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Statistical Sample Survey Design for Estimation of Agricultural Water Use

by

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Abstract: This report defines and discusses the objectives of the agricultural water use survey proposed by the St. Johns River Water Management District. As part of this discussion the information content of the District water well permitting files is examined. Preliminary survey design parameters are presented along with suggestions for a final survey design.

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Introduction

The overall objective of this project is to evaluate the problem of obtaining objective estimates of agricultural water consumption in the St. Johns River Water Management District. The project examines the parameters which need to be collected to satisfy requirements for future management and resource inventory models along with the number of wells needed to obtain statistically valid estimates for chosen agricultural commodities.

In order to get a better idea of the consumption of groundwater by growers of agricultural crops, the St. Johns River Water Management District (hereafter referred to as SJRWMD) is planning to upgrade its Benchmark Farms Program. This report is provided as an aid in the design of a statistically valid sample survey study which will attempt to obtain objective measures of agricultural water consumption through the use of gauges on irrigation well heads. This information is needed to provide inputs necessary to the development of basin groundwater models for the District.

Because of the cost and effort involved in collecting agricultural water consumption statistics, it is important that the best estimates be obtained. In this report, information available from the permitting data base at the District as well as from the current Benchmark Farms Program data base is examined and used in the development of the sampling plan. Preliminary survey design parameters are presented along with suggestions for determining a final design.

Methods

This research is concerned primarily with identifying that information needed in order to get reliable and unbiased estimates of agricultural water use in the St. Johns River Water Management District. The outline for obtaining this information is that used by all researchers in the design of sample based research projects. This involves the following:

I. A formal statement of the objectives of the proposed agricultural water use study.
II. A definition of the population to be examined.
III. An outline of which parameters are to be estimated.
IV. A statement of the degree of precision desired of these parameter estimates.
V. An examination of the number of samples needed to have a high probability of obtaining the desired precision.
VI. A decision of how the data will be collected in order to generate the actual estimates.

Inherent in this outline is an evaluation of current sources of information which might be pertinent to this project as well as the determination of sample size estimates. To perform these tasks, information

from County Agricultural Extension Agents and the SJRWMD permitting database are used. In addition, the information on agricultural water use measured as part of the SJRWMD Benchmark Farms Program will be used to examine the sample size question. No other information sources were available or used in this report.

The results are organized by Task as listed above, followed by a discussion section and a recommendations section.

Results

TASK I: Statement of the objectives of the proposed water use survey.

1. To determine the amount of water used monthly (in acre inches) for the major irrigated crops and sub-categories of these crops.
2. To determine the amount of ground water used for freeze protection for certain specific crops.
3. To determine total ground water and surface water consumed for agriculture in the District.

TASK II: Definition of population to be examined.

The survey or target population consists of the major agricultural crops irrigated within the District and sub-categories of these crops as listed below:

1. Citrus
   - 1a Flatwood soils
   - 1b Ridge soils
2. Potatoes
   - 2a Potatoes used for table stock
   - 2b Potatoes used in processing
3. Cabbage
   - 3a Cabbage grown in the fall (Sept.-Dec.)
   - 3b Cabbage grown in the winter (Jan.-Apr.)
4. Fern
   - 4a Leather-leaf fern
   - 4b Tree fern
5. Nursery Stock
   - 5a Stock grown indoors in greenhouses (primarily flowers and foliage)
   - 5b Stock grown outdoors (primarily woody ornamentals)
6. Blueberries
7. Turf Grasses
   - 7a Turf grown on golf courses
   - 7b Turf grown for sod
8. Vegetables
9. Pasture
10. Other

The relative importance of these crops in the District is illustrated by the estimates of crop acreage given in Table I. These data were compiled through discussion with individual county extension agents and land use planners.

NOTE: A second measure of the importance of these crops to the District is the number of consumptive use well permits taken out for these crops. An analysis of the permitting files was performed in an attempt to determine this quantity. The desired information is found in the 'project descriptions' field in the permitting files. Because of the free form entry allowed in this field, little consistency in coding of projects was found. In Appendix I is presented a list of all project description codes found in the file. Many wells are permitted for a combination of crops and in some cases acreage targeted for irrigation was also provided, although this information has been deleted in the list in Appendix I. This combination coding makes it practically impossible to provide the good assignment of crops-to-wells needed to assess crop representation in the District. Multiple passes through the files resulted in each well being assigned to one or more crops and is the basis of the data in Table II. Other assignment rules are possible and may be utilized in future analysis.

In addition to the crops described in Table I, the type of irrigation system used in conjunction with these operations is also of prime consideration. The following irrigation systems are of interest:

1. Low volume systems
   - Micro jet systems
   - Drip systems
2. Overhead systems
   - Sprinkler systems
   - Gun systems
3. Flood systems
4. Seepage systems
5. Other systems
6. No system

Not all systems are used with all crops. Some limited information on irrigation systems was also available from discussion with county personnel. Estimates of acreage irrigated by commodity and crop are given in Table II.

NOTE: The quality and quantity of information on irrigation methods in the permitting database was also examined. In Appendix II is listed the actual descriptions of irrigation systems as presented on the permitting files. As with the project descriptions, the free form entry of irrigation method makes it practically impossible to utilize this information for analysis purposes.

TASK III: Outline of the parameters to be estimated.

The primary parameter of interest is total water use for agriculture in the District as a whole, as well as breakdown statistics for major crops and irrigation systems. This parameter can be measured directly by use of pump gauges or indirectly via statistical or engineering models. The direct method, for which this report is being directed, is much more expensive than the use of models, but is a necessary first step to the development of useful models.

Table I. Crop acreage by category, 1986, from County Extension Office estimates.

Crop	Acreage	Percent of Total
Improved Pasture	116000	30.65
Agricultural Crops	262443	69.35
TOTAL	378445	100.00
Breakdown of Agricultural Crops		
Citrus	115724	44.10
Potatoes	24820	9.46
Miscellaneous Vegetables	20667	7.87
Carrots	20200	7.70
Sweet Corn	20090	7.66
Field Corn	13431	5.12
Turf Grass (golf courses)	10025	3.82
Cabbage	8330	3.17
Fern	6762	2.58
Sod (lawn grasses)	4295	1.64
Watermelons	4250	1.62
Cucumbers	3945	1.50
Sorghum	2300	0.88
Woody Ornamental (outside)	2298	0.88
Flowers and Foliage (outside)	1804	0.69
Wheat	1000	0.38
Blueberries	578	0.22
Peppers	400	0.15
Pecans	390	0.15
Watercress	210	0.08
Soybeans	200	0.08
Miscellaneous Grains	150	0.06
Tomatoes	107	0.04
Peanuts	100	0.04
Peaches	95	0.04
Miscellaneous Fruit	90	0.03
Tobacco	80	0.03
Grapes	52	0.02
Strawberries	50	0.02
TOTAL	262443	100.00

Table II. Number of Permits by Crop and Irrigation Method, 1985-86, from St. Johns River Water Management District Permitting Files.

Irrigation Method	Crop: Citrus	Crop: Potatoes	Crop: Fern
Low volume			
Jet	294 (20.93%)	0 (0.00%)	11 (1.70%)
Drip	106 (7.54%)	0 (0.00%)	2 (0.32%)
Overhead			
Sprinkler	499 (31.96%)	0 (0.00%)	629 (97.37%)
Gun	204 (14.52%)	0 (0.00%)	0 (0.00%)
Flood	296 (21.07%)	169 (100.0%)	1 (0.15%)
Other	55 (3.91%)	0 (0.00%)	3 (0.46%)
None	1 (0.07%)	0 (0.00%)	0 (0.00%)
Total	1405 (100.0%)	169 (100.0%)	646 (100.0%)

The additional parameters which could be used in estimating water use depend on the agricultural commodity. The basic parameters which would need to be measured for all crops are:

Water pumped by month by irrigation method.
Local area rainfall
Local area temperature
Solar radiation
Number of acres irrigated
A qualitative measure of managerial skill of grower
Soil characteristics (soil survey information)

Those variables which are specific to crop are:

1. Citrus
   - Varieties grown
   - Crop physiological stage
   - Soil Type: Ridge vs. Flatwood
2. Potatoes
   - Length of irrigation season
   - Growth period (Late vs. Early plantings)
   - Crop physiological stage
3. Cabbage
   - Length of irrigation season
   - Growth period (Fall vs. Winter)

4. Fern
   - Water pumped for freeze protection
   - Shade clothe grown or oak hammock
5. Nursery Stock
   - Water pumped for freeze protection
   - Soil or potting medium used
6. Blueberries
   - Crop physiological stage
   - Soil water holding capacity
7. Turf Grasses
   - Soil water holding capacity
   - Acres irrigated
   - Fairways to greens ratio
8. Vegetables
   - Varieties grown
   - Length of irrigation season
9. Pasture
   - Type of forage
   - Animal density
10. Other
   - Specific to activity

These water use parameters will need to be collected using personal interviews at the beginning and/or end of each growing season. These parameters represent factors which have been identified as important in properly modeling water use behavior for agricultural crops.

NOTE: Solar radiation is directly related to the physiological water needs of the crop and could be used to determine the relative efficiency of irrigation. It is especially important in low rainfall periods since it measures the rate at which soil moisture for crop growth is depleted. Unfortunately, this parameter is relatively expensive and difficult to measure accurately.

TASK IV: Definition of the degree of precision desired for the estimates.

It is assumed that only a sample of the total agricultural community will be examined/measured to obtain objective measures of agricultural water use. For this reason, the final estimates of water use will be subject to uncertainty. The level of uncertainty is directly related to the proportion of total wells measured as well as the inherent variability in water use from well-to-well and month-to-month, in addition to the variability in flow measuring devices.

There are two ways in which the degree of precision desired in a survey can be specified. An absolute specification is a statement indicating the total deviation from true use which will be allowed. Such a specification would be stated as "the final estimate of total water use will be within plus or minus x units (acre inches) of the true water use with, say, 95% confidence". The absolute specification holds regardless of the underlying level of water use.

The alternative approach is to specify degree of precision as a fraction of the total water use. Such a specification would be stated as "the final

estimate of total water use will be within plus or minus z% of the true water use with, say, 95% confidence". Thus the width of the confidence interval will change as the total (monthly) water use changes. Usual values for z are 5%, 10%, 20%, 30% or 50%, depending on the relative variability in water use.

In the absence of definitive information on true water use, the relative specification is easier to work with when attempting to determine sample size. The sample size estimates are given in the next section for different values of z, using mean and variance estimates of water use from the current Benchmark Programs data.

TASK V. Number of samples needed to obtain the desired precision.

To obtain sample sizes needed to attain specified levels of precision for each crop study, the following procedure was used. Let

μ = average monthly water use in acre inches for a crop.
(This is obtained from the Benchmark Farms Program database)

σ = standard deviation of monthly water use in acre inches for a crop.
(This is obtained from the Benchmark Farms Program database)

z = the specified relative precision required by the final estimate.
(This is a percentage expressed as a proportion, our precision statement is "the estimated use is within z x 100% of the true use with, say αx100% confidence).

$t(N,\alpha)$ = the α x 100% deviate of a t-distribution with N degrees of freedom.
(Obtained from a table of deviates or a special computer program).

The sample size estimate is obtained as follows:

Let

$$N' = (t(N',\alpha) \times \sigma/(z \times \mu))^2$$

An initial value of N' is chosen, say 25, and the left hand expression is computed. From this a new value of N' is obtained as the integer part of this calculated value. The left hand expression is again computed and a new value of N' calculated. This process is continued until the new value of N' is no different than the old value. This usually takes from 3 to 7 iterations. The iteration must take place because the t-deviate changes with different values of N'.

Once the value of N' is obtained, the final sample size estimate only requires some knowledge of the total number of wells being used for the crop. Let

M = the total number of wells being used for the crop under study.

Then

N = the required sample size

= $N' / (1 + N'/M)$

This last equation assures us that the sample size estimate will be no larger than the full population number, and is usually referred to as the finite population correction term.

Estimated sample sizes for the three recommended study crops are given in Tables III, IV and V, using mean and standard deviation estimates provide by the current Benchmark Farms Program database. The data used in this analysis is given in Appendix III. Five levels of precision are provided in order to allow comparisons to be made as to required study sizes.

Table III. Sample size estimates for citrus, based on an estimated total of 1405 permits related to citrus production, and 1986-87 Benchmark Farms Program data.

Month	Acre-Inches		Relative Precision				
	Mean	Standard Deviation	50%	30%	20%	10%	5%
Jan	1.231	1.530	17	46	98	416	882
Feb	0.256	0.444	33	86	239	633	1077
Mar	0.745	0.931	17	46	99	419	886
Apr	1.175	1.200	12	32	68	311	748
May	1.141	1.194	12	33	71	323	765
Jun	0.744	0.855	15	39	85	372	829
Jul	1.262	2.980	59	203	387	848	1207
Aug	0.560	0.815	23	62	177	514	981
Sep	0.558	0.693	17	46	98	416	882
Oct	1.168	1.370	15	41	88	383	844
Nov	0.370	0.720	40	106	289	715	1132
Dec	0.263	0.531	43	154	305	739	1147

Table IV. Sample size estimates for ferns, based on a total of 647 permits related to fern production, and 1986-87 Benchmark Farms Program data.

Month	Acre-Inches Mean	Standard Deviation	Relative Precision 50%	30%	20%	10%	5%
Jan	9.317	4.643	3	8	17	62	239
Feb	5.715	3.555	4	12	26	91	309
Mar	3.777	2.570	5	14	31	138	338
Apr	4.733	2.625	4	10	21	75	272
May	4.671	2.834	4	11	24	87	301
Jun	3.473	2.302	5	13	29	133	329
Jul	3.739	3.405	9	24	52	213	428
Aug	2.623	2.278	8	23	48	199	414
Sep	3.488	3.180	9	24	53	213	428
Oct	4.042	2.701	5	14	30	135	332
Nov	4.886	3.740	7	18	38	166	376
Dec	4.141	3.366	7	20	42	181	394

Table V. Sample size estimates for Potatoes, based on a total of 169 permits related to potato production, and 1986-87 Benchmark Farms Program data.

Month	Acre-Inches Mean	Standard Deviation	Relative Precision* 50%	30%	20%	10%	5%
Jan	0.065	0.309					
Feb	0.254	0.526	36	87	119	153	164
Mar	1.719	1.495	8	21	40	106	147
Apr	7.544	3.732	2	8	16	48	116
May	3.080	3.392	12	31	55	123	154
Jun	0.000	0.000					
Jul	0.000	0.000					
Aug	0.000	0.000					
Sep	0.000	0.000					
Oct	0.000	0.000					
Nov	0.000	0.000					
Dec	0.104	0.556					

* Lack of a sample size estimate indicates that either there was no crop activity during these months or the standard deviation is much greater than the mean.

TASK VI: Method of measurement.

Water use from selected wells will be measured using flow measuring devices. Because flow measuring devices are not entirely dependable, a combination of two such devices will be used on each sample well. The combination will consist of an in-line Ultra-sonic flowmeter (rate of flow

meter) along with a timing meter (electric hour meter or inductive time totalizer). This combination should provide a very accurate picture of the water pumped from the sample well.

Local rainfall and temperature will be measured with standard devices, a rain gauge of the tipping bucket type and a air temperature probe. Due to costs, it may not be feasible to provide a meteorological station at each sample well, although this is highly recommended. If the study is restricted to a specific crop/geographical locality, representative sites for meteorological stations should be chosen to provide uniform spatial area coverage.

Many of the crop specific factors will be collected through a combination of questionnaires and monitoring. The questionnaires will be useful in establishing varieties, number of acres, estimated and actual yield, soil parameters and freeze protection pumping strategies. Crop physiological stage will be monitored on a monthly basis by visual evaluation at the time measurements are taken of well flow.

Managerial skill is a difficult parameter to measure but one very critical to the effective measurement of water use. This set of parameters quantify a grower's strategies of water management for crop growth, as well as relate such strategies to established optimal management strategies. Additional research will be needed to determine how best to perform this assessment.

Discussion

Sample size

As one can see from Tables III, IV and V, the higher the precision required of our estimates, the larger the sample size needed. Thus, for example, if it is decided that a 20% relative precision is needed for Citrus, then from Table III we find that a maximum of 387 sites would be needed. This many are needed to satisfy the high amount of variability in water use on Citrus in the month of July, which also happens to be a high water use (1.262 acre inches per well on average) month. This degree of precision would allow us to estimate the true average water use in acre-inches to within plus or minus 20% of the true value with a 95% confidence probability for each month.

The above discussion does not take into account the fact that high precision in our water use estimates may be needed only for certain critical months. Thus, for example, if April were the critical month for water management in the Citrus area, then only 68 wells would be needed to estimate water use to within plus or minus 20% with 95% confidence. Other strategies for use of these tables must take into account the very specific goals and needs for water management for specific crops. In all cases, a compromise will occur in number of sample sizes, in that the minimum number will be inadequate for most months and the maximum number will be to costly in materials and manpower.

The tables provide the basic information needed to design the initial study. Relative precision is only one aspect of the sample size question. Other concerns, such as cost per well in the sample, manpower, grower cooperation and time also must be figured into the equation in order to come to

a final sample size. These other factors are not statistical in nature and must be provided by the staff of the St. Johns River Water Management District. The recommendation as to final sample size made in this report does not directly take these factors into account.

Sample Frame and the SJRWMD Permitting Database

Once a sample size for number of wells is determined, there still remains the problem of selecting individual wells for participation into the study. What is required for a data base to be a good sample frame is:

1. A means of identifying each well in the District which has a permit.
2. Information as to the owner, size, and location of each well.
3. Information as to the actual or projected agricultural uses for that well, including acreage estimates.

It was hoped that the SJRWMD permitting database would provide the sampling frame from which individual wells could be selected using some random mechanism. A review the characteristics of the copy of the permitting files which was made available to the principle investigator of this study indicated some major problems with the organization of the database, specifically relating to its use as a sample frame. Some of its problems are:

1. A permit record in the database may refer to one or more wells, hence it is difficult to identify each permitted well in the District.
2. Agricultural crops irrigated by these wells are not clearly identified, or identified in a free-formatted field which makes getting counts of wells by crop type very difficult.
3. Irrigation methods are coded in a free-formatted field with no consistency of names for system types, making it impossible to get counts of wells by irrigation type.
4. Other information, such as well size, efficiency, and capacity are entered without error checks and hence there are a number of 'impossible' values in the dataset.

Some decision would have to be made as to how to handle wells which are used for multiple crops. This is especially a problem with field crops which are usually rotated in the same field but at different times of the year. Once these decisions were made and the files properly organized, a random list of prospective participants could be chosen, and hopefully, with proper encouragement, these growers would allow the necessary information to be gathered.

Alternative sampling frames

An alternative sampling frame to the permitting file would be to approach the different crop grower associations and solicit participants from the membership. Samples drawn with such a method would have to examined very carefully for bias. Growers belonging to associations may be better informed in the management of their crops and use better irrigation practices than the 'average' grower. Some attempt would need to be made to entice non-association growers to participate in addition to members from the association list. By

analyzing the selected group against the permit file list, some indication of the possible bias might be available.

Estimation of total water usage

The information on monthly acre-inches of water used collected from each study participant would be used to compute an average monthly acre-inches of water use for the crop, call this value r. Some estimate of total acreage in the crop for the season would be needed in order to come up with a total water use for the crop. The total water used in a month by a crop would be estimated as:

$$T = r \times A$$

where A is the total acreage in the crop.

Total acreage estimates are very important to getting a good estimate of total water use. It is important that this acreage number is as accurate as possible for each crop for which estimates are needed. Total acreage estimates can be obtained from a number of sources, including the USDA Crop Reporting Service survey estimates, satellite images, and/or county extension agent tallies. In times of crop stress, such as drought situations, it would be necessary to update crop acreage on a monthly basis in order to get the best estimate of water use.

The SJRWMD permitting database is another source of information on acres of irrigated crops. Currently this information is not organized to be used for the estimation of irrigated acres but there seem to be the capability to collect this information. Since permits are issued for greater than one growing season, the information on crops and irrigation on the permit becomes less accurate as time goes on. It is quite possible to envision a permitting scheme which requires the periodic updating of these crops and irrigation data in order to keep the database relatively current. This will become much more important as the District attempts to manage groundwater for agricultural uses.

Totals for the year for a crop would be determined by summing over the months. Overall totals would be obtained by summing over the crop estimates. The precision of these estimates would be obtained by calculation of the appropriate standard error of the estimate.

Empirical modeling

The justification for obtaining information on water use parameters (rainfall, temperature, solar radiation, acres irrigated, soil characteristics, managerial skill of the grower, and crop specific variables) is to eventually develop models which can predict, at least in the short run, the water use over a season for a crop and the whole agricultural community. With three to five years of monthly data on a couple of hundred wells, such empirical models will be feasible. Statistical procedures, such as linear and/or non-linear regression, can then be used to quantify the relationships between these water use parameters and actual water used.

These empirical models can be used in conjunction with groundwater flow

models, surface water management models, and recharge models to examine the impact of agriculture on groundwater inventories for the current year. In addition, these models can be used in a research mode to explore the impact of changes in climate or agricultural practices on groundwater. The combination of these models will provide the necessary tools to perform informed water management on a timely basis.

Recommendations

The probability of success in an undertaking of this type is dependent on appropriately matching the scope of the study to the resources available to perform the study. The St. John's Water Management District, through the Benchmark Farms Program, has attempted to assess agricultural water use. While useful in providing the preliminary information necessary to designing a more quantitative survey, the Benchmark Farms Program lacks the depth needed to properly access agricultural water use. Because depth of study requires much more time and effort, and because the full benefits of this work are not apparent at this time, it is recommended that the scope of the proposed new study be initially restricted to the following crops.

Citrus

Because of its importance as an agricultural commodity to the Florida economy, and as a major user of ground water, it is critical that citrus be chosen as a primary commodity of interest. The citrus industry has a history of cooperation in studies of this type which increases the probability of successful data collection. Table III can be used to determine the number of wells used in citrus which should receive recording meters. At least 200 wells should be used if any accurate estimate of water use is to be computed.

The distribution of the 200+ monitoring sites for citrus needs to take into account the special crop characteristics of varieties grown and soil types. Since water needs of ridge grown citrus are different from flatwood grown citrus, both types should be represented in the sample. The optimal allocation of samples to each type would require knowing the expected water use and associated variability of use for the different soils and varieties. Instead, initial allocation will be proportional to acreage of varieties and soil type with reallocation of samples over time as knowledge of water use in these different categories increases.

Ferns

The fern industry is a logical second choice for study crop. Both irrigation and cold protection on ferns, as well as the number of permits issued for fern production place it as the second largest user of agricultural water. This agricultural product is less dominated by large producers, which will require many more individual producers to be involved in the study. From Table IV it can be seen that between 75 and 100 wells need to be measured if a good estimate of water use in the fern industry is to be available. Note that with this number of wells, a good estimate of water used for cold protection should be available.

The allocation of sample wells for determining water use by the fern industry must take into account the fact that ferns grown in oak hammocks require less water for freeze protection than do ferns grown under shade clothe. This is primarily due to the heat holding characteristic of the surrounding tree canopy. The allocation of sample sites should reflect differences in variability of water use between the two nursery types. Without information on this variability, the initial allocation should be proportional to number of wells used by each nursery type, with reallocation of sample wells as our knowledge of different water use in the different systems increases.

Potatoes

Potatoes, because of its concentration to a relatively small geographic region with a limited number of growers, and short, well defined growing season, is representative of many traditional agronomic crops in North Florida. Since many of the same growers who produce potatoes also grow vegetables in the summer, and cabbage in the winter, three commodity groups could be represented by one group of growers. From Table V it is determined that a large fraction of the total wells permitted for potatoes will need to be measured if an accurate estimate of water use is desired. An acceptable compromise number of wells would be 55, representing roughly one third of the projected number of wells permitted to potatoes.

It needs to be pointed out here that a large proportion of the variability in water use from permit-to-permit for potatoes may be due to the large variation in planting dates observed in the industry. For example, in the month of February, a large proportion of the potato crop is not irrigated. The average water used in this month is small, but actually represents little or no water use for most of the wells, with high water use for some early plantings. This leads to a very high variability estimate in average water use. With some information on the proportion of acreage planted by month, it is possible to stratify the potato acreage and associated wells, obtain estimates of water use in each planting cohort (early, middle and late plantings) and combine these to produce a more precise estimate of total water use. Such stratification has the potential of reducing overall variability and thus overall sample sizes. Again, more information would be needed than is currently available from the Benchmark Farms Program.

Other crops

It is difficult to choose among the other crops as to which should also be included in the initial phases of this study. Improved pasture certainly seems to cover a large proportion of the land used for agriculture in the District, but very little of this land is irrigated with any regularity. This irregularity translates to high variability in water use which in turn translates to the need to include in the study a large fraction of the wells used to irrigate pasture. Other seasonal crops, such as watermelons, corn, miscellaneous vegetables, etc. have high variability in water use and hence would require large sample sizes to get accurate estimates.

At this point in the study, it seems best to begin with the three major crops discussed above, and leave the other crops to a later date. As the

ability of the District to perform these measurement studies grows, these other crops can be examined using smaller, targeted, studies of limited duration. These studies would be needed to determine the changes which would have to be made to the empirical models in order to get a prediction of water use for this crop.

Other factors necessary to a successful program

The next step in this program has to be the development of a sampling frame. This almost certainly requires that the permitting database be reexamined by District staff for its usefulness as a sampling frame. It may be necessary to completely restructure the permit to obtain information needed to make the overall estimates and hence to restructure the permit database. If such a restructuring is not feasible, the alternative sample frame approaches should be implemented.

If the permit database is to be restructured, it should address and incorporate as many of the concepts of geographical information systems (usually referred to as GIS) as possible. All of the work discussed here has a very strong geographical component. The wells are geographical points, and the agricultural fields and farms are geographical areas. Both of these entities can best be represented on the computer as a geographically organized database. Such an organization of the data would facilitate the inclusion of soils and climate information into the empirical models which will be built. Such a GIS based sampling frame would also allow the creation of a spatially representative sample of wells which would result in better water use estimates. The Soil Conservation Service has already identified agricultural well locations in some counties. The District could benefit from this work and incorporate it into their plans if the GIS approach were implemented.

Closing

This report has outlined the changes which need to be made to the Benchmark Farms Program in order to obtain statistically valid information, and data needed to determine water use models for agriculture. These changes represent a large increase in the current level of activity on measuring agricultural water use. These changes also reflect the information needed if the District is to be able to perform informed water management in the future.

Appendix I

Project Descriptions in Permitting Database

1 AGRICULTURAL
2 AGRICULTURAL LIVESTOCK
3 ALFALFA CORN
4 APPLES PEACHES CITRUS PASTURE ROTATED WITH VEG
5 AQUACULTURE PASTURE
6 BAHIAGRASS
7 BEEF CATTLE PASTURE
8 BLUEBERRIES FERN FRUIT NURSERY MIXED VEGETABLES
9 BROCCOLI CABBAGE CUCUMBERS
10 BROCCOLI CORN
11 CABBAGE
12 CABBAGE CORN
13 CABBAGE CORN MIXED VEGETABLES POTATOES
14 CABBAGE CORN POTATOES
15 CABBAGE CUCUMBER
16 CABBAGE FLOWERS
17 CABBAGE MIXED VEGETABLES POTATOES
18 CABBAGE PASTURE SOD
19 CABBAGE POTATOES
20 CABBAGE POTATOES VEGETABLES
21 CABBAGE WATERMELONS
22 CANTALOUPES WATERMELONS
23 CELERY CITRUS
24 CITRUS
25 CITRUS CORN MIXED VEGETABLES
26 CITRUS CORN POTATOES
27 CITRUS COTTON VEGETABLES
28 CITRUS FERN
29 CITRUS FERN MIXED VEGETABLES
30 CITRUS FERN PASTURE
31 CITRUS FERN PASTURE VEGETABLES
32 CITRUS FERN TURF GRASS
33 CITRUS FERN VEGETABLES
34 CITRUS FOLIAGE
35 CITRUS FOLIAGE LANDSCAPE
36 CITRUS FOLIAGE NURSERY
37 CITRUS GARDEN LIVESTOCK
38 CITRUS GOLF COURSE
39 CITRUS GRASS ROW CROPS
40 CITRUS HAY
41 CITRUS HERBS PASTURE VEGETABLES WATERCRESS
42 CITRUS HORTICULTURAL
43 CITRUS LIVESTOCK
44 CITRUS LIVESTOCK PASTURE

45 CITRUS NURSERY
46 CITRUS NURSERY STOCK
47 CITRUS NURSERY PASTURE
48 CITRUS NURSERY VEGETABLES
49 CITRUS ORNAMENTAL
50 CITRUS PASTURE
51 CITRUS PASTURE ALTER. W/RYE MILLET WATERMELONS
52 CITRUS PASTURE VEGETABLES
53 CITRUS PASTURE WATERMELONS
54 CITRUS PERSIMMONS
55 CITRUS PROCESSING PLANT
56 CITRUS PUBLIC SUPPLY
57 CITRUS SAND MINING
58 CITRUS TURF GRASS
59 CITRUS VARIOUS AGRONOMIC HORTICULTURAL CROPS
60 CITRUS VEGETABLES
61 CITRUS WATERMELONS
62 CORN FERN HAY PASTURE
63 CORN HAY LIVESTOCK SORGHUM
64 CORN LIVESTOCK SORGHUM TURF
65 CORN MIXED VEGETABLES
66 CORN MIXED VEGETABLES POTATOES
67 CORN PASTURE
68 CORN PASTURE SOYBEANS WATERMELONS
69 CORN PEANUTS
70 CORN PEANUTS VEGETABLES
71 CORN POTATOES
72 CORN POTATOES ROTATED
73 CORN POTATOES VEGETABLES
74 CORN RYE SORGHUM RYE MILLET PASTURE
75 CORN SORGHUM
76 CORN SORGHUM LIVESTOCK PASTURE
77 FERN
78 FERN FIELD GROWN FLOWERS
79 FERN FLOWERS FOLIAGE
80 FERN FLOWERS ORNAMENTAL WOODY ORNAMENTAL
81 FERN FOLIAGE
82 FERN GREENHOUSE FOLIAGE
83 FERN MIXED VEGETABLES
84 FERN NURSERY
85 FERN ORNAMENTAL
86 FERN PACKING HOUSE
87 FERN PASTURE
88 FERN PEACHES
89 FERN ROW CROPS
90 FERN RYE
91 FERN TURF GRASS
92 FERN WATERMELONS LIVESTOCK
93 FERN WOODY ORNAMENTAL

94 FERN WOODY ORNAMENTAL FOLIAGE NURSERY
95 FOLIAGE
96 FOLIAGE GREENHOUSE LIVESTOCK
97 FOLIAGE NURSERY
98 FORAGE PASTURE
99 GOLF COURSE
100 GOLF COURSE URBAN LANDSCAPE
101 GROUNDWATER FROM THE FLORIDAN AQUIFER
102 HORSES NURSERY FOLIAGE PASTURE
103 LEATHERLEAF FERN SPRENGERII
104 LIVESTOCK PASTURE
105 LIVESTOCK PASTURE SOD
106 LIVESTOCK PASTURE VEGETABLES WATERMELONS
107 MIXED VEGETABLES POTATOES
108 NURSERY
109 NURSERY PASTURE
110 PASTURE
111 PASTURE PRODUCE
112 PASTURE ROW CROPS
113 PASTURE VEGETABLES
114 PASTURE WATERMELON
115 PEACHES
116 POTATOES
117 POTATOES VEGETABLES
118 RECREATION TURF AND URBAN TURF
119 ROSES ORNAMENTAL ROSES FOLIAGE PLANTS
120 TURF GRASS
121 VEGETABLES
122 WATERCRESS
123 WATERMELONS

Appendix II

Irrigation methods as listed in Permit file

1 "NONE SPECIFIED"
2 AUTOMATIC SPRINKLER SYSTEM
3 AUTOMATIC SPRINKLERS
4 CENTER PIVOT
5 CENTER PIVOT SPRINKLER
6 CENTER SPRINKLERS
7 CITRUS
8 COMBINATION OVERHEAD & MICROJET
9 CONT. FLOW THROUGH THE BEDS
10 CROWN FLOOD
11 DANSET
12 DITCH
13 DITCH & FURROW
14 DITCH FLOOD
15 DITCH SEEPAGE
16 DITCH SEEPAGE SYSTEM
17 DITCH; SEEPAGE AND OVERHEAD
18 DITCHES
19 DOUBLE BED
20 DRIP
21 DRIP & FLOOD
22 DRIP & MICRO-JET
23 DRIP & PIVOT
24 DRIP & UNDERTREE
25 DRIP & UNDERTREE IMPACT SPRINKLERS
26 DRIP AND OVERHEAD SPRINKLERS
27 DRIP HAND SPRINKLER & MICRO-JET
28 DRIP IRRIGATION
29 DRIP; DITCH SEEPAGE & MICRO-JET
30 DRIP; OVERHEAD AND MICRO-JET
31 DUAL OVERHEAD SPRINKLER
32 FERN IRRIGATION
33 FLOOD
34 FLOOD & DRIP
35 FLOOD & FURROW
36 FLOOD & JET
37 FLOOD & LOW PRESSURE-LOW VOLUME
38 FLOOD & LOW VOLUME
39 FLOOD & LP/LV
40 FLOOD & MICRO-JET
41 FLOOD & MICROJET
42 FLOOD & OPEN DITCH
43 FLOOD & OVERHEAD
44 FLOOD & SEEPAGE
45 FLOOD & SPRINKLER

46 FLOOD AND DRIP
47 FLOOD AND MICRO
48 FLOOD AND MICRO-JET
49 FLOOD AND MICROJET
50 FLOOD AND SEEPAGE
51 FLOOD DRIP
52 FLOOD IRRIGATION
53 FLOOD SEEPAGE
54 FLOOD SYSTEM
55 FRIP
56 FURROW
57 FURROWS
58 GRAVITY FEED THRU & RAINBIRD MICRO-JET
59 GUN
60 HIGH VOLUME WATER GUNS
61 HYDRO JETS
62 IMPACT AND SPRAY SPRINKLERS
63 IMPACT SPRINKLERS
64 INGROUND SPRINKLERS
65 INJECTION OVERHEAD
66 INTERNAL CANAL SYSTEM
67 JET
68 JET IRRIGATION
69 JET MICRO SPRINKLERS
70 JET SPRINKLERS
71 JET SYSTEM
72 JETS
73 JETS & DRIP
74 JR. RAINBIRDS
75 LATERAL DITCHES
76 LATERAL LINES & TRAVELING GUN
77 LOW ANGLE SPRINKLERS
78 LOW PRESSURE
79 LOW PRESSURE DRIP
80 LOW PRESSURE DRIP SYSTEM
81 LOW PRESSURE IRRIGATION
82 LOW PRESSURE JET SYSTEM
83 LOW PRESSURE LOW VOLUME
84 LOW PRESSURE UNDER TREE
85 LOW PRESSURE VOLUME
86 LOW PRESSURE-LOW VOLUME
87 LOW PRESSURE-LOW VOLUME IRRIGATION
88 LOW PRESSURE/LOW VOLUME
89 LOW PROFILE SPRINKLER
90 LOW PROFILE SPRINKLERS
91 LOW VOL. TRICKLE
92 LOW VOLUME
93 LOW VOLUME & LOW PRESSURE
94 LOW VOLUME AND SEEPAGE DITCH

95 LOW VOLUME IRRIGATION SYSTEM
96 LOW VOLUME JET
97 LOW VOLUME LOW PRESSURE
98 LOW VOLUME MICRO SPRINKLER
99 LOW VOLUME MICRO-JET & OVERHEAD
100 LOW VOLUME MICRO-JETS
101 LOW VOLUME MICRO-SPRINKLER
102 LOW VOLUME MICROJET
103 LOW VOLUME SETS
104 LOW VOLUME SPRINKLER
105 LOW VOLUME SPRINKLERS & FLOOD
106 LOW VOLUME UNDER TREE
107 LOW VOLUME UNDER TREE SPRINKLER
108 LOW VOLUME UNDER TREE SPRINKLERS
109 LOW VOLUME UNDERTREE
110 LOW VOLUME; DRIP
111 LOW VOLUME-LOW PRESSURE
112 MAXIJET
113 MICRO JET
114 MICRO JET SPRINKLERS
115 MICRO JET SYSTEM
116 MICRO JETS
117 MICRO SPRINKLER
118 MICRO SPRINKLERS
119 MICRO-DRIP GREENTIP
120 MICRO-JET
121 MICRO-JET
122 MICRO-JET & FLOOD
123 MICRO-JET & LOW VOLUME
124 MICRO-JET & OVERHEAD
125 MICRO-JET & OVERHEAD SPRINKLERS
126 MICRO-JET & SPRINKLER
127 MICRO-JET & TRAVELING GUN
128 MICRO-JET AND FLOOD
129 MICRO-JET AND VOLUME
130 MICRO-JET SPRINKLER
131 MICRO-JET SPRINKLERS
132 MICRO-JETS
133 MICRO-SPRINKLER
134 MICRO-SPRINKLERS
135 MICROJET
136 MICROJET & FLOOD
137 MICROJET & OVERHEAD SPRINKLERS
138 MICROJET AND FLOOD
139 MICROJET SPRINKLERS
140 MICROJET; OVERHEAD & VOL. GUN
141 MICROJET, OVERHEAD, RECIRCULATION FLOW-THROUGH
142 MICRO-JET
143 MICRO-JET

144 MISTERS
145 MUSHROOM SPRINKLERS
146 NONE
147 OPEN DITCH
148 OPEN DITCH & FLOOD
149 OPEN DITCH & PIPELINE SEEPAGE
150 OPEN DITCH AND FLOOD
151 OPEN DITCH SEEPAGE
152 OPEN DITCH SEEPAGE & PIPELINE
153 OPEN DITCHES
154 OPEN FLOOD
155 OPEN SEEPAGE
156 OVER-HEAD SPRINKLER
157 OVERHEAD
158 OVERHEAD & DRIP
159 OVERHEAD & JET
160 OVERHEAD & LOW PRESSURE
161 OVERHEAD & LOW VOLUME MICROJET
162 OVERHEAD & LOW VOLUME UNDER TREE
163 OVERHEAD & MICRO-JET
164 OVERHEAD & MICRO-JET SPRINKLER SYSTEM
165 OVERHEAD & MICRO-JET SPRINKLERS
166 OVERHEAD & MICROJET SPRINKLERS
167 OVERHEAD & MIST SPRINKLERS
168 OVERHEAD & PIVOT
169 OVERHEAD & POP-UP
170 OVERHEAD & RAINBIRD SPRINKLERS
171 OVERHEAD & SPRINKLER
172 OVERHEAD & TRAVELING GUN
173 OVERHEAD & UNDER TREE
174 OVERHEAD & VOLUME GUN
175 OVERHEAD AND PIPE SPRINKLER SYSTEM
176 OVERHEAD AND VOLUME
177 OVERHEAD AND VOLUME GUN
178 OVERHEAD DRIP
179 OVERHEAD GUN
180 OVERHEAD IRRIGATION
181 OVERHEAD RAINBIRD
182 OVERHEAD RAINBIRD & SPRINKLER
183 OVERHEAD RAINBIRD VOLUME GUNS
184 OVERHEAD RAINBIRDS
185 OVERHEAD RAINBIRD & IMPACT SPRINKLER
186 OVERHEAD RED RAINBIRDS
187 OVERHEAD SPIKES
188 OVERHEAD SPRINKLERS
189 OVERHEAD SPRINKLERS
190 OVERHEAD SPRINKLERS
191 OVERHEAD SPRINKLER
192 OVERHEAD SPRINKLER & LARGE SPRAY GUN

193 OVERHEAD SPRINKLER & MICRO-JET
194 OVERHEAD SPRINKLER & TRAVELING GUN
195 OVERHEAD SPRINKLER & UNDER TREE IMPACT
196 OVERHEAD SPRINKLER & UNDERTREE
197 OVERHEAD SPRINKLER & VOLUME GUN
198 OVERHEAD SPRINKLER AND MICRO-JET
199 OVERHEAD SPRINKLER AND PERFORATED PIPE
200 OVERHEAD SPRINKLER IRRIGATION SYSTEM
201 OVERHEAD SPRINKLER SYSTEM
202 OVERHEAD SPRINKLERS
203 OVERHEAD SPRINKLERS & VOLUME GUN
204 OVERHEAD SPRINKLERS AND SEEPAGE
205 OVERHEAD SPRINKLER
206 OVERHEAD SYSTEM
207 OVERHEAD VOL. GUN
208 OVERHEAD VOLUME GUN
209 OVERHEAD WALKING GUN
210 OVERHEAD, TRAVELING GUN & MICRO-JET SPRINKLERS
211 OVERHEAD SPRINKLER
212 PERF. PIPE
213 PERFORATED PIPE
214 PERFORATED PIPES
215 PERM. OVERHEAD
216 PERMANENT MAIN WALKING GUN
217 PERMANENT OVERHEAD
218 PERMANENT OVERHEAD & TRAVELING GUN
219 PERMANENT OVERHEAD SPRINKLERS
220 PERMANENT SET OVERHEAD
221 PIPE
222 PIPELINE
223 PIPELINE & OPEN DITCH
224 PIPELINE & OPEN SEEPAGE
225 PIPELINE SEEPAGE
226 PIPELINE SEEPAGE & CENTER PIVOT
227 PIPELINE SEEPAGE & FLOOD
228 PIPELINE SEEPAGE & LARGE GUN SPRAY
229 PIPELINE SEEPAGE & OPEN DITCH
230 PIPELINE SEEPAGE & OVERHEAD
231 PIPELINE SEEPAGE & VOLUME GUN
232 PIPELINE SEEPAGE AND TILE DRAIN
233 PIPELINE SEEPAGE SYSTEM
234 PIVOT SPRINKLER SYSTEM
235 PIVOTING SPRINKLERS
236 POP UP RAINBIRD
237 POP UP SPRINKLERS
238 POP UPS
239 POP-UP SPRINKLER
240 POP-UP SPRINKLER SYSTEM
241 POP-UP SPRINKLERS

242 PORTABLE PIPE
243 PORTABLE SPRINKLER
244 PORTABLE TRAVELING GUN & OVERHEAD
245 POTATOES
246 PROFILE SPRINKLERS & MICRO-JET
247 PUMPED
248 RAINBIRD
249 RAINBIRD SPRINKLER
250 RAINBIRD SPRINKLERS
251 RAINBIRD TRAVELING GUN
252 RAINBIRDS
253 RAINBIRDS & MIST LINE SMALL SPRINKLERS
254 RAINBIRDS & OVERHEAD
255 RAISED SPRINKLERS
256 ROTATING SPRINKLERS
257 SEEPAGE
258 SEEPAGE AND OPEN DITCH
259 SEEPAGE AND OPEN-DITCH
260 SEEPAGE AND PIPELINE
261 SEEPAGE OPEN DITCH
262 SEEPAGE OR SPRINKLERS
263 SEEPAGE PIPELINE
264 SEEPAGE PIPELINE AND OPEN DITCH
265 SEEPAGE TURBINE PUMP
266 SELF PROPELLED GUN
267 SOAKER HOSE
268 SPRINKLER
269 SPLIT PIPE
270 SPRAY
271 SPRAY IRRIGATION
272 SPRAYS
273 SPRINKLER
274 SPRINKLER & FLOOD
275 SPRINKLER AND LARGE GUN SPRAY
276 SPRINKLER MICRO-JET & DRIP
277 SPRINKLER PIPE
278 SPRINKLER POP-UPS
279 SPRINKLER SYSTEM
280 SPRINKLER SYSTEMS
281 SPRINKLER; LARGE GUN SPRAY AND LOW VOLUME
282 SPRINKLER; MICRO-JET; TRAVELING
283 SPRINKLERS
284 SPRINKLERS & PIPE
285 SPRINKLERS & TRAVELING GUN
286 SPRINKLERS AND MICRO-JET
287 STAND PIE SPRINKLERS
288 STAND PIPE
289 STAND PIPES
290 STANDARD RAINBIRD

291 STANDPIPE SPRINKLERS
292 STANDPIPES
293 STATIONARY GUN
294 STATIONARY RAINBOW GUNS
295 STATIONARY VOLUME
296 SWALE DITCHES & CULVERTS
297 TEXAS SIDEWALKER
298 TIMED SPRINKLERS
299 TORO POP-UP SPRINKLER
300 TORO SPRINKLER
301 TORO SPRINKLERS
302 TORO TURBINE DRIVE IMPULSE STREAM ROTOR
303 TRAVEL GUN
304 TRAVELING GUN
305 TRAVELING GUN & MICRO JET
306 TRAVELING GUN & OVERHEAD
307 TRAVELING GUN & OVERHEAD RAINBIRDS
308 TRAVELING GUN & OVERHEAD SPRINKLER
309 TRAVELING GUN & PERMANENT OVERHEAD
310 TRAVELING GUN & SEEPAGE
311 TRAVELING GUN AND MICRO JET
312 TRAVELING GUN AND OVERHEAD
313 TRAVELING GUN SPRINKLER
314 TRAVELING GUN; OVERHEAD; MICRO JET & LOW VOLUME
315 TRAVELING GUNS
316 TRAVELING GUNS & SPRINKLERS
317 TRAVELING VOLUME GUN
318 TRICKLE
319 UNDER GROUND SEEPAGE
320 UNDER THE TREE SPRINKLER
321 UNDER TREE
322 UNDER TREE & OVERHEAD SPRINKLERS
323 UNDER TREE BIRDS
324 UNDER TREE IMPACT
325 UNDER TREE IMPACT SPRINKLER
326 UNDER TREE IMPULSE
327 UNDER TREE IMPULSE; TRAVELING GUN
328 UNDER TREE KICK AROUND
329 UNDER TREE MICRO-JETS
330 UNDER TREE SPRINKLER
331 UNDER TREE SPRINKLER & IMPULSE SPRINKLER
332 UNDER TREE SPRINKLER & TRAVELING GUN
333 UNDER TREE SPRINKLER & TRAVELING GUN SPRINKLER
334 UNDER TREE SPRINKLER AND IMPULSE SPRINKLER
335 UNDER TREE SPRINKLERS
336 UNDER TREE SPRINKLERS & IMPULSE SPRINKLER
337 UNDER-THE-TREE IMPACT SPRINKLER
338 UNDER-THE-TREE IMPACT SPRINKLERS
339 UNDER-THE-TREE SPRINKLER

340 UNDER-THE-TREE SPRINKLERS
341 UNDER-TREE IMPACT SPRINKLER
342 UNDERGROUND
343 UNDERGROUND & PIPELINE SEEPAGE
344 UNDERGROUND PIPE SYSTEM
345 UNDERGROUND SPRINKLER
346 UNDERTREE AND OVERHEAD
347 UNDERTREE RAINBIRD
348 UNDERTREE SPRINKLERS
349 VOL. GUN
350 VOLUME
351 VOLUME GUN
352 VOLUME GUN & OVERHEAD SPRINKLER
353 VOLUME GUN AND MICRO-JET
354 VOLUME GUN MICRO-JET & SPRINKLERS
355 VOLUME GUNS
356 VOLUME GUNS & WALKING GUNS
357 VOLUME TRAVEL GUN
358 VOLUME TRAVELING GUN
359 WALKING GUN
360 WALKING GUN & MICRO-JET
361 WALKING GUN & OVERHEAD
362 WALKING GUN & OVERHEAD SPRINKLER
363 WALKING GUN & TEXAS SIDEWALKERS
364 WALKING GUN VOLUME
365 WALKING GUNS
366 WALKING GUNS & MICRO-JET
367 WALKING GUNS & OVERHEAD SPRINKLERS
368 WALKING GUNS & SPRINKLERS
369 WATER WINCH
370 WATER WINCH & DRIP
371 WELL
372 WHITE BASE MICRO-JET
373 11/21/84 "gave date as irrigation method"

Appendix III

Citrus data from Benchmark database used to compute sample sizes.

			Acre-Inches										
ID #	YR	Acres	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
501101	87	90.0	0.001	0.000	0.000	0.001	0.001	0.001	0.003	0.002	0.000	0.001	0.000	0.000
501401	87	19.0	1.180	0.213	0.395	0.446	0.755	0.690	0.443	0.535	0.480	0.302	0.182	0.127
501701	87	80.0	1.497	0.260	0.813	2.306	2.283	1.716	0.187	1.009	0.148	1.461	0.542	0.520
501801	87	80.0	1.044	0.000	0.955	1.134	2.404	2.139	0.121	1.222	0.421	2.723	0.271	0.000
502501	87	10.0	0.000	0.000	0.000	0.001	0.027	0.018	0.007	0.042	0.006	0.004	0.002	0.000
504401	87	45.0	1.511	0.239	0.163	0.772	0.784	1.014	0.895	0.760	1.110	0.644	0.306	0.255
507401	87	20.0	3.576	0.000	0.715	1.176	1.344	2.253	0.353	2.064	1.306	0.732	0.000	0.000
507501	87	25.0	4.681	0.000	0.825	0.909	3.642	2.408	0.354	1.145	1.757	0.314	0.000	0.281
507601	87	23.0	.	.	.	.	.	.	.	.	.	.	.	.
507701	87	4.0	0.000	0.000	0.000	0.014	0.000	0.021	0.012	0.008	0.000	0.000	0.000	0.000
507801	87	80.0	.	.	0.972	0.932	2.354	1.514	1.675	2.753	0.879	1.858	0.000	0.587
508101	87	40.0	.	.	.	.	.	.	.	.	.	.	.	.
508201	87	40.0	.	.	.	.	.	.	.	.	.	.	.	.
507901	87	33.0	0.000	0.000	0.003	0.001	0.010	0.001	0.000	0.000	0.001	0.006	0.000	0.000
508301	87	43.0	1.109	1.111	1.907	0.474	1.451	0.731	0.366	1.777	2.083	1.539	0.087	0.000
501901	87	10.0	3.857	0.725	1.044	1.369	1.703	2.221	1.340	3.020	0.007	4.264	0.037	0.037
502001	87	40.0	0.001	0.001	0.000	0.002	0.004	0.007	0.002	0.003	0.005	0.002	0.001	0.000
502201	87	40.0	0.543	0.000	0.000	1.767	1.445	2.166	0.000	0.000	0.000	0.000	0.000	0.000
501101	86	90.0	0.000	.	0.002	0.002	0.001	0.001	0.003	0.001	0.009	0.001	0.001	0.000
501401	86	19.0	.	.	.	.	.	0.240	0.240	0.288	0.895	1.026	0.285	0.148
501701	86	80.0	.	1.369	1.511	2.427	2.147	1.035	3.571	0.877	1.632	1.843	1.219	1.240
501801	86	80.0	.	0.000	2.652	3.049	4.331	0.000	0.344	0.000	1.676	5.700	2.992	2.494
502501	86	10.0	0.000	0.000	0.005	0.015	0.011	0.006	0.000	0.000	0.000	0.005	0.002	0.000
504401	86	45.0	1.722	0.191	0.501	1.519	0.990	0.191	2.876	0.998	0.553	1.798	0.394	0.402
507401	86	20.0	2.025	1.142	1.099	1.956	2.977	0.668	3.602	0.302	0.069	2.172	0.715	0.000
507501	86	25.0	.	.	.	1.717	0.185	0.432	0.488	0.000	0.000	0.572	0.000	0.000
507601	86	23.0	0.000	0.000	0.000	0.393	0.742	0.326	0.004	0.000	0.000	1.139	.	.
507701	86	4.0	.	.	.	0.039	0.012	0.014	0.000	0.000	0.000	0.000	0.000	0.000
507801	86	80.0	.	.	.	3.857	2.371	1.313	2.415	0.480	0.050	2.202	.	.
508101	86	40.0	1.292	0.000	1.520	2.675	0.774	1.145	16.585	0.000	.	.	.	.
508201	86	40.0	1.065	.	0.997	1.803	0.399	2.081	3.422	0.238	.	.	.	.
507901	86	33.0	.	.	0.007	0.024	0.010	0.006	0.005	0.001	0.000	0.005	0.000	0.000
508301	86	43.0	0.000	0.000	0.000	0.015	0.000	0.010	0.417	0.736	1.415	2.728	1.760	0.721
501901	86	10.0	5.071	0.044	3.864	3.775	1.999	0.185	1.873	0.222	1.421	1.355	1.925	0.822
502001	86	40.0	0.000	0.000	0.003	0.008	0.004	0.003	0.000	0.000	0.001	0.000	0.003	0.002
502201	86	40.0	0.589	1.112	1.643	3.028	1.359	0.000	0.029	0.000	1.373	1.810	0.000	0.000

Fern data from Benchmark database used to compute sample sizes.

			Acre-Inches										
ID #	YR	Acres	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
508001	87	7.0	14.226	4.397	8.257	10.399	8.842	9.107	8.660	8.988	3.591	7.427	4.034	10.112
511701	87	4.8	12.642	1.367	4.524	4.367	4.149	2.635	4.919	2.718	9.833	1.733	4.947	1.144
501001	87	7.0	8.174	4.193	1.960	4.463	5.312	5.376	4.328	3.336	4.556	3.730	2.925	5.492
502901	87	4.0	3.364	1.906	1.243	1.558	2.055	1.591	1.790	1.359	1.790	1.442	1.143	1.922
509901	87	8.0	13.616	8.511	1.718	7.221	6.130	7.644	6.420	7.700	2.970	9.009	9.787	7.021
502301	87	18.0	0.000	.	0.000	.	.	.	.	.	.	.	.	.
502801	87	7.0	17.827	10.326	5.732	8.684	1.740	3.370	1.696	3.157	1.210	1.620	5.996	15.768
508601	87	7.6	10.751	10.459	3.401	5.062	6.122	3.196	1.929	3.678	5.247	4.960	9.240	2.904
508801	87	7.0	4.895	5.058	3.322	3.467	4.772	3.889	0.000	0.000	1.523	1.913	1.780	0.881
508901	87	12.0	8.678	6.827	3.547	2.358	3.212	3.310	2.018	1.538	1.643	2.047	7.769	4.225
509001	87	5.5	12.119	6.983	6.355	2.919	2.881	3.455	2.491	0.899	0.630	1.827	6.599	6.863
509101	87	7.5	4.970	3.626	4.062	2.522	1.665	1.311	1.974	1.052	5.144	2.115	2.586	6.655
509201	87	7.0	11.425	7.683	5.094	4.529	4.554	3.707	2.976	2.726	1.864	.	5.397	4.688
509301	87	13.5	5.301	3.333	1.661	7.194	6.666	3.007	.	.	.	2.714	3.534	3.090
509401	87	12.0	2.714	2.945	3.360	3.931	3.411	2.177	8.290	3.365	1.407	2.077	3.924	1.599
509501	87	7.0	4.271	2.111	2.695	6.868	4.006	5.356	3.684	5.275	3.578	3.248	4.994	3.617
509601	87	10.0	23.055	13.588	7.571	7.984	.	.	2.488	6.047	4.940	4.358	13.037	13.724
509701	87	5.0	11.779	6.795	2.277	1.519	4.396	3.941	2.320	4.414	0.868	3.647	7.350	4.856
509801	87	2.3	4.253	2.775	6.501	7.924	10.795	11.882	11.669	8.397	8.337	8.347	13.985	8.694
502001	87	8.0	5.192	4.507	0.789	3.183	4.974	3.475	0.448	0.180	.	.	.	.
512101	87	19.0	6.741	5.408	4.191	4.776	6.597	4.442	5.087	4.387	3.855	4.143	6.093	4.391
512201	87	6.5	5.011	2.281	3.065	2.415	3.176	2.731	3.190	2.927	2.082	2.368	2.734	1.717
512301	87	10.0	5.435	5.468	1.863	3.038	2.897	3.093	0.836	1.121	1.262	3.725	4.645	3.271
512401	87	10.0	13.158	4.959	1.663	7.937	9.791	6.310	3.582	7.471	3.037	3.429	6.025	4.930
512501	87	18.0	12.850	7.711	5.402	2.860	2.674	2.146	2.255	2.310	1.906	1.499	9.242	4.859
512701	87	7.0	2.003	4.739	3.553	5.133	4.925	4.684	0.578	.	.	.	3.023	4.368
513101	87	4.0	4.636	2.958	1.239	3.453	1.321	1.835	0.000	0.000	0.000	0.865	0.000	0.524
508001	86	7.0	.	.	5.931	15.362	.	.	.	0.019	18.534	11.529	9.760	7.094
511701	86	4.8	.	.	2.269	2.076	3.580	1.594	4.333	0.798	5.145	7.579	8.682	5.301
501001	86	7.0	13.111	2.903	2.198	6.679	4.891	3.033	1.766	.	.	.	.	.
502901	86	4.0	7.524	1.757	1.011	2.469	1.508	0.679	1.690	0.895	0.795	2.121	0.464	0.812
509901	86	8.0	12.877	6.332	5.733	4.608	5.937	4.275	4.385	3.191	3.033	6.708	2.821	1.963
502301	86	18.0	2.898	3.372	1.227	0.722	0.938	.	.	.	.	.	.	.
502801	86	7.0	10.961	17.140	14.489	3.741	4.735	2.012	0.450	2.036	1.752	3.243	1.444	4.713
508601	86	7.6	11.803	7.274	7.134	4.611	5.615	3.058	4.175	2.447	4.132	4.578	2.743	1.899
508801	86	7.0	12.624	5.040	3.889	5.467	3.590	3.988	3.296	1.817	1.603	5.109	2.320	1.998
508901	86	12.0	10.828	7.588	5.721	3.586	3.717	2.621	1.941	.	.	.	.	.
509001	86	5.5	10.812	10.654	3.683	4.485	3.845	0.087	1.738	0.990	1.478	3.535	3.173	1.446
509101	86	7.5	6.928	4.603	2.649	1.598	1.720	.	.	.	.	.	.	.
509201	86	7.0	9.683	10.023	3.157	3.921	2.510	2.945	4.659	2.622	1.667	.	.	.
509301	86	13.5	11.258	.	0.984	4.278	3.793	1.796	2.716	0.680	1.174	2.646	3.033	1.923
509401	86	12.0	8.724	0.538	1.671	4.375	4.141	2.848	3.099	1.461	4.105	2.965	2.360	0.930
509501	86	7.0	10.889	1.026	1.196	3.791	5.724	1.191	2.153	0.594	4.102	4.024	0.912	1.368
509601	86	10.0	21.278	10.633	6.900	5.543	16.484	8.783	18.180	3.477	7.490	11.444	16.437	8.482
509701	86	5.0	9.741	8.293	6.755	2.129	2.279	0.825	.	.	.	.	.	.
509801	86	2.3	6.467	2.418	4.131	6.490	8.115	4.717	10.352	1.998	5.149	7.811	1.849	2.442
502001	86	8.0	9.671	2.070	0.962	.	.	0.526	3.575	0.000	3.235	2.849	2.474	1.509
512101	86	19.0	9.073	6.335	5.018	8.237	8.929	3.052	4.324	.	.	.	.	.
512201	86	6.5	11.723	3.191	2.475	3.229	2.381	3.466	0.987	2.252	2.111	0.808	2.680	1.759
512301	86	10.0	8.625	3.334	2.317	2.796	2.716	0.691	1.000	0.615	3.038	2.488	1.540	2.027
512401	86	10.0	.	6.775	3.187	5.617	5.544	4.260	6.588	1.849	6.459	5.848	4.568	3.732
512501	86	18.0	9.933	12.115	6.697	5.096	4.467	3.137	2.297	3.482	2.179	.	.	.
512701	86	7.0	.	.	.	.	.	.	8.413	1.138	1.535	2.205	2.039	1.338
513101	86	.	.	.	.	.	.	.	.	.	.	.	.	.

Potato data from Benchmark database used to compute sample sizes.

			Acre-Inches										
ID #	YR	Acres	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
503601	87	120.0	0.000	0.000	0.538	4.133	1.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000
511801	87	19.0	0.000	0.000	0.500	4.960	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500101	87	19.0	0.000	0.000	5.376	8.240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
502601	87	35.0	0.000	0.000	1.625	6.118	2.419	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504101	87	.	.	.	.	.	.	.	.	.	.	.	.	.
506001	87	40.0	0.000	0.000	2.325	5.955	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
506101	87	40.0	0.000	0.421	1.255	4.168	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
506201	87	50.0	0.000	0.000	0.576	6.387	1.540	0.000	0.000	0.000	0.000	0.000	0.000	0.000
506501	87	30.0	0.000	0.000	0.497	5.800	3.978	0.000	0.000	0.000	0.000	0.000	0.000	0.000
507101	87	30.0	0.006	0.000	0.017	9.667	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
507201	87	35.0	0.000	0.000	1.661	8.054	1.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000
512601	87	26.0	0.000	0.000	1.006	2.436	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
512901	87	38.0	0.000	0.000	0.826	6.358	1.328	0.000	0.000	0.000	0.000	0.000	0.000	0.000
513201	87	27.0	0.000	0.000	1.707	4.798	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
513301	87	40.0	0.000	0.000	1.658	3.808	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500201	87	70.0	0.000	0.000	0.823	4.498	4.486	0.000	0.000	0.000	0.000	0.000	0.000	0.000
502701	87	125.0	0.000	0.000	1.718	10.474	6.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000
503001	87	110.0	0.000	0.000	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
503101	87	40.0	0.000	0.000	2.168	12.297	5.462	0.000	0.000	0.000	0.000	0.000	0.000	0.000
503901	87	20.0	0.000	0.118	0.661	10.880	5.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504001	87	50.0	0.000	0.000	1.215	7.388	2.258	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504201	87	35.0	0.000	0.000	3.413	11.559	2.804	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504701	87	60.0	0.000	0.000	0.981	9.254	8.114	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504801	87	40.0	0.000	0.000	1.494	5.417	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504901	87	40.0	0.000	0.000	0.860	4.263	2.093	0.000	0.000	0.000	0.000	0.000	0.000	0.000
505001	87	30.0	0.068	0.007	0.000	4.957	4.536	0.000	0.000	0.000	0.000	0.000	0.000	3.236
505101	87	60.0	0.000	0.000	0.119	9.691	4.228	0.000	0.000	0.000	0.000	0.000	0.000	0.000
505201	87	40.0	0.000	0.000	2.081	10.325	2.892	0.000	0.000	0.000	0.000	0.000	0.000	0.000
506901	87	35.0	0.000	0.000	1.734	13.075	2.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000
507001	87	68.0	0.000	0.000	0.000	3.782	4.716	0.000	0.000	0.000	0.000	0.000	0.000	0.000
511901	87	17.0	.	0.000	0.769	8.866	6.768	0.000	0.000	0.000	0.000	0.000	0.000	0.000
513001	87	46.0	.	0.000	2.950	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
503601	86	120.0	0.000	0.661	1.432	4.735	0.489	0.000	0.000	0.000	0.000	0.000	0.000	0.000
511801	86	.	.	.	.	.	.	.	.	.	.	.	.	.
500101	86	19.0	0.000	1.746	5.695	11.123	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
502601	86	35.0	0.000	1.257	3.180	13.092	0.833	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504101	86	40.0	.	.	.	0.000	.	.	.	.	.	.	.	.
506001	86	40.0	0.000	2.334	4.407	5.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
506101	86	40.0	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
506201	86	50.0	0.000	0.851	0.674	10.079	7.977	0.000	0.000	0.000	0.000	0.000	0.000	0.002
506501	86	30.0	0.000	0.454	1.864	6.512	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
507101	86	30.0	0.002	1.084	1.581	13.256	2.620	0.000	0.000	0.000	0.000	0.000	0.000	0.000
507201	86	35.0	0.000	0.000	1.785	8.963	7.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500201	86	70.0	0.000	0.000	0.627	5.758	5.507	0.000	0.000	0.000	0.000	0.000	0.000	0.000
502701	86	125.0	0.001	0.635	3.141	12.378	2.307	0.000	0.000	0.000	0.000	0.000	0.000	0.000
503001	86	110.0	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
503101	86	40.0	0.000	1.284	5.860	15.326	4.176	0.000	0.000	0.000	0.000	0.000	0.000	0.049
503901	86	20.0	0.027	0.111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504001	86	50.0	.	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000
504201	86	35.0	0.000	0.000	2.897	12.020	13.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504701	86	60.0	0.000	0.011	1.798	13.810	13.810	0.000	0.000	0.000	0.000	0.000	0.000	0.000
504801	86	40.0	.	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000
504901	86	40.0	0.001	1.293	5.045	2.459	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
505001	86	30.0	1.705	0.951	1.609	5.510	2.260	0.000	0.000	0.001	0.000	0.000	0.000	2.846
505101	86	60.0	1.330	0.013	0.065	10.213	9.685	0.000	0.000	0.000	0.000	0.000	0.000	0.001

Potato data from Benchmark database used to compute sample sizes (cont).

			Acre-inches										
ID #	YR	Acres	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
505201	86	40.0	.	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000
506901	86	64.0	.	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000
507001	86	68.0	.	.	.	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000
506901	87	35.0	0.000	0.000	1.734	13.075	2.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000
507001	87	68.0	0.000	0.000	0.000	3.782	4.716	0.000	0.000	0.000	0.000	0.000	0.000	0.000
511901	87	17.0	.	0.000	0.769	8.866	6.768	0.000	0.000	0.000	0.000	0.000	0.000	0.000
513001	87	46.0	.	0.000	2.950	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix IV

Miscellaneous analysis of permitting database on citrus, fern and potatoes.

Citrus Crops

OBS	CROPS
1	APPLES PEACHES CITRUS PASTURE ROTATED WITH VEG
2	CELERY CITRUS
3	CITRUS
4	CITRUS CORN MIXED VEGETABLES
5	CITRUS CORN POTATOES
6	CITRUS COTTON VEGETABLES
7	CITRUS FERN
8	CITRUS FERN MIXED VEGETABLES
9	CITRUS FERN PASTURE
10	CITRUS FERN PASTURE VEGETABLES
11	CITRUS FERN TURF GRASS
12	CITRUS FERN VEGETABLES
13	CITRUS FOLIAGE
14	CITRUS FOLIAGE LANDSCAPE
15	CITRUS FOLIAGE NURSERY
16	CITRUS GARDEN LIVESTOCK
17	CITRUS GOLF COURSE
18	CITRUS GRASS ROW CROPS
19	CITRUS HAY
20	CITRUS HERBS PASTURE VEGETABLES WATERCRESS
21	CITRUS HORTICULTURAL
22	CITRUS LIVESTOCK
23	CITRUS LIVESTOCK PASTURE
24	CITRUS NURSERY
25	CITRUS NURSERY NURSERY STOCK
26	CITRUS NURSERY PASTURE
27	CITRUS NURSERY VEGETABLES
28	CITRUS ORNAMENTALS
29	CITRUS PASTURE
30	CITRUS PASTURE ALTER. W/RYE MILLET WATERMELONS
31	CITRUS PASTURE VEGETABLES
32	CITRUS PASTURE WATERMELONS
33	CITRUS PERSIMMONS
34	CITRUS PROCESSING PLANT
35	CITRUS PUBLIC SUPPLY
36	CITRUS SAND MINING
37	CITRUS TURF GRASS
38	CITRUS VARIOUS AGRONOMIC HORTICULTURAL CROPS
39	CITRUS VEGETABLES
40	CITRUS WATERMELONS

Citrus Crops

CROPS	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
APPLES PEACHES C	1	0.1	1	0.1
CELERY CITRUS	1	0.1	2	0.1
CITRUS	1291	91.9	1293	92.0
CITRUS CORN MIXE	1	0.1	1294	92.1
CITRUS CORN POTA	1	0.1	1295	92.2
CITRUS COTTON VE	1	0.1	1296	92.2
CITRUS FERN	26	1.9	1322	94.1
CITRUS FERN MIXE	1	0.1	1323	94.2
CITRUS FERN PAST	3	0.2	1326	94.4
CITRUS FERN TURF	1	0.1	1327	94.4
CITRUS FERN VEGE	1	0.1	1328	94.5
CITRUS FOLIAGE	4	0.3	1332	94.8
CITRUS FOLIAGE L	1	0.1	1333	94.9
CITRUS FOLIAGE N	1	0.1	1334	94.9
CITRUS GARDEN LI	1	0.1	1335	95.0
CITRUS GOLF COUR	2	0.1	1337	95.2
CITRUS GRASS ROW	1	0.1	1338	95.2
CITRUS HAY	1	0.1	1339	95.3
CITRUS HERBS PAS	1	0.1	1340	95.4
CITRUS HORTICULT	1	0.1	1341	95.4
CITRUS LIVESTOCK	2	0.1	1343	95.6
CITRUS NURSERY	24	1.7	1367	97.3
CITRUS NURSERY N	1	0.1	1368	97.4
CITRUS NURSERY P	1	0.1	1369	97.4
CITRUS NURSERY V	1	0.1	1370	97.5
CITRUS ORNAMENTA	1	0.1	1371	97.6
CITRUS PASTURE	15	1.1	1386	98.6
CITRUS PASTURE A	2	0.1	1388	98.8
CITRUS PASTURE V	1	0.1	1389	98.9
CITRUS PASTURE W	2	0.1	1391	99.0
CITRUS PERSIMMON	1	0.1	1392	99.1
CITRUS PROCESSIN	5	0.4	1397	99.4
CITRUS PUBLIC SU	1	0.1	1398	99.5
CITRUS SAND MINI	1	0.1	1399	99.6
CITRUS TURF GRAS	2	0.1	1401	99.7
CITRUS VARIOUS A	1	0.1	1402	99.8
CITRUS VEGETABLE	2	0.1	1404	99.9
CITRUS WATERMELO	1	0.1	1405	100.0

OBS	CROPS
1	BLUEBERRIES FERN FRUIT NURSERY MIXED VEGETABLES
2	CITRUS FERN
3	CITRUS FERN MIXED VEGETABLES
4	CITRUS FERN PASTURE
5	CITRUS FERN PASTURE VEGETABLES
6	CITRUS FERN TURF GRASS
7	CITRUS FERN VEGETABLES
8	CORN FERN HAY PASTURE
9	FERN
10	FERN FIELD GROWN FLOWERS
11	FERN FLOWERS FOLIAGE
12	FERN FLOWERS ORNAMENTALS WOODY ORNAMENTALS
13	FERN FOLIAGE
14	FERN GREENHOUSE FOLIAGE
15	FERN MIXED VEGETABLES
16	FERN NURSERY
17	FERN ORNAMENTALS
18	FERN PACKING HOUSE
19	FERN PASTURE
20	FERN PEACHES
21	FERN ROW CROPS
22	FERN RYE
23	FERN TURF GRASS
24	FERN WATERMELONS LIVESTOCK
25	FERN WOODY ORNAMENTALS
26	FERN WOODY ORNAMENTALS FOLIAGE NURSERY
27	LEATHERLEAF FERN SPRENGERII

CROPS	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
BLUEBERRIES FERN	1	0.2	1	0.2
CITRUS FERN	24	3.7	25	3.9
CITRUS FERN MIXE	1	0.2	26	4.0
CITRUS FERN PAST	3	0.5	29	4.5
CITRUS FERN TURF	1	0.2	30	4.6
CITRUS FERN VEGE	1	0.2	31	4.8
CORN FERN HAY PA	1	0.2	32	5.0
FERN	570	88.2	602	93.2
FERN FIELD GROWN	1	0.2	603	93.3
FERN FLOWERS FOL	1	0.2	604	93.5
FERN FLOWERS ORN	1	0.2	605	93.7
FERN FOLIAGE	22	3.4	627	97.1
FERN GREENHOUSE	1	0.2	628	97.2
FERN MIXED VEGET	1	0.2	629	97.4
FERN NURSERY	1	0.2	630	97.5
FERN ORNAMENTALS	4	0.6	634	98.1
FERN PACKING HOU	1	0.2	635	98.3
FERN PASTURE	2	0.3	637	98.6
FERN PEACHES	1	0.2	638	98.8
FERN ROW CROPS	1	0.2	639	98.9
FERN RYE	1	0.2	640	99.1
FERN TURF GRASS	1	0.2	641	99.2
FERN WATERMELONS	1	0.2	642	99.4
FERN WOODY ORNAM	3	0.5	645	99.8
LEATHERLEAF FERN	1	0.2	646	100.0

OBS	CROPS
1	CABBAGE CORN MIXED VEGETABLES POTATOES
2	CABBAGE CORN POTATOES
3	CABBAGE MIXED VEGETABLES POTATOES
4	CABBAGE POTATOES
5	CABBAGE POTATOES VEGETABLES
6	CITRUS CORN POTATOES
7	CORN MIXED VEGETABLES POTATOES
8	CORN POTATOES
9	CORN POTATOES ROTATED
10	CORN POTATOES VEGETABLES
11	MIXED VEGETABLES POTATOES
12	POTATOES
13	POTATOES VEGETABLES

CROPS	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
CABBAGE CORN MIX	12	7.1	12	7.1
CABBAGE CORN POT	47	27.8	59	34.9
CABBAGE MIXED VE	2	1.2	61	36.1
CABBAGE POTATOES	19	11.2	80	47.3
CITRUS CORN POTA	1	0.6	81	47.9
CORN MIXED VEGET	5	3.0	86	50.9
CORN POTATOES	42	24.9	128	75.7
CORN POTATOES RO	1	0.6	129	76.3
CORN POTATOES VE	6	3.6	135	79.9
MIXED VEGETABLES	1	0.6	136	80.5
POTATOES	31	18.3	167	98.8
POTATOES VEGETAB	2	1.2	169	100.0

OBS	METHOD
1	
2	CENTER SPRINKLERS
3	CITRUS
4	COMBINATION OVERHEAD & MICROJET
5	CROWN FLOOD
6	DANSET
7	DITCH
8	DITCH FLOOD
9	DITCH SEEPAGE
10	DITCH; SEEPAGE AND OVERHEAD
11	DOUBLE BED
12	DRIP
13	DRIP & FLOOD
14	DRIP & MICRO-JET
15	DRIP & PIVOT
16	DRIP & UNDERTREE
17	DRIP & UNDERTREE IMPACT SPRINKLERS
18	DRIP AND OVERHEAD SPRINKLERS
19	DRIP HAND SPRINKLER & MICRO-JET
20	DRIP IRRIGATION
21	DRIP; DITCH SEEPAGE & MICRO-JET
22	DRIP; OVERHEAD AND MICRO-JET
23	FLOOD
24	FLOOD & DRIP
25	FLOOD & FURROW
26	FLOOD & JET
27	FLOOD & LOW PRESSURE-LOW VOLUME
28	FLOOD & LOW VOLUME
29	FLOOD & LP/LV
30	FLOOD & MICRO-JET
31	FLOOD & MICROJET
32	FLOOD & OVERHEAD
33	FLOOD & SEEPAGE
34	FLOOD & SPRINKLER
35	FLOOD AND DRIP
36	FLOOD AND MICRO
37	FLOOD AND MICRO-JET
38	FLOOD AND MICROJET
39	FLOOD DRIP
40	FLOOD SYSTEM
41	FRIP
42	FURROWS
43	GUN
44	HIGH VOLUME WATER GUNS
45	HYDRO JETS
46	IMPACT SPRINKLERS
47	JET
48	JET IRRIGATION
49	JET MICRO SPRINKLERS
50	JET SYSTEM
51	JETS
52	JETS & DRIP
53	JR. RAINBIRDS
54	LATERAL DITCHES
55	LOW ANGLE SPRINKLERS

OBS	METHOD
56	LOW PRESSURE
57	LOW PRESSURE DRIP
58	LOW PRESSURE DRIP SYSTEM
59	LOW PRESSURE IRRIGATION
60	LOW PRESSURE JET SYSTEM
61	LOW PRESSURE LOW VOLUME
62	LOW PRESSURE UNDER TREE
63	LOW PRESSURE-LOW VOLUME
64	LOW PRESSURE-LOW VOLUME IRRIGATION
65	LOW PRESSURE/LOW VOLUME
66	LOW PROFILE SPRINKLERS
67	LOW VOL. TRICKLE
68	LOW VOLUME
69	LOW VOLUME & LOW PRESSURE
70	LOW VOLUME AND SEEPAGE DITCH
71	LOW VOLUME IRRIGATION SYSTEM
72	LOW VOLUME JET
73	LOW VOLUME LOW PRESSURE
74	LOW VOLUME MICRO SPRINKLER
75	LOW VOLUME MICRO-JET & OVERHEAD
76	LOW VOLUME MICRO-JETS
77	LOW VOLUME MICRO-SPRINKLER
78	LOW VOLUME MICROJET
79	LOW VOLUME SETS
80	LOW VOLUME SPRINKLER
81	LOW VOLUME SPRINKLERS & FLOOD
82	LOW VOLUME UNDER TREE
83	LOW VOLUME UNDER TREE SPRINKLER
84	LOW VOLUME UNDER TREE SPRINKLERS
85	LOW VOLUME UNDERTREE
86	LOW VOLUME; DRIP
87	LOW VOLUME-LOW PRESSURE
88	MAXIJET
89	MICRO JET
90	MICRO JET SPRINKLERS
91	MICRO JET SYSTEM
92	MICRO JETS
93	MICRO SPRINKLER
94	MICRO SPRINKLERS
95	MICRO-DRIP GREENTIP
96	MICRO-JECT
97	MICRO-JET
98	MICRO-JET & FLOOD
99	MICRO-JET & LOW VOLUME
100	MICRO-JET & OVERHEAD
101	MICRO-JET & OVERHEAD SPRINKLERS
102	MICRO-JET & SPRINKLER
103	MICRO-JET & TRAVELING GUN
104	MICRO-JET AND FLOOD
105	MICRO-JET AND VOLUME
106	MICRO-JET SPRINKLER
107	MICRO-JET SPRINKLERS
108	MICRO-JETS
109	MICRO-SPRINKLER
110	MICRO-SPRINKLERS

OBS	METHOD
111	MICROJET
112	MICROJET & FLOOD
113	MICROJET & OVERHEAD SPRINKLERS
114	MICROJET AND FLOOD
115	MICROJET SPRINKLERS
116	MICROJET; OVERHEAD & VOL. GUN
117	MICROJET, OVEREHEAD, RECIRCULATION FLOW-THROUGH
118	MICROO-JET
119	MIRCO-JET
120	MISTERS
121	MUSHROOM SPRINKLERS
122	NONE
123	OVERHEAD
124	OVERHEAD & DRIP
125	OVERHEAD & JET
126	OVERHEAD & LOW PRESSURE
127	OVERHEAD & LOW VOLUME MICROJET
128	OVERHEAD & LOW VOLUME UNDER TREE
129	OVERHEAD & MICRO-JET
130	OVERHEAD & MICRO-JET SPRINKLERS
131	OVERHEAD & MICROJET SPRINKLERS
132	OVERHEAD & PIVOT
133	OVERHEAD & POP-UP
134	OVERHEAD & RAINBIRD SPRINKLERS
135	OVERHEAD & SPRINKLER
136	OVERHEAD & TRAVELING GUN
137	OVERHEAD & UNDER TREE
138	OVERHEAD & VOLUME GUN
139	OVERHEAD AND PIPE SPRINKLER SYSTEM
140	OVERHEAD AND VOLUME
141	OVERHEAD AND VOLUME GUN
142	OVERHEAD GUN
143	OVERHEAD IRRIGATION
144	OVERHEAD RAINBIRD
145	OVERHEAD RAINBIRD & SPRINKLER
146	OVERHEAD RAINBIRD VOLUME GUNS
147	OVERHEAD RAINBIRDS
148	OVERHEAD RANIBIRD & IMPACT SPRINKLER
149	OVERHEAD RED RAINBIRDS
150	OVERHEAD SPIKES
151	OVERHEAD SPRINKLER
152	OVERHEAD SPRINKLER & LARGE SPRAY GUN
153	OVERHEAD SPRINKLER & MICRO-JET
154	OVERHEAD SPRINKLER & TRAVELING GUN
155	OVERHEAD SPRINKLER & UNDER TREE IMPACT
156	OVERHEAD SPRINKLER & UNDERTREE
157	OVERHEAD SPRINKLER & VOLUME GUN
158	OVERHEAD SPRINKLER AND MICRO-JET
159	OVERHEAD SPRINKLER AND PERFORATED PIPE
160	OVERHEAD SPRINKLER IRRIGATION SYSTEM
161	OVERHEAD SPRINKLER SYSTEM
162	OVERHEAD SPRINKLERS
163	OVERHEAD SPRINKLERS & VOLUME GUN
164	OVERHEAD SPRINKLERS AND SEEPAGE
165	OVERHEAD SRINKLER

OBS	METHOD
166	OVERHEAD VOL. GUN
167	OVERHEAD VOLUME GUN
168	OVERHEAD, TRAVELING GUN & MICRO-JET SPRINKLERS
169	PERF. PIPE
170	PERFORATED PIPE
171	PERFORATED PIPES
172	PERM. OVERHEAD
173	PERMANENT MAIN WALKING GUN
174	PERMANENT OVERHEAD
175	PERMANENT OVERHEAD & TRAVELING GUN
176	PERMANENT OVERHEAD SPRINKLERS
177	PERMANENT SET OVERHEAD
178	PIPE
179	PIPELINE SEEPAGE
180	PIPELINE SEEPAGE & FLOOD
181	PORTABLE PIPE
182	PORTABLE SPRINKLER
183	PORTABLE TRAVELING GUN & OVERHEAD
184	PROFILE SPRINKLERS & MICRO-JET
185	RAINBIRD
186	RAINBIRD SPRINKLER
187	RAINBIRD SPRINKLERS
188	RAINBIRD TRAVELING GUN
189	RAINBIRDS
190	RAINBIRDS & OVERHEAD
191	SEEPAGE
192	SELF PROPOLLED GUN
193	SPRAY
194	SPRAY IRRIGATION
195	SPRINKLER
196	SPRINKLER PIPE
197	SPRINKLER SYSTEM
198	SPRINKLER; LARGE GUN SPRAY AND LOW VOLUME
199	SPRINKLER; MICRO-JET; TRAVELING
200	SPRINKLERS
201	SPRINKLERS & PIPE
202	SPRINKLERS & TRAVELING GUN
203	STAND PIPE
204	STATIONARY GUN
205	STATIONARY RAINBOW GUNS
206	STATIONARY VOLUME
207	SWALE DITCHES & CULVERTS
208	TRAVEL GUN
209	TRAVELING GUN
210	TRAVELING GUN & MICRO JET
211	TRAVELING GUN & OVERHEAD
212	TRAVELING GUN & OVERHEAD RAINBIRDS
213	TRAVELING GUN & OVERHEAD SPRINKLER
214	TRAVELING GUN & PERMANENT OVERHEAD
215	TRAVELING GUN & SEEPAGE
216	TRAVELING GUN AND MICRO JET
217	TRAVELING GUN AND OVERHEAD
218	TRAVELING GUN SPRINKLER
219	TRAVELING GUN; OVERHEAD; MICRO JET & LOW VOLUME
220	TRAVELING GUNS

OBS	METHOD
221	TRAVELING GUNS & SPRINKLERS
222	TRAVELING VOLUME GUN
223	TRICKLE
224	UNDER THE TREE SPRINKLER
225	UNDER TREE
226	UNDER TREE & OVERHEAD SPRINKLERS
227	UNDER TREE BIRDS
228	UNDER TREE IMPACT
229	UNDER TREE IMPACT SPRINKLER
230	UNDER TREE IMPULSE
231	UNDER TREE IMPULSE; TRAVELING GUN
232	UNDER TREE KICK AROUND
233	UNDER TREE MICRO-JETS
234	UNDER TREE SPRINKLER
235	UNDER TREE SPRINKLER & IMPULSE SPRINKLER
236	UNDER TREE SPRINKLER & TRAVELING GUN
237	UNDER TREE SPRINKLER & TRAVELING GUN SPRINKLER
238	UNDER TREE SPRINKLER AND IMPULSE SPRINKER
239	UNDER TREE SPRINKLERS
240	UNDER TREE SPRINKLERS & IMPULSE SPRINKLER
241	UNDER-THE-TREE IMPACT SPRINKLER
242	UNDER-THE-TREE IMPACT SPRINKLERS
243	UNDER-THE-TREE SPRINKLER
244	UNDER-THE-TREE SPRINKLERS
245	UNDER-TREE IMPACT SPRINKLER
246	UNDERTREE AND OVERHEAD
247	UNDERTREE RAINBIRD
248	UNDERTREE SPRINKLERS
249	VOL. GUN
250	VOLUME
251	VOLUME GUN
252	VOLUME GUN & OVERHEAD SPRINKLER
253	VOLUME GUN AND MICRO-JET
254	VOLUME GUN MICRO-JET & SPRINKLERS
255	VOLUME GUNS
256	VOLUME GUNS & WALKING GUNS
257	VOLUME TRAVEL GUN
258	VOLUME TRAVELING GUN
259	WALKING GUN
260	WALKING GUN & MICRO-JET
261	WALKING GUN & OVERHEAD
262	WALKING GUN & OVERHEAD SPRINKLER
263	WALKING GUN VOLUME
264	WALKING GUNS
265	WALKING GUNS & MICRO-JET
266	WALKING GUNS & OVERHEAD SPRINKLERS
267	WALKING GUNS & SPRINKLERS
268	WATER WINCH
269	WATER WINCH & DRIP
270	WELL
271	WHITE BASE MICRO-JET
272	11/21/84

Citrus Crops

METHOD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
	3	.	.	.
CENTER SPRINKLER	1	0.1	1	0.1
CITRUS	2	0.1	3	0.2
COMBINATION OVER	1	0.1	4	0.3
CROWN FLOOD	4	0.3	8	0.6
DANSET	1	0.1	9	0.6
DITCH	1	0.1	10	0.7
DITCH FLOOD	1	0.1	11	0.8
DITCH SEEPAGE	1	0.1	12	0.9
DITCH; SEEPAGE A	1	0.1	13	0.9
DOUBLE BED	1	0.1	14	1.0
DRIP	78	5.6	92	6.6
DRIP & FLOOD	11	0.8	103	7.3
DRIP & MICRO-JET	1	0.1	104	7.4
DRIP & PIVOT	1	0.1	105	7.5
DRIP & UNDERTREE	2	0.1	107	7.6
DRIP AND OVERHEA	1	0.1	108	7.7
DRIP HAND SPRINK	1	0.1	109	7.8
DRIP IRRIGATION	4	0.3	113	8.1
DRIP; DITCH SEEP	1	0.1	114	8.1
DRIP; OVERHEAD A	1	0.1	115	8.2
FLOOD	238	17.0	353	25.2
FLOOD & DRIP	7	0.5	360	25.7
FLOOD & FURROW	1	0.1	361	25.7
FLOOD & JET	1	0.1	362	25.8
FLOOD & LOW PRES	1	0.1	363	25.9
FLOOD & LOW VOLU	1	0.1	364	26.0
FLOOD & LP/LV	1	0.1	365	26.0
FLOOD & MICRO-JE	4	0.3	369	26.3
FLOOD & MICROJET	1	0.1	370	26.4
FLOOD & OVERHEAD	1	0.1	371	26.5
FLOOD & SEEPAGE	3	0.2	374	26.7
FLOOD & SPRINKLE	1	0.1	375	26.7
FLOOD AND DRIP	3	0.2	378	27.0
FLOOD AND MICRO	1	0.1	379	27.0
FLOOD AND MICRO-	2	0.1	381	27.2
FLOOD AND MICROJ	1	0.1	382	27.2
FLOOD DRIP	1	0.1	383	27.3
FLOOD SYSTEM	1	0.1	384	27.4
FRIP	1	0.1	385	27.5
FURROWS	1	0.1	386	27.5
GUN	1	0.1	387	27.6
HIGH VOLUME WATE	1	0.1	388	27.7
HYDRO JETS	1	0.1	389	27.7
IMPACT SPRINKLER	1	0.1	390	27.8
JET	5	0.4	395	28.2
JET IRRIGATION	1	0.1	396	28.2
JET MICRO SPRINK	1	0.1	397	28.3
JET SYSTEM	1	0.1	398	28.4
JETS	1	0.1	399	28.5
JETS & DRIP	1	0.1	400	28.5
JR. RAINBIRDS	1	0.1	401	28.6
LATERAL DITCHES	1	0.1	402	28.7
LOW ANGLE SPRINK	1	0.1	403	28.7
LOW PRESSURE	11	0.8	414	29.5

Citrus Crops

METHOD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
LOW PRESSURE DRI	2	0.1	416	29.7
LOW PRESSURE IRR	2	0.1	418	29.8
LOW PRESSURE JET	1	0.1	419	29.9
LOW PRESSURE LOW	1	0.1	420	30.0
LOW PRESSURE UND	3	0.2	423	30.2
LOW PRESSURE-LOW	2	0.1	425	30.3
LOW PRESSURE/LOW	2	0.1	427	30.5
LOW PROFILE SPRI	1	0.1	428	30.5
LOW VOL. TRICKLE	1	0.1	429	30.6
LOW VOLUME	7	0.5	436	31.1
LOW VOLUME & LOW	2	0.1	438	31.2
LOW VOLUME AND S	1	0.1	439	31.3
LOW VOLUME IRRIG	1	0.1	440	31.4
LOW VOLUME JET	3	0.2	443	31.6
LOW VOLUME LOW P	1	0.1	444	31.7
LOW VOLUME MICRO	5	0.4	449	32.0
LOW VOLUME SETS.	1	0.1	450	32.1
LOW VOLUME SPRIN	2	0.1	452	32.2
LOW VOLUME UNDER	11	0.8	463	33.0
LOW VOLUME; DRIP	1	0.1	464	33.1
LOW VOLUME-LOW P	1	0.1	465	33.2
MAXIJET	1	0.1	466	33.2
MICRO JET	2	0.1	468	33.4
MICRO JET SPRINK	1	0.1	469	33.5
MICRO JET SYSTEM	1	0.1	470	33.5
MICRO JETS	1	0.1	471	33.6
MICRO SPRINKLER	12	0.9	483	34.5
MICRO SPRINKLERS	7	0.5	490	35.0
MICRO-DRIP GREEN	1	0.1	491	35.0
MICRO-JECT	1	0.1	492	35.1
MICRO-JET	200	14.3	692	49.4
MICRO-JET & FLOO	5	0.4	697	49.7
MICRO-JET & LOW	1	0.1	698	49.8
MICRO-JET & OVER	6	0.4	704	50.2
MICRO-JET & SPRI	1	0.1	705	50.3
MICRO-JET & TRAV	1	0.1	706	50.4
MICRO-JET AND FL	4	0.3	710	50.6
MICRO-JET AND VO	1	0.1	711	50.7
MICRO-JET SPRINK	15	1.1	726	51.8
MICRO-JETS	5	0.4	731	52.1
MICRO-SPRINKLER	1	0.1	732	52.2
MICRO-SPRINKLERS	2	0.1	734	52.4
MICROJET	8	0.6	742	52.9
MICROJET & FLOOD	1	0.1	743	53.0
MICROJET & OVERH	2	0.1	745	53.1
MICROJET AND FLO	1	0.1	746	53.2
MICROJET SPRINKL	3	0.2	749	53.4
MICROJET; OVERHE	1	0.1	750	53.5
MICROJET, OVEREH	1	0.1	751	53.6
MICROO-JET	1	0.1	752	53.6
MIRCO-JET	1	0.1	753	53.7
MISTERS	1	0.1	754	53.8
MUSHROOM SPRINKL	1	0.1	755	53.9
NONE	1	0.1	756	53.9
OVERHEAD	109	7.8	865	61.7

METHOD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
OVERHEAD & DRIP	2	0.1	867	61.8
OVERHEAD & JET	1	0.1	868	61.9
OVERHEAD & LOW P	1	0.1	869	62.0
OVERHEAD & LOW V	3	0.2	872	62.2
OVERHEAD & MICRO	8	0.6	880	62.8
OVERHEAD & PIVOT	1	0.1	881	62.8
OVERHEAD & POP-U	1	0.1	882	62.9
OVERHEAD & RAINB	1	0.1	883	63.0
OVERHEAD & SPRIN	1	0.1	884	63.1
OVERHEAD & TRAVE	3	0.2	887	63.3
OVERHEAD & UNDER	1	0.1	888	63.3
OVERHEAD & VOLUM	1	0.1	889	63.4
OVERHEAD AND PIP	1	0.1	890	63.5
OVERHEAD AND VOL	2	0.1	892	63.6
OVERHEAD GUN	1	0.1	893	63.7
OVERHEAD IRRIGAT	2	0.1	895	63.8
OVERHEAD RAINBIR	5	0.4	900	64.2
OVERHEAD RANIBIR	1	0.1	901	64.3
OVERHEAD RED RAI	1	0.1	902	64.3
OVERHEAD SPIKES	1	0.1	903	64.4
OVERHEAD SPRINKL	165	11.8	1068	76.2
OVERHEAD SRINKLE	1	0.1	1069	76.2
OVERHEAD VOL. GU	1	0.1	1070	76.3
OVERHEAD VOLUME	1	0.1	1071	76.4
OVERHEAD, TRAVEL	1	0.1	1072	76.5
PERF. PIPE	1	0.1	1073	76.5
PERFORATED PIPE	9	0.6	1082	77.2
PERFORATED PIPES	1	0.1	1083	77.2
PERM. OVERHEAD	3	0.2	1086	77.5
PERMANENT MAIN W	1	0.1	1087	77.5
PERMANENT OVERHE	3	0.2	1090	77.7
PERMANENT SET OV	1	0.1	1091	77.8
PIPE	2	0.1	1093	78.0
PIPELINE SEEPAGE	3	0.2	1096	78.2
PORTABLE PIPE	1	0.1	1097	78.2
PORTABLE SPRINKL	1	0.1	1098	78.3
PORTABLE TRAVELI	1	0.1	1099	78.4
PROFILE SPRINKLE	1	0.1	1100	78.5
RAINBIRD	4	0.3	1104	78.7
RAINBIRD SPRINKL	2	0.1	1106	78.9
RAINBIRD TRAVELI	1	0.1	1107	79.0
RAINBIRDS	6	0.4	1113	79.4
RAINBIRDS & OVER	1	0.1	1114	79.5
SEEPAGE	2	0.1	1116	79.6
SELF PROPOLLED G	1	0.1	1117	79.7
SPRAY	4	0.3	1121	80.0
SPRAY IRRIGATION	2	0.1	1123	80.1
SPRINKLER	9	0.6	1132	80.7
SPRINKLER PIPE	4	0.3	1136	81.0
SPRINKLER SYSTEM	3	0.2	1139	81.2
SPRINKLER; LARGE	1	0.1	1140	81.3
SPRINKLER; MICRO	1	0.1	1141	81.4
SPRINKLERS	12	0.9	1153	82.2
SPRINKLERS & PIP	1	0.1	1154	82.3
SPRINKLERS & TRA	1	0.1	1155	82.4

METHOD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
STAND PIPE	1	0.1	1156	82.5
STATIONARY GUN	1	0.1	1157	82.5
STATIONARY RAINB	3	0.2	1160	82.7
STATIONARY VOLUM	1	0.1	1161	82.8
SWALE DITCHES &	1	0.1	1162	82.9
TRAVEL GUN	1	0.1	1163	83.0
TRAVELING GUN	69	4.9	1232	87.9
TRAVELING GUN &	9	0.6	1241	88.5
TRAVELING GUN AN	2	0.1	1243	88.7
TRAVELING GUN SP	1	0.1	1244	88.7
TRAVELING GUN; O	1	0.1	1245	88.8
TRAVELING GUNS	1	0.1	1246	88.9
TRAVELING GUNS &	1	0.1	1247	88.9
TRAVELING VOLUME	2	0.1	1249	89.1
TRICKLE	5	0.4	1254	89.4
UNDER THE TREE S	1	0.1	1255	89.5
UNDER TREE	4	0.3	1259	89.8
UNDER TREE & OVE	1	0.1	1260	89.9
UNDER TREE BIRDS	1	0.1	1261	89.9
UNDER TREE IMPAC	2	0.1	1263	90.1
UNDER TREE IMPUL	5	0.4	1268	90.4
UNDER TREE KICK	1	0.1	1269	90.5
UNDER TREE MICRO	1	0.1	1270	90.6
UNDER TREE SPRIN	15	1.1	1285	91.7
UNDER-THE-TREE I	2	0.1	1287	91.8
UNDER-THE-TREE S	2	0.1	1289	91.9
UNDER-TREE IMPAC	2	0.1	1291	92.1
UNDERTREE AND OV	1	0.1	1292	92.2
UNDERTREE RAINBI	1	0.1	1293	92.2
UNDERTREE SPRINK	1	0.1	1294	92.3
VOL. GUN	1	0.1	1295	92.4
VOLUME	1	0.1	1296	92.4
VOLUME GUN	34	2.4	1330	94.9
VOLUME GUN & OVE	3	0.2	1333	95.1
VOLUME GUN AND M	1	0.1	1334	95.1
VOLUME GUN MICRO	1	0.1	1335	95.2
VOLUME GUNS	1	0.1	1336	95.3
VOLUME GUNS & WA	1	0.1	1337	95.4
VOLUME TRAVEL GU	5	0.4	1342	95.7
VOLUME TRAVELING	1	0.1	1343	95.8
WALKING GUN	28	2.0	1371	97.8
WALKING GUN & MI	1	0.1	1372	97.9
WALKING GUN & OV	3	0.2	1375	98.1
WALKING GUN VOLU	2	0.1	1377	98.2
WALKING GUNS	12	0.9	1389	99.1
WALKING GUNS & M	1	0.1	1390	99.1
WALKING GUNS & O	1	0.1	1391	99.2
WALKING GUNS & S	1	0.1	1392	99.3
WATER WINCH	6	0.4	1398	99.7
WATER WINCH & DR	1	0.1	1399	99.8
WELL	1	0.1	1400	99.9
WHITE BASE MICRO	1	0.1	1401	99.9
11/21/84	1	0.1	1402	100.0

rern crops

OBS	METHOD
1	DRIP IRRIGATION
2	DUAL OVERHEAD SPRINKLER
3	FERN IRRIGATION
4	JET SPRINKLERS
5	LOW PRESSURE VOLUME
6	MICRO-JET
7	MICRO-JET & OVERHEAD SPRINKLERS
8	MICROJET & OVERHEAD SPRINKLERS
9	OVER-HEAD SPRINKLER
10	OVERHEAD
11	OVERHEAD & DRIP
12	OVERHEAD & JET
13	OVERHEAD & LOW VOLUME MICROJET
14	OVERHEAD & MICRO-JET
15	OVERHEAD & MICRO-JET SPRINKLER SYSTEM
16	OVERHEAD & MICRO-JET SPRINKLERS
17	OVERHEAD & MICROJET SPRINKLERS
18	OVERHEAD & MIST SPRINKLERS
19	OVERHEAD & PIVOT
20	OVERHEAD AND PIPE SPRINKLER SYSTEM
21	OVERHEAD DRIP
22	OVERHEAD IRRIGATION
23	OVERHEAD RAINBIRD
24	OVERHEAD SPINKLERS
25	OVERHEAD SPRINKELRS
26	OVERHEAD SPRINKERS
27	OVERHEAD SPRINKLER
28	OVERHEAD SPRINKLER & LARGE SPRAY GUN
29	OVERHEAD SPRINKLER & MICRO-JET
30	OVERHEAD SPRINKLER AND MICRO-JET
31	OVERHEAD SPRINKLER SYSTEM
32	OVERHEAD SPRINKLERS
33	OVERHEAD WALKING GUN
34	OVERHEAD, TRAVELING GUN & MICRO-JET SPRINKLERS
35	PIVOTING SPRINKLERS
36	PUMPED
37	RAINBIRD SPRINKLERS
38	RAINBIRDS
39	RAISED SPRINKLERS
40	SPINKLER
41	SPRINKLER
42	SPRINKLER & FLOOD
43	SPRINKLER SYSTEM
44	SPRINKLER; LARGE GUN SPRAY AND LOW VOLUME
45	SPRINKLERS
46	SPRINKLERS & TRAVELING GUN
47	STAND PIE SPRINKLERS
48	STAND PIPE
49	STAND PIPES
50	STANDARD RAINBIRD
51	STANDPIPE SPRINKLERS
52	STANDPIPES

METHOD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
DRIP IRRIGATION	1	0.2	1	0.2
DUAL OVERHEAD SP	1	0.2	2	0.3
FERN IRRIGATION	2	0.3	4	0.6
JET SPRINKLERS	3	0.5	7	1.1
LOW PRESSURE VOL	1	0.2	8	1.2
MICRO-JET	3	0.5	11	1.7
MICRO-JET & OVER	1	0.2	12	1.9
MICROJET & OVERH	2	0.3	14	2.2
OVER-HEAD SPRINK	1	0.2	15	2.3
OVERHEAD	116	18.0	131	20.3
OVERHEAD & DRIP	1	0.2	132	20.4
OVERHEAD & JET	1	0.2	133	20.6
OVERHEAD & LOW V	1	0.2	134	20.7
OVERHEAD & MICRO	4	0.6	138	21.4
OVERHEAD & MIST	1	0.2	139	21.5
OVERHEAD & PIVOT	1	0.2	140	21.7
OVERHEAD AND PIP	1	0.2	141	21.8
OVERHEAD DRIP	1	0.2	142	22.0
OVERHEAD IRRIGAT	3	0.5	145	22.4
OVERHEAD RAINBIR	1	0.2	146	22.6
OVERHEAD SPINKLE	1	0.2	147	22.8
OVERHEAD SPRINKE	3	0.5	150	23.2
OVERHEAD SPRINKL	438	67.8	588	91.0
OVERHEAD WALKING	1	0.2	589	91.2
OVERHEAD, TRAVEL	1	0.2	590	91.3
PIVOTING SPRINKL	1	0.2	591	91.5
PUMPED	1	0.2	592	91.6
RAINBIRD SPRINKL	1	0.2	593	91.8
RAINBIRDS	1	0.2	594	92.0
RAISED SPRINKLER	1	0.2	595	92.1
SPINKLER	1	0.2	596	92.3
SPRINKLER	14	2.2	610	94.4
SPRINKLER & FLOO	1	0.2	611	94.6
SPRINKLER SYSTEM	3	0.5	614	95.0
SPRINKLER; LARGE	1	0.2	615	95.2
SPRINKLERS	19	2.9	634	98.1
SPRINKLERS & TRA	1	0.2	635	98.3
STAND PIE SPRINK	1	0.2	636	98.5
STAND PIPE	5	0.8	641	99.2
STAND PIPES	1	0.2	642	99.4
STANDARD RAINBIR	1	0.2	643	99.5
STANDPIPE SPRINK	1	0.2	644	99.7
STANDPIPES	2	0.3	646	100.0

Potato Crops

OBS	METHOD
1	DITCH SEEPAGE
2	FLOOD & OPEN DITCH
3	FLOOD SEEPAGE
4	FURROW
5	OPEN DITCH
6	OPEN DITCH & PIPELINE SEEPAGE
7	OPEN DITCH SEEPAGE
8	OPEN FLOOD
9	OPEN SEEPAGE
10	PIPELINE
11	PIPELINE & OPEN DITCH
12	PIPELINE & OPEN SEEPAGE
13	PIPELINE SEEPAGE
14	PIPELINE SEEPAGE & CENTER PIVOT
15	PIPELINE SEEPAGE & FLOOD
16	PIPELINE SEEPAGE & OPEN DITCH
17	PIPELINE SEEPAGE & VOLUME GUN
18	PIPELINE SEEPAGE AND TILE DRAIN
19	PIPELINE SEEPAGE SYSTEM
20	POTATOES
21	SEEPAGE
22	SEEPAGE AND OPEN DITCH
23	SEEPAGE AND OPEN-DITCH
24	SEEPAGE AND PIPELINE
25	SEEPAGE OR SPRINKLERS
26	SEEPAGE PIPELINE
27	SEEPAGE TURBINE PUMP
28	UNDER GROUND SEEPAGE
29	UNDERGROUND
30	UNDERGROUND & PIPELINE SEEPAGE
31	UNDERGROUND PIPE SYSTEM

METHOD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
DITCH SEEPAGE	1	0.6	1	0.6
FLOOD & OPEN DIT	1	0.6	2	1.2
FLOOD SEEPAGE	1	0.6	3	1.8
FURROW	1	0.6	4	2.4
OPEN DITCH	7	4.1	11	6.5
OPEN DITCH & PIP	1	0.6	12	7.1
OPEN DITCH SEEPA	5	3.0	17	10.1
OPEN FLOOD	1	0.6	18	10.7
OPEN SEEPAGE	1	0.6	19	11.2
PIPELINE	14	8.3	33	19.5
PIPELINE & OPEN	3	1.8	36	21.3
PIPELINE SEEPAGE	110	65.1	146	86.4
POTATOES	1	0.6	147	87.0
SEEPAGE	6	3.6	153	90.5
SEEPAGE AND OPEN	4	2.4	157	92.9
SEEPAGE AND PIPE	4	2.4	161	95.3
SEEPAGE OR SPRIN	1	0.6	162	95.9
SEEPAGE PIPELINE	2	1.2	164	97.0
SEEPAGE TURBINE	1	0.6	165	97.6
UNDER GROUND SEE	1	0.6	166	98.2
UNDERGROUND	1	0.6	167	98.8
UNDERGROUND & PI	1	0.6	168	99.4
UNDERGROUND PIPE	1	0.6	169	100.0