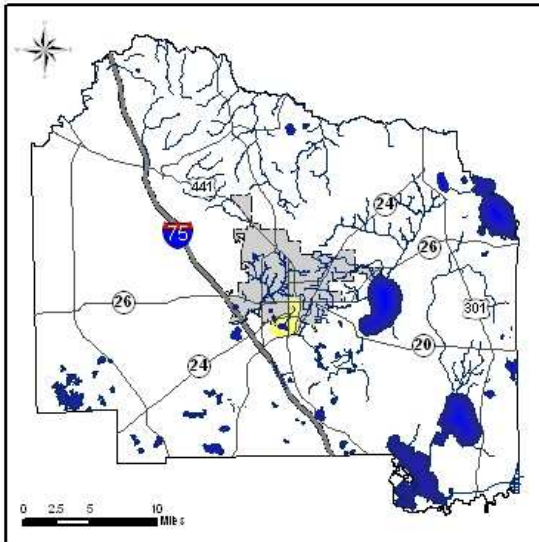


### 3.1 Introduction

Bivens Arm is a small shallow lake located in southwest Gainesville (Figure 3.1 and 3.2). The surface area of the lake is approximately 189 acres (Lakewatch 2000). The lake supports a wide diversity of plant and animal life in an urban setting, and is part of the Tumblin Creek Watershed. Tumblin Creek, which is fed by small springs and seeps originating upstream of Shands at Alachua General Hospital (AGH), drains into Bivens Arm and is the primary source of drainage into the lake. Bivens Arm forms the northern extension of the greater Paynes Prairie Watershed.



**Figure 3.1** Location of Bivens Arm in the Tumblin Creek Watershed

Bivens Arm is a solution lake in which the underlying limestone has been eroded by fluvial (water) processes. Sediments surrounding the lake are fine to medium grained sands, silts, and clays originating from the Plio-Pleistocene age and from the Miocene age Hawthorn Group formations, which are comprised of quartz sands, silts, clayey sands and sandy clays, carbonates (limestone and dolostone), and phosphates (Scott 1988, White 1970).



**Bivens Arm Lake**

The early history of Bivens Arm is not well documented. The earliest known use of the land around the lake was as hunting grounds by Native Americans. Beginning in the late 1800's, the land was used mostly for agricultural purposes including cattle ranching, swine farms, vegetable farms, and orange groves.

In the 1930's, Bivens Arm was designated as a bird sanctuary and rookery and was cared for by a resident ranger (Pickard 1994). In 1965, the State of Florida designated the lake area as a wildlife sanctuary (Bill No. 1356 Chapter 65 1005). In 1981, the City of Gainesville purchased the land between the lake and Williston Road to form the Bivens Arm Nature Park. This park features a lush live oak hammock habitat and marshlands that periodically become inundated.

Bivens Arm Lake provides an urban sanctuary for many species of plants and animals. Alligators can often be seen basking on the lake's surface, and osprey and bald eagles can be observed hunting overhead. Other common bird species include herons, egrets, ibis, gallinules, double-crested cormorants, and anhingas.

Wildlife can be best observed from the Bivens Arm Nature Park, as all other land around Bivens Arm is privately owned or has limited access. An array of freshwater fish exist in the lake including native species such as the speckled perch and exotic species such as blue tilapia. Angling on the lake is a popular activity and species commonly caught include catfish, blue tilapia, black crappie, bass, bluegill, and shellcrackers.

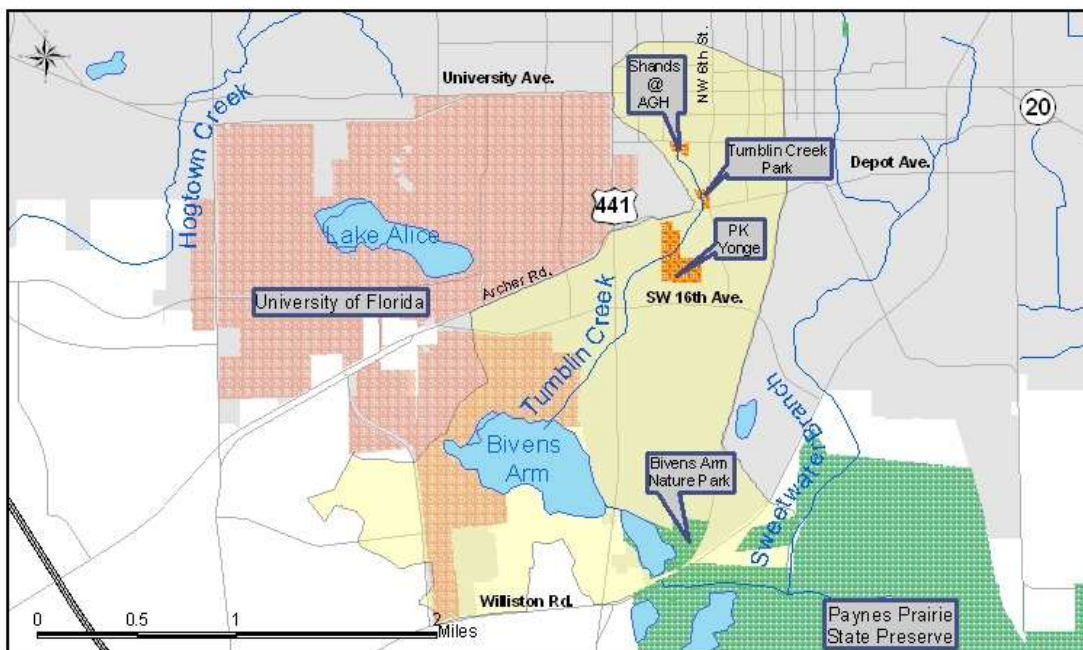
**3.2 Water Quality**

Bivens Arm Lake is surrounded by a restaurant, a hotel, apartments, private residences, and University of Florida restricted access property. According to the City of Gainesville (2002), 60% of the watershed is impervious. Due to its urban location and impervious drainage area, the lake receives large quantities of stormwater runoff from urban and commercial lots and surrounding roads including SW 13th Street (US 441), which bisects the lake.

**Table 3.1 Water quality summary for Bivens Arm Lake**

Parameter	unit	Count (n)	Median
Alkalinity (Alk)	mg/L	65	71.5
Chlorophyll a corrected	ug/L	65	56.23
Dissolved Oxygen (DO)	mg/L	63	10.87
pH	SU	63	8.92
Secchi	m	68	0.295
Turbidity (Turb)	NTU	65	20.0
Ammonia, total (NH <sub>4</sub> -T)	mg/L	16	0.020
Nitrate + Nitrite, total (NO <sub>x</sub> -T)	mg/L	16	0.016
Total Kjeldahl Nitrogen, total (TKN-T)	mg/L	65	2.160
Total Nitrogen, total (TN-T)	mg/L	16	2.781
Orthophosphate, total (PO <sub>4</sub> -T)	mg/L	16	0.070
Total Phosphorous, total (TP-T)	mg/L	65	0.181

The lake is classified as hypereutrophic as indicated by the high levels of nutrients, extensive algal and vascular plant growth, and high productivity (Lakewatch 2000).



**Figure 3.2 Notable features of Bivens Arm Lake in the Tumblyn Creek Watershed**

Table 3.1 displays median water quality data for Bivens Arm. Generally speaking, water quality in Bivens Arm is similar to other large lakes in the Orange Creek Basin (OCB). The median Total Kjeldahl Nitrogen (TKN-T) concentration in Bivens Arm, 2.160 mg/L, falls between median values for Orange and Newnans lakes, 1.501 mg/L and 3.947 mg/L respectively (Figure 3.3).

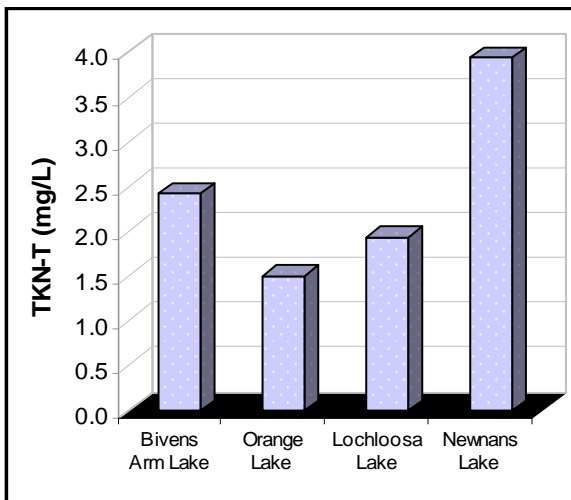


Figure 3.3 Median Total Kjeldahl Nitrogen (TKN-T) concentrations in Bivens Arm and surrounding lakes in the Orange Creek Basin

The median total phosphorous (TP-T) concentration in Bivens Arm at 0.181 mg/L, however, is higher than all the other large lakes in the Orange Creek Basin (Figure 3.4). The median chlorophyll a (corrected) concentration (56.23 µg/L) is mid-range among the other OCB lakes, with concentrations indicative of hypereutrophic conditions (Figure 3.5). High total phosphorous and TKN-T levels are likely caused by the nutrient inputs from Tumbling Creek and resuspension of nutrients deposited in the sediments as plants die and decay. Once these nutrients enter the lake, the longer retention times allow the nutrients to be utilized by algae and macrophytes.

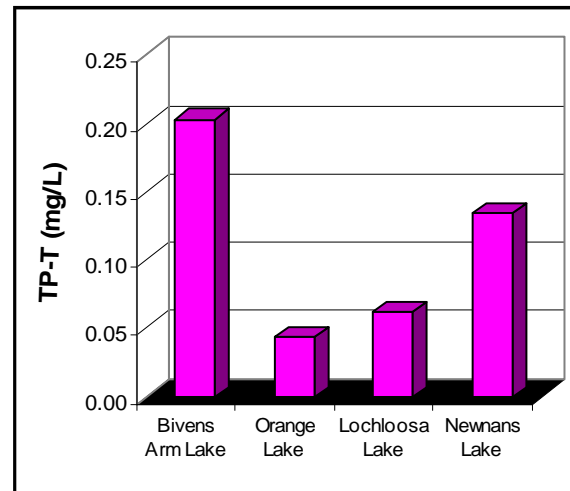


Figure 3.4 Median total phosphorus (TP-T) concentrations in Bivens Arm and surrounding lakes in the Orange Creek Basin

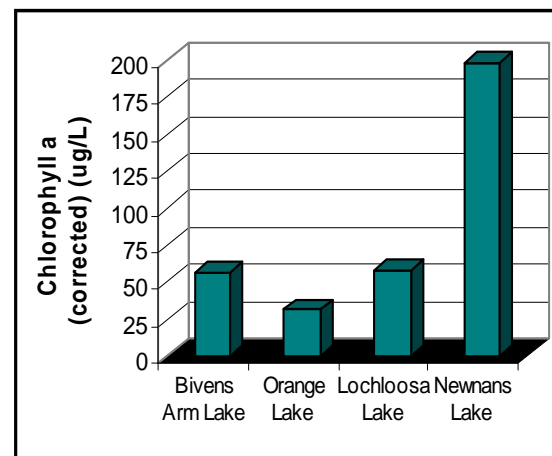


Figure 3.5 Median chlorophyll a (corrected) concentrations in Bivens Arm and surrounding lakes in the Orange Creek Basin

### 3.3 Aquatic Plant Management

Aquatic weeds have been a problem in Bivens Arm since the 1950's. Not all aquatic plants pose a nuisance, as they provide habitat for fish and lower trophic level organisms. Non-native, invasive species of aquatic plants, however, can out-compete native species and quickly spread throughout the water body resulting in densities that negatively impact fish

populations and human recreation (IFAS 2000). Several non-native species of plants have become established in Bivens Arm. Of these species, four are classified as 'Category I' invasive exotics by the Florida Exotic Plant Pest Council and have been targeted for control within the lake.

Hydrilla (*Hydrilla verticillata*) was introduced to Florida in the 1950's and has become a major aquatic weed problem in many waterbodies in the state. Several strategies for control have been implemented in Bivens Arm. In the spring of 1999, Alachua County released 2,500 triploid grass carp (*Ctenopharyngodon idella*) into Bivens Arm to manage the hydrilla that was overtaking the lake. The management plan specified the addition of grass carp in combination with periodic spraying of the herbicide Aquathol®-K to reduce the levels of hydrilla. By summer 2000, the grass carp had cleared the hydrilla from all but the shallow bank areas of the lake. The grass carp were so successful in the summer of 2000 that there was no additional spraying of Aquathol® -K. This change in vegetation is reflected in water quality changes. After the removal of the hydrilla, algae became the dominant open-water plant species, turning the water a green color. This switch in primary productivity is reflected in a dramatic rise in chlorophyll a (corrected) concentrations in Bivens Arm Lake in 2000 (Figure 3.6).

Water hyacinth (*Eichhornia crassipes*) was introduced into Florida in the late 1890's. Since that time, it has become one of Florida's major invasive plant problems. However, with current plant management practices, this plant is now under

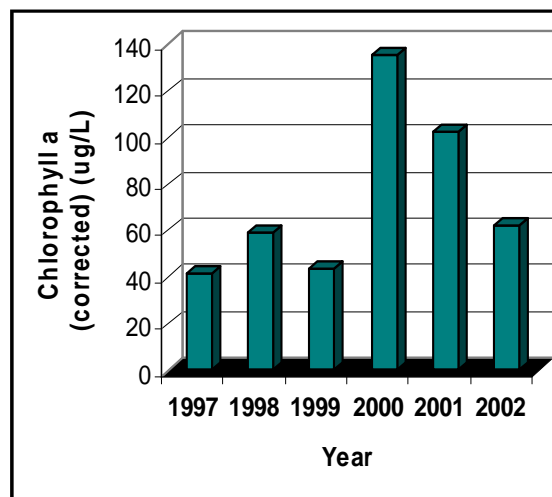
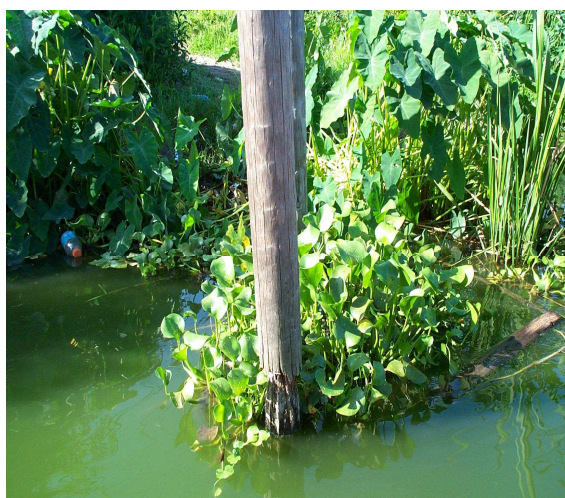


Figure 3.6 Chlorophyll a (corrected) concentrations in Bivens Arm Lake before and after the introduction of Grass Carp

control in most areas. In Bivens Arm, water hyacinth management has been achieved and only moderate levels of control are now necessary. Currently, water hyacinth is the only chemically controlled plant on the lake and is controlled using Reward® and 2,4-D.

Water lettuce (*Pistia stratiotes*) is an invasive species first recorded in Florida in 1765. It is less prevalent in Bivens Arm



Water Hyacinth (*Eichhornia crassipes*), an invasive exotic plant in Bivens Arm Lake

and can be controlled in the same manner as water hyacinth.

Wild taro (*Colocasia esculenta*) is an emergent, non-native invasive species which inhabits the shoreline of many Florida wetlands. In Bivens Arm this species has recently inhabited the shore and is becoming dominant along several areas. Control of this species is slated to begin in 2004 along state owned property.



**Wild Taro (*Colocasia esculenta*) growing along the shoreline of Bivens Arm Lake**

### 3.4 Summary

Existing water quality data indicate significantly elevated concentrations of chlorophyll and nutrients in Bivens Arm. The lake has been classified as hypereutrophic and is, therefore, in need of restoration and management efforts.

Nutrient inputs to Bivens Arm are largely from Tumblin Creek, and include:

- stormwater runoff containing fertilizers from residential, commercial, and agricultural activities
- wild animal and/or pet waste
- failing septic tank systems

- leaking sanitary sewer lines or sewer line connections and
- atmospheric deposition in the watershed

Stormwater quality data indicate that nutrients and suspended solids increase significantly in Tumblin Creek at US 441 directly upstream of Bivens Arm Lake. These high loads contribute considerable amounts of nutrients to the lake.

The implementation of recommendations outlined for Tumblin Creek in Chapter 2 is critical to the restoration of Bivens Arm. Water quality monitoring is proposed to continue in Bivens Arm Lake. The existing water quality data should be evaluated in detail and the monitoring program modified to address changes in the Tumblin Creek/Bivens Arm Watershed including the restoration of the wetlands on the north side of the lake.

Large capital expenditures and significant recurring operation and maintenance costs will likely be necessary as the restoration and management recommendations for Tumblin Creek are implemented. The FDEP, the SJRWMD, Alachua County, and the City of Gainesville must continue to work together to secure funding for these efforts.



**Overgrown forested area of Bivens Arm Lake**