

## **APPENDIX B. AUTHORITIES**

Herbert Hoover Dike  
**Dam Safety Modification Study**

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## **B HERBERT HOOVER DIKE**

Herbert Hoover Dike is a component of the Central and Southern Florida (C&SF) Project for Flood Control and Other Purposes. It is generally understood that the birth of the C&SF Project began with the Flood Control Act of 1948; however, Federal participation in local flood control efforts started much earlier, in response to the disastrous hurricanes of 1926 and 1928. The River and Harbor Act of 1930 authorized the construction of levees, for protection from storm surge-induced flooding, along the north and south shores of Lake Okeechobee. The 1948 Act created the C&SF Project and included authorization for enlargement of the existing levees and construction of additional levees along the northeast and northwest shores. The Flood Control Act of 1960 authorized the name of all levees around the shore of Lake Okeechobee to be "Herbert Hoover Dike", in honor of the former President and his role in implementing levee construction.

### **B.1 CONGRESSIONAL ACTS AND HOUSE AND SENATE DOCUMENTS**

#### **B.1.1 RIVER AND HARBOR ACT OF 1930**

On July 3, 1930, the River and Harbor Act of 1930, P.L. 71-520, was enacted. The Act provided for improvements to the Caloosahatchee River and Lake Okeechobee drainage areas in accordance with Senate Document Number 115, Seventy-first Congress, 2nd Session. The Act required the United States to construct all the levees to be built pursuant to the Senate Document and required the State of Florida or other local interests to contribute \$2,000,000 toward the cost of the above improvements, in lieu of the contributions called for in Senate Document Number 115 and that no expense shall be incurred by the United States for the acquisition of any lands necessary for the purpose of the improvements. The 1930 Act provides:

*Caloosahatchee River and Lake Okeechobee drainage areas, Florida, in accordance with the report submitted in Senate Document Numbered 115, Seventy-first Congress, second session, and subject to the conditions set forth in said document, except that the levees proposed along Lake Okeechobee shall be constructed to an elevation of thirty-one feet instead of thirty-four feet above sea level and shall be so built as to be capable of being raised an additional three feet, and that the United States shall perform the work of constructing all levees: Provided, That the State of Florida or other local interests shall contribute \$2,000,000 toward the cost of the above improvements, in lieu of the contributions called for in the aforesaid document: And provided further, That no expense shall be incurred by the United States for the acquirement of any lands necessary for the purpose of this improvement.*

#### **B.1.1.1 SENATE DOCUMENT 115, SEVENTY-FIRST CONGRESS, SECOND SESSION DATED MARCH 15, 1930**

In the Chief of Engineers Report for Senate Document Number 115, Seventy-first Congress, Second Session dated March 15, 1930, the Chief of Engineers recommended approval of a project for navigation and flood control in the Caloosahatchee River-Lake Okeechobee areas, including:

*(a) For improving the Caloosahatchee River and Canal from Lake Okeechobee to the Gulf of Mexico by straightening and by dredging a channel which will provide a discharge outlet capacity*

*of 2,500 cubic feet per second from Lake Okeechobee, and a navigation channel at least 6 feet deep and 80 feet wide, including the necessary control works.*

*(b) For improving Taylors Creek by providing a channel 6 feet deep and 60 feet wide from Okeechobee City into Lake Okeechobee.*

*(c) For a levee and navigation channel 6 feet deep and 80 feet wide following in general the south shore of the lake.*

*(d) For a levee on the north shore of the lake.*

*(e) For improving the St Lucie River to provide a channel 6 feet deep and 80 feet wide.*

*(f) For protection works in St Lucie Canal.*

### **B.1.2 RIVER AND HARBOR ACT OF 1935**

On August 30, 1935, the River and Harbor Act of 1935, P.L. 74-409, was enacted. The Act provided:

*Caloosahatchee River and Lake Okeechobee drainage areas, Florida: The existing project is hereby modified to provide that the United States shall maintain all project works when completed and shall bear the cost of all drainage structures heretofore or hereafter constructed in connection with said project: Provided, That the total cash contribution required of local interests toward the cost of the project shall be \$500,000.*

In the Conference Report considering the Rivers and Harbor Act of 1935, the above language was added as an amendment in the Senate version of the bill:

*Amendment 30, page 13: Caloosahatchee River and Lake Okeechobee Drainage Areas, Fla. This amendment modifies the existing project so as to provide that the United States shall maintain all project works when completed and shall bear the cost of all drainage structures heretofore or hereafter constructed in connection with said project. It also reduces the cash contribution required of local interests \$500,000. Under the project as adopted local interests were required to contribute in all \$2,000,000. The cost of the drainage structures referred to is estimated to be \$762,000. The cost of maintaining the completed levees and channels and operating the hurricane gates will be \$90,000 annually for the first two years and \$50,000 annually thereafter if undertaken by the Federal Government. House conferees recede.*

Pursuant to the 1930 and 1935 Rivers and Harbors Acts, the USACE constructed the levees on the south shore totaling approximately 67.8 miles and the levees on the north shore totaling approximately 15.7 miles, 5 hurricane gates in the levees surrounding Lake Okeechobee and 16 drainage culverts in the levees surrounding Lake Okeechobee.

By virtue of the Rivers and Harbors Act of 1935, the USACE became responsible for operation and maintenance of the Culverts; the hurricane gate structures and the original 67.8 miles of the southern levee and the 15.8 mile of the northern levee and the responsibility of operation and maintenance of the St. Lucie Canal and the Caloosahatchee River Canal as well as the Okeechobee Waterway through Lake Okeechobee.

Pursuant to the Central and Southern Florida, Culvert Letter Report, Herbert Hoover Dike dated March 2011, and the approved by HQUSACE on 18 May 2011 and by the Assistant Secretary of the Army (Civil Works) on 25 May 2011, the following culverts are being replaced in kind: Culverts 1, 1A, 2, 3,

4A, 5, 5A, 6, 8, 10, 10A, 11, 12, 12A, 13 and 16. The following culverts operational functions were discontinued in prior years by abandonment and burial and will be removed Culverts 7, 9, 14 and Taylor Creek Culverts.

It should be noted that as of October 1936, the following culverts had been completed: Culverts 1, 1A, 2, 3, 4A, 5, 5A, 10, 10A, 11, 12, 12A, 13, 14, 15 and 16. Culverts 6, 7, 8, 9, and TCC were completed late in 1936 after the report was submitted.

### **B.1.3 FLOOD CONTROL ACT OF 1948**

The levees around Lake Okeechobee became components of the Central and Southern Florida (C&SF) Project in 1948. The Flood Control Act of 1948, P.L. 80-858, approved by Congress on 30 June 1948, authorized the first phase of a comprehensive plan to provide flood protection and other water control benefits in central and south Florida. Specifically, the Act as listed under Title II- Flood Control:

*Sec. 203. ... Central and Southern Florida*

*The project for Caloosahatchee River and Lake Okeechobee drainage areas, Florida, authorized by the River and Harbor Act of July 3, 1930, as amended, is hereby modified and expanded to include the first phase of the comprehensive plan for flood control and other purposes in central and southern Florida as recommended by the Chief of Engineers in House Document Numbered 643, Eightieth Congress, subject to the conditions of local cooperation prescribed therein, and there is hereby authorized to be appropriated the sum of \$16,300,000 of partial accomplishment of said plan.*

The Act of 1948 included measures to enhance control of Lake Okeechobee. Construction and modification of spillways and other structures as well as enlargement of the Lake Okeechobee levees were included to provide the intended flood protection, water storage, and water supply. The Act of 1948 also authorized levee operation and maintenance by the United States of America.

#### **B.1.3.1 HOUSE DOCUMENT 643, EIGHTIETH CONGRESS, 1948**

In House Document Numbered 643, Eightieth Congress, 1948, the Chief of Engineers concurred with the Report of the Board of Engineers for Rivers and Harbors in House Document 643 in the modification of the existing Federal project for the Caloosahatchee and Lake Okeechobee drainage areas and set forth the items of local cooperation in Page 5, Paragraph 16 which states:

*...subject to the conditions that local interests shall provide all lands, easements and rights-of-way; make a cash contribution of 15 percent of the estimated construction cost for each part of the work prior to its initiation, except that the total cash contribution for the comprehensive project shall not exceed \$29,152,000; and furnish assurances satisfactory to the Secretary of the Army that they will hold and save the United States free from damages due to the construction and operation of the works and that **they will maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army, except the levees, channels, locks, and control works of the St. Lucie Canal, Lake Okeechobee, and Caloosahatchee River and the main spillways of the conservation areas.** Emphasis added.*

The Chief recommended that the first phase of the project should be *“the first phase of the project should be construction of the principal structures required for protection of the east coast area and the principal works necessary to control lake levels and reduce flood damage in the improved area south of Lake Okeechobee.”* Page 3, paragraph 9.

On Pages 12 and 13, paragraph 17, the Board of Engineers provided the following recommendations as to the first phase of the project:

*The Board recommends modification of the existing Federal project for the Caloosahatchee and Lake Okeechobee drainage areas to provide for further improvement in the interests of flood control, drainage, and related purposes, generally in accordance with the district engineer's comprehensive plan for flood control and other purposes in central and southern Florida, with such modifications thereof as in the discretion of the Secretary of the Army and the Chief of Engineers may be advisable, at an estimated cost to the United States of \$171,041,000 for construction and \$749,000 annually for maintenance and operation, subject to the conditions that local interests shall provide all lands, easements and rights-of-way; make a cash contribution of 15 percent of the estimated construction cost for each part of the work prior to its initiation, except that the total cash contribution for the comprehensive project shall not exceed \$29,152,000; and furnish assurances satisfactory to the Secretary of the Army that they will hold and save the United States free from damages due to the construction and operation of the works and that they will maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army, **except the levees, channels, locks and control works of -the St. Lucie Canal, Lake Okeechobee, and Caloosahatchee River and the main spillways of the conservation areas.***

Pages 40 through 42, paragraph 58 provide the details of the recommended plan for the Lake Okeechobee-Everglades Area. On pages 40 and 41, paragraph 58(a)(3) provides:

*(3) Levees: The existing levees around the perimeter of Lake Okeechobee were designed to withstand a hurricane attack even more severe than that of 1928. They served their intended purpose in 1945 and 1947 by withstanding hurricane-driven tides and waves with relatively minor damage and with no danger of overtopping or breaching. Experience gained as a result of the floods and winds of 1947 indicates; however, that a low levee should be extended around the lake shore from the St. Lucie Canal northward to tie in with the present north shore levee, to protect the development which has taken place in that area since the existing levee project was built. Also, a low levee should be provided along the northwestern shore of the lake from the Kissimmee River to Fisheating Creek to protect pasture lands of the Indian Prairie section from overflow by normal rises and wind tides on the lake. This limited protection along the northwestern shore is adequate for present protection of this area, which is pasture land without urban development. In addition to these extensions, some modification of existing levees may be found desirable in the light of experience gained during the 1947 storm.*

Section X starting on page 51 of House Document 643 sets forth the entire requirements and items of local cooperation. Paragraphs 73, 74 and 76 provide as follows:

*73. Lands, easements, and rights-of-way .- In the accomplishment of flood-control projects such as the levees, control works, diversion channels, flood-channel improvements, and major drainage canals, or such as are proposed in the comprehensive plan, it has been found that local interests are best qualified to furnish necessary lands, easements, and rights-of-way. Moreover, present*

*flood-control law requires that local interests furnish such lands, easements, and rights-of-way for local flood-protection projects. Establishment and operation of the conservation areas planned for the Everglades would require flowage easements over lands of these areas and the imposition of suitable restrictions on use of these lands. The State or other responsible local interests should be required to acquire title to or flowage easements over these lands; to impose and enforce restrictions as to use which are considered satisfactory to the Secretary of the Army; and to furnish, without cost to the United States, the necessary flowage easements over lands of the conservation areas. This requirement should be considered applicable to any other lands which future development of the comprehensive plan may indicate to be required for conservation areas. The total cost of lands, easements, and rights-of-way, including provision of the conservation areas, to be borne by local interests is estimated at \$3,898,000.*

*74. Relocations and alterations.-Local interests should be required to bear the cost of all relocations and alterations of highways and public utilities which may be required for the construction of the project, including alterations and relocations of highway bridges, and to bear the cost of lands required for such relocations and changes. However, enlargement of the Tamiami Trail embankment, and provision of control structures therein, to form the southern levee of the Everglades conservation area is an integral construction feature of the comprehensive development. Similarly, the portions of State Roads 84 and 25 adjacent to the conservation area would be enlarged to form portions of the conservation area retention levees proposed in the comprehensive plan. This work is not required for highway purposes and effects no essential improvement in the existing highway. The cost of the embankment and highway thereon should, therefore, be borne entirely by the United States. The total cost of relocations and alterations to be borne by local interests, as described above, is estimated as \$4,044,000. The cost of relocations and alterations of railroad bridges would be borne by the Federal Government.*

*76. Lake Okeechobee levees and outlets.-Lake Okeechobee together with its outlets is, in effect, a multiple-use reservoir with flood-control, navigation, and water-supply functions. Its improvement and operation for these purposes is the heart of the comprehensive plan. It appears essential that maintenance and operation of the control works, channels, navigation locks, and levees involved in this feature be by the Federal Government. The modifications of levees and lake control now proposed in the comprehensive plan would result in large benefits by providing deeper navigation channels and providing a higher degree of flood protection to the thickly populated area around Lake Okeechobee. These modifications would also provide improved control and conservation of water which would be of substantial benefit to the agricultural area south and east of Lake Okeechobee. The fact that modification of lake control and the levees about Lake Okeechobee produces large increased land-use benefits, as well as benefits from flood control and navigation, has been recognized by the following division of cost for the entire project which results in dividing the cost of proposed modifications about 61 percent to the Federal Government and 39 percent to local interests.*

***NOTE: The Chief of Engineers modified this recommendation of the district engineer to have the local interests make a cash contribution of 15 percent of the estimated construction cost for each part of the work prior to its initiation, except that the total cash contribution for the comprehensive project shall not exceed \$29,152,000.***

#### **B.1.4 FLOOD CONTROL ACT OF 1954**

The Flood Control Act of 1958, Public Law 83-780, 83rd Congress, 2nd Session authorized the 2nd Phase of the C&SF Project to include the Kissimmee River and Upper St Johns River basins. It increased the Lake Okeechobee outlet capacity at the Caloosahatchee River.

#### **B.1.5 FLOOD CONTROL ACT OF 1958**

The Flood Control Act of 1958, P.L. 85-500, provided additional authorization and modified the comprehensive plan as recommended by the Chief of Engineers in House Document Numbered 186, Eighty-fifth Congress.

##### *CENTRAL AND SOUTHERN FLORIDA*

*In addition to previous authorizations, there is hereby authorized to be appropriated the sum of \$40,000,000 for the prosecution of the comprehensive plan for flood control and other purposes in central and southern Florida approved in the Act of June 30, 1948, and subsequent Acts of Congress, and such comprehensive plan is hereby modified as recommended by the Chief of Engineers in House Document Numbered 186, Eighty-fifth Congress,*

##### **B.1.5.1 HOUSE DOCUMENT 186, 85TH CONGRESS, 1ST SESSION**

House Document 186, 85th Congress, 1st Session removed monetary cap on local sponsor contributions set in 1948 authorization. It established local share or project costs for 2<sup>ND</sup> Phase of the construction and S&A costs plus LERRD plus O&M responsibilities. The USACE is responsible for O&M of Lake Okeechobee outlets. The following quote is from pages 6 and 7 of the Report of the Chief of Engineers, Department of the Army:

*24. There has been close coordination with the Central and Southern Florida Flood Control District during the preparation of this cost-sharing study, and careful consideration has been given to its views. The comments and view of that agency are included with the district engineer's report as appendix E. In these letters of comments the chairman of the governing board of the district recognizes the cooperation that has existed. He questions, however, certain of the procedures used in arriving at the division of cost, but states that the State of Florida is ready to share in the cost of this project on any basis that may be adopted by the Congress as applicable generally throughout the United States for projects of similar character. He concludes that in the absence of establishment of such a policy by the Congress, revision of cost sharing for the C&SF project would be premature.*

*25. The Corps of Engineers is required by law to present its recommendations on this matter, based on the best available information, policy guidance, and judgment. I have, therefore, given careful consideration to the views of local interests and to the information contained in the district engineer's study. As a result I concur in the views of the reporting officers and recommend—*

*(a) That the plan of improvement set forth in this study be established as that to be accomplished under the 1948 and 1954 authorizations for the C&SF Project, subject to such modifications in detail as further planning may require.*

*(b) That the monetary limit of \$29,152,000 in cash contribution to the entire project, contained in House Document 643, 80th Congress, be removed.*

*(c) That for the second phase of the project authorized by the Flood Control Act of 1954, non-Federal interests be required to contribute 20 percent toward the cost of contracts for construction plus supervision and administration thereof, to provide the necessary lands and relocations, to bear the cost of maintenance and operation of all works except those having to do with the regulation of Lake Okeechobee, and to hold and save the Federal Government free from damages resulting from project construction and operation.*

#### **B.1.6 FLOOD CONTROL ACT OF 1960**

The Flood Control Act of 1960, P. L. 86-654, designated the levees around Lake Okeechobee, Florida to be "Herbert Hoover Dike".

*Sec 201. ...Central and Southern Florida*

*That the levees around Lake Okeechobee, Florida, authorized by the Rivers and Harbors Act approved July 3, 1930, and modified by the Flood Control Act approved June 30, 1948, and subsequent Acts, shall be known and designated as the Herbert Hoover Dike, and any law, regulation, document, or record of the United States in which such levees are referred to under any other name or designation shall be held to refer to such levees as the Herbert Hoover Dike.*

#### **B.1.7 FLOOD CONTROL ACT OF 1962**

Section 207 of the Flood Control Act of 1962 authorized the Chief of Engineer to construct, maintain and operate public park and recreation facilities at water resource projects under the control of the Department of the Army. Section 207 provides:

*The Chief of Engineers, under the supervision of the Secretary of the Army, is authorized to construct, maintain, and operate public park and recreational facilities at water resource development projects under the control of the Department of the Army, to permit the construction of such facilities by local interests (particularly those to be operated and maintained by such interests), and to permit the maintenance and operation of such facilities by local interests. The Secretary of the Army is also authorized to grant leases of lands, including structures or facilities thereon, at water resource development projects for such periods, and upon such terms and for such purposes as he may deem reasonable in the public interest: Provided, That leases to nonprofit organizations for park or recreational purposes may be granted at reduced or nominal considerations in recognition of the public service to be rendered in utilizing the leased premises: Provided further, That preference shall be given to Federal, State, or local governmental agencies, and licenses or leases where appropriate, may be granted without monetary considerations, to such agencies for the use of all or any portion of a project area for any public purpose, when the Secretary of the Army determines such action to be in the public interest, and for such periods of time and upon such conditions as he may find advisable: And provided further, That in any such lease or license to a Federal, State, or local governmental agency which involves lands to be utilized for the development and conservation of fish and wildlife, forests, and other natural resources, the licensee or lessee may be authorized to cut timber and harvest crops as may be necessary to further such beneficial uses and to collect and utilize the proceeds of any sales of timber and crops in the development, conservation, maintenance, and utilization of such lands. Any balance of proceeds not so utilized shall be paid to the United States at such time or times as the Secretary of the Army may determine appropriate. The water areas of all such projects shall be open to public use*

*generally, without charge, for boating, swimming, bathing, fishing, and other recreational purposes, and ready access to and exit from such areas along the shores of such projects shall be maintained for general public use, when such use is determined by the Secretary of the Army not to be contrary to the public interest, all under such rules and regulations as the Secretary of the Army may deem necessary. No use of any area to which this section applies shall be permitted which is inconsistent with the laws for the protection of fish and game of the State in which such area is situated. All moneys received by the United States for leases or privileges shall be deposited in the Treasury of the United States as miscellaneous receipts.*

### **B.1.8 FLOOD CONTROL ACT OF 1968**

Authorizations for the Central & Southern Florida Project contained in the Flood Control Act of 1968, P.L. 90-483 read as follows:

#### *CENTRAL AND SOUTHERN FLORIDA*

*The project for Central and Southern Florida, authorized by the Flood Control Act of June 30, 1948, is further modified in accordance with the recommendations of the Chief of Engineers in Senate Document Numbered 101, Ninetieth Congress, at an estimated cost of \$8,072,000, and in accordance with House Document Numbered 369, Ninetieth Congress, at an estimated cost of \$58,182,000.*

#### **B.1.8.1 HOUSE DOCUMENT 369, 90TH CONGRESS, 2ND SESSION**

House Document Numbered 369 contains the Water Resources Plan for Central and Southern Florida.

House Document 369, 90th Congress, 2nd Session authorized raising upper lake regulation level (maximum water conservation level) an additional four feet and authorized raising lake levees and modifications to water control structures to implement same. Established cost at \$49.485M. (Note: most of these modifications were never initiated. The local sponsor did not support the higher lake levels at that time.)

On page 109 of the District Engineers Report the plan of improvements to the Herbert Hoover Dike levees are discussed:

*a. Introduction.--Lake Okeechobee is the largest natural reservoir in Florida. It has a drainage area of over 5,000 square miles and a surface area of more than 700 square miles. ... The levee system has been designed to withstand the effects of hurricane tides and wave action that could occur during critical combinations of lake stage and storm intensity. Raising lake levels by various increments to provide additional conservation storage would reduce the available flood storage and result in a lower degree of flood protection than is now planned unless alternative means of compensating for those results were provided. Those means include raising the encircling levees to restore the planned degree of protection, providing additional canal and structure outlet capacity to compensate for the loss of flood storage, or some combination of both. In addition, any plans for increasing storage levels in the lake must include the necessary modifications for drainage of areas behind the lake levees and for protection of those areas against flooding.*

*b. Scope and purpose.--The purpose of these studies is to determine required modifications and additions to the approved project so that the degree of protection will not be reduced if lake levels are raised. Alternative plans of improvement and preliminary cost estimates are presented.*

*f. Flood control storage.--Routings of the 100-year and standard project floods were made to determine the amount of flood control storage required in Lake Okeechobee for each 1-foot increment of increase in regulation schedule above the authorized plan. The design floods are those which would occur after project works in the tributary basins are completed; the inflow hydrographs for Lake Okeechobee shown in Part IV, Supplement 2, Section 7, were used. Typical hydrographs showing Lake Okeechobee stages and discharges for Plans A and B with a 17.5 to 19.5-foot seasonal regulation schedule are plotted on figure D-6. Similar routings were made for other combinations of lake regulation schedule and outlet capacity. The resulting design flood stages for Plans A, B, and C with alternative type regulation schedules are shown on figure D-7.*

*g. Required levee grades.--(1) General.--The general design memorandum on combinations of hydrologic and hydraulic factors affecting height of levees (Part IV, Supp. 2, Sec. 7) established the recommended combinations of hydrologic and hydraulic factors which determine required levee heights where a high degree of protection is to be provided. Hydraulic combination A, recommended for use in designing final levee grades around the lake, consists of the following alternative possibilities:*

*(a) Maximum probable hurricane occurrence with the lake at the top of the conservation pool.*

*(b) Standard project hurricane occurrence with the lake at the highest 30-day average stage resulting from the 100-year flood.*

*(c) Moderate hurricane occurrence with the lake at the highest 30-day average stage resulting from the standard project flood.*

*(2) Design hurricanes.--The analyses leading to the selection of design hurricane parameters for Lake Okeechobee are presented in Part IV, Supplement 2, Section 2. A tabulation of the basic parameters which define the range of hurricane intensity is given in table D-5.*

*Design studies for the existing levees have indicated that alternative (c)--moderate hurricane coincident with S.P.F.--does not control any of the levee grades; therefore, no further consideration was given to that particular combination of hurricane intensity and lake stage.*

*(3) Design wind tides.--Using computation procedures described in Part IV, Supplement 2, Section 3, relationships between stage coincident with hurricane occurrence and wind-tide elevation were developed; typical curves are plotted on figure D-8.*

*(4) Design waves.--The general design memorandum on wave action coincident with wind tides (Part IV, Supp. 2, Sec. 4 (revised)) presented procedures for computing shallow-water significant wave heights and periods; the analyses were based on Lake Okeechobee data. Using the parameters wind speed, average depth, and available fetch length, the maximum wave height, significant wave height, and significant period were determined for fetches to 24 critical points around the lake.*

*(5) Design wave runup.--Wave runup on design poolside slopes (which range from about 1 on 5 to 1 on 8), using the wave height and period criteria determined in the preceding paragraph, was computed using procedures given in appendix A to Part IV, Supplement 2, Section 4. Runup factors are based on results of model tests at the Coastal Engineering Research Center and are shown on figure D-9. In all cases, the runup resulting from the maximum wave was about equal to runup from the significant wave, since the maximum wave is steeper and has a lower relative runup factor.*

*(6) Design levee grades.--(a) Plans A, B, and C.--The wave runup added to the associated wind-tide elevation determined the required levee grade for the various combinations of hurricane and lake level. The relationships between stage coincident with hurricane occurrence and required*

levee grade, determined for critical points around the lake, were used in conjunction with the various regulation schedules and design flood stages to determine design levee grades; typical relationships in terms of required increase in design levee grade are shown on figure D-8. Weighted average increases in design grade were determined for each of the nine sections of the Lake Okeechobee levees for alternative plans and schedules; these values formed the basis for preliminary cost estimates. The lakewide average increases in levee grades for each plan investigated are plotted on figure D-8. Typical required levee grades for Plan A are shown on figure D-10 along with existing design grades. Wind-tide elevations and required levee grades for the recommended plan are given in appendix F. As shown on those figures, approximately 50 percent of the design levee grade is controlled by M.P.H. occurrence on the top of the conservation pool and 50 percent by S.P.H. occurrence coincident with the 100-year flood.

As indicated on figure D-8, the average increase in levee grades required with the alternative plans investigated is about the same with both seasonal and nonseasonal schedules. If zone B in nonseasonal schedules is eliminated, required levee grades for corresponding increases in lake stages decrease about 0.5 foot since for the same increase in Lake Okeechobee stages the upper limit of the conservation pool and design flood levels are lower. Increasing the outlet capacity is not particularly effective in reducing required levee grades; with Plan C--which includes the maximum increase in outlet capacity considered--average levee grades are reduced from 0.4 to 0.7 foot below those which would be required for each foot of increase in lake stage with existing outlets.

The recommended plan of improvement included the following:

#### *PLAN OF IMPROVEMENT*

*100. Plan.--The recommended plan is shown on plate 1. Details of the plan are in appendix F and general features are described below.*

*a. Raise Lake Okeechobee level.--It is proposed to raise the lake level about 4 feet above its authorized upper regulation level for flood control--that is, to about 4 feet above the authorized elevation 17.5 feet (present elevation is 15.5 feet until current levee raising is completed). The proposed plans will require raising of the lake levees, changes in hurricane gate structures around the lake, and a lock at Port Mayaca where St. Lucie Canal flows from the lake. The lock would necessitate discharge of excess water from Martin County, which formerly had access to Lake Okeechobee, to the ocean. To prevent this waste, Martin County drainage would be backpumped into Lake Okeechobee through the proposed 1,230-c.f.s. pumping station (S-308A). Low lands bordering the lake on the northeast and northwest will require new or modified interceptor levees to keep out drainage from higher lands and new or modified pumping stations to remove floodwaters from direct rainfall and seepage from the low lands. The estimated cost of all changes and additions required to raise the lake level is \$49,458,000.*

The plan as authorized by the 1968 Flood Control Act included for conservation and conveyance of additional water supply to users, the following:

- 1. Facilities for pumping excess water from the east coast areas into storage in Lake Okeechobee and the water conservation areas;*
- 2. A system of interrelated canals, levees, pumping stations, and control structures for conveyance of water to demand areas;*
- 3. Deepening the navigation channel across Lake Okeechobee;*
- 4. Construction of recreation facilities;*

5. *Raising the Lake Okeechobee levees to provide for an increase of about 4 feet of authorized regulation stages;*
6. *Deletion of the deepening of the St. Lucie Canal from the authorized project; and*
7. *The construction of the small craft lock in Buttonwood Canal.*

The Lake Okeechobee levees (Herbert Hoover Dike) were not raised due to environmental concerns with the lake's littoral zone.

## **B.2 GENERAL AND DETAILED DESIGN MEMORANDUMS**

The plan of improvement in House Document 643 was very generic and conceptual and provided that the Chief of Engineers and the Secretary of the Army could make such modifications as in the discretion of the Secretary of the Army and the Chief of Engineers may be advisable.

After approval of the Comprehensive Plan in 1948, a series of Design Memorandums, General Design Memorandums and Detailed Design Memorandums were completed by the Jacksonville District for the approval of various components of the Comprehensive Plan including for the Lake Okeechobee Regulation Schedule, the design heights and grades of the Herbert Hoover Dike levees (L-D1, L-D2, L-D3, L-D4, L-D9, Levee 47, Levee 48, Levee 49 and Levee 50) as well as Detailed Design Memorandum for each of the Structures which penetrate the HHD. The following are the Design Memorandums, General Design Memorandums, and Detailed Design Memorandums related to the Herbert Hoover Dike levees as approved by the Chief of Engineers authority pursuant to the 1948 act.

### **B.2.1 PARTIAL DEFINITE PROJECT REPORT Part 1, COASTAL AREAS SOUTH OF ST. LUCIE CANAL, AGRICULTURAL AND CONSERVATION AREAS (WITH PRELIMINARY INFORMATION ON LAKE OKEECHOBEE AND PRINCIPAL OUTLETS)**

The first report was dated JULY 10, 1951 entitled PARTIAL DEFINITE PROJECT REPORT Part 1, COASTAL AREAS SOUTH OF ST. LUCIE CANAL, AGRICULTURAL AND CONSERVATION AREAS (WITH PRELIMINARY INFORMATION ON LAKE OKEECHOBEE AND PRINCIPAL OUTLETS). This report as one of its objectives was to determine:

*The hydrologic and hydraulic studies contained in this portion of the report are for the purpose of developing criteria and determinations to serve as a basis for selecting the following: The ultimate heights of levees surrounding Lake Okeechobee and conservation areas Nos. 1., 2, and 3, considering storage requirements, critical rainfall, inflow, wind tides, freeboard allowances, and other related factors.*

The final recommendations as to proposed Lake Okeechobee modifications are contained in Paragraph 12-14, which provides:

*Recommended plan of improvement, Lake Okeechobee.--The most favorable plan for improvement of Lake Okeechobee would provide for increased flood control and agricultural use storage. On the basis of cost and benefit comparisons, which have been developed and presented in preceding paragraphs, it is recommended that the plan of improvement consist of the following general features: (1) Raise the existing levees, where required, to furnish complete protection from wind tides and waves as superimposed on higher operating stages; relocate State Roads 15 and 78, and*

*developments at Lakeport and vicinity; purchase lands on the northeast and northwest shores of the lake where frequent flood damages would occur; and purchase Kreamer, Ritta, and Torry Islands; (2) adopt an upper limit of the conservation pool at 16.4 feet; dredge existing navigation channels in the lake to increase their depths by 2 feet; open St. Lucie Canal for discharge when lake stage reaches elevation 16.4 feet; begin operation of Caloosahatchee River and the agricultural canals for regulatory purposes when capacity is available. The recommended plan would defer construction of new levees and improvement of the two principal lake outlets. The spillway, originally recommended and approved for Caloosahatchee Canal at Moore Haven, would be deferred until such time as the need for it is definitely established. Recommended levee heights, with the lake at elevation 20.61 feet during the standard project flood...*

This report was the first to discuss the "standard project flood". Levee costs used in the estimate were based on a maximum pool elevation of 21.0 feet for the standard project flood.

It should be noted that the recommended plan of improvement set forth in this report differed from the recommended plan contained in House Document 643.

### **B.2.2 SECTION 1 STORAGE LEVEL IN LAKE OKEECHOBEE AT BEGINNING OF CRITICAL HURRICANES**

Dated October 13, 1953 Part IV Supp. 2, Section 1 Storage Level In Lake Okeechobee At Beginning Of Critical Hurricanes, this DM also set forth the problems with determination of the heights of the Lake Okeechobee levees: Paragraph A.2. states:

*The problem.--a. General.--Accurate determination of the height required and erosion protection needed for Lake Okeechobee levees is of prime importance in project design. The levees must be high enough and sufficiently erosion-resistant to withstand the most severe combination of lake-storage levels, wind tides, and wave action that is expected; however, in view of the great costs involved in any increase in levee elevations (estimated roughly at \$4,000,000 for each foot raised), it is important that designs not be too conservative.*

*b. Factors governing the heights of levees required to contain Lake Okeechobee waters during critical periods are:*

- (1) Storage level of Lake Okeechobee at the beginning of critical hurricanes.*
- (2) Hurricane winds coincident with lake levels produced by severe floods.*
- (3) Wind tides produced by hurricanes.*
- (4) Wave action coincident with wind tides.*
- (5) Lake-regulating facilities.*
- (6) Resistance of levees to wave erosion.*
- (7) Critical combination of hydrologic and hydraulic factors affecting height of Lake Okeechobee levees.*

In this DM the Chief of Engineers provided the following comments on the recommendations of the Jacksonville District:

*Comment 1. "b. Some adjustments in water supply quantities referred to in la may be called for after details of the Kissimmee River basin developments are known. Such revisions may affect economic benefit estimates and conclusions as to the dependable water supply to be assured by a given draw-down capacity in Lake Okeechobee, but are not likely to affect estimates of required levee heights if the lake is assumed full to top of conservation pool at the beginning of the Standard*

*Project Flood, as proposed in the subject memorandum. In view of this consideration and the relatively frequent filling of the conservation pool indicated by available data (approx. 1 year out of 2), assumption of a full conservation pool at the beginning of the standard project flood series is approved."*

*Comment 1.i."It is noted that the proposed standard project flood estimate for the Lake Okeechobee drainage area conforms closely with runoff that might be expected from 100-year frequency rainfall combinations, whereas the standard project flood estimate previously adopted for the conservation pools and agricultural areas conformed with rainfall quantities 25 percent higher than 100-year frequency values. Although no revision in the proposed estimate is considered necessary at this time, it is requested that a routing of the flood based on 125 percent of the 100-year rainfall be added to the subject memorandum in order that the information will be available for consideration when combinations of hydrologic events governing the Lake Okeechobee levee grades are selected."*

The factors governing the heights of levees were further evaluated in the following DMs  
Dated December 31, 1953 Part IV Supplement 2, section 2, Hurricane Winds over Lake Okeechobee  
Dated January 12, 1954 Part IV Supplement 2, section 5 Lake-Regulating Facilities  
Dated August 12, 1954 Part IV Supplement 2, section 6 Resistance of Levees to Wave Erosion  
Dated March 28, 1955 Part IV Supplement 2, section 5A Additional Lake-Regulating Facilities  
Dated July 26, 1956 Part IV Supplement 2, section 3 Wind Tides Produced By Hurricanes (Revised)  
Dated July 27, 1956 Part IV Supplement 2, section 4 Wave Action Coincident with Wind Tides (Revised)

The conclusions and recommendations contained in these DMs were then combined into General Design Memorandum entitled Part IV Supplement 2, section 7 Combinations of Hydrologic and Hydraulic Factors Affecting Height of Levees

### **B.2.3 1959 GENERAL DESIGN MEMORANDUM (USACE, 1959-SUPPLEMENT 2, SECTION 7-ENTITLED COMBINATIONS OF HYDROLOGIC AND HYDRAULIC FACTORS AFFECTING HEIGHT OF LEVEES DATED FEBRUARY 25, 1959**

A 1959 General Design Memorandum (USACE, 1959-SUPPLEMENT 2, Section 7-entitled COMBINATIONS OF HYDROLOGIC AND HYDRAULIC FACTORS AFFECTING HEIGHT OF LEVEES) concluded that if Lake Okeechobee is to be operated as a multipurpose reservoir, a levee system which will protect developed areas and provide sufficient outlet capacity to permit the lake to be regulated within safe limits must be provided. It also discussed the hydrologic and hydraulic factors which are important in the design of lake levees and outlet channels are as follows: a. Conservation storage needed to meet the water-supply requirements of the area with expected development. b. Effect of existing and proposed outlets on lake levels during the floods of record, 100-year flood, and standard project flood. c. Height of levees required to protect developed areas from wind tides, waves, and wave runup which could be expected if a major hurricane should occur.

The plan of improvement included (a) construction of levees on the northwest and northeast shores of Lake Okeechobee, and (b) raising of existing levees. It was recommended that the design of project works be based on the following hydraulic conditions: probable maximum hurricane on a 17.5-ft pool, standard project hurricane on a 21.6-ft pool (the 30-day average 100-year flood stage at that time), and moderate hurricane on a 23.5-ft pool (the 30-day average Standard Project Flood stage at that

time). This resulted in levee crown elevations which ranged from 32 to 46 feet, NGVD. Typical elevations of adjacent lands ranged from about 10 to 18 feet, NGVD.

The Recommendations of the District Engineer were as follows:

*a. Plan of improvement.--It is recommended that project works required to maintain a conservation pool in Lake Okeechobee which varies seasonally from 15.5 to 17.5 feet, substantially in conformity with schedule 7, be constructed and that Caloosahatchee River be enlarged to a regulatory capacity of 9,300 cubic feet a second as soon as funds are available. It is further recommended that the design of project works be based on hydrologic combination (1.) with the maximum probable hurricane on the 17.5-foot pool, (2.) the standard project hurricane on the 21.2-foot pool, or (3.) the moderate hurricane on the 23.5-foot pool. The plan of improvement includes the following items and should be accomplished in the following order of priority:*

*(1) Construct levees on the northwest and northeast shores of Lake Okeechobee with the protective measures needed to prevent erosion of levee faces during minor storms, and construct the primary canals and pumping stations needed to prevent flooding in areas protected by the levees; or acquire the lands which may be flooded by high lake stages where protection is not economically feasible. The plan of improvement for these areas will be developed in general design memorandum studies. (2) Raise existing levees and provide protective measures needed to prevent erosion of levee faces during minor storms. (3) Construct the primary canals and pumping stations needed to protect the area behind the existing north shore levees from increased flooding when the lake levels are raised. (4) Increase the lake-regulation capacity of Caloosahatchee River to 9,300 cubic feet a second. (5) Stabilize the banks of St. Lucie Canal where necessary to prevent erosion when releases through the canal are being made at a velocity of 2.5 feet a second.*

This General Design Memorandum was approved by the Chief of Engineers on June 6, 1959 who also approved seasonal regulation of Lake Okeechobee between elevations 15.5 and 17.5 feet as a basis for establishing ultimate levee grade requirements and design of pertinent facilities. The approval also recommended appropriate interim regulation schedules should be developed to conform most satisfactorily with various stages of project modifications.

This GDM changed the Plan of Improvement from the first report that was dated JULY 10, 1951 entitled PARTIAL DEFINITE PROJECT REPORT Part 1, COASTAL AREAS SOUTH OF ST. LUCIE CANAL, AGRICULTURAL AND CONSERVATION AREAS (WITH PRELIMINARY INFORMATION ON LAKE OKEECHOBEE AND PRINCIPAL OUTLETS) discussed above and modified the Standard Project Flood elevation from 21 feet NGVD to 23.5 feet NGVD.

The levees were designed in the subsequent Detailed Design Memoranda to contain the Standard Project Flood and were to prevent overtopping and overwash.

#### **B.2.4 DETAILED DESIGN MEMORANDUMS**

From 1959 through 1965, a series of General and Detailed Design Memoranda documented design efforts related to the dike improvements. They are summarized here to identify the extent of those improvements.

A Detailed Design Memorandum for Lake Istokpoga-Indian Prairie Area (Canal 39A, 40 (*Harney Pond Canal*) and 41 (*Indian Prairie Canal*) and Structures 70, 71, 72, 75 and 76) completed May 1956-included design of new bridges over Canal 40 and 41 with deck elevations at 31 feet. (Levees 48, 49 and 50)

A Detailed Design Memorandum for Levees 48, 49 and 50 was completed on May 29, 1959 and approved by the Chief of Engineers on December 4, 1959. For these levees (Levees 48, 49 and 50), with the design elevation for the levees ranging between 32.3 feet to 39.0 feet with lakeside side slopes of 1 on 6 and landside side slopes of 1 on 2 and 1 on 4.

A Detailed Design Memorandum for Levees D-1, D-2 (Part) and D-3 (Part) was completed on May 26, 1961 and approved by the Chief of Engineers on August 14, 1961. The design elevation for the 1.5 miles for the part of Levee D-3 was between 34.7 and 37.5 feet m.s.l. with a 1 on 3 landside side slope. The design elevation for the entire Levee D-1 was 34.5 to 38.7 feet m.s.l. with a 1 on 3 landside side slope. The design elevation for the part of Levee D-2 consisting of 14.9 miles was between 35.3 and 43.4 feet m.s.l. with a 1 on 6 lakeside side slope and a 1 on 3 landside side slope.

A Detailed Design Memorandum for Kissimmee River Basin Canal 38, Section 1, (Kissimmee River) and Control Structure 65E, completed June 21, 1961 included design of new bridges over Canal 38 with deck elevations at 33 feet. (LD-4 and Levee 47)

A Detailed Design Memorandum for Levees D-2 (Part), D-9 and D-4 (Part) was completed on September 18, 1962 and approved by the Chief of Engineers on October 18, 1962. The design elevation for the 7.4 miles for the part of Levee D-2 was between 37.1 and 40.9 feet m.s.l. with a 1 on 6 lakeside side slope and a 1 on 3 to 1 on 5 landside side slope. The design elevation for the entire Levee D-9 (15 miles) was 36.5 to 37.8 feet m.s.l. with a 1 on 6 lakeside side slope and a 1 on 3 to 1 on 5 landside side slope. The design elevation for Levee D-4 consisting of 7.6 miles was between 34.4 and 41.1 feet m.s.l. with a 1 on 8 lakeside side slope and a 1 on 3 landside side slope.

A Detailed Design Memorandum for Levee D-3 (Remainder) was completed on September 5, 1963 and approved by the Chief of Engineers on November 29, 1963. This portion of Levee D-3 comprised of 9.8 miles had a design elevation of between 33.5 to 36.1 with a 1 on 6 lakeside side slope and a 1 on 3 landside side slope.

A General and Detailed Design Memorandum was completed on March 13, 1963 for Levee 47 as well as for Structures 133, 134, 135, 152, 153 and 154 and was approved by the Chief of Engineers on February 1965.

A Detailed Design Memorandum for Levee 47 was completed on March 8, 1965 and approved by the Chief of Engineers on May 19, 1965. Levee 47 was divided into two Sections. Section 1 comprised of 7.5 miles had a design elevation of between 33.6 feet to 37.0 feet m.s.l. with side slopes of 1 on 6 lakeside side slope and a 1 on 3 and 1 on 4 landside side slope. Section 2 comprised of 10.4 miles had a design elevation of between 37.0 feet to 40.0 feet m.s.l. with side slopes of 1 on 6 lakeside side slope and a 1 on 3 landside side slope.

For all the Levees, stability analyses were performed with lake stage assumed at +17.5 feet.

**B.2.5 Other General and Detailed Design Memoranda related to Structures which penetrate the Herbert Hoover Dike are listed below:**

Design Memorandum, Hydrology and hydraulic design of Hillsboro Canal and related works (L-14, L-15, S-2, and S-6) dated June 8, 1953.

Design Memorandum, Pumping Station 2 dated July 29, 1953.

Design Memorandum, Hydrology and hydraulic design of Miami Canal and related-works (L-23, L-24, L-25, S-3, and S-8) dated August 17, 1953.

Design Memorandum, Pumping Station 3 dated October 30, 1953.

Design Memorandum, Hydrology and hydraulic design, Resistance of levees to wave erosion dated August 13, 1954.

General Design Memorandum, Caloosahatchee River and control structures (Canal 43 and Lock and Spillway Structures 77, 78, and 79) dated April 24, 1957.

Design Memorandum, General development plan, recreation, public use, and operation dated May 6, 1958.

Detail Design Memorandum, Automatic electric control system for Structures 66, 68, 70, 71, 72, 75, 82, 83, and 84, Lake Istokpoga-Indian Prairie area dated October 30, 1958.

Detail Design Memorandum, Pumping Stations 127, 129, and 131 dated September 7, 1960.

Detail Design Memorandum, Spillways and Locks on Canal 38, Structures 65, 65A, 65B, and 65C, dated July 20, 1962.

Detail Design Memorandum, Structures 77 and 78 on Canal 43 dated November 15, 1962.

General Design Memorandum, Nine-Mile Canal Area, (C-20, C-21, L-D1 borrow canal, S-4, S-47, S-169, S-170, railroad bridges, etc.) dated March 29, 1963.

Detail Design Memorandum, Pumping Stations 133 and 135 dated April 30, 1965.

Detail Design Memo, Lock Structure 193 dated June 5, 1967.

Detail Design Memorandum, Pumping Station 4 dated April 22, 1968.

General and Detail Design Memorandum, Pumping Station 236 dated February 28, 1972.

General and Detail Design Memorandum, Port Mayaca Lock (S-308B) and Spillway (S-308C) dated November 1972.

General and Detail Design Memorandum, Lock Structure 310 (S-310) dated May 1976.

General Design Memorandum, Spillway Structures 351 (HGS-4) dated June 1984.

Design Memorandum Spillway Structure 351 (HGS-4) dated June 1985.

General Design Memorandum Spillway Structure 352 (S-352) dated August 1985.

Detail Design Memorandum Spillway Structure 352 (S-352) dated May 1986.

General Design Memorandum Spillway Structure 354 (S-354) dated December 1986.

Detail Design Memorandum Spillway Structure 354 (HGS-3) dated April 1987.

### **B.3 SUBSEQUENT DOCUMENTS RELATED TO CONSTRUCTION EFFORTS ON HERBERT HOOVER DIKE AFTER 2000**

HERBERT HOOVER DIKE, 2000 MAJOR REHABILITATION REPORT, REACH 1, Design included seepage berm on the landside and seepage trench to relieve uplift pressure. Prioritizes dike work with Reach 1, Port Mayaca to Belle Glade, at highest risk. Report approved by HQ-USACE.

HERBERT HOOVER DIKE, 2002 VALUE ENGINEERING STUDY, recommended Reach 1 design changed to cutoff wall and seepage trench in federal right-of-way.

HERBERT HOOVER DIKE, FINAL ENVIRONMENTAL IMPACT STATEMENT September 2005. Authorized construction of approximately 22 miles of impervious hanging cutoff wall and a relief trench with inverted filter and relief berm.

HERBERT HOOVER DIKE, CULVERT LETTER REPORT dated February 2011, approved by Assistant Secretary of the Army (Civil Works) May 25, 2011- replacement of 28 federal culverts and removal of four federal culverts.

HERBERT HOOVER DIKE, MRR SUPPLEMENT dated May 2015, Approved by HQ-USACE June 15, 2015-Construction of cutoff wall in area of HHD that extends from Miami Canal to St Lucie Canal and fully contained within Palm Beach County.

#### B.4 STRUCTURES OPERATED AND MAINTAINED BY USACE IN HERBERT HOOVER DIKE

HERBERT HOOVER DIKE STRUCTURES	LOCATION	AUTHORIZING DOCUMENT
Culvert 1	LD1	1935 River&Harbor Act
Culvert 1A	LD1	1935 River&Harbor Act
Culvert 2	LD1	1935 River&Harbor Act
Culvert 3	LD2	1935 River&Harbor Act
Culvert 4A	LD2	1935 River&Harbor Act
Culvert 5	LD3	1935 River&Harbor Act
Culvert 5A	L-D3	1935 River&Harbor Act
Culvert 6	LD4	1935 River&Harbor Act
Culvert 7	LD4	1935 River&Harbor Act
Culvert 8	LD4	1935 River&Harbor Act
Culvert 9	LD4	1935 River&Harbor Act
Culvert 10	LD9	1935 River&Harbor Act
Culvert 10A	LD9	1935 River&Harbor Act
Culvert 11	LD9	1935 River&Harbor Act
Culvert 12	LD2	1935 River&Harbor Act
Culvert 12A	LD2	1935 River&Harbor Act
Culvert 13	LD9	1935 River&Harbor Act
Culvert 14	LD9	1935 River&Harbor Act
Culvert 16	LD9	1935 River&Harbor Act
Culvert FC-1	L-50	1948 Flood Control Act
Culvert HP-1	L-49	1948 Flood Control Act
Culvert HP-2	L-49	1948 Flood Control Act
Culvert HP-3	L-49	1948 Flood Control Act
Culvert HP-5	L-50	1948 Flood Control Act
Culvert HP-6	L-50	1948 Flood Control Act
Culvert HP-7	L-50	1948 Flood Control Act
Culvert IP-1	L-48	1948 Flood Control Act
Culvert IP-2	L-49	1948 Flood Control Act
Culvert IP-3	L-49	1948 Flood Control Act
Culvert KI-1	L-48	1948 Flood Control Act
Culvert KI-2	L-48	1948 Flood Control Act
Taylor Creek Culvert	LD4	1935 River&Harbor Act
Structure 77	L-D9	1948 Flood Control Act
Structure 77 LOCK	L-D9	1948 Flood Control Act
Structure 308 LOCK	LD9	1930 River&Harbor Act and 1968 Flood Control Act
Structure 308B	LD9	1930 River&Harbor Act and 1968 Flood Control Act
Structure 308B	LD9	1930 River&Harbor Act and 1968 Flood Control Act

Structure 351	LD2	1930 River&Harbor Act and 1948 Flood Control Act
Structure 352	LD9	1930 River&Harbor Act and 1948 Flood Control Act
Structure 354	LD2	1930 River&Harbor Act and 1948 Flood Control Act
Levee LD-1		1930 River&Harbor Act and 1948 Flood Control Act
Levee LD-2		1930 River&Harbor Act and 1948 Flood Control Act
Levee LD-3		1930 River&Harbor Act and 1948 Flood Control Act
Levee LD-4		1930 River&Harbor Act and 1948 Flood Control Act
Levee LD-9		1930 River&Harbor Act and 1948 Flood Control Act
Levee 47		1948 Flood Control Act
Levee 48		1948 Flood Control Act
Levee 49		1948 Flood Control Act
Levee 50		1948 Flood Control Act

### B.5 STRUCTURES OPERATED AND MAINTAINED BY SFWMD AND OTHERS IN HERBERT HOOVER DIKE

Henry Creek Lock	L-47	None
Pumping Station 135 And Lock	L-47	1948 Flood Control Act and 1968 Flood Control Act
Structure 127 Lock (Buckhead Ridge)	L-48	None
Structure G-208	L-48	None
Pumping Station 127	L-48	1948 Flood Control Act
Structure 65E and Lock	L-48	1954 Flood Control Act
Structure 72	L-48	1954 Flood Control Act
Structure 84 and 84X or 84A	L-48	1954 Flood Control Act
Structure G-76	L-49	None
Pumping Station 129	L-49	1948 Flood Control Act and 1968 Flood Control Act
Structure G-207	L-50	None
Pumping Station 131 and Lock (Lakeport)	L-50	1948 Flood Control Act and 1968 Flood Control Act
Structure 71	L-50	1954 Flood Control Act
Pumping Station 4	LD1	1948 Flood Control Act and 1968 Flood Control Act
Pumping Station 2	LD2	1948 Flood Control Act and 1968 Flood Control Act
Pumping Station 236	LD2	1948 Flood Control Act
Pumping Station 3	LD2	1948 Flood Control Act and 1968 Flood Control Act
Structure 310 (old Hurricane Gate No.2)	LD2	1930 River&Harbor Act and 1948 Flood Control Act
Pumping Station 133	LD4	1948 Flood Control Act and 1968 Flood Control Act
Structure 154	LD4	1948 Flood Control Act and 1968 Flood Control Act
Structure 191	LD4	1948 Flood Control Act and 1968 Flood Control Act
Structure 193 (old Hurricane Gate No.6)	LD4	1930 River&Harbor Act and 1948 Flood Control Act

## **B.6 REGULATIONS SCHEDULES OF LAKE OKEECHOBEE**

### **B.6.1 Background and Related Environmental Documents**

The regulation of Lake Okeechobee water levels is performed by the U.S. Army Corps of Engineers (Corps), in consultation with the South Florida Water Management District (SFWMD). Lake Okeechobee is managed as part of the Central and Southern Florida (C&SF) Project for water supply and flood protection needs of the rapidly growing population of south Florida. The main inflows to Lake Okeechobee are the Kissimmee River, Taylor Creek-Nubbin Slough, Indian Prairie Canal, Harney Pond Canal, and Fisheating Creek. The main outflows east and west are the St. Lucie Canal, and the Caloosahatchee River, which comprise the largest outflow capacity. The main outflows south are through the Miami Canal, North New River Canal, Hillsborough Canal, and the West Palm Beach Canal. Inflows to Lake Okeechobee frequently exceed total outflow capacity. The HHD and several water control structures allow management of Lake Okeechobee to meet project purposes which include flood control, water supply, navigation, recreation and environmental enhancement. The tool used to perform Lake Okeechobee operations is referred to as a regulation schedule. A regulation schedule is a guideline for water managers to use in regulating the inflow and outflow of water through the various water control structures, i.e. pumps, spillways and locks. Regulation schedules for Federal water resources projects are included in water control manuals prepared in accordance with engineering regulations, and are accompanied by the appropriate environmental documentation required under the National Environmental Policy Act (NEPA). Since construction of the C&SF Project, there have been several authorized Lake Okeechobee Regulation schedules to accommodate structure capabilities, such as HHD (levee) height, and to attempt to address the water supply needs of the growing population of south Florida.

The 1948 authorization did not specify what lake regulation schedule should be adopted. Two basic regulation schedules have been used throughout the design of the C&SF Project. The first was a flat schedule of 16.4 ft., NGVD, approved by the Chief of Engineers in 1951 (Basic Report, Part I, 10 July 1951).

A variety of lake regulation schedules were utilized during construction of the C&SF Project facilities necessary to implement the 15.5-16.5 ft., NGVD schedule.

#### **B.6.1.1 1951**

In 1951, an interim schedule with three zones was put into effect. This schedule is illustrated in Figure 3-1, following the text. When the water levels were in Zone C, the only releases made from the lake were for agricultural use. In Zone B, releases were made not only for agricultural use, but also if it became apparent that sufficient inflow was going to occur to raise the lake into Zone A. The Lake Okeechobee outlets were opened as required to offset the projected inflows entering the lake and prevent the lake from entering Zone A. During the wet season (June 1 to October 31), the Caloosahatchee River was used as the primary outlet with the St. Lucie Canal being used only if additional discharges were required. During the dry season (November 1 to May 31) releases were initially made through the agricultural area when the capacity was available even before they were made to the Caloosahatchee River. Maximum discharges were always to be made when the lake water level entered Zone A.

**B.6.1.2**     1954

In response to the very wet years prior to 1954, particularly the fall of 1953, Figure 3-2 (which follows the text), a new schedule was put into effect in May 1954 in an effort to offer a higher degree of flood protection. It had maximum discharges through the Caloosahatchee River while water levels were in Zone B. Other features that increased the flood protection afforded by this schedule were the earlier spring decline of the lower schedule and the lower elevation of the upper schedule in the summer and fall months. It may be assumed that the absence of Zone B during the period between November 15 and February 1 was incorporated to increase the water supply for spring water use requirements.

**B.6.1.3**     1958

In 1958, refinements were made to the schedule adopted in 1954, which are illustrated in Figure 3-3, following the text. These refinements were made in an effort to reduce the overall flow to the St. Lucie Canal during the wet season and also attempted to prevent erosion within the St. Lucie Canal by limiting the velocity of flow through the St. Lucie Canal when possible. The second schedule evaluated was a seasonal 15.5-16.5 ft., NGVD schedule which because of its one foot zone of variable releases became known as the 15.5-17.5 ft., NGVD schedule. This schedule was approved by the Chief of Engineers in Part IV, Supplement 2, Section 7, dated 25 February 1959. It was determined that the 15.5-16.5 ft., NGVD schedule would provide the same level of irrigation benefits as the flat 16.4 ft., NGVD schedule. This report pointed out that large additional benefits could be obtained from sufficient conservation storage in Lake Okeechobee to supply the need of urban areas along the coast during droughts. In addition, this schedule would provide seasonal flood control storage which would help minimize damages caused to estuaries by large regulatory releases.

**B.6.1.4**     1965

In 1965, the regulation schedule was modified to allow storage to accumulate during the wet season. This was in response to the dry conditions of the early 1960's and particularly the dry spring months of the same year so that water could be stored for water use purposes. This schedule was only in operation for the summer and fall of 1965. This was one of the first schedules put into operation that did not have the lowest point of the schedule immediately prior to the peak of hurricane season.

**B.6.1.5**     1966

The schedule put into operation in January 1966 was derived primarily in accordance with an interagency agreement to deliver water to the ENP.

**B.6.1.6**     1972

In 1972, Zone C was discontinued and the lowest level on Zone B was raised one-half of one foot in an attempt to increase water supply.

**B.6.1.7**     1978

The 1978 schedule increased the range of water levels over which the lake is operated from 14.5-16.0 ft., NGVD, to 15.5-17.5 ft., NGVD. This regulation schedule was created in an effort to store a greater amount of water, available during the wet periods, for use during subsequent extended dry periods. During the period between 1960 and 1978, the lake experienced several extended periods during which rainfall amounts remained precariously low. The available water supply stored in the lake was stressed several times during this period, particularly in 1971 and 1974. In addition, with the projected increase in water use requirements of the service areas surrounding the lake and those of

the LEC, it was estimated that the situation might get worse in the future. The 1978 schedule defines three zones. A brief description of those zones is provided below.

#### B.6.1.7.1 Zone C

The bottom zone, Zone C, is characterized by an upper limit between 15.5 and 17.5 ft., NGVD. These levels define the conservation pool and they reflect the maximum desirable water surface elevations for Lake Okeechobee. When the lake stage is within Zone C, SFWMD allocates water to various users. The only other releases are related to navigation.

#### B.6.1.7.2 Zone B

Zone B extends one foot above Zone C and it defines lake level conditions under which moderate regulatory releases are made from the lake to the St. Lucie and Caloosahatchee estuaries. Due to problems associated with large releases, discharges are limited to 2,500 cfs into St. Lucie Canal and 4,500 cfs into the Caloosahatchee River. The major problems associated with larger discharges are related to sedimentation and disruption of favorable salinity regimes in the estuaries.

#### B.6.1.7.3 Zone A

Zone A lies above Zone B, and it corresponds to the maximum, safe release of floodwaters from the lake. This zone defines the point at which up to maximum regulatory releases are initiated through all of the lake's outlets. Those discharges should be maintained until the lake level recedes to a point in Zone B. While a Zone A condition does not necessarily imply the existence of flooding due to excess water in the lake, it is very important that the lake level be reduced quickly to provide adequate storage capacity for the next possible flood event. The reduction in lake level is directed primarily at relieving levee stress and erosion, and at reducing detrimental impact on the lake's littoral zone.

### **B.6.1.8 Run 25**

In May 1992, an alternative regulation schedule, RUN 25, was put into effect for a two year period (Figure 3-8). The RUN 25 schedule ranges from 15.65 to 16.75 ft., NGVD, with multiple operation zones that vary flood releases over a wide range before reaching maximum release rates. The purpose of the 15.65 to 16.75 ft., NGVD regulation schedule is to reduce damaging flows to the St. Lucie Canal and Caloosahatchee River estuaries without sacrificing the flood control or water supply benefits derived from the lake. The two year test period was extended for three months. In 1994, an Environmental Assessment (EA) resulting in a Finding of No Significant Impact (FONSI) was prepared for the schedule referred to as Run 25. Lake Okeechobee was operated under the Run 25 schedule until 2000.

### **B.6.1.9 Water Supply and Environment**

A Final Environmental Impact Statement (EIS) supporting the Water Supply and Environment (WSE) was completed in 1999, with a Record of Decision (ROD) signed in July 2000. When the WSE schedule was approved in 2000, south Florida was in the beginning of a severe drought that lasted through much of 2001. Lake Okeechobee experienced a record low water level of 8.82 ft. NGVD on July 2, 2007. Then to the other extreme, Lake Okeechobee experienced consecutive very wet summers in 2003-2005, with the water level reaching a high of 18.02 ft. NGVD on October 13, 2004. Much of the wet weather pattern was a result of the historically significant hurricane seasons in 2004 and 2005. WSE did not allow for sufficient releases to be made under the hydrological conditions that existed at

that time. Due to the continuing problems with high water elevations under the WSE schedule, in 2003, the Corps officially deviated from the WSE schedule in an attempt to lower Lake Okeechobee. The WSE regulation schedule limited releases from Lake Okeechobee during certain hydrological conditions when water levels were high and during some periods when the lake's littoral zone and estuaries would have benefited from such releases.

**B.6.1.10 2008 LORRS**

In 2008, a Final Supplemental Environmental Impact Statement supported operational changes to the Lake Okeechobee Regulation Schedule (2008 LORRS). The Corps expected to operate under this interim schedule until the earlier of (1) implementation of a new Lake Okeechobee schedule as a component of the system-wide operating plan to accommodate the Comprehensive Everglades Restoration Plan (CERP Band 1 projects) and the State of Florida's fast track Acceler8 projects, or (2) completion of HHD seepage berm construction or equivalent dike repairs for reaches 1, 2 and 3.