NATURAL RESOURCES
WATER

A. Introduction

Water as rain, in rivers, streams and lakes, and underground - is a critical component of Alachua County's natural resource base, its ecology, its economy and its residents' quality of life. Water is a finite resource - all the water we have is what exists on our earth at this time. Although the vast majority of the Earth's surface is covered with water, the oceans and seas are salty. Only 3% is fresh - and two-thirds of that is ice. This means that only about half a percent of our planet's water resources is fresh water. Of these fresh water resources, 0.02% is found in rivers, lakes and streams while the rest, 0.48%, is ground water (APA, 2001). This tiny fraction of fresh water sustains a multitude of very specific life forms, including our own. Groundwater supplies the drinking water we need to survive. The economic support offered by plentiful and high quality surface waters includes agricultural irrigation, process and cooling waters for power plants, and chemical, steel, lumber, mining, and other industrial operations. In addition, lakes, rivers, and streams provide boating, swimming, fishing, and other forms of recreation.

The groundwater system is the principal source of water for domestic, agricultural, and industrial use in Alachua County. There are three aquifer systems present in Alachua County: the surficial aquifer system, the intermediate aquifer system and the Floridan aquifer system (SEGS, 1986). The Floridan aquifer system underlies the entire County. The surficial and intermediate aquifer systems are present only in the eastern portion of the County where sediments of the Hawthorn Group are present. These aquifers are described in Inset 5. Groundwater quality is generally good. However, with the potential for groundwater pollution, particularly in the area where the Floridan Aquifer is unconfined and the numerous stream to sink basins, it is necessary to continue monitoring groundwater on a long-term basis. In addition, policies that protect all three aquifers for potable supply and ecosystem health are necessary.

The surface water systems of Alachua County include areas of standing and flowing water, whether permanent, intermittent, or temporary, as well as the wetlands and floodplains associated with them. The rivers and streams that flow through Alachua County historically meandered through broad floodplains. Because of urbanization and agriculture, these broad floodplains have been restricted to narrower belts along the rivers and streams or otherwise modified for flood control. The general location of surface waters, wetlands, and floodplains today is shown on Map 17. For more detailed location and inventory of surface waters, the U.S. Fish and Wildlife Service, Florida Wetland Inventory maps and the USGS topographic maps are on file at the Alachua County Office of Planning and Development.

Surface water types in Alachua County include sand-bottomed creeks, large calcareous streams, springs, lakes, and ponds. Characteristics of these surface water bodies, as well as common plants and animals associated with them, are described in the context of three major study areas of water systems health: the Santa Fe River and springs, the Orange Creek Basin Study, and urban streams and creeks. A great wealth of wildlife may be found frequenting surface waters, and nearly all species do so at times. They may thus be considered as components of the surface water communities. Some species, however, may be considered as being truly aquatic, relying on those habitats for survival at nearly all times. For example, the Suwannee Cooter, the Florida Chorus Frog and the Pugnose Minnow are species which are endemic to aquatic communities in Alachua County. Although the species may be found in other portions of Florida, they are found no where else in the world.

Within the modified landscape, remaining riparian habitat is of great value to resident and migratory animal species as it provides corridors and linkages to and from the biotic regions of the County. The numerous essential habitat elements provided by the remaining riparian/riverine corridors in Alachua County make them perhaps the most significant contributor to wildlife habitat throughout the County.

Inset 5: Three Aquifer Systems in Alachua County

Surficial Aquifer

The surficial aquifer occurs primarily near the surface and consists of a few feet of sands of the Plio-Pliestocene Age that overlie the Hawthorn Group. This aquifer is absent in the Western Valley in Western Alachua County and varies around 100 feet above mean sea level near the escarpment. It is greater than 150 feet above sea level northwest of Highway 24 between Gainesville and Waldo. In many places, the water table is less than ten feet below the surface and is recharged directly by rainfall and, to a minor extent, by upward seepage from the lower aquifers. The lower limit of the surficial aquifer system coincides with the top of the Hawthorn Group.

Water in the surficial aquifer moves from places of recharge to places of discharge following topography. Part of the water that leaves the aquifer is discharged either by evaporation from the surface of the land or by transpiration through vegetation. Part is withdrawn from wells, while part seeps downward into lower aquifers, when the water table is higher than the potentiometric surface of those aquifers (see discussion of Floridan aquifer). Finally, in some areas, water from the surficial aquifer is discharged into lakes and streams in the County. This occurs along portions of the Santa Fe River, all streams in eastern Alachua County, Hatchet Creek, and probably Newnans Lake.

Ground water flow in the surficial aquifer system generally follows topography. Many natural flow regimes have been altered by ditching and drainage modifications necessary for construction. In the central and eastern portion of the County the surficial aquifer system ranges from zero to 30 feet in thickness. Water depth below land surface in the surficial aquifer system ranges from zero to approximately 20 feet. Depth to water in the surficial aquifer system varies seasonally, as it is directly recharged by rainfall. Water in the surficial aquifer system is seldom used for potable supply due to low capacity to yield water and high iron concentrations (Clark et al., 1964).

Intermediate Aquifer

The intermediate aquifer is sandwiched between the surficial aquifer and the Floridan aquifer. Water contained within it is generally confined and under artesian conditions, such that water in a well penetrating the aquifer would rise above the aquifer surface.

These materials, in general, consist of fine grained clastic deposits interlayered with carbonate strata belonging to all or parts of the Miocene and younger Series. In places poorly-yielding to non-water-yielding strata mainly occur and there the term "intermediate confining unit" applies. In other places, one or more low to moderate-yielding aquifers may be interlayered with relatively impermeable confining beds; there the term "intermediate aquifer system" applies.

The intermediate aquifer is limited vertically and laterally in extent, and occurs primarily in a few limestone layers and sandy layers within the Hawthorn Group. Although there are many wells drawing water from this aquifer system, its yield is generally low, being dependent on its recharge from the overlying surficial aquifer, or from the underlying Floridan aquifer in areas where the Floridan aquifer is under higher pressure than the intermediate aquifer. Discharge from the intermediate aquifer occurs upward to the surficial aquifer or downward to the Floridan aquifer when it is under higher pressure than either of those two aquifer systems.

Ground water flow within the intermediate aquifer system is not well understood. The carbonates and sands in the Hawthorn Group which yield water are not consistent and may not be continuous through out the eastern part of the County. The quantity of water that can be removed from a well in the intermediate aquifer system may be adequate for individual domestic supply, but is generally not sufficient for large withdrawals such as extensive irrigation or municipal supply.

Floridan Aquifer

The Floridan aquifer system is a thick carbonate sequence which includes all or part of the Paleocene to early Miocene Series and functions regionally as a water-yielding hydraulic unit. This aquifer is present throughout the state and is the deepest part of the active ground-water flow system on mainland Florida. In Alachua County it is found within the upper several hundred feet of limestone.

This aquifer is the most productive since it transmits and stores water easier than the other aquifers. The aquifer is confined (overlain by the Hawthorn Group) and therefore under artesian conditions in the Eastern part (plateau region) of the County. The Floridan aquifer is unconfined (water table condition) where the Ocala Limestone is near the surface. This is primarily in the Western Valley region.

Map 16, which shows the degree of confinement of the Floridan aquifer system, also illustrates areas where Hawthorn sediments are present in Alachua County. These sediments serve to confine the Floridan aquifer system. In the west, the Floridan aquifer system is unconfined and sediments of the Ocala Limestone are overlain by porous sands. In the central portion of the County, sediments of the Hawthorn Group overlie the Eocene limestones, but these sediments are perforated by sinkholes, providing a direct connection to the Floridan aquifer system. In the eastern portion of the County, sediments of the Hawthorn Group overlie the Floridan aquifer system.

For the most part, the top of the aquifer system coincides with the top of the Suwannee Limestone, where present, or the top of the Ocala Limestone. In small areas of central peninsular Florida and the southeast Florida where the Suwannee and Ocala are missing, the Avon Park Limestone forms the top of the Floridan aquifer system. In other parts of the State, permeable carbonate beds of either the Hawthorn Formation, the Bruce Creek Limestone, the St. Marks Formation, or the Tampa Formation constitute the uppermost part of the aquifer system. The base of the aquifer system in peninsular Florida, coincides with the appearance of the regionally persistent sequence of anhydrite beds that lies near the top of the Cedar Keys Limestone.

Flow is generally from the Eastern part of the County toward the Northwest.

B. Importance: Hydrologic connections

The water that is used in Florida is not only found within surface and ground water resources, but it moves back and forth between these water resources. This means the impacts that development will have on the quantity and quality of one water resource cannot be assessed without also assessing its impacts on all other water resources.

1. Aquifer recharge

Water enters the aquifer, or replentishes it, in several important ways. In the south and western portions of Alachua County, where the Floridan aquifer is at or near the surface, rainfall percolates directly into the groundwater. In addition, water recharges the Floridan aquifer through the intermediate aquifer, as well as through sinkholes and numerous stream-to-sink basins throughout the County. Groundwater recharge is important for many reasons, some of which are listed below.

- *Replenishment of water supplies*. Water withdrawals from an aquifer must be balanced by recharge to ensure the sustainable use of ground water.
- *Saltwater intrusion protection*. The Florida Peninsula is both surrounded and underlain by saline water. Any reduction in the volume of water stored in freshwater aquifers above the saline zone results in the upward or lateral movement of salt water. Once freshwater aquifers are thus contaminated, restoration is difficult and costly if not impossible.
- *Maintenance of lake levels, stream flows, and spring flows*. Many surface water systems have hydraulic connections to ground water, which may support surface water levels for all or part of the year via baseflow. Reduced groundwater recharge can result in a decline in groundwater levels, and a corresponding decline in surface water levels and spring flows.
- *Dilution of contaminants*. Ground-water recharge introduces fresh water underground which may serve to improve water quality where ambient ground water is degraded.
- *Reduction of surface flooding*. Natural recharge provides water storage during rainfall events, reducing and delaying stormwater runoff and thus the potential for flooding.
- *Prevention of sinkhole formation*. In some susceptible areas, the hydrostatic pressure of groundwater can prevent or retard the development of sinkholes. A drop in ground water levels in susceptible areas can induce a series of sinkhole formations.

2. Aquifer discharge

Water leaves the aquifer, or is discharged, primarily through pumping, but also through flow onto the surface, as occurs at springs. The primary area of discharge for the underground water of the County occurs along the Santa Fe River below River Rise. During flood stages, the direction of flow may be reversed, so that the underground course of the river serves as an area of recharge to the aquifer. Other areas of recharge occur in the vicinity of Lake Lochloosa, Orange Lake, and along the Santa Fe River.

Because they provide such important interconnections, springs and sinkholes constitute significant geological resources and are identified as primary conservation areas in need of protection. These features are described in Inset 6.

Inset 6: Description of Springs and Sinks

Springs:

Many springs discharge water from the Floridan aquifer, along the Santa Fe River and in other areas of the County. The two types of springs which occur in the County are water table springs and artesian springs.

Water Table Springs: Water table springs occur usually in streams, where rain that permeates through permeable sediments, such as sand, reaches a relatively impermeable bed, such as clay. This water then moves down-gradient along the top of the impermeable bed to a place of outcrop where the water issues as a spring or seep. Flow is normally small and variable.

Artesian Springs: Springs from the intermediate and Floridan aquifers are generally artesian springs. These occur where water is confined in permeable sediments beneath impermeable confining beds, and is under sufficient hydrostatic pressure to rise to the surface through a natural breach in the confining beds. Most of Florida's large springs are of this type, as are many of the smaller ones. The water originates from deep, generally vertical holes in limestone. Some of these holes open into nearly horizontal caverns.

The cavity through which water ascends to an artesian spring is generally a former sink in which direction of motion of the water has been reversed by the rise of the water table. If the water table were to fall below the mouth of the cavity, the spring would cease to flow and would revert to the form of a sink, provided the tubular cavity leading to the spring does not penetrate an impervious stratum, which might confine the water below it under pressure.

The runs of some of the larger springs may be characterized as calcareous streams, including the Silver and Wakulla rivers. The majority of Florida springs, including those in Alachua County, are much smaller. Vegetation is very dense just below the exit of a spring, but around the spring itself there is nothing but bare sand. Immediately beyond the periphery of the "boil" milfoil, coontail, arrowhead, and water primrose may become very abundant. The surface of the vegetation close to the spring is usually covered with a coating of calcium carbonate deposited from the water as the bicarbonate exposed to the air changes to carbonate.

The low oxygen content of the water is reflected in the small populations of truly aquatic insects in this region; however, snails of the genus Goniobasis are exceedingly numerous on the vegetation, and Ampullaria occurs frequently on the bottom sands. Approximately a quarter of a mile below the head of the springs, a more abundant insect fauna becomes noticeable, and in this region the plants are free of the calcium carbonate. The water of the springs is crystal clear, cool, and definitely alkaline.

Sinkholes

Sinkholes and solution channels are the result of the action of water in the highly soluble Ocala Limestone. As underlying limestones are eroded, caverns and underground channels are formed. Then, either through solution of limestone at the surface or from the excess weight of overlying sediments, collapse of these sediments may occur, forming sinkholes.

Sinkholes formed in this manner may provide a direct connection to the Floridan aquifer. In other instances, the connection is not complete or sediments may partially fill and block the channel. In such cases, perched ponds may form which fluctuate with rainfall. This may also be the cause of the many cypress domes in flatwoods areas where other formations overlie the aquifer system.

Stream-to-sink basins

Across the western edge of the erosional escarpment, sinkholes capture the several streams which flow across it. These streams often begin as seepage or springflow from the swampy areas of the northern highlands, and have been responsible for the erosion of the Hawthorne Group as they cut headward into the highlands.

The capture of streams by sinkholes in Alachua County occurs along an unusually linear band known as the Cross-County Fracture Zone (see Map 18). This band extends approximately 45 miles from the sink which captures the Santa Fe River to the sink in Orange Lake. Nearly all the sinkholes which capture streams in the County occur along this band

Most noteworthy of streams captured by sinkholes in the County is the Santa Fe River, which rises in the Northeast corner of the County at Santa Fe swamp, flows westward forming the northern border of the County, and flows underground for approximately three miles in the Northwest portion of the County near High Springs. The Santa Fe then re-emerges at River Rise and continues its flow to the Suwannee River.

Several other streams between the Santa Fe River and Paynes Prairie are also captured by sinkholes. Among these are: Townsend Branch, Mill Creek, the streams flowing into Burnetts Lake, Turkey Creek, Blues Creek, Hogtown Creek, and Sweetwater Branch/Canal. Additionally, a sink in the southeastern end of Orange Lake has been observed to drain that lake during periods of drought.

Orange Lake, which is very linear in shape, is also concurrent with this band, as is a large embankment on the Northeastern border of Paynes Prairie. Both of these features parallel the linear trend of the Cross-County Fracture Zone (Map 18).

Other prominent features which occur in this band are the Devil's Millhopper, and Sanchez Prairie in San Felasco Hammock State Preserve. The Devil's Millhopper is a very large sink Northwest of Gainesville, which is over 125 feet deep. It is presently maintained as a State Geological Site. Sanchez Prairie is a fairly large, flat-bottomed depression, some 80 to 90 feet below the surrounding highlands.

3. Water table elevation

The potentiometric surface of a confined aquifer is the elevation to which water would rise if it were unconfined, and is generally an expression of the "hydraulic head" or pressure within the confined aquifer. Alachua County performs mapping of the elevation of the Floridan aquifer system on a semi-annual basis over 50 wells. In addition, the County collects data from monthly water level trend wells.

The potentiometric surface of the Floridan aquifer varies seasonally, with highest and lowest levels occurring in September and May, respectively. See Maps 19 and 20 for seasonal 2001 data. September is normally the end of the wet season; May, the end of the dry season. Generally, more stress is placed on the aquifer in May because seasonal rains have not yet begun and crop irrigation is heaviest. Also, tourism in late winter and early spring places additional demands on the freshwater supply at a time when rainfall is least.

The amount of rainfall is the most important factor affecting the elevation of the potentiometric surface of the Floridan aquifer. For example, in 1998, which was a year marked by a relative abundance of rainfall, the water table was significantly higher than in 2001, the end of a multi-year drought. The difference is shown in Map 21. In May, 2001, water-levels ranged from 30 to 75 feet, whereas in May, 1998, water-levels ranged from 35 to 85 feet. Declines range from over 10 feet in eastern areas of the County to as much as 15 feet in the southwest.

4. Groundwater flow

The potentiometric surface maps also illustrate ground water flow in the Floridan aquifer system. The groundwater tends to move downgradient (i.e., from higher to lower elevations). Flow is generally from the Eastern part of the County toward the Northwest, and most discharge from the aquifer occurs beyond the boundaries of Alachua County. Local pumpage from wells, sinkholes, fractures in the limestones, rainfall and other factors may influence the flow regime. For example, the circular low of 40 feet near Gainesville is caused by pumping at the Murphree Wellfield for Gainesville's water supply. Drawdown in this manner may increase the amount of recharge that occurs in the vicinity of this pumping.

5. Surface water flows

Surface water flows are not only a product of runoff, but also include a groundwater baseflow component. In fact, many surface water systems in central Florida are closely interconnected with the underlying groundwater system through springs and sinkholes, as described above. In accordance with hydrologic conditions, these natural interconnections may augment flow, reduce flow, or perform both functions intermittently. Because the region manifests annual wet and dry seasons with significant variations in precipitation frequency and intensity, the contribution of surface runoff and groundwater baseflow to stream varies. This cyclic pattern of changing baseflow conditions results in variable surface water quantity and quality.

Extreme steam flow fluctuations occur due to intense and erratic seasonal precipitation. Excessive groundwater withdrawals in combination with periods of low rainfall have recently resulted in significant wetland and lake draw-downs leading to both temporary and permanent ecological damage to these natural systems. The summer of 2000 brought record drought to Florida. Water bodies receded and in some cases disappeared. In Lake Pithlachocco, the receding shoreline exposed an incredible discovery: ancient dugout canoes, some dating back 5,000 years.

This is in contrast to the high water conditions experienced only a few years earlier. High water conditions in 1998 led to a request by Alachua County for updated FEMA floodplain mapping. Floodplain areas serve as important reserve areas to store floodwaters during various magnitude storm events. In their natural state, they may also act as wildlife habitat areas. Information on areas where flood problems have been identified can be found in the Stormwater Element.

6. Watersheds

Surface water flow may be understood within the context of watersheds. Watersheds are nature's boundaries. They are the areas that drain to surface water bodies. A watershed generally includes lakes, rivers, estuaries, wetlands, streams, and the surrounding landscape. Activities within each watershed will impact surface waters and groundwaters accordingly.

There are two major surface water drainage systems in Alachua County: the Santa Fe River system, and the Oklawaha River System. The Waccasassa River System is only a groundwater system in Alachua County. They bear strong correlation to the physiographic regions described in the previous section. Watershed basins are shown on Map 22 and described in Inset 7. More detailed information on drainage basins within the County and an analysis of the effects of stormwater runoff can be found in the Stormwater Element.

Inset 7. Description of Major Watershed Basins in Alachua County

*The **Santa Fe River Basin**, in the Northern area of the County, includes several tributary creeks along the Santa Fe River such as Monteocha Creek and Rocky Creek and includes several springs along the Santa Fe River itself toward the Northwest. All surface waters in the Northern part of the County drain through this system west to the Suwannee River.*

*The **Oklawaha River Basin**, extending into the Southeastern area of the County, includes all urban creeks in Alachua County, including Hogtown Creek, the Newnans Lake/ Hatchet Creek system, the Lochloosa/Orange Lake system, and the Orange Creek system. The surface waters in the Southeastern part of the County drain through these systems into Orange Creek and are carried east to the Oklawaha River which drains into the St. Johns River.*

*The **Waccasassa River Basin** that includes the Watermelon pond area in the Southwestern portion of the County is mainly comprised of internally drained areas. Surface waters enter the groundwater system via sinkhole ponds or through percolation into the thin layer of sands overlying the Floridan Aquifer. This area provides direct recharge to the aquifer.*

*Another type of watershed basin that is prevalent in Alachua County is the **stream to sink basin**. These are found primarily in the central portion of the County around Gainesville and North to the Alachua/High Springs area. Some of these including Hogtown Creek, Sweetwater Branch, Mill Creek, Turkey Creek and Blues Creek are situated within or near urban development areas. As such they are susceptible to the adverse effects of pollutants from urban stormwater runoff. This point is especially critical as these creeks drain into sinkholes which provide direct connections to the Floridan Aquifer, the primary drinking water source for the North Central Florida region.*

For the past five years, EPA has promoted the watershed approach nationally as a means to further restore and maintain the physical, chemical and biological quality of our nation's waters. ACEPD shares EPA's vision is to achieve clean and healthy watersheds that support aquatic life and many human uses. The vision will be met by encouraging and supporting comprehensive water resource management. Recognizing that today's problems require more creative, comprehensive solutions, ACEPD has taken several steps to transcend political, social, and economic boundaries, placing greater attention on the resource systems and the achievement of real ecological results rather than administrative requirements. A more thorough understanding of threats and conditions in watersheds provides a stronger basis for targeting priority concerns. In addition to partnering with FDEP, SJRWMD, SRWMD, the City of Gainesville, and other agencies on multi-jurisdictional water resource issues, ACEPD has committed to generating reader-friendly status reports that describe the conditions of each watershed in Alachua County.

Activities such as urbanization and intensive agricultural practices on the land surface can and do have adverse impacts upon the quality and quantity of ground and surface waters. The watershed approach considers activities that occur throughout the watershed, including activities on and adjacent to surface waters and their associated wetlands and floodplains, as well as uplands. The intent is to foster an integrated approach to the management of our biological and physical environments so as to maintain, protect and improve our natural, managed, and human communities.

7. Wetlands and floodplains

Wetlands and floodplains play a critical role in regulating the movement of water within watersheds as well as in the global water cycle (Richardson 1994; Mitsch and Gosselink 1993). Wetlands, by definition, are characterized by water saturation in the root zone, at, or above the soil surface, for a certain amount of time during the year. This fluctuation of the water table (hydroperiod) above the soil surface is unique to each wetland type. The types and characteristics of wetland communities are described in the Natural Communities section of this data and analysis.

Wetlands may have different functions as a result of their position in the landscape and their dominant water source. For purposes of water quality and watershed management, wetlands are described below based on dominant water source. Wetlands may be precipitation dominated, surface flow dominated, or ground water dominated (Brinson 1993).

Wetlands store precipitation and surface water, and then slowly release the water into associated surface water resources, ground water, and the atmosphere. Wetland types differ in this capacity based on a number of physical and biological characteristics, including: landscape position, soil saturation, the fiber content/degree of decomposition of the organic soils, vegetation density and type of vegetation (Taylor et al. 1990). During the growing season, plants actively take up water and release it to the atmosphere through evapotranspiration. This process reduces the amount of water in wetland soil and increases the capacity for absorption of additional precipitation or surface water flow. As a result, water levels and outflow from the wetland are less than when plants are dormant. Larger plants and plants with more surface area will transpire more.

Precipitation dominated wetlands

Wetlands on local topographic heights are often precipitation dominated. Precipitation dominated wetlands may also be in flat or slightly elevated areas in the landscape, where they receive little or no surface runoff. Generally such wetlands have a clay and peat layer that retains the precipitation and also prevents discharge from ground water. Because wet meadows and wet prairies, for instance, are largely isolated from other surface water resources, these wetlands contribute little to watershed surface quality. When they do receive surface water inflow, they function like marshes, removing nutrients and other pollutants (Mitsch and Gosselink 1993; Rickerl et al. 1993). Wet meadows, and wet prairies generally contribute to ground water recharge (Weller 1981; Mitsch and Gosselink 1993).

Groundwater dominated wetlands

Wetlands also form in landscape positions at which the water table actively discharges, particularly at the base of hills and in valleys. Such ground water dominated wetlands may also receive overland flow but they have a steady supply of water from and to groundwater.

Surface water dominated wetlands

Most wetlands in low points on the landscape or within other water resources are dominated by overland flow. Such riverine and fringe (marsh) wetlands actively play a role in the landscape since they come in contact with, store, or release large quantities of water and act upon sediments and nutrients. These wetlands may be recharged by ground water as well, but surface water provides the major source of water. Two hydrologic connections related to two significant types of these wetlands, marshes and riparian forested wetlands, are described in Inset 8.

Inset 8: Hydrologic connections of marshes and riparian forested wetlands

Marshes

Marshes form in depressions in the landscape, as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). They are frequently or continually inundated with water, deriving most of their water from surface water, including streams, runoff, and overbank flooding; however, they receive inputs from ground water as well (Mitsch and Gosselink 1993; Brinson 1993). Marshes may help reduce local peak and flood flows and moderate stream flow (Demissie and Khan 1993; Mitsch and Gosselink 1993; Gosselink et al. 1990).

Marshes are also valuable in terms of protecting water quality. As a gross estimation, removal of nitrogen from surface water by marshes is approximately 50% and phosphorus removal is approximately 10 - 15% of inputs (Mitsch and Gosselink 1993). Marshes slow the flow of water moving through the system and facilitate the settling of suspended solids and pollutants adhering to sediment. Vegetation quantity and type are important factors in determining the ability of a wetland to reduce water velocity. Marsh vegetation utilizes nutrients, and, more importantly, provides attachment surfaces and a carbon source for organisms that assimilate and transform nutrients. Plant roots oxygenate the soil and provide additional microbial habitat, facilitating such processes (Whigham et al., 1988).

Riparian forested wetlands

Riparian forested wetlands are linear systems found along lakes, streams, and rivers from headwaters down to the sea. Dominated by surface water, these wetlands are saturated or inundated with water during the winter, when evapotranspiration is low, because plants are dormant and precipitation is high; and during the early part of the growing season, when precipitation and runoff are still abundant. These wetlands are generally not wet in the summer or fall except during flood conditions.

Riparian wetlands are particularly productive ecosystems, receiving large inputs of water and nutrients from upstream sources during flooding. This feature has led to their conversion for agricultural use, a practice that has contributed to water quality degradation (Mitsch and Gosselink 1993).

Southern deepwater swamps are riparian systems notable for the standing water present during much of the year. While they may be traversed by rivers or streams, which provide seasonal water inputs, these systems may also be headwaters. A cypress dome is an anomalous southern deepwater swamp type that is typically precipitation versus surface water, dominated. Cypress domes typically exist as isolated depressions in very gently sloping landscapes. Other examples of riparian forested wetlands include maple swamps, bottomland hardwood forests, and cottonwood riparian areas.

Riparian systems provide a continuum of water quality benefits. Headwater wetlands are the source of water; the forested wetlands and marshes along low order streams protect water quality and aquatic life; and wetlands along higher order streams provide flood control, water quality maintenance, and life support.

Water supply: *Riparian forested wetlands and swamps have a significant water storage and ground water recharge role, and thus are valuable in water supply and flood control (Reilly et al. 1991; Hook et al. 1988; Ewel 1990; Brinson 1993; Demissie and Khan 1993; Brown and Sullivan 1988; Gosselink et al. 1990). The wider the floodplain, the greater the storage action and reduction of flood peaks that can occur. Large floodplains with long retention times can be important ground water recharge areas, depending on substrate permeability (Taylor et al. 1990; O'Brien 1988). A forested wetland overlaying permeable soil may produce 100,000 gallons of water per acre per day (Anderson and Rockel 1991).*

Water quality: *Riparian wetlands are important sinks for pollutants carried in upland runoff and from upstream areas (Brinson 1993). Riparian wetlands that are adjacent to small streams are particularly valuable in trapping pollutants and preventing nonpoint source pollution from ever reaching larger water resources (Gilliam 1994; Walbridge 1993). Riparian wetlands also serve as valuable transformers of pollutants. They are noted for processing large fluxes of energy and materials from upstream sources, and they typically show high primary productivity, functions that make them important ecological links and valuable habitat. Examples of the importance of forested wetlands in nutrient removal from water resources:*

- *A 50-meter wide riparian forest in an agricultural watershed of the Chesapeake Bay removed about 89% of the nitrogen that entered the forest from runoff, ground water, and precipitation (Peterjohn and Correll 1984).*

- *Riparian forests can reduce phosphate concentrations in runoff and flood water by 50% (Gilliam 1994). Systems with high concentrations of aluminum may remove up to 80% of total phosphorus (Peterjohn and Correll 1984; Richardson 1985; et al. 1994; Walbridge and Struthers 1993).*

- *Forested wetlands can protect ground water from agricultural runoff. The concentration of nitrate in ground water in an agricultural area was lower beneath forested wetlands than beneath upland covers (Phillips et al. 1993).*

C. Status of water systems health in Alachua County

Both ground and surface water resources can be disrupted by contamination. Pathogens, minerals, and organic and inorganic chemicals polluting the ground water can cause surface water to become polluted and vice versa due to the interconnections between the two. Significant contamination sources include agricultural chemical use, wastewater discharges from wastewater treatment plants and on-site wastewater disposal systems, solid and hazardous waste landfills, storage tanks, and industrial materials spills and waste impoundments. Impervious surfaces can not only reduce aquifer recharge but also can increase water pollution and flood hazards by increasing the amount of runoff. Aquifer penetrations - such as injection wells, or improperly constructed or abandoned wells - may introduce contaminants directly into an aquifer. Atmospheric deposition of contaminants can also impair water quality. The minimal attenuation and the impracticality of remediation of contaminants in ground water, and the high cost of water treatment make prevention of contamination the only really effective means of protecting aquifers and the most efficient means of protecting surface water resources.

Alachua County has been identified as an area experiencing some aquifer contamination. Recent studies conducted by the ACEPD in conjunction with the WMDs have detected pollutants seeping into the Floridan aquifer and returning through springs. Rising levels of nitrogen-based nutrients have been detected in regional surface waters. Studies point to inorganic fertilizers as causes for increased nitrogen loadings in springs and in the groundwater of northwest Alachua County.

Surface water quality varies temporally and areally throughout the County. Poorest overall surface water quality has been observed in the urbanized watersheds of Tumblin Creek and Sweetwater Branch. The water quality in urban streams exhibits characteristics associated with human activities. Water quality generally declines during heavy precipitation events following a long period of drought. Rural watersheds show the effects of agricultural and septic tank use within the watershed. These effects are often manifested by the presence of high levels of nutrients and fecal coliform.

Three major focal areas for water systems health include: the Santa Fe River and its springs, the large lakes of Alachua County, and the urban creeks in and around the City of Gainesville. The characteristics of each system are first described, followed by a discussion of associated health concerns.

1. Santa Fe River and Springs

Santa Fe River corridor

One of the best examples of the interconnection between ground and surface waters may be observed along the Santa Fe River and its springs. The Santa Fe River (Spanish for "Holy Faith") begins at Santa Fe Lake and Little Santa Fe Lake in northeast Alachua County. Additional flow is derived from the many tributary streams which enter the Santa Fe River from the north and south as it courses along the County. Flowing west for 50 miles, it serves as the northern boundary for Alachua and Gilchrist Counties. Hernando DeSoto explored the river in 1539. Although scattered residential development dots certain sections of the streambank, visitors today may still observe a scenic canopy and an abundance of wildlife along the corridor, particularly in the upper sections. The Santa Fe is a living water system that supports an array of biological functions and values which change with the hydrology of the river.

The upper part of the Santa Fe River is an oligotrophic, blackwater stream underlain by thick Hawthorn Formation sediments and clay. Thus, the river and the swamps from which it flows are perched above the Floridan Aquifer. Water levels in this part of the river fluctuate only moderately. As the river moves westward, its characteristics evolve towards increasing fertility and water level variability. At Worthington Springs, the river gradually starts to become a spring fed river, thus increasing flow, clarity, pH, calcium content, temperature stability, and overall fertility. For the next two miles to I-75 and the start of O'Leno State Park, the river is intermingling freely with the Floridan Aquifer, and is deep, broad and slow moving. Apple snails are in evidence for the first time, indicating the higher calcium levels in the water. Even here, the water is dark, and the character of the river is more like that of a blackwater river than a typical Florida spring fed river.

It is not until the river goes underground in O'Leno State Park and comes up again at the River Rise, that it dramatically changes to a strongly spring fed river. Within the state park, the river goes underground to pass through the Cody Scarp (or escarpment), an ancient coastline that divides the Gulf Coast Lowlands from what is called Florida's "Northern Highlands" (SRWMD, n.d.). After flowing underground for three miles, the river rises again just north of High Springs. Under new definitions, this river rise is considered a spring, adding another substantial first magnitude spring to the currently recognized total of 33. See Inset 6 for further discussion of springs in Alachua County.

As a calcareous stream at this point, the Santa Fe is clear, cool, and of moderate flow. This type of stream is the richest in Florida, both in numbers of individuals and fauna species. The Santa Fe ranges in depth from three to 20 feet or more, in width from 75 to 300 feet. Vegetation is composed chiefly of tapegrass, arrowhead, naiads, mosses, and many algae, which in the shallower zones form dense mats completely covering the floor of the stream. Leaf draft and other debris become entangled in fallen trees and other catchalls, and such debris forms an important habitat for small aquatic organisms. In some areas, there are outcrops of limestone, and many loose rocks are also of great importance as habitats for such organisms. Clearing and channelization of these streams and the smaller sand-and silt-bottomed types removes these habitats, in addition to increasing the possibility of flooding further downstream.

Local and state experts recognize the Santa Fe River corridor as some the best, most varied, and most important wildlife habitat in Alachua County and in the state of Florida. From the biological perspective, the Santa Fe River and its floodplain provides a critically important wildlife corridor connecting most of the various wildlife habitat areas in northern Alachua County to one another and to many areas to the north and west of the County. This is the most important natural systems connector in Alachua County, from both biological and hydrological perspectives. It provides an excellent connection from Lake Alto Swamp and the Northeast Flatwoods to O'Leno State Park and the River Rise Preserve. Its tributary creeks provide connectors of varying strength to all the rest of the sites in the northern part of Alachua County. Even San Felasco Hammock State Preserve and its satellite sites are tenuously connected in this way. In addition, the river's tributaries on the north side, such as the New River, Olustee Creek, and Sampson Creek provide wildlife connections as far north as The Osceola National Forest, which is, in turn, connected to the Okefenokee Swamp in Georgia.

Although much of the Santa Fe is in good condition, segments are showing degradation due in part to increased nutrients causing excessive algal mats and/or non-native species of algae. All the connections of the tributaries to the river corridor need protecting, and some of them are in great need of strengthening. There is a small percentage of the area that is fire-adapted upland that would require prescribed fire to maintain it in good condition.

Cooperative efforts and agreements with landowners and with organizations, both government and non-government, are also needed to help protect this resource. These cooperative efforts can help with river cleanups, facility maintenance, public education, and with the frequent observation, monitoring, and reporting of events that is needed to enforce laws and keep track of problems and changes. Enforcement of regulations pertaining to construction in the floodplain, septic tanks, clearing of bank vegetation, dredge and fill, and other related matters is also needed.

The Santa Fe River is used for swimming, fishing, canoeing, and other recreational activities. It is not a large river, and could easily be damaged by too much use or by inappropriate use. Carrying capacities need to be determined for various uses. Some uses, such as jet skis and power boats with powerful motors, may be inappropriate, due to the level of impact per user. These powerful motor vehicles can cause large wakes which damage the banks and the river channel. The wakes and the loud noise they make can also disturb and disrupt wildlife and other recreational users.

Springs

As described above, River Rise may be considered a spring, and along with Poe Spring and Hornsby Spring, form the major discharges into the Santa Fe River from Alachua County. River Rise, Hornsby Spring, and the newly discovered Treehouse Spring are all first magnitude springs, which discharge, on average, greater than 100 cubic feet of water per second. The major springs of Alachua County, their classification by magnitude, and the location of each, are listed in Table 10. Magnitude classifications are identified in Table 11.

Florida's springs are a world class natural resource that have been used and enjoyed by humans since this land was first occupied. Native Americans hunted, fished, drank from and lived by them for at least 12,000 years. According to legend, Ponce de Leon's search for a spring, "the Fountain of Youth," led to the European discovery of Florida in 1513. In the early 1900s, health spas were built at several springs because of their perceived medicinal qualities, and churches commonly conducted baptisms in local springs. Boulware Spring, in Gainesville, once provided water to the city of Gainesville. Today it is a city park and a National Historic Landmark. Described as "bowls of liquid light" by Marjory Stoneman Douglas, the mere mention of springs evokes, in most people, something magical, mysterious, pure, and visceral. Springs are part of our natural identity and comprise a multi-million dollar tourist industry. Florida's twelve state parks that are named for springs attracted over two million visitors in 1999.

Nitrates problem

Unfortunately, while some of our springs are still healthy, many are becoming impaired. Between 1950 and 1990, Florida's human population more than quadrupled, and our population continues to increase. With growth has come an unavoidable rise in water use, as well as extensive land use changes. Since the 1970s, scientists have documented a decline in water quality in most Florida springs, particularly in regard to nutrients such as nitrates. Nitrates are steadily increasing in most springs causing ecological degradation, most notably the rapid growth of algae and the invasive exotic hydrilla. Many springs have reduced flow and some have stopped flowing because of withdrawals from their recharge basins.

Increased levels of nitrates can cause nitrate poisoning in infants, and at-risk adults. Because of these health risks, a standard of 10 mg/L has been set for nitrates in drinking water. In surface water, nitrates are important to photosynthesis, but too much can cause rapid growth of algae and aquatic plants, depleting oxygen levels in the water.

Currently there is no environmentally based standard for nitrates, and negative environmental effects will occur at lower levels than current drinking water standards. Anecdotal evidence and field observations documented in the Florida Springs Task Force report suggest nitrate levels of less than 1 mg/L cause a significant shift in the balance of spring ecological communities, leading to intensified degradation of biological systems. What is safe for human consumption is, in the case of nitrate, catastrophic for biological systems.

Table 10. Springs of Alachua County

Spring Name	Magnitude	Location
Hornsby Spring	1	1.5 miles north of High Springs
Treehouse Spring	1	1.5 miles north of High Springs
Poe Spring	2	3 miles west of High Springs
Magnesia Spring	3-4	4 miles west of Hawthorne
Glen Spring	4	Northwest quadrant of Gainesville; tributary to Hogtown Creek
Bouleware Spring	-	2 miles southeast of Gainesville; used by the old City waterworks
Darby Spring	-	2 miles north of High Springs
Ford Spring	-	1/2 mile southeast of Melrose
High Springs	-	Several small springs near the City of High Springs
Iron Spring	-	In City of High Springs
Sulphur Spring	-	In City of High Springs

Table 11. Magnitude of Springs

Magnitude	Average Flow (Discharge)
1	100 or more cubic feet per second (cfs)
2	10 - 100 cfs
3	1 - 10 cfs
4	100 gallons per minute (gpm) - 1 cfs
5	10 - 100 gpm
6	1 - 10 gpm
7	1 pint per minute - 1 gpm
8	less than 1 pint per minute

Research efforts

In 1997, ACEPD evaluated available surface water and groundwater data for nutrients, including nitrates (Bird, 1998). It was observed in review of the data that nitrate plus nitrite in groundwater varied with the land use, aquifer, the degree of confinement of the aquifer, and well construction. In 1997, groundwater sampling of 39 wells was conducted as part of the FDEP Ambient Monitoring Program (FDEP, 1997). The highest nitrate plus nitrite concentration was found to be 3.7 mg/L (Bird, 1998). The highest concentrations of nitrate plus nitrite are generally found in areas where the Floridan aquifer system is unconfined or poorly confined. Nitrate plus nitrite concentrations for this same sampling event in the northwestern portion of Alachua County ranged from 0.33-2.20 mg/L.

More recent sampling activities have confirmed these elevated levels of nitrates in western and northwestern Alachua County. As part of the FDEP Ambient Monitoring Program, Status Network sampling was conducted in the Suwannee River Basin during 2001 (FDEP, 2002). During this time period, 20 groundwater sites in western Alachua County were sampled. The nitrates concentrations for samples from these sites ranged from <0.004 milligrams per liter (mg/L) to 4 mg/L. In June 2001, ACEPD sampled selected monitor and residential supply wells southwest of the City of Alachua in an area that had been used historically for agricultural activities. Concentrations in the samples obtained from these wells ranged from 1.6 to 30.3 mg/L (ACEPD, 2001).

The nitrate plus nitrite concentrations determined from surface water samples collected in 1997 showed a trend of increasing concentration downstream and the springs augment flow in the Santa Fe River. Generally, nitrates plus nitrites are higher when the river is under low flow conditions (Hornsby, 1997). The data show an increased trend of nitrates in the Santa Fe River downstream of River Rise. Upon review of the data, it appears that these increased levels in groundwater are the source of elevated nitrate-nitrogen concentrations observed in the river downstream from River Rise State Park, Hornsby Springs, and Poe Springs.

The inherent nature of karst geology, such as solution features, sinkholes, and caves, makes groundwater flow unpredictable. In limestone aquifers flow may follow fractures or solution features as conduit flow. The impact of development in Alachua County and adjacent areas on the level of nitrates in surface and groundwater cannot be determined with available information.

More research is necessary. Heightened water quality and water level monitoring (and possibly tracer studies) to identify flow paths and water level fluctuations, as well as water quality, will be required to determine the source and effect of nitrates in the County. To further the knowledge base, ACEPD is currently in the process of applying for a grant to fund additional studies of this problem.

Contamination is a major threat to our springs. Potential sources of nitrate contributors include: septic tanks, animal production wastes, fertilization of row crops and pasture, stormwater runoff, and atmospheric deposition from air pollution. Water can carry contaminants from the land surface into springs. Stormwater runoff can carry oil, fertlizer, pesticides, and bacteria. Septic tanks and underground storage tanks can contribute nutrients, bacteria, and chemicals via seepage. It should be noted that on-site domestic septic systems do not treat for nitrates. Air pollution releases ammonia, carobon dioxide, hydrogen sulfide, and methane, with deposition up to two miles away; causes excess fertilization and leaching of nitrates through soil. In "springsheds," recharge basins where surface water enters the aquifer through direct connections such as sinkholes and sinking streams, springs are especially vulnerable to contamination. Specific management strategies for springsheds are discussed later in the resource-based protection portion of this section.

2. ***Orange Creek Basin Study***

The Orange Creek Basin consists of approximately 600 square miles in the lower Ocklawaha River System within portions of Alachua, Marion, and Putnam counties. The basin is characterized by a limestone topography and by the presence of shallow lakes, level prairies, irregular drainage patterns and several large sinkholes. Its six major sub-basins or drainage units are (1) Hogtown Creek, (2) Paynes Prairie, (3) Newnans Lake, (4) Lochloosa Lake, (5) Orange Lake, and (6) Orange Creek. In Alachua County, this includes the following surface water bodies: Bivens Arm, Cross Creek, Hatchet Creek, Hogtown Creek, Lake Forest Creek, Lake Lochloosa, Little Hatchet Creek, Little Lake Lochloosa, Little Orange Creek, Newnans Lake, Orange Creek, Orange Lake, Possum Creek, Prairie Creek, River Styx, Sweetwater Branch, Tumblin Creek.

Many wildlife species use the aquatic, wetland and upland habitats in the basin, including bald eagles, wood storks, Florida sandhill cranes, and several egret species. One of Florida’s five most important bald eagle nesting sites is located in the Newnans-Orange-Lochloosa lakes area. The marshy River Styx area is home to a wood stork rookery, which was established more than 80 years ago. Paynes Prairie harbors many species of birds, reptiles and amphibians and is home to the round-tailed muskrat.

Over the years, the lakes of Orange Creek Basin have experienced significant changes in ecology and hydrology due to diversions of natural flow, drought, and various construction and transportation projects. In 1993 the SJRWMD recommended development of a comprehensive surface water management plan for the Orange Creek Basin in response to growing public concern regarding lake issues in the basin, including water levels. Approved by the SJRWMD Governing Board in 1996, the management plan is intended to provide a comprehensive, holistic basin-wide plan for management and restoration of aquatic and wetland resources in the basin. Some of the specific issues addressed include (1) altered hydrologic regimes, including impacts of water control structures; (2) extreme low lake levels; (3) control of exotic vegetation; (4) protection and restoration of native aquatic plant populations; (5) management of floating vegetation; (6) sources of pollution in the basin; (7) lake trophic conditions and trends; (8) organic sediment accumulation in lakes; (9) management and enhancement of fish and wetland wildlife habitats; (10) land conservation and restoration, and (11) public awareness and participation.

The environmental quality of lakes in Alachua County depends in large part on the intensity of human activity, both directly along the shoreline and within the lake's watershed. Lakes can be affected in different ways by a number of activities. Water quality data for the Orange Creek Basin, including Newnans Lake, Orange Lake, and Lake Lochloosa are available from the SJRWMD, and indicate declining water quality from the 1980s to the mid 1990s. Sufficeth to say that all of these lakes are experiencing eutrophication. Because Florida lakes tend to be relatively shallow and nutrient-rich, and our climate is warm and temperate, eutrophication, the natural aging process of lakes and ponds, is relatively rapid here naturally. Mankind’s activities tend to hasten the process, which leads to an increase in total bio-mass but a reduction in over-all biological diversity and a general reduction in perceived benefits to mankind.

General characteristics of lakes and ponds in Alachua County are discussed in Inset 9.

Inset 9. Characteristics of Lakes and Ponds in Alachua County

Lakes:

Nearly all lakes in Florida are the result of a solution of underlying limestone. Those found in Alachua County are primarily silt-bottomed, and very shallow. They are typified by often dense mats of floating vegetation, particularly water hyacinths. The continual accumulation of dead hyacinths on the bottom of these lakes gives rise to thick layers of silt, which almost completely covers the bottoms to a depth of several feet. Almost no living organisms can be found in these bottom deposits, inasmuch as conditions are not conducive to life. The waters have a definite brownish tinge and are rather turbid.

Newnans, Orange, and Lochloosa Lakes in southeastern Alachua County are lakes of the type described above. Orange Lake is noteworthy in having many floating islands of vegetation, some of which are large enough to support trees. Santa Fe Lake, in the northeastern corner of the County, is less typical. Its bottom is much deeper, and the lake is more conducive to recreational activities, such as swimming and water skiing.

Ponds:

Sinkhole ponds are formed either when the bottom of a sink fills in with silt and other debris such that an impermeable lens is formed, preventing the downward movement of water; or when the local water table is above the bottom of the sink, in the case of a sink with a direct connection to groundwater. Though some of these ponds are dry, most have standing water that maintain a fairly constant level because the water table is high enough to supply the ponds continually. The sides of sinkhole ponds are steep and the zone of rooted aquatic vegetation is very limited. The sides of the sinkholes above the water are usually covered with vegetation that extends up to the rim of the depression.

The surface of the pond is often covered with a layer of floating vegetation, either water hyacinths or one of duckweed, water velvet, or floating moss. In this case, there is rarely any submergent or emergent vegetation. When there is no such floating vegetation, there is often a rich growth of both emergent and submergent vegetation, extending from the margin of the pond outward to the region where a dropoff to deep water occurs. The vegetation is usually some or all of bladderworts, cattails, rushes, or smartweed.

Fluctuating ponds are commonly found in Alachua County, and are often the inner or deeper portions of marshes, wet prairies, and wooded ponds. These ponds are very shallow, and are frequently just slight depressions in the flat topography. The level of the water in these hollows varies with the amount of rain and surface runoff. Though there is a great fluctuation in the area occupied by the water because a slight rise or fall causes marked spread or retreat of the margins, the depth usually does not change greatly because of the shallowness of the pond.

True aquatic vegetation follows the rise and fall of the water to some extent, but is chiefly confined to the part of the pond below the more permanent water level. The vegetation includes many true aquatics such as pickerelweed, smartweed, cattails, and water primrose, as well as maidencane, hydrocotyl, and many other semiaquatics. Plants are not confined to a shore zone as in the sinkhole ponds, but may extend much further out. Trout Pond is a typical example.

In April of 1997, the Orange Creek Basin Partnership was formed to address water quality and stormwater issues in the Orange Creek Basin. The partnership is comprised of six agencies: the SJRWMD, GRU, City of Gainesville Public Works, Alachua County Public Works, FDEP, and ACEPD. As part of this effort the ACEPD is currently under contract to conduct a large portion of the water quality assessment activities. Beginning in March of 1998, ACEPD has performed monthly baseflow sampling of urban surface waters in Gainesville. In January 2000, contract tasks were expanded to include: stream surveys, storm event monitoring, habitat assessments, benthic sampling, stream sign installation, and summary report preparation. Through stream surveys we have discovered several point sources of pollution, such as illicit discharges, leaking sanitary sewer lines, and abandoned landfills.

The sample collection portion of the study is nearing completion. Scientists are currently analyzing the data and will report a series of recommendations to address water quality concerns within the basin. On completion of the study, Alachua County will seek to implement these recommendations where feasible.

Protection of environmentally sensitive lands in the basin is also a high priority. The SJRWMD has purchased more than 16,000 acres of uplands and wetlands, and has purchased development rights on more than 19,200 acres within two conservation easements to forever preserve the area's water quality and wildlife habitat.

A restoration project is now under way at the former Orange Creek muck farm, located just east of Orange Lake in southern Alachua County and northern Marion County. Acquired by the SJRWMD in 1998, this 3,500-acre property is being restored to wetland habitat for many native aquatic, wetland and upland animal and plant species. This cost-share partnership between the SJRWMD and the USDA's NRCS was funded through the Wetland Reserve Program and two wetland mitigation projects.

The process of implementing the surface water management plan for the basin is progressing because of the concerned citizens and organizations who share a common goal - the restoration and protection of the natural environment and habitats throughout Orange Creek Basin.

3. <u>Urban streams and creeks</u>

All of the urban creeks in Alachua County are sand-bottom creeks. These are small, shallow, gently flowing streams with sandy beds. The creeks vary from as little as one foot to forty feet in width, and in depth from a couple of inches to as much as five feet. The bottom is composed of loose rolling sand that builds up in mid-stream into small ridges behind which small masses of debris accumulate. Several of these types of creeks exist in Alachua County.

Pebbles may be found in gravelly riffles where the water becomes quite shallow. There are occasional pools, but they are not a conspicuous element of the streams. The pools are usually small, quiet areas near the banks or at curves. Debris accumulates to a marked degree in some of the streams, almost any obstacle forming a nucleus for the accumulation of much leaf drift, sticks, and other objects.

Most of these streams are circumneutral to slightly acidic, but some may be extremely acidic. Nearly all of them have tinted waters which vary in shade from almost colorless to a strong tea color, according to the area drained and to the amount of rainfall. Most of the streams drain flatwoods, hammock lands, or swampy areas, and are fed by springs or diffuse seepage areas. Vegetation is almost completely absent from the streams except for a few scattered aquatic plants, such as golden club and smartweed.

Generally, the poorest water quality is observed in the more urbanized water sheds, Tumblin Creek, and Sweetwater Branch. Both of these streams have been channelized, are in part concrete lined, receive primarily urban runoff and point source discharges. The water quality in urban streams exhibits characteristics associated with human activities. Water quality generally declines during heavy precipitation events following a long period of drought.

There are several large industrial sites associated with water pollution of our surface waters and groundwaters. Two of the more well known sites are the Cabot Carbon/Koppers Superfund Site in northeast Gainesville, and the GRU Main Street Waste Water Treatment Plant in downtown Gainesville.

Organic contaminants were detected in sediment samples from Springstead and Hogtown creeks in 1995 and 1996. These materials are likely residuals from discharges to a ditch the leads to Springstead Creek from the area of the Cabot/Koppers Superfund site. The Superfund site is still undergoing active remediation. More information may be obtained from ACEPD or the U.S. EPA.

GRU discharges treated effluent from its Main Street Wastewater Treatment Plant into Sweetwater Branch. Flow from this point continues to its terminus at Alachua Sink in Paynes Prairie Preserve State Park, where it drains into the Floridan Aquifer system. This situation required GRU to obtain a NPDES permit from the U.S. EPA. Additionally, the high levels of nitrates in the effluent discharge have in the past been a problem in the flora management of Paynes Prairie Preserve State Park. The elevated level of nutrients in Sweetwater Branch has caused an increase of plant communities not native to the preserve. There are several smaller, private wastewater facilities that also discharge treated effluent to surface water systems and have the potential to create similar water quality problems.

Under contract with SJRWMD, the ACEPD conducts monthly water quality sampling of Gainesville urban creeks. The department maintains a kiosk at Sweetwater Branch which displays information and pamphlets regarding stormwater and the environment. Recently, the ACEPD conducted field exercises with local Cub Scouts to educate them on the importance of keeping streams clean.

In addition, Current Problems, Inc. programs were established in Alachua County to take an active role in helping to keep our waterways free of litter. The Up The Creek! program provides for ongoing litter abatement work by adopting out stretches of streams and creeks to caring citizens who live on or nearby these waterways. Up The Creek! also conducts storm drain marking projects.

D. <u>Protecting and improving water systems health</u>

In addition to the efforts described above, the ACEPD has spearheaded numerous efforts to protect and improve water systems health in Alachua County. These include monitoring various indicators of resource health, and protecting water systems through both resource specific strategies and pollutant strategies. Resource specific strategies are focused on the protection of areas considered particularly vulnerable to contamination, including wellfield protection areas, high aquifer recharge areas, and surface waters, wetlands, and floodplains. Pollutant source strategies are focused on the manner in which activities that threaten the health of water systems are conducted, particularly stormwater management, fertilizer applications, wastewater treatment, mining and excavation, and hazardous materials operations.

1. <u>Monitoring programs</u>

In order to assess and improve the health of water systems in Alachua County, we measure numerous conditions, identify significant point and non-point sources of water pollution, and act to reduce the harmful impacts of these pollutants on the natural environment.

Our perspective has evolved from a strict focus on water quality alone to an integrated monitoring protocol that incorporates biological, water quality, habitat, and discharge monitoring. To successfully manage an ecosystem, a basic understanding of the system's biological components is critical. The members of a biological system respond cumulatively to a wide variety of factors, both natural and of human origin. When human actions adversely affect a system, biological populations will change, leading to an impaired or imbalanced community. Pollution-sensitive species will disappear, food webs will be disrupted, diversity of species will decrease, and undesirable nuisance species may dominate the community. Protection of ecological integrity requires four components: good water quality, natural discharge, appropriate habitat, and healthy biological communities.

a. <u>What do we monitor?</u>

Water Quality - In practical terms, water quality refers to the fitness of water for both human and natural uses, and can be described by concentrations of specific parameters (such as bacteria) or by the relation of observed concentrations to state standards (e.g., allowable levels of bacteria). The Clean Water Act requires states to conduct water quality surveys to determine if water resources are of sufficient quality to meet the designated use. Groundwater is regulated for potable use in the form of drinking water standards.

For the most part, surface waters in Alachua County are required to meet standards for recreational uses and the propagation and maintenance of healthy, well-balanced populations of fish and wildlife. In addition, there are several streams and lakes that require special protection as Outstanding Florida Waters (OFW) because of their exceptional richness of aquatic and wetland wildlife habitats. See Inset 10.

When groundwater emerges to land surface at a spring, the water is classified as surface water. Even though it is the same water, as surface water it is protected for different uses. Waters that interact, as Florida's groundwater and surface waters do, should be protected across the boundary between the two, and for all uses. Florida's water quality rules do not provide for protection that takes into account the unique interaction that naturally occurs between ground water and surface water at springs and sinks.

Plants - The numbers and diversity of the plants and animals that live in surface waters paint a picture of the water's health. A Floristic Quality Index for Florida is currently under development by FDEP scientists. Monitoring allows scientists to distinguish a water body's natural plant community from one that is out of balance. Changes in a water body's plant community is an early indicator of, for example, elevated nitrates. Nuisance algal mats and non-native species of rooted aquatic plants such as hydrilla have become increasingly common as high nitrate levels have become widespread in streams. Nuisance and non-native plants have caused adverse changes in many spring runs. These changes include the reduction of water flow, reduction in dissolved oxygen, and habitat changes. Monitoring is an important tool for distinguishing a natural spring-run plants community from one that has been affected by nitrate pollution.

Animals – Benthic macroinvertebrates are small animals without backbones that live on the bottoms of streambeds and within the plants that grow there. Many are juvenile forms of insects such as dragonflies and mayflies. Crayfish and other freshwater shellfish are also benthic macroinvertebrates. They are a critical link in the food web. These small animals do not respond directly to the nitrate enrichment so common in Florida's springs. They are, however, affected by changes in food quality, plant overgrowth, and decreased dissolved oxygen, all of which are caused by nitrate enrichment. They are also directly affected by pesticide contamination. Standardized methods for determining impairment exist and are in use in Alachua County.

Large aquatic vertebrates, such as birds or fish, are the last group adversely affected by changes in surface water quality. Their familiarity to casual observers and status at the top of the food web make this group worthy of limited monitoring efforts.

Spring and cave animals – Our spring caves harbor one of the richest underground aquatic faunas in North America. Many of Florida's spring and cave creatures are extremely rare. In fact, 22 Florida cave-dependent species are found nowhere else in the world. The FCREPA has recognized that most Florida spring and cave dependent species merit protection. However, currently only three species are protected under state or federal law. These populations of rare species are particularly vulnerable to changes in water quantity and quality, as well as to natural and manmade catastrophes. For instance, human-caused erosion may seal the entrances to these caves and may extinguish the species.

Inset 10. Surface Water Quality Classification

The Florida Department of Environmental Protection has developed a classification system for surface waters within the state. These classifications are arranged in order of the degree of protection required for each waterbody:

1. CLASS I	*Potable Water Supplies*
2. CLASS II	*Shellfish Propagation or Harvesting*
3. CLASS III	*Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife*
4. CLASS IV	*Agricultural Water Supplies*
5. CLASS V	*Navigation, Utility and Industrial Use*

Most waterbodies within Alachua County are designated as CLASS III waters. However, there are several streams and lakes that require special protection. Because of their exceptional richness of aquatic and wetland wildlife habitats, they have have been classified as ***Outstanding Florida Waters (OFWs)*** *by the state. In Alachua County, OFWs include waterbodies within:*

1. *San Felasco Hammock Preserve State Park*
2. *Paynes Prairie Preserve State Park*
3. *River Rise Preserve State Park*
4. *O'leno State Park*

Within the OFW classification the following waterbodies are categorized as ***special waters:***

1) *Lochloosa Lake (including Little Lochloosa Lake, Lochloosa Lake Right Arm, and Lochloosa Creek upstream to County road 20(a).*

2) *Orange Lake up to the U.S Highway 301 Bridge, the River Styx up to Camps Canal, and Cross Creek.*

3) *Santa Fe River system - consisting of the Santa Fe River, Lake Santa Fe, Little Lake Santa Fe, Santa Fe Swamp, Olustee Creek, and the Ichetucknee River below S.R. 27, but excluding all other tributaries.*

While water quality samples give snap shots of water quality, benthic macroinvertebrates act as continual natural monitors of environmental quality. Results from benthic sampling alone cannot distinguish between pollution and habitat problems. Habitat assessments look at stream characteristics that favor a healthy macroinvertebrate population. Water quality data, habitat assessments, and benthic sampling results can be used together to describe the overall health of a water system.

b. Who does the monitoring?

Since 1986, the County has maintained a groundwater monitoring network under contract with the state, pursuant to the Water Quality Assurance Act of 1983. Three phases of this ambient groundwater monitoring program consisted of a background network (79 wells) to evaluate water quality against EPA recommended standards for drinking water; a "Very Intense Study Area" network in the southwest urban area (19 sites) to evaluate impacts of land use on water quality; and a Background Temporal Variability Network (16 wells) to take more frequent samples of a subset of the background network wells. In addition, a high density unconfined Background Network was designed to focus on water quality in the aquifer-unconfined area.

Approximately 30 background wells were sampled every three years under this framework. However, beginning in 1998, the FDEP reconfigured its ambient groundwater monitoring program to include surface waters, resulting in decreased groundwater monitoring. The state program has dramatically reduced the number of wells in its network and now conducts two types of sampling, status and trend. As the name indicates, status sampling gives a broad picture or snapshot of water quality in a basin. Status network sampling is conducted every five years on randomly selected wells. Sites are sampled for a selected set of parameters based on the type of resource. For example, a lake resource would be sampled for chlorophyll while groundwater would not. Trend monitoring is also conducted; the sampling frequency is higher, but the number of samples is lower. Two groundwater sites have been identified for trend monitoring in Alachua County - one in the Floridan aquifer, and one in the intermediate aquifer.

The methodology for the state's new approach is felt to be defensible statistically and will provide FDEP a regional look at water quality across the state. However, on a county-level, the reorganization means fewer, less frequent, and less consistent (due to the random nature of the sampling) groundwater monitoring. Sites sampled in 2000 and 2001 are identified in Map 23 for groundwater, Map 24 for lakes and Map 25 for streams.

In addition, Alachua County has monitored numerous surface water parameters since the late 1970s and early 1980s. Although the number and types of parameters have increased with scientific and technological advances, the number of sites monitored and frequency of monitoring has decreased. During the late 1980's the number of surface water sites monitored was also reduced from approximately 50 to 30 sites currently monitored under the ACEPD and SJRWMD programs. The focus of the ACEPD surface water program today is to monitor water quality and biological health in selected urban and rural streams not monitored by the water management districts. Since the SJRWMD monitors surface water quality in urban Gainesville as part of the Orange Creek Basin Study, ACEPD discontinued monitoring the urban creeks to avoid repetition and now focuses on surface waters in the SRWMD. Locations are expected to change through time to maximize coverage, as additional monitoring is conducted by various agencies including the SJRWMD, the SRWMD, and the FFWCC. See Map 26 for current sample locations.

For the County to begin to find the solutions to the problems identified in this section, it must have surface and ground water monitoring programs with sufficient flexibility, spatial coverage, breadth of parameters, and frequency/duration of sampling to address known and future problems in a scientifically supportable manner. As Alachua County continues to grow, this issue will become more and more important in finding an appropriate balance between economic development and natural resource protection.

2. ***Resource-specific strategies***

a. Wellfield Protection

As of 1997, there were 22 community public water systems and four non-transient non-community public water systems in Alachua County, all of which draw water from the Floridan aquifer. Eight of these are municipal systems serving Alachua, Archer, Gainesville, Hawthorne, High Springs, Micanopy, Newberry, and Waldo. The remaining 14 community systems serve subdivision and mobile home parks. The four non-transient, non-community systems serve child care centers, an educational institution, and an industrial facility.

In 1995, a study of potential contamination sources near wellfield areas was conducted by the Alachua County Environmental Protection Department and reported in Final Project Report: A Comprehensive Contaminant Source and Well Inventory Near Wellfield Areas of Alachua County, March 25, 1996. The results of the study were (1) a contaminant source inventory of FDEP-regulated activities within the 500-foot setback distance identified in Chapter 62-521, Florida Administrative Code, and facilities regulated by Alachua County's Hazardous Materials Management Code within a one-mile radius of the identified 26 well systems, (2) a Floridan aquifer system comprehensive well inventory, a water level data collection program and potentiometric surface mapping, and (3) a review of existing federal, state, and local government files to obtain data on local aquifer hydraulic properties which were used to prepare County-wide maps of transmissivity, hydraulic conductivity, aquifer thickness, and confining unit thickness.

This project clearly defined the existing and potential risks for public water system contamination resulting from the close proximity of facilities with existing groundwater contamination, or the high potential of a discharge to soil or groundwater. It also identified the areas of highest concern for potential groundwater contamination, based upon a high number of facilities and the vulnerability of the Floridan aquifer system. A need for additional work was identified in four areas: (1) location of potential contamination sources County-wide, (2) long term aquifer tests to determine aquifer hydraulic characteristics, (3) evaluation of aquifer recharge in areas where the Floridan aquifer is confined, and (4) modeling wellhead protection areas for community and non-transient non-community water systems.

Current wellfield protection regulations are as follows:

1) The Murphree Wellfield Protection Code (Chapter 355 of the Alachua County Code) was developed to protect the primary water supply for the Gainesville Urban Area. This is a deep well system operated by the City of Gainesville that penetrates the Floridan Aquifer. The code regulates hazardous material transport and storage, well construction, and related activities in three protection zones around the Murphree Well Field.

2) The Hazardous Materials Management Code (Chapter 353 of the Alachua County Code) contains siting prohibitions for certain hazardous materials storage facilities within specified distances from public and private water supply wells.

3) Conservation Policy 4.5.2 in the Alachua County Comprehensive Plan provides for interim wellfield protection areas around public potable water supply wells serving at least 15 service connections or regularly serving at least 25 individuals daily at least 60 days out of the year and permitted to pump more than 100,000 gpd. These areas consist of a 200-foot exclusionary zone and a 200-400 foot restricted zone. These restrictions are to be replaced by permanent regulations once better data is available through modeling.

4) Conservation Policy 4.5.2 in the Alachua County Comprehensive Plan also provides for permanent wellfield protection areas around public potable water supply wells serving at least 15 service connections or regularly serving at least 25 individuals daily at least 60 days out of the year and permitted to pump less than 100,000 gpd. These areas also consist of a 200-foot exclusionary zone and a 200-400 foot restricted zone.

5) State Wellhead Protection rule, Chapter 62-521, FAC, implementing FS s. 403.061, restricts or prohibits certain uses within 500 feet of public water wells serving (1) at least 15 service connections used by year-round residents or regularly serving at least 25 year-round residents, or (2) at least 25 of the same persons over 6 months per year.

The Murphree Wellfield Protection Code was amended in the year 2000 to increase the size and extent of the existing wellfield protection zones based on hydrogeologic modeling (see Map 27). Criteria were added for well abandonment, backflow prevention, and testing. In addition, revisions to the code set up criteria for ACEPD to perform inventories of wells and non-residential septic systems. ACEPD has completed the initial stages of the well inventory and identified the potential for nearly 600 wells located within the protection zones. The code requires the proper abandonment of all wells not in use or which pose a threat to groundwater.

The current wellfield protection efforts need to be furthered by developing land development regulations for the other larger wellfields in the unincorporated area, and by working with the smaller municipalities to identify appropriate wellfield protection mechanisms for municipal wellfields in the smaller incorporated areas.

b. <u>High Aquifer Recharge Protection</u>

As described above, aquifer recharge can generally be defined as the replenishment of water in an aquifer system. There are two basic dimensions to the issue of recharge area protection: water quantity and water quality. From the quantity perspective, it is desirable to ensure enough recharge to sustain projected ground-water requirements for natural systems and the future population of the region. But in terms of water quality, recharge areas are sensitive zones, because water moving downward from the surface can transport contaminants to the aquifer.

Identification

Several studies have been conducted concerning aquifer recharge areas of Florida. As the most important source of potable water for the State, protection of the Floridan Aquifer has become a critical issue. The Alachua County Comprehensive Plan currently designates high aquifer recharge areas as those areas in the County where the Floridan Aquifer is unconfined or semi-confined. This method has the advantage of recognizing aquifer vulnerability in those areas where little or no clay confining layer exists between the ground surface and the aquifer.

Recharge rates depend on many variables, the most important of which are listed below:

- Permeability of surface soils and materials;
- Storage capacity of surface soils and materials;
- Elevation of the water table relative to the land surface;
- Elevation of the potentiometric surface relative to the land surface (confined aquifers);
- Rainfall frequency, duration and intensity;
- Rate of evapotranspiration;
- Vegetative cover, type and density
- Topography;
- Degree of development of natural surface drainage;
- Depth to the aquifer;
- Presence and nature of confining units;
- Hydraulic conductivity of the confining unit;
- Vertical hydraulic gradient; and
- Transmissivity and hydraulic gradient of the receiving aquifer.

Notice that some of the factors are interdependent, a fact that complicates the estimation of recharge. In general, the most productive recharge areas are uplands with highly permeable soils and poorly developed surface drainage. Most wetlands are not highly productive recharge areas, due to their tendency to hold water above ground. Many wetlands are in fact discharge areas, where ground water seeps to the surface.

Areas of recharge to the Floridan aquifer in Alachua County have been mapped by numerous investigators, using a variety of methods, which have often led to conflicting results. Six of these efforts are described in Inset 11, and the maps associated with these efforts are shown on the following pages.

All parties recognize a lack of basic parameter data, rendering all existing modeling efforts very general in nature. While the SJRWMD model suggests the presence of high aquifer recharge areas even in areas where the Floridan aquifer is confined, the USGS conclusions estimate recharge rates to the Upper Floridan aquifer ranging from less than 12 inches per year in confined areas to 16-31 inches per year in unconfined areas, with semi-confined areas receiving intermediate amounts of recharge.

Additional studies are underway by various agencies, including the water management districts, to incorporate updated data and more accurately specifically identify these areas within their jurisdiction. The FDEP is currently revising the state's aquifer vulnerability mapping through a new program called Florida Aquifer Vulnerability Assessment (FAVA), which will be complete in approximately two years. FAVA accounts for karst and should represent a dramatic improvement in vulnerability mapping.

Before using any other mapping of high aquifer recharge areas in the County, more evaluation and analysis is needed. Alachua County has relied upon the 3-color map for the purposes of land use and development regulation over the last ten years. Policies relating to landfills, stormwater design, and hazardous materials management, and the Alachua County Hazardous Materials Code itself, require performance standards administered using the 3-color map (see policies 4.5.5, 4.5.6, 4.5.19). Because use of any of the more recent maps would result in the delineation of different high aquifer recharge areas than those currently adopted, policy 4.5.3 identifies the need for an updated recharge study to resolve potential discrepancies.

The County will coordinate a partnership with the USGS, WMDs, GRU, and other willing participants to perform the updated study, to be phased over the next four years at an estimated cost of $90,000. Most of the cost would involve data collection and analysis, such as evapotranspiration studies and baseflow stream flow monitoring. Upon completion of the study, the Plan will be amended to adopt high aquifer recharge areas mapped as part of the updated study. Until more accurate information becomes available, the County is utilizing the Aquifer Confinement Zones, mapped by the Florida Geological Survey (Open File Report No. 21, 1988), as the basis for adopting regulations for the protection of aquifer recharge areas.

Regulations

State law requires the Comprehensive Plan to include objectives and policies that protect the functions of natural groundwater recharge areas and natural drainage features (see F.A.C. 9J-5.011(2)). Several policies in this element require groundwater protection for all of Alachua County (see 4.5.8-4.5.16, 4.4.4-4.4.6), and particularly earmark high aquifer recharge areas for increased protection (see 4.5.5, 4.5.6 and 4.5.19). In addition, the **Hazardous Materials Management Code** provides restrictions on hazardous materials applicable to aquifer-unconfined and/or semi-confined areas of the County. In the unconfined area (Western Alachua County), certain hazardous materials considered unsuitable due to their volatile nature or potential as severe groundwater contaminates are prohibited. The Code also prescribes containment standards, limits on the types and amounts of hazardous materials that may be stored, operating procedures including handling and transport, methods for monitoring and inspections, and emergency procedures.

Inset 11: High Aquifer Recharge Identification

FGS Aquifer Confinement [Map 16]

FGS Open File Report 21, "Geologic Interpretation of the Aquifer Pollution Potential in Alachua County, Florida" contains a map three areas of relative confinement of the Floridan aquifer in Alachua County. This report was published in 1988. Based on this map, high aquifer recharge areas are identified as areas where the Floridan aquifer is unconfined or semi-confined, as well as stream-to-sink basins. This includes most of the western half of Alachua County.

SJRWMD Annual Recharge [Map 28]

In 1993, the SJRWMD published a report on aquifer recharge entitled, "Mapping Recharge to the Floridan Aquifer System Using a Geographic Information System." An outgrowth of this report was the creation of a map of recharge areas to the Floridan Aquifer in Alachua County. This map depicts five ranges of recharge/discharge based on calculations using generalized, District-wide data. High aquifer recharge areas are identified as areas of annual recharge greater than or equal to eight inches per year. According to this map, high aquifer recharge areas potentially include a much larger portion north of Gainesville (between US 441 and SR 24), and east of US 301 (Orange Heights, Melrose, Campville vicinity) than the FGS map. However, use of this map would exclude much of the semi-confined portion south of Gainesville to Micanopy (between US 441 and CR 234 around Paynes Prairie).

SRWMD Recharge Potential [Map 29]

In 1994, the SRWMD published a report entitled "Recharge Potential of the Floridan Aquifer in the Suwannee River Water Management District." This report identifies on a qualitative color scale, from high to low, six areas of potential recharge/discharge to the Floridan Aquifer. As with the FGS map, most of the western portion of Alachua County is identified as high aquifer recharge, and most of the eastern portion of the County is excluded as low recharge.

USGS Recharge Study [Map 30]

The SRWMD contracted with the USGS to conduct another recharge study. The outcome of the study was USGS WRI Report 97-4283, "Recharge Rates to the Upper Floridan Aquifer in the Suwannee River Water Management District, Florida." This study includes a map of aquifer confinement akin to the FGS map. However, portions of Alachua County identified as unconfined and poorly confined are larger in geographic extent than those depicted on the FGS map. For example, while the southeastern portion of the County is identified as unconfined and poorly confined in the USGS map, the same area is depicted as confined in the FGS map. Based on degrees of confinement, recharge is estimated at 16-31 inches per year in unconfined areas.

***DRASTIC* [Map 31]**

*In addition, a fifth analysis, DRASTIC, has been performed by FDEP to map the hydrogeologic pollution potential of Alachua County. Hydrogeologic settings form the basis of the system and incorporate the major hydrogeologic factors which affect and control ground water movement including: the **D**epth to water table, net **R**echarge to the **A**quifer, **S**oil media, **T**opography, **I**mpact of the vadose zone, and hydraulic **C**onductivity of the aquifer. The application of the DRASTIC system to the Floridan Aquifer in Alachua County has generated a map with symbols and colors which illustrate the areas of ground water vulnerability to contamination (Aller, 1985). The map identifies areas of high aquifer recharge that coincide fairly closely to the County's designation of unconfined and semi-confined areas of the aquifer.*

***NCFRPC's Composite Map* [Map 32]**

Yet another effort to identify recharge areas appears in the North Central Florida Regional Planning Council's Strategic Regional Policy Plan (SRPP), amended August 28, 1997. Its map of Regionally Significant Ground Water Resources synthesizes data from various sources, some of which are described above. The NCFRPC emphasizes that the map has been prepared as part of a strategic regional planning program and should be used only in conjunction with the text of the SRPP.

Bluebelt Ordinance

In recognition that Florida's groundwater is among the state's most precious and basic natural resources, the Florida Legislature created the Bluebelt Act of 1996 (Section 193.625, Florida Statutes) as an attempt to create private incentives for groundwater protection. This state law authorizes a voluntary tax assessment ("bluebelt") program that allows a tax reduction in high-water recharge areas. High-water recharge lands are those areas that contribute significant groundwater recharge to underlying aquifer systems, as determined by the appropriate water management district based on the hydrologic characteristics of the soils and the underlying geologic formations.

Eligible lands must be identified by one of two methods: (1) prime groundwater recharge areas established pursuant to F.S. 373.0395 ("groundwater basin resource availability inventory"); or (2) areas considered by the WMDs to supply significant groundwater recharge. The first method is not available for Alachua County. While the water management districts have provided a map that identifies "significant groundwater recharge" areas, the County is not satisfied with use of that map to implement the ordinance, given the mapping issues discussed above. Policy 4.5.4 indicates the bluebelt assessment will be considered on completion of updated study.

The bluebelt ordinance is an example of a tax incentive that is intended to encourage conservation and protection of natural resources, which is encouraged by Alachua County's comprehensive plan. A draft bluebelt ordinance is essentially ready to be advertised for public hearing in terms of format. However, several areas of concern must be addressed before proceeding. It should be noted that the legislature did not provide for the state to reimburse the counties for lost tax revenues under the program. In addition to reduced tax revenue, there are problematic issues related to potential undesired effects on land use patterns and land conservation initiatives, and quantifying the environmental benefit. There are specific policy issues where flexibility may be exercised by the Board, and no consensus has been reached on the combination of variables (minimum acreage requirements, length of contract, amount of tax reduction, eligible land use classifications) that would yield the desired outcome.

c. Springshed management

Florida's water quality rules do not provide for protection that takes into account the unique interaction that naturally occurs between ground water and surface water at springs. Waters that interact, as Florida's groundwater and surface waters do, should be protected across the boundary between the two, and for all uses. What is known to date must be considered in attempting to address the problem before it is too late. There are three fundamental tenets upon which the Florida Springs Task Group suggests we base our management strategies.

(1) A spring is only as healthy as its recharge basin, or "springshed."

(2) Activities within springsheds can and do have adverse impacts upon the quality and quantity of groundwater, thereby affecting spring flow, water quality, and the health of spring-run ecosystems.

(3) Protection of spring water must occur in the springshed before the water reaches the spring.

Critical parcels of land around or within springsheds must be protected. Through a combination of public education, intergovernmental coordination, regulations, incentives, and voluntary purchase or conservation easements, land necessary for the survival of springs can be acquired or properly managed. When residents appreciate the springs, are aware that a problem exists, and understand how their actions affect not only the springs but their drinking water, they are motivated to help.

The Florida Springs Task Force recommends the creation of zones of special consideration for land use planning or regulation, according to model protocol for the development of wellhead protection areas and groundwater capture zones. Springsheds and areas that drain into sinkholes and other karst features should be included in these zones of protection via ordinances and land development regulations. Within these zones, the following should be required:

- a minimum 100-foot buffer around sinkholes and other karst features that are connected to spring conduits

- extension of OFW protections for streams and karst features that are known to have hydrologic connections to OFWs

- alternative OSTDSs technologies, which are currently capable of removing up to 75% of nitrogen from OSTDS effluent; with mandatory OSTDS inspection and maintenance every five years or on sale of the property.

- limited or discontinued use of fertlizer

- tree preservation and landscaping standards that reduce water and fertilizer consumption. Native vegetation should be preserved as much as possible when land is cleared for residential development. Where native vegetation is not preserved, promote the use of plants that require a minimum of water. Minimize turf areas in landscape design and in common areas within subdivisions. Intersperse turf around large areas of native vegetation that is adapted to Florida soils and does not require fertilizer. Limit the area devoted to lawns (to reduce the need for fertilizer) and impervious surfaces (to reduce runoff).

- agricultural and silvicultural best management practices.

As Alachua County looks to protect its springs, we should consider each of these strategies sooner rather than later. The effects of chemical contamination on spring life, including submerged cave life, is not well known – much about the life cycles of these animals has yet to be learned. The known range of many of these species is limited to a few or only one spring system. Thus, entire species are highly vulnerable, with their survival totally dependent on a continuing supply of clean water.

Although certain land uses, such as landfills, are obviously unsuitable for sensitive karst areas and springsheds, where to draw the line, short of leaving all land in its natural state, remains a question. The challenges ahead include controlling high intensity land uses in the springsheds, reducing the use of fertilizers on residential lawns, golf courses and pastures, and insuring that the withdrawal of groundwater from springsheds will not reduce spring flow.

d. Surface waters and wetlands protection/restoration

The Santa Fe River, as well as other streams, creeks, lakes, and ponds are important natural and community resources that serve as scenic and recreational amenities while performing a number of beneficial environmental functions. They serve as important fisheries and as parts of wildlife habitat mosaics, providing sources of food for a variety of wildlife, including listed species such as osprey and southern bald eagle. Wetlands and their surrounding uplands also serve as natural buffers from development, filtering and attenuating stormwater and providing reliable aquifer recharge. Recreation opportunities along lakes and streams in Alachua County include fishing, boating, canoeing, swimming, windsurfing and other aquatic recreation activities. In the future it will be important to balance the demand for additional recreational access to water resource areas with the maintenance of sufficient undisturbed habitat and feeding areas for the numerous wildlife species in the County.

Surface waters and wetlands are protected in accordance with the Alachua County Surface Waters and Wetlands Code (Alachua County Code, Chapter 359, adopted 1992). The ordinance defines wetlands without reference to size and prohibits development activity adjacent to or connected to a surface water or wetland areas that would alter the surface water or hydroperiod necessary to sustain wetland structure and function equivalent to predevelopment levels. In addition, Newnans, Orange, Santa Fe, and other lakes are ‘managed’ as sovereign submerged lands by the state. There are currently no land use or management guidelines specific to lakes in effect County-wide.

Please see the Wetland Ecosystems section of this data and analysis for more specific discussion of techniques to minimize and mitigate impacts, buffers, financial incentives, cost-share and certification programs, and education and outreach.

Rivers and lakes are an important part of Alachua County's natural heritage, and the maintenance of their integrity is crucial. Management objectives must be realistic; lakes must be managed to produce the most feasible mix of multiple uses conducive to maintaining the desired level of environmental quality for any given lake. Generally, it is more economically feasible to maintain a natural resource in its existing state than attempt to restore it from a degraded condition. Therefore, the County's management objective should be to establish a process wherein a lake’s existing environmental quality can be identified, and performance standards and criteria applied such that beneficial lake functions are maintained and, where feasible, restored.

The County has also established several policies relevant to lakes and streams. However, despite the amount of information available, there is not a significant database for a vast majority of the County’s lakes and streams, and many lakes are becoming eutrophic at an accelerated rate, with potential for ecosystem collapse.

Invasive vegetation control

One of the undesirable water quality trends that has been identified in Alachua County is excessive algal and invasive plant growth in local surface waters, primarily due to increased concentrations of nitrogen and phosphorus. ACEPD is leading several efforts targeted at control and elimination of invasive vegetation. Special projects include aquatic weed management at Bivens Arm, an invasive plant inventory at Lake Santa Fe (with Adopt a River), and a revegetation project at Lake Lochloosa (with FFWCC).

Under the Bivens Arm program, hydrilla control has been achieved through an extensive grass carp release in 1999/2000, eliminating the need for chemical control. The area is currently under maintenance control for water lettuce/hyacinth. Grass carp are affecting plants by eating roots. Work to commence on wild taro control in spring 2002 in cooperation with UF Center for Aquatic and Invasive Plants. Pilot work will be performed on the UF area of the lake.

Watershed cleanups

In addition, Current Problems, Inc. programs were established in Alachua County to take an active role in helping to keep our waterways free of litter. The Adopt A River and Up the Creek! programs conduct waterway cleanups in the Santa Fe River and Orange Creek Basins. The Adopt A Shore and Up The Creek! programs both provide for ongoing litter abatement work by adopting out stretches of river, creek, or shoreline to caring citizens who live on or nearby these waterways. Up The Creek! focuses on Gainesville's urban creeks, while Adopt A River works throughout the County. Up The Creek! also conducts storm drain marking projects.

Current Problems also offers environmental education presentations about our region's aquatic systems and the threats to our waters at schools, libraries, and organization meetings.

e. Floodprone areas

It is the County's objective to protect and maintain the natural functions of the 100-year flood plain. Floodplain areas serve as important reserve areas to store floodwaters during various magnitude storm events. In their natural state, they also act as some of the most important wildlife habitat areas and movement corridors in Alachua County. Water purification and water supply are other important functions of floodplains. Protection of public health and safety and natural systems are dual goals.

The eastern lakes area of the County still contain large wetlands, floodplains and wildlife refuge areas that support many specialized plant and animals species. Policies under Objective 4.8 seek to protect riparian and wetland habitats in the County while allowing compatible uses where appropriate. The County will support the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient storage, and wildlife habitats.

Policy language encourages the development of a comprehensive watershed management program. The purpose is to identify and map the 100-year floodplain, evaluate the flood-handling capacities of natural drainage systems, maintain and enhance water quality, protect natural ecosystems, develop floodplain management guidelines, incorporate watershed information into a data base system, protect the hydrologic functions of the 100-year floodplain by prohibiting fill in a flood prone area without mitigation.

Identification

The 100-year floodplain in Alachua County has been delineated by various agencies, including the Federal Emergency Management Agency (FEMA), the U.S. Geological Survey (USGS), the Army Corps of Engineers (ACE), and the North Central Florida Regional Planning Council (NCFRPC). The County utilizes all these sources as well as onsite investigations to determine 100-year flood elevations. The County adopts by reference the FEMA maps for purposes of identifying flood-prone areas (see Map 33). Recent flood conditions have resulted in a call for reevaluation of FEMA floodplain mapping. Updated mapping should be available in digitized format by the end of 2002.

Acquisition

The County will work toward the acquisition by public agencies or private non-profit conservation organizations of creek corridors, wetland, meadows, and areas rich in wildlife or of a fragile ecological nature as public open space where such areas cannot effectively be preserved through the regulatory process. Such protection may take the form of fee acquisition or protective easements and may be carried out in cooperation with other local, state, and federal agencies and private entities. Acquisition will include provisions for maintenance and management in perpetuity.

Regulations

The County regulates development in the 100-year floodplain by designating these areas as Conservation areas. Development is required to cluster on upland portions of the property and minimize impacts on the conservation resource. The County also regulates development activity in 100-year floodprone areas in order to protect public safety by maintaining flood carrying capacity.

This is accomplished through the provisions of Alachua County Code, Chapter 342 (Flood Hazard Areas) and by prohibiting subdivision of land after 1/21/93 that would create new lots lacking sufficient buildable area as defined by setback requirements and other development standards, outside of the 100-year floodprone areas. If any lots in a proposed subdivision lack sufficient buildable area outside the flood prone area, the lots must be enlarged or otherwise reconfigured until the requirement is met.

In addition, County regulations require that the SRWMD and SJRWMD shall be notified of all development proposals within the 100-year floodplain of the Santa Fe River. Rule 64E-6.007(2), FAC, regulates location of septic system drainfields within the 10-year floodplain of rivers, streams, and other bodies of flowing water. The vegetative buffer overlay district also regulates development activity within 660 feet of Preservation areas in order to protect the natural functions of these areas (Preservation lands are lands held in public ownership for conservation/preservation purposes). Within the 660 foot buffer, a variable-width setback may be required, limiting permitted uses in order to attenuate visual, noise, herbicide and pesticide, listed species habitat, or water quality or quality impacts on the adjacent Preservation lands.

Other County activities directly or indirectly aimed at protecting floodprone areas include (1) County monitoring of the use of County-owned facilities at Poe Springs, partially located within the 100-year floodplain of the Santa Fe River, (2) participation by Alachua County Superintendent of Parks on SRWMD’s Land Management Review Team, planning for recreational use of SRWMD-owned properties; and (3) completion of a County-sponsored ecological inventory of significant natural areas which included many areas subject to periodic flooding.

Currently, the County is divided into three stormwater management districts, with a County public works supervisor monitoring stormwater management and needs in each district. No comprehensive watershed management program has been implemented or is planned with respect to stormwater due to lack of available funding. The County implements individual watershed management plans as the need arises. Alachua County’s approach to issues relating to flood prone areas is primarily need-based and reactive in nature due to funding constraints. If future developments point to a need for a more proactive stance on stormwater-related issues, a source of funding for needed activities will have to be identified.

3. Pollutant-source strategies

a. Stormwater

Stormwater is a major source of pollutants to lakes, streams, and creeks. Unlike domestic or industrial sources, stormwater is a nonpoint pollution. Undeveloped uplands and wetland systems help maintain good water quality by filtering, settling and/or assimilating these pollutants as stormwater flows through and across them. Land development with its accompanying increased impervious surfaces (roads and roof tops) fundamentally disrupts the natural treatment of rainfall and runoff. The quantity of runoff and rate of runoff is increased because roads and storm sewers provide a direct, unimpeded conduit to the receiving water. The problem is further compounded because there is less vegetation which results in lower nutrient uptake/assimilation. Thus, stormwater is laden with nutrients which are readily available to aquatic vegetation and algae, exacerbating the eutrophication problems evident in our lakes and streams.

The state first began regulating stormwater discharges in 1980s because of flooding and water quality impacts from stormwater. The stormwater rule required that new development include stormwater treatment systems, such as retention basins and detention ponds, to remove pollutants. In 1992, Alachua County adopted stormwater management regulations (Alachua County Code ch.343) to provide standards for the design, construction, and operation of stormwater management systems. Best overall management practices, as they existed at the time, were required to address the control of runoff volume and treatment of stormwater runoff for the protection of surface water and groundwater quality, and for the control and prevention of erosion, sedimentation, and flooding. New development plans must include stormwater management system designs documenting the location of the 100-year floodplain, if applicable, and providing for the creation of a Homeowner's Association to maintain these systems. Alternatively, a regional stormwater benefit assessment district may be created to address stormwater management needs on a regional basis and assess properties benefitted by any improvements.

Stormwater management remains a priority issue in the urban portions of the County, where runoff and discharges from construction activity, small municipal separate stormwater systems, industrial stormwater systems, and combined sewer overflows threaten surface and ground water quality. Updated best management practices, many employing land use controls, offer an important strategy for controlling these risks. Stormwater should be considered a water resource instead of a waste product, with natural attenuation, infiltration, and recharge promoted over collection, transport, storage, treatment and discharge.

Karst areas

In certain karst areas of western Alachua County, the limestone that contains the Floridan Aquifer is at or near the land surface and can be easily contaminated. The most common system used in karst areas is dry retention basins. Dry retention basins treat stormwater by percolating runoff into the ground beneath the basin. As runoff passes through soil, filtration, adsorption, and biological removal of contaminants occurs.

After a few years, it became apparent that special considerations were warranted when stormwater systems were sited in certain karst areas of the SJRWMD. There is concern in these areas by the tendency of solution–pipe sinkholes to form in the bottom of some stormwater basins. When a solution pipe forms, it creates a direct connection between the bottom of the basin, where pollutants are concentrated, and the aquifer below. Runoff entering the aquifer by this route bypasses treatment. To address the problem, SJRWMD adopted more stringent criteria within sensitive karst areas of western Alachua County. These criteria are incorporated by reference in Chapter 343 of the Alachua County Code, Stormwater Management. These include: Ch. 40B-4, FAC (SRWMD); Ch. 62-25, 40, FAC (FDEP); Ch. 40C-42, FAC (SJRWMD). Alachua County Code sec. 343.07(c)(4) provides alternative stormwater treatment and basin design standards for karst areas of the County.

NPDES Permits

Polluted storm water runoff is often transported to municipal separate storm sewer systems ("MS4s") and ultimately discharged into local rivers and streams without treatment. A municipal separate storm sewer system (MS4) is a publicly-owned conveyance or system that is designed for the discharge of stormwater to surface waters of the State.

EPA's Storm Water Phase I & II Rules established an MS4 storm water management program that is intended to improve the nation's waterways by reducing the quantity of pollutants that storm water picks up and carries into storm sewer systems during storm events. Phase I Permits cover discharges from "medium" and "large" MS4s (i.e., those MS4s located in areas with populations of 100,000 or greater). Phase II Permits cover discharges from certain "small" MS4s. Regulated MS4 operators must obtain an NPDES stormwater permit and implement appropriate pollution prevention techniques to reduce the contamination of stormwater runoff and prohibit illicit discharges to the MS4. All large and medium MS4s are currently permitted. Regulated small MS4s will have until March 10, 2003 to obtain permit coverage.

Operators of regulated MS4s, including Alachua County and the City of Gainesville, are required to obtain a permit and implement a program to reduce the discharge of pollutants to the "maximum extent practicable" (MEP). Implementation of the MEP standard will typically require the development and implementation of Best Management Practices (BMP) and the achievement of measurable goals to satisfy the following six minimum control measures:

1. Public Education and Outreach
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Control
6. Pollution Prevention/Good Housekeeping

The County's proposed Water Quality Ordinance includes language to address two of these control measures: illicit discharge detection and elimination and construction site runoff control.

b. Fertilizer Use

Various land uses within watersheds can contribute to the pollution of groundwater and surface waters from nutrients, primarily phosphorus and nitrogen. BMPs for all land uses should be evaluated for effectiveness in water quality protection. Strategies to increase the efficiency of fertilizer use, and reduce the need for fertilizers, are essential to the survival of surface water systems.

Agricultural activities are known sources of nutrients from animal waste and commercial fertilizers. There is a concern that application of fertilizers and pesticides in karst areas and adjacent to surface waters may affect water quality. The effectiveness of Silviculture BMPs for groundwater protection needs to be evaluated. Based on scientific evidence, BMPs should be modified as necessary to achieve appropriate resource protection. Implementation of BMPs is necessary for protection of water quality.

This includes implementation of Landscape Fertilization BMPs, Florida Yards and Neighborhoods program to educate large groups (garden clubs, retailers, lawn care service companies) on the importance of the use of slow-release fertilizers for residential lawns and gardens as more effective.

With the increasing popularity of golf, and Florida's growing population, many new golf courses are being built in the state. Over 1,500 course, representing over 200,000 acres of land use, exist in Florida in the year 2000. Studies have shown that chemicals used on golf course can contaminate groundwater and surface water resources. The use of BMPs in the operation and maintenance of golf courses can reduce the potential for negative impacts to water resources. An integrated pest management plan (IPMP) is the cornerstone of environmentally responsible golf course management. An IPMP guides golf course managers in the responsible storage, handling, and application of chemicals and in the use of native vegetation in golf course landscape plans. Ideally, IPMPs include water quality monitoring programs.

c. Wastewater treatment program

Chapter 363, Article IV of the Alachua County Code (Wastewater and Wastewater Treatment Facilities Ordinance) provides for the regulation, monitoring, and inspection of wastewater treatment facilities by requiring special use permits and establishing treatment facility design and effluent disposal standards. Four general types of treated wastewater disposal are allowed; these include deep well injection, disposal into surface waters, disposal into percolation ponds, and spray irrigation. The County currently monitors and inspects facilities with a monthly visual inspection and a bi-monthly (six times per year) testing. Monitoring data is provided to FDEP, Jacksonville office, which provides any enforcement action required, usually as a result of chronic non-compliance.

A 1998 draft report on ACEPD's Wastewater Treatment Plant Monitoring Program has been prepared to determine its effectiveness in meeting Florida and Alachua County regulations governing the operation of effluent treatment facilities within Alachua County. Total effluent design flow of all WWTPs permitted in the County is 22.4 million gallons per day (mgd).

There are nearly thirty treatment plants in Alachua County, which run the gamut from two large plants maintained by Gainesville Regional Utilities to smaller facilities serving seasonal or special event needs. See Map 34 for locations of wastewater treatment plants in Alachua County. Numerous plants experience chronic violations. ACEPD is working with TREEO to assess options for five problem plants, including: Hillcrest Mobile Home Park, Brittany Estates, Prairie View Apartments, Arredondo Mobile Home Park, and Gainesville Raceway.. The problems are generally related to poor plant operation and maintenance. FDEP is currently monitoring these plants closely and has taken enforcement action against Hillcrest Mobile Home Park. Plans are to encourage connection to GRU, where feasible, find funding sources to assist plants with connection costs, work with FDEP to include connection provisions in plant permits, and research additional options.

In addition, four plants will be removed from service by the summer of 2003 when they are connected to the municipal plants in the Cities of Alachua (Turkey Creek and Progress Mobile Home Park) and Hawthorne (Sonny's and Texaco Food Mart). Two new wastewater treatment plants are planned in the High Springs area.

The County will be revising the wastewater treatment plant code to decrease monitoring frequency from bimonthly to quarterly, in conjunction with more stringent inspections and the addition of ticketing authority for permit violations.

d. Septic tank regulation

Chapter 64E-6, Florida Administrative Code, implemented by the Florida Department of Health county health departments, establishes standards for on-site sewage treatment and disposal systems (OSTDS). These standards apply throughout the state as minimum standards, although local governments are free to apply stricter standards if they choose. The regulations include a permitting requirement and standards for location, site evaluation, system size, system type, and other requirements. In floodways, the bottom of the drainfield must be elevated above the 10-year flood level. For lots created before 1/17/90 and not meeting this requirement, however, a permit may be obtained if the lot is at least one-half acre in size and the bottom of the drainfield is at least 36 inches above the two-year flood level and the applicant installs certain alternative technologies.

In a 1991 report prepared by Henigar and Ray Engineering Associates, Inc., for SFWMD entitled Placement and Maintenance of Individual Septic Systems (On-Site Disposal Systems), some issues were identified as potentially applicable in many areas of Florida. These included minimum required distance between septic systems and private drinking water wells, the importance of the minimum 24-inch unsaturated zone beneath drainfields, septic tank density limitations, system maintenance issues, and the importance of public education. There have been numerous changes in septic system regulations since 1991 (e.g., increasing performance standards).

There is no conclusive evidence, however, that state rules governing septic system placement are adequate for eliminating the likelihood of groundwater pollution, particularly in areas of demonstrated high recharge/contamination potential. The question of whether or not existing locational standards and operational procedures is unresolved, but there is mounting evidence that poorly sited and maintained septic systems and disposal of septage and other sewereage by-products may lead to increased water quality problems.

In 1999, the Florida legislature began a state-wide review of current septic tank regulations. The ACEPD has assisted with the submittal of surveys and other information. ACPED has also provided technical assistance to Alachua County Public Health personnel in regards to their review of existing septic tank regulation. See the Potable Water/Sanitary Sewer Element for more information on this subject. The County will work to improve the siting and operation and maintenance of these systems, and enforce requirements for connections to central facilities where available.

e. Private well regulation

According to one estimate in the Potable Water and Sanitary Sewer Element, there were approximately 20,000 private wells in use in Alachua County in the year 2000. Each of these wells represents a potential avenue for contamination of the surficial, intermediate, and Floridan aquifers. Improperly constructed or abandoned wells can provide opportunities for water supply contamination and aquifer interconnection, especially for larger wells used for public water supply, industrial, and irrigation purposes. To address this potential, the ACEPD performs some limited oversight of private wells in order to protect groundwater quality for public health, safety and welfare, and to ensure that the viability and functional values of other natural resources are maintained.

Pursuant to the Well Registration Code (Chapter 356 of the Alachua County Code), registration with ACEPD is required prior to construction, modification, or proper abandonment of any well less than 6" in diameter within the SJRWMD. This regulation is intended to supplement the existing regulations of other agencies. The SJRWMD currently permits wells greater than or equal to six inches in diameter and any size public supply well. The SRWMD currently permits all wells. The Alachua County Public Health Unit inspects and permits well construction, primarily to eliminate contamination from nearby septic tanks. See the Potable Water and Sanitary Sewer Element for more discussion of private wells.

f. Mining and excavation

The current Surface Mining/Reclamation Ordinance (Alachua County Code, Ch. 352) has been effect for over 20 years. It requires a special use permit for new or expanded mining operations. Application requirements include identification of wetlands, soil types, aquifer recharge areas, depth to ground water, drainage plans, and a reclamation plan, among other things. To protect groundwater resources, mining operations are limited to maximum water withdrawals of 500 gallons per minute without a hydrological investigation. To protect surface waters and floodplains, mining activities may not occur within 100 feet of the 100-year floodplain of a flowing stream or natural lake. Surface water drainage must be free of pollutants and directed away from any groundwater connection. Impacts on water quality and quantity in aquifers to be intercepted by the mining operation must be evaluated.

The County also regulates excavation and fill activities through its zoning regulations (Alachua County Code, sec. 393.13), requiring a Special Use Permit for these activities. Policies in the "Mineral Resources" section of this element call for a comprehensive review and revision of all regulations that address mining, land excavation, and filling activities to ensure comprehensive natural resources protection and consistency with state law.

g. Hazardous materials

In 2001, there are over 1,000 hazardous materials facilities regulated under the County's Hazardous Materials Management Code. Each poses a different potential threat to the environment. The regulatory permitting process seeks to control this potential harm by setting strict locational, construction and maintenance standards for these facilities. Inspections are conducted to ensure compliance.

A "Pollution Source Network" has been compiled for Alachua County that contains 952 sites with actual or potential polluting capability. Most of these are hazardous waste generators (456) and underground storage tank facilities (432). Other sites include wastewater treatment plants, abandoned dumps, and landfills.

The FDEP "Early Detection Incentive Program" (EDI) was established under the State Underground Petroleum Environmental Response Act of 1986. EDI was designed to encourage early detection, reporting and cleanup of petroleum contamination from leaking underground storage systems. Currently, there are approximately 310 petroleum contaminated sites in Alachua County - up from the original 60 sites reported - in all phases of cleanup. Since the establishment of the petroleum program in the County in 1988, 78 facilities have been cleaned up, and 104 facilities have been prioritized for clean up. Priorities are based on several factors including the extent of contamination and potential endangerment to drinking water and other critical natural resources. The number of facilities being cleaned up has been increasing steadily with time. The risk of new discharges of petroleum products is considered to have decreased with the requirement for use of double walled tanks.

Dry-cleaning facilities are another significant source of industrial water pollution. Tetrachloroethylene is a chlorinated solvent used and, in the past, released into the groundwater by dry cleaning facilities. This solvent is considered to be less biodegradable than petroleum products and more of a threat to groundwater quality. However, the threat is relatively low in Alachua County where the numbers of dry-cleaning sites is low. The County works with the FDEP under the state's dry cleaning solvent remediation program to address these sites.

There are several large industrial sites associated with water pollution of our surface waters and groundwaters. Two of the more well known contamination sites are the Cabot Carbon/Koppers Superfund Site in Gainesville, which has contaminated the surficial and intermediate aquifers, as well as Hogtown Creek, and the Florida Department of Transportation (FDOT) disposal pit in Fairbanks. These sites are undergoing remediation. More details are provided in the Hazardous Materials Section.

A total of twenty-nine dump sites have been identified in Alachua County. Many of these sites were used for landfilling by small municipalities such as Alachua, Archer, Waldo, Hawthorne, Newberry, High Springs, LaCrosse, Windsor, Orange Heights, and Arredondo. Although these sites have not been extensively investigated, they are generally less than ten acres in size and were used primarily for municipal refuse. The potential for industrially generated hazardous waste is felt to be minimal.

Many other small dump sites are located throughout the County. ACEPD receives information regarding dumping primarily in the form of complaints. These small dump sites are primarily a litter problem. County staff inspect the sites and usually refer them to codes enforcement. The owner of the dump site property is responsible for cleaning up the site. Any sites found that appear to contain hazardous wastes are referred to appropriate outside agencies (i.e., FDEP, EPA).

There are continued concerns about the potential impacts of construction and demolition (C&D) landfills on groundwater. There is particularly a need for environmental monitoring of these landfills and specifically a need for funding of an inspector to monitor these and other uses with potential environmental impacts. Although a new state rule has strengthened state regulation of C&D landfills, the rule exempts "clean fill" operations which will need heightened review to ensure environmentally safe operations. See the Hazardous Materials and Solid Waste section for further discussion.

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