

TECHNICAL PUBLICATION SJ 82-3
INVESTIGATION OF FERN WATER USE
IN SOUTHEAST PUTNAM COUNTY,

BY
PHILIP L. LEARY

WATER RESOURCES DEPARTMENT
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
Palatka, Florida
February, 1982
Project Number 2002325

TECHNICAL MEMORANDUM NO. 5

Investigation of Fern Water Use
in Southeast Putnam County, Florida

BY

PHILIP L. LEARY

WATER RESOURCES DEPARTMENT
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Palatka, Florida

February, 1982

Project Number 2002325

INTRODUCTION

Most commercial plantings of leatherleaf and plumosus ferns are grown south of an east-west line through Palatka; Putnam, and Ocala, Marion Counties. Ferns require sandy, well drained soils well above the water table for efficient production. Overhead irrigation utilizing impact or spinner designed sprinkler heads are currently used by most leatherleaf producers for irrigation and freeze protection.

A detailed investigation on fern water use within the St. Johns River Water Management District would consist of four parts. 1. Monitoring sites of approximately 2 acres on cooperative farms, in each of the five counties where ferns are produced. 2. Installation of complete weather stations and flow meters to compare pumping to atmospheric conditions at each site. 3. Soil samples taken after extensive pumping for freeze protection, to determine soil condition. 4. Plants yields recorded by individual cooperative growers at each test site.

An investigation as described above would be conducted over a three year period to establish average water use values for irrigation, fertigation and freeze control. The data collection effort for a large investigation would involve an intensive amount of manhours, monitoring equipment and travel.

Therefore, a one year study to determine fern water use was initiated. This scaled down version of the above mentioned investigation also monitored atmospheric conditions and pumpage. Recognizing ferns are grown in a region of similar soil type using basically the same irrigation methods, the study done by the District is an attempt to understand the water requirements for the irrigation of ferns.

This study relates to a larger investigation in that, the data which was collected and interpreted provides an insight to fern water use. It was completed without the significant amount of data called for in the larger investigation, given manpower and monetary constraints. Therefore, the study done by the District, is just one point on a distribution curve which could be expanded upon if a larger investigation were ever to be conducted.

The study is important to the District in determining actual water use of the expanding fern industry. Ferns are the largest user of water on a per acre basis within the St. Johns River Water Management District. By determining an actual gallon per minute (gpm) per acre per year number, this value can be used for both resource evaluation and management purposes.

This study will assist the District in solving several problems.

1. Consumptive use permitting in the fern industry.
2. Problems associated with the excessive volumes of water used in freeze protection.
3. Establishing the need for improved methods of freeze protection.
4. The continued establishment of catch ponds for recycling water.

Also, other problems that may occur with the continued expansion of ferns within the District.

The following information was compiled during the period of December 1979 through March 1981. During this time period, data collected from two winters of freeze protection pumping was recorded.

This study is not intended to replace a large investigation but to provide some insight to the urgent questions which needed to be addressed concerning fern water use.

Purpose and Scope

The Fern Water Use investigation was conducted in Southeast Putnam County, Florida during 1980, to determine the actual water use of a typical fernery. Figure 1 shows the location of the fernery. Prior to this investigation, only estimates of irrigation requirements of ferns were available through county extension agents, Agricultural Stabilization Conservation Service (A.S.C.S.) or Soil Conservation Service (S.C.S.) agents. Therefore it was intended to refine those estimates provided by these agencies and determine the magnitude of withdrawals during freeze protection periods. It was found that an average application rate of 14 gallons per minute (gpm) per acre, per week is used over a one year period. A previous investigation by Ross, 1980, substantiates drawdown caused by freeze protection, but total amounts of withdrawals were still estimated.

The expanding 600-acre fern industry contributes approximately four million dollars annually to the local economy and is the areas largest user of ground water (Ross, 1980). Ferns grow abundantly in the region's well drained sandy soils but require supplemental irrigation to maintain optimum soil moisture for maximum growth.

Background

A typical fernery irrigation system consists of an 8 inch or larger diameter well, equipped with a large capacity centrifugal or turbine pump capable of withdrawing 1500 gpm or more. Pumped water delivered to "rain bird" sprinklers is distributed at a rate of 200 gpm per acre, requiring one well for approximately each 7 1/2 acres of ferns.

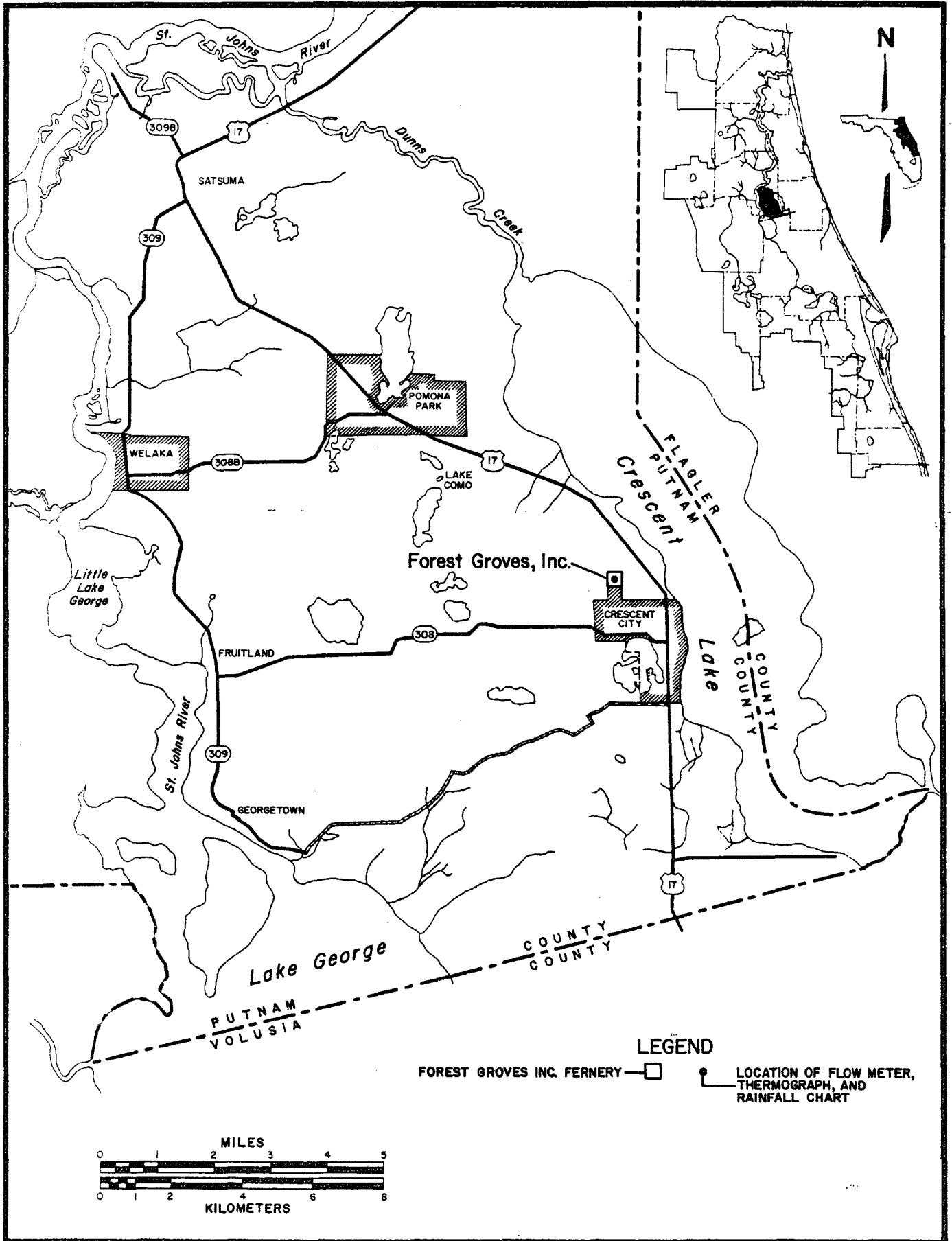


FIGURE 1 - Map of Southeast Putnam County Showing Location of Forest Groves, Inc.

In comparing water use, ferns on the average use relatively the same amount of water for supplemental irrigation as a vegetable crop would if grown year round (St. Johns River Water Management District Annual Water Use Survey Research, 1979). Fern water use differs from other types of agricultural irrigation due to the fact that the majority of water pumped is used for freeze protection. When protected against temperatures below 32 degrees Fahrenheit fern will produce fronds throughout the year. Although pumpage seems high, the largest withdrawals are for freeze protection. Heat energy stored in ground water protects ferns from the freezing temperatures. An application rate of .35 inch per hour releases approximately 11,400 BTU per acre, however, a continuous fresh film of water must be uniformly applied to plants, otherwise greater damage occurs than if sprinkler systems are not used (Ross, 1980). This accounts for the large amounts of water necessary for preventing freeze damage. With the high volume of water being pumped over long periods of time, (4 to 16 hours) four specific problems occur:

1. Leaching of nutrients, herbicides, and pesticides
2. Root and plant diseases
3. Soil erosion
4. Damage to structure and texture of soil

For the purpose of this investigation, a monitoring network was installed consisting of the following: a recording flow meter, thermograph and rain recorder.

Data Collection

The amount of water piped into a 2 1/2 acre fern plot was measured by attaching a flowmeter to the 6 inch main irrigation line (Figure 2). Atmo-

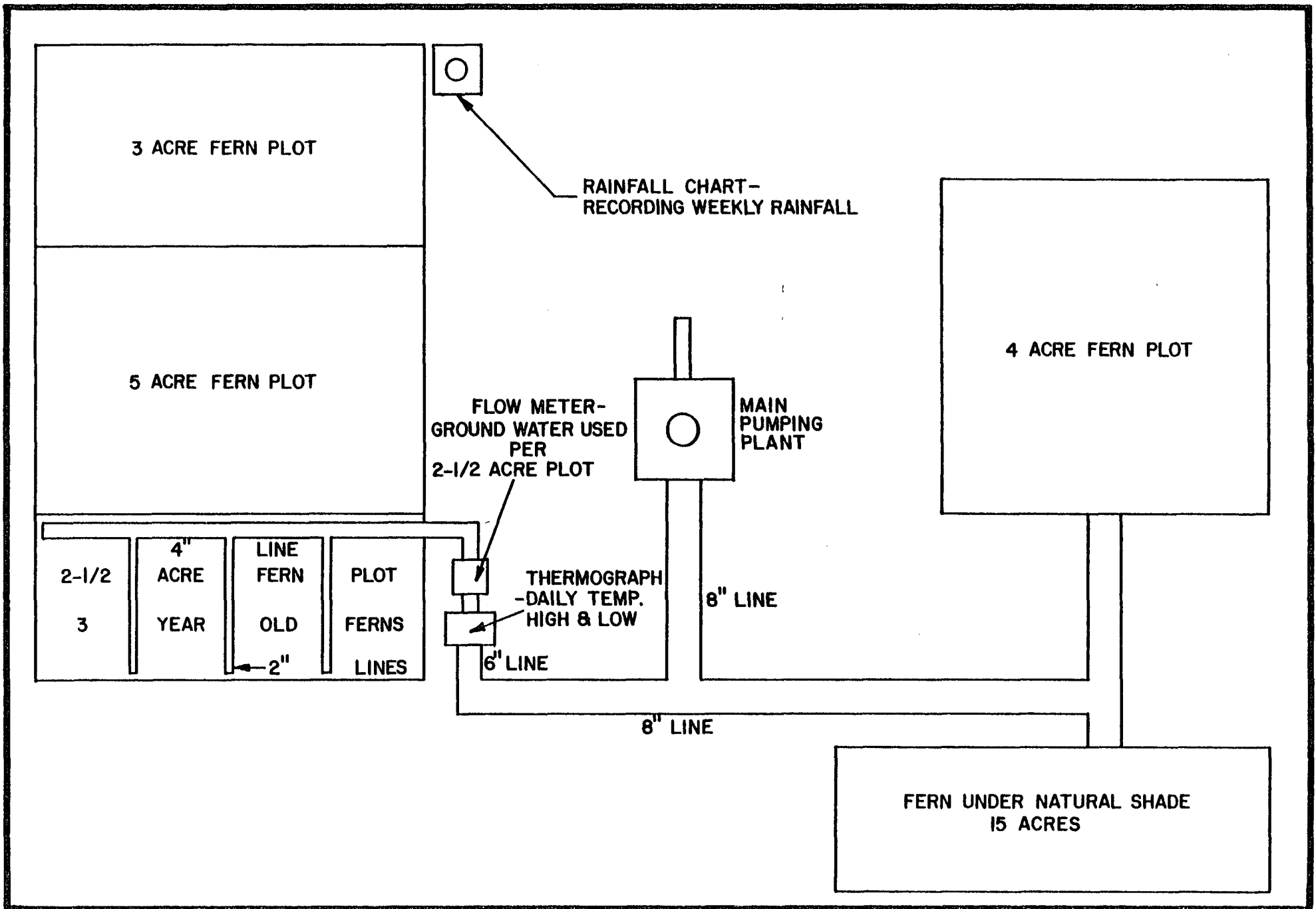


FIGURE 2 - Forest Groves, Inc., Study Site

spheric conditions, (temperature and rainfall) were monitored to determine correlations between pumping frequency. A recording thermograph was set up directly above the flowmeter, and a rainfall recorder was placed in an open area opposite the west end of the fernery.

Figure 3 shows the relationships between ground water pumped, and weekly rainfall and temperature. The relationship between pumpage and temperature is best shown during periods of freeze control. The majority of pumping occurred during the winter months of December 1979, January, February and the first two weeks of March 1980. Rainfall during this period was abnormally high due to seasonal cold fronts, which also account for significant changes in temperature (Figure 3).

In protecting the 2 1/2 acres of ferns during a freeze, water is pumped from an 8 inch Floridan aquifer irrigation well, producing 1500 gpm. Cold fronts preceded freezes on January 7-8, February 1-5 and March 2-4, 1980 with maximum pumpage of 340,360, 334,997 and 739,350 gallons respectively. During the March freeze in excess of 20 hours of pumping occurred. Weekly pumping, rainfall and average temperatures are shown in Table 1.

Results of atmospheric measurements show that rainfall for the year totaled 48.36 inches. This amount is 8 inches below the 10 year average compiled by the National Weather Service (N.W.S.) of 56.86 inches. Temperatures during spring and summer months of the study period, averaged 79.36 degrees which is approximately 5 degrees above the mean temperature of 74.50 degrees recorded for spring and summer months. From April to November, ground water pumpage for normal irrigation and fertigation of fern averages approximately 30,000 gallons per week on the 2 1/2 acre plot. Peaks in the pumping, occurring during this time are due to abnormally high temperatures or lack of

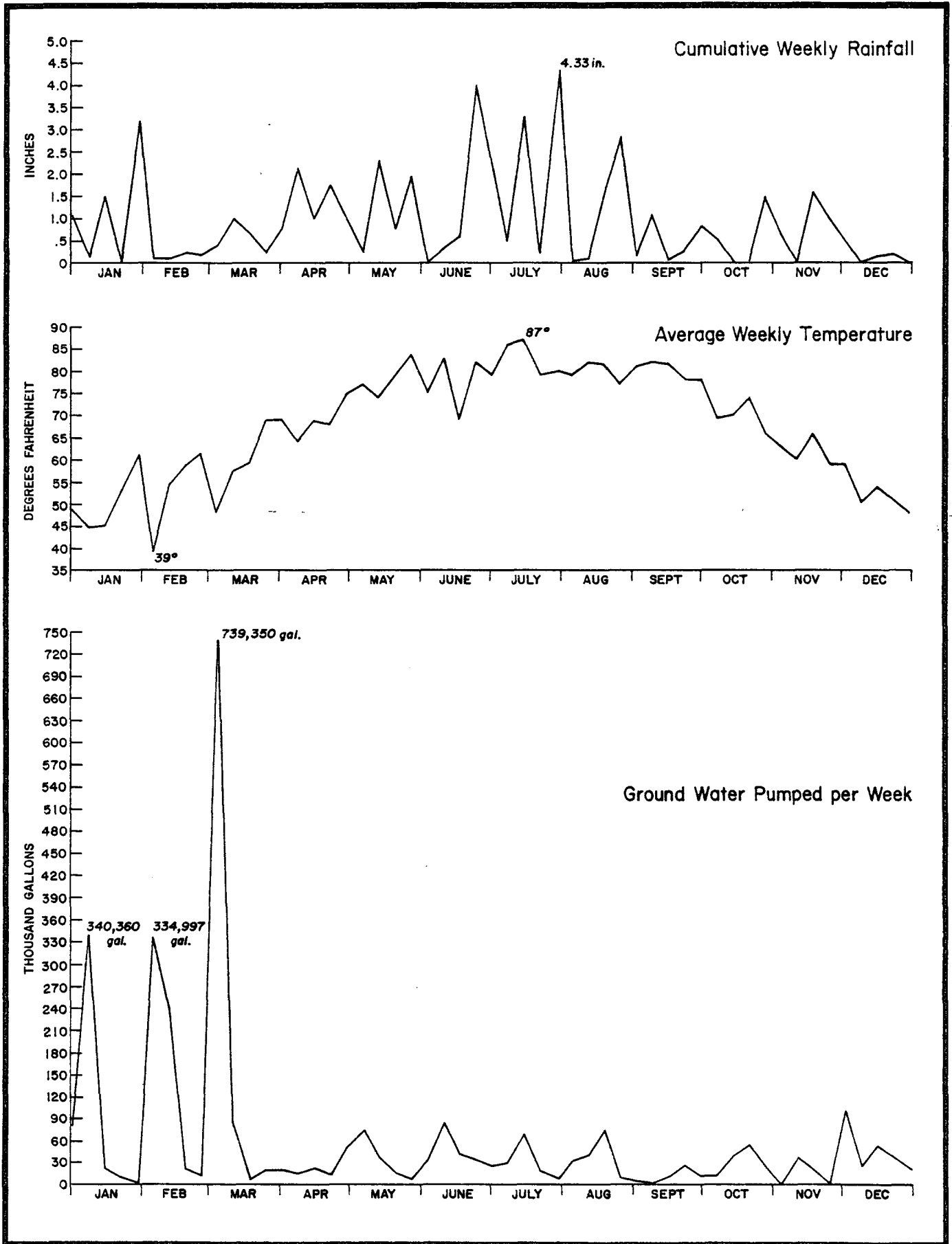


FIGURE 3 - Graphs Showing Weekly Rainfall, Temperature and Ground Water Pumped

TABLE 1 - FERN WATER USE STUDY

WEEK ENDING DATES/PER 7 DAYS	AVG. WEEKLY TEMP.	WEEKLY RAINFALL	GALLON PUMPED PER WEEK
12/25/79	48 ^o	0"	23,000 gal
01/01/80	52 ^o	.105"	87,000 gal
01/08/80	44 ^o	.15"	340,360 gal Short Freeze 1/3/80 6 hours
01/15/80	45 ^o	1.50"	18,790 gal
01/22/80	53 ^o	0"	12,273 gal
01/29/80	61 ^o	3.17"	0 gal
02/05/80	39 ^o	.07"	334,997 gal
02/12/80	52 ^o	.08"	230,530 gal
02/19/80	57 ^o	.24"	26,990 gal
02/26/80	62 ^o	.19"	17,610 gal
03/04/80	48 ^o	.40"	739,350 gal 3/2-3/4 pumped 32 hours
03/11/80	58 ^o	1.0"	77,715 gal
03/18/80	62 ^o	.65"	4,885 gal
03/25/80	69 ^o	.23"	21,410 gal
04/01/80	68 ^o	.77"	22,520 gal
04/08/80	64 ^o	2.12"	16,160 gal
04/15/80	68 ^o	1.0"	23,752 gal
04/22/80	67 ^o	1.75"	14,243 gal
04/29/80	75 ^o	1.0"	54,935 gal
05/06/80	77 ^o	.23"	74,439 gal
05/13/80	74 ^o	2.28"	33,610 gal
05/20/80	79 ^o	.80"	15,078 gal
05/27/80	84 ^o	1.94"	7,122 gal
06/03/80	75 ^o	0"	16,795 gal
06/10/80	83 ^o	.34"	80,805 gal
06/17/80	68 ^o	.60"	43,490 gal
06/24/80	82 ^o	3.99"	36,619 gal
07/01/80	79 ^o	2.13"	14,821 gal
07/08/80	86 ^o	.50"	15,670 gal
07/15/80	87 ^o	3.27"	72,240 gal
07/22/80	79 ^o	.19"	21,785 gal
07/29/80	80 ^o	4.33"	7,820 gal
08/05/80	79 ^o	.04"	15,306 gal
08/12/80	83 ^o	.07"	39,960 gal
08/19/80	79 ^o	1.5"	75,200 gal
08/26/80	77 ^o	2.84"	7,960 gal
09/02/80	81 ^o	.14"	4,460 gal
09/09/80	82 ^o	1.10"	1,690 gal
09/16/80	79 ^o	.05"	12,750 gal
09/23/80	78 ^o	.25"	14,160 gal
09/30/80	78 ^o	.81"	11,000 gal
10/07/80	69 ^o	.50"	11,120 gal
10/14/80	70 ^o	0"	40,040 gal
10/21/80	74 ^o	0"	28,770 gal
10/28/80	66 ^o	1.48"	23,550 gal
11/04/80	63 ^o	.64"	0 gal
11/11/80	60 ^o	0"	23,550 gal
11/18/80	66 ^o	2.09"	17,240 gal
11/25/80	58 ^o	.97"	0 gal
12/02/80	58 ^o	.50"	113,540 gal
12/09/80	50 ^o	0"	25,270 gal
12/16/80	54 ^o	.15"	53,570 gal
12/23/80	51 ^o	.20"	40,370 gal

rainfall during the study period, these figures are moderate in relation to freeze control pumpage that would take place during normal winters. During normal to severe winters, pumpage for freeze protection could increase 10 to 20 percent.

Results and Application

Over the one year period of the study, 3,066,050 gallons were pumped over the 2 1/2 acre fern plot for irrigation, fertigation and freeze protection. This is equivalent to 1.23 million gallons per acre. Freeze protection accounted for 60% (.73 MG/ac) of the total pumpage recorded. The remaining 40% (.49 MG) was used for irrigation, fertigation and distribution of herbicides and pesticides (Figure 4).

Data collected from the study plot was used to determine an average application rate of 14 gpm per acre. Over the one year study period, 2.34 gpm per acre reflects the amount of water that would be pumped each minute of each day if irrigation occurred every day of the year, although this does not occur in practice.

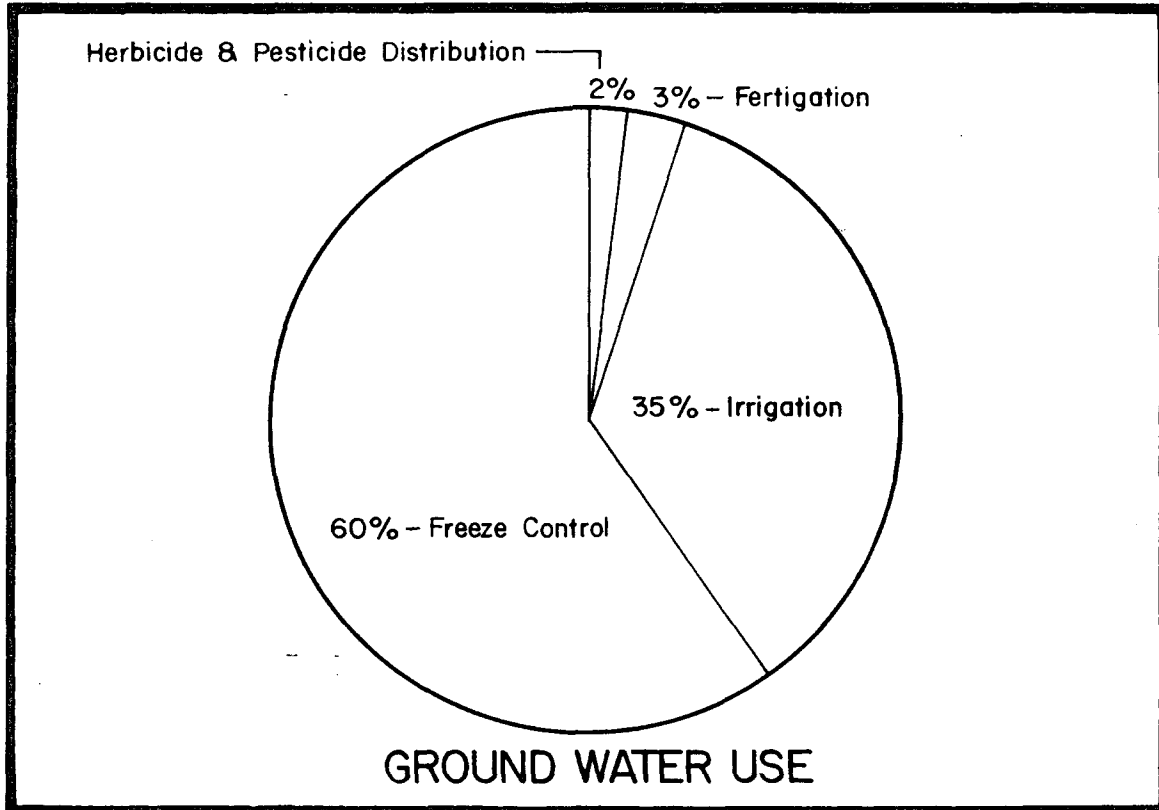


Figure 4 - Percentage of ground water pumped for freeze protection, irrigation, fertigation and distribution of herbicides and pesticides

There are approximately 3,820 acres of ferns in production within the District and concentrated in four counties (Figure 5). The fern production belt includes 600 acres of ferns in Putnam County, 200 in Lake County, 20 in Seminole County and 3000 in Volusia County. Considering 3,820 irrigated acres utilizing 1.2 million gallons of water per acre per year, (based on data collected) approximately 4.58 billion gallons of ground water were withdrawn for fern production within the St. Johns River Water Management District. This figure represents a significant amount of ground water of which the majority is used for freeze protection.

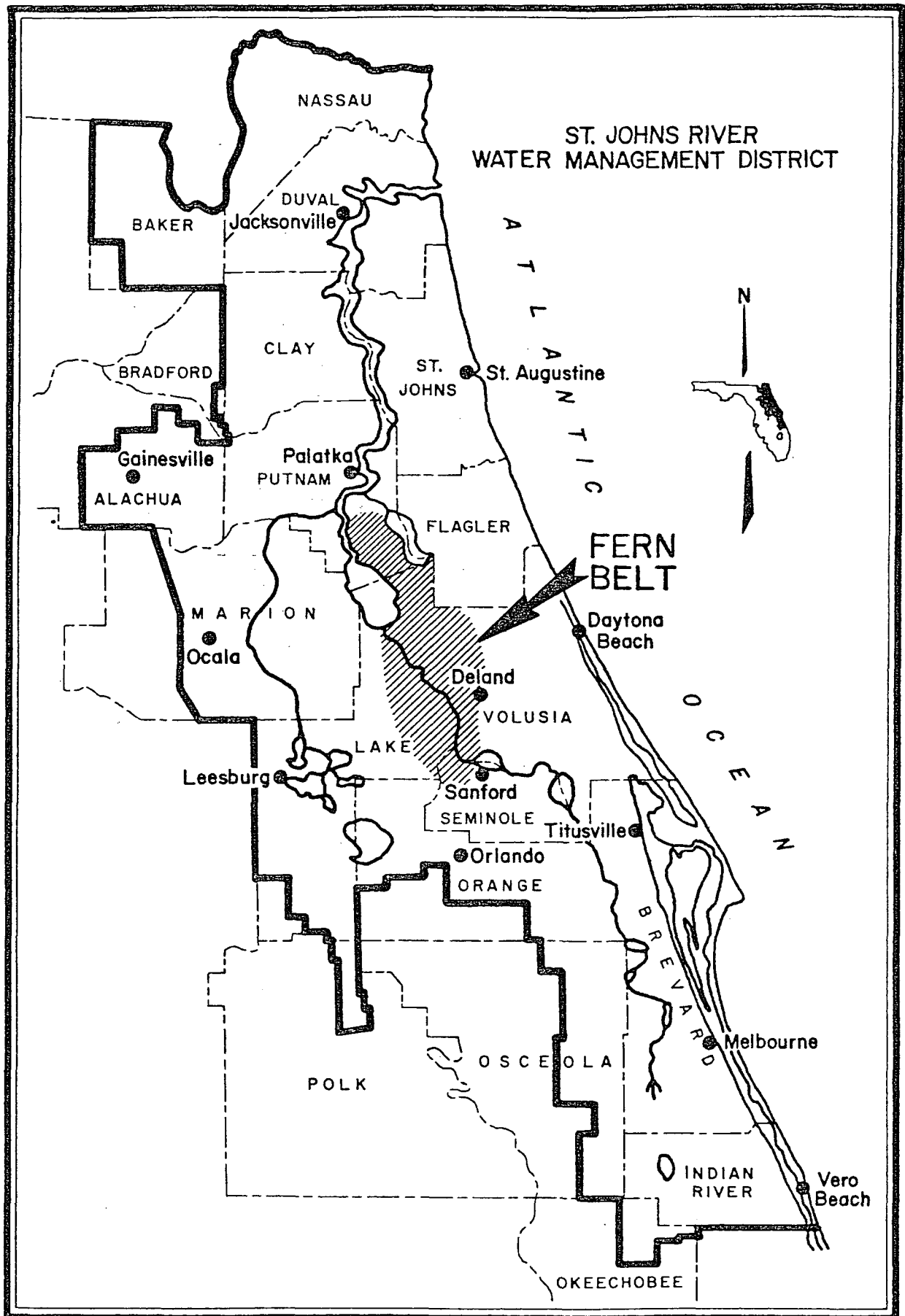


FIGURE 5 - Map showing location of fern growing areas in Putnam, Lake, Volusia, and Seminole Counties.

RECOMMENDATIONS

It is recommended that a continued program assisting fern growers, residents, contractors and local governments be followed. This program should include the following:

1. Remain aware and up-to-date on expansion and installation of new ferneries and irrigation systems through a District wide regulatory program.
2. Increase efforts of researching and applying new and improved methods of freeze protecting ferns by working with the Institute of Food and Agricultural Science (IFAS), University of Florida.
3. Establish better lines of communication with individual growers, informing them of the results of our studies.

REFERENCES

Ross, F. W., March 1980, Effects on the Floridan Aquifer of Ground Water Withdrawals for Fernery Freeze Protection, Southeast Putnam County, Florida; Technical Report No. 8, St. Johns River Water Management District.

Marella, R. and Leary P. L., The 1979 Annual Water Use Survey, July 1981, Technical Report No. 10, St. Johns River Water Management District.

Henley, R. W., Tgia, B., Loadholtz, L. L. Commercial Leatherleaf Fern Production in Florida; Bulletin 191; Florida Cooperative Extension Service, I.F.A.S. University of Florida Gainesville, Florida 32611

ACKNOWLEDGEMENTS

I would like to express my appreciation for the cooperation extended by the managers of Forest Groves, Inc., John and Robert Newbold.

This study was conducted with the viewpoint that investigation of ground water use and its relationship in agriculture production, will result in its reasonable and beneficial use. It is hoped that knowledge gained from this study will lead to a program of efficient and profitable use of water resources in the fern industry.