

Georgia Environmental Protection Division
Lower Flint-Ochlockonee Council
Agricultural Water Use

I. BACKGROUND

Agricultural water use includes both crop production and non-crop agricultural (livestock, nurseries, etc.) water use. Additionally, in Georgia, some golf courses have agricultural water withdrawal permits for their irrigation systems, and therefore, are included in agricultural water use numbers. The agricultural water use forecasts by the University of Georgia (UGA) for the water planning process and additional estimates developed with industry input to address sectors not included in the original forecast from UGA. More information on the agricultural water use forecasts can be found at the following UGA website: <http://www.nespal.org/SIRP/waterinfo/State/AWD/AgWaterDemand.htm>

II. UGA Agricultural Water Use Forecasts

Forecasts of agricultural water use were prepared by the University of Georgia under contract with the Georgia Environmental Protection Division and the Georgia Environmental Finance Authority. The purpose of the contracts was to prepare forecasts of irrigation water demand that will meet the needs of the agricultural sector for the Georgia economy during the first half of this century. The projections covered the row and orchard crops as well as most vegetable and specialty crops that cover more than 95% of Georgia's irrigated land.

The forecasts provided projections of agricultural irrigation water demand for groundwater and for surface water sources for the years 2011, 2020, 2030, 2040, and 2050. Each year's projection included wet year, normal year, and dry year use estimates to support planning for a range of weather conditions that might reasonably be encountered in future years.

The forecasts were computed as the product of three values:

- Projected irrigated area for a crop (acres),
- Predicted monthly irrigation application depth (inches),
- Proportion of irrigation water derived from a source (fraction).

To be consistent with other water planning efforts, acre-inches per month was converted to million gallons per day (MGD) by converting to gallons/month and dividing by the days in the month. For annualized summaries, withdrawals in million gallons were summed for the year and divided by 365 days.

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The forecasted agricultural demand for the Lower Flint-Ochlockonee Water Planning Region is shown in Table 1.

Table 1: Agricultural Water Forecasts by County for the Lower Flint-Ochlockonee Region						
County	Aggregate Dry Year Agricultural Forecasts ^{1,2}					Current Livestock Estimate
	2010	2020	2030	2040	2050	2010
Baker	42.86	43.92	45.26	46.71	48.28	0.14
Calhoun	28.57	28.98	29.53	30.13	30.79	0.22
Colquitt	49.27	52.85	57.25	62.14	67.58	0.68
Decatur	69.17	72.79	77.36	82.44	88.12	0.26
Dougherty	33.26	33.53	33.92	34.32	34.75	0.04
Early	40.70	41.65	42.86	44.16	45.58	0.26
Grady	22.31	22.84	23.55	24.33	25.20	0.40
Lee	44.65	45.08	45.77	46.52	47.35	0.36
Miller	54.80	56.68	59.07	61.69	64.58	0.30
Mitchell	100.21	102.76	106.07	109.73	113.76	1.24
Seminole	53.77	55.72	58.15	60.81	63.72	0.15
Terrell	25.73	26.39	27.22	28.11	29.08	0.08
Thomas	13.93	14.37	14.92	15.53	16.19	0.44
Worth	32.78	34.17	35.90	37.80	39.90	0.30
Total	612	632	657	684	715	4.9

Notes:
 1. Values reflect annual average daily use in millions of gallons per day for dry (75th percentile drought condition) years.
 2. Aggregate demand is representative of forecasted water use for crop and nursery (green industry) irrigation. Values for current golf course irrigation are also included and held constant through 2050.

III. Other Agricultural Water Uses

After the initial review of the UGA forecasts for water use by the agricultural sector, several additional estimates were developed by council members and industry leaders in cooperation with UGA, EPD, and other agencies and organizations. These additional estimates were made to provide water use information on sub-sectors of agriculture that were not included in the initial UGA forecasts. Generally, these sub-sectors were not a substantial portion of use statewide, but they were substantial in some water planning regions.

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Green Industry

Representatives from several regional water councils worked with leaders from the state green industry and several agencies and organizations (e.g., EPD, UGA, Albany State University - Georgia Water Planning and Policy Center) to develop estimates and forecasts of water use by the green industry (in-ground, container and low input nurseries and greenhouse operations). These estimates were incorporated into the UGA forecasts discussed above and are reflected in Table 1.

Animal Operations

Water demands for livestock production were estimated for current conditions for EPD through a collaborative effort led by the University of Georgia and the Albany State University - Georgia Water Planning and Policy Center in partnership with representatives of various regional water councils and leaders from the state livestock industry. Generally, these operations use less than 100,000 gallons per day, which is the threshold level of use at which an agricultural withdrawal permit is required, and therefore most of these users are not included in permit withdrawal information.

The livestock estimates that were developed by this collaborative represent the water used to raise livestock, not including processing facilities. The estimates were organized by water planning region, but data was lacking to allocate this use to water sources and river basins. Therefore, these estimates were not included in the resource assessment modeling by EPD. However, they were provided to the regional water councils as information to consider when evaluating water use.

A discussion of the methods used to develop these estimates and the results for the Lower Flint-Ochlockonee Region are included as Appendix A in this document. Total water use by livestock operations in the Lower Flint-Ochlockonee Region is estimated to be 4.85 million gallons per day.

Golf Courses

Water use estimates for golf courses with agricultural withdrawal permits for their irrigation systems were developed through a collaborative analysis by EPD and the Georgia Golf Course Superintendents Association. Current water use under normal and dry climate conditions was estimated for existing permitted golf courses. The golf course estimates were included in the

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resource assessment modeling inputs, but because only current use estimates were available, the current dry year estimates were held constant through the planning horizon.

A discussion of the methods used to develop these methods and the results are included as Appendix B in this document. Total water use by golf courses with agricultural withdrawal permits in the Lower Flint-Ochlockonee Region is estimated to be 1.305 million gallons per day in a normal year and 2.785 million gallons per day in a dry year.

http://www.nespal.org/SIRP/waterinfo/State/AWD/AgWaterDemand_NonPrmt&Animal.htm

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*Water for Georgia's Livestock**

Mark Masters
Flint River Water Policy Center
Albany State University, Albany, GA



(UGA Photo/Jay Oliver)

In counties and planning regions where there are substantial quantities of animals, their water needs should be included in any planning for future water use. As planners in the Water Councils heard presentations about agricultural demand for irrigation water, many asked, "What about animal water use?" To address this question in a consistent manner across livestock interests and regions, an ad hoc team of experts was pulled together to estimate animal water use in current farming operations. While this group did not predict numbers of animals that would be using water use in future use, they did determine aggregate water use in each livestock sector for each county and planning region. Participants included representatives from the Water Councils, The Georgia Farm Bureau, Georgia Cooperative Extension Service, Georgia Milk Producers, Inc., and the Georgia Poultry Federation. Data was assembled at the Flint River Water Policy Center.

**Includes Non-Permitted Uses:* State regulations require that farmers who withdraw more than 100,000 gpd from streams and aquifers obtain a permit from the Environmental Protection Division. While that limit means that most field irrigation withdrawals fall into the permit category, the opposite is true for livestock watering and other animal-related water uses. Excepted in larger confinement systems or dairies, most farms and farmers use less than 100,000 gallons per day supplying water needs for animals.

Data Set: [Livestock Water Use](#).

County-by-county record of annual water use by various sectors of animal agriculture.
(Excel file - last update 11/30/2009)

PROCEDURES:

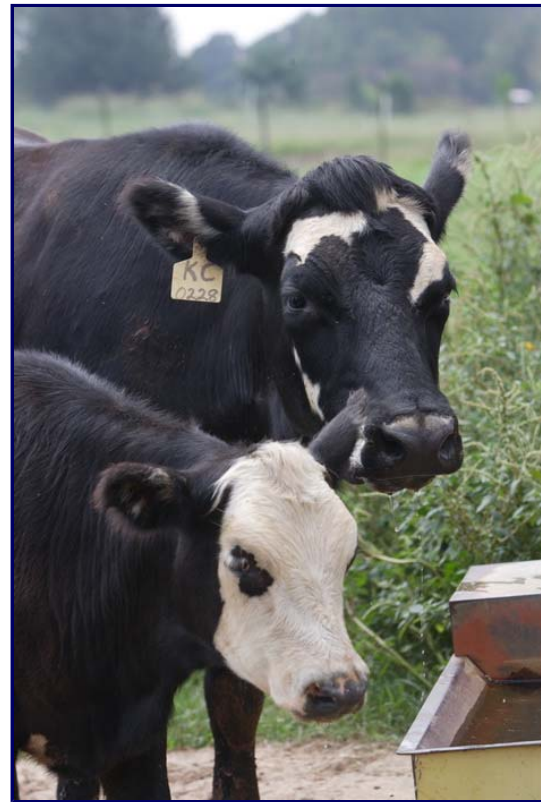
Beef Cattle, Goats, Sheep and Horses

Total annual water use was calculated by multiplying the total number of animals (head) by the estimated daily water use per head by 365 days. Total head per county data for 2008 was compiled by Mark Masters (ASU Flint River Water Policy Center) using the [Georgia Statistics System](#) operated by the UGA Center for Agribusiness and Economic Development. Daily water use per head was compiled by Mark Risse (UGA Biological and Agricultural Engineering) and estimated as follows:

- Beef Cattle – 15 gallons per day (gpd)/head

- Goats – 2.5 gpd/head
- Sheep – 2.5 gpd/head
- Horses – 12 gpd/head

It was assumed that drinking water was the only requirement that contributed to total use. An estimate from the higher end of the range found in the literature was used to account for losses such as leaks and evaporation.



(UGA Photo/John Amis)



(UGA Photo/John Amis)

Swine

Total annual water use was calculated by multiplying the total head per county by the estimated daily water use per head by 365 days. Total head per county data for 2008 was compiled by Mark Masters using the Georgia Statistics System operated by the UGA Center for Agribusiness and Economic Development. Daily water use per head was compiled by Mark Risse. Unfortunately, it is difficult to know exactly what the total head county numbers are based on. On a farrow to finish operation, there would be a lot more feeder pigs than sows. A low end drinking water requirement for a sow was used to account for this since it is assumed the total number of pigs is probably biased toward more feeder size pigs than sows.

- Drinking 3 gpd/head
- Cooling/building wash 1 gpd (these are closed cooling systems usually)
- Waste Management 25 gpd (assumes much lower use of recycled water)
- 5% for losses such as leaks/evaporation/etc.
- Total Use 30 gpd/head

Dairy

Total annual water use was calculated by multiplying the total head per county by the estimated daily water use per head by 365 days. Total head per county and estimated daily water use per head information was compiled by the [Georgia Milk Producers, Inc.](#) in coordination with local dairy producers throughout Georgia.:

- Cow Drinking – 40 gpd/head
- Cow Cooling – 33 gpd/head
- Milk Equipment Washing – 5 gpd/head
- Parlor Flushing (freshwater portion) – 30 gpd/head
- Feed Equipment Cleaning – 3 gpd/head
- Total Use – 111 gpd/head



(UGA Photo/John Amis)

In addition, water use per head for heifers was estimated at 15 gpd/head. Total number of heifers was assumed to be 90% of total number of cows.

Poultry

Total annual water use was calculated by multiplying the total head per county by the estimated daily water use per head by 365 days. Total head per county (broilers only) was based on the [2007 USDA Census of Agriculture](#). Daily water use per head (0.68 gpd) was estimated from a number of representative broiler houses by Brian Fairchild (UGA Extension Poultry Science). Water consumption includes both bird and evaporative cooling water usage. It is assumed that a farm will have birds on site 285 days of the year assuming 5.5 flocks per year with 14 day downtime between flocks.



(UGA Photo/Stephen Morton)



(UGA Photo/John Amis)

Last updated 02/02/2010 James E. Hook

LOWER FLINT-OCHLOCKONEE WATER PLANNING REGION

Water Use by Livestock, Gallons per Year (2008)

County	Beef	Dairy	Goat/Sheep	Horse	Swine	Poultry	TOTAL
Baker	35,587,500	0	456,250	87,600	547,500	14,101,500	50,780,350
Calhoun	42,431,250	0	0	109,500	0	36,792,000	79,332,750
Colquitt	79,935,000	0	1,163,438	473,040	17,793,750	149,042,607	248,407,835
Decatur	37,777,500	39,171,435	547,500	0	7,117,500	9,493,225	94,107,160
Dougherty	14,235,000	0	593,125	438,000	0	0	15,266,125
Early	90,337,500	0	114,063	525,600	3,285,000	0	94,262,163
Grady	100,740,000	13,859,963	844,063	2,628,000	2,463,750	23,866,500	144,402,275
Lee	43,800,000	84,068,625	182,500	876,000	1,642,500	0	130,569,625
Miller	79,387,500	0	228,125	0	22,995,000	7,024,500	109,635,125
Mitchell	85,957,500	205,172,888	479,063	4,380,000	0	155,224,762	451,214,212
Seminole	41,610,000	4,907,790	410,625	1,357,800	6,351,000	0	54,637,215
Terrell	29,291,250	0	150,563	876,000	657,000	0	30,974,813
Thomas	98,276,250	35,536,035	120,450	1,248,300	2,025,750	21,997,500	159,204,285
Worth	62,962,500	34,536,300	1,998,375	1,095,000	164,250	7,826,700	108,583,125
<i>Planning Region Total</i>	842,328,750	417,253,035	7,288,138	14,094,840	65,043,000	425,369,294	1,771,377,057

http://www.nespal.org/SIRP/waterinfo/State/AWD/AgWaterDemand_GolfCourses.htm

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*Water Use For Georgia Agricultural (Farm Use) Withdrawal Permitted Golf Courses**

Cliff Lewis
Georgia Environmental Protection Division
Tifton, GA



(NAIP Imagery, GoogleEarth (tm))

In counties and state water planning regions where there are non-municipality water supplied golf courses, their water needs should be included in any planning for future water use. To address this need in a consistent manner across state water planning regions, the Georgia Golf Course Superintendents Association (GGCSA) partnered with Georgia EPD to estimate water use in current agriculturally permitted golf course operations. In addition, Clint Waltz, University of Georgia Assistant Professor and Turfgrass Extension Specialist, UGA Campus at Griffin, provided data related to his research on GGCSA Best Management Practices (BMPs). That data provided on annual irrigation needs for well-managed golf courses. Although the data presented here does not forecast golf course water use in the future, it does provide water use estimates in an average rainfall year and in a dry year. These annual amounts are representative of Georgia golf course turf water use. Data was assembled by Georgia EPD's Agricultural Permit Program in Tifton, Georgia.

**Includes only Golf Course Agricultural (Farm Use) Permits:* State regulations require that farmers and others who withdraw more than 100,000 gpd from streams and aquifers obtain a permit from the Environmental Protection Division. With that limit, most golf course irrigation systems require permits. However, provisions in Georgia Code stipulate alternate permitting for golf courses in certain areas:

Under the 1988 Amendments to the Georgia Water Quality Control Act, a 'Farm Use' is defined as follows:

*"...irrigation of any land used for general farming, forage, aquaculture, pasture, turf production, orchards, or tree and ornamental nurseries; provisions of water supply for farm animals, poultry farming, or any other activity conducted in the course of farming operations. Farm uses shall also include the processing of perishable agricultural products **and the irrigation of recreational turf**, except in the Chattahoochee River watershed upstream from the Peachtree Creek confluence, where irrigation of recreational turf shall not be considered a farm use."*

The Georgia Groundwater Use Act defines a 'Farm Use' as follows:

*"...irrigation of any land used for general farming, forage, aquaculture, pasture, turf production, orchards, or tree and ornamental nurseries; provisions of water supply for farm animals, poultry farming, or any other activity conducted in the course of a farming operation. Farm uses shall also include the processing of perishable agricultural products **and the irrigation of recreational turf**, except in Chatham, Effingham, Bryan, and Glynn counties, where irrigation of recreational turf shall not be considered a farm use."*

In cases where recreational areas, including golf courses, are not considered farm uses, golf course withdrawals for irrigation are permitted as other commercial uses in those areas. Additionally, some golf courses, typically community owned, receive their water from local municipal suppliers. **Water use for golf courses with municipal and industrial permits or municipal supplies are NOT included in the statewide estimates of (farm use) golf course irrigation withdrawals given below.**

Data Sets: Agricultural Permitted Golf Courses

Water Use By Permitted Golf Courses in each Water Planning Region.

Region by Region record of total annual water use by golf courses.
(Excel file - last update 4/13/2010)

Water Use By Permitted Golf Course by water source in each Water Planning Region.

WPR-by-WPR record of annual golf course irrigation water use by permitted sources.
(Excel file - last update 4/13/2010)

Water Use By Permitted Golf Course by water source in each county

County-by-county record of annual golf course irrigation water use by permitted sources.
(Excel file - last update 4/13/2010)

ASSUMPTIONS:

Some assumptions were made in order to calculate estimated water use for Georgia Agriculturally permitted golf courses:

1. Water use calculations were made using permitted acreages for Ag permitted golf courses in the EPD agricultural permit database. These permitted acreages represent the most reliable source of irrigated acreage information currently available to EPD. No comparison has been made between area permitted and as-installed area of tees, greens, fairways, and other irrigated landscapes within those golf courses.
2. “The standard recommendation for turfgrass irrigation is one-inch of water per week, supplemental to rainfall, and Georgia has a 30 week growing season (April 1 to October 31). Therefore, 30 inches of irrigation would be recommended.” (Clint Waltz, Research Update: Evaluation of the GGCSA BMPs, 2008).
3. Using water use reported in GGSCSA BMPs, the average water use was 14.06 inches per year (Clint Waltz, Research Update: Evaluation of the GGCSA BMPs, 2008).
4. Since none of the water application depths in Clint Waltz's GGCSA's BMPs were reported as “average”, “wet”, or “dry” years, it is assumed that the data was from “average” years. This assumption is credible when you compare the 14.06 inches per year number with the 12.30 inches per year calculated by EPD from 2005 (wet year) GGCSA BMP water use data for the 61 county provided to EPD by GGCSA during the 2007 Level IV drought period. The reason 12.30 inches is not used in the range produced here is because the number is only representative of approximately one year of collected water use golf course data (2005). Waltz's calculation of 14.06 inches is representative of golf course water use collected from 2004 – 2007 GGCSA member golf courses of and is thereby a more expansive data set.

PROCEDURES:

Using the above assumptions and water use as reported in the GGCSA BMPs, the average use was 14.06 acre-inches per year. Since 30 acre-inches is optimal, a water use range of 14.06 – 30 acre-inches per year was produced. The 14.06 acre-inches represent an “Average rainfall year”, and the 30 acre-inches represents a “Dry year (no rainfall)”.

For each EPD Ag permitted golf course, the “average rainfall year” water use was calculated by multiplying the total number of permitted acreage by 14.06 acre-inches. This calculation provided the total acre-inch water use in a year of average rainfall, for an April 1 – October 31 growing season.

Similarly, for each EPD Ag permitted golf course, the “Dry year (no rainfall)” water use was calculated by multiplying the total number of permitted acreage by 30 acre-inches. This calculation provided the total acre-inch water use in a dry year of no rainfall, for an April 1 – October 31 growing season.

Conversions:

1 MGD = 1120 acre-feet per year

1120 acre-feet X 12 = 13, 440 acre-inches

1 MGD = 13, 440 acre-inches



SCENARIOS THAT REQUIRE A GOLF COURSE TO USE IN EXCESS OF 30 ACRE-INCHES IN A GROWING SEASON:

- *Overseeding* - Overseeding is needed in order to keep a golf course in playing condition throughout the entire year. Overseeding is done when a golf course's main grass in the fairways, tee boxes, and greens is about to go into its dormant stage. The overseeding procedure is performed by placing a great deal of seed onto the course. In order for the seed to take, enough water must be used for the seed to germinate. At times after the seed has germinated and grown into the ground irrigation may continue to be necessary to ensure the seed takes.
- *Grow-in / Renovations* – Newly planted turf will require more water than an established turf.
- *Fertilizer/Pesticide Application* – Additional irrigation gets the material into the ground where it can be used by plants and turf.
- *Sandy Soils* - Sandy soils are light and have a poor ability to hold water.
- *Salt-Water Flushing* - In Coastal areas, salt can become problematic to turfgrass. Salt reduces the ability of plants and turfgrass to take up water and causes reductions in growth rate.

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***Water Use For Georgia Agricultural (Farm Use) Withdrawal Permitted
Golf Courses in State Water Planning Regions as of 11/23/2009***

SWP Region	Total Number of Permits	Total Permitted Acres	Average rainfall year water use, GPD	Dry year (no rainfall) water use, GPD	Average- year MGD	Dry-year MGD
Altamaha	20	1159	1,212,299	2,586,697	1.212	2.587
Coastal Georgia	7	924	966,492	2,062,216	0.966	2.062
Coosa_North Georgia	21	2437	2,549,070	5,438,983	2.549	5.439
Lower Flint_ Ochlockonee	16	1248	1,305,392	2,785,331	1.305	2.785
Middle Chattahoochee	17	1269	1,327,357	2,832,199	1.327	2.832
Middle Ocmulgee	26	1677	1,754,120	3,742,788	1.754	3.743
MNGWPD	113	12077	12,632,385	26,953,879	12.632	26.954
Savannah_Upper Ogeechee	31	3585	3,749,863	8,001,131	3.750	8.001
Suwannee_Satilla	22	1402	1,466,474	3,129,034	1.466	3.129
Upper Flint	10	824	861,893	1,839,033	0.862	1.839
Upper Oconee	32	3377	3,532,298	7,536,909	3.532	7.537
Totals	315	29,979	31,357,643	66,908,200	31.358	66.908

* Athletic Fields Not Included in this Data Set

GPD = Gallons Per Day

MGD = Million Gallons Per Day

**Water Use For Georgia Agricultural (Farm Use) Withdrawal Permitted Golf Courses by Water Source in State
Water Planning Regions as of 11/23/2009**

SWP Region	Permit Type	Number Of Permits	Total Permitted Acres	Average rainfall year water use, GPD	Dry year (no rainfall) water use, GPD	Average-year MGD	Dry-year MGD
Altamaha	Groundwater	11	538	562,741	1,200,728	0.563	1.201
Altamaha	Surface Water	7	431	450,820	961,921	0.451	0.962
Altamaha	Well to Pond	2	190	198,738	424,049	0.199	0.424
Coastal Georgia	Groundwater	3	260	271,957	580,277	0.272	0.580
Coastal Georgia	Surface Water	3	460	481,154	1,026,644	0.481	1.027
Coastal Georgia	Well to Pond	1	204	213,381	455,294	0.213	0.455
Coosa_North Georgia	Groundwater	7	810	847,249	1,807,787	0.847	1.808
Coosa_North Georgia	Surface Water	14	1627	1,701,821	3,631,197	1.702	3.631
Lower Flint_Ochlockonee	Groundwater	10	666	696,627	1,486,403	0.697	1.486
Lower Flint_Ochlockonee	Surface Water	2	105	109,829	234,343	0.110	0.234
Lower Flint_Ochlockonee	Well to Pond	4	477	498,936	1,064,586	0.499	1.065
Middle Chattahoochee	Groundwater	1	200	209,197	446,367	0.209	0.446
Middle Chattahoochee	Surface Water	15	969	1,013,561	2,162,649	1.014	2.163
Middle Chattahoochee	Well to Pond	1	100	104,599	223,184	0.105	0.223
Middle Ocmulgee	Groundwater	9	302	315,888	674,014	0.316	0.674
Middle Ocmulgee	Surface Water	13	988	1,033,435	2,205,054	1.033	2.205
Middle Ocmulgee	Well to Pond	4	387	404,797	863,720	0.405	0.864
MNGWPD	Groundwater	24	1831	1,915,202	4,086,491	1.915	4.086
MNGWPD	Surface Water	83	9406	9,838,553	20,992,646	9.839	20.993
MNGWPD	Well to Pond	6	840	878,629	1,874,742	0.879	1.875
Savannah_Upper Ogeechee	Groundwater	11	1730	1,809,557	3,861,076	1.810	3.861
Savannah_Upper Ogeechee	Surface Water	18	1745	1,825,247	3,894,553	1.825	3.895
Savannah_Upper Ogeechee	Well to Pond	2	110	115,059	245,502	0.115	0.246
Suwannee_Satilla	Groundwater	9	605	632,822	1,350,261	0.633	1.350
Suwannee_Satilla	Surface Water	7	415	434,085	926,212	0.434	0.926
Suwannee_Satilla	Well to Pond	6	382	399,567	852,561	0.400	0.853
Upper Flint	Groundwater	4	294	307,520	656,160	0.308	0.656
Upper Flint	Surface Water	5	400	418,395	892,734	0.418	0.893
Upper Flint	Well to Pond	1	130	135,978	290,139	0.136	0.290
Upper Oconee	Groundwater	3	83	86,817	185,242	0.087	0.185
Upper Oconee	Surface Water	27	3104	3,246,744	6,927,618	3.247	6.928
Upper Oconee	Well to Pond	2	190	198,738	424,049	0.199	0.424
Totals		315	29,979	31,357,643	66,908,200	31.358	66.908

* Athletic Fields Not Included in this Data Set

GPD = Gallons Per Day

MGD = Million Gallons Per Day