Marion County
Springs Protection Program

REPORT

Strategies and Recommendations for Protecting Silver and Rainbow Springs

Prepared By

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in association with

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Certification

This basis document was prepared for the use of the Marion County Board of County Commissioners in preparing a Springs Protection ordinance for the County by the undersigned.

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Cover Photographs

Upper image:. The Rainbow River, the spring run that originates at Rainbow Springs, Marion County, Florida

Lower image: World-famous, glass-bottomed boat over the spring pool at Silver Springs, Marion County, Florida

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LIST OF ACRONYMS

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BMP	Best Management Practices
BOD	Biological Oxygen Demand
CFC	CFC – Chlorofluorocarbon
CFS	CFS – Cubic feet per second
CUP	Consumptive Use Permits
DEET	N,N-diethyl-meta-toluamide, or N,N-diethyl-3-methylbenzamide
DRASTIC	Depth to water, Recharge, Aquifer media, Soil media, Topography, Impact of vadose zone, and hydraulic Conductivity
DRI	Development of Regional Impacts
EDB	Ethylene dibromide
FDEP	Florida Department of Environmental Protection
FLUCCS	Florida Land Use and Cover Classification System
FGS	Florida Geologic Survey
HRS	Health and Rehabilitative Services
IPMP	Integrated Pest Management Program
MCL	Maximum Contaminant Level
MFL	Minimum Flows and Levels
mgd	million gallons per day
NGVD	National Geodetic Vertical Datum
NRCS	Natural Resources Conservation Service
OSDS	On-Site Sewage Disposal Systems
SCS	Soil Conservation Service
SJRWMD	St. Johns River Water Management District
SWFWMD	Southwest Florida Water Management District
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Loads
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WRAMS	Water Resource and Management Study
WUP	Water Use Permit

GLOSSARY

GLOSSARY

Antimony	A metal often used in batteries, bearing alloys, solders, and pewter. Compounds of antimony are used in flame-retardants, paints, and dyes.
Benzene	A colorless, flammable liquid made from gasoline.
Best Management Practices	Best Management Practices (BMPs) are effective, practical, structural or nonstructural methods which prevent or reduce the movement of sediment, nutrients, pesticides and other pollutants from the land to surface or ground water, or which otherwise protect water quality from potential adverse effects of land use activities.
Cadmium	A metal often used in alloys, batteries, electroplating, and television tubes.
Carbonates	Rock material containing the carbonate ion as part of its chemical composition. Limestone, composed of calcium carbonate, is probably the most common example of this rock type.
CFCs	Chlorofluorocarbons (CFCs) are compounds commonly used as aerosol propellants, refrigerants and solvents. Freon, which is used in automobile airconditioning systems, is a common example of a CFC.
Chert	Also known as flint, chert is a microcrystalline form of quartz and is often found in limestone.
Color	The amount of discoloration in a water body or water sample. Color is often derived from dissolved materials in a water mass, much like food coloring in dyes.
Conduit flow	The flow of ground water through passages in rock aquifer. These passages are typically described as having openings that exceed 1 centimeter in width. Some passages, such as those often found in limestone aquifers, can be actual cave passages several tens of feet across.

Confined aquifer	An aquifer that is overlain by confining beds of sufficient thickness to impede the downward flow of water in the subsurface. The ground water in a confined aquifer is generally under pressure and, in some instances, will flow to the surface if penetrated by a well.
Confining beds	A body of relatively impermeable rock or material which impedes the flow of ground water in the subsurface.
DEET	An insecticide often used to repel mosquitoes.
Depositional facies	The environmental setting in which sediment is deposited.
Discharge	The rate of a stream's discharge or the rate of water flow out of an aquifer at a spring.
Dolostone	A carbonate rock type which contains a significant amount of magnesium in its chemical composition.
DRASTIC	A computer model designed to show the relative vulnerability of an aquifer to contamination. See Acronym list for the parameters used in the DRASTIC model.
Eocene	A time period lasting from approximately 54 to 37.5 million years ago. The Eocene Epoch is part of the Tertiary Period which lasted from approximately 65 million to 1.8 million years ago.
Erosional unconformity	An erosional feature in the subsurface which is identified by a sudden transition in rock type or fossil characteristics of a rock mass. Erosional unconformities are usually identified in Florida by a sudden shift in fossils in the limestone. Erosional unconformities may indicate that millions of years passed between the deposition of two adjacent limestones in the subsurface.
Evaporites	A rock type composed of salt, typically, sodium chloride or calcium sulfate.

FAVA	A computer model designed to show the relative vulnerability of an aquifer to contamination. The FAVA model is likely to surpass the DRASTIC model for assessing aquifer vulnerabilities in Florida.
Floridan aquifer	The principal aquifer which underlies the entire Florida peninsula. The Floridan aquifer is primarily composed of limestone and dolostone which ranges in age from Eocene to Miocene. The Floridan aquifer is one of the most productive aquifers in the world.
FLUCCS	Florida Land Use and Cover Classification System
Fluvial	Produced or deposited by the action of a river or stream.
Geomorphology	The classification, description, and study of the origin and development of landforms with respect to their neighboring features and geologic setting.
Groundwater basin	The underground drainage basin for a spring. Groundwater basins are not visible from the land surface and can only be identified by making water-level measurements in a number of closely spaced wells and mapping the water table in the aquifer.
Guidance concentrations	The level at which a particular contaminant becomes a concern to public health and regulatory officials and warrants further investigation. Due to the lack of scientific knowledge, the guidance concentrations are generally compiled from various public health data sources and are used as an interim contaminant level until more precise numeric standards or MCLs are developed.
Gypsum	A rock type composed of calcium sulfate salt. Gypsum typically occurs in shallow lagoons where seawater is evaporated, leaving behind salts enriched in sulfate.
Hard-rock phosphate	A rock type composed of re-precipitated phosphate. Hard-rock phosphate deposits were once mined throughout north Florida, typically in sinkholes and small deposits.

Holocene	A time period lasting from approximately 10 thousand years ago to the present. The Holocene Epoch is part of the Quaternary Period which lasted from approximately 1.8 million years ago to the present.
Hydraulic conductivity	The flow rate of ground water (in gallons per day) through a one square foot cross section of an aquifer in a direction perpendicular to the flow direction.
Intermediate confining unit	A group of fine-grained sediments, typically clay and clayey sand, which because of its low permeability retards the downward flow of ground water into the Floridan aquifer.
Internal drainage	The characteristic of a watershed whereby surface flow is directed into the subsurface through karst features such as sinkholes. Sinking streams, which are common in north and central Florida, are good examples of internal drainage.
Karst	The characteristic landform created when soluble rocks, such as limestone, are near the surface and dissolve as the result of weathering. Karst landscapes, such as those found throughout Florida, typically contain sinkholes, caves, sinking streams, and internal drainage.
Lacustrine	Produced or deposited by the action of a lake or ponded body of water.
Lake Condition Index (LCI)	In Florida, the Lake Condition Index is calculated by assessing the biologic diversity and abundance in streams and statistically comparing those diversity/abundance conditions to conditions observed in other Florida lakes.
Lead	A metal often used in batteries, bearing alloys, solders, and pewter.
Limestone	A carbonate rock type composed of calcium carbonate. Limestone often contains impurities such as iron and magnesium.

Magnitude	A flow descriptor developed by the USGS to describe the amount of groundwater discharge at a spring. First-magnitude springs discharge more than 64 million gallons per day, while second-magnitude springs discharge between 6.4 and 64 million gallons per day. Third-magnitude springs discharge 0.64 million gallons per day.
Marine	Produced or deposited by the action of an ocean or small sea.
MCL	Maximum contaminant level. The level at which a contaminant in drinking water becomes a health risk.
Mercury	A toxic metal typically used in thermometers, barometers and mercury-vapor lamps. Salts containing mercury may be used as fungicides.
Methemoglobinemia	Also known as "blue baby" syndrome. A medical condition by which hemoglobin in an infants blood stream are converted to methemoglobin, thus retarding the uptake of oxygen in the blood stream. This condition causes the skin of the infant to turn blue.
mgd	Million gallons per day
MFL - Minimum Flows & Levels	Statutorily required regulatory level to be established for priority water bodies for the purpose of establishing levels of water body use before significant harm is incurred.
Middle confining unit	A body of relatively impermeable rock in the Floridan aquifer. The middle confining unit often lies several hundred feet below the land surface and generally separates potable water in the upper Floridan aquifer from non-potable, saline ground water in the lower Floridan aquifer.
Miocene	A time period lasting from approximately 24.5 to 5 million years ago. The Miocene Epoch is part of the Tertiary Period which lasted from approximately 65 to 1.8 million years ago.
NGVD	National Geodetic Vertical Datum
Non-point source	A source of pollution that is widespread and not from a point source such as a pipe or man-made structure.

Paleocene	A time period lasting from approximately 65 to 54 million years ago. The Paleocene Epoch is part of the Tertiary Period which lasted from approximately 65 to 1.8 million years ago.
Permeability	The capacity of a porous rock mass or sediment to transmit water or other fluid.
Phosphatic	Containing phosphorite
Phosphorite	A rock type composed of phosphate. Phosphorite is typically found in Miocene age sediments in Florida. Phosphorite deposits are large enough in some areas of Florida to be commercially mined and developed for fertilizer.
Photo-lineaments	A linear topographic feature of regional or sub-regional extent that identified by the use of aerial photography. Photo-lineaments are thought to reflect the underlying structure of the bedrock, typically fault lines, fractures, and zones of weakness.
Physiographic provinces	A region of the earth's surface of which all the parts share similar geologic structure and climate. In Florida, physiographic provinces are generally lumped into three broad categories: uplands, plains, and lowlands.
Pinnacles	Small, nearly vertical ridges or spires of limestone that show considerable relief (generally tens of feet or more) above the surrounding limestone surface. Pinnacles are a mature karst landform that may capped by sand and clay in Florida.
Pleistocene	A time period lasting from approximately 1.8 million to 10 thousand years ago. The Pleistocene Epoch is part of the Quaternary Period which lasted from approximately 1.8 million years ago to the present.
Pliocene	A time period lasting from approximately 5 to 1.8 million years ago. The Pliocene Epoch is part of the Tertiary Period which lasted from approximately 65 to 1.8 million years ago.

Point source	A source of pollution that is typically associated with a specific location or geographic area such as a pipe, buried drum, or industrial facility.
Poljes	A Slavic word for "field" often used to describe a large, flat-floored depression in a karst landscape. Poljes commonly cover several square miles, are internally drained, and may contain a variety of other karst features (e.g., sinking streams) within them. An observer in a large polje may not know that he/she is actually in a large karst feature.
Potentiometric surface	The imaginary surface representing the level to which ground water will rise in a well completed into a semi-confined or confined aquifer. When the potentiometric surface of the aquifer is higher than the land surface, a well or spring will flow under natural conditions.
Primary drinking water standards	Water quality standards established by the USEPA and various states to protect human and environmental health. Primary drinking water standards are enforceable standards by which Federal and state government agencies may take action to curb or eliminate a pollution source either through voluntary compliance by the polluter or by regulatory/legal enforcement.
Quaternary	A time period lasting from approximately 1.8 to 10 thousand years ago.
Recharge	The rate at which water is supplied to an aquifer, lake, or stream over a specified amount of time.
Residence time	The amount of time a particular mass of water has remained in the subsurface.
Secondary drinking water standards	Water quality standards established by the USEPA and various states to protect the aesthetic qualities of potable water for human consumption and environmental health. Like primary drinking water standards, secondary drinking water standards are enforceable standards, and Federal and state government agencies may take action to curb or eliminate a pollution source either through voluntary compliance by the polluter or by regulatory/legal enforcement.

Semi-confining unit	A group of fine-grained sediments, typically clay and clayey sand, which because of its low permeability retards the downward flow of ground water into the Floridan aquifer.
Shell marl	A type of carbonate rock composed of shell intermixed with fine-grained carbonate materials or carbonate mud.
Siliciclastic	Containing clastic, non-carbonate rock materials such as quartz sand, aluminosilicate clays, and silt-sized sediment.
Stratigraphy	The study of rock strata, their mode(s) of origin, geologic history, and chronologic order.
Stream Condition Index (SCI)	Much like the LCI, the Stream Condition Index is calculated by assessing the biologic diversity and abundance in streams and statistically comparing those diversity/abundance conditions to conditions observed in other Florida streams.
Surficial aquifer	The upper most aquifer in the subsurface that is exposed to atmospheric pressures and is generally recharged by rainfall. The bottom of the surficial aquifer is generally taken to be composed of fine-grained materials such as clay and/or clayey sand, which impede downward flow of ground water.
Tannins	A complex group of natural, organic chemicals that are found in leaves, fruit, and bark. Upon decay, tannins often leach out of organic debris that litters the ground in forested and swampy areas and colors surfaces waters a light to dark brown color.
Tertiary	A time period lasting from approximately 65 to 1.8 million years ago.
Trophic state index (TSI)	In Florida, the Trophic state index is calculated by assessing the chemical concentrations of nitrogen and phosphorus, and chlorophyll levels in a water body and statistically comparing those levels to levels observed in baseline conditions in hundreds of Florida lakes.
Uvalas	A Yugoslavian term for an elongated closed depression in a karst landscape that has formed by the coalescence of several sinkholes that have enlarged towards each other. Although commonly dry, uvalas may contain sinking streams or small ponds or lakes of water.

Vinyl Chloride	An organic chemical used in the manufacturing of polyvinyl chloride (PVC), adhesives for plastics, and as solvents. Vinyl chloride also forms as a result of the microbial degradation of di- and trichloroethene.
Water quality index (WQI)	In Florida, the Water quality index is calculated by assessing several chemical characteristics of a water including the biological oxygen demand, dissolved oxygen, nutrient, and bacteria levels as well as water clarity in a water body, and statistically comparing that those levels to levels observed in baseline conditions in Florida streams.

EXECUTIVE SUMMARY

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Within the State of Florida there is a growing statewide concern regarding the quantity and quality of water discharging from Florida springs in response to a regionalized trend of increasing nitrate concentrations derived from wastewater disposal, application of fertilizers and stormwater runoff. In recognition of this real concern in Marion County, the Marion County Board of County Commissioners approved Resolution 05-R-106 on April 5, 2005, to "develop support for the protection of Marion County springs and directing staff to develop recommend policies for springs protection and to pursue interim measures reflective of the high priority established for protection of Marion County springs". In response to this directive from the Board of County Commissioners, the County initiated the development of a Springs Protection Program (Program).

The County's springs are discharge points for local groundwater, the dominant source of potable water in the County. Springs are often referred to as "windows to the aquifer" because water quality in the springs directly reflects water quality in the surrounding aquifer systems. Hence springs protection efforts additionally contribute to the overall health and welfare of the County's residents by protecting their drinking water supply, whether it comes from a public system or their own private well. Initial efforts for spring protection are focused on the two largest, first-magnitude springs within the County, Silver and Rainbow, due to heavy development pressure and increased water quality degradation within their respective recharge areas. The Silver and Rainbow Rivers, whose flows are fed primarily by the Silver and Rainbow Springs respectively, have been designated as Outstanding Florida Waters in reflection of their diverse ecosystem that includes numerous species of fish, birds and reptiles. Marion County's springs, especially its first magnitude springs, are major tourist attractions that bring millions of dollars in revenues to the County each year. Silver Springs had an estimated direct annual spending impact in Marion of $61.45 million in 2001 (SJRWMD, Bonn, 2004) and Rainbow Springs $6.9 million in FY 2003/2004 (FDEP, 2004).

The current and predicted trends clearly show a declining water quality condition. Recent studies by USGS (Phelps, 1994 and 2004) and SWFWMD (Jones, et al., 1996) of Silver Springs and Rainbow Springs, respectively, have found a number of disturbing concerns relative to groundwater quality. The most significant of these concerns include rising nitrate concentrations and the presence of trace pollutants. The sources of these pollutants are linked to various land uses that introduce organic and inorganic nitrogen and other pollutants into the aquifer. Most significant contributors of these pollutants are fertilizers, domestic wastewater disposal and stormwater runoff. The karst geography that characterizes Marion County allows rapid infiltration of surface pollutants to the Floridan aquifer that discharge at the springs. The current levels of nitrate in the springs are sufficient to cause undesirable changes, including increased turbidity, undesirable and possibly toxic algal growth, and loss of biological and aesthetic value.

It is important to realize that current levels of nitrate in spring discharges have increased as much as seventy fold (.02 to 1.4 ppm) over naturally occurring background conditions and are expected to rise further in the future. The increased nitrate levels observed by both the USGS and SWFWMD studies reflect the influence of nitrogen loading into the Floridan aquifer from the early 1990s, on average. Hence, the nitrogen load that has migrated to the aquifer system since that period, which corresponds to a significant growth period for Marion County, has yet to be observed at the springs. Marion County has a current population of approximately 300,000 residents. Population estimates through the year 2055 indicate an increased population range of 616,000 to 965,000 residents, an increase of 105-222% (GIS Associates, Inc., 2005). As the County's growth takes hold, residential, commercial and transportation land uses will also increase replacing predominantly agricultural land uses (WRAMS Inventory Report, 2005). Most importantly, these replacement land uses produce an increased per acre pollution load from fertilizers and wastewater disposal. This degrading water quality trend emphasizes the need to implement a strong, comprehensive springs protection management plan as soon as possible. Florida has witnessed dramatic examples of spring contamination disasters, most notably the City of Tampa's Sulphur Springs, where communities ignored the warning signs of springs pollution only to lose the recreational use of their precious natural resource due to public health concerns.

The recommended springs protection strategy for Marion County encompasses three major elements.

1. **A sound scientific basis to support the spring protection measures.** This basis for the Springs Protection Program is detailed in the Marion County Water Resource and Management Study (WRAMS) Inventory and Data Analyses Report (WRA, 2005) that compiles and evaluates completed studies and data documenting impacts to the County's springs. Additionally, the Program has prepared two spring protection zones for each spring where human activities, such as waste disposal, fertilization or water use, are most likely to have negative impacts on the water discharging from the spring. The Primary Spring Protection Zone includes the model-predicted, 0-10 year travel time area. The Secondary Protection Zone includes all the model-predicted 10-100 year travel time area.

2. **A legal and administrative framework to provide the basis for governmental implementation of spring protection standards.** The Program recommends the enactment of a County ordinance for immediate spring protection actions to be followed by specific amendments to the County's Comprehensive Plan and Land Development Regulations.

   The major components of the proposed management strategy include the following:

   - Wastewater Management
   - Nutrient Management/Water Conservation
   - Stormwater Management
   - Land Use Prohibitions and Restrictions
   - County Based Initiatives
   - Incentives

   To address the elements of the Program in the County's land use planning and management process, a total of approximately 50 goals, objectives and/or policies are recommended for amendment to the County's Comprehensive Plan. Two new policies were added to the Recreation and Open Space Elements regarding the recreational value of springs and one additional policy was developed for intergovernmental coordination in developing Springshed Protection measures between Marion County and the Cities of Dunnellon, Belleview and Ocala and the counties of Levy and Citrus.

3. **A public education and awareness program for springs protection.** Government regulation for springs protection has it limits and must be augmented with an effective, targeted communication program to reach all land users in the County. The goal of the education and awareness program would be to communicate to the public at large about managing their land in a manner that will provide long-term protection to the springs. It also assists the business and development community to better understand how protection of groundwater and springs is critical to preserving long-term economic prosperity of the County.

Implementation of the Program will require additional staffing to manage the Program elements, associated equipment and support to complete their respective responsibilities. The total projected first year cost for the Program is $890,000 with funding being potentially available from a variety of sources including ad valorem taxes, special assessments, permitting fees, utility charges, impact fees and grants from outside agencies.

In summary, springs protection for Marion County is a critical and cost effective component of a comprehensive growth management strategy that should provide long-term, "quality of life" benefits to the County, its residents and provide an excellent model to follow for other communities in Florida.

SECTION 1

1.0 INTRODUCTION

There is a growing statewide concern about the quantity and quality of water discharging from Florida springs (Florida Springs Task Force, 2000). Concerns about water quality deal largely with the flux of contaminants to the springs in storm and wastewater from sources surrounding the springs. A statewide trend of increasing nitrate concentrations derived from wastewater, fertilizers, and stormwater is a special concern. The quantities of water discharged from many Florida springs also appear to have declined. Local governments are being encouraged to take measures to protect the springs from contamination (Florida Departments of Community Affairs and Environmental Protection, 2002). Sulphur Spring in Tampa presents a prime example of the serious degradation that can occur in the absence of planning and protection that is based on an understanding of the dynamics of the aquifer. In an effort to manage its stormwater, the City of Tampa directed runoff into sinkholes that ultimately feed into the spring. Some of the sinks have since been filled yet this action has resulted in reduced groundwater flow to the spring and pollution that led to the closing of this once popular swimming spot (FDEP, 2005).

In recognition of this growing and real concern as it pertains to Marion County, the Marion County Board of County Commissioners approved Resolution 05-R-106 on April 5, 2005, to "develop support for the protection of Marion County springs and directing staff to develop recommend policies for springs protection and to pursue interim measures reflective of the high priority established for protection of Marion County springs". County staff has initiated the Springs Protection Program (Program) in response to the Commissions' directive and this report provides the recommended polices and procedures to implement the Program.

1.1 Need for Springs Protection

1.1.1 Value and Significance of Springs

The County's springs are discharge points for local groundwater, the dominant source of potable water in the County. Springs are often referred to as "windows to the aquifer". Water quality in the springs directly reflects water quality in the surrounding aquifer systems, so spring protection contributes to the overall health and welfare of the County's residents whether they are receiving their drinking water from a public or private system.

Marion County springs are very significant water resources on a county, state and national level. The County has a total of eight major springs ranging in discharge from an average 525 million gallons per day (MGD) to 2.9 MGD. Silver Springs is the largest non-tidal spring group in Florida (Phelps, 2004) and has an average flow of 525 MGD and forms the headwaters of the Silver River. The Silver River has been designated an Outstanding Florida Water in reflection of its diverse ecosystem that includes numerous species of fish, birds and reptiles. Rainbow Springs is the fourth largest spring in Florida with an average flow of 493 MGD and forms the first 1.5 miles of the Rainbow River (Champion and others, 2001) also designated as an Outstanding Florida Water. In 1972, Rainbow Springs was also designated a National Natural Landmark by the National Park Service.

Table 1-1 Marion County's First and Second Magnitude Springs

SPRING NAME	AVG. DISCHARGE (MGD)[1]	MAX. DISCHARGE (cfs)[2]	MAGNITUDE[3]
Silver Springs	525	820	1
Rainbow Springs	493	763	1
Silver Glen Springs	72.4	112	2
Salt Springs	52.1	80.7	2
Fern Hammock Springs	9.0	13.9	2
Sweetwater Springs	8.2	13	2
Juniper Springs	7.4	11.4	2

[1] **million gallons per day**
[2] **cubic feet per second**
[3] **see Glossary**

Marion County's springs (Table 1-1) (Exhibit 1), especially the first magnitude springs, are major tourist attractions that bring millions of dollars in revenues to the County each year. The three first magnitude springs in the County, Silver, Silver Glen and Rainbow, draw approximately 1 million visitors annually with 70% of visitors from outside the County (SJRWMD, Bonn, 2004). Silver Springs had an estimated direct annual spending impact in Marion of $61.45 million in 2001 (SJRWMD, Bonn, 2004) and Rainbow Springs $6.9 million in FY 2003/2004 FDEP, 2004.)

1.1.2 Current and Future Trends

In conjunction with the Springs Protection Program, the BCC initiated a Water Resource Assessment and Management Study (WRAMS) in 2004 to provide a comprehensive plan to assess and manage all of the County's water resources. The first major component of the WRAMS is an Inventory and Analysis Report (Report) of the County's water resources, which was finalized in September 2005. Among other things, this Report forms the scientific basis for the determination that the County's groundwater aquifers and springs are being degraded by the County's current land use activities and the related pollutants they generate. The Report documents water quality trends in the springs and provides analyses to predict the continued degradation that will take place if water quality protection measures are not enacted as the County continues to grow.

Marion County has a current population of approximately 300,000 residents. Population estimates through the year 2055 indicate an increased population range of 616,000 to 965,000 residents, an increase of 105-222% (GIS Associates, Inc., 2005). (Figure 1-1) As the County's growth takes place, residential, commercial and transportation land uses will also increase replacing predominantly agricultural land uses (WRAMS Inventory Report, 2005). These land uses each have both common and unique associated pollutants that are generated as a result of their respective land use. Most importantly, these land uses produce increased pollution from fertilizers and wastewater disposal. The objective of the Springs Protection Program is to manage these new and existing lands uses to minimize the amount of pollutants that can be introduced into the aquifer systems and ultimately discharged at the springs.

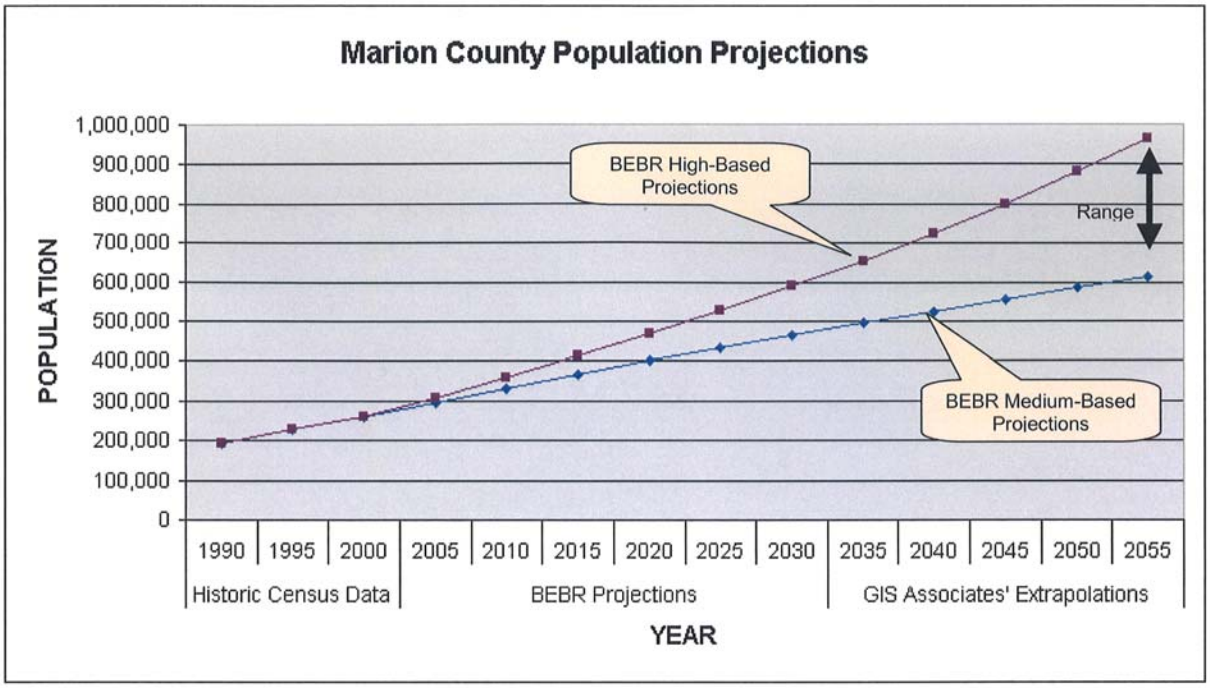
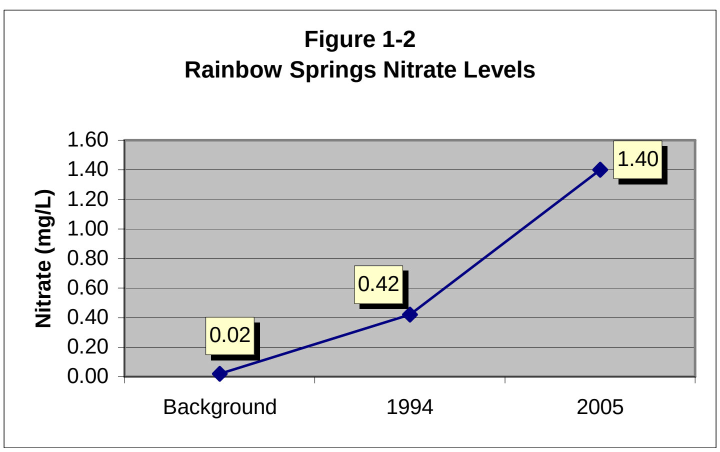


Figure 1-1 Marion County Potable Water Demand Projections (Public Supply and Domestic Self Supply) Source GIS Associates, Inc. (July 2005)

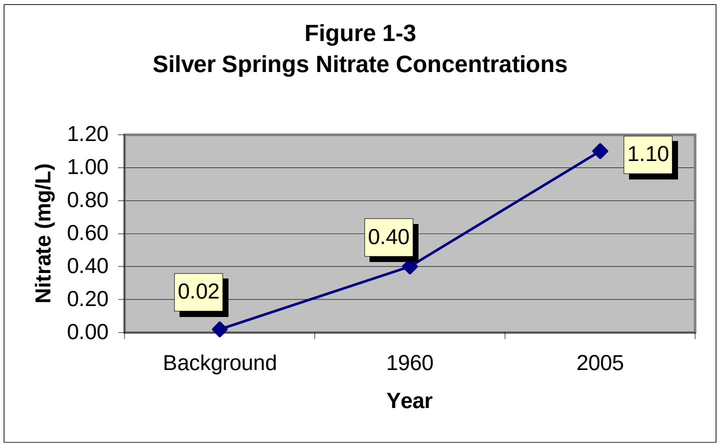
1.1.3 Water Quality Impacts to Springs

Recent studies by USGS (Phelps, 1994, 2004) and SWFWMD (Jones et al., 1996) at Silver Springs and Rainbow Springs, respectively, have found a number of alarming concerns relative to springs and groundwater quality. The most significant of these concerns include rising nitrate concentrations and the presence of trace pollutants. (Figures 1-2 and 1-3) The sources of these pollutants result from various land uses that introduce organic and inorganic nitrogen and other pollutants into the aquifer. Most significant contributors of these pollutants are fertilizers, domestic wastewater disposal and stormwater runoff. The karst geography that characterizes Marion County allows rapid infiltration of surface pollutants to the Floridan aquifer that discharges at the springs. While these constituents do not appear to present health hazards to humans at the present time, increasing levels can present human health issues (WRAMS Report, 2005). The current levels of nitrate in the springs are sufficient to cause undesirable changes, including increased turbidity, unwanted and possibly toxic algal growth, and loss of biological and aesthetic value.



Source: SWFWMD

It is important to realize that current levels of nitrate in spring discharges have increased as much as 70 times (0.02 – 1.40 mg/l) over naturally occurring background conditions and are expected to rise further. The increased nitrate levels observed by both the USGS and SWFWMD studies reflect the influence of nitrogen loading into the Floridan aquifer from the early 1990s on average. Hence, the nitrogen load that has migrated to the aquifer system since that period, which corresponds to a significant growth period for Marion County, has yet to be observed at the springs.



Source USGS

Current pollution control regulations do not provide adequate protection from increased levels of nitrate and other contaminants. State domestic wastewater discharge limits for nitrates is 10mg/L, which studies have already discovered to be too high a level to prevent adverse ecological impacts to springs and other surfacewater systems. Additionally, stormwater treatment regulations` do not provide adequate pollution abatement in closed basin, karst environments that are present in the County (WRAMS Inventory Report, 2005).

1.2 Initial Focus of Springs Protection Program

Initial efforts for spring protection are focused on the largest two, first-magnitude springs within the County that have groundwater basins that are rapidly urbanizing. These springs (Rainbow and Silver) represent important economic, ecological, and water resources to the citizens of the County and State. Other first-magnitude and high second-magnitude springs (e.g., Silver Glen, Salt, and Juniper springs) are located within the Ocala National Forest, which provides significant protection from contamination. Therefore, these springs are not being considered for additional protection at this time. It is important to understand that by instituting a program to protect the County’s two most significant springs, related County water resources will also receive similar protection, including lakes, wetlands and river systems.

SECTION 2

2.0 APPROACH

2.1 Background

Springs protection must have several elements in place in order to be successful in the long term. Specifically, the following elements, at minimum, are necessary:

1. A sound scientific basis to support the spring protection measures. In the case of the need for springs protection in Marion County, the recently completed Data Inventory and Analysis Report developed for the County Water Resource and Management Study (WRAMS) documents the present degraded water quality condition and increasing pollution threat to the springs if additional protection measures are not put into place. In addition, the Springs Protection Program has developed two spring protection zones based on hydrogeologic studies and modeling to address the areas of most concern.

2. A legal and administrative framework to provide the basis for governmental implementation of spring protection standards. Since the method to protect springs involves the management of land uses, a necessary tool to address a springs protection strategy is the County's Comprehensive Plan. In addition to determining the necessary amendments to the County's Comprehensive Plan, other tools may be utilized to implement the strategy including ordinances and modification of the County's Land Development Regulations and a County Ordinance. This initial effort should address amendments to the County's Comprehensive Plan and recommendations to adopt appropriate ordinances and Land Development Regulations to further implement the strategy.

3. An education and awareness program to cultivate public support and understanding for the springs protection effort. This is an extremely important component of the overall springs protection strategy, as it will help develop springs protection as an additional tool to regulation in a cost effective manner. It is acknowledged that not all aspects of managing pollution to the springs can be controlled by government, such as application of fertilizers for lawn and landscaping. Yet managing these types of activities is critical to the success of a springs protection program. To address these activities, individual's mindsets and resulting behavior must be changed to encourage land management decisions that will be protective of the springs. The education process will provide a personal connection to the springs that will motivate individuals to make better choices to protect the springs. Additionally, once educated, these individual's behavior will be changed on a long-term basis and in turn they will educate others.

2.2 Scientific Basis

2.2.1 WRAMS Data Inventory and Analysis Report

The WRAMS Data and Inventory Report (WRA, 2005) characterized all of the County's water resources and investigated the cause and effect relationship between land use activities and the resulting water quality and quantity conditions in the County. Specific findings of the Report, as it pertains to springs protection, are:

- Marion County is characterized as a closed basin topography with an underlying karst geology that has and will continue to produce numerous sinkholes throughout the County.

- The County is characterized as having very large recharge rates throughout most of the County, which provides the benefit of replenishing the aquifers with rainfall and the problem of being vulnerable to contamination from surface pollutants such as fertilizers and wastewater discharges.

- Water use in the County is estimated at 55 million gallons per day (MGD) in 2002 and is expected to increase to a permitted quantity range of 100 MGD to 147 MGD in the year 2055, based predominantly on the growth of potable water demand.

- Water quality for the 87 watersheds as rated by the FDEP ranged from poor to good with the majority of fair to good quality.

- Silver Springs is the largest non-tidal spring system in Florida with an annual average flow of 525 MGD. Rainbow Springs is the fourth largest spring system in Florida with an annual average flow of 493 MGD.

- The most significant source of pollution to the Floridan groundwater system and springs comes from inorganic nitrogen related to the application of fertilizers and organic nitrogen from the disposal of wastewater effluent from centralized wastewater facilities and on-site sewage systems.

- The County has 90,000-100,000 existing on-site sewage systems that discharge an estimated 2.5 million pounds per year of nitrates to the groundwater system. Centralized wastewater systems discharge an estimated 3-6 mg/l TN resulting in 0.17 million pounds per year of nitrates (County Planning staff, 2005).

- Fertilizer application nitrogen loads from residential/commercial land uses are estimated at 1.2 million pounds per year while agricultural operations are estimated at 3.3 million pounds per year. In the year 2055, the nitrogen loading is projected to shift to 1.8 million pounds per year for agriculture to 3.7 million pounds per year from residential and commercial land uses in reflection of shifting land uses.

- Existing point source pollution in the County potentially comes from 32 abandoned landfills, 229 fuel storage and handling facilities, and eight dry cleaning facilities that are currently being monitored by the FDEP.

- Water quality degradation being currently observed in the springs is a result of pollutant loading from a period of 10 or more years ago and therefore the results of Marion County's explosive growth over the past decade are yet to be seen.

- As land use in the County shifts from agriculture to residential, commercial, recreation and transportation in response to population growth, the nutrient load to the Floridan aquifer will increase at an increasing rate if not appropriately managed.

2.2.2 Spring Protection Zones

Spring protection zones are subareas of the ground and surface water basins that supply water to the springs. Within these areas human activities, such as waste disposal, landscape fertilization and water use, are most likely to have negative impacts on water quality and quantity. Spring-protection zones require special water and land use management because:

- Aquifers in Florida are the major water supply source, most predominantly drinking water;
- Springs provide surface water flow that impacts the quality of recreation, wildlife and estuarine systems;
- Aquifers are highly vulnerable to contamination from waste disposal, storm water, pesticide use, and fertilization, among other causes;
- There is a high probability of direct connections between the protection area and springs as a result of karst features;
- Impacts to the springs can cause long-term water quality problems that can be very costly to remediate in terms of money and time; and
- It is much more effective to prevent pollution to the springs than to attempt a cleanup from a contaminated aquifer system.

When these, or similar, conditions exist and a protection area has been developed, adverse conditions at the spring as a result of land use within the protection area can be minimized through use of:

- Land use management and zoning by local government,
- Adoption of minimum flows and levels (MFLs) by the water management districts,
- Adoption of best management practices (BMPs) by land users within the spring protection zones,
- Development of an informed and environmentally aware public, and
- Engineered waste-management or water-use solutions such as more effective on-site sewage treatment systems.

2.3 Legal and Regulatory Provisions

2.3.1 Comprehensive Plan Amendments

The established implementing instrument for land use management in the State of Florida and Marion County is the Comprehensive Land Use Plan. This Plan serves as the overarching goals, objectives and policies that guide how the County will plan and manage future land use. In the process of amending the Comprehensive Plan for springs protection, the following objectives were observed:

- Identify any elements, goals and objectives that pertain to springs protection;

- Assess the sufficiency of the existing Comprehensive Plan elements for springs protection; and
- Identify and draft amendments to the Comprehensive Plan that will provide clear and concise springs protection directives.

2.3.2 Land Use Regulations

Land development regulations are the tools used to implement goals, objectives, and policies (GOP's) in the Comprehensive Plan. In most cases, existing land development regulations can be refined and new ones can be added to address springs protection issues, based on the language that already exists in the Comprehensive Plan. Where there is an insufficient basis for justifying new regulations, it is recommended that Comprehensive Plan language be adopted first in order to avoid inconsistency issues. Certain regulations should be adopted via ordinance as soon as possible given the large volume of land use amendments that are currently under review. Others may be developed and implemented on an incremental basis over a period of time. Specific standards may need to be revised and updated over time as new and improved technologies are developed and/or as existing ones are deemed ineffective or problematic for pollution prevention.

2.3.3 Ordinances

Adoption of a series of "Springs Protection Ordinances" would emphasize the importance of spring's protection measures in Marion County while serving as the legal framework for enacting specific recommendations. An initial ordinance would be used to adopt the recommended new and revised land development regulations that are consistent with the existing Comprehensive Plan. A second ordinance would be required to adopt new and revised GOP text that is approved by the Board during a future Comprehensive Plan adoption hearing. Ordinances subsequent to that would then be used to adopt those needed regulations that are enabled as a result of the updated Comprehensive Plan.

2.3.4 Waivers and Variances

Waiver and variance procedures are a necessary provision to any regulatory process to allow a justified exception to a rule or policy that still meets the objectives of the rule or policy. The use of waivers and variances to avoid the requirements of the rule or policy without sufficient justification that the objectives will be met or mitigated in other acceptable ways defeats the purpose of the rule or policy and may result in inequitable and ineffective regulation.

The Springs Protection Program should require strict adherence to the adopted policies, rules and regulations if the desired outcome of springs protection is to be realized in the future. It is recommended that waivers and variances from policies, rules and regulations related to Springs Protection be granted only in extreme circumstances, and only under the following conditions:

1. The waiver or variance will not generate any additional pollution load to the Floridan aquifer system;
2. The waiver or variance will not produce any new type of pollution to the Floridan aquifer;
3. The waiver or variance will not result in any additional water loss to the spring system;
4. The waiver or variance will not limit the County's ability to require full compliance within the policy, rule or regulation if the variance does not accomplish the objectives of the policy, rule or regulation;

5. Any waiver or variance must provide a contingency plan to meet the intent of the policy, rule or regulation in the event the approved variance is not successful;
6. All analyses provided in support of the variance must be certified by a registered professional engineer and/or professional geologist; and
7. All variances are to be approved by the Marion County BCC.

2.4 Public Education and Awareness

Many of the measures to protect the springs will require monitoring and compliance on behalf of the County if they are to be effective in the long term. This monitoring and compliance process can be expensive and bureaucratically cumbersome for a government entity. In view of the above circumstances, a comprehensive education and awareness program can promote a better probability of compliance with the measures in a more cost effective and long lasting manner. Research has shown that individuals will make better and more environmentally sensitive choices if they understand how behavior affects the environment. These education objectives are critical since many significant spring protection measures such as water conservation, the application of fertilizers, herbicides and pesticides and agricultural practices cannot be effectively or legally regulated and therefore education and awareness is the most effective method of reducing the potential for pollution.

The goal of the education and awareness program would be to communicate to the public at large, businesses and other land users in the County about the importance of managing their land use in a manner that will provide long-term protection to the springs. A specific objective of the education and awareness program is to educate the public on the most effective fertilization and water use practices.

SECTION 3

3.0 ANALYSES

3.1 Spring Protection Zones

This section introduces the methods utilized to develop the proposed spring protection zones. Characterization of spring protection zones in karst terrains is somewhat imprecise because of the unknown locations and orientations of the many caverns and fractures in the limestone of the springsheds. Therefore, several approaches were utilized to identify potential protection zones. Use of multiple approaches allows one to account for the uncertainties while using a conservative approach to protection-area delineation.

3.1.1 Hydrologic Concepts

Groundwater begins as precipitation (Exhibit 2). When it falls on the earth, a proportion is returned as evapotranspiration (evaporation and transpiration, or movement of water to the atmosphere through plants). The remainder enters the aquifer or runs off in streams and rivers. In west and central Marion County, the only major streams are spring runs, streams that are primarily fed by springs. Therefore, recharge to the underlying Floridan aquifer is a critical component of spring protection.

Because of the karstic limestone[1] in Marion County, the land surface is dotted with sinkholes which direct runoff to openings where the water can directly enter the aquifer. In other words, the landscape is internally drained. Therefore, recharge to the primary, potable aquifer (the Floridan aquifer in Marion County) is largely controlled by the distributions of sinking streams, sinkholes, poljes, or uvalas.[3]

The infiltrating water recharges the groundwater, which flows through fractures, caverns, and pore spaces to discharge points (springs). While moving from the land surface to (and through) the aquifer, the water picks up chemicals that are a result of natural deposition in rainfall, natural weathering of soil and rock materials, and wastes deposited by human activity.

The Floridan aquifer is composed of limestone and dolostone[2], soluble rocks that are slowly dissolved by the groundwater to form caverns and other voids. These rocks are often also brittle, so they develop cracks (fractures) and they are deformed by geologic processes.

Karstic and/or fractured rocks are typically inefficient at mitigating contaminants that are introduced into large pore spaces, such as fractures or caverns. For example, water that passes through dissolution- or fracture-enlarged pore spaces may not come into contact with geological materials that can filter or absorb the chemicals contained in the recharge waters. Also, conditions in the aquifer are typically insufficient for efficient biodegradation of contaminants. The only significant process that can reduce the concentrations of contaminants

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[1] The rock is slowly dissolved by slightly acidic water as it recharges the limestone aquifer. Over geologic time, the limestone develops karst topography. The term “karst” is derived from the Serbo-Croatian and literally means a dry terrain. Modern use of the term karst refers to landforms created by the action of water on the limestone. Karst landforms include sinkholes, uvalas (large sinkholes formed by coalescing of several smaller sinkholes), poljes (uvalas that have been partly filled by lake sediments [viz. Paynes Prairie]), sinking streams, springs, natural bridges, and an irregular upper surface of the limestone.

[2] Limestone is predominantly composed of the mineral calcite, a calcium carbonate mineral with the formula $CaCO_3$. Dolostone is made of dolomite ($CaMg(CO_3)_2$). Both minerals, and rocks, are slightly soluble in groundwater in Florida.

in the aquifer is dilution. As a result, little or no improvement of water quality occurs in the karst aquifer and partly diluted chemicals pass through the aquifer and to the springs.

3.1.2 Karst Conduits and Flow Systems

The rocks of central Florida have been subjected to minor folding as a result of geologic stresses (tectonic stresses) that caused uplift of Florida. This folding, combined with the stresses of tidal movement of the rock (earth tides) have resulted in a complex array of fractures in the limestone/dolostone bedrock. The fractures are aligned in preferred orientations by the stresses generated by folding and by the tidal movement. Fracture orientations in central Florida are represented by two dominant orientations: northwest-southeast (NW-SE) and northeast-southwest (NE-SW). Because the fractures are zones in the rock where permeability is higher than elsewhere, the fractures preferentially develop cavernous porosity as a result of additional dissolution of the rock by groundwater. When these caverns are explored, it is often noted that the caverns follow fractures and that they have NE-SW and/or NW-SE orientations. For example, the Silver Springs cavern (Exhibit 3a) and Briar Cave (Exhibit 3b), which is located just southwest of Ocala, have dominant passage orientations in the NE-SW and NW-SE directions.

There are over a dozen small caverns in the Ocala area, and all reveal this set of orientations. Because the processes that caused the rock to develop these orientations are ubiquitous in Marion County, it is appropriate to assume that similar conditions exist in the Rainbow Springs springshed, even though cave maps are unavailable.

These fractures are of special concern because they can transport large volumes of water long distances with minimal improvement in water quality. For example, dye tests in Rose Sink, a sinkhole (swallet) into which an intermittent sinking stream enters the ground near Ichetucknee Springs in Columbia County, clearly establish a connection between the swallet and discharge at the springs. The dye trace data (Karst Environmental Services, 1997) show that travel times are rapid (up to a mile per day) within the cavern system that connects the swallet to the springs. Additional dye trace studies in the area (Butt and Murphy, 2003) have confirmed the rapid transport of dye with some dilution over even greater distances. Unfortunately, dye tracing is difficult and has not been widely applied to Florida karst systems. Therefore, while we know the phenomenon of karst conduit flow occurs to springs, such as Rainbow and Silver, documentation of specific fractures/conduits that contribute to the springs is generally lacking.

Knochenmus (1967) conducted a dye trace within the Ocala area as part of a study of the use of tracers in the karst of the Floridan aquifer. In 1965-1966, fluorescein was introduced to water in the Floridan aquifer at Ocala Caverns, which is located approximately 8 miles south-southwest of Ocala, and fluorescence was monitored in Wolf Sink, approximately 1.3 miles north-northeast of Ocala Caverns. The dye was introduced into a cavern system, the orientation of which is most certainly related to local fracture patterns in the limestone of the Floridan aquifer. Based on the dye study, the travel velocity of water in the fracture/cavern system was estimated to be 0.22 miles per day, with an uncertainty of 0.14 to 0.44 miles/day. Based on a probable, 15-mile long flow path to Silver Springs as derived from a January 1967 potentiometric surface map (Knochenmus, 1967, Fig. 1), it would take 34 to 107 days for a contaminant to pass from Ocala Caverns vicinity to the springs. If the contaminant were to move on a straight path to the springs (~9.5 miles), the constituent would reach the spring in 43 to 68 days. These travel times provide little reaction time and suggest that protection zones should extend far enough from the spring to provide dilution of contaminants.

The dye tracing report by Knochenmus (1967, Fig. 1) includes a potentiometric surface map of the upper Floridan aquifer based on January 1967 data. This map is moderately well constrained by data points in, and near, Ocala and Silver Springs, and it was drawn at a 5-foot contour interval. Of interest is a ridge in the potentiometric surface that extended northwest to southeast between Belleview and Silver Springs. This ridge protruded into the cone of depression drawn for the springs and strongly suggests that flow towards the springs from the south was anisotropic[3]. Flow lines drawn from the Belleview area to Silver Springs show flow to the north-northwest from Belleview to the Ocala vicinity. In Ocala, the flow lines appear to have turned to the east and toward the spring. This flow-line pattern and position of the ridge strongly suggest that fracture flow involved in the movement of water in the Floridan aquifer in the Ocala area. The map does not extend far enough to delineate the ground-water basin, but it does illustrate the need for consideration of conduit (fracture or cavern) flow when constructing protection zones.

Faulkner (1973) utilized tritium activities and aquifer properties to estimate travel times from the proposed Summit Pool of the Cross-Florida Barge Canal to Silver Springs. The travel distance would have been approximately 5 miles, and the estimated travel time was 140 days. This indicates that the flow to the Silver Springs would have been approximately 200 feet per day. Faulkner also noted that this estimate did not account for “solution channels”. If they were present, the estimated travel velocity was thought to be about 1,000 feet per day.

The work by Knochenmus (1967) and Faulkner (1973) provide benchmarks for evaluating the extent of spring protection zones. The estimated travel rates from these two studies range from 13.8 miles/year (Faulkner estimate) to 80.3 miles/year (Knochenmus estimate). These estimates emphasize the need to protect extensive areas of Marion County’s springsheds, and they dramatize the ability of events distant from the springs to rapidly and unexpectedly affect spring discharge.

In summary, karst conduits are a major concern because:

1. They may result in extremely rapid flow to the springs, thus reducing reaction time in the case of a contaminant spill;

2. They are typically locations where attenuation of contaminants is minimal and there may also be minimal dilution – in other words, there may be little to mitigate the concentrations of any contaminant that enters the aquifer; and

3. With the exceptions of a few conduit systems where dye traces have been conducted or cave divers have been able to penetrate, we do not know where the karst conduits are located.

To identify potential karst conduits, scientists conduct “photolineament analyses”, which are sometimes termed “fracture-trace analyses.” Because the fractures are caused by tidal stresses, fracture-related conduits are normally nearly vertical and straight as depicted on large-scale maps. Because groundwater preferentially enlarges the fractures to form caverns, fracture traces can be considered probable locations for caverns in limestone or dolostone.

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[3] Anisotropic aquifers are aquifers within which flow is not unidirectional. In other words, the flow follows specific directions – in this case, fracture or cavern conduits.

A photolineament is a linear alignment of geologic or vegetative features (sinkholes, lakes and streams, soil tones, vegetation patterns, etc.) that may reflect an underlying fracture or karst conduit. Fractures can be tentatively identified by identification of photolineaments because the downward flow of groundwater into the fracture may cause sinkholes (Littlefield and others, 1984), deepen soils and, thus, affect vegetation and soil moisture content, and control the ability of streams to cut downward. Where efforts have been made to confirm that photolineaments reflect fracture traces (Culbreth, 1988; Donovan and others, 2000), the results indicate that a significant proportion of properly identified photolineaments reflect subsurface conditions typical of fractures.

Photolineaments were identified in the vicinity of Rainbow and Silver Springs using Geographic Information System (GIS) maps of closed depressions and stream drainage systems in conjunction with panchromatic, color, and infrared aerial and satellite images. Because of urbanization, it was not possible to identify natural soil tonal differences and vegetative patterns from aerial images of the Ocala vicinity. The major photolineaments were indicated by lines on appropriate maps. Note that each fracture may consist of a swarm of cracks and solution-enlarged conduits and it may be several hundred feet in width. Drawing a line on a map to indicate a proposed photolineament does not suggest that the fracture it is thought to represent is narrow. The line only reflects the approximate location of the feature. These photolineament maps are discussed below.

3.1.3 Identification of Springsheds

There are several methods in common use for delineation of the extent of a springshed. The most common method is by flow-net analysis of potentiometric surface[4] maps of the aquifer. If a high-resolution map[5] of the potentiometric surface can be constructed, the springshed can be delineated by drawing flow lines that are perpendicular to the isopotential contour lines. The extremities of the springshed are represented by ridges (drainage divides) and discharge points on the potentiometric map.

Springsheds have been previously determined for both Rainbow and Silver springs through this method. Faulkner (1973) identified springsheds for both Rainbow and Silver Springs. More recently, Jones and others (1996) and Phelps (2004) presented springshed delineations for Silver and Rainbow Springs, respectively. While such studies provide a very general depiction of the overall extent of these springsheds, the potentiometric map for central and western Marion County does not have sufficient resolution to accurately delineate detailed springsheds. The distribution of potentials is relatively uniform and drainage divides are not always evident in the potentiometric maps. Furthermore, these spring basin maps give no indication of travel times of groundwater flowing to the springs from various portions of the springshed. Therefore, another means of identifying the extents of the springsheds is needed.

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[4] A potentiometric surface is an hypothetical surface to which water will rise in an aquifer. Where the aquifer is unconfined, as is the case for central and western Marion County, the potentiometric surface of the Floridan aquifer is the elevation of the water table. Where the aquifer is confined, the potentiometric surface is constructed by contouring the elevations to which water rises in wells. In theory, water flows down toward lower elevations (potentials) on the potentiometric surface map. Furthermore, it can be assumed that the direction of flow is perpendicular to the orientation of the contour lines of the map.

[5] The resolution of the potentiometric surface map and, therefore, springshed delineation is determined by the number of measurement points used to construct the map. The more wells or other measurement points per unit area of the map, the higher the resolution of the map.

The second most commonly used method of delineating spring recharge basins is through the use of groundwater flow models. Ability to accurately characterize the extents of springsheds is dependent upon the characteristics of the flow model. The critical characteristics include

- Model grid size and number of layers used to represent the aquifer system(s);
- Accuracy of the conceptual model used to design the flow model;
- Method for dealing with isotropy and homogeneity[6] of the strata represented by the layers;
- Accuracy and precision of model calibration;
- Proximity of the springshed to model boundaries;
- Method for estimating recharge and evapotranspiration in the model; and
- Temporal structure of the model (steady state or transient; frequency of time steps in the transient model case).

3.1.4 Groundwater Flow Models

The models used to characterize the springsheds of Silver and Rainbow Springs are:

1. The North-Central Florida, or NCF, model (Motz and Dogan, 2004),
2. The Peninsular Florida, or PF, model (Sepulveda, 2002), and
3. The Suwannee River Water Management District, or SRWMD, model (Schneider and others, 2005).

All three models are based on the numerical flow-model MODFLOW code developed by the U.S. Geological Survey (McDonald and Harbaugh, 1988). The Southwest Florida Water Management District (SWFWMD) is developing a regional model that should assist in characterizing the Rainbow Springs springshed and protection zones, but it was not available at the time of preparation of this report. The SRWMD model domain includes the entire Suwannee River Water Management District. The Rainbow Springs vicinity was included during model construction to avoid placing a model boundary near the District boundary (Exhibit 4). While the model boundary is located near the springs, the Rainbow Springs springshed extends to the north of the springs whereas the model boundary is south of the spring system. The SRWMD model also includes Silver Springs, however it is located very near the eastern model boundary. Therefore, the SRWMD model was only used to characterize the Rainbow Springs springshed.

The SRWMD model is a fully three-dimensional, three-layer, steady state, numerical flow model. The Floridan aquifer constitutes the bottom layer. Grid size is 5,000 x 5,000 feet, and recharge is a calibration variable. The SRWMD model was calibrated to September 1990 observed or estimated groundwater heads and fluxes. Model calibration is generally excellent; the absolute residual mean for 231 wells located within the Floridan Aquifer is 3.88 ft. Simulated flows for approximately 120 springs and river reaches are within 10% of observed or estimated flows.

[6] Isotropy is a property of an aquifer in which hydraulic properties are the same in all three directions. Karstic aquifers are typically anisotropic because of fractures, caverns, and other types of porosity. Homogeneity and heterogeneity refer to the variability of materials that comprise the stratum. For example, the distributions of grain size, porosity, fracturing, hydraulic conductivity are uniform throughout the layer. Karstic limestone is typically heterogeneous.

The original PF model (Exhibit 5) is a quasi-three-dimensional model. In other words, separate model layers were utilized to simulate each aquifer in the groundwater system, and the confining units are simulated by leakance terms between the layers. The version of the PF model used to characterize the Rainbow and Silver Springs springsheds has been converted to a fully three-dimensional model by SDII Global Corporation. Grid size is 5,000 x 5,000 feet, and recharge is a calibration variable.

The PF model is calibrated to average groundwater heads for the period of August 1993 to July 1994, as well as to measured or estimated spring flows and river baseflow. Model calibration for the PF model is generally excellent, with an overall root-mean-square (RMS) residual of 3.4 feet, and simulated spring flow equaling 96% the total measured or estimated spring flow in the model area.

The NCF model covers approximately 5,650 mi^2 in north-central Florida, including most of Marion County, all of Putnam County, and portions of surrounding counties (Exhibit 6). The NCF model contains both Rainbow and Silver Springs. However Rainbow Springs is located very near the western boundary of the model. The NCF model was used to characterize the Silver Springs and Rainbow Springs springsheds.

The NCF model is a steady-state, quasi-three-dimensional model that simulates the aquifers as active layers within the model and confining units as vertical leakances between these layers. Cell size in the NCF model is 2,500 x 2,500 feet. Recharge was computed by considering estimates of rainfall, irrigation, septic inflow, and evapotranspiration. The NCF model was calibrated to average 1995 observed or estimated ground-water heads and fluxes.

The model calibration is generally excellent, with a root mean square error of 3.27 ft for the upper Floridan aquifer. Total simulated springflow equals 100% of the total observed or estimated springflow. The NCF model was used to characterize the Silver Springs springshed.

Note that the springs are typically surrounded by high transmissivity/hydraulic conductivity in all three groundwater flow models (Exhibits 4 through 6). This reflects the development of conduits and rapid travel times in the vicinities of the springs. The spring protection zones are constructed to account for these features.

3.1.5 Particle Tracking

A method known as particle tracking is used to numerically determine the extent of each springshed and predicted travel times of groundwater to the springs. MODFLOW includes a software "package" that simulates the movement of hypothetical particles of water within the model domain. If simulated particles are placed near the boundaries of the springshed in the model, their simulated movement can be tracked to determine if they follow a pathway to the spring. Simulated particles can also be placed at the location of the spring and the model run "backwards" to identify springshed boundaries. Determining the origin and direction of water movement or the final location of these simulated particles delineates the springshed. In order to simulate travel times, the particles can be placed at the location of the spring and the model run backwards to determine where they would have been located in the model in the simulated past time.

Shoemaker and others (2003) utilized particle tracking within three, existing groundwater flow models (including an earlier version of the NCF model) to delineate the 100-year springshed[7] for several springs in north-central Florida, including Silver Springs. While springsheds delineated by all three models were generally similar, the area common to all three models (345 mi^2) is only about half of the area covered by at least one of the models (741 mi^2), even though no one of these models was considered to be of better or worse quality than the others. This highlights the potential variability in the results achieved through use of different models due to various factors such as the calibration period and the different hydraulic parameters in each model.

The St. John's River Water Management District ran the NCF model for use in this analysis. Particle tracking was run in the reverse mode in the model to determine the extent of the Silver Springs springshed within various time frames. SDII Global Corporation ran the SRWMD and PF models in the reverse mode to characterize the Rainbow Springs (SRWMD and PF model) and Silver Springs (PF model only) springsheds.

3.1.6 Travel Time Area Delineation

Two time intervals over which water would travel to the springs were simulated using each flow model. These areas were based on the 10-year and 100-year travel times. Recall that the groundwater flow models assume that the Floridan aquifer does not have fractures and caverns through which water may preferentially flow long distances and/or rapidly. Based on dye-trace studies in central Florida karst systems, areas included within these estimated travel-time envelopes may grossly underestimate distances over which water may travel within these time frames.

As indicated above, at least two models were run for each spring. Where the extents of time-of-travel to the springs differed, the areas included within each model were combined for the purposes of indicating possible spring protection zones. This combining of the two models is because of uncertainties associated with groundwater flow modeling and the conduit systems known to exist in each springshed.

3.1.6.1 Silver Springs Travel Time Estimates

Exhibits 7 and 8 depict the estimated extents of water with travel times of 100 years, 10 years, respectively, to Silver Springs. Note that the results of the PF and NCF models are similar for the extent of water that is predicted to flow to the springs in 100 years. Exhibit 8 illustrates the 0-10 year flow area. The results of the models were similar and the figure shows the combined extents of model results.

3.1.6.2 Rainbow Springs Travel Time Estimates

The PF and SRWMD models differed in areal extents of zones with similar travel times to Rainbow Springs. Exhibit 9 illustrates the 100-year travel-time area for Rainbow Springs. While the SRWMD model results appear somewhat more realistic, the extents of both capture zones were combined for protection zone analysis. Similarly, the 0-10 year capture zone areas differed (Exhibit 10), and their areas were combined for the Primary Spring Protection Zone.

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[7] The 100-year springshed is the area within a spring's ground-water recharge basin that contributes discharge to the spring within an estimated 100-year time frame.

3.1.7 Categories of Proposed Spring-Protection Zones

It is proposed that two levels of spring protection be adopted. These are:

- **Primary Spring-Protection Zone** – The Primary Spring Protection Zone is the area in close proximity to the spring (including spring group, where applicable) within which there is a high probability of rapid storm-water runoff and/or transport through the aquifer system to the spring. Because of the probable rapid flux of contaminants to the spring, ability to prevent or remediate contamination from reaching the spring after contamination event is limited. The level of protection in the Spring Protection Zone, therefore, is high relative to other area areas of the springshed. The Primary Spring Protection Zone includes the model-predicted, 0–10 year travel time area.

- **Secondary Spring Protection Zone** – A Secondary Protection Zone is the area within the springshed that is vulnerable to contamination but is far enough from the spring or major karst conduits to the spring that dilution, chemical retardation, and, possibly, remedial actions will assist in minimizing adverse impacts of the spring. For the purpose of this report, it is proposed that the Secondary Protection Zone include all areas within the 10-100 year travel time area that are not included in the Primary Spring Protection Zone.

3.2 Basis for Protection Zone Delineation

3.2.1 Recent Springshed Delineation Studies in Marion County

The two spring systems (Silver and Rainbow) have recently been investigated with respect to sources of potential chemical constituents of interest, especially nitrate. Jones and others (1996) investigated sources of nitrate in Rainbow Springs. Phelps (2004) investigated contamination sources near Silver Springs. Both studies included springshed delineations and analyses of the probable nitrogen loadings as a result of land use. Both determined that land-use changes have resulted in increased nitrogen loadings and, therefore, the increases in nitrate concentrations that have been documented in both springs. In addition, Phelps (2004) identified numerous anthropogenic constituents in the groundwater of the Silver Springs springshed and in water discharging from Silver Springs that indicate rapid recharge and high potentials for groundwater contamination.

3.2.2 Previous Work on Spring-Protection Area Delineation In Florida

There have been several earlier attempts at springshed-protection area delineation in Florida. These include several springsheds in north Florida. For example, the North Central Florida Regional Planning Council (1978) and Upchurch and Champion (2002, 2004) prepared suggested protection areas around the Ichetucknee Spring Group. Upchurch and Champion (2004) also crafted hypothetical spring-protection areas for Madison Blue, Troy, Manatee, and Fanning springs.

3.2.3 Models for Protection Areas

Upchurch and Champion (2004) analyzed high-resolution potentiometric data for five springsheds (Ichetucknee, Troy, Madison Blue, Fanning, and Manatee) located in the SRWMD and identified at least two different springshed types. These are (1) the “scarp-bounded springshed", which is characterized by the presence of a karst escarpment[8] at the margin of the springshed, and (2) the "unconstrained springshed", which does not have a well-defined physical boundary. They suggested somewhat different protection strategies, based on the structure of the hydraulics of the two types of springsheds.

While the clay-rich strata of the Ocala and Fairfield Hills (Rohrer, 1984) partly confine the Floridan aquifer, they do not appear to affect the extents of the springsheds. Therefore, the "unconstrained springshed" model of Upchurch and Champion (2004) appears to best characterize Marion County spring systems. Rainbow Springs and Silver Springs are not obviously controlled by the presence of escarpments, highlands with confined aquifers, or significant swallet systems. These springsheds appear to be relatively simple, radial flow systems Exhibits 11 and 12) that are unconstrained by major changes in hydrogeologic conditions (i.e., transmissivity, confinement, recharge) within the aquifer system. In this type of unconstrained springshed, selection of protection areas is typically related to travel time to the spring rather than aquifer vulnerability because of the absence of significant spatial changes in the hydraulics and potentiometric surfaces of the ground-water basins.

The concept of delineating two spring-protection zones (Primary Spring-Protection Zone and, Secondary Spring-Protection Zone) can be used in areas where unconstrained springsheds exist. Since the aquifer is not significantly confined within the springshed, streams that drain to swallets are of minor importance and stream systems that introduce surfacewater is of limited concern. Here, protection zones depend on knowledge of the groundwater flow system, patterns of karst, travel times, and potential dilution and retardation estimates.

3.2.4 Criteria for Protection Zone Identification

The criteria utilized for the delineation of protection zones in unconstrained-type springsheds are discussed below. Critical data for delineation of the protection areas include

- Spatial topographic data, including locations and spatial characteristics of sinkholes and escarpments, if any;

- High quality potentiometric surface data and the location and extent of the spring's ground-water recharge basin;

- Knowledge of fracture and cavern system locations, such as cave maps and photolineament (fracture trace) maps;

- Spatial extents of surfacewater basins that drain into swallets within the springshed, if present;

- Knowledge of the locations of swallets and, where possible, dye traces that connect the swallets with the spring system; and

- Spatial data indicating conditions of confinement of the aquifer.

[8] A karst escarpment is a topographic and hydrologic boundary (Upchurch, 2002). On one side, the uplands, the aquifer is confined and recharge to the underlying is minimal. On the other side, the lowlands, the confining beds are absent or sporadic, so recharge is high. The lowlands side is characterized by mature karst topography. The transition zone between the two domains is often characterized by large sinkholes (uvalas and poljes), sinkhole streams, and disappearing lakes (Upchurch and Lawrence, 1984).

3.2.5 Spring-Protection Zone Boundaries

Spring-Protection Zone boundaries enclose the areas that are most vulnerable to rapid movement of contamination to the spring and groundwater withdrawals from the spring or cavern system. The boundaries are drawn to include the following:

- The spring or spring system if there are multiple vents,
- Known cavern systems and/or traces, and
- All areas predicted by the available groundwater flow model(s) to be within a distance over which water can flow to the spring within 10 years, or less.

3.3 Comprehensive Plan Review

The Marion County Springs Protection Program required the assessment of the County's Comprehensive Plan to identify areas of improvement to address springs protection. To accomplish this requirement, the 12 current Marion County Comprehensive Plan Elements provided by Marion County in May 2005, were reviewed to identify if potential spring protection issues were adequately addressed within the Plan. These Elements and Sub-Elements included:

- Future Land Use
- Transportation
- Housing
- Sanitary Sewer
- Solid Waste
- Storm water
- Potable Water
- Natural Groundwater Aquifer Recharge
- Conservation
- Recreation and Open Space
- Intergovernmental Coordination
- Capital Improvements

WRA reviewed the 12 elements of the Marion County Comprehensive Plan to identify existing goals, objectives and policies that could be interpreted to provide springs protection to some degree. Policies were identified that may address one or more of the major issues associated with a spring protection initiative. These included:

- Economic;
- Environmental;
- Recreational;
- Social;
- Legal; and
- Administrative issues.

The Marion Comprehensive Plan Elements were then individually reviewed to identify goals, objectives or policies that addressed, partially addressed or could be interpreted to address the general and specific issues. Once this screening had been completed, a list of those goals, objects and policies was prepared. A policy in any given comprehensive plan element could address several issues, while some “identified issues” had no policies in any of the elements that appeared to address that issue.

A list of potential springs-related goals, objectives and policies was compiled and organized by Comprehensive Plan Element. Examples of strong existing policies, policies requiring revision and proposed new policies were prepared for discussion to illustrate how they could be modified within the existing comprehensive plan framework to implement springs protection measures. These policies were then reviewed for applicability and appropriateness under the Springs Protection Initiative.

Selected terms like: “karst-sensitive”, “high recharge”, wellhead protection”, “wellfield”, “springs”, “groundwater” and others were used to assist in identifying the goals, objectives or policies that could be used or revised to meet the desires of the Springs Protection Initiative.

The current County Comprehensive Plan utilizes an Environmentally Sensitive Overlay Zone (ESOZ) to implement additional regulatory measures necessary to protect the identified environmental features. Generally speaking, these measures protect shoreline ecology and minimize polluted runoff. An ESOZ Map defines the areas where these special protections apply. Currently, the ESOZ encompasses specified setbacks from major spring runs, rivers, streams and lakes within the county. While the ESOZ provides additional protection for spring runs, it does not address the groundwater basin that provides the flow to the spring itself.

The selected goals, objectives and policies were presented to the Marion County Water Resource Committee (Committee) for review and consideration on June 27, 2005. It was the general consensus of the Committee that utilization of the ESOZ approach would be the most effective way to implement springs protection measures, particularly since it is a framework that is currently accepted and working well in Marion County.

SECTION 4

4.0 RESULTS

4.1 Proposed Spring Protection Zones

4.1.1 Silver Springs Protection Zones

The proposed Secondary Protection Zones for Silver Springs is the combined extents of the areas in the PF and NCF models with a 100-year, or less time to the springs (Exhibit 13).

The Primary Spring Protection Zone is depicted on Exhibit 14. Because of the high rates of travel to the springs in conduits and the evidence of extensive cave and conduit zones in the Ocala/Silver Springs area, the 10-year zone includes the known cave and cavern systems, a number of distinctive photolinear features that appear to connect with the spring, and the area that constitutes most of the flow to the springs.

4.1.2 Rainbow Springs Protection Zones

The proposed Secondary Protection Zone for Rainbow Springs (Exhibit 15) includes the areas delineated as having 100 year, or less travel times to the springs by the PF and SRWMD models.

The Primary Spring Protection Zone (Exhibit 16) is also based on the combined PF and SRWMD model results. The 10-year travel-time zone has a truncated boundary on the southwestern side. Faulkner (1973) explained this phenomenon as a function of the distribution of permeable strata west of the spring. The combined springshed protection zones for both Silver and Rainbow Springs are illustrated in Exhibit 17.

4.2 Comprehensive Plan Amendments

A total of approximately 50 goals, objectives and/or policies were revised. Two new policies were added to the Recreation and Open Space Element regarding the recreational value of springs. One additional policy was developed for intergovernmental coordination in developing Springshed Protection measures between Marion County and the Cities of Dunnellon, Belleview and Ocala and the counties of Levy and Citrus. The proposed revised Comprehensive Plan Elements are detailed in Appendix IV with a summary table.

SECTION 5

5.0 SPRINGS PROTECTION STRATEGY

5.1 Spring Protection Components

An effective springs protection strategy must have a series of management components that support and complement each other to provide an effective and cost efficient springs protection program. This combination should include understandable goals, enforceable regulations, and a comprehensive communication plan. The strategy must be easily translated to decision makers from within and without the County who will be responsible to justify the costs to implement the strategy as compared to the benefits received.

The major components of the proposed strategy include the following:

- Domestic Wastewater Management
- Nutrient Management and Water Conservation
- Stormwater Management
- Prohibited or Restricted New Land Uses and Activities by Protection Zone
- Public Education and Awareness
- County Initiatives
- Incentives

Each springshed protection component is detailed in Appendix I by protection zone and land use category.

5.1.1 Domestic Wastewater Management

5.1.1.1 Sources

Organic nitrogen loads from wastewater systems in the County are a major source of pollution to the aquifer. Phelps (2004) concluded that the predominate source of the organic waste in the Silver Springs system was domestic wastewater facilities, namely, on-site sewage treatment and disposal systems (septic tank systems) and central wastewater treatment facilities (regional wastewater and package plants). A subsequent analyses performed by the County Planning Department revealed that on-site and municipal wastewater systems within the County contributed a total estimated nitrate load of 1,330 tons per year, of which an estimated 416 tons of nitrate (31 percent) are generated within the Rainbow and Silver Springs springsheds annually.

As the County continues to grow, there will be a proportionate increase in the wastewater discharges. Given the current configuration of central wastewater systems, it appears that the majority of new development will likely utilize on-site sewage treatment and disposal systems. It is critical for long term springs protection that wastewater effluent be treated to minimize the load of total nitrogen to the groundwater system.

5.1.1.1.1 On-Site Sewage Treatment Systems

On-site sewage treatment systems, also referred to as septic tank systems, are the most prevalent wastewater disposal system in Marion County. Current estimates show approximately 90-100,000 septic tank systems installed in the County. A fully functioning on-site sewage system has an estimated average effluent quality of 50mg/l total nitrogen. This is in contrast to municipal wastewater facilities in the County that have an FDEP effluent limit of 10 mg/l but operate closer to 3-6 mg/l on average (County Planning Staff, 2005). These on-site systems are regulated by the Florida Department of Health.

In a recent study prepared for the Department of Community Affairs, the Florida Department of Health reviewed options for reducing nitrogen loads from on-site sewage treatment systems in the Wekiva Study Basin (FDOH, 2004). As part of the review, the DOH examined a number of alternative septic systems that utilize currently available advanced technology. It found there are a number of performance-based systems on the market that can achieve a 70% to 80% reduction on total nitrogen (TN), which equates to an effluent level of about 10 mg/l.

Based on its findings and the water quality needs in the Wekiva Basin, the FDOH recommended to the Florida Legislature that septic systems installed within high vulnerability areas be capable of achieving the 10 mg/l TN criteria. Marion County may adopt a local ordinance to require on-site septic system that have more effective treatment than what is required by the FDOH, without the need for legislation. (Personal communication with FDOH staff, 2005).

5.1.1.1.2 Centralized Wastewater Systems

According to recent estimates, 6.28 million gallons per day (MGD) of wastewater was discharged within the Rainbow and Silver Springs springsheds from centralized systems as compared to 4.89 MGD from on-site sewage treatment facilities (Marion County Planning staff, 2005). In terms of overall nitrate load to the springs, however, the on-site sewage treatment facilities contribute 743,846 lbs/yr as compared to 89,870 lbs/yr for centralized facilities (Table 5-1). Centralized wastewater systems will continue to increase in size and number as the County's population grows. An additional challenge for these centralized systems is to get them extended throughout the populated areas of the County so that they can replace small private package plant systems and on-site sewage systems and take advantage of their ability to produce a discharge with lower nitrate concentrations.

Table 5-1 – Estimated Wastewater Contribution within Springshed Protection Zones

SOURCE	TOTAL DISCHARGE (MGD)		TOTAL NITRATE LOAD (lbs/yr)	
	Silver	Rainbow	Silver	Rainbow
Centralized facilities	6.12	0.16	87,162	2,744
On-site facilities	4.29	0.60	652,996	90,850
TOTAL	10.41	0.76	740,158	93,594

Source: Marion County Planning staff, 2005

The Florida Department of Environmental Protection (FDEP) regulates centralized wastewater treatment facilities through the National Pollutant Discharge Elimination System (NPDES) Program. FDEP recommended nitrogen reduction limits to the Wekiva Coordinating Committee in 2004. These recommendations were specifically to address the discharge from centralized wastewater facilities within the Wekiva basin.

Specific recommendations by FDEP for the Wekiva Basin included the following:

In the Primary Protection Zone (FDEP, 2004)

1. Requiring existing large wastewater treatment facilities with rapid rate systems as the primary reuse method to reduce nitrogen in their discharge to 3.0 mg/l TN as N within five years.
2. Existing facilities with regional reuse irrigation systems were required to reduce nitrogen in the applied reclaimed water to 10 mg/l TN as N within five years.
3. No land application of wastewater residuals for new facilities.

In the Secondary Protection Zone

1. Requiring existing large wastewater treatment facilities with rapid rate systems as the primary reuse method to reduce nitrogen in their discharge to 6.0 mg/l TN as N within five years.
2. Existing facilities with regional reuse irrigation systems were required to reduce nitrogen in the applied reclaimed water to 10 mg/l TN as N within five years.
3. No land application of wastewater residuals for new facilities

In consideration of the considerable research and analyses that was performed in support of the on-site sewage treatment and centralized system standards for the Wekiva Study Basin, it seems reasonable and prudent to adopt the same wastewater treatment standards for Marion County. More specifically, the springs protection initiative for the Wekiva Study Basin is very similar in many respects to the Marion County springs protection initiative. In both cases the current monitored nitrogen level in the groundwater system has risen to levels well above natural conditions. In both situations, domestic wastewater discharge, in addition to fertilizers, is a major component of the rise in nitrates in the groundwater system.

We do, however, recommend modifications to the FDEP Wekiva Basin standards with respect to the spring protection zones based on the numerous fracture zones in the Marion County springsheds and increasing trend data for nitrates shown for both the Rainbow and Silver Spring systems as compared to the Wekiva study that did not show an increasing trend. We believe that stricter standards should be applied to the Secondary Protection Zones.

General Recommendations:

On-Site Sewage Treatment Systems

1. **New or replaced on-site sewage treatment facilities are required to be performance based systems capable of a 10mg/l (TN) discharge.**

Central Wastewater Treatment Facilities

1. **All new facilities designed to achieve TN concentration of less than 3.0 mg/l. under normal operating conditions.**
2. **Maximize amount of reclaimed water for reuse.**
3. **Require groundwater monitoring of nitrates.**
4. **Limit use of percolation ponds, subsurface discharge and wastewater residuals disposal.**
5. **Retrofit facilities to meet new standards and restrictions.**
6. **Provide for expansion to provide service to communities in Primary Protection Zone.**

5.2 Nutrient Management / Water Conservation

The use of fertilizers in the springsheds presents the most significant threat to springs water quality along with domestic wastewater disposal. However, the prevention of nutrient loading to groundwater is very difficult since the application of fertilizers is very difficult to regulate. BMPs for agriculture are in place but are difficult to customize for each agricultural activity and therefore difficult to seek compliance. It is anticipated that the newly developing Total Maximum Daily Load (TMDL) rules will require additional regulation of fertilizer applications but this is yet to be fully developed.

The most effective method to reduce over-fertilization is to practice avoidance of the need to fertilize and educate the public about the use and misuse of fertilizers. Avoidance can be achieved in part through the use of Florida friendly landscaping that can reduce the need for fertilization and promote water conservation. Additionally, avoiding the development of natural habitat areas, drainage ways and high recharge zones can reduce the need for fertilization and also reduce irrigation and stormwater runoff.

Marion County's adopted Farm BMPs (Exhibit II) and UF-IFAS BMPs for agriculture address fertilizer use for agricultural operations. Additionally, the SJRWMD have developed a model landscaping code for voluntary adoption by local governments. The County should adopt the SJRWMD code as a County ordinance and work with County located agricultural operations to follow the Marion County Farm Best Management Practices adopted 11/02/04.

The conservation of water use also has many benefits in the protection of springs. First, the reduction of water withdrawn from the groundwater system will allow more discharge to the springs and associated river systems. This less consumed groundwater flow reduces the concentration level of pollutants in this open flowing system as well as preserving the water supply, wildlife habitat and recreational aspects of the spring.

Second, reduced water consumption for irrigation uses has a direct impact on the volume of contaminated water that migrates to the Floridan aquifer and eventually the springs.

The most effective method of reducing potable water use is to restrict the amount of water used for irrigation. Research has shown that almost 50% of domestic use is for lawn and landscape irrigation (Kavouras, 2002). This irrigation is best reduced to efficient levels by limiting watering days, requiring the use of reclaimed water or gray water and charging more for large amounts of water used in the home or business, presumably for irrigation. Additionally, the implementation of Florida friendly vegetation for landscaping reduces the amount of water and fertilizers required to maintain the landscaping.

General Recommendations:

1. **Require and/or encourage (as applicable by land use) BMPs for lawn and landscape fertilization.**
2. **Initiate year round irrigation restrictions.**
3. **Require the use of Florida friendly landscaping.**
4. **Require connections to reclaimed waste- and stormwater systems when available.**
5. **Require water conserving rate structures for public potable supply system.**

5.3 Stormwater Management

As potential pollutants accumulate on the land surface, rainfall transports them toward a water resource feature for eventual deposition and contamination of that water resource. In the case of Marion County where most of the topography is characterized by closed basins, the surface runoff eventually migrates into the groundwater system through sinkholes or percolation through porous soils.

The water management districts have stormwater management regulations that require treatment of the stormwater prior to offsite discharge. The regulations call for the collection and treatment of the first one-half inch of runoff in an attempt to capture the "first flush" of pollutants. By theory, most pollutants are then removed through deposition and uptake by vegetation in the stormwater basin. The regulatory presumption states that if the design criteria for the water management districts are followed, the discharge will meet state water quality standards Chapter 62-50 F.A.C. The treatment process is dependant upon nutrient removal through plant adsorption or soil filtration through extended contact time. This period of contact is highly dependant upon the connection the pond has with the underlying aquifer system. If the connection with the aquifer is conducive to high leakance, the runoff will not have sufficient time to be treated prior to leaching into to the groundwater system. Such is the case for most of Marion County where the karst geology short circuits the stormwater treatment process for many stormwater systems resulting in less than desirable removal of pollutants prior to deposition into the Floridan aquifer. Additionally, the accumulation of water in retention/detention facilities can create sinkholes and require additional geotechnical design considerations to avoid this condition.

General Recommendations:

1. **Require treatment of stormwater runoff consistent with the requirements for discharge into an Outstanding Florida waterway.**
2. **Require pretreatment/treatment train practices such as swales, ditchblocks and bioretention basins that will provide additional nutrient removal prior to discharge into DRA.**
3. **Design stormwater systems to be consistent with karst system design criteria provided by the SJRWMD.**
4. **Require all facilities to implement recommended BMPs for stormwater management.**
5. **Require preservation of natural drainage and recharge areas for new developments.**
6. **Minimization of impervious areas to the extent practicable.**
7. **Require capture and reuse of stormwater for irrigation.**

5.4 Prohibited or Restricted New Land Uses and Activities by Protection Zone

There are specific types of land use that have the potential to have dramatic, acute water quality impact on the springs. Examples of such land uses include industrial operations that manufacture, store or utilize toxic chemicals, dry cleaning and fuel handling facilities. Most aspects of these land uses are regulated by federal or state agencies, however spills can still occur and proximity of the operations to water resources such as springs is not a regulated issue. These types of land uses will have dramatic and potentially long lasting impacts on spring water quality if such facilities were to have a spill or leak that migrated to the groundwater system and eventually the springs. These land uses should be prohibited in the Primary Protection Zone that reflects the most rapid connection to the springs. These land uses may be allowed within the more distant zones but only with safeguards to provide adequate protection from a leak or spill event. Such safeguards include, spill containment systems, active monitoring, spill prevention and abatement plans, financial instruments such as bonds for cleanup and licensing agreements sealed by registered engineers.

There are other land uses that although they do not have the potential for a dramatic acute pollution event, they do have the ability to produce a chronic pollution condition. Examples of such land uses include residential and commercial development, agricultural operations, mining operations and wastewater disposal facilities. Such land uses may require restrictions or prohibitions in specific protection zones dependant upon the characteristics of their operations while others may require the use of best management practices (BMPs) if not regulated by federal or state agencies.

These land uses listed below, if located within a springshed, have a significant potential to cause substantial adverse water quality impacts to the springs.

5.4.1 Agriculture

5.4.1.1 Livestock Operations

Florida's dairy and livestock industry is one of the largest in the country, occupying over 700,000 acres of land statewide. Livestock farms can have a significant impact on both the quality and quantity of Florida's aquifers. In Marion County, the major animal production commodities are thoroughbred horses and beef cow/calf operations. Each year, over 400,000 tons of animal waste enters Florida’s groundwater through surface streams, sinkholes, and swallet holes, and through direct infiltration into the soil. (FDEP, 2005) In Marion County, it is estimated that 2992 tons of manure per day and 12.67 tons per day of nitrogen (USDA) is generated from cattle, horses and swine. Most is deposited directly by the animals on the land surface as they graze, where it poses no significant harm. However, there are many locations around the County where horse waste is buried, dumped in sinkholes or stockpiled in mounds exceeding hundreds of cubic yards.

Livestock operations are regulated by the FDEP and the USEPA if the operation meets specific thresholds based on numbers of animals. While very few farms in Marion County meet this threshold, those that do will be required to develop Comprehensive Nutrient Management Plans, which in part regulates the land application of manure.

In 2004, Marion County developed and adopted Farm BMPs, which it currently encourages both large and small operations to implement voluntarily. (Appendix II) In addition, the FDEP, in conjunction with the Florida Department of Agriculture and Consumer Services has developed BMPs for the beef industry, and is in the process of developing one for the equine industry. It is unclear at this time how these will be implemented in a manner that will result in springs protection.

General Recommendations:

1. **Limited operations in the Primary Protection Zone.**
2. **Require implementation of state and local BMPs.**

5.4.1.2 Crop Production

Profitable crop production is dependant upon high yields, which requires significant fertilizer and pesticide applications. In most cases the application of these chemicals are not regulated to the extent they would provide springs protection. Pesticides in the form of DEET and inorganic fertilizer constituents have been identified in spring water quality monitoring showing linkage between land uses that use these compounds and groundwater contamination (Phelps, 2004).

The Farm BMPs established by Marion County reflect the crop production and water quality protection practices developed and promoted by state and federal agencies. Crop production BMPs, like those for manure, are a critical element of a springs protection program.

General Recommendations: (Specific recommendations by land use activity in Appendix I).

1. **Require compliance with state and local BMPs.**
2. **Require water use permit conservation compliance and/or BMPs.**

5.4.2 Cemeteries

Research shows that poorly sited cemeteries pose a threat of groundwater pollution, at least equal in magnitude to that posed by conventional waste-disposal sites. The nature of pollution emanating from a cemetery site differs from that produced by conventional waste-disposal sites, primarily because cemetery leachates pose a greater health hazard. Decomposing corpses release a variety of pathogenic organisms and hazardous chemicals. An incorrectly sited cemetery can lead to contamination of the groundwater and the water supply in general, therefore posing a serious health risk to the community which could, in certain circumstances, lead to an epidemic.

General Recommendations:

1. **New cemeteries prohibited in Primary Protection Zone.**
2. **Special evaluations and conditions for new cemeteries in Secondary Zone.**

5.4.3 Fuel handling facilities and other Urban "Hot Spots"

EPA's federal underground storage tank (UST) regulations have contributed greatly to reducing soil and groundwater contamination (by MTBE and other fuel components). MTBE is found in gasoline (and other petroleum fuels) that is commonly stored in USTs. MTBE is typically added to reformulated gasoline, oxygenated fuel, and premium grades of unleaded gasoline. EPA has not set a national standard for MTBE [in drinking water], although some states have set their own limits. In December 1997, EPA issued a Drinking Water Advisory that states concentrations of MTBE in the range of 20 to 40 ppb of water or below will probably not cause unpleasant taste and odor for most people, recognizing that human sensitivity to taste and odor varies widely.

In addition to USTs, there are many other potential sources of MTBE contamination, such as discharge of unburned fuel from water craft (especially 2-stroke engines); gasoline spills from automobile and tanker truck accidents; gasoline spills and drips when refueling automobiles, lawnmowers, tractors and other machines; plus leaks from pipelines and aboveground storage tanks.

Another chemical compound related to fuel handling facilities is ethylene dibromide (EDB). No longer used today, EDB is a man-made chemical that was used for over 70 years in the United

States. In addition to be being a fuel additive, it was also used as a fumigant for agricultural practices. The major cause for concern from digesting high levels of EDB is increased risk of cancer. Limits for EDB in drinking water were established by the State of Florida in 1984 at a level of 0.02 parts per billion.

The FDEP actively regulates the fuel handling industry and has strict controls on the storage of the fuels. The major concern to be addressed by the County is the capture and treatment of stormwater that interacts with the spilled fuel on the surface and moves directly to the stormwater management system which is not designed to handle fuel contamination.

General Recommendations:

1. **Require enhanced stormwater pretreatment systems.**

5.4.4 Golf courses

A golf course is a largely artificial environment and, as such, requires intensive management. The typical golf course is mowed, watered, fertilized, cored, sprayed and otherwise treated to reach a state where large numbers of people can walk and ride across it and still expect a smooth, green, true playing surface. Golf courses have had a strong reliance on chemicals since the 1950s, when the use of modern pesticides became common. Due mainly to government regulation and concern for the environment, golf course management has moved away from the largely chemical-based strategies of the past, towards an approach that integrates natural, mechanical, and chemical management strategies.

General Recommendations: (Specific recommendations by land use activity in Appendix I).

1. **Require annual BMP compliance certification and reporting.**

5.4.5 Hazardous Waste Handlers

The handling of hazardous waste materials is significant to the prevention of pollution. This can include such operations as heavy manufacturing or salvage yards that can utilize a host of raw materials and produce finished products, many of which have the potential to contaminate the water resources if transported as a fluid by runoff or a spill. Hazardous waste materials entering a drinking water resource can have deadly impacts and long-term residual problems that can require years to remediate. The storage of these hazardous wastes is regulated by the FDEP and USEPA.

General Recommendations:

1. **New facilities to have County approved spill prevention and response plan.**

5.4.6 Landfill/Dump Operations

Currently, the County has a prohibition against any new Class I, II, and III landfill operations in the County. Construction and Demolition (C&D) landfills are still allowed, however. These facilities are not closely monitored and may result in springs pollution if hazardous materials are deposited on-site. Currently, there are 19 existing landfill operations identified within the springsheds of Rainbow and Silver springs.

General Recommendations (C&D):

1. **Prohibition of new facilities in the Primary Protection Zone.**
2. **New facilities in Secondary Protection Zone to be lined and leachate collected and treated.**

5.4.7 Mining Operations

The FDEP and water management districts regulate mining operations for water use and water quality discharges. However, since the mining operations have such a close connection to the Floridan aquifer, vulnerability to contamination from a hazardous waste is a clear and present problem. The FDEP and WMDs do not regulate the siting of these facilities with respect to protection of groundwater quality. Special attention needs to be addressed with regard to location of these operations relative to springs.

General Recommendations:

1. **Prohibition of new operations in the Primary Protection Zone.**
2. **Require restoration plans that will provide springs protection measures such as revegetating with Florida friendly vegetation anad creation of water quality improvement features such as wetlands and lakes with bioretention.**

5.4.8 Salvage Yards

Salvage yard businesses buy or accept discarded, wrecked and abandoned automobiles, trucks, buses and trailers. Generally, junk vehicles remain in the junkyard for a specified time period (6 months – 1 year) during which all useful parts are removed and offered for sale. Junk vehicles may also be sold intact. Vehicles that remain in the lot for a long period of time are usually crushed and sent to a scrap metal facility. Some junkyard operators collect brake and transmission fluids, antifreeze, batteries, gasoline and motor oil from the junk vehicles. Waste fluids are generally stored on-site in 55 gallon drums or in tanks. Uncontaminated gasoline may be stored for use by junkyard forklifts and other machinery. Usable batteries are stored and offered for sale; unusable batteries are collected and stored. Storage areas for waste fluids are a potential threat to groundwater quality.

General Recommendations: (Specific recommendations by land use activity in Appendix I).

1. **Prohibited new facilities in Primary Protection Zone.**
2. **Require runoff containment and management practices.**

5.5 County-Based Initiatives

Many components of the program capital will require the County to take the lead in developing and implementing a program capital component. The following 12 initiatives are specifically outlined for implementation.

5.5.1 Land Preservation and Management

Throughout the State of Florida, there have been active government sponsored land acquisition programs to take control of land that is necessary to provide long-term environmental protection or preservation of the natural resources. By taking control of targeted parcels of land in critical locations, the County can reduce or eliminate the pollution potential to the springs.

The County has a current program to gain control of specific, targeted land in the County using the Transfer of Development Rights (TDR). This program should be utilized to assist in achieving the goal of springs protection by acquiring the development rights to property that has been determined to be critical to springs protection.

5.5.2 Public Education and Outreach

The County should implement a public education and awareness effort to provide the land users and residents of the County with the information necessary to make informed decisions regarding springs protection. The County should lead this effort and coordinate with other regulatory agencies to create consistent messages that are applicable to Marion County. This information should be shared with the municipal governments in the County and the counties of Levy and Citrus to implement a coordinated communication strategy. The education and awareness process should begin as soon as possible to allow the public to understand the rationale and purpose of the Program. Specific issues need to be identified and clearly communicated such as the following:

1. Why the springs are important
   i) Windows to the aquifer
   ii) Recreation, tourism, economic development, sales tax funds to County
2. How the springs and groundwater are related
   i) Karst geology
   ii) Sinkholes
   iii) Groundwater feeds springs and rivers
3. What benefits are provided to public if springs are protected
   i) Health of springs for future generations
   ii) Healthy groundwater for domestic wells
   iii) Less future treatment of municipal water supply- lower water bills
   iv) Less future treatment of domestic water supply- less equipment and maintenance costs
4. The ways in which springs are polluted
   i) Runoff
   ii) Septic tanks
   iii) Fertilizer and herbicide application
5. Relationship between water use and springs protection
   i) Runoff
   ii) Wastewater volume
6. The ways they can reduce pollution
   i) Reduce water use
   ii) Reuse gray water
   iii) Connect to municipal wastewater system
   iv) Maintain septic tank system
   v) Minimize fertilizer, pesticide and herbicide applications
   vi) Use Florida native vegetation
7. Proper application of fertilizers, herbicides and pesticides
   i) Timing of application
   ii) Volume of applications
   iii) Choosing vegetation that requires minimal non-natural supplements

5.5.3 Utility Development Program

5.5.3.1 Centralized Wastewater Utility Service Area Expansion

Develop and implement a utility expansion program that addresses the need to provide water and wastewater service to users in the Primary Protection Zone as an initial effort, followed by the Secondary Protection Zone on a more targeted basis. The ability to have as many County water users on a centralized water and wastewater system will allow improved management of water use and wastewater management to better protect the Floridan aquifer system. Central wastewater treatment facilities have a lower nutrient load per 1000 gallons than on-site sewage systems and central water systems can instill water conserving measures to improve conservation of water. In the Secondary Protection Zone, dense communities that are efficiently linked to central systems or located near fracture zones should be targeted for connection.

5.5.3.2 Utility-Based Septic System Inspection and Maintenance Program For All On-Site Systems (EPA Management Level 4)

In addition to addressing the standard for effluent quality, the management of onsite sewage treatment facilities is a critical factor in the long-term compliance with the performance standard. The U.S. Environmental Protection Agency has developed five model guidelines for management of on-site sewage disposal systems (FDOH, 2004) (Table 5-2). The State has already incorporated some of these guidelines into the on-site sewage system laws and regulations specifically, the state of Florida, Chapter 64E-6, (F.A.C.) and Section 381.0065, F.S.

Table 5-2 USEPA Recommended On-Site Sewage Facilities Management Models

USEPA MODEL	REQUIREMENTS	REQUIREMENTS MET BY EXISTING FLORIDA REGULATIONS?	MOST APPLICABLE CIRCUMSTANCES	COMMENTS
1. System Inventory & Awareness of Maintenance Needs	Requires awareness of maintenance Needs	Yes	Low environmental sensitivity area	**Pro:** Low cost **Con:** Least reliability for performance
2. Management thru Maintenance Contracts	Requires maintenance	Yes	Difficult to maintain sites or close proximity to wellheads	**Pro:** Improved reliability **Con:** Unable to implement compliance without permit
3. Management thru Operating Permits	Requires maintenance contract and operating permit	Yes	Require specific water quality criteria to protect sensitive resources	**Pro:** Improved reliability with ability to regulate further by permit **Con:** Numerous permittees
4. Utility O&M	Identical to No.3 but permittee is a utility instead of homeowner	Partially	Requires high degree of reliability	**Pro:** Easier to manage for regulator **Con:** Potentially more costly to homeowner if private utility used instead of government utility
5. Utility Ownership & Management	Same as No.4 but ownership is a utility instead of homeowner	Partially	Same as No. 4	**Pro:** Most effective program **Con:** Costly to administer for regulator

Source: FDOH Wekiva Basin Study, 2004

In recognition of the fact that nutrient loading from on-site septic systems is a major contributor of nutrients to the groundwater system in Marion County and the use of on-site systems will continue to increase as Marion County grows, it is critical that these systems be managed in a consistent and reliable manner. This is particularly important with enhanced performance based systems which involve motorized and finer mechanical components that can easily fail if not properly maintained. It is recommended that the County initiate an on-site sewage system program following USEPA Management Model No. 4. The program would serve as the Responsible Maintenance Entity which would administer a monitoring and inspection program to ensure the long-term proper function of on-site systems. It is understood that this will take a period of time to develop but it is considered a worthwhile investment to reduce a major pollution source to the drinking water supply and protect the County's springs.

5.5.4 Stormwater Improvement Program

The County would implement a program to identify and plan for the upgrade of stormwater facilities that do not meet proposed design standards. Priorities should focus on upgrading systems in redeveloping and urban areas where inadequately treated stormwater poses a threat to groundwater quality.

5.5.5 Countywide Irrigation Rule

The County should develop and adopt a countywide irrigation ordinance that should be at least as stringent as required by the WMDs. Specific consideration should be given to addressing County specific issues regarding compliance, monitoring and exemptions.

5.5.6 Interagency Cooperation for Monitoring and Compliance

The County should develop and initiate specific technical tools, research and monitoring efforts with state and local agencies to further evaluate the land use – springs protection relationship and develop better management tools. Additionally, the County should develop and implement a cooperative agreement with the cities of Ocala, Belleview and Dunnellon and the counties of Levy and Citrus to coordinate spring protection efforts. This initiative would be the primary responsibility of the Planning Department.

5.5.6.1 Aquifer Vulnerability Mapping

County should initiate a cooperative effort with DCA, FDEP and the WMDs to develop a Marion County aquifer vulnerability assessment (MCAVA) map. This map would serve as a land use management tool for the County and be extremely useful in making more informed land use decisions for future development.

5.5.6.2 Effluent and Residuals Disposal

Develop monitoring projects and initiate remediation of potential contamination sources to the Floridan aquifer through karst features within the County.

5.5.6.3 Facilities that Generate, Use and /or Store Hazardous Waste

Ensure adequate monitoring and compliance of facilities or operations that generate, use or store hazardous waste within the County, specifically those located within the Primary Protection Zone.

5.5.6.4 Mining Operations

Ensure adequate monitoring and compliance of mining operations within the County, specifically those located within the Primary Protection Zone.

5.5.6.5 Landfills and Dumps

Ensure adequate monitoring and compliance of landfill and dumps within the County, specifically those located within the Primary Protection Zone.

5.5.6.6 Additional Evaluations

Conduct additional studies to gain greater understanding of springs protection issues and management alternatives including, but not limited to:

-Nutrient transport in karst systems;

-Fertilizer use regulations;

-Improved agricultural practice BMPs;

-Improved methods of reducing impervious surfaces in urban settings; and

-Water conserving rate structures for the public water supply system.

5.5.6.7 Administrative Improvements

Develop additional tools to assist in the efficient management of the springs protection program including, but not limited to,

-Update and improve land use and zoning applications to address springs protection measures;

-Evaluate changes to zoning classifications for easier identification springs protection use impacts;

-Update Land Development Regulations to address current golf course BMPs

-Improved administrative and operations methods to provide efficient and effective springs protection management.

5.6 Incentives

The use of incentives can be a feature that offsets the impacts of regulation and/or encourages the implementation of spring protection measures that cannot be practically regulated. Incentives can be very difficult to structure properly so that there is proper inducement to the land user to implement a measure desired by the government in return for an outcome worth equal value. However, if an incentive can be developed, it can advance an objective of springs protection in conjunction with other measures.

Examples of incentives to consider include:

- Small grants to homeowner associations or businesses that retrofit their landscaping to Florida friendly vegetation.
- Reduced open space requirements to developers that integrate Florida friendly vegetation or water conserving irrigation systems into their developments.
- Dwelling unit bonuses for developments that utilize clustering, Florida-friendly landscaping, low impact development and other water quality and recharge area protection measures.
- Decreased open space requirements for existing developments that retrofit existing stormwater management facilities to meet current County requirements.
- Operating permit fee waiver for existing individual homesites that “retrofit” their septic tanks with performance based sewage treatment systems that meet the County requirements for new on-site systems.

5.6.1 Staffing and Administration Requirements

Many of the recommendations will require tasks that are not addressed by a current County staff position or will create a significant additional workload for current staff, which are not included in current job responsibilities. A more comprehensive evaluation of current job responsibilities is necessary to determine if current County positions can be shifted or merged into positions necessary to implement the Springs Protection Program. However, the following offers a manpower assessment based on the assumption that there are no existing positions or staff time available to address the additional responsibilities. (Table 5-3) Additionally, it is recommended that the County engage a Professional Geologist (PG) to review geologic and hydrogeologic investigations that may be periodically required by the County as part of the zoning or site review process.

Currently, there are no existing procedures to determine if a proposed land use activity will meet the conditions specified within a Springs Protection ESOZ. Coordination between County departments will be required in addition to an established procedure to ensure compliance with the springs protection program. These organizational and operational issues should be investigated further to develop an effective springs protection implementation process. Consultation with the County Administrator is recommended to provide the appropriate organizational structure and responsibility assignments to carry out the duties related to the approved recommendations.

Table 5-3 Estimated Staffing for Springs Protection Program

SPRINGS PROTECTION PROGRAM TASK	JOB RESPONSIBILITY	DEPARTMENT	POSITION	NUMBER OF FTEs[(1)]
Public education and outreach campaign	Develop and implement springs protection education and communication materials, speakers, etc.	Clean Water	Outreach Specialist	1
Zoning plan review	Review zoning plans and perform inspections to ensure compliance with springs protection criteria	Zoning	Zoning Specialist	2.0
Site plan review	Review site plans an rezoning requests to ensure compliance with springs protection criteria	Planning	Site Planner	1.0
Stormwater system review	Review and inspect stormwater plans to ensure compliance with springs protection criteria	Clean Water	Clean Water Engineer	1.0
On-site sewage system maintenance and permitting	Provide maintenance of on-site sewage maintenance and issue permits	Utilities	(1) Supervisor, (2) Technicians and (1) Administrative Assistant	4.0
			TOTAL	**9.0**
Contracted Professional Geologist (PG) for technical submittal reviews for geological or hydrogeological investigations				**0.25**

[(1)] FTE – Fulltime equivalent position

5.6.2 Funding Alternatives

5.6.2.1 Annual Program Budget

Table 5-4 Estimated Annual Springs Protection Implementation Budget

Staff Positions	Staffing Cost (1)	Capital Equipment (2)	Additional Studies (3)	Other (4)	Total
9	$582,000	$67,000	$250,000	$97,000	**$996,000**

(1) Includes 45% for benefits and salaries based on salary ranges for comparable positions and PG retainer

(2) Includes 0.25 vehicles per each of eight positions (total of 2 vehicles) and personal computer systems for nine positions

(3) Studies may include scientific investigations, monitoring or researching new pollution abatement methods

(4) Includes a 15% salary and capital equipment overhead for other items such as space, office supplies, vehicle operating expenses

5.6.3 Funding Sources

Funding for a Springs Protection Program can be generated from a variety of sources including ad valorem taxes, special assessments, licensing and permitting fees, utility charges, impact fees and grants from outside agencies. Each source has its particular advantages and disadvantages that should be considered in determining which makes the most sense from various considerations. The following is a description of various funding alternatives and how they are linked to the components of the Program.

5.6.3.1 Ad Valorem taxes

Creating a line item budget within the annual County budget is an option that would create an annual source of funding, subject to annual approval by the BCC. This funding amount could be budgeted at any level up to the full cost of the Program, estimated at $890,000.

The use of ad valorem taxes would link the cost of springs protection to the landowner however agricultural lands would be exempt due to “greenbelting”. This would create a disparity in equity since agricultural lands represent a majority of the nutrient load to the springs.

5.6.3.2 Special Assessments

A special assessment targeted to springs protection would be an excellent method of assessing all landowners in an equitable manner. The current Clean Water Program is assessing landowners a fee of $15 per parcel and generating approximately $3.5 million per year. The goals of the Clean Water Program are very consistent with the Springs Protection Program and could serve as the vehicle for a special assessment. Based upon the approximately 233,000 parcels assessed to generate the Clean Water Program’s budget, an additional assessment of $3.28 per parcel would generate the funds necessary for the administering the Springs Protection Program.

5.6.3.3 Licensing and Permitting Fees

Licensing and permitting fees are a method of funds generation that allows the County to target fees to those that are contributing to the problem or being benefited by the Program. Licensing fees that can be directly related to springs protection include:

- On-site septic system construction
- On-site septic system operating permits
- Stormwater systems

County Health Department staff predicts an annual increase of on-site septic systems averaging 2300 systems per year. A fee of $387 per system would be required to fund the Program strictly from licensing fees. This fee would represent approximately 4 percent at the cost of a new on-site performance based septic system that is being recommended by the Program.

5.6.3.4 Utility Fees

Utility fees can be assessed based upon consumption of services and therefore has level of use equity. In connection to a spring protection program, assessing a fee on wastewater utility charges would relate directly to one of the more significant nutrient pollutant sources, domestic wastewater. If fees are selected to assess owners of on-site septic systems, then a wastewater utility fee for springs protection would provide equity for those on centralized sewage systems. Based upon the latest figures for centralized wastewater systems in the County, approximately 11 MGD would be available for assessment. An assessment of $0.22 per thousand gallons of wastewater would generate $900,000 annually.

5.6.3.5 Grants from Outside Agencies

Springs protection is an issue that has gained great importance and popularity in Florida. Marion County has taken the initiative to be the first government in the State to address spring protection in a comprehensive and meaningful manner. Currently, there exists funds appropriated by the State of Florida and water management districts that can be utilized to implement a springs protection program. Specifically, the FDEP Springs Protection Initiative is funded by the Florida Legislature to provide funds to study and implement springs protection initiatives. The water management districts funds and funds generated by the recently passed Senate Bill 444 both can be used for springs evaluation and protection initiatives. Currently, both the SJRWMD and the SWFWMD are funding partners with the County for the development of the County Water Resource and Management Study (WRAMS), of which, springs protection is a major component. The federal government also has programs that can be accessed for springs protection on a competitive basis however the current federal funding of environmental programs is very limited due to other national priorities.

Such grants will normally only fund special projects such as monitoring, planning, education, and scientific investigations. The proposed budget for the Springs Protection Program earmarked $250,000 for special studies that could be funded by these grants. Typically these grants are based on a 50-50 match with the local cooperator, therefore the County would be responsible for $125,000.

5.6.4 Suggested Funding Alternatives

The ideal Program funding plan would, at minimum, address all of the following four objectives:

1. Distributes the cost burden onto both the existing and future landowners in the County who should benefit from the Program.
2. Targets those landowners that have the greatest potential to contribute to the pollution of the springs.
3. Creates an adjustable and predictable funding source for the Program.
4. Does not create an unacceptable level of administration to collect and administer funds.

The following funding scenario in Table 5-5 and Figure 5-1 illustrates, for consideration, a funding plan that would address the four objectives using numerous sources. Numerous variations for the scenario can be developed. The simplest funding plan would be to increase the Clean Water Program assessment by approximately $3.30 per parcel to fund the Program. (Table 5-6 and Figure 5-2) This funding mechanism is already in place, publicly accepted and directly related to springs protection.

Table 5-5 Springs Protection Program Funding Scenario 1

Funding Source	Assessment per Unit	Estimated Units to be Assessed Annually	Total Funds Generated Annually	Connection to Springs Protection
Clean Water Program	$2 per parcel	233,000 parcels	$466,000	County Land users who contribute to pollution from all sources and will benefit from groundwater and springs water quality protection
New On-site Septic System Operating Permit	$85 per system	2000 systems	$170,000	County land users who contribute to pollution from wastewater disposal
Wastewater Utility Fee	$0.06 per 1000 gallons	4.015 billion gals.	$240,000	County land users who contribute to pollution from wastewater disposal
Grants	NA	NA	$125,000[1]	Landowners throughout the State who benefit from protected Marion County springs
		Total	**$1,010,000**	

(1) Most grant programs are 50-50 matching funds, therefore the County would only need to provide $125,000 to obtain $250,000 in available funds.

Figure 5-1
Springs Protection Program Funding Scenario 1

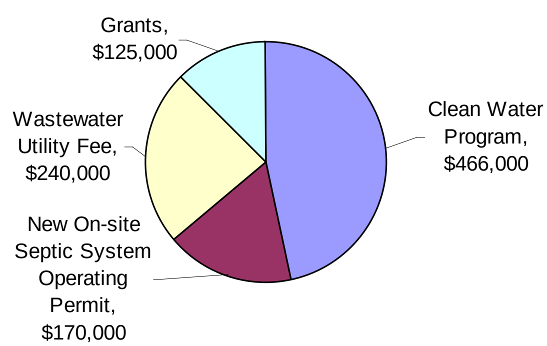
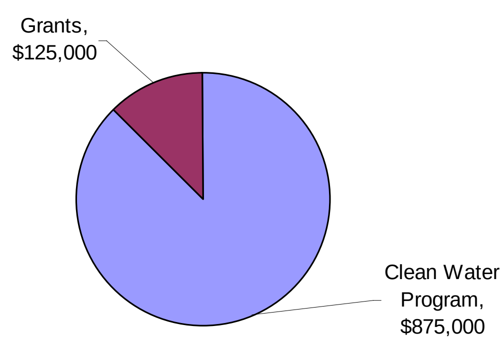


Table 5-6 Springs Protection Program Funding Scenario 2

Funding Source	Assessment per Unit	Estimated Units to be Assessed Annually	Total Funds Generated Annually	Connection to Springs Protection
Clean Water Program	$3.75 per parcel	233,000 parcels	$875,000	County land users who contribute to pollution from all sources and will benefit from groundwater and springs water quality protection
Grants	NA	NA	$125,000(1)	Landowners throughout the State who benefit from protected Marion County springs
		Total	**$1,000,000**	

(1) Most grant programs are 50-50 matching funds, therefore the County would only need to provide $125,000 to obtain $250,000 in available funds

Figure 5-2
Springs Protection Program Funding Scenario 2



SECTION 6

6.0 RECOMMENDATIONS

6.1 New Land Development Regulations

6.1.1 (Short term) Prepare and adopt ordinance to enact springs protection recommendations that are consistent with existing Marion County Comprehensive Plan text .

6.1.2 (Long term) Prepare and adopt ordinance to enact recommendations that are needed to implement amended Comprehensive Plan.

6.2 Comprehensive Plan Amendments

6.2.1 Finalize recommendations for Comprehensive Plan GOP's amendments to ensure sufficient guidance and authority is provided for necessary springs protection measures, including changes to existing text and addition of new GOP's.

6.2.2 Update ESOZ map to include Primary and Secondary Protection Zones based upon the 10 and 100-year travel times.

6.2.3 Consolidate and organize existing groundwater, springs, karst sensitive area, and high recharge area technical text and references into the Natural Groundwater Protection Sub-Element.

6.2.4 Consolidate existing, revised and new land development related policies within the Future Land Use Element.

6.2.5 Finalize and submit final text amendment language for adoption hearing.

6.2.6 Prepare and adopt ordinance to incorporate approved Comprehensive Plan changes.

6.3 Necessary Administrative Tasks

6.3.1 Work with the County Administrator to evaluate the organizational, staffing and operations components necessary to effectively and efficiently implement the Springs Protection Program.

6.3.2 Develop formalized administrative process and procedures to insure that the revised ESOZ Map, Comprehensive Plan and Land Development Codes are integrated into the Marion County land development review and approval process for effective application.

6.3.3 Develop interlocal agreements with the City of Ocala, City of Dunnellon, City of Belleview, Levy County and Citrus County for strategies to implement Springs Protection Zones.

6.3.4 Establish a coordinated staffing plan to ensure adequate monitoring and compliance with the adopted ordinance, Comprehensive Plan policies and Land Development Regulations.

6.3.5 Evaluate and implement a Springs Protection Program funding mechanism that provides equitable cost sharing between affected parties and is directly linked to springs protection.

6.4 Develop and Implement Springs Protection Initiatives

6.4.1 Develop and implement a utility-based onsite sewage treatment system inspection and maintenance program for all on-site systems (EPA Management Level 4).

6.4.2 Develop and implement a stormwater management improvement program to upgrade stormwater systems that do not meet current design standards.

6.4.3 Develop and implement an intensive education and outreach campaign to promote and encourage water conservation and Florida-friendly landscaping principles.

6.4.4 Adopt and enforce countywide irrigation ordinance, consistent with water management district irrigation rules.

6.4.5 Design and adopt a water conserving rate structure for the County public water supply system.

6.4.6 Develop and implement monitoring and remediation program for known landfills and dumps.

6.4.7 Revise County TDR program to include in sending areas lands within the primary protection zones that have high recharge and karst characteristics and exclude receiving areas within the primary protection zones.

6.4.8 Develop Cooperative Interagency Initiatives.

6.4.9 Develop and implement programs in cooperation with state agencies and WMDs, as appropriate, related to:

- Monitoring residuals disposal areas and initiate remediation where sinkholes or other active karst features are forming or present
- Ensuring adequate monitoring and compliance of commercial and industrial facilities that generate, use and or store hazardous waste
- Ensuring adequate monitoring and compliance of mining operations
- Developing Marion County Aquifer Vulnerability Assessment Map (MCAVAM)
- Researching nutrient transport and transformation in stormwater management systems in closed basin, high recharge and karst environments

SECTION 7

7.0 SPRINGS PROTECTION PROGRAM IMPLEMENTATION

Implementation of a Springs Protection Program (Program) is complex and largely unexplored as a water-management strategy. It will require an educated constituency and active cooperation between regulatory agencies, local government, industry, and residents of the springshed. A recommended implementation strategy is to divide the tasks into three phases over an 18-month period after the BCC approves the Program. Each phase has a distinct purpose and builds upon the previous phase.

7.1 Implementation Plan

7.1.1 Implementation Plan Objectives

7.1.1.1 Phase 1 Objectives

- Provide legal adoption of recommended measures
- Determine human and financial resources to implement Program
- Begin the process of securing program funds

7.1.1.2 Phase 2 Objectives

- Develop and implement an interlocal agreement for springs protection cooperation
- Develop and implement a public education and awareness program
- Develop and implement a technical working group for further Program element development

7.1.1.3 Phase 3 Objectives

- Complete Land Development Regulations modifications
- Initiate remaining County based initiatives

PHASE 1 **(Time frame: 3 Months after Program approval)**

1. Adoption of the Program recommendations by the Marion County Board of County Commissioners.
    a. Prepare recommendations and present to BCC for adoption of Springs Protection Program.
    b. Board information should contain specific tasks to be accomplished, a schedule of and general budget costs to implement the Program.
    c. Recommendations should include sources of funding.
2. Initiate administrative review to assess need for staffing of implementation of adopted recommendations and compliance.

a. A manpower and organizational evaluation should be completed to determine the most efficient methods to implement the recommendations with current and/or new staff.

b. Staffing and organizational recommendations should be presented to the County Administrator for review and concurrence.

3. Draft an ordinance to implement springs protection measures within the selected zones.

   a. Prepare the draft ordinance language to incorporate the rationale, scientific basis and specific conditions to be implemented by the ordinance and modify Land Development Regulations consistent with the existing Comprehensive Plan.

   b. Present the ordinance to the BCC for consideration and provide presentation materials to the public at required workshops and hearings.

4. Amend County Comprehensive Plan to include recommended policy changes to reflect springs protection.

   a. Provide BCC with recommended amendments to Comprehensive Plan to provide more specific springs protection language.

   b. Submit amendments to DCA by December, 2005 for approval.

5. Investigate funding for implementation of the education, remediation and other measures requiring government action.

   a. Make application to the FDEP Springs Initiative Program.

   b. Seek funds from the FDEP for TMDL implementation funds.

   c. Make application to the SJRWMD and SWFWMD funding programs.

   d. Seek USEPA funding for clean water programs.

PHASE 2 (Time frame: 6 Months after Program approval)

1. Develop an interlocal agreement with cities and counties to coordinate on spring protection efforts.

   a. Meet, discuss and share information relating to springs protection with interested cooperators.

   b. Develop interlocal agreements, which would be approved by city and county elected boards with specific tasks to be completed by each entity.

   c. Agreements would seek to collectively acquire funding for task implementation.

2. Develop and implement a public education and awareness initiative to communicate springs protection management to the County residents. Specific education and awareness tasks should include:

a. Procure a public communication consultant to assist in the development of a education and awareness program.

b. Review watershed protection materials produced by water management districts and incorporate applicable features into County materials.

c. Develop a consistent "springs protection" message to be repeated through all materials.

d. Develop a Springs Protection Program exhibit for County events.

e. Development of public education materials including:

    i. Brochures

    ii. Pamphlets for inclusion in water or wastewater bills

f. Develop a speaker's bureau to address organizations across the County including homeowners associations, garden clubs, realtors, homebuilder associations, etc.

g. Develop a presentation for speaking engagements to address the objectives of the education and awareness program.

h. Seek funding assistance from FDEP, USEPA, SJRWMD and SWFWMD to assist in the development and operation of the education and awareness program.

i. Promote environmental community projects such as painting stormwater manholes covers with messages that educate about what not to discard in storm sewers.

3. Develop a springs protection work group that would involve County and cooperating governments staffs. Objectives of the group would include:

    a. Develop detailed criteria for spring protection Land Development Regulations.

    b. Develop a communication protocol for coordinated development reviews.

    c. Develop a measurement criterion to assess impact of ordinance.

    d. Develop framework for monitoring and additional studies.

    e. Develop incentives for improved springs protection where regulations are limited.

PHASE 3 (Time frame: 12-18 Months after Program approval)

1. Amend Land Development Regulations to address specific design criteria, conformance language and variance procedures (as necessary).

2. Develop procedures to monitor residuals disposal areas and initiate remediation where sinkholes or other active karst features are forming or present.

3. Develop procedures to ensure adequate monitoring and compliance of commercial and industrial facilities that generate, use and or store hazardous waste.

4. Develop procedures to ensure adequate monitoring and compliance of mining operations.
5. Develop Marion County Aquifer Vulnerability Assessment Map (MCAVAM).
6. Research nutrient transport and transformation in stormwater management systems in closed basin, high recharge and karst environments.
7. Develop and implement monitoring and remediation program for known landfills and dumps.
8. Revise County TDR program to include in sending areas lands within the primary protection zones that have high recharge and karst characteristics and exclude receiving areas within the primary protection zones.

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APPENDICES

APPENDIX I

Appendix I

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

RESIDENTIAL/COMMERCIAL DEVELOPMENT			
SPRINGS MANAGEMENT COMPONENT	**PRIMARY PROTECTION ZONE**	**SECONDARY PROTECTION ZONE**	**LEAD ENTITY(S)**
NEW			
Wastewater Management	Residential and non-residential subdivisions within an Urban Area: Connection to regional wastewater system shall be required regardless of density. When regional facilities are not available, an alternative central system meeting equivalent treatment standards may be used as an interim measure.	Same	Utilities
	Rural subdivisions (e.g. Hamlets): Provision of centralized sewer services shall be preferred. Where central services are not available and the Planning department determines that they are not necessary based on other land use considerations, then the alternative waste treatment and disposal methods may be used, provided that an equivalent level of treatment is achieved.	Same	
	Major site plans: Connection to regional wastewater system shall be required. Where regional facilities are not available, enhanced on site sewage treatment and disposal systems may be used as an interim measure, provided that a performance-based treatment system meeting advanced secondary treatment standards is used.	Same	

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

RESIDENTIAL/COMMERCIAL DEVELOPMENT			
SPRINGS MANAGEMENT COMPONENT	**PRIMARY PROTECTION ZONE**	**SECONDARY PROTECTION ZONE**	**LEAD ENTITY(S)**
	New construction on existing parcels where central services are not available or otherwise required: Residential parcels less than 10 acres is size and all commercial parcels shall utilize a performance-based treatment system (PBTS) [1] with a shallow subsurface drip irrigation drainfield. The PBTS shall achieve a 10mg/l TN discharge limit. Where economically feasible, community or cluster onsite systems meeting an equivalent level of treatment and monitoring shall be preferred.	Same, except that the PBTS shall achieve a 20mg/l TN discharge limit.	Planning, Zoning and Health Department
Nutrient Management & Water Conservation	Florida-friendly landscaping shall be used across 100% of open space areas.	Florida-friendly landscaping shall be used across 75% of open space areas	Planning, Zoning, Extension, Building
	Landscaping design and maintenance shall be consistent with model guidelines established by SJRWMD (2005), except that overhead or spray irrigation shall be limited to 50% or less of the landscapable area.	Same	
	All new irrigation systems shall be constructed in compliance with Florida Building Code, Appendix F	Same	
	(New subdivisions and major site plans) Install reuse transmission and distribution lines for irrigation and other non-potable uses. Connection to reclaimed stormwater and or wastewater source shall be required where available.	Same	
	(New subdivisions) Participation in FYN Programs via Covenants and Homeowner Associations	Same	

[1] Per Chapter 64E-6, Part IV, Florida Administrative Rule. Owners of PBTS's must obtain operating permit issued by responsible maintenance entity (RME) subject to ongoing maintenance contract and annual fees to cover monitoring and inspection requirements.

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

RESIDENTIAL/COMMERCIAL DEVELOPMENT

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
Stormwater Management	Stormwater systems shall be designed utilizing low-impact development and treatment train approaches, including but not limited to grass swales, ditch plugs and other bioretention facilities designed to treat and infiltrate "first flush". Treatment volume shall be consistent with OFW design and performance criteria under Chapter 40C-42, FAC. (SJRWMD, 2005)	Same	Planning, Zoning, Transportation
	All stormwater basins shall be designed according to karst sensitive basin criteria under 40C-41, FAC. (SJRWMD, 2005)	Same	
	Existing drainage patterns and high recharge areas shall be protected through clustering, lot size reductions, reduced impervious surfaces and other measures. Where high recharge encompass that majority of the property, a minimum of 60% of the developable area shall be maintained in natural and or other low-intensity, low-maintenance uses.	Existing drainage patterns and high recharge areas shall be protected through clustering, easements and other measures. Where high recharge encompass that majority of the property, a minimum of 40% of the developable area shall be maintained in natural and or low-maintenance uses	
	(New subdivisions and major site plans) Stormwater shall be reclaimed and made available for reuse to supplement irrigation needs	Same	

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

RESIDENTIAL/COMMERCIAL DEVELOPMENT			
SPRINGS MANAGEMENT COMPONENT	**PRIMARY PROTECTION ZONE**	**SECONDARY PROTECTION ZONE**	**LEAD ENTITY(S)**
	<u>Additional Provisions Specific to Non-residential Urban Uses</u>: Prevent changes in recharge quantity and quality by incorporating the following to the maximum extent practicable: • Minimizing impervious surface areas and directly connected impervious surfaces • Utilization of Florida-friendly landscaping • Designing stormwater systems consistent with low-impact/treatment train design principles for commercial areas, including but not limited to recessed landscaping, grassed swales, pre-treatment ponds, clean-water separation, etc. • Connecting to reuse systems where and when available	Same	
Potable Water Source	(New subdivisions and major site plans) Central water supply shall be required		
	No private wells where public supply is available		
EXISTING			
Wastewater Management	Onsite septic system requiring major repairs or replacement shall be upgraded to meet the current applicable treatment standards	Same	Health Department
	Connect to central sewer services when available	Same	Utility
Nutrient Management & Water Conservation	All new irrigation systems shall be constructed in compliance with Florida Building Code, Appendix F	Same as Primary Zone	Planning, Building
Stormwater Management	Urban areas being redeveloped shall comply with current standards	Same as Primary Zone	Planning, Zoning, Transportation
Potable Water Supply	No new private wells were public supply is available	Same	Planning, Zoning ,Utilities
	Disconnect private wells when central water supply is available	Same	

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

CENTRALIZED WASTEWATER TREATMENT FACILITIES			
SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY
NEW			
Wastewater Management	• Meet a maximum total nitrogen (TN) concentration of 10mg/l, with a goal of being able to regularly achieve less than 3 mg/l. • The primary means of effluent disposal shall be limited to reuse, including turf, landscape and agricultural irrigation. • All effluent disposal sites shall be free from fracture zones and other active karst features. • Require discharge sampling and groundwater monitoring for nitrates • New facilities shall be constructed to maximize the amount of reclaimed water available for reuse • Wastewater residuals disposal shall be prohibited	• Same, with exception that residuals disposal may be permitted	Utilities
EXISTING			
Wastewater Management	• Require discharge sampling and groundwater monitoring for nitrates • Reduce nitrogen concentrations to 10mg/l TN as N within 8 years, except that existing facilities with rapid-rate and subsurface infiltration systems must attain 3 mg/l TN or convert to a reuse system within 8 years.	• Require discharge sampling and groundwater monitoring for nitrates • Reduce nitrogen concentrations to 10mg/l TN as N within 15 years, except that existing facilities with rapid-rate and subsurface infiltration systems must attain 3 mg/l TN or convert to a reuse system within 15 years.	Utilities

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

AGRICULTURAL OPERATIONS

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Prohibitions/Restrictions & Nutrient Management & Water Conservation	No new animal feedlots	Feedlots permitted by special use, subject to compliance with federal, state and local BMP's	Planning, Zoning, Extension
	New livestock operations permitted by special use subject to implementation of applicable state and local manure and nutrient management BMPs	Same	
	New cropland permitted by special use subject implementation of applicable state and local nutrient management and water conservation BMPs	Same	
EXISTING			
Nutrient Management & Water Conservation	Conservation plans and implementation of applicable state and local manure and nutrient management and water conservation BMPs required within 5 years	Conservation plans and implementation of applicable state and local manure and nutrient management and water conservation BMPs required within 10 years	Planning, Zoning, Extension

GOLF COURSES

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Nutrient Management & Water Conservation	Supplement existing code requirements with annual certification of compliance with BMPs and reporting of total fertilizer usage for the purpose of watershed nutrient loading analysis	Same	Planning, Zoning
EXISTING			

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

SALVAGE YARDS

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Prohibitions/Restrictions	New uses prohibited	New facilities permitted by special use with approved hazardous waste and runoff containment plan	Planning, Zoning
EXISTING			
Prohibitions/Restrictions	Existing facilities to be removed or retrofitted with enhanced containment and management practices	Same	Planning, Zoning, Transportation

DUMPS/LANDFILLS

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Prohibitions/Restrictions	New Class I, II and III already prohibited	C&D landfills allowed subject to County approved siting, containment and monitoring plan	Planning, Zoning
EXISTING			
Prohibitions/Restrictions	Develop and implement active program for monitoring fill activities and sinkhole development	Same	Planning, Zoning

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

MINING OPERATIONS			
SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Prohibitions/Restrictions	New uses prohibited	New mines require restoration plans consistent with springs protection	Planning, Zoning
EXISTING			
Nutrient Management & Water Conservation	Require restoration plans consistent with springs protection	Same	Planning, Zoning

COMMERCIAL AND INDUSTRIAL FACILITIES HANDLING HAZARDOUS MATERIALS			
SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Prohibitions/Restrictions	Allowable subject to County approved spill prevention and response plan	Same	Planning, Zoning
EXISTING			
	See County-based Initiatives		

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

URBAN HOTSPOTS (gas stations, auto repair facilities, used auto parking lots, etc.)

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Stormwater Management	Runoff from impervious surfaces shall collected and treated separately from other stormwater, utilizing appropriate filtration technology	Same	Planning, Zoning, Transportation
EXISTING			

CEMETERIES

SPRINGS MANAGEMENT COMPONENT	PRIMARY PROTECTION ZONE	SECONDARY PROTECTION ZONE	LEAD ENTITY(S)
NEW			
Prohibitions/Restrictions	New uses prohibited	New uses permitted by special use subject to site suitability evaluation consistent with system developed by the Council for Geoscience	Planning, Zoning
EXISTING			

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

COUNTY BASED INITIATIVES		
SPRINGS MANAGEMENT COMPONENT	**ACTIVITY DESCRIPTION**	**LEAD ENTITY(S)**
Wastewater Management	Develop and implement utility development program that aims to expand municipal sewer system into unserved areas with urban land use types and or densities, with high priority placed upon projects within the primary protection zone, followed by projects within the secondary protection zone	Planning, Utilities
	Develop and implant a County utility based on-site sewage inspection and monitoring program consistent with USEPA Management Level 4	
Stormwater Management	Develop and implement a stormwater management improvement program to upgrade stormwater systems that do not meet current design standards. Priorities should focus on upgrading systems in redeveloping areas and in urban watersheds where inadequately treated discharge poses a significant threat to groundwater quality. Priority should be given to drainage wells.	Planning, Zoning, Transportation
	Propose and develop scientific research project aimed at promoting a better understanding of nutrient transport and transformation in stormwater management systems in closed basin, high recharge and karst environments	
	Investigate and propose options for reduction of minimum street widths, parking areas and other impervious surfaces in within urban areas.	
Nutrient Management & Water Conservation	Adopt and enforce countywide irrigation ordinance, consistent with water management district irrigation rules	Planning, Zoning, Transportation, Extension
	Consider and develop fertilizer use restrictions that encourage use of slow-release and organic nitrogen fertilizers	
	Update LDC to ensure it reflects most current golf course BMP's	
	Work cooperatively with the appropriate state agencies and WMDs to help agricultural community implement BMP's	
	Develop and implement an intensive education and outreach campaign-built upon existing FYN program-to promote and encourage water conservation and Florida-friendly landscaping principles	
	Develop and implement water conserving rate structure for users of public potable supply system	

PROPOSED RECOMMENDATIONS FOR MARION COUNTY SPRINGS PROTECTION

COUNTY BASED INITIATIVES		
SPRINGS MANAGEMENT COMPONENT	**ACTIVITY DESCRIPTION**	**LEAD ENTITY(S)**
Interagency Cooperation	Develop and implement programs in cooperation with state agencies and WMDs, as appropriate, related to: • Monitoring residuals disposal areas and initiate remediation where sinkholes or other active karst features are forming or present • Ensuring adequate monitoring and compliance of commercial and industrial facilities that generate, use and or store hazardous waste • Ensuring adequate monitoring and compliance of mining operations • Developing Marion County Aquifer Vulnerability Assessment Map (MCAVAM) • Researching nutrient transport and transformation in stormwater management systems in closed basin, high recharge and karst environments	Planning, Zoning, Transportation, Utilities
Land Use and Zoning Evaluations and Resources	Evaluate and propose revisions to TDR program to a) include in sending areas lands within the primary protection zones that have high recharge and karst characteristics and b) exclude receiving areas within the primary protection zones.	Planning, Zoning
	Evaluate administrative processes and procedures in terms of efficiencies and effectiveness in protecting groundwater supplies and related water resources	
	Develop Marion County Aquifer Vulnerability Assessment map. The map shall replace the DRASTIC Index map (consistent with FDEP and DCA advances) and identify levels of aquifer vulnerability based on the most current and accurate available data	
	Update land use and zoning change applications to include identification of ESOZ, and if present, potential impacts to recharge quantity and quality and proposed measures that would be taken to avoid, mitigate and or minimize potential impacts	
	Evaluate and propose revisions to existing zoning classifications for the purpose sorting out some uses based on potential impacts and risks to groundwater	
	Develop and implement monitoring and remediation program for known landfills and dumps	Solid Waste, Planning

APPENDIX II

APPENDIX II

Summary of Draft Marion County Springs Protection Recommendations

WRA Inc., September, 2005

Farm Best Management Practices Adopted by the Marion County BCC (11/02/04)

Objective	Best Management Practice	
Minimize potential contamination of local water resources	1. Avoid stockpiling manure in sinkholes, wetlands and floodplains.	
	2. Avoid placing or burying manure below the ground surface or other internally-drained depressions.*	
	3. Avoid placing stockpiles of 60 cubic yards or greater within the following distances:*	
	• Public well:	500'
	• Private Well or Sinkhole:	150'
	• Lake, River or Stream:	125'
	• Intermittent waterway or storm drainage system:	100'
	4. Avoid placing stockpiles of less than 60 cubic yards within the following distances: *	
	• Public well:	150'
	• Private Well or Sinkhole:	75'
	• Lake, River or Stream:	75'
	• Intermittent waterway or storm drainage system:	50'
	5. Prevent leachate and sediments from stockpiled or spread manure from traveling into any of the following locations: • A lake, river, stream, drainage ditch or sinkhole; • Within 150' of a public well and 75 feet of a private well; • Neighboring property	
	6. Ensure rain and surface runoff from adjacent areas (building, pastures, driveways, etc.) can drain away from stockpiles; do not allow internal draining or ponding.	
	7. Spread manure on land at rates that do not exceed normal and accepted agronomic practices.	
	8. If feasible, construct a roofed pole structure or impervious storage area for stockpiled manure. (Contact local extension agents for design ideas and standards.)	
Minimize hazards and nuisances to the health, welfare and safety of humans and animals	9. Do not place stockpiles piles 2 cubic yards or greater within 100 feet of any lot line or any residence.**	
	10. Keep manure stockpiles to 8 feet or less in height.	
	11. Limit stockpile size to no more than 25 cubic yards per animal, up to a maximum size of 1000 cubic yards.*	
	12. Adequately fence the perimeter of large manure stockpiles to prevent access by humans and animals.	
	13. Locate stockpiles out of view from public places and neighboring residences. (This may require shielding the stockpile with a "living screen" or solid fence.)	
	14. Consider prevailing winds when selecting a stockpile site.	
Manage pastures in a manner that minimizes potential soil erosion and groundwater pollution	15. Maintain a minimum 80% vegetative cover on pasture areas. (This requires managing stocking rates and grazing periods in a manner which allows pasture grasses to regenerate and remain productive.	
	16. Follow current UF-IFAS recommendations when fertilizing pastures, hay fields and croplands.	
	17. Where feasible, divide large pastures into smaller paddocks so that animals can be rotated to one pasture while others are allowed to recover.	
	18. Limit animal access to environmentally sensitive areas, including wetlands, drainage areas, waterways and areas that may be susceptible to erosion.	

* Exceptions may be provided if manure is adequately covered and or contained within an approved storage bin or structure.

** Existing code requirement

APPENDIX III

APPENDIX III

Best Management Practices (BMPs) for Golf Courses

Mixing and storing chemicals

- Store and mix chemicals in a covered, contained area ensuring that all stormwater is directed away from the contained area
- Inspect bulk storage containers regularly, and replace them if rusted or damaged
- Store empty drums and containers undercover, and have them removed as soon as possible
- Make sure there is a spill plan and that staff are trained to deal with spills; a spill kit containing dry absorbent spill material should be clearly identified and easily

Applying pesticides

Pesticides in waterways can result in dramatic changes within ecosystems through direct destruction of organisms and habitats, and more subtly through small doses, which may impair reproduction, cause greater susceptibility to disease and inhibit growth. Aquatic animals are particularly susceptible to pesticides because they can absorb them from the water and sediments in which they live.

The major opportunity for minimizing the risk of contamination of stormwater with pesticides is by reducing overall use. To achieve this you can:

- Use non-chemical pest control methods
- Choose the least toxic, least persistent pesticide
- Limit the number of applications and/or the amount used in each application
- Develop an integrated pest management (IPM) strategy (see below).

Applying fertilizers

Poor application practices or poor choice of product for given conditions can lead to fertilizers going directly into stormwater, or indirectly by leaching into groundwater. To minimize the impact of fertilizers:

- Try to limit spray drift by selecting the correct nozzle, operating pressure and droplet size
- On sandy soils, which are unlikely to retain nutrients, apply small quantities of fertilizer more often (rather than larger amounts less often)
- Consider using soil conditioning products, which can improve fertilizer efficiency and the health of turf species
- Limit fertilizers to key heavy duty areas such as greens, tees and selected fairway areas
- Do not apply fertilizer directly to any natural or artificial body of water, or the adjacent riparian zones (at the water's edge)
- Do not apply fertilizers during times of high wind or high temperature, when rainfall is imminent, or when soil is very wet
- Use fertilizers and pesticides which have low heavy metal content; if such information is not included on the label it can be obtained from the supplier.

Irrigation

Because golf course users expect the course to look a particular way all the time, course managers can tend to over-irrigate. This can lead to surface water flow, which increases the leaching of fertilizers and other chemicals into nearby waterways.

To avoid this:

- Develop an irrigation plan which considers the relative costs of different types of irrigation equipment
- Time irrigation so that plants make the best use of irrigation water
- Check equipment regularly to ensure accurate, efficient and reliable metering and dispersal
- Install soil moisture monitoring equipment to improve irrigation efficiency; the planning of irrigation should consider the level of stored water in the soil, the water storage capacity of the soil, and impending climatic conditions.

Mowing

Grass clippings from mowing and edging are generally not collected by courses, because of the cost and because they are seen as a natural fertilizer. Many grassed areas are next to stormwater drains, gutters and paved areas, so grass may enter stormwater directly or due to wind or runoff.

With mowing and edging there is the potential for spills of petroleum products when decanting fuels and operating machinery.

To deal with these problems you can:

- Ensure mowers and edgers project grass clippings away from waterways, drains and gutters
- Use a grass catcher in sensitive areas and, if possible, send collected grass clippings to a composting facility or worm farm (to be recycled for use in gardens)
- Use mowers which mulch clippings into smaller particles to help break them down, or mow high and often as this creates small volumes of grass clippings which will break down more easily
- Remove clippings from paved areas such as footpaths, driveways, roads and gutters; this may be easier if mowing is coordinated with street-cleaning operations
- Wash plant and equipment where wastewater will not flow into.

Washing vehicles and equipment

Leaks from vehicles and equipment, such as oil and spills from refueling, can be significant contributors to stormwater pollution. In addition, water from washing vehicles contains sediments, oil and grease and any detergents used in washing.

To deal with these problems:

- Ensure the wash-down area is 'zero-release', i.e. lets no water escape
- Use recycled water for washing
- Where these are not feasible, wash on well-turfed parts of the course.

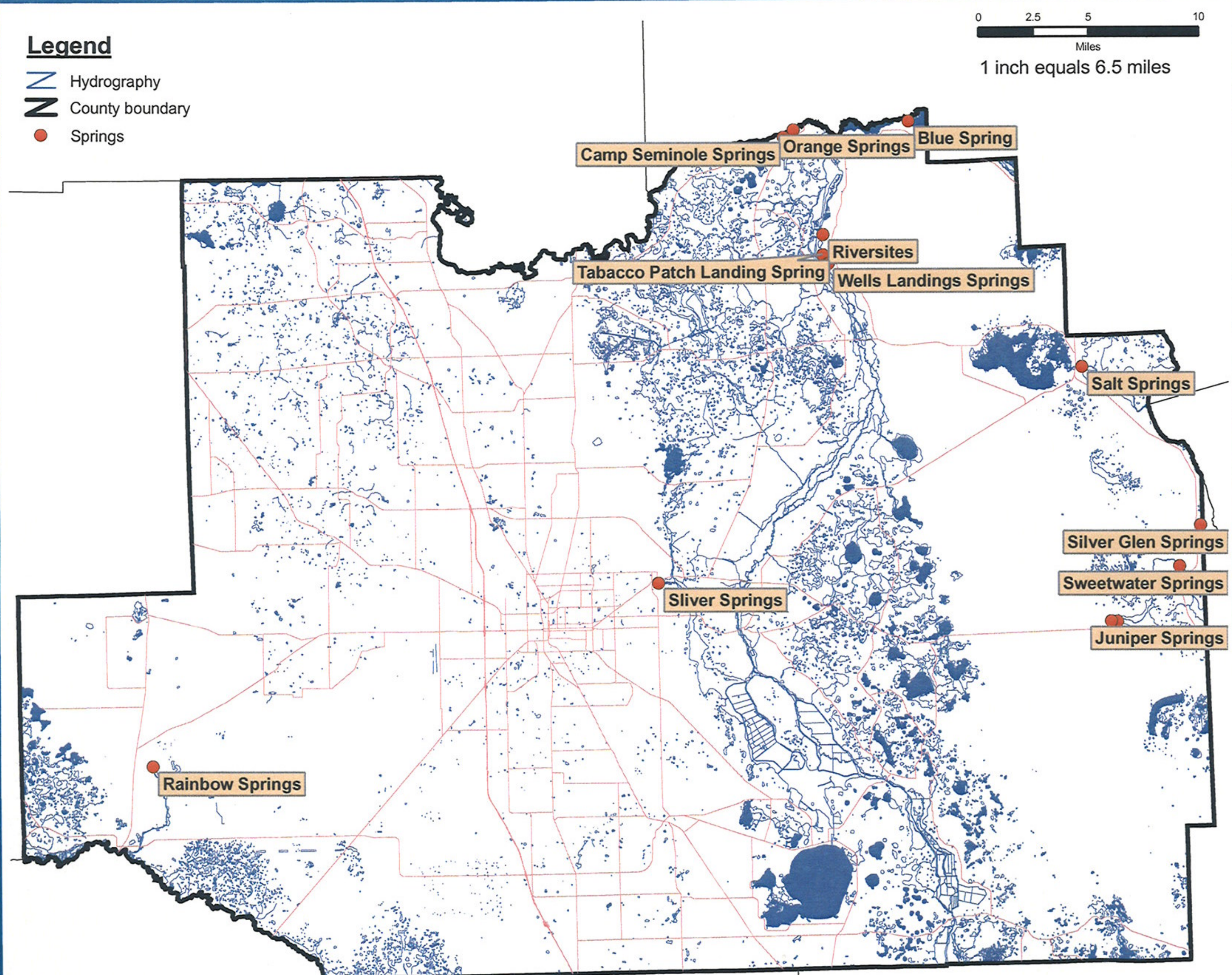
APPENDIX VI

APPENDIX IV

IS A

WORK IN PROGRESS

APPENDIX V



*This figure was prepared for planning purposes only and is intended to assist the County in the development of spring protection strategies.

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PROJECT: Marion County Springs Protection Initiative

Exhibit 1 - Location of springs in Marion County

N W E S

1:410,000

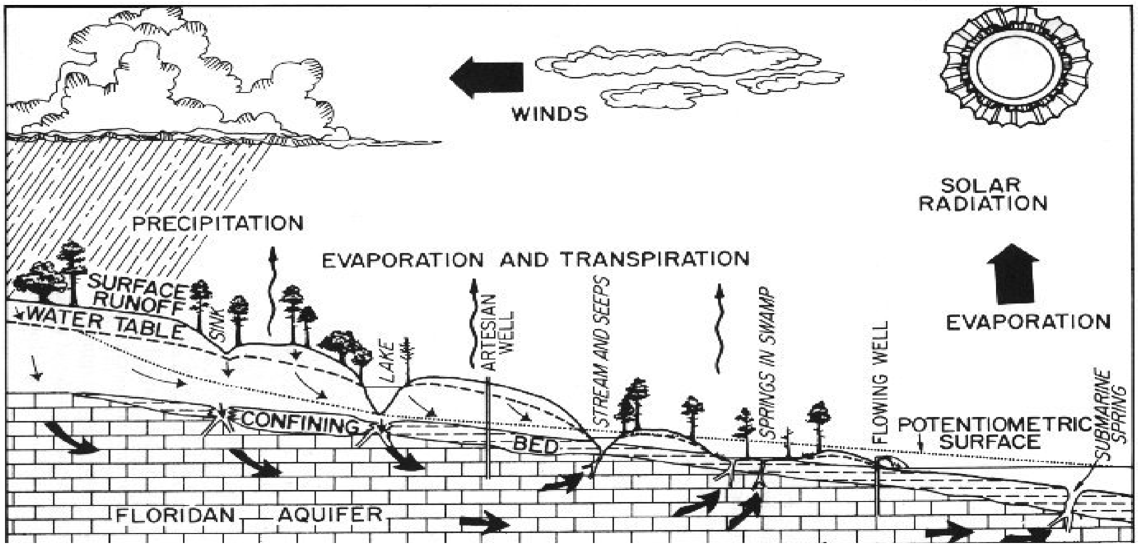


Exhibit 2 - The hydrologic cycle.
[Image courtesy of the Florida Geological Survey]

Exhibit 3a – Silver Springs cave map showing pronounced northwest-southeast and northeast-southwest fracture orientations.
(Source: Modified from Hutchinson and others, 1993, unpublished cave map provided by the St. Johns River Water Management District)

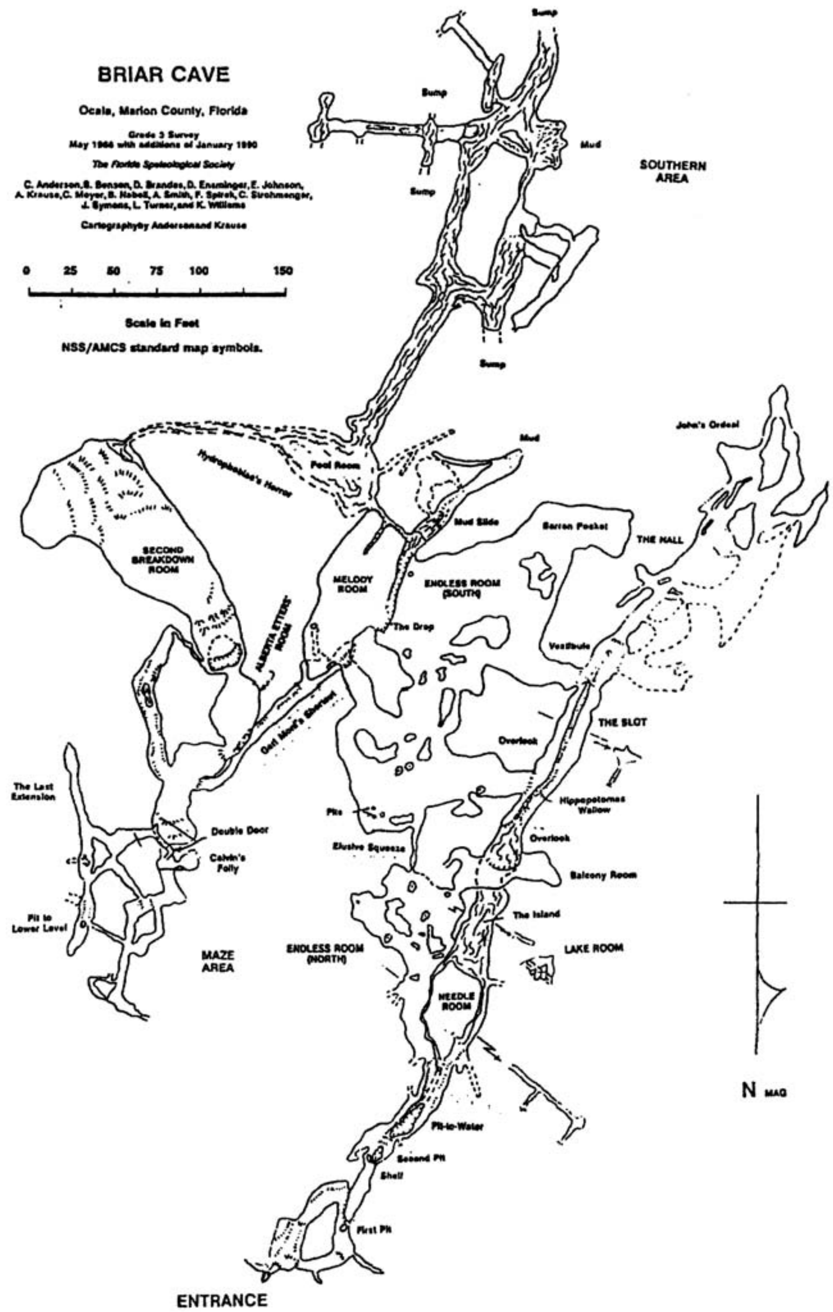
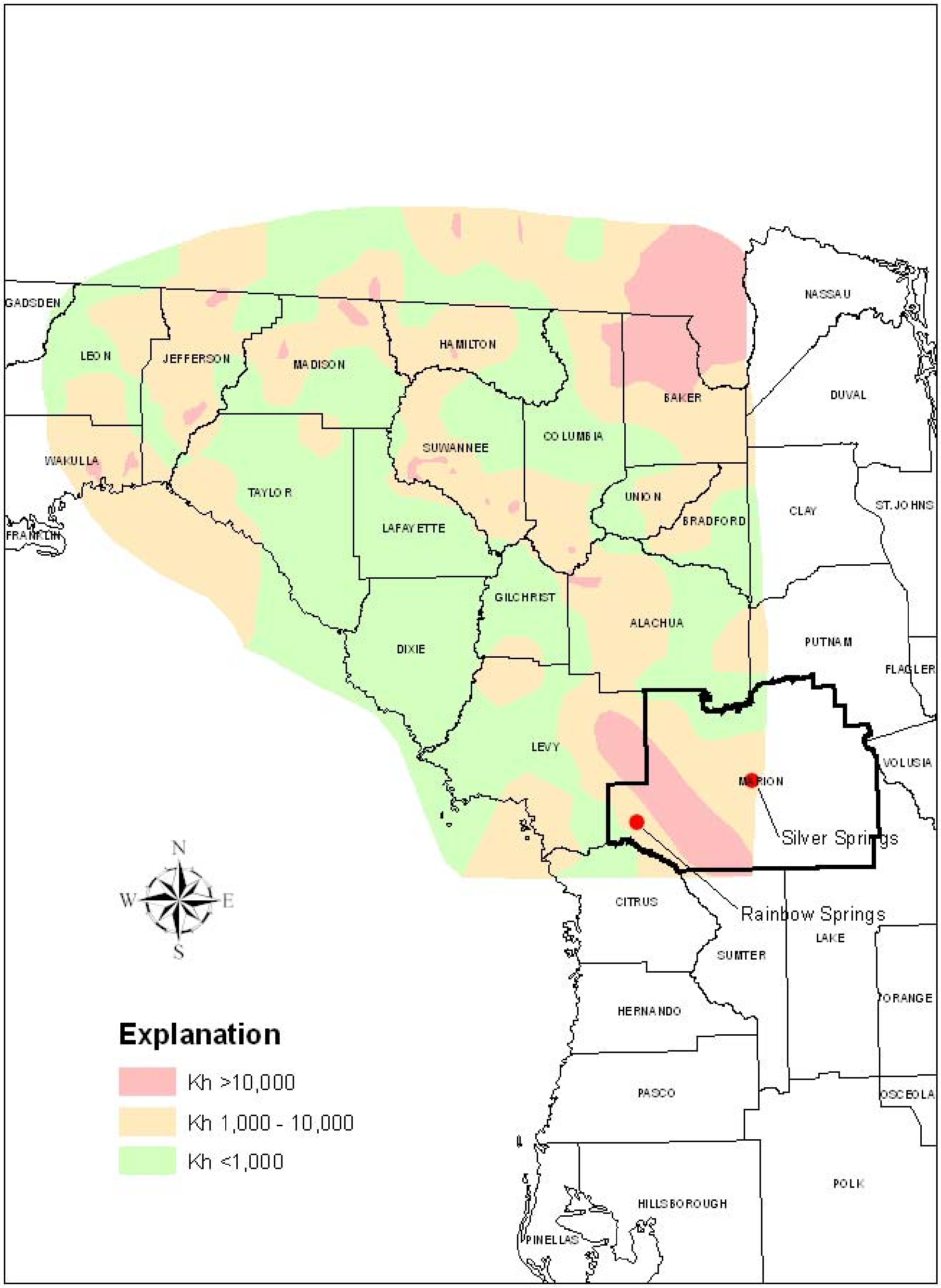


Exhibit 3b – Map of Briar Cave showing pronounced northeast-southwest fracture orientations.

(Source: Weesner, 2002; map prepared by the Florida Speleological Society, 1990)



Exhbit 4 – Extent of the Suwannee River Water Management District groundwater flow model.

(Source: SDII Global Corporation, 2005)

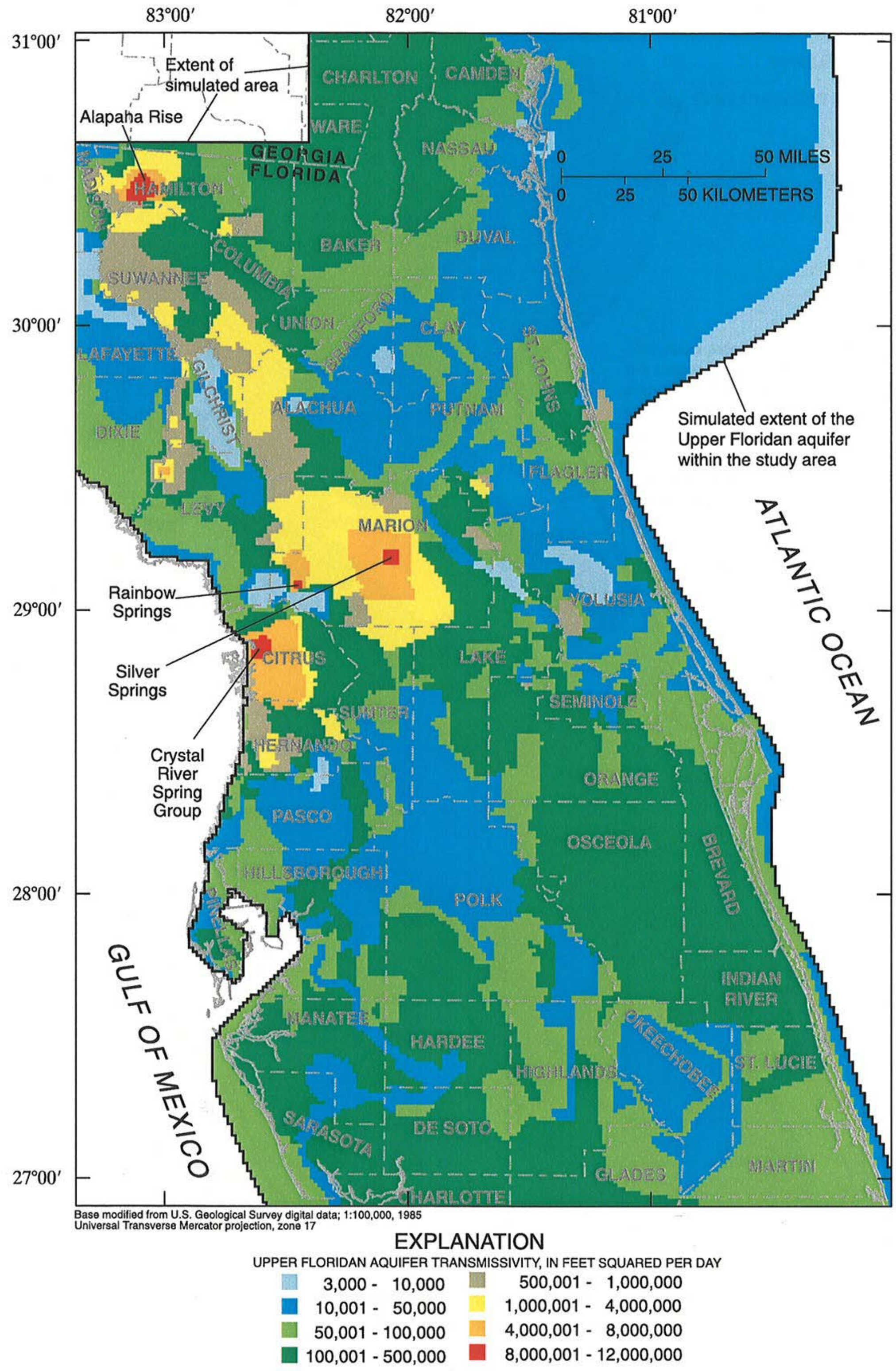


Exhibit 5 - Extent of the PF groundwater flow model. Note the high transmissivity zones near the springs.
(Source: Sepulveda, 2002)

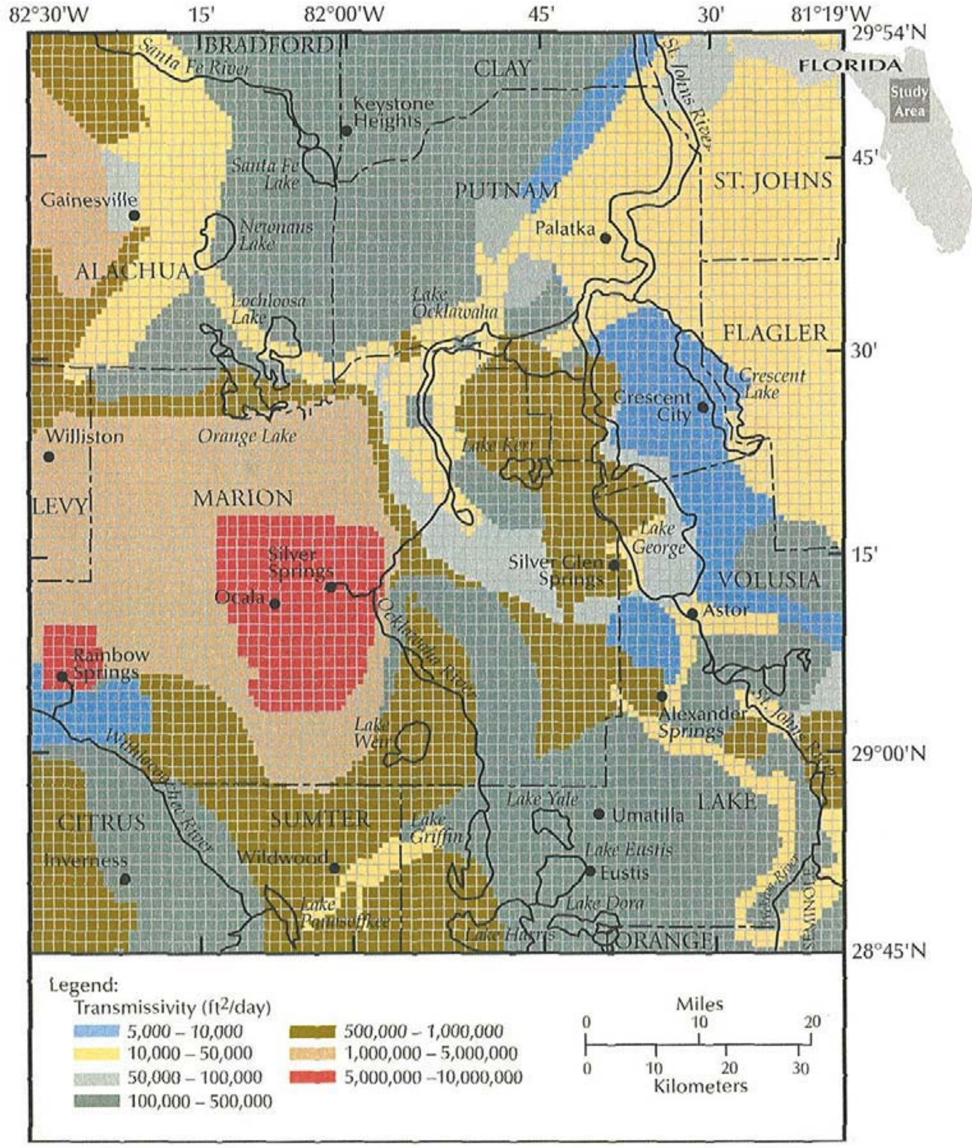
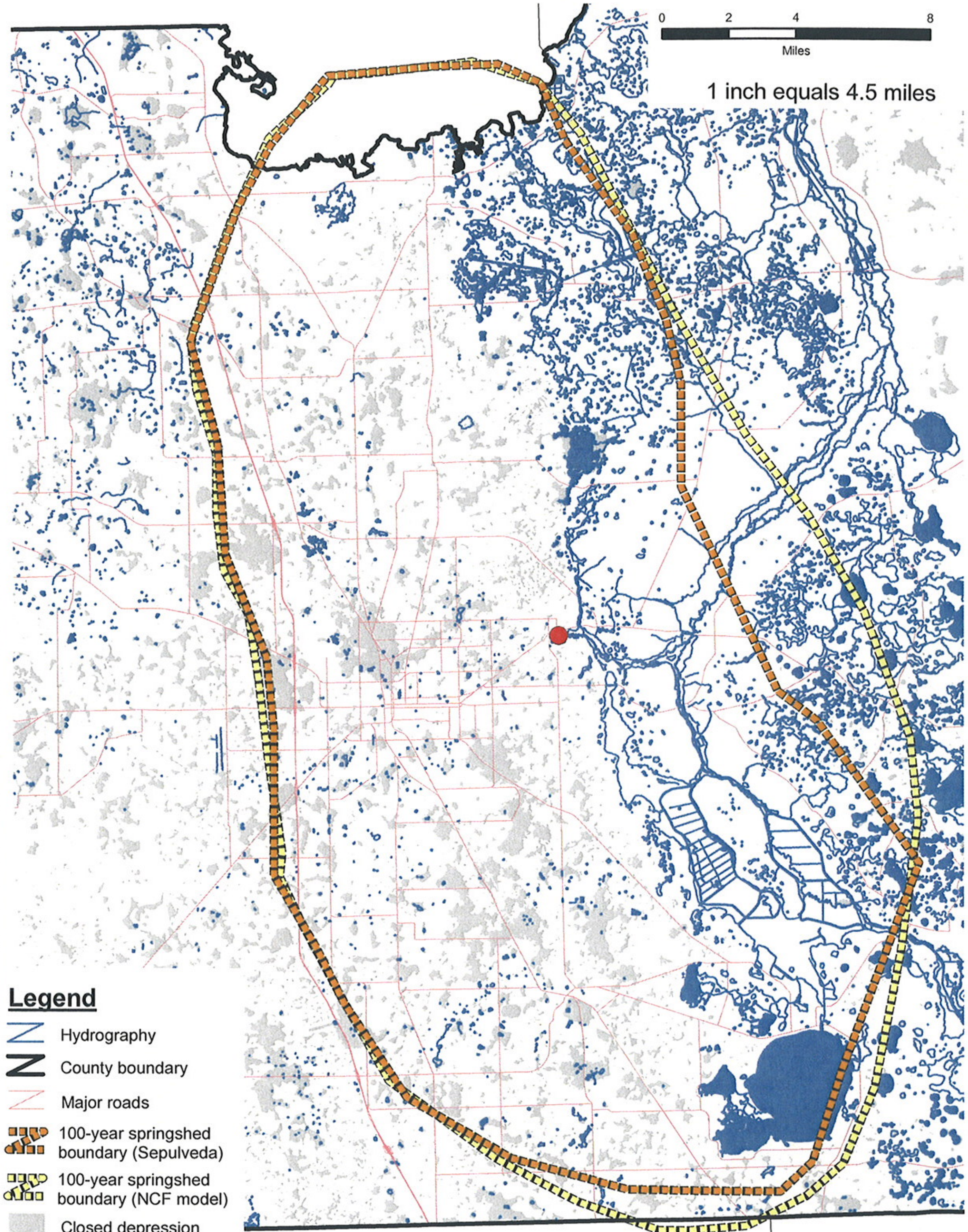


Exhibit 6 - Extent of the NCF groundwater flow model. Note the high transmissivity zone in the vicinity of the springs.

(Source: Motz and Dogan, 2004)



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PROJECT: Marion County Springs Protection Initiative

Exhibit 7 - Estimated extent of 100-year ground-water travel time to Silver Springs.

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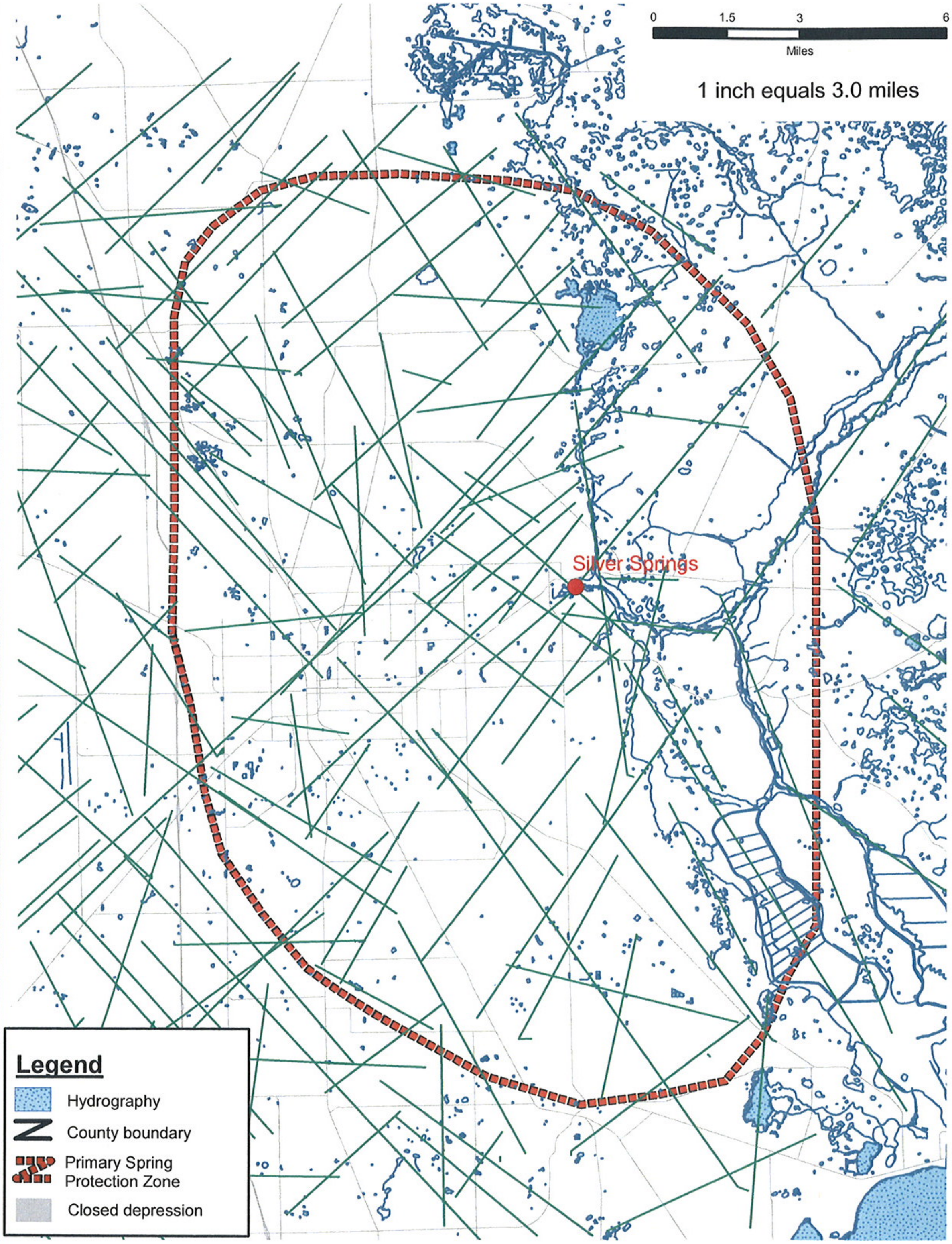

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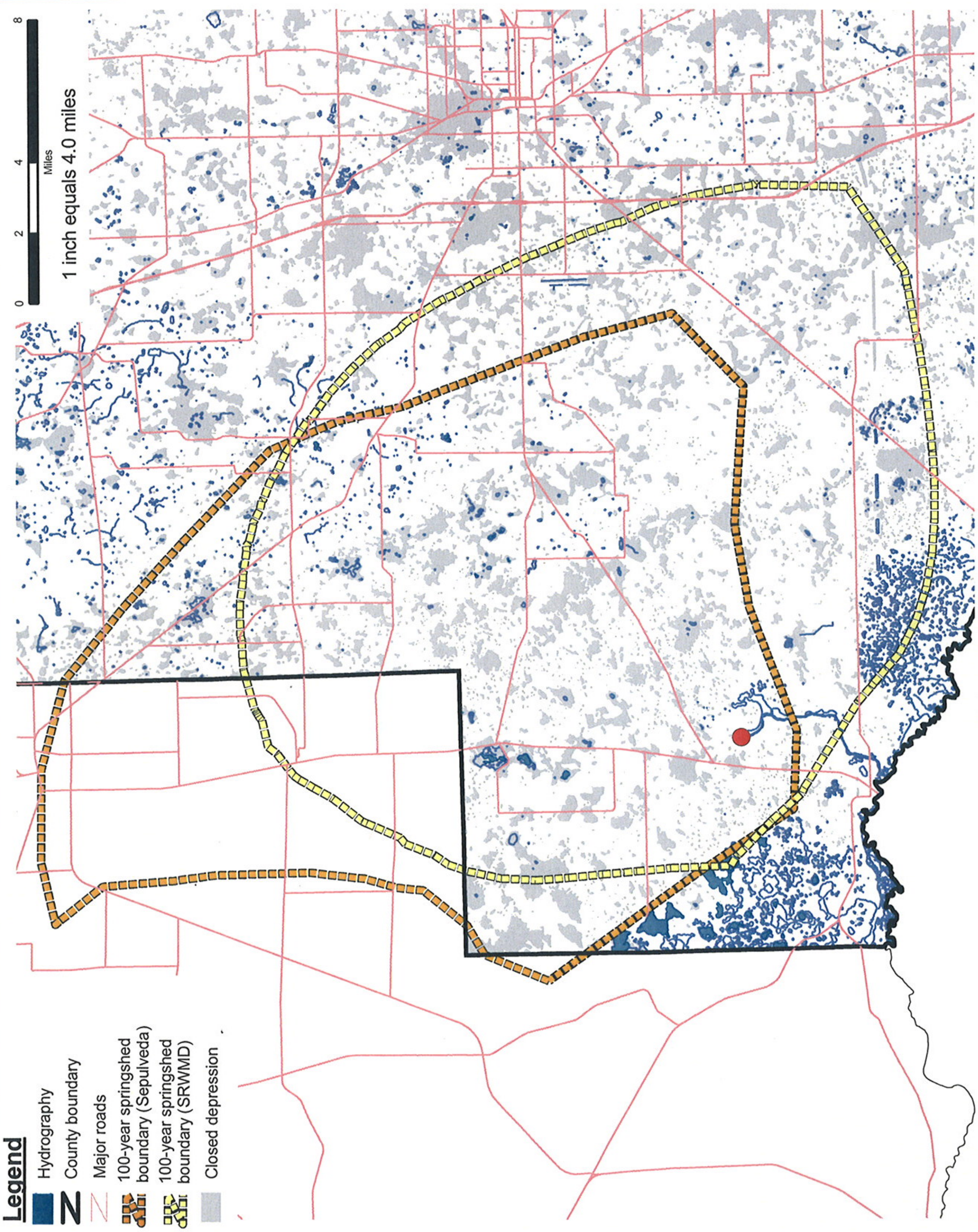
PROJECT: Marion County Springs Protection Initiative

Exhibit 8 - Estimated extent of the 10-year ground-water trvel time to Silver Springs.

N W E S

1:190,179



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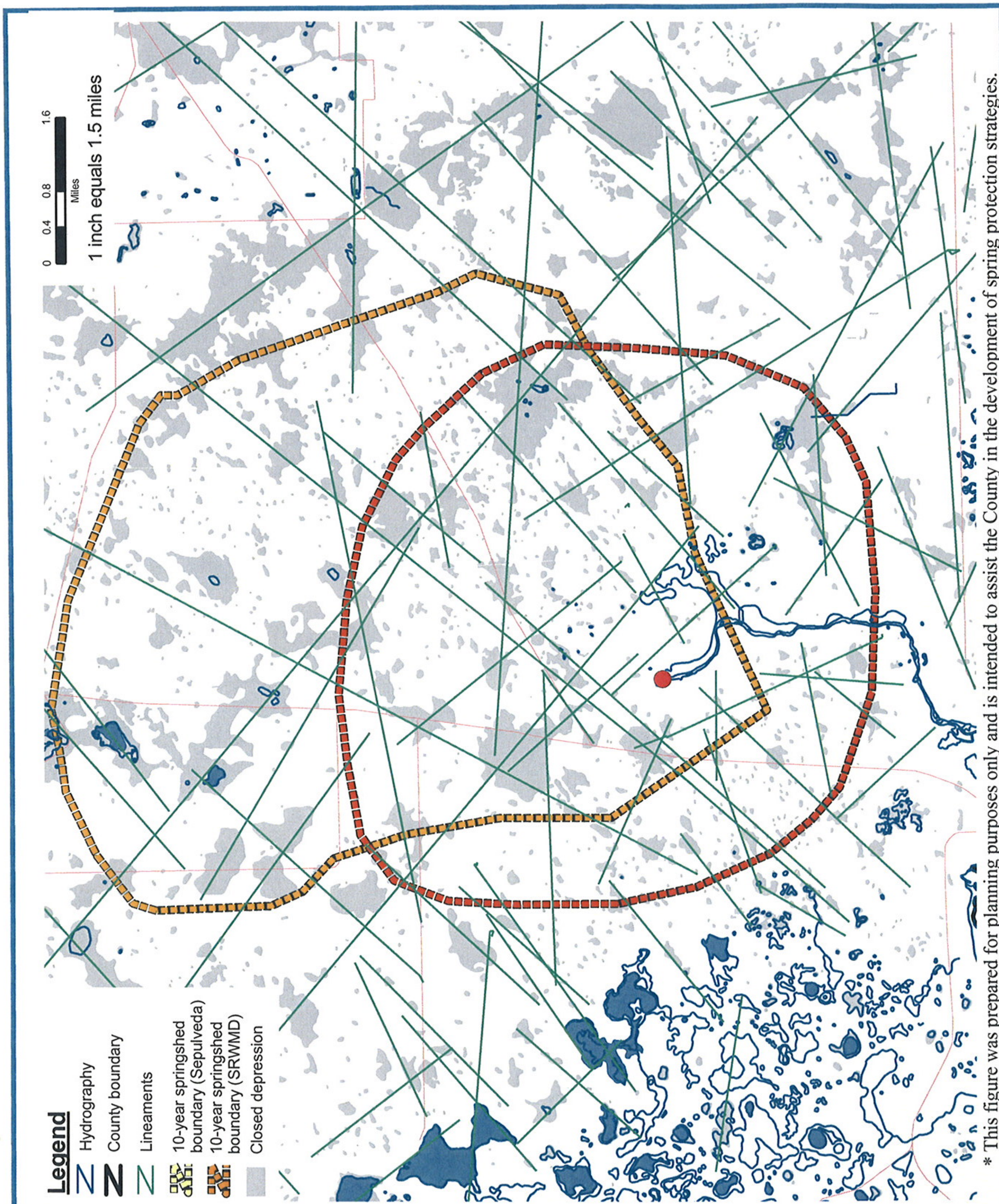
PROJECT: Marion County Springs Protection Initiative

Exhibit 9 - Estimated extent of 100-year ground-water travel time to Rainbow Springs.

N E S W

1:255,109



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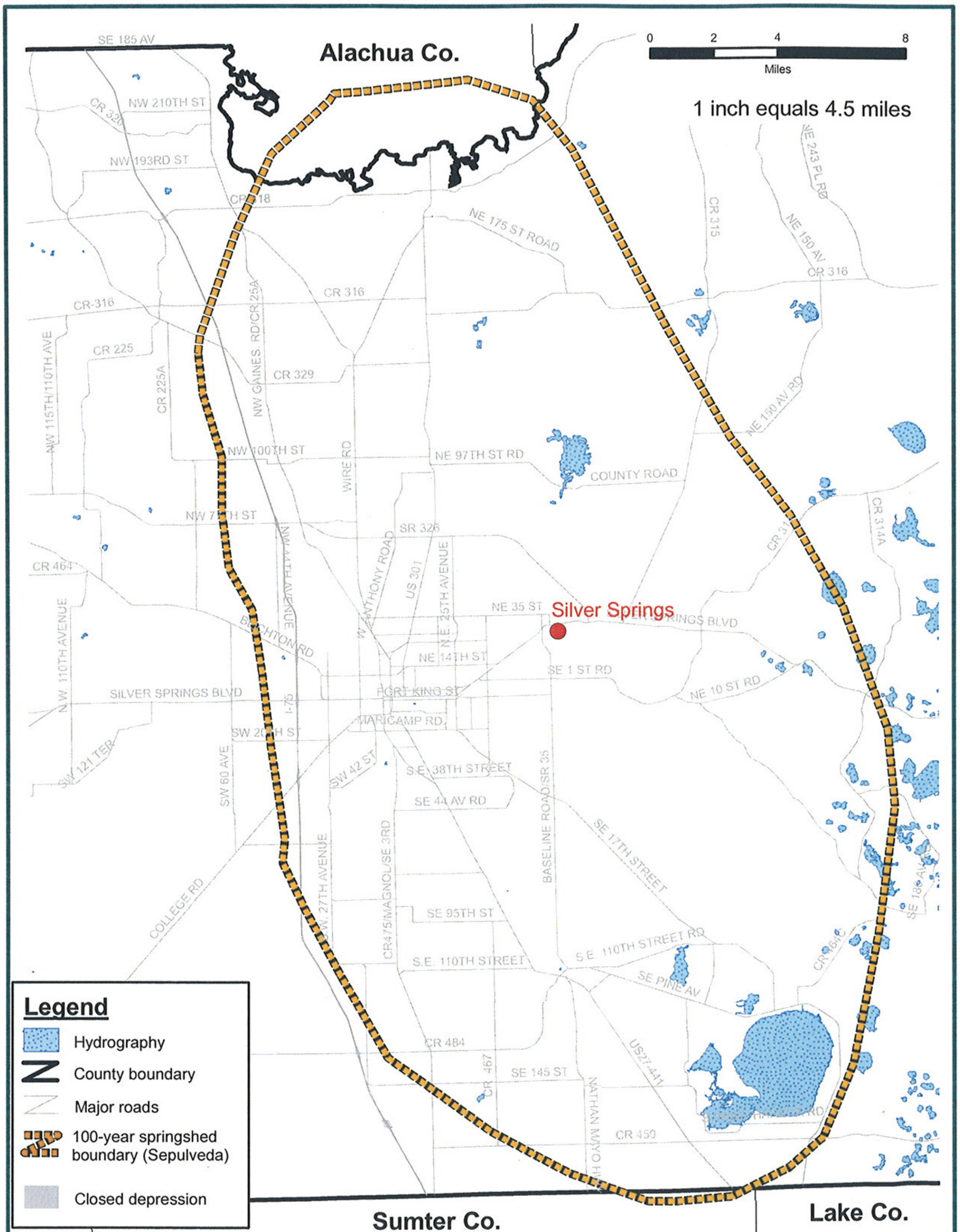
PROJECT: Marion County Springs Protection Initiative

Exhibit 10 - Estimated extent of 10-year ground-water travel time to Rainbow Springs.

N E S W

1:97,000



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PROJECT: Marion County Springs Protection Initiative

Exhibit 11 - Extent of the proposed Springshed Protection Zone around Silver Springs.

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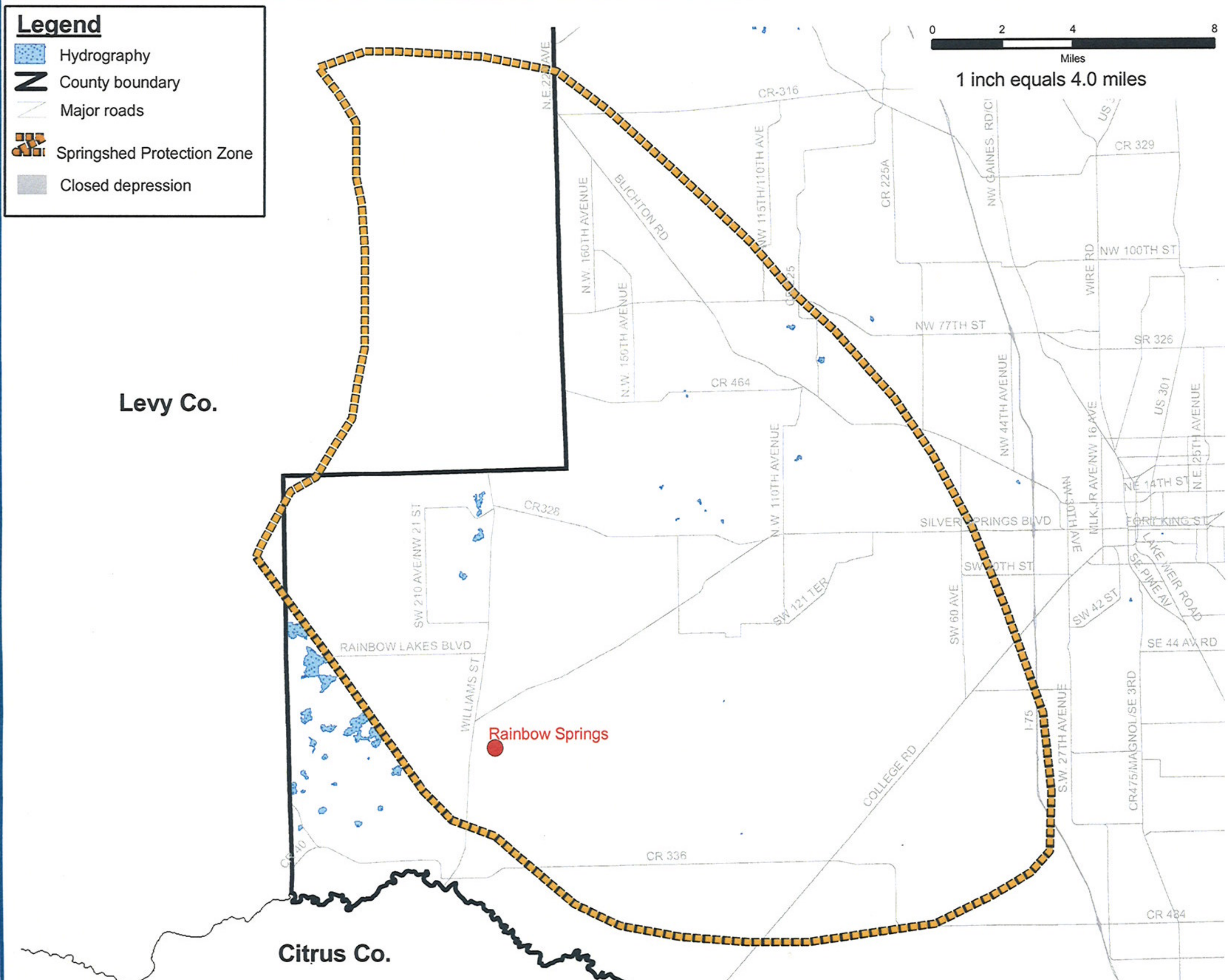

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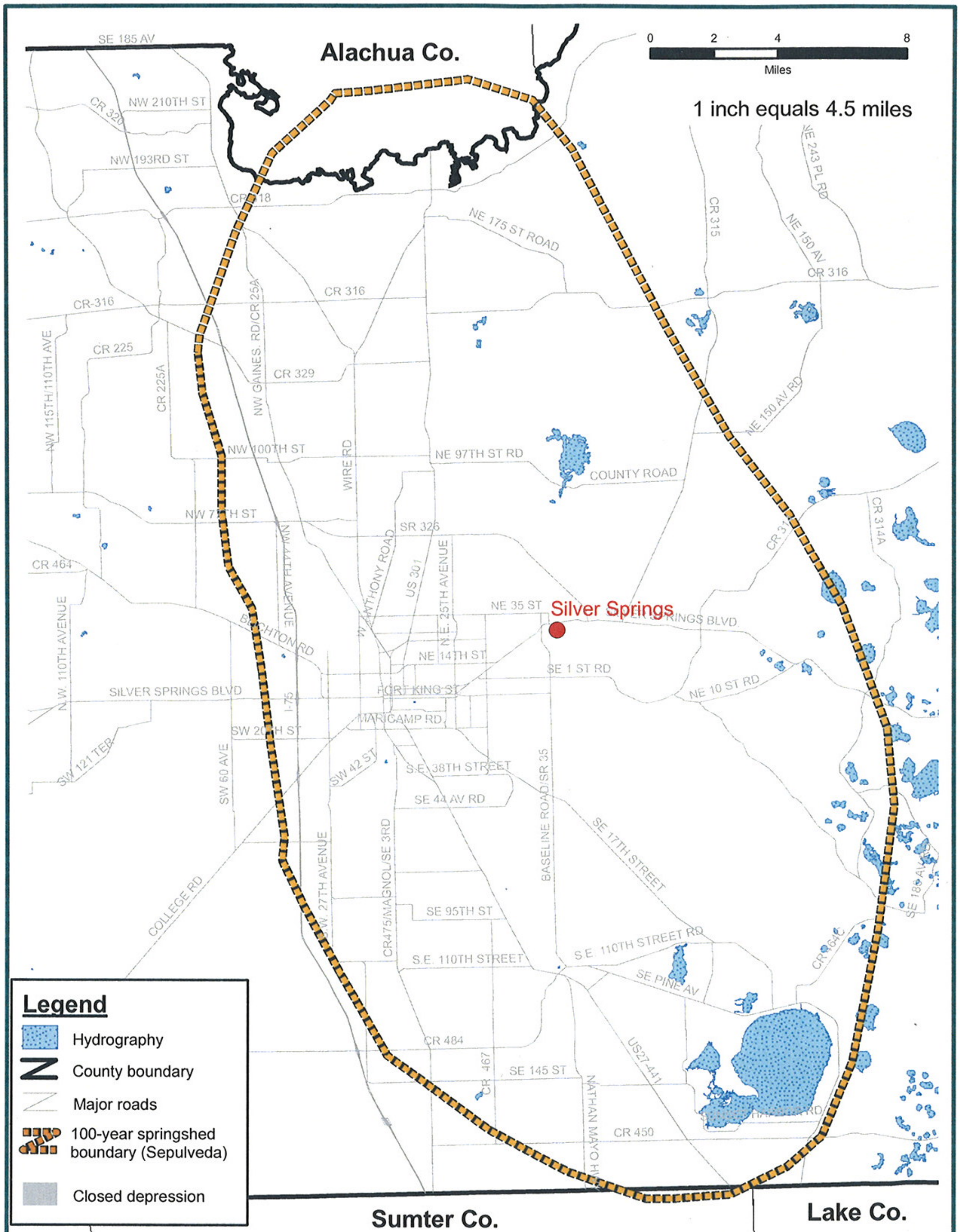
PROJECT: Marion County Springs Protection Initiative

Exhibit 12 - Extent of the proposed Springshed Protection Zone around Rainbow Springs.



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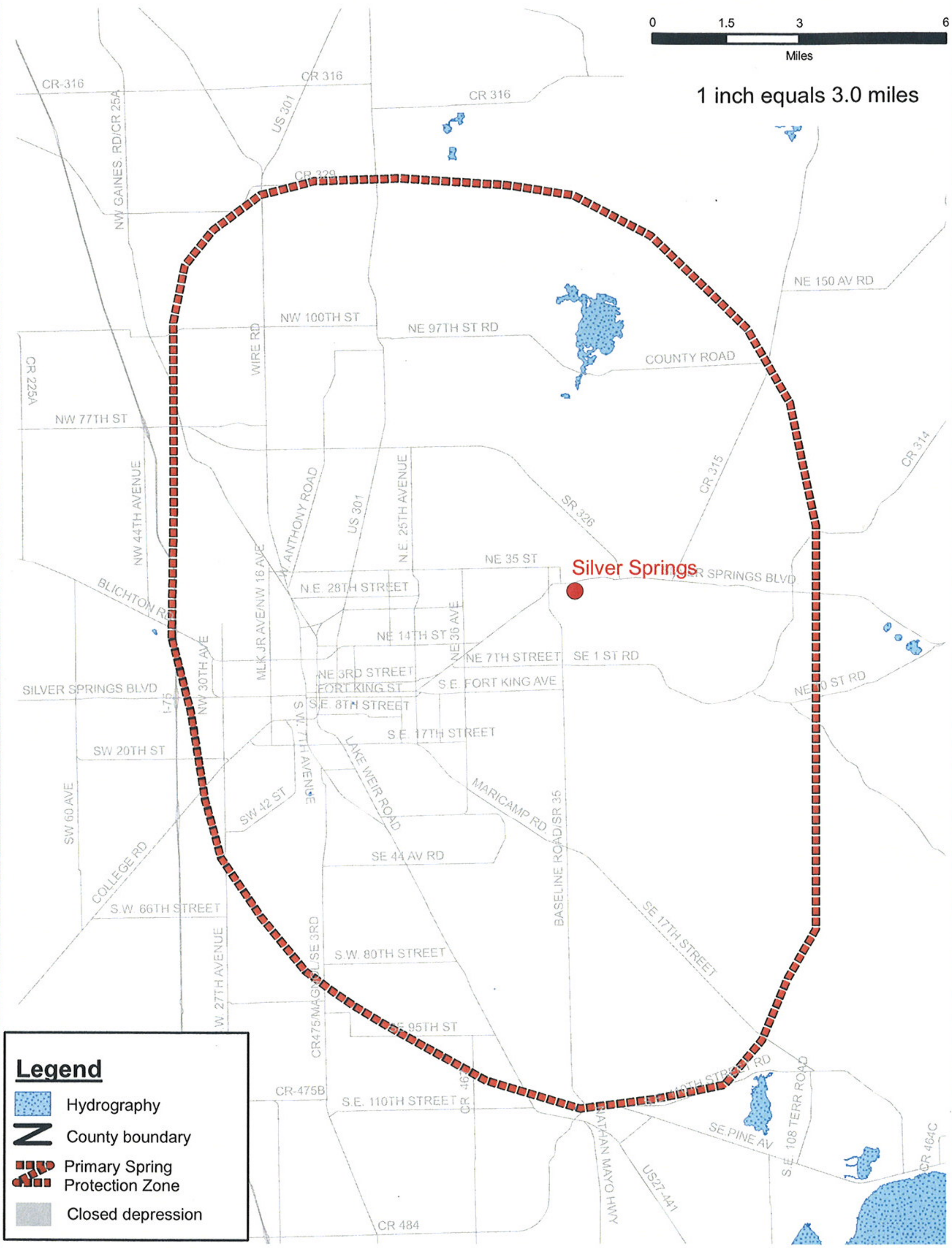
WRA Water Resource Associates, Inc. Engineering ~ Planning ~ Environmental Science 4260 W. Linebaugh Ave Phone: 813-265-3130 Fax: 813-265-6610 www.wraconsultants.com	PROJECT: Marion County Springs Protection Initiative Exhibit 13 - Extent of the proposed Secondary Protection Zone around Silver Springs.	N W E S 1:285,000



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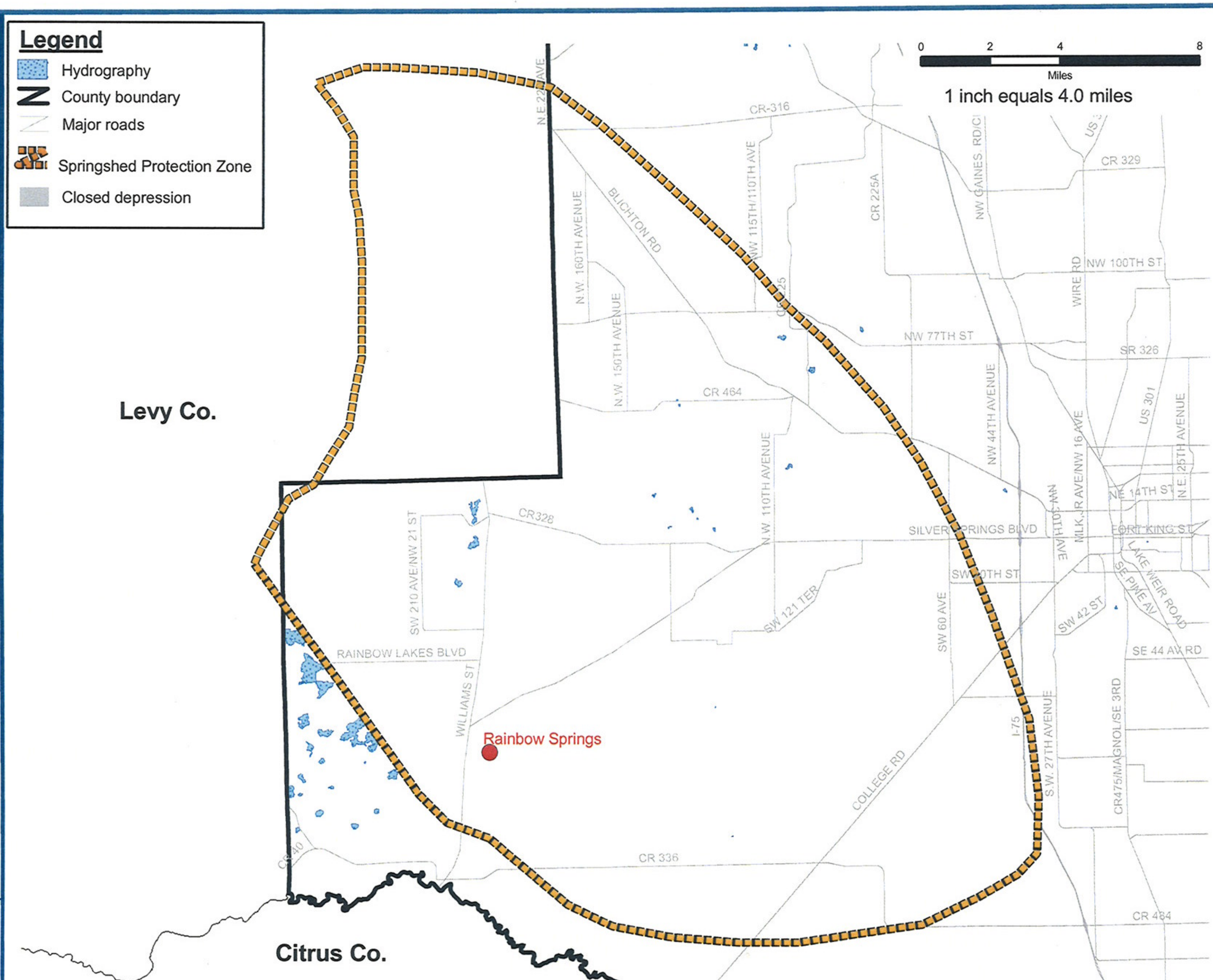
PROJECT: Marion County Springs Protection Initiative

Exhibit 14 - Extent of the proposed Silver Springs Primary Spring Protection Zone around Silver Springs.

N W E S

1:190,179



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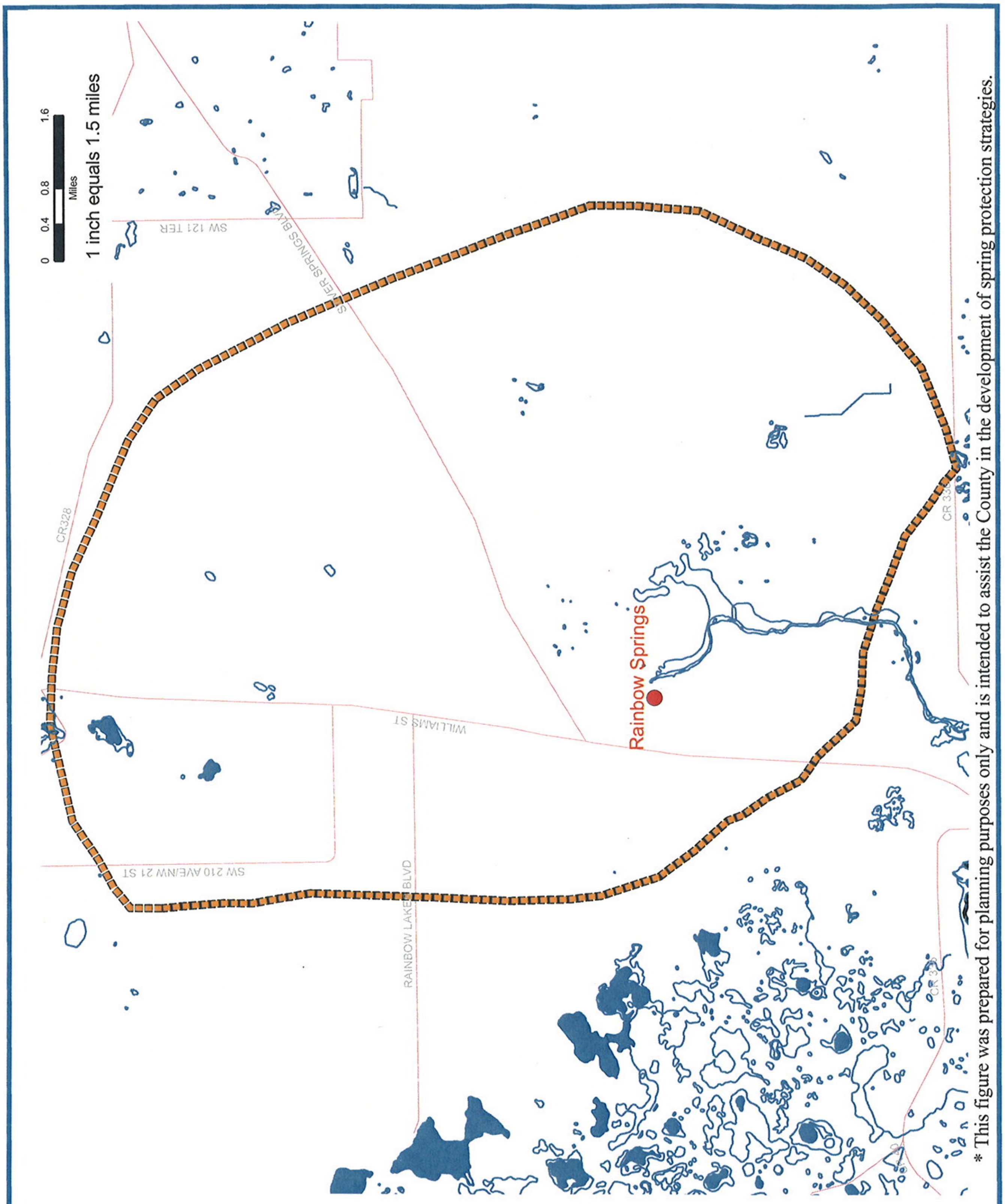
PROJECT: Marion County Springs Protection Initiative

Exhibit 15 - Extent of the proposed Secondary Protection Zone around Rainbow Springs.

1:255,182



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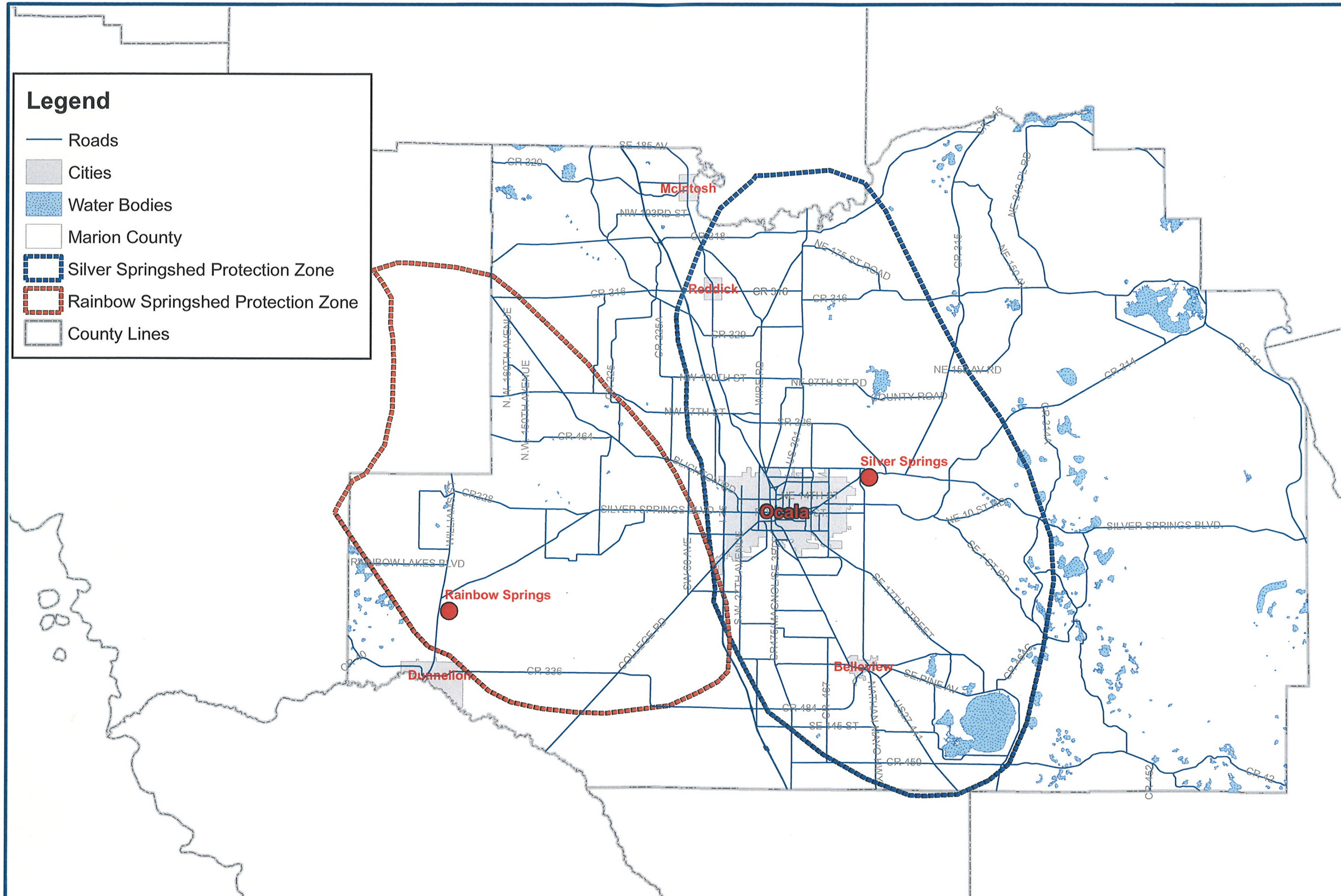
PROJECT: Marion County Springs Protection Initiative

Exhibit 16 - Extent of the proposed Primary Spring Protection Zone around Rainbow Springs.

N E S W

1:97,028



PROJECT: Marion County Springs Protection Iniatiative

Exhibit 17 Extent of the proposed Springshed Protection Zones around Silver and Rainbow Springs

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APPENDIX VI

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

LANDSCAPE WATER CONSERVATION ORDINANCE GUIDELINES

This document provides guidelines for the development of local government landscape water conservation ordinances. Local governments are required by Sections 125.568 and 166.048, Florida Statutes (*FS*), to consider adopting ordinances that require water-conserving landscapes. Section 373.185, *FS*, requires each water management district to provide a model ordinance to provide guidance to local governments in ordinance development. Local governments are not required by SJRWMD to adopt an ordinance based on these guidelines.

These guidelines were prepared with the assistance of a committee consisting of representatives from city and county governments, including elected officials and staff involved with planning, zoning, code enforcement, water conservation, utility operation and management, and senior management; professional and special interest organizations, including Florida Native Plant Society, Florida Irrigation Society, Florida Build Green Coalition, Florida Nursery Growers and Landscape Association, Florida Sod Growers Cooperative; landscape architects, the land development community, environmentalists, and concerned citizens; and government agencies, including Florida Department of Environmental Protection, Florida Department of Agriculture and Consumer Services, University of Florida Institute of Food and Agricultural Sciences Agricultural Extension Service and Lake County Water Authority.

The guidelines focus on issues that affect water use and do not address aesthetics, water quality, soil erosion control, fire resistance, and other considerations which may be included in comprehensive landscape regulations. Additional regulations may be needed to protect water quality or to assure aesthetically acceptable and safe landscapes.

Recommended Provisions for Local Landscape Water Conservation Ordinances

- **Landscapes** (model ordinance provisions provided)
  - Prior to installation, landscape plans meeting Florida-friendly landscape principles must be certified by appropriately licensed design professionals.
  - Newly installed landscapes must be inspected by appropriately licensed design professionals to ensure that they were installed as designed.
  - Landscape maintenance must be performed in accordance with recommendations in the current edition of *Florida Green Industries Best Management Practices for Protection of Water Resources in Florida* or the *Florida Yards & Neighborhoods Handbook*.
  - A person providing landscape installation or maintenance services for hire must be appropriately licensed.
  - Demonstration landscapes must be provided.

- **Irrigation Systems** (model ordinance provisions provided**)**
  - Permanent irrigation systems must meet design and construction standards in Appendix F of the Florida State Building Code and the Florida Irrigation Society's (FIS) January 1, 2002 or most current version of *Standards and Specifications for Irrigation Systems* for any features not treated in Appendix F.
  - Irrigation systems must be designed and installed by appropriately licensed professionals.
  - Overhead or spray irrigation may be used only for turfgrass and other ground covers that normally have a mature or maintained height no greater than one foot. Trees, shrubs, and other plants may be irrigated only with low volume irrigation at the base of the plant.
  - Overhead or spray irrigation is limited to 70 percent or less of the landscapable area. A lower percentage is recommended for areas identified as Priority Water Resource Caution Areas in SJRWMD's District Water Supply Plan.
  - Installation of non-potable water lines must be required when a source is available or anticipated to become available.
  - Irrigation systems must be connected to available non-potable water supply systems.
  - Irrigation systems connected to reclaimed water supply systems must be metered.
  - Irrigation systems must be operated and maintained in accordance with the *Florida Green Industries Best Management Practices for Protection of Water Resources in Florida* (2002 or the most current edition) or the *Florida Yards and Neighborhood Handbook.*

- **Licensing and Certifications** (model ordinance provisions provided)
  - The state-licensed professionals allowed to perform regulated services should be identified.
  - If other than state-licensed professionals can perform regulated services, the appropriate certification and training must be specified.

- **Site Design Standards**
  - Existing native vegetation must be preserved on a site percentage basis and/or by targeting specific vegetative communities for preservation.
  - Land clearing regulations must protect native vegetation prior to and during land development activities.
  - Plants prohibited by Florida Department of Agriculture and Consumer Services rule, Chapter 5B-57 *F.A.C.*, must be removed from the site.
  - Impervious surface areas are limited by zoning or future land use category.

- **Inspection and Enforcement**
  - Enforcement of this set of regulations includes the issuance of citations, the treatment of each day a violation occurs as a separate offense, the imposition of fines that are significant and progressive, and the suspension or revocation of licenses or certifications.
  - Inspections are required to assure compliance with the provisions of the ordinance.

Before enacting an ordinance a local government should determine whether or not the ordinance is consistent with or implements the local government's comprehensive plan. If the local government determines that the ordinance is not consistent with or does not implement its comprehensive plan, then appropriate comprehensive plan amendments should be adopted before proceeding with ordinance adoption.

MODEL ORDINANCE PROVISIONS

The following model ordinance provisions are examples on which a local ordinance may be based. The local ordinance need not duplicate the exact wording of these examples as long as the required provisions are satisfactorily addressed.

I. LANDSCAPES

1. In general

New landscapes or substantially replaced landscapes shall meet the standards established in this section. Maintenance of all landscapes shall comply with maintenance standards of this section.

2. Landscape Design

All landscapes shall be designed to use water efficiently and follow Florida-friendly landscape principles. The most current versions of *Florida Yards & Neighborhoods Handbook*, the Water Management Districts' *Waterwise Florida Landscapes*, *Xeric Landscaping with Florida Native Plants* by the Association of Florida Native Nurseries, the *Florida Green Industries Best Management Practices for Protection of Water Resources in Florida*, and *Water Right: Conserving our Water, Preserving our Environment* published by the International Turf Producers Foundation shall guide landscape designs.

A landscape design certified by a landscape design professional shall be submitted to the City/Town/County prior to landscape installation. Landscape design documents shall include a landscape layout and planting plan, and if irrigation is provided, an irrigation plan completed in accordance with the irrigation system design requirements of this ordinance. Landscape design professionals shall meet the licensing and certification requirements of this ordinance.

3. Landscape installers

Any person providing landscape installation services for hire is a landscape installation professional and shall meet the licensing and certification requirements of this ordinance.

4. Appropriate plant selection and location

Plant selection for landscaped areas shall be based on the plant's adaptability to the existing conditions present at the site, and shall consider the appropriate hardiness zone, soil type and moisture conditions, exposure to sun, and mature plant size. Plants selected must be suited to withstand the soil and physical growing conditions found in the microclimate of each location on a site with supplemental irrigation only during periods in which rainfall has been less than one inch in the last seven days.

Plants shall be grouped in accordance with their respective water and maintenance needs to provide for efficient irrigation. Plants with similar water soil, climate, sun, and light requirements shall be grouped together.

Plants prohibited by Florida Department of Agriculture and Consumer Services rule, Chapter 5B-57 *F.A.C.*, shall not be used not be used for landscaping purposes. Controlled plants named in Chapter 5B-57, *F.A.C.*, may not be used except as allowed by Chapter 5B-57, *F.A.C.*

5. Use of mulches

Mulches with a minimum depth of two inches shall be used in all planting beds.

6. Landscape certification

The completed landscape installation shall be certified by a landscape design professional who meets the licensing and certification requirements of this ordinance. When the landscape installation is part of a construction project, the certification is required before issuance of the Certification of Occupancy or its equivalent. The certification shall indicate that plants were installed as specified in the landscape design documents, that an irrigation audit has been performed, and that the audit confirmed that the system functions properly.

7. Landscape maintenance standards

Landscape maintenance shall be performed in accordance with the *Florida Green Industries Best Management Practices for Protection of Water Resources in Florida,* the University of Florida Cooperative Extension Service and with the *Florida Yards & Neighborhoods Handbook*.

8. Landscape maintenance professionals

Any person providing services for hire regarding any aspect of landscape maintenance including the application of fertilizer and pesticide is a landscape maintenance professional and must meet the licensing and certification requirements of this ordinance.

9. Demonstration landscapes

The City/Town/County shall provide demonstration landscapes at government facilities. Developers of single family residential subdivisions, PUDs, or any non-residential development, which include model buildings, shall provide demonstration landscapes at the site of at least one model building. Information about Florida-friendly landscape principles shall be provided at demonstration landscape sites and signs shall identify the sites as examples of water efficient landscapes.

II. IRRIGATION SYSTEMS

1. In general

Installation of an irrigation system is not required by this ordinance. A construction permit is required if an irrigation system is installed or substantially replaced.

2. Irrigation system design

A new or substantially replaced irrigation system shall be designed and constructed in accordance with the technical standards contained in Appendix F of the Florida State Building Code and the Florida Irrigation Society's (FIS) January 1, 2002 or most current edition of *Standards and Specifications for Irrigation Systems* for any features not treated in Appendix F.

An irrigation system plan certified by an irrigation design professional shall be provided prior to issuance of a permit. Plans shall be clearly readable, to reasonable scale, show the entire site to be irrigated, and include all improvements and equipment specifications. Irrigation design professionals must meet the licensing and certification requirements of this ordinance.

3. Irrigation system installation

Irrigation installation professionals meeting the licensing requirements of this ordinance may install irrigation systems. An irrigation valve site diagram detailing valve locations, gallons per minute demands, precipitation rates, plant types within valve circuits, and operating pressure requirements for each valve shall be developed by the installer. This diagram shall be attached inside each irrigation controller or be kept in another readily available location if it is not practical to insert it in a small controller. Irrigation scheduling information, with instructions for seasonal timer and sensor changes, and a regular irrigation system maintenance schedule shall be provided to the owner by the installer or by the builder to the owner at the sale of newly constructed building.

4. Limits to in-ground irrigation system installation

Overhead or spray irrigation may be used only for turfgrass and other ground covers that normally have a mature or maintained height no greater than one foot. Trees, shrubs, and other plants may be irrigated only with low volume irrigation at the base of the plant. Permanent in-ground overhead or spray irrigation shall be limited to 70 percent of the landscapable area on a site. Lower percentages may be required in the development review process as part of the approval criteria for developments to be awarded additional density, or for specific large scale development approval such as developments of regional impact. The remainder of the landscapable area on a site may be irrigated with a drip or other low volume irrigation system.

5. Meters required on in-ground irrigation systems using reclaimed water.

All newly installed in-ground irrigation systems connected to a reclaimed watersupply shall be equipped with meters at the time of installation to measure water usage.

6. Mandatory connection of irrigation system to non-potable water supply

All irrigation systems shall be connected to a non-potable water supply such as reclaimed water, storm water, or surface water, if such supply is available.

7. Non-potable water lines

Site plans and plans for subdivisions and planned unit developments shall include transmission and distribution lines for non-potable water, such as reclaimed water, storm water, or surface water for landscape irrigation if a supply of such water is available or is anticipated to become available to the area. The lines shall be installed prior to construction.

8. Operation and maintenance

All irrigation systems shall be operated and maintained in accordance with the *Florida Green Industries Best Management Practices for Protection of Water Resources in Florida* (2002 or the most current edition) or the *Florida Yards and Neighborhood* program, and in accordance with the irrigation scheduling information and with the system maintenance schedule provided by the builder to the owner at the sale of newly constructed building, by the installer at the time of installation, or by an existing owner to a new owner at the time of sale. A regular irrigation maintenance schedule shall include but not be limited to checking, adjusting, and repairing irrigation equipment; and resetting the automatic controller according to the season.

To maintain the original performance and design integrity of the irrigation system, repair of the equipment shall be done with the originally specified materials or their equivalents.

The irrigation system, including automatic rain sensor shutoff device, must be certified by an irrigation system installation professional to be operating properly and in good repair at such time as the property may be resold.

III. LICENSING AND CERTIFICATIONS

1. In general

The license or certification specified in this section is required to provide the corresponding services regulated in this ordinance.

2. Landscape design professionals

Landscape design professionals shall include landscape architects licensed in the State of Florida, and landscape designers certified by the Florida Nurserymen Growers and Landscapers Association, the Florida Yards & Neighborhoods program or comparable program.

3. Landscape installation professionals

Landscape installation professionals shall include landscape architects licensed in the State of Florida, and landscape contractors certified by the Florida Nurserymen Growers and Landscapers Association, the Florida Yards & Neighborhoods program, or comparable program.

4. Landscape maintenance professionals

Landscape maintenance professionals shall include landscape architects licensed in the State of Florida, landscape contractors certified by the Florida Nurserymen Growers and Landscapers Association, the Florida Yards & Neighborhoods program, or comparable program, and holders of a valid pesticide license issued under Ch. 482 or Ch 487, *FS*, (for pesticide applications only).

5. Irrigation design professionals

Irrigation design professionals shall include state-licensed plumbers operating within the limits of the Florida Building Code, professional engineers or landscape architects registered in the State of Florida, and irrigation designers certified by the Irrigation Association or Florida Irrigation Society.

6. Irrigation Installation and Maintenance Professionals

Irrigation installation and maintenance professionals shall include state-licensed plumbers operating within the limits of the Florida Building Code, and specialty contractors licensed by the City/Town/County and certified by the Irrigation Association or the Florida Irrigation Society.

7. Training

The professionals listed above must annually complete a minimum of 4 professional development hours (PDH) in principles of Florida-friendly landscaping from an approved training organization unless their license or certification requires a minimum of 4 PDH per year or 8 PDH over a two-year period to maintain licensing or certification. 50 minutes of instruction equals a PDH.

IV. DEFINITIONS

For the purpose of this ordinance, the following words and phrases shall have the meanings respectively ascribed to them by this section.

Automatic Controller. A mechanical or electronic device, capable of automated operation of valve stations to set the time, duration, and frequency of a water application

Best Management Practices (BMPs). A practice or combination of practices based on research, field-testing, and/or expert review, determined to be the most effective and practicable on-location means, including economic and technological considerations, for improving water quality, conserving water supplies, and protecting natural resources.

Ground cover. Low growing plants, other than turfgrass, used to cover the soil and form a continuous, low mass of foliage.

Florida-friendly landscape. Quality landscapes that conserve water and protect the environment, and are adaptable to local condition. Florida-friendly landscape principles include planning and design, appropriate choice of plants, soil amendments, efficient irrigation, practical use of turf, appropriate use of mulches, and proper maintenance.

Landscapable area. The area of a site less the building area, natural water features, driveways, paved walkways, and hardscapes such as decks, patios, and fountains, but including areas set aside for the preservation of native vegetation, swales, retention and detention basins.

Low volume irrigation (Microirrigation). The application of small quantities of water directly on or below the soil surface, usually as discrete drops, tiny streams, or miniature sprays through emitters placed along the water delivery pipes (laterals). Microirrigation encompasses a number of methods or concepts including drip, subsurface, bubbler, and trickle irrigation.

Turf or turfgrass. A mat layer of monocotyledonous plants such as Bahia, Bermuda, Centipede, Paspalum, St. Augustine, and Zoysia.