

FINAL

BASIN MANAGEMENT ACTION PLAN

**for the Implementation of Total Maximum Daily Loads
adopted by the
Florida Department of Environmental Protection
in the
Rainbow Springs Basin Management Area**

for

**Rainbow Springs Group and the Rainbow Springs Group
Run**

prepared by the
Division of Environmental Assessment and Restoration
Water Quality Restoration Program
Florida Department of Environmental Protection
Tallahassee, FL 32399

in cooperation with the
Rainbow Springs Basin Management Action Plan Working Group

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ACKNOWLEDGMENTS

The Florida Department of Environmental Protection adopted the *Rainbow Springs Basin Management Action Plan* by Secretarial Order as part of its statewide watershed management approach to restore and protect Florida’s water quality. The plan was developed in cooperation with the Rainbow Springs Basin Working Group (BWG), identified below, with participation from affected local, regional, and state governmental interests; elected officials and citizens; and private interests.

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Levy County	Florida Department of Environmental Protection (including the Central District Office and Rainbow Springs Aquatic Preserve)	Private Sector Agriculture and Businesses
City of Dunnellon	Florida Department of Health in Marion County	General Public
City of Williston	Florida Department of Transportation, Districts 2 and 5	-
City of Ocala	Florida Fish and Wildlife Conservation Commission	-
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LIST OF ACRONYMS AND ABBREVIATIONS

BMAP	Basin Management Action Plan
BMP	Best Management Practice
BWG	Basin Working Group
CR	County Road
department	Florida Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
ERP	Environmental Resource Permitting
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
F.S	Florida Statutes
FWRA	Florida Watershed Restoration Act
GIS	Geographic Information System
in/yr	Inches per Year
IFAS	Institute of Food and Agricultural Sciences
lbs/yr	Pounds per Year
LID	Low Impact Development
mi ²	Square Miles
MGD	Million gallons per day
mg/L	Milligrams per Liter
MS4	Municipal Separate Storm Sewer System
NO ₃ -N	Nitrate as Nitrogen
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NSILT	Nitrogen Source Inventory and Loading Tool
OAWP	Office of Agricultural Water Policy
OFW	Outstanding Florida Water
OSTDS	Onsite Sewage Treatment and Disposal System
SCADA	Supervisory Control and Data Acquisition
SPOZ	Springs Protection Overlay Zone
SR	State Road
SRF	State Revolving Fund
SRWMD	Suwannee River Water Management District
STORET	Storage and Retrieval (database)
SW	Southwest
SWFWMD	Southwest Florida Water Management District
TDR	Transfer of Development Rights
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TVR	Transfer of Vested Rights
UCF	University of Central Florida
UF	University of Florida
UFA	Upper Floridan Aquifer

USGS	United States Geological Survey
WBID	Waterbody Identification
WMP	Watershed Management Program
WWTP	Wastewater Treatment Plant
WWTF	Wastewater Treatment Facility

SUMMARY

This document describes the management priorities for the first phase of the Rainbow Springs Basin Management Action Plan (BMAP). The Rainbow Springs BMAP was developed over a two-year period beginning in July 2013. It addresses nutrient impairment in Rainbow Springs Group, and Rainbow Springs Group Run (Rainbow River), which were verified as impaired under the Florida Watershed Restoration Act (FWRA) (Chapter 403.067, Florida Statutes [F.S.]) and the Impaired Surface Waters Rule (IWR) (Rule 62-303, Florida Administrative Code [F.A.C.]). This BMAP was developed in conjunction with the Silver Springs BMAP and many of the restoration efforts will benefit both springs.

The BMAP documents more than 97 management actions that have been or will be undertaken by local, regional, state, or private entities, as funds are made available, to reduce the amount of nitrogen released into the upper Floridan aquifer (UFA), the source of flow in Rainbow Springs and Rainbow River. These actions address all the major source categories that contribute nitrogen loading to the UFA (agriculture, land application of wastewater, onsite sewage treatment and disposal systems [OSTDS], urban fertilizer, and drainage wells). Reducing the amounts of nitrogen entering the UFA will help achieve the water quality standards and designated uses established by the Florida Department of Environmental Protection. Rainbow Springs Group, Rainbow Springs Group Run are designated as Class III, suitable for recreational use and for the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. They are also designated as Outstanding Florida Waters (OFWs).

An important part of the BMAP process for Rainbow Springs is the participation and commitment of local stakeholders in the process. Local governments, water management districts, state agencies, agricultural interests, environmental interests, other private interests, as well as department District Offices provided valuable information and input.

The BMAP process enhanced communication and cooperation among basin stakeholders that will have benefits beyond the BMAP. That enhanced interaction and communication will allow the BMAP to support the initiation of three management efforts, whose outcomes will be improved coordination between stakeholders and the identification of solutions that will result in further reductions in nitrogen loading to the UFA. These three management efforts comprise the OSTDS 9-1-1 Strategy (wastewater management), stormwater education and outreach effort, and small farms equine outreach effort.

RAINBOW SPRINGS MANAGEMENT AREA

The Rainbow Springs BMAP area is located in western Marion County and eastern Levy County. The BMAP area approximates the extent ground water capture area determined by the Southwest Florida Water Management District. It includes the surface drainage area for Rainbow River.

The area contributing recharge, or the ground water contributing area, to Rainbow Springs varies significantly from year to year in response to climatic conditions. Estimates of the location of the contributing area depend on amount of rainfall, seasonality and the density of measuring wells. In any given year, the eastern portion of the BMAP area may contribute flow to Silver Springs. For these reasons, the BMAP area does not coincide with any particular year's potentiometric surface.

The eastern boundary of the BMAP area is coincident with the western extent of the Silver Springs BMAP area at Interstate (I) 75 in Marion County. I-75 is also the boundary separating the St. Johns River Water Management District (SJRWMD) from the Southwest Florida Water Management District (SWFWMD).

TOTAL MAXIMUM DAILY LOAD

A Total Maximum Daily Load was adopted for Rainbow Springs Group, and Rainbow Springs Group Run in 2013 that sets a target concentration of 0.35 milligrams per liter (mg/L) of nitrate (NO₃ as N) and requires a 82% reduction in nitrate concentration for each of the impaired waterbodies. The waterbodies to which this TMDL applies are identified by their unique waterbody identification (WBID) numbers as well as common name and consist of Rainbow Springs Group (WBID 1320A), and Rainbow Springs Group Run (WBID 1320B). These waterbodies were considered nutrient impaired because of an imbalance of flora and fauna evidenced by excessive algal growth and smothering of submerged aquatic vegetation. The excessive algal growth was correlated to elevated levels of nitrate contributed from ground water.

RAINBOW SPRINGS BMAP

This BMAP represents a commitment by stakeholders to restore water quality to Rainbow Springs and Rainbow River. Stakeholders recognize that no one management action will restore water quality and agree that the entire BMAP area should be considered when identifying loading reduction management actions. This decision was based on the acknowledgment that, based on their impacts, all stakeholders have a proportionally shared responsibility in restoring Rainbow Springs and Rainbow River.

Management actions are identified for the first phase of the BMAP that constitute sufficient efforts that should result in improved water quality.

This BMAP provides for phased implementation under Subparagraph 403.067(7)(a)1, F.S., and this adaptive management process will continue until the TMDL is met. The phased BMAP approach allows for incrementally reducing loadings through the implementation of management actions, while simultaneously monitoring and conducting studies to better understand water quality dynamics (sources and response variables) in each impaired waterbody. In subsequent five-year management cycles, progress will be evaluated and adjustments made or new projects added, as needed, to meet the TMDL.

Phased implementation is particularly important in ground water systems because of “legacy” nitrogen already in ground water. A legacy source contributes to the continuing rise in nitrate concentrations, but the source entered the aquifer as a result of past land use practices. The response of ground water–driven systems to changes in land use or practices is typically slower than surface water–driven systems and can be on the order of years or decades. This lag time in response to reductions in nitrate loading by changes in practices is one of the factors that should be considered when evaluating the success of management actions.

Detailed allocations with specified reductions in total nitrogen (TN) loading could not be assigned to each stakeholder for this first BMAP phase, because of the uncertainty associated with the fate and transformation of nitrogen in the UFA. If information becomes available that provides a better understanding of ground water movement and impacts to its quality as well as the fate and transformation of nitrogen, the findings will be applied during the second BMAP phase.

Guiding principles were developed with stakeholder input to provide defined expectations for the management of TN loadings from wastewater, stormwater, and agriculture sources. The purpose of these principles is to encourage stakeholders to apply technologies and management strategies that reduce nitrogen loading and to consider areas of high recharge and potential high loading as priorities for retrofit opportunities. These guiding principles are intended as recommendations and as a guide for future project selection and focusing of efforts that support the implementation of the BMAP.

NITROGEN SOURCE INVENTORY LOADING TOOL

The department developed the Nitrogen Source Inventory Loading Tool (NSILT) to provide a BMAP-area wide evaluation of the potential sources of TN loading to the UFA, to provide stakeholders with information on the comparative importance of different sources, and to assist in the selection and targeting of projects to reduce nitrogen loading. The NSILT provides the best available assessment of where nitrogen is currently being applied in the BMAP area relative to aquifer recharge rates.

The NSILT is a GIS- and spreadsheet-based tool that provides estimates of the relative contribution of nitrogen from the following sources:

- Agricultural and nonagricultural (urban) fertilizers.
- Livestock waste (predominantly horse and cattle).
- OSTDS.
- Wastewater land applications.
- Atmospheric deposition.

The results of the NSILT indicate that an estimated 1.34 million pounds of nitrogen (lbs-N) enter the UFA annually. This represents approximately 11% of the annual input at the land surface, which is estimated to be 11.9 million lbs-N. The majority of the load entering the UFA, 67%, is from high-recharge areas. Agricultural commodities contribute the greatest potential loading to the UFA, each providing 67% of the annual estimated contribution of nitrogen to the UFA. OSTDS contribute 19% of the annual estimated contribution. Urban fertilizer contributes 6% of the annual estimated contribution of nitrogen to the UFA through both infiltration to ground water and stormwater runoff.

MANAGEMENT ACTIONS

Stakeholder management actions, including more than 96 specific projects identified in this BMAP, will reduce nitrogen loading to the UFA. These management actions are categorized as follows:

- Stormwater Structural Best Management Practices (BMPs).
- Agricultural BMPs.
- Regulations, Ordinances, and Guidelines.

- Special Studies and Planning Efforts.
- Education and Outreach Efforts.
- Basic Stormwater Management Program Implementation.
- Conservation Land Acquisition.
- OSTDS Conversion.
- Wastewater System Upgrade and Improved Management and Infrastructure Management, Maintenance, and Repair.

Projects are identified that address each of the nitrogen source categories evaluated in the NSILT. Project details are listed in **Chapter 4**. Projects identified for agricultural sources are in addition to the required commodity specific BMPs. Loading reductions were calculated based on the nitrogen load to the land surface and not the UFA.

This BMAP proposes three specific initiatives (listed as projects) to continue efforts to reduce nitrogen loading in the basin, find better methods for reducing and managing nitrogen loads, and, as noted above, address the largest sources identified by the NSILT. Local municipal stormwater and wastewater utility managers provided input and guidance to the department in the development of these initiatives. The initiatives are as follows:

- OSTDS and other wastewater issues are addressed through the wastewater management project OSTDS 9-1-1 Strategy (R071), which will engage local government and private utilities as well as community and environmental interests to develop a strategy that addresses the large loading from OSTDS. This project is also considering BMAP area-specific effluent standards for WWTFs in an effort to provide more consistency between facilities. This project will be a combined effort with Silver Springs.
- Stormwater Public Education Coordination, Project B036, provides public education and outreach coordination and consistency among stakeholders related to stormwater impacts on springs.

- An outreach program will be implemented for the Small Farm Equine BMP Manual (Project B012) in collaboration with FDACS, Marion County, University of Florida–Institute of Food and Agricultural Sciences (UF–IFAS), and other stakeholders.

ANTICIPATED OUTCOMES OF BMAP IMPLEMENTATION

Through the implementation of the wastewater, stormwater education, and small farm equine BMP initiatives, other projects and activities listed in this BMAP, and future NSILT source assessment, stakeholders expect the following outcomes:

- Decreased concentration of nitrate in Rainbow Springs Group, and Rainbow Springs Group Run.
- Decreased loading of nitrogen to the UFA.
- Improved coordination and communication between state and local governments and between all levels of government and the community.
- Improved project selection and targeted project implementation through the use of the guiding principles and the NSILT.
- Enhanced public awareness and understanding of the impacts of nitrogen loading on Rainbow Springs Group, and Rainbow Springs Group Run.

BMAP COST

Costs were provided, when available, for the management actions identified in the BMAP, consisting of an estimated total cost of more than \$97 million. These costs include a substantial investment made to improve wastewater treatment (about \$43 million) and the projected cost for purchase of conservation lands (\$47 million) for water quality protection. The funding sources for the projects range from local contributions to legislative appropriations. Stakeholders will continue to explore new sources of funding to ensure that the activities listed in this BMAP can be achieved at the necessary level of effort.

BMAP FOLLOW-UP

The department and stakeholders will continue to track projects and other implementation efforts, as well as monitor water quality in TMDL waterbodies, to ensure that the BMAP is carried out and to measure its effectiveness. As needed, the NSILT may be updated in the future to reflect new information about sources and to evaluate nitrogen management efforts. New information and

refinements to source loadings that result from ongoing research will be incorporated into the second phase of the BMAP to the extent possible.

Stakeholders will meet at least annually to discuss implementation issues, consider new information, and determine other management actions needed for waterbodies that are not projected to meet their TMDLs. Each stakeholder responsible for implementing management actions as part of the BMAP will complete an annual report for submittal to the department. The report will track the implementation status of any management actions listed in the BMAP and document additional projects undertaken to further water quality improvements in the basin. Additional projects are expected with the implementation of the wastewater initiative and stormwater education and outreach initiative.

As part of the BMAP, a strategy was developed for monitoring water quality based on existing surface and ground water monitoring stations, maintained by SWFWMD, to determine if water quality is improving and the TMDL is being met.

Observations of water quality conditions will be reported to stakeholders and the general public at least annually as part of the BMAP reporting process. Water quality data will be used to support the adaptive management process, assess projects, and identify the need for new projects.

COMMITMENT TO BMAP

The management actions outlined in this BMAP as well as the proposed management initiatives provide sufficient direction for this BMAP to achieve reductions in nitrogen loading to Rainbow Springs Group and Rainbow Springs Group Run. The guiding principles and BMAP initiatives will help to define additional management actions that will further improve water quality in Rainbow Springs Group and Rainbow Springs Group Run.

Chapter 1: CONTEXT, PURPOSE, AND SCOPE OF THE PLAN

The Rainbow Springs Basin Management Action Plan (BMAP) was developed between March 2013 and August 2015. It addresses nutrient impairment in the Rainbow Springs Group (waterbody identification [WBID] number 1320A) and Rainbow Springs Group Run (WBID 1320B), also referred to as the Rainbow River, which were verified as impaired under the Florida Watershed Restoration Act (FWRA) (Chapter 403.067, Florida Statutes [F.S.]) and the Identification of Impaired Surface Waters rule (Rule Chapter 62-303, Florida Administrative Code [F.A.C.]). These waters were considered nutrient impaired because of excessive algal growth correlated to elevated levels of nitrate contributed from ground water. TMDLs were adopted for these waterbodies in 2013 (**Table 1**). The TMDL sets a target concentration of 0.35 milligrams per liter (mg/L) of nitrate as nitrogen (NO₃-N) for the spring discharge and Rainbow River to restore water quality.

The decline in water quality in Rainbow Springs and the Rainbow River are a result of nitrogen loads applied to the land surface from agricultural activities, wastewater disposal, and urban land uses and from nitrogen loads applied below the land surface from OSTDS. Part of this loading is a product of historical land use practices complicating the restoration of these waterbodies.

The BMAP documents the management actions that have been or will be undertaken by local, regional, state, or private entities to reduce the amount of nitrogen released into the Upper Floridan Aquifer (UFA), which is the source of flow in Rainbow Springs and Rainbow River. Reducing the amount of nitrogen entering the UFA will help achieve water quality standards and designated uses established by the Florida Department of Environmental Protection. Rainbow Springs and the Rainbow River are designated as Class III waterbodies (i.e. suitable for recreational use and for the propagation and maintenance of a healthy, well-balanced population of fish and wildlife). They are also designated as outstanding Florida waters (OFWs).

An important result of the BMAP process for Rainbow Springs has been the level of local stakeholder participation and commitment. The BMAP process enhanced communication and cooperation among basin stakeholders that will have benefits beyond the BMAP. Their management action will reduce nitrogen load to the UFA. These management actions are categorized as follows:

- Structural Best Management Practices (BMPs) – Quantifiable and Unquantifiable Load Reductions.
- Agricultural BMPs.
- Restoration and Water Quality Improvement Projects.
- Regulations, Ordinances, and Guidelines.
- Special Studies and Planning Efforts.
- Education and Outreach Efforts.
- Basic Stormwater Management Program Implementation.
- Conservation Land Acquisition/BMP Land Acquisition.
- Wastewater Infrastructure Management, Maintenance, Repair, and Upgrade.

The department developed a Nitrogen Source Inventory and Loading Tool (NSILT) in support of the BMAP decision making process. The NSILT was developed from extensive review of literature on nitrogen sources and migration/transformation to the aquifer and eventually to Rainbow Springs. Various stakeholder groups also provided valuable insight into activities contributing nitrogen, such as fertilization practices and cattle and horse grazing activities. The NSILT provides the best available assessment of where the nitrogen is currently being applied in the BMAP area, and is thus contributing to continuing elevated nitrogen concentrations in Rainbow Springs and Rainbow River. The NSILT is intended as a tool to assist stakeholders and department in identifying locations where future projects will have the greatest impact in reducing nitrogen loads.

This BMAP provides for phased implementation under Paragraph 403.067(7)(a)1, F.S. The management strategies and adaptive management approach described in the BMAP will address nitrogen reductions needed to meet the TMDLs. This adaptive management process will continue until the TMDL targets, or water quality standards are met.

A phased implementation is particularly important in ground water systems because of the potential for “legacy” nitrogen in the ground water. A legacy source contributes to the continuing rise in Nitrate as Nitrogen (NO₃-N) concentrations in Rainbow Springs but entered the aquifer as a result of past land uses

or practices that no longer exist. The response of ground water driven systems to changes in land use or practices is typically much slower than in surface water-driven systems, with sub-surface transport often occurring on the order of years or decades.

The adoption as a phased BMAP allows for the implementation of projects designed to achieve incremental reductions from current land uses and practices, assess and control growth of nitrogen loads as a result of projected future land use changes, while simultaneously monitoring discharge at Rainbow Springs and the aquifer throughout the BMAP area to identify changes in NO₃-N concentrations. Subsequent five-year management cycles will evaluate progress and make adjustments or add new projects, as needed, to meet the applicable water quality standards.

1.1 BACKGROUND

The Rainbow Springs BMAP has been developed as part of the department's TMDL Program, which is authorized by the FWRA (see Section 403.067, F.S., Establishment and implementation of total maximum daily loads). The department implements the FWRA using a watershed management approach that includes a five-year rotating basin cycle. Each year of the cycle represents a different activity for the waters within a given basin group, as follows: initial basin assessment, strategic monitoring, ate analysis and TMDL development, BMAP development, and BMAP implementation. At the end of each five-year, five-phase cycle, a new cycle begins for each group of basins in which additional waters may be identified for TMDL establishment and implementation.

TMDLs are water quality targets for waterbodies that the department has identified as impaired for specific pollutants. TMDLs, which the department adopts by rule, establish the maximum amount of specific pollutants that a waterbody can assimilate while maintaining water quality standards, indicated by designated uses.

TMDLs may be implemented through BMAPs, which contain strategies to reduce and prevent pollutant discharges through various cost-effective means. Section 403.067, F.S., contains provisions that guide the development of BMAPs and other TMDL implementation approaches.

Stakeholder involvement is critical to the success of the TMDL implementation program, and varies with each phase of implementation to achieve different purposes. The BMAP development process is structured to achieve cooperation and consensus among a broad range of interested parties. Under

statute, the department invites stakeholders to participate in the BMAP development process and encourages public participation to the greatest extent practicable. The department must hold at least one noticed public meeting in the basin to discuss and receive comments during the planning process. Stakeholder involvement is essential to develop, gain support for, and secure commitments to implement the BMAP.

1.2 TOTAL MAXIMUM DAILY LOAD

TMDLs for Rainbow River and Rainbow Springs were adopted in May 2013 (Rule 62-304, F.A.C.) and are listed in **Table 1**. The TMDLs were based on multiple lines of evidence which concluded that nitrate concentration was the primary factor causing the impairment due to imbalance of flora and fauna. The concentration of nitrate needed to restore ecological balance was determined by examining the relation between concentration and response of attached forms of algae (periphyton). At higher concentrations of nitrate periphyton produce more biomass for each incremental increase of nitrate when compared to the periphyton response at lower nitrate concentrations. A change point analysis was done that identified the point along a gradient of increasing nitrate concentration when the algae respond with increased biomass. It is this change point concentration that was used to set the TMDL targeted level of nitrate. The change point analysis determined that the nitrate concentration at which excessive algal growth occurs was between 0.378 and 0.629 mg/L with 95% confidence. Thus the TMDL target concentration was set just below this range. TMDLs may be re-evaluated, modified, and re-adopted if the underlying science or data for a system changes and new targets are found to be appropriate. Complete details of the process to set the TMDL target can be found in the TMDL document for Rainbow Springs, and Rainbow Springs Group Run (Holland and Hicks, 2013) is available at the following link <http://www.dep.state.fl.us/water>.

TABLE 1: TMDLS ADDRESSED IN THE RAINBOW SPRINGS BMAP AREA

NA = No data

¹ Load allocation for nonpoint sources (fertilizer, domestic wastewater from onsite sewage treatment and disposal systems (OSTDS) and wastewater application sites, animal waste, atmospheric deposition, and stormwater discharges to ground water).

WBID	Parameter	TMDL (mg/L)	TMDL % reduction	Wasteload Allocation for Wastewater	Wasteload Allocation for National Pollutant Discharge Elimination System (NPDES) Stormwater % Reduction	Load Allocation % reduction ¹	Margin of Safety
Rainbow Springs Group (WBID 1320A)	Nitrate as a monthly average	0.35	82%	NA	82%	82%	Implicit

WBID	Parameter	TMDL (mg/L)	TMDL % reduction	Wasteload Allocation for Wastewater	Wasteload Allocation for National Pollutant Discharge Elimination System (NPDES) Stormwater % Reduction	Load Allocation % reduction ¹	Margin of Safety
Rainbow Springs Group Run (WBID 1320B)	Nitrate as a monthly average	0.35	82%	NA	82%	82%	Implicit

1.3 REGIONAL SETTING OF THE RAINBOW SPRINGS BASIN MANAGEMENT AREA

The Rainbow Springs Group is one of the largest spring groups in Florida by magnitude, discharging an average flow of 705 cubic feet per second (456 million gallons per day [MGD]). The spring group is the main source of flow for the 5.7 mile spring run known as the Rainbow River. The spring group and the river have significant habitat and recreational value, including swimming, kayaking, and canoeing from the head springs and tubing on the river. Rainbow Springs has been a tourist destination since the 1920s and continues to have economic significance to north-central Florida. Since the 1990s the head springs has been part of Rainbow Springs State Park.

The Rainbow Springs BMAP area (**Figure 1**) is located in western Marion County and eastern Levy County. Rainbow Springs Group and Rainbow Springs Group Run are segments of the Rainbow River designated as WBIDs 1320A and 1320B, respectively (**Figure 2**). Flow in the Rainbow River is primarily from spring discharge of ground water, consisting of a surficial aquifer, with a confining unit in places and the underlying carbonate aquifer, the UFA. There are no significant surface tributaries to the impaired segments of the Rainbow River. Consequently, the surface watershed of the Rainbow Spring and River system is very limited. The UFA is recharged from rainfall falling onto karst terrain in the BMAP area. A description of the karst terrain in North Central Florida is contained in the TMDL report (Holland and Hicks, 2013).

The 679-square mile (mi²) BMAP area is primarily (65% or 442 mi²) located in western Marion County with the remainder (35% or 237 mi²) in eastern Levy County. It includes a portion of the City of Ocala, City of Dunnellon, and City of Williston. The western and southern BMAP boundary generally follows the ground water contributing area delineated by the Southwest Florida Water Management District (SWFWMD) (Jones *et al.*, 1996), which tends to follow major county roads in Levy and Marion Counties. The area contributing recharge, the springshed, to Rainbow Springs Group and Group Run may vary significantly from year-to-year in response to climatic conditions. A comparison of the

SWFWMD delineation of the Rainbow Springshed and various Silver Springs potentiometric springshed delineations indicated that an area of southeastern Alachua and western Marion Counties could, in any given year, contribute to a different spring due to variations in the potentiometric surface of the UFA. This area where the springshed can overlap is shown in **Figure 3**. The eastern boundary of the BMAP area is coincident with the western extent of the Silver Springs BMAP area at Interstate 75 in Marion County to avoid duplication of effort. Similarly, the northern boundary was set at the Alachua County line to avoid duplication of effort.

Land use (**Figure 4**) varies significantly in the BMAP area. Agricultural land use (40%) is the largest group of land uses followed by residential (27%) and forest (27%), which includes silviculture, land uses. The water quality problems in Rainbow Springs and the Rainbow River result from nitrogen loads applied to the land surface from agricultural, commercial, residential, and other land uses. Conservation land within the BMAP area (**Figure 5**) include part or all of several State-owned tracts, most notably Rainbow Springs State Park which includes the head springs and much of the east bank of the Rainbow River (**Figure 6**).

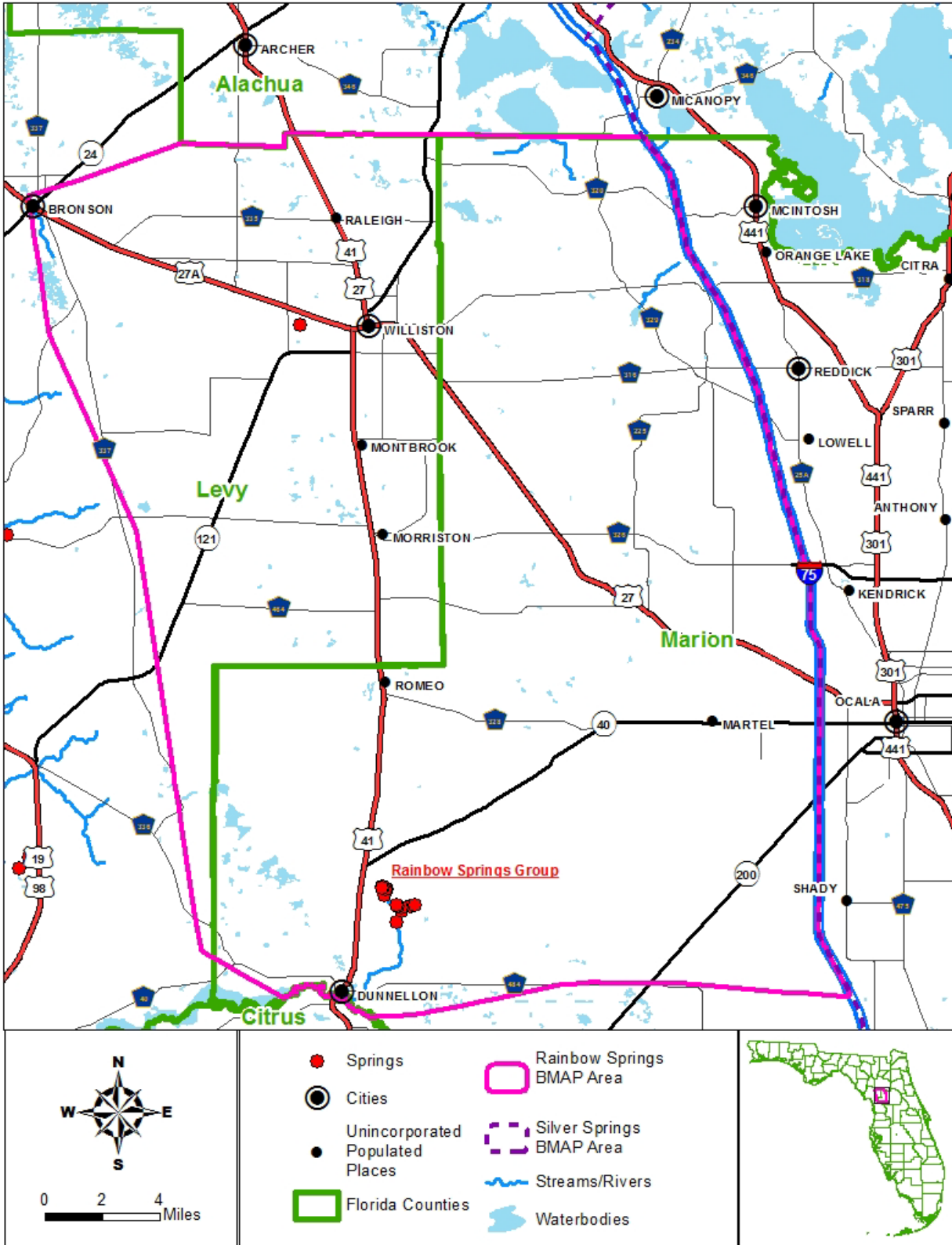


FIGURE 1: RAINBOW SPRINGS BMAP AREA

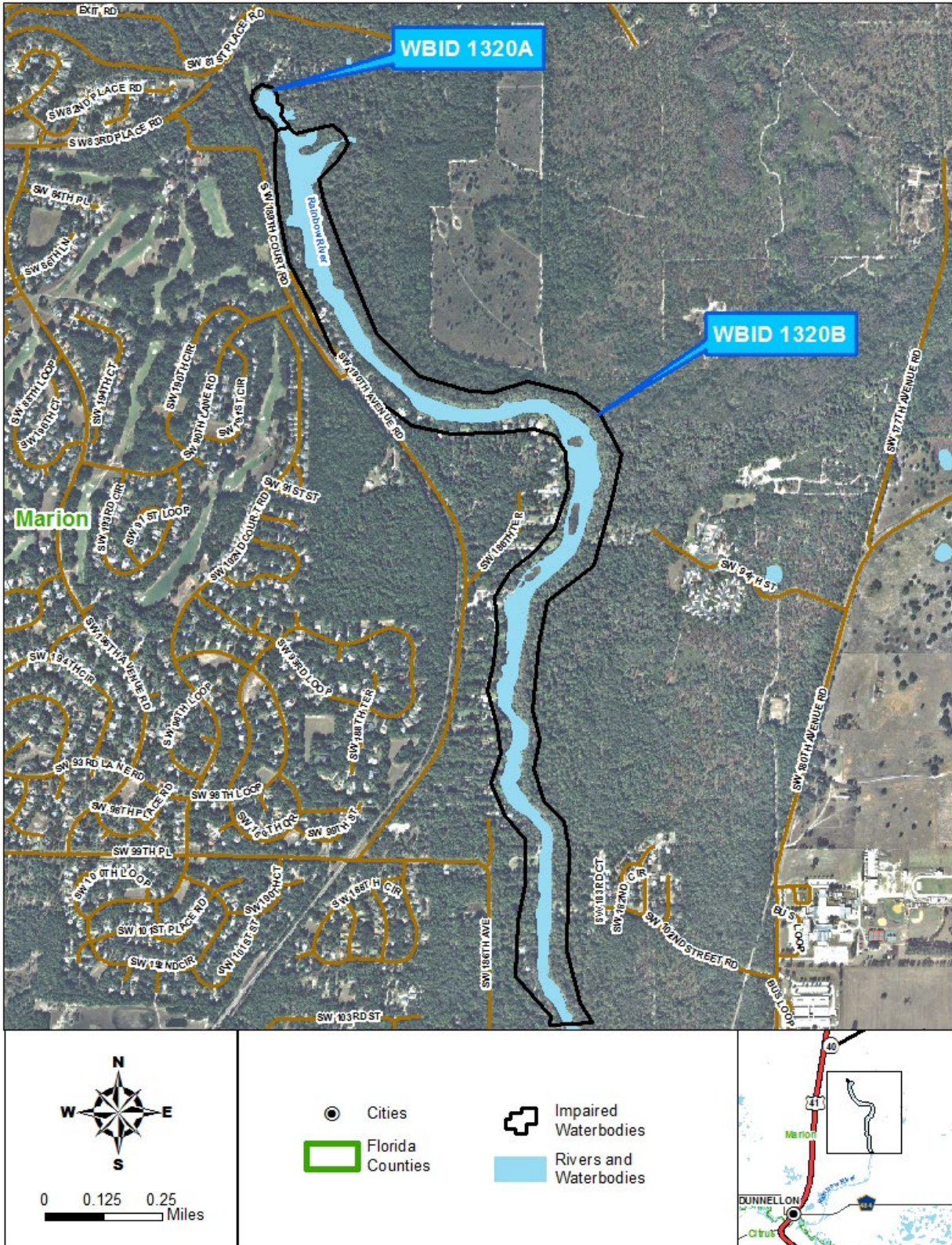


FIGURE 2: LOCATION OF IMPAIRED WATERBODIES

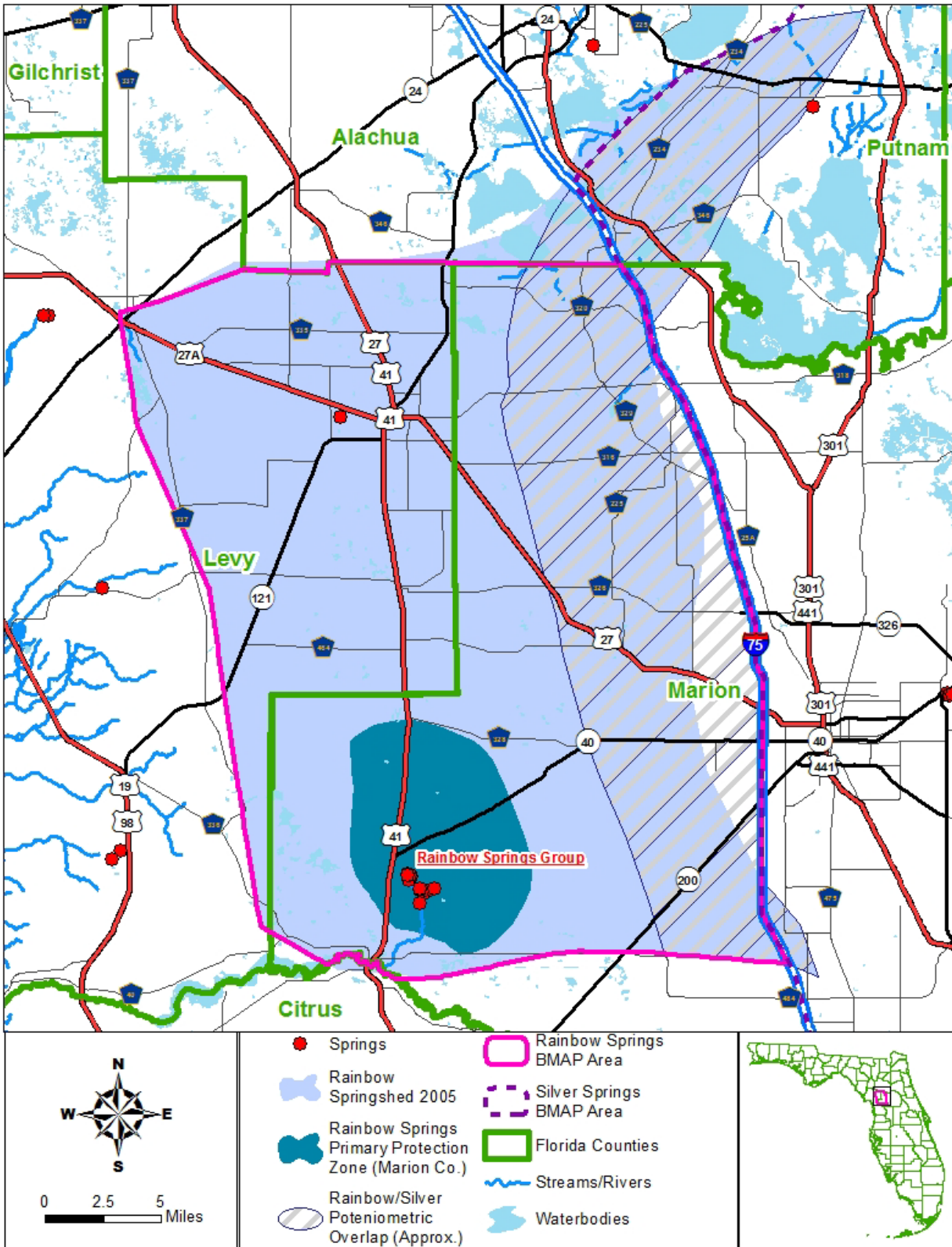


FIGURE 3: RAINBOW SPRINGS SPRINGSHED

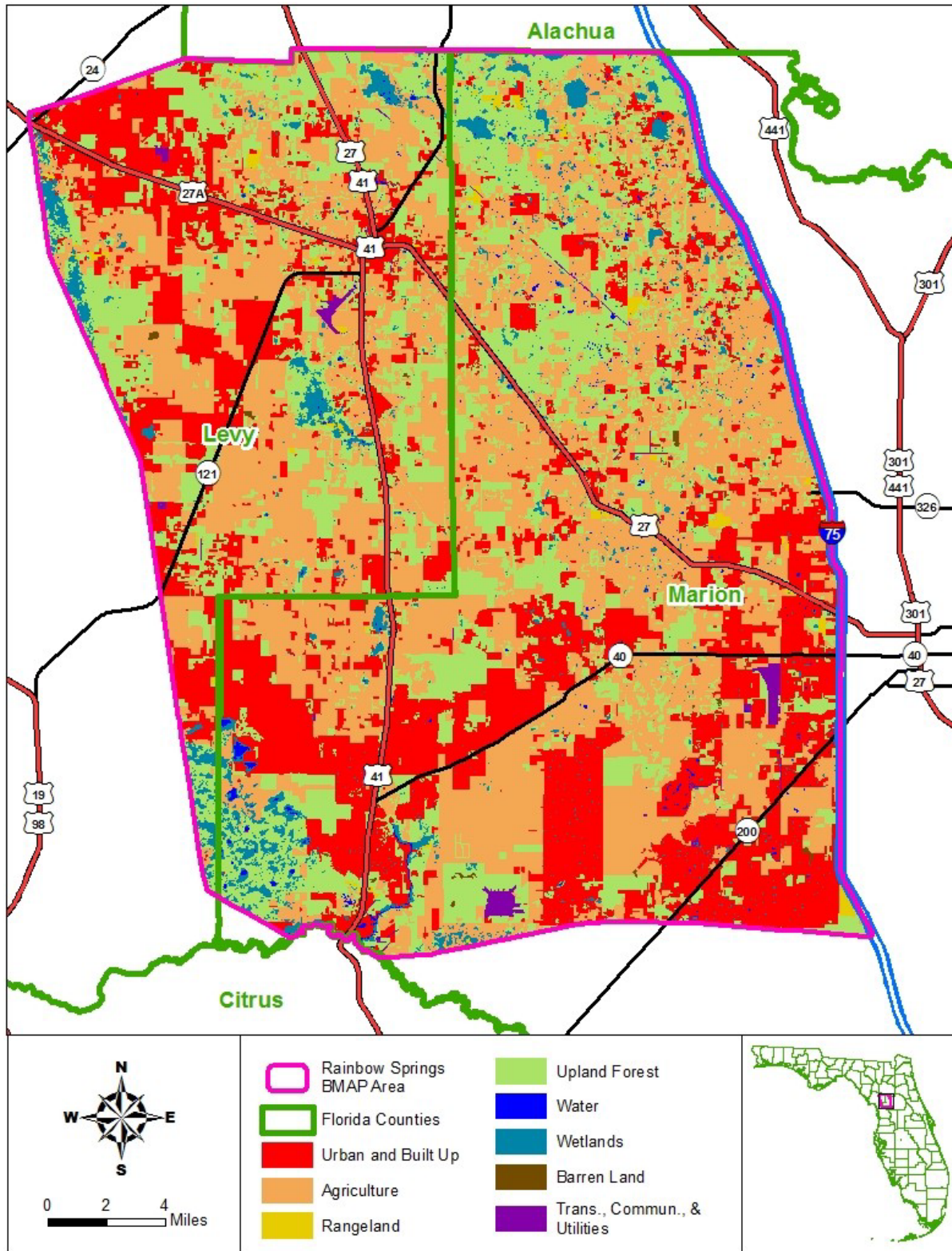


FIGURE 4: LAND USE IN THE RAINBOW SPRINGS BMAP AREA

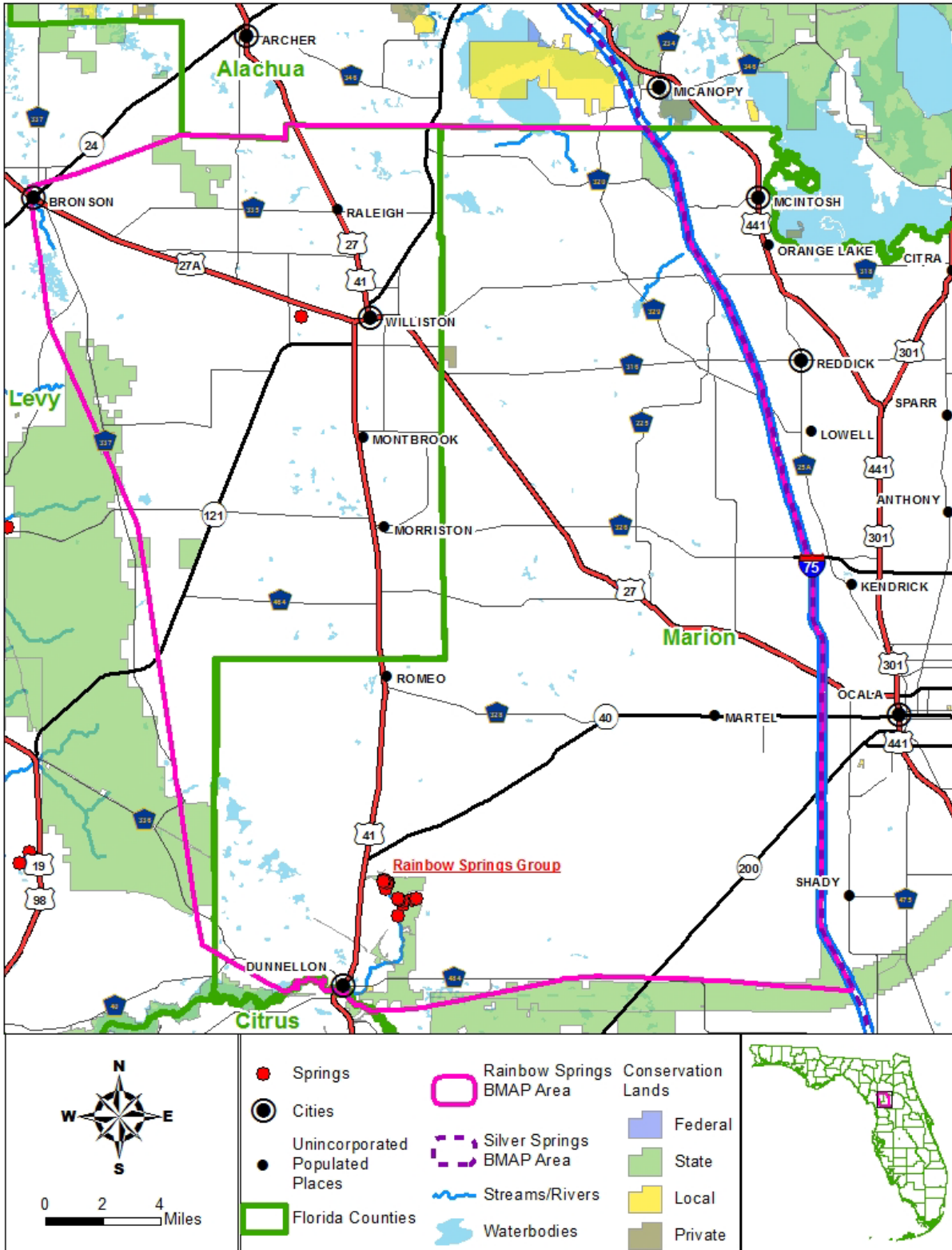


FIGURE 5: CONSERVATION LANDS IN THE RAINBOW SPRINGS BMAP AREA



FIGURE 6: CONSERVATION LANDS NEAR RAINBOW SPRINGS

1.4 BMAP ASSUMPTIONS AND CONSIDERATIONS

The water quality benefits of BMAP implementation are based on a number of fundamental assumptions and considerations, as follows:

- **Project Collection Period** – Project information collected from 2000 to 2015 were considered for inclusion in the BMAP.
- **Unquantified Project Impacts** – Some of the management strategies contained in this BMAP cannot currently be quantified with regard to the reductions in nitrogen they might achieve, e.g., maintenance of wastewater collection systems. However, because of their positive project impact, it is assumed that these strategies will help reduce pollutant loads and estimates of loading reductions may be determined at a later date.
- **Source Identification** – The NSILT represents an effective way to estimate the current total nitrogen (TN) load and sources based on the best available information; however, it does have uncertainty associated with it. The estimated loading to ground water must also account for both an attenuation factor within the soil column and the rate of ground water recharge. These rates are averages and can vary substantially, adding a degree of uncertainty to the loading estimates.
- **Legacy Sources** – Land uses not currently active in the basin may still be affecting the nitrate concentration of Rainbow Springs. Historical commercial fertilizer sales data and agricultural land use indicate that there may be a lag between nitrogen input to ground water and discharge from Rainbow Springs. Because this delay is not well understood, projects implemented since 2000 are included in BMAP in addition to future projects.
- **Implementation Schedule** – BMAP implementation will be a long-term process. The adaptive management approach used for this BMAP requires regular follow-up to ensure that management strategies are carried out and that their incremental effects are assessed. This type of approach acknowledges that there is some uncertainty associated with the outcomes of proposed management strategies. As each five-year iteration is completed and more information is gathered, additional management

strategies to achieve the TMDLs will be developed or existing strategies refined to better address the sources of nitrogen loading.

1.5 BMAP DEVELOPMENT PROCESS

In July 2013, the department convened the first of a series of public stakeholder meetings. Representatives from local, regional, state, business, and community interests provided input during the development of the NSILT and BMAP. The BMAP process was structured to achieve cooperation and consensus among a broad range of interested parties, with the intent of engaging local stakeholders in a coordinated and collaborative manner to address the reduction of nutrients needed to meet water quality standards in Rainbow Springs. Stakeholders are listed in the Acknowledgements Section.

All stakeholder meetings held in the basin were noticed in the *Florida Administrative Record* and on the department's website. Public comment from interested citizens was solicited during stakeholder meetings. A public workshop presenting the BMAP, as proposed for adoption, was held on, October 8, 2015, which was advertised in the *Riverland News* and *Ocala Star Banner* newspapers.

1.6 POLLUTANT REDUCTIONS

The TMDL addressed by this BMAP requires a 82 percent reduction in nitrate concentration in Rainbow Springs and the Rainbow Springs Run. To aid in the identification of nitrogen sources, the department developed the NSILT to provide a BMAP-area wide evaluation of the potential sources of total nitrogen loading to the UFA, to provide stakeholders with information on the comparative importance of different sources, and assist in the selection and targeting of projects to reduce nitrogen loading. Unlike a TMDL developed for a surface waterbody, this TMDL does not explicitly identify an allowable loading that supports water quality standards and criteria.

The BMAP area and NSILT include the area of potential overlap between Silver Springs and Rainbow Springs springsheds in western Marion County. Individual projects in this area have the potential to benefit both springs and many strategies and initiatives are expected to be implemented across an entire jurisdiction (e.g. across all of Marion County). Because both springs have similar impairments and required load reductions, projects and initiatives benefiting both springs are identified in both BMAPs.

Guiding principles are presented to provide defined expectations for the management of TN loadings from wastewater, stormwater, and agriculture sources. They were developed with stakeholder input.

The purpose of these principles is to encourage stakeholders to apply technologies and management strategies that reduce nitrogen loading and to consider areas of high recharge and potential high loading as priorities for retrofit opportunities. The principles are presented in more detail in **Chapter 4**. These guiding principles do not supercede local, water management district, or state regulations but are intended as a guide for future project selection and focusing of efforts that support the implementation of the BMAP.

Detailed allocations with specified reductions in TN loading were not assigned to each stakeholder for this first BMAP phase, because of the uncertainty associated with the fate and transformation of nitrogen in the UFA. These TMDLs require a percent reduction in the concentration of nitrate in the discharge from Rainbow Springs and do not translate directly to a nitrogen loading to the springs from different land uses. Unlike a TMDL developed for a surface water, these TMDLs do not identify an allowable loading that supports water quality standards and criteria. Instead, the NSILT was developed to provide a BMAP area wide evaluation of the potential sources of nitrogen loading to the UFA, provide stakeholders with the comparative importance of different sources, and assist in the selection and targeting of projects that accomplish nitrogen loading reduction. Guiding Principles have been developed that encourage stakeholders to apply technologies that reduce nitrogen loading and to consider areas of high recharge and potential loading for retrofit opportunities. These will be discussed in **Chapter 4**.

Chapter 2: NITROGEN SOURCES AND FUTURE GROWTH

Most identified nitrogen sources for Rainbow Springs are nonpoint in nature and dispersed throughout the BMAP area. Nitrogen applied over a broad area at or just below the land surface infiltrates through the soil to the aquifer where it is applied, or in retention ponds or topographic low points where nitrogen has been transported by stormwater runoff or via ground water seepage. Wastewater treatment applied through sprayfields or rapid infiltration basins (RIBs) also constitutes nonpoint source pollution. This is different from a point source of nitrogen where pollutant sources may be traced to a specific facility or outfall. In addition, nitrogen in organic form may undergo nitrification to nitrate during infiltration under aerobic soil conditions.

This chapter discusses the nitrogen source inventory developed to estimate the sources of nitrogen applied at the land surface, and just below the land surface in the case of OSTDS. The NSILT evaluates existing nitrogen loading data from various sources, along with information from studies and input from stakeholders. It was developed to assist stakeholders in identifying and planning future nutrient reduction efforts for this BMAP. Finally, the chapter discusses the relationship of the BMAP to other impaired waterbodies as well as the management of pollutant sources from future growth and the role of land conservation in protecting spring water quality.

2.1 NITROGEN SOURCE INVENTORY AND LOADING TOOL

The NSILT is geographic information system- (GIS-) and spreadsheet-based tool that provides estimates of the relative contribution of nitrogen from various sources:

- Agricultural and non-agricultural fertilizers.
- Livestock waste.
- Wastewater land applications.
- OSTDS
- Atmospheric deposition.

The NSILT was provided as a tool for the development and implementation of the BMAP to identify areas where nitrogen source reduction efforts could be focused to achieve the most beneficial and cost

effective effect on water quality. Other loading models, developed by stakeholders, may also provide similar benefits.

This section of the BMAP contains a summary of the NSILT. A detailed discussion of the NSILT methods, results and supporting references are documented in a separate report (Eller and Katz, 2015). The general approach of the NSILT, within the BMAP area, was to characterize ground water recharge, identify categories of land use that are potential nitrogen sources, estimate nitrogen input at the land surface, and finally calculate the estimated nitrogen load to the UFA. Nitrogen loadings expressed in this document are calculated as total nitrogen and expressed as pounds nitrogen per year. The nitrogen input at the land surface is not the equivalent of the amount of nitrogen (load) delivered to the UFA. Nitrogen input at the land surface is attenuated by varying biological and geochemical processes as well as variations in rate of recharge to the aquifer that affect the estimated nitrogen loading to the UFA.

2.1.1 GROUND WATER RECHARGE AND LAND USE

The NSILT characterized recharge (**Figure 7**) based on numerical modeling done by the United States Geological Survey (USGS). The recharge rates were then aggregated into two recharge categories: medium recharge (4.0-9.9 inches per year [in/yr]), and high recharge (10.0 in/yr or greater).

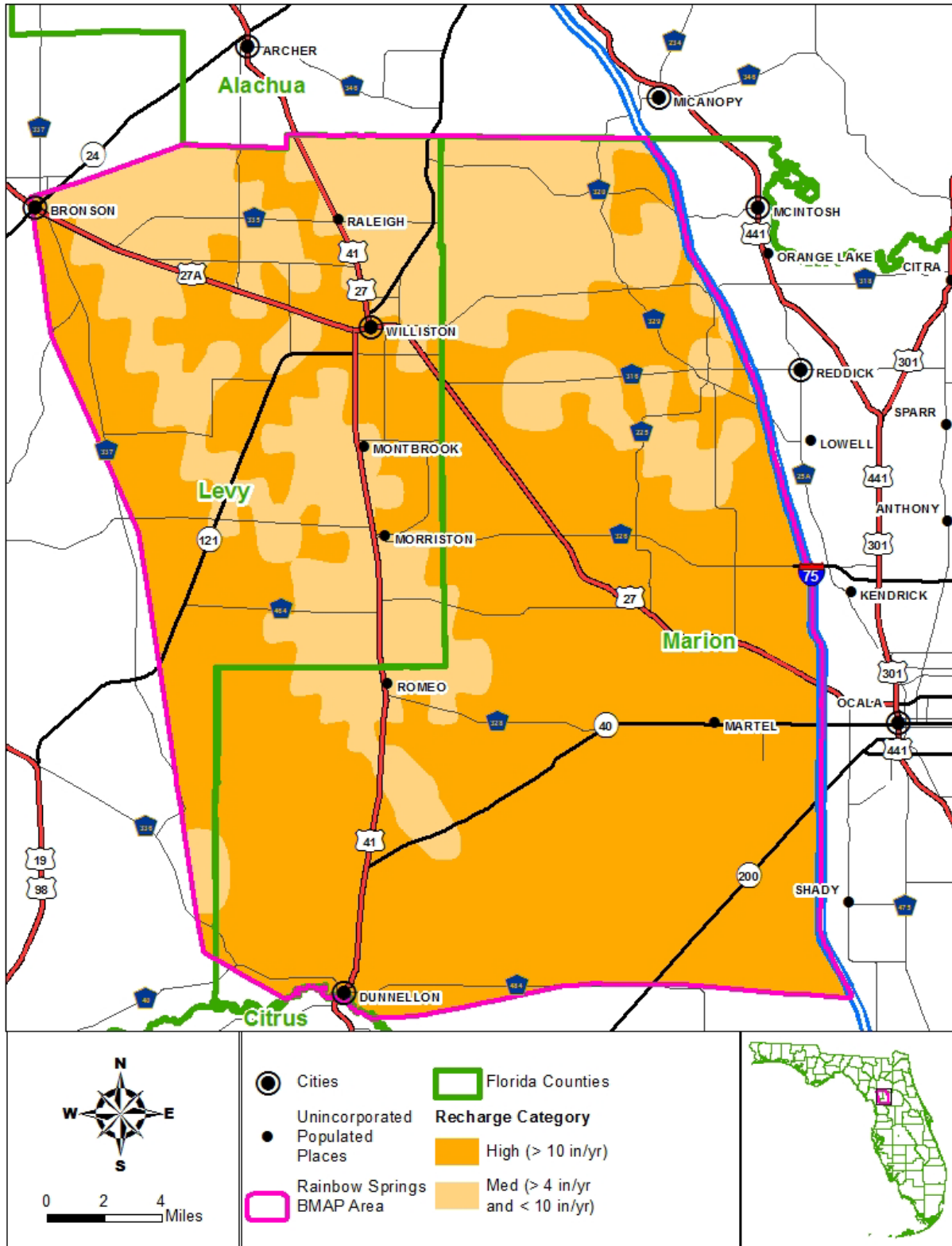


FIGURE 7: DISTRIBUTION OF RECHARGE RATES

Land use within the BMAP area was developed using data from SWFWMD, Suwannee River Water Management District (SRWMD), and data supplied by county property appraisers. The county property appraisers provided detailed information on specific agricultural practices and agricultural land use classifications.

2.1.2 ESTIMATING NITROGEN INPUTS TO LAND SURFACE

Nitrogen load to the land surface was estimated for each of the source categories. Nitrogen load was further categorized by recharge category. . Eller and Katz (2015) provide a full discussion of the methods and source references used to develop the estimates. It was estimated that 11.9 million pounds of nitrogen per year (lbs-N/yr) are applied at the land surface. **Figure 8** shows percent contribution of nitrogen load applied to the land surface in the BMAP area by source category.

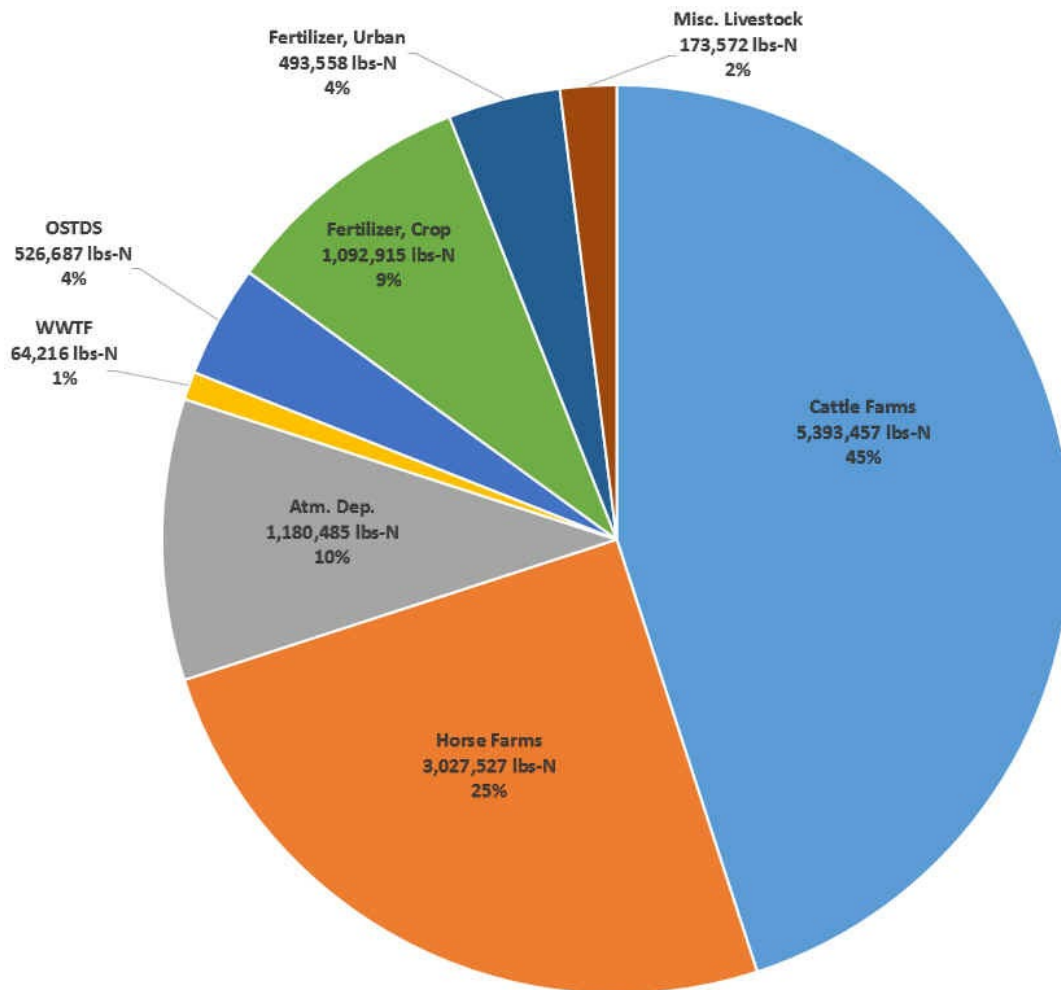


FIGURE 8: RELATIVE NITROGEN INPUTS TO THE LAND SURFACE

2.1.2.1 Atmospheric Deposition

Atmospheric deposition rates (wet and dry) were estimated for the BMAP area. The wet deposition rate was estimated using the Bradford Forest (FL03) and Chassahowitzka National Wildlife Refuge (FL05) monitoring stations of the National Atmospheric Deposition Program. Dry deposition rate was estimated from the Indian River Lagoon (IRL141) monitoring station of the Clean Air Status and Trends Network. The resulting rate (summation of the wet and dry rates) was multiplied by land area (in this case the recharge area) to estimate nitrogen load.

2.1.2.2 Wastewater Land Applications

Nitrogen load from each of the 37 wastewater treatment facilities (WWTFs) in the BMAP area was estimated by multiplying an average TN concentration by average yearly flow. Average TN concentrations and flow were taken from reported data to the department's Wastewater Facility Regulation database. One complete year of reporting (2012-2013) was used to develop the annual averages. Facilities, typically smaller ones (<0.1 million gallons per day [MGD]), without any reporting data were assumed to have a TN concentration of 8.97 milligrams per liter (mg/L) and an annual flow 50% of the permitted capacity. If the facility reported NO₃-N instead of TN concentration, it was assumed that NO₃-N represented 38.5% of the TN. For this calculation, the NO₃-N value is divided by 0.385 resulting in an estimated TN concentration.

2.1.2.3 OSTDS

Nitrogen load from OSTDS was estimated using a rate of 9.9 lbs-N/person per year. The number of persons per OSTDS was developed from census data in Marion and Levy Counties. The number of OSTDS was estimated from a 2009 Florida department of Health (FDOH) model, except for in Marion County where the county provided data based on GIS analysis of property appraiser and utility services area information. The majority of OSTDS were located in Marion County.

2.1.2.4 Livestock Operations

Nitrogen load from livestock waste was subdivided into the load from horses, cattle, and other animals. County-wide numbers of livestock were determined from the 2012 U.S. department of Agriculture Census of Agriculture for Marion and Levy Counties. Other livestock includes chickens, goats, hogs, sheep, and turkeys. Beef cow-calf operations comprise most of the cattle industry in the BMAP area. Based on a literature review, a calf produces approximately 20% of the nitrogen that its mother produces. The average residence time for calves in the basin is 183 days. The overall nitrogen

contribution from horse manure was calibrated based on manure handling practice information provided by the University of Florida–Institute of Food and Agricultural Sciences (UF–IFAS), specific to Marion County, as required by County ordinance. Pasture fertilization is also included for inputs from livestock operations. Fertilization rates can vary widely from year to year; however, estimates of the average annual fertilizer applications to pasture were developed based on information received through meetings with the Marion County Cattlemen’s Association, UF–IFAS, and Florida Farm Bureau.

2.1.2.5 Other Agricultural and Non-Agricultural Fertilizer

County property appraiser data were used to determine the types of crops grown in the BMAP area. The total amount of fertilizer and nitrogen content were estimated from Florida department of Agriculture and Consumer Services (FDACS) countywide data and applied based on UF–IFAS recommended rates. The nitrogen load in the BMAP area from urban sources was determined based on the area of the total countywide urban land uses in the BMAP area. Urban land uses were primarily residential lawns and golf courses.

2.1.3 ESTIMATED LOAD TO THE UFA

Nitrogen inputs to the land surface in a given year are not equivalent to the estimated nitrogen loading to the UFA. The estimated loading to ground water must also account for both an attenuation factor within the subsurface and the annual rate of ground water recharge.

The results of the NSILT estimate that 1.34 million pounds of nitrogen enters the UFA annually. This represents approximately 11% of the loading at the land surface. The majority of the load, 78%, is from high recharge areas. **Figure 9** shows the breakdown, by percent, of nitrogen reaching the UFA by land use category. OSTDS and the aggregate contribution of agricultural commodities contribute the greatest potential loading, providing 19% and 67% of the annual estimated contribution of nitrogen to the UFA, respectively. Urban fertilizer contributes 6% of the annual estimated contribution of nitrogen to the UFA through both infiltration to ground water and stormwater runoff.

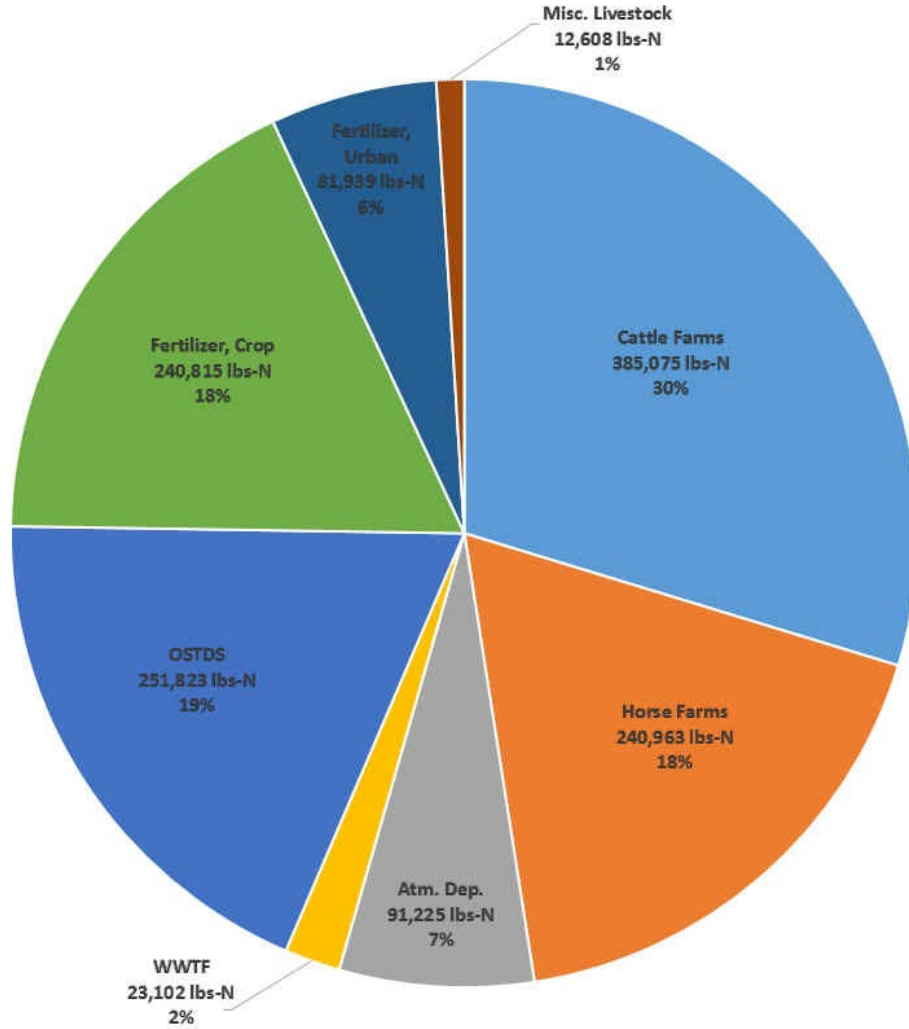


FIGURE 9: RELATIVE NITROGEN INPUTS TO THE UFA BY SOURCE CATEGORY

2.2 ESTIMATING CHANGES IN POTENTIAL LOADING TO THE UFA

The NSILT was developed to be a tool for the department’s evaluation of the contribution of different source categories to nitrogen loading to the UFA under different land use scenarios. As changes in land use occur in the basin, the NSILT will be useful for making estimates of potential loading to the UFA. If necessary or as new data become available a reevaluation of the NSILT will be initiated. This reevaluation will provide the department and stakeholders with a new estimate of the distribution of loading by source categories and their comparative contribution to overall loading to the UFA. It will also help identify any changes in the contribution of categories of sources from the previous NSILT

evaluation. Changes in the distribution of sources are expected with time as different nitrogen loading reduction management actions are implemented, population growth results in shifts between types of land use (particularly between urban and agriculture land uses), and business practices change within specific land uses categories. Along with surface and ground water monitoring data the NSILT evaluation will help the department and stakeholders identify the direction to be taken during the second and future phases of the BMAP.

2.3 ADDITIONAL VERIFIED IMPAIRED WATERBODIES

Rainbow Springs is a ground water dominated system. The BMAP contains surface waters which may be evaluated separately for impairment, which may be from other pollutants. It is also possible for the BMAP area of a nearby surface water to overlay the BMAP area for Rainbow Springs, due to the extended area included because of the influence of ground water.

Rainbow Springs and Rainbow River are part of the Withlacoochee Basin, a Group 4 Basin. Group 4 basins were assessed in 2010 and will be reassessed in 2016. Rainbow Springs Group and Rainbow Springs Group Run are currently the only verified impaired waters in the Withlacoochee Basin. The 2016 assessment could result in the addition of other waters. Furthermore, on November 30, 2012, the U.S. Environmental Protection Agency (EPA) approved the department's numeric nutrient criteria for rivers, streams, lakes, and some estuaries. In January 2014, a federal judge granted EPA's motion to discontinue federal rulemaking and allow the department to implement its numeric nutrient criteria. Future evaluations for impairments in the basin will be based on the state's numeric nutrient criteria which set a concentration of 0.35 mg/L of nitrate as the criteria for springs, the same as the concentration target for the Rainbow Springs and Rainbow Springs Group Run TMDLs.

2.4 MANAGING POLLUTANT LOADS FROM FUTURE GROWTH

Local land development regulations, comprehensive plans, local codes, incentives, BMPs, and Environmental Resource Permit (ERP) requirements provide mechanisms for protecting water resources and reducing the impact of new development as other land use changes as they occur. They are the primary mechanisms available to address additional nitrogen loadings from urban and agricultural growth. Future agricultural operations will be subject to the same requirements as existing operations with regard to the implementation of FDACS-adopted BMPs. **Chapter 3** provides further discussion of the FDACS enrollment program. The Rainbow Springs BMAP recognizes the local protections

described in this section (**Table 2**) as an important component of the BMAP and encourages these local governments to further strengthen these local watershed protection frameworks.

2.4.1 MARION COUNTY

Marion County's Spring Protection Resolution was passed in 2005 and the resulting development standards were included in subsequent updates to the land development code (Marion County, 2013). Standards included effluent concentration limits for WWTFs, lot size restrictions for OSTDS in new developments, OSTDS maintenance requirements, ground water recharge requirements, and stormwater management standards encouraging low impact development (LID). The Marion County fertilizer ordinance was passed in 2008, and its provisions were subsequently incorporated in its land development code. Provisions included fertilizer content standards, allowable application rates, "fertilizer free" zones, and certification standards for commercial applicators.

Future nitrogen loadings may be added from properties with vested development rights.. Such developments are not subject to the most current land development regulations. For example, OSTDS tank density that is not permissible under current land development regulations may be possible in these developments. Thus, they have the potential become future sources of nitrogen. Marion County has enacted a Transfer of Vested Rights (TVR) program to address these developments (see **Table 2** for details).

2.4.2 CITY OF DUNNELLON

The City of Dunnellon (2012) designated river protection corridor areas for both the Rainbow and Withlacoochee River in the city's land development code. These corridors extend 150 feet from the ordinary high water line and implement specific development standards for new development and for construction on existing lots with vested development rights. Restrictions for new development include development of a habitat management plan, design standards for river access, prohibitions on seawalls and requirement of hook up to central water and sewer. For property with vested development rights after 2008 (lots of record), buffers are required and the direct discharge of stormwater runoff is prohibited.

TABLE 2: PLANNING AND LAND DEVELOPMENT REGULATIONS

Project Type	Project Number	Project Title	Lead Entity	Project Description	Start Date	Status
Planning	R070	2013-2017 Springs Management Plan	SWFWMD	The District's Springs Management Plan summarizes the vision, issues, and solutions that the District will address over the next five years to manage and protect springs. Through strategic investments and partnerships, the District is implementing projects to conserve and restore the ecological balance of our spring systems, thereby supporting regional economies and quality of life. This Plan lays out a general restoration strategy, an overview of the goals and issues, and a list of proposed projects.	2013	Ongoing
Planning	B001	Marion County Transfer of Development Rights (TDR)	Marion County Growth Services	The TDR Program is designed to protect natural resources, especially those listed in Policy 1.1.2 of the Conservation Element of the Marion County Comprehensive Plan and locally important and prime farmlands within Marion County. These resources include, but are not limited to, the preservation of high water recharge and underground drainage basins, springs, karst areas, sinkholes, sinks, sinkhole ponds, and other karst features. The land from which development rights are transferred is subject to a conservation easement. Article 3 of the Land Development Code defines the TDR program and eligible sending and receiving areas.	2000	Ongoing
Planning	B002	Marion County Transfer of Vested Rights (TVR)	Marion County Growth Services	The TVR Program is designed to minimize dense development of vested properties without central water and sewer systems, and/or other supporting infrastructure, and thereby protect natural resources especially those listed in Policy 1.1.2 of the Conservation Element of the Marion County Comprehensive Plan, encourage and enhance the development of larger parcels, reduce the County's inventory of vested properties, and permit the County to better plan for future growth. The land from which vested rights are transferred is subject to a conservation easement. Article 3 of the Land Development Code defines the TVR program and eligible sending and receiving areas.	2000	Ongoing
Planning	B003	Marion County Hamlet Design Option	Marion County Growth Services	Comprehensive Plan Future Land Use Element Policy 2.1.13 establishes the Hamlet Development Option designed to provide for clustered low-density development patterns in the Rural designated lands while requiring permanent open spaces reserved from development and some increased additional urban services (e.g., central water, central sewer, designed/constructed stormwater systems) that comply with Marion County's design and development standards, including Springs Protection. Article 3 of the Land Development Code generally defines the Hamlet design provisions.	2000	Ongoing

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Start Date	Status
Planning	B004	Marion County Rural Community Land Use Designation	Marion County Growth Services	Comprehensive Plan Future Land Use Element Policy 2.1.18 establishes the Rural Community future land use designation to provide for clustered urban-density development patterns in the Rural designated lands while requiring permanent open spaces reserved from development and complete urban services (e.g., central water, central sewer, and designed/constructed stormwater systems) that comply with Marion County's design and development standards, including Springs Protection. Article 3 of the Land Development Code will generally define the Rural Community design provisions.	2000	Ongoing
Planning	B005	Marion County Community Redevelopment Area Program	Marion County Growth Services	Comprehensive Plan Future Land Use Element Objective 2.2 establishes specific limited density and specialized design standards for wetland and flood plain areas slated for development. Articles 5 & 6 of the Land Development Code sets forth the specific design and development criteria related to the applicable areas.	2000	Ongoing
Regulation or Ordinance	R001	River Protection Corridors	City of Dunnellon	The City of Dunnellon River Protection Corridor Areas for both the Rainbow and Withlacoochee River. The corridor extends 150 feet from the ordinary high water line and implements specific development standards for new development and for construction on existing lots with vested development rights after 2008.	2008	Ongoing
Regulation or Ordinance	B006	Marion County Springs Protection Zones	Marion County Growth Services	Comprehensive Plan Future Land Use Element Objective 7.2 establishes the SPOZ and identifies the extent of the Primary and Secondary Zones along with other design and development standards. Articles 5 & 6 of the Land Development Code sets forth the specific design and development criteria related to the applicable SPOZ. Originally Resolution 05-R-106 establishing springs protection zones and development standards.	2005	Ongoing
Regulation or Ordinance	B007	Marion County Irrigation Ordinance	Marion County Office of the County Engineer	Water Conservation for Landscape Irrigation. Sets an enforceable irrigation schedule and rates of irrigation for Marion County. It also identifies efficient irrigation systems that are exempt from the schedule.	2008	Ongoing
Regulation or Ordinance	B008	Marion County Fertilizer Ordinance	Marion County Office of the County Engineer	Florida Friendly Fertilizer Use on Urban Landscapes. This Ordinance regulates the proper use of fertilizers by any applicator; requires proper training of commercial and institutional fertilizer applicators; establishes training and licensing requirements; specifies allowable fertilizer application rates and methods, fertilizer-free zones, low maintenance zones, and exemptions. It requires the use of best management practices which provide specific management guidelines to minimize negative secondary and cumulative environmental effects associated with the misuse of fertilizers. 2008 ordinance has now been included in the latest Land Development Code	2008	Ongoing

2.5 PROTECTION OF SURFACE WATER AND GROUND WATER RESOURCES THROUGH LAND CONSERVATION

Maintaining land at lower intensity uses through land purchases or easements for conservation and recreational use is one strategy for reducing water quality impacts to Rainbow Springs, the UFA, and Rainbow River. Rainbow Springs State Park encompasses the Rainbow Springs group and a large portion of the east bank of the Rainbow River. Other land acquisition opportunities have been identified in the BMAP area. **Table 3** lists these acquisition targets that have been added to the Florida Forever projects list since 2000. A large portion of the Carr Farm/Price's Scrub and a small portion of the Rainbow River Corridor have been acquired. The project costs are taken from the project Florida Forever descriptions.

TABLE 3: CONSERVATION LAND PURCHASES

Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Completion Date	Cost of Purchase
R002	Rainbow River Corridor	department - Division of State Lands	The Rainbow River Corridor project is designed to protect most of the undeveloped or minimally developed private land remaining along the Rainbow River. The southern parcels would bring a remaining large portion of undeveloped shoreline along the eastern side of the river into state ownership, and provide a connection to the southern end of the Rainbow Springs State Park. Public acquisition of these lands will prevent further development and conflicting land uses that could further degrade the ecological value of this area. In addition, the potential restoration of altered habitats would help restore and maintain water quality and habitat along one of Florida's largest spring-run streams. 32 acres were acquired for Blue Run of Dunnellon Park (R013) in 2008.	City of Dunnellon, Marion County, Rainbow River Conservation	2007	32 acres acquired	\$3,200,000
R066	South Goethe	department - Division of State Lands	This addition provides a corridor from the Goethe State Forest to the Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area along the Withlacoochee River and also forms a linkage to the Etoniah Cross Florida Greenway Florida Forever project. One of the primary concepts of this project is to protect the Withlacoochee River's watershed by connecting Goethe State Forest with the greenway. Another stated goal of the project is provide a significant buffer along the southern boundary of the forest while eventually enhancing the forest and its associated habitat through restoration.	n/a	2006	0 acres acquired	\$11,574,303
R067	Bear Hammock	department - Division of State Lands	Acquiring the Bear Hammock project in southern Marion County would meet the state goals of enhanced coordination of land-acquisition efforts by making a conservation link that fills a gap among several other properties. One goal of state conservation is to preserve areas of at least 50,000 acres, and Bear Hammock provides a connector between Goethe State Forest and the Marjorie Harris Carr Cross Florida Greenway, creating a continuity of more than 200,000 acres.	n/a	2008	0 acres acquired	\$32,576,529
R068	Carr Farm/Price's Scrub	department - Division of State Lands	The Carr Farm/Price's Scrub in southwestern Alachua County and northwestern Marion County includes scrub, upland mixed forest, scrubby flatwoods, wet flatwoods, depression marsh, marsh lake and sinkhole lake. This scrub is one of the northernmost examples of the community in peninsular Florida. 962 acres, located in Marion County, have been acquired to date.	Office of Greenways and Trails	2001	962 acres acquired	\$2,061,144

Chapter 3: REGULATORY LINKS AND RESEARCH STRATEGIES

This BMAP requires implementation of specific management strategies by local government entities and agricultural producers in the basin. This chapter describes the regulatory framework that applies to the entire Rainbow Springs BMAP area and enforces the implementation of management strategies. The management strategies are discussed in **Chapter 4**. The understanding of how loading of nitrogen applied to the land surface travels to and impacts the UFA and Rainbow Springs is not well understood. An overview of the research efforts to better understand the fate and transport of nitrogen is included in this chapter.

3.1 REGULATORY LINKS TO BMAP ENFORCEMENT

3.1.1 ERP

Activities that exceed SWFWMD's permitting thresholds for stormwater must be authorized by an ERP (Rules 40D-4 through 40D-400, F.A.C.) that incorporates both stormwater treatment and the mitigation of any wetland impacts. To obtain an ERP where existing ambient water quality does not meet state water quality standards, an applicant must demonstrate that the proposed activity will result in a net improvement in the parameters that do not meet standards.

3.1.2 NPDES MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) STORMWATER PROGRAM

The NPDES stormwater program regulates discharges to surface waters for several entities in the basin. The basic requirements of this program serve as a foundation for the stormwater management efforts of the basin's communities. Phase I of the program addressed large and medium MS4s located in incorporated places and counties with populations of 100,000 or more, as well as specific industrial activities. Phase II addresses additional sources, including small MS4s. All of the MS4s in the BMAP area are Phase II. Nonpoint source discharges of stormwater to ground water are addressed as nonpoint sources within this BMAP.

Under a generic permit, the operators of regulated Phase II MS4s must develop a Stormwater Management Program that includes BMPs, with measurable goals, to effectively implement the following six minimum control measures: public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control,

post-construction runoff control, and pollution prevention/good housekeeping. **Table 4** lists local governments and other entities in the BMAP area that are currently designated as Phase II MS4s.

The generic permit (Subsection 62-621.300[7][a], F.A.C.) also states, “If a TMDL is approved for any waterbody into which the Phase II MS4 discharges, and the TMDL includes requirements for control of stormwater discharges, the operator must review its Stormwater Management Program for consistency with the TMDL allocation. If the Phase II MS4 is not meeting its TMDL allocation, the operator must modify its Stormwater Management Program to comply with the provisions of the TMDL Implementation Plan applicable to the operator in accordance with the schedule in the Implementation Plan.” The infiltration of stormwater runoff into ground water will be addressed as nonpoint source loading in this BMAP.

TABLE 4: ENTITIES IN THE RAINBOW SPRINGS BMAP AREA DESIGNATED AS REGULATED PHASE II MS4s

PERMITTEE	MS4 PERMIT NUMBER
Marion County	FLR04E021
City of Ocala	FLR04E046
City of Dunnellon	FLR04E154
Florida Department of Transportation (FDOT) District 5	FLR04E024

3.1.3 URBAN NONPOINT SOURCES

Paragraph 403.067(7)(b)2.f, F.S., prescribes the pollutant reduction actions required for nonagricultural pollutant sources that are not subject to NPDES permitting. These “non-MS4” sources must also implement the pollutant reduction requirements detailed in a BMAP. The City of Williston, the Town of Bronson, as well as Levy County are the entities that may be responsible for reducing nonpoint sources in the BMAP area.

Failure by a nonpoint source to reduce loadings, as required in a BMAP, can result in enforcement action by the department under Paragraph 403.067(7)(b)2(h), F.S. The department can designate an entity as a regulated Phase II MS4 if its discharges are determined to be a significant contributor of pollutants to surface waters of the state in accordance with Section 62-624.800, F.A.C. The designation of an entity as a Phase II MS4 can occur when a TMDL has been adopted for a waterbody or segment into which the entity discharges the pollutant(s) of concern. If an entity is designated as a regulated Phase II MS4, it is subject to the conditions of the Phase II MS4 Generic Permit.

3.2 AGRICULTURAL BMP IMPLEMENTATION

Commercial agricultural nonpoint sources in a BMAP area are required by state law (Subsection 403.067[7], F.S.) either to implement FDACS-adopted BMPs or to conduct water quality monitoring prescribed by the department or SWFWMD, to demonstrate compliance with water quality standards. Failure either to implement BMPs or conduct monitoring may bring enforcement action by the department or SWFWMD. The implementation of FDACS-adopted, department-verified BMPs in accordance with FDACS rule provides a presumption of compliance with state water quality standards.

Pursuant to section 403.067(7)(c), F.S., implementation of FDACS-adopted, department-verified BMPs in accordance with FDACS rule provides a presumption of compliance with state water quality standards. In addition, growers who implement BMPs may be eligible for cost share from FDACS, SWFWMD, or others. Through the Office of Agricultural Water Policy (OAWP), the Florida Forest Service, and Division of Aquaculture, FDACS develops, adopts, and assists producers in implementing agricultural BMPs to improve water quality and water conservation.

The breakdown of agricultural land uses in the Rainbow Springs BMAP area, according to 2009 SWFWMD land use data, is shown in **Table 5. Figure 10** shows the approximate location of these agricultural lands. The primary agricultural land use in the Rainbow Springs basin is cow/calf (pasture). Other agricultural land uses include horse farms (specialty farms), row crops, and nurseries. Many of the horse farms are likely to be small, noncommercial hobby farms; however, the FDACS BMP program's equine manual is intended for commercial operations. These noncommercial hobby farms are encouraged to read and implement practices from the FDEP's "Small Scale Horse Operations: Best Management Practices for Water Resource Protection in Florida" (October 2013).

Land use data are helpful as a starting point for estimating agricultural acreage and developing BMP implementation strategies; however, there are inherent limitations. The time of year during which land use data are collected (through aerial photography) affects the accuracy of photo interpretation and can result in inappropriate analysis of the data and hamper decision making. Another limitation is that the specific agricultural activity being conducted is not always apparent. For example, some acreage under the improved pasture classification may be used for cattle grazing, some may consist of forage grass that is periodically harvested and sold for hay, and/or some may comprise a fallow vegetable field awaiting planting. Operations that may fall into this land use category fertilize at different rates (e.g., hay

operations and some other commodities typically fertilize at or below rates recommended by UF-IFAS; therefore, it is meaningful for the purposes of evaluating potential nutrient impacts to identify specific land uses on a property rather than assuming that operations and present conditions are uniform across a specific land use. Because of error in the collection and characterization of land use data and changes in land use over time, land use acreage estimates are subject to adjustment, as discussed later in this section.

TABLE 5: AGRICULTURAL LAND USES IN THE RAINBOW SPRINGS BASIN (2009 SWFWMD LAND USE)

Land Use Code	Code Description	Total Acres
2100	Cropland and Pastureland	90,343.7
3100	Herbaceous (Rangeland)	71.5
3200	Shrub and Brushland	1,043.3
3300	Mixed Rangeland	1,519.0
2140	Row Crops	10,816.4
2200	Tree Crops	37.1
2400	Nurseries and Vineyards	1,484.4
2300	Feeding Operations	196.6
2500	Specialty Farms	43,618.8
2600	Other Open Lands - Rural	28,169.2
2540	Tropical Fish Farms	27.9
	Total	177,328.0

3.2.1 AGRICULTURAL BMPs

BMPs are individual or combined practices determined through research, field-testing, and expert review to be the most effective and practicable means for improving water quality, taking into account economic and technological considerations. FDACS has authority for establishing agricultural BMPs through the Florida Forest Service (silviculture BMP program), Division of Aquaculture (Aquaculture Certification Program), and OAWP (all other agricultural BMP programs).

The OAWP BMPs fall into two categories: structural and management. Structural BMPs involve the installation of structures or changes to the land and are usually more costly. They include water control structures, fencing, and tailwater recovery systems, among other things. Management BMPs, such as nutrient and irrigation management, comprise the majority of the practices. Nutrient management addresses fertilizer type, amount, placement, and application timing, and includes practices such as soil and tissue testing to determine crop nutrient needs, application methods, correct fertilizer formulations,

and setbacks from water resources. Irrigation management is the maintenance, scheduling, and overall efficiency rating of irrigation systems. In most areas of the state, FDACS-funded Mobile Irrigation Labs are available to evaluate irrigation system efficiency and provide recommendations to producers to improve efficiency. The implementation of these recommendations results in billions of gallons of water saved throughout the state and helps reduce nutrient runoff and leaching.

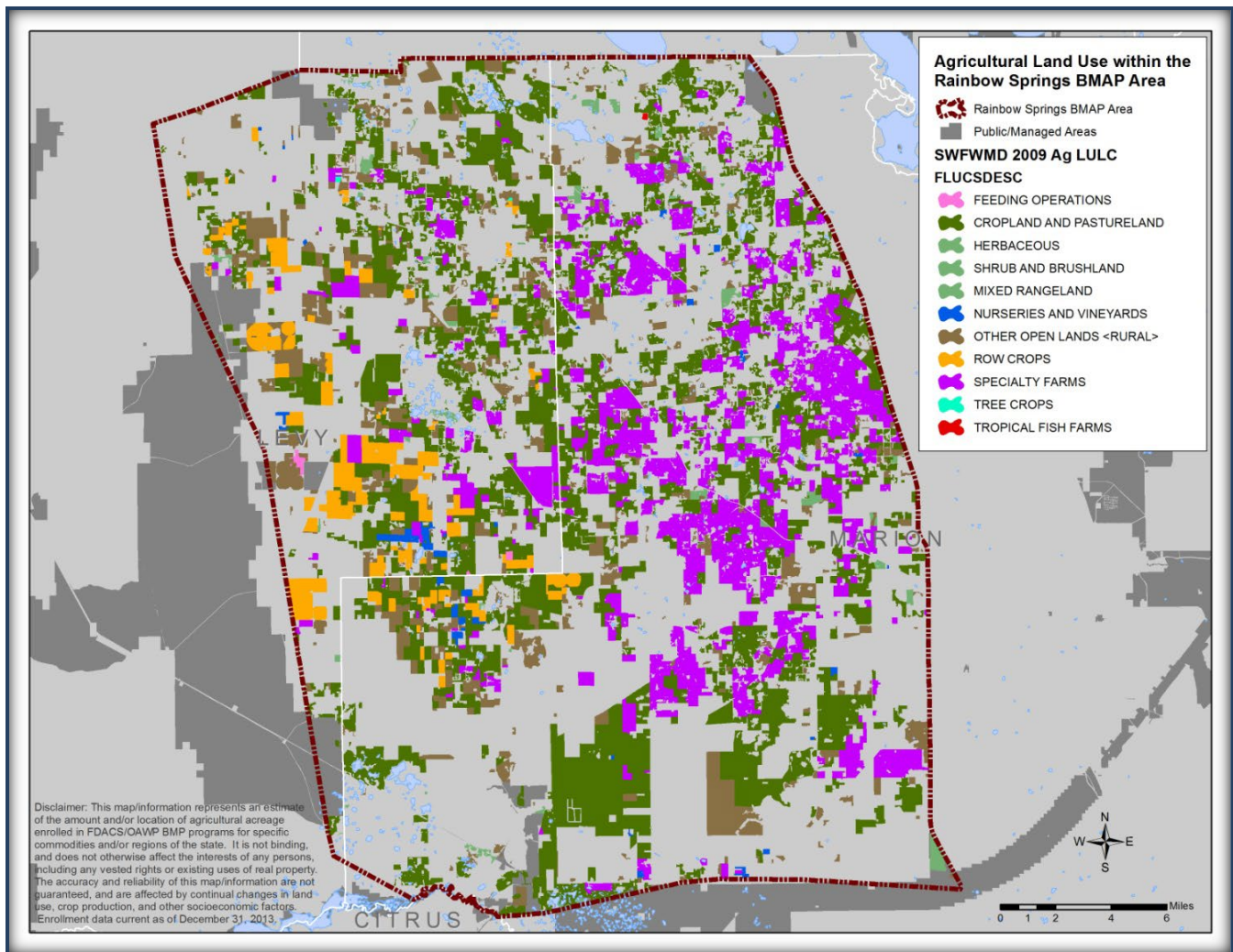


FIGURE 10: AGRICULTURAL LANDS IN THE RAINBOW SPRINGS BASIN

Table 6 identifies key management and structural BMPs that would be applicable to agricultural operations in the basin. By definition, BMPs are developed to be technically and economically feasible. However, FDACS’ BMP manuals do contain some BMPs that may be affordable only with financial assistance through cost-share programs. The BMP checklists allow producers to indicate whether implementing a BMP requires financial assistance, on a case-by-case basis. Through cost-share

programs, FDACS works with producers to implement applicable key BMPs that otherwise are not affordable.

For assistance with enrolling in the FDACS BMP program or with obtaining cost-share funds, interested producers should contact OAWP staff. Information on the BMP manuals and field-staff contact information can be obtained here: <http://www.freshfromflorida.com/Water/Best-Management-Practices-BMPs>. Printed BMP manuals can be obtained in the local extension office at county agricultural extension centers USDA Natural Resource Conservation Offices, or by contacting OAWP field staff.

TABLE 6. KEY MANAGEMENT AND STRUCTURAL BMPs ADOPTED BY FDACS' OAWP

DETERMINING NUTRIENT NEEDS

Soil and Tissue Testing: Used to base fertilizer applications on plant needs and available nutrients in the soil; helps prevent the overapplication of fertilizer.

Nutrient Budgeting: Adjustment of fertilizer regime to account for other nutrient sources, such as biosolids, legumes, manure, and nutrient-laden irrigation water; helps prevent the overapplication of fertilizer.

MANAGING NUTRIENT APPLICATION

Precision Application of Nutrients: Use of specialized equipment for precise placement of nutrients on targeted areas at specified rates; reduces total amount used and prevents stray applications.

Equipment Calibration/Maintenance: Ensures proper functioning of equipment; prevents misapplication or over-application of fertilizer materials.

Split Fertilizer Applications: Multiple applications timed with optimal growth stages; allows plants to assimilate nutrients more efficiently; reduces nutrient loss in leaching and runoff.

Fertigation: Application of fertilizer through irrigation water; allows for direct nutrient application to the crop root zone and more efficient assimilation by plants, reducing nutrient loss in leaching and runoff.

Controlled-Release Fertilizer: Use of fertilizer formulations that have a controlled nutrient release curve; reduces nutrient loss to leaching and runoff.

Fertilizer Application Setbacks from Waterbodies (wetlands, watercourses, sinks, springs, etc.): Establishes a zone where no fertilizer will be applied; reduces nutrient loadings to waterbodies.

MANAGING IRRIGATION

Irrigation Scheduling: Planning when to irrigate to reduce water and nutrient losses, based on available soil moisture content, evapotranspiration levels, recent rainfall, and time of day.

Monitoring Soil Moisture and Water Table: Use of devices that measure the water table level and the amount of water in the soil; is a key component of proper irrigation scheduling.

Tailwater Recovery: Use of down-gradient catchment ponds to trap irrigation tailwater to be reused on cropland; reduces offsite transport of nutrients and conserves water.

TREATMENT AND EROSION CONTROL

Filter Strips: Vegetated strips of land designed to reduce nutrients and sediments in surface water runoff from fields, pastures, and livestock high-intensity areas before it reaches downstream waterbodies.

Vegetative Buffers: Establishment of riparian and/or wetland buffers to attenuate and assimilate nutrient- or sediment-laden surface flows coming from cropped/grazed areas.

Ditch Maintenance and Retrofits: Use of rip rap, sediment traps, staging structures, and permanent vegetative bank cover to minimize erosion and transport of nutrient-laden sediments.

LIVESTOCK MANAGEMENT (APPLICABLE TO COW/CALF AND EQUINE OPERATIONS)

Manure Management: Appropriate storage and disposal of animal waste.

Alternative Water Sources: Use of upland livestock watering ponds and/or water troughs; minimizes manure deposition in waterbodies.

Rotational Grazing: Movement of cattle to different grazing areas on a planned basis; prevents concentrated waste accumulations and denuding of pasture areas. May involve fencing.

High-Intensity Areas Location: Siting of cowpens, supplemental feed areas, *etc.*, away from waterbodies to minimize nutrient loadings.

OPERATIONS MANAGEMENT

Fertilizer Storage: Proper location/storage of bulk fertilizer products to prevent nutrient loadings.

Fertilizer Mix/Load: Use of appropriate dedicated or temporary mix/load areas located away from waterbodies to prevent nutrient loading.

Employee Training: Training provided to farm workers on how to implement BMPs.

Record Keeping: Proper record keeping provides accountability in the implementation of BMPs, and assists the producer in making nutrient and irrigation management decisions.

3.2.2 BMP ENROLLMENT

Table 7 summarizes the land use data figures for agriculture in the BMAP area, the acreages associated with commodity types addressed by OAWP BMP manuals and the acres enrolled in BMP programs..

Figure 11 is a map of the acres enrolled in BMPs as of June 30, 2015.

Based on aerial imagery and local staff observations, FDACS adjusted these figures to reflect the current agricultural land use acreage more accurately. Approximately 28,000 acres were classified as “Other Open Lands – Rural” in the land use, which is grouped with the agricultural land use classifications. This classification is assigned when the land is in a rural area but the use cannot be determined, so acreage in this category may or may not be in active agricultural production. Review of aerial imagery in the BMAP area shows that some of the land in this category may be pasture associated with potential cow/calf ranching operations, but some smaller tracts are located within subdivisions/residential areas or natural areas. More significantly, however, several large row crop operations are within this classification, which causes an underrepresentation of the row crop acreage in the land use data for this basin. Acreage in this category known to be in row crop production was transferred to the row crop category in **Table 7**, but the row crop acreage is likely still underrepresented. At this time, FDACS staff are unable to estimate the amount of acreage that may be in production versus acreage that is likely not in production within this category. However, it is assumed that some of the acreage is no longer in production.

It is important to understand that, even if all targeted agricultural operations are enrolled, not all of the acreage listed as agriculture in **Table 7** will be included in enrollment figures. The notices of intent (NOIs) document the estimated total number of acres on which applicable BMPs are implemented, not the entire parcel acreage. This is because land use data can contain nonproduction acres (such as

buildings, parking lots, and fallow acres) that will not be counted on the NOIs submitted to FDACS. There also may be significant amounts of acreage that do not need to be enrolled, such as lands that are not actively involved in commercial agriculture (operations conducted as a business). These areas are often low-density residential uses on large parcels of grassed land, or land that was but is no longer in commercial agricultural production. This information frequently is impossible to discern in the photo interpretation process used to generate land use data. Local government or department BMPs may address these noncommercial sources.

Agricultural enforcement for BMAP actions is based on the FWRA, which states that nonpoint source dischargers who fail either to implement the appropriate BMPs or conduct water quality monitoring prescribed by the department or a water management district that demonstrates compliance with water quality standards may be subject to enforcement action by either of those agencies. All agricultural nonpoint sources in the BMAP area are statutorily required either to implement FDACS-adopted BMPs or to conduct water quality monitoring that demonstrates compliance with state water quality standards. As of June 30, 2015, 127 producers within the Rainbow Springs basin had submitted NOIs to OAWP covering about 69,815 acres to implement FDACS-adopted BMPs. This represents 77 row/field crop operations, and 24 equine, 23 cow/calf, and three specialty fruit/nut operations. No producers are conducting water quality monitoring in lieu of implementing BMPs at this time.

FDACS field staff are focusing on enrolling commercial equine and cow/calf operations in this region and will continue to do so. The availability of cost-share funds is expected to have a significant impact in increasing equine BMP implementation in both the Rainbow and Silver Springs BMAP areas. In the 2015-16 fiscal year, FDACS plans to contract with the Marion Soil and Water Conservation District to distribute up to \$250,000 in cost-share funds to agricultural producers in the region. Staff will also work to enroll other agricultural operations within the basin. FDACS will report annually to the department on its progress in contacting and enrolling producers, including number of operations and acres enrolled. In conducting outreach to producers, FDACS will work with the soil and water conservation districts, resource conservation and development councils, county Extension staff, and others to convey the statutory imperative for agriculture to implement BMPs, as well as their benefits to the environment and the producers.

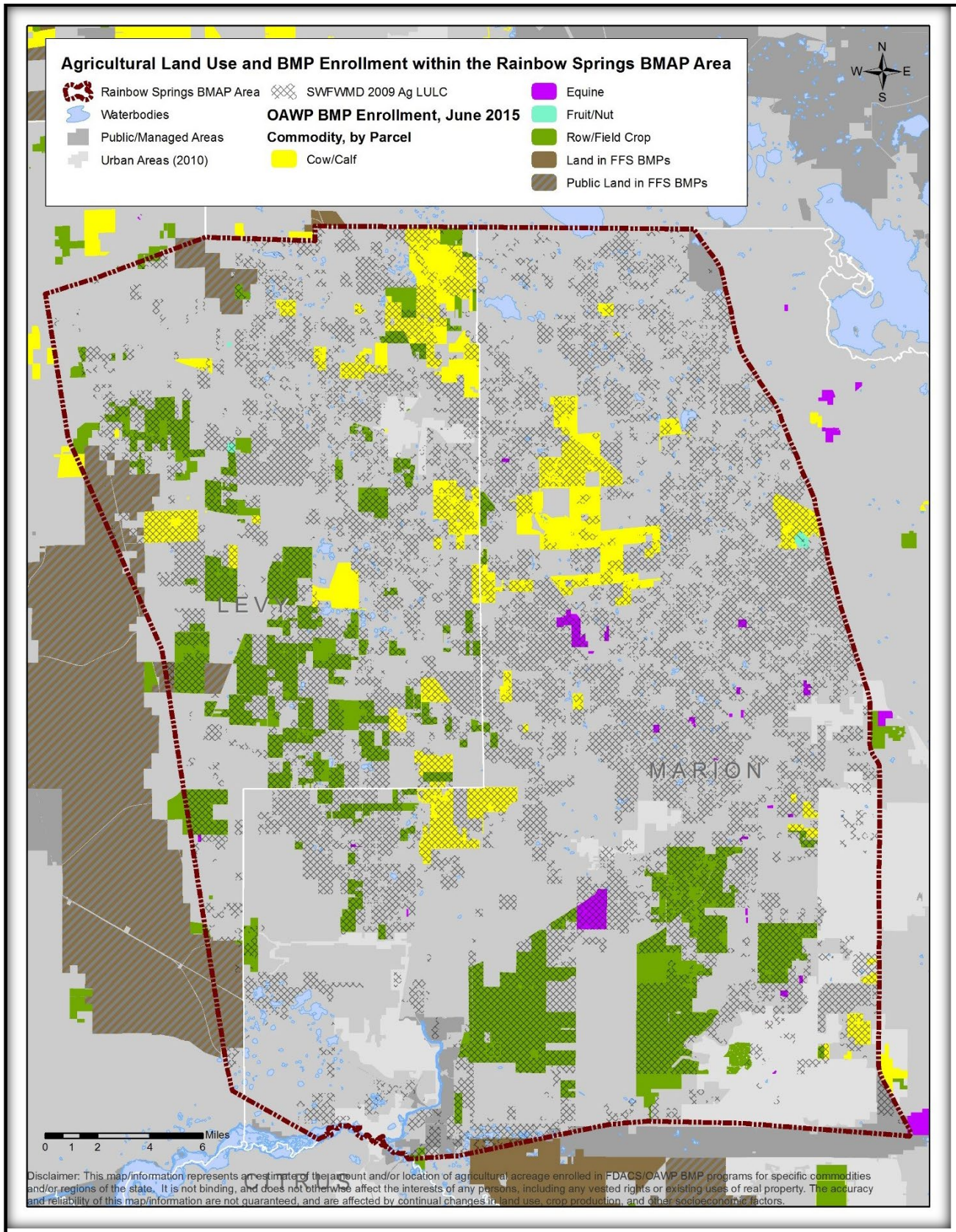


FIGURE 11: BMP ENROLLMENT IN THE RAINBOW SPRINGS BASIN AS OF JUNE 30, 2015

TABLE 7: AGRICULTURAL ACREAGE AND BMP ENROLLMENT FOR THE RAINBOW SPRINGS BMAP AREA AS OF JUNE 30, 2015

N/A = Not applicable.

¹ FDACS staff-adjusted acreage for purposes of enrollment is based on a review of more recent aerial imagery in the basin and local staff observations.

² There is no enrollment in the citrus manual at this time in the Rainbow Springs BMAP area

2009 SWFWMD Land Use	2009 Acres	FDACS-Adjusted Acres¹	Related FDACS BMP Programs	Acreage Enrolled	Related NOIs
Cropland and Pastureland (2100) and Rangeland (3100, 3200, 3300)	92,977.5	92,977.5	Cow/Calf, Future (Hay)	23,886.9	23
Row Crops	10,816.4	10,816.43	Vegetable/Agronomic Crops	44,708.6	77
Tree Crops	37.1	37.1	Specialty Fruit & Nut, Citrus ³	80.2	3
Nurseries & Vineyards	1,484.4	1,484.4	Nurseries	0.0	N/A
Specialty Farms	43,618.8	43,618.8	Equine	1,139.4	24
Feeding Operations	196.6	196.6	Conservation Plan Rule	0.0	N/A
Other Open Lands – Rural	28,169.2	N/A	Enrollment may not be needed	N/A	N/A
Aquaculture	27.9	N/A	(FDACS Aquaculture Division)	N/A	N/A
Totals	177,328.0	149,130.9		69,815.1	127

3.2.3 AGRICULTURAL BMP LOAD REDUCTION ESTIMATES

Due to inaccuracies in the 2009 land use data and to changes in land use since 2009, agricultural loadings may be less than perceived. However, there are no detailed allocations in this BMAP, so the total estimated load or required reductions for agriculture are not defined. Consequently, an estimated average load reduction percentage was derived for agriculture in this basin, based on an averaged range of expected reductions for agricultural BMPs in Florida. Percentages represent the relative amount of nitrogen reduction expected for “typical” agricultural BMP implementation, which includes nutrient management, stormwater retention, limited wetland retention/restoration, and rotational livestock grazing practices, as applicable to the commodity and operation. A BMP average efficiency of 30% is applied to the acreage enrolled in the Rainbow Springs BMAP area. Agricultural BMP implementation in the Rainbow Springs BMAP area is anticipated to reduce agricultural loadings of nitrogen for row crops, cow/calf, citrus, nurseries, fruit/nut, and equine operations.

The region is expected to have continuing shifts from agricultural to residential land uses, which will reduce the agricultural load further. More precise information will be incorporated into the next iteration of the TMDL and/or the BMAP. If the department plans to develop an estimate of agricultural loadings in the future, the refinement of a basin- and commodity-specific agricultural loading/reduction model should be considered.

3.2.4 FDACS OAWP ROLE IN BMP IMPLEMENTATION AND FOLLOW-UP

The OAWP works with producers to submit NOIs to implement the BMPs applicable to their operations, provides technical assistance to growers, and distributes cost-share, as available, to eligible producers for selected practices. The OAWP follows up with growers through written surveys and site visits, to evaluate the level of BMP implementation and record keeping, identify areas for improvement, if any, and discuss cost-share opportunities, among other things.

When the department adopts a BMAP that includes agriculture, it is the agricultural producer’s responsibility to implement BMPs adopted by FDACS to help achieve load reductions. If land use acreage corrections and BMP implementation do not fully account for the current agricultural load reduction allocation, it may be necessary to develop and implement cost-assisted field- and/or regional-level treatment options that remove nutrients from farms and other non-point sources. In that case,

FDACS will work with the department and the SWFWMD to identify appropriate options for achieving further agricultural load reductions.

The FWRA requires that, where water quality problems are demonstrated despite the proper implementation of adopted agricultural BMPs, FDACS must reevaluate the practices, in consultation with the department, and modify them if necessary. Continuing water quality problems will be detected through the BMAP monitoring component and other department and SWFWMD activities. If a reevaluation of the BMPs is needed, FDACS will also include the SWFWMD and other partners in the process.

3.2.5 OAWP IMPLEMENTATION ASSURANCE PROGRAM

The OAWP formally established its Implementation Assurance (IA) Program in 2005 in the Suwannee River Basin as part of the multi-agency/local stakeholder Suwannee River Partnership. In 2007, OAWP initiated the IA Program in the Lake Okeechobee Watershed and launched a standardized follow-up program for the remaining areas of the state in 2013, beginning with the Ridge Citrus and Indian River Citrus BMPs. Because of program-specific needs, the follow up process for each of these three components was different. In early 2014, the OAWP began to streamline the IA Program to ensure consistency statewide and across commodities and BMP manuals. This effort resulted in a single IA site-visit form, which is currently used by OAWP staff.

The current IA Program consists of two key components—mail-out surveys and site visits. Mail-out surveys are developed by OAWP staff, in conjunction with commodity experts. This component of the IA Program was borne out of the recognition that OAWP staff resources are limited; therefore, visits to each of the enrolled producers across the state were not possible within a short/contemporary time frame. All enrolled producers are mailed these surveys and are asked to fill out the surveys and return them to OAWP staff.

Site visits, the second component, are conducted by OAWP field staff and technicians as workload allows. For the visits, field staff and technicians use a standard form (non-commodity or BMP-manual specific) that was developed in 2014. This site-visit form focuses on nutrient-management, irrigation-management, and water-resource protection BMPs that are common to all of the adopted BMP manuals. The paper forms are submitted to OAWP staff and compiled into a spreadsheet, and the data are reported annually in reports such as this one. From 2007–2014, OAWP conducted over 1,200 site visits.

However, it is difficult to compare data collected prior to implementation of the single IA site-visit form developed in 2014 because of regional differences (e.g., different forms and information asked) in administration of the IA Program.

In late 2014, the OAWP commenced efforts to revise and restructure its current IA Program, and these efforts are ongoing. The OAWP expects to increase its site visits in the future.

3.2.6 FLORIDA FOREST SERVICE ROLE IN BMP IMPLEMENTATION AND MONITORING

FDACS' Florida Forest Service's silviculture BMP program is responsible for the development, implementation, and monitoring of silviculture BMPs across the state. Silviculture BMPs are applicable to all bona fide ongoing forestry operations. However, silviculture BMPs are not intended for use on tree removal or land clearing operations that are associated with a planned land use change to a non-forestry objective. The current 2008 *Silviculture BMP Manual* (Florida Forest Service, 2008) contains 150 individual BMPs within 14 categories. Silviculture BMPs are both structural (forest roads, stream crossings, etc.) and management (pesticide and fertilizer application, special management zones, etc.) based. The silviculture BMP NOI program began on February 11, 2004. As of August 2014, there were 15,983.1 acres signed up under the silviculture BMP NOI within the Rainbow Springs Basin.

Since 1981, the Florida Forest Service has monitored silviculture operations for compliance with BMPs by conducting biennial surveys. Surveys are conducted on both public and private silviculture operations with on-the-ground evaluations of randomly selected sites where recent silviculture operations have taken place. The *2013 Silviculture BMP Implementation Survey Report* included sites from both Marion and Levy counties. Data for these counties was collected from 12 different silviculture operations. The overall silviculture BMP compliance for these two counties in 2013 was 100%.

An important aspect of silviculture BMPs is that they have been proven effective. A multi-year study conducted by the Florida Forest Service with assistance from the department looked at the effectiveness of silviculture BMPs in protecting aquatic ecosystems during silviculture operations including clear-cut harvesting, intensive mechanical site preparation, machine planting, post-planting herbicide treatments, and a forest fertilization treatment. Silviculture BMP effectiveness was evaluated using water chemistry analysis, habitat assessment, and the stream condition index (a bio assessment methodology developed for Florida stream ecosystems). The study concluded that silviculture BMPs were effective at protecting

aquatic habitat in nearby streams with no evidence of impacts or impairments to the designated beneficial use of the streams (Vowell, 2001; Vowell and Frydenborg, 2004).

In cooperation with the University of Florida, the Florida Forest Service is also assisting with two more research projects to evaluate the effectiveness of silviculture BMPs for forest fertilization. One study, completed in November 2013, examined the effectiveness of forest fertilization BMPs for protecting ground water from nutrient leaching. Study results showed that the ground water concentrations of ammonium, total Kjeldahl nitrogen, and TP observed for wells monitored in the fertilization treatment area did not increase compared with prefertilization baseline levels or distant control wells (Minogue, et al., 2013). An ongoing study that looks at the effectiveness of forest fertilization BMPs for protecting nearby surface waters was initiated in 2012 and is expected to be completed in 2017.

More information on silviculture BMPs and FDACS's Florida Forest Service's silviculture BMP program is available from www.FloridaForestService.com.

3.3 SWFWMD SPRINGS 2013-2017 MANAGEMENT PLAN

SWFWMD's Springs Management Plan (SWFWMD, 2013) summarizes the vision, issues, and SWIM Plan Revisions that over the next five years will be implemented to manage and protect springs. The plan is focused on understanding natural variability while mitigating impacts caused by human activity where practical. Through strategic investments and partnerships, SWFWMD is implementing projects to conserve and restore the ecological balance of the spring systems. The plan is a road map that is consistent with SWFWMD's Strategic Plan and builds upon previous plans like the Springs Coast Comprehensive Watershed Management Plan (SWFWMD, 2001) and the Springs Coast Initiative (SWFWMD, 2002), as well as more than twenty years of district-wide expertise designing and implementing projects and monitoring activities. This plan is a living document with adaptive management at its core. This plan lays out a general restoration strategy, an overview of the goals and issues, and a list of proposed projects for the five-year period of 2013–2017. In 2014, SWFWMD together with local, regional, and state partners formed the Springs Coast Steering Committee, whose first goal is to develop comprehensive conservation and management plans tailored for each of the five first-magnitude spring systems, beginning with Rainbow Springs. These plans will identify the issues, solutions, and specific management actions for each spring system, including water quality improvement

projects to reduce nitrogen loading from sources identified in the BMAP. The plan may be accessed from the SWFWMD website: WaterMatters.org/Springs.

3.4 OTHER RESEARCH EFFORTS

Table 8 lists other research and modeling efforts that have been completed or proposed. Marion County initiated a county-wide watershed management program (WMP). This program is in cooperation with SWFWMD within the Rainbow Springs BMAP area. The WMP develops detailed hydrologic and hydraulic models that identify floodplains and areas of diminished level of service due to road flooding. A detailed pollutant loading model is also produced to identify locations of significant stormwater pollutant loading to surface waters and ground water (i.e. via sinkholes, recharge in natural depressions, and retention ponds). Conceptual capital projects are identified in the WMP to address water quality and flooding level of service concerns. The WMP results may also be used in the land development review process.

The City of Dunnellon completed the Dunnellon WMP, in cooperation with SWFWMD, in 2004. The plan identified areas of floodplain in the city and also stormwater outfalls where discharge to the Rainbow and Withlacoochee Rivers was a water quality concern.

Marion County also completed a Floridan aquifer vulnerability assessment in 2007. This assessment is more detailed and locally specific than the state aquifer vulnerability maps. Maps generated from that exercise are used to guide development actions and reduce impacts to ground water.

TABLE 8: RESEARCH AND MODELING EFFORTS

Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Completion Date
Data Collection	B034	Marion County WMP	Marion County Office of the County Engineer	WMPs will be completed county-wide and are used to identify and address Marion County water quality issues. The WMPs will include creation and maintenance of a comprehensive geodatabase for Marion County storm sewer system data, watershed boundaries and hydrologic features county-wide.	SWFWMD	2003	Ongoing
Studies	B035	Marion County Aquifer Vulnerability Assessment	Marion County Office of the County Engineer	Identification of vulnerable areas of aquifer. Project provides a scientifically defensible water-resource management and protection tool that will facilitate planning of human activities to help in minimizing adverse impacts on ground water quality. Aquifer vulnerability maps are displayed in classes of relative vulnerability (one area is more vulnerable than another). The maps benefit local government, planners and developers in guiding growth into more appropriate areas (e.g. ground water recharge areas) and improve site selection for expanding existing or establishing new well fields. Benefits: Identifies areas where aquifer is vulnerable to pollution. Potential for future management of activities in those areas to reduce pollution of ground water.	None	2007	2007
Studies	R022	Dunnellon WMP	City of Dunnellon	The Dunnellon WMP developed a hydrologic and hydraulic model and water quality treatment recommendations for nine stormwater discharge outfalls to the Rainbow and Withlacoochee Rivers.	Marion County, SWFWMD	2004	2004
Studies	R023	WR01 Rainbow River Phosphate Mine Pit Feasibility Study	SWFWMD	Feasibility study to assess restoration alternatives in lower Rainbow River and adjacent phosphate mine pits.	None	2014	2015
Studies	R070	2013-2017 Springs Management Plan	SWFWMD	The District's Springs Management Plan summarizes the vision, issues, and solutions that the District will address over the next five years to manage and protect springs. Through strategic investments and partnerships, the District is implementing projects to conserve and restore the ecological balance of our spring systems, thereby supporting regional economies and quality of life. This Plan lays out a general restoration strategy, an overview of the goals and issues, and a list of proposed projects.	None	2013	2017

Chapter 4: NITROGEN LOADING SOURCES MANAGEMENT STRATEGIES

This chapter presents projects that address reduction of nitrogen loads in the Rainbow Springs BMAP area. Individual project summaries are presented by source category. Project descriptions include projects completed since 2000 in addition to projects to be implemented in the future. This period corresponds with an increase in awareness by local governments and community interests of the impacts of elevated nitrate concentrations in Rainbow Springs. Many of these projects are ongoing activities of existing programs, e.g., street sweeping, but their continuation is important for the management of pollutant loads to the UFA.

Projects anticipated to be implemented over the five-year period covered by the BMAP include fully funded projects, planned projects, and conceptual projects. Project number designated with an R are applicable to only Rainbow Springs while projects designated with a B apply to both Rainbow and Silver Springs. Planned projects typically lack either sufficient funds or have not yet entered the design phase. They may not be identified in an agency's current adopted budget but may be identified in near-term budget planning documents (e.g., capital improvement plan). Projects categorized as conceptual do not currently have committed funding but will be considered as funds become available. Planned and conceptual projects are priorities for securing adequate funding during the first phase of the BMAP.

The BMAP projects and activities represent a considerable local, regional, and state investment in a multifaceted approach to water quality protection and restoration. Responsible entities submitted these management strategies to the department with the understanding that the strategies would be included in the BMAP, thus requiring each entity to implement the proposed strategies in a timely manner and perform any required operations or maintenance. However, projects and activities are meant to be flexible enough to allow for changes that may occur over time. Any change in listed projects and activities, or the deadline to complete these actions, must first be approved by the department. Substituted strategies must result in equivalent or greater nutrient reductions than expected or an equivalent benefit from the original strategies.

4.1 MANAGEMENT EFFORTS FOCUSED ON RAINBOW RIVER

Management strategies that have been or will be undertaken by stakeholders are not limited to reduction of nutrient load to the UFA. **Table 9** lists the 12 projects identified by stakeholders that primarily protect

Rainbow River and thus directly address the TMDL for the river. The projects address stormwater runoff, primarily from public facilities such as roads.

4.2 AGRICULTURAL MANAGEMENT STRATEGIES

Overall agricultural production contributes 67% of the loading to the UFA. Cattle and horse farms provide 47% of the loading of nitrogen to the UFA. In addition to the implementation of BMPs for appropriate agricultural commodities, there are additional activities proposed that address the loading from agriculture.

Agricultural sources combined contribute an estimated 9,519,891 lbs-N/yr at the land surface. Individual agriculture source categories loading reduction estimates are displayed in **Table 10**. Currently 46.8% of the identified agricultural acreage is covered by a NOI from FDACS. (Table 6). An efficiency of 30% is assumed for each BMP and when applied to the acreage signed up under each BMP Program yields an estimated total loading reduction of 754,375 lbs-N/yr or 7.9 % at the land surface.

The largest contribution of loading to the land surface comes from cattle farms (**Table 10**). Cattle operations in the BMAP area are mainly cow-calf operations for the production of beef cattle. Calves were assumed to have an average residence time in the BMAP area of 183 days, based on input from stakeholders. Pasture fertilization is part of horse farm and cattle farm nitrogen loading.

TABLE 9: MANAGEMENT STRATEGIES FOCUSING ON RAINBOW RIVER

Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Urban Structural BMP	R003	Blue Cove Emergency Overflow Project	City of Dunnellon	Project to construct a retention pond with a control structure and pipe conveyance system to treat and convey flood overflows from Blue Cove to the Rainbow River. Prior to construction overflows sheet flowed through residential neighborhood to the River.	SWFWMD	2000	Complete	2011
Urban Structural BMP	R004	Datesman Park Overflow Parking Lot Improvement	City of Dunnellon	Project retrofitted a car and boat trailer overflow parking lot with pervious pavers and a stormwater retention pond.	None	2000	Complete	2010
Urban Structural BMP	R012	CR 484 Stormwater Retrofit, Phase 1	Marion County Office of the County Engineer	Construction of a bioretention area and collection system to treat runoff from bridge spanning the Rainbow River.	SWFWMD	2009	Complete	2010
Urban Structural BMP	R013	CR 484 Stormwater Retrofit, Phase 2	Marion County Office of the County Engineer	Construction of a wet detention pond to treat runoff discharged into the Rainbow River from CR 484.	SWFWMD	2011	Complete	2012
Urban Structural BMP	R014	CR 484 Stormwater Retrofit, Phase 3	Marion County Office of the County Engineer	Upgrade of limerock parking lot in Blue Run of Dunnellon Park with a pervious brick paver parking area and paved aisles to address sediment discharge into the Rainbow River. Three wet detention ponds were constructed to treat stormwater runoff from the new parking lot and CR 484 east of the Rainbow River. the 32.44 acre Blue Run of Dunnellon Park was purchased through the Florida Communities Trust and deeded to the City of Dunnellon as part of the Rainbow River Corridor (R059).	SWFWMD, Marion County Parks, City of Dunnellon	2011	Complete	2011
Urban Structural BMP	R018	WR01 Rainbow River Phosphate Mine Pit Restoration	SWFWMD	Implementation of restoration alternatives in lower Rainbow River and adjacent phosphate mine pits	None	2016	Not Started	2016
Urban Structural BMP	R062	Sa-Te-Ke Village Stormwater Retrofit	Marion County Office of the County Engineer	Construction of retention storage along the Rainbow River to treat direct discharge to the River from a culvert discharging along Southwest (SW) 183rd Court and SW 102nd Street Road.	SWFWMD	2011	Complete	2011

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Urban Structural BMP	R064	Blue Cove Lake Water Quality Structure	FDOT District 5	Load reduction estimated using efficiency for Baffle Box. However, the box includes 'bold and gold' filter media which may reduce the estimated pollutant load more than estimated.	None	2013	Complete	2013
Urban Structural BMP	R050	Rainbow River Acres Stormwater Retrofit	City of Dunnellon	Proposed project in the vicinity of Oak St and Palmetto Way in the Rainbow River Acres subdivision. The Project would construct a stormwater pond to address flooding and to provide water quality for untreated stormwater runoff the currently sheet flows into the Rainbow River.	None	2020*	Not Started	2020*
Education and Outreach	R035	Rainbow River Vegetation Education	SWFWMD	Funding helped develop DVDs, brochures and posters describing the value of aquatic vegetation to the sustainability of the aquatic community and recommending proper etiquette of river use.	Rainbow River Conservation	2010	Complete	2010
Education and Outreach	R040	Blue Run Aquatic Planting	SWFWMD	Approx. 30 volunteers learned how aquatic plants help filter stormwater and participated in planting at Blue Run.	Marion County Parks and Recreation; Rainbow River Conservation	2009	Complete	2009
Education and Outreach	R044	Aquatic Vegetation Video	SWFWMD	A ten minute video showing the value of submerged and emergent aquatic vegetation in the Rainbow Springs Aquatic Preserve and the impact of recreational use on vegetation.	Paul Marraffino; Tracy Colson	2009	Complete	2009

TABLE 10: SUMMARY OF AGRICULTURE BMP LOADING REDUCTIONS

¹Calculated as percent acreage covered by NOI (Table 7) times source loading to land surface times 30% efficiency.

AGRICULTURE SOURCE	LOADING TO LAND SURFACE (LBS-N/YR)	BMP PROGRAM	ESTIMATED LOADING REDUCTION AT THE LAND SURFACE ¹
Horse Farms	3,027,527	Equine	23,725
Cattle Farms	5,225,877	Cow/Calf	402,775
Miscellaneous Livestock	173,572	Conservation Plan Rule	No acreage covered
Fertilizer, Crops	1,092,915	Vegetable/Agronomic Crop; Citrus; Specialty Fruit/Nut and Nursery	327,875

Agricultural loadings of nitrogen and phosphorus are associated primarily with fertilization, irrigation, and manure disposal practices. Nutrients from fertilization and animal manure can find their way into water resources through irrigation or stormwater runoff, and can be carried in sediments that are transported through runoff. As set out in Paragraph 403.067(7)(c), F.S., agricultural producers in a BMAP area must either implement FDACS-adopted BMPs or monitor their water quality, to demonstrate compliance with state water quality standards. Producers in the Rainbow Springs BMAP area have so far chosen to implement BMPs. While there are FDACS BMP manuals for eight different commodity groups (including forestry), each manual addresses the principles of nutrient management, irrigation management, sedimentation and erosion control, and water resources protection. FDACS developed a set of guiding principles for agricultural producers based on recommended BMP practices. **Table 11** lists the guiding principles related to the implementation of BMPs in each of these key categories.

TABLE 11: GUIDING PRINCIPLES FOR AGRICULTURAL LOAD REDUCTIONS IN THE RAINBOW SPRINGS BMAP AREA

- *Nutrient Management* -
 - o Producers should strive to achieve the most appropriate combination of nutrient source, amount, placement, and application timing, based on crop needs, soils, and weather conditions, to increase the availability of nutrients to the crop and decrease the potential for runoff or leaching of nutrients to the environment.
 - o On animal operations, such as cow/calf and equine, producers also should ensure the proper management of manure, either through application/spreading onsite at agronomic rates or appropriate disposal offsite.

- ***Irrigation Management*** – Producers should, to the extent feasible, do the following:
 - Maximize irrigation system efficiency, based on system design specifications, through proper maintenance and use.
 - Manage the frequency, timing, and amount of irrigation applications to target water delivery to the plant root zone.
 - Incorporate the use of simple but effective irrigation management tools, such as soil moisture sensors, rain gauges, and on-site or online weather station data, *etc.*
 - If one is available, consult with a Mobile Irrigation Lab regarding potential ways to increase irrigation system efficiency and improve irrigation management.
- ***Sedimentation and Erosion Control*** – Producers should maintain vegetation in areas prone to erosion, to hold soil and decrease the velocity of irrigation and stormwater runoff.
- ***Water Resources Protection*** – Producers should employ buffers, swales, and/or setbacks to reduce the potential for pollutant discharges to water resources.

Table 12 lists other agricultural related management strategies underway or proposed for the Rainbow Springs BMAP area. The Marion County Clean Farms Initiative (B010) was designed to assist Marion County farm owners and managers with implementation of BMPs, and to recognize them for their cooperative efforts. As a result of the Initiative, the Farm Outreach Coordinator position was created. The Farm Outreach Coordinator is responsible for the Water Quality Education and Equine Farm Best Management Practices program (B011), which is an ongoing effort of UF-IFAS Extension Marion County. The department recently published the *Small Equine BMP Manual*. A new effort in the Rainbow and Silver Springs BMAP areas will be an outreach program featuring the new manual and directed towards small, typically non-commercial (hobby), horse farms. The new manual provides a set of manure management and nutrient reduction BMPs that are appropriate for hobby farms. Hobby farms are numerous within the basin, and may have issues with manure storage and disposal, denuded areas, etc., but not the acreage to resolve these issues. It is typically not appropriate or possible for hobby farms to enroll under the FDACS equine BMP program. A joint outreach and education effort between local government, the department, and UF-IFAS is under development to address these operations.

An outreach strategy for the equine hobby farms is expected to be completed during the first phase of the BMAP, and implementation will be an ongoing effort. Initial steps will be to identify ways to reach the target audience, identify and engage agencies with existing outreach programs, and develop outreach materials to supplement the new department manual. A method of assessing program effectiveness with regard to the BMPs implemented on hobby farms and the amount of acreage involved also will be developed, possibly using existing programs.

In addition to signing up producers for a BMP NOI, FDACS has focused its priorities and increased its activity in the BMAP area in the following manner:

- **BMP Enrollment** – OAWP will focus its BMP enrollment efforts on the high recharge areas. Staff and contractors will identify active commercial agricultural operations through grower associations, information on county agricultural tax classifications, field staff knowledge, and other means. OAWP will attempt to ensure that all producers are aware of their statutory obligation to implement BMPs, through letters, e-mail, workshops, brochures, and/or other means. Staff/contractors will assist producers in selecting the appropriate BMPs, with emphasis on nutrient management, irrigation management, sediment/erosion control, water resources protection, and record keeping.
- With funding targeted toward springs protection, FDACS will be providing BMP cost share for the Rainbow Springs BMAP area.
- To help focus cost-share expenditures and BMP implementation follow-up, FDACS will review its rule-adopted cow/calf and equine BMPs to identify the practices likely to have the greatest nutrient load reduction benefits.
- FDACS is considering hiring an additional BMP technician to increase focus on BMP enrollment in springs-related basins, including Rainbow Springs.

TABLE 12: OTHER AGRICULTURAL MANAGEMENT STRATEGIES

Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Completion Date
Agriculture BMP	B009	Silviculture BMP Implementation and Compliance	Florida Forest Service	Covers silviculture lands in Rainbow and Silver Springs BMAP areas. BMPs for silviculture are applicable to public and private industrial and non-industrial forest-lands. Silviculture BMPs were first developed in the mid-1970's in response to the Federal Clean Water Act. The first Silviculture BMP Manual was published in 1979; it was most recently revised in 2008. Silviculture BMPs are the minimum standards for protecting and maintaining water quality during ongoing silviculture activities, including forest fertilization. Ongoing projects include biennial BMP surveys, targeted training, and technical assistance for landowners and forestry professionals.	FDACS, Florida Forest Service	2004	Ongoing	Ongoing
Agriculture BMP	B010	Clean Farms Initiative	Marion County Office of the County Engineer	The Clean Farms Initiative was designed to assist Marion County farm owners and managers with implementation of BMPs, and to recognize them for their cooperative efforts. The Initiative was begun by passage of Resolution 04-R-384, by the Marion County Board of County Commissioners, which recognizes the importance of agriculture to the county's history and economy, while also recognizing the need to protect water resources. As part of the Initiative, more than 7,500 surveys and brochures were mailed in October 2006 to owners of agricultural land, ranging from large operations of several hundred acres to small tracts of land with fewer than a dozen animals. The survey measures current manure management and fertilization practices. Results of the survey, and input from focus groups held in February and March 2007 were used to create a Farm Outreach Coordinator position to educate horse farm owners and managers on water quality, targeting practices such as manure management and fertilization.	UF-IFAS Extension Marion County	2003	Complete	2008
Agriculture BMP	B011	Water Quality Education and Equine Farm Best Management Practices (BMPs)	UF-IFAS Extension Marion County	Equine Best Management Practices and Manure Management Education and Outreach Program sponsored by UF/IFAS Extension and Marion County. Between 2010 and 2013 the program developed 44 types of educational materials, made 3,507 client consultations of which 464 were in the field. 301 producers participated in group education events including a manure management summit and tour. The program website received 446 views during this period. The program is on-going.	SWFWMD	2010	Ongoing	Ongoing

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Completion Date
Agriculture BMP	B012	Implementation of Outreach Program for Small Equine BMP Manual	department	The Small Equine BMP manual is intended to educate owners of non-commercial horse farms on BMPs to reduce nutrient loads. An outreach program will be developed for effective implementation of BMPs on non-commercial horse farms in the Silver and Rainbow Springs BMAP areas. The implementation program will consist of identification of key agencies with existing public education activities where the BMP manual can be incorporated, development or modification of existing recognition programs to provide measureable goals for both participants and also types of BMPs implemented, and identification of existing cost share programs that may assist non-commercial operations in BMP implementation.	To be determined	2015	Not Started	Ongoing
Agriculture BMP	B041	FDACS Cost-Share Programs	FDACS	FDACS will be providing at least \$250,000 in BMP cost-share for Silver Springs/Rainbow Springs BMAP areas.	None	2014	Not Started	Ongoing
Agriculture BMP	B042	FDACS Refinement of Appropriate BMPs	FDACS	To help focus cost-share expenditures and BMP implementation follow-up, FDACS will review its rule-adopted cow/calf and equine BMPs to identify practices likely to have greatest nutrient load reduction benefits.	None	2020	Not Started	Ongoing
Agriculture BMP	B043	Technical Agriculture Committee	UF-IFAS Extension Marion County	Formation of a technical agriculture committee consisting of representatives from local interest groups, local government, water management districts and state agencies. Purpose of the group would be to ensure consistent and accurate information for pollutant load contribution associated with agricultural uses and evaluate effectiveness of best management practices.	Local Interests; Local and State agencies; WMDs	2016	Not Started	2020

4.3 WASTEWATER MANAGEMENT

WWTFs and OSTDS are the two sources of nitrogen loading from wastewater considered in the NSILT. Wastewater sources of nitrogen occur from both centralized and decentralized (package plants) treatment plants. The results of the NSILT indicate that OSTDS account for 19% of nitrogen loading to the UFA while WWTFs (both large centralized facilities and small package plants) account for 2%.

Stakeholders having responsibilities for managing or regulating wastewater collection and disposal agreed to a set of guiding principles (**Table 13**) as a mechanism to aide future actions and the selection of projects to address wastewater sources. The guiding principles are proposed for the use of utility stakeholders, both public and private, who operate wastewater treatment and collection systems and the state agencies with regulatory authority over or water quality interests related to WWTFs and OSTDS.

TABLE 13: GUIDING PRINCIPLES FOR WASTEWATER AND OSTDS NITROGEN SOURCES

- Utility stakeholders are encouraged to implement technology that maximizes nitrogen removal from effluent when upgrading, replacing, or constructing new facilities in areas of high recharge, as indicated by the NSILT or other similar analysis.
- Operators of package plants within Marion County will comply with applicable County Codes to decommission these facilities when they cannot be replaced or practically upgraded to meet applicable effluent standards and where better centralized facilities are available, particularly in areas of high recharge and with high nitrogen effluent concentrations. Package plants in Levy County, but located within the BMAP area, are encouraged to do the same.
- FDOH and utility stakeholders are encouraged to participate with the department on developing strategies for providing alternative effluent treatment to areas currently with dense concentrations of septic tanks and package plants. The following factors may be considered:
 - Definition of dense concentration of OSTDS and package plants.
 - Identification of priority areas for centralized sewer expansion.
 - Development of financial assistance programs for construction of infrastructure and individual connections to such infrastructure.

4.3.1 NITROGEN LOADING FROM WWTFs

In the Rainbow Springs BMAP area, treated effluent containing nitrogen from WWTFs is discharged to spray fields, rapid infiltration basins or percolation ponds, or is used for irrigation water (reuse).

Throughout the BMAP area, WWTFs contribute two percent of the potential loading of total nitrogen to

ground water. Although those percent contributions are smaller than the contributions from OSTDS or agriculture, discharge location and level of treatment of wastewater can be important factors to consider when addressing loadings to the UFA. Additionally, addressing the nitrogen loading from OSTDS could include increasing the volume of effluent treated and disposed of by WWTFs.

There are 37 WWTFs located within the Rainbow Springs BMAP boundary that were used for evaluation of nitrogen loading in the NSILT (Eller and Katz, 2015). Of that number only six facilities discharge more than 100,000 gallons of treated effluent per day. Four of these facilities were also estimated to contribute more than 1,000 kg-N (2,204.62 lbs-N) annually between 2012 and 2013. The larger municipal WWTFs are operated by Marion County Utilities, City of Ocala, City of Williston, and the On Top of The World Development (Bay Laurel Community Development District). Most of the remaining WWTFs, except for four operated by the City of Dunnellon, are package plants and typically serve mobile home parks, residential properties, commercial property, and schools where central sewer is not available. Additionally there are 18 permitted industrial wastewater discharges and two permitted residuals application site in the BMAP area that were not included in the NSILT because wastewater effluent limits are not applicable for these facilities.

The volume of wastewater discharged by a WWTF is not a complete indicator of the impact of nitrogen loading and concentration contributed by that plant on the UFA. Smaller facilities can contribute large amounts of nitrogen loading compared with the volume of wastewater produced or have high estimated concentrations of nitrogen in their effluent. Noncompliance with permit conditions is a periodic problem for a number of the smaller facilities. In areas where small facilities are aggregated, the impact to the UFA is magnified. Because of the small volume of wastewater treated at these facilities, there are not many cost-effective options available to improve treatment besides connection to larger utilities.

Required monitoring varies between facilities and not all report the same type of data resulting in inconsistencies in the data collected for WWTFs. For larger facilities, the annual effluent input to the land surface was estimated using the average TN concentration and the reported (not permitted capacity) discharge (volume), but this information was not always available for smaller facilities. Smaller WWTFs (by volume <0.1 MGD) are not required to monitor and report effluent concentrations and, therefore, not all these facilities had available data while others reported NO₃-N concentrations in the effluent instead of TN. For these facilities, the TN concentration was estimated at 8.97 mg/L based on a

2009 cooperative study with the department and Water Reuse Foundation of 40 domestic WWTFs across the state. Also, some facilities for some years reported NO₃-N rather than TN for their effluent concentrations. For these, the department estimated TN concentrations by extrapolating from the NO₃-N data (assuming the NO₃-N concentration was 38.5% of the TN). Additionally, smaller facilities are not required to report the actual discharge volume and the nitrogen input was estimated assuming the plant was discharging effluent at 50% of its permitted design capacity.

There are ten projects identified that address wastewater management and their details are contained in **Table 14**. They fall into the following strategies or categories: wastewater collection system maintenance, wastewater service area expansion to connect package plants to central sewer, reuse, and system upgrades or improvements to effluent treatment to improve its quality.

Operational improvements to the Bay Laurel Center Community Development District WWTF serving the On Top of The World development have resulted in a significant reduction in effluent TN concentration since implementation in 2013, when compared to pre-2013 levels.

The wastewater coordination efforts (projects R052 and R054) between the Marion County Utilities and the City of Dunnellon have resulted in conceptual plan to replace the existing City of Dunnellon WWTFs with a single WWTF that meets AWT standard for TN. The required collection system infrastructure would also allow five package plants to be connected to the new plant. At this time the plan is dependent on funding being available.

Overall, the projects would remove an estimated 17,811 lbs-N/yr, or about 27.7%, of the potential nitrogen loading to the land surface from WWTFs based on current flows. This does not include load reduction from reuse projects. Reuse of effluent is used to offset fertilizer application in urban areas. Load reduction from reuse projects are included in the urban fertilizer source category.

Marion County (2013) has adopted as part of their local land development code requirements (Article 6 Technical Standards and Requirements, Division 16. Wastewater Facilities, hereafter “the code”) for WWTFs and effluent quality that are currently applicable within unincorporated Marion County. The code identifies two protection zones, a Primary Protection Zone that approximates the ten-year ground water capture zone and a Secondary Protection Zone that includes all the remaining area of Marion County. Six facilities are within the County’s Primary Protection Zone.

Pursuant to the code, new or expanded WWTFs since August 1, 2009, are subjected to minimum TN effluent quality standards, depending on discharge volume and type of treatment and which protection zone they are located in. The standards set forth in the code are summarized in **Table 15**. Existing facilities are not required to modify operations to meet the code and continue to be permitted in the same manner.

By January 1, 2019, the Marion County code requires existing WWTFs currently using RRLA or RIBs to either connect to a central sewer system that does not utilize RRLA, or meet a standard of 10 mg/L TN and convert to a slow-rate land application system or a public access reuse system. The code provides for waivers for RIB disposal systems unable to meet the code requirements.

In unincorporated Marion County, the code requires facility operators to test effluent for nitrate and TN concentrations monthly for facilities discharging greater than 0.1 MGD and quarterly sampling for facilities discharging less than 0.1 MGD.

TABLE 14: MANAGEMENT STRATEGIES FOR WASTEWATER AND OSTDS SOURCES

TBD = To be determined

Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Wastewater Service Area Expansion (OSTDS)	R019	Sewer Conversion Project, Phases 1-4	City of Dunnellon	Project constructed new sewer system within the City limits allowing properties previously on OSTDS (140 in Phase 2) to be hooked up to central sewer.	None	2000	Complete	2012
Wastewater Service Area Expansion (OSTDS)	R053	Wastewater Level of Service Coordination – OSTDS Abatement	Marion County Utilities/City of Dunnellon	Coordination between Marion County Utilities and the City of Dunnellon utility to improve the level of treatment of wastewater in the Rainbow Springs area. It is also anticipated that project would initially allow approximately 266 OSTDS to hook up to central sewer, with the potential for additional connections in the future.	Marion County	2020*	Not started	2020*
Wastewater Service Area Expansion (Package Plants)	R054	Wastewater Level of Service Coordination – Package Plant Abatement	Marion County Utilities/City of Dunnellon	Coordination between Marion County Utilities and the City of Dunnellon utility to improve the level of treatment of wastewater in the Rainbow Springs area. It is also anticipated that the project would initially allow 5 package plants to hook up to central sewer, with the potential for additional connections in the future.	Marion County	2020*	Not started	2020*
Wastewater Service Area Expansion (OSTDS)	R065	Levy Blue Spring Water Quality Improvement Project	Town of Bronson	The project will expand the Town of Bronson’s existing wastewater collection and transmission system and eliminate the use of approximately 60 OSTDS and holding tanks at no cost to the homeowners.	State Legislature Funds; SRWMD	2015	In Progress	2015
Wastewater Service Area Expansion (Planning)	R071	OSTDS 9-1-1 Strategy	department/ FDOH	Develop a strategy for addressing OSTDS and other wastewater management issues. Goal is to enhance communication and coordination among utilities and agencies.	Local utilities, SJRWMD, SWFWMD, and other interested parties	2015	Not Started	2018
Wastewater System Upgrade	R020	P301 Feasibility Phase - Wastewater Disposal Treatment Wetlands	SWFWMD	Siting and feasibility assessment for treatment wetlands to polish wastewater treatment plant (WWTP) effluent.	None	2014	In Progress	2015

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Wastewater System Upgrade	R052	Wastewater Level of Service Coordination – System Upgrade	Marion County Utilities/City of Dunnellon	Coordination between Marion County Utilities and the City of Dunnellon utility to improve the level of treatment of wastewater in the Rainbow Springs area. The project would improve the existing level of treatment provided by the existing four city treatment facilities by constructing a new facility that meets advanced wastewater treatment standards.	Marion County	2020*	Not started	2020*
Wastewater System Upgrade	R055	P301 Design and Permitting Phase - Wastewater Disposal Treatment Wetlands	SWFWMD	Design and permitting of treatment wetland(s) to polish WWTP effluent.	None	2020*	Not Started	2020*
Wastewater System Upgrade	R056	P301 Implementation Phase - Wastewater Disposal Treatment Wetlands	SWFWMD	Construction of treatment wetland(s) to polish WWTP effluent.	None	2020*	Not Started	2020*
Wastewater System Upgrade	R057	Rio Vista WWTP Decommissioning	City of Dunnellon	Planned project will decommission the Rio Vista WWTP and convert an existing lift station to pump waste water to the Rainbow Springs Plant.	None	2014	Complete	2015
Wastewater System Upgrade	R072	Operational Improvements	Bay Laurel Center CDD	Operational staff have begun utilizing oxidation-reduction potential probes and cyclic aeration to provide denitrification.	None	2013	Ongoing	Ongoing
Reuse Project	R073	Public Access Reuse	Bay Laurel Center CDD	The project was for the design and construction of a reclaimed water system including, pumping, storage, and distribution main which will provide reclaimed water for irrigation at the On Top of the World and Candler Hills Golf Courses.	None	2008	Complete	2010
Wastewater Collection System Maintenance	R058	Rio Vista Collection System Maintenance	City of Dunnellon	Companion project to the Rio Vista WWTP decommissioning. The collection system is subject to high infiltration into the system after storm events resulting in overflows from the plant holding pond.	None	2014	Complete	2015
Wastewater Collection System Maintenance	R059	Supervisory Control and Data Acquisition (SCADA) Installation	City of Dunnellon	Planned phased project for installation of SCADA at city WWTPs followed by installation at lift stations.	None	2020*	Not started	2020*

TABLE 15: MARION COUNTY WASTEWATER EFFLUENT STANDARDS FOR PRIMARY AND SECONDARY PROTECTION ZONES

Primary Protection Zone

DESIGNED AVERAGE DAILY FLOW (MGD)	RAPID-RATE LAND APPLICATION (RRLA) EFFLUENT DISPOSAL SYSTEM	SLOW-RATE LAND APPLICATION EFFLUENT DISPOSAL SYSTEM	PUBLIC ACCESS REUSE EFFLUENT DISPOSAL SYSTEM
Greater than 0.5 MGD	3 mg/L	3 mg/L	10 mg/L
Less than 0.5 and greater than or equal to 0.01 MGD	3 mg/L	6 mg/L	10 mg/L
Less than 0.01 MGD	10 mg/L	10 mg/L	10 mg/L

Secondary Protection Zone

DESIGNED AVERAGE DAILY FLOW (MGD)	RRLA EFFLUENT DISPOSAL SYSTEM	SLOW-RATE LAND APPLICATION EFFLUENT DISPOSAL SYSTEM	PUBLIC ACCESS REUSE EFFLUENT DISPOSAL SYSTEM
Greater than or equal to 0.5 MGD	3 mg/L	3 mg/L	10 mg/L
Less than 0.5 but greater than or equal to 0.1 MGD	3 mg/L	6 mg/L	10 mg/L
Less than 0.1 but greater than or equal to 0.01 MGD	6 mg/L	6 mg/L	10 mg/L
Less than 0.01 MGD	10 mg/L	10 mg/L	10 mg/L

4.3.2 PROPOSED WASTEWATER STANDARDS FOR THE RAINBOW RIVER BMAP AREA

In an effort to provide regulatory consistency across the BMAP area, as well as continue the improvement of wastewater management to protect Rainbow Springs and River, the department will require the following in any new or existing permit unless the facility can make a demonstration that reasonably assures the reuse or land application of effluent (as specified in **Appendix B** would not cause or contribute to a violation of the 0.35 mg/L nitrate concentration established by the Rainbow Springs TMDL. Should the department concur with the reasonable assurance demonstration request, the TN effluent requirements established here may be modified or waived. Based on currently available data and analysis, these effluent limitation requirements are appropriate to protect ground water quality and prevent contribution to water quality impairment in Rainbow Springs and Rainbow River. Effluent standards are as follows:

1. Require the reporting of effluent discharge for TN.
2. Require at least quarterly sampling of effluent discharge for TN.
3. Within the Marion County Primary Protection Zone, apply the effluent standards set forth in **Table 15** as an annual average to all new and existing WWTFs that have a permitted nutrient discharge.
4. Outside the Marion County Primary Protection Zone, apply an effluent standard no greater than 6 mg/L TN as an annual average or discharge to a public reuse system with an effluent standard of 10 mg/L TN as an annual average to all new and existing WWTFs that have a permitted nutrient discharge and permitted capacity of 10,000 gallons per day or greater.
5. Outside the Marion County Primary Protection Zone, WWTFs with a permitted nutrient discharge and a permitted capacity less than 10,000 gpd apply an effluent standard no greater than 10 mg/L TN as an annual average.
6. New effluent standards would take effect at the time of permit renewal or no later than five years after BMAP adoption, whichever is sooner.

All WWTFs in Marion County using RRLA as a primary wastewater disposal method are required by County code to investigate the practicality of increasing treatment (*i.e.*, nitrogen removal), connecting to a central sewer systems, or converting to a slow-rate land application system or public access reuse system. WWTFs in Levy County, but are located within the BMAP area, are encouraged to do the same.

4.3.3 NITROGEN LOADING FROM OSTDS

OSTDS contribute 19% of the overall loading of TN that potentially enters the UFA across the entire BMAP area. This makes OSTDS significant contributors to TN loading to the UFA. A total of 21,772 OSTDS were identified in the BMAP area, the vast majority (16,236 or 75%) of which are located within Marion County. The remaining 5,536 OSTDS are within Levy County. Approximately 8% of OSTDS are located within the Rainbow Springs Primary Protection Zone, as defined by Marion County.

Over 16,000 OSTDS are located in high recharge areas. There are 4,568 OSTDS located in medium and high density residential areas (>2 dwelling units per acre). Another 453 OSTDS are located in other

urban land uses. Combined, this represents 23% of OSTDS, over 90% of which are in high recharge areas. In contrast, 13,374 OSDTS, 61% of the total OSTDS in the BMAP area, are located in low density residential land uses. Nearly 70% of these are located in high recharge areas.

Three Service area expansion projects listed in Table 14 (R019, R053 and R065) begin to address the loading from OSTDS. Collectively, these projects will reduce the nitrogen loading from OSTDS by 11,140 lbs-N/yr or 2.1% of the loading calculated at the land surface without attenuation. Project B040 is not included in this reduction. Project B040 is a conceptual project that would allow material from pumped OSTDS to be treated in the central sewer system in lieu land application.

The City of Dunnellon has completed a Sewer Conversion Project, R019, that expanded sewer service within the City limits resulting in 140 OSTDS being connected to centralized sewer. The Levy Blue Spring Water Quality Improvement, R065, is currently underway and will connect 60 OSTDS to the City centralized sewer. This project is cooperative effort the City of Bronson, Suwannee River WMD and the department.

One of the projects, R053, is part of the wastewater coordination efforts between the Marion County Utilities and the City of Dunnellon. This conceptual plan would replace the existing City of Dunnellon WWTFs with a single WWTF that meets AWT standard. The required collection system infrastructure would also allow 266 OSDTS to be connected to the new plant. There is also potential that the collection system infrastructure could be used to connect other areas that currently are served by OSTDS to the new WWTF in the future. At this time the plan is dependent on funding being available.

Local codes and permitting authority vary within the BMAP area. Current statutory language (Section 381.00655, F.S.) requires the owner of a properly functioning OSTDS to connect to sewer within 365 days of notification that central sewer is available for connection.

Under Marion County Land Development Code (Section 6.14.3 Onsite Waste Treatment and Disposal Systems), activities that require a repair or modification permit from the FDOH in Marion County for new, modified, or repaired OSTDS, are required to meet a minimum of 24-inch separation between the bottom of the drainfield and estimated wettest season water table. This applies to all development including those OSTDS installed before 1983. New development in unincorporated Marion County is required to connect to central sewer. Only vested developments may obtain OSTDS permits.

Technologies that are currently in use for nitrogen reduction are similar to secondary and advanced secondary wastewater treatment facilities. They include an aeration treatment step, and generally an element of recirculation to increase nitrogen reduction. Several studies have indicated that such technologies can reduce nitrogen concentration in the effluent of OSTDS by 50 to 70%. Currently, development of nitrogen reduction strategies for OSTDS is underway by the FDOH, but will most likely not be completed before the adoption of this BMAP (<http://www.floridahealth.gov/nitrogen>). Preliminary results of field testing done at active home sites shows a 90-95% reduction of total nitrogen. FDOH is also characterizing nitrogen removal from effluent in the soil underneath OSTDS and in the shallow ground water, as well as developing a nitrogen fate and transport model that can be applied to conditions specific to Florida.

With financial support from the department, limited testing of three different alternative treatment methods was performed at the University of Central Florida (UCF) Stormwater Academy. Design methods included the use of a sand filter, an experimental bioabsorptive media filter (trademarked as Bold and Gold), and a subsurface upflow wetland. The bioabsorptive media filter obtained a 70% reduction in TN (Chang *et al.* 2011). Additionally, the department is evaluating the effectiveness of drainfield amendments on the denitrification process. Any new OSTDS product or technology requires approval by FDOH prior to installation.

FDOH updated the Florida Water Management Inventory starting in 2014 with the stated goal of documenting and mapping the wastewater treatment method and source of drinking water for 6 million improved land parcels in the state. The inventory was last completed in 2009. Marion County and Alachua County are pilot counties for this inventory.

4.4 WASTEWATER MANAGEMENT STRATEGY

As population grows in the watershed, the question of how to address and direct the impacts of wastewater disposal becomes more important. A more coordinated planning effort is needed. OSTDS are one component of wastewater disposal but are also one of the more difficult sources of nitrogen loading to the UFA to address. Solutions are complex and frequently controversial. Connection to central sewer systems is sometimes considered as the option for addressing this source. However, several factors such as cost-effectiveness of the sewerage project and available WWTF capacity need to

be considered. Conversely, OSTDS do provide needed wastewater treatment in areas where central sewer is not economically feasible or practical.

There are other wastewater management concerns in the Rainbow Springs BMAP area besides OSTDS. Some of the small WWTFs evaluated under the NSILT contribute large loadings of nitrogen relative to the size of their discharge, and so there is a need to develop better solutions for poorly performing WWTFs. Local government regulations applicable to wastewater management, including effluent quality standards, vary between jurisdictions.

The wastewater coordination efforts between Marion County Utilities and the City of Dunnellon (projects R052, R053 and R054) have resulted in a conceptual framework to address wastewater issues in the immediate vicinity of Rainbow Springs. However, wastewater management concerns extend throughout the BMAP area.

Given the complexity and scope of the issues related to OSTDS and other wastewater management issues, the best course of action was to use the BMAP process to more fully develop an integrated wastewater management strategy applicable to the entire BMAP area. Project R071, OSTDS 9-1-1 Strategy, will be initiated within three months after the adoption of the BMAP and completed no later than 30 months after initiation. The primary purpose of this project is to identify effective, financially feasible strategies that address the current and future nitrogen loading from OSTDS as well as other wastewater sources. The project goal is enhanced coordination and communication among utilities, the public, and responsible agencies in the Rainbow Springs BMAP area that results in the better management of nitrogen from wastewater sources. The timing of the implementation of project components may change, depending on legislative mandates and allowances or other unforeseen extenuating circumstances interfering with that schedule.

The basic elements that the strategy will address include (but are not limited to) BMAP area-specific wastewater effluent standards, the prioritization of geographic areas of concern, upgrades to existing treatment systems, connection to central sewer, alternative solutions to central sewer, and education and outreach. An effective public education and outreach component will strengthen the overall wastewater management strategy.

The department, with assistance from Marion County and FDOH, will facilitate the organization of an Advisory Committee with representation from vested interests such as private and public utilities, local governments, CDDs, homeowners, Rainbow River Conservation, businesses, and other interested parties. Because a portion of the Rainbow Springs BMAP area includes a ground water contributing area that overlaps with the Silver Springs ground water contributing area and Marion County is affected by the requirements for both springs' BMAPs, this Committee will be a joint Committee with Silver Springs.

The Advisory Committee will, as part of the BMAP implementation of Project R071, OSTDS 9-1-1 Strategy, build upon existing utility management plans and studies to develop agreed upon priorities for connection of OSTDS to central sewer and develop solutions for areas where central sewer is not feasible. The three main objectives of the Advisory Committee are to (1) collect and evaluate existing plans, priorities, and studies to build a framework with priority projects for funding and identify missing parts or conflicts within that framework, (2) develop a wastewater management plan that includes the identification and development of projects that reduce nitrogen loadings from wastewater including OSTDS, and (3) develop a public education plan that at a minimum provides area residents with reliable and understandable information about the impacts of nitrogen loading on Rainbow Springs and proper and effective wastewater management.

The project is intended to supplement and support local efforts to improve wastewater management and not delay their implementation. Local stakeholders are encouraged to submit projects that address needed wastewater improvements for financial support or initiation at any time during Project R071. Completed studies and existing ordinances provide direction for the scope of the project. Public education and outreach is identified by stakeholders as a priority component of this project, and efforts will begin upon its initiation. The expected project outcome is a management plan that will be used to identify actions and projects local utilities can implement before the start of the second phase of the BMAP.

The three objectives that this project will address as part of its overall management strategy are outlined below with expected deliverables and general time frames:

Objective 1: Data Collection

- Finalize project definition and scoping.

- Update the OSTDS geographic distribution map and database for the BMAP area.
- Update WWTF location, level of treatment information, and facility-related information.
- Compile and update existing or planned wastewater utility jurisdictions and their wastewater collection infrastructure data.
- Compile and summarize existing ordinances, statutes, and studies related to OSTDS and wastewater management in the BMAP area.

Deliverable: These tasks will be completed as soon as possible and no later than one year after project initiation and will generate a refined project scope as well as drafts of an OSTDS geographic map and database, a sewer collection system database, and the compilation of existing ordinances and results of studies for the BMAP area that can be shared between participating stakeholders and used for decision making.

Objective 2: Analysis and Prioritization

- Identify and prioritize locations where wastewater loadings from WWTFs and OSTDS are a concern for water quality in the UFA or surface waters and should be addressed.
- Identify and prioritize potential actions that remediate the effects of wastewater on the quality of ground water or surface water.
- Identify and prioritize locations where the connection of OSTDS to central sewer is the preferred and appropriate management strategy.
- Identify potential funding sources for proposed actions.

Deliverable: Analysis and prioritization will be completed as soon as possible and no later than the end of the 30-month project. The products of this element are a Management Plan for Wastewater and agreement among cooperating entities on projects/actions that meet the implementation requirement of the management plan. Projects will be initiated as funding becomes available based on the prioritization agreed upon by the cooperating entities but no later than five years from BMAP adoption.

Objective 3: Public Education and Outreach

- Compile information about existing education and outreach efforts in the BMAP area—in particular, what has been successful and what are the strengths and weaknesses of these efforts.
- Coordinate BMAP area outreach efforts with state level OSTDS education and outreach initiatives.
- Design an outreach effort that explains to landowners proper wastewater management including, but not limited to, how an OSTDS works; the proper maintenance of an OSTDS; the impacts of fats, oil, and grease (FOG) on collection systems; potential impacts to ground water and surface water quality; and where and why OSTDS should be upgraded to a better treatment system or removed. Information collected from existing education and outreach efforts as well as information obtained from Objectives 1 and 2 will be helpful for designing the outreach effort.

Deliverable: The compilation of existing program information and drafting of education outreach effort will be completed within one year after project initiation. The entire public education and outreach program will be finalized by the end of the 30-month project. Implementation of education and outreach efforts will be ongoing through the duration of the project.

4.5 URBAN FERTILIZER

There is limited surface water drainage within the BMAP area, and nitrogen washed off the land surface in stormwater runoff enters ground water via percolation through drainage retention areas, sinkholes, stormwater ponds, or natural areas where runoff collects. Nitrogen from fertilizer can also infiltrate into ground water directly where it is applied.

Stormwater managers agreed to a set of guiding principles summarized in **Table 16** as a mechanism to direct future actions and the selection of projects to address stormwater sources. These principles include recommendations for source control. They are intended to supplement and support the implementation of the Rainbow Springs BMAP.

The nitrogen loading contribution from urban fertilizer was calculated from urban land uses, including residential, commercial, parks and recreational areas, and golf courses. The NSILT identifies urban fertilizer as contributing about 6% of the nitrogen loading to the UFA.

There are four categories of management actions identified that reduce the impacts of urban fertilizer. Management categories include installing structural BMPs to reduce the loading from urban stormwater, operating and maintaining structural BMPs (such as cleaning), sweeping streets, and public education and outreach.

TABLE 16: GUIDING PRINCIPLES FOR URBAN FERTILIZER

Stormwater

- Stakeholders are encouraged to implement, where feasible, emerging stormwater treatment technologies or innovative implementations of more established technologies that offer improved nitrogen treatment efficiency over typical stormwater treatment practices, in new facilities or as retrofits of existing facilities in areas of high nitrogen load. The department may be able to provide guidance in stormwater management technology and financial support through grants.
- To focus efforts in areas of high nitrogen load, stakeholders are encouraged to use the NSILT or develop their own methods to determine areas of high nitrogen load.
- To focus efforts in areas of high nitrogen load, stakeholders are encouraged to develop decision making processes to prioritize potential stormwater retrofit projects. These prioritization processes can be included in the BMAP as projects. The following factors are provided as guidance:
 - The feasibility of improving treatment of nitrogen over what is currently provided by existing facilities or the absence of facilities.
 - The potential reduction in nitrogen versus cost (\$/lbs/yr or similar method),
 - The location of the project in a high recharge area as identified in the NSI or other similar analysis.

Source Control

- Stakeholders are encouraged to participate in public outreach and education programs that make information available to residents in urban areas regarding methods they can take to reduce nitrogen sources and protect Rainbow Springs. Efforts, that are not community-wide, should be directed towards areas of high loading.
- Stakeholders are encouraged to consider implementing ordinances and regulations that address the over application of nitrogen from fertilizer in urban areas, including golf courses.
 - Operators of golf courses should implement the practices in the Department's BMP manual for golf courses.

- Operators of golf courses and other entities, such as home owners associations, using reuse water should learn how to properly adjust fertilizer application rate to account for nitrogen supplied through reuse water.

Total reductions for education and outreach were calculated by applying an approach that allows up to a 6% credit based on the total urban fertilizer loading, provided that specific program elements are present. **Table 17** outlines this approach. Urban fertilizer loading was apportioned to entities based on the percent area of urban land within their jurisdiction contributing to the overall loading, as calculated by the NSILT.

TABLE 17: CREDITING APPROACH APPLIED FOR PUBLIC EDUCATION CREDITS

ACTIVITY	PERCENT CREDIT
Florida Yards and Neighborhood Program	3%
Local Codes and Ordinances	2% total for all four
Landscaping	0.5%
Irrigation	0.5%
Fertilizer	0.5%
Pet Waste Management	0.5%
Public Service Announcement	0.25%
Informational Pamphlets	0.25%
Website	0.25%
Inspection Program and Call in Number for Illicit Discharges	0.25%

Table 18 summarizes 44 projects to address the reduction in nitrogen loading from urban fertilizer. Overall, the management actions undertaken in the BMAP area will reduce nitrogen loading to the land surface by 41,771 lbs-N/yr or about 7.3% of the loading calculated at the land surface without attenuation. Stormwater managers agreed to include only those dry retention structural BMPs that were retrofits to better nitrogen removal technologies or located on soils that provided a net removal of nitrogen—largely poorly drained soils. The largest measurable single reduction in nitrogen loading from a single project was achieved by FDOT (10,285 lbs-N/yr) through the cessation of fertilizer use on the medians and rights-of-way of state-maintained roadways in Marion County. Reuse of effluent from the WWTF in the On Top of the World development reduced nitrogen load 6,025 lbs-N/yr by offsetting the use of fertilizer. The reduction due to fertilizer cessation in Levy County, will be quantified later.

Marion County has completed stormwater management projects that utilize bioabsorptive media to reduce nitrogen loading and have other projects planned for the first BMAP phase. Project R063

proposes the use of a patented bioabsorptive media referred to as Bold and Gold to enhance nitrogen removal under three priority drainage retention areas (stormwater ponds).

Education and outreach activities comprise 28 projects. Their contribution to loading reduction was estimated based on applying appropriate education credit for each entity to the land surface loading from urban fertilizer in the BMAP area, based on the crediting approach outlined in **Table 17**. Those local entities with MS4 permits have education and outreach as one of the requirements of their permit. Overall, the credits obtained by all education and outreach activities are greater than any other management category.

There is support among stormwater managers in both the Rainbow Springs and Silver Springs BMAP areas for a more coordinated education and outreach approach for spring-related materials. The formation of a public education coordination team facilitated by Marion County and consisting of representatives from local government, state agencies, water management districts, and local interest groups is proposed to meet this interest (Project B036). The coordination team will be a joint effort between both BMAP areas. The purpose of the group would be to ensure that citizens are provided with consistent and accurate information about the impacts of stormwater runoff on springs water quality as well as advice on protecting and restoring Rainbow Springs. The project will maximize outreach efforts among coordination team members and enhance communication between team members.

TABLE 18: MANAGEMENT STRATEGIES FOR URBAN FERTILIZER SOURCES

TBD= To be determined.

Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Urban Structural BMP	R011	Village of Rainbow Springs Stormwater Retrofit	Marion County Office of the County Engineer	Retrofit of an existing drainage retention area with aerobic filtration cells for conversion of TN to nitrate and an infiltration cell lined with Bold and Gold for nitrate removal. The project also includes a stormwater wetland to treat runoff discharged into Section 16 Lake.	SWFWMD	2014	Complete	2015
Urban Structural BMP	R015	Rainbow Springs Country Club Estates Stormwater Retrofit	Marion County Office of the County Engineer	Expansion and conversion of an existing retention pond to a wetland/wet retention pond to enhance nitrate removal from runoff generated from County road, a golf course and residential land uses.	SWFWMD	2012	Complete	2012
Urban Structural BMP	R016	Rainbow Park Unit 8 Stormwater Retrofit	Marion County Office of the County Engineer	Construction of three wet detention ponds to provide treatment of runoff prior to discharge to a relic karst feature and isolated surface wetlands.	SWFWMD	2012	Complete	2013
Urban Structural BMP	R017	Rolling Hills unit 5 Stormwater Retrofit	Marion County Office of the County Engineer	Construction of an inter-connected system of four retention ponds and one wet retention ponds to treat stormwater runoff from roads, residential and agricultural land uses.	SWFWMD	2012	Complete	2013
Urban Structural BMP	R051	Bold and Gold Stormwater Retrofits in Rainbow Springs BMAP Area	Marion County Office of the County Engineer	Project proposes \$1,400,000 through fiscal year 2019 for retrofit of county-owned DRAs in Rainbow Springs BMAP area. Number and location of DRAs retrofitted will depend on several factors, including potential load reductions, land availability, and location in priority focus areas identified in BMAP. Project is currently in preliminary scoping stages and is identified in adopted 2014 Stormwater Implementation Plan.	None	2015	Planned	2019
Urban Structural BMP	R063	Rainbow Springs 5th Replat Stormwater Retrofit	Marion County Office of the County Engineer	This project will retrofit three drainage retention areas in Rainbow Springs 5th Replat with the nitrogen reducing Bold and Gold media. It is estimated that this retrofit will prevent 250 pounds of Total Nitrogen from reaching the aquifer annually.	None	2016	Not Started	2016
Urban Structural BMP	B022	State Road (SR) 40 Design Project-Pond 3	FDOT District 5	238719-1, SR 40 from County Road (CR) 328 to SW 80th Ave (CR 225A) - Pond 3 / Dry Retention-Closed basin in poorly drained soils	Not Applicable	2014	In Progress	2020
Urban Structural BMP	B023	SR40 Design Project-Pond 4	FDOT District 5	238719-1, SR 40 from CR 328 to SW 80th Ave (CR 225A) - Pond 4 / Dry Retention-Closed basin in poorly drained soils	Not Applicable	2014	In Progress	2020

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Urban Structural BMP	B024	SR40 Design Project-Pond 5	FDOT District 5	238719-1, SR 40 from CR 328 to SW 80th Ave (CR 225A) - Pond 5 / Dry Retention-Closed basin in poorly drained soils	Not Applicable	2014	In Progress	2020
Urban Structural BMP	B025	SR40 Design Project-Pond 6	FDOT District 5	238719-1, SR 40 from CR 328 to SW 80th Ave (CR 225A) - Pond 6 / Dry Retention-Closed basin in poorly drained soils	Not Applicable	2014	In Progress	2020
Urban Structural BMP	B028	SW 85th St/SW 40th Ave Stormwater Retrofit	Marion County Office of the County Engineer	Construction of a drainage retention area lined with Bold and Gold soil amendment to enhance nitrogen removal. Post construction event monitoring has shown a 70% reduction in TN through the soil amendment layer.	SWFWMD	2012	Complete	2012
Urban Structural BMP	B029	West Highway 316 at 119th Ave Stormwater Retrofit	Marion County Office of the County Engineer	Proposed project to construct a wet retention area to reduce nitrate in stormwater runoff from transportation and residential land uses that is currently infiltrating to the aquifer without treatment. The project is currently identified in the adopted 2014 Stormwater Implementation Plan.	SWFWMD	2016	Not Started	2016
Urban Structural BMP	B030	West Highway 316 at Highway 329 Stormwater Retrofit	Marion County Office of the County Engineer	Proposed project to construct a retention area to reduce nitrate in stormwater runoff from transportation and residential land uses that is currently infiltrating to the aquifer without treatment. The project is currently identified in the adopted 2014 Stormwater Implementation Plan.	SWFWMD	2016	Not Started	2016
Stormwater Operation and Maintenance	R021	Fertilizer Cessation	FDOT District 2 and 5	FDOT operations and maintenance fertilizer cessation.	NA	2010/2012	Ongoing	Ongoing
Stormwater Operation and Maintenance	B032	Sinkhole Repair Program in County DRAs	Marion County Office of the County Engineer	Part of ongoing stormwater system maintenance activities. Performed as needed by county crews or contractors depending on size and scope of repair.	None	2003	Ongoing	Ongoing
Street Sweeping	B033	Street Sweeping of Marion County Roads	Marion County Office of the County Engineer	Sweeping of Marion County-maintained roads. Sweeping of roads with curb and gutter is completed nine times per year. Benefits: Remove debris, sediment, and potential pollutants from streets. Prevent entry into storm sewer system.	None	2003	Ongoing	Ongoing
Education and Outreach	R024	Efficient Irrigation Workshops	SWFWMD	Community presentations on efficient-irrigation practices.	Florida Irrigation Society	2005	Complete	2005

Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Education and Outreach	R025	Florida-Friendly Landscaping Coordinator	SWFWMD	UF's Florida-Friendly Landscaping™ program educates homeowners about how to design, install and maintain healthy landscapes that use a minimum of water, fertilizer and pesticides. SWFWMD funds programs in 11 of its 16 counties in partnership with county governments and the university.	UF, Marion County	2004	Complete	2013
Education and Outreach	R026	Restoring Our Springs! media campaign	SWFWMD	Public service advertising to promote SWFWMD's "Restoring Our Springs!" media campaign. Advertising will be in Citrus, Hernando and Marion counties and will direct people to "Join us in the community effort to restore our springs."	None	2014	Complete	2014
Education and Outreach	R027	Newspaper in Education: Springs in west-central Florida	SWFWMD	An in-depth look at springs in west-central Florida through a Newspaper in Education produced by the Tampa Bay Times. Distributed to middle school students in Citrus, Hernando and Marion counties as well as Tampa Bay Times and Citrus County Chronicle readers.	None	2013	Complete	2014
Education and Outreach	R028	Crystal River/King's Bay/Rainbow River Public Service Advertising	SWFWMD	Messaging on how residents can help protect the quality of local springs through proper application of fertilizer. Social research was used to help develop messages.	None	2007	Complete	2011
Education and Outreach	R029	Crystal River/King's Bay/Rainbow River Outreach Coordinator	SWFWMD	Education effort to reduce water quality impacts from landscaping and other homeowner practices — like over-fertilization and leaky OSTDS — that increase nitrates in springs. Targeted homeowners, landscape professionals, retail outlets, OSTDS maintenance companies and others. Included education effort titled "You want your lawn green, not your water. Don't over-fertilize."	None	2008	Complete	2011
Education and Outreach	R030	Marion County Springs Festival Sponsorship	SWFWMD	Event to educate the public on the protection of Marion County's springs and other water resources. Event alternates between Rainbow Springs State Park and Silver Springs State Park.	None	2006	Complete	2014
Education and Outreach	R031	Marion County Master Gardeners Spring Festival Sponsorship	SWFWMD	Festival supporting Florida Friendly Landscaping outreach and education including a focus on water conservation, watersheds and water quality.	None	2000	Complete	2011
Education and Outreach	R032	Spring Awareness Week - Springs Neighborhood Challenge	SWFWMD	One-day workshop taught participants about water quality issues specific to Rainbow Springs and Crystal River/Kings Bay. Proper fertilizer application was a main focus of the workshop.	Howard T. Odum Florida Springs Institute	2011	Complete	2011

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Education and Outreach	R033	Get Out and Explore Marion County Springs	SWFWMD	Guided canoe trip, hiking trip and water quality demonstration to educate residents about aquatic ecology, karst geology, native and invasive plants, water sampling and human impacts to springs.	Marion County UF/IFAS Extension Office	2012	Complete	2012
Education and Outreach	R034	Marion County Earth Day	SWFWMD	This one-day event educated approximately Marion County residents about springs and water quality protection.	Marion County UF/IFAS Extension Office	2011	Complete	2011
Education and Outreach	R035	Micro-irrigation workshops	SWFWMD	Through three educational workshops and distribution of micro-irrigation kits, this project educated homeowners living in 55+ communities about Florida-Friendly Landscaping principles and the benefits of using micro-irrigation.	Marion County Office of the County Engineer	2011	Complete	2011
Education and Outreach	R037	Soil Analysis by UF	SWFWMD	Up to 200 soil analysis tests were conducted as part of the Crystal River/King's Bay/Rainbow River Watershed Education project.	UF-IFAS	2010	Complete	2010
Education and Outreach	R038	Best Management Practices Awareness Campaign	SWFWMD	This project educated equine enthusiasts on the importance of protecting water resources to ensure water quality by utilizing proper manure management, fertilization techniques and water conservation practices.	Marion Soil and Water Conservation District	2010	Complete	2010
Education and Outreach	R039	Florida-Friendly Landscaping Expo	SWFWMD	This project encouraged Marion County homeowners to reduce water use by incorporating Florida-Friendly Landscaping principles.	Marion County UF-IFAS Extension Office	2010	Complete	2010
Education and Outreach	R041	Storm drain markers	SWFWMD	Storm drain markers will be purchased to conduct storm drain marking events in Marion County.	Rainbow River Conservation; Boy Scouts of America	2009	Complete	2009
Education and Outreach	R042	Community Landscape/Irrigation Evaluation Specialist	SWFWMD	Consultant evaluated ten locations in five counties, including Marion, and made recommendations for water conservation in community landscapes and irrigation.	None	2009	Complete	2009
Education and Outreach	R043	Rainbow River Springshed Tour	SWFWMD	An educational program to inform local officials, homeowners, retail store managers and lawn care providers of how fertilizer impacts the local springshed.	None	2009	Complete	2009
Education and Outreach	R045	Florida Friendly Demonstration Garden at the Dunnellon Library	SWFWMD	Florida Friendly Demonstration Garden was installed to educate visitors to the Dunnellon Library about the benefits of Florida-Friendly landscaping principles.	Friends of the Dunnellon Library	2009	Complete	2009

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Education and Outreach	R047	Transferring Development Rights for Watershed Protection	SWFWMD	Through a series of five workshops, landowners, developers and citizens were educated about the Transfer of Development Rights program and the Farmland Preservation Area in Northwest Marion County.	Marion County Citizens Coalition, Inc.	2007	Complete	2007
Education and Outreach	R048	Florida Yards and Neighborhoods Program -Color in the Landscape Spring Festival	SWFWMD	This Florida-Friendly Landscaping festival provided information workshops on practices.	Marion County UF-IFAS Extension Office	2006	Complete	2006
Education and Outreach	R049	Splash! grants to teachers in Marion County	SWFWMD	Various water resources grants most projects were directly related to education about Rainbow Springs.	Marion County School District	2007	Complete	2013
Education and Outreach	R050	Dunnellon High School Legacy Program	SWFWMD	This program taught students basic land management techniques. Students also educated the community, which included promoting springshed protection. In 2007, educational signage about watershed protection was placed in kiosks at drop-in and take-out tubing sites at Rainbow River State Park.	Marion County School District	2004	Complete	2007
Education and Outreach	R051	Dunnellon Elementary School Rain Barrels	SWFWMD	Students and families were educated on the use of rain barrels for irrigation as a way of conserving water.	Marion County School District	2003	Complete	2003
Education and Outreach	B036	Public Education Coordination	Marion County Office of the County Engineer	Formation of a public education coordination team consisting of representatives from local government, state agencies, water management districts and local interest groups. Purpose of the groups would be to ensure consistent and accurate information on pollution prevention is provided to citizens and maximize efforts among coordination team members.	Local, State and Federal agencies; WMDS; local interest groups	2015	Not Started	Ongoing
Education and Outreach	B037	Marion County Stormwater Program - NPDES MS4 Permit	Marion County Office of the County Engineer	Public outreach and education programs including informational pamphlet distribution, PSAs, and public outreach events. Other efforts include: Illicit discharge inspection and education, mapping and modeling efforts, construction site pollution prevention program, and municipal operations pollution prevention program.	None	2003	Ongoing	Ongoing
Education and Outreach	B038	FDOT Public Education	FDOT District 2 and 5	FDOT conducts inspections and provides annual illicit discharge, spill prevention and erosion & sediment control training to staff and contractors.	None	2013	Ongoing	Ongoing

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Project Type	Project Number	Project Title	Lead Entity	Project Description	Project Partners	Start Date	Status	Complete Date
Education and Outreach	B039	Springs Awareness for Educators	Rainbow River Conservation	A workshop for Marion County teachers and educators to provide resources on springs, water issues and wildlife which can be used in the classroom to enhance teaching the common core standards.	SWFWMD; Florida Springs Institute; Marion County School District	2014	Ongoing	Ongoing

Chapter 5: ASSESSING PROGRESS AND MAKING CHANGES

This chapter summarizes the goals of this BMAP and outlines the steps stakeholders will take to track progress in implementing projects and observing the results of those projects in BMAP waterbodies. It also summarizes information about grants or loans available for implementation of projects.

5.1 SUFFICIENCY OF EFFORT

The BMAP represents a “sufficient effort” or commitment by stakeholders to restore water quality to Rainbow Springs and the Rainbow River. It is recognized by stakeholders that there is no one management action that will restore water quality in Rainbow Springs and Rainbow River. Stakeholders agreed that the entire BMAP area should be considered when identifying loading reduction management actions. This decision was based on the acknowledgment that all stakeholders have a shared responsibility in restoring Rainbow Springs and Rainbow River and should have at least a minimal level of involvement in the restoration process.

Load reductions at the land surface are expected to result in reduction in concentration of nitrate in Rainbow Springs. Existing monitoring efforts in the springs and on Rainbow River will be used to support the progress made toward achieving the TMDL target nitrate concentration. A process for communicating progress information among the Basin Working Group (BWG) members is also discussed in this chapter.

Sufficiency of effort was evaluated in several ways. The first is ensuring that all potential source categories of TN loading identified in the NSILT are addressed with projects and secondly ensuring the participation of stakeholders located in the BMAP area in the BMAP process. This BMAP summarizes the number of projects, the TN sources that they address, and project status. Conservation lands were not explicitly evaluated with the NSILT, but were included as projects because stakeholders agreed that they are an important tool for protecting water quality preventing some future loadings. There are projects completed or underway as well as planned or conceptual projects for each of the source categories. **Table 19** summarizes the pounds of nitrogen loading removed by the management actions proposed for each source category. The percent reduction in loading is calculated from the nitrogen loading applied at the land surface and not at the top of the UFA. The greatest reductions in nitrogen

loading are achieved with the agriculture and urban fertilizer sources, however, all source categories have contributed nitrogen loading reductions.

The second evaluation of sufficiency considered the number of projects that will result in large loading reductions, address sources close to the springs, or pursue innovative technologies that produce larger reductions for the specific project type than typically expected. These types of projects are representative of a long-term commitment to improving the water quality of Rainbow Springs and Rainbow River and they support the guiding principles outlined in the BMAP. The following projects meeting these criteria are:

- The wastewater coordination efforts (Projects R052, R053 and R054) between Marion County Utilities and the City of Dunnellon has resulted in a conceptual framework to improve wastewater treatment facilities nearest to the springs to AWT standard for TN and connect the package plants nearest the springs to new treatment plant. The necessary collection system infrastructure would result in 266 OSTDS being connected to centralized sewer with the potential for many more to be connected in the future.
- Marion County has completed projects that utilize bioabsorptive media to reduce nitrogen loading and have other projects planned for the first BMAP phase. Project R063 proposes the use of a patented bioabsorptive media referred to as Bold and Gold to enhance nitrogen removal under three priority drainage retention areas (stormwater ponds). In addition, Marion County has proposed funds for future projects through 2019 (Project R051)
- FDACS is targeting cost-share funding for springs protection with emphasis on enrolling agriculture operations in high recharges areas and Marion County supports the Clean Farms Initiative and Water Quality Education and Equine Farm BMPs outreach (Projects B010, B041, and B011). FDACS will review its rule-adopted cow/calf and equine BMPs to identify the practices likely to have the greatest nutrient load reduction benefits (Project B043).

The final measure of sufficiency considered if the BMAP had next steps or a path forward so that management actions that reduce nitrogen loading would continue and strengthen as the BMAP process continues into later phases. An initiative (listed as a project) was created to address each of the major anthropogenic sources. They are:

- OSTDS and other wastewater issues are addressed through the wastewater management project OSTDS-9-1-1 Strategy, Project R071.
- Public Education Coordination, Project B036, addresses public education and outreach related to stormwater impacts.
- The implementation of an outreach program for the small farm equine BMP manual (Project B012) in collaboration with FDACS, Marion County, and other stakeholders.

Guiding principles developed for the source categories of wastewater, OSTDS, urban fertilizer, and agriculture, cover all the anthropogenic sources. These principles support the three BMAP initiatives described above as well as provide guidance for the BMAP process. Though these principles are not requirements they do provide stakeholders with recommended outcomes of management actions.

The management actions outlined in this BMAP as well as the proposed management initiatives provide sufficient direction for this BMAP to achieve reductions in nitrogen loading to Rainbow Springs and the Rainbow River. The guiding principles and BMAP initiatives help to define additional management needs that support the restoration of Rainbow Springs and Rainbow River water quality. Monitoring plans outlined in **Section 5.2** and the SWFWMD Springs Initiative provide for additional information and advancement of knowledge about the system to allow for adaptive changes to the management actions outlined in this BMAP and the initiation of additional actions as supported by data.

TABLE 19: LOADING REDUCTIONS BY SOURCE CATEGORY

¹ Includes credit for education and outreach efforts by stakeholders and reuse of effluent from WWTFs.

² Currently 46.8% of acreage covered by a NOI.

³ Number of agriculture projects represents activities that are in addition to BMP enrollment.

SOURCE CATEGORY	NUMBER OF PROJECTS ADDRESSING SOURCE	TN LOADING REDUCTION (LBS-N/YR)	TN LOADING AT LAND SURFACE (LBS-N/YR)	PERCENT REDUCTION
Urban Fertilizer ¹	44	41,771	493,558	8.5%
Wastewater	10	17,811	64,216	27.7%
OSTDS	4	11,140	526,687	2.1%
Agriculture ²	7 ³	754,375	9,519,891	7.9%

5.2 MONITORING WATER QUALITY

The existing SWFWMD monitoring network will support the evaluation of progress made toward achieving the TMDL target nitrate concentration of 0.35 mg/L. The sampling locations identified in this

Chapter represent the minimum requirements needed to achieve this purpose. The monitoring strategy includes the following two distinct sampling networks:

- **Surface Water Network** – Purpose is to evaluate the water quality of Rainbow Springs and the Rainbow River and identify and follow changes.
- **Ground Water Network** – Purpose is to evaluate changes in ground water quality in the Rainbow Springs BMAP area as well as the response of the aquifer to different land uses.

5.2.1 MONITORING OBJECTIVES AND ANTICIPATED BENEFITS

The water quality monitoring objective is to assess the impact of the management strategies undertaken by stakeholders to reduce nitrogen inputs to the UFA and Rainbow River. The monitoring goals are:

- 1. Identify and track changes in nitrate concentration in Rainbow Springs (at spring discharge) and Rainbow River to determine if TMDL targets are being achieved.*
- 2. Identify and track changes in nitrate concentration in the Floridan aquifer at specific well locations to estimate progress made towards achieving the TMDL target concentration at Rainbow Springs.*

The monitoring will allow stakeholders and the department to determine if the rise in nitrate (as nitrogen) concentration in the impaired WBIDs is being reversed and to adjust management strategies accordingly. Monitoring data will be reviewed with the stakeholders at annual meetings.

5.2.2 MONITORING NETWORK

SWFWMD maintains water quality monitoring stations (**Figure 12**) in the impaired segments that will provide data to assess the surface water changes. Ground water monitoring wells (**Figure 13**) in the BMAP area are also maintained by SWFWMD, where they perform sample collection and processing. These efforts will be used as the ground water monitoring component of the BMAP. The department anticipates that SWFWMD will be able to support these monitoring efforts through the five-year BMAP cycle.

Any station modifications or presence of unusual conditions should be noted in the field notes associated with specific sampling events. Every effort should be made to communicate this information to other stakeholders to support the accuracy of future trend analyses.

The surface water quality data will be the primary component of the monitoring program. Ground water data from SWFWMD or other agencies, if available, may also be used in the assessment of the stakeholder's management strategies if such data are useful.

5.2.3 QUALITY ASSURANCE/QUALITY CONTROL MECHANISMS

The collection of both ambient and performance-based water quality data will be conducted in a manner consistent with the department's standard operating procedures (SOPs) for QA/QC. The most current version of these procedures can be downloaded from the department's SOP website:

<http://www.dep.state.fl.us/water/sas/sop/sops.htm>. All stakeholders contributing data in support of the BMAP agree to follow these SOPs.

Quality control measures and field procedures have been implemented by SWFWMD. Sample chain of custody is maintained at all times. Laboratories performing analysis of the collected samples have the necessary quality control procedures in place to ensure accurate test results.

5.2.4 DATA MANAGEMENT MECHANISMS FOR DATA STORAGE AND RETRIEVAL

Data collected through the above activities will need to be tracked, compiled, and analyzed to be useful in support of the BMAP. The Florida Storage and Retrieval (STORET) database will serve as the primary resource for storing data and providing access for all stakeholders. Stakeholders have agreed to upload data to STORET in a timely manner, after the appropriate QA/QC checks have been completed.

STORET uploads are only appropriate for data that is representative of ambient conditions.

Performance-based data collected as part of a localized source identification project, BMP investigation, or similar activity are not representative of ambient water quality conditions. These data will not be uploaded into the STORET database.

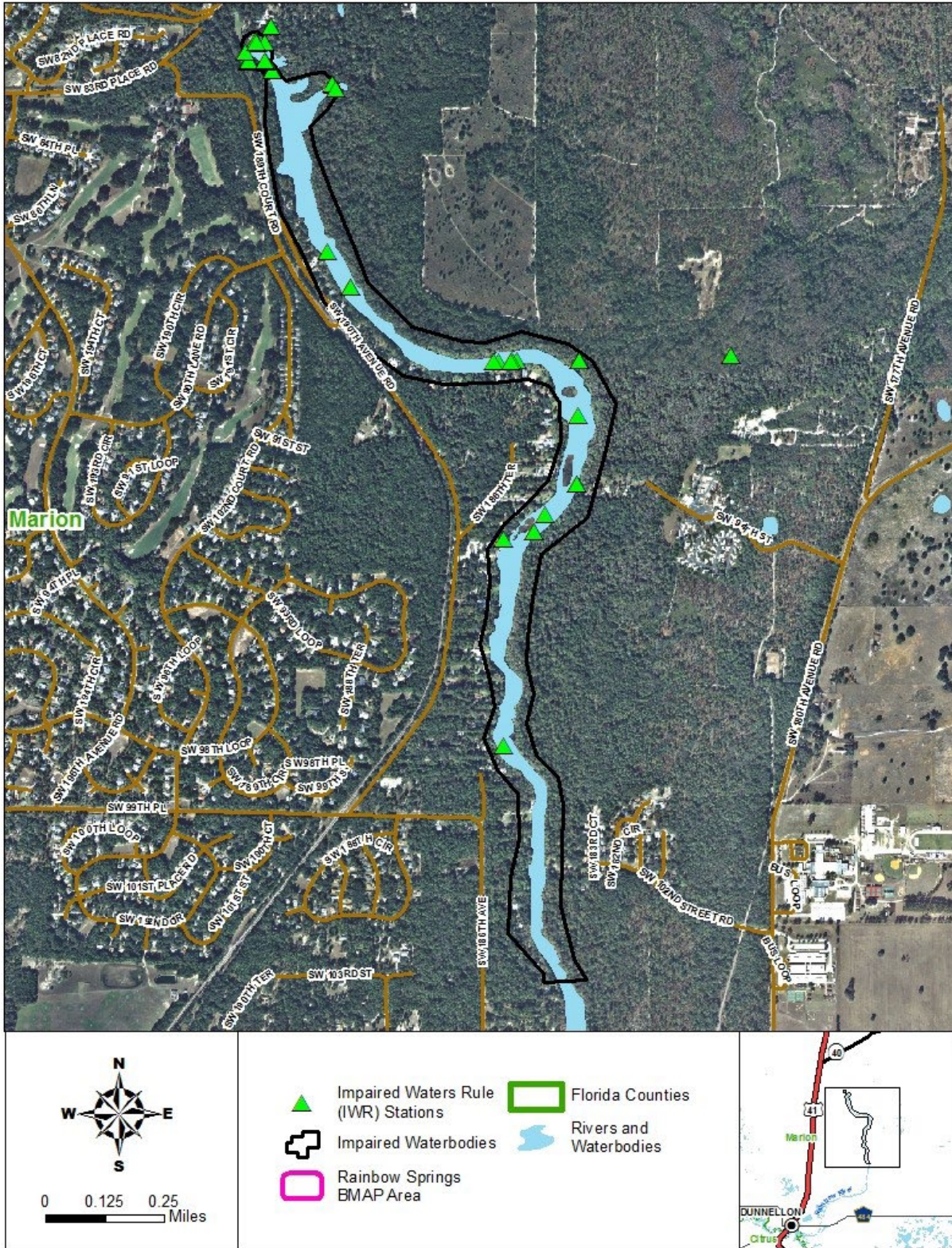


FIGURE 12: SURFACE WATER NETWORK MONITORING SITES

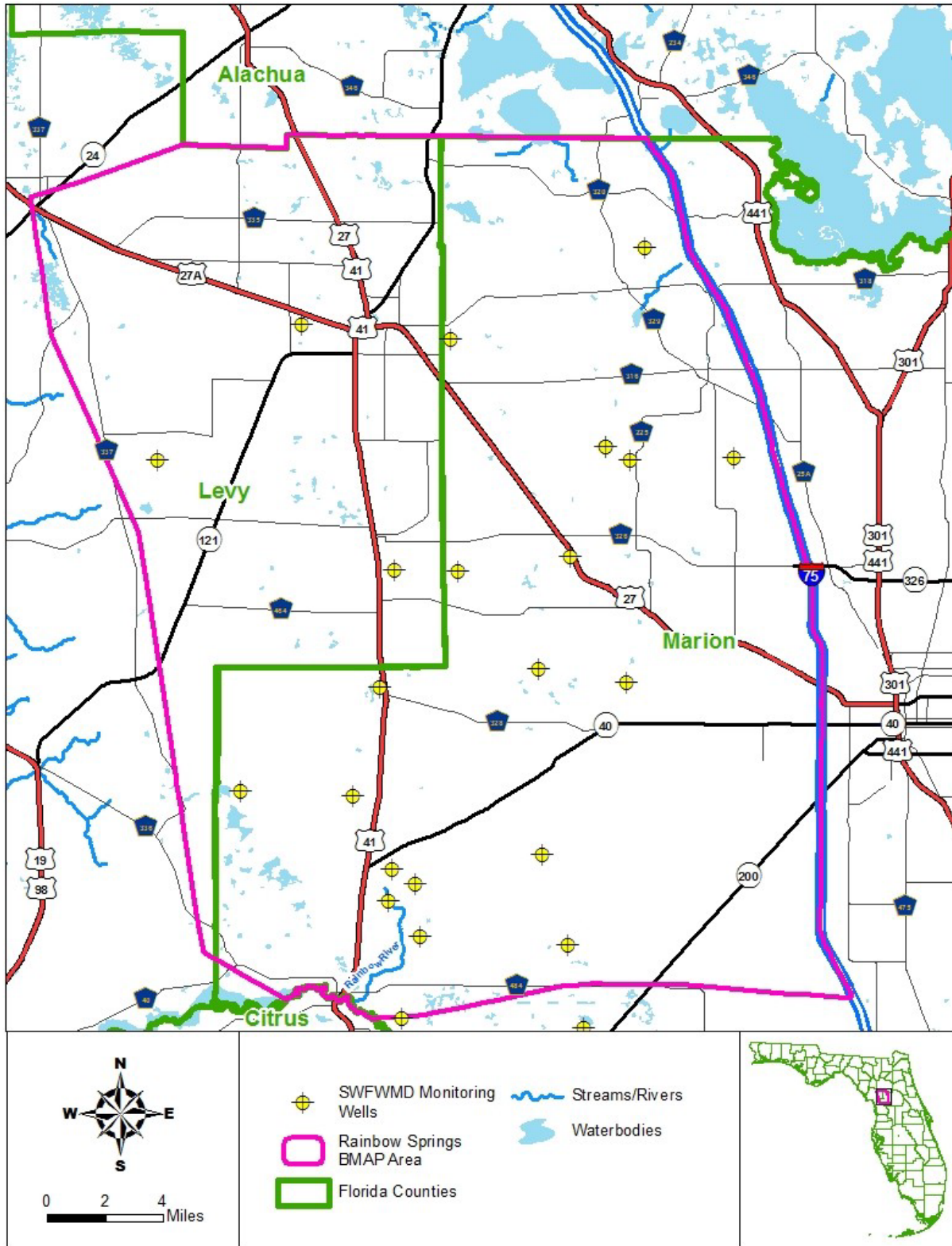


FIGURE 13: SWFWMD GROUND WATER QUALITY MONITORING SITES

5.3 FUNDING STRATEGIES FOR BMAP IMPLEMENTATION

The management strategies and associated projects presented in this BMAP require adequate funding for their implementation. The BMAP requires that stakeholders secure their own funding for a project; however, numerous federal, state, and local programs provide grants or loans for water quality improvement. This section provides an overview of state, water management district, and local funding sources. **Appendix C** contains more complete descriptions and information on where to find additional funding for state and federal resources.

Local governments provide funding through assessments of value of property or through fees or assessments collected for specific services. Stormwater assessment fees are generated by Marion County and Ocala to support their stormwater management programs. Many of the stormwater improvement projects adopted with the BMAP by these entities are funded through these locally generated fees.

The department makes available grants and loans for wastewater, drinking water, and stormwater management through different provisions of the Clean Water Act and also state funding sources. The Clean Water State Revolving Fund (SRF) Loan Program provides low-interest loans to local governments to plan, design, and build or upgrade wastewater, stormwater, and nonpoint source pollution prevention projects. The Drinking Water SRF loan program provides low-interest loans to local governments and certain private utilities to plan, design, and build or upgrade drinking water systems. Discounted assistance for small communities may be available.

The Small Community Wastewater Facilities Grants Program provides grants to fund the construction of wastewater facilities in municipalities with 10,000 or fewer people and per capita income levels below Florida's average per capita income. The program is linked to the Clean Water SRF Loan Program outlined above and is highly competitive.

Florida's Section 319 Grant Program administers funds received from the EPA to implement projects or programs that reduce nonpoint sources of pollution. Projects or programs must benefit Florida's priority watersheds (impaired waters); eligible activities include the demonstration and evaluation of urban and agricultural stormwater BMPs, stormwater retrofits, and public education.

Florida's Water Quality Restoration Grants administered by the department are awarded **three** times a year (March, July, and November) and are available to local governments and water management districts. The program prioritizes stormwater retrofit projects to benefit impaired waters, using similar selection criteria as the Section 319 Grant Program listed above.

Periodically, the legislature may solicit applications directly for Community Budget Issue Request projects, including water projects, in anticipation of upcoming legislative sessions. This process is an opportunity to secure the legislative sponsorship of project funding through the state budget. Other programs at both the state and local level offer the possibility of water infrastructure funding. Florida department of Economic Opportunity Small Cities Community Development Block Grant Program funds are available annually for water and sewer projects that benefit low- and moderate-income persons. Monies also may be available for water and sewer projects that serve a specific "job-creating entity," as long as most of the jobs created are for people with low or moderate incomes.

Water management districts offer financial assistance, through a cost-share program, for water conservation, alternative water supply development, water quality/nutrient loading, and water resource development. To be eligible for the SWFWMD cooperative funding initiative, the project should support one of the district's strategic initiatives, which for this BMAP would primarily be the Water Quality and Natural Systems Initiatives.

5.4 TRACKING AND FOLLOW-UP ACTIONS

BMAP implementation will be a long-term process. Significant unknowns remain regarding nutrient sources for Rainbow Springs and the steps needed to remediate them, as well as the fate and transport of nitrogen in the UFA. It is recognized that additional projects and initiatives will be required.

The department will track projects and other implementation efforts and monitor water quality in TMDL waterbodies to ensure that the BMAP is carried out and to measure its effectiveness. Key components of adaptive management are tracking implementation, monitoring water quality and pollutant loads, and holding periodic BWG meetings to share information and expertise. The department will request, as part of the tracking of projects, that stakeholders provide information regarding new projects for inclusion in the BMAP. The FWRA requires that the plan be revised, as appropriate, in collaboration with basin stakeholders.

Adaptive management measures include the following:

- Procedures to determine whether additional restoration actions are needed.
- Determining whether and when plan components need to be revised.
- Descriptions of the BWG’s role after BMAP completion.

5.5 ANTICIPATED OUTCOMES OF BMAP IMPLEMENTATION

Through the implementation of the stormwater education, wastewater, and small farm equine BMP initiatives, other projects and activities listed in this BMAP and future NSILT source assessment, stakeholders expect the following outcomes:

- Decreased concentration of nitrate in Rainbow River and Rainbow Springs Group Run.
- Decreased loading of nitrogen to the UFA.
- Improved coordination and communication among state and local governments and among all levels of government and the community.
- Improved project selection and targeted project implementation through the use of the Guiding Principles and use of the NSILT.
- Enhanced public awareness and understanding of the impacts of nitrogen loading on Rainbow Springs and Rainbow Springs Group Run.

5.6 COMMITMENT TO PLAN IMPLEMENTATION

While the BMAP is linked by statute to permitting and other enforcement processes that affect individual entities, successful implementation requires that local stakeholders willingly and consistently work together to achieve adopted TMDLs. This collaboration fosters the sharing of ideas, information, and resources. On a practical level, BMAP implementation also depends on adequate resources and necessary authorizations. The management strategies contained in the BMAP are either under way or are planned in good faith. Current and future actions are contingent on necessary funding and approvals for their initiation and/or continuation.

Stakeholders members have made commitments to address the following actions:

- Follow the Guiding Principles when developing new projects and continue to use an equitable and cost-effective, coordinated, comprehensive watershed management approach that applies the best available science to achieve TMDL-related pollutant load reductions and water quality improvements within a stakeholder’s authority.
- Seek necessary approvals and funding to implement consensus management strategies identified in the BMAP and implement those actions as required approvals and funding are secured.
- Track the implementation of management strategies for which a BWG member is responsible to ensure that the BMAP is carried out.
- Inform the department and the BWG of any permanent obstacles to carrying out management strategies for which they are responsible, including technical, funding, and legal obstacles.
- Conduct water quality monitoring (if applicable) according to the monitoring strategy.
- Continue to communicate and coordinate actions and funding across agencies and community groups with regard to BMAP implementation.

APPENDIX A: REFERENCES

- Chang, N., *et al.*, 2011. *On-Site Sewage Treatment and Disposal Systems Evaluation for Nutrient Removal*. Florida Department of Environmental Protection Project #WM 928. Orlando, FL: Stormwater Management Academy, University of Central Florida.
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APPENDIX B: REASONABLE ASSURANCE DEMONSTRATION

Those WWTFs which are permitted by the department on or before the date of BMAP adoption and which have not already achieved permit limitations equal to or more stringent than those required in **Section 4.3.2**, shall be given an opportunity to make a demonstration that reasonably assures the reuse or land application project would not cause or contribute to a violation of the 0.35 mg/L nitrate concentration established by the Rainbow Springs and Rainbow River TMDLs. The permittee shall submit this request to the appropriate department Regulatory District Office - Wastewater Program staff prior to or at the time of permit application. The demonstration shall be based on relevant water quality data, physical circumstances, or other credible information, and shall include at a minimum the information required in either paragraph (a) or (b) below:

- (a) Monitoring data from ground water well(s) sampling based on a department approved ground water monitoring plan, showing the annual median value (a minimum of four quarterly samples) for nitrate to be less than or equal to 0.35 mg/L at each demonstration well. The demonstration well shall be located within the flow path of the Floridan aquifer from the effluent reuse or land application site to Rainbow Springs, with the well depth of 15 to 20 feet below the depth of saturation within the Floridan aquifer. For facilities with a permitted capacity of less than 100,000 gpd, ground water data must be provided from at least one demonstration well. For facilities with a larger permitted capacity, ground water data must be provided from multiple demonstration wells, which must be placed using flow gradient data obtained from three local piezometers to define flow gradient. This data will dictate placement of the demonstration wells. The demonstration well(s) is to be located as proximate to the reuse or land application site as practicable. The demonstration shall include monitoring well information which indicates the presence or absence of karst conduits within the monitoring well's intersection of the ground water flow pattern. If this information indicates the presence of karst conduits within the monitoring well's intersection of the ground water flow pattern, additional information to that noted in this paragraph may be necessary for a final determination of the necessary TN effluent limit. The demonstration well(s) for rapid infiltration basin reuse or land application sites are to be located as proximate to the site as practicable without compromising the reuse or land application site integrity. The demonstration well(s) for spray irrigation reuse or land application sites is to be located along the downgradient border within the spray irrigation area.*

(b) Site specific information as necessary to make a demonstration of no contribution of nitrate at a concentration of 0.35 mg/L to the Floridan aquifer at a demonstration target depth of 15 to 20 feet below the depth of saturation within the Floridan aquifer. This demonstration may include factors such as:

- Dilution.
- Site-specific geological conditions.
- Research/studies, including dye tracer tests.
- Ground water transport modeling.

The demonstration will be jointly reviewed by appropriate staff from the following department programs: Central District Office or Southwest District Office as appropriate – Wastewater Program, Florida Geological Survey (FGS), and Division of Environmental Assessment and Restoration. If the department's review results in concern that the reuse or land application site effluent is reaching karst conduits, additional information to that noted in paragraphs (a) or (b) above may be necessary for a final determination of the necessary TN effluent limit. The final decision of demonstration of reasonable assurance will be made by the appropriate District Director in conjunction with input from staff in the department's FGS and the Division of Environmental Assessment and Restoration.

If the TN final effluent limit as described in Section is modified or waived subsequent to the demonstration of reasonable assurance, the permit shall include effluent monitoring requirements for TN and ground water monitoring requirements from the Floridan aquifer for nitrate as nitrogen. At each permit renewal, the demonstration of reasonable assurance shall be reviewed by the department programs previously identified in the joint review to reasonably assure the reuse or land application would not cause or contribute to a violation of the 0.35 mg/L nitrate concentration established by the Rainbow Springs and Rainbow River TMDLs. This review shall include the original data obtained during the initial demonstration as well as any new data that has been obtained since permit issuance.

APPENDIX C: FUNDING SOURCES

A BMAP must identify feasible funding strategies for implementing the management strategies presented. This appendix provides a list of potential funding sources.

The **Clean Water State Revolving Fund (SRF) loan program** provides low-interest loans to local governments to plan, design, and build or upgrade wastewater, stormwater, and non-point source pollution prevention projects. Certain agricultural best management practices may also qualify for funding. Discounted assistance for small communities is available. Interest rates on loans are below market rates and vary based on the economic wherewithal of the community. The Clean Water SRF is Florida's largest financial assistance program for water infrastructure. More information is available at www.dep.state.fl.us/water/wff/cwsrf.

The **Drinking Water SRF loan program** provides low-interest loans to local governments and certain private utilities to plan, design, and build or upgrade drinking water systems. Discounted assistance for small communities may be available. Interest rates on loans are typically 40% below market rates. More information is available at www.dep.state.fl.us/water/wff/dwsrf.

The **Small Community Wastewater Facilities Grants Program** provides grants to fund the construction of wastewater facilities in municipalities with 10,000 or fewer people and per capita income levels below Florida's average per capita income. A local match is required. The program is linked to the Clean Water SRF loan program outlined above, and is highly competitive. More information is available at www.dep.state.fl.us/water/wff/cwsrf/smalcwgp.htm.

Florida's **Section 319 grant program** administers funds received from EPA to implement projects or programs that reduce non-point sources of pollution. Projects or programs must benefit Florida's priority watersheds ("impaired waters"), and local sponsors must provide at least a 40% match or in-kind contribution. Eligible activities include demonstration and evaluation of urban and agricultural stormwater BMPs, stormwater retrofits, and public education. More information is available at www.dep.state.fl.us/water/non-point/319h.htm.

Funding for projects related to the implementation of **Total Maximum Daily Load** determinations may be available through periodic legislative appropriations to the department. When funds are available, the program prioritizes stormwater retrofit projects to benefit impaired waters, somewhat along the lines of the Section 319 grant program listed above. More information is available at www.dep.state.fl.us/water/watersheds/tmdl_grant.htm.

The Florida Legislature may solicit applications directly for **Community Budget Issue Request** projects, including water projects, in anticipation of upcoming legislative sessions. This process is an opportunity to secure legislative sponsorship of project funding through the state budget. The Legislature may coordinate applications with the department. In other years, the Legislature will not solicit projects but may include them in the budget in any event. You are advised to contact your local legislative delegation to determine whether there are opportunities available to fund your project. Information on contacting Senators and Representatives is available at www.leg.state.fl.us.

There are a number of other programs at both the state and federal levels that offer the possibility of water infrastructure funding. These include:

Florida Department of Economic Opportunity **Small Cities Community Development Block Grant Program** – Funds are available annually for water and sewer projects that benefit low- and moderate-income persons. Monies also may be available for water and sewer projects that serve a specific “job-creating entity” as long as most of the jobs created are for people with low or moderate incomes. For more information, visit <http://www.floridajobs.org/community-planning-and-development/assistance-for-governments-and-organizations/florida-small-cities-community-development-block-grant-program>.

Florida Rural Water Association Loan Program – This program provides low-interest bond or bank financing for community utility projects in coordination with the department’s SRF programs discussed above. Other financial assistance may also be available. For more information, visit www.frwa.net/ and look for the links to “Funding” and “Long-Term Financing.”

Enterprise Florida – Enterprise Florida’s program is a resource for a variety of public and private projects and activities, including those in rural communities, to facilitate the creation, capital investment, and strengthening and diversification of local economies by promoting tourism, trade and economic development. The various Enterprise Florida programs and financial incentives are intended,

among other things, to provide additional financial assistance to enable communities to better access other infrastructure funding programs. For more information, visit www.eflorida.com/; contact information is available from the “Contact Us” link at the top of the page.

Florida’s **five regional water management districts** also offer financial assistance for a variety of water-related projects, for water supply development, water resource development, and surface water restoration. Assistance may be provided from ad valorem tax revenues or from periodic legislative appropriations for Alternative Water Supply Development and Surface Water Improvement and Management projects. The amount of funding available, matching requirements, and types of assistance may vary from year to year. For information on funding opportunities, contact the water management district with jurisdiction in your area—see www.dep.state.fl.us/secretary/watman for a map and links to each of the districts.

U.S. Department of Commerce **Economic Development Administration Public Works and Development Facilities Program** – The program provides funding to help distressed communities in economic decline revitalize, expand, and upgrade their physical infrastructure to attract new industry, encourage business expansion, diversify local economies, and generate or retain long-term, private sector jobs and investment. The program focuses on redeveloping existing infrastructure. For more information, visit www.eda.gov/investmentPriorities.htm.

U.S. Department of Agriculture **Rural Development Rural Utilities Service Guaranteed and Direct Loans and Grants** – This program provides a combination of loans and grants for water, wastewater, and solid waste projects to rural communities and small incorporated municipalities. Some nonprofit entities also may be eligible. For more information, visit http://www.rurdev.usda.gov/UWEP_HomePage.html.

Congress’s **State and Tribal Assistance Grant Program** provides the opportunity to secure Congressional sponsorship of project funding, including water project funding, through the annual federal budget process. The program’s stated purpose is to strengthen state, local governments, and tribal abilities to address environmental and public health threats while furthering environmental compliance. You may want to consider contacting your Representatives or Senators for assistance in pursuing funding; see <http://thomas.loc.gov/links/>.

Grants.gov at <http://www.grants.gov/>, which is the official federal website for information on more than 1,000 federal grant programs. The site includes an automatic email notification system for keeping apprised of federal grant opportunities.

Catalog of Federal Domestic Assistance at <http://www.cfda.gov/>, which provides a database of all federal programs available to state and local governments; public, quasi- public, and private profit and nonprofit organizations and institutions; specialized groups; and individuals. There are a variety of sources of niche funding that may be appropriate to your situation. There are also private funding sources (endowments, private trusts, etc.) that may, on occasion, fund water-related projects; a variety of sources to investigate these opportunities are available on the web.

The **Florida Resource Directory** at <http://redi.state.fl.us/> provides a searchable directory of information about and links to many state and federal programs with resources available to help local communities. Funding for water-related projects is just one of many types of assistance identified here.

If you are interested in **disaster relief**, your first contacts should be to Florida's **Division of Emergency Management** at <http://www.floridadisaster.org/> or your county emergency management agency (see www.floridadisaster.org/fl_county_em.asp); and the **Federal Emergency Management Agency** at 1.800.621.FEMA (3362), or visit www.fema.gov/government/grant/pa/index.shtm, where the process for securing disaster-related infrastructure assistance begins.