TECHNICAL MEMORANDUM

AN ATLAS OF EASTERN DADE COUNTY SURFACE WATER MANAGEMENT BASINS

By

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South Florida Water Management District
Resource Planning Department
Water Resources Division

AN ATLAS OF EASTERN DADE COUNTY SURFACE WATER MANAGEMENT BASINS

EXECUTIVE SUMMARY

This atlas contains information about the surface water management basins in Dade County, Florida. The South Florida Water Management District (District) and the U.S. Army Corps of Engineers (COE) have authority over water management in these basins. The District has sponsored publication of this atlas so that up-to-date non-technical descriptions of the surface water management basins in Dade County are available to District personnel, to local governments in Dade County, and to other interested persons. By text, maps, and tables of information, the basins are defined and located within the county, and those canals, levees, and control structures within each basin and under the management of the District or the COE are located within the basin and are described and discussed with regard to their operation and management.

The surface water management basins of eastern Dade County, Florida, were first delineated in the 1950s by the COE in their General Design Memorandum (GDM) for the Central and Southern Florida Flood Control Project (Project). Based on the hydrology of the basins, the COE designed and constructed a system of canals, levees, and control structures to provide flood protection for southern and central Florida. The Project is dynamic with new works being constructed and old ones being modified to meet the changing needs of southern Florida. Most of the works constructed under the Project are now under the management of the District.

Seventeen basins are described: the C-1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9, C-100, C-102, C-103, C-111, North Canal, Florida City Canal, Model Land, and Homestead Air Force Base basins. These basins are located in the eastern half of Dade County. Water Conservation Areas 3A and 3B and Everglades National Park which occupy the western half of the county are included in a separate atlas.

The Project canals in Dade County serve a variety of functions. The primary function of all the canals is to provide flood protection for the basins in which they occur. Secondary uses of the canals include land drainage for agriculture and urban or residential development, and regulation of groundwater table elevations to prevent saltwater intrusion into local groundwater. Many of the canals are used to supply water for irrigation and to recharge the wellfields of local municipalities.Two canals, C-6 and C-4, are used to discharge excess water from the Water Conservation Areas to tidewater.

The Project control structures in Dade County regulate the flow of water in the canals. In general they are used to discharge excess water from the basins during flooding and to maintain minimum water levels in the canals during drought periods. Some structures are usually closed to prevent water from passing from one basin to another, but can be opened to supply water from one basin or canal to another as necessary. The coastal structures have the additional function of preventing saltwater from a tidal or storm surge from entering those canals discharging to tidewater.

The South Dade Conveyance System (SDCS) interconnects several of the basins in southern Dade County. The canals associated with SDCS are used to supply water to Everglades National Park and to canals in southern Dade County for irrigation, for well field recharge, and for control of saltwater intrusion into canals and groundwater near the coast.

A bibliography is included with the atlas. It lists publications concerning hydrology and hydraulics, water use, water quality, and land use in Dade County. For the reader unfamiliar with some of the concepts and words used in these descriptions, the appendices contain a discussion of some basic hydrologic and hydraulic concepts, and a glossary of terms.

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ABSTRACT

An atlas of the surface water management basins in eastern Dade County, Florida, is presented. Seventeen basins are described by text, maps, and tables of information. The basins are defined and located within the county, and the canals, levees, and control structures within each basin are located and are described and discussed with regard to their operation and management. Description and discussion of the canals, levees, and control structures in the basins are limited to those works constructed for the Central and Southern Flood Control District. Included as a final section in the atlas is a description of the South Dade Conveyance System (SDCS). The SDCS interconnects several basins in southern Dade County. It is used to supply water from the Water Conservation Areas to the basins in southern Dade County during drought periods.

ACKNOWLEDGEMENTS

This atlas was compiled under the supervision of Richard Tomasello, Supervising Professional Engineer, Water Resources Division, Department of Resource Planning. The authors wish to extend their thanks to the many people who contributed to the completion of this atlas: to Alan Hall whose suggestion it was to publish the atlas as a Technical Memorandum, to Dawn Reid for creating the excellent maps used in the atlas, to Joel Van Arman for producing the tables and for supplying most of the citations in the bibliography, to Nettie Winograd for typing the manuscript, and to the many people who reviewed the manuscript and offered their comments and suggestions.

AN ATLAS OF EASTERN DADE COUNTY SURFACE WATER MANAGEMENT BASINS

INTRODUCTION

This atlas contains information about the surface water management basins in Dade County, Florida. The South Florida Water Management District (District) and the U.S. Army Corps of Engineers (COE) have authority over water management in these basins. The District has sponsored publication of this atlas so that up-to-date non-technical descriptions of the surface water management basins in Dade County are available to District personnel, to local governments in Dade County, and to other interested persons. By text, maps, and tables of information, the basins are defined and located within the county, and those canals, levees, and control structures within each basin and under the management of the District or the COE are located within the basin and are described and discussed with regard to their operation and management.

The surface water management basins of eastern Dade County were first delineated in the 1950's by the COE in their General Design Memorandum (GDM) for the Central and Southern Florida Flood Control Project (Project). Presented in the GDM were the COE's analysis of the hydrology of each basin and an assessment of the flood risk for a storm of specified intensity and duration. Based on the hydrology of the basins, the COE designed a system of canals, levees, and control structures to provide some desired level of flood protection for each basin. Designs of these works were presented in the GDM and in the Detailed Design Memorandum for the Project. Most of the works constructed under the Project are now under the management of the District.

The Project is dynamic. As the population in South Florida has grown, and as land use and water demands have changed, the Project has evolved in response to these changes. Some parts of the original Project were never built, other parts have been rebuilt or modified, and as the need has arisen, new structures have been designed and constructed. In some cases, the basins themselves have been redefined. As the COE can not always participate in construction of new works, the District has occasionally assumed responsibility for design and construction of additions or modifications to the Project.

This atlas describes the seventeen surface water management basins in eastern Dade County, Florida, and the Project works associated with each. An atlas describing the Water Conservation Areas and Everglades National Park which occupy western Dade County is contained in a separate memorandum.

A chapter describing the South Dade Conveyance System (SDCS) follows the basin descriptions. The SDCS is a system of canals and control structures interconnecting several basins in Dade County. It is used to supply water to the Everglades National Park and to basins in southern Dade County. Occasional reference is made to the SDCS in the basin descriptions.

Following the chapter on the SDCS is a bibliography of publications related to the surface water management basins in Dade County. A variety of subjects are included: hydrology, hydraulics of canals and structures, water use, water quality, and land use. Included under hydrology and hydraulics are publications describing

various statistical and mathematical models used by the District to predict rainfall, runoff, and canal flow.

Although the basin descriptions are not technical, the reader unfamiliar with the hydrology of lands within the county and with basic water resources engineering may find some words and concepts unfamiliar. Where this is the case, the reader is referred to the appendices. In Appendix 1, is **BASIC CONCEPTS**, which discusses the important concepts the reader should be familiar with to understand the basin descriptions. In Appendix 2 is a glossary of terms, abbreviations, and acronyms used in these descriptions. Also defined in the glossary are the District's designations for the various Project and District works: canals, levees, and control structures.

Using the Basin Descriptions

Surface water management basins (hereafter drainage basins) in Dade County are identified by the same designation as the major Project canal located in that basin. For example, C-111 is a canal draining 100 square miles in southern Dade County. The drainage basin, therefore, is the C-111 basin.. In most cases, the canal also has a common name by which it is known. For example, C-1 is know as the Black Creek Canal. The common name is given parenthetically in the chapter titles following the Project designation for the canal. A few Project canals in Dade County do not have a Project designation. In these cases, the canals are referenced by name only.

The descriptions of the drainage basins in this atlas have been arranged by geographic location. They are presented as they occur from north to south in the county, beginning with the C-9 basin and ending with the C-111 basin. All of the basins are shown on Figure 1. Map A (folded and placed in the pocket of the flyleaf) is a large map showing the basin boundary, canals, levees, and control structures relative to local roads and landmarks. This map should be referenced to precisely locate basin boundaries and District and Project works within the county.

Each description contains three parts. The first part is a written discussion of the basin and is divided into two sections. The first section, **Description of the Basin**, provides a general description of the basin and its Project and District works: the drainage area; the general location of the basin within the county; the purpose of and general operation of canals in the basin; the alignment of and direction of water flow in these canals; the location of inlets and outlets to the canals; and the location, purpose, and operation of structures controlling flow in the canals. The second section, **Comments on Design and Historic Operation**, provides commentary on a variety of topics related to the basin: the design storm (see **Design Storm** under **BASIC CONCEPTS**); significant changes to the basin and its works (e.g., urban development or enlargement of a canal) since the GDM was written , particularly with regard to any changes in flood protection for the basin; and proposals under consideration to redefine the basin or to modify any canals or control structures.

The second part of each basin description is a set of two maps. The first map locates the basin relative to other basins in Dade County. The second map is a schematic drawing of the basin and its canals and control structures. It is intended that these maps should be used in conjunction with the written descriptions to understand the layout and operation of canals and structures in the basin. Major roads and landmarks are included on the schematic maps to help the reader locate

the basin within the county. Precise location of canals or structures within the basin can be obtained by reference to Map A.

The third part of each basin description is a table presenting information about Project and District control structures (see **Control Structures** under **BASIC CONCEPTS**) located in the basin. The tables provide a physical description of each structure: type of structure, method of controlling water flow, and pertinent dimensions or elevations. Where a structure has been designed to pass a specified discharge under specified conditions of upstream and downstream water levels, this information is included as the design discharge, design headwater stage, and design tail water stage, respectively. The specified discharge is generally the flood discharge expected to pass the structure for the design storm (see **Design Storm** under **BASIC CONCEPTS**). In some cases, however, the design discharges may refer to water passed through the structure to supply downstream users or to maintain a specified water level in a canal downstream. If a structure was designed to be used to maintain a specified upstream water level under normal non-flooding conditions, this information is included as the optimum headwater stage. Peak water levels upstream and downstream of the structures, and peak discharges through the structures, are also given for those structures where this information has been recorded. Other information about the structures may be cited as relevant.

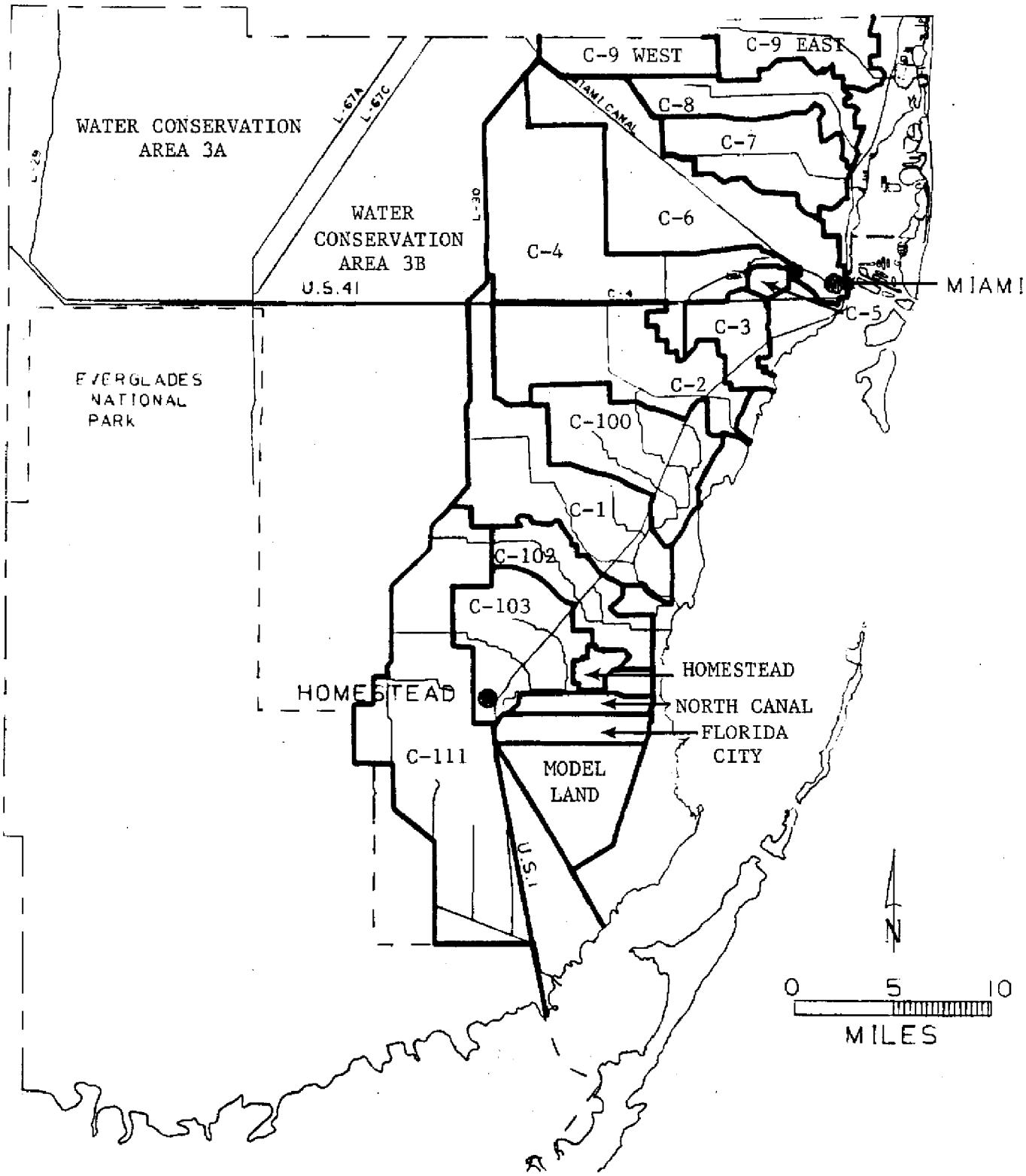


FIGURE 1 DADE COUNTY DRAINAGE BASINS

C-9 (SNAKE CREEK CANAL) BASIN

Description of the Basin

The C-9 basin has an area of approximately 98 square miles and is located in northeastern Dade County (39 square miles) (Figures 2 and 4) and southeastern Broward County (59 square miles). The basin is comprised of two subbasins, C-9 East (45 square miles) and C-9 West (53 square miles). The boundary between the subbasins is Flamingo Road in Broward County and N.W. 67th Avenue in Dade County. The subbasin boundaries relative to local roads and landmarks are shown on Map A. Schematic maps showing the basin boundaries, canals, and control structures are given in Figures 3 and 5.

There are two Project canals in the C-9 basin: C-9 and the L-33 borrow canal. These canals have three functions: (1) to provide flood protection and drainage for the C-9 basin, (2) to supply water to the basin for irrigation and municipal water supply, and (3) to maintain a groundwater table elevation near the lower reach of C-9 adequate to prevent saltwater intrusion into local groundwater. During periods of low natural flow, water is supplied to the basin from Water Conservation Area (WCA) 3B either as seepage through L-33 or by way of C-6 and S-32.

C-9 begins in the east borrow canal of L-33 one mile north of the intersection of L-30 and L-33 and one-half mile west of U.S. Highway 27. Flow in C-9 is to the east with discharge via S-29 to Dumbfoundling Bay.

The L-33 borrow canal is aligned north-south along the west boundary of the C-9 basin and is connected to C-9 at its west end by way of S-32. Seepage from WCA 3B is intercepted by the borrow canal and is the primary source of water supplied to the C-9 basin. The rate of seepage from the WCA is controlled by the stage maintained in the borrow canal. During the dry season, when the rate of seepage to the L-33 borrow canal may be reduced because of low water in WCA 3B, water can be supplied to the C-9 basin from C-6 by way of S-32 and the L-33 borrow canal.

When drainage to C-9 is more than adequate to maintain the optimum stage in the canal, excess water from rainfall and seepage can be stored in the area between L-33 and U.S. Highway 27. This water can be released to C-9 through S-30 as needed for water supply.

There are three Project control structures in the C-9 basin: S-29, S-30, and S-32. (1) S-29 is a gated spillway located in C-9 just east of U.S. Highway 1. It controls stages in C-9, and it regulates discharges to tidewater. A headwater stage is maintained by S-29 adequate to prevent intrusion of saltwater into local groundwater and to provide for recharge of well fields near C-9. (2) S-30 is a gated spillway located in C-9 on the west side of U.S. Highway 27. S-30, S-32, and S-9XS (in the C-11 basin) control the stage held in the L-33 borrow canal. S-30 also regulates the amount of water entering C-9 from the L-33 borrow canal. (3) S-32 is a gated culvert located in the L-33 borrow canal just north of C-6. In addition to controlling

the stage in the L-33 borrow canal, S-32 regulates discharges from C-6 to the L-33 borrow canal.

Design criteria for the structures in this basin are given in Table 1.

There is one small tributary canal, known locally as the Snake Creek Canal. The canal is aligned north-south, west of and parallel to Flamingo Road, and makes an open channel connection with C-9. Normal flows in the canal are to the south. Flows of 110 to 140 cfs are pumped to this canal from a portion of the C-11 basin in the Pembroke Pines area. Without pumping, the runoff from the Pembroke Pines area would flow north to C-11S. Of the flow entering C-9 from the Snake Creek Canal, 40-50 cfs may subsequently be diverted to C-8 by way of the west borrow canal of N.W. 67th Avenue.

The C-9 West subbasin is in Area B (Appendix 2). Area B is poorly drained and is subject to severe limitations on development.

Comments on Design and Historic Operation

C-9 in the eastern subbasin was designed to pass 100 percent of the Standard Project Flood. The western subbasin, however, is very prone to flooding because of low ground surface elevations relative to the eastern subbasin. Major storms can reverse flow in C-9 from east to west because of rapid runoff into the eastern reaches of C-9. Allowable pumped inflow to C-9 in the western subbasin is limited to three-quarters of an inch of runoff per day. However, unlimited gravity inflow to C-9 is allowed in the western basin if development limitations are met.

Seepage from Water Conservation Area 3B is a major contributor to flows in C-9. Contributions can be as high as 250 cfs. Average daily discharges from C-9 range from 191 cfs in January to 416 cfs in September.

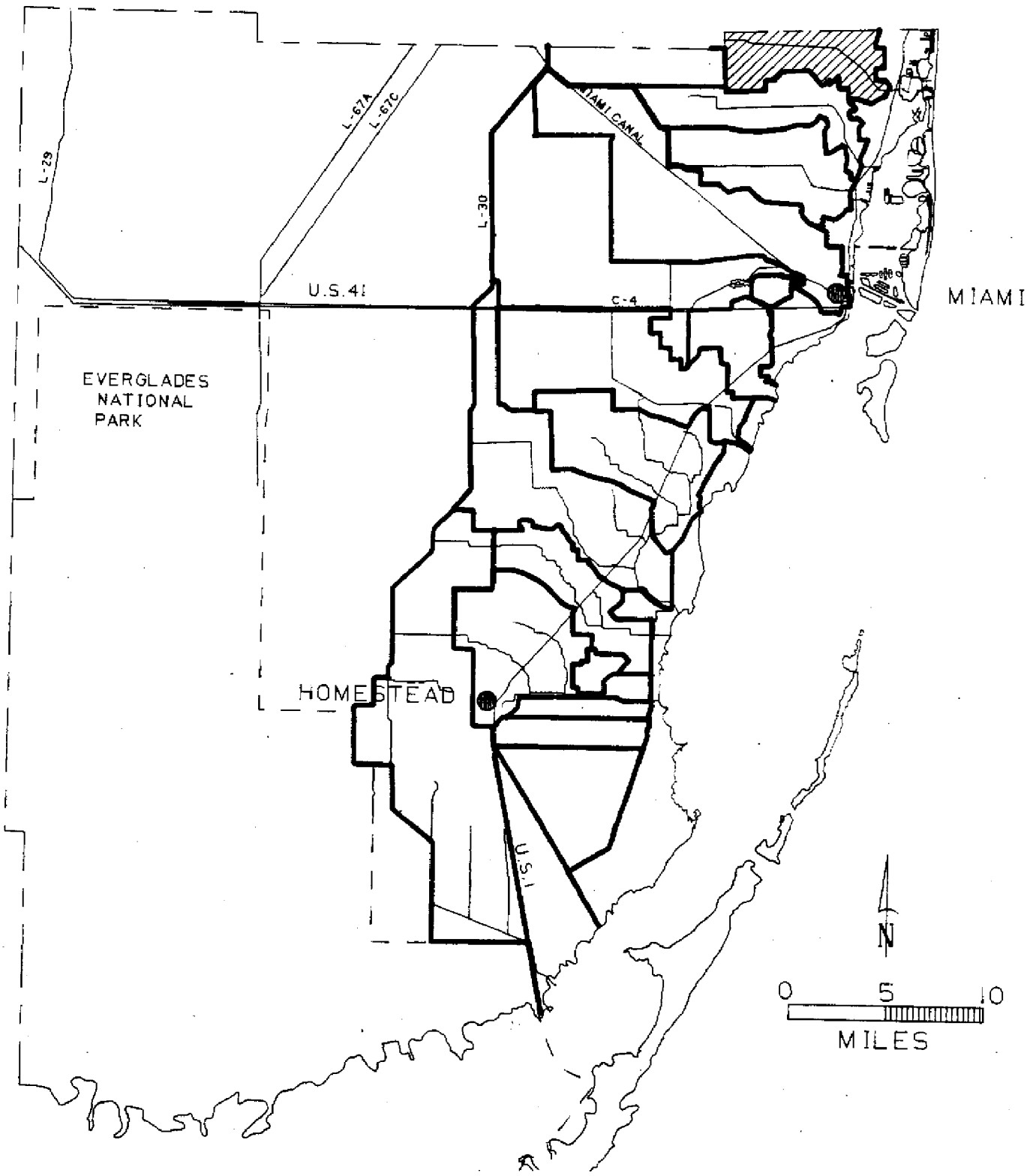


FIGURE 2 C-9 EAST BASIN LOCATION MAP

C-9 EAST

~34.000 ACRES

~14.000 ACRES DADE

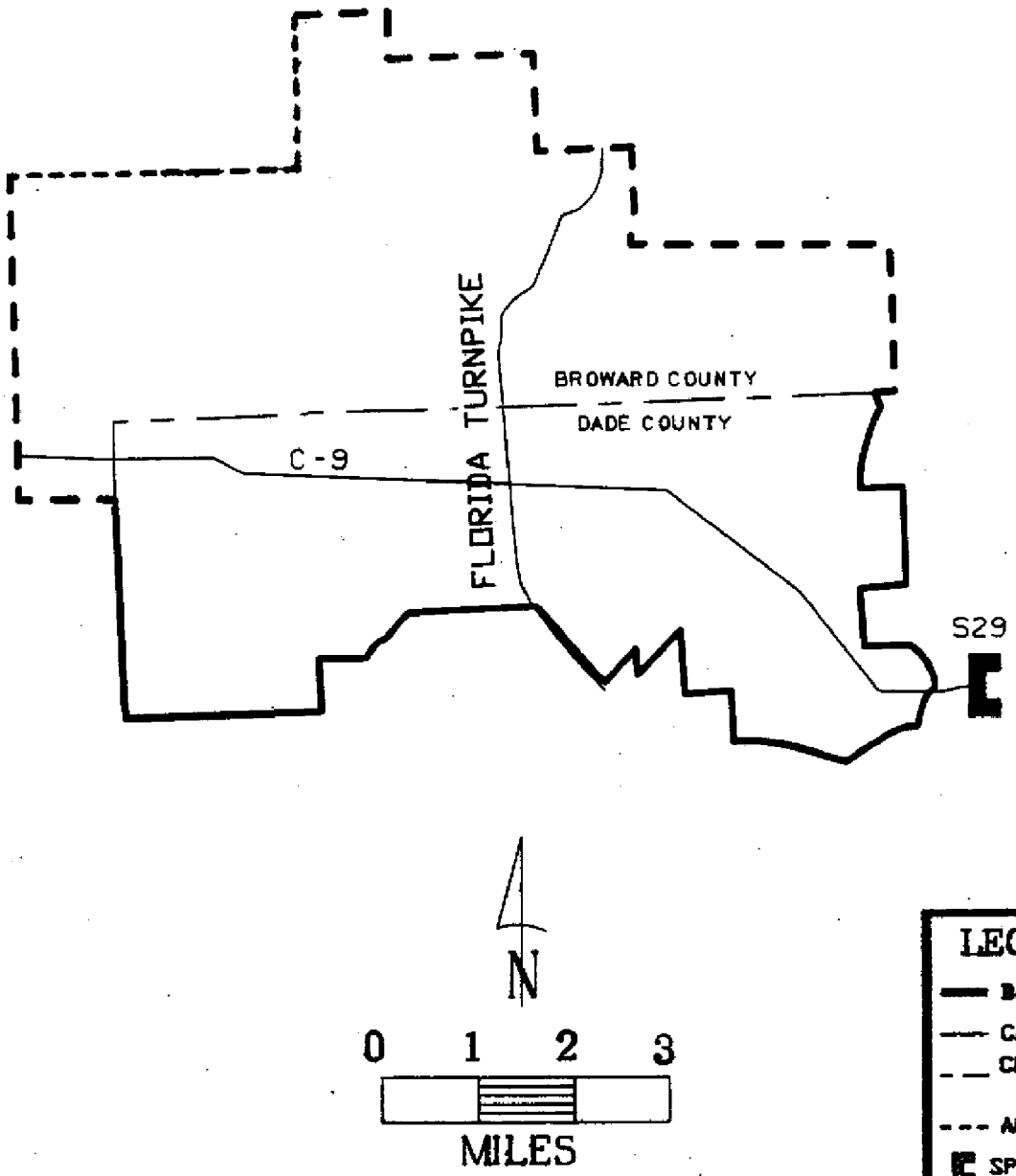
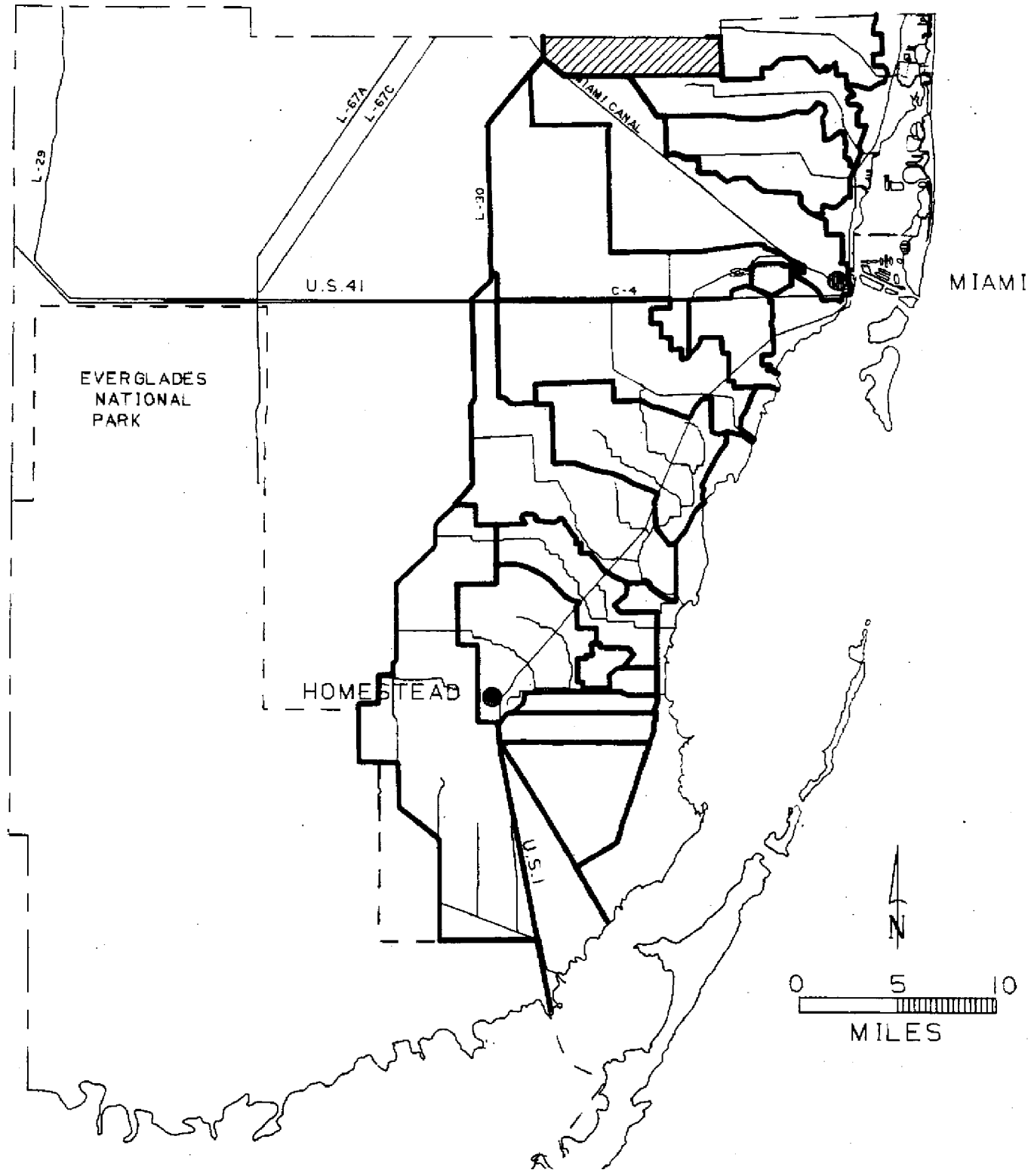


FIGURE 3 C-9 EAST BASIN MAP



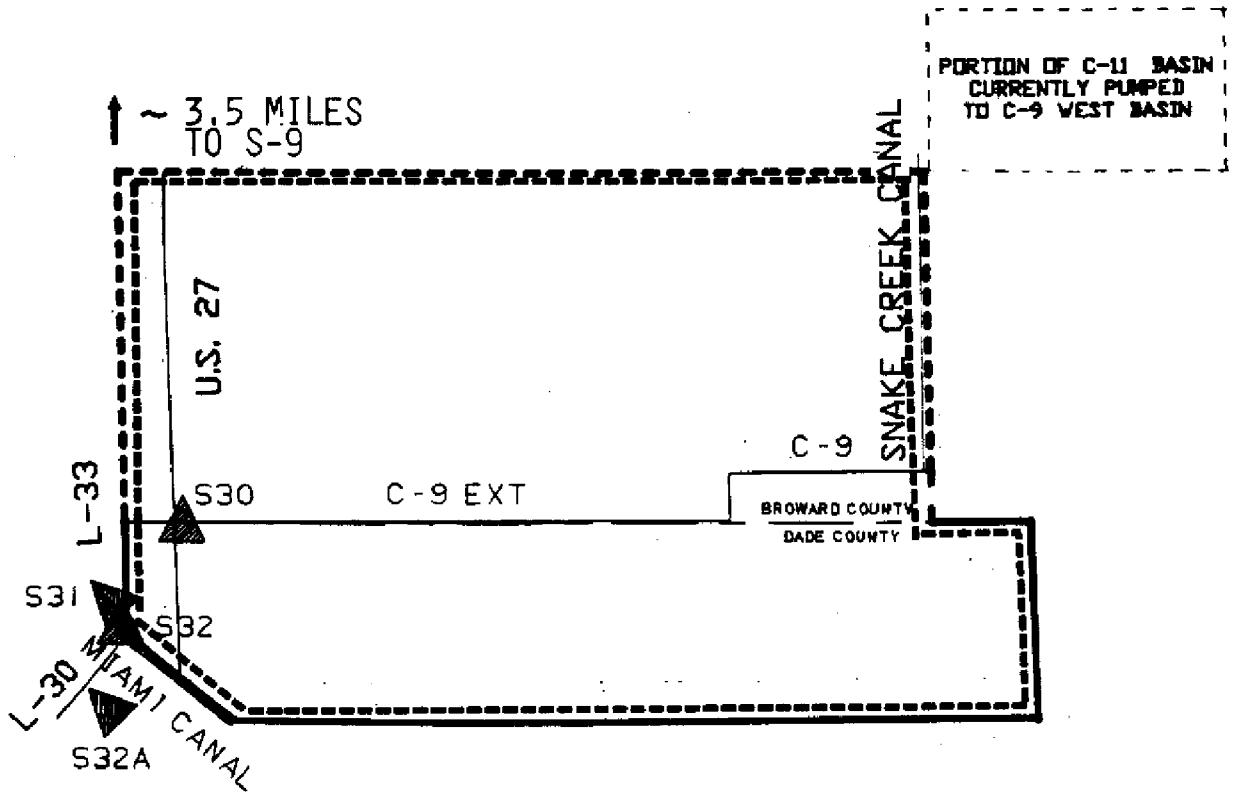
C-9 WEST BASIN

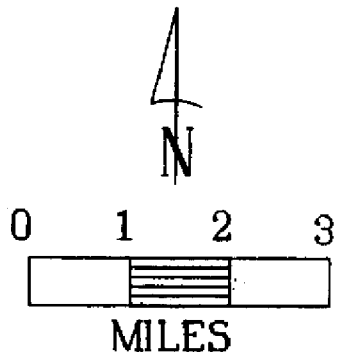
FIGURE 4 C-9 WEST BASIN LOCATION MAP

C-9 WEST

~29.000 ACRES

~ 11.000 ACRES DADE





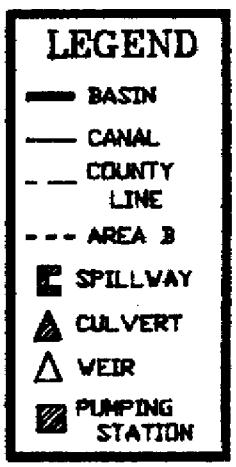


FIGURE 5 C-9 WEST BASIN MAP

TABLE 1. C-9 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-29 Stage divide	Spillway, 4 gates, 22ft x 15ft Crest lgth = 88ft Crest elev = 11ft NGVD	3.0	2.5	~2.0	4780	HW = 3.88 Q = 4100	9/8/65 9/19/64
S-31 Controls outflow from CA-3B to C-6	Gated Culvert 3-84inx172ft CMP Invert elev = -3.0ft NGVD	6.0 (Not fixed Used for regulatory or water supply discharges from CA-3B to C-6)	4.0 (Not fixed Used for regulatory or water supply discharges from CA-3B to C-6)		700	TW = 6.59 Q = 1090	7/1/82 3/20/70
S-30 Controls water stored between L-30 and US Hwy 27	Gated Culverts 3-84in x 288ft CMP Invert elev = -5.0ft NGVD			6.8 (L-30 borrowcanal)	560		
S-32 Water supply to C-9	Culvert 1-72"x40ft CMP Invert elev = -2.0ft NGVD			6.8 (L-30 borrowcanal)		HW = 6.59	7/1/82

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-8 (BISCAYNE CANAL) BASIN

Description of the Basin

The C-8 basin has an area of approximately 31.5 square miles and is located in northeastern Dade County (Figure 6). The basin boundary relative to local landmarks and roads is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 7.

C-8 is the only Project canal in the C-8 basin. The canal has two functions: (1) to provide flood protection and drainage for the C-8 basin, and (2) to maintain a groundwater table elevation adequate to prevent saltwater intrusion into local groundwater.

C-8 begins in the east borrow of the Palmetto Expressway at the northwest corner of the Miami Lakes subdivision. Flow in the canal is to the east with discharge via S-28 to Biscayne Bay just south of the municipal boundary between Miami Shores and Biscayne Park.

There is one Project control structure in the C-8 basin. S-28 is a gated spillway located in C-8 just west of the Florida East Coast Railway. The structure controls stages in C-8, and it regulates discharges to tidewater. A headwater stage is maintained by S-28 adequate to prevent saltwater intrusion to local groundwater. Design criteria for S-28 are given in Table 2.

The portion of the C-8 basin west of the Palmetto Expressway (4.3 square miles) is in Area B (Appendix 2). Area B is poorly drained and is subject to severe limitations on development.

Comments on Design and Historic Operation

C-8 (in Area A) was designed to pass 100 percent of the Standard Project Flood. The design flow is 3220 cfs. Only 200 cfs of this design flow is for runoff from the portion of the C-8 basin in Area B.

Since the construction of the canal, large borrow lakes have been created in the western reaches. These lakes have probably lowered the actual stages in the canal relative to those specified in the Army Corps of Engineers General Design Memorandum. This has not been documented.

Pre-Project water surface elevation control for C-8 consisted of a sheet pile weir located at N.E. 131st Street. The Project control for C-8, S-28, was constructed two miles downstream of this sheet pile weir. This location was chosen so that the canal could be used to maintain local water table elevations high enough to prevent saltwater intrusion into a local wellfield. The average water table elevation rose from 0.7 ft NGVD to about 2.0 ft NGVD which is the mean ground surface elevation. This created flooding problems for a small subdivision called Seaboard Acres. The flooding was alleviated by installing a pump station designed to maintain water table elevations in the subdivision between 0.5 and 1.1 ft NGVD.

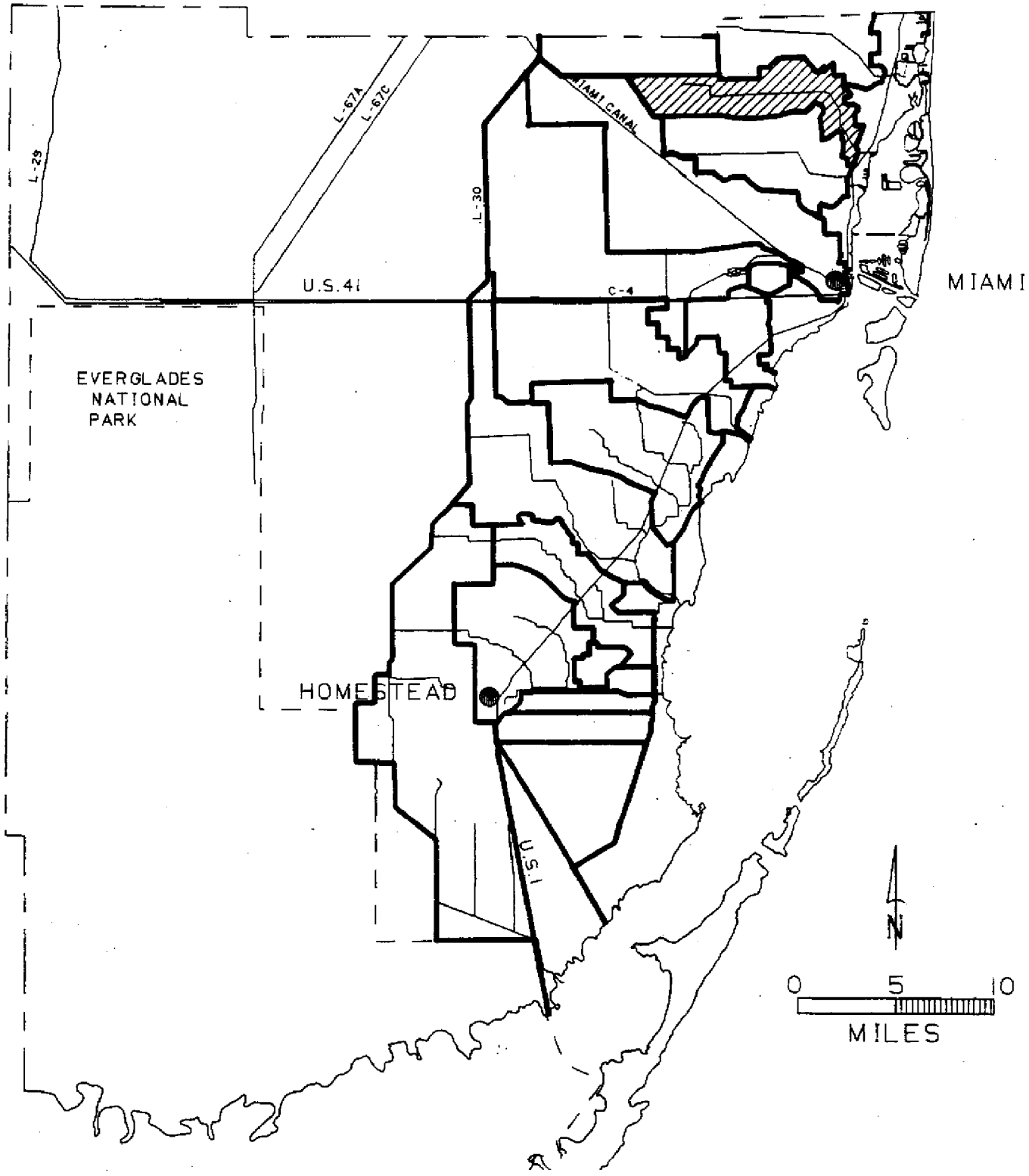


FIGURE 6 C-8 BASIN LOCATION MAP

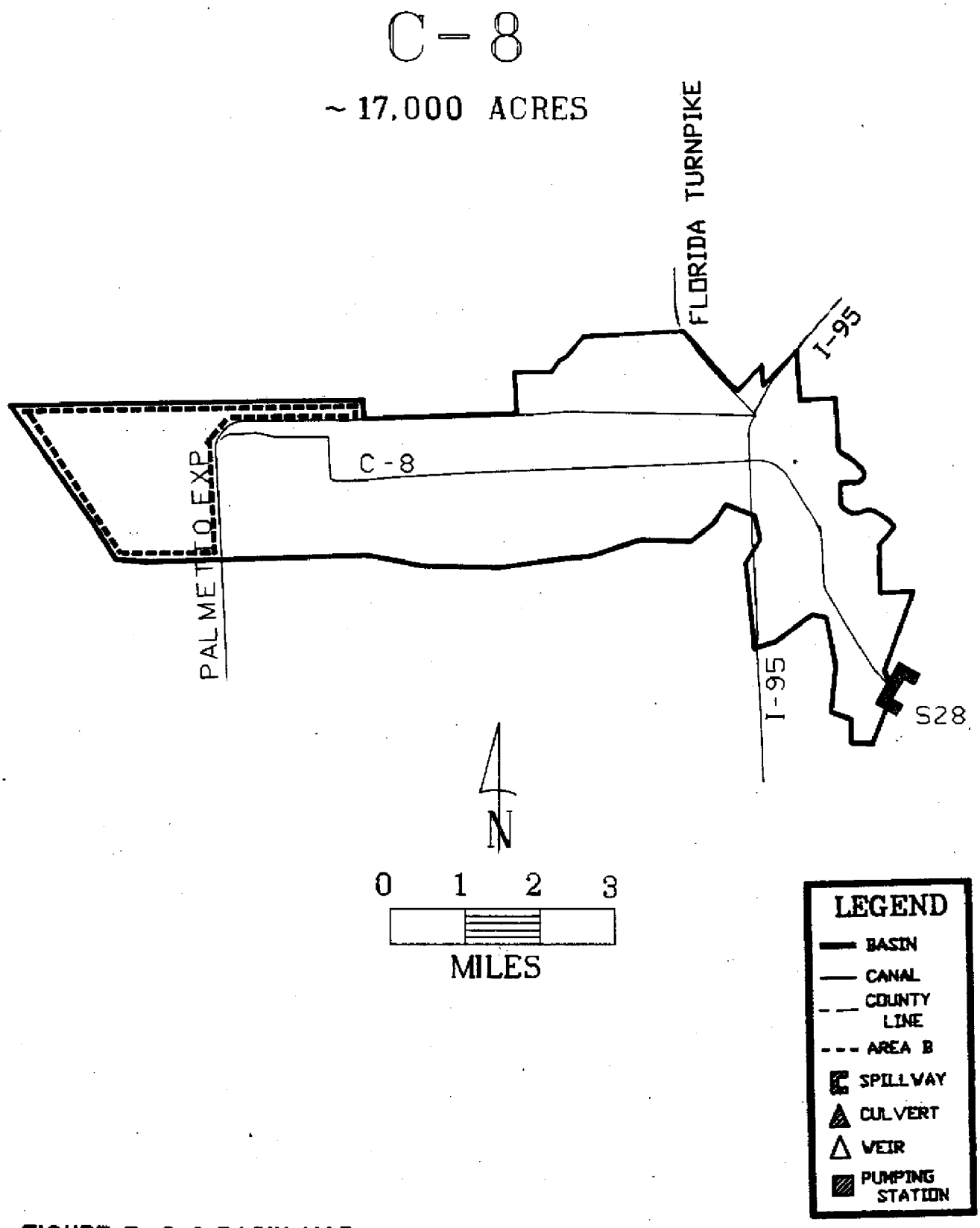


FIGURE 7 C-8 BASIN MAP

TABLE 2. C-8 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-28 Stage divide	Spillway, 2 gates 27ftx17.5ft Crest lgth = 54ft Crest elev = 13.5ft NGVD	2.3	1.8	1.8	3220	HW = 4.24 Q = 1640ds Q = 835ups	10/31/65 5/29/66 9/8/65

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-7 (LITTLE RIVER CANAL) BASIN

Description of the Basin

The C-7 basin has an area of approximately 35 square miles and is located in northeastern Dade County (Figure 8). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 9.

C-7 is the only Project canal in the C-7 basin. The canal has two functions: (1) to provide flood protection and drainage for the C-7 basin and (2) to maintain a groundwater table elevation adequate to prevent saltwater intrusion into local groundwater. During periods of low natural flow, water is supplied to the basin from C-6.

C-7 is a bifurcation of C-6, beginning one mile west of the intersection of West 49th Street and the Palmetto Expressway. Flow in the canal is to the east with discharge via S-27 to Biscayne Bay.

There are two Project control structures in the C-7 basin: S-27 and G-72. (1) S-27 is a gated spillway located in C-7 at the Florida East Coast Railway crossing. It controls stages in C-7, and it regulates discharges to tidewater. A headwater stage is maintained by S-27 adequate to prevent saltwater intrusion into local groundwater. (2) G-72 is a gated culvert located in C-7 at the canal's bifurcation of C-6. G-72 is normally closed and acts as a divide between the C-6 and C-7 basins. It can be opened to supply water from C-6 to the C-7 basin when the stage in C-7 is below optimum.

Design criteria for the structures in this basin are given in Table 3.

If the stage in C-6 is high enough, up to 50 cfs will flow from C-6 to C-7 by way of the borrow canal along the Palmetto Expressway.

The portion of the C-7 basin west of the Palmetto Expressway is in Area B (Appendix 2). Area B is poorly drained and is subject to severe limitations on development.

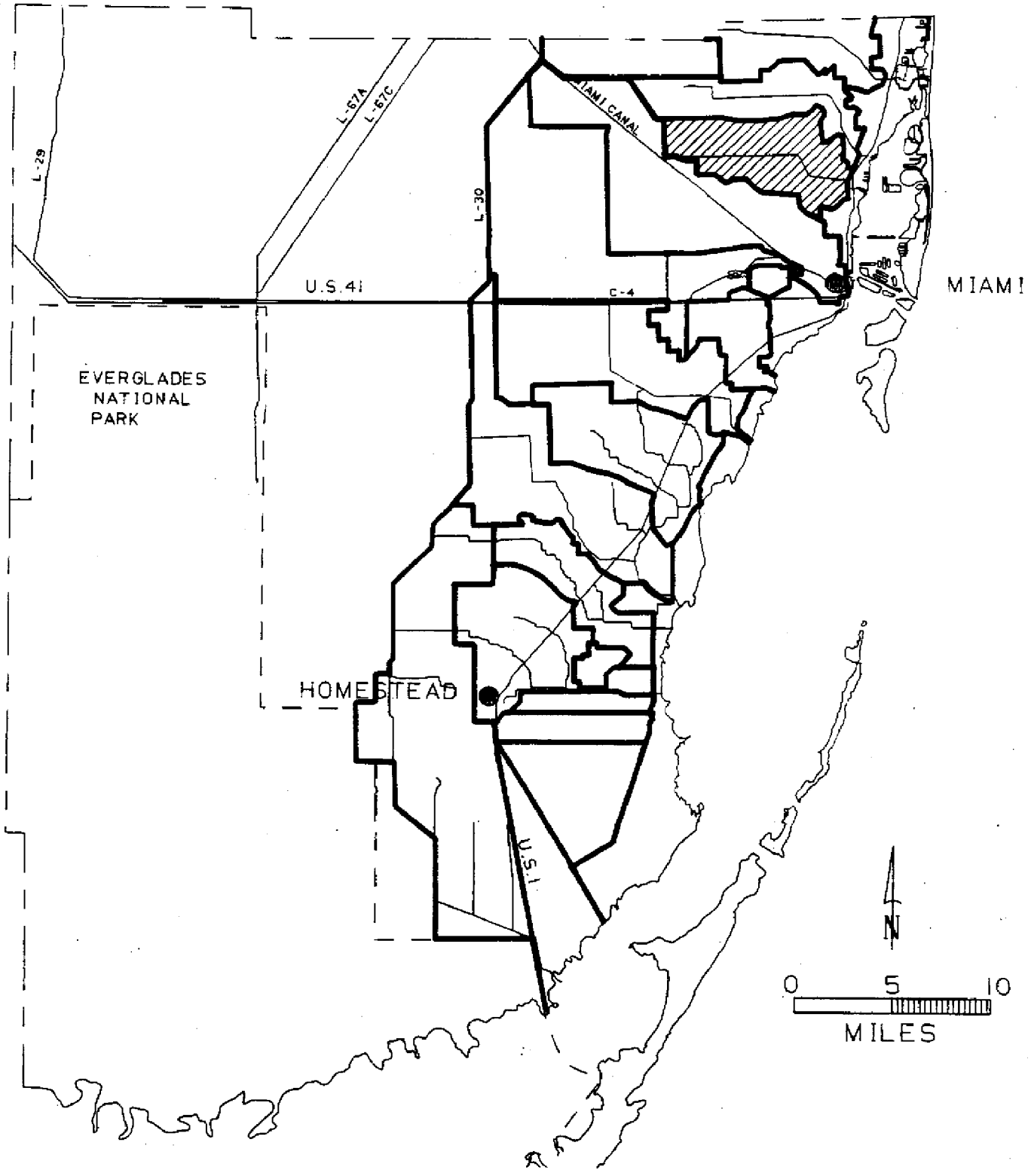
Comments on Design and Historic Operation

C-7 was designed to pass the runoff from a 1-100 year storm. However, much of this basin (west of Red Road) was in agricultural production at the time the canal was designed and constructed. Subsequent development of the area to residential and commercial properties may have significantly increased the runoff and decreased the flood protection provided by the canal.

The original Dade County control on C-7 was a sheet pile weir at N.W. 2nd Street approximately one mile upstream of the present control structure, S-27. The location for S-27 was chosen so that the canal could be used to raise local water table elevations high enough to prevent saltwater intrusion into local groundwater. Raising the water table created drainage problems for theresidential area of Little

River Acres. Streets and yards flooded whenever the rainfall exceeded about two inches. More severe storms caused flooding of homes. A pump station has recently been installed in Dade County that maintains the water table elevation in the subdivision at a level low enough to minimize drainage problems regardless of the surrounding water table elevation. The District should now be able to raise the optimum water surface elevation in the canal from 1.7 ft NGVD to 2.2 ft NGVD without causing further drainage problems in Little River Acres.

Some of Dade County's secondary canals connect C-7 to the C-6 and C-8 canals.



C-7 BASIN

FIGURE 8 C-7 BASIN LOCATION MAP

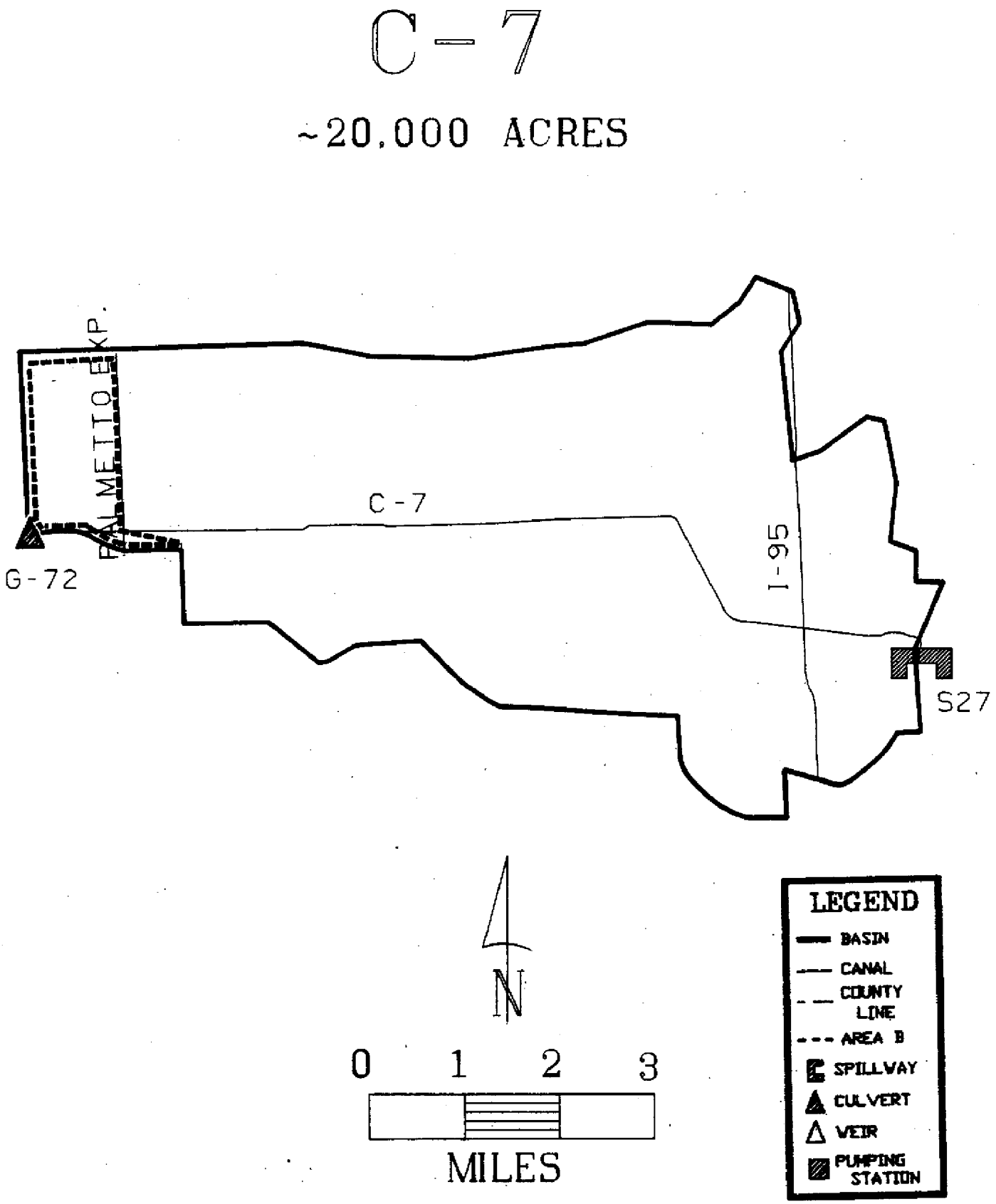


FIGURE 9 C-7 BASIN MAP

TABLE 3. C-7 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-27 Stage divide	Spillway, 2 gates 27ft x 15ft Crest lgth = 54ft Crest elev = 11.0ft NGVD	3.2	2.7	~1.7	2800	HW = 4.49 Q = 1100 HW = 3.81 Q = 892	9/8/65 10/29/64 4/25/79 4/25/79
G-72 Divide C-7 and C-6 basins	Culvert 4-72in x 75ft CMP Flashboards Variable Invert elevs = -2.44 to -1.97ft NGVD				(Divide structure water supply)		

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-6 (MIAMI CANAL) BASIN

Description of the Basin

The C-6 basin has an area of approximately 69 square miles and is located in eastern Dade County (Figure 10). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals and control structures is given in Figure 11.

C-6 is the only Project canal in the C-6 basin. The canal has four functions: (1) to provide flood protection and drainage for the C-6 basin, (2) to supply water to the C-6, C-7, and C-9 basins for irrigation and municipal water supply, (3) to maintain a groundwater table elevation near the lower reach of C-6 adequate to prevent intrusion of saltwater into local groundwater, and (4) to accept flows from the C-5 and C-4 canals and to convey these discharges to Biscayne Bay. During periods of low natural flow, water is supplied to the C-6 basin from WCA 3B as needed to maintain the optimum stage in C-6 and to recharge wellfields at Hialeah and Miami Springs. Water is subsequently diverted from C-6 to the C-7 and C-9 basins as needed to maintain the optimum stages in the canals in those basins and to recharge wellfields near C-9. C-4 and C-5 discharge to tidewater in C-6 downstream of S-26.

C-6 begins at S-31 at the intersection of L-30 and L-33 just west of State Road 27. Flow in the canal is to the southeast with discharge via S-26 to Biscayne Bay just north of U.S. Highway 41.

There are four Project canals connected to C-6: C-4, C-5, C-7, and the L-33 borrow canal. C-4 and C-5 are tributary to C- 6. C-4 makes an open channel connection with C-6 just upstream of State Road 9, and C-5 makes an open channel connection with C-6 three-quarters of a mile downstream of S-26. Normal flows are from C-4 and C-5 to C-6. C-7 is a bifurcation of C-6, beginning one mile west of the intersection of W. 49th Street and the Palmetto Expressway. Normal flows are from C-6 to C-7 by way of G-72. The L-33 borrow canal is connected by way of S-32 to the west end of C-6. The borrow canal is aligned north-south along the east boundary of WCA 3B. Normal flows are from C-6 to the borrow canal.

There are five structures controlling flow in the C-6 basin: S-26, S-31, G-72, S-32, and S-32A.

1. S-26 is a gated spillway located in C-6 at the 36th Street crossing. This structure controls stages in C-6, and it regulates discharges to tidewater. A headwater stage is maintained by S-26 adequate to prevent intrusion of saltwater into local groundwater.

2. S-31 is a gated spillway in L-33 at the west end of C-6. It is used to supply water from Water Conservation Area (WCA) 3B to the C-6 basin directly, to the C-9 basin by way of S-32 and the L-33 borrow canal, and to the C-7 basin by way of C-6 and G-72.

3. G-72 is a gated culvert located in C-7 at the bifurcation of C-7 and C-6. It is normally closed and acts as a divide between the C-6 and C-7 basins. It may be opened to supply water from C-6 to C-7 when the stage in C-7 is below optimum.

4. S-32 is a gated culvert located in the L-33 borrow canal north of C-6. This structure (along with S-30 and S-9XS) is used to regulate the stage in the L-33 borrow canal to control seepage from WCA 3B. The structure is also used to supply water to C-9 from C-6 by way of the L-33 borrow canal and S-30, during the dry season when seepage to the L-33 borrow canal may not be adequate to supply the C-9 basin with water for irrigation and to maintain the optimum stage at S-29.

5. S-32A is a gated culvert in the L-30 borrow canal south of C-6. It is always closed and acts as a divide between the C-6 and C-4 basins.

Design criteria for the structures in the basin are given in Table 4.

If the stage in C-6 is high enough, up to 50 cfs of water flows from C-6 to C-7 by way of the borrow canal along the Palmetto Expressway.

The portion of the C-6 basin upstream of the Florida East Coast Railroad is in Area B (Appendix 2). Area B is poorly drained and is subject to severe limitations on development.

Comments on Design and Historic Operation

C-6 was designed to pass 100 percent of the Standard Project Flood from Area A (downstream of the Florida East Coast Railroad). The design flow for the canal is 3470 cfs. Of this flow 1240 cfs is for runoff from the 11.6 square miles of Area A and 2230 cfs is for runoff from the 40 square miles of Area B.

S-31 is opened when normal drainage is not adequate to supply water via C-6 to wellfields in Hialeah and Miami Springs. During the dry season months of March, April, and May up to 500 cfs have been discharged to C-6 to recharge the wellfields. With the opening of the Northwest Wellfield, the demand for pumpage from the Hialeah and Miami Springs wellfields will be reduced. Consequently the distribution of surface water diverted for groundwater recharge of wellfields will change. Water will be diverted from WCA 3B to the Northwest Wellfield by way of the L-30 borrow canal, and an enlarged Dade-Broward levee borrow canal (see Comments on Design and Historic Operation for C-4)

S-31 is also used to make discharges of excess water from WCA 3A to tidewater when the stage in WCA 3A is above its regulation schedule. Water is released to WCA 3B from WCA 3A by way of S-151, and then released to C-6 from WCA 3B by way of S-31. Discharges of up to 1000 cfs have been made.

C-4 and C-6 are connected by the Florida East Coast Railway borrow canal that runs north-south along the west side of the Miami International Airport. It is possible to pass up to 100 cfs south from C-6 to C-4.

Backpumping of the runoff from the Area B portion of the C-6 basin has been proposed. The plan calls for pumping 3200 cfs into WCA 3B. A design section and hydraulic profile for C-6 has been calculated for this rate of pumping.

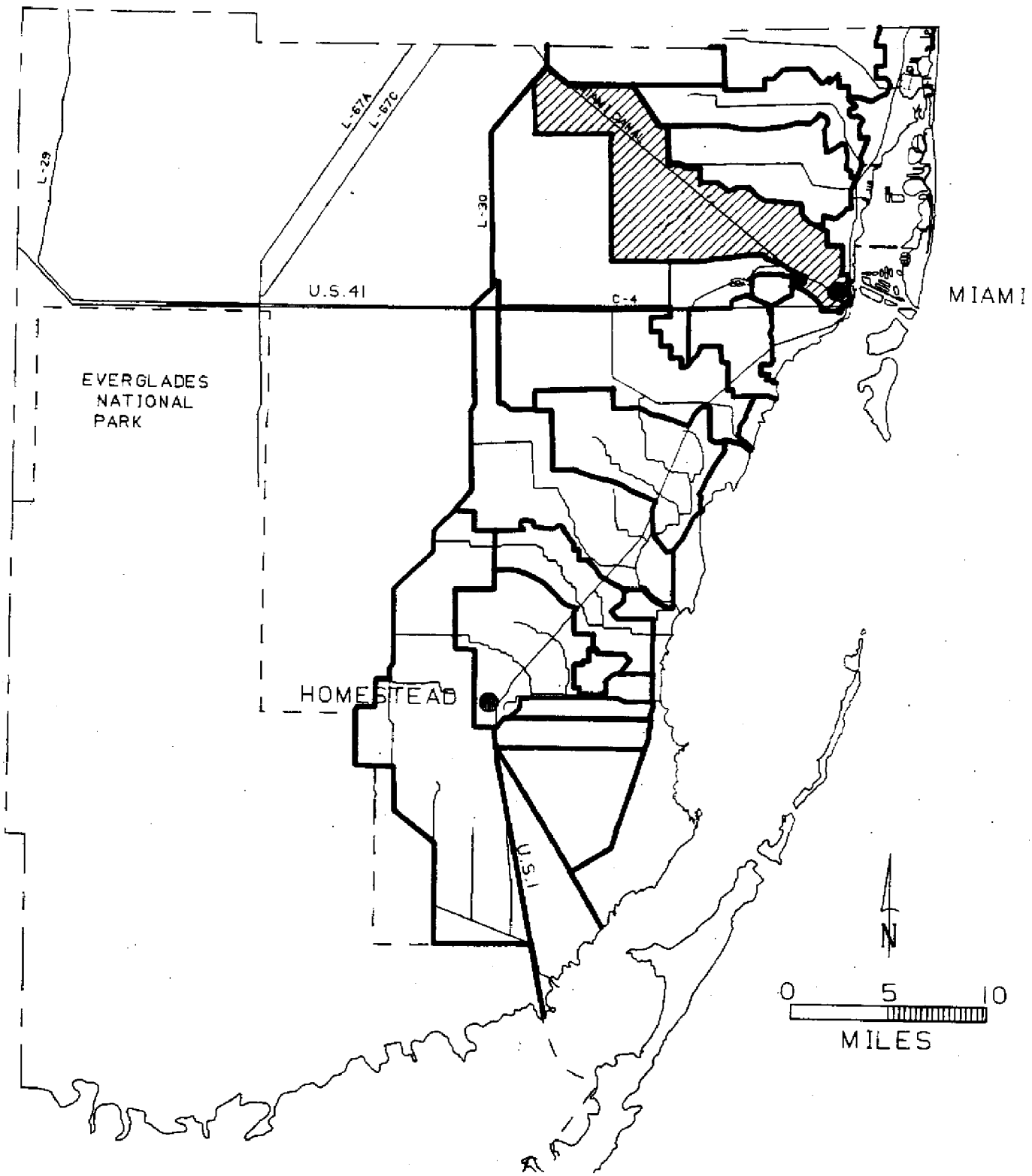


FIGURE 10 C-6 BASIN LOCATION MAP

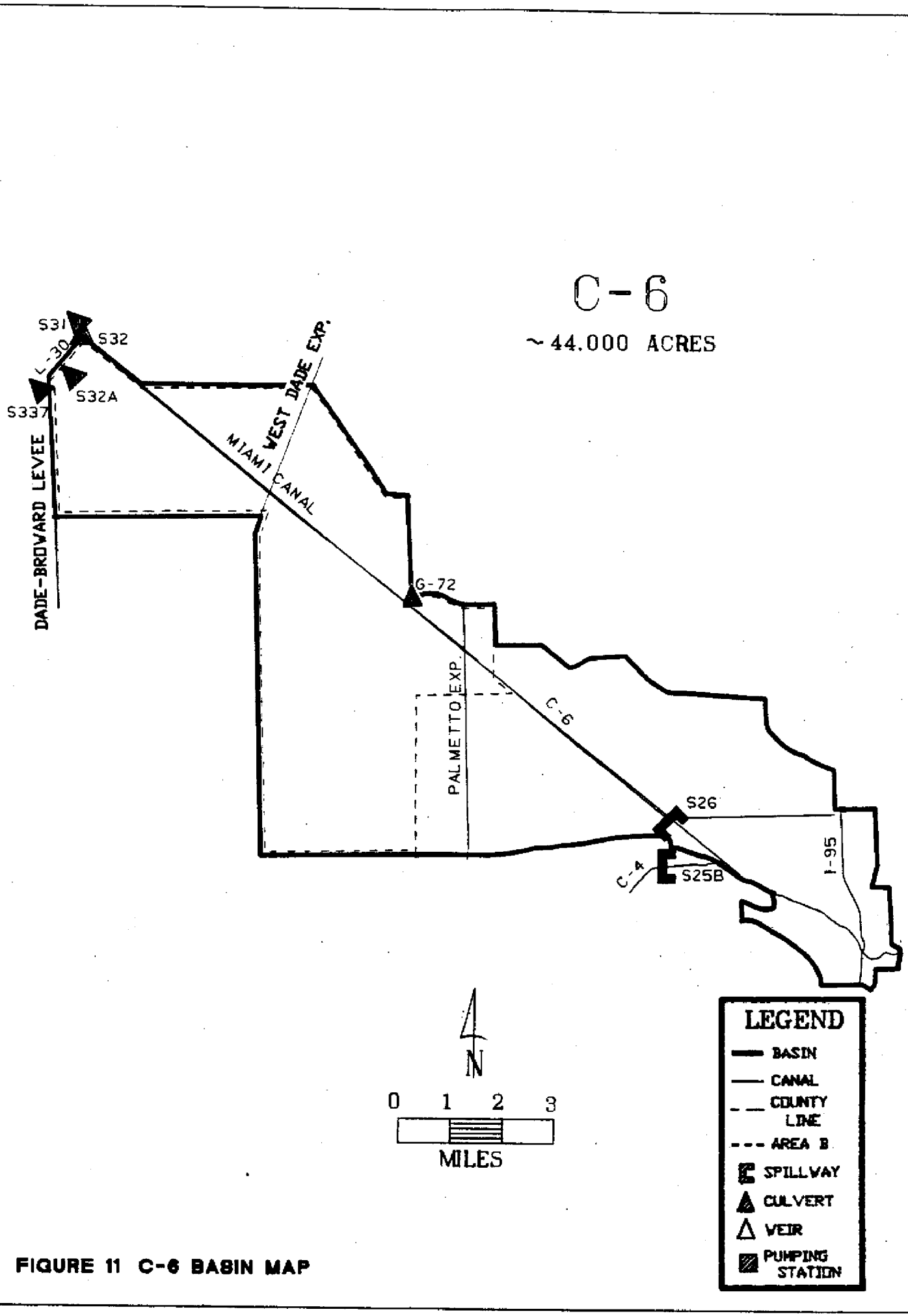


FIGURE 11 C-6 BASIN MAP

TABLE 4. C-6 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-26 Stage divide.	Spillway, 2 gates, 26 ft x 14.1ft Crest lgth = 52ft Crest elev = -10.1ft NGVD	4.4	3.9	~2.5	3470	HW = 5.14 Qds = 1900 Qups = 515	9/8/65 10/2/59 9/8/65
S-25B Stage divide	Spillway, 2 gates, 22ft x 11.9ft Crest lgth = 44ft, Crest elev = - 7.9ft NGVD	4.4	4.1	2.8	2000	HW = 3.19ft Q = 1668	4/24/82 4/26/82
G-72 Divide C-7 and C-6 basins	Culvert 4-72in x 75ft CMP Flashboards Variable Invert elevs = -2.44 to -1.97ft NGVD				(Divide structure water supply)		
S-31 Controls outflow from CA-3B to C-6	Gated Culvert 3-84inx172ft CMP Invert elev = -3.0ft NGVD	6.0 (Not fixed. Used for regulatory or water supply discharges from CA-3B to C-6)	4.0 (Not fixed. Used for regulatory or water supply discharges from CA-3B to C-6)		700	TW = 6.59 Q = 1090	7/1/82 3/20/70
S-32A Divide C-6 and C-4 Basins	Culvert 1-54in x 102ft CMP		--Never Opened--				
S-32 Water supply to C-9	Culvert 2-72inx40ft CMP Invert elev = -2.0ft NGVD					HW = 6.59	7/1/82
S-337 Water supply, South Dade Conveyance System	Culvert 6-84in x 164ft CMP Invert elev = -3.0 to -4.0ft NGVD	5.5	5.2		605		

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-4 (TAMIAMI CANAL) BASIN

Description of the Basin

The C-4 basin has an area of approximately 60.9 square miles and is located in eastern Dade County (Figure 12). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 13.

There are two Project canals in the C-4 basin: C-4 and the L-30 borrow canal. The canals have three functions: (1) to provide flood protection and drainage for the C-4 basin; (2) to supply water to the C-2, C-3, C-4, and C-5 basins; and (3) to maintain a groundwater table elevation near the lower reach of C-4 adequate to prevent intrusion of saltwater into local groundwater. During periods of low natural flow, water is supplied as needed to the C-4 basin from Water Conservation Areas (WCA) 3A and 3B by way of the South Dade Conveyance System (SDCS). Water can be subsequently diverted from C-4 to the C-2, C-3, and C-5 basins.

C-4 begins in the east borrow canal of L-30. Flow in the canal is to the east with discharge to tidewater in C-6 just upstream of State Road 9.

The L-30 borrow canal is aligned north-south along the west boundary of the basin. It is connected to C-4 at its west end by way of S-335. The borrow canal is part of the SDCS for supplying water to basins in south Dade County. Flow in the canal is normally to the south.

C-4 is connected to three other Project canals: C-2, C-3, and C-5. These three canals are bifurcations of C-4. (1) C-2, the Snapper Creek Canal, makes an open channel connection with C-4 at S.W. 117th Avenue. Normal flow is from from C-4 to C-2. (2) C-3, the Coral Gables Canal, makes an open channel connection to C-4 just east of the Palmetto Expressway. Flow is normally from C-4 to C-3, however, during the dry season a stage below 3.0 ft NGVD in C-4 at S-25B can cause flow from C-3 to C-4. (3) C-5 branches from C-4 at Blue Lagoon east of Coral Gables. It connects downstream to C-6. Normal flow is from C-5 to C-6.

The area in the C-4 basin between Krome Avenue and the Dade-Broward Levee drains to C-4 by an open channel between S-336 and G-119. When drainage from the rest of the basin and from the C-2 and C-3 basins is adequate to supply the water needs of the three basins, S-336 and G-119 are closed, and rainfall on the area is impounded and stored. The stored water can be released to C-4 by way of G-119 as needed to meet water demands in the C-2, C-3 and C-4 basins.

There are four Project structures controlling flow in C-4: S-25B, S-25A, S-336, and G-119.

1. S-25B is a gated spillway located just downstream of LeJeune Road. It controls water surface elevations in C-4, and it regulates discharges to C-6. The stage held in C-4 determines the discharge from C-4 to C-2, C-3, and C-6. At a

minimum, the stage in C-4 is maintained at a level adequate to prevent saltwater intrusion into local groundwater.

2. S-25A is a gated culvert located in C-5 at the N.W. 45th Street crossing just east of Blue Lagoon. S-25A is a divide structure between the C-4 and C-5 basins. It is normally closed. If the quality of the water in C-5 becomes poor during periods of low natural flow, S-25A may be opened as necessary to dilute the poor quality water and to "flush" out the canal.

3. S-336 is a gated culvert located in C-4 just west of Krome Avenue. This structure is ordinarily closed. It is opened to supply water from the L-31N borrow canal to C-4, and to C-2 and C-3, when the stage in C-4 at S-25B or in C-2 at S-22 falls below 2.8 ft NGVD and no water is available in the area between the Dade-Broward Levee and Krome Avenue.

4. G-119 is a gated culvert located in C-4 just east of Krome Avenue. This structure is operated in the same manner as S-336 except that it may be opened when S-336 is closed to release water from the area between Krome Avenue and the Dade-Broward Levee.

There are three other control structures in the basin: S-32A, S-337, and S-335. These structures are part of the SDCS.

1. S-32A is a gated culvert in the L-30 borrow canal at its north end. It is always closed and acts as a divide between C-6 and L-30 borrow canal.

2. S-337 is a gated spillway located in L-30 at its north end. It is used to supply water to the SDCS from WCA 3B. Water is discharged to the south by way of the L-30 borrow canal.

3. S-335 is a gated spillway in the L-30 borrow canal north of C-4. It controls the stage held in the L-30 borrow canal, and it regulates discharges to the L-31N borrow canal and to the SDCS.

Design criteria for the structures in the basin are given in Table 5.

The portion of the C-4 basin west of S.W. 87 Avenue is in Area B (Appendix 2). The drainage from this area is limited, and the area is subject to severe limitations on development.

Comments on Design and Historic Operation

C-4 was designed to pass 100 percent of the Standard Project Flood from the area east of S.W. 87th Avenue (Area A). That portion of the C-4 basin in Area B (west of S.W. 87th Avenue) is poorly drained. A stage of 5.5 ft NGVD will cause flooding in Sweetwater east of S.W. 117th Avenue. The most western portion of the C-4 basin in Area B and the portion of the C-2 basin north of Sunset Drive (also in Area B) are the subject of an Army Corps of Engineers' Survey Review Study to determine the feasibility of backpumping runoff from these areas to Water Conservation Area 3B. The proposal is to build a pumping facility adequate to handle two inches of runoff per day from the combined 59 square miles of the Area B portions of the C-2 and C-4 basins.

Several changes have been made in the basin (to C-4 and to its control structures) that have probably changed the hydraulic profiles in C-4 from that

reported in the Army Corps of Engineers General Design Memorandum. The channel between Flagler Street and Blue Lagoon has been excavated. The sheet pile weir at the Florida East Coast Railway crossing has been removed, and a control structure (S-25B) has been built at LeJeune Road. The hydraulic profiles for C-4 need to be recalculated.

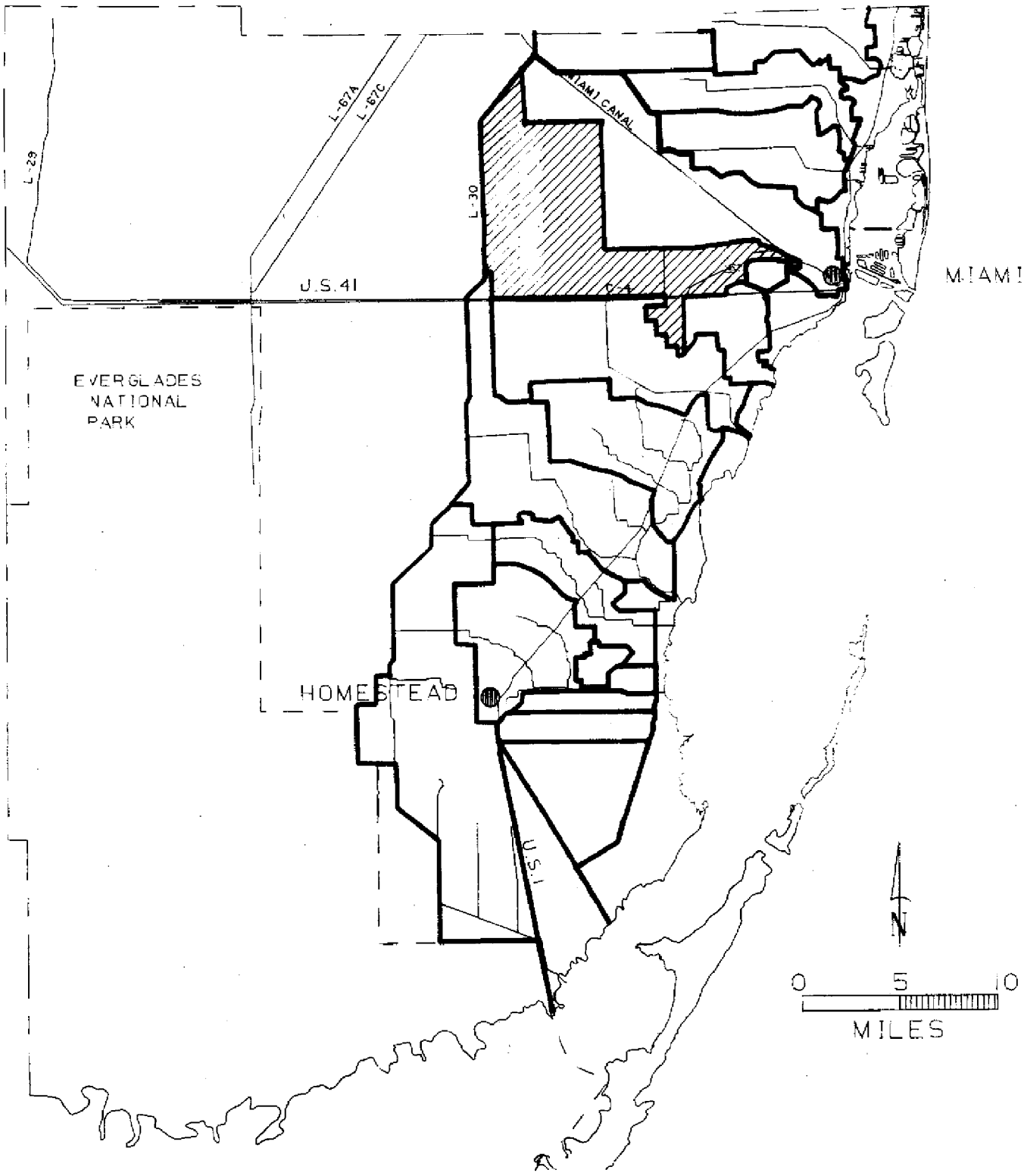
C-4 and C-6 are connected by the Florida East Coast Railway borrow canal that flows to the south along the west side of the Miami International Airport. It is possible to pass up to 100 cfs south from C-6 to C-4.

A plan to increase water supply to the C-4 basin by 500 cfs is currently being implemented. The water will be released from WCA 3B to the L-30 borrow canal by way of S-337. A new canal being constructed north of the Pensuco Canal will convey 400cfs of water to the east borrow canal of the West Dade Expressway and 100cfs to the Dade-Broward Levee borrow canal. All the water conveyed to the Dade-Broward levee borrow canal and 100 cfs of the water conveyed to the east borrow canal of the West Dade Expressway will be conveyed south by these canals and discharged to C-4. The other 300 cfs conveyed to the east borrow canal of the West Dade Expressway will recharge the Northeast Wellfield. The Northwest Wellfield is located west of the Expressway between C-6 and C-4. A landfill is located east of the Expressway also between C-6 and C-4. The water supplied to the wellfield will create a groundwater divide between the wellfield and the landfill. The groundwater divide will prevent seepage of possibly contaminated groundwater from the landfill from entering the wellfield.

The U.S.Geologic Survey has a discharge station at a footbridge near S.W. 87th Avenue. The period of record is from 1940 to the present. The peak flow occurred August 27, 1981 (Tropical Storm Dennis).

Maximum flow	= 934 cfs
Daily mean flow	= 675 cfs
Peak stage	= 6.38 ft NGVD

Flow is normally from C-4 to C-2, however, Hurricane Donna created an upstream flow of 780 cfs under the U. S. Highway 41 bridge with a stage of 6.94 ft NGVD at the bridge.



TAMIAMI BASIN

FIGURE 12 C-4 BASIN LOCATION MAP

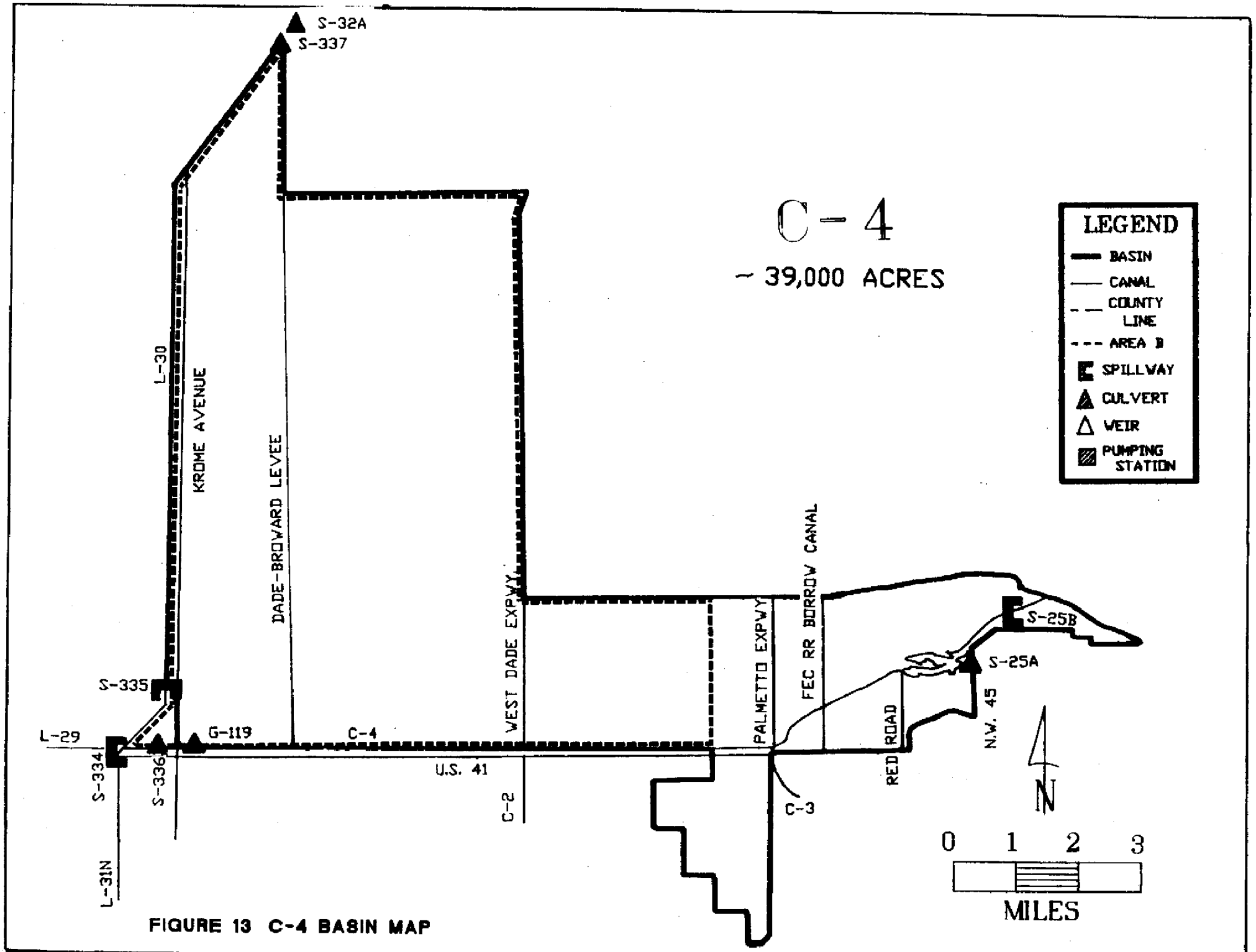


FIGURE 13 C-4 BASIN MAP

TABLE 5. C-4 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-25 Stage divide	Culvert 1-96in x 60ft CMP Invert elev = -4.0ft NGVD with automated slide gate	2.5	~1.60	2.0	260	HW = 3.60 Q = 258	4/25/79 4/25/79
S-25B Stage divide	Spillway, 2 gates, 22ft x 11.9ft Crest lgth = 44ft, Crest elev = - 7.9ft NGVD	4.4	4.1	2.8	2000	HW = 3.19ft Q = 1668	4/24/82 4/26/82
S-25A Divide structure between C-4 and C-5	Gated Culvert 1-60in x 73ft CMP (upstream 13ft is 54in) Invert elev = -1.7ft NGVD						
S-32 Water supply to C-9	Culvert 2-72inx40ft CMP Invert elev = -2.0ft NGVD					HW = 6.59	7/1/82
S-336 Water supply, South Dade Conveyance System	Gated Culvert 3-54in x85ft CMP Invert elev = -1.8 ft NGVD	4.7	4.2	(TW stage rise to -6.5 ft during wet season)	145		
G-119 Water Supply to C-4	Gated Culvert 2-72in x 64ft CMP Invert elev = -3.5ft NGVD						
S-334 Water supply, South Dade Conveyance System	Spillway 1 gate 29ft x 14.6ft Crest lgth = 29ft Crest elev = -6.9ft NGVD	5.0	4.7		1230		
S-335 Water supply, South Dade Conveyance System	Spillway 1 gate 20ft x 11.2ft Crest lgth = 20ft Crest elev = -4.2ft NGVD	5.0	4.8		525		

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-5 (COMFORT CANAL) BASIN

Description of Basin

The C-5 basin has an area of 2.3 square miles and is located in eastern Dade County (Figure 14). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canal, and control structures is given in Figure 15.

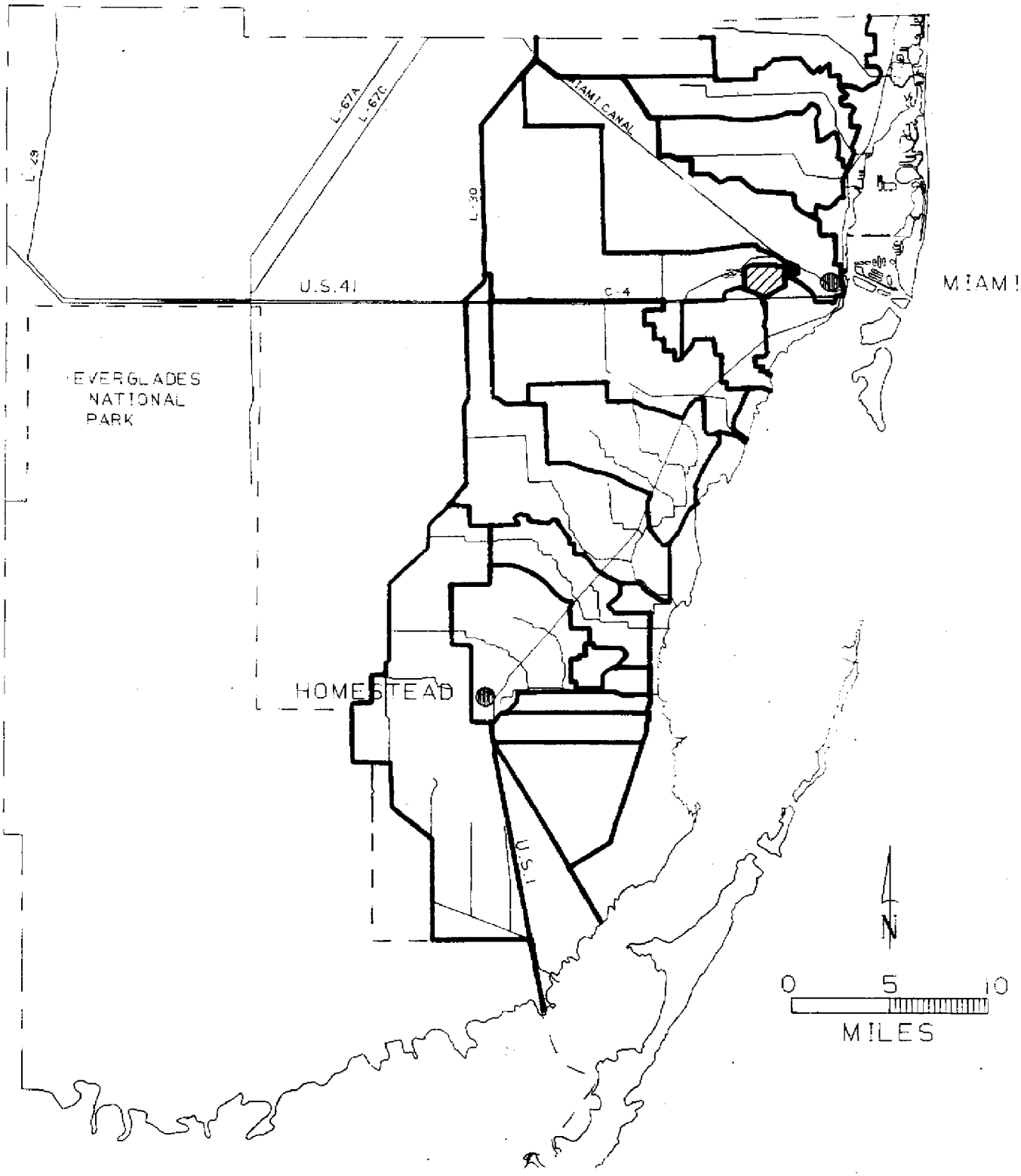
C-5 is the only Project canal in the C-5 basin. It provides drainage and flood protection for the basin. C-5 begins as a bifurcation of C-4 at Blue Lagoon northwest of Coral Gables. Flow in the canal is to the east to the canal's confluence with C-6, three-quarters of a mile downstream of S-26.

There are two Project control structures in the C-5 basin: S-25A and S-25. (1) S-25A is a gated culvert located in C-5 just east of Blue Lagoon and under N.W. 45th Avenue. S-25A is a divide structure between the C-4 and C-5 basins. It is normally closed. If the quality of the water in C-5 becomes poor during periods of low natural flow, S-25A may be opened as necessary to dilute the poor quality water and to "flush" out the canal. (2) S-25 is a gated culvert located in C-5 on the west side of N.W. 27th Avenue. It controls the stage in C-5, and it controls discharge to C-6. Design criteria for the structures in the basin are given in Table 6.

Comments on Design and Historic Operation

Design flow for C-5 is 260 cfs with a design stage of 2.5 ft. NGVD. The basin is very small with a high percentage of impervious surface, the result of urban development. As a consequence, flood stages peak rapidly. Telemetry control of the gate at S-25 makes it easier to control the height of flood stages.

C-5 drains an old section of Miami with natural ground surface elevation as low as 2.5 ft NGVD. Some homes in the area are subject to flooding during severe storms (e.g., the storm of April 25, 1979).

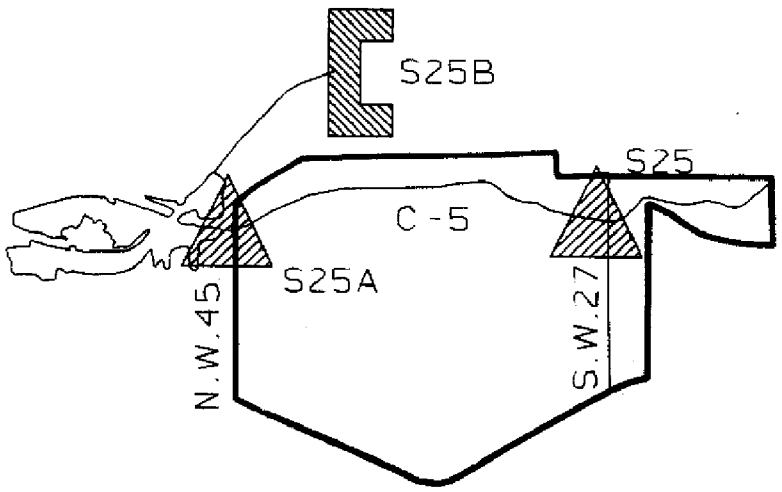


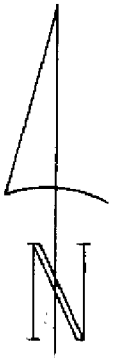
C-5 BASIN

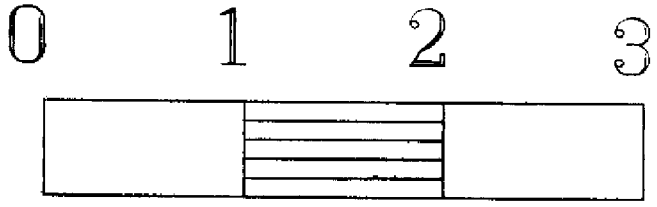
FIGURE 14 C-5 BASIN LOCATION MAP

C-5

~1,400 ACRES







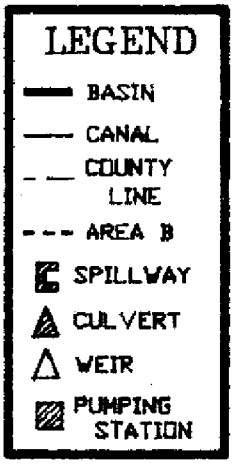


FIGURE 15 C-5 BASIN MAP

TABLE 6. C-5 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-25 Stage divide	Culvert 1-96in x 60ft CMP Invert elev = -4.0ft NGVD with automated slide gate	2.5	~1.60	2.0	260	HW = 3.60 Q = 258	4/25/79 4/25/79
S-25A Divide structure between C-4 and C-5	Culvert 1-60in x 73ft CMP (upstream 13ft is 54in) Invert elev = -1.7ft NGVD						

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-3 (CORAL GABLES CANAL) BASIN

Description of the Basin

The C-3 basin has an area of approximately 18 square miles and is located in eastern Dade County (Figure 16). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canal, and control structure is given in Figure 17.

C-3 is the only Project canal in the C-3 basin. It provides drainage and flood protection to the basin, and it maintains a groundwater table elevation adequate to prevent intrusion of saltwater into local groundwater.

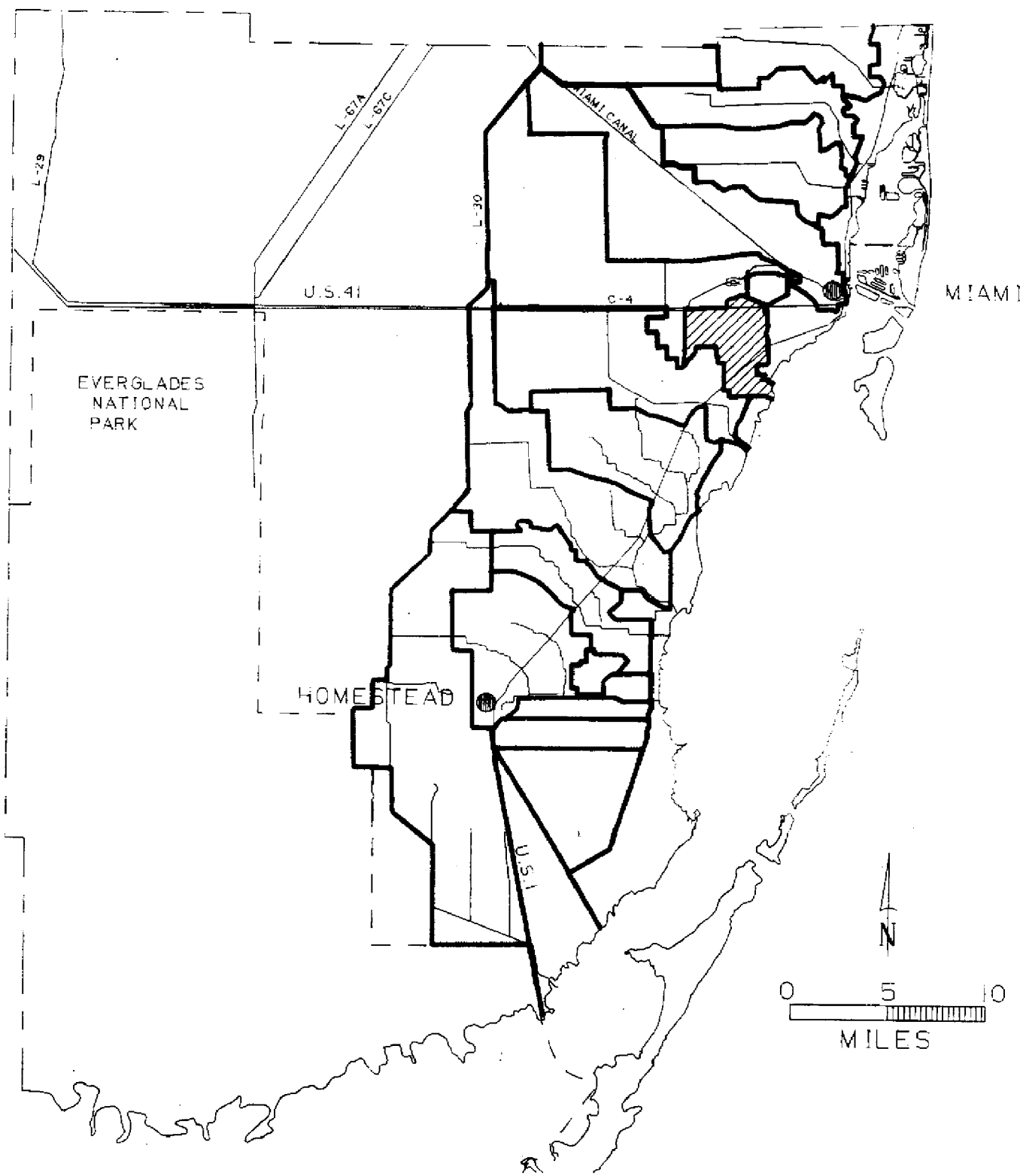
C-3 begins as an open channel connection with C-4 just northeast of the intersection of U. S. Highway 41 and the Palmetto Expressway. Flow is normally to the south from C-4 to C-3. Water flow in C-3 is to the southeast, with discharge to Biscayne Bay at Sunrise Harbor.

There is one Project control structure in C-3. G-97 is a sheet pile weir located at the 57th Street crossing. It has eight pile sections that can be removed to pass flood discharges. G-97 maintains a stage in C-3 adequate to prevent saltwater intrusion into local groundwater. Since G-97 has a fixed crest elevation of 3.0 ft NGVD, stages less than 3.0 ft NGVD north of G-97 in C-3 and in C-4 may result in flow northward in C-3 to C-4. In this case S-25B provides control of water surface elevations in C-3 north of G-97. Design criteria for G-97 are given in Table 7.

Comments on Design and Historic Operation

C-3 was designed to provide 1-25 year flood protection. Design discharge at G-97 is 640 cfs which consists of 540 cfs from the Coral Gables Canal basin and 100 cfs from C-4. Urban development of the area has probably increased runoff to C-3 and decreased the flood protection although this has not been documented. There are some older urban areas with low lying streets and low floor elevations which flood during heavy rainfalls.

Plans are being made to replace G-97 with an automated structure, possibly in the 1987-88 fiscal year.



CORAL GABLES BASIN

FIGURE 16 C-3 BASIN LOCATION MAP

C-3

~10,000 ACRES

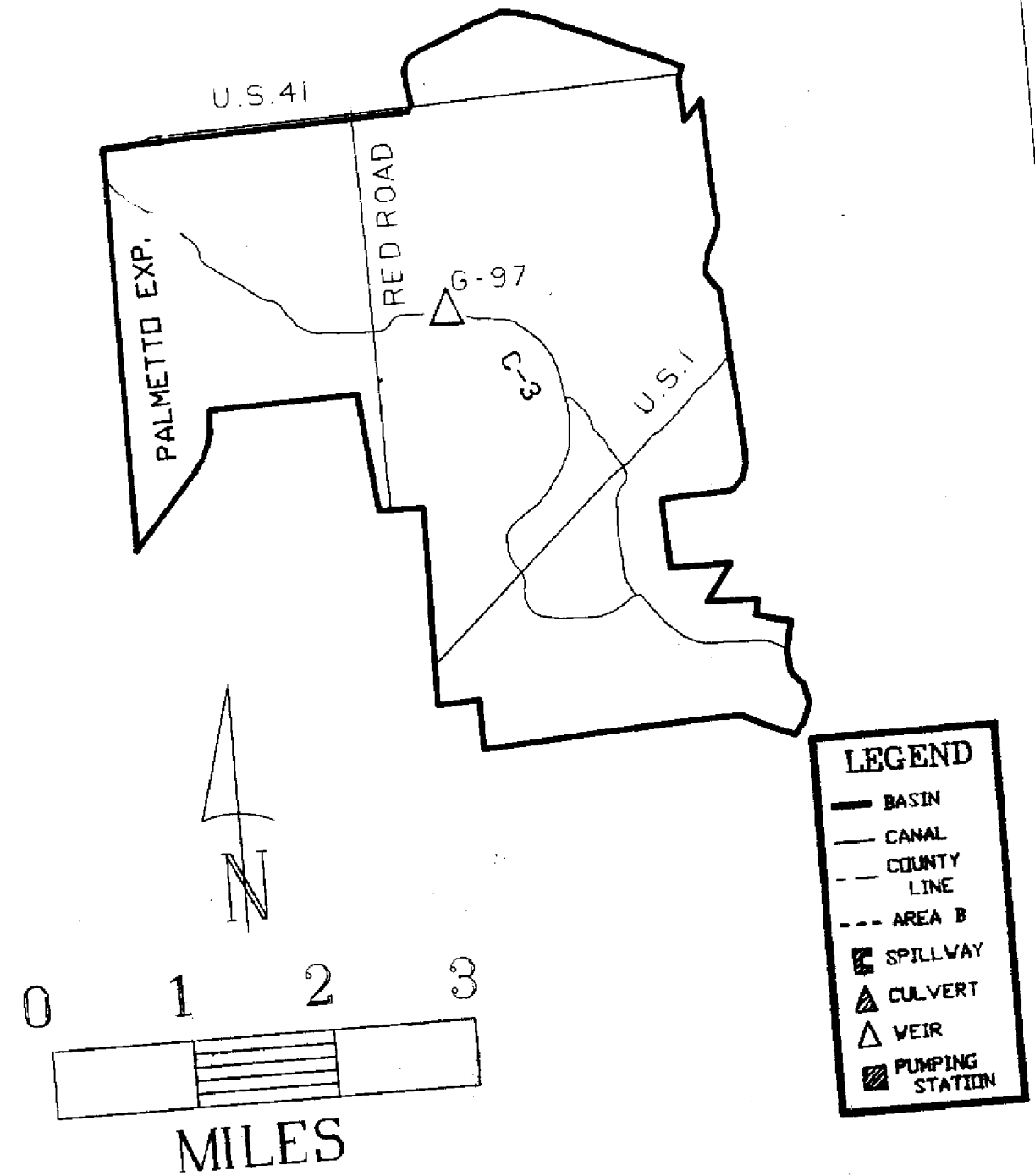


FIGURE 17 C-3 BASIN MAP

TABLE 7. C-3 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
G-97 Coral Gables Canal	Sheet Pile Weir 8 Removable piles Crest lgth = 47ft Crest elev = 3.0ft NGVD	4.5	3.0	2.5 to 3.0 (Controlled by S-25B in C-4)	640 (540 from C-6 Basin, 100 from C-4 Basin)	HW = 6.58 Qus = 613 HW = 5.73 Qds = 933	9/8/65 9/8/65 8/18/81 8/18/81

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-2 (SNAPPER CREEK) BASIN

Description of the Basin

The C-2 basin has an area of approximately 53 square miles and is located in eastern Dade County (Figure 18). This basin is also known as the Snapper Creek basin. The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 19.

C-2 is the only Project canal in the C-2 basin. It has three functions: (1) to provide drainage and flood protection for the basin, (2) to supply water to the C-2 and the C-100 basins for irrigation, and (3) to maintain a groundwater table elevation near the lower reach of C-2 adequate to prevent saltwater intrusion into local groundwater. During periods of low natural flow, water is supplied to the basin from C-4, and water supply is made to the C-100 basin from C-2 by way of C-100C and S-121.

C-2 begins as a bifurcation of C-4 near the intersection of the Homestead Extension of the Turnpike and U.S. Highway 41. From the open channel connection of C-2 and C-4, water flow in C-2 is to the southeast with discharge via S-22 to Biscayne Bay just south of Matheson Hammock Park.

C-2 is connected to one other District canal. C-100C joins C-2 three-quarters of a mile southeast of the Sunset Drive crossing of C-2. Normal flows are from C-2 to C-100C.

There are two Project control structures in the C-2 basin: S-22 and S-121.

1. S-22 is a gated spillway located in C-2 on the east side of Red Road. The structure controls water surface elevations in C-2, and it controls discharges to tidewater. A headwater stage is maintained by S-22 adequate to prevent saltwater intrusion into local groundwater.

2. S-121 is a gated culvert in C-100C at the State Road 94 crossing. There are no specific operational guidelines for this structure. In general, it is closed to prevent flood flows in the C-2 basin from entering the C-100 basin, and it is opened to supply water from C-2 to the C-100 basin for irrigation and to maintain the optimum stage in the lower reaches of canals in the C-100 basin.

The western portion of the C-2 basin is in Area B (Appendix 2). Drainage from this area is limited. During flooding, the portion of the C-2 basin in Area B will contribute only a small amount of runoff to C-2. The area is subject to severe limitations on development.

Comments on Design and Historic Operation

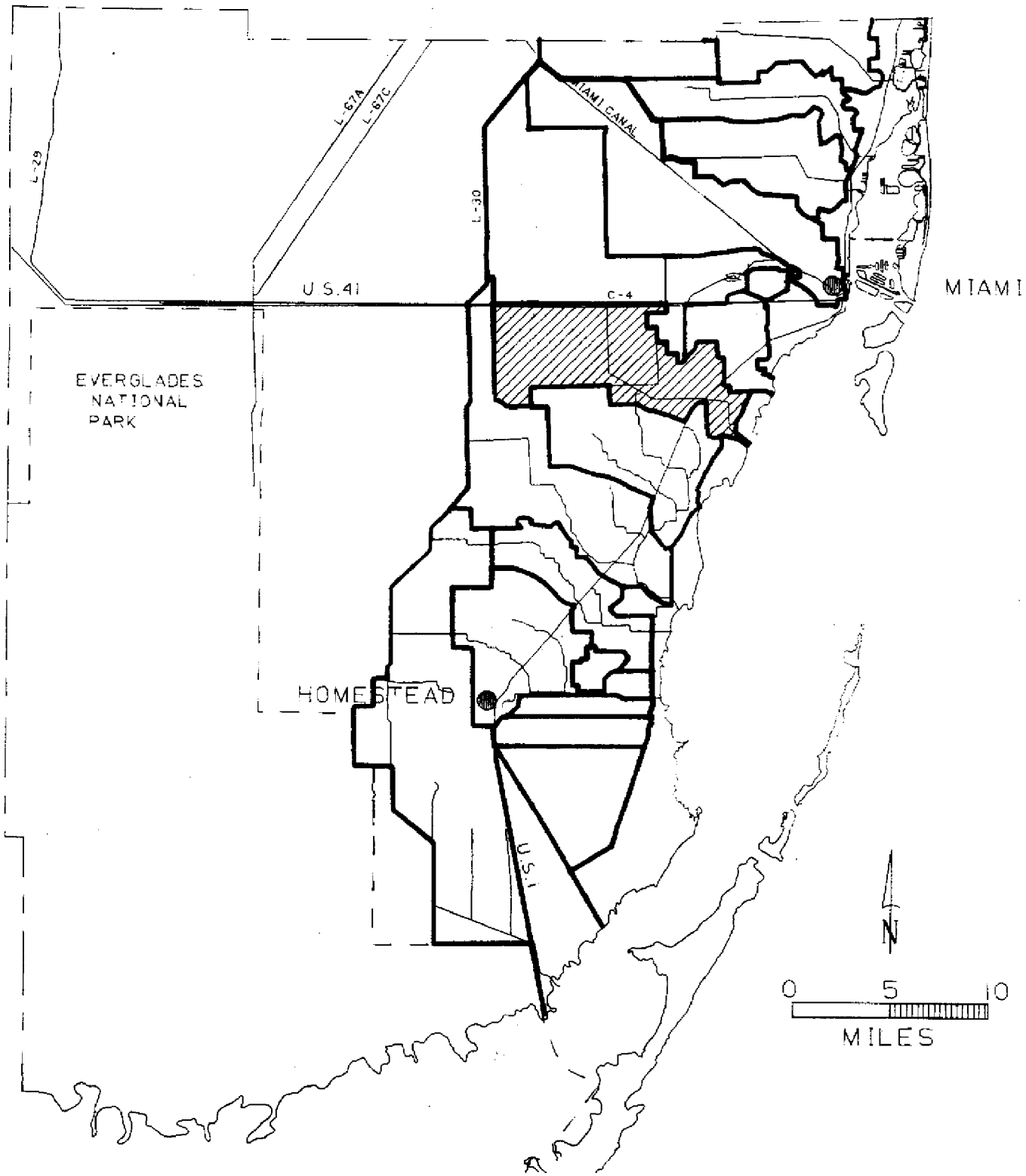
C-2 was an existing Dade County Canal at the time of the Project. It was enlarged by the Project to pass 100 percent of the Standard Project Flood (SPF) for the Area A portion of the C-2 basin.

The hydraulic profile expected to occur in C-2 for the SPF was calculated and was included in the U. S. Army Corps of Engineers' General Design Memorandum for

the Project, however, this profile is not correct. A new hydrologic analysis of the C-2 basin is needed. There are three reasons for this: (1) At the time of its construction, C-2 upstream of S-22 to Sunset Drive was over-excavated 150 to 300 percent, (2) the canal has been enlarged from Sunset Drive to U. S. Highway 41 in order to provide fill for the Homestead Extension of the Turnpike, and (3) the basin has experienced considerable urban development with an increase in the impervious surface in the basin. The enlargement of the canal has reduced the stage that will occur in the canal for a given discharge. Using the original hydrologic data developed by the Corps for inflows to the canal during the Standard Project Storm and using the actual cross-sectional area of the canal, the calculated stage at Sunset Drive was found to be reduced from 7.29 to 4.98 ft NGVD compared to the original calculation of the hydraulic profile for the design cross-sectional area. The decrease in the stage in the canal for a given discharge increases the amount of runoff that can occur from the basin. The increase in impervious area due to urban development also increases the runoff from the basin. It is possible that a storm less severe than the SPF will create actual flows in C-2 greater than those calculated to occur for the SPF in the original Corps analysis. An indication of this is given by the discharge that occurred at S-22 for Tropical Storm Dennis (approximately a 1-100 year event). The discharge was 200 cfs greater than the Corps predicted discharge for the structure for a 1-200 year storm.

A plan has been proposed to backpump water from the C-2 basin to Water Conservation Area 3B. This would provide better drainage for the portion of the basin in Area B.

Flow is normally from C-4 to C-2, however, Hurricane Donna created an upstream flow of 780 cfs under the U. S. Highway 41 bridge with a stage of 6.94 ft NGVD at the bridge.

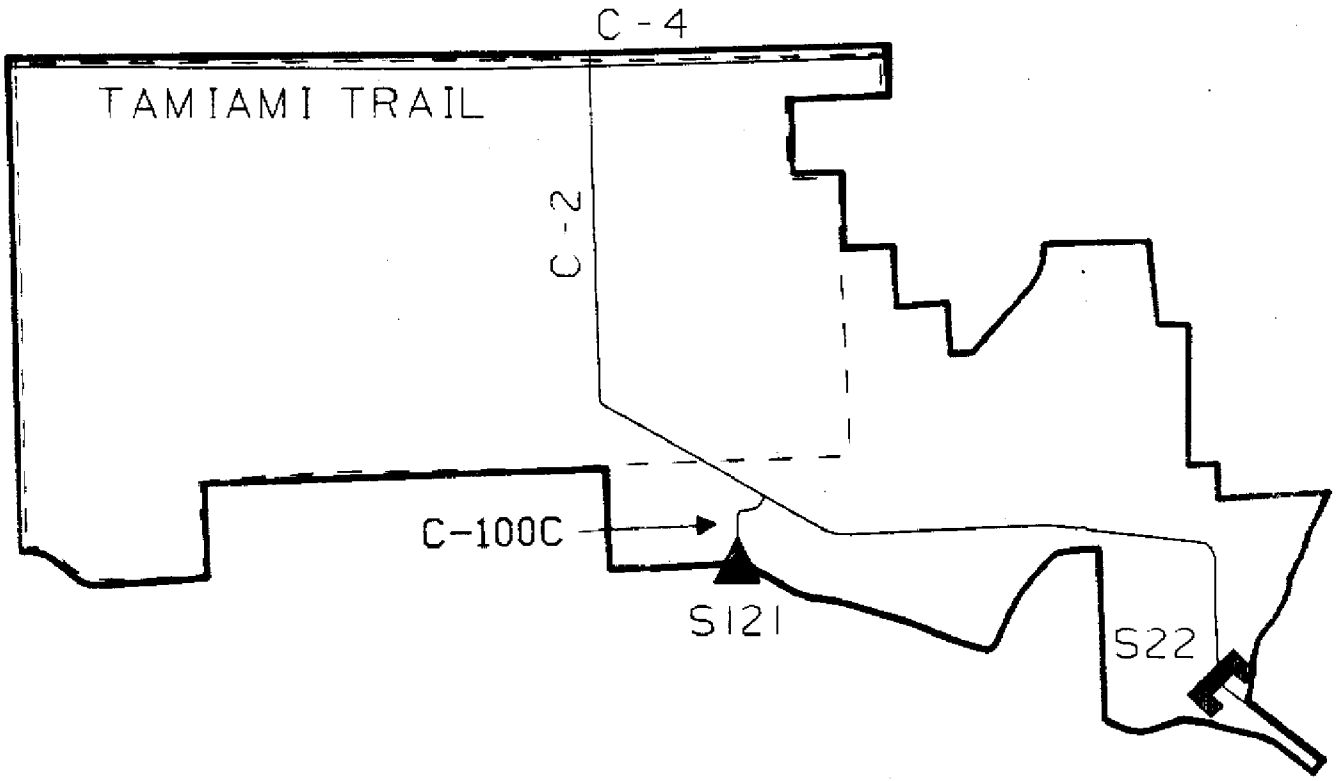


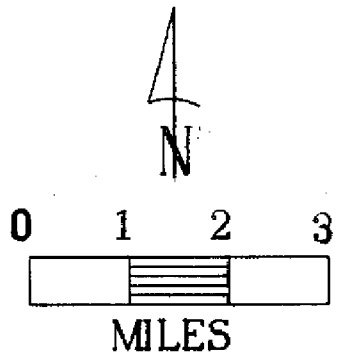
C-2 BASIN

FIGURE 18 C-2 BABIN LOCATION MAP

C-2

~34,000 ACRES





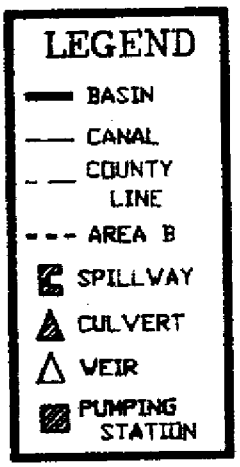


FIGURE 19 C-2 BASIN MAP

TABLE 8. C-2 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-22 Stage divide	Spillway, 2 gates, 17ft x 15ft Crest lgth = 34ft Crest elev = 11.0ft NGVD	3.5	2.7	2.9	1915	HW = 3.6 Q = 2110 ds Q = 1220 ups HW = 6.02 (Betsy)	8/17/81 8/18/81 9/10/60 9/8/65
S-121 Divide structure C-2 and C-100C Water supply C-2 to C-100C	Culvert 8ft x 8 ft box x 128ft 8ft x 8ft gate Invert elev = -4.5ft NGVD	2.9 (water supply)	2.8 (water supply)		100 (water supply)		

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-100 BASIN

Description of the Basin

The C-100 basin has an area of approximately 40.6 square miles and is located in eastern Dade County (Figure 20). This basin is also known as the Cutler Drainage Basin. The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 21.

There are four Project canals in the C-100 basin: C-100, C-100A, C-100B, and C-100C. These canals have three functions: (1) to provide drainage and flood protection for the C-100 basin, (2) to supply water to the basin for irrigation, and (3) to maintain a groundwater table elevation near the lower reach of C- 100 adequate to prevent saltwater intrusion to local groundwater. Water is supplied to the basin during periods of low natural flow from C-1 by way of S-122 and C-100B and from C-2 by way of S-121 and C-100C.

C-100 begins just north of the intersection of Killian Road and Lingren Road. Flow in the canal is to the southeast with discharge via S-123 to Biscayne Bay east of Old Cutler Road. C-100A, C-100B, and C-100C are tributary to C-100. (1) C-100A begins in Green Mar Acres at U.S. Highway 1. Flow in C-100A is to the south to the canal's confluence with C-100 one-half mile west of Biscayne Bay. (2) C-100B connects C-100 to C-1. C-100B enters the C-100 basin at S-122 one-tenth of a mile south of the east end of Peters Road. Normal flows in C-100B are to the northeast to the canal's confluence with C-100 one-quarter mile west of Biscayne Bay. (3) C-100C connects C-100 to C-2. C-100C enters the C-100 basin at S-121 at State Road 94. Normal flows in C-100C are to the southeast to the canal's confluence with C-100A one-quarter mile north of Coral Reef Drive.

There are six Project control structures in the C-100 basin: S-118, S-119, S-120, S-121, S-122, and S-123.

1. S-123 is a gated spillway located in C-100 at Biscayne Bay three-quarters of a mile south of Richmond Drive. It controls the stage in the lower reaches of C-100, C-100A, C-100B, and C-100C, and it regulates discharges to tidewater. A headwater stage is maintained by S-123 adequate to prevent saltwater intrusion into local groundwater.

2. S-118 is a gated culvert located in C-100 just east of U.S. Highway 1. It controls the stage in the upper reach of C- 100, and it regulates discharges to the lower reach of C-100.

3. S-119 is a gated culvert located in C-100C just west of U.S. Highway 1. It controls the stage in the upper reach of C- 100C, and it regulates discharges to C-100A and C-100.

4. S-121 is a gated culvert located in C-100C at the State Road 94 crossing. There are no specific operational guidelines for this structure. In general it is closed to prevent flood flows in the C-2 basin from entering the C-100 basin, and it is opened as necessary to supply water from C-2 to the C-100 basin for irrigation and to maintain the optimum stage in the lower reaches of canals in the basin.

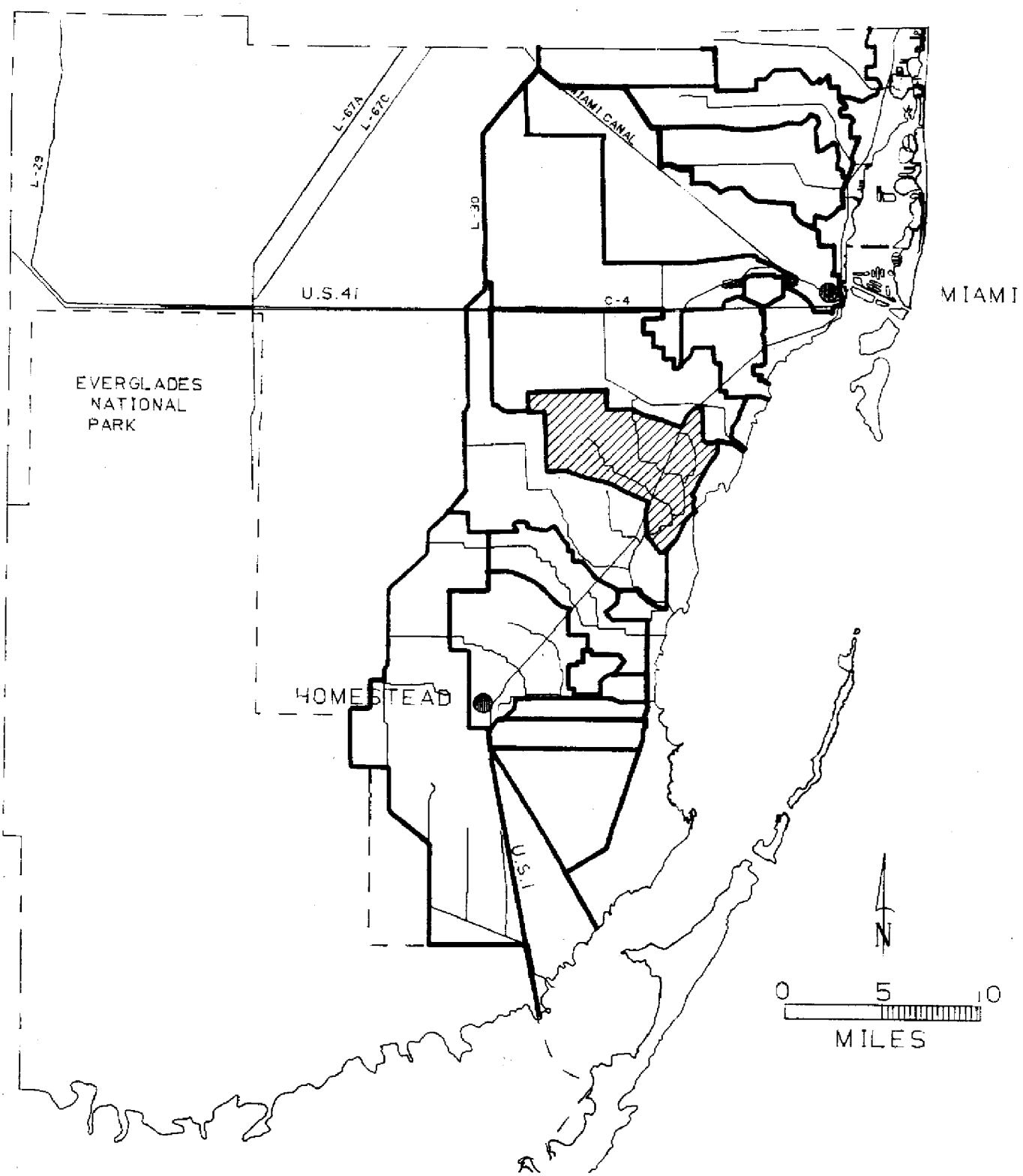
5. S-122 is a gated culvert located in C-100B one-tenth of a mile south of the east end of Peters Road. There are no specific operational guidelines for this structure. In general it is closed to prevent flood flows in the C-1 basin from entering the C-100 basin, and it is opened as necessary to supply water from C-1 to the C-100 basin for irrigation and to maintain the optimum stage in the lower reaches of canals in the basin.

6. S-120 is a gated culvert located in C-100A at U.S. Highway 1. It controls inflows to C-100A from local drainage systems.

Design criteria for the structures in this basin are given in Table 9.

Comments on Design and Historic Operation

C-100 was designed for 1-10 year flood protection. The design discharge is 2300 cfs. The peak discharge for Tropical Storm Dennis was 3000 cfs. This caused flooding west of U. S. Highway 1 and north of C-100C.



C-100 BASIN

FIGURE 20 C-100 BASIN LOCATION MAP

C-100

~ 26,000 ACRES

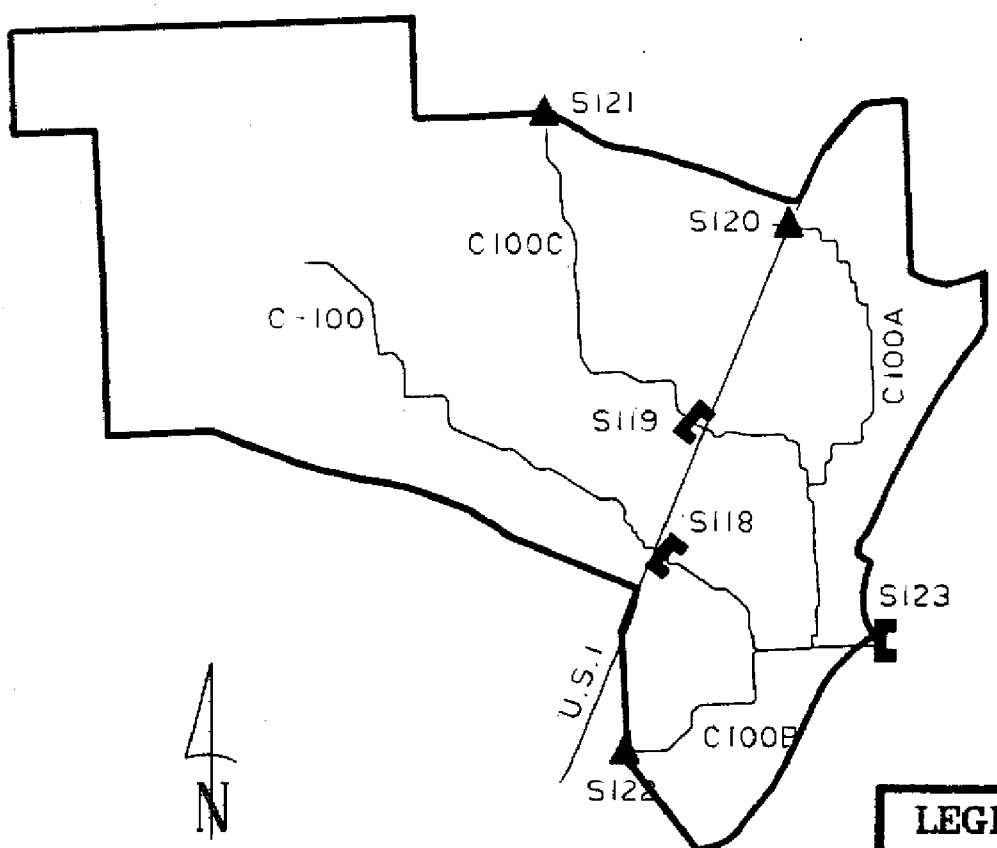


FIGURE 21 C-100 BASIN MAP

TABLE 9. C-100 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-123 Stage divide	Spillway, 2 gates, 25ft x 12.7ft Crest lgth = 50ft, Crest elev = - 7.3ft NGVD	2.0	1.5	2.0 Wet Season 3.5 Dry Season	2300	HW = 3.87 TW = 2.90 Q = 3000	8/17/81 8/17/81 8/18/81
S-118 Stage divide	Spillway 1 gate 20ft x 10ft Crest lgth = 20ft, Crest elev = - 5.0ft NGVD	3.6	3.1	3.7	860	HW = 4.94	8/17/81 (storm Dennis)
S-119 Stage divide	Spillway, 1 gate 12ft x 7.3ft Crest lgth = 12ft, Crest elev = - 2.4ft NGVD	4.4	3.9	4.7	400		
S-120 Stage divide	Culvert 9ft x 9ft box x 104ft 6ft x 6ft gate Invert elev = -3.0ft NGVD	4.8	4.3	5.0	150		
S-121 Water supply, C-2 to C-100C.	Culvert 8ft x 8 ft box x 128ft 8ft x 8ft gate Invert elev = -4.5ft NGVD	2.9 (water supply)	2.8 (water supply)		100 (water supply)		
S-122 Water supply, C-1 to C-100B,	Gated Culvert 3-72in x 60ft RCP Invert elev = -4.0ft NGVD	2.5 (water supply)	2.0 (water supply)		200 (water supply)		

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-1 (BLACK CREEK) BASIN

Description of the Basin

The C-1 basin has an area of 56.9 square miles and is located in southeastern Dade County (Figure 22). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 23.

There are four Project canals in the C-1 basin: C-1, C-1W, C-1N, and the L-31N borrow canal. These canals have three functions: (1) to provide drainage and flood protection for the C-1 basin, (2) to supply water to the C-1 and the C-100 basins for irrigation, and (3) to maintain a groundwater table elevation near the lower reach of C-1 adequate to prevent saltwater intrusion to local groundwater.

C-1 and C-1W are continuous and make up the main canal (hereafter, designated C-1/C-W) in the basin. C-1N and the L-31N borrow canal are tributary to C-1/C-1W. C-1/C-1W begins in the east borrow canal of L-31N, one and one-half miles north of Howard Drive. Flow in the canal is to the southeast with discharge via S-21 to Biscayne Bay southwest of Black Point. C- 1N begins at the intersection of Lingren Road and Coral Reef Drive. Flow in the canal is to the south to the confluence of the canal with C-1/C-1W just east of the West Dade Expressway. The L-31N borrow canal is aligned along the west boundary of the basin. This canal is part of the South Dade Conveyance System. When operating to supply water to basins in south Dade County, flow in the canal is to the south. During a storm event, flow in the L-31N borrow canal is to C-1/C-1W.

There is one other Project canal associated with the C-1 basin. C-100B connects C-1N to C-100. C-100B joins C-1N one-half mile downstream of the F.E.C. Railway. The canal leaves the basin at S-122. Normal flows in the canal are to the north to the C-100 basin.

There are ten Project control structures in the C-1 basin. Five of these (S-21, S-148, S-338, S-149, and S-122) are directly related to the operation of C-1/C-1W and C-1N. The other five structures (S-173, S-331, S-334, S-335, and S-336) along with the L-31N borrow canal are part of the South Dade Conveyance System (SDCS) which supplies water to basins in south Dade County.

The structures in the western part of the basin have two basic types of operation: for storm drainage and for water supply. During a storm event, S-173, S-335, and S-336 are closed to prevent excess flows in the C-1 basin from entering the C-4 basin to the north or the C-111 basin to the south. S-338 is opened to provide drainage to the east for the L-31N borrow canal. When water is being supplied to south Dade County, S-335, S-336, and S-173 or S-331 are in operation, and S-338 is closed except as needed to supply water to the C-1 basin.

S-21 is a gated spillway located in C-1 one mile west of Black Point. It controls stages in the lower reaches of C-1/C-1W and C-1N, and it controls discharges to tidewater. A headwater stage is maintained by S-21 adequate to prevent saltwater intrusion to local groundwater.

S-148 is a gated spillway located in C-1W at the Florida East Coast Railway crossing. It controls stages in the upper reach of C-1/C-1W, and it regulates discharges to the lower reach of C-1/C- 1W.

S-338 is a gated culvert located in C-1W at Krome Avenue. It controls inflows to C-1/C-1W from the L-31N borrow canal, and it helps to maintain the optimum stage in the borrow canal.

S-149 is a gated culvert located in C-1N at the Florida East Coast Railway crossing. It controls stages in the upper reach of C-1N, and it regulates discharges to C-1.

S-122 is a gated culvert located in C-100B one-tenth mile south of the east end of Peters Road. There are no specific operational guidelines for this structure. In general it is closed to prevent flood flows in the C-1 basin from entering the C-100 basin, and it is opened as necessary to supply water from C-1 to the C-100 basin for irrigation and to maintain the optimum stage in the lower reaches of canals in the C-100 basin.

S-173 is a gated culvert located in the L-31N borrow canal at the divide between the C-1 and C-111 basins. It is adjacent to pumping station S-331 just north of Richmond Drive. It is closed during storm events to prevent flood flows from passing from one basin to the other. It is also closed when the pumps at S-331 are in operation.

S-331 is a pumping station in the L-31N borrow canal at the divide between the C-1 and C-111 basins. It is adjacent to S-173 just north of Richmond Drive. The pumping station is a component of the SDCS. Its function in conjunction with S-173 is to supply water to South Dade County basins and to Everglades National Park (i.e., Taylor Slough and the Panhandle). It also controls the stage in the L-31N borrow canal and protects the residential area west of L-31N from flooding. Water is supplied to the south whenever the headwater stage at any downstream structure is more than 1.5 feet below optimum.

S-336 is a gated culvert located in C-4 just west of Krome Avenue at the divide between the C-1 and C-4 basins. This structure is ordinarily closed. It is opened to supply water from the L-31N borrow canal to C-4, and to C-2 and C-3, when the stage in C-4 at S-25B or in C-2 at S-22 falls below 2.8 ft NGVD and no water is available in the area between the Dade-Broward Levee and Krome Avenue.

S-334 is a gated spillway located in the L-29 borrow canal at the west end of C-4. It is used to supply water to the SDCS from WCA 3A (via S-333 and the L-29 borrow canal). Water is discharged to the south by way of the L-31N borrow canal.

S-335 is a gated spillway in the L-30 borrow canal north of C-4. It controls the stage held in the L-30 borrow canal, and it regulates discharges to the L-31N borrow canal and the SDCS.

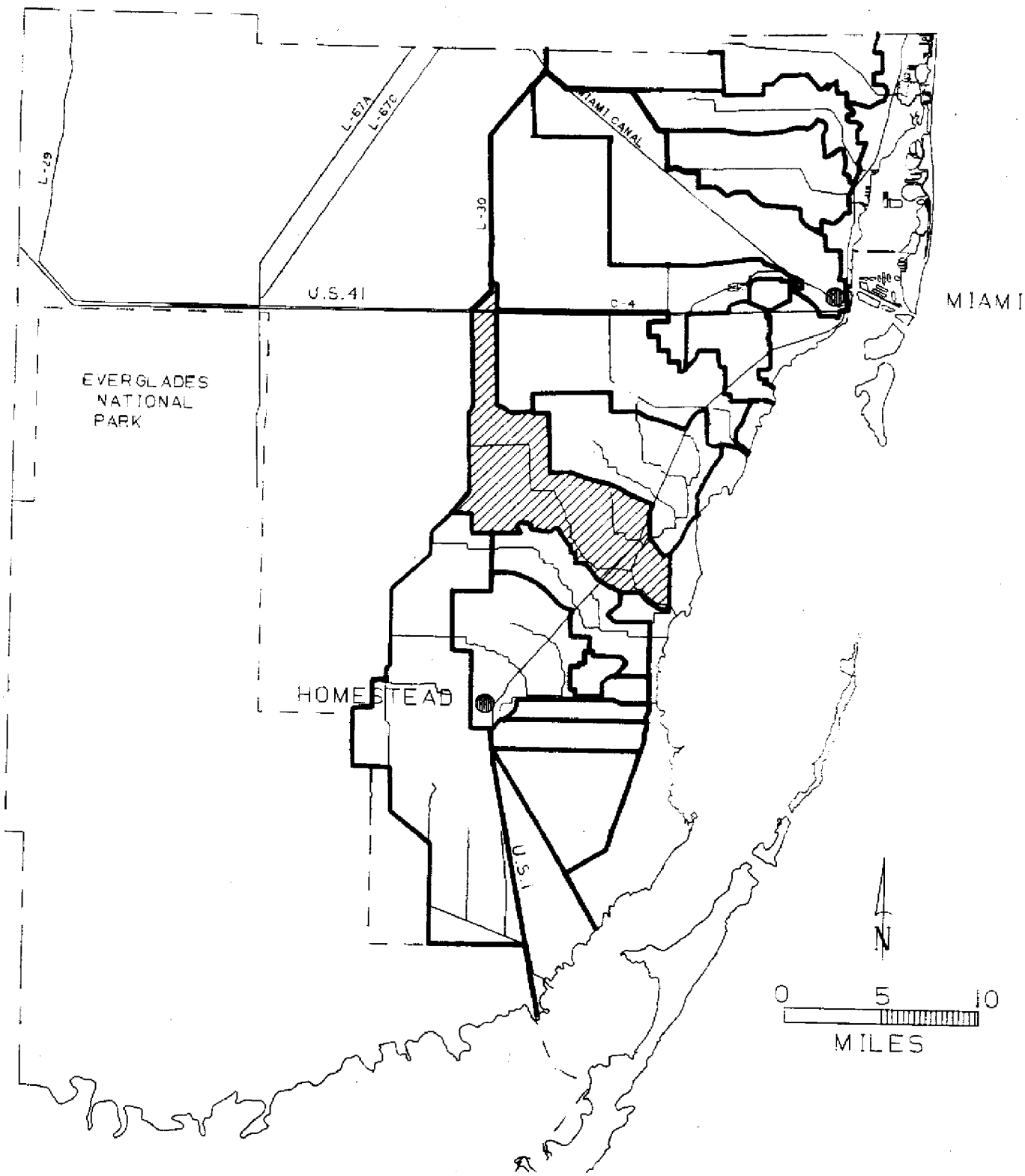
Design criteria for the structures in the C-1 basin are given in Table 10.

The portion of the C-1 basin north of Howard Drive is in Area B (Appendix 2). Drainage from this area is limited, and the area is subject to severe limitations on development.

Comments on Design and Historic Operation

C-1 (in Area A) was designed to pass 40 percent of the Standard Project Flood (SPF), however, right-of-way was purchased for a canal large enough to pass 60 percent of the SPF. All bridges replaced during construction, or bridges constructed later were sized to pass 60 percent of the SPF. The area east of the Seaboard Coast Line Railway also has 60 percent SPF protection. Actual stages in the canal are probably lower than the design stages tabulated in the Army Corps of Engineers General Design Memorandum due to over-excavation and free-digging in the lower reaches of the canal. Downstream of the West Dade Expressway the channel has been excavated from a 60 percent to a 100 percent SPF hydraulic section. The western reaches have been enlarged to handle over design flows when the South Dade Conveyance System (SDCS) is supplying water to downstream reaches during drought conditions.

The optimum stage upstream of S-148 and S-149 is 5.5 ft NGVD; however, this is rarely achieved due to large amounts of seepage past the structures. Flows of 40-50 cfs have been measured with the structures closed.



C-1 BASIN

FIGURE 22 C-1 BASIN LOCATION MAP

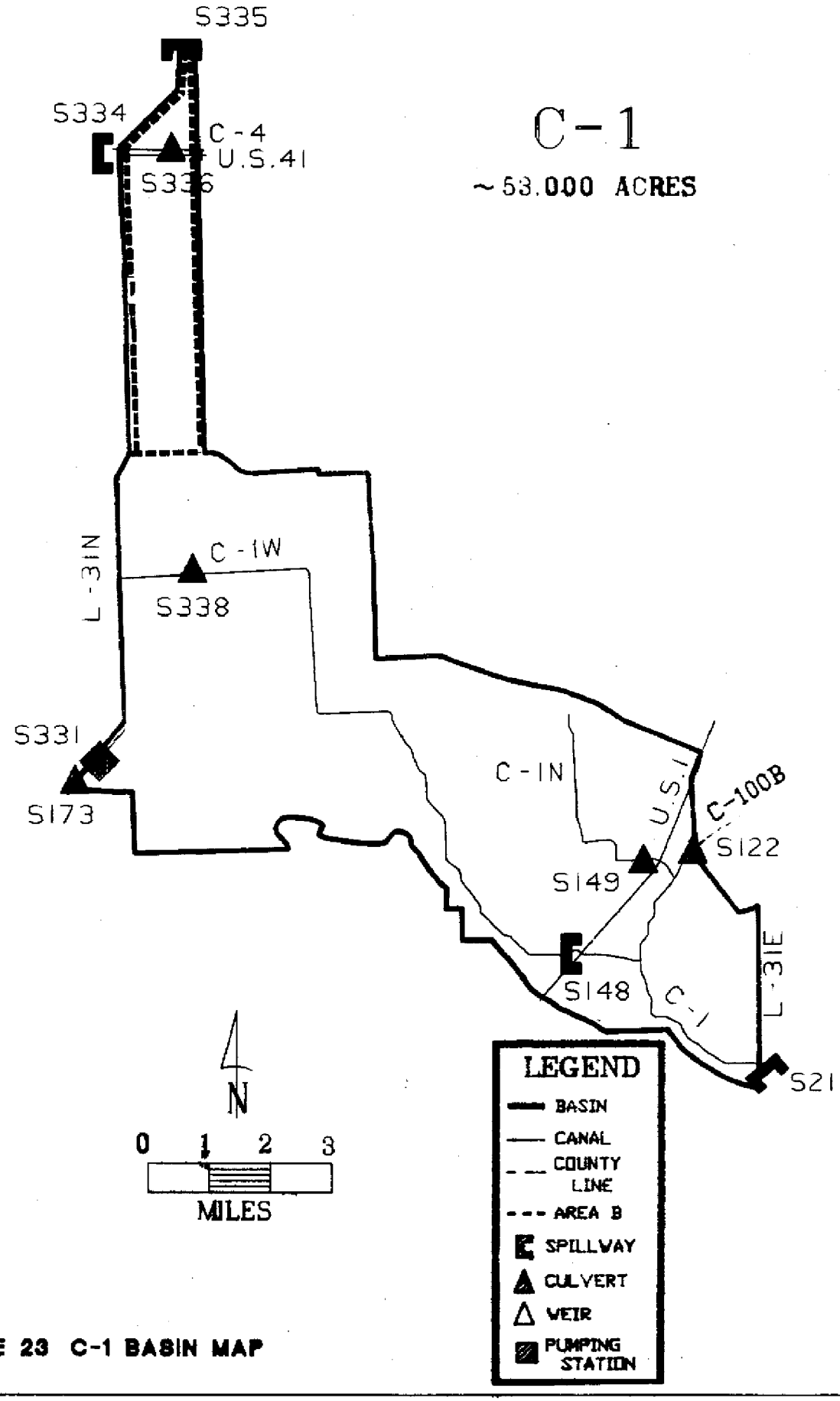


FIGURE 23 C-1 BASIN MAP

TABLE 10. C-1 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-21 Stage divide	Spillway, 3 gates, 27ft x 10.7ft Crest lgth = 81ft Crest elev = -6.5ft NGVD	1.9	1.4	1.2 (dry season) 2.0 (wet season)	2560	HW = 2.80 Q = 2340 TW: ~ 11.5 (Hurr. Betsy, over-topped levee at L-31E by ~ 4ft)	8/17/81 8/17/81
S-148 Stage divide	Spillway, 2 gates, 20ftx12ft Crest lgth = 40ft Crest elev = -7.0ft NGVD	3.9	3.7	4.5	1500	HW = 5.80 (storm Dennis)	8/81
S-149 Stage divide	Gated Culvert 2-84inx63ft CMP Invert elev = -3.0ft NGVD	5.0	3.8	5.5	400	HW = 4.9	8/18/81
S-122 Divide structure C-1 and C-100B, water supply, C-1 to C-100B	Gated Culvert 3-72inx60ft RCP Invert elev = -4.0ft NGVD	2.5 (water supply)	2.0 (water supply)		200 (water supply)		
S-338 Water supply, C-1	Gated Culvert 2-84inx 85ft CMP Invert elev = -4.5ft NGVD	6.5	6.0		305	HW = 8.16	8/19/81
S-334 Water supply, South Dade Conveyance System	Spillway 1 gate 29ft x 14.6ft Crest lgth = 29ft Crest elev = -6.9ft NGVD	5.0	4.7		1230		
S-335 Water supply, South Dade Conveyance System	Spillway 1 gate 20ft x 11.2ft Crest lgth = 20ft Crest elev = -4.2ft NGVD	5.0	4.8		525		
S-336 Water supply, South Dade Conveyance System	Gated Culvert 3-54in x85ft CMP Invert elev = -1.8ft NGVD	4.7	4.2	(TW stage rise to ~-6.5 ft during wet season)	145		
S-331 Water supply to C-111	Pump 3 units	3.0 (water supply)	6.0 (water supply)	4.5 to 5.0 HW (depending on stage at ground-water well Angel)	1160		
S-173 Divide structure	Culvert 1-72in x 70ft RC Invert elev = -2.5ft NGVD	5.0 (Divide structure when pumps operate)	4.5 (Divide structure when pumps operate)	4.5 to 5.5 (depends on conditions in E. Everglades)	150	HW = 8.02 TW = 8.25 (storm Dennis)	8/81

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-102 BASIN

Description of the Basin

The C-102 basin has an area of approximately 25.4 square miles and is located in southeastern Dade County (Figure 24). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and structures is given in Figure 25.

There are two Project canals in the C-102 basin: C-102 and C-102N. These canals have three functions: (1) to provide drainage and flood protection for the C-102 basin, (2) to supply water to the basin for irrigation, and (3) to maintain a groundwater table elevation adequate to prevent intrusion of saltwater into local groundwater. Water is supplied to the C-102 basin from the South Dade Conveyance System (SDCS) during periods of low natural flow.

C-102 begins in the L-31N borrow canal one and one-half miles south of Richmond Drive. Flow in the canal is to the southeast with discharge via S-21A to Biscayne Bay north of Fender Point. C-102N is tributary to C-102. It begins at S-195 northwest of the intersection of U.S. Highway 1 and Silver Palm Drive. Flow in the canal is to the south to the canal's confluence with C-102 just south of the West Dade Expressway crossing of C-102N.

During normal operation, the 9.4 square mile area adjacent to C-102 west of Krome Avenue drains to the east via C-102 to Biscayne Bay. During flood conditions S-194 is closed and this area drains to the west to the L-31N borrow canal and the C-111 basin.

There are four Project control structures in the C-102 basin: S-21A, S-165, S-195, and S-194.

1. S-21A is a gated spillway located in C-102 one mile west of Biscayne Bay. It controls stages in C-102 and C-102N, and it regulates discharges to tidewater. A headwater stage is maintained by S-21A adequate to prevent saltwater intrusion into local groundwater.

2. S-165 is a gated spillway located in C-102 just west of U.S. Highway 1. It controls the stage in the upper reach of C- 102, and it regulates discharges to the lower reaches of C-102 and C-102N.

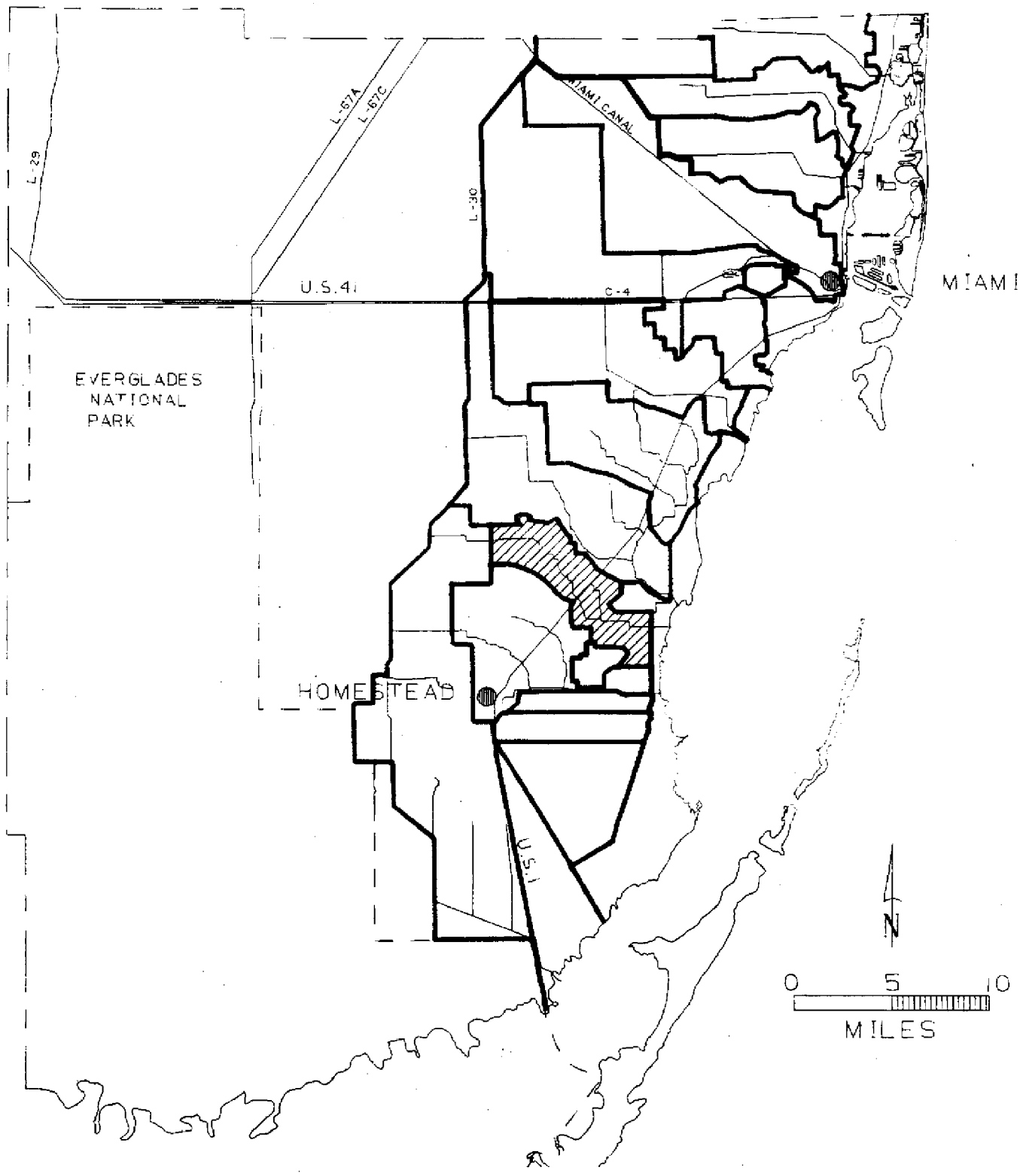
3. S-195 is a gated culvert located in C-102N at its upper end just west of U.S. Highway 1. It controls inflows to C-102 from local drainage systems.

4. S-194 is a gated culvert located in C-102 just west of Krome Avenue on the divide between the C-111 and C-102 basins. The structure is normally open to supply water to the C-102 basin from the L-31N borrow canal. During flooding the gates at S-194 are closed to prevent water from passing from one basin to the other.

Design criteria for the structures in the C-102 basin are given in Table 11.

Comments on Design and Historic Operation

C-102 was designed for 1-10 year flood protection (40 percent SPF), but there is sufficient right-of-way for a canal that provides 1-30 year flood protection (60 percent SPF). During Tropical Storm Dennis the discharge at S-21A was 2450 cfs. Flooding occurred upstream of U.S. Highway 1 all the way west to the L-31N borrow canal.



C-102 BASIN

FIGURE 24 C-102 BASIN LOCATION MAP

C-102

~16,000 ACRES

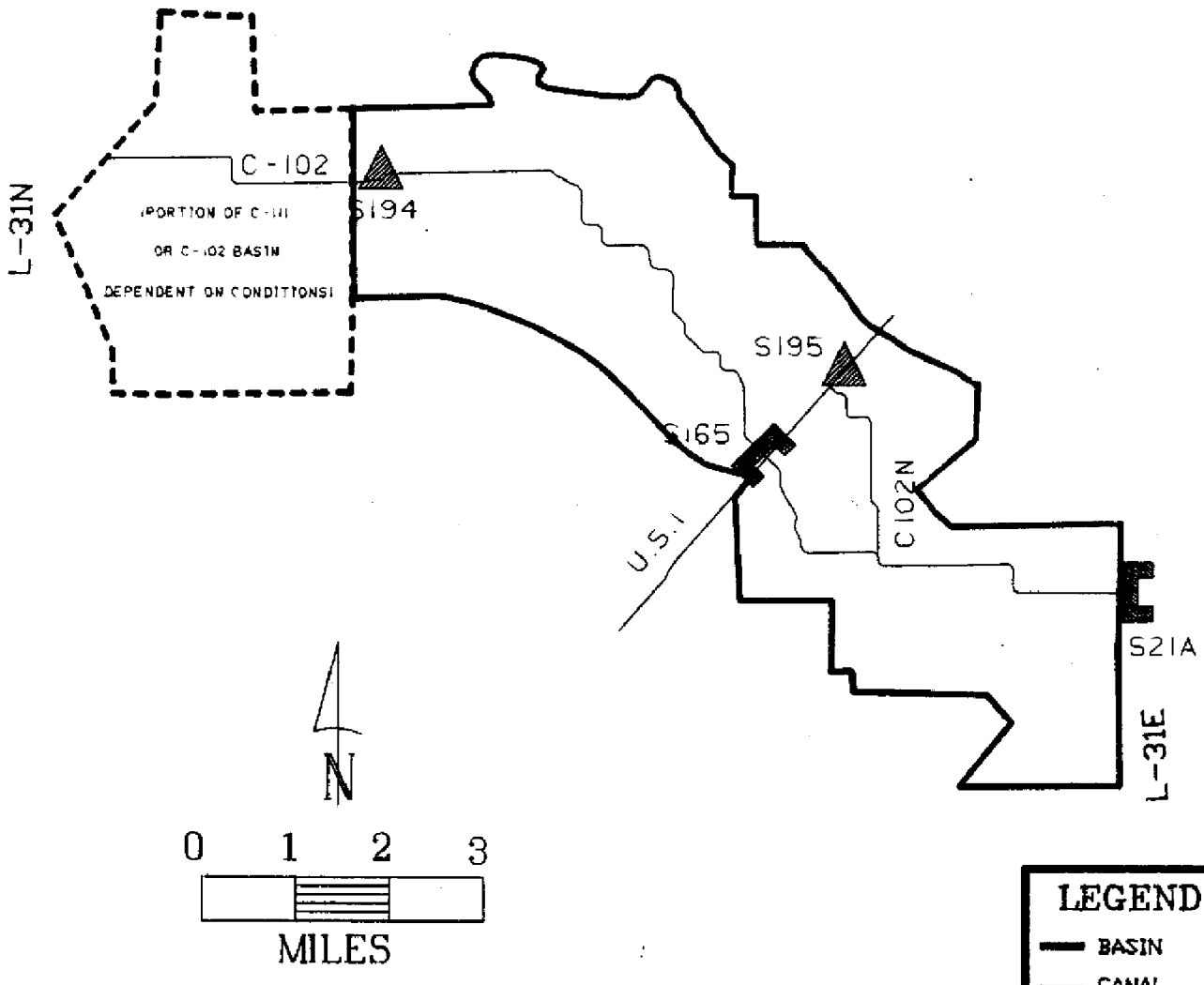


FIGURE 25 C-102 BASIN MAP

TABLE 11. C-102 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-21A Stage divide	Spillway, 2gates 20ft x 11.8ft Crest lgth = 40ft Crest elev = -7.8ft NGVD	1.9	1.4	1.2 (Dry Season) 2.0 (Wet Season)	1330	HW = 2.87 TW = 2.37 Q = 2454cfs	8/16/81 8/16/81 8/16/81
S-195 Divide structure	Gated Culvert 97in x 152in x 90ft CMP Arch Invert elev = -1.8ft NGVD	5.6	4.8	5.5	180	HW = 7.1 TW = 6.4 Q = 400	
S-194 Divide structure	Culvert 2-84in x 90ft RCP, gated Invert elev = -2.5 to -3.5ft NGVD	3.9 (water supply)	3.7 (water supply)	5.5 (to west)	~190 (water supply divide structure during flood)	HW = 9.23 TW = 9.15 (storm Dennis)	8/18/81 8/18/81
S-165 Stage divide	Spillway, 1 gate 12ft x 7ft Crest lgth = 12ft Crest elev = -0.5ft NGVD	5.6	4.6	5.5	450	HW = 7.55 TW = 6.28 Q = 666	8/18/81 8/18/81 8/19/81

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-103 BASIN

Description of the Basin

The C-103 basin has an area of approximately 40.6 square miles and is located in southeast Dade County (Figure 26). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structures is given in Figure 27.

There are three Project canals in the C-103 basin: C-103, C-103S, and C-103N. These canals have three functions: (1) to provide drainage and flood protection for the C-103 basin, (2) to supply water to the basin for irrigation, and (3) to maintain a groundwater table elevation adequate to prevent intrusion of saltwater into local groundwater. Water is supplied to the C-103 basin from the South Dade Conveyance System (SDCS) during periods of low natural flow.

C-103 begins in the L-31N borrow canal one mile west of Loveland Road between Bauer Drive and Epmore Drive. Flow in the canal is to the southeast with discharge via S-20F to Biscayne Bay north of Convoy Point. C-103S and C-103N are tributary to C-103. C-103S begins at North Canal Drive, one-half mile east of Krome Avenue. Flow in the canal is to the east to the canal's confluence with C-103 one-quarter mile south of Campbell Drive. C-103N begins at Tennessee Road south of Plummer Drive. Flow in the canal is to the southeast to the canal's confluence with C-103 one-half mile southwest of the intersection of Campbell Drive and Tallahassee Road.

During normal operation, the 4.5 square mile area adjacent to C-103 west of Richard Road drains to the east via C-103 to Biscayne Bay. During flood conditions S-196 is closed and this area drains to the west to the L-31N borrow canal and the C-111 basin.

There are five Project control structures in the C-103 basin: S-20F, S-179, S-167, S-166, and S-194.

1. S-20F is a gated spillway located in C-103 one mile west of Biscayne Bay. It controls stages in the lower reach of C-103, and it regulates discharges to tidewater. A headwater stage is maintained by S-21A adequate to prevent saltwater intrusion into local groundwater.

2. S-179 is a gated spillway located in C-103 just west of Tallahassee Road. It controls the stage in the middle reach of C-103 and in the lower reaches of C-103S and C-103N, and it regulates discharges to the lower reach of C-103.

3. S-167 is a gated spillway located in C-103 just west of Tennessee Road. It controls stages in the upper reach of C-103, and it controls discharges to the middle reach of C-103.

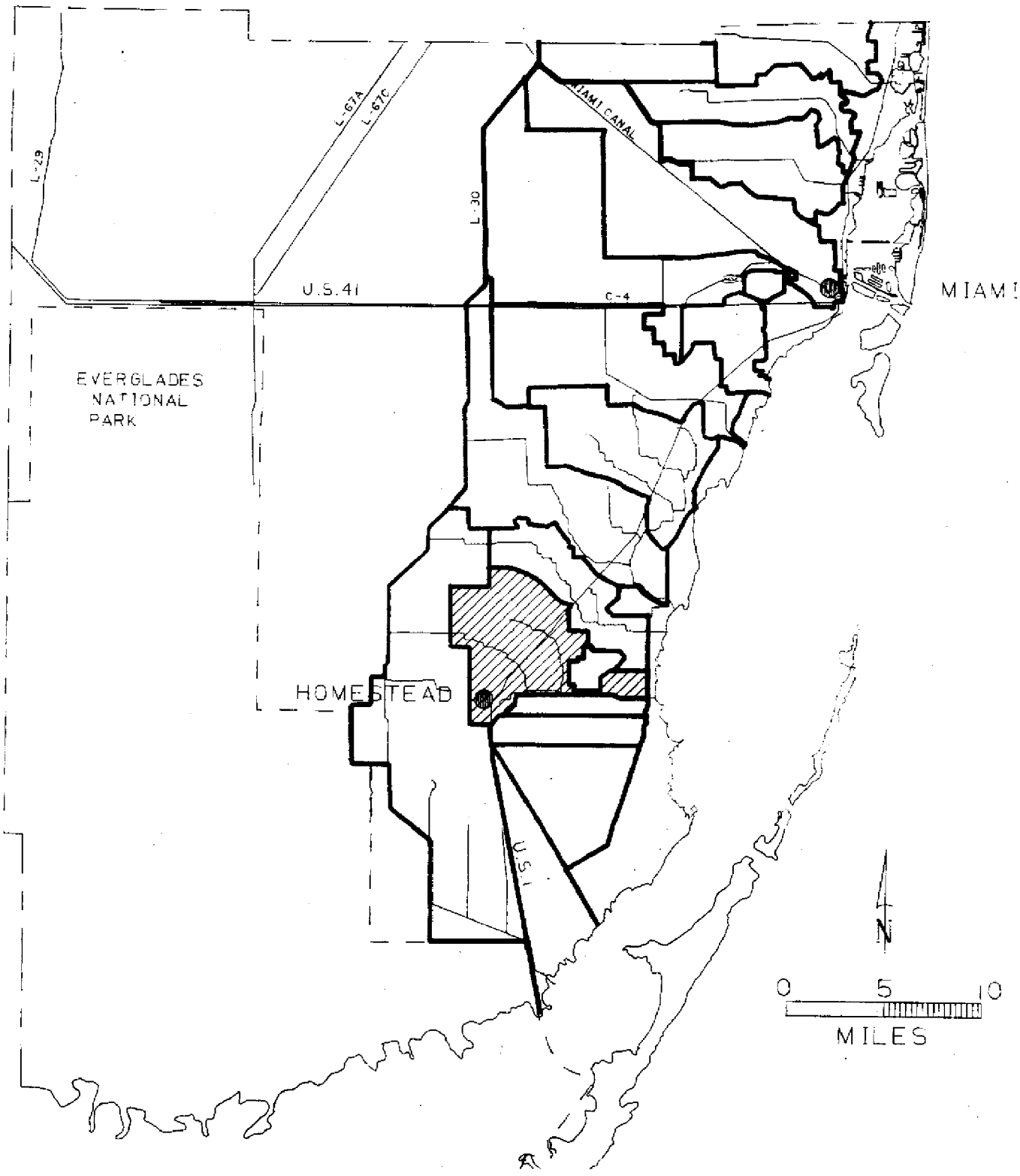
4. S-166 is a gated spillway located in C-103N just west of U.S. Highway 1. It controls stages in the upper reach of C-103N, and it controls discharges to the middle reach of C-103.

5. S-196 is a gated culvert located in C-103 just west of Richard Road on the divide between the C-111 and C-103 basins. The structure is normally open to supply water to the C-103 basin from the L-31N borrow canal. During flooding the gates at S-196 are closed to prevent water from passing from one basin to the other.

Design criteria for the structures in the C-103 basin are given in Table 12.

Comments on Design and Historic Operation

5.2 square miles of the C-103 basin in the Homestead and Florida City area are not drained. At the time C-103S was constructed, the city commissioners of Homestead and Florida City declined to have the canal constructed within their respective city limits. The cities were advised at that time that any drainage problems would be their responsibility. Both cities have more recently considered construction of storm drains to alleviate flooding that occurs during severe storms. No action has been taken to date.

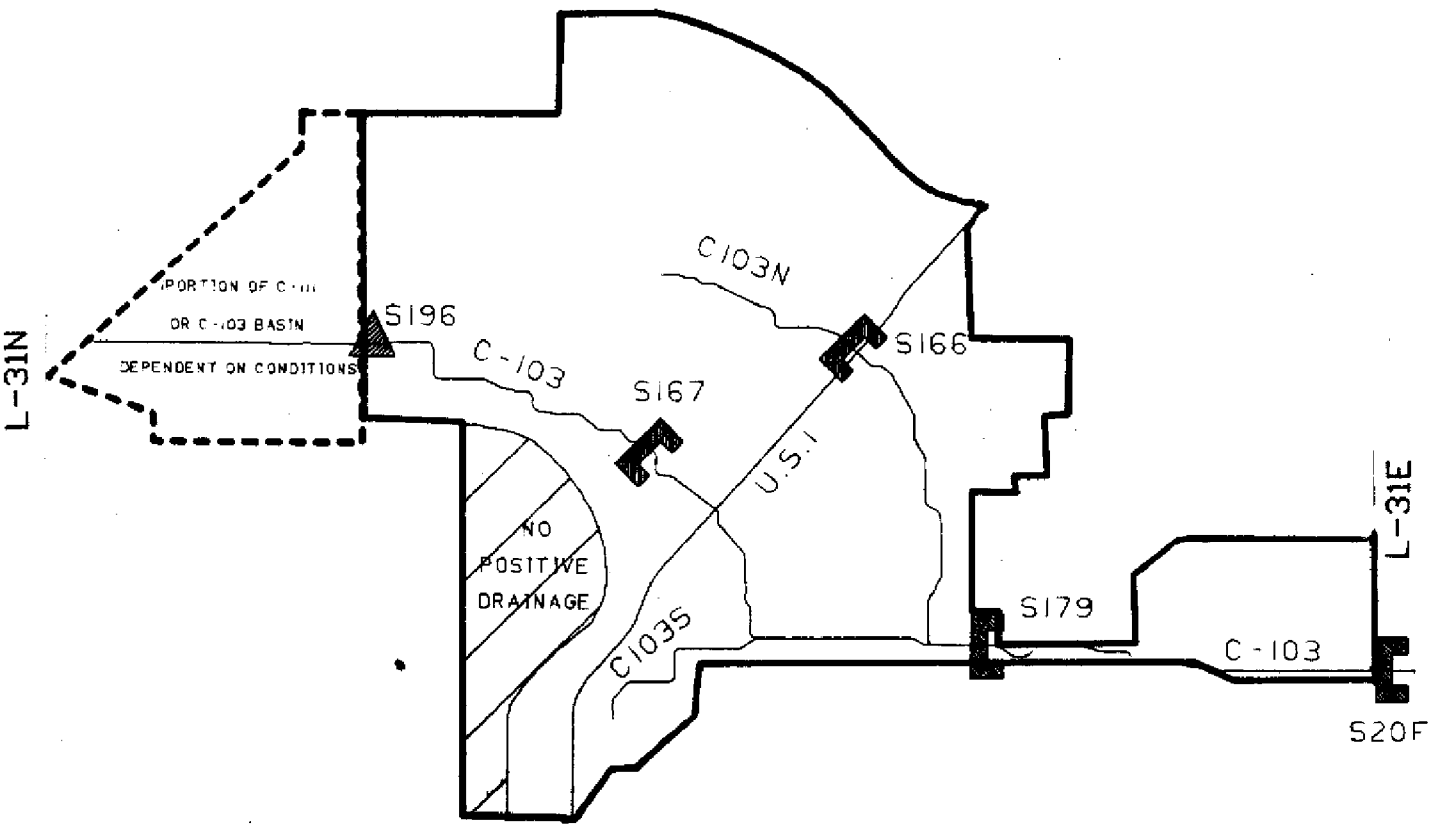


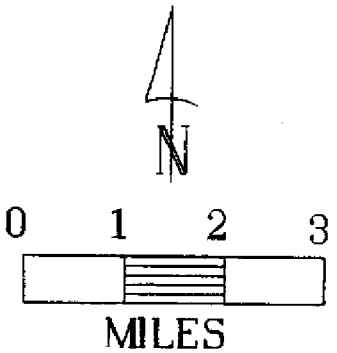
C-103 BASIN

FIGURE 26 C-103 BASIN LOCATION MAP

C-103

~26,000 ACRES





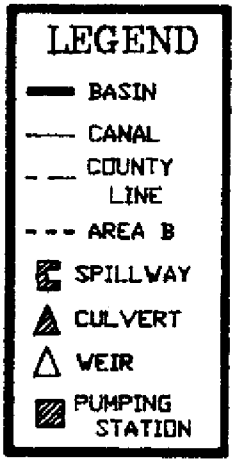


FIGURE 27 C-103 BASIN MAP

TABLE 12. C-103 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-20F Stage divide	Spillway, 3 gates 25ft x 13ft Crest lgth = 75ft, Crest elev = 9.0ft NGVD	1.9	1.4	1.4 (Dry Season) 2.2 (Wet Season)	2900	HW = 3.05 TW = -0.5 Q = 5780 (storm Dennis)	8/18/81
S-179 Stage divide	Spillway, 2 gates, 25ft x 12ft Crest lgth = 50ft, Crest elev = -7.5ft NGVD	3.8	3.2	2.5 to 3.5 (Dry Season depending on rainfall) 3.5 (Wet season)	1920	HW = 4.94 TW = 3.82 Q = 2680 (storm Dennis)	8/17/81 8/17/81 8/18/81
S-167 Stage divide	Spillway, 1 gate 12ft x 7 ft Crest lgth = 12ft, Crest elev = -0.5ft NGVD	5.6	4.8	5.5	330	HW = 7.68 TW = 5.5 Q = 410 (storm Dennis)	8/18/81 8/18/81 8/19/81
S-166 Stage divide	Spillway, 1 gate 12ft x 8.5 ft Crest lgth = 12ft, Crest elev = -2.0ft NGVD	5.2	4.6	5.5	420	HW = 6.84 TW = 5.90 Q = 653 (storm Dennis)	8/18/81 8/18/81 8/18/81
S-196 Divide structure	Culvert 1-84in x 58ft RCP gated Invert elev = 2.5 to 3.5ft NGVD	6.5	5.5	5.5 (to west)	200 at 1 ft (divide structure closed during storms)	HW = 8.75 TW = (under water) (storm Dennis)	8/81

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

NORTH CANAL, FLORIDA CITY CANAL, MODEL LAND AND HOMESTEAD AIR FORCE BASE BASINS

Description of the Basins

The area occupied by the Homestead Air Force Base, and the area south of the C-103 basin, east of Old Dixie Highway and Card Sound Road, and west and north of L-31E is drained by five existing Dade County canals:

1. The Military Canal which drains the 4.7 square miles of the Homestead Air Force Base (Figure 28)
2. The North Canal which drains 7.8 square miles (Figure 30)
3. The Florida City Canal which drains 12.5 square miles (Figure 32)
4. The North Model Land Canal and
5. The South Model Land Canal which together drain 28.1 square miles (Figure 34)

The basin boundaries for these four basins are shown on Map A. Schematic maps of the Homestead, North Canal, Florida City, and Model Land Canal basin boundaries, their canals, and their control structures are shown in Figures 29, 31, 33, and 35, respectively.

Drainage from Homestead Air Force Base is pumped into Military Canal just west of Allapattah Drive. The canal flows due east discharging into Biscayne Bay via S-20G.

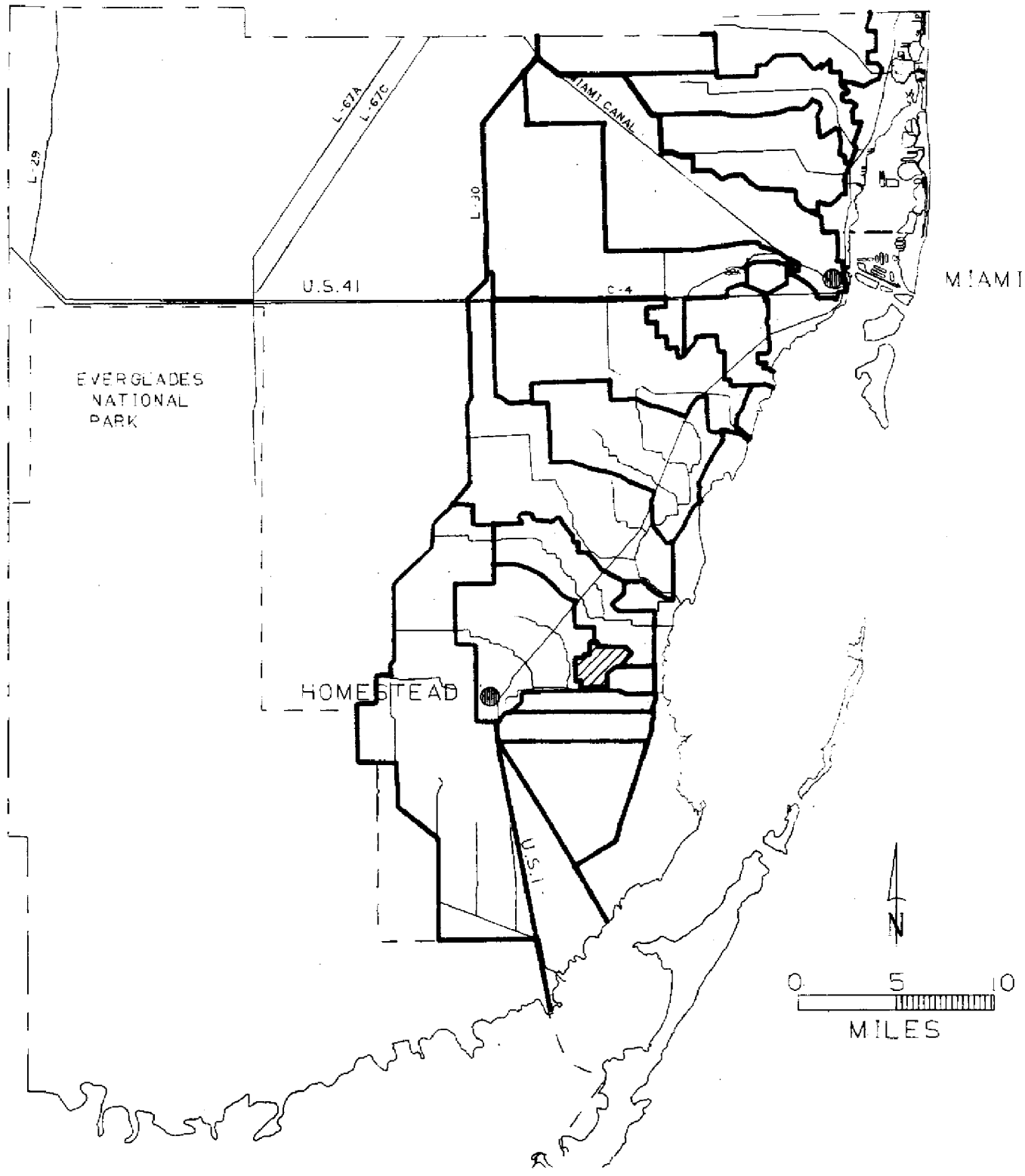
The North Canal and Florida City canals drain to C-103 via the west borrow of L-31E. This adds approximately 26 square miles to the basin served by S-20F. North Canal parallels North Canal Drive beginning at the south end of C-103S and ending in the west borrow canal of L-31E. The Florida City Canal is one mile south of and parallel to North Canal. It flows from U. S. Highway 1 East to the east, to the west borrow of L-31E.

The land within the Model Land basin drains to the west borrow canal of L-31E. Water in the west borrow canal of L-31E is passed through L-31E by way of S-20. The water is routed to the south around the cooling basin for the Florida Power and Light Turkey Point Power Plant and is discharged to Biscayne Bay.

All of the operational Project control structures (S-20G, S-20F, and S-20) in these basins provide water surface elevation control upstream of their locations in the canals in which they occur. S-20F is actually in C-103; however, since the Florida City Canal and the North Canal are connected by open channel connections with the L-31E borrow canal which, in turn, joins C-103 by an open channel connection upstream of S-20F, the structure effectively controls water surface elevations in the Florida City and North Canals. The design criteria for the structures in these basins are given in Tables 13, 14, and 15.

Comments on Design and Historic Operation

The Model Land basin was to have been drained by two canals, C-106 and C-107. These canals would have been aligned due west from S-20A and S-20 respectively. The canals were never built. S-20A is not operational, and S-20 is used to pass the flow in the Model Land canals to tidewater.



HOMESTEAD BASIN

FIGURE 28 HOMESTEAD BASIN LOCATION MAP

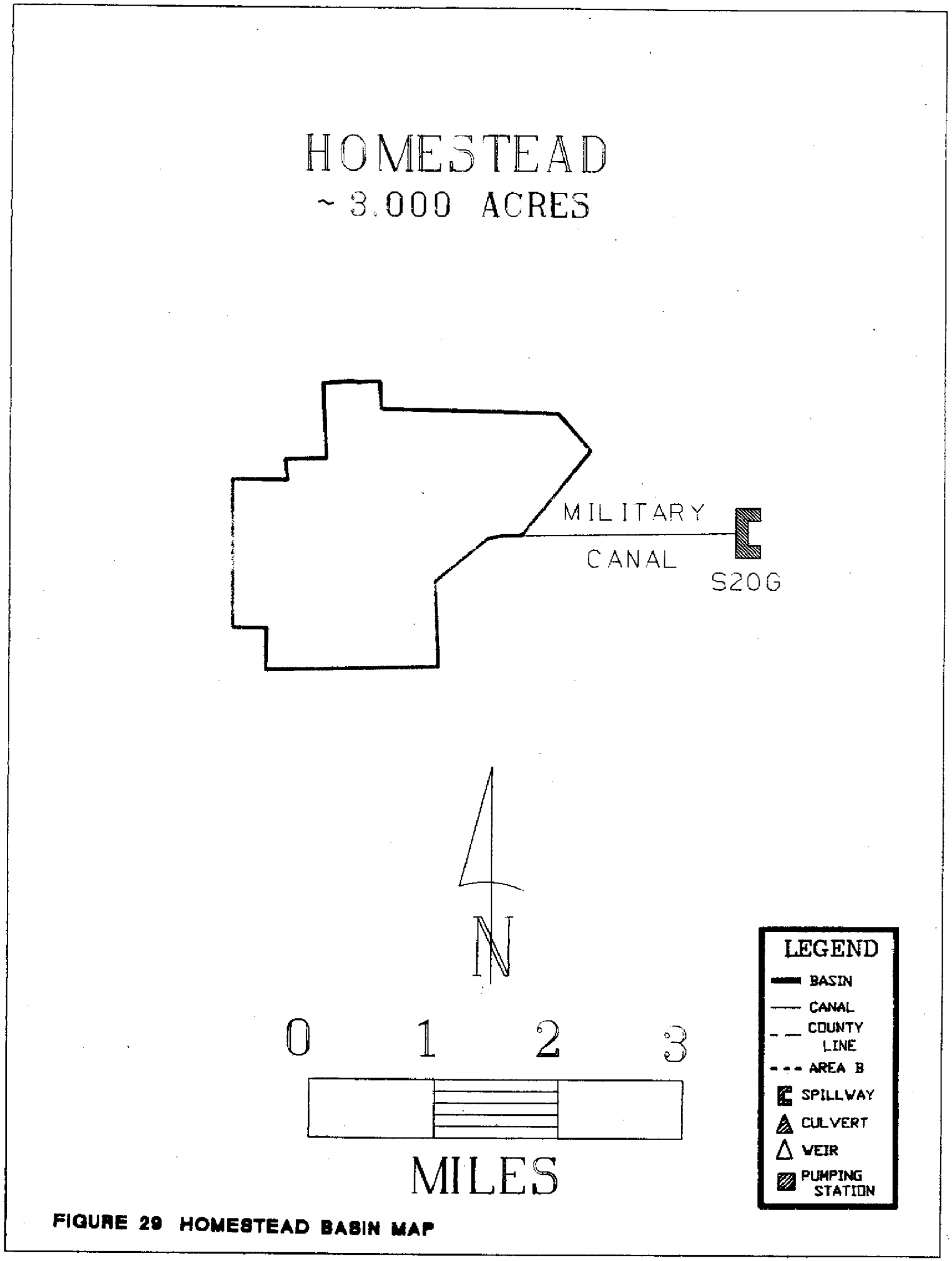
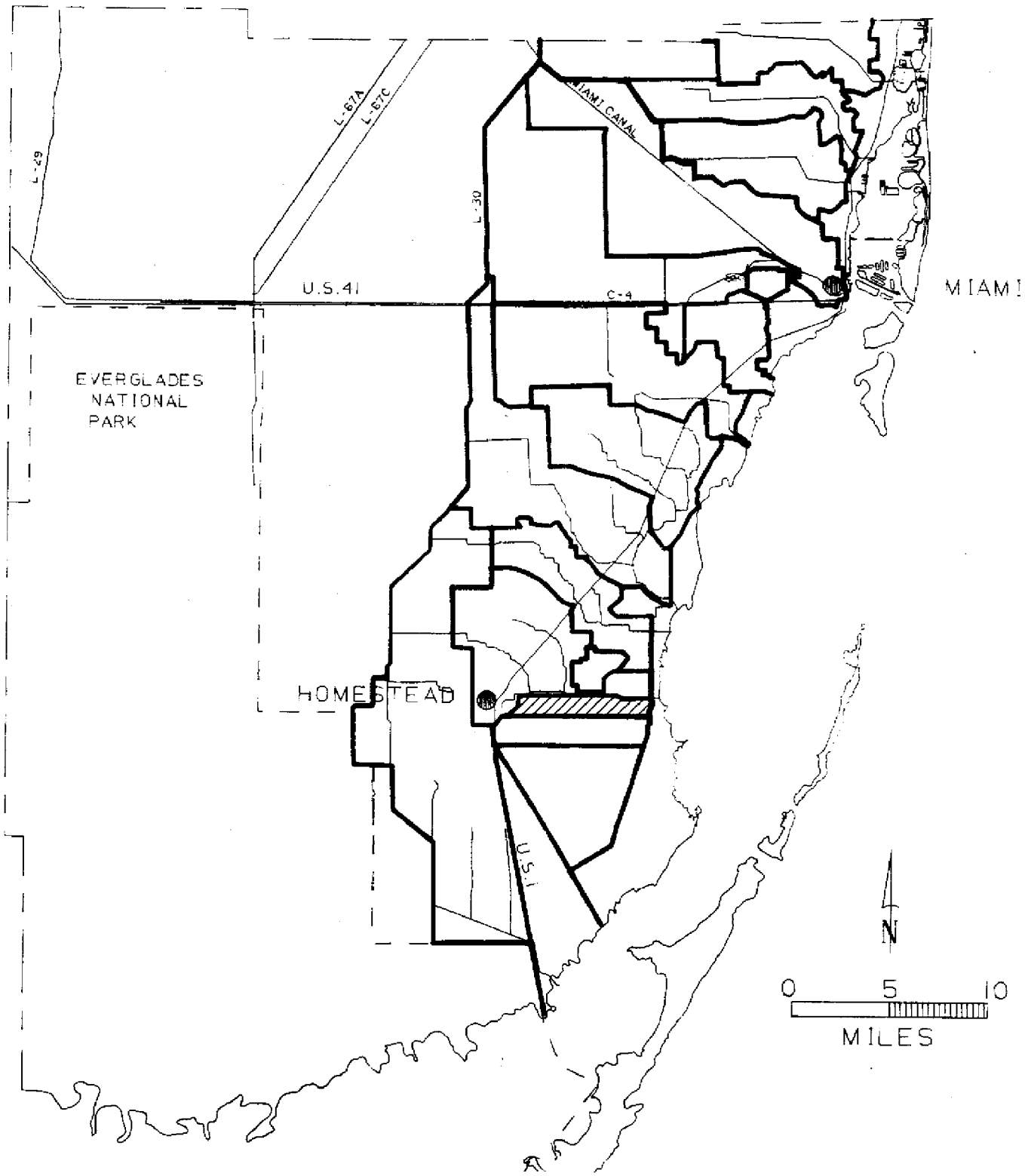


FIGURE 29 HOMESTEAD BASIN MAP

TABLE 13. Homestead Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-20G Stage divide	Spillway, 1 gate 25ft x 12.3ft Crest lgth = 25ft Crest elev = -8.3ft NGVD	2.0	1.5	1.0 (Dry Season) 2.0 (Wet Season)	900	HW = 3.89 TW = 2.47 Q = 1030	8/17/81 8/16/81 8/19/81

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream



NORTH CANAL BASIN

FIGURE 30 NORTH CANAL BASIN LOCATION MAP

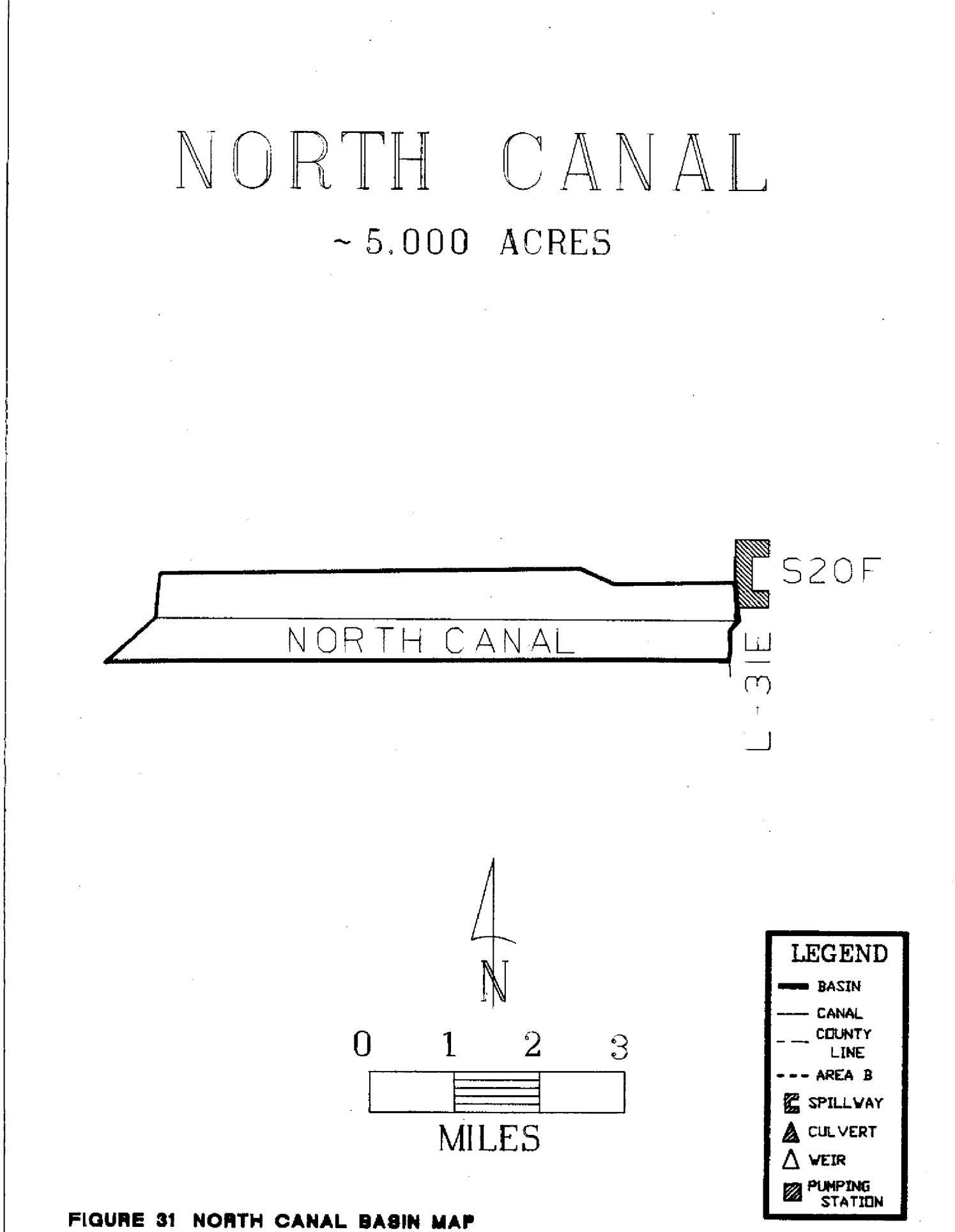
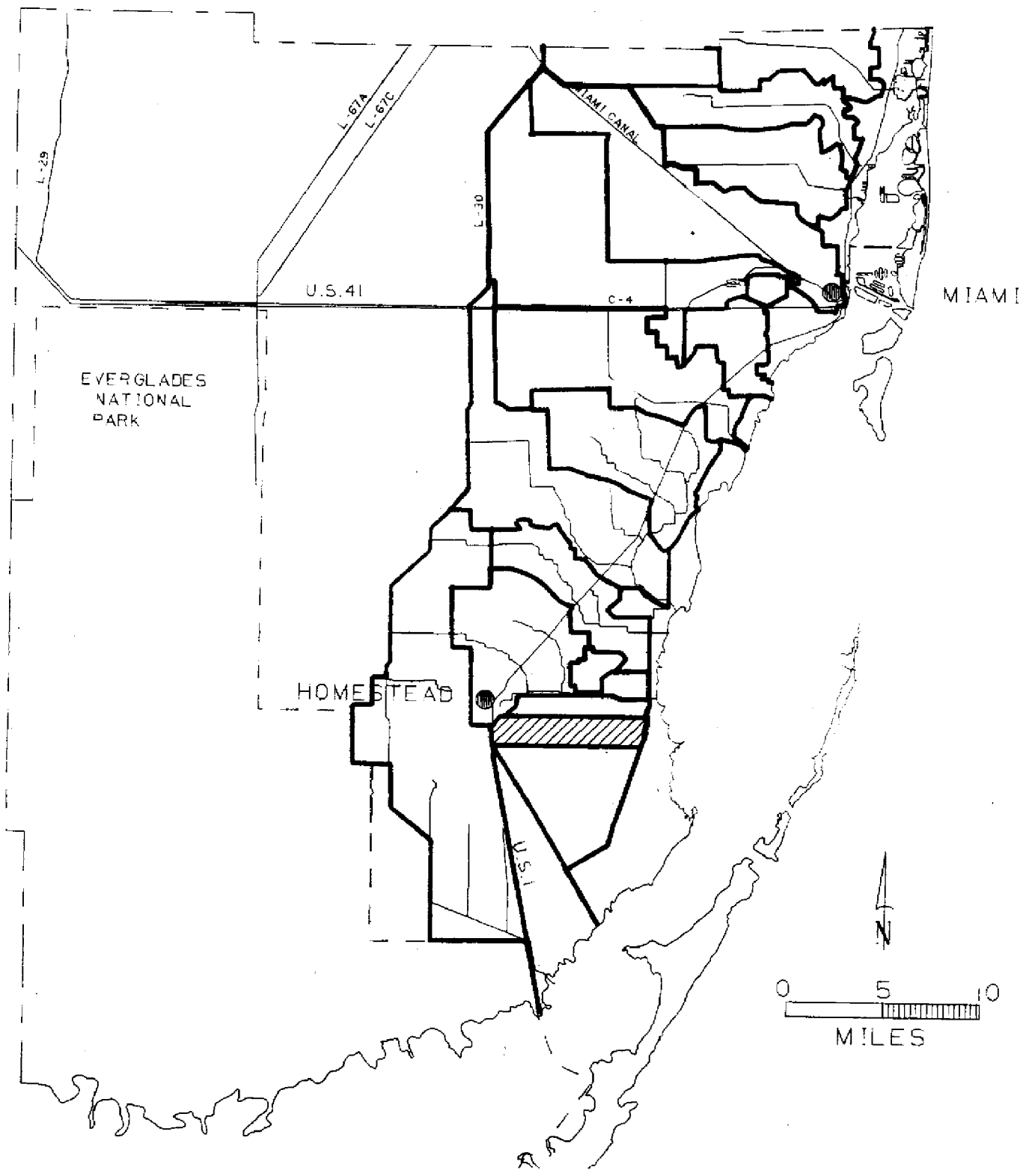


FIGURE 31 NORTH CANAL BASIN MAP

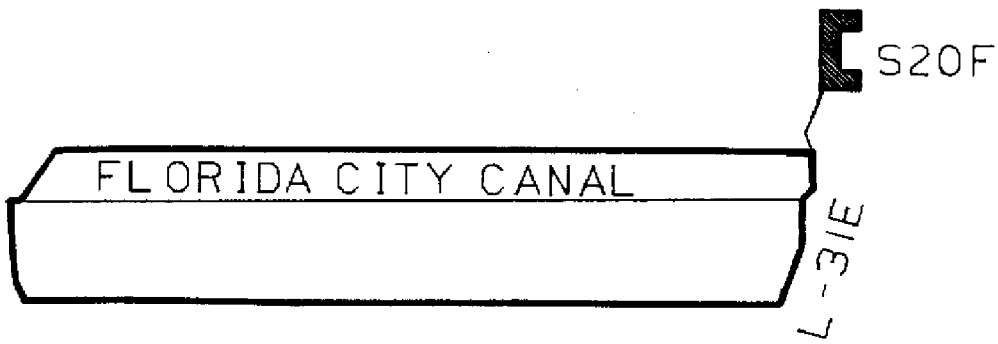


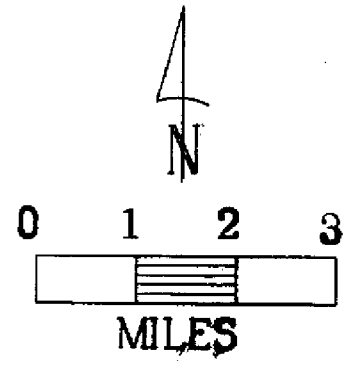
FLORIDA CITY BASIN

FIGURE 32 FLORIDA CITY CANAL BASIN LOCATION MAP

FLORIDA CITY

~ 8,000 ACRES





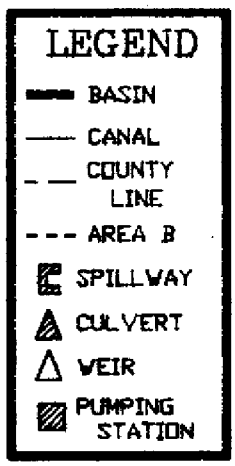
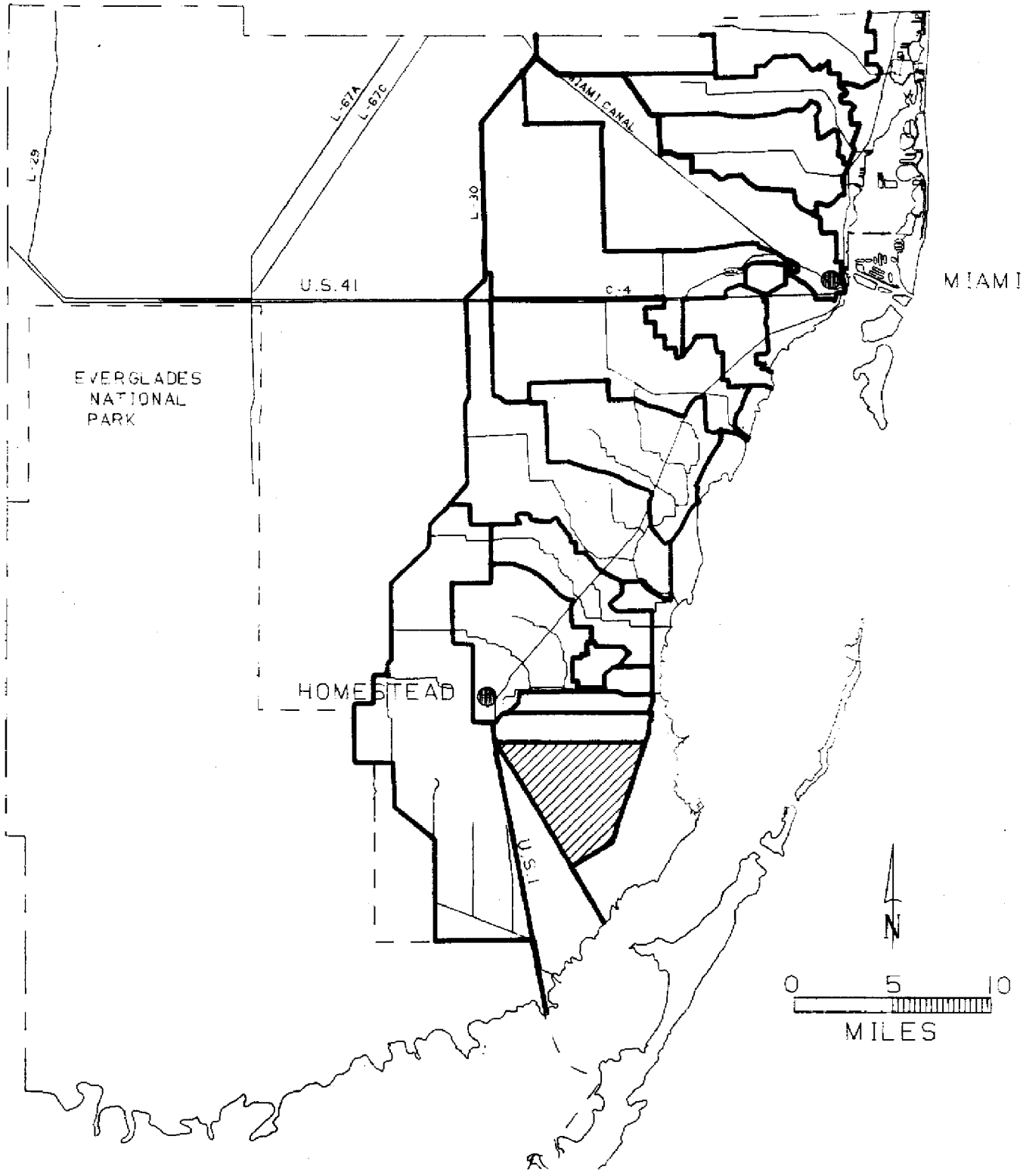


FIGURE 33 FLORIDA CITY CANAL BASIN MAP

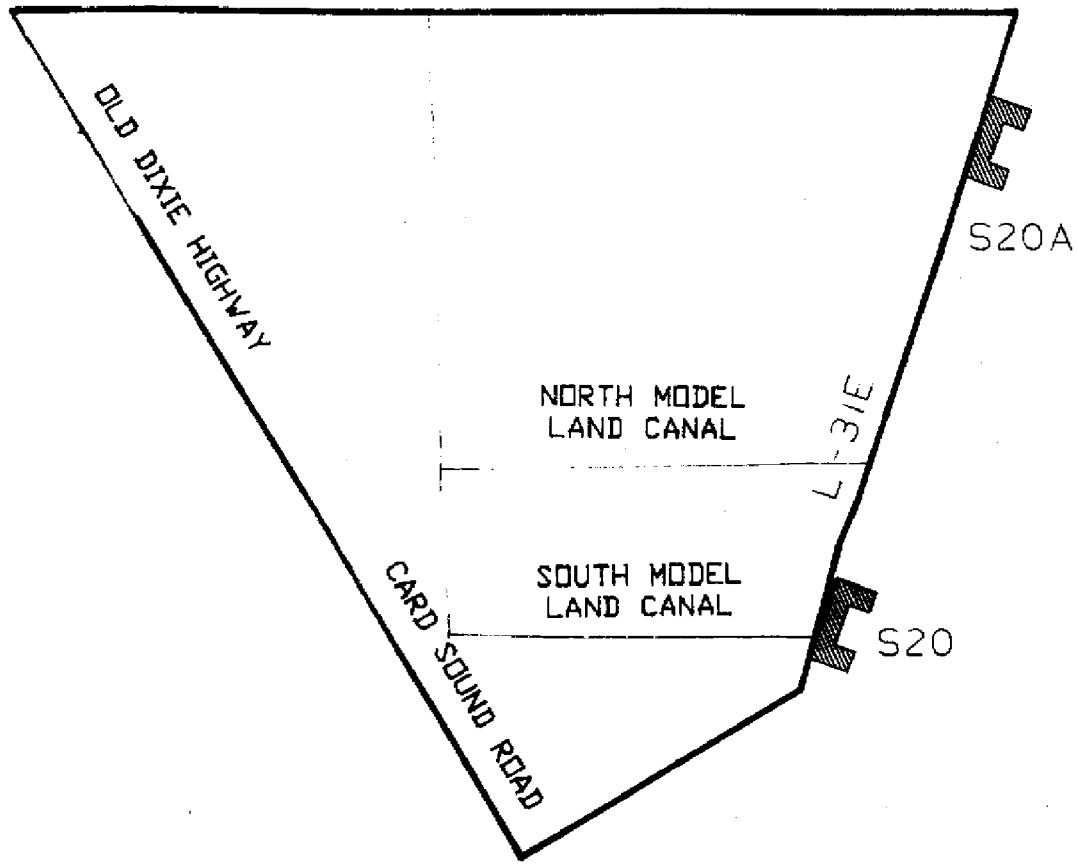


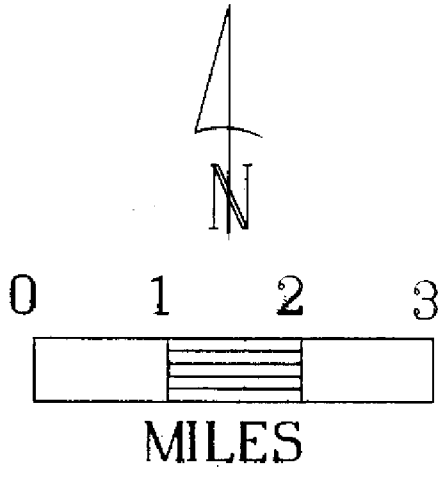
MODEL BASIN

FIGURE 34 MODEL LAND CANAL BASIN LOCATION MAP

MODEL LAND

~ 18,000 ACRES





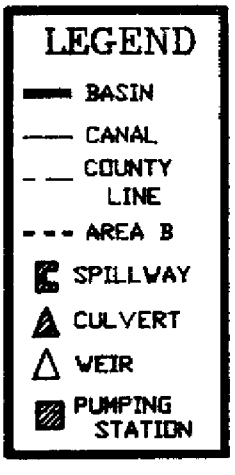


FIGURE 35 MODEL LAND CANAL BASIN MAP

TABLE 14. Model Land Canal Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-20 Stage divide	Spillway, 1 gate 16ft x 11.4ft Crest lgth = 16ft Crest elev = -7.4ft NGVD	1.5	1.0	1.2 (Dry Season) 1.5 (Wet Season)	450	HW = 2.78 TW = 2.31 Q = 740	8/19/81 8/19/81 8/20/81
S-20A Stage divide	Spillway, 1 gate 16ft x 13.3ft Crest lgth = 16ft Crest elev = -9.3ft NGVD		--Never Opened--				

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

TABLE 15. North Canal and Florida City Canal Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-20F Stage divide	Spillway, 3 gates 25ft x 13ft Crest lgth = 75ft Crest elev = -9.0ft NGVD	1.9	1.4	1.4 (Dry Season) 2.2 (Wet Season)	2900	HW = 3.05 TW = -0.5 Q = 5780 (storm Dennis)	8/18/81

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

C-111 BASIN

Description of Drainage Basin

The C-111 basin has an area of approximately 100 square miles and is located in southern Dade County (Figure 36). The basin boundary relative to local roads and landmarks is shown on Map A. A schematic map showing the basin boundary, canals, and control structure is given in Figure 37.

There are five operational Project canals in the C-111 basin: C-111, C-111E, C-113, the L-31N borrow canal, and the L- 31W borrow canal. These canals have three functions: (1) to provide drainage and flood protection for the C-111 basin; (2) to supply water to the C-111, C-102, and C-103 basins, and to the Everglades National Park (i.e., to Taylor Slough and the Panhandle of the Park); and (3) to maintain a groundwater table elevation near the lower reach of C-111 adequate to prevent intrusion of saltwater into local groundwater. Water is supplied to the C-111 basin by the South Dade Conveyance System (SDCS) by way of the L-31N borrow canal. The L-31W borrow canal is used to make water deliveries to Taylor Slough in Everglades National Park by way of S-332 and S-175. Water is discharged to the Panhandle of the Park by way a series of gaps in the south berm of C-111 between S-18C and S-197.

The L-31N borrow canal is part of the SDCS for delivering water to basins in south Dade County from the Water Conservation Areas to the north. It is aligned north-south along the west sides of the C-1 and C-111 basins. The borrow canal enters the C-111 basin at S-173 just north of Richmond Drive. One mile north of Mowery Drive the borrow canal discharges to C-111 by way of S-176 and to the L-31W borrow canal by way of S-174. Flow in the canal is to the south.

C-111 begins at S-176 one mile north of Mowery Drive. Flow in the canal is to the south with discharge via S-197 to Barnes Sound east of U.S. Highway 1. C-111E and C-113 are tributary to C-111. C-111E begins at State Road 27, four-tenth of a mile west of Country Club Road. The canal extends three miles to the south to its open channel connection with C-111. Flow in the canal is to the south. C-113 begins at Richard Road one-quarter mile north of Mowery Drive. The canal extends to the west to its open channel connection with C-111 just downstream of S-176. Flow in the canal is to the west.

The L-31W borrow canal is part of the SDCS. It is aligned along the west boundary of the Frog Pond agricultural area on the west side of the C-111 basin. This borrow canal begins at the southern end of the L-31N borrow canal and is connected to the L-31N borrow canal by way of S-174. The borrow canal discharges to Taylor Slough by way of S-332 and S-175.

There are two other Project canals connected to the L-31N borrow canal: C-102 and C-103.

C-102 makes an open channel connection with the L-31N borrow canal one and one-half miles south of Richmond Drive. The canal is aligned east-west and leaves the basin at S-194 at Krome Avenue. During normal operation, the 9.4 square mile area adjacent to C-102 west of Krome Avenue drains to the east via

C-102 to Biscayne Bay. During flood conditions S-194 is closed and this area drains to the west to the L-31N borrow canal and the C- 111 basin.

C-103 makes an open channel connection with the L-31N borrow canal one mile west of Loveland Road between Bauer Drive and Epmore Drive. The canal is aligned east-west and leaves the basin at S-196 at Richard Road. During normal operation, the 4.5 square mile area adjacent to C-103 west of Richard Road drains to the east via C-103 to Biscayne Bay. During flood conditions S-196 is closed and this area drains to the west to the L-31N borrow canal and the C-111 basin.

There are twelve Project control structures in the C-111 basin: S-331, S-173, S-194, S-196, S-176, S-174, S-332, S-175, S-177, S178, S-18C, and S-197.

S-173 is a gated culvert located in the L-31N borrow canal at the divide between the C-1 and C-111 basins. It is adjacent to pumping station S-331 just north of Richmond Drive. It is closed during storm events to prevent flood flows from passing from one basin to the other. It is also closed when the pumps at S-331 are in operation.

S-331 is a pumping station in the L-31N borrow canal at the divide between the C-1 and C-111 basins. It is adjacent to S-173 just north of Richmond Drive. The pumping station is a component of the SDCS. Its function in conjunction with S-173 is to supply water to South Dade County basins and to Everglades National Park (i.e., Taylor Slough and the Panhandle Area). It also controls the stage in the L-31N borrow canal and protects the residential area west of L-31N from flooding. Water is supplied to the south whenever the headwater stage at any downstream structure is more than 1.5 feet below optimum.

S-194 is a gated culvert located in C-102 just west of Krome Avenue on the divide between the C-111 and C-102 basins. The structure is normally open to supply water to the C-102 basin from the L-31N borrow canal. During flooding the gates at S-194 are closed to prevent water from passing from one basin to the other.

S-196 is a gated culvert located in C-103 just west of Richard Road on the divide between the C-111 and C-103 basins. The structure is normally open to supply water to the C-103 basin from the L-31N borrow canal. During flooding the gates at S-196 are closed to prevent water from passing from one basin to the other.

S-176 is a gated spillway at the south end of the L-31N borrow canal. S-176 and S-174 control the stage in the L-31N borrow canal. The stage determines the discharge to C-102 and C-103 from the borrow canal. S-176 also regulates discharges to C-111 from the L-31N borrow canal.

S-174 is a gated spillway at the south end of the L-31N borrow canal. S-176 and S-174 control the stage in the L-31N borrow canal. The stage determines the discharge to C-102 and C-103 from the borrow canal. S-174 also regulates discharges to the L-31W borrow canal from the L-31N borrow canal.

S-332 is a pumping station located in the L-31W borrow canal at the head of Taylor Slough. Water supply to Taylor Slough is made by way of this pumping station.

S-175 is a gated culvert located in the L-31W borrow canal. It is downstream of and approximately one mile southeast of S-332. The structure maintains the stage in the L-31W borrow canal and passes any excess flows to the south to the Park.

S-177 is a gated spillway located in C-111 at State Road 27. It controls the stage in C-111 upstream to S-176 and in C-113, and it regulates the discharge from the upper reach of C-111 to the middle reach of C-111.

S-178 is a gated culvert located in C-111E at State Road 27. It controls inflows to C-111E from local drainage systems.

S-18C is a gated spillway located in C-111 approximately five miles south of State Road 27. It controls stages in C-111 upstream to S-177 and in C-111E, and it regulates discharges from the middle reach of C-111 to the lower reach.

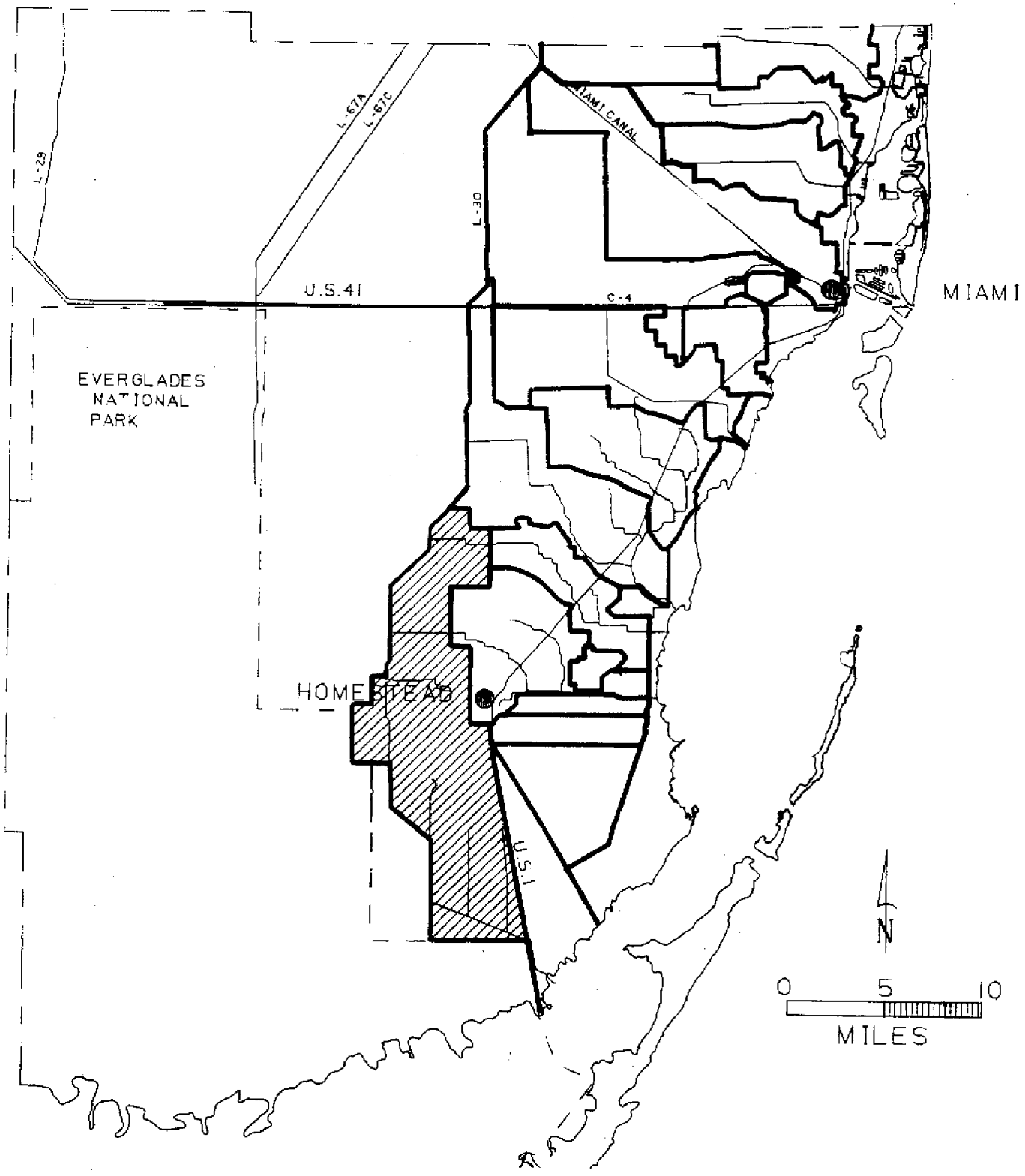
S-197 is a gated culvert in C-111 at U.S. Highway 1. It controls the stage in C-111 upstream to S-18C. The stage determines the discharge to the Panhandle of the Park through the gaps in the south berm of C-111. S-197 also regulates discharges to tidewater.

Design criteria for the structures in the C-111 basin are given in Table 16.

Comments on Design and Historic Operation

C-111 is designed to give flood protection from a 1-10 year storm. The system adequately handled the April 25, 1979 storm, a 1-25 year or slightly greater event, with 11-12 inches of rain. However, Tropical Storm Dennis, a 1-100 year event with up to 25 inches of rain caused extensive flooding in the basin with considerable flood damage.

The southern portion of the C-111 basin was to have been drained by two tributary canals: C-109 and C-110. C-109 was completed and C-110 was partially completed before work on the canals was stopped. Two structures were also built, S-18 in C-109 and S-199 in C-110 Both structures still exist, but the gates and operating mechanisms have been removed. Earthen plugs have been placed at the confluence of the canals with C-111. Although the canals exist, neither has an open channel or controlled connection with C-111.



C-111 BASIN

FIGURE 36 C-111 BASIN LOCATION MAP

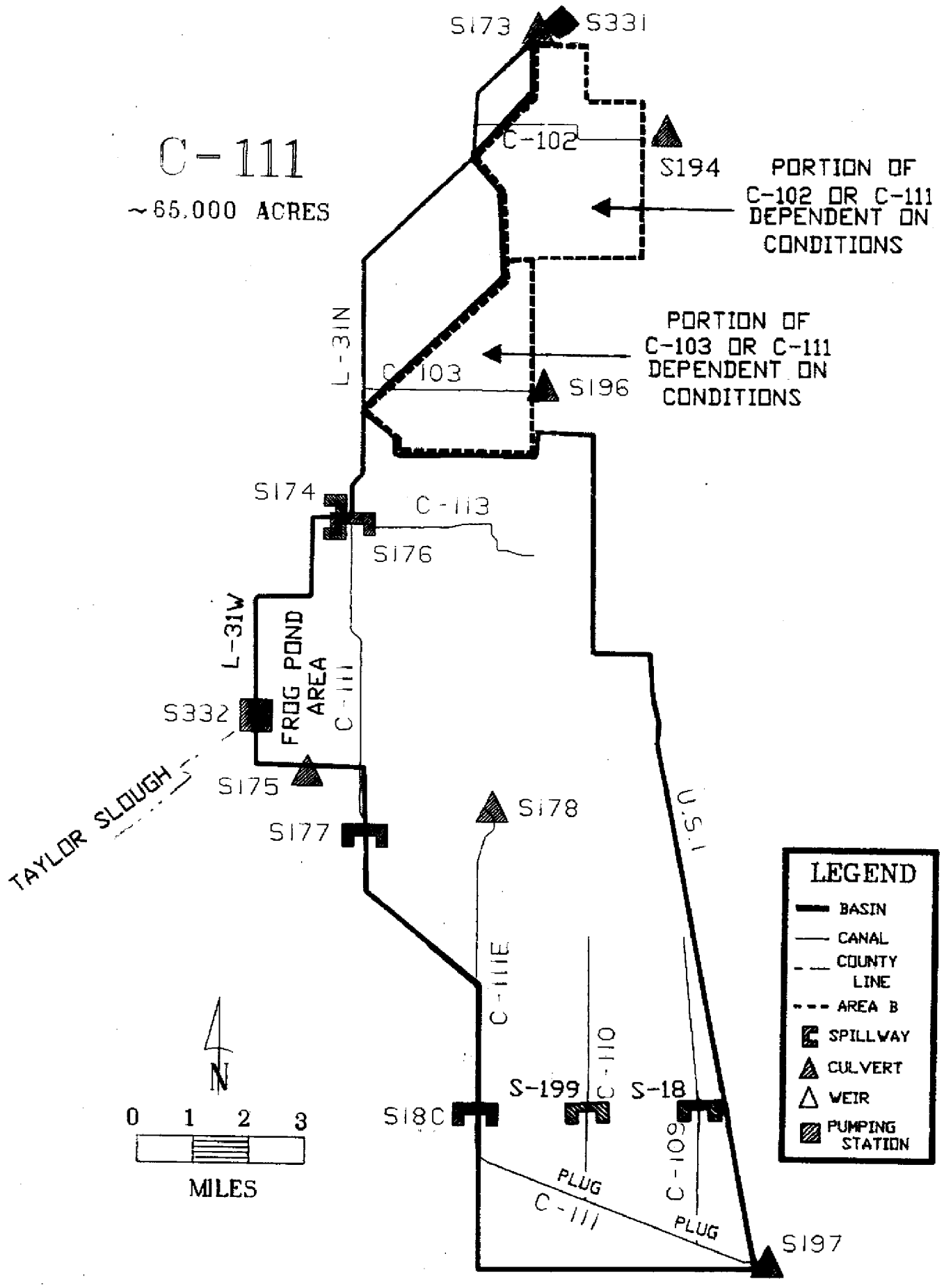


FIGURE 37 C-111 BASIN MAP

TABLE 16. C-111 Basin Structures - Design Criteria

Structure	Type	Design HW Stage (ft NGVD)	Design TW Stage (ft NGVD)	Optimum Stage (ft NGVD)	Design Q (cfs)	Peak Stage (ft NGVD) and Q (cfs)	
S-177 Stage divide	Spillway, 1 gate, 22ft x 12 ft Crest lgth = 22ft Crest elev = -7.1ft NGVD	4.7	4.2	2.8-3.3 (October) 3.0-3.7 (after planting to harvest) 3.6-4.2 (rest of yr)	1400	HW = 4.94 TW = 4.30 Q = 1695 (storm Dennis)	8/18/81 8/18/81 8/19/81
S-176 Stage divide	Spillway 1 gate 20ft x 8ft Crest lgth = 20ft Crest elev = -1.0ft NGVD	6.3	5.9	5.5	630	HW = 7.53 TW = 7.15 Q = 888 (storm Dennis)	8/18/81 8/18/81 8/19/81
S-174 Stage divide	Spillway, 1 gate 16ft x 8ft Crest lgth = 16ft Crest elev = -1.5ft NGVD	6.0	5.5	TW = 3.5 (Oct to Feb or Mar) HW = 4.5	500	HW = 7.56 TW = 7.18 Q = 550	8/18/81 8/18/81 8/18/81
S-175 Stage divide	Culvert 3.84m x 56ft RCP gated Invert elev = -5.0ft NGVD	5.0	4.5	HW = 3.5(Oct to end of harvest) HW = 4.5 (rest of year)	500	HW = 5.85 TW = 5.16 Q = 534 (storm Dennis)	8/18/81 8/20/81 8/19/81
S-332 Water Supply to Taylor Slough for ENP	Pump, 6 units	2.0	<5.8		165		
S-196 Divide Structure	Culvert 1.84m x 58ft RCP gated Invert elev = -2.5 to -3.5ft NGVD	6.5	5.5	5.5 (to west)	200 cfs at 1 ft (divide structure closed during storms)	HW = 8.75 TW = (under water-storm Dennis)	8/81
S-194 Divide Structure	Culvert 2.84m x 90ft RCP, gated Invert elev = -2.5 to 3.5ft NGVD	3.9 (water supply)	3.7 (water supply)	5.5 (to west)	~190 (water supply, divide structure during flood)	HW = 9.23 TW = 9.15 (storm Dennis)	8/18/81 8/18/81
S-173 Divide structure	Culvert 1.72m x 70ft RCP Invert elev = -2.5ft NGVD	5.0 (Divide structure when pumps operate)	4.5 (Divide structure when pumps operate)	4.5 to 5.5 (depending on conditions in E Everglades)	150	HW = 8.02 TW = 8.25 (storm Dennis)	8/81
S-178 Stage divide	Box Culvert 12ft x 10ft, controlled by 2-8ft x 8ft gates, top of gate closed at 5.0ft	4.6	3.9	4.5	300		
S-197 Flood Discharges	Gated culvert 3-84in x 66ft CMP Invert elev = -8.0ft NGVD	1.4	0.6	Normally closed (Open when S-18C TW = 1.9 Closed when HW = 1.6)	550	HW = 2.74 Q = 3430	
S-18C Stage divide	Spillway 2 gates, 22ft x 11ft Crest lgth = 44ft Crest elev = -7.0ft NGVD	3.3	2.8	HW = 2.3ft NGVD	2100	HW = 3.20 TW = 2.90 Q = 2170	
S-331 Water supply to C-111	Pump, 3 units	3.0 (water supply)	6.0 (water supply)	HW = 4.5 - 5.0 (depending on Stage at ground water well Angel)	1160		

in = inches
ft = feet
elev = elevation
lgth = Length
TW = Tail water
Q = discharge in cfs
CMP = Corrugated metal pipe
RCP = Reinforced concrete pipe
ft NGVD = Feet relative to National Geodetic Vertical Datum
HW = Head water
CFS = Cubic feet per second
ds = downstream
ups = upstream

SOUTH DADE CONVEYANCE SYSTEM

Purpose of the System

The South Dade Conveyance System (SDCS) was mandated by an act of Congress. Its primary purpose is to supply 55,000 acre-feet of water per year to the Everglades National Park (ENP). Under District-wide drought conditions, if the water allocated to ENP cannot be supplied from storage, the ENP receives (by way of SDCS) 16 percent of the surface water supplied to District canals south of Lake Okeechobee.

A secondary purpose of the SDCS is to supply water to South Dade County canals to maintain water table elevations at high enough stages (2.0 ft NGVD at downstream control structures) to prevent saltwater intrusions into local fresh groundwaters. Design flows for the SDCS to South Dade County canals are adequate to replace seepage losses in the canals for a 2.0 ft NGVD stage.

Another purpose of the SDCS is to supply water to the Alexander Orr and the Florida City Wellfields. Placement of a wellfield near the intersection of C-1 and the L-31N borrow canal is being considered. SDCS would also supply this wellfield.

Description of the System and Its Operation

The South Dade Conveyance System (SDCS) supplies water to Everglades National Park (ENP) at all times and to District canals (C-6, C-4, C-1, C-102, C-103, C-113, and C-111) in Dade County during conditions of low natural flow. A schematic map of the SDCS is shown in Figure 38.

The system was built using existing Project canals and structures. C-304, the L-30 borrow canal and the L-31N borrow canal were enlarged. S-151 was enlarged and S-335 was changed from 2 - 72 inch corrugated metal pipes to a gated spillway. Only S-336,S-337, and S-338 were constructed for the SDCS.

Under design conditions (1-10 year drought) water is released to the SDCS from storage in Water Conservation Area 3A at a stage of 7.5 ft NGVD. The design discharge is 1955 cfs. This discharge includes the amount allocated to ENP, the amount required to replace seepage losses in South Dade County canals, and the amount required to recharge the Alexander Orr and the Florida City Wellfields. 1350 cfs is discharged at S-333 into the L-29 borrow canal ,and 605 cfs is discharged at S-337 into the L-30 borrow canal.

The water discharged at S-333 is conveyed to the east by the L-29 borrow canal to S-334 at the intersection of the L-29 borrow canal and the L-30 borrow canal. The design tailwater stage at S-333 is 7.0 ft NGVD, and the design headwater stage at S-334 is 5.0 ft NGVD. 120 cfs of the 1350 cfs entering the L-29 borrow canal at S-333 is lost to flow to the south through culverts under U.S. Highway 41 between S-333 and S-334. 1230 cfs is discharged to the L-30 borrow canal from the L-29 borrow canal via structure S-334.

605 cfs is discharged by S-337 to the L-30 borrow canal. Flow in the L-30 borrow canal is to the south to S-335, just north of the intersection of the L-30 borrow canal with the L-29 borrow canal and C-4. 105 cfs are expected to be lost to seepage in the L-30 borrow canal between S-337 and S-335.

South of S-335, the 500 cfs from the L-30 borrow canal joins the 1230 cfs from the L-29 borrow canal. The combined discharge of 1730 cfs flows south in the L-31N borrow canal at a beginning stage of 4.7 ft NGVD. 145 cfs of this flow is discharged east through S-336 to C-4 for recharge of the Alexander Orr Wellfield east of C-2, 305 cfs is discharged to C-1, and 120 cfs is lost to seepage upstream of S-173. The headwater stage at S-173 is 3.0 ft NGVD. During drought flow S-173 is closed and the pump station, S-331, is used to raise the tailwater stage at S-173 to 6.0 ft NGVD. Between S-173 and the intersection of the L-31N borrow canal with the L-31W borrow canal, 260 cfs is supplied to C-102 at a stage of 5.4 ft NGVD, 210 cfs is supplied to C-103 at a stage of 4.7 ft NGVD, and approximately 205 cfs is lost to seepage. 485 cfs are left to be divided between the C-111 canal to the south and the L-31W borrow canal to the west.

210 cfs is discharged to the L-31W borrow canal by way of S-174. 160 cfs (37,000 acre-feet per year) is pumped to Taylor Slough by S-332. Any remaining flow, not lost to seepage, is discharged to the ENP through S-175.

275 cfs is discharged to C-111 from the L-31N borrow canal by structure S-176. The tailwater stage at S-176 is 3.0 ft NGV. South of 176, 140 cfs is supplied to C-113 (to recharge the Florida City Wellfield), 60 cfs is lost to seepage and 75 cfs (18,000 acre-feet per year) is discharged through S-18C at a stage of 2.0 ft NGVD. This flow is discharged to the pan handle portion of ENP through gaps in the south berm of C-111 between S-18C and S-197.

A summary of the design flows and stages in the SDCS is given in Table 17.

Comments on Design and Historic Operation

The system is capable of passing much larger discharges that the design flows. Regulatory releases can be made from Water Conservation Area 3A to the SDCS. The releases are limited to flows that do not cause flooding at the Indian Village on the north berm of L-29 and to flows that do not exceed the capacity of the pumps at S-331 (1160 cfs). By making regulatory releases through the SDCS, it may be possible to occasionally bring headwater stages at S-148 (C-1), S-165 (C-102), and S-167 (C-103) up to their optimum stages (5.5 ft NGVD).

If the stage in the L-29 borrow canal could be raised to slightly above 8 ft NGVD, approximately 450 cfs would flow south through the culverts under U.S. Highway 41 to the Shark River Slough.

ERRATA SHEET
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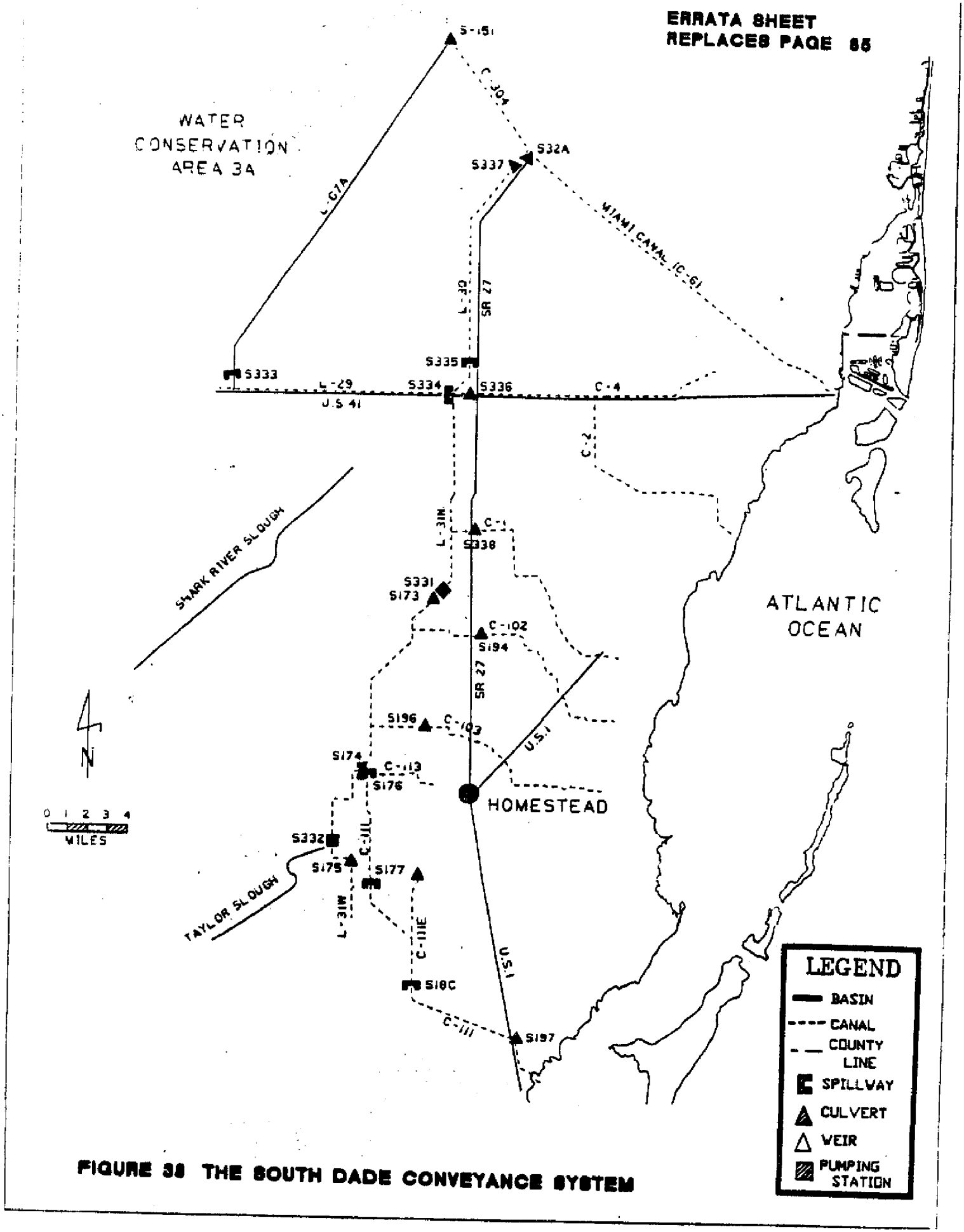

FIGURE 38 THE SOUTH DADE CONVEYANCE SYSTEM

TABLE 17. South Dade Conveyance System - Design Flows and Stages

		Stage (ft NGVD)	Discharge (cfs)
L-29 @ S-333		7.0	1350
L-20 @ S-334		5.0	1230
L-30 @ S-337		5.2	605
L-30 @ S-335	upstream	5.0	525
	downstream	4.8	525
L-30 @ L-29 or L-31N		4.7	500
L-31N @ US 41		4.7	1585
L-31N @ C-1	upstream	3.5	1490
	downstream	3.5	1185
L-31N @ S-331	upstream	3.0	1160
	downstream	6.0	1160
L-31N @ C-102	upstream	5.4	1115
	downstream	5.4	855
L-31N @ C-103	upstream	4.7	740
	downstream	4.7	530
L-31N @ S-174	upstream	4.6	485
	downstream	3.1	210
L-31N @ S-176	upstream	4.6	275
C-111 @ S-176	downstream	3.0	275
C-111 @ C-113	upstream	3.0	275
	downstream	3.0	135
C-111 @ S-177	upstream	3.0	135
	downstream	2.0	135
C-111 @ C-111E	upstream	2.0	97
	downstream	2.0	97
C-111 @ C-18C	upstream	2.0	75
	downstream	1.4	75

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APPENDIX 1 - BASIC CONCEPTS

Runoff and Drainage - Several things can happen to rain after it falls to earth. At the beginning of a rain event, the rain will most likely seep into, or "infiltrate", the soil. As soil becomes saturated, however, the rain will tend to pool on the surface of the ground in puddles or ponds. These detention areas have only a limited storage volume, and when their capacity is exceeded, the excess water will flow downhill to the nearest stream or canal. That part of the rainfall that "runs off" of the soil surface to enter local streams is termed "surface runoff". Of the water that is detained on the surface, some will evaporate and the balance will eventually seep into the ground.

Water seeping into the ground enters a reservoir of subsurface water known as groundwater. Since, in south Florida, many soils are very sandy and underlying rock strata tend to be very porous, water flows easily between surface water and groundwater. The surface of the groundwater is known as the "water table". When the water table level is higher than local surface water levels, water will enter the surface water from groundwater. When the water table is lower than the local surface water level, flow is from surface water to groundwater. In general, groundwater supplements stream flow during periods of low rainfall, and surface water recharges groundwater storage during periods of high rainfall. Although subsurface flow from groundwater to surface water is important to the long term supply of water to a canal or stream (it is sometimes referred to as "base flow"), it does not make significant contributions, if at all, to streamflow during storm events with high rainfall.

In the context of these basin descriptions, the term drainage is used to refer to the total surface and subsurface flows entering a canal from its drainage basin. It may be useful to keep in mind, however, that during a rain event (especially one severe enough to cause flooding), it is surface runoff that is the important contributor to this flow, and at times between rain events, subsurface flow from groundwater to surface water is most important.

Runoff from an area is influenced by several factors: how much rain has fallen recently, the depth to the water table, and how the land in the area is used. The amount of recent rain, and the depth to the water table dictate how much water is in the soil. The degree to which the soil is saturated, in turn, determines how much of the falling rain may infiltrate the soil, and thus, how much of the rain will run off to local streams.

Land use has a large impact on the amount of surface runoff entering local streams and canals. For example, most of the surface area in an urban area (e.g., roofs, roads, and parking lots) is impervious to water. Almost all the rain impacting these areas becomes surface runoff. Some water may be detained and will evaporate, but the percentage of rainfall that enters local canals or streams by surface flow in an urban area can be quite high. As a result, urban areas are subject to high stream flows (flooding) during rain events.

A vegetated area intercepts and retains a large part of the rainfall, and subsequent surface runoff from a rain event. This intercepted water has additional opportunity to evaporate or seep into the ground. In general, a smaller percentage of the rain falling on a vegetated area will enter local streams and canals as surface

runoff than a comparable urban area. As a result, stream flows in vegetated areas are moderated compared to urban areas.

Drainage Basin - If rains falls over a large enough area, some of the runoff from that storm will likely enter one stream, and some of it will enter another stream. It is said that those streams "drain" different basins, that they are in different "drainage basins". The drainage basin of a stream is all the land that contributes runoff to the stream or its tributaries. It is usually specified to be the land draining to the stream upstream of a given point, such as the mouth of the stream. The boundary between drainage basins is termed a "divide". Runoff is divided along the boundary, runoff on one side of the boundary flowing to one stream, and runoff on the other side of the boundary flowing to another stream.

Water Surface Elevations - A water surface elevation in a canal is the distance from the water's surface to some reference elevation or "datum". In the District, all elevations are relative to the National Geodetic Vertical Datum (NGVD). Water surface elevations are measured in feet (ft). Water surface elevations may also be referred to as "stages".

Important water surface elevations are the headwater (upstream) stage, and the tailwater (downstream) stage at the control structures (see **Control Structures**). The difference between these stages will affect the flow through or over the structure. Gravity flow is always from the highest to lowest elevation and, in general, flow increases as the difference in elevation increases. Note that in some basins, pumps are used to move water from lower to higher elevations.

Water surface elevations anywhere else in the canal are also important. Obviously, if the stage exceeds the elevation of the top of the canal, flooding will result. Not as obvious is the fact that the stage in the canal largely determines the water table elevation of the local groundwater (see **Runoff and Drainage**). The stage in the lower reaches (near the ocean) in some canals is maintained at levels high enough to prevent intrusions of saltwater into the local groundwater. In other areas, stages are maintained that keep water table elevations low enough to prevent drainage problems in low lying areas.

Control Structures - The structures referred to in the basin descriptions are devices (e.g., weirs, spillways, and culverts) placed in the canals to control water surface elevations (stage divide), amount of flow (stage divide or water supply structure), or direction of flow (divide structure) in the canals. A structure may have more than one function. In general, a stage divide controls water surface elevation upstream of the structure, and it controls water flow (or discharge) downstream of the structure. A divide structure is usually located at or near a basin boundary. It prevents water in one basin from entering the other basin. A water supply structure is also usually located near a basin boundary. It is used to pass water from one canal to another (i.e., from one basin to another).

Hydraulic Analysis - A set of water surface elevations taken along the length of a canal is known as the hydraulic profile of the canal. The elevations always increase upstream. This, in the simplest sense, says that water runs downhill, but is has more important implications for design of canals and structures. The water surface elevations are a function of the size and shape of the canal, the amount and location of inflow to the canal, the roughness and slope of the canal, and the downstream water surface elevation of the canal (often determined by some control structure). Canals are designed to pass a certain amount of flow without

over-topping their banks. Designing a canal and its structures consists of selecting values for the factors listed above for which none of the water surface elevations of the resulting hydraulic profile exceed the elevation of the banks of the canal for the design discharge. Since the design discharge is given, and to a large extent the slope of the canal is determined by the topography of the basin, it is the size and shape of the canal, and the downstream water surface elevation (to be maintained by some structure), that are varied to achieve a successful design. (The downstream structure must also be large enough to pass the design discharge.) Because the factors that determine the water surface elevations are either known or can be reasonably estimated, it is possible to calculate the hydraulic profile of a proposed canal design. In this way an appropriate design can be selected. Similarly, calculation of the hydraulic profile, can be used to determine the flood protection provided by a canal constructed without regard to a specific design storm, or for a canal that has been modified with regard to its design specifications. For example, increasing the cross-sectional area of a canal will, in general, allow the canal to pass a given flow at stages lower than before enlargement (i.e., the hydraulic profile is lowered). Hydraulic analysis may determine for this canal that the flood protection has increased, that is, the canal can now pass the runoff from a storm more severe than the design storm.

Design Storm - The design storm for a basin is the most severe storm for which the canals and structures in the basin will accommodate that storm's runoff without flooding occurring in the basin. Sometimes a basin is described as having "flood protection" up to a certain design storm.

A severe storm is described by the frequency with which it may occur. On a long term average a storm of given intensity may occur, for example, once in every ten years (i.e., the storm has a ten percent chance of occurring in any given year). This is written as 1-10 years, and is read as one in ten years. It must be emphasized, however, that a storm of a given intensity can occur at any time regardless of the frequency assigned to it. For example, two severe storms, of an intensity that occurs on average only once in every one hundred years (1-100 year storm), occurred in northern Palm Beach County within three months of each other in the early 1980s.

The Army Corps of Engineers specifies a Standard Project Storm (SPS) for south Florida. The rainfall amounts for the SPS are those for a 1-100 year storm increased by 25 percent. The storm is assumed to occur during the hurricane, or wet season, when water tables are high and soils are wet. These conditions will maximize the runoff from the storm. The runoff from the SPS is designated the Standard Project Flood (SPF). The capacity of a canal and its structures may be given as a percentage of the SPF (e.g., 40 percent SPF). The storm that would generate this amount of runoff is given by its recurrence interval (e.g., 1-10 years). Note that it is implicitly assumed that these storms occur for antecedent weather conditions that will maximize the runoff from the storm in the basin of interest.

A severe storm of a certain frequency may not generate the same amount of runoff in different basins of the same size even when antecedent weather conditions or water table elevations for the basins are similar. Land use in the basins will also affect the relative amounts of surface runoff to be expected from the basins (see **Runoff and Drainage**). Urban areas will have relatively more surface runoff than will more vegetated areas.

The amount of runoff to be expected per unit area for design storms at various recurrence intervals, antecedent conditions, and land use can be found in the Army

Corps of Engineers' General Design Memorandum (GDM) for the Project. The runoff calculated to occur for a given set of storm frequency, antecedent conditions, and land use is the design discharge. It should be noted that land use in Dade County has changed considerably since the GDM was written.

APPENDIX 2 - GLOSSARY

Designations Given to District Works

C-XXX The letter C followed by a number, designates a Central and Southern Florida Flood Control Project canal. For example, C-111 reads as "Canal 111".

G-XXX The letter G followed by a number, designates a Central and Southern Florida Flood Control Project structure (see Control Structures, under Basic Concepts). For example, G-72 reads as "Control Structure 72". G structures were built by the District.

L-XXX The letter L followed by a number, designates a Central and Southern Florida Flood Control Project levee. For example, L-38E reads as "Levee 38 east".

S-XXX The letter S followed by a number, designates a Central and Southern Florida Flood Control Project control structure (see Control Structures, under Basic Concepts). For example, S-26 reads as "Control Structure 26". S structures were built by the U.S. Army Corps of Engineers.

Terms

Area A and Area B

These are areas of relatively good and relatively poor drainage, respectively, in north-central Dade County and in south-central Broward County. In Dade County Area B is approximately bounded on the north by the Dade-Broward County Line, on the south by Kendall Drive, on the west by L-31N and L-30, and on the east by the Palmetto Expressway. Land elevations in this area are low relative to the coastal ridge in eastern Dade County. Consequently drainage from this area is poor, and the area is prone to flooding. Severe limitations are placed on land use and development in Area B. Several of the basins in Dade County include portions of Area B. This is noted in the text and on the maps where it occurs. Area A is better drained and less likely to flood. In Dade County it includes all lands excluding Area B, Everglades National Park, and the Water Conservation Areas. Restrictions on land use and development are less severe than for Area B.

District

This refers to the South Florida Water Management District (formerly the Central and South Florida Flood Control District), the agency which operates and maintains the Project.

Free Digging Contract

This refers to an agreement between the District and an outside party whereby that party excavates a canal (or a portion of a canal). The outside party receives the excavated material as payment for the excavation. The material is generally used as fill for residential and commercial developement.

General Design Memorandums

This is a document prepared by the U.S. Army Corps of Engineers that reports all work done preliminary to preparation of the final design of a project. In the General Design Memorandum for the Central and Southern Florida Flood Control Project:

- the basins are delineated.
- a design storm is specified and the resulting runoff is estimated for each basin.
- the flood protection to be afforded each basin is identified.
- the size of canals, and the size and number of control structure is determined.

The final design of the canals and structures is given in the Detailed Design Memorandum.

1-XXX Year

This designates the recurrence interval for a design storm (see **Design Storm**, under **Basic Concepts**). For example, "1-100 year storm" reads as one in one-hundred year storm.

Project This refers to the Central and South Florida Flood Control Project. The Project has been responsible for the construction of most of the major canals and structures in south Florida.

Regulation Schedule

A regulation schedule specifies the level of water to be held in a reservoir (e.g., a WCA) as a function of the time of year.

Regulatory Release

A regulatory release is water discharged from a reservoir (e.g., a WCA) to lower the water level in the reservoir to the regulation schedule.

Water Conservation Areas

The five Water Conservation Areas (WCAs 1, 2A, 2B, 3A, and 3B) are located in western Dade and Broward Counties and in central Palm Beach County. Only WCA 3B borders on basins described in this publication (Figure 1). The WCAs are remnants of the original everglades in South Florida. Water is impounded in the WCAs by Project levees, and water flow into and out of the WCAs is regulated by various Project control structures. The WCAs are managed to store water and to provide viable wetlands habitat. Water is stored in the WCAs according to a set of regulation schedules, one for each WCA. A regulation schedule specifies the level of water to be held in the WCA at any time during the year. When the water level in a WCA exceeds its schedule, water is released from the WCA through the structures on its periphery. These are called regulatory releases. If the water level in a WCA is below the regulation schedule, releases from the WCA are restricted. During periods of low natural flow, water stored in WCAs 3A and 3B can be supplied to basins in Dade County by way of the South Dade Conveyance System and by way of C-6.

ABBREVIATIONS

cfs : cubic feet per second

ft : Feet

GDM : General Design Memorandum

NGVD : National Geodetic Datum (see **Control Structures**, under **Basic Concepts**)

SPF : Standard Project Flood (see **Design Storm**, under **Basic Concepts**)

SPS : Standard Project Storm (see **Design Storm**,under **Basic Concepts**)

WCA : Water Conservation Area