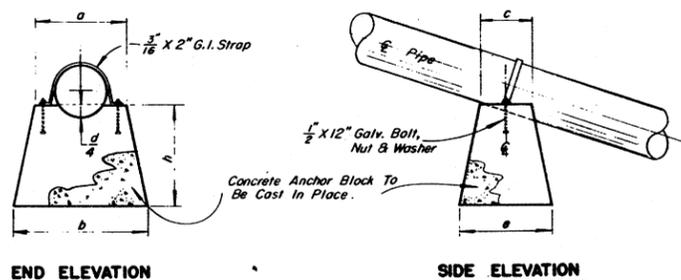


NOTE: Excavation & Backfill For Pipes Thru Levee Section At Depth Less Than 3 Ft. Below Levee Crown.

NOTES: 1. Typical Section in Landside 1/2' of Pipe Below Flood Plane.
2. Detail Section for Modification of Existing Pipes only.

FIGURE 7
EXCAVATION AND BACKFILL FOR PIPE LINES

Not To Scale



END ELEVATION

SIDE ELEVATION

ANCHOR BLOCK DIMENSIONS & QUANTITIES						
Pipe Dia. d	a	b	c	e	h	Conc. Cy.
4"	1'-4"	2'-0"	8"	12"	2'-4"	.12
6"	1'-4"	2'-0"	8"	12"	2'-4"	.12
8"	1'-6"	2'-3"	8"	1'-4"	2'-4"	.17
10"	1'-9"	2'-6"	10"	1'-8"	2'-6"	.26
12"	2'-0"	3'-0"	12"	2'-0"	2'-6"	.37
14"	2'-3"	3'-4"	1'-2"	2'-3"	2'-9"	.51
16"	2'-6"	3'-8"	1'-4"	2'-6"	3'-0"	.69
18"	2'-9"	4'-0"	1'-6"	2'-9"	3'-0"	.84

FIGURE 2

CONCRETE ANCHOR BLOCK

Not To Scale

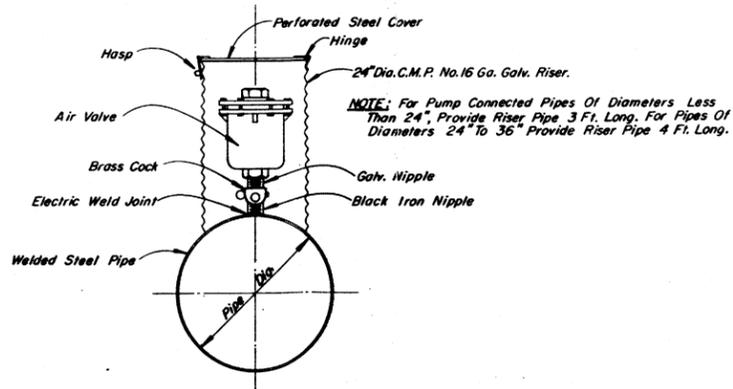


FIGURE 5
SIPHON BREAKER UNIT FOR DRAINAGE LINE

Not To Scale

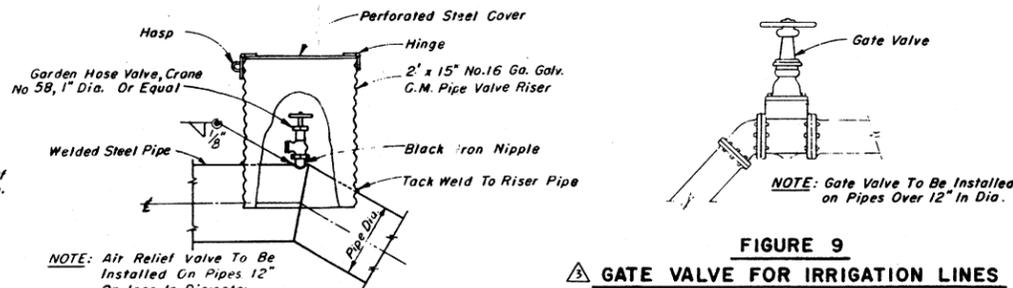


FIGURE 8
STANDARD GARDEN HOSE AIR RELIEF VALVE FOR IRRIGATION LINES

Not To Scale

FIGURE 9
GATE VALVE FOR IRRIGATION LINES

SYMBOL	DATE	DESCRIPTION	BY	CHK
△	27 Jul 72	Revised Drawing & Added Fig. 9		W
△	8 Nov 71	Modified Fig. 3 and added Fig. 8.		W
△	12 Nov 70	Revised cut off wall detail		W

U. S. ARMY ENGINEER DISTRICT		CORPS OF ENGINEERS		SACRAMENTO, CALIFORNIA	
STANDARD DRAWING					
IRRIGATION & DRAINAGE STRUCTURES					
PIPE INSTALLATION, CUT-OFF WALLS, EXCAVATION & BACKFILL DETAILS					
DESIGNED BY:	DATE:	APPROVED:	DATE:		
DRAWN BY: E. GARCIA	25 September 1969				
CHECKED BY: A. SMITH					
PREPARED BY: R. CLARKE					
SCALE AS SHOWN			SHEET NO.		
FILE NO. 50-4-4488			SHEET NO.		
4488/1 TO 4488/8			4488/6,3		

NOTE: This sheet supersedes sheet number 3674/7, File No. 50-4-3674, Dtd. 13 Oct. 1960

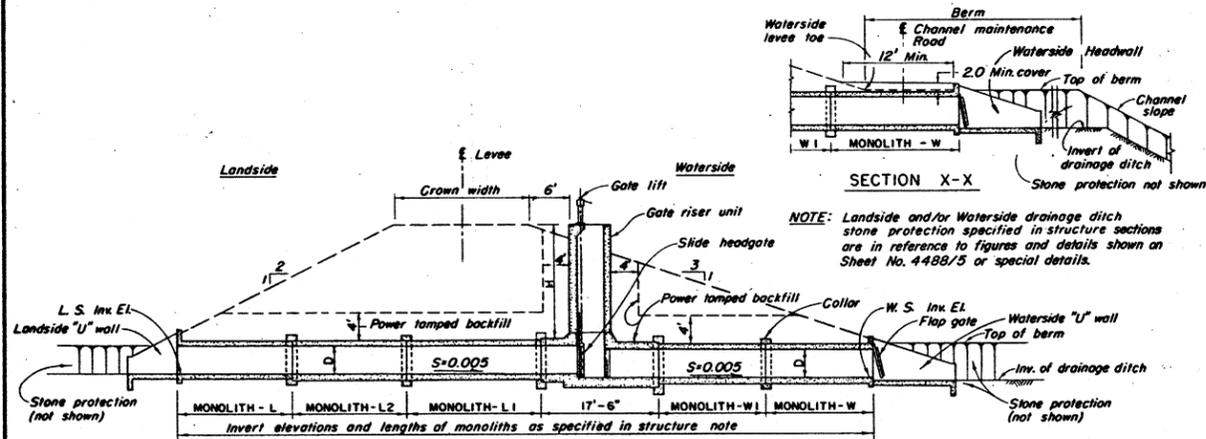


FIGURE 1
SECTION - TYPICAL GRAVITY DRAINAGE STRUCTURE
REINFORCED CONCRETE CONDUIT
SCALE: 1/4" = 1'-0"

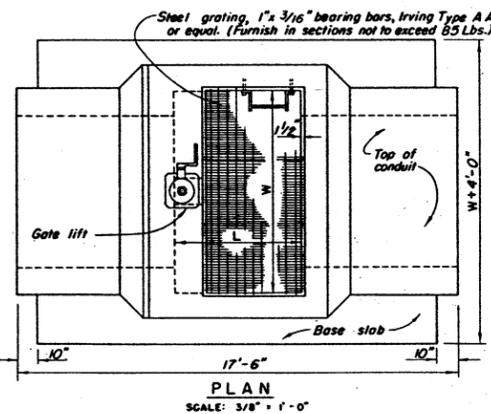


FIGURE 2
GATE RISER UNIT
SCALE: 3/8" = 1'-0"

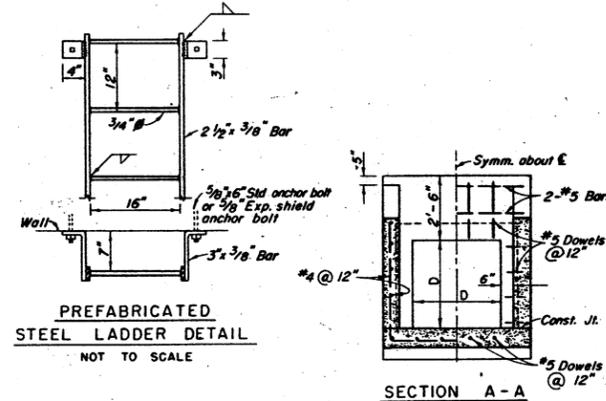


FIGURE 3
PREFABRICATED
STEEL LADDER DETAIL
NOT TO SCALE

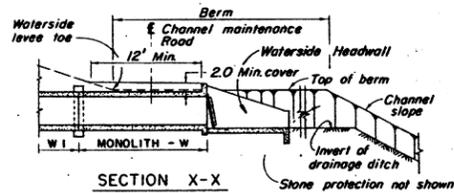


FIGURE 4
SECTION X-X
NOTE: Section X-X to be used when necessary to traverse berm with vehicle.

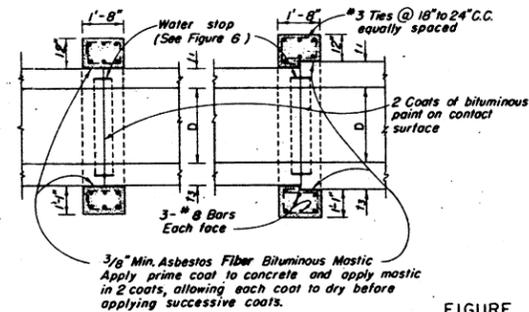


FIGURE 5
SECTIONS OF CONDUIT AND COLLARS
NOT TO SCALE

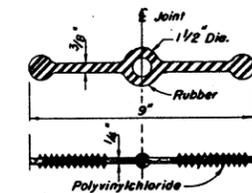


FIGURE 6
WATER STOP DETAILS

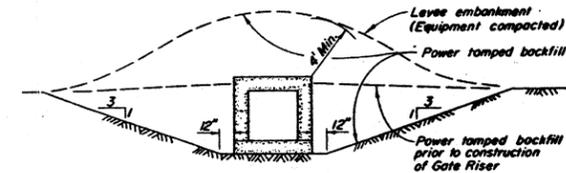
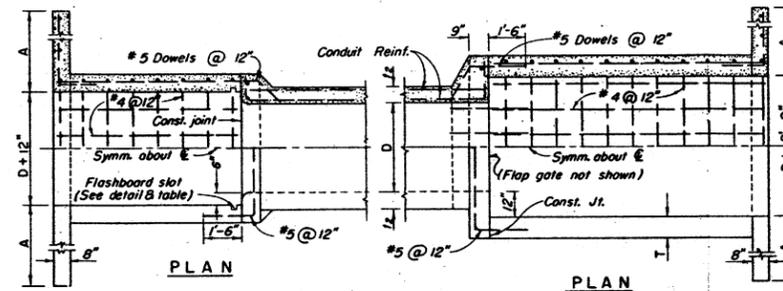


FIGURE 8
CONDUIT EXCAVATION AND BACKFILL
NOT TO SCALE

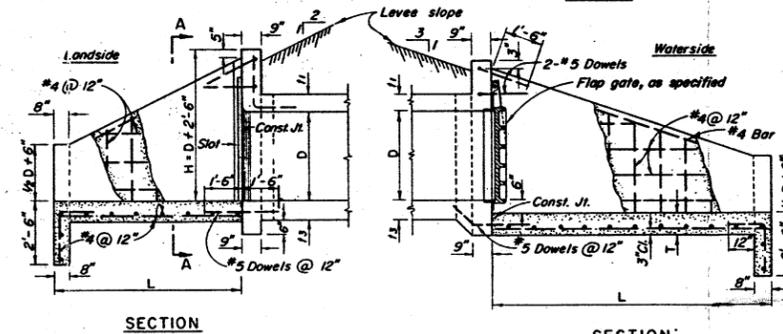


FIGURE 9
INLET AND OUTLET HEADWALLS
SCALE: 3/8" = 1'-0"

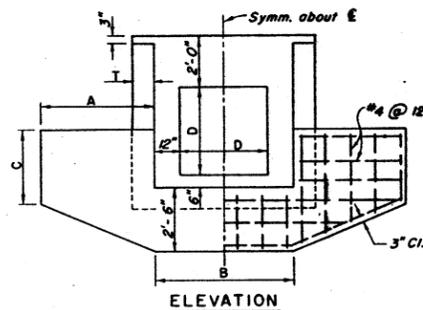


FIGURE 10
ELEVATION

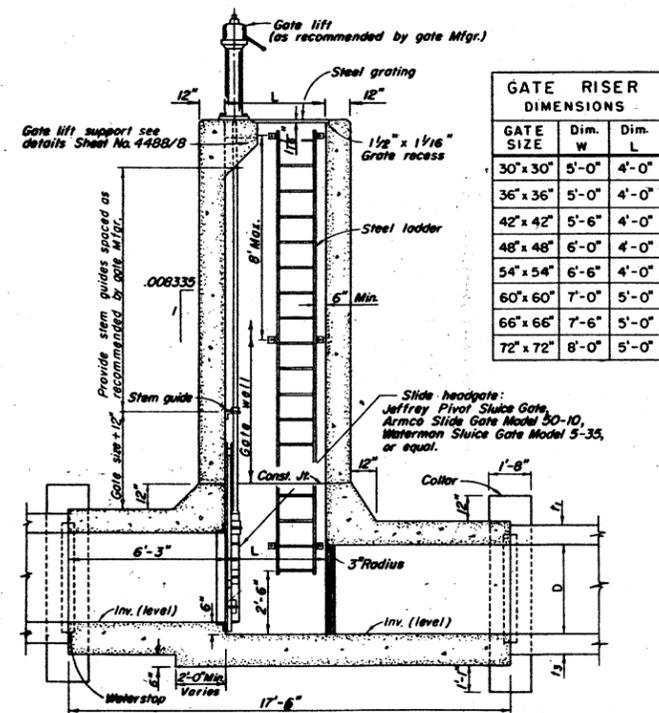
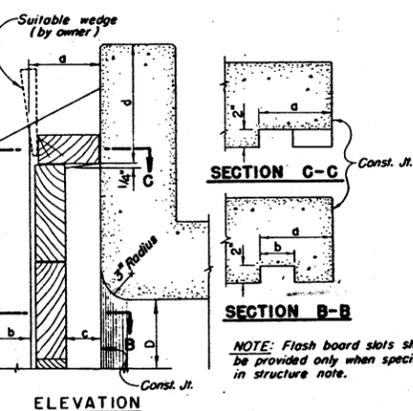


FIGURE 11
FLASHBOARD SLOT DETAILS
NOT TO SCALE



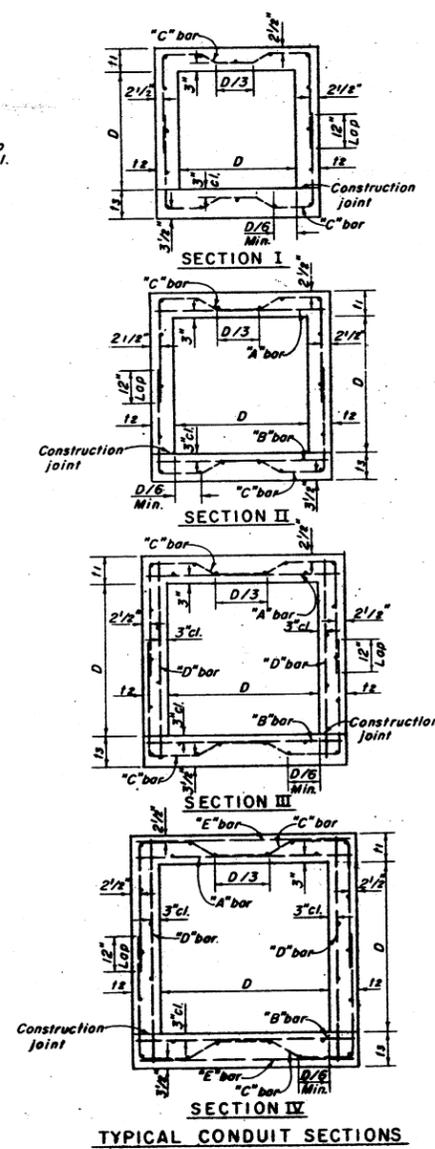
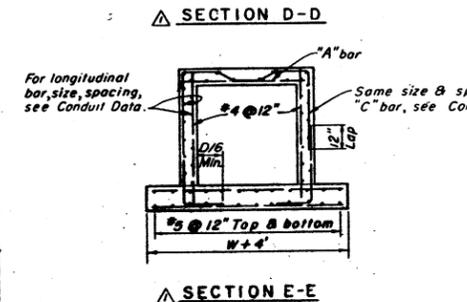
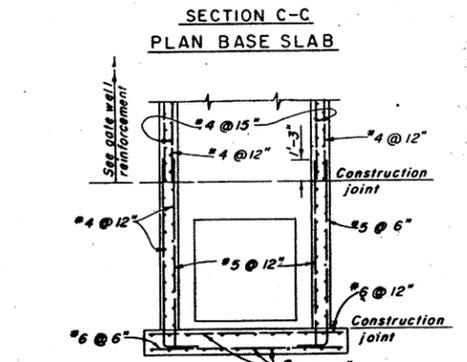
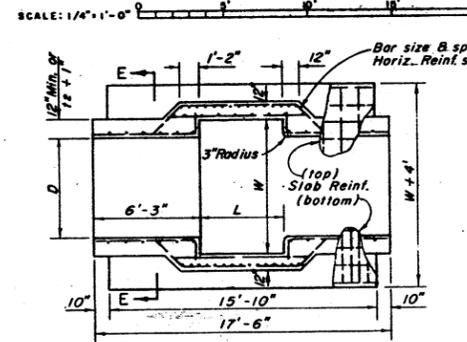
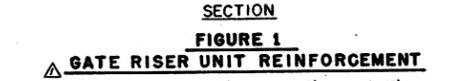
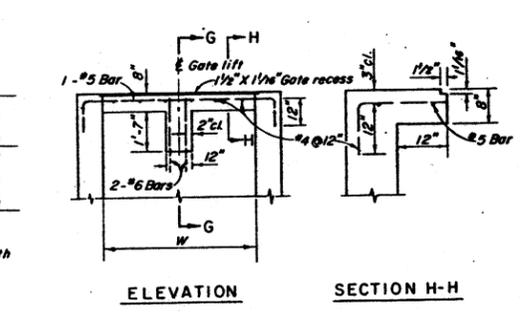
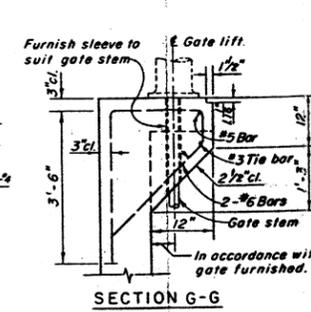
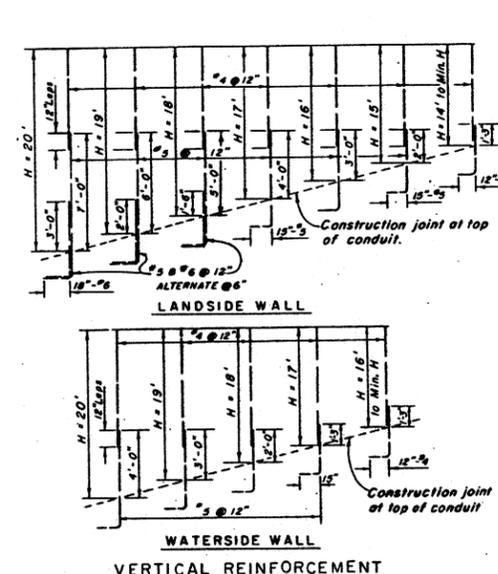
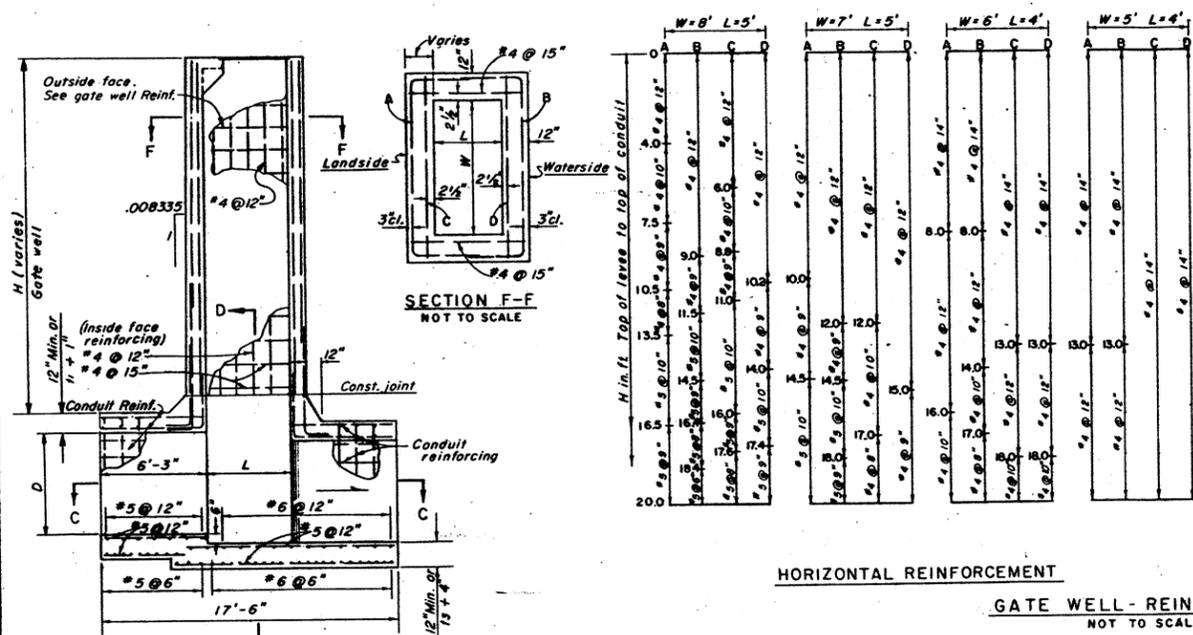
FLASH BOARD SLOT AND BOARD DIMENSIONS	Furnish Boards	Length
30"	6 1/2	3'-9 1/2"
36"	6 1/2	4'-3 1/2"
42"	6 1/2	4'-9 1/2"
48"	6 1/2	5'-3 1/2"
54"	6 1/2	5'-9 1/2"
60"	6 1/2	6'-3 1/2"
66"	6 1/2	6'-9 1/2"
72"	6 1/2	7'-3 1/2"

SYMBOL	REINFORCED CONCRETE HEADWALL DIMENSIONS AND QUANTITIES															
	LANDSIDE HEADWALL				LEVEE SLOPE 1 ON 2				WATERSIDE HEADWALL - LEVEE SLOPE 1 ON 3							
CONDUIT SIZE D	30"x30"	36"x36"	42"x42"	48"x48"	54"x54"	60"x60"	66"x66"	72"x72"	30"x30"	36"x36"	42"x42"	48"x48"	54"x54"	60"x60"	66"x66"	72"x72"
H	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"
L	6'-4"	6'-0"	7'-6"	7'-0"	8'-4"	8'-10"	9'-4"	9'-10"	9'-8"	10'-5"	11'-2"	11'-11"	12'-8"	13'-5"	14'-2"	14'-11"
T	8"	8"	9"	9"	10"	10"	10"	10"	8"	8"	9"	9"	10"	10"	10"	10"
A	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"
B	3'-6"	4'-0"	6'-0"	6'-6"	7'-2"	7'-8"	8'-2"	8'-8"	4'-6"	5'-0"	7'-0"	7'-6"	8'-2"	8'-8"	9'-2"	9'-8"
C	2'-6"	2'-6"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	2'-6"	2'-6"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"
X #			1'-9"	2'-0"	2'-9"	3'-0"	3'-6"	4'-3"			1'-6"	2'-9"	4'-3"	5'-9"	7'-3"	8'-9"
Y #					1'-3"	1'-9"	2'-3"				1'-3"	2'-9"	4'-3"	5'-9"	7'-3"	8'-9"
Z #											0'-9"	1'-9"	3'-0"			
CONCRETE CY.	2.36	2.83	3.80	4.34	5.41	6.24	6.94	7.78	3.56	4.33	5.61	6.46	8.11	9.23	10.33	11.53
REBAR #4	3.24	3.89	5.23	5.97	7.74	8.58	9.34	10.70	4.90	5.95	7.71	8.33	11.15	12.69	14.20	15.85
REBAR #4	136	190	244	268	315	378	437	480	226	272	326	406	472	590	555	759

* See Figure 4 Sheet No. 4488/8

NOTES:
All steel reinforcement to be deformed bars.
At splices, lap all bars a minimum distance of 24 diameters of smaller bar in splice unless noted otherwise.
All longitudinal steel in headwalls #4 bars unless noted, maximum spacing 12" on centers.
All exposed edges of concrete to be chamfered 3/4" unless noted.
For Gate Riser and Conduit reinforcement and details see Sheet No. 4488/8.
In lieu of a square form for the inside of the conduit, a round smooth steel pipe, or other suitable round form, may be used and left in place. The round pipe or form will have a diameter equal to the inside dimension of the square conduit, but in no instance will it be less than 30 inches. When a square conduit is sized for a certain capacity, and a round section reduces the capacity to the extent that it is not adequate, the round pipe or form, as well as the entire conduit, will be enlarged to conform to the capacity requirement.

REVISION	DATE	DESCRIPTION	BY	DT
U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA				
STANDARD DRAWING IRRIGATION & DRAINAGE STRUCTURES GATE RISER UNIT DETAILS AND HEADWALL REINFORCING DETAILS				
DESIGNED BY: G. SWARTZ	DRAWN BY: E. WARNER			
CHECKED BY: A. SMITH	PREPARED BY: N. HACKEN			
SUBMITTED BY: J. B. HANCOCK	APPROVED: <i>[Signature]</i>			
DATE: 25 September 1969	SCALE: AS SHOWN			
FILE NO. 50-4-4488	SHEET NO. 4488/1 TO 4488/8 4488/7			



CONDUIT SIZE	DIMENSIONS			TRANSVERSE Bar Size - Spacing			Ref. to Sec.	LONGITUDINAL Bar Size - Spacing	QUANTITIES / Lin. Ft.			
	1	2	3	"A"	"B"	"C"			Conc.	Cement	Reinf. Steel	
30" x 30"	7"	6"	8"	"4-9"	"4-9"	"4-9"	I	"4 @ 15"	.25	.34	22.5	
36" x 36"	7"	6"	8"	"4-9"	"4-9"	"4-9"	I	"4 @ 15"	.30	.41	27.3	
42" x 42"	7 1/2"	6"	8"	"4-9"	"4-9"	"4-9"	I	"4 @ 15"	.34	.47	34.5	
48" x 48"	8"	7"	9"	"4-12"	"4-12"	"5-12"	II	"4 @ 15"	.44	.60	41.8	
54" x 54"	8 1/2"	8"	10"	"4-12"	"4-12"	"5-12"	II	"4 @ 15"	.53	.72	46.3	
60" x 60"	9 1/2"	8"	10"	"4-11"	"4-11"	"5-11"	III	"4 @ 15"	.63	.86	70.0	
66" x 66"	10"	9"	11"	"4-11"	"4-11"	"5-11"	III	"4 @ 12"	.76	1.04	77.6	
72" x 72"	10 1/2"	10"	11"	"4-10"	"4-10"	"5-10"	III	"4 @ 12"	.88	1.21	89.4	
H = 10 Ft. to 12 Ft.												
30" x 30"	7"	6"	8"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.25	.34	24.2	
36" x 36"	7 1/2"	7"	8"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.33	.45	30.3	
42" x 42"	8"	7"	9"	"4-10"	"4-10"	"4-10"	I	"4 @ 15"	.40	.54	35.2	
48" x 48"	8 1/2"	7"	9"	"4-12"	"4-12"	"5-12"	II	"4 @ 15"	.46	.63	41.2	
54" x 54"	9"	8"	10"	"4-11"	"4-11"	"5-11"	II	"4 @ 15"	.56	.77	50.5	
60" x 60"	9 1/2"	9"	10"	"4-10"	"4-10"	"5-10"	III	"4 @ 15"	.67	.92	75.7	
66" x 66"	10 1/2"	10"	11"	"4-10"	"4-10"	"5-10"	III	"4 @ 12"	.82	1.12	82.5	
72" x 72"	11"	10"	12"	"4-10"	"4-10"	"5-10"	III	"4 @ 12"	.91	1.25	89.6	
H = 12 Ft. to 14 Ft.												
30" x 30"	7"	7"	8"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.28	.38	26.0	
36" x 36"	7 1/2"	7"	8"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.33	.45	30.9	
42" x 42"	8"	8"	9"	"4-9"	"4-9"	"4-9"	I	"4 @ 15"	.43	.59	38.5	
48" x 48"	8 1/2"	8"	10"	"4-12"	"4-12"	"5-12"	II	"4 @ 15"	.51	.70	43.3	
54" x 54"	9 1/2"	9"	10"	"4-10"	"4-10"	"5-10"	II	"4 @ 15"	.61	.84	53.3	
60" x 60"	10"	9"	11"	"4-10"	"4-10"	"5-10"	III	"4 @ 12"	.70	.96	76.4	
66" x 66"	10 1/2"	10"	11"	"4-10"	"4-10"	"5-10"	III	"4 @ 12"	.85	1.17	84.4	
72" x 72"	11 1/2"	11"	12"	"4-10"	"4-10"	"5-10"	III	"4 @ 12"	.98	1.34	112.1	
H = 14 Ft. to 16 Ft.												
30" x 30"	8"	8"	9"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.32	.45	29.5	
36" x 36"	8 1/2"	8"	9"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.38	.52	35.7	
42" x 42"	9 1/2"	8"	10"	"4-9"	"4-9"	"4-9"	I	"4 @ 15"	.45	.62	37.1	
48" x 48"	9"	8"	10"	"4-11"	"4-11"	"5-11"	II	"4 @ 15"	.51	.70	44.7	
54" x 54"	10"	9"	11"	"4-11"	"4-11"	"5-11"	II	"4 @ 15"	.64	.88	51.4	
60" x 60"	10 1/2"	10"	11"	"4-11"	"4-11"	"5-11"	III	"4 @ 12"	.75	1.03	86.0	
66" x 66"	11 1/2"	11"	12"	"4-12"	"4-12"	"5-12"	III	"4 @ 12"	.91	1.24	100.0	
72" x 72"	12"	12"	13"	"4-11"	"4-11"	"5-11"	III	"4 @ 12"	1.06	1.46	117.4	
H = 16 Ft. to 18 Ft.												
30" x 30"	8 1/2"	8"	9"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.33	.45	29.2	
36" x 36"	8 1/2"	8"	9"	"4-8"	"4-8"	"4-8"	I	"4 @ 15"	.38	.53	35.0	
42" x 42"	9"	8"	10"	"4-9"	"4-9"	"4-9"	I	"4 @ 15"	.44	.60	39.7	
48" x 48"	9 1/2"	9"	10"	"4-11"	"4-11"	"5-11"	II	"4 @ 15"	.57	.78	44.4	
54" x 54"	10 1/2"	9"	11"	"4-11"	"4-11"	"5-11"	II	"4 @ 12"	.69	.94	53.6	
60" x 60"	11"	10"	12"	"4-12"	"4-12"	"5-12"	III	"4 @ 12"	.78	1.07	82.1	
66" x 66"	11 1/2"	11"	12"	"4-12"	"4-12"	"5-12"	III	"4 @ 12"	.94	1.29	106.0	
72" x 72"	12 1/2"	12"	13"	"4-12"	"4-12"	"5-12"	III	"4 @ 12"	1.10	1.51	116.1	
H = 18 Ft. to 20 Ft.												
30" x 30"	8 1/2"	8 1/2"	9"	"4-8"	"4-8"	"4-8"	I	"4 @ 12"	.34	.47	31.7	
36" x 36"	8 1/2"	8 1/2"	9"	"4-8"	"4-8"	"4-8"	I	"4 @ 12"	.40	.54	35.3	
42" x 42"	9"	9"	10"	"4-10"	"4-10"	"5-10"	II	"4 @ 15"	.49	.67	46.8	
48" x 48"	9"	9"	10"	"4-10"	"4-10"	"5-10"	II	"4 @ 15"	.58	.80	50.7	
54" x 54"	10"	10"	11"	"4-10"	"4-10"	"5-10"	III	"4 @ 15"	.70	.96	63.9	
60" x 60"	10 1/2"	11"	12"	"4-11"	"4-11"	"5-11"	III	"4 @ 12"	.84	1.15	95.6	
66" x 66"	11 1/2"	11"	12"	"4-11"	"4-11"	"5-11"	IV	"4 @ 12"	1.00	1.37	113.7	
72" x 72"	13"	13"	14"	"4-12"	"4-12"	"5-12"	IV	"4 @ 12"	1.16	1.60	121.5	

CONDUIT DATA

GATE LIFT SUPPORT DETAILS NOT TO SCALE

FIGURE 2 WATERSIDE HEADWALL REINFORCEMENT NOT TO SCALE

FIGURE 3 LANDSIDE HEADWALL REINFORCEMENT NOT TO SCALE

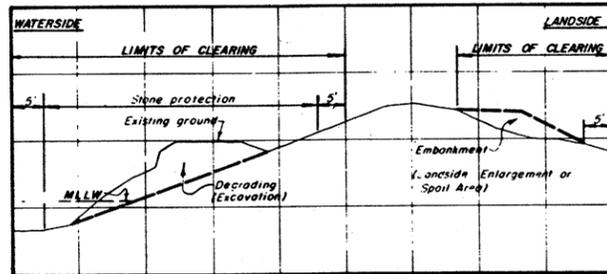
NOTE: See Table Reinforced Concrete Headwall, Sheet 4488/7 For The Dimensions Of X, Y, B & Z.

NOTE: This sheet supersedes sheet number 3674/10, File No. 50-4-3674, Dtd. 23 March 1965

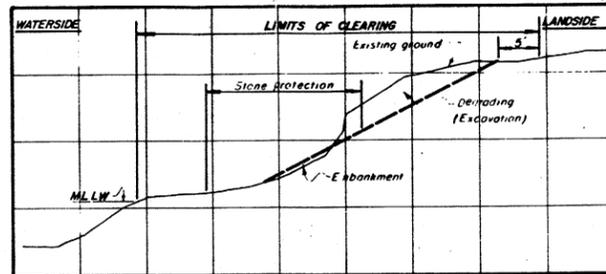
DESIGNED BY: SWARTZ	CHECKED BY: KANENAGA	APPROVED: [Signature]	DATE: 25 September 1969
DRAWN BY: KANENAGA	CHECKED BY: A. SMITH	PREPARED BY: HACKEN	SCALE: AS SHOWN SPEC. NO.
SUBMITTED: [Signature]		FILE NO. 50-4-4488	
SHEET NO. 4488/1 TO 4488/8		SHEET NO. 4488/8	

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

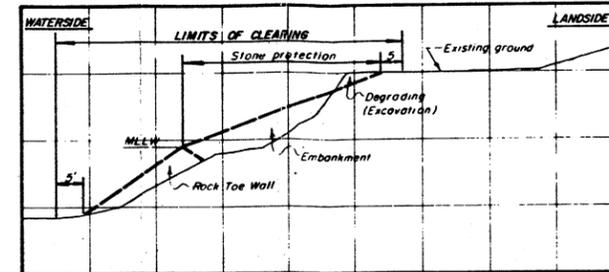
STANDARD DRAWING
IRRIGATION & DRAINAGE STRUCTURES
REINFORCING DETAILS FOR
GATE RISER, CONDUIT SECTIONS
AND HEADWALLS



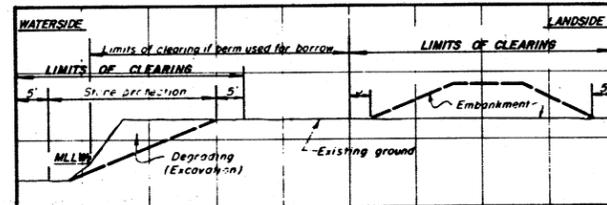
BANK SLOPING AND STONE PROTECTION EXTENDING BELOW LOW WATER OR MEAN LOWER LOW WATER AND LANDSIDE LEVEE ENLARGEMENT OR SPOILING



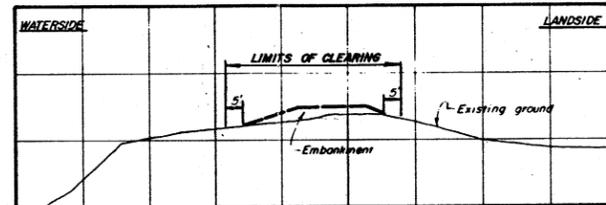
RIVERSIDE LEVEE SLOPING AND STONE PROTECTION ABOVE LOW WATER OR MEAN LOWER LOW WATER



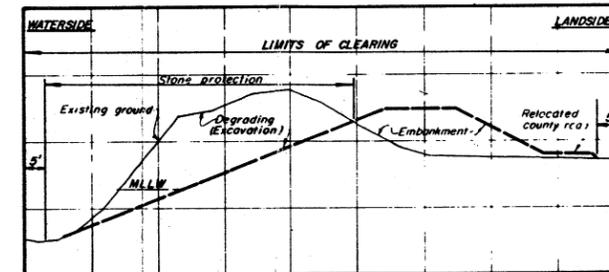
BANK SLOPING AND ROCK TOE WALL PLACEMENT



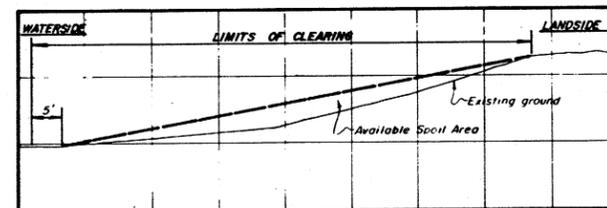
NEW LEVEE CONSTRUCTION WITH BANK SLOPING OR BERM USED AS BORROW



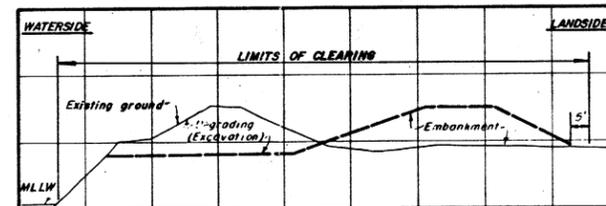
LEVEE RAISING AND ENLARGEMENT



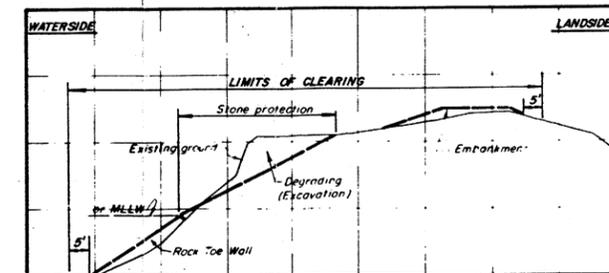
LEVEE SETBACK WITHOUT BERM, RELOCATED ROADWAY, DEGRADING OF EXISTING LEVEE AND RIVER BANK



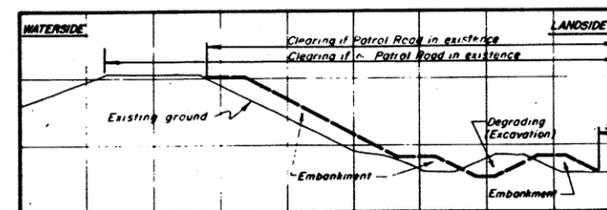
RIVERSIDE SLOPE OF LEVEE USED FOR SPOIL AREA



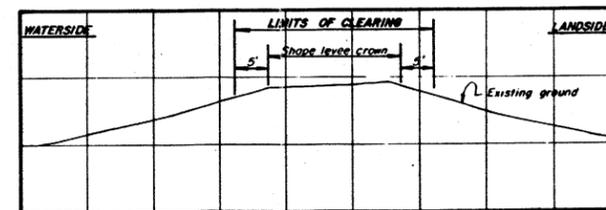
LEVEE SETBACK WITH BERM AND DEGRADING OF EXISTING LEVEE AND BERM



LEVEE ENLARGEMENT AND BANK SLOPING WITH PLACEMENT OF ROCK TOE WALL



LANDSIDE LEVEE ENLARGEMENT AND RELOCATED IRRIGATION AND/OR DRAINAGE DITCH



LEVEE CROWN SHAPING AND SURFACING FOR PATROL ROAD

REVISION	DATE	DESCRIPTION	BY	BT
U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA				
DESIGNED BY:	E. GARCIA			
DRAWN BY:	A. SMITH			
CHECKED BY:	R. CLARKE			
PREPARED BY:	R. CLARKE			
SUBMITTED BY:	R. CLARKE			
APPROVAL, RECOMMENDED	APPROVED	DATE	29 September 1969	
PREPARED UNDER THE DIRECTION OF	SCALE	ENGINEER DISTRICT		
FILE NO.	50-10-4502			
SHEETS	4502/1			
IN ONE SHEET				

EXHIBIT G

SPKGD 800.12

26 September 1955

SUBJECT: Interior Drainage in Local Protection Projects

TO: Division Engineer
South Pacific Division
Corps of Engineers, US Army
San Francisco, California

1. Information requested in OCE red-bordered letter, 30 August 1955, subject as above, and SPD letter, 9 September 1955, same subject, is given herein:

CURRENT PRACTICE IN SACRAMENTO DISTRICT

2. Criteria for inclusion of interior drainage. - Interior drainage is provided when natural drainage is prevented by project works. Interior drainage is generally classified as follows:

- a. Gravity outlets through levees.
- b. Pumping plants through levees.
- c. Interior drainage works.

Gravity outlets and pumping plants are generally built and paid for by the Federal Government. Interior drainage works (collection system) are built and paid for by local interests. Exceptions to this general procedure have occurred in the past, particularly with regard to the Sacramento River Old Project which has been under construction for many years, and the component parts of which have been built under laws specifying different requirements of local cooperation. There is inclosed a tabulation showing our interpretation of current O&R instructions as well as the practice followed (or proposed to be followed) in this District on drainage problems of the Sacramento River Flood Control Project, Sacramento River Major and Minor Tributaries, American River Levee, and San Joaquin River Levee Project. Interior drainage is subject to the same economic analysis as any other component part of the project. The degree of protection provided is governed by the same economic factors.

3. Cost-sharing arrangements. - Collecting systems (except main intercepting ditches) are normally paid for by local interests; gravity outlets through levees or pumping plants through levees are normally paid

SPKGD 800.12

SUBJECT: Interior Drainage in Local Protection Projects

for by the Federal Government. Exceptions to this general rule have occurred, particularly in the Sacramento River Flood Control Project, in order to maintain consistency with past arrangements for the same project or general area. For instance, pumping plants required in connection with the levees proposed in the Chico Landing to Red Bluff Report of the District Engineer (the levees were subsequently deleted by the Division Engineer) were charged to local interests, whereas the pumping plant required for the authorized American River levee is considered to be a Federal responsibility. See tabulation in inclosure 1.

RECOMMENDATIONS FOR UNIFORM POLICY

4. Criteria for inclusion in future reports. - Interior drainage should be provided when natural drainage is prevented by project works and when found to be economically justified. The economic analysis should be conducted by following the same principles and concepts as are used for any other component part of the project. When practicable, the incremental method of analysis should be used. The degree of protection or improvement provided should vary with the character and nature of the improved area. Interior drainage works (Collection system) should normally be built and paid for by local interests, the cost thereof to be deducted from project benefits. Gravity outlets through project levees or pumping plants to pass drainage water through or over project levees should be built by Federal Government.

5. Cost-sharing arrangements. - Interior drainage works (Collection system) should be paid for by local interests. Gravity outlets or pumping plants should be paid for by the Federal Government, the cost thereof to be distributed in the same manner as the cost of the levee and other items built by the Federal Government. Local interests would, of course, contribute the necessary rights-of-way for construction and pondage as in other items of work. With regard to the method of distributing the construction cost incurred by the Federal Government the following comments are considered pertinent:

a. Flood control, land enhancement, and drainage benefits are very difficult to separate, since all such benefits are reflected in increased property values. The dividing line is largely imaginary and subject to judgment interpretations. For this reason, it is recommended that the same formula be applied to the three types of benefits.

b. In any division of cost formula that may be developed, the capitalized value of maintenance and operation cost should be fully taken into account, as is done in the current "drainage formula," rather than ignored as is done in the current "land enhancement formula."

c. The cost of lands, utility relocations, etc. paid for by local

SPKGD 800.12

SUBJECT: Interior Drainage in Local Protection Projects

interests, (except the cost of such interior drainage works as are a part of the project only in that the cost thereof was deducted from the benefits) should be fully taken into account in any division of cost formula that may be developed, as is presently done in the current land enhancement and drainage formulas.

d. The division of cost formula should be simple and uniform for all projects, and should be independent of the breakdown of benefits into flood control, land enhancement, and drainage. Thus, the formula should be of this type:

Construction cost (Federal)	= A
Cost of lands, utilities, etc. (non-Federal)	= B
Capitalized value of M&O (non-Federal)	= C
Total project cost	= $A+B+C$
Non-Federal share	= $k \frac{A+B+C}{A+B+C}$
Non-Federal cash contribution to construct cost	= $k \frac{A+B+C}{A+B+C} - \frac{B+C}{A+B+C}$

The value of "k" should be same for all local protection projects. A value of 0.50 is suggested as being appropriate. The non-Federal cost should in no case be less than $\frac{B+C}{A+B+C}$.

6. Recognition to future expansion. - When future expansion in urban areas can be anticipated with a reasonable degree of accuracy, and protection therefor is found to be economically justified, it should be provided. The degree of protection to be provided should be governed by economic considerations as well as by the nature and character of the area to be protected.

7. Special consideration. - Local interior drainage to prevent ponding or to lower the groundwater table should be built and paid for entirely by local interests. Such improvements should be made a part of the project only in that the cost thereof should be deducted from the project benefits.

20 September 1955

Division of Costs
 Drainage Works Supplemental to Levee Construction

Feature	: Orders		: Sacramento River: Major and Minor		: San Joaquin River: American River	
	:& Regulations:	F.C. Project	:Trib. Project(1)	:and Tribs. Project(1)	:and Tribs. Project:Right Bank Levee	:and Tribs. Project:Right Bank Levee
	:Fed.:Non-Fed.:	Fed. : Non-Fed:	Fed. :Non-Fed :	Fed. : Non-Fed:	Fed. : Non-Fed:	Fed. :Non-Fed.
Replacement of Existing Facilities						
Gravity Outlets thru Levees	x	x	x (3)	x	x	x
Pumping Plants thru Levees	x	x	x (3)	x	x	x
Interior drainage works						
Main Intercepting ditches	x	x	x (3)	x	x	x
Collection ditches or systems	x	x	x	x	x	x
Construction of New Facilities						
Gravity Outlets thru Levees	x	x		x	x	x
Pumping Plants thru Levees	x	(2)		x	x	x
Interior drainage works						
Main Intercepting ditches	x	(2)		x	x	x
Collection ditches or systems	x	x	x	x	x	x

- NOTES: (1) A part of Sacramento River F. C. Project but carried separately for budgetary purposes.
 (2) Determined jointly with local interests in each case, as condition develops.
 (3) On work completed to date, these features were carried as a Federal cost.

TABULATION OF FEDERAL OR NON-FEDERAL COSTS
ON VARIOUS ITEMS OF PROJECT WORK

NOTE 1. All plans prepared by the Sacramento District must be based on the most economical overall cost consistent with sound engineering design. After this is accomplished the division of cost between Federal and Non-Federal is on the following basis.

NOTE 2. Representatives of Local Sponsor must make determination whether a structure is abandoned.

ITEM	FACILITY	Federal	Non-Federal
1	Clearing of site of all abandoned buildings, slabs, etc.	X	
2	Removal of abandoned telephone and power lines and poles.		X
3	Channel excavation in excess of project requirements or at request of Local Sponsor.		X
4	Embankment in excess of project grade and section.		X
5	Rock toe wall or stone protection in lieu of right-of-way for levee setback.		X
6	Construction of landside or riverside berm fills to Government requirement to provide adequate structure.	X	
7	Construction of landside or riverside berm fills in excess of Government requirement.		X
8	Construction of earth pads for State or property owner use.		X
9	Retaining walls constructed on landside of levee to reduce right-of-way cost.		X

ITEM	FACILITY	Federal	Non-Federal
10	Replacement of existing road ramps (including surfacing and culverts) which need to be moved - due to Government work. (Not required for maintenance access).		X
11	Relocation of existing road ramps (including surfacing and culverts) for owners convenience.		X
12	Construction of new road ramps (including surfacing and culverts) for convenience of owner.		X
13	Replacement or construction of new road ramps including surfacing and culverts) required for access to levee for maintenance purposes.	X	
14	Overhaul of embankment and spoil at request of Local Sponsor.		X
15	Surfacing levee for maintenance purposes to minimum Government requirements.	X	
16	Surfacing levee or road ramps in excess of Government requirements.		X
17	Surfacing access roads from public road to levee.	X	
18	Removal of fencing and gates to permit Government construction.	X	
19	Replacing fencing and gates.		X
20	Constructing new fencing.		X
21	Constructing new gates (at request of Local Sponsor).		X

ITEM	FACILITY	Federal	Non-Federal
22	Constructing new gates to prevent unauthorized access.	X	
23	Replacement in kind of existing drainage pipe through an existing levee (being modified).		X
24	Replacement of drainage pipe through an existing levee to a higher standard at request of local interests.		X
25	Construction of new drainage pipe through an existing levee (being modified). (Not required for project).		X
26	Construction of new drainage pipe through a new levee.	X	
27	Construction of new drainage pipe through new levee in excess of project requirements.		X
28	Modification of either riverside or landside drainage ditches where existing levee is being modified. (Includes ditch pads where necessary).	X	
29	Construction of either riverside or landside drainage ditches where new levee is being constructed for project drainage.	X	
30	Modification in kind of an existing drainage pump where existing levee is being modified.		X
31	Construction of new drainage pump where existing levee is being modified and pump is not required for project purposes.		X

ITEM	FACILITY	Federal	Non-Federal
32	Construction of new drainage pump where new levee is being constructed and pump is required for project purposes.	X	
33	Construction of new drainage pumps, (where new levee is being constructed) in excess of project design requirements.		X
34	Replacement in kind of existing irrigation pipe through existing levee being modified.		X
35	Replacement to higher standard of existing irrigation pipe through existing levee being modified.		X
36	Construction of new irrigation pipe through new levee being constructed.		X
37	Modification in kind of an existing irrigation pump where existing levee is being modified.		X
38	Construction of new irrigation pump where existing levee is being modified.		X
39	Construction of new irrigation pump where new levee is being constructed.		X
40	Construction or modification of either riverside or landside irrigation ditch where existing levee is being modified (includes ditch pad).		X
41	Construction or modification of either riverside or landside irrigation ditch where new levee is being constructed.		X
42	Removal and/or relocation of all utilities including gas, water, power, telephone, etc.		X
43	Bridge modifications. <i>(Except railroads)</i>		X

EXHIBIT I

OFFICE MEMORANDUM - UNITED STATES GOVERNMENT

SPKGD-L

8 July 1963

Memorandum to Unit Chiefs

SUBJECT: Inspection of proposed contract work during "Contractor Showings"

Reference is made to our discussion this morning, relative to changes in field conditions between the time of the District Review and the advertising date, which are not reflected in the plans and/or specifications. I discussed the problem with the Field Office and was advised that they adhere to the scheduled "Contractor Showings" listed in the specifications. Therefore, in the future please arrange to have a representative present during the first field showing listed in the specifications in order that you may be advised and make any necessary changes to the drawings or specifications. During the showing, we must be very careful not to interpret the plans and specifications or offer any advice to the project engineer. Have the person making the inspection write a Memo For File, regardless of whether any changes result from the trip.

R. W. BARSDALE
Chief, Levees and Channels Section

EXHIBIT J

CHECK LIST FOR CONTRACT PLANS AND SPECIFICATIONS

LEVEE AND CHANNEL SECTION

PROJECT _____ TITLE OF WORK _____
DRAWING NUMBER _____ SPECIFICATION NO. _____

INITIALS OF
PERSON MAKING
CHECKS & DATE

1. What is status of wage rates? _____
2. Has tabulation of items chargeable to local interests been prepared? _____
3. Has basis of design been prepared? _____
4. Has right-of-way clearance been given in writing by the local interests? _____
5. Has right-of-entry to work site been acquired and is it shown on the contract drawings and covered in the specifications? (Including ingress and egress to work areas, isolated areas, borrow areas, structures and pertinent features.) _____
6. Do plans and specifications conform with the right-of-way agreements and have all special provisions been included? _____
7. Are property limits and owners names shown on drawings? _____
8. Do the specifications allow for sufficient and proper time to perform the required construction? _____
9. Does the amount of liquidated damages cover Government costs and would be incurred if the job is not completed on time? _____
10. Do the specifications provide for the Contractor to make repairs to any existing roads used by him for ingress or egress, hauling from or to borrow and/or spoil areas? (Including completed levee patrol roads.) _____

11. Have detours been provided where necessary, or, if made the responsibility of the contractor, is this clearly provided for in the specifications? _____
12. Is there agreement between plans and specifications on borrow and/or spoil area designation and location? _____
13. Do plans and specifications have same title and does it agree with the PB-2A program sheets? _____
14. Are bench marks and coordinates shown on the plans? _____
15. Is river and/or channel mileage and direction of flow indicated on the plans? (Where necessary) _____
16. Are angle points on traverse clearly labelled? _____
17. Is centerline stationing clearly marked? _____
18. Are typical cross sections clearly labelled and stationed on the plans? And are they truly typical for all conditions? _____
19. Does profile agree with plans as to limits of work, type, etc.? _____
20. Have plans and specifications been checked for misspelling, grammatical errors and proper nomenclature? _____
21. Does the locality map give a clear picture? _____
22. Were standard guide specifications followed? _____
23. Does inspection ditch agree with Standard Drawing? _____
24. Does levee crown provide proper freeboard above the flood plane? _____
25. Have levee standards (as shown on Standard Drawing) been complied with? i.e., crown width and slopes. If other than 20' crown, 1 on 2 landside and 1 on 3 waterside check reason for change. _____
26. Was soils reconnaissance made? (Review log covering inspection.) _____

INITIALS OF
PERSON MAKING
CHECKS & DATE

27. Were borings or tests made and were recommendations resulting therefrom complied with? _____
28. Are results of borings and tests shown on the contract drawings and correlated with Embankment Section? _____
29. Are levee ramps and approaches shown at all locations where there are existing road crossings or where they are specifically called for in the right-of-way agreements? Did you check right-of-way agreements? _____
30. Have you studied the mass diagram and/or cumulative yardage curves for the job and relation of borrow available to embankment required? _____
31. Do you consider the shrinkage factor and settlement allowance for computation of total required yardage of embankment adequate? _____
32. Did a field check of toe stakes indicate an infringement on existing buildings, structures or other improvements? _____
33. Do you consider spoil areas as shown on the plans to be adequate and properly located in relation to material to be wasted? _____
34. On the drawings do the spoil and borrow areas show the existing ground elevations? _____
35. Are spoil areas shown on the landside of levee unless an exceptional condition exists? _____
36. Has provision been made in the specifications for excess or shortage of embankment or spoil yardage if in great variance with the estimated quantities? _____
37. Has a berm fill been provided across lateral sloughs and through long reaches of low lying lands? _____
38. Are tie-ins to existing roads, ramps, railroads, bridges or other grades properly detailed on the drawings and provided for in the plans and specifications? _____
39. Do any of the right-of-way agreements provide for a certain sequence of construction and do specifications so provide? _____

INITIALS OF
PERSON MAKING
CHECKS & DATE

40. Do the specifications provide for clearing the river berm and the river bank between the berm and the MLLW line?

41. Have the ramps, access roads, etc., as shown on the drawings, been coordinated with the location of irrigation and drainage structures, etc., to avoid conflict and subsequent relocation?

42. Do plans and specifications clearly indicate limits of stone protection and provide that under water bank paving shall not lag behind the bank sloping operation by more than 100'?

43. Has a constant bank slope been followed for bank protection and have standards for stone protection been followed?

44. Is alternative of quarry stone or cobbles plainly shown on both plans and specifications?

45. Has provision been made for tying new bank protection work into existing bank protection? (Remove and replace existing rock protection.)

46. Has filter been provided at locations where required by Embankment Section?

47. Are there any abandoned pipes in the levee? If so, will they be removed or plugged?

48. Are new pipes of the proper gauge, size, coating and type? (See Design Manual)

49. Are cut-off walls provided, and are they correctly located?

50. Are the proper gates and valves included for a given condition? (C of E requirements for positive shut-off and access during high water, etc.)

51. Have air releases been provided on all siphons?

52. If required, has provision been made for aprons, headwalls or bank protection at ends of pipes?

INITIALS OF
PERSON MAKING
CHECKS & DATE

40. Do the specifications provide for clearing the river berm and the river bank between the berm and the MLLW line?

41. Have the ramps, access roads, etc., as shown on the drawings, been coordinated with the location of irrigation and drainage structures, etc., to avoid conflict and subsequent relocation?

42. Do plans and specifications clearly indicate limits of stone protection and provide that under water bank paving shall not lag behind the bank sloping operation by more than 100'?

43. Has a constant bank slope been followed for bank protection and have standards for stone protection been followed?

44. Is alternative of quarry stone or cobbles plainly shown on both plans and specifications?

45. Has provision been made for tying new bank protection work into existing bank protection? (Remove and replace existing rock protection.)

46. Has filter been provided at locations where required by Embankment Section?

47. Are there any abandoned pipes in the levee? If so, will they be removed or plugged?

48. Are new pipes of the proper gauge, size, coating and type? (See Design Manual)

49. Are cut-off walls provided, and are they correctly located?

50. Are the proper gates and valves included for a given condition? (C of E requirements for positive shut-off and access during high water, etc.)

51. Have air releases been provided on all siphons?

52. If required, has provision been made for aprons, headwalls or bank protection at ends of pipes?

INITIALS OF
PERSON MAKING
CHECKS & DATE

53. Do pipes have sufficient coverage to withstand the traffic on the levee? _____
54. Are structure notes complete and do they check with notes on the drawings? _____
55. Do structure notes provide for removing and reinstalling all structures through bank paving and/or toe walls? _____
56. Are all existing structures shown on the plans? _____
57. Do structure details check with the right-of-way agreements? _____
58. Does a field check of diameter of pipes and physical features of pumping stations agree with those shown on the drawings? _____
59. Have the quantities (number of units) of pipe, gates, etc., set up in the bid items been checked with the number shown on the drawings? _____
60. Where new levees are to be constructed, has field study been made to determine if additional ditches and structures will be required to provide adequate drainage and/or irrigation? _____
61. Have levee and bank protection alignments been checked for irregularities? _____
62. Where siphon discharges culminate in a spillbox, or similar structure, check to see that the discharge end of the pipe is lower than the structure outlet so that the end of pipe will be under water to permit priming. _____
63. Do the specifications for concrete pipe cover joints? _____
64. Have handrails been provided for stairs and walkways? _____
65. Has provision been made for screens on all suction lines disturbed by the work? _____
66. Has proper consideration been given to utilities?
a. Is sufficient clearance provided for electric or telephone wires over and above levee roadway? _____

INITIALS OF
PERSON MAKING
CHECKS & DATE

- b. Are adjacent utility poles high enough? _____
- c. Are all buried wires and pipes shown on the drawings? _____
- d. Has provision been made in the plans and specifications for removal or modification of buried wires and pipes that will be disturbed by the work? _____
- e. Do the specifications state how the contractor will be compensated for removal or modification of utilities encountered but not shown on the drawings? _____
67. Does the electrical section of the specifications include installation to comply with General Order No. 95, California Railroad Commission and National Electric Code? _____
68. Has removal and reconstruction of fence been kept to the minimum? _____
69. Has a check been made to see that the materials listed to be furnished by the Government are available? (If applicable.) _____
70. Is patrol road provided for and does it conform to standards as described in the design manual? If not standard, have we letter from Reclamation Board requesting a particular type of surface? _____
71. Have local interests been advised of subsequent revisions to plans furnished for rights-of-way? (Local interests should be advised in order that landowners may know of any changes in plans as they affect right-of-way agreements.) _____
72. Has the Reclamation Board been notified officially that utilities are to be relocated? _____
73. Do specifications include provision for a portable office to be used by Government inspectors? _____
74. Do the plans and specifications agree with the Design Memorandum? _____

If any basic major changes are found, they should be flagged for the Division at the time plans and specifications are forwarded for approval and changes in the Design Memorandum will be made, if required.

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

SPKVR

8 August 1968

DISTRICT MEMORANDUM
NO. 405-2-3

REAL ESTATE

Adequacy of Assurances and Rights-of-Way
Documents Furnished by Local Interests

1. Purpose and Scope. The purpose of this memorandum is to implement the procedures and policies of the Corps of Engineers relating to the acquisition of real estate by local interests for conveyance to the United States for flood control and river and harbor projects. It applies to all personnel having Civil Works real estate responsibilities.
2. Reference. ER 405-2-680
3. Responsibilities. It is the responsibility of the District Engineer to accept assurances of cooperation for flood control and river and harbor projects in accordance with the procedures and policies referred to in paragraph 2 above, provided that:
 - a. The assurance furnished is in strict compliance with the pertinent Act of Congress.
 - b. The local interest furnishing the assurance has legal authority to do so and is financially responsible to fulfill all measures of local cooperation.
 - c. The instrument is legally sufficient.
4. Procedures. To assist the District Engineer in making his determination, the following procedures are established:
 - a. Engineering Division - For all projects except those performed under emergency authorities:

This DM rescinds District Memorandum No. 405-2-3 dated 8 August 1962.

(1) Notify the local interest concerned by letter of the required conditions, and request formal assurances that the required conditions will be met. The letter of notification will be staffed through Real Estate Division.

(2) Furnish assurances received to the Real Estate Division. If assurances are not adequate, they will be returned to the local sponsor by the Real Estate Division through the Engineering Division.

(3) Postpone issuance of Invitation for Bids until notified of acceptance of assurances by District Engineer.

b. Construction-Operations Division - For projects performed under emergency authorities:

(1) Notify the local interest concerned by letter, of the required conditions and request formal assurances that such conditions will be met. Copies of correspondence will be furnished to Real Estate Division.

(2) Furnish assurances received to the Real Estate Division. If assurances are not adequate, they will be returned to the local sponsor by the Real Estate Division through the Construction-Operations Division.

(3) Start construction only after notification of acceptance of assurances by District Engineer.

c. Real Estate Division.

(1) Review assurances and prepare a memorandum for record indicating the adequacy of the assurances, to include the methods used in determining and evaluating the financial and legal ability to perform the required obligations.

(2) Secure the determination of the District Engineer.

(3) If required, process assurances through SPD and OCE.

(4) Notify local interest when assurances have been accepted. Engineering Division, Construction-Operations Division, and Supply Division will be furnished copies of the letter of acceptance.

5. Procedure for Obtaining and Determining the Adequacy of Rights-of-Way Documents Furnished by Local Interests are as Follows:

a. Engineering Division - For all projects except those performed under emergency authorities:

(1) Request local interest to obtain necessary rights-of-way and furnish evidence of having done so.

(2) Obtain project map indicating rights-of-way requirements, tract ownership, and property lines.

(3) Furnish Real Estate Division copies of rights-of-way documents and project map for review as to legal sufficiency, pursuant to paragraph 5c(1).

(4) Utilize findings of Real Estate Division on legal sufficiency to determine that satisfactory rights-of-way for the entire project, or a complete unit thereof, have been provided.

(5) Notify Supply Division and Construction-Operations Division that necessary rights-of-way have been obtained and Invitation for Bids may be issued.

b. Construction-Operations Division - For emergency projects:

(1) Request local interest to obtain necessary rights-of-way and furnish evidence of having done so. Copies of such requests will be furnished Real Estate Division.

(2) Obtain project map indicating rights-of-way requirements, tract ownership, and property lines.

(3) Furnish Real Estate Division copies of rights-of-way documents and project map, for review as to legal sufficiency, pursuant to paragraph 5c(1) below.

(4) Utilize findings of Real Estate Division on legal sufficiency to determine that satisfactory rights-of-way for the entire project, or at least a complete unit thereof, have been provided.

(5) For work to be performed by hired labor, notify the appropriate Field Engineer that necessary rights-of-way have been obtained and field operations may proceed. For work to be performed by contract, notify the Supply Division that Invitation for Bids may be issued.

c. Real Estate Division.

(1) Utilize comments from Engineering Division or Construction-Operations Division to analyze rights-of-way documents for legal sufficiency. This analysis will not include adequacy of legal description or estate required.

(2) Notify Engineering Division for authorized projects and the Construction-Operations Division for emergency projects when the rights-of-way documents are accepted as being legally sufficient.

DISTRIBUTION
E,Z

CRAWFORD YOUNG
Colonel, CE
District Engineer

EXHIBIT L

SECTION I

PROCEDURES AND SEQUENCE OF ACTIONS TO BE FOLLOWED IN DEVELOPING DESIGN
OF LEVEE AND/OR CHANNEL PROJECTS IN THE CENTRAL VALLEY OF CALIFORNIA

1. Written assurances of local cooperation will be requested and obtained by the Sacramento District (hereafter called the District) from the State Reclamation Board (hereafter called the Board). The timing of such request will be dependent upon Federal and State legislation and normally will not affect the timing of the design work.
2. Written agreement will be reached between the District and the Board as to the relative priority of individual projects and separate project units. After the fiscal year funding has been determined, the District and the Board will jointly develop a design schedule in conformity with the priority and the procedures outlined herein.
3. Request for right-of-entry for surveys (36 months before advertising)
The District will make a written request (by individual project or project units) to the Board for rights-of-entry for survey and exploration purposes.
4. Initiation of request for surveys (35 months before advertising)
Prior to initiation of the survey, a joint reconnaissance will be made by representatives of the District and the Board. The District and the Board at this time will each assign a "liaison" engineer for each project or project unit. The Board will also assign a land agent at this time. In connection with the joint reconnaissance, a Memorandum for Record will be made by the District (with a copy to the Board) which will delineate any features not normally included in the survey.
5. The surveys by the District shall include all of the items listed in the memorandum for record, and shall also include the following:
 - a. All structures such as pipes, ramps, fences, buildings, etc.
 - b. Any other features which may be desirable for design and property acquisition.
 - c. Longitudinal coverage approximately 200 feet beyond the extreme limits of the work at either end.
 - d. At least one property tie at each site.
 - e. Lateral limits shall be approximately 400 feet landward from the levee centerline for man-made structures and approximately 200 feet from the levee centerline for topographic features.

f. Cross sections at lateral toes and lateral crowns of ramps and fills such as pads and holes such as ditches.

g. Structural cross sections shall be made for all major structures through the levees such as drains, culverts, or irrigation pumps.

h. Traverses shall be checked and computed and tied into the State Coordinate System.

i. Three sets of bench mark information and computations shall be furnished by the District to the Board.

6. Initiation of preparation of design memorandum (31 months before advertising) Those surveys pertinent to the initiation of the design memorandum studies (basically those required for hydraulic computations) will be completed progressively (from the downstream end) at the earliest possible date. This will enable the District to initiate design studies and the preparation of the preliminary draft of the design memorandum.

7. Transmittal of survey drawings (28 months before advertising) Upon completion of the surveys and preparation of the topographic maps (average time required six months), three sets of prints of the survey drawings will be forwarded to the Board in order that they may begin laying the groundwork for subsequent land acquisition.

8. Property line surveys (28 months before advertising) The Board will initiate property line surveys using the topographical maps referred to in paragraph 7 above on which to base the limits of their work.

9. Adopted plan of improvement (24 months before advertising) The District will informally furnish the Board a map showing the adopted plan of improvement for their information and use. This will be at the conclusion of the hydraulic studies. The map will show the proposed limits of the project, the estimated width of right-of-way required, major structure modifications, a few typical sections, and such other information as the Board may need for the preparation of the non-Federal cost estimate for design memorandum purposes.

10. Board right-of-way memorandum for design memorandum purposes (24 months before advertising) The Board will initiate preparation of a Right-of-Way Memorandum (non-Federal cost estimate) for the rights-of-way and for all the structure revisions or relocations. Those to be included in the Corps' construction contract will be so noted. Upon request by the District the estimate will be informally furnished by the Board and will be incorporated in the District Design Memo. The Board will also request the District by letter to undertake the design and construction of the non-Federal construction items which are to be included in the District's plans and specifications as a part of the District's construction contract.

11. Preliminary plans (22 months prior to advertising) The District will develop and furnish to the Board by letter, the plan of improvement to District standards. These preliminary plans are for the purpose of furnishing the Board information for their use in engineering reconnaissance and discussion with the landowners. These plans will show:

- a. Centerline of the levee (including transitions).
- b. Typical Sections.
- c. Approximate right-of-way line.
- d. Preliminary structural sections.
- e. Approximate spoil or borrow areas.

12. Preliminary contacts with landowners (22 months prior to advertising) The Board engineering staff will carry on field reconnaissance and discussions with the affected property and utility owners and progressively advise the District of decisions so their effect can be considered and reflected in the final design. Right-of-way personnel of the Board may participate in this field reconnaissance. On those properties where it appears that it is not possible to reach agreement with the owners concerning structural items the Board's engineering staff will make a decision and advise the District concerning these structural items so that their effect can be included in the design.

13. Completion of design memorandum draft (20 months before advertising) Upon completion of the draft of the design memo, the District by formal letter will furnish a copy to the Board for concurrent review with District forces. (Such review usually will be limited to a two-week period.) If either the District or the Board feels that another field reconnaissance is desirable in connection with such review, a joint reconnaissance will be made during the review period. Comments resulting from the Board's review will be furnished the District in a review conference.

14. Submission of design memorandum for approval (approximately 19 months before advertising) After the Design Memorandum conference the District will modify the Design Memorandum as necessary, assemble it in final form and transmit it to its higher authority for approval.

15. Distribution of design memorandum (approximately 17 months before advertising) Upon receipt of comments on and approval of the Design Memorandum by Higher Authority, the District will make any necessary modifications and distribute the Design Memorandum. At that time two copies of the final approved Design Memorandum will be transmitted to the Board by letter.

16. Right-of-way plans (17 months before advertising) The District will furnish to the Board one set of cronaflex reproducibles and three sets of prints showing the minimum take line required for the work. These plans will contain at least the following information and will be as near a final design as possible at this time:

- a. Crown and toe of existing levee.
- b. Centerline of proposed levee (including transitions).
- c. Tick marks at 100-foot intervals and at all stations.
- d. Minimum take line (right-of-way) 10 feet landward of the new levee toe or 10 feet landward of the existing levee toe. (If the work does not extend landward therefrom.)
- e. Right-of-way lines shall be carried through ramps.
- f. Extent of all proposed ramps, including the actual limits of fill, shall be shown on the plans.
- g. The right-of-way line shall be shown where houses and other buildings are on pads and shall be between 5 feet and 10 feet landward of the point where the proposed new fill intersects the existing pad.
- h. Final structure designs.
- i. Show relocated irrigation ditches.
- j. Show actual location and extent and depth of applicable borrow and spoil areas, including method of draining of proposed borrow areas. The miscellaneous right-of-way requirement lines as shown on the plans shall be predicated on working out design details of ramp locations to fit buildings. They shall also be based on the determination of whether other facilities shall be relocated, destroyed, or shall remain in place. The lines shown shall be sufficiently final for use in appraisal and negotiation work.

17. Immediately upon receipt of these maps showing right-of-way lines the Board's staff will place the property lines, owners names, approximate areas and limits of necessary right-of-way parcels on the maps. These maps designated as appraisal maps will be furnished to the Board's Right-of-way Acquisition Branch, for use in making appraisals. If deemed necessary, a joint field reconnaissance will be conducted to clear up problems. Review of the District plans and comment by the Board staff will be furnished informally to the District within one month of receipt of plans.

18. Appraisal work (16 months before advertising) The Board's Right-of-way Acquisition Branch will initiate appraisal work. The appraisal reports will be furnished to the District as soon as approved by the Board and Department of General Services.
19. Right-of-way engineering (16 months before advertising) The Board's engineering staff will prepare legal descriptions and final right-of-way maps which will be furnished to the acquisition staff progressively as they are completed. The Board's engineering staff will at this time furnish right-of-way plans to the District by letter so that right-of-way lines may be shown on the contract drawings.
20. Negotiations (10 months before advertising) The Board will start negotiations with property owners for property rights as soon as the right-of-way maps, descriptions and appraisals have been completed and will furnish copies of the right-of-way documents progressively to the District. At the end of the negotiation period, a list of parcels that will have to be condemned, will be prepared. The Board at this time will make a decision on these parcels as to any changes in structural items to be included in the District's contract. This information will be furnished to the District three months before advertising.
21. Review of contract plans (approximately 3 months before advertising) Upon completion of the contract plans and specifications a set will be furnished the board by formal letter for concurrent review by the District and Board forces. (Such review will normally be limited to a period of two weeks.) The review will include a joint field reconnaissance by Board and District personnel to check the plans against field conditions. A District review conference will be held subsequent to the field reconnaissance for the purpose of reaching agreement on the design as finally incorporated in the plans and specifications. Representatives of the Board will participate in this conference. On completion of such review, the contract plans and specifications will be modified as necessary, assembled in final form and transmitted to the District's higher authority for approval (2 months before advertising).
22. Condemnation (3 months before advertising) The Board will initiate condemnation proceedings approximately 3 months before advertising.
23. Final right-of-way agreements (1 month prior to advertising) All right-of-way contracts which have been negotiated and which require modification of the contract plans and specifications will be furnished by the Board no later than one month prior to the mutually agreed to advertising date, in order to allow the District time to make the necessary changes to the plans and specifications. (Up to 10 days are required for reproduction of plans and specifications.) All right-of-way agreements or order of possession shall be furnished the District by the Board two weeks before the scheduled advertising date. This will permit the District to issue the required two week advance notice to bidders.

24. A set of plans and specifications, as issued, will be furnished formally to the Board by the District for record purposes concurrently with the advertising of the work. (0 months)

CORPS OF ENGINEERS, U. S. ARMY
SACRAMENTO DISTRICT

EXHIBIT M

PROCEDURES AND SEQUENCES OF ACTIONS TO BE FOLLOWED IN DEVELOPING DESIGN
OF BANK PROTECTION ON THE SACRAMENTO RIVER

1. Written assurances of local cooperation on the Sacramento River Bank Protection Project were furnished to the Sacramento District (hereafter called the District) by the State Reclamation Board (hereafter called the Board) on December 6, 1962.
2. A reconnaissance will be made yearly by representatives of the District, the Board, and Department of Water Resources to determine the priority of sites which will be used in making up each separate unit of work for the Sacramento River Bank Protection Project. Agreement will be reached between the District and the Board as to the relative priority by which the individual sites will be repaired. The District will write the Board furnishing the suggested list of sites. The Board will review and reply as appropriate. The sites will then, insofar as possible, be grouped geographically into project (contract) units. After the fiscal year funding has been determined, the District and the Board will meet and jointly develop a schedule in conformity with the priority and the procedures outlined herein.
3. Initiation of surveys (30 months before advertising) Prior to initiation of the survey, a joint reconnaissance will be made by representatives of the District, the Board, and Department of Water Resources. The District, the Board, and Department of Water Resources at this time will each assign a "liaison" engineer who will coordinate all activities in connection with each project unit. The Board will also assign a land agent at this time. Subsequent to the joint reconnaissance, a formal memorandum will be made by the District which will delineate any features not normally included in the survey. The surveys by the District shall include all of the items listed in the formal memorandum and shall also include the following:
 - a. All structures such as pipes, ramps, fences, buildings, etc. As required.
 - b. Lateral limits shall be determined individually for each site of work.
 - c. Cross sections as required by the proposed work at each site which shall include the existing levee.
 - d. Structural cross sections as required by the proposed work at each site.
 - e. Traverses shall be based on the California State Coordinate System and shall derive from the horizontal control traverses previously made by the Board where applicable. Upon completion of the control traverses by

the District, the District will furnish to the Board descriptions of the monumentation for use as aerial photography control. The Board will then obtain vertical aerial photography for subsequent scale controlled enlargements. Negatives will be available and enlargements will be furnished to the District. Three sets of traverse computations shall be furnished by the District to the Board.

4. Request for right-of-entry for surveys (30 months before advertising) The District will make a written request (by project units) to the Board for rights of entry for survey and exploration purposes. The Board or DWR will formally transmit the rights of entry to the District as they are secured from the property owners.

5. Topographic Maps (23 months before advertising) As soon as the District completes the survey and has prepared the topographic maps (average time required 6 months), the District will furnish paper reproducible prints to the Board. The Board will initiate any necessary property line surveys at this time, using the topographic maps on which to base the limits of the Board's work.

6. Proposed plan of improvement (17 months prior to advertising) The District will develop and furnish to the Board by letter, paper reproducible prints of the proposed plan of improvement. These plans are for the purpose of furnishing the Board information for their use in engineering reconnaissance and discussions with the landowners and will show:

- a. Crowns of the levee and levee toes (by offset tab).
- b. Typical sections.
- c. Approximate areas needed for construction.
- d. Preliminary structural sections.
- e. Preliminary spoil and borrow quantities.

7. Preliminary contacts with landowners (17 months prior to advertising) The Board will continue to conduct field reconnaissances and discussions with the affected property and utility owners with a view to reaching agreement on necessary modifications or relocation of facilities. Right-of-way personnel of the Board may participate in the field reconnaissances. The Board will finalize the location of borrow and spoil areas and specify the conditions in which they will be left upon completion of the contract work. They will also designate temporary access routes needed for use during construction as well as permanent access routes (when necessary) for maintenance after construction. On those properties where it is not possible to reach timely agreement with the owners concerned, the Board will decide on the modifications desired and promptly advise the District

so that their effect can be included in the design. This information will be progressively furnished the District. At this time the Board will progressively conduct such preconstruction pump tests as are considered necessary.

8. Appraisal work (16 months prior to advertising) The Board will initiate appraisal work upon receipt of the District's Proposed Plan of Improvement. Appraisal reports will be completed and all approvals secured 8 months before advertising.

9. Preliminary plans (13 months prior to advertising) The District will furnish the Board one set of paper reproducibles showing the minimum take line required for the work. These plans will contain at least the following information and will be as near a final design as is possible at this time:

a. If required the centerline of the proposed levee, including transitions.

b. Crown and toes of existing levee.

c. Tick marks at 100-foot intervals.

d. Minimum take line.

(1) At locations where a levee setback is required to provide for the placement of the stone protection, the take shall extend from the landside toe of the new levee riverward to the mean low water line.

(2) At locations where there is little or no riverside berm, the take line shall extend from the landside toe of the existing levee riverward to the mean low water line.

(3) At locations where there is an existing riverside berm which has been developed for use by the owner, the take shall consist of a 20-foot strip parallel and adjacent to the top of the new stone protection as well as the existing levee from landside toe to waterside toe. Where the berm is undeveloped, the 20-foot strip will also be acquired as well as the existing levee from landside toe to waterside toe and, dependent upon the width of the existing berm, consideration will be given to obtaining rights over the entire berm area. Necessary rights will be acquired to provide access to the 20-foot strip.

(4) Take lines shall be carried through ramps.

e. Extent of all proposed ramps, including the actual limits of fill, shall be shown on the plans.

f. Structure designs.

g. Irrigation and drainage ditches and other facilities to be removed or relocated.

h. Location and extent of borrow and spoil areas.

i. Location of access roads.

10. Appraisal Maps (11 months prior to advertising) The Board will identify the additional take lines required for relocations and review the proposed project take lines. They will formally provide comments to the District within 2 months after receipt of the preliminary plans. If deemed necessary a joint field reconnaissance will be conducted with the District to clear up problems. The appraisal maps will be completed using the take lines finally agreed upon and the additional takes required for relocations. These appraisal maps will show the property lines, owners' names, approximate areas and the limits of the necessary right-of-way. The appraisal maps will be completed 11 months before advertising and will be the basis for final appraisal. Appraisal maps will at this time be furnished to the District by letter so that the right-of-way lines may be shown on the contract drawings.

11. Right-of-Way Engineering (11 months before advertising) Right-of-Way Engineering will complete legal property descriptions so that negotiations can start 8 months before advertising.

12. Negotiations (8 months before advertising) The Board will start negotiations with property owners for property rights as soon as the right-of-way maps, descriptions, and appraisals have been completed and will furnish copies of the right-of-way documents progressively to the District. Four months before advertising the Board will inform the District of those parcels that will have to be condemned and will advise the District of any changes resulting from negotiations. (Changes will be held to the minimum.)

13. Preliminary Contract Plans and Specifications (3 months before advertising) Upon completion of the contract plans and specifications 4 sets of each will be furnished the Board by formal letter for concurrent review by the District and Board. (Such review will be limited to a two week period.) The review will include a joint field reconnaissance by the Board, District, and DWR personnel to check the plans against field conditions with the intent of reaching agreement on plans and specifications. Upon completion of the review the contract plans and specifications will be modified as necessary, assembled in final form and transmitted to the District's higher authority for approval. (2 months before advertising)

14. Condemnation (3 months before advertising) The Board will initiate condemnation proceedings approximately 3 months before advertising.

15. Rights-of-Way (2 weeks prior to advertising) All right-of-way contracts not previously furnished, orders of possession, and certification that all rights-of-way are available for construction shall be furnished the District by the Board two weeks before the scheduled advertising date.

16. Board Requirements for Contract Plans and Specifications (3 weeks before advertising) Before advertising the Board will informally notify the District of the number of sets of full and half size plans and specifications that will be required for Board use.

17. Contract Plans and Specifications (0 months) The requested number of sets of plans and specifications, as issued, will be furnished formally to the Board by the District for record purposes concurrently with the advertising of the work. Within 1 month after the award of the contract the District will furnish the Board one set of chronoflex reproducibles of the contract plans together with any addendums issued during the advertising period.