MEMORANDUM REPORT

ON SURFACE WATER AVAILABILITY IN THE

ST. LUCIE COUNTY AREA

RESOURCE PLANNING DEPARTMENT

JULY, 1974

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TABLE OF CONTENTS

INTRODUCTION

The St.Lucie County agricultural area is composed of the drainage basins of C-23, C-24, and C-25 Canals west of Ft. Pierce, Florida. The portions of the drainage basins which do not contribute to flow upstream of structure S-97, S-49, and S-99 respectively, were excluded from this analysis. (see Figure 1). A system of drainage canals for an urban development established in the early 1960's, effectively decreased the size of the C-24 drainage basin by 5,550 acres. Improvements in the North St.Lucie Drainage District at about the same time added 7,020 acres. The present size of the study area is 293,000 acres.

The North St.Lucie Drainage District contributes substantial runoff to both C-24 and C-25 as well as discharging to areas outside the study area. Since much of this drainage district consists of interconnected canals which could divert excess from one part of the drainage district to another, the respective areas contributing flow to and receiving irrigation water from C-24 and C-25 were apportioned according to the discharge capabilities of the major structures.

Land use in the basin consists primarily of pasture and undeveloped areas with a rapid and substantial increase in citrus acreage during the last decade. (see Table 1).

At the present time, rainfall on the area is the principal source of water for irrigated as well as non-irrigated crops. Irrigation water is drawn principally from storage in the major canal system and from groundwater in the immediate vicinity of the canals which enter the canals as seepage. At present, there are a few surface storage reservoirs and some use is made of free flowing artesian wells when water quality in these wells is suitable. Very few shallow pumped wells are used for agricultural purposes at this time.

Canal 24 has a single control structure (S-49), a gated spillway. Canals 23 and 25 each have two water level control structures; the upper ones (S-97 and S-99, respectively) being gated spillways and the lower ones (S-48 and S-50, respectively) being fixed crest spillways. Excess rainfall is presently discharged to tide water through or over the downstream control structures on each major canal. Discharges are normally made when the stage upstream of the gated spillway structure reaches a predetermined level.

A proposed system of canals with facilities for withdrawing water from Lake Okeechobee and returning excess rainfall to the lake may change the drainage/water supply pattern in the future.

The Central and Southern Florida Flood Control District has been issuing surface water withdrawal permits in this area for a number of years. Unlimited withdrawals are allowed under this system provided that the stage in the main canals upstream of the gated spillways does not fall below elevation 14.0 ft. msl. At elevation 14.0, all withdrawals are curtailed to prevent sloughing of the canal banks.

The purpose of the present study is to determine an equitable system for the issuance of surface water withdrawal permits based on the hydrological characteristics of the basin.

A secondary objective is to determine if the hydrologic resources of the basin are sufficient to meet present needs and if they are a constraint to future development.

GENERAL

The volume of surface water which is potentially available for allocation for beneficial use in the St.Lucie County area consists of three components: (a) runoff generated from rainfall over the basin, (b) storage within the boundaries of the channels and, (c) groundwater seepage into the canals.

The first component requires the development of catchment areas and/or surface storage for full utilization of this resource.

The second component, channel storage, is being used to the greatest extent possible at the present time as indicated by the extremely low stages reached in the canal system at frequent intervals.

The third component can be visualized as consisting of: (1) a relatively constant portion which arises from the average groundwater gradient between the canal water surface and the groundwater table a considerable distance from the channel,and (2) another portion which fluctuates much more and is derived from changes in channel bank storage arising from changes in canal stage.

The majority of the present demand for allocable surface water is satisfied by the canal storage and associated seepage components.

It would be desirable to separate the three components and further to define the time-space interaction between these components. At present, however, insufficient data is available to adequately define each of the separate elements. The approach used in this paper will be to define the volume of surface water which is potentially available for allocation as the total amount of water that would reach the channel as runoff or seepage during a given month in the absence of any diverted water. This volume will be called the basin yield.

All of the basin yield is potentially available for allocation and use. However, minimum flow requirements downstream of the control structures must be met. These requirements come "off the top" and thus the volume of surface water available for allocation is the potential volume minus the minimum flow volume. It has been considered that not all of this adjusted volume should be made available for allocation; that is, that some portion be reserved for contingent uses not foreseen at this time. The minimum flow requirements were determined as the minimum monthly volume of water that is required to maintain a natural seasonal pattern of freshwater flows into the downstream saline water reaches.

A more or less arbitrary selection of monthly minimum flows was made based on a percentage of the basin yield. These values will be subject to later adjustment as additional knowledge is gained concerning the environmental significance of maintaining fresh water discharges from this system in terms of both quantity and quality.

Additionally, a portion of the total basin yield has been reserved for contingent uses not now foreseen. The total unallocated volume, which consists of the minimum flow volume and the reserved volume, was set as that volume of water which is equivalent to 21% of the basin yield.

The remaining volume is termed the "adjusted basin yield."

BASIC DATA

Land use data was compiled (Table 1) from basic land use maps for the years 1957, 1968, and 1972. From these maps the areas in each basin under the following seven categories were obtained: urban, pasture, truck. citrus, forested natural areas, and non-forested natural areas. A linear relation was assumed for land use in the intervening years.

Measured discharge through structures S-97, S-49, and S-99 from the time of completion in 1963, 1962 and 1965, respectively, through 1973, were used as the flow out of the areas drained by C-23, C-24, and C-25. (Table 2). There is an undetermined amount of flow which enters the C-25 basin from outside the drainage boundary as defined in Figure 1. This flow enters C-25 proper at the Radebaugh Culverts. This flow was not considered in the present analysis due to difficulties in assigning a reasonable estimate of this quantity.

Precipitation (Table 3) is the weighted average, by the Thiessen Method, of six rainfall stations distributed as indicated in Figure 1. Two of the stations are maintained and operated by the Agricultural Research Service and the remainder by the Flood Control District.

Pan Evaporation (Table 4) was taken from records at Raulerson 3 on Taylor Creek Watershed supplied by the Agricultural Research Service, U. S. Department of Agriculture.

Groundwater records (Table 5) are the average of the month-end groundwater elevations for groundwater observation wells StL 41 and StL 42 operated by the U. S. Geological Survey at the locations shown on Figure 1.

Channel stages (Table 6) are tabulated as the month-end stages upstream of S-99, S-49 and S-97, for canals C-25, C-24, and C-23 respectively. Changes in channel storage in acre-feet corresponding to the respective changes in stage were calculated from channel cross section data and are also given in this table.

BASIN YIELD

For the purpose of this paper, basin yield is defined as the monthly volume of water which can be collected from surface and shallow groundwater sources for irrigation and downstream uses. The volume of water which will be allocated for irrigation is the basin yield, i.e., the volume of water that will be replenished from natural sources over the long term, less the amount reserved for contingent uses and maintenance of minimum flows.

Two methods were used to determine the basin yield and the results compared to select the estimate to be used as the basis for water allocations:

The first method utilizes the water budget over the entire basin:

$P - Q = ET + \Delta S$,

Where P = precipitation

Q = flow out of the basin

ET = basin wide evapotranspiration

and ΔS = change in basin storage with a positive sign indicating an increase in storage.

ET was calculated by the above relationship using the combined groundwater fluctuations and change in channel storage for ΔS. Groundwater changes (see Table 5) were divided by 6.67 to convert the change in elevation in feet to change in equivalent feet of free water. This value was derived from the composite moisture absorption and desorption curves for soils typical of W2 basin in the Taylor Creek Watershed as presented by W.H. Speir, 1971 Annual Report, Agricultural Research Service, USDA. The resulting ET values were compared to pan evaporation values in corresponding months. The ratio of ET to pan evaporation appeared, from experience in other watersheds, to be too erratic and it was concluded that the two wells used were insufficient to reflect basin wide ground water fluctuations. Since errors in estimating storage changes in previous months are likely to be reflected in the calculated monthly ET, several methods of averaging calculated ET with previous month's calculated ET were tried. The mean of the month under consideration and the previous month were found to yield the most reasonable ratio of ET to pan evaporation. This estimate was used as the corrected monthly basin ET. Basin yield (Table 7) was calculated as the difference between monthly precipitation and corrected monthly basin ET.

The second method used to calculate basin yield (Table 8) is based on a water budget for the respective canals only, and is the summation of channel discharge out of the basin, irrigation applied from channel and shallow groundwater, and change in channel storage. Discharge out of the basin was obtained from Table 2. Changes in channel storage were taken from Table 6. Irrigation applied (Table 9) was approximated by the positive difference between monthly water requirements for citrus and precipitation over the area devoted to citrus. It is realized that some of the citrus is at times irrigated by deep water wells in the artesian aquifer and that some pasture is irrigated with surface water. However, as these two quantities are difficult to get a numerical answer for and tend to operate in a compensating manner, they were omitted from the present analysis. Monthly water requirements for citrus were obtained from Dr. R.C.J. Koo of the Institute of Food and Agricultural Science, Agricultural Research and Education Center, Lake Alfred, Florida. These citrus requirements were checked against the water records for Callery - Judge Groves in Palm Beach County. While the comparison did not show excellent agreement in all individual months, the total volume over a three year period differed by only 3%. Input and outflow from existing surface reservoirs in the C-25 area were determined to have a negligible effect on the basin yield over the area and were omitted from the analysis.

The second method of calculating the basin yield, e.g., using the water budget for the channel system only, was selected as the most appropriate for showing the monthly volume of water potentially available for allocation.

A comparison of the two methods shows encouraging agreement between the two methods for yearly totals. The lack of general agreement between monthly values is to be expected because of the time lag between basin wide change in groundwater storage and basin discharge.

Downstream flow requirements are tabulated in Table 10. They are based on an arbitrary judgment that 10% of the basin yield will be adequate to satisfy fresh water flow requirements to the estuarine areas on an interim basis.

The total unallocated volume of water calculated as the sum of the down-stream flow requirements and a reservation for contingencies is also tabulated in Table 10: it is 21% of the basin yield.

The monthly volume of surface water which is considered to be allocable is defined as the adjusted monthly basin yield and is presented in Table 11. It was calculated as the monthly basin yield which is expected to be exceeded 50% of the time, on a long term basis, as determined from an empirical frequency distribution with the adjustment applied for downstream flow requirements and a reserved volume of water.

Basin yield values used may possibly include irrigation return flow from artesian wells.

SURFACE WATER ALLOCATIONS

The "Memorandum Report on Surface Water Availability in the Lake Istokpoga-Indian Prairie Area" dated July, 1974, presents a general discussion on surface water allocation procedures. It should be referred to as providing some background for the approach recommended for the study area of this report.

The principle to be used for apportionment of the available monthly volume of water for irrigation is that each unit of area within its respective sub-basin will be allotted an equal share of the available water, irrespective of present land use or state of development. This is accomplished by dividing the adjusted monthly basin yield by the total area in acres of the sub-basin and assigning this volume to each acre permitted.

Storage reservoirs or impoundments for the purpose of capturing runoff from adjacent lands or for holding water in storage which is pumped from the major canal system during periods of excess rainfall will be allowed and should be encouraged. These impoundments will be allowed to store all of the runoff that is captured from the part of its catchment area that lies within the area permitted provided the monthly volume reserved for downstream uses is released at the appropriate times.

Under this type of use, withdrawals from the canal system will not be allowed except under the following conditions:

A. If part of the permitted area discharges runoff into the primary canal system rather than into the reservoir, withdrawals may be made from the canal system up to the amount of the adjusted monthly basin yield for the part of the permitted area which discharges to the canal system.

B. When the upstream stage above the respective control structure is above the maximum regulatory stage and downstream flow requirements for the month have been met, permission may be obtained by the permit holder for additional withdrawals on a first come, first served basis until a limit based on stage and other considerations is reached.

Maximum discharge criteria for reservoir discharge structures will be set by the District to prevent damage to downstream facilities.

Recognizing that: (a) a portion of the basin yield is reserved for "contingent" uses, and (b) all lands in the basins are not presently developed, there will be, as a result, an unappropriated and unused seasonal surplus of water based on the once-in-two year frequency adjusted basin yield. Therefore, it appears reasonable to permit these excesses to be captured or diverted on a short-term basis by those permittees who have developed off-line impoundments. It is recommended that the Regulation Division maintain a record of unappropriated water by basin and that a procedure be established whereby short-term (not to exceed two years, and renewable administratively) permits can be issued to impoundment permittees for the capture or diversion of an equitable share of the unappropriated wet season (June-October) surplus.

The standard permits for impoundment-type uses are to be based on monthly allocations. See the Lake Istokpoga-Indian Prairie report. The unit land area values listed in Table 11 are to be used only as a guide in the technical evaluation of applications. Allocations can be given for lesser amounts; the amounts listed represent the maximums. As noted in the preceding paragraphs, these amounts can be exceeded but only under special conditions:

1. At time of surplus water discharge at the downstream spillways; and

2. When there is an unappropriated wet season surplus.

In consideration of the capital outlay required for construction of an impoundment system, the maximum permit period of twenty years should be used in the issuance of impoundment type permits.

Direct withdrawals from the canal system for areas which do not involve storage reservoirs will be handled with a different type of permit. Permits for withdrawal of surface water from the canal system will be based on a maximum withdrawal for the irrigation season, November to May, of the seasonal amount specified in Table II for the respective canal. Greater withdrawals will be allowed when the stage is above regulatory stage and will not be counted toward satisfying the stated seasonal allocation. It is recommended that the Department of Field Services consider a method for apprising permittees of this condition, if such notification is believed necessary, in order that they may take advantage of this situation when it arises.

All permittees, existing and new, will be required to submit daily withdrawals on a monthly basis, or in the case of permits involving reservoirs, the amount impounded on a monthly basis.

MINIMUM STAGES AND MINIMUM FLOWS

1. The District has established, and had in effect for a number of years, a minimum stage constraint on water withdrawals from Canals 23, 24,and 25. This constraint is based on maintenance of canal side-slope stability, thereby protecting the substantial public investment in these facilities. This is a reasonable and supportable basis for such a constraint. The established minimum stage constraint is 14.0 ft.msl. for each canal.

This constraint operates such as to terminate all water withdrawals when the minimum stage is reached. It is recommended that this constraint be retained in the same fashion as it now exists. It has been accepted by water users in the affected basins; all operations and the majority of surface water withdrawal facilities are adjusted to that constraint.

2. Minimum flows for each of the three canals serving this area are listed in Table 10. It is recommended that they be adopted officially.

These minimum flows were established based on historical basin yields above at the gated spillways in each canal. In the cases of C-23 and C-25 the flows listed in Table 10 are to be maintained, and measured, at the downstream fixed crest spillways (S-48 and S-50, respectively). The discharge curves contained in the District's structures manuals can be used for determining flows at S-48 and S-50. (see Table 12).

It is recommended that administratively some flexibility be provided by allowing for the suspension of these minimum flow requirements during critical water short periods during the dry season. It is suggested that criteria for suspension of these requirements be established by the Department of Field Services using, perhaps, a stage of 1.0 or 1.5 ft. above minimum canal stage for this suspension.

Special conditions relating to minimum flows and stages for C-25 are discussed on page 17, et seq.

SHALLOW GROUNDWATER USE

Detailed procedures for issuance of permits for groundwater wells is outside the scope of this study. However, as there may be a relationship between groundwater usage and water available for surface withdrawals under some conditions, limitations on surface water use in systems conjunctively using groundwater will be considered.

Artesian wells tapping the Floridan Aquifer do not detract from the basin yield as the study area is not a recharge area for this aquifer. Thus, no decrease in adjusted mean basin yield need be applied for these wells. Water quality of these wells may be a problem but is outside the scope of this study.

Groundwater wells tapping the shallow aquifer will decrease the basin yield due to higher average infiltration rates to replenish the drawdown of the groundwater table and interception of subsurface water flow to the canal system. Groundwater wells in this study area will be considered in the same manner as in the Lake Istokpoga-Indian Prairie area. See "Memorandum Report on the Surface Water Availability in the Lake Istokpoga-Indian Prairie Area" dated July 1974.

In this preliminary analysis, a withdrawal from the shallow groundwater aquifer in the neighborhood of the canals will be considered equivalent to a withdrawal from the adjusted basin yield and thus effectively reduce the amount of surface water allocated to each permittee by the amount of withdrawal from the shallow aquifer system. In the case of reservoirs for intercepting surface runoff, any volume of water pumped from groundwater would have to be released from the reservoir the same month. In the case of pumped storage and immediate application, the volume allowed for withdrawal directly from the canal system would be reduced by the volume of water pumped from the shallow groundwater table.

Shallow groundwater wells which are a sufficient distance from the canal system will not be considered as affecting the surface water withdrawal permits. See Istokpoga report for criteria.

Later detailed studies of the groundwater resources in this area may result in a better picture of the spatial time-volume relationship between groundwater storage and surface water availability. This relationship may allow defining a less conservative conjunctive use criteria for groundwater.

CANAL 25 SUB-BASIN

The Canal 25 watershed contains certain unique features with respect to drainage and water use which are not present in the C-23 and C-24 watersheds. These several features warrant separate discussion as they touch on basin yield, allocable water, minimum flows, minimum stages and types of water use.

Water levels in C-25 east of S-99 are controlled by S-50, a fixed weir at crest elevation 12.0 ft.msl. Stages in this reach are maintained by groundwater inflow and by releases of excess water from upstream of S-99. Minor, highly localized surface drainage may enter this reach of C-25; but it is not significant. The North St.Lucie River Drainage District operates and maintains a pumping station in the North Emergency Relief Canal which discharges into this reach of C-25. Such runoff as may enter this reach of C-25 is not included in the basin yield computations; only the runoff above S-99 is so considered.(see page 1).

However, there are three known and permitted withdrawals of water from this reach of C-25:

1. Ft. Pierce Farms Drainage District 36" irrigation intake culvert, provided under the P.L. 566 project, agreed to by the District,and installed for "emergency supplemental water use"; irrigation water supply in that district being largely furnished by deep wells.
2. City of Ft.Pierce well field consisting of 10 wells having a total capacity of 3,850 gpm (about 20 A.F./day), located within the south right-of-way for C-25.

3. St.Lucie County 10,000 gpm pump at Angle Canal (Virginia Ave.), for furnishing water to the recreational area in the Savannah. Formerly a City installation when the Savannah was the City's water supply source. The City's original water allocation by agreement with the District was transferred to the County when the Savannah's use was converted from water storage to recreation.

The exact nature of these three uses has not been quantified and an interim approach must be developed until a record of use at these locations is established through the reporting requirements of Chapter 373 and the District's Rules and Regulations. It appears, in any event, that these demands may have to be met during critical periods from water generated in the basin upstream of S-99.

Assigning design values to these three uses it was determined that the minimum flows for C-25, established at S-99, as presented in Table 10 are insufficient to meet these theoretical demands. They can be met, however, by use of some portion of the "reserved" basin yield which is unallocated for irrigation water supply in the basin above S-99.

The Ft.Pierce Farms Drainage District withdrawal presents no problem. When canal stage upstream of S-99 reaches 14.0 ft.msl. that district is to be placed on notice that water withdrawals via their 36" culvert must terminate. They are thereby put on the same footing as agricultural irrigators in the basin above S-99.

Concerning the City of Ft.Pierce's withdrawals it appears reasonable to assume that the City's withdrawals and ultimate allocation during critical periods will come out of the "reserved" portion of the calculated basin yield. For non-critical periods the City's requirements should be amply met by groundwater inflow (yield) into the reach of C-25 between S-99 and S-50. Until the City makes application for a water withdrawal permit and the Hydrology of this reach of C-25 is examined in further detail it is recommended that the City's requirements be met through operational procedures, as follows:

1. Maintain minimum flows at S-99 as given in Table 10, or such flow as is necessary to produce a minimum stage of 12.1 ft.msl. at S-50.
2. When stage above S-99 recedes to 15.0 ft. or 15.5 ft.msl. (see page 14) maintain flows at S-99 sufficient to produce a minimum stage of 12.0 ft. msl. at S-50.
3. When stage above S-99 recedes to 14.0 ft. msl. terminate releases at S-99.
4. When stage above S-50 reaches 11.5 ft. msl. initiate restrictions in water use for City of Ft. Pierce.

The approach to the allocation of water to the Savannah recreational area is somewhat more difficult to develop at this point. As noted, the City's right by agreement to withdraw surface water from C-25 was transferred intact to the County. However, the original water use was for public water supply whereas the present water use is for recreation. The original use has a higher use priority in comparison with, say, agricultural use; but the present use has, presumably, a lower use priority. It is recommended, therefore, that District Counsel render an opinion to the Regulation Division as to the effect this existing water use agreement will have on making the normal priority distinction between agricultural use and recreational use.

Our suggested approach is to consider this recreational use to have the same priority as agricultural uses insofar as water generated upstream of S-99 is concerned. That is, that when stage above S-99 reaches 14.0 ft.msl., releases at S-99 terminate. Recreational use withdrawals from this point on would be dependent completely upon water generated in the intermediate reach of C-25; between S-99 and S-50. These withdrawals would be permitted to continue as long as there was some flow over S-50; in this condition the recreational use would be in the same category as the City of Ft.Pierce's use via its well-fields.

When stage above S-50 drops to 12.0 ft. msl. it seems appropriate to make some distinction between recreational use and public water supply use. Consequently, it is recommended that between the stages of 12.0 ft.msl and 11.5 ft.msl. the recreational withdrawals be scaled down on a percentage basis such that they have a value of 50% of the desired withdrawal rate at 11.5 ft.msl., the stage at which water use restrictions will be applied to the City of Ft. Pierce's withdrawals.

Another unique feature of the C-25 sub-basin is the occasional indefinite nature of the western boundary of the drainage basin. This was alluded to on page 5 of this report. The per acre yield of this basin is higher than for C-23 and C-24 and this may be affected by the occasional introduction of flows into C-25 from the area above the "Repeater X" culverts. It does not appear warranted at this time to expend time and effort to gage these inflows. However, when and if a plan for the St.Johns area is implemented these flows will be directed northward and basin yield would then have to be re-calculated. Even then this would not necessarily affect the unit values of allocable water presented in this report since the volumes diverted northward would quite probably be absorbed within the contingent water reservation volume allowed for in establishing the adjusted basin yield.

In this same general connection, the Radebaugh Culverts present another unique feature if the Turnpike borrow canal through the Radebaugh property is considered as being a westerly extension of C-25 which, in fact, it is. The Radebaugh Culverts then represent a privately operated structure within a primary canal. This structure is under permit to the District and is, presumably, not creating any particular problems at this time. However, discharges at this location should be gaged in order that the yield of that portion of the C-25 basin can be determined for future water use allocations in that area and for the establishment of minimum flow values at the Radebaugh Culverts.

Also a unique feature is the existence of several established off-line reservoirs in this sub-basin. The assumption was made (see page 8) that the inflow/outflow balance for these reservoirs had a negligible affect on the basin yield. This will require verification, hopefully through the reporting procedures the District will require as permits are issued for these impoundments.

Finally, the interconnection between C-25 and C-24, and through C-24 to C-23 permits of some flexibility in water transfer operations. During dry periods there is generally more water available in C-25 than in C-24 and transfers are made from C-25 to assist in stage maintenance in C-24 and C-23. These transfers are made by the Department of Field Services based on informed judgment and 10 years of experience. These operational judgments cannot be translated into specific rules and regulations, and no attempt should be made to do so. These operational decisions should continue to be made by the Department of Field Services, balancing the estimated requirements of, and water availability in, the interconnected watersheds as a purely administrative and operational procedure.

PRESENT IRRIGATION USE AND FUTURE PROSPECTS

Having apportioned the available water for irrigation in the drainage basin, the question arises as to how often the District can supply the water allocated. The procedure used for analysis, that of selecting the two-year frequency basin yield with adjustments for downstream flow mainenance, insures that over a long period of time the District can supply at least the volume of water allocated approximately one-half of the time if every landholder utilizes all of the water reserved for him, e.g., all of the basin is under irrigation. As of 1970 an estimated 25% of the land was under irrigation from surface water sources. A comparison of 25% of the allocable volume with the historical values of total basin yield minus downstream flow indicates that the volume allocated could have been supplied in all of the period of record under present development for both the total yearly allocation and the irrigation season allocation.

Being satisfied that the allocated water can be supplied most of the time at the present state of development, the next question to be considered is whether the allocated amount is sufficient to meet irrigation requirements under full development. The predominant method of irrigation in this area for citrus crops is flood irrigation. One source of information reveals that approximately 12 inches are applied in one application under this method and that from one to four applications, which generally occur in April or May, are required during each season. Of this 12 inch amount per application, approximately 3 inches are used by the crop and 9 inches are returned to the groundwater table and eventually to the canal system. This indicates that the proposed surface water allocation is entirely inadequate to meet the irrigation requirements under the flood irrigation system unless adequate surface water storage can be developed or use is made of the shallow groundwater systems. In the case that local storage is developed, 2 or possibly 3 flood irrigations per year could be handled under the proposed allocation.

An alternative to flood irrigation of the type described could be developed which would utilize supplemental water more in tune with the evapotranspiration of the crop and with far less water being detained in temporary groundwater storage during critical periods. This method would entail much smaller applications at more frequent intervals. Such a system might result in irrigation demands similar to those presented in Table 9. Using the assumption that irrigation demand will follow the tabulated values during the irrigation season and any deficit during the wet season will be satisfied by rainfall excess in succeeding months, it is found that the allocation will be theoretically sufficient to meet these requirements roughly 95%, 75%, and 95% of the time in C-23, C-24, and C-25 respectively, on a yearly basis. Over a long period of time, the volume allocated on a yearly basis appears to be adequate to meet irrigation requirements. That is, properly designed storage facilities, either as surface storage reservoirs or a combination of reservoirs and groundwater, should theoretically be able to meet the irrigation requirements on a long-term basis, especially in the light of the provision for withdrawal of water in excess of the basic allocation when available.

In the case of no supplemental storage capabilities, and assuming 3" of available soil moisture between field capacity and the wilting point can be stored in the top 3 feet of the soil profile with provision for recharge of a portion of rainfall excess, only the conditions in irrigation seasons 1967 and 1971 were severe enough to cause extensive, permanent damage to mature citrus trees under the allocation system proposed, although some loss of production and damage to young trees might have resulted in other years.

A preliminary analysis of the water resources of these basins indicates that the shallow groundwater system is generally of adequate quality for development as an irrigation potential at the present time if the water is not applied directly to the foliage of citrus. The shallow groundwater aquifer can supply a substantial part of the required storage for full development in localized areas provided the development of a large number of small capacity wells proves economical. This is predicated on the assumption that no further contamination of the shallow aquifer system due to introduction of poor quality water from the artesian aquifer will occur.

In summary, there are definite hydrologic constraints on the availability of supplemental water for intensive agricultural irrigation use in this area. Surface water availability is limited by the basin yield; there is no surface water source from which supplemental water can at present be imported into the area. Maximum use of the basin yield cannot be made however, without the development of private off-line impoundments. Several of these have been developed in the C-25 basin with, apparently, some measure of success. Nevertheless, it appears that even with large-scale development of off-line impoundments the surface and shallow groundwater resources of the area may be insufficient to sustain more or less complete devotion of the area's land resources to water use-intensive agricultural uses at a high level of performance.

In addition, economic considerations may well be another constraint on full use of the water resources of this area when such use requires the construction and operation of off-line reservoir systems. This question of the costs and benefits to a private individual of providing off-line impoundment capability should certainly provide some yardstick for evaluating the justification for the expenditure of public funds to provide similar impoundment/withdrawal capability in Lake Okeechobee. An early District study by J. P. Clawson which found substantial justification for the private development of impoundments should be reviewed and up-dated with specific application to this study area, and to the proposal for two-way pumping to and from Lake Okeechobee.

In view of the hydrologic factors noted it is mandatory that all new permits for water use in all three sub-basins of the study area be issued in accordance with the unit land area values presented in this report. Serious consideration should also be given to requiring that existing valid permits coming in for conversion to the new permits system be accorded allocations on the same basis.

In regard to the off-line impoundments already in existence in the C-25 basin, it is recommended that every effort be made to place these under permit at the earliest possible date. These will be permits to "operate and maintain" and there appears to be at present no other choice but to permit these systems "as is." A key requirement, however, is that complete monthly records be obtained concerning the movement of water into and out of these impoundments. The need for placement of these systems under permit at an early date derives from the need to obtain inflow/outflow data for future evaluation of these systems in terms of their conformance with the water allocation criteria for the C-25 sub-basin.

All permits in these basins, both old and new, and for both "as needed" withdrawals and impoundments, are to be reviewed and evaluated at the same time, and no later than approximately mid-1977.

WATER SUPPLY AND WATER USE ACCOUNTING

The previously referenced report on surface water availability in the Lake Istokpoga-Indian Prairie Area presents a discussion of the potential conflict between a procedure which absolutely terminates water withdrawals at some point and the statutory provisions (also incorporated in the District's Rules and Regulations) for "declaration of a water shortage." The St.Lucie County Agricultural Area is the classic example of this procedure, which has been invoked on several occasions in the past, whereby withdrawals are completely terminated when a specified condition is reached whereas in the period immediately prior to such termination no official restrictions on water use had been imposed.

In this area there is at the present time no logical or reasonable basis, in terms of protecting either the public interest or the water resource, for requiring a staged or phased reduction in water use when a water shortage develops or becomes apparent. The resource itself is adequately protected by the 14.0 ft.msl. canal stage limitation the primary purpose of which is, admittedly, the protection of the canals' integrity. The fact that the resource is adequately protected is evidenced by the fact that the record shows consistent recovery of canal stage to optimum levels during the wet season.

Considering the public interest, on a very broad-based view that interest is also served by the establishment of the 14.0 ft.msl. minimum stage. The general District taxpayer is thereby relieved of the potential burden of extensive and expensive canal repair costs. On a more limited view, the only other public interest involved in the study area is the interest represented by the agricultural irrigators themselves (aside from the public interest which is served by the maintenance of minimum flows and those interests discussed in the section on C-25 - see page 17). All available information indicates that the agricultural interests would prefer to use what is needed when, and as long as, it is available, recognizing the potential future complete termination of use. If the District introduced a procedure whereby agricultural use would be restricted when a shortage developed or became apparent it could only be for the purpose of conserving water for the future benefit of this single class of users; users who do not wish to be rationed now on a speculative basis, but who are perfectly willing to accept complete termination of use when it becomes necessary. The District would, in effect, be in the position of telling these users what is good for them which is inappropriate since it is unnecessary in this case.

Consequently, there is no necessity at this time to develop a water supply accounting procedure in order to assess the availability of water and compare it with water allocations/use for the purpose of applying restrictions to agricultural use. The simple observation of stages and stage recession rates will be sufficient to provide ample notification of the degree of water shortage and the timing of potential termination of withdrawals.

It may be necessary, in order to satisfy statutory requirements, to provide for an official declaration of a water shortage. This can be done based on a specified stage condition for each canal (C-23, 24, 25). The recommended stages above S-97, S-49, and S-99 are 14.5, 14.5, and 14.9 ft. msl. respectively. Such declaration of water shortage for agricultural users, however, will not carry with it requirements for water use restrictions.

Figure 2 indicates that canal stages, for 3 consecutive days, are at or below the above recommended elevations during one year in every 3 or 4 years.

Conditions for declaration of water shortage in the C-25 basin for other types of water use are presented in the section of this report starting on page 17.

PERMIT CLASSIFICATION

A discussion of the recommended approach to permit classification was presented in the previously referred to report on surface water availabilty in the Lake Istokpoga-Indian Prairie Area.

The same system of permit classification is recommended herein for the study area of this report. It is suggested that water uses from the primary canal system and all surface water bodies connected thereto be given the source designation "S" and that water uses from the shallow water table aquifers having substantial hydraulic connection with these surface waters be given the source classification "G-1." Both of these ("S" and "G-1") are to be considered as a single source.

All other water table aquifer systems will have the designation "G-2", and the Floridan Aquifer (artesian) will have the designation "G-3." On the assumption there is no hydraulic connection between the "G-2" and "G-3" sources, these will be considered as separate sources.

Use classifications will be as recommended in the Lake Istokpoga-Indian Prairie report.

The geographical area will be that generally shown on the map of Figure 1.

On the basis of the discussion in the previous section there is no need, at this time, for the development of formulae for application under a declaration of water shortage.

It will be noted that the area to which the recommendations of this report with respect to agricultural water use apply excludes: (a) the reach of C-25 between S-99 and S-50; and (b) the reach of C-23 between S-97 and S-48. The reason for this is that, with one exception, there are no present agricultural withdrawals from these two canal reaches. The one exception, on C-25, has been discussed in the section of this report starting on page 17.

As a matter of policy, there will be no further withdrawals for agricultural use permitted on this reach of C-25. With regard to withdrawals from C-23 above S-48, a separate brief report on allocable volumes will be prepared for this reach as time permits.

RECOMMENDATIONS

The following recommendations are made:

1. That the District adopt and publish by the appropriate and necessary means the values for:

   (a) Maintenance of minimum flows in Canals 23, 24, and 25 as measured at the downstream structure in each canal. (see pages 9 and 13; and Table 10).

   (b) Minimum stages in Canals 23, 24, and 25 upstream of Structures S-97, S-49, and S-99 respectively. (see page 13).

2. That the minimum stages as set forth in 1(b), above, be clearly defined as that stage below which:

   (a) Further withdrawals from the surface water system and the conjunctive groundwater system upstream of the indicated control structures will not be permitted; and

   (b) Downstream releases to maintain minimum downstream stages (C-23 and C-25) will not be made.

3. That the Department of Field Services consider the necessity and desirability of establishing minimum stages (based on canal bank stability considerations) for the reaches of C-23 and C-25 between the upper and lower controls.

4. That in the event minimum stages as in item 3 are established they be officially adopted and published by the District; but that it be left to the operational discretion of the Department of Field Services to decide whether or not to make upstream releases to maintain downstream minimum stage on occasions when the upstream stage is at or below the established minimum (see item 2(b), above).

5. That the Department of Field Services establish a reasonable upstream stage for each upper control structure below which downstream releases will not be made to meet minimum flow requirements; and that these stages be formally adopted and published by the District. (see page 13).

6. That the procedural and operational guidelines suggested herein concerning the reach of Canal 25 between S-50 and S-99 be adopted on an interim basis pending additional study, unless District Counsel recommends different procedures based on legal considerations. (see pages 19 and 20).

7. That the necessity for a formal declaration of water shortage be determined by District Counsel; and if such is found to be necessary that the upstream canal stages as recommended herein be formally adopted as representing the situation under which an official water shortage condition exists. (see page 27).

8. That subsequent to a formal declaration of a water shortage (if such is found necessary), the District officially adopt a policy that no water use restrictions will be applied until the minimum upstream stage is reached, at which point all withdrawals from the upstream surface water/conjunctive groundwater source will be terminated. (see page 13).

9. That, again assuming the necessity for a formal water shortage declaration, a stage of 12.0 ft.msl. at S-50 be adopted as reflecting a condition of water shortage in the reach of C-25 between S-50 and S-99. Restrictions on recreational use withdrawals would be applied at that stage, and restrictions on public water supply use would start at a stage of 11.5 ft.msl. (see page 20).

10. That new surface water allocations in the C-23, C-24, and C-25 basins be made using the values presented in Table 11 as guidelines.

11. That consideration be given to applying these same values (Table 11) to existing permits to be converted to the new permit system; the final decision here to be made by the Executive Director upon the recommendation of the Regulation Division.

12. That the potential for conjunctive use of groundwater from the water table aquifers and surface water be taken into account in considering applications for shallow groundwater use in the three sub-basins of this study area.(see page 15; see also the Lake Istokpoga-Indian Prairie Area memorandum report).

13. That the Regulation Division develop a procedure for allocation of water to drainage districts (rather than to individual users) in those cases where drainage district facilities are used to make water withdrawals; i.e., North St.Lucie River D.D., at the North Header Canal (C-25) and South Header Canal (C-25), and Ft.Pierce Farms D.D., at the 36" culvert downstream of S-99 (C-25).

14. That a permit classification system, as to source and use, be established for the study area. (see page 29 ; see also the Lake Istokpoga-Indian Priairie Area memorandum report).

15. That all permittees, both old and new, be required to submit monthly reports of water usage in a form satisfactory to the District. Of particular importance are use reports from:

(a) County for recreational water use in the Savannah; and

(b) North St.Lucie D.D., which shall include discharges out of the irrigation service areas to Ten Mile Creek.

16. That the Regulation Division take early steps to place the existing private impoundments under District permit, and under these permits to require submission of monthly inflow/outflow data which shall include:

(a) Discharges into the impoundment at all inflow locations;

(b) Withdrawals from the impoundment at all withdrawal locations;

(c) Month-end impoundment stages;

(d) Discharges from impoundment and drainage area (if separate) to primary canal system; and

(e) Rainfall, if available.

Required application data shall include:

(a) Size, location and type of all facilities discharging into and removing water from the impoundment; and

(b) Stage-area and stage-capacity relationships for the impoundment.

17. That all permits, both old and new, be re-evaluated as a unit at the same time, and no later than mid-1977.

18. That the following further studies be undertaken by the Resource Planning Department:

(a) Water availability in the reach of C-25 between S-99 and S-50;

(b) Water availability in the reach of C-23 between S-97 and S-48;

(c) Investigation of hydraulic relationships between the water table aquifers and the surface water system;

(d) Extent of Floridan Aquifer water use in the study area and estimate of extent to which return flow from this source contributes to basin yield;

(e) Gaging of flows at the Radebaugh Culverts;

(f) Evaluation of City of Ft.Pierce's well-field adjacent to C-25 as a conjunctive groundwater/surface water use;

(g) Economic evaluation of private impoundments; and

(h) Need for minimum flow requirement in terms of effect on downstream saline water bodies.

LAND USE IN ST. LUCIE COUNTY AREA
DRAINAGE BASINS - ACRES

C-23 Basin Above S-97

			PASTURE		UNDEVELOPED			
YEAR	CITRUS	TRUCK	IMPROVED	RANGE	WOODLANDS	OTHER	URBAN	TOTAL
1958	3,640	---	10,690	50,880	4,230	22,430	130	92,000
1968	14,590	340	11,020	42,340	4,230	19,350	130	92,000
1972	21,020	310	14,890	32,070	4,230	19,350	130	92,000
C-24 Basin Above S-49								
1958	10,371	0	40,283	34,316	3,550	17,530	50	99,080
1968	17,240	940	38,830	18,870	3,550	16,570	4,550	100,550
1972	21,370	0	38,520	15,990	3,550	16,570	4,550	100,550
C-25 Basin Above S-99								
1958	13,909	780	23,805	44,016	5,040	13,180	---	100,730
1968	25,098	1,370	21,810	40,430	5,040	7,000	---	100,730
1972	27,640	1,590	21,130	38,350	5,040	7,000	---	100,730

NOTE: The area includes portions of St. Lucie County, Okeechobee County, and Martin County which lies within the drainage basins of C-23, C-24, and C-25 above the respective control structures.

TABLE 1

C-23 AT S-48 DISCHARGE CFS-DAYS

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY TOTALS
1963								390	1,865	3,800	1,335	2,810	
1964	(2,030)	(4,580)	1,256	803	1,118	820	5,309	13,083	13,557	8,011	3,349	940	54,857
1965	180	3,209	2,184	476	71	612	3,298	3,714	4,720	11,611	5,516	731	36,322
1966	14,878	10,320	3,904	1,468	1,799	13,748	23,226	14,399	9,156	22,420	2,620	1,089	119,027
1967	699	1,192	905	258	99	2,761	8,917	5,811	1,807	7,930	904	275	31,558
1968	213	196	166	166	2,939	29,451	29,677	6,234	2,131	3,054	3,782	878	78,887
1969	1,008	941	7,389	1,345	7,730	11,706	6,535	21,938	12,798	27,148	14,833	11,584	124,955
1970	(4,500)	8,341	22,969	4,880	2,190	6,761	9,511	(13,606)	8,540	18,645	1,833	573	102,349
1971	463	468	551	595	589	3,061	6,868	5,224	9,880	9,473	8,189	1,210	46,571
1972	401	1,229	343	1,477	7,418	18,210	5,372	4,349	1,174	379	251	491	41,094
1973	1,496	1,753	1,220	778	368	6,790	11,018	10,282	19,270	9,539	1,233	1,144	64,891

TABLE 2a

( ) estimated by rainfall-discharge relationship.

NOTE: For the purpose of this study, discharges at S-97 are assumed equivalent to discharges at S-48.

C-24 AT S-49 DISCHARGE CFS-DAYS

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY
1962				120	260	1,960	5,640	18,510	38,320	15,170	930	240	
1963	0	0	0	0	800	30	1,670	0	8,020	5,050	1,720	2,610	19,740
1964	3,960	6,320	280	880	940	310	3,820	15,010	11,630	2,700	1,070	550	47,085
1965	0	1,740	340	0	0	0	2,980	430	4,090	7,050	2,750	270	19,480
1966	9,420	8,050	3,800	340	3,610	8,730	11,040	8,070	3,120	14,670	0	0	70,270
1967	0	590	0	0	0	4,431	4,753	249	3,834	5,839	399	0	20,095
1968	0	0	0	0	3,728	40,348	13,856	892	3,916	6,170	1,792	0	70,752
1969	1,712	0	9,464	384	7,310	5,991	2,796	25,792	15,989	21,336	19,302	9,755	119,821
1970	18,515	8,759	11,491	3,575	0	1,172	5,872	5,909	5,702	18,802	1,876	0	81,673
1971	0	380	2,657	0	55	5,965	10,704	5,220	10,073	13,211	8,222	3,556	60,043
1972	6,302	3,209	1,676	6,635	5,537	13,432	1,826	2,892	1,604	786	990	8,598	53,487
1973	4,157	3,009	1,972	1,896	1,442	7,006	5,667	5,407	11,002	8,804	1,340	433	52,135

TABLE 2b

PROVISIONAL DATA
C-25 AT S-99 DISCHARGE CFS-DAYS

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1964			0	42	709	1,091	LR	7,009	15,667	12,614	636	1,042	
1965	97	1,566	4,174	74	0	0	6,478	4,914	1,781	5,492	7,836	992	33,404
1966	7,517	8,259	5,238	1,691	3,697	12,207	12,202	16,746	11,197	18,555	6,754	0	104,063
1967	0	334	86	0	0	4,286	10,881	6,066	3,579	5,622	850	14	31,718
1968	603	310	339	0	1,982	18,975	13,694	3,738	5,439	9,410	7,423	6,586	68,499
1969	1,919	735	13,540	458	11,388	1,149	2,112	11,566	9,799	10,534	10,959	6,707	80,866
1970	4,875	5,226	16,907	4,838	3,198	1,135	1,186	5,104	4,616	15,578	1,647	0	64,310
1971	0	923	918	0	24	5,925	8,595	8,768	7,654	7,463	4,362	2,446	47,078
1972	985	4,086	2,020	1,820	2,982	11,378	7,326	1,666	2,015	0	0	0	34,278
1973	5,343	8,702	2,392	1,990	411	14,750	8,596	10,017	8,381	8,173	6,823	1,418	76,996

TABLE 2c

NOTE: These discharges have been reduced 20% from those calculated by the theoretical rating curve on the basis of two flow measurements.

PRECIPITATION OVER ST. LUCIE COUNTY AREA

C-23 PRECIPITATION

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1962	1.00	.70	3.55	2.79	3.29	7.97	8.56	10.53	7.22	1.24	3,31	.22	50.38
1963	.80	4.21	1.44	.85	5.65	4.33	3.66	3.30	6.77	7.22	3.02	5.92	47.19
1964	2.10	4.32	1.26	4.61	3.21	3.53	6.85	12.99	6.74	4.57	.64	2.38	53.20
1965	.44	4.96	2.23	.97	.81	5.95	7.04	4.35	6.17	7.10	.98	1.12	42.13
1966	6.97	4.72	1.33	3.83	4.46	12.00	5.78	8.33	6.55	8.08	1.10	1.09	64.24
1967	1.31	3.03	1.47	.26	.43	9.78	9.72	6.44	4.87	7.17	1.14	1.95	47.59
1968	.79	2.55	.88	.26	10.60	18.57	5.94	5.62	8.67	7.68	2.69	.03	64.28
1969	1.94	1.22	6.61	1.80	9.01	5.98	7.27	10.00	7.48	12.88	3.19	2.96	70.34
1970	4.66	2.74	9.07	.09	7.14	7.15	6.35	9.34	9.07	7.64	.11	.45	63.82
1971	.17	2.55	1.40	.75	4.34	9.18	7.19	5.56	5.71	7.34	2.39	1.82	48.40
1972	.73	2.23	5.74	1.83	7.67	8.03	4.04	6.13	1.38	2.07	3.00	1.64	44.48
1973	2.87	1.76	2.65	1.71	5.74	8.77	8.43	6.19	7.47	5.65	.38	1.18	52.80
AVE.	1.98	2.92	3.14	1.65	5.20	8.43	6.74	7.40	6.51	6.55	1.83	1.73	54.07

C-24 PRECIPITATION

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1962	1.00	.71	3.23	2.13	2.39	6.32	8.06	9.74	6.94	1.20	3.75	.22	45.69
1963	.70	3.89	1.40	.82	5.47	4.01	3.80	2.74	5.83	8.06	2.94	5.81	45.48
1964	2.12	4.43	1.40	4.46	2.93	2.93	6.48	12.67	6.78	3.86	.47	2.24	50.75
1965	.36	5.07	1.82	.89	.88	5.15	7.33	3.91	6.32	6.90	1.23	1.16	41.00
1966	6.68	4.81	1.14	3.74	4.05	10.86	5.29	7.60	6.45	7.92	1.06	1.13	60.73
1967	1.35	2.79	1.58	.18	.34	8.61	9.32	4.77	3.94	6.14	1.18	1.81	42.03
1968	1.00	2.49	.89	.21	10.64	17.65	5.06	5.34	8.31	7.16	2.56	.02	61.32
1969	1.75	1.09	5.98	1.81	8.16	4.88	7.02	9.64	7.80	12.54	3.11	2.94	66.71
1970	4.15	2.39	8.04	.08	6.92	6.10	6.17	9.24	8.99	7.64	.20	.45	60.37
1971	.13	1.97	1.26	.90	3.01	8.74	6.73	5.39	4.80	7.54	2.16	1.58	44.22
1972	.88	2.12	5.73	1.30	6.53	7.02	3.64	5.05	1.14	1.91	2.71	1.42	39.46
1973	2.60	1.66	2.40	1.78	5.68	8.41	7.79	5.78	7.10	5.56	.25	.98	50.00
AVE.	1.89	2.79	2.91	1.53	4.75	7.56	6.39	6.82	6.20	6.37	1.80	1.65	50.65

TABLE 3a

C-25 PRECIPITATION

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1962	.89	.57	3.64	1.89	3.34	10.28	8.45	9.72	7.08	.88	3.23	.40	50.36
1963	.68	4.36	1.36	.84	5.32	5.89	3.70	3.27	8.53	2.65	3.65	4.87	45.12
1964	2.28	4.23	.86	4.26	2.92	3.44	6.07	11.69	6.83	3.90	.73	1.30	48.52
1965	.34	4.32	2.02	1.51	.78	5.80	7.97	6.03	6.21	5.62	1.34	1.25	43.19
1966	6.59	3.78	1.07	2.80	3.86	10.73	6.77	6.70	4.25	5.43	1.14	.90	54.01
1967	.95	2.90	1.28	.55	.26	12.25	8.07	7.39	5.70	4.63	.45	2.09	46.51
1968	1.30	1.67	.72	.29	7.49	14.53	6.84	4.16	4.79	4.83	2.38	.09	49.08
1969	1.93	1.13	7.16	1.27	8.89	5.44	4.14	9.38	6.24	11.44	4.00	2.34	63.35
1970	4.36	2.69	6.97	.19	6.69	5.86	6.13	4.56	5.75	5.79	.59	.36	49.93
1971	.16	3.97	1.39	.71	5.11	9.25	6.62	6.68	4.84	5.27	1.11	2.03	47.13
1972	.86	2.87	4.41	1.47	6.42	7.13	5.28	8.80	.89	1.92	2.47	1.61	44.13
1973	3.38	1.70	3.15	1.62	5.20	8.20	9.16	6.02	5.66	5.60	1.03	1.29	52.01
AVE.	1.98	2.85	2.83	1.45	4.69	8.23	6.60	7.03	5.56	4.83	1.84	1.54	49.44

TABLE 3b

PAN EVAPORATION FOR RAULERSON (W2-3)

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY TOTALS
1962	3.50	4.74	6.65	6.55	7.78	5.44	6.76	5.38	4.90	4.88	3.39	2.75	62.72
1963	2.80	3.52	5.77	7.23	7.23	6.48	6.78	6.98	5.17	5.25	3.80	2.91	63.92
1964	2.29	3.71	6.05	6.43	6.87	6.98	6.52	6.38	5.43	4.25	2.96	3.18	61.05
1965	3,25	4.10	5.37	7.05	7.89	6.58	6.39	5.63	5.14	3.88	3.32	2.71	61.31
1966	2.46	3.25	4.75	6.32	6.53	6.32	5.83	5.56	4.62	4.12	3.49	2.92	56.17
1967	3.05	3.49	5.21	7.35	8.91	6.27	5.93	5.55	5.00	4.06	3.38	2.98	61.18
1968	2.73	3.74	5.90	6.75	7.09	5.30	5.69	5.22	4.54	4.54	3.52	2.99	58.01
1969	3.03	3.96	4.32	5.51	6.06	6.19	6.26	5.88	4.15	3.92	2.82	2.86	54.96
1970	2.52	3.30	4.80	6.31	7.29	6.29	5.88	6.02	5.18	4.14	3.56	3.19	58.48
1971	3.52	4.31	6.10	6.98	8.33	6.54	6.28	5.69	4.45	3.96	3.23	2.83	62.22
1972	3.25	3.76	6.04	6.50	6.69	6.60	6.33	5.67	5.53	4.65	3.10	3.01	61.15
1973	2.80	3.36	5.38	6.17	7.03	6.57	5.40	5.35	4.53	4.22	3.43	2.62	56.86
Mean	2.93	3.77	5.53	6.60	7.31	6.30	6.17	5.78	4.89	4.32	3.33	2.91	59.84

NOTE: This is an Agricultural Research Service Station in the Taylor Creek Basin

TABLE 4

GROUND WATER ELEVATIONS IN OBSERVATION WELLS
ST. LUCIE 41 and ST. LUCIE 42

AVERAGE MONTH-END VALUES IN FEET M.S.L.

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1962	24.70	24.45	25.42	25.32	25.04	27.57	26.10	27.95	27.33	25.44	25.42	25.44
1963	25.37	26.21	25.59	24.90	26.30	26.29	25.53	25.00	27.49	25.46	25.63	26.57
1964	26.23	25.87	25.40	25.97	25.09	26.13	25.98	27.62	26.11	25.97	25.38	24.97
1965	24.70	25.76	25.52	24.45	23.98	24.86	26.21	26.16	26.55	27.15	25.60	25.40
1966	25.75	25.95	24.90	24.65	24.74	26.35	26.33	26.84	25.77	25.70	24.86	24.70
1967	24.83	25.04	24.54	24.16	23.90	26.38	26.03	25.42	24.98	25.82	24.96	24.90
1968	24.63	24.53	24.34	24.07	26.35	27.12	26.00	25.19	25.63	25.91	25.46	24.39
1969	25.19	25.12	25.97	24.85	26.15	25.85	26.37	26.52	26.67	27.42	26.70	25.75
1970	26.07	25.80	27.17	24,97	26.02	25.62	25.55	26.05	26.85	26.35	25.33	24.95
1971	24.30	25.05	24.50	24.25	24.75	26.50	25.65	25.90	25.25	26.52	25.52	25.46
1972	24.92	25.00	25.87	24.75	25.60	26.27	25.37	26.95	25.00	24.35	24.51	24.55
1973	25.22	25.09	25.32	24.60	25.77	26.20	26.65	26.47	26.92	26.60	25.25	25.05

TABLE 5

MONTH-END UPSTREAM STAGE
C-23 at S-97

FEET M.S.L.

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964	21.66	20.58	21.48	20.95	20.78	22.34	20.10	21.50	20.60	20.90	21.78	21.14
1965	22.46	22.00	20.73	18.26	18.18	22.82	22.86	22.77	21.95	21.77	21.68	22.00
1966	22.00	21.35	22.77	20.39	20.77	21.20	18.25	21.55	21.27	21.26	21.24	22.21
1967	22.40	22.35	20.83	15.49	15.49	21.34	21.54	19.60	21.73	21.65	20.64	21.61
1968	19.83	21.38	17.00	17.00	20.87	21.34	19.76	20.57	21.72	21.65	21.80	20.36
1969	23.42	22.88	22.75	18.16	22.48	20.96	21.42	20.55	20.42	19.91	22.54	22.59
1970	21.94	22.19	20.34	16.14	20.38	21.20	21.02	21.47	21.23	21.33	21.57	19.74
1971	17.79	21.25	20.12	18.73	22.03	21.54	20.99	21.34	21.33	22.18	21.89	22.08
1972	22.80	21.28	15.90	18.24	22.17	21.39	20.42	21.78	19.06	18.62	21.87	22.55
1973	21.94	22.46	22.26	17.37	23.36	21.44	21.76	21.44	21.11	21.75	21.00	21.45

STORAGE CHANGE
C-23 above S-97

ACRE-FEET

1964	0	-372	309	-183	- 58	546	-775	477	-309	102	306	-223
1965	466	-165	-442	-861	- 25	1,564	15	- 33	-295	- 64	- 32	113
1966	0	-229	506	-834	128	148	-966	1,087	- 98	- 3	- 7	342
1967	68	- 18	-533	-1,643	0	1,819	70	-655	722	- 28	-348	334
1968	-605	524	-1,404	0	1,229	162	-533	270	397	- 25	53	-496
1969	1,084	-200	- 48	-1,544	1,446	-535	159	-298	- 44	-170	910	18
1970	-233	89	-541	-1,297	1,310	279	- 62	156	- 63	35	84	-620
1971	-615	1,124	-380	-453	1,107	-173	-191	121	- 3	300	-103	68
1972	260	-541	-1,685	688	1,310	-275	-332	469	-914	-139	1,088	244
1973	-219	186	- 72	-1,606	2,008	-693	112	-112	-114	223	-261	156

\- indicates a decrease in channel storage

TABLE 6a

MONTH-END UPSTREAM STAGE
C-25 at S-99

FEET M.S.L.

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964		18.20	19.06	20.35	19.72	20.10	19.00	19.64	19.90	19.92	20.83	21.07
1965	20.24	19.80	20.45	18.15	17.78	20.04	19.78	20.02	19.81	19.80	21.05	20.99
1966	19.76	19.80	19.85	18.85	19.82	19.70	19.80	19.75	19.80	19.75	19.78	20.09
1967	19.66	20.59	18.90	16.51	13.98	19.98	19.98	19.97	19.98	19.96	19.87	21.21
1968	21.19	21.39	19.39	14.99	20.00	20.01	20.03	20.05	20.01	19.97	20.49	20.83
1969	20.59	21.35	20.52	19.17	20.16	19.85	20.34	18.87	18.78	19.93	20.79	20.73
1970	20.67	21.21	20.34	19.57	20.35	20.94	19.37	19.94	19.93	19.94	19.75	20.50
1971	19.58	21.94	18.96	16.44	20.13	22.05	20.02	20.09	20.14	19.90	21.28	22.29
1972	21.12	22.30	16.62	18.84	20.98	20.11	20.03	19.70	21.20	18.65	21.12	20.99
1973	21.66	21.28	21.76	18.98	22.20	21.36	21.31	19.88	19.96	22.40	20.20	21.16

STORAGE CHANGE
C-25 above S-99

ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964		0	86	135	- 67	40	-115	66	27	2	98	26
1965	- 90	- 47	69	-237	- 36	229	- 27	25	- 22	- 1	134	- 7
1966	-132	4	5	-103	100	- 13	10	- 5	5	- 5	3	33
1967	- 45	99	-177	-231	-221	564	0	- 1	1	- 2	- 9	144
1968	- 2	22	-214	-417	481	1	2	2	- 4	- 4	55	37
1969	- 26	83	- 91	-142	103	- 33	52	-153	- 9	119	92	- 7
1970	- 7	59	- 95	- 81	82	64	-167	59	- 1	1	- 20	80
1971	- 98	256	-321	-244	365	211	-223	7	5	- 25	149	114
1972	-131	133	-589	215	225	- 94	- 8	- 35	161	-269	260	- 14
1973	74	- 42	54	-298	348	- 95	- 6	-154	8	269	-244	104

TABLE 6b

NOTE: - indicates a decrease in channel storage

MONTH-END UPSTREAM STAGE
C-24 at S-49

FEET M.S.L.

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1962	19.38	19.60	19.72	19.31	18.30	18.41	19.71	18.30	15.99	19.68	18.94	20.32
1963	19.96	19.85	16.32	16.57	19.23	19.88	19.43	18.92	19.50	19.29	20.08	19.10
1964	18.94	19.21	20.17	19.40	18.61	20.25	19.14	19.03	19.80	19.61	20.95	20.38
1965	20.04	19.06	19.62	18.15	15.94	20.07	19.25	19.71	19.34	19.23	20.68	20.12
1966	20.67	19.34	20.30	17.86	19.24	18.99	19.12	19.40	19.46	19.66	19.45	19.59
1967	19.85	20.23	18.91	14.91	14.06	19.29	19.38	19.09	20.12	19.07	18.51	20.76
1968	19.49	20.49	18.47	14.67	19.53	19.28	18.45	19.00	19.48	19.63	20.79	19.42
1969	20.59	20.34	20.83	17.63	19.80	19.77	19.49	18.86	18.34	19.39	20.31	20.79
1970	20.07	19.94	20.19	16.64	20.12	19.16	19.44	19.02	19.30	19.16	19.80	17.35
1971	16.28	20.68	17.20	14.49	19.98	20.32	19.76	19.11	19.84	19.62	20.27	21.18
1972	20.81	20.95	15.20	16.95	21.13	19.74	19.78	20.09	20.35	19.88	21.36	21.30
1973	20.62	20.43	20.17	17.26	20.94	19.27	19.86	19.76	19.70	20.04	18.98	20.15

STORAGE CHANGE
C-24 above S-49

ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1962	0	58	32	-109	-261	28	339	-367	-567	923	-195	367
1963	- 97	- 29	-398	-431	667	172	-120	-134	152	- 55	210	-260
1964	- 42	70	256	-206	-206	433	-296	- 29	203	- 51	364	-157
1965	- 92	-260	147	-381	-527	1,039	-218	122	- 98	- 29	390	-153
1966	150	-358	257	-637	354	- 65	34	74	16	53	- 56	37
1967	69	102	-350	-967	-187	1,254	24	- 76	274	-279	-145	598
1968	-243	269	-534	-907	1,183	- 66	-215	142	126	40	314	-370
1969	315	- 68	134	-839	559	- 8	- 74	-165	-133	272	246	132
1970	-197	- 35	67	-905	890	-258	74	-110	73	- 37	169	-629
1971	-258	1,125	-904	-630	1,343	92	-151	-172	193	- 59	175	251
1972	-123	39	-1,449	410	1,090	-379	11	83	71	-127	407	- 17
1973	-189	- 53	- 71	-752	961	-452	156	- 27	- 16	91	-281	310

(-) indicates a decrease in channel storage

TABLE 6c

C-23 BASIN YIELD BY
BASIN WATER BUDGET

ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1964	2990	4369	-21389	14873	- 7359	4293	24686	52133	7053	6056	- 6133	3219	84793
1965	-11499	25146	- 3219	-14796	-13109	24379	23843	6363	17786	29746	-11883	-3986	68769
1966	39176	16559	- 8433	3986	3449	56426	24839	50139	15640	32046	- 6976	-1993	224633
1967	2146	10043	-11193	-14719	- 5749	55353	27139	-4139	- 4139	24763	-12726	-1916	64859
1968	- 5673	3449	-13416	- 6363	58113	86786	1226	22156	22846	9276	- 6516	-14106	157779
1969	6976	4216	32353	-18169	33886	12496	21926	42089	29516	65166	8969	13569	252999
1970	18936	1763	60336	-14796	23996	16253	11269	33733	29439	27446	-17479	-5826	184383
1971	- 9046	9429	- 3603	- 8969	15639	37106	5443	2990	14873	34346	3143	229	101583
1972	- 7589	2989	16253	-16866	30053	22079	-9276	23536	-15716	-11576	5903	-2223	37566
1973	11193	1456	2529	- 7436	17939	30589	25299	13953	37259	21696	-18859	-3066	132557
MEAN	- 4761	7942	5022	- 8326	15686	34576	15639	24295	15456	23897	- 6256	-1610	130992

INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1964	0.39	0.57	-2.79	1.94	-.96	.56	3.22	6.80	.92	.79	- .80	.42	11.06
1965	-1.50	3.28	-.42	-1.93	-1.71	3.18	3.11	.83	2.32	3.88	-1.55	- .52	8.97
1966	5.11	2.16	-1.10	.52	.45	7.36	3.21	6.54	2.04	4.18	- .91	- .26	29.30
1967	0.28	1.31	-1.46	-1.92	-.75	7.22	3.5	-.54	-.54	3.23	-1.66	- .25	8.46
1968	-.74	.45	-1.75	-.83	7.58	11.32	.16	2.89	2.98	1.21	- .85	-1.84	20.58
1969	.91	.55	4.22	-2.37	4.42	1.63	2.86	5.49	3.85	8.50	1.17	1.77	33.02
1970	2.47	.23	7.87	-1.93	3.13	2.12	1.47	4.40	3.84	3.58	-2.28	-.76	24.14
1971	-1.18	1.23	-.47	-1.17	2.04	4.84	0.71	.39	1.94	4.48	.41	.03	13.25
1972	-0.99	0.39	2.12	-2.20	3.92	2.88	-1.21	3.07	-2.05	-1.51	0.77	-0.29	4.90
1973	1.46	0.19	0.33	-0.97	2.34	3.99	3.30	1.82	4.86	2.83	-2.46	-0.40	17.29
MEAN	0.62	1.04	.66	-1.09	2.05	4.51	2.04	3.17	2.02	3.12	- .82	- .21	17.09

TABLE 7a

C-24 BASIN YIELD
BASIN WATER BUDGET

ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1963	-1508	17596	-16506	-16506	24969	5278	-7792	-14831	36616	21702	-18182	25807	56726
1964	-1508	9552	-21869	13574	-8462	2262	25724	55637	10138	-4524	-11563	1089	70049
1965	-12820	26310	- 8965	-16674	-13658	22288	29913	754	18601	25724	-18266	-7792	45415
1966	34354	8127	-15166	2178	3269	53878	10054	32846	5195	18601	-18350	-5446	129541
1967	418	8295	-11982	-17847	-5446	57229	28824	-19607	-5614	24215	-12987	-2597	42901
1968	-5278	586	-16087	- 8043	62089	101974	-4524	1759	17177	9887	-8127	-18853	132558
1969	5865	3770	35024	-13490	32762	6032	18266	44744	39214	64016	7289	14663	258162
1970	26226	16423	50191	-28748	21618	5530	5195	27818	24886	26478	-19607	-7122	148897
1971	-10809	7373	251	- 7373	8379	48263	14579	6787	12484	41309	2932	2681	127447
1972	754	10976	23796	-13574	32762	33432	-83	18898	-14076	-10725	6703	4021	92087
1973	19607	5865	2597	- 7457	18182	44744	28572	-1256	22120	10557	-25891	-6787	110856
MEAN	5027	10443	1934	10359	16042	34537	13520	13886	15158	20658	-10550	-30	110421

INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1963	-0.18	2.10	-1.97	-1.97	2.98	0.63	-0.93	-1.77	4.37	2.59	-2.17	3.08	6.77
1964	-0.18	1.14	-2.61	1.62	-1.01	0.27	3.07	6.64	1.21	-0.54	-1.38	0.13	8.36
1965	-1.53	3.14	-1.07	-1.99	-1.63	2.66	3.57	0.09	2.22	3.07	-2.18	-0.93	5.42
1966	4.10	0.97	-1.81	0.26	0.39	6.43	1.20	3.92	0.62	2.22	-2.19	-0.65	15.46
1967	0.05	0.99	-1.43	-2.13	-0.65	6.83	3.44	-2.34	-0.67	2.89	-1.55	-0.31	5.12
1968	-0.63	0.07	-1.92	-0.96	7.41	12.17	-0.54	0.21	2.05	1.18	-0.97	-2.25	15.82
1969	0.70	0.45	4.18	-1.61	3.91	0.72	2.18	5.34	4.68	7.64	0.87	1.75	30.81
1970	3.13	1.96	5.99	-3.43	2.58	0.66	0.62	3.32	2.97	3.16	-2.34	-0.85	17.77
1971	-1.29	0.88	0.03	-0.88	1.07	5.76	1.74	0.81	1.49	4.93	0.35	0.32	15.21
1972	0.09	1.31	2.84	-1.62	3.91	3.99	-0.01	2.16	-1.68	-1.28	0.30	0.48	10.99
1973	2.34	0.70	0.31	-0.89	2.17	5.34	3.41	-0.15	2.64	1.26	-3.09	-0.81	13.23
MEAN	.60	1.25	.23	-1.24	1.92	4.13	1.61	1.66	1.81	2.47	-1.26	.00	13.18

TABLE 7b

C-25 BASIN YIELD
BASIN WATER BUDGET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY
1965	-7640	23004	- 755	-10074	-16875	24683	32156	14272	11250	16875	-10494	-3526	72876
1966	34674	4533	- 6968	1763	8311	57763	21157	32911	14356	27622	1091	-1007	196206
1967	- 923	9487	-15784	-15448	- 8311	69853	13937	11670	2518	9739	-11250	503	65991
1968	-4953	-3526	-10326	- 6296	46512	76066	8143	-8059	10326	19646	6548	-6548	127533
1969	13853	4197	42734	-20149	38620	- 839	-6212	35766	12845	58434	6464	-5373	180340
1970	16791	- 419	43658	-13853	25103	8983	3358	2854	26278	25523	-13937	-8983	115356
1971	-9739	15112	-13685	-10998	17379	41643	7388	11922	21745	21745	- 3778	2518	101252
1972	-7304	8899	15-28	-11838	22752	28545	8983	30728	-32239	-10998	3442	-2014	53984
1973	17631	9403	17296	- 7388	19142	40383	36018	6800	20905	17547	-15616	-2098	160023

INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY
1965	-.91	2.74	-.09	-1.20	-2.01	2.94	3.83	1.70	1.34	2.01	-1.25	-.42	8.68
1966	4.13	.54	-.83	.21	.99	6.88	2.52	3.92	1.71	3.29	.13	-.12	23.37
1967	-.11	1.13	-1.88	-1.84	-.99	8.32	1.66	1.39	.30	1.16	-1.34	.06	7.85
1968	-.59	-.42	-1.23	-.75	5.54	9.06	.97	-.96	1.23	2.34	.78	-.78	15.19
1969	1.65	.50	5.09	-2.40	4.60	-.10	-.74	4.26	1.53	6.96	.77	-.64	21.48
1970	2.00	-.05	5.20	-1.65	2.99	1.07	.40	.34	3.13	3.04	-1.66	-1.07	13.74
1971	-1.16	1.80	-1.63	-1.31	2.07	4.96	.88	1.42	2.59	2.59	-.45	.30	12.06
1972	-.87	1.06	1.79	-1.41	2.71	3.40	1.07	3.66	-3.84	-1.31	.41	-.24	6.43
1973	2.10	1.12	2.06	-.88	2.28	4.81	4.29	.81	2.49	2.09	-1.86	-.25	19.06

TABLE 7c

C-23 BASIN YIELD
CHANNEL WATER BUDGET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
						ACRE-FEET							
1964	(4,931)	(8,714)	3,962	1,421	2,654	2,889	9,721	26,379	26,539	15,938	8,454	1,618	113,220
1965	2,161	6,211	4,204	1,967	2,915	2,752	6,521	7,945	9,030	22,954	12,236	2,509	81,405
1966	29,462	20,228	9,551	2,077	3,688	27,353	45,008	29,629	18,019	44,375	6,504	3,533	239,427
1967	2,256	2,366	2,518	1,861	3,974	7,283	17,747	10,700	4,286	15,685	2,851	372	71,899
1968	1,296	926	994	3,507	7,060	46,613	58,208	12,607	4,614	6,052	7,537	3,740	153,154
1969	3,191	2,603	14,560	2,614	16,729	22,631	13,110	43,159	25,319	53,599	30,253	22,974	250,742
1970	(8,688)	15,878	44,657	12,198	6,220	13,228	18,904	(19,873)	16,272	36,495	6,987	3,178	202,578
1971	3,266	2,011	2,666	4,154	2,273	5,232	13,067	10,187	18,946	22,642	15,595	2,915	102,954
1972	3,283	1,813	-640	5,413	16,409	34,593	11,486	8,878	6,458	2,928	1,563	2,032	94,216
1973	2,790	3,806	2,506	1,923	3,298	12,316	21,349	20,674	36,833	18,637	5,924	4,346	134,372
MEAN	6,132	6,423	8,498	3,714	6,522	17,489	21,512	19,003	16,632	23,931	9,790	4,721	144,396
						INCHES OVER ENTIRE BASIN							
1964	(.64)	(1.14)	.52	.19	.35	.38	1.27	3.44	3.46	2.08	1.10	.21	14.78
1965	.28	.81	.55	.26	.38	.36	.85	1.04	1.18	2.99	1.60	.33	10.63
1966	3.84	2.64	1.25	.27	.48	3.57	5.87	3.86	2.35	5.79	.85	.46	31.23
1967	.29	.31	.33	.24	.52	.95	2.31	1.40	.56	2.05	.37	.05	9.38
1968	.17	.12	.13	.46	.92	6.08	7.59	1.64	.60	.79	.98	.49	19.97
1969	.42	.34	1.90	.34	2.18	2.95	1.71	5.63	3.30	6.99	3.95	3.00	32.71
1970	(1.13)	2.07	5.82	1.59	0.81	1.73	2.47	(2.59)	2.12	4.76	0.91	0.41	26.41
1971	0.43	0.26	0.35	0.54	0.30	0.68	1.70	1.33	2.47	2.95	2.03	0.38	13.62
1972	0.43	0.24	-0.08	0.71	2.14	4.51	1.50	1.16	0.84	0.39	0.20	0.27	12.29
1973	0.36	0.49	0.33	0.25	0.43	1.61	2.78	2.70	4.80	2.43	0.77	0.57	17.52
MEAN	0.80	0.84	1.11	0.48	0.85	2.28	2.81	2.48	2.17	3.12	1.28	0.62	18.83

TABLE 8a

NOTE: ( ) indicates missing flow records estimated from a flow - rainfall relationship

C-24 BASIN YIELD
CHANNEL WATER BUDGET

ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1962											1,646	2,927	
1963	1,284	-30	935	1,928	2,263	312	4,620	1,822	16,540	9,950	3,596	4,896	48,115
1964	7,815	12,588	2,426	1,517	2,348	2,078	7,254	29,679	23,250	5,289	4,627	948	99,491
1965	1,703	3,177	1,290	2,060	3,245	1,039	5,674	1,803	7,980	13,904	7,651	1,639	51,153
1966	18,810	15,609	9,486	16	7,474	17,220	21,885	16,033	6,194	29,086	1,663	1,298	144,849
1967	1,021	1,266	1,209	2,675	4,462	10,045	9,415	415	7,877	11,260	2,366	805	52,821
1968	1,395	269	1,937	2,886	8,794	79,945	27,222	1,922	7,907	12,255	3,878	2,974	151,014
1969	3,784	987	18,855	1,639	15,045	11,872	5,450	50,903	31,526	42,501	38,440	19,467	240,469
1970	36,447	17,318	22,839	10,604	890	2,059	11,674	11,616	11,360	37,221	7,595	2,026	171,729
1971	2,843	1,901	6,409	3,014	1,466	11,913	21,025	10,140	20,151	26,089	16,468	7,785	129,203
1972	14,619	6,355	1,926	15,442	12,077	26,231	5,164	5,791	8,418	3,776	2,367	17,804	119,969
1973	8,047	6,176	3,837	5,104	3,823	13,438	11,400	10,694	21,797	17,543	6,152	2,888	111,030
MEAN	8,888	5,965	6,468	4,207	5,626	16,013	11,889	12,802	14,818	18,988	8,618	5,685	119,986

INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1962											0.20	0.35	
1963	0.15	0	0.11	0.23	0.27	0.04	0.55	0.22	1.97	1.19	0.43	0.58	5.74
1964	0.93	1.50	0.29	0.18	0.28	1.25	0.87	3.54	2.77	0.63	0.55	0.11	11.90
1965	0.20	0.39	0.15	0.25	0.39	0.12	0.68	0.22	0.95	1.66	0.91	0.20	6.10
1966	2.24	1.86	1.13	0	0.89	2.06	2.61	1.91	0.74	3.47	0.20	0.15	17.29
1967	0.12	0.15	0.14	0.32	0.53	1.20	1.12	0.05	0.94	1.34	0.28	0.10	6.30
1968	0.17	0.03	0.23	0.34	1.05	9.54	3.25	0.23	0.94	1.46	0.46	0.35	18.02
1969	0.45	0.12	2.25	0.20	1.80	1.42	0.65	6.07	3.76	5.07	4.59	2.32	28.70
1970	4.35	2.07	2.73	1.28	0.11	0.25	1.39	1.39	1.36	4.44	0.91	0.24	20.49
1971	0.34	0.23	0.76	0.36	0.17	1.42	2.51	1.21	2.40	3.11	1.97	0.93	15.42
1972	1.74	0.76	0.23	1.84	1.44	3.13	0.62	0.69	1.00	0.45	0.28	2.12	14.32
1973	0.96	0.74	0.46	0.61	0.46	1.60	1.36	1.28	2.60	2.09	0.73	0.34	13.25
MEAN	1.06	0.71	0.77	0.51	0.67	1.91	1.42	1.53	1.77	2.27	1.03	0.68	14.32

TABLE 8b

C-25 BASIN YIELD
CHANNEL WATER BUDGET

ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1965	1,297	3,101	9,314	2,663	5,471	0	12,826	9,730	3,524	10,874	17,434	3,503	79,737
1966	15,361	16,670	13,286	3,358	7,320	24,170	24,170	33,157	22,265	36,739	15,773	2,285	214,734
1967	2,097	661	2,808	4,695	7,073	8,486	21,544	12,011	7,086	11,132	5,580	28	83,201
1968	2,657	1,275	4,602	5,457	3,924	37,571	27,112	9,158	10,769	18,632	14,739	17,244	153,140
1969	3,948	3,105	26,811	4,402	22,505	2,275	5,811	22,901	19,402	20,857	21,699	13,280	166,996
1970	9,653	10,347	33,476	15,533	6,332	2,247	2,348	11,072	9,140	30,844	7,237	3,823	142,052
1971	4,140	1,828	4,540	4,928	48	11,732	17,018	17,361	15,155	14,777	11,539	5,000	108,066
1972	4,576	8,090	4,010	6,896	5,904	22,528	14,504	3,299	11,842	3,408	0	1,129	86,186
1973	10,579	17,701	4,736	6,956	814	29,205	17,020	19,834	16,594	16,182	16,642	4,714	160,977
MEAN	6,034	6,975	11,509	6,119	6,599	15,357	15,817	15,391	12,864	18,161	12,294	5,667	132,788

INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1965	0.15	.37	1.11	0.32	0.65	0	1.53	1.16	0.42	1.30	2.08	0.42	9.50
1966	1.83	1.99	1.58	0.42	0.87	2.88	2.88	3.95	2.65	4.38	1.88	0.27	25.58
1967	0.25	0.08	0.33	0.56	0.84	1.01	2.57	1.43	0.84	1.33	0.66	0	9.91
1968	0.32	0.15	0.55	0.65	0.47	4.48	3.23	1.09	1.28	2.22	1.76	2.05	18.24
1969	0.47	0.37	3.19	0.52	2.68	0.27	0.69	2.73	2.31	2.48	2.59	1.58	19.89
1970	1.15	1.23	3.99	1.85	0.75	0.27	0.28	1.32	1.09	3.67	0.86	0.46	16.92
1971	0.49	0.22	0.54	0.59	0.01	1.40	2.03	2.07	1.81	1.76	1.37	0.60	12.87
1972	0.55	0.96	0.48	0.82	0.70	2.68	1.73	0.39	1.41	0.41	0	0.13	10.27
1973	1.26	2.11	0.56	0.83	0.10	3.48	2.03	2.36	1.98	1.95	1.98	0.56	19.18
MEAN	0.72	0.83	1.37	0.73	0.79	1.83	1.88	1.83	1.53	2.16	1.46	0.67	15.82

TABLE 8c

IRRIGATION REQUIREMENTS FOR CITRUS
ST. LUCIE COUNTY

INCHES

	YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
	1963	1.20	---	1.16	2.05	---	0.07	1.24	1.70	---	---	---	---	7.42
	1964	---	---	1.34	---	0.59	0.87	---	---	---	---	1.76	---	4.56
	1965	1.41	---	.37	1.93	2.99	---	---	0.65	---	---	1.42	0.98	9.75
	1966	---	---	1.27	---	---	---	---	---	---	---	1.30	1.01	3.58
	1967	0.69	---	1.13	2.64	3.37	---	---	---	---	---	1.26	0.15	9.24
C-23	1968	1.21	---	1.72	2.64	---	---	---	---	---	---	---	2.07	7.64
	1969	0.06	0.68	---	1.10	---	---	---	---	---	---	---	---	1.84
	1970	---	---	---	2.81	---	---	---	---	---	---	2.29	1.65	6.75
	1971	1.83	---	1.20	2.15	---	---	---	---	---	---	.01	0.28	5.47
	1972	1.27	---	---	1.07	---	---	0.86	---	2.92	1.33	---	0.46	7.91
	1973	0	0.14	---	1.12	---	---	---	---	---	---	2.02	0.92	4.27
	MEAN	0.70	0.01	0.74	1.59	0.63	0.09	0.08	0.06	0.27	0.12	0.91	0.68	6.22
	1962	1.00	1.19	---	0.77	1.41	---	---	---	---	2.20	---	1.88	8.45
	1963	1.25	---	1.20	2.08	---	0.39	1.10	2.26	---	---	---	---	8.28
	1964	---	---	1.20	---	.87	1.47	---	---	---	---	1.93	---	5.47
	1965	1.53	---	.78	2.01	2.92	---	---	1.09	---	---	1.17	.94	10.44
	1966	---	---	1.46	---	---	---	---	---	---	---	1.34	.97	3.77
C-24	1967	.65	---	1.02	2.72	3.46	---	---	0.23	0.36	---	1.22	0.29	9.95
	1968	1.00	---	1.71	2.69	---	---	---	---	---	---	---	2.08	7.48
	1969	0.25	0.81	---	1.09	---	---	---	---	---	---	---	---	2.15
	1970	---	---	---	3.08	---	---	---	---	---	---	2.40	1.80	7.28
	1971	1.87	---	1.34	2.00	.79	---	---	---	---	---	0.24	0.52	6.76
	1972	1.12	---	---	1.60	---	---	1.26	---	3.16	1.49	---	0.68	9.31
	1973	---	0.24	0.19	1.12	---	---	---	---	---	---	2.15	1.12	4.82
	MEAN	0.72	0.19	0.74	1.60	0.79	0.16	0.20	0.30	0.29	0.31	0.87	0.86	7.01
	1965	0.61	---	.58	1.39	3.02	---	---	---	---	---	1.06	0.85	8.56
	1966	---	---	1.53	0.10	---	---	---	---	0.05	---	1.26	1.20	4.14
	1967	1.05	---	1.32	2.35	3.54	---	---	---	---	---	1.95	---	10.21
C-25	1968	0.70	0.23	1.88	2.61	---	---	---	0.84	---	---	0.02	2.01	8.29
	1969	0.07	0.77	---	1.63	---	---	0.76	---	---	---	---	---	3.23
	1970	---	---	---	2.71	---	---	---	0.44	---	---	1.81	1.74	6.70
	1971	1.84	---	1.21	2.19	---	---	---	---	---	---	1.29	0.07	6.60
	1972	1.14	---	---	1.43	---	---	---	---	3.41	1.48	---	0.49	7.95
	1973	---	0.20	---	1.28	---	---	---	---	---	---	1.33	0.81	3.62
	MEAN	0.60	0.13	0.72	1.74	0.73	0	0.08	0.14	0.38	0.16	0.97	0.80	6.59

NOTE: The values are based on estimated evapotranspiration minus rainfall

TABLE 9

MINIMUM MONTHLY RELEASES AT DOWNSTREAM STRUCTURES
ST. LUCIE COUNTY

	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
TOTAL REQUIRED RELEASES (CONTINGENT USES PLUS DOWNSTREAM REQUIREMENTS)													
C-23													
Acre-Ft.	613	690	767	460	843	2,453	3,220	3,220	3,527	4,447	1,457	613	22,310
Inches	0.08	0.09	0.10	0.06	0.11	0.32	0.42	0.42	0.46	0.58	0.19	0.08	2.91
C-24													
Acre-Ft.	922	670	670	587	922	3,435	2,095	3,435	2,681	3,435	922	503	20,277
Inches	0.11	0.08	0.08	.07	0.11	0.41	0.25	0.41	0.32	0.41	0.11	0.06	2.42
C-25													
Acre-Ft.	1,007	839	1,175	1,091	923	2,686	3,442	2,938	2,518	3,526	3,022	839	24,006
Inches	0.12	0.10	0.14	0.13	0.11	0.32	0.41	0.35	0.30	0.42	0.36	0.10	2.86
MINIMUM DOWNSTREAM REQUIREMENTS (FOR ESTUARY MAINTENANCE)													
C-23													
Acre-Ft.	292	329	365	219	401	1,168	1,533	1,533	1,680	2,118	694	292	10,624
C-24													
Acre-Ft.	439	319	319	280	439	1,636	998	1,636	1,277	1,636	439	240	9,656
C-25													
Acre-Ft.	480	400	560	520	440	1,279	1,639	1,399	1,199	1,679	1,439	399	11,433

TABLE 10

ADJUSTED BASIN YIELD
ST. LUCIE COUNTY

MAXIMUM MONTHLY VOLUME OF SURFACE WATER
TO BE ALLOCATED IN INCHES

	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
C-23	0.30	0.35	0.36	0.23	0.43	1.20	1.57	1.57	1.71	2.17	0.73	0.30	10.92
C-24	0.40	0.29	0.27	0.24	0.39	1.55	.96	1.55	1.18	1.55	0.41	0.22	9.01
C-25	0.45	0.36	0.52	.51	0.39	1.20	1.54	1.35	1.13	1.58	1.34	0.36	10.75

SEASONAL ADJUSTED BASIN YIELD (NOV.-MAY)
FOR USE WITH NON-RESERVOIR APPLICATIONS IN INCHES

C-23	4.29
C-24	3.38
C-25	4.24

NOTE: Yields are based on the 1 in 2 year frequency basin yield minus the minimum releases at the downstream structure and a contingency reservation.

TABLE 11

STAGES ABOVE S-50 AND S-48 CORRESPONDING
TO MINIMUM FLOW REQUIREMENTS

JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
AVERAGE MONTHLY STAGE AT S-50 REQUIRED TO MEET MINIMUM DOWNSTREAM FLOW REQUIREMENTS											
12.08	12.07	12.09	12.09	12.08	12.17	12.19	12.17	12.16	12.19	12.18	12.06
AVERAGE MONTHLY STAGE AT S-48 REQUIRED TO MEET MINIMUM DOWNSTREAM FLOW REQUIREMENTS											
8.03	8.04	8.04	8.02	8.05	8.12	8.14	8.14	8.19	8.20	8.07	8.03

NOTE: Theoretical Stage-Discharge Curves Presented in Structure Descriptions - Book 5, FCD

TABLE 12

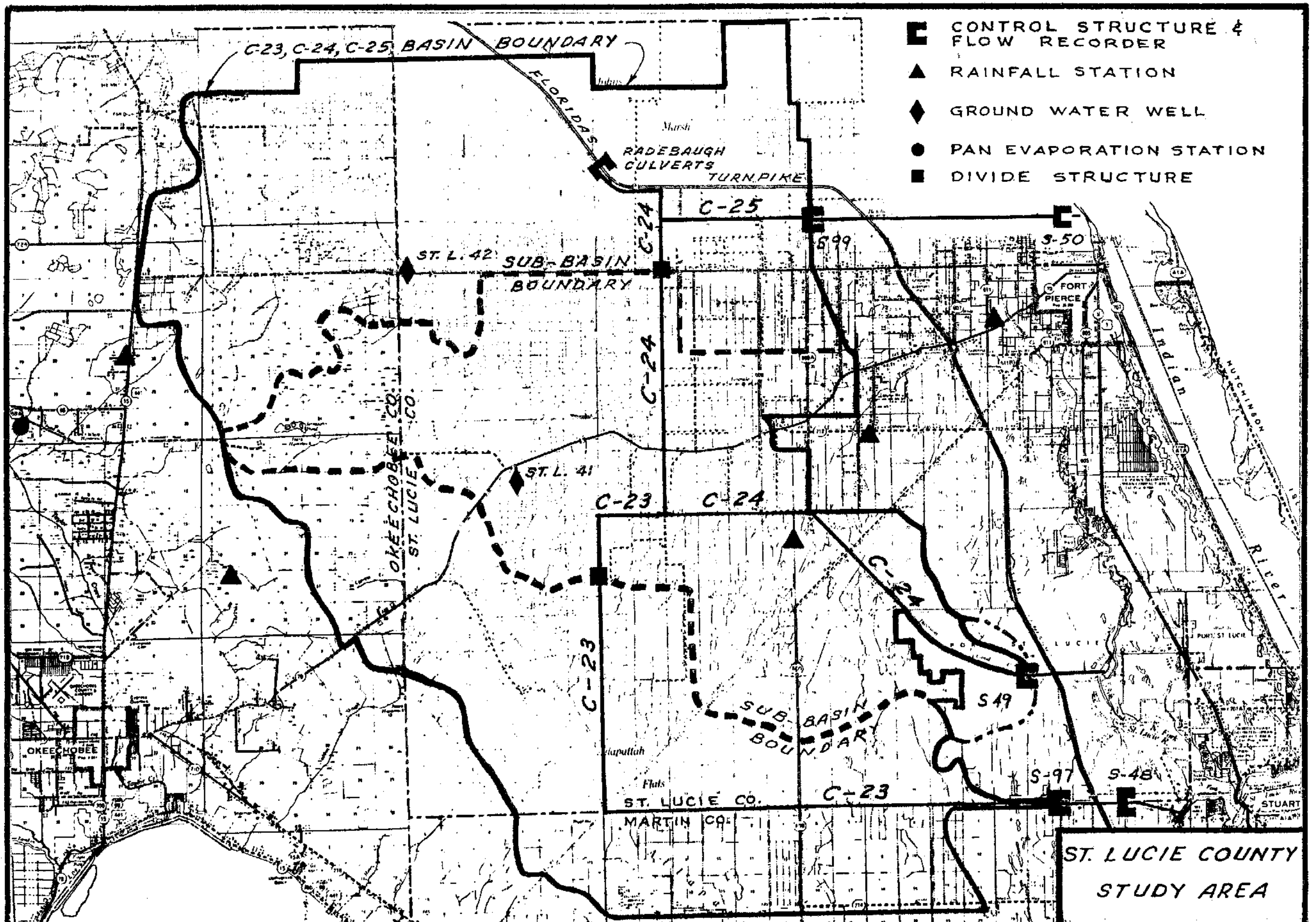
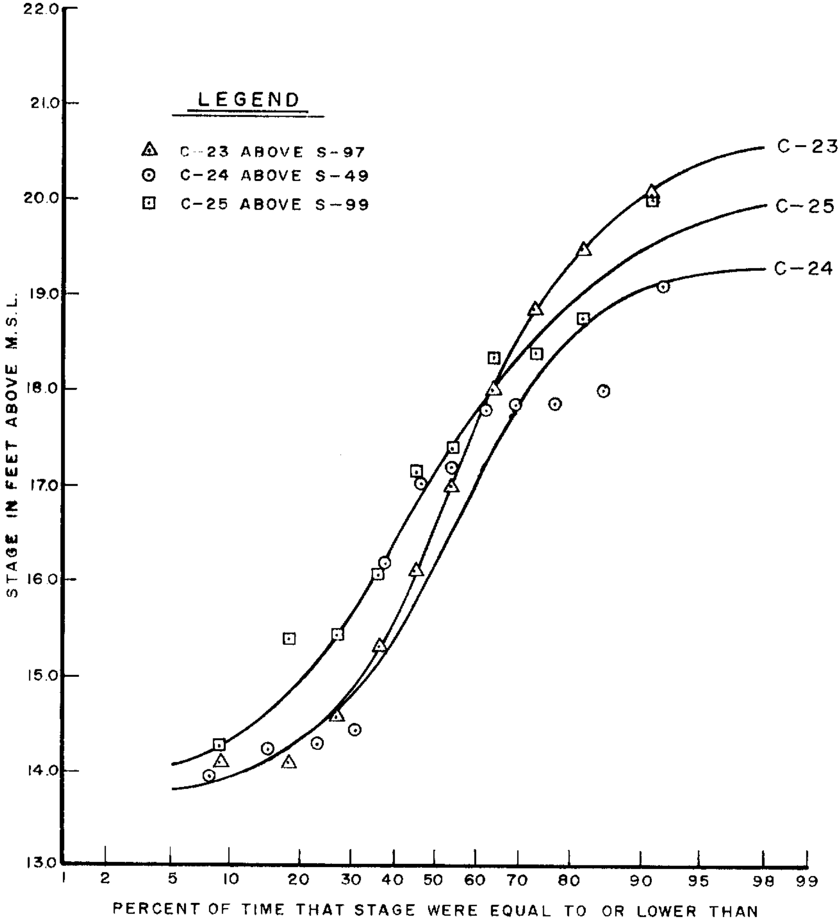

CONTROL STRUCTURE & FLOW RECORDER
RAINFALL STATION
GROUND WATER WELL
PAN EVAPORATION STATION
DIVIDE STRUCTURE
C-23, C-24, C-25 BASIN BOUNDARY
FLORIDAS
RADEBAUGH CULVERTS
TURNPIKE
C-25
C-24
C-23
S-99
S-50
FORT PIERCE
ST. L. 42
SUB-BASIN BOUNDARY
ST. L. 41
OKEECHOBEE CO.
ST. LUCIE CO.
MARTIN CO.
S 49
S-97
S-48
Indian River
HUTCHINSON
PORT ST LUCIE
STUART
OKEECHOBEE
Marsh
Flats
ST. LUCIE COUNTY STUDY AREA

FIGURE 1



3—DAY LOW STAGE IN DRY SEASON

FIGURE 2