



Water Quality/Quantity Best Management Practices for Florida Dairy Operations

2015 Edition

FDACS-P-02008



Florida Department of Agriculture and Consumer Services
Adam H. Putnam, Commissioner





FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES COMMISSIONER ADAM H. PUTNAM

COMMENTS BY COMMISSIONER ADAM H. PUTNAM

Dear Agricultural Producers:

This manual, *Water Quality/Quantity Best Management Practices for Florida Dairy Operations*, reflects the hard work of representatives of the industry; federal, state, and local government; and other stakeholders. In general, agricultural lands maintain valuable water recharge areas and preserve open spaces. The practices in this manual address water quality and quantity impacts from dairy production activities and help maintain the environmental advantages of keeping the land in agriculture.

While best management practices have been in place for many years in our state, their role in environmental protection was formally established in 1999 with the passage of the Florida Watershed Restoration Act. This legislation provides the framework for implementing Florida's Total Maximum Daily Load program, which sets water quality targets for impaired waters. It also identifies best management practices implementation as the means for agriculture to help meet those targets.

As Florida's population continues to increase, there are more impacts to and competition for Florida's limited water resources. All Floridians must take part in conserving and protecting these resources. This manual represents the industry's commitment to do just that.

As a native Floridian whose family has long been involved in agriculture, I want to thank all who participated with the Department in the development of this important manual. With the active support and participation of so many dedicated people, I am optimistic about the future of Florida's agricultural industry. I trust that you will join me in supporting this valuable water resource protection effort.

Sincerely,

A handwritten signature in black ink, appearing to read "Adam H. Putnam".

Adam H. Putnam
Commissioner of Agriculture

ACKNOWLEDGEMENTS

The following is a list of individuals who participated in the development of this manual. Each of these individuals and their organizations made important contributions to the process, and their work is sincerely appreciated.

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ACRONYM LIST

AFO – Animal Feeding Operation	GPS – Global Positioning System
ARS – Agricultural Research Service	HDPE – High Density Polyethylene
ASABE – American Society of Agricultural and Biological Engineers	HIA – High Intensity Area
BMAP – Basin Management Action Plan	IPM – Integrated Pest Management
BMP – Best Management Practices	K – Potassium
CAFO – Concentrated Animal Feeding Operation	MPH – Miles per Hour
C:N – Carbon to Nitrogen Ratio	N – Nitrogen
CNMP – Comprehensive Nutrient Management Plan	NMP – Nutrient Management Plan
CRF – Controlled Release Fertilizer	NOI – Notice of Intent
EPA – Environmental Protection Agency	NPDES – National Pollutant Discharge Elimination System
ERP – Environmental Resource Permit	NRCS – Natural Resources Conservation Service
ET – Evapotranspiration	P – Phosphorus
F.A.C. – Florida Administrative Code	RPM – Revolutions per Minute
F.S. – Florida Statutes	SWCD – Soil and Water Conservation District
FAWN – Florida Automated Weather Network	TKN – Total Kjeldahl Nitrogen
FDACS – Florida Department of Agriculture and Consumer Services	TMDL – Total Maximum Daily Load
FDEP – Florida Department of Environmental Protection	TN – Total Nitrogen
FEMA – Federal Emergency Management Agency	TP – Total Phosphorus
FIRM – Flood Insurance Rate Maps	UF/IFAS – University of Florida, Institute of Food and Agricultural Sciences
FOTG – Field Office Technical Guide	USDA – United States Department of Agriculture
GPM – Gallons per Minute	USGS – United States Geological Survey
	WMD – Water Management District
	WSP – Waste Storage Pond

INTRODUCTION

Things to Keep in Mind as You Use this Manual

- Italicized words that appear in **bolded red** are defined in the glossary
- Specific record-keeping requirements are noted using a “pencil mark” icon: 
- You can access this manual electronically at: <http://www.freshfromflorida.com/Water/Best-Management-Practices-BMPs>.

Dairy Operations Intended to Use this Manual

In order to enroll in the Florida Department of Agriculture and Consumer Services (FDACS) Dairy **Best Management Practices** (BMPs) program, farm operations must raise cows for milk production. BMPs for **pastures** and for field crops or forages grown for production of hay or silage that is fed back to the cows associated with the dairy are included in this manual. Growers that produce crops or livestock other than those covered by this manual should use the appropriate FDACS BMP manual. Dairies with a National Pollutant Discharge Elimination System (NPDES) or Florida Department of Environmental Protection (FDEP) Groundwater Discharge permit must follow their permit requirements, as FDACS BMPs do not replace these requirements. However, permitted dairies may want to use this manual for aspects of their operation that are not addressed by their permit.

For very small animal operations that are below the scale intended for this manual, please see the Livestock and Poultry Environmental Stewardship program at <http://www.extension.org/pages/8890/lpes-curriculum-small-farm-fact-sheets> or the Maryland Small Ruminant Page at <http://extension.umd.edu/sheep-goats> or UF-IFAS Extension at <http://edis.ifas.ufl.edu/>.

Dairy Overview

The **dairy** industry is extremely diverse and covers many geographic regions of Florida. There are an estimated 130 dairy farms currently operating in Florida, with most concentrated in Lafayette and Okeechobee counties.

According to the Florida Agricultural Statistics Service data from 2012, Florida has cash receipts of \$520 million for dairy products and is ranked 16th in the United States for dairy product production.

Florida’s milk production was 2.34 billion pounds in 2012. There were an estimated 122,000 milk cows in Florida on January 1, 2013. In addition, according to the Florida Dairy Farmers organization, Florida dairy farmers recycle about 170,000 tons of byproducts, such as citrus pulp, brewers’ grain, and whole cottonseed, which are consumed by the cows instead of ending up in landfills.

Dairies in Florida vary widely from pasture-based operations to confinement facilities where the cows spend the entire day under roof. Some dairies have cooling and/or feed barns that allow the cows to spend a portion of the day under roof and the rest in open pasture.

Cow comfort is of concern due to the Florida heat. Good cow comfort results in better milk production. Modern freestall barns have beds the cows can access as desired, are shaded all the time, and contain fans and misters that are run during the hot parts of the day. Cooling/feeding barns are used at some facilities to house the cows after milking to allow them to remain cool while feeding. These barns also allow for better feed control. However, usually only the high producing groups are allowed to remain in the barn during the day due to space restrictions.

Cows are usually milked twice a day in most pasture operations and three times a day in confinement operations. On pasture-based dairies, the cows may tend to stay close to the barns and not wander far away. This can lead to high nutrients on barren ground from overgrazing and concentrated manure deposition. Similar conditions can also occur around feed and watering troughs. Although some barren areas are always going to occur, the goal is to minimize these areas as much as possible.

Wastewater from the flushing of freestall barns, cooling/feed barns, and milk areas is collected and temporarily stored in a **waste storage pond** (WSP). The milking parlor must be cleaned by fresh water, but the other barns and crowd areas can be flushed with recycled water from the WSP. The wastewater usually goes into a sand or solids separator before going to a WSP. Some dairies also scrape or vacuum **manure** from barns in order to compost or haul it offsite.

Important Concepts Related to Dairy Management

Dairy management for water quality protection must consider strategic, tactical, and operational management variables. Strategic management directs the long-term goals of the farm, but information may be poorly structured and is often subjective. Farm goals and resources are essential variables of strategic management. Tactical management is intermediate between strategic and the day-to-day operational information, and integrates the details of farm organization with general management guidelines. Operational management determines and affects daily activities, and the technical information is very farm-specific, subject to rapid changes, such as weather, and relatively well structured. At this level, the characteristics of a dairy farm and the resources available to management are usually a fixed entity.

Producers should exploit whatever management means are at their disposal to achieve nutrient balance, which is an expected outcome of this manual. However, while some BMPs need to be prescriptive, most are flexible, allowing producers the opportunity to adapt to real operational situations. This encourages innovation and development of alternative solutions to accomplish the outcomes of water quality protection while maintaining or improving profitability.

Best Management Practices

BMPs are individual practices or combinations of practices that, based on research, field-testing, and expert review, have been determined to be the most effective and practicable means for maintaining or improving water quality. BMPs typically are implemented in combination to prevent, reduce, or treat pollutant **discharges**. BMPs must be based on sound science and be technically and economically feasible.

BMPs and Water Quality

Since the industrial permitting programs of the 1970s and 80s, more recent studies conducted by the United States Environmental Protection Agency (EPA) indicate that urban and agricultural nonpoint sources are now the nation's greatest contributors to water pollution. Much of the contribution is due to rainwater carrying pollutants into lakes, rivers, wetlands, estuaries, and ground water. It is good stewardship and makes sense for growers to prevent or minimize these impacts by using BMPs. The Florida Legislature has established BMP implemen-

tation as the non-regulatory means for agricultural nonpoint sources to comply with state water quality standards. When you implement BMPs you are also affirming the Legislature's support for this approach.

Total Maximum Daily Loads

Under the Federal Clean Water Act and Florida law (section 403.067, F.S.), the Florida Department of Environmental Protection (FDEP) must identify impaired **surface waters** and may establish Total Maximum Daily Loads (TMDLs) for those specific pollutants entering these waters. A TMDL establishes the maximum amount of a pollutant that can be discharged to a waterbody and still meet state water quality standards. Some pollutants for which TMDLs have been set include: total phosphorus, total nitrogen, total suspended solids, and coliform bacteria.

FDEP may develop and adopt Basin Management Action Plans (BMAPs), which contain the activities that affected interests need to undertake to reduce point and nonpoint source pollutant loadings. In **watersheds** with adopted BMAPs, and in some other areas, agricultural producers either must implement FDACS-adopted BMPs or conduct water quality monitoring prescribed by FDEP or the water management district (WMD).

Florida already has adopted a significant number of TMDLs and BMAPs, and many more are pending. More information on listed waterbodies and adopted TMDLs is available at <http://www.dep.state.fl.us/water/tmdl/index.htm>. To see a map of BMAP areas and learn more about BMAP development, go to <http://www.dep.state.fl.us/water/watersheds/bmap.htm>. If you need help figuring out whether you are in a BMAP area, call (850) 617-1727, or e-mail AgBMPHelp@freshfromflorida.com.

Benefits of Implementing BMPs

Before FDACS adopts BMPs, both FDACS and FDEP staff work closely with the industry and the extension service to ensure a full understanding of the agronomic, practical, managerial, environmental, and financial issues to be addressed by the manual. During the drafting stage, on-farm field evaluations of the manual are conducted with willing stakeholders. The FDEP conducts a final review before rulemaking to determine whether the BMPs will be effective in addressing water quality impacts from agricultural operations.

Benefits to enrolling in and implementing FDACS BMPs include:

- Maintaining support for this non-regulatory approach to meeting water quality and conservation goals through demonstrating agriculture's commitment to protecting water resources.
- Some BMPs increase production efficiency and reduce costs.
- Eligibility for cost share (as available) and technical assistance to help with BMP implementation.
- A presumption of compliance with state water quality standards for the pollutants addressed by the BMPs.
- Release from fines for damages imposed under section 376.307(5), F.S., for pollutants addressed by the BMPs.
- The Florida Right to Farm Act (section 823.14, F.S.) generally prohibits local governments from regulating an agricultural activity that is addressed through rule-adopted BMPs that growers implement.
- Producers who implement FDACS-adopted BMPs might satisfy some WMD permitting requirements.

Implementation of BMPs does not exempt agricultural operations from complying with applicable permitting or other regulatory requirements.

State and Federal Regulations

The EPA has delegated authority to FDEP to issue all applicable EPA permits that might be required. In general, dairies that have less than 700 mature cows (annual average basis) in confinement do not need to have an **NPDES permit**, unless the dairy has a direct discharge of **process wastewater** to surface waters of the state. Examples of a direct discharge are runoff from a barren lot into a creek, wastewater from a WSP flowing into a wetland that exits the property, or cows from confinement areas that wade into a stream.

If your farm/facility is considered to be a **concentrated animal feeding operation** (CAFO), or an **Animal Feeding Operation** (AFO) you may be subject to federal and/or state permitting requirements. The threshold for this is when animals have been, are, or will be stabled or **confined** and fed or maintained for a total of 45 days or more in any 12-month period; and when crops, vegetation, forage growth, or post-harvest residues cannot be sustained in the normal growing season over any portion of the lot or facility due to animal activity. If so, federal National Pollutant Discharge Elimination System regulations pursuant to 40 CFR, Part 122, and/or state regulations pursuant to 62-670, F.A.C., may apply. See <http://www.dep.state.fl.us/>

[water/wastewater/iw/afo.htm](http://www.dep.state.fl.us/water/wastewater/iw/afo.htm) or call the FDEP Industrial Wastewater Program at (850) 245-8589 if you need help determining whether your facility requires a permit.

Permit Exemptions

Some agricultural activities, especially those that alter on-site hydrology may require an Environmental Resource Permit (ERP). Check with your WMD or FDACS before beginning construction of any stormwater management system to see whether a permit is needed, or whether the following exemptions apply:

Under subsection 373.406(2), F.S., any person engaged in the occupation of agriculture may alter the topography of any tract of land for purposes consistent with the practice of agriculture. However, these activities may not be for the sole or predominant purpose of diverting or impeding surface waters, or adversely impacting wetlands. Agricultural activities that meet these criteria may be exempt from an ERP. If a formal dispute between a land owner and a WMD arises, FDACS has the exclusive authority to make a binding determination, if either party requests it.

Under subsection 373.406(9), F.S., environmental restoration activities on agricultural lands that have minimal or insignificant impacts to water resources may also be exempt from an ERP, upon written request by the producer and written notification from FDEP or the WMD that the proposed activity qualifies for the exemption.

Under subsection 373.406(13), F.S., upland, unconnected farm ponds up to 15 acres in size may be exempt as long as the average depth is less than 15 feet and they are located at least 50 feet from wetlands.

Even if an exemption applies, agricultural producers within a watershed with an adopted BMAP that addresses agricultural loadings either must implement BMPs or conduct water-quality monitoring.

Local Government Regulation

In general, nonresidential farm buildings are exempt from the Florida Building Code and associated county building codes, in accordance with sections 604.50 and 553.73, F.S. However, permits may still be required for construction or improvement of certain farm buildings, so it is important to check with your county building and permitting office before beginning construction.

The Florida Right to Farm Act (section 823.14, F.S.) provides that, with certain exceptions, a farm that has been in operation for one year or more and was not a nuisance at the time of its established date of operation is not a public or private nuisance, if the farm conforms to generally accepted agricultural management practices. In addition, the Act provides that a local government may not adopt any ordinance, regulation, rule, or policy to limit an activity of a bona fide farm operation (with an agricultural land classification under s. 193.461, F.S.) if the activity is regulated through implemented BMPs adopted by FDEP, FDACS, or a WMD. Not all activities conducted on a farm are addressed by adopted BMPs, and some other exceptions apply, so it is important to research this beforehand.

POTENTIAL WATER QUALITY IMPACTS ASSOCIATED WITH DAIRIES

Dairies produce significant amounts of nitrogen (N) and **phosphorus** (P) via animal manure, which is an organic fertilizer product that reduces a farmer's dependence on commercial fertilizer. Some of these manure products may be hauled off site, but a majority on most farms is recycled and applied to crops or hayland, which can present water quality challenges.

Nutrients

Excess N and P are the most common causes of water quality impairments in Florida. These nutrients can enter surface waters through stormwater or irrigation runoff, or leach through soils into ground water.

Nitrate is a special health concern because excessive levels in drinking water can cause methemoglobinemia (blue baby syndrome) in infants. Case studies show that the likelihood of this condition increases rapidly when water contains nitrate-N above 20 parts per million. Because of the extensive interconnection of Florida's aquifers and surface waters, Florida requires that all potable ground waters meet federal drinking water standards. For nitrate-N, federal and state regulations set this standard at 10 parts per million. Extremely shallow wells (less than 50 feet), and old wells that may have faulty casings, are at the highest risk for nitrate contamination.

The form of N most abundant in natural surface waters is soluble organic nitrogen. In aerobic well-drained soils, nitrogen is usually transformed by bacteria to nitrate (NO_3^-) which is a plant-available form. Due to its high mobility, NO_3^- can also leach from soil into ground water. Nitrogen and P are key elements necessary for the growth of plants and animals. In terms of freshwater ecology, P tends to be the (growth) limiting nutrient, especially in lakes. Phosphorus is more effectively retained in the soil than N. However, P attached to particulate matter usually enters waterbodies via sediment transport, or can be dissolved in water. In rare cases, some P may be prone to leaching into ground water.

The Nitrogen Cycle

The N cycle, like other cycles, has no clear beginning or end, as shown in **Figure 1**. In theory, the cycle begins with N in soil organic matter, where it can be decomposed and converted into inorganic forms by soil microorganisms (bacteria and fungi) in a process called mineralization. These specialized bacteria and fungi, also called decomposers, are generally found in the uppermost soil layers.

In the presence of oxygen, certain bacteria convert ammonia (NH_3) via nitrite (NO_2^-) into NO_3^- through a process known as nitrification. If NO_3^- is not taken up by plant roots, it is very mobile and can be transported below the root zone and leached; **denitrified** in anaerobic (low-oxygen) soils into nitrogen (N_2) or nitrous oxide (N_2O) gas; or volatilized into ammonia gas. In sandy soils, the bottom of the root zone is typically 12 inches for shallow-rooted crops and 3 feet for the deepest-rooted crops (the actual rooting depth may be limited by the presence of compaction layers, acidic layers, or a spodic horizon). Because the water-holding capacity of most sandy soils is typically 10%, the top 12 inches of soil can only hold about 1 inch of water. If more water is added, water will readily move downward.

Once below the root zone, NO_3^- may enter the hydrologic system and can become a pollutant. It not only affects surface waters such as springs, lakes, rivers and streams upon re-emergence,

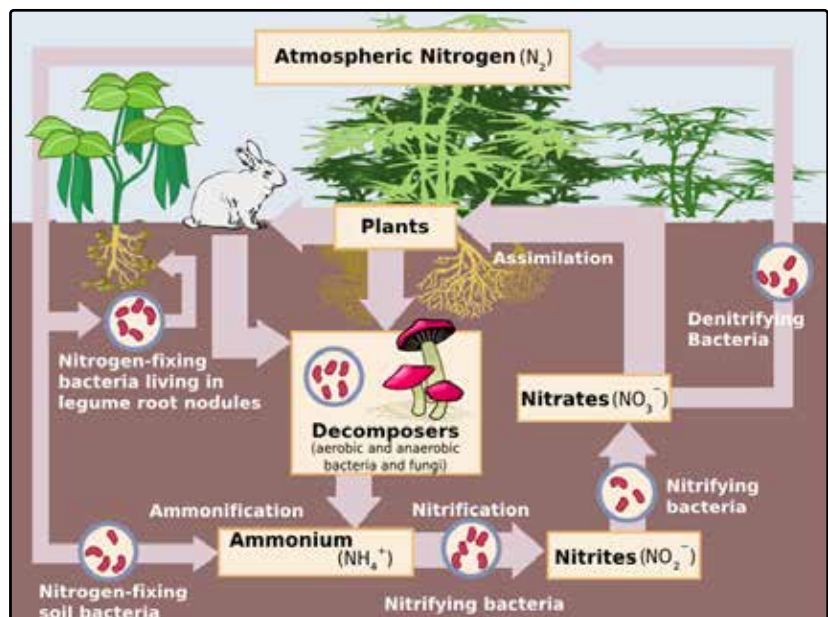


Figure 1

but can also cause human health concerns for potable wells. **Karst** geology is commonly found throughout Florida, where a sand layer of variable thickness covers a limestone base, as depicted in **Figure 2**. Through repeated wet/dry cycles, limestone can slowly dissolve to create **sinkholes** and other fissures, where pollutants can enter ground water, and later re-emerge through springs vents that flow to spring-fed rivers.

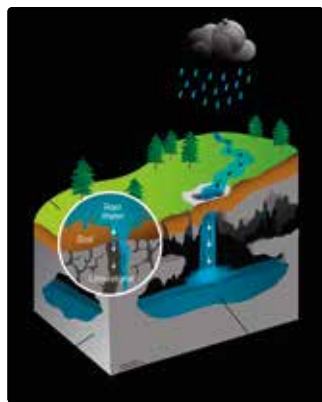


Figure 2

Nitrogen gas can be biochemically converted in soil by specialized microorganisms, through a process called nitrogen fixation, which makes N available to crops. This generally occurs in legume plants that have nitrogen-fixing bacteria living within their root nodules. The main legume crops that are grown commercially in Florida are peanuts, snap beans, soybeans, black-eyed peas, alfalfa, and perennial peanut forages. The environmental benefit of growing legumes is a significant reduction in commercial N fertilizer inputs.

The last phase of the N cycle is the return of organic matter to the soil. Soil organic matter may

originate from crop residue, incorporation of cover crops, and/or the addition of organic amendments such as compost, manure, or biosolids. In Florida, soil organic matter content is often very low, and is quickly decomposed and mineralized.

The Phosphorus Cycle

The P cycle, as depicted in **Figure 3**, is much different than the N cycle. The three major forms of P in mineral soils are organic P associated with humus, insoluble P, and plant-available P in soil solution. The most biologically active form of P is the phosphate ion (PO_4^{-3}). P is present in plants, manures, soil organic matter, and in mineral deposits such as sand and rock. When plant residues and other organic materials biodegrade, phosphate is released and returned to the environment.

In soil, P species exist as a soluble form in the soil solution, a labile (relatively soluble) form, or as an immobilized (insoluble) form. The change (transformation state) between these three forms generally depends on microbiological reactions and soil pH. Unlike N which is highly mobile, P mobility is limited in most environments due to low solubility and soil adsorption. Plant availability of soluble P is dependent on soil chemistry. P adheres to mineral soil particles and clay components through a process known as adsorption. Further, P tends to build up near the soil surface, making it readily available for transport as particulate matter in runoff via erosion. The exception to this is on coarse uncoated sands, predominant in areas of Central and South Florida, which have an extremely low ability to adsorb P.

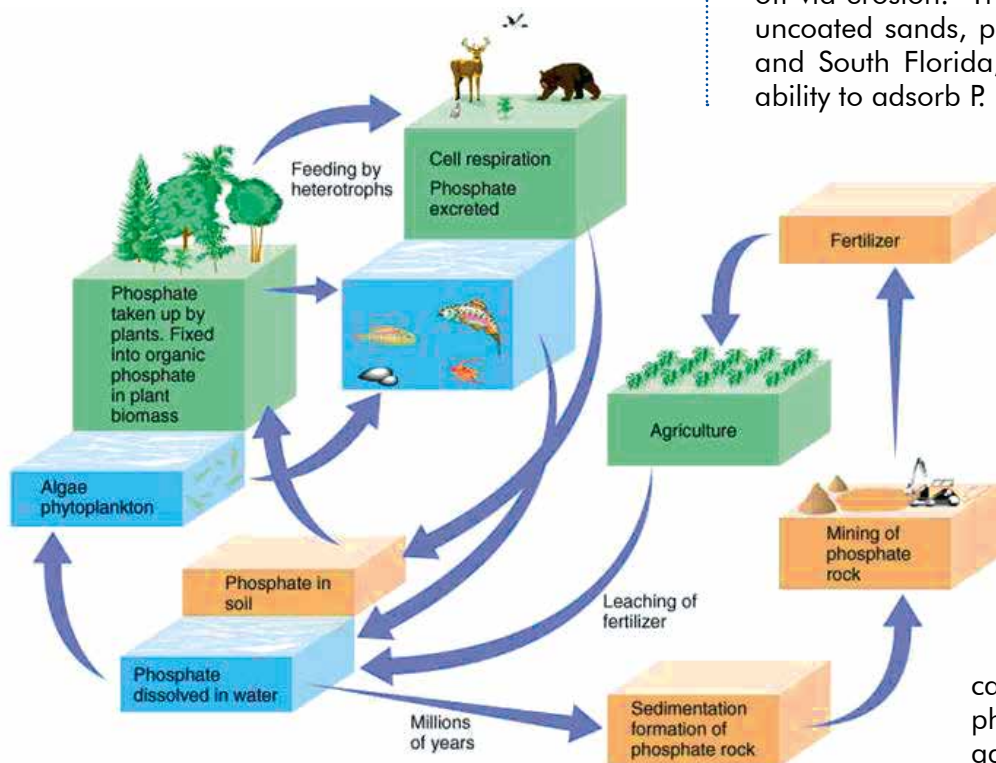


Figure 3

Excess Algal Growth

Algae are microscopic food-chain plants that provide the nutrition necessary to support aquatic animal life. Certain types of algae also provide habitat for aquatic organisms. However, high levels of nutrients in surface waters result in abnormal plant growth, including algae. The presence of algal blooms, submersed aquatic vegetation, and too many floating aquatic plants can block sunlight necessary for photosynthesis by submerged aquatic plants. The mass die-off and decomposition of these mate-

rials lower the available dissolved oxygen, which can lead to fish kills.

Blue-green algae (**Cyanobacteria**) can become so abundant that they can cause a scum layer to form on the surface, shading the sunlight-dependent life below and disturbing the food chain. Cyanobacteria can also produce toxins known to cause liver and nervous system effects in humans.

Sedimentation

Sedimentation occurs when eroded soils are washed into surface waters, creating a buildup of solids on the bottom and suspended solids (turbidity) in the water column. Sedimentation impacts most commonly associated with agricultural operations come from the erosion of unprotected (non-vegetated) soils. Slope can further exacerbate this issue.

Sediment can fill in water bodies, clog waterways, carry pollutants, and affect water clarity. These effects combine to reduce fish, shellfish, and plant populations, and decrease the overall productivity of lakes, streams, estuaries, and coastal waters. Decreased penetration by sunlight can affect the feeding and breeding behaviors of fish, and sediments can clog gills and cause irritation to the mucous membranes covering the eyes and scales. As the sediment settles, fish eggs can be buried. Recreational use may also decline because of reduced fish populations, less visibility, and reduced desirability of associated swimming areas.

Sediment deposits reduce the flow capacity of ditches, streams, rivers, and navigation channels, which can require more frequent maintenance dredging or result in flooding of farm areas. Nutrients and other contaminants, such as pesticides, can attach to sediments and have a negative water quality effect on downstream areas. Over time, these contaminants may be released from the sediment and become suspended in the water column, posing new problems.

Fecal Coliforms

Fecal coliforms from wildlife, uncomposted manure, or improperly treated or applied **biosolids** are another cause of water quality degradation. The likelihood of contamination is increased if these materials are applied in excess of agronomic rates or under wet weather conditions. The decomposition of fecal and other organic matter in water can lead to increased biological oxygen demand and lower dissolved oxygen levels. Fecal coliforms also can have serious human health impacts.

Other Regional Considerations

In the South Florida flatwoods production region, many farms' waste application areas are on flat, sandy soils that have a **spodic horizon**, commonly referred to as hardpan. These soils typically are poorly drained and have high water tables. Because of these characteristics, artificial drainage is often required to grow viable crops, or wastewater must be stored for long periods of time to avoid being applied when water tables are high.

In contrast, parts of the North Florida production region are on karst geology. This type of geology is very vulnerable to leaching of NO_3^- to ground water, and runoff into karst features and sinkholes that link to the aquifer. Wastewater applications during or prior to excessive rainfall events often cause nutrients to leach below the active root zone area, increasing the risk of nitrate contamination of the aquifer and spring system. The standard in Florida for springs and springs runs is 0.35 mg/l nitrate. Where springs or other surface waters are influenced by the groundwater, this standard will likely affect agricultural operations within a springshed. From a practical standpoint, large sinkholes that appear in pastures or **land application areas** should be fenced off around the buffer.

Some other parts of this production region are known for slope and loamy soils, making them more prone to erosion and sedimentation.

KEYS TO POLLUTION PREVENTION

It is agriculture's responsibility to protect water quality and water supply by implementing BMPs. Implementing BMPs helps demonstrate the industry's commitment to protecting water resources, and maintains support for this non-regulatory approach. Below are key guidelines.



Understand Water Quality Issues on Your Operation

Water quality includes chemical, biological, and physical characteristics. Elevated levels of phosphorus, nitrogen, sediment, bacteria, and organic material contribute to the degradation of water quality. The potential for discharges from agricultural operations to cause water quality problems varies, depending on soil type, slope, drainage features, nutrient management practices, and activities in or near **wetlands**, surface waters, or karst features. Farm management practices determine an operation's impact on water quality. For more information on surface water quality, go to the following link: <http://lakewatch.ifas.ufl.edu/LWcirc.html>. For information on ground water quality, go to: <http://edis.ifas.ufl.edu/fe601>.



Manage Nutrients Properly

Managing nutrients carefully is critical to protecting water quality. Minimize the pollutants that leave your property by controlling the types of materials used on your operation. Nutrient-related pollutant discharges can come from excess use or inefficient placement or timing of commercial fertilizer, manure, wastewater and/or biosolids applications. Fundamental to sound fertilizer management are the 4Rs, which involve using the right fertilizer, at the right time, at the right rate, with the right placement. More information about the 4Rs can be found at: www.nutrientstewardship.com. Dairies can be a particular challenge because manure is produced 24 hours a day, 365 days a year. The advantage of manure is that it acts as a slow-release fertilizer; that is, not all the nutrients are released immediately.



Manage Irrigation Carefully

Water is the carrier for nearly all pollutants. Irrigating in excess of the soil's water-holding capacity will lead to increased runoff or leaching. Precisely managing irrigation to keep moisture primarily in the plant's root zone will significantly reduce nutrient-related impacts from fertilizers.



Minimize the Potential for Erosion Impacts

Land clearing, culvert installation, road construction, ditch and canal maintenance, livestock activity and cultivating short-term crops can expose soil and lead to erosion and increased pollutant loading. It is very important to take appropriate erosion control measures during these activities.



Impervious Areas

Impervious areas (trails, roads, barn roofs, parking and staging areas, etc.) are inevitable, but they should be limited as much as possible. Impervious areas can increase and channelize the runoff (flow) from the farm, which can in turn lead to greater erosion or flooding problems. Problems can be compounded downstream, as high flows often cause undercutting and slumping along stream banks, leading to increased stream sedimentation. Therefore, minimize the creation of impervious areas as much as possible. Check with FDACS or your WMD before creating any new impervious areas on your property, since this may be a regulated activity.

USER'S GUIDE TO BMP ENROLLMENT AND IMPLEMENTATION

The steps below will help you select which BMPs to implement to reduce or avoid impacts to water quality coming from your operation.


Notes:

- In areas where FDEP has adopted a Basin Management Action Plan, agricultural operations must either implement applicable FDACS-adopted BMPs or monitor their water quality to demonstrate compliance with water quality standards.
 - Producers who submit a Notice of Intent (NOI) to implement the BMPs in this manual, implement and maintain the applicable BMPs, and achieve nutrient balance on the dairy operation covered under the NOI have a presumption of compliance with state water quality standards for nitrogen and phosphorus. Dairies with a National Pollutant Discharge Elimination System (NPDES) or FDEP Groundwater Discharge permit are governed by their permit requirements.
 - If you have a Natural Resources Conservation Service (NRCS) approved **comprehensive nutrient management plan** (CNMP) or FDEP approved **nutrient management plan** (NMP), and are implementing all listed practices, you do not need to complete the Nutrient and Waste Storage Pond Calculations that begin on page "Nutrient and Waste Storage Pond Calculations" on page 56.
 - If you have a dedicated replacement heifer operation to supplement the dairy herd, implement the applicable BMPs in Sections 1.1.1, 1.1.2; and Chapters 3, 4, 5, 6, 7 and 9. You do not need to complete the Nutrient and Waste Storage Pond Calculations that begin on page "Nutrient and Waste Storage Pond Calculations" on page 56.
- 1. Request On-farm Technical Assistance, as Needed.** FDACS field staff, NRCS, and contractors are available to assist you with evaluating what BMPs are applicable to your operation. For free assistance, call (850) 617-1727, email AgBmpHelp@FreshFromFlorida.com, or contact a field person in your area (see **Appendix 9**)
 - 2. Conduct an Inventory.** The selection of BMPs begins with a basic inventory of the farm's natu-

ral features, structures, and other improvements. Sources include:

- ✓ Aerial photographs (<http://earth.google.com>, or other providers)
- ✓ NRCS soil survey maps (<http://websoilsurvey.nrcs.usda.gov/app/>)
- ✓ USGS topographic maps (<http://topomaps.usgs.gov>)
- ✓ National Wetlands Inventory (<http://www.fws.gov/wetlands/>)

- 3. Select the Applicable BMPs.** Carefully read the manual and select all of the BMPs that are applicable to your operation and feasible for you to implement. Applicable Level 1 BMPs must be implemented. Level 2 BMPs only need to be implemented if certain criteria apply. Record the BMPs on the checklist in **Appendix 10** of this manual. The checklist includes a column for you to schedule BMP implementation if a practice is not already in place.
- 4. Required Calculations for this Manual.** Besides implementing BMPs, a significant number of calculations are required by this manual to demonstrate nutrient balance. Tables and flowcharts have been provided in the appendices to help producers complete these calculations.
- 5. File a Notice of Intent (NOI) to Implement BMPs.** Complete and submit to FDACS an NOI, contained in **Appendix 10** of this manual, along with the BMP checklist and, if applicable, a copy of your CNMP or FDEP approved NMP. Once received by FDACS, the NOI formally enrolls your operation under the BMP program. Implementation of the BMPs provides a presumption of compliance with state water quality standards for the pollutants the BMPs address. Implementation includes ongoing record keeping and maintenance of the BMPs.
- 6. Implement the BMPs.** Implement all applicable Level I BMPs as soon as practicable, but no later than 18 months after submittal of the Notice of Intent to Implement. Level II BMPs may take longer than 18 months, depending upon the availability of state or federal cost-share.
- 7. Keep records on BMP Implementation.** FDACS rule requires record keeping to document BMP implementation. Fertilizer, manure solids,

wastewater applications and rainfall amounts are types of record keeping. Record-keeping requirements are identified by a  in the manual. All BMP records should be accurate, clear, and well-organized. You may develop your own record-keeping forms or use the ones provided in **Appendix 8**. You must retain the records for at least 5 years. However, it is desirable to retain records for as long as possible, to address any potential future legal issues. All documentation is subject to inspection. Confidential records should be labeled appropriately, in accordance with chapters 812 and 815 F.S., or section 403.067 F.S.

BMP Implementation Plan

It is advisable to consolidate your inventory and all your BMP decision-making, including the BMP Checklist, into a simple implementation plan, which will serve as a record of scheduled and completed BMPs, including operation and maintenance activities. A well thought-out, written plan enables managers and owners to schedule their activities and accomplish their objectives. Remember to keep the plan available and update it regularly. It will help you communicate with your employees, your county extension agent, FDACS and USDA-NRCS staff, or others.

BMP Implementation Follow-Up

FDACS has developed a BMP “Implementation Assurance” program to help evaluate how BMPs are being implemented, and to gather feedback on whether there are obstacles to using any of the practices. On a cyclical basis by BMP program, FDACS mails surveys to enrollees, which contain questions about BMP-related activities. The surveys are anonymous in terms of a producer’s identity. Also, FDACS staff visit enrolled operations, at a mutually agreed upon time, to get more direct input from producers. The Implementation Assurance effort helps in:

- Documenting the level of participation in implementing agricultural BMPs.
- Identifying needs for education and implementation assistance.
- Reinforcing the importance of BMP implementation.
- Evaluating the effectiveness of FDACS BMP programs.
- Updating FDACS NOI records.

Your participation in these follow-up activities is vital to the continuing success of agricultural BMP programs in Florida.



BEST MANAGEMENT PRACTICES



1.0 NUTRIENT MANAGEMENT

Nutrient management is the control of the source, rate, placement, and application timing of feed, nutrients, and soil amendments to ensure nutrient balance and minimize impacts to water quality.

All applicable Level I and necessary Level II BMPs in the sections below must be implemented in addition to the nutrient management calculations which appear later in this manual. While nutrient management is the most obvious issue for most dairies, many other areas of the operation also provide opportunities to reduce offsite transport of pollutants. These too are addressed in the BMPs in this manual.

Nutrient management is the most important aspect of minimizing impacts to Florida's waters. If at any point the dairy is not in nutrient balance, the producer should carefully review the BMPs again and re-evaluate nutrient sources to uncover additional opportunities to implement applicable practices.

Whole Farm Nutrient Balance

Dairies, as with many types of farms, are perceived by a large segment of the public as a threat to the environment. As with many such perceptions, they

are founded on a grain of truth, many questionable assumptions, and a large dose of media attention.

Dairies have two key over-riding attributes: nutrients and profitability. Nutrients, mainly in the form of nitrogen (N) and phosphorus (P), should ideally be balanced. Doing so requires an accounting of all N and P nutrient sources entering the farm, minus those leaving the farm as "managed flows" to achieve as close to a zero sum as possible. Some studies, though none were from Florida, found dairies with N imbalances as high as 59% to 86%. The laws of thermodynamics notwithstanding, dairies must do their best given the constraints of practicality and on-farm economics. Even though a zero sum is impossible to achieve, dairies should strive to achieve nutrient balance.

Nutrient inputs include those from purchased feed, fertilizers, and animals; atmospheric deposition from both wet (rain) and dry (windborne dust) sources; N fixed from the atmosphere by legumes; and, nutrients in irrigation and drinking water for the animals. Managed outputs include animals, milk, or crops sold or otherwise removed from the site, and manure or manure products transported

off-site (e.g., fertilizer on another farm or composted product sold to the public). The imbalance between inputs and managed outputs are the unmanaged outputs (soil storage, erosion, volatilization, runoff, leaching, animals defecating directly into a stream, etc.) that over time will negatively impact a dairy operation.

A farm which is close to whole farm nutrient balance and minimizes unmanaged outputs is almost impact-free from a water quality standpoint, and very likely profitable since maximum use is made of all purchased nutrients. Ultimately, an unrecoverable loss of nutrients through unmanaged outputs results in a loss of cash flow used to purchase those nutrients in the first place.

Feed Sources, Nutrition and Feed Storage Considerations

All dairies import nutrients in the form of commercial feed, animals, and/or fertilizer. They also export considerable nutrients in milk and in any animals that are removed. Significant recycling of nutrients occurs on most dairies through land application of manure, uptake by crops planted in the application areas, and feed that the crop produces, which is usually fed to the cows. Several of the dairy feed stocks result from agricultural by-products that otherwise might have to be disposed of in a landfill. Citrus pulp, cottonseed hulls, and brewers' grain are used extensively on Florida dairies as part of the feed ration.

Most dairies have a certified nutritionist, or a very knowledgeable operator, who designs feed mixtures to meet the cow's nutrient requirements at different stages of lactation and milk production. Feed must be adjusted to supply only what is needed based on breed, days in lactation, and milk production. Cows typically have the most milk production and require the most nutrients between 60 and 120 days after they calve.

Farmers should work with their feed supplier or nutritional consultant to ensure they are meeting

the basic requirements for the stage of growth or lactation. Extra nutrients cost the farmer money and can harm the environment. If feed contains excess nutrients, they simply pass through the cow and are deposited in the manure. Phosphorus additives typically are not needed in the feed ration in Florida. A ration that contains about 0.42 percent P is all that is required for healthy lactating cows. Nitrogen is supplied via protein, but protein content greater than 16 percent rarely provides any extra benefit. It is a good idea to sample commercial feed to assure that the labeling or guaranteed analysis is correct. Phosphorus requirements are shown below. The full table of nutritional requirement is available on the Merck website.

Certain forages are harvested, mixed, stored, and fed to livestock as silage or haylage. Crops such as corn and sorghum are particularly well-suited to harvesting as silage because of their high energy value and the fact that their thick stalks delay drying. If farmers are feeding products such as silage, several samples from different parts of the field or during different times of the harvest should be used, especially if it is bagged. Materials harvested from different parts of the field are not mixed well during bagging. Samples should be taken again once the silage is ready to be fed. Silage stored in bags around fields has few runoff issues. However, large silage pits can have leaching issues, especially if several pits are located together.

Bermudagrass and bahiagrass are usually harvested as hay or greenchop. Greenchop can be harvested a little at a time and fed directly to cows or a field can be cut all at once and made into haylage. Hay may be cut and harvested four to seven times per year. Hay baled at too high a moisture level will generate excessive heat and can even catch on fire. Further, hay stored outside for a prolonged period of time may result in leaf shatter, dry matter loss, and reduced forage quality due to rain. To offset this effect, hay bales should be stored under roof or wrapped, or oriented in north-south rows to get more exposure to sunlight.

	Dry		Lactating				Heifer (age in months)			
	Dry (Far Off)	Close (Close up)	Fresh	Early	Mid	Late	6	12	18	24 (Close up)
Body weight (lb.)	1,500	1,500	1,500	1,500	1,500	1,500	440	660	1,000	1,375
Dry matter intake (DMI) (lb.)	32	22	34	66	52	45	11	16	25	23
Phosphorus, %DM	0.22	0.26	0.42	0.38	0.35	0.32	0.28	0.23	0.18	0.23

Source, Merck Veterinary Manual, *Feeding Guidelines for Large-Breed Dairy Cattle*, adapted from National Academy of Sciences, 2001. http://www.merckvetmanual.com/mvm/management_and_nutrition/nutrition_cattle/nutritional_requirements_of_dairy_cattle.html#v4638295

Also, the rounded sides of bales should not touch one another.

If the dairy is grazing cattle, the grazing must be accounted for as part of the cows' diet in order to determine the appropriate amount of supplemental commercial feed needed. Allowing cows to eat too much concentrated feed discourages them from eating the pasture grass, wastes money, and leads to over-consumption of nutrients. Irrigated pastures are much more consistent in terms of plant growth and nutrient content, and **rotational grazing** provides even more forage for the cows. Forage analysis results and an estimate of pounds of grass the cows are harvesting will provide information needed to calculate nutrient intake from grazing.

Excess feed often can be used to feed heifers or dry cows. Any remaining feed still contains nutrients, of course, and must be disposed of properly. Adding it to a composting operation is preferable, but if no composting exists, it can be land applied separately or mixed with other waste. If significant amounts of waste are land-applied, it should be sampled and the nutrient load should be included in the nutrient balance calculation.

Accurate laboratory testing of feed and forage will provide the information needed to formulate animal feeding rations, and forage analysis can establish a basis for commercial hay sales. For more information about sample collection and laboratory analysis, see the publication, *Understanding and Improving Forage Quality* at: http://extension.uga.edu/publications/files/pdf/B%201425_1.PDF.

1.1 General Feed Ration BMPs Level I

- ✓ 1. Seek the help of a qualified nutritionist when formulating diets if you are not trained in nutrition principles.
- ✓ 2. Ensure that phosphorus is less than 0.42% of total feed ration (dry matter basis). Do not discount P in grains and forage, as ruminant bacteria make P available.
- ✓ 3. Store feed so it has no contact with rainwater (wet brewers grain is an exception).
- ✓ 4. Use moisture analysis results to adjust and mix feeds to ensure the proper ration of formulated diets.
- ✓ 5. Clean up feed spills immediately, and land-apply or compost spoiled feed.

- ✓ 6. If applicable, contain or treat silage leachate so that it does not affect surface or ground waters.

1.1.1 Milking Cows Feed Ration BMPs Level I

- ✓ 1. Adjust feed for each group based on the phase of lactation and amount of milk production. Note that dry cows eat about half as much dry matter as high-production lactating cows.
- ✓ 2. Feed the minimum amount of nitrogen required to maintain good milk production.
- ✓ 3. If feasible, milking three times per day may reduce the amount of nutrients excreted by 7% per unit of milk.

1.1.2 Heifer or dry Cows Feed Ration BMPs Level I

- ✓ 1. Implement forage testing and feed programs for heifer groups ranging from 0 to 6 months, 7 to 11 months, and from 12 to 24 months to ensure that heifers are not over-conditioned or under-conditioned.
- ✓ 2. Sort heifers into more uniform groups and feed all sorted heifers at feed bunks at the same time or use some form of locking head gate(s) to prevent dominant heifers from consuming more than their proportionate share of feed.
- ✓ 3. Carefully monitor heifer body weight. A reasonable average daily gain goal is 1.7 pounds.
- ✓ 4. Eliminate or limit the supplementation of P in heifer and dry cow diets as the recommended percentage of dietary dry matter (0.20-0.35%) is normally provided in basal feeds.

References

1. Nutrient Requirements of Dairy Cattle, Seventh Revised Edition, National Research Council http://www.nap.edu/openbook.php?record_id=9825&page=1
2. Nutrient Requirements Computer Model <http://www.nap.edu/catalog/dairymodel/>
3. Animal Nutrition Handbook, Chapter 15: Dairy Cattle Nutrition. <http://www.ag.auburn.edu/~chibale/an00contents.pdf>
4. Feed Management. Code 592. 2009. USDA-NRCS FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

Wastewater Generation: Manure and Milk Waste

Wastewater is generated on every dairy farm in Florida. Wastewater production can be as little as 15 gallons per cow per day to almost 200 gallons per cow per day. Since WSPs need to hold all of the wastewater for a certain **design storage period** (depending on farm soils and location), minimizing wastewater production is important. However, there are times of year when crops need significant irrigation water, and during those times wastewater minimization may not be necessary.

Cooling systems are used for evaporative cooling to relieve heat stress in dairy cows in hot periods of the year. Their use has shown increases in cow comfort (lower body temperature and respiration rates) and milk production. In Florida, they may be used anywhere from 120 to 240 days per year. Two types of evaporative cooling systems are available: (1) sprinkler systems (**Figure 4**) that wet the cows using fans to evaporate the water and cool the cows. These systems work very well, if managed efficiently using automatic sensors. They should be avoided if your water supply and/or storage capacity are limited; and, (2) high pressure fogging systems that allow water to be evaporated between the fan and the cow, cooling the air before it is blown across the cow. These systems waste less water and keep floors dryer, but require more management. If using a fogging system, water filters must be checked, cleaned, or replaced as needed on a regular basis or the fogging nozzles may plug.

All milking equipment must be washed as required by FDACS Division of Food Safety. This wastewater, including any wasted milk, should be directed to the waste stream of the dairy, but it typically makes up a very small portion of the wastewater.

1.2 Wastewater Generation BMPs Level I

- ✓ 1. When practical, divert clean roof water, runoff water, and **plate water** from the waste management system.
- ✓ 2. Install timers to control flush times, if needed.
- ✓ 3. Reduce use of udder washers when cows are clean.
- ✓ 4. Use timer, temperature, and/or humidity controllers to cycle cooling systems.
- ✓ 5. Reduce flushing times to a minimum needed to adequately clean the floors.



Figure 4

- ✓ 6. Establish protocols that minimize water use for cleaning milking equipment.

Level II BMPs

If your answer to the following question is “yes,” implement one or more of the Level II BMPs below.

Question: After completing the calculation section, is wastewater production still too high, creating an inability for the WSP to meet holding capacity requirements? Yes No

- ✓ 7. Eliminate udder washers.
- ✓ 8. Use recycled water in all freestall barns.
- ✓ 9. Use high-pressure misters instead of sprinklers.
- ✓ 10. Use scraping in addition to or instead of flushing.

References

1. Water Budgets for Florida Dairy Farms, UF-IFAS, Circular 1091 <http://edis.ifas.ufl.edu/ds121>
2. Manure Production and Characteristics, ASABE, Standard D384.2 <http://www.extension.org/pages/15375/manure-production-and-characteristics>

Solids Separation

Waste collected in barns is flushed or scraped to a collection area. Farms that vacuum barns usually use the same trailer or truck to spread the manure so it does not have to be handled twice. Farms that scrape usually do so into a holding area at the down slope of the barn. Vacuuming and scraping keeps the manure as concentrated as possible for future hauling or composting. If the manure is going to be applied on site, it is almost always flushed to save time and wear and tear on expensive equipment.

Almost all dairies in Florida use wastewater to flush the crowd area and any freestall or holding barns.



Figure 5

Unless waterbeds are used in the stalls, the loose bedding material will likely become part of the waste stream. If the freestall is bedded with sand, a sand separation lane or mechanical sand separator (**Figure 5**) is recommended to separate and recycle the sand. This is a huge cost savings for the farm and helps keep the rest of the system functioning properly. Although mechanical separators are used in other parts of the country with success, the native sand of Florida seems to separate much better in a long sand lane sloped about 0.25 percent.

After sand separation, solids separation may occur. Mechanical separators, such as inclined screens, do a very good job of removing fibrous materials. These materials contain few nutrients but can clog other portions of the waste system, especially sprinklers. Static separation pits are popular for solids separation, due to their efficiency and relatively low cost.

Static separation involves slowing the water down and allowing heavy solids to settle out. In sandy soils, these devices are constructed of concrete and are sometimes referred to as “vat” separators as shown in **Figure 6**. Either a concrete weir and associated skimmer maintain the water level, or a picket fence consisting of either horizontal or vertical boards placed with a $\frac{1}{4}$ to $\frac{3}{4}$ inch gap between them lets water run out while retaining as many solids as possible. These can be sized to accumulate one day of solids, but most farms prefer to clean them out less frequently so they are usually sized between 7 and 30 days. Most farms have two separators side by side; when one is filled, it is allowed to dry and is cleaned out while the other one fills up. It is very important that these separators are cleaned before they are full so that they operate as designed. A full separator will not



Figure 6

allow the water to slow down enough to settle out the solids.

Once wastewater has flowed through any sand or solids separation, it enters the WSP. These ponds are designed to hold wastewater until it can be land applied. In scrape facilities that use very little water, the material will be like slush and, although it can be pumped, it must usually be spread via wagon or truck with injector hose. Wastewater from a flushed confinement type dairy will be watery with lower solids content. This material is usually best applied via irrigation with large nozzles (guns) if solids separation is not done. Wastewater that has gone through a solids separation process and an adequately sized WSP can usually be applied with most conventional sprinkler systems.

Sometimes, if the WSPs are accessible and can be cleaned out easily, solids separation is skipped because the WSP provides the necessary solids separation. The accumulated solids must be cleaned out as needed, typically about every three to five years. As long as the WSP is designed to allow for solids accumulation this is an acceptable practice. WSPs designed to accept all of the solids should be long and narrow so that a track hoe or other equipment can access the pond from both sides to remove all solids. Nutrients in this material vary considerably, but are usually more concentrated, particularly for P. A sample of the solids should be sent to the laboratory before spreading to determine appropriate application amounts for each field. If that is not possible, base application amounts on previous sampling results.

1.3 Solid Separation BMPs

Level I

- ✓ 1. Clean sand lanes daily.
- ✓ 2. Clean static separators before they are full to allow for maximum separation.
- ✓ 3. Clean inclined screens at least weekly to prevent screen from clogging.
- ✓ 4. Ensure that all solids from separators or other manure piles are on impervious surfaces and the runoff is directed into the wastewater system.

Level II BMPs

If your answer to the following question is “yes,” implement the Level II BMP below.

Question: After completing the calculation section, is the farm still out of nutrient balance? Yes No

- ✓ 5. Choose a solids separation system using the information in **Table 3** of **Appendix 2** so that the maximum amount of nutrients are removed from the wastewater. This will result in less nutrients in the wastewater but more solids to be removed from the farm.

References

1. Certification Training for Operators of Animal Waste Management Systems, Chapter 2: System Components and Operation, North Carolina Cooperative Extension Service http://www.soil.ncsu.edu/certification/Manual/a/intro_a.htm
2. Sustainable Dairy Production Best Management Practices, Manure Management, Louisiana State University <http://www.lsuag-center.com/en/communications/publications/publications+catalog/crops+and+livestock/best+management+practices/>
3. Solid and Liquid Waste Separation, Code 632; Short-Term Storage of Animal Waste and Byproducts, Code 318; Waste Recycling, Code 633. USDA-NRCS FOTG Section IV. <http://www.nrcs.usda.gov/technical/efotg/>

Wastewater Storage Ponds

Wastewater storage ponds hold liquid waste from a dairy operation. They are often inappropriately referred to as lagoons. The term lagoon is primarily used for storage ponds that are specifically designed to provide anaerobic treatment. Therefore, this document will use the term WSP, which is



Figure 7

more descriptive of the ponds used by most dairy farmers in Florida.

Farms located on soils listed in **Table 1** of **Appendix 2** are considered **high water table soils**. These areas have almost no downward movement of groundwater. Rainwater leaves these areas through surface runoff, evapotranspiration, or horizontal shallow groundwater flow. The runoff may flow to natural depressions, surface waters, or man-made ditches. Existing WSPs in high water table soils are not required to be lined, since the head difference between the pond and the surrounding water table is low. However, there should be no drainage features deeper than 18-inches within 300 feet of the WSP; if so, an interceptor ditch, tile drain, or other engineered solution will be required. All new WSPs will require a liner that meets the requirements of NRCS Code 521 unless a Professional Engineer certifies that denitrification and agronomic use of N and P by the surrounding vegetation is sufficient to prevent losses to receiving waters.

Waste storage ponds located in non-high water table sandy soils require a **liner** made of high-density polyethylene, concrete, or other suitable material (**Figure 7**) in order to prevent wastewater from seeping into the groundwater. **Clay liners** are acceptable if they have been designed and approved by a Professional Engineer, or meet the criteria that follow. Where significant amounts of natural clay soils are present, predominantly in the panhandle, earthen WSPs dug into clay may not need to be lined. For new WSPs, if the soil used to seal the pond meets the requirements of NRCS Code 521D, then the clay is acceptable. If the construction material is unknown, a core sample

can be taken two feet below the design bottom elevation and sides to observe how thick the clay is and whether it is acceptable as described above. In all cases the material will need to be tested at a laboratory to verify the percent clay. For existing WSPs, if the soil is at least 50% clay, which is identifiable in the field by being able to be spread into a wide, thin ribbon between two fingers, with no gritty texture, then the clay is acceptable if at least two feet thick.

Since sandy soils in sprayfields hold little water and available moisture is used quickly, wastewater can be applied frequently over the year and storage times can be greatly reduced, if sufficient land is available. However, wastewater should never be applied in excess of crop uptake. A minimum of seven days of storage is required under NRCS standards. As an alternative, storage may be reduced to as little as five days provided that sufficient backup equipment is present and used in case of mechanical or electrical failure (including a generator or PTO driven pump). However, not meeting the NRCS standard will preclude federal cost-share funding, so producers should consider all options.

In exceptional situations, direct spraying may be a viable alternative if backup equipment is available. In addition, a written statement by the Engineer of Record that both surface water and groundwater will be protected is required.

Waste storage ponds should be treated like liquid fertilizer storage areas. Except in high water table situations, the amount of water stored is usually a very insignificant source of irrigation water. Effluent levels in WSPs should be kept as low as possible to allow for maximum storage in the event of heavy rain or equipment failure. It should never be higher than the standard operating level that allows for storage of a 25-year, 24-hour storm event. Under normal conditions, wastewater should never be applied to a saturated field; however, under emergency conditions, wastewater must be applied to a field if the pond becomes full. In an emergency, it is more desirable to apply excess wastewater to a field than to let it discharge directly from the WSP. Be sure to document this if it happens.

1.4 Waste Storage Pond BMPs **Level I**

- ✓ **1.** Verify that the WSP meets the minimum storage requirement.
- ✓ **2.** Keep the water level in the WSP as low as practical.

- ✓ **3.** Minimize wastewater production to maximize reserve capacity in the WSP.
- ✓ **4.** Inspect and maintain all pumping equipment.

Level II BMPs

If your answer to the following question is “no,” implement the appropriate Level II BMP below.

Question: Does your farm meet the criteria in Appendix 3? Yes No

- ✓ **5.** If you have a high water table with a close surface outlet, either move the surface outlet (ditch, tile drain) or install interceptor tile or a ditch that pumps back into the pond.
- ✓ **6.** On a non-high water table soil that does not have lined pond, line the existing pond or build a lined pond.
- ✓ **7.** If the pond does not meet the lining requirements, use an artificial liner or add bentonite to the existing clay to make it acceptable. The amount of bentonite is dependent upon soil type.

References

- 1.** Certification Training for Operators of Animal Waste Management Systems, Chapter 2: System Components and Operation, North Carolina Cooperative Extension Service http://www.soil.ncsu.edu/certification/Manual/a/intro_a.htm
- 2.** Waste Storage Facility, Code 313; Waste Treatment, Code 629; Waste Treatment Lagoon, Code 359; Pond Sealing or Lining Code 521. USDA-NRCS FOTG Section IV. <http://www.nrcs.usda.gov/technical/efotg/>

Alternative Waste Handling Systems

Some dairies do not have adequate cropping or pasture land to land apply nutrients based on their herd size. If the calculations described in this manual show that the cows you have produce more nutrients than you can apply at an agronomic rate, then one of the following alternatives needs to be considered: grow crops with higher nutrient uptake; reduce cow numbers; haul manure offsite; process manure to create a marketable product; and/or employ denitrification or volatilization technologies if N is an issue.

The simplest way to remove nutrients from the farm is to collect and haul separated solids; however, these will have a limited amount of nutrients. A more effective way is to collect and haul scraped or vacuumed manure from the barns as depicted

in **Figure 8**. Based on calculations described later, dairy farmers can determine how much manure their cropland can accommodate, and what amount of nutrients must be hauled offsite. Manure that is hauled offsite should be in a water-tight wagon or truck that does not leak and limits odor release. The nutrients in dairy manure typically do not bring enough revenue to cover the cost of hauling, since the manure is so heavy due to being mostly water. It is important to let the receiving farmer know the nutrient content of the manure and to provide him a copy of this BMP manual so that he can calculate proper spreading rates.

In order to cover hauling costs, some dairies compost manure to sell. Using animal waste to fertilize crops raised for cattle feed may be more economical, but composting and hauling is an option to remove excess nutrients from the dairy. Screened solids often can be composted on their own, since enough carbon is contained in the solids to have a proper C:N ratio (30:1 is ideal). However, raw manure or separated solids usually need to have a carbon source added. Used horse bedding, yard waste, sawdust, and peanut hulls are examples of carbon sources that can be mixed with raw manure to create compost. Proper moisture, turning, and temperature are important. Most weed seeds and pathogens are killed above 130 degrees F.

Another nutrient reduction measure is the creation of larger WSPs to increase retention. This allows more time for nitrogen to volatilize and for phosphorus to settle out. When ponds are cleaned out, the extra phosphorus that settles will have to be dealt with at that time. If solid separation methods are utilized, chemicals such as metal salts and/or polymers can greatly enhance the nutrient retention within the solids portion. Studies have shown that flocculation methods using chemicals can remove more than 90 percent of the phosphorus and 50 percent of the nitrogen from the liquid waste stream. However, chemical treatment of wastewater have been done, but may not be economically feasible for the producer.

Constructed wetlands may also be used for additional treatment of wastewater. The design and permitting of these systems is beyond the scope of this BMP manual. However, treatment efficiencies may approach 95% or more for both N and P under certain design conditions.



Figure 8

1.5 Offsite Manure Hauling BMPs Level I

- ✓ 1. Use water-tight trucks or trailers so spillage does not occur.
- ✓ 2. Dispose of product only at a bona fide agricultural site.
- ✓ 3. 📄 Provide the receiving farmer a copy of the latest analysis so the product can be spread at agronomic rates.

1.6 Onsite Manure Storage and Composting BMPs — Level I

- ✓ 1. Mix raw manure with enough dry material so that leaching does not occur from pile.
- ✓ 2. Ensure that there is no discharge from manure storage areas into watercourses, lakes, wetlands, drinking water wells, or sinkholes. Possible measures include distance setbacks (minimum 30 feet of vegetative buffer), constructing an impervious base (concrete or compacted clay), using a berm upgradient of the manure pile to deflect incoming flow, and/or covering the pile with a tarp or other waterproof material. Use the BMP checklist to provide a written description of the measures you are using or will use.
- ✓ 3. Manure storage areas located in a karst area must be on an impervious surface that drains back to the waste system or covered with a tarp or other waterproof material to prevent leaching.

Level II BMPs

If your answer to the following question is “no,” implement the Level II BMP below.

Question: If P is the limiting nutrient, are you able to achieve a P balance? Yes No

- ✓ 4. Evaluate the addition of alum to flocculate soluble and particulate P. This will reduce the amount of P that is land applied through irrigation, but may increase chemical treatment and offsite hauling costs. A second option is to evaluate the potential for a constructed wetland system. In either case, the evaluation should contain an economic analysis (capital and operating) of the options.

References

1. Composting 101: A Guide for Starting, USDA-NRCS. <http://www.ext.colostate.edu/sam/compost.pdf>
2. BMPs for Reducing Nitrate Contamination of the Groundwater on Dairy Farms, ASABE. <https://elibrary.asabe.org/azdez.asp?AID=25633&T=2>
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Crop Fertilization and Land Application of Waste

Growing good crops is essential for feed production and nutrient uptake. Some dairies remove all of the waste from their site and give it to neighbors or other producers, resulting in no onsite land application of waste. However, on most dairies, at least some of the liquid is usually applied onsite to grasses or crops via an irrigation system as shown in **Figure 9**.

The most critical factor in good crop nutrient uptake is plant nutrition management. Nitrogen, phosphorus, and potassium are the three main nutrients plants require, and are the focus of this discussion. Extra potassium is rarely needed on a waste application field. If crop fertilization is based on nitrogen, phosphorus is already adequate or may



Figure 9

exceed crop uptake, so commercial phosphorus fertilizer should never be applied. However, if crop fertilization is based on phosphorus, extra nitrogen will often be required.

Warm-season perennial grasses comprise the majority of hay production in Florida. Bermudagrass, stargrass, and bahiagrass dominate, primarily because they grow for 6 to 12 months of the year, depending on the location. Cool-season grasses, which are generally grown in North and Central Florida, include small grains (rye, wheat, oats, and triticale) in addition to annual ryegrass. Legumes such as perennial peanut, vetch, clover, lupine, or alfalfa also may be used in hay production and can take up large amounts of applied nitrogen. They are considered luxury users of nitrogen, and will use N applied to the field before making their own N. Additionally, some producers plant summer annual crops such as corn, sorghum, and millet for silage to supplement animal feedstocks.

Maturity stage at harvest is the most important factor determining quality, as forage quality usually declines with advancing maturity. *Table 6: Forage Grazing Heights* provides the growth stages of various crops. Injecting or incorporating manure into the soil between row crops as soon as possible after surface application will reduce nutrient losses.

Soil Test and Interpretation

A scientifically reliable method to determine the amount of nutrients, other than N, to grow a crop is annual soil testing. Soil test results provide soil pH information (lime requirement), and the amounts of P, K, Ca, Mg, and micronutrients needed to meet a crop's nutritional requirement. There is no soil test-based recommendation in Florida for N, due to its high rate of mineralization and mobility in soil water. The appropriate lab method for P analysis

depends primarily on the soil type. **Appendix 5** discusses this in more detail.

Soil pH is the single most important chemical parameter of the soil. For most crops, the target soil pH is between 6.0 and 6.5. Most dairy manure is between 6.5 and 7.0. Many nutrient-related disorders may be corrected simply by adjusting the pH. Soil pH can be increased by the addition of lime, and reduced by the addition of powdered sulfur or other acidifying materials. Most acidic soils require periodic liming to increase soil pH; the addition of dolomitic lime also supplies Ca and Mg. The availability of many nutrients decreases with low soil pH. Therefore, producers should strongly consider a regular liming program to maintain optimum availability of these nutrients. Always apply lime according to soil test results/recommendations.

Very few waste application fields need supplemental P. Producers should apply P only when supported by a valid soil test (showing deficient amounts of soil P) that has been accepted for use in Florida, and the P contained in the planned waste application field is not sufficient for crop growth.

Tissue Test to Diagnose Plant Nutritional Status

Tissue analysis, used in conjunction with soil analysis, is a powerful tool to diagnose the overall effectiveness of a fertilization program. Soil testing alone does not always indicate nutrient availability to plants because it is just a snapshot of what is present at the time of sampling. The concentrations of various nutrients inside plant tissue are the best indicators of crop nutritional status. Most wastewater application fields that are fertilized based on N already are receiving adequate N, so tissue sampling is not necessary. However, on P based fields or on fields that are not receiving the maximum amount of N, leaf tissue analysis is an important tool.

The two main tissue-testing techniques are the analysis of dried plant parts (lab) and fresh plant-sap (field). Laboratory analysis of dried plant parts, consisting of the most-recently matured leaf, is accurate but time consuming. Plant-sap quick tests have been calibrated for N and K for several crops in Florida; these instruments can be used in the field and are especially useful in fine-tuning fertilization programs. Dairy farmers are encouraged to contact their local extension agent before embarking on a tissue testing program. **Figure 10** illustrates the use of handheld tissue test equipment.

For more information on tissue testing and interpretation of results, see *Soil and Plant Tissue Testing* at: <http://edis.ifas.ufl.edu/ss625>

Calibration and Calculations of Fertilizer, Manure, and Wastewater Application Equipment

The benefits of nutrient budgeting and soil and tissue testing in determining appropriate fertilization rates can be negated when the manure and fertilizer application equipment is not properly calibrated in accordance with equipment and fertilizer material specifications. Improperly calibrated spreading equipment may result in under- or over-fertilizing the target crop. Consequently, crop yields may be drastically reduced and/or fertilizer wasted and introduced into the environment. Both cost the dairy farmer money. It is important to remember that wastewater is fertilizer and should be applied based both on water and nutrient content.

Calibration methods vary based on the type of fertilizer or manure used and type of application equipment. Calibration should be done in accordance with the manufacturer's recommendations, and whenever wear or damage is suspected to have changed the delivery rate. A catch pan or a plastic sheet can be used to collect fertilizer or manure over a set distance in order to calibrate output rates. For granular materials, it may be necessary to recalibrate whenever using a new material that has different flow characteristics.

Manure can vary in nutrient content and water content. It is important to take representative samples to determine the actual nutrient content. Manure should be mixed as much as possible before spreading to ensure uniform placement and distribution of nutrients. It is important to maintain the same speed and rpm to achieve even application throughout the field.



Figure 10

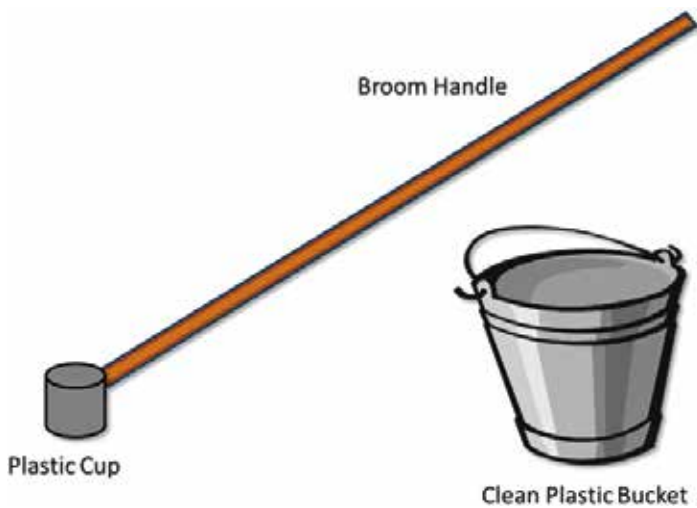


Figure 11

The N and P application rates for manure can be determined by converting the number of loads per field to tons applied, multiplying that by the nutrient content of the manure in lbs/ton, and dividing the result by the acreage. Use the laboratory analysis test results from the manure sample(s), or appropriate book values, and remember to account for the fact that not all of the manure N and P are available to the crop during the first year, as there can be significant N losses during and after application.

If it is possible to get a sample of the manure analyzed before spreading it, the same calculation can be applied to the amount of material spread over a known area of plastic tarp laid on the ground, and the result extrapolated to the production acreage to determine how many tons per acre should be applied to achieve a specific N and P application.

For wastewater, determine the gallons pumped. This is easy if the pump is equipped with a flow meter. If not, the gallons pumped can be calculated by multiplying the number of minutes the pump runs, by the pump's capacity (measured in gallons per minute or GPM). Pumps should be calibrated every three years to determine GPM. If the GPM for each type of sprinkler are within 15 percent of each other, an average can be used for all. The time of application to each field should be recorded and the wastewater test results should be multiplied by the laboratory results per gallon. **Figure 11** shows a collection technique to obtain a WSP sample. Some labs will include nitrogen losses, but **Table 4** in **Appendix 2** contains common losses if they do not.

Pivots, solid set sprinklers (including guns), and traveling guns should be run so that they spray evenly over the entire field. Solid sets should be

run in a consistent pattern that assures all nozzles are used evenly. Pivots and traveling guns should start applying waste where the last waste application ceased and should apply to the entire field at the same setting before the setting is changed.

Commercial fertilizer should be ordered with the appropriate nutrients needed for that field. Manure is usually expressed as elemental P and K, while fertilizer is expressed as P_2O_5 and K_2O . The P and K conversion formulas can be found in the glossary.

For more information on calibration, see *Equipment Calibration Information Sheet* at: <http://www.extension.iastate.edu/Publications/NMEP9.pdf>.

Commercial Fertilizer Types and Application Methods

Commercial fertilizers may be granular or liquid, fully soluble or timed-release (also known as water-insoluble N). Conventional fertilizer products are water soluble, while controlled-release fertilizers (CRF) become soluble and available under the combined action of heat, moisture, and microbes. One group of fertilizer products that has potential advantages for increasing nutrient use efficiency and reducing environmental nutrient loss is enhanced-efficiency fertilizers. While CRF is one example, the term also refers to other nitrogen fertilizer products that are treated with urease and/or nitrification inhibitors. Some of these products are now registered with EPA, and claim to reduce leaching and/or volatilization losses of nitrogen, especially on reduced-tillage operations where there is little to no opportunity to incorporate fertilizer product into the soil. Producers who are expanding their production to include more nitrogen-dependent crops are encouraged to investigate the use of these products.

Methods for granular fertilizer application include the broadcast method (granular fertilizer is applied over the entire field), and the modified-broadcast method (granular fertilizer is applied only over the areas where raised beds will be formed). Liquid fertilizers may be applied through over-head irrigation systems, knifed into the row, or injected into drip-irrigation systems (fertigation).

While most fertilizers are soil-applied, foliar fertilization consists of applying dilute fertilizer solutions directly to the plant leaf. However, plant leaf structure and waxy coatings may inhibit direct foliar nutrient absorption. In addition, evaporation may increase the concentration of the fertilizer solution and lead to leaf burn. Therefore, foliar fertilization is used mostly for the application of micronutrients.





Figure 12

Precision Agriculture

Many agronomic or field crop growers have readily embraced precision agriculture tools. A good example of this is through the use of a global positioning system (GPS) and associated navigation instrument (e.g., light-bar system) to more precisely direct the path of fertilizer applications to avoid skips and overlaps. **Figure 12**

depicts a cab-mounted GPS and light-bar system. With this system, the skip and overlap rate between passes can be as low as 2%, whereas conventional foam markers achieve a skip/overlap rate reduction of about 10%. This technology helps prevent over-application of fertilizer or pesticide materials. For more information on this system, see *Precision Farming Tools: GPS Navigation* at: <http://www.pubs.ext.vt.edu/442/442-501/442-501.html>

1.7 Crop Fertilization and Land Application BMPs — Level I

- ✓ 1. Follow published UF-IFAS N fertilizer rate recommendations or those listed in **Table 5** in **Appendix 2**. If those rates are not adequate for crop production, and more is needed, then this must be justified based on measured crop uptake.
- ✓ 2.  For established fields, take annual soil samples in November or December. Refer to **Appendix 5** for guidance on P extraction methods and sample collection. Keep a copy of all laboratory test results to track changes over time.
- ✓ 3. Do not apply supplemental commercial P to waste application fields that are based on N. On dairies where waste application is based on P, ensure that applications from all sources of P do not exceed crop uptake.
- ✓ 4. Do not apply wastewater to saturated fields, except in an emergency.
- ✓ 5. Maintain cropping system nutrient balance based on annual averages. However, if located on karst terrain, try to maintain a balance of readily available N throughout each crop cycle.
- ✓ 6.  Keep written records of N and P applications.

For hay or silage production, implement the additional BMPs below: 

- ✓ 7. Do not apply supplemental commercial fertilizer unless the field is not receiving enough N or P from applied waste. On farms with crop fertilization based on P, apply supplemental N only in the spring and after each cutting.
- ✓ 8. Begin spring harvest (first cutting) for hay or silage when the plant reaches a height of 14 to 18 inches, and cut every 4 weeks for silage or every 4 to 6 weeks for hay.

Winter waste application caution: During the winter months, milk production is normally at its peak and so is wastewater. However, due to shorter days and cooler weather (especially in North Florida), crop nutrient uptake is limited. Therefore, use caution when applying wastewater to cropland, only applying the minimum amount of water necessary based on your wastewater storage pond's working volume and capacity. This will help prevent leaching of mobile nutrients beyond the plant's root zone.

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Maintaining Nutrient Balance

Maintaining nutrient balance on a dairy farm involves planting an optimum cropping system so that crop uptake is balanced by the application of wastewater nutrients. This may include rotations such as perennial bermudagrass hay harvested every four to six weeks with small grains overseeded in the winter (except in South Florida where grass grows year round), or corn followed by either tropical corn or sorghum (with reduced tillage) followed by a small grain in the winter. Some farmers have been able to establish ryegrass in the winter, which has significantly higher uptake than the small grains, but care must be taken to re-establish the spring crop in time.


Irrigation and wastewater system maintenance, periodic sampling, and record keeping are other key components of nutrient balance. This requires that records are kept in a form that is easy to understand and meaningful to the producer. Examples can be found in **Appendix 8**. Alternatively, modern technology allows for the use of customized services that provide excellent record keeping and report generation with the ease of a computer or smart phone app. Even small dairies may find this an attractive and affordable option.

1. On a regular basis inspect and maintain the animal's water and cooling systems, ditches or wastewater conveyance structures, associated berms, the WSP and separators, and pipelines and irrigation systems.
2. Obtain daily rainfall totals from an onsite rainfall gauge or nearby weather station and record them for use in irrigation scheduling (if applicable).
3. Once nutrient balance is achieved, collect samples over a one-year period every five years. During this period, samples should be taken at least quarterly to be used for calculations.
4. If the dairy increases its herd size by more than 10%, has major changes to the operation, or decreases its land application area, a new sampling period should begin. If the previous nutrient balance indicated that the proposed herd size would still be in balance, a new sampling period is not required until the next five-year cycle.
5. Collect grab or composite samples (at least four combined into one sample) from the WSP or a spigot during an irrigation pump cycle. A secondary method is to collect a sample in the final WSP using a pole and plastic bucket near the irrigation pump. The pail should be turned upside down and pushed under to near the bottom of the WSP, then turned open-end-up and brought up through the water column. Preserve the samples properly and send them to a reputable lab that adheres to recognized quality assurance/quality control (QA/QC) for analysis for TKN, ammonia, pH, and total phosphorus. The IFAS lab website is: <http://soilslab.ifas.ufl.edu/LWTL%20Home.asp>. Private labs often may be closer and easier to use than the IFAS lab. TKN can be used instead of total nitrogen, since there is very little nitrate and nitrite in the manure and wastewater.
6. Record the time the pumps are run and multiply that time by the pump output to determine wastewater application rates. This combined with the lab results and applicable losses can be used to verify application rates for sprayfields.
7. Four times a year, or when solids are removed from a separator (if less than four times a year), take a composite sample from different parts of the solid stack. Take at least seven different samples from random points within the pile, spaced apart both vertically and horizontally to include the bottom, middle and top of pile as well as the sides. Samples should be combined in a plastic bucket and thoroughly mixed before taking a representative sample. Send the representative sample to a reputable lab to determine TKN, ammonia, pH, and total phosphorus content.
8. Record the number of loads of manure hauled offsite, and determine the weight of a representative load.
9. If the solids are spread onsite, determine the loads per acre that can be applied appropriately, and record the number of loads per field.
10. Determine the tons of each crop harvested during the year by counting the number of hay bales that are removed after each cutting, or by counting loads and obtaining a representative weight.
11. Collect a composite sample of plant tissue from several different loads of each crop by taking a minimum of seven samples throughout the field, including that portion of the plant that is

harvested, or from actual bales or loads of hay. For hay, as long as the sample is collected just after baling, the outer part of the bale can be used from seven different bales throughout the field. Send the composite sample to a reputable lab for analysis of dry matter content, percent phosphorus, and percent crude protein. This data can be used to compute crop uptake and verify that the farm is in nutrient balance.

Again, sampling should occur the first year all BMPs are in place. As long as the results show that nutrient balance for the nutrient of concern is being achieved, sampling is not required for another four years, provided no major changes to the operation occur. However, annual record keeping is still required.

1.8 Sampling and Recordkeeping BMPs Level I

- ✓ 1.  Use the record forms in **Appendix 8**, or an equivalent system, to demonstrate that the farm is maintaining nutrient balance.

- ✓ 2. Collect WSP samples quarterly; solid samples quarterly or whenever they are removed from the separator (if less than four times a year); and crop tissue samples after each cutting. Sampling is required for one year out of every five years, unless significant operational changes are made.
- ✓ 3. Use a reputable lab to perform the appropriate analyses.

References

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2.0 IRRIGATION MANAGEMENT

Irrigation management involves selecting and maintaining the appropriate irrigation system for your crop, and adjusting irrigation methods, scheduling, and amounts to maximize irrigation efficiency, based on monitoring soil, plant, and weather conditions.

The goal of irrigation management is to keep both the irrigation water and the nutrients in the crop root zone. This requires knowledge of the characteristics (particularly rooting depth) of the crop, so that water and fertilizer inputs can be precisely targeted and properly managed. It also requires knowledge of the primary soil type characteristics to determine how they influence the availability of water to the plant. To be successful at irrigation management, producers must readily adjust irrigation methods (such as scheduling) and amounts of water, based on soil, plant, and weather conditions.

Dairy wastewater usually comprises less than 10% of a crop's water requirements, so additional irrigation from another source will be needed. However, as discussed earlier, the WSP should always be kept as low as practical and never higher than the standard operating level that allows for storage of the 25-year, 24-hour storm event. This may require some irrigation of wastewater at times when irrigation might not

be needed. In an emergency, it is more desirable to apply wastewater to a field than to let it discharge from a WSP. The grasses will filter and settle particulates and dilute the applied nutrients even if the soils are already saturated. This limited treatment is still better than no treatment at all.

Irrigation System Design and Installation

The predominant types of irrigation systems used to grow crops on dairies in Florida are pressurized systems such as solid-set sprinklers (including guns), traveling guns (hard hose or cable tow), or center pivots; and, to a much lesser extent, seepage or subsurface systems.

Subsurface Irrigation Systems

Subsurface (seepage) irrigation involves raising the water table to a desired level by pumping water into ditches or canals. It can be very inefficient, as water is easily lost through evaporation and unlined canal and ditch infiltration, but is used in some high water table dairies to grow grasses. Irregular fields can be irrigated with this method, and pumping costs are lower, since there is very little pressure needed, but distribution of moisture and nutrients is not as uniform as with other systems.

Pressurized Irrigation Systems

These systems deliver water under pressure via closed pipelines. The most common pressurized systems used on dairy farms in Florida are solid set sprinkler guns, traveling guns, and center-pivots. Most wastewater has significant solids and must be applied through large nozzle guns unless solids are removed. Long term storage pond water or coarse-screen solid separators will usually allow wastewater to be applied through large impact sprinklers, but for drip or drop nozzles, much finer screens and larger WSPs will be required to prevent clogging. Most impact-sprinkler systems have an intake screen before the pump to help keep out animals and large vegetation. These screens need to be checked and cleaned periodically.

The irrigation system choice and design generally depend on factors such as topography, field shape, field acreage, soil type and crop type. An irrigation system needs to be designed to meet a crop's peak water requirements. This means that irrigation water in addition to the wastewater must be available for maximum crop production. Backflow protection must be provided to protect the source water from contamination by wastewater. Dairies with short term storage ponds must apply often enough to keep the WSP effluent levels low, but this should not be confused with irrigation, because wastewater is only applied to a small part of the field and at a relatively small amount (usually less than one-half an inch) depending on soil water holding capacity and crop rooting depth.

Irrigation system design requires in-depth technical knowledge, and should be handled by trained professionals. These professionals use existing standards and criteria, as well as manufacturers' recommendations, to design the most appropriate irrigation system for a particular cropping system and location. For information about professionals who design and install irrigation systems, go to the *Florida Section of the American Society of Agricultural and Biological Engineers* at: <http://www.fl-asabe.org/> or contact NRCS or a reputable irrigation installer.

Before making a final design decision, producers who are considering installing new or retrofitting existing irrigation systems should consult the information in **Appendix 6**.

Irrigation Water Sources

Agricultural irrigation water sources include ground water, surface water, or non-conventional sources. Water with elevated chloride and/or dissolved salt

that has an electrical conductivity measurement greater than 1,200 micro-Siemens per centimeter can significantly stress plants, leading to low yield, leaf drop, dieback, and reduction in growth. This is especially true for irrigation systems that wet the plant canopy. Moreover, highly saline irrigation water that is allowed to run off may cause impacts to off-site water resources. Obtaining routine water quality analyses will help you determine whether the water is appropriate to use on your crop.

Crop Water Requirements and Irrigation and Wastewater Scheduling

Crop water requirements refer to the actual water needs for plant growth, taking into account **evapotranspiration** (ET) and other climatic factors. Enough water should be applied only to wet the entire root zone. However, small applications which do not wet the entire root zone often encourage shallow rooting, increases soil compaction, and favor disease outbreaks.

Irrigation scheduling consists of determining when to start irrigating, at what intervals to irrigate, and how long to irrigate. In order to develop an irrigation schedule, you should:

- Estimate irrigation water requirements.
- Adjust the estimate based on available soil moisture content, soil water tension, or historic or real-time ET and appropriate crop factors.
- Make adjustments based on replenishment of soil moisture through rainfall.

Irrigation scheduling should be based on information such as: potential ET rates; rainfall total by rain gauges; and soil moisture by the use of sensors. ET rates can be obtained from the UF-IFAS Florida Automated Weather Network (FAWN), or by using your own weather station data. The observation of visual symptoms (e.g., wilting) coupled with irrigation technology will make you a better irrigation manager.

Irrigation system water loss rates are affected by sunlight, wind speed, relative humidity, and air temperature. Water loss can be reduced by irrigating when conditions do not favor excessive evaporation, especially when overhead irrigation systems are used. Some fields are large enough that continuous irrigation is required to supply enough water in peak growth periods, but, when possible, irrigation should occur in the early morning hours before air temperatures rise and relative humidity drops. Irrigating at this time also allows sufficient time for infiltration into the soil, and allows the

plant canopy to dry, thereby reducing the chances of disease development.

Prior to implementing an irrigation schedule, the irrigation system should be evaluated to determine the system's rate of application per acre and other performance variables. Mobile Irrigation Labs (MILs) can help with this. There are a number of MILs strategically positioned around the state that will perform this service for free.



Figure 13

Irrigation Scheduling Support Systems

The FAWN system maintains weather stations throughout the state. FAWN provides producers with accurate, real-time weather data, which can be accessed via the Internet or by phone. FAWN stations (Figure 13) measure air temperature, soil temperature, ET, wind speed and direction, rainfall, relative humidity and solar radiation. These parameters are critical in calculating supplemental irrigation requirements for your crop. FAWN also provides information on other irrigation tools. You can access this information at: <http://fawn.ifas.ufl.edu>.

2.1 Irrigation Management BMPs Level I

- ✓ 1. 🛠️ Install rain gauges on your operation and monitor them to help schedule irrigation events. Rainfall of ¼ to ½ inch usually is sufficient to substitute for an irrigation event.
- ✓ 2. Use available tools and data to assist in making irrigation decisions. Tools may include water table observation wells, on-site soil moisture sensors, crop water use information, thermometers, rain gauges, and other weather-related data. Real-time weather data, although not required, is available through FAWN or other regional services, or by installing your own on-site weather station. Indicate on the BMP checklist what tools you are or will be using.
- ✓ 3. If a Mobile Irrigation Lab is available, get an evaluation to check the distribution or emission uniformity and the conveyance efficiency of the irrigation system(s). This should be done every three to five years. Make adjustments and repairs as needed.

- ✓ 4. Do not irrigate beyond field capacity. When irrigation needs are greater (during long, warm days) or when plants are in the elongation phase of growth, splitting irrigation events into multiple daily applications may be of benefit.
- ✓ 5. Irrigate with wastewater first to keep the WSP as low as possible and always below the maximum operating level.

2.2 Irrigation Maintenance BMPs Level I

- ✓ 1. On a periodic basis, examine sprinkler nozzles or emitters for wear and malfunction, and replace them as necessary.
- ✓ 2. When using small nozzles, flush irrigation lines regularly to prevent clogging. To reduce sediment build up, make flushing a regular part of your maintenance schedule.
- ✓ 3. 📝 Test irrigation source water quality annually to detect issues with water chemistry that may result in irrigation system plugging or affect plant health.
- ✓ 4. Ensure that the pump, engine/motor, and fuel tank (if applicable) are mounted on a firm foundation, and that they are operating within the manufacturer's specifications.

References

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3.0 DAIRY WATERING REQUIREMENTS AND SOURCES

Dairy watering requirements are an estimate of the drinking water needs, and sources are strategically located to reduce environmental impacts.

Dairy cattle, like humans, need a reliable source of fresh water in order to survive. Water requirements are influenced by several factors, including milk production, stage of pregnancy, activity, type of diet, feed intake, and air temperature. On average, a lactating dairy cow's estimated daily intake of freshwater is 25 to 40 gallons per day while heifers need between 10 and 25 gallons per day, depending upon the time of year. Hot weather can nearly double the daily water intake requirements, compared to winter months.

For lactating animals, drinking water requirements almost always are met with well water. However, pastured heifers get their water from wells, surface waters, and natural isolated wetlands. Limiting water intake can depress animal performance more quickly than any other nutrient-related deficiency.

Nonpoint source pollution problems on cattle operations can occur in the vicinity of watering

sites and supplemental feed and/or loafing areas, where animals tend to congregate most often. Using stagnant sources of surface water alone can pose health hazards to livestock. Cattle liver fluke and leptospirosis are waterborne diseases that can infect the cows.

Providing fresh water and strategically locating supplemental feed facilities away from perennial streams and discharge canals will help keep cows out of watercourses. Artificial shade structures also may be used to encourage the use of upland sites for shading and loafing. These planning considerations are essential components to avert water quality problems related to livestock distribution. This is especially important when stocking rates are increased and pasture rest periods are minimized. Ultimately, careful planning and site-specific decisions involving alternative cattle water sources can have a significant role in protecting water quality and can preclude the need to install costly exclusion fencing adjacent to natural watercourses.

It is important to maintain clean water sources for all cattle. Most modern facilities have tipping water



Figure 14

troughs (**Figure 14**) in the barns, which allows the water to be dumped and replaced once a day or after each milking. These troughs must still be cleaned periodically with a mild bleach solution to prevent algae buildup and other issues. Water troughs in pastures can be more difficult to clean, but should still be emptied and cleaned out on a regular basis. Some types of fish can be used in large tanks to help keep algae in check.

FDACS and other governmental agencies are responsible for assuring a clean milk supply, and may have regulations that exceed this manual. The farmer is responsible for following all applicable government regulations. FDACS samples the water used in the parlor at least annually; if any issues are discovered, they must be addressed immediately. Strict protocols should be developed for cleaning milking equipment; they should be printed in English and any other language spoken at the farm, and placed in plain view of all operators. The milk room and parlor area should be kept as clean as possible. The milk room floor and walls should be washed on a regular basis. While milking, frequent

hose rinsing should be used to remove any manure or other soils from the work area.

3.1 Water Requirement BMPs Level I

- ✓ 1. Locate watering troughs and associated shade facilities to keep cattle away from perennial streams or watercourses as much as possible.
- ✓ 2. Construct troughs or tanks with a stable base to reduce health hazards to livestock.
- ✓ 3. Ensure that water troughs are at least 100 feet away from surface waters.
- ✓ 4. Maintain riparian buffers to prevent bank damage and manure deposits in the watercourse.
- ✓ 5. Maintain all wells, troughs, and other associated structures in good working order.

References

1. Pond, Code 378; Watering Facility, Code 614; Livestock Pipeline, Code 516; Livestock Shade Structure, Code 576, Exclusion Fencing, Code 382. USDA-NRCS FOTG-Section IV, <http://www.nrcs.usda.gov/technical/efotg>
2. Water Budgets for Florida Dairy Farms, UF-IFAS Publication 1091. <http://edis.ifas.ufl.edu/ds121>
3. Water: The Most Important Nutrient for Dairy Cattle, UF-IFAS <http://dairy.ifas.ufl.edu/dpc/1994/Beede.pdf>
4. Dairy Operator's Guide to Milking Machine Cleaning and Sanitation, University of Wisconsin. <http://milkquality.wisc.edu/wp-content/uploads/2011/10/operators-guide-to-milking-machine-cleaning-and-sanitation.pdf>
5. Milk Parlor Cleaning, UF-IFAS Publication DS10. <http://edis.ifas.ufl.edu/ds151>



4.0 PASTURE AND GRAZING MANAGEMENT

Pasture and grazing management involve managing the harvest of vegetation by grazing and/or browsing livestock.

Pasture management is extremely important in dairy operations. Since the lactating cows are always being fed grains or silage in addition to grazing or hay, they deposit more nutrients in their manure than do dry cows, heifers, or beef cattle. Also, because they are milked at least twice a day, they tend to linger around the barn more. It is important that pastures maintain a healthy grass in order to take up nutrients. Some barren areas are acceptable, but the producer should follow the BMPs to try and minimize and isolate these areas. Large, barren areas are not acceptable unless they are located in a high water table or clayey soil situation where the runoff is captured and sent to the waste system; or treated in an alternative manner to meet surface and groundwater standards.

Dairies sometimes use rotational grazing, rotating cows to new pastures every day or so, which maximizes grass production and allows harvesting of grass at the peak of nutrient content. This is better

than continuous pasture grazing, since in **continuous grazing**, the grass is not allowed to recover and the cows will select the more desirable plants leaving more undesirable plants to grow.

Dry cow and heifer pastures are easier to maintain. A lot of dairies feed these cattle in portable troughs, permanent troughs, or other dedicated feed areas. Water and shade usually are provided in these pastures. Suggested stocking rates to ensure that excreted nutrients are being used by grasses are provided in **Table 7 of Appendix 2**. Note that the stocking rates listed in this table are not necessarily the ones that will ensure long term persistence and productivity of the all pasture species or cultivars. Pasture health (e.g., forage species growth and persistence, weed presence, bare areas, etc.) should be monitored and stocking rates adjusted if needed. Pastures are not land application areas. If any waste that is collected outside of a field is applied to that field, it is not considered a pasture, and calculations that include excrement from the grazing animals and the waste applied are needed to ensure the field is in nutrient balance.

High-Intensity Areas

Small high-intensity areas (HIA) are expected to form in pastures. In all pastures, including dry and heifer pastures, barren areas will form around water troughs, shade, and feed. Rotational grazing helps with these problems and is highly encouraged. If the pasture or HIA is in a high water table or clayey situation and the runoff is captured and directed to the waste system, then the farmer needs only to manage the HIA for cow comfort and ease of travel. Otherwise, barren areas need to be reduced as much as possible and managed to control nutrient loss.

Areas around permanent feed and water stations should be cleaned of manure solids on a regular basis. This is usually performed twice a year, and clean soil is needed to replace what is removed from these areas. Try to minimize these areas as much as possible, since some leaching occurs over time even though the material is removed on a regular basis.

If the farmer maintains permanent pastures, portable feed and shade devices can be moved around frequently to prevent HIAs. Providing water can be a more difficult task, but many farmers have attached flexible hoses to permanent risers to allow for periodic movement of the tanks. The more spread out these items are on the pasture, the more spread out the cows will be.

For lactating cows, the areas close to the barn usually are the main areas of concern. Because the cows are milked at least twice a day and many are fed in a barn just after milking, they tend to congregate close to the barn. Travel lanes should be used and rotated to encourage cows to move into designated fields quickly. The entrance to the field should be rotated to prevent barren areas. Feed, shade, and water should be placed around the field to encourage cows to spread out across the pasture, rather than enter the pasture and lay down.

Cooling ponds should be located only on high water table or very clayey soils. If the cooling ponds are located in pastures, care must be taken to minimize the barren areas that can form around the ponds. Cooling ponds should be located so that no discharges to surface waters of the state occur. This can be accomplished by placing a shallow berm around them as noted in **Figure 15**. Fencing can help direct where the cows enter

the ponds, and the entryways can be rotated as needed to prevent the formation of large barren areas. Water pumped from the ponds must be directed to the waste system; solids removed should be treated the same as manure solids and applied at agronomic rates.

Prescribed and Rotational Grazing

Prescribed grazing is managing the harvest of vegetation by grazing and/or browsing animals. All pastures should be managed based on vegetative heights contained in **Table 6** of **Appendix 2**. If excess pasture grass is available, it should be cut for hay or haylage so that nutrients are harvested off the pasture. When possible (except in South Florida), overplant a small grain in the winter to provide continuous uptake of nutrients.

Intensive rotational grazing involves dividing large pastures into small **paddocks** and allowing cows to graze continuously on these small paddocks for one to three days at a time. This prevents the formation of almost all HIA areas and provides the cows with better grass. Paddock rotation should be based on the grass height (provided in *Table 6: Forage Grazing Heights*). Many dairies do intensive rotational grazing under a pivot and use the pivot to support misters/sprinklers for cooling the animals. Intensive rotational grazing allows better uptake of pasture feed by the cows, spreads out manure more evenly, and is less intensive than other types of dairy operations.

Replacement Heifers

Successful heifer replacement programs begin with providing proper nutrition including high quality forages and supplemental feeds. Many of the forages grown in Florida contain considerably lower levels of crude protein (CP) and total digestible nutrients



Figure 15

(TDN) compared to forages grown in more temperate regions. On average, yearling heifers require a diet that is 8 to 9% CP and 50 to 65% TDN. Most of the hay utilized by cattle producers in Florida is well below this need. Because of this, heifers need to be supplemented to meet the nutrient requirements for acceptable weight gains. Given their need for a special diet, heifers should be managed separate from mature animals to minimize competition and maximize growth. See Chapter 1 for more information and a link to the Merck nutrition table.

4.1 Grazing BMPs

Level I

- ✓ 1. Use travel lanes to move cows away from concentrated areas and disperse them across pastures.
- ✓ 2. As practicable, use rotational grazing techniques.
- ✓ 3. Use incentives such as portable shade, feed, and water structures to disperse cows over the entire pasture and locate them on flat (less sloping) areas. Move them as necessary to prevent large barren areas.
- ✓ 4. If using hay to feed onsite in a pasture, use a feeding panel or hay ring to restrict access and reduce trampling. Try to introduce only a one-day supply of feed at a time.
- ✓ 5. Avoid overgrazing by following the leaf length information in **Table 6** of **Appendix 2** to ensure that pastures have adequate forage.

4.2 Special Grazing BMPs for Heifer Operations — Level I

- ✓ 1. Locate feed bunks or fence-line feeders at least 200 feet away from wetlands, streams, lakes, springs or spring runs.

- ✓ 2. Account for the N and P contribution from collected manure (from piles) that is land applied to pastures, and reduce commercial fertilization accordingly. Book values can be used to determine this.
- ✓ 3. For HIAs that are denuded and close to drainage ditches/canals, wetlands, streams, lakes, or sinkholes, install and maintain vegetated buffers to protect water quality.

References

1. Design of a Rotationally Grazed Dairy in North Florida. <http://eurekamag.com/research/002/796/design-rotationally-grazed-dairy-in-florida.php>
2. Agricultural Waste Management Field Handbook, USDA-NRCS
3. Conservation Cover, Code 327; Fence, Code 382; Use Exclusion, Code 472; Forage and Biomass Planting, Code 512; Forage Harvest Management, Code 511; Prescribed Grazing, Code 528; Range Planting, Code 550; Livestock Shade Structure, Code 576. USDA-NRCS FOTG-Section IV. <http://www.nrcs.usda.gov/technical/efotg>
4. National Management Measures for the Control of Nonpoint Pollution from Agriculture, Chapter 4E, EPA. Document EPA 841B03004. http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm
5. Forage Planting and Establishment Methods, UF-IFAS Publication SS-AGR-161. <http://edis.ifas.ufl.edu/AG107>
6. General Guidelines for Managing Pastures for Dairy Cows, UF-IFAS SS-AGR-94 <http://edis.ifas.ufl.edu/ag162>



5.0 SEDIMENT AND EROSION CONTROL MEASURES

Sediment and erosion control measures are permanent or temporary practices to prevent sediment loss from fields, slow water flow, and/or trap and collect debris and sediments in runoff water.

Runoff containing sediments with nutrients and pesticides attached can adversely affect surface waters or ground water. Site characteristics such as clay-type soils and/or sloped terrain can significantly increase the risk of erosion and off-site sediment transport. The first principle of erosion control is to maintain vegetation to hold soil and decrease the velocity of runoff water. Removal of natural vegetation and topsoil increases the potential for soil erosion, which can change runoff characteristics and result in loss of soil, increased turbidity, and sedimentation in surface waters.

Stormwater Management

Alteration of the land (e.g., construction of impervious surfaces such as roads, driveways, parking lots, and urban and agricultural structures) increases stormwater runoff. Lack of appropriate stormwater management can lead to on-site and off-site flooding, increased pollutant loading to surface

and ground waters, and erosion and sedimentation. Do not place fill within a delineated 100 year floodplain, except to repair eroded areas, or place fill in a manner which obstructs inflows from offsite areas.

Construction of a stormwater management system (e.g., retention or detention pond) may alter on-site hydrology, and therefore may require an ERP or other WMD surface water management permit. Check with your water management district before beginning construction of any stormwater management system or if installing significant amounts of new impervious areas.

There may be individual farm circumstances that create the need for specific stormwater management practices. Some operations already may have an ERP or other WMD surface water management permit that requires on-site stormwater management requirements. However, if stormwater problems exist that are not addressed by a WMD permit, it is important to develop and implement a stormwater management plan suited to the operation's unique circumstances.

Erosion Control

Examples of erosion control BMPs are critical-area planting, prescribed grazing, conservation buffers, and exclusion fencing, where appropriate, as shown in **Figure 16**. Conservation buffers are permanently vegetated, non-cultivated areas that are positioned strategically upstream of discharge areas. They are used primarily to retain water and soil onsite to reduce pollutants in surface water runoff. They include farm area borders, filter strips, grassed waterways, and **riparian** buffers, and are particularly effective in providing water quality treatment near sensitive discharge areas.

- **Borders** are strips of permanent vegetation, either natural or planted, at the edge or perimeter of farm areas. They function primarily to help reduce erosion from wind and water, protect soil and water quality, and provide wildlife habitat. Consider installing borders based on adjacent land uses and their environmental sensitivity.
- **Filter strips and grassed waterways** are areas of permanent vegetation between **production areas** that drain to natural waterbodies. Their main purpose is to decrease the velocity of runoff water and remove sediment particles before they reach surface waters.
- **Riparian buffers** can be forested or herbaceous areas located adjacent to streams, which help trap sediment, organic material, nutrients, and pesticides in surface water sheetflow before they reach a waterbody, and stabilize the banks to prevent bank erosion and collapse. They also may eliminate the need for more expensive fencing options for animal exclusion by providing a barrier to animals entering the water body. Riparian buffers are most effective on highly sloped lands when next to perennial or intermittent streams with high ground water recharge potential.

Ditch Maintenance

There are many factors that influence the flow of water in open ditches. One of the most important of these is the “cleanliness” of the ditch. Debris or rubbish, if allowed to accumulate in an open ditch, will decrease its capacity. Grass and weeds may also grow in open ditches to such an extent as to reduce the capacity of the ditch to less than half, so routine custodial maintenance of open ditches is very important.

In some cases, ditches may also function to deliver irrigation water to plants. Ditches are common



Figure 16

on farms in the flat areas of Florida and are used for irrigation and drainage. It is normal design for ditch bottoms to be at lower elevation than the common water table. These ditches usually contain water all year.

Additional ditch design and maintenance practices that reduce sediment transport include:

- **Use of vegetation to stabilize ditch and canal banks** – Planting vegetation or maintaining existing vegetation in a strip along ditch and canal banks to trap sediments.
- **Ditch bank berms** – Placing dug materials along top of ditch banks, covering with organic soil, and promoting vegetative cover.
- **Grassed field ditch connections to laterals** – Using grass as a soil stabilizer at the point of field ditch connections to lateral canals.
- **Sediment sump in field ditches** – Creating and maintaining sumps to trap sediment at field ditch connections to lateral canals.
- **Field ditch culverts** – Placing and maintaining culverts above the bottoms of field ditches at connection to lateral canals.
- **Slow field ditch drainage near discharge pumps** – Placing and maintaining culverts with risers and boards on laterals and/or field ditch connections near farm discharge pumps.
- **Sediment traps near discharge pumps** – Constructing and maintaining sediment traps by placing rock barriers or widening section of canal near farm discharge pumps.
- **Sediment sumps near discharge pumps** – Constructing and maintaining sediment sumps in canal bottoms near farm discharge pumps to

trap bottom sediments (This is different than the dug-out area when setting the pump).

- **Systematic canal cleaning program** – Cleaning all canals and farm ditches regularly through a systematic management plan to remove sediments, thus preventing off-site discharge.
- **Floating barriers at pump stations** – Reducing debris (P source) leaving the site by installing debris barriers at discharge locations.


Erosion-control devices should be used progressively, beginning with the more passive devices first (e.g., guttering, re-vegetation, prescribed grazing, filter strips), and subsequently employing more aggressive measures as the need arises (e.g., sediment traps to allow enough time for larger particles to settle out). Collectively, these practices will reduce the load of sediment reaching a waterbody, which will help protect water quality.

Construction Activities

Erosion control during construction is critical, since areas under construction will be especially prone to sediment loss. When constructing pens, barns, roads, trails, or other infrastructure, minimize the amount of land that is cleared of vegetation. Use silt fences when protection from sedimentation during sheetflow conditions is needed. Properly trench in, backfill, and compact silt fences in accordance with the Florida Stormwater, Erosion, and Sediment Control Inspector's Manual referenced below. Whenever feasible, clearing vegetation to develop new pastures should be conducted during the dry season, and re-vegetation with forage should occur as quickly as possible.

5.1 Stormwater BMPs

Level I

- ✓ 1. Install gutters and downspouts on all buildings adjacent to HIAs, and divert this water away from the HIA toward pastures or other vegetated areas.
- ✓ 2. Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure that they operate as designed.
- ✓ 3.  If you have an existing operation that does not have an ERP or other WMD surface water permit and has a history of downstream flooding issues, develop and implement a written stormwater management plan that provides specific responses to various types and levels of rainfall, as feasible. The goal of the plan

should be a reduction in volume of off-site discharge while maintaining a healthy rooting environment. Evaluate the plan's effectiveness, and make adjustments as needed.

Contact your local NRCS District Conservationist to obtain information about the soil types for the proposed or existing farm location. The District Conservationist can identify soil types that historically are prone to flooding or standing water. Evaluate the storage capacity, size, and elevations of existing ditches, ponds, creeks, rivers, and wetlands, and the size, layout, and elevations of the fields. You should also contact your county or water management district to obtain maps (FEMA, FIRM) or other information related to flooding issues at the proposed or existing location. You can access this information via the web at <http://www.fema.gov/>.


5.2 Erosion Control BMPs

Level I

- ✓ 1. Manage livestock and vegetation to minimize areas of erosion.
- ✓ 2. Minimize denuded areas in feeding, watering, and other high-traffic locations.
- ✓ 3. Seed and mulch denuded areas, as needed, to promote healthy pastures.
- ✓ 4. Use **level spreaders**, filter strips and grassed waterways to treat and infiltrate water.
- ✓ 5. Use temporary exclusion fencing on denuded areas to allow for the re-growth of vegetation.
- ✓ 6. Install or maintain field borders around the perimeter or, at a minimum, in areas where runoff enters or leaves the pasture.
- ✓ 7. Use silt fences and other appropriate BMPs during any onsite construction activities.

5.3 Ditch Maintenance BMPs

Level I

- ✓ 1. Maintain permanent vegetative cover on ditch banks.
- ✓ 2. Protect ditch banks from erosion in areas subject to high water velocities, using rip-rap, concrete, headwalls, or other buffering materials.
- ✓ 3. Keep all control structures free from obstructions.
- ✓ 4.  Do not remove sediments below the ditch's original invert elevation, which can be determined by permit drawings, basic survey drawings, and/or changes in soil characteris-

tics and color. Keep drawings of the design cross-sectional area for future reference.

5.4 Road Construction BMPs

Level I

- ✓ 1. Stabilize access roads or trails that cross streams and creeks, using rock crossings, culverts, or bridges.
- ✓ 2. Maintain vegetative cover on road banks.
- ✓ 3. When constructing above-grade access roads, keep road width to a minimum, maintain hydrology, and locate the road(s) a minimum of 25 feet from regulated wetlands.

Level II BMPs

If your answer to the following question is “yes,” implement the Level II BMP below.

Question: Under normal wet-season weather conditions, have you ever had a road with a culvert “blow out” due to high water levels? Yes No

- ✓ 4. Install a new culvert of the appropriate size, if the existing culvert is not functional. Contact NRCS or FDACS for technical assistance.

References

1. Access Road, Code 560; Heavy Use Protection Area, Code 561; Critical Area Planting, Code 342; Recreation Trail and Walkway, Code 568; Structure for Water Control, Code 587; Grade Stabilization, Code 410; Sedimentation Basin, Code 350; Runoff Management, Code 570. USDA-NRCS FOTG-Section IV. <http://www.nrcs.usda.gov/technical/efotg>
2. The Florida Stormwater, Erosion, and Sediment Control Inspector’s Manual. FDEP. <http://www.dep.state.fl.us/water/nonpoint/erosion.htm>

3. Revised Universal Soil Loss Equation, Version 1.06, USDA-ARS. <http://www.ars.usda.gov/Research/docs.htm?docid=5974>
4. Water Management Districts, ERP Stormwater Quality Applicant’s Handbook
5. ANSI/ASAE, Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas, EP302.4.
6. Field Border, Code 386; Riparian Herbaceous Cover, Code 390; Riparian Forest Buffer, Code 391; Filter Strip, Code 393; Grassed Waterway, Code 412; Anionic Polyacrylamide Application, Code 450; and Herbaceous Wind Barrier, Code 603; USDA-NRCS FOTG-Section IV, <http://www.nrcs.usda.gov/technical/efotg>
7. National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm
8. General Specifications for Establishing Riparian Forest Buffers, USDA-NRCS, Florida Technical Note Forestry FL-17
9. Farming for Clean Water in South Carolina: A Handbook of Conservation Practices
10. Riparian Buffers and Controlled Drainage to Reduce Agricultural Nonpoint Source Pollution, Technical Bulletin 318. <http://www.bae.ncsu.edu/extension/ext-publications/water/protecting/tb-318-riparian-buffers-evans.pdf>
11. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Universal Soil Loss Equation, USDA Agricultural Research Service, Agricultural Handbook No. 703, <http://www.ars.usda.gov/Research/docs.htm?docid=6028>



6.0 WATER RESOURCE PROTECTION

Water resources are distinct hydrologic features, including wetlands, springs, Lakes, streams, and aquifers.

Wetlands, Springs, and Streams Protection

Under Florida Law, wetlands are areas inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto.

Chapter 62-340, Florida Administrative Code, entitled Delineation of the Landward Extent of

Wetlands and Surface Waters, contains the methodology that must be used by all state and local governments in Florida to determine the boundary between uplands and wetlands and other surface waters. The National Food Security Act manual is used by NRCS to determine wetlands boundaries on agricultural lands. In most cases, both methodologies produce the same or nearly the same determinations.

The Florida Geological Survey defines a spring as a point where underground water emerges to the earth's surface. Springs flow naturally from underlying aquifers and are classified based on their magnitude, or amount of flow coming from the spring vent. Springs and spring runs attract wildlife, provide over-wintering habitat for endangered manatees, contain unique biological communities, and are important archeological sites.

The area within ground water and surface water basins that contributes to the flow of the spring, is a spring's recharge basin, also called a "spring-

shed.” This area may extend for miles from the spring, and the size of the area may fluctuate as a result of underground water levels. First magnitude springs discharge 64.6 million gallons per day (MGD) or more; second magnitude springs discharge between 6.46 to 64.6 MGD. FDEP has initiated an effort to delineate springsheds in the state, on a prioritized basis.

Wetlands and springs are important components of Florida’s water resources. Wetlands often serve as spawning areas and nurseries for many species of fish and wildlife, perform important flood-storage roles, cycle nutrients in runoff water, contribute moisture to the hydrologic cycle, and add plant and animal diversity. Both wetlands and springs offer valuable recreational opportunities for the public and can provide an economic benefit to the surrounding communities.

Rivers and streams are naturally flowing water-courses. There are approximately 51,000 miles of rivers and streams in Florida. They are generally classified as sand-bottom, calcareous, swamp and bog, alluvial, or spring-fed systems. There are three measurable components that contribute to stream flow: base flow, interflow, and surface runoff. Surface runoff is most affected by rainfall (storm-water runoff), and contributes most to peak flow. Rivers and streams can readily transport pollutants received in stormwater runoff to wetlands, lakes, estuaries, and other water bodies. Consequently, it is important to minimize pollutant discharges to rivers and streams.

Aquifer Protection

With the majority of Florida’s water supply originating from underground sources (aquifers), it is extremely important for agricultural operations to protect wellheads from contamination. Successful wellhead protection includes complying with regulatory requirements and using common-sense measures with regard to well placement and agricultural practices near wells. For existing wells, the focus should be on management activities near the wellhead, aimed at reducing the potential for contamination. For new-well construction, the initial focus should be on well location and following sound well-construction practices, followed by proper maintenance. Sinkhole(s) proximity to irrigated fields and/or HIAs can also introduce contaminants to the aquifer.

6.1 Wetlands Protection BMPs Level I

- ✓ 1. Do not dredge or fill in wetlands. Consult with the WMD and the NRCS prior to conducting activities in or near wetlands to ensure that you are complying with any permitting or NRCS program eligibility requirements.
- ✓ 2. Minimize adverse water quality impacts to receiving wetlands by applying measures progressively until the problem is addressed. Practices such as filter strips, sediment sumps, conservation buffers, swales, or holding water on-site may preclude the need for more aggressive treatment measures.
- ✓ 3. Install and/or maintain a minimum 25-foot, non-fertilized **vegetated buffer** upland of the landward boundary of all wetlands and lakes, unless you have an existing WMD permit (e.g., ERP, or management and storage of surface waters permit) that specifies a different buffer. For any nutrient or fecal coliform impaired waters, expand the buffer to at least 50-feet.
- ✓ 4. For existing operations without an ERP that are unable to meet the vegetated buffers specified above, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (Use the comments section at the end of the BMP checklist).
- ✓ 5. Install a filter strip to treat runoff from concentrated livestock areas, such as feed areas, shade, or water areas, that are directly adjacent to wetlands and sinkholes.

Note: Use a NRCS county soil survey map to help identify the location of wetlands, hydric soils, or frequently flooded areas. If you do not have an ERP (which provides a wetlands delineation), seek technical assistance from the WMD or NRCS to determine the landward boundary of wetlands on your operation.

References

1. Wetland Enhancement, Code 659; Nutrient Management, Code 590, USDA-NRCS FOTG-Section IV. www.nrcs.usda.gov/technical/efotg
2. National Management Measures for the Control of Nonpoint Pollution from Agriculture. EPA. http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm
3. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the

Abatement of Nonpoint Source Pollution. EPA-841-B-05-003, Chapter 4. <http://water.epa.gov/polwaste/nps/wetmeasures/>

6.2 Streams Protection BMPs

Level I

- ✓ 1. Install and/or maintain a riparian buffer along perennial streams on production areas that exceed 1-percent slope and discharge directly to streams, or where pasture allows direct access to the stream by cows. Contact FDACS, NRCS, or an NRCS-approved Technical Service Provider for assistance in properly designing the riparian buffer.
- ✓ 2. Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function and to maintain natural flows.

Level II BMPs

If your answer to the following question is “yes,” implement the Level II BMP below.

Question: Are there areas where a riparian buffer or other BMPs are unable to keep animals out of the stream? Yes No

- ✓ 3. Install exclusion fencing where necessary.

References

1. Field Border, Code 386; Riparian Herbaceous Cover, Code 390; Riparian Forest Buffer, Code 391; Filter Strip, Code 393; Stream Habitat Improvement and Management, Code 395; Grassed Waterway, Code 412; Stream Crossing, Code 578; Streambank and Shoreline Protection, Code 580. USDA-NRCS FOTG-Section IV. www.nrcs.usda.gov/technical/efotg
2. Riparian Buffer Width, Vegetative Cover and Nitrogen Removal Effectiveness. EPA 600/R-05/118. <http://nepis.epa.gov/>

6.3 Protection for First- and Second-Magnitude Spring Recharge Basins

Level I

- ✓ 1. Install and/or maintain a minimum 100-foot non-fertilized vegetated buffer upland of the landward boundary of springs and spring runs.
- ✓ 2. Install and/or maintain a minimum 50-foot non-fertilized vegetated buffer around sinkholes.

- ✓ 3. If you have a sinkhole on your property, never use it to dispose of used pesticide containers or other materials.

References


1. Protecting Florida’s Springs, Land Use Planning Strategies and Best Management Practices, FDEP. www.dep.state.fl.us/springs/reports/files/springs-manual_2002.pdf.
2. Karst Sinkhole Treatment, Code 527. USDA-NRCS FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

6.4 Well Operation and Protection

When installing a new well, contact your WMD to see whether the well requires a consumptive use/water use permit and/or a well construction permit. Potable water wells as defined by Chapter 62-521, F.A.C, must follow the requirements of that rule.

Locate new wells up-gradient as far as practical from likely pollutant sources, such as petroleum storage tanks, septic tanks, chemical mixing areas, or fertilizer storage facilities. Use a licensed Florida water well contractor, and drill new wells according to local government code and WMD well-construction permit requirements.

Level I

- ✓ 1. Use backflow-prevention devices at the wellhead to prevent contamination of the water source, if injecting fertilizer, wastewater, or chemicals.
- ✓ 2. Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.
- ✓ 3.  Maintain records of new well construction and modifications to existing wells.

References

1. Water Well, Code 642; Well Decommissioning, Code 351; Well Plugging, Code 755. USDA-NRCS FOTG-Section IV. www.nrcs.usda.gov/technical/efotg
2. Water Well Permitting and Construction Requirements Rule, Chapter 62-532, F.A.C. FDEP. www.dep.state.fl.us/legal/Rules/rulelistnum.htm
3. Florida Water Permits. <http://flwaterpermits.com/>



7.0 INTEGRATED PEST MANAGEMENT AND PHARMACEUTICALS

Integrated pest management involves the monitoring of pest and environmental conditions with the judicious use of cultural, biological, physical, and chemical controls to manage pest problems.

Integrated Pest Management (IPM) combines proper plant selection, correct cultural practices, the monitoring of pest and environmental conditions, the use of biological controls, and the judicious use of pesticides to manage pest problems. The term “pests” includes any organism that is damaging to livestock, crops, humans, or land fertility.

The basic steps of an IPM program are as follows:

- Identify key pests.
- Determine the pest’s life cycle, and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Use cultural, mechanical, or physical methods to prevent problems from occurring (for example, prepare the site and select resistant plant cultivars), reduce pest habitat (for example, practice good sanitation), or promote biological control

(for example, provide nectar or honeydew sources for natural enemies).

- Decide which pest management practice is appropriate and carry out corrective actions. Direct the control where the pest lives or feeds. Use properly timed preventive chemical applications only when your professional judgment indicates that they are likely to control the target pest effectively, while minimizing the economic and environmental costs.
- Determine whether the methods used actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.

Pesticide Selection and Use

The EPA and the FDACS regulate the use of pesticides in Florida. The term pesticide is defined by EPA as any substance or mixture of substances intended for preventing, destroying, repelling, or

mitigating any pest. Pesticides include insecticides, herbicides, fungicides, rodenticides, etc.

Pesticides should be used only when necessary. To minimize the potential for pollution of water resources, base pesticide selection on the characteristics of the pesticide (solubility, toxicity, degradation, etc.) and the site (geology, depth to water table, proximity to surface water, etc.). Use pesticides that have the least effect on beneficial organisms.

Choosing the proper pesticide in this class also requires familiarity with product labels and performance. **Always follow the label directions.** The label is the single most important document in determining the correct use of a pesticide, and state and federal pesticide laws require strict adherence to label directions.

Proper records of all pesticide applications should be kept according to state and federal requirements. These records help to establish proof of proper use, facilitate the comparison of results of different applications, or find the cause of an error. Sample record keeping forms can be found at the FDACS Bureau of Licensing and Enforcement.

Pesticide Application Equipment Calibration

In general, equipment used for application of herbicides should not be used for applying insecticides and fungicides. This will prevent accidental destruction of desirable plants. Controlling application rates and calibrating pesticide equipment will reduce the potential for pollutant loading to ground and surface waters. To apply the precise amount of pesticide to targeted pests or weeds, pesticide application equipment must be calibrated. Application rates must be in accordance with the label in order to prevent contamination to the environment.

Equipment calibration should take place away from wells, sinkholes, or waterbodies, and should be done with clean water. Calibrate sprayers every time nozzles or pumps are replaced.

Pesticide Mixing and Application

Avoid mixing pesticides and loading or rinsing sprayers immediately adjacent to wells or waterbodies, since spills in these areas can easily contaminate water supplies. If the farm does not have a permanent or temporary mixing and loading facility, use nurse tanks and mix at random sites to prevent a buildup of contamination in the soil. If this is not possible, run a long hose (100 to 200 feet) away and preferably downhill from the

supply well to the mix-and-load area, and guard against accidental spills. Install anti-siphon devices or ensure that there is an air gap between the hose and the tank when sprayers are filled.

Minimize field applications of pesticides just prior to periods of anticipated heavy or sustained rainfall to prevent surface water contamination, accelerated leaching to ground water, and/or ineffective control of target pests. If applying restricted-use pesticides, the applicator must be fully trained and licensed in accordance with Chapter 5E-9.024, F.A.C., or must hire someone appropriately certified. Applicators must read and follow all label directions and the directions on the Material Safety Data Sheets.

Chemical Storage

Most dairies have several chemicals used in the operation from pipe and tank cleaning agents to iodine and other cow dips and medicine. Bulk chemicals greater than 60 gallons should be stored under roof in rooms that do not have floor drains leading directly to surface waters or the wastewater storage pond. Chemicals should never be disposed of in the wastewater system or in ditches or creeks. Return unused or outdated chemicals to the supplier or take them to the local landfill or other authorized disposal agent.

Pesticide Waste

Pesticide equipment wastewater should be minimized and contained as much as possible. If economically feasible for large operations, an impermeable floor with a curb can be constructed to handle mixing and loading pesticides or herbicides, and washing pesticide residues from equipment. The equipment needs to be washed only when changing from one pesticide to another, not after every application, unless directed by the label. This practice will reduce the amount of **rinsate**, which can be collected and used in accordance with the label during the next application.

Pesticide spills should be cleaned up immediately following an incident. Barriers and absorbent materials generally are used to contain spills. Soil contaminated by a spill should be collected, stored in a special container, and re-used during subsequent applications. Spill clean-up equipment and trained emergency responders should be used when handling spills. The quick containment and clean-up of pesticide spills will help protect the environment and minimize your liability.

For additional information, refer to Best Management Practices for Agrichemicals and Farm Equip-

ment Maintenance which can be accessed online at: <http://www.floridaagwaterpolicy.com/BestManagementPractices.html>

Pharmaceutical Use

The use and misuse of pharmaceuticals, such as antibiotics and hormones, can have a negative impact on water quality. This is an issue nationwide, as sampling has revealed detectable amounts of antibiotics, hormones, sterols, and other substances in surface waters from various sources. Because of this, it is very important to use these products responsibly. Follow all state and federal regulations and properly dispose of spent needles, expired or unused pharmaceuticals, and pharmaceutical containers.

The proper disposal of unused pharmaceuticals is necessary for environmental, livestock, and human health. Expired medications often can be returned to the supplier/manufacturer or some veterinary offices. Check with your local municipality to see if they will accept pharmaceuticals during household hazardous waste disposal events.

Proper disposal of spent needles, referred to as “sharps,” is regulated by EPA. These regulations require that needles be disposed of in a biomedical container designed for collection of sharps. (See: www.epa.gov/osw/nonhaz/industrial/medical/disposal.htm) Spent needles should be collected in these containers to avoid accidental needle sticks of farm workers or animals. Local veterinary offices should be able to provide these containers, labeled “Biohazard,” as illustrated in **Figure 17**. Many county solid waste departments will take the sharps containers and properly dispose of them for a small fee, and some counties provide this service for free. Contact the local solid waste office for more information. Operators should check with their county extension office to see whether local ordinances apply.



Figure 17

Follow pharmaceutical label instructions for disposal of unused product. **Do not** pour unused product down a sink or drain. Instead, use the following guidelines:

- Pour product into a sealable plastic bag. If it is a solid (pill, liquid capsule, etc.), crush it or add water to dissolve it.
- Add kitty litter, sawdust, or coffee grounds to the plastic bag. Seal the plastic bag and put it in the trash.
- Remove and destroy identifying personal information (prescription label) from all containers before recycling them or throwing them away.

7.1 Pesticide and Pharmaceutical BMPs Level I

- ✓ 1. Practice IPM and use all pesticides in accordance with the label. When applying a pesticide close to a stream, canal, pond, or other waterbody, choose a pesticide with an active ingredient that has a lower toxicity to aquatic organisms
- ✓ 2. Store pesticides in a roofed structure with a lockable door, at least 100 feet from wells, surface waters, and sinkholes.
- ✓ 3. When mixing pesticides in the field, conduct loading activities at random locations. Use a check valve or air gap separation to prevent backflow into the tank when filling a sprayer.
- ✓ 4. Rinse, recycle, or dispose of empty pesticide containers following federal, state, and local regulations.
- ✓ 5. Dispose of spent needles and unused pharmaceutical products by using an approved biomedical container, or by following other guidance approved by the EPA.

References

1. Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance. FDACS/FDEP <http://www.floridaagwaterpolicy.com/BestManagementPractices.html>
2. Use Management Practices to Protect Groundwater from Agricultural Pesticides, UF-IFAS Publication PI 1. <http://edis.ifas.ufl.edu/PI001>
3. Management Practices to Protect Surface Water from Agricultural Pesticides, UF-IFAS Publication PI 22.
4. Agrichemical Handling Facility, Code 309; On-Farm Secondary Containment Facility. NRCS Code 319; Pest Management, Code 595. USDA-NRCS FOTG-Section IV. <http://www.nrcs.usda.gov/technical/efotg>



8.0 ODOR PREVENTION AND MANAGEMENT

Odor prevention and management involves addressing the factors most associated with chronic dairy odor problems.

Odor associated with dairies generally comes from feed sources (mostly silage) or from areas with accumulated manure. Barns, HIAs, solids separa-

tors and storage areas, WSPs, and land application of manure or wastewater are the predominate sources of odor. When building new facilities, locate barns and waste management systems as internal to the property as possible. The table below is a good guide to help producers identify potential odor sources and ways to minimize them.

Odor Sources and Causes

Source	Cause	BMPs to Minimize Odor
Farmstead	Dairy production	Vegetative or wooded buffers
Paved lots or barn alley surfaces	Wet manure-covered surfaces	Scrape or flush daily Promote drying/ventilation Routine water line checks
Bedded areas	Urine Partial microbial decomposition	Promote drying/ventilation Replace wet or manure-covered bedding
Manure dry stacks	Partial microbial decomposition	Provide adequate drainage
Settling basin	Partial microbial decomposition Mixing while filling Agitation when emptying	Liquid drainage from settled solids Remove solids regularly

Uncovered manure, slurry, or field application	Volatile gas emissions while drying	Soil injection of slurry/sludge Soil incorporation within 48 hours Spread in thin layers for rapid drying Proven biological additives
Flush tanks	Agitation of recycled liquid while tanks are filling	Flush tank covers Extend fill lines to near bottom of tanks
WSP surfaces	Volatile gas emission Biological mixing Agitation	Proper WSP capacity Minimum surface area-to-volume ratio Minimum agitation when pumping Mechanical aeration
Irrigation sprinkler nozzles	High pressure agitation Wind drift	Irrigate with little or no wind Pump intake near WSP liquid surface Flush residual manure from pipes
Dead animals	Carcass decomposition	Proper disposition of carcasses
Standing water around facilities	Improper drainage Microbial decomposition	Grade so that water drains away from facilities

Adapted from Appendix D, Manual A, NC Animal Waste Operator Certification Program.

Waste Storage Ponds

Treatment of waste is accomplished through bacteria that decompose organic matter in an **anaerobic** environment. True anaerobic lagoons typically are used because of their efficiency, but cost prevents using these except in South Florida and some areas of the panhandle. A properly sized and operated lagoon reduces organic material (which is the source of the majority of the odor), reduces the nitrogen concentration of the waste, allows treated liquid to be used for flushing, and allows solids to settle out. A WSP typically used in other areas (less than 28 days of storage) increases the need for more intensive management and pumping frequency. It also increases odor potential and requires more frequent solids removal.

Solid Manure Management

Composting solids can greatly reduce odors. **Figure 18** shows a dedicated composting area. To facilitate composting, it should have the appropriate ratio of carbon to nitrogen, and the appropriate moisture level. If composting is not used, solids should be stored internal to the site and spread as soon as practical.

Land Application

Many odor complaints are a result of land-applying manure. When the manure is applied to land, the exposed surface area is enlarged which allows a large odor plume to form. Dairies with solid separators usually spread manure between one and four times a month. Lagoon cleanouts also

can produce significant solids that must be spread. Wastewater application can create odors as well.

Prior to waste application, consider odor level, proximity of neighbors, and weather forecasts. If multiple fields are available, apply waste to the field that has the fewest neighbors downwind. Try to avoid applying on weekends or holidays or during extremely windy days (greater than 10 mph). Maintaining vegetation around fields can help by trapping particulates out of the air which can also decrease the smell. Dairies that have good solids separation or long-term storage ponds can apply wastewater through impact sprinklers instead of guns, which reduce volatilization and odors. Some farmers have attempted pivot irrigation with drop nozzles, with limited success. There must be excel-



Figure 18

lent solids separation and filtration in order for the nozzles not to plug.

Good Neighbor Policy

Good neighbor and community relationships are critical for good business with minimal complaints. Make sure immediate neighbors have the phone number of someone associated with the farm who can assist them with a complaint. One option for disposal is neighbors and others in the community who may be willing to receive manure at no charge.

8.1 Odor Management BMPs

Level I

- ✓ 1. In populated areas, establish a vegetative buffer around the farm consisting of dense lower vegetation combined with higher vegetation. Cedar trees combined with pines work well.

- ✓ 2. Consider wind direction and neighbor locations before applying waste. Do not apply wastewater if winds are more than 10 mph.
- ✓ 3. If odors are a problem, clean out settling basins at least once every two weeks.
- ✓ 4. When practical, inject or incorporate manure into the soil.

References

1. Sustainable Dairy Production Best Management Practices, Manure Management, Louisiana State University <http://www.lsuag-center.com/en/communications/publications/publications+catalog/crops+and+livestock/best+management+practices/>



9.0 ANIMAL MORTALITY MANAGEMENT

Animal mortality management involves the proper transport, storage, and disposal of dead animals to avoid impacts to water quality and livestock and human health.

Animal carcasses contain microorganisms, some of which may be pathogenic (disease-causing) to animals and/or humans. Proper management of carcasses will reduce the risk of transmitting diseases to healthy livestock, prevent odor problems, and protect surface waters from organic loads that can lower dissolved oxygen levels and kill fish.

Depending on location, some animals may be removed by third parties such as rendering plants or facilities with exotic carnivores such as lions or other big cats. If these are not available, composting and/or burial are used. In order to protect groundwater quality and to assure that pathogens are not spread, animals must be buried with the carcass a minimum of two feet above the highest expected water table level (available in the soil survey for the county) and a minimum of 24-inches of cover surrounding all sides of the carcass. The burial site should be at least 100 feet from a **private drinking water well**, 200 feet from a

public drinking water well, 100 feet from the property line, 500 feet from a residence, and 200 feet from a stream, lake, pond, or wetland. This is in accordance with Section 823.041, F.S., and meets NRCS Standard 316 for animal mortality. In areas with high water tables, this requires a mound system to be constructed, with the carcass resting above the ground surface but still surrounded by the required amount of soil.

Composting is the preferred method of disposal. A designated compost area should be established using the setbacks given above for burial sites. Screened solids, dried solids, wood chips, chipped yard waste, peanut hulls, old hay, or a similar carbon source should be used to surround the carcass. Like burial, the area beneath the carcass should be at least two feet above the highest expected water table and should be surrounded by 30-inches of material on all sides. After 6 to 9 months the pile should be turned and re-covered with new material. The bones can be buried or disposed of in a landfill. The bottom of the compost pile should consist of 24 inches minimum of high carbon source material that is preferably absorptive. Compost piles can

be built as windrows that are added to as mortality occurs.

9.1 On-Site Carcass Disposal BMPs Level I

- ✓ **1.** For below-ground burial, move dead cows to an upland area at least 100 feet from adjacent property and at least 200 feet from watercourses, streams, wetlands, wells, or sinkholes. Locate burial sites at least 2 feet above the seasonal high ground water table and allow for at least 2 feet of cover. Identify burial sites on a map and keep it available for future reference.
- ✓ **2.** For above-ground burial, move dead cows to an upland area at least 100 feet from

adjacent property and at least 200 feet from watercourses, streams, wetlands, wells, or sinkholes. Cover with 6 inches of compacted soil and at least 2 feet of additional soil.

- ✓ **3.** If composting onsite, establish a compost area using the setbacks given above.

References

- 1.** Methods of Large Animal Carcass Disposal in Florida. UF-IFAS Publication VM 171 <https://edis.ifas.ufl.edu>
- 2.** Animal Mortality Facility, Code 316; Composting Facility, Code 317. USDA-NRCS FOTG-Section IV. <http://www.nrcs.usda.gov/technical/efotg>
- 3.** Florida Animal Producer Guidance for Routine Disposal of Animal Carcasses. FDACS.



10.0 RECYCLING AND WASTE MANAGEMENT

Waste Stream Management involves other environmental, health and safety issues that farms typically encounter.

Farm maintenance areas are sites where pesticides are mixed and loaded into application equipment; tractors and other pieces of farm equipment are serviced; or pesticides, fuel, fertilizer, and cleaning solvents are stored. These are areas of the farm where accidental pollution of soil, surface water, or ground water is most likely to occur. Contamination can occur when pesticides, lubricants, solvents, or other chemicals are spilled, rinse water from container or equipment cleaning is dumped on the ground or discharged into surface water, or improperly cleaned containers are stockpiled or buried. Proper management of farm maintenance areas is an important part of responsible chemical and pesticide use. Proper handling and disposal practices at these sites can help avoid serious environmental problems, protect the farm's water supply, reduce exposure of the owner to legal liability for contamination and cleanup (including fines), and foster a good public image for agriculture.

Use the guiding principles below in farm maintenance areas to help prevent contamination:

- **Isolate** all potential contaminants from soil and water.
- **Do not discharge** any waste material onto the ground or into surface waterbodies.
- **Conserve** resources to maximize efficient use of irrigation, fertilizers, and pesticides.

Try to eliminate the discharge of materials such as equipment wash water to ground or surface waters.

Surface water contamination can occur directly through spills or releases to a lake or canal, or indirectly through stormwater drains, field ditches, or swales. Discharge to ground water may occur by percolation through highly permeable soils from repeated activity at a single location, or by flow into sinkholes, improperly constructed wells or other direct conduits to ground water.

Fertilizers

If not handled properly, fertilizers can be a significant source of water pollution. The nutrients in fertilizers can lead to algal blooms and stimulate growth of noxious plants in lakes and streams.

Storage

Always store nitrogen based fertilizers separately from solvents, fuels, and pesticides since many fertilizers are oxidants and can accelerate a fire. Ideally, fertilizer should be protected from rainfall, and stored in a concrete building with a flame-resistant roof. Storage of dry bulk materials on a concrete or asphalt pad may be acceptable if the pad is adequately protected from rainfall and from water flowing across the pad. Secondary containment of stationary liquid fertilizer tanks containing greater than 80 percent nutrients or phosphoric acid is required per FDEP Chapter 62-762, F.A.C. Even where not required, the use of secondary containment is a sound practice.

Loading and Spill Containment

Load fertilizer into application equipment away from wells or surface waterbodies. A concrete

or asphalt pad with rainfall protection is ideal, as this permits easy recovery of spilled material. If this is not feasible, loading at random locations in the field can prevent a buildup of nutrients in one location. Do not load fertilizers on a dedicated pesticide chemical mixing center because of the potential for cross-contamination. Fertilizers contaminated with pesticides may cause crop damage or generate hazardous wastes. Clean up spilled material immediately. Collected material may be applied as fertilizer.

Solvents and Degreasers

The routine release of even small amounts of solvents can result in serious environmental and liability consequences due to the accumulation of contaminants in soil or ground water. As little as 25 gallons per month of used solvent disposal can qualify you as a “small quantity generator” of hazardous waste, thus triggering reporting requirements. Whenever practical, replace solvent baths with re-circulating water-based washing units (which resemble heavy duty dishwashers). Soap and water or other water-based cleaners often are as effective as solvent-based ones. Blowing off equipment with compressed air instead of washing with water often is easier on hydraulic seals and can lead to fewer oil leaks. Minimize the need for storage by carefully planning and ordering chemicals only as they are needed. Store solvents and degreasers in lockable metal cabinets in an area away from ignition sources (e.g. welding areas, grinders) and provide adequate ventilation. Many are toxic and highly flammable. Never store them with pesticides or fertilizers or in areas where smoking is allowed. Keep solvent containers covered to reduce volatile organic compound emissions and fire hazards. Keep an inventory of the solvents stored and the Safety Data Sheets and emergency response equipment on the premises near the storage area, but not inside the area itself, since it may not be available when needed most.

Use and Disposal

Always wear the appropriate personal protective equipment (PPE), especially eye protection, when working with solvents. Never allow solvents to drain onto pavement or soil, or discharge into waterbodies, wetlands, storm drains, sewers or septic systems, even in small amounts. Solvents and degreasers should be used over a collection basin or pad that can collect all used material. Most solvents can be filtered and reused many times. Store

the collected material in marked containers until it can be recycled or legally disposed.

Private firms provide solvent wash basins that drain into recovery drums and a pick-up service to recycle or properly dispose of the drum contents. Collect used solvents and degreasers, place them into containers marked with the contents and the date, and then have them picked up by a service that will properly recycle or dispose these materials. Never mix used oil or other liquid material with the used solvents. Use only licensed contractors when disposing of spent material offsite.

Paint

Paints, stains, or other finishing materials may be either oil-based or latex. The best method of disposal for empty latex paint cans is to allow the can to fully dry and then dispose of it as solid waste. Unused latex paints can be mixed together, re-tinted, and used. Charitable housing groups will often accept unused latex paint.

Oil and solvent based coatings which cannot be used should be disposed as hazardous waste, so check with your county for disposal options. However, most empty cans may be allowed to fully dry and then disposed of as solid waste.

Used Oil, Antifreeze, and Lead-Acid Batteries

Collect used oil, oil filters, and antifreeze in separate marked containers and recycle. In Florida, recycling is the only legal option for handling used oil. Oil filters should be drained into a container (puncturing and crushing helps speed drainage) and taken to the place that recycles your used oil. Many gas stations or auto lube shops will accept small amounts (including oil filters) from individuals. Do not mix used oil with used antifreeze or sludge from used solvents. Antifreeze must be recycled or disposed as a hazardous waste. Commercial services are available to collect this material.

Lead-acid storage batteries are classified as hazardous wastes unless they are recycled. All lead-acid battery retailers are required by law to accept returned batteries for recycling. Make sure all caps are in place to contain the acid. Store used batteries on an impervious surface and under cover.

Gasoline and Diesel Fuel

Design and manage fuel dispensing areas to prevent soil and water contamination. Place fuel pumps on concrete or asphalt surfaces. Fuel pumps with automatic shut off mechanisms reduce



Figure 19

the potential for overflow and spillage during fueling. Do not locate the pumps where a spill or leak would cause fuel to flow onto soil, or into a storm drain or surface waters.

Stationary fuel storage tanks should be in compliance with FDEP storage tank regulations (Chapter 62-761, F.A.C. for underground tanks and 62-762, F.A.C. for aboveground tanks) and EPA Oil Spill Prevention, Control, and Countermeasure rule at: www.epa.gov/osweroel/content/spcc/spcc_ag.htm. In general, underground tanks with volumes over 110 gallons and above-ground tanks with volumes over 550 gallons must be registered and located within secondary containment systems (Figure 19) unless of double-wall construction. While containment is not usually required for smaller tanks, it is still a good practice.

The water to be discharged from secondary containment must be checked for contamination. This can be done by looking for an oil sheen, observing any smell of fuel or oil, or through the use of commercially available test kits. Never discharge to the environment any water that is contaminated. If the water is not contaminated, it can be reused, or safely discharged.

General Equipment Cleaning

Clippings and dust removed from machinery should be handled separately from other waste materials and equipment wash water. Many manufacturers now recommend the use of compressed air to blow off equipment. This is less harmful to the equipment's hydraulic seals, eliminates wash water, and produces dry material that is easy to handle.

Wash equipment over a concrete or asphalt pad that allows water to be collected, or to run off onto grass or soil, but not into a surface waterbody or canal. After the residue dries on the pad, it can be collected and composted or spread in the field. To

keep crop residue and other debris from becoming contaminated with pesticide, do not conduct such operations on a pesticide mixing and loading pad.

Minimize the use of detergents. Use only biodegradable non-phosphate detergents. The amount of water used to clean equipment can be minimized by using spray nozzles that generate high pressure streams of water at low volumes.

Wash water generated from the general washing of equipment, other than pesticide application equipment, may not have to be collected. This wash water must not, however, be discharged to surface or ground water either directly or through ditches, storm drains or canals. For regular wash down of ordinary field equipment, allow the wash water to flow to a grassed retention area or swale. Do not allow any wash water to flow directly into surface waters or to a septic system.

Pesticide Application Equipment Washwater

Wash water from pesticide application equipment must be managed properly since it will contain pesticide residues. Wash the outside of the equipment at random spots in the field using water from a nurse tank. Clean the tires and particularly dirty areas of the equipment exterior prior to bringing it into the pad area. These practices prevent unwanted dirt from getting on the mix/load pad and sump or from being recycled into the sprayer. Avoid conducting washing in the vicinity of wells or surface waterbodies. For intensive centralized or urban operations, it may be necessary to discharge the wash water to a FDEP permitted treatment facility.

The inside of the pesticide application equipment should be washed on the mix/load pad. The rinsate may be applied as a pesticide (preferred) or stored for use as make-up water for the next compatible application. Otherwise it must be treated as a (potentially hazardous) waste. After washing the equipment and before an incompatible product is handled, the sump should be cleaned of any liquid and sediment.

Recycling and Industrial Waste Management BMPs

10.1 Waste Reduction BMPs

Level I BMPs

- ✓ 1. Store fertilizers in an enclosed, roofed structure with an impervious floor and lockable door, at

least 100 feet from wetlands, waterbodies, or sinkholes.

- ✓ **2.** Recycle used oil, solvent bath waste, and antifreeze using appropriate means.
- ✓ **3.** Ensure that all regulated petroleum storage tanks are registered, and meet the requirements of FDEP rule for secondary containment.

References

- 1.** USDA-NRCS Conservation Practice On-Farm Secondary Containment Facility, Code 319 FOTG-Section IV. www.nrcs.usda.gov/technical/efotg



11.0 DAIRY CLOSURE

Dairy Closure is the decommissioning of facilities in an environmentally safe manner.

When it becomes necessary to close a facility, certain actions must be taken. Producers may want to conduct pre-closure soil and water testing to establish baseline data as a means of due diligence.

All of the wastewater from the solids separators and WSP should be land applied at agronomic rates. The remaining solids from the WSP, separator, perimeter ditch, or any other place of significant accumulation should be removed and applied to land at agronomic rates or hauled off-site. The solids should be removed to the maximum extent possible by agitation and pumping, dredging, or physical means (heavy equipment). Sometimes clean water can be pumped into storage/treatment areas and agitated before being pumped out to land application fields. This practice should continue until the water becomes clear and the solids are removed.

Existing waste transfer components (including pipes) and conveyances should be removed and replaced with compacted earth material, or decommissioned. Historical stormwater related conveyance

ditches should not be filled without WMD review and authorization. All disturbed areas should be re-vegetated or treated using other erosion control measures.

Once a WSP has been cleaned, it should be filled in or breached, unless the farmer wants to maintain it for alternative water use purposes.

11.1 Closure BMPs

Level I

- ✓ 1. Clean all areas where concentrated manure has accumulated, including WSPs.
- ✓ 2. Breach, fill, or use WSP for an approved alternative water use purpose.
- ✓ 3. Contact the WMD about proper abandonment of onsite wells.
- ✓ 4. Identify and properly dispose of chemicals and other waste materials.

References

1. Waste Facility Closure, Code 360. USDA-NRCS FOTG-Section IV. <http://www.nrcs.usda.gov/technical/efotg>

NUTRIENT AND WASTE STORAGE POND CALCULATIONS

A whole farm nutrient balance considers all nutrient inputs and managed outputs. The difference, or level of imbalance, contributes to a farm's water quality risk profile. In addition, each application field must be in balance for the nutrient of concern over the year to ensure nutrients do not become excessive in the soil profile or lead to unmanaged losses to the environment.

Manure nutrient balance considers only the manure and fertilizers applied to the cropland, and is the focus of this section. The following steps document that a dairy is in manure nutrient balance and has an acceptable WSP:

1. Determine whether the dairy nutrient application should be designed on N or P based on the local risk to impaired waters.
2. Document the amount of wastewater production.
3. Determine whether the WSP meets the criteria in this manual.
4. Document the N or P in excrement. For a whole farm balance, also include feed, fertilizer, and products such as milk and animals which are removed from the farm.
5. Determine manure nutrient losses based on type of waste treatment and land application system.
6. Determine the crop and pasture uptake, and whether the farm fields are in balance.

This section is not required to be submitted with the NOI; however, it is important to remember to record the calculation results in the General and WSP tables in **Appendix 8**.

If manure nutrient balance cannot be achieved, then one of the following alternatives needs to be considered: grow crops with higher nutrient uptake; reduce cow numbers; haul manure offsite; process manure to create a marketable product; consider chemical treatment; and/or (for N) employ denitrification or volatilization technologies.

Step 1: Determine farm nutrient design.

As mentioned earlier, plants and animals require N and P to live. Some natural systems can accept larger amounts of either N or P than others, although every system has its limitations. Florida has some of the largest natural deposits of P in the world, with large mines in the area of White Springs (near the intersection of I-10 and I-75) and Bartow (east

of Tampa). These areas, as well as others, have high levels of natural P, so additional P generally will not harm the ecosystem. Other ecosystems, such as Lake Okeechobee and the Everglades have little natural P, and any addition of P can have a detrimental effect on the system.

Scientists often refer to the limiting nutrient when discussing a water body or plant growth. In the example above of the P-rich areas, N is the limiting nutrient because with an increase in N, different plants can grow and flourish that might not normally do so. The opposite is true for the Everglades. Excess nitrogen can be added and it may make little difference, because there is not enough P to support additional plant growth.

When waste emerges from a cow, it has nearly the correct ratio of N and P for plant uptake of both nutrients at the same rate. However, as shown in Step 6 below, there are significant nitrogen losses that cause the manure to have excess P. If your farm area is P limited, you almost always will need to provide commercial N fertilizer to meet crop demand. However, if your farm area is N limited, it is acceptable to base your applications on N crop requirements. Farms that are N limited rarely need extra commercial fertilizer to grow crops (some farms will use small amounts of N fertilizer at critical growth times for crops).

Alternatively, you may contact the FDEP Industrial Wastewater staff in your District office, your NRCS District Conservationist, FDACS, the Water Management District, or a professional engineer for assistance with this determination.

Use Appendix 3 to determine the limiting nutrient (N or P) for your farm and indicate it here, along with other sources (soil tests, maps, status of receiving water body, P-Index etc.) used in this determination.

Nitrogen Phosphorus

Sources: _____

Step 2a: Determine average wastewater and runoff volumes.

Wastewater production amount is the average volume of wastewater entering the waste treatment system every day. For dairies without freestall or cooling barns, wastewater production is fairly con-

stant all year, with some variation depending on how much runoff from rainwater enters the waste stream. However, cooling systems increase the summer wastewater volume in freestall and cooling barns.

If a 25-year, 24-hour storm event has occurred since construction of the WSP, a farmer can document that the WSP has the capacity to retain this storm event by verifying that it has not had an overflow (without a significant change in wastewater or storage volume) other than ones caused by storm events greater than those shown in **Figure 20**. If this is the case, and the WSP liner requirement is met, the capacity is adequate. Therefore, the rest of this step does not have to be completed, although it may be useful to do so.

If the above does not apply and there are farm records for the amount of wastewater pumped, then those records can be added up for a year and divided by 365 to determine the average daily wastewater production.

In the absence of farm records, all of the water used in generating wastewater must be added up in order to determine the average daily wastewater volume. Here is how to do so.

- If using hoses, a 5-gallon bucket and a stopwatch can be used to determine hose output rate.

Gallons per minute (GPM) = 5 ÷ number of minutes to fill bucket. There are 60 seconds in a minute, so if it took 3 minutes and 45 seconds to fill the bucket, divide the seconds by 60 to get parts of a minute (3.75 minutes). (5gal. ÷ 3.75 min. = 1.33 GPM)

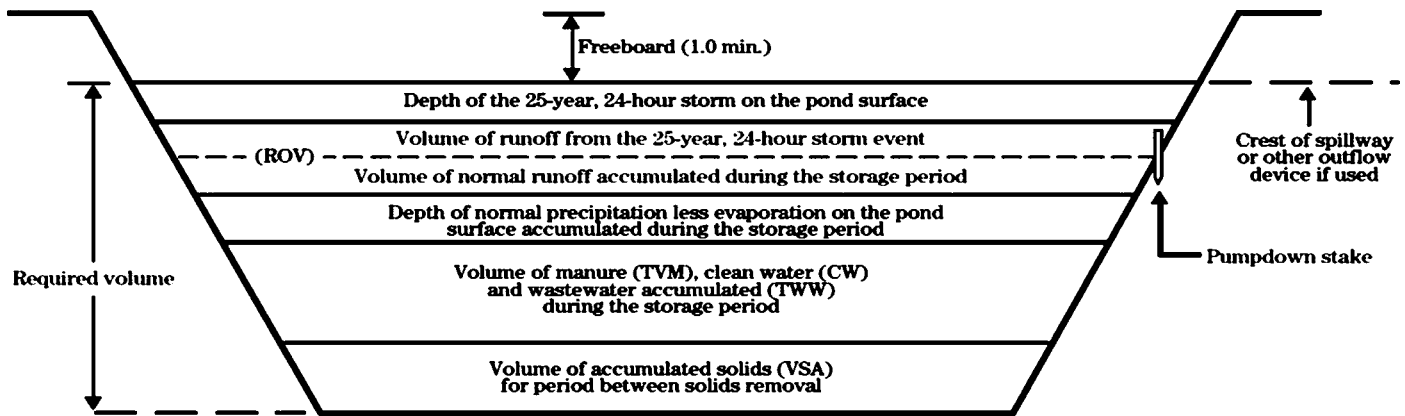
- Udder washers (sprinklers) can produce large amounts of wastewater. If sprinkler output is unknown, it is usually possible to estimate it using a bucket. Hold the bucket so as much of the sprinkler water as possible goes into the bucket. Fill the bucket for one minute and then measure the water in the bucket using 1-gallon jugs or a measuring cup to determine gallons per minute. If output is high, follow the instructions from the paragraph above. Once sprinkler output rates are determined, multiply the GPM by the number of sprinklers, then multiply that result by the average minutes a day they are used, in order to get total output of wastewater.
- Cow manure also adds to the wastewater production amount. Estimates are given in **Table 2** of **Appendix 2**. Solids accumulation can be

significant, especially in ponds that do not have solids separation prior to the pond, and in ponds that are not agitated. Solids accumulation must be considered when sizing ponds.

- For flushing systems, only count fresh water flushes. Recycled flush water does not enter into the equation. Volume used per flush can be determined by measuring how far down the water goes in the tank after each flush.

Volume used in gallons per flush = 5.9 × diameter of tank × diameter of tank again × distance from filled tank to water level after flush. All measurements are in feet. For fractions of a foot, divide the number of extra inches by 12 and add the result to the number of full feet. For example, 4-feet, 3-inches would be 3 ÷ 12 or 0.25, and written as 4.25 feet.

- Most farmers know the output of their cooling system sprinklers and the time they run. If the sprinklers are run for 1 minute every 10 minutes, then they run 6 minutes an hour, which can be multiplied by the average hours per day that they run. Some dairies use sophisticated systems that turn on at a specific temperature and/or humidity level. The farmer still has to use best judgment to determine, on average, how many hours a day these systems run. An evaporation loss of 30 percent can be deducted from any cooling system that creates a fine mist.
- Plate cooling water that drains into the waste management system also needs to be added to the wastewater production amount. Since milk is a valuable commodity, very little is wasted and it is not a significant part of the waste stream.
- Any runoff from high-intensity areas (HIA) that are not part of a pasture must be captured and sent to the WSP. Use the adjacent table for average wet season rainfall values and calculate the normal runoff contribution. A cross-sectional schematic of a WSP, with typical storage volumes, is depicted in **Figure 21**. It is assumed that direct rainfall and evaporation from a WSP are about equal so rainfall onto the WSP does not need to be considered. Then use the formula box below to calculate the volume added by runoff from all areas, including the HIA, that drain to the WSP.



*or other outflow device

Figure 21

Wet Season Rainfall

City	Wet Season Rainfall May-Oct Daily Avg. (in)
Fort Myers	0.23
Miami	0.25
West Palm Beach	0.25
Tampa	0.19
Orlando	0.20
Gainesville	0.20
Jacksonville	0.20
Tallahassee	0.20
Pensacola	0.19

Adapted from Augustin, 2000. UF-IFAS Bul. 200

Using the above table of average daily rainfall:

Volume of runoff in gallons per day =
27,154 x acres x inches of rain from table.

Or, volume of runoff in gallons per day =
0.623 x square feet x inches of rain.

Determine total average wastewater and runoff in gallons/day and enter here: _____

Step 2b: Determine the 25-year design stormwater volume.

- The area exposed to rainfall that drains into the WSP was calculated above. These areas can be considered impervious and used for calculations, or a professional engineer can assist. For the 25-year storm, the rainfall deposition over

the WSP cannot be ignored. The surface area of the WSP should be measured in square feet.

- Now use **Figure 20**, or for more accuracy, go to the link at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=fl to determine the 25-year, 24-hour storm for your farm. If you are unsure of your exact position, get as close as you can; or, if you have a permit from either the WMD or FDEP, use this number instead. Then use the formula below to calculate gallons added by runoff into the system.

(27,154 x acres of impervious surface generating runoff x inches of rain from design storm) + (square feet of WSP at top of bank x inches of rain from design storm x 0.623) = gallons added to the WSP by a 25-year, 24-hour storm.

Once all wastewater sources are added up to give you a known volume, the pond size must be determined. For irregular-shaped ponds, a professional engineer may be needed. A rough estimate in cubic feet is **length half way down the side slope x width half way down side slope x total depth of pond** (all measured in feet). The number of days of storage can be determined by dividing the total pond volume by the average daily wastewater production amount, in cubic feet.

Gallons per day ÷ 7.48 = cubic feet per day

Determine days of storage calculated above and enter here: _____

Step 3: Determine whether your waste storage pond and other conveyance and storage meet lining requirements.

Use the flowcharts in **Appendix 3** to assist you with this section.

If your farm (especially the WSP) is located predominately on one of the soils listed in **Table 1** of **Appendix 2**, you are considered a high water table dairy. If your farm has a soil with predominantly the same characteristics of the soils that are listed but the name is different in your web soil survey or county soil survey manual, the following still applies.

Existing waste storage ponds and separators in high water table soils do not need to be lined, since the high water table serves as a natural barrier to deeper groundwater. However, if there is a surface water outlet (ditch or creek) that is deeper than 18 inches and within 300 feet of the WSP, then an interceptor ditch or drain tile is often needed to prevent

contaminated water from flowing offsite. All new WSPs will require a liner that meets the requirements of NRCS Code 521 unless a Professional Engineer certifies that denitrification and agronomic use of N and P by the surrounding vegetation is sufficient to prevent losses to receiving waters.

Unless the associated sprayfield has tile or surface drains to keep the water table artificially low, WSPs either need to be designed using computer modeling (StoWat and Drainmod), which is preferred, or have 180 days of storage. If tile drains are installed, storage time usually can be greatly reduced, but computer modeling is required to determine storage requirements.

If your WSP or separator is located in sandy non-high water table soils, you will have to have a liner. For new systems, clay liners are acceptable if they have been designed and approved by a Professional Engineer and meet the requirements of NRCS Code 521.

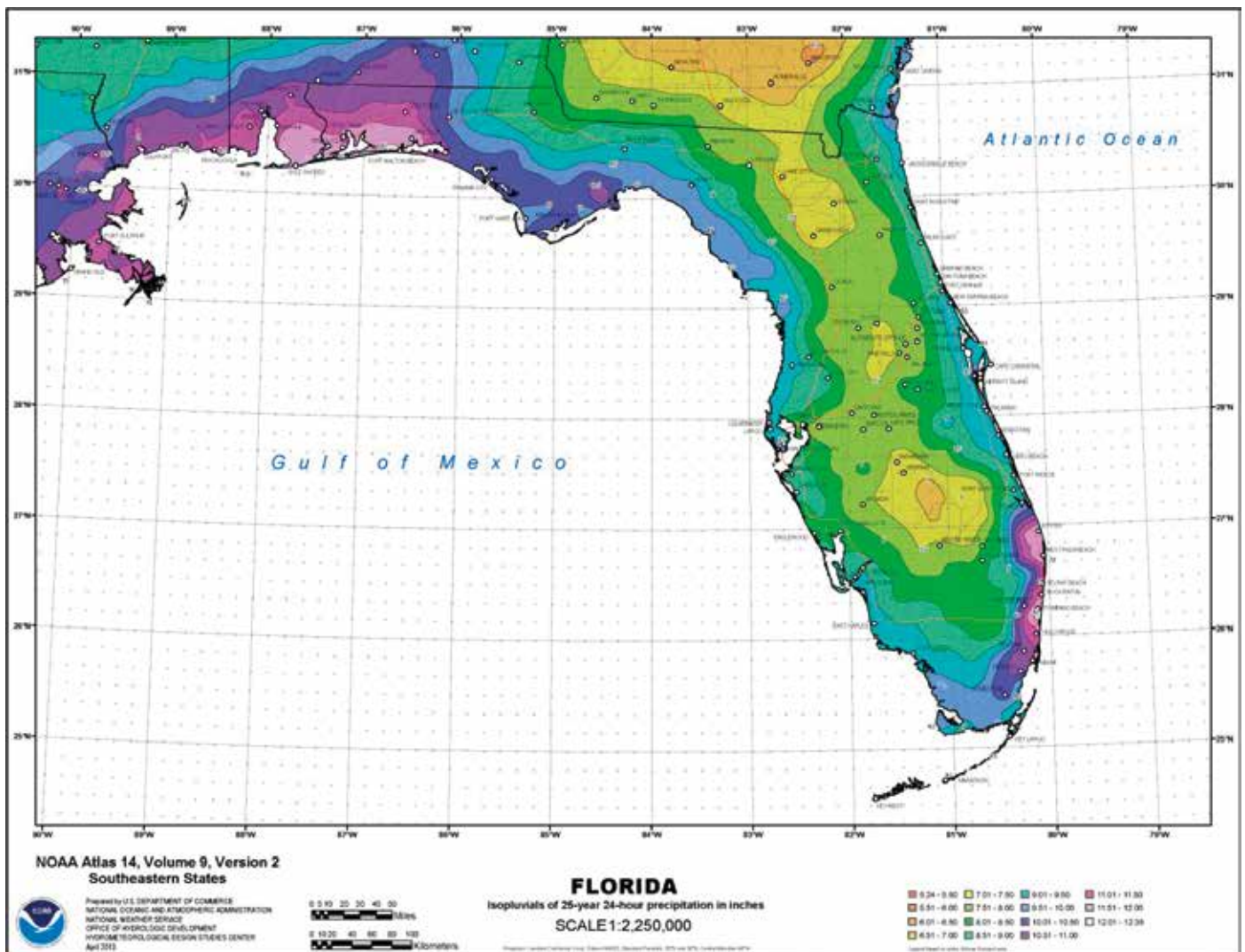


Figure 20

In the panhandle, earthen WSP or separators dug into heavy clay may not need to be lined. Typically, the topsoil does not contain enough clay to allow for the WSP to be unlined. However, if the soil used to seal the pond is at least 50 percent clay (identifiable in the field by being able to be spread into a wide, thin ribbon between two fingers, with no gritty texture) then the clay is probably acceptable as a liner, if spread at least two feet thick.

In high water table dairies, conveyance ditches may not need to be lined, since the restrictive layer serves as a natural barrier to deeper groundwater. Similarly, conveyance ditches in areas where there are heavy clay soils may not need to be lined. If the conveyance moves water, but does not normally stay wet (wastewater is not flowing at all times), then soil textures may be sandy clay, loamy clay, or similar types following USDA textural terminology. However, if wastewater sits still, the conveyance must be located in heavy clay soils. In sandy soils, all conveyances and ponds must be lined.

Do your waste handling facilities meet the lining and holding time requirements of Flowcharts 1 and 2 of Appendix 3 of this manual? Yes No

Even if your WSP does not meet these criteria, finish all of the calculations to determine where other opportunities for improvement may exist.

Step 4: Determine N and P in manure.

If the farmer has accurate records of the amount of waste solids and wastewater spread on site, along with current sample analysis results, they can skip this section and go on to Steps 5 and 6.

In order to estimate the amount of N and P in cow manure, literature values can be used from **Table 2 of Appendix 2** or the current ASABE Standard D384.2, *Manure Production Characteristics*. For lactating animals, the equations below can be used. Actual samples should be taken to verify book values; these samples along with other records will show whether the facility is in compliance with this BMP manual.

Calculations for lactating cows are as follows:

$$\text{Amount of N in manure per cow per day} = (\text{lbs dry matter per cow per day} \times \text{percent protein in feed} \times 0.0016) - (\text{lbs milk per day} \times 0.005)$$

$$\text{Amount of P in manure per cow per day} = (\text{lbs dry matter} \times \text{percent P in feed} \times 0.01) - (\text{lbs milk per day} \times 0.001)$$

Typical dry matter intake per day for a lactating cow ranges from 48 to 55 lbs. Typical protein content is 14 to 18 percent, and typical phosphorus content is 0.38 to 0.42 percent. Milk production averages from 50 to 80 lbs/day. These are ranges only. Use farm-specific values instead.

Record average pounds of nitrogen and phosphorus in manure per lactating cow per day.

N: _____ P: _____

Once you know how much manure is being produced, you must determine where it is deposited. A workable assumption is that cows deposit manure in the pasture in proportion to the time they spend there. Therefore, if a cow is in the pasture eight hours out of 24, one third (33 percent) of the manure is deposited in the pasture and the remainder wherever it spends the rest of the time (e.g., the barns).

Wastewater usually flows through some sort of separator and a portion of the nutrients are contained in the solids. **Table 3 of Appendix 2** shows values for separation systems commonly found in Florida.

$$\text{Amount of N or P in manure per cow per day} \times \text{number of lactating cows} \times \text{percent of day in the barns} \times \text{percent of retained nutrient from Table 3 (Appendix 2)} = \text{lbs of nutrient per day in wastewater.}$$

$$\text{Amount of N or P in manure per cow per day} \times \text{number of lactating cows} \times \text{percent of day in the barn} \times (1 - \text{percent of retained nutrient from Table 3}) = \text{lbs of nutrient per day in separated solids.}$$

Determine and enter the daily load for the farm nutrients.

Wastewater: _____ lbs N
Separated solids: _____ lbs N

Wastewater: _____ lbs P
Separated solids: _____ lbs P

Scraped or vacuumed manure to be hauled: _____ lbs N

Scraped or vacuumed manure to be hauled: _____ lbs P

Step 5: Calculate nutrient losses.

Determining nutrient losses through a dairy system and after field application is the most difficult portion of a nutrient budget.

Phosphorus does not turn into a gas at a normal dairy operation but stays in the wastewater, settles out, and is removed with solids, or settles out and is left in the bottom of the pond. Excess P that migrates into the soil can be bound by soil particles or taken up by surrounding crops.

Nitrogen enters the air as a gas through two methods, volatilization or denitrification. Therefore, a large amount of N can be lost to the atmosphere, and only a percentage of the N that comes out of the cow will be available for crop uptake.

Due to Florida's hot climate, **dry soil** conditions, and fairly high winds, nitrogen losses are high when waste is applied. Losses occur from the barn floor or pasture as soon as the feces or urine hits the ground, during waste storage and waste application, and even after the waste has been applied.

Typical dairy wastewater systems for Florida are shown in **Table 4** of **Appendix 2**, with the estimated N and P remaining after losses. These losses will need to be included in the N budget calculations. Remember to read the footnotes in this appendix, as volatilization is influenced by pH. Most dairy waste in Florida is very near a pH of 7, but if it becomes too acidic, volatilization is decreased. Also, N in the ammonia form is about the only form that volatilizes. Most dairy waste has significant portions of ammonia, but if lab tests indicate that your waste does not, losses may be decreased.

Determine and enter the daily load after losses, for the nutrients in the following.

Wastewater: _____ lbs N
Separated Solids: _____ lbs N

Wastewater: _____ lbs P
Separated Solids: _____ lbs P

Scraped or Vacuumed Manure to be Hauled: _____ lbs N

Scraped or Vacuumed Manure to be Hauled: _____ lbs P

Step 6: Determine crop and pasture uptake and overall balance.

Once you have determined whether your farm or a particular field should be designed based on N or P, use the record keeping work sheets in **Appendix 8** and the calculations below to ensure that the operation is in manure nutrient balance. In some cases, you may need to calculate both N and P.

If your application is less than or equal to crop uptake, then the field is in balance. Repeat this process for each crop field and then check stocking rates for pastures (See **Tables 5-7** of **Appendix 2** for appropriate tables). As mentioned before, any commercial fertilizer used must be included in these calculations.

Determine the crop uptake for each field for the limiting nutrient, and ensure that application after losses is less than crop uptake.

Check the stocking rate of pastures and make sure the number of cows per acre is less than available carrying capacity.

For each field receiving waste

Amount of N in applied manure after losses (Step 5) x 365 day/year x percent of total waste applied to that field = applied lbs of manure-N/year to field + total fertilizer N applied to field per year = total applied lbs of N/year.

Crop rotation cycle

_____ - _____ - _____

Crop 1 uptake x yield + Crop 2 uptake x yield + Crop 3 uptake x yield = Total N removed in crop yield. (This assumes use of Table 5 for uptake values. If tissue test is reported as protein, multiply protein yield/acre x 0.16 to get N uptake/acre)

If total applied lbs of N/year - total N removed in crop yield ≤ 0 then field is in N balance.

For each field receiving waste

Amount of P in applied manure after losses (Step 5) x 365 day/year x percent of total waste applied to that field = applied lbs of manure-P/year to field + total fertilizer P applied to field per year = total applied lbs of P/year.

Crop rotation cycle

_____ - _____ - _____

Crop 1 uptake x yield + Crop 2 uptake x yield + Crop 3 uptake x yield = Total P removed in crop yield. (This assumes use of Table 5 for uptake values. If tissue test is reported as protein, multiply protein yield/acre x 0.16 to get N uptake/acre)

If total applied lbs of P/year - total P removed in crop yield ≤ 0 then field is in P balance.

Limiting Nutrient from Step 1:

Nitrogen Phosphorus

Has overall nutrient balance been achieved?

Yes No

IF THE APPLICATION OF LEVEL I AND LEVEL II BMPS IS NOT SUFFICIENT TO BRING THE FARM INTO BALANCE, IT MAY BE NECESSARY TO REDUCE NUTRIENT INPUTS OR INCREASE NUTRIENT UPTAKE OR REMOVAL BY DOING ONE OR MORE OF THE FOLLOWING:

- Increase crop/pasture area.
- Increase uptake by incorporating more irrigated areas.
- Move cows from pasture to confinement.
- Remove manure from the farm.
- Reduce cow numbers.
- Employ denitrification or volatilization technologies for N.
- Employ chemical treatment.

Calculation Notes

27,154 gallons/acre-inch; 43,560 square feet/acre; 7.48 gallons/cubic foot.

Volume of a flush tank is area multiplied by height of water used. Area of a circle is pi (3.14) times the diameter squared, divided by 4. Therefore $3.14 \times 7.48/4 = 5.9$. $5.9 \times \text{diameter squared} \times \text{height of water in feet} = \text{gallons used}$.

As a general rule, 16 percent of protein is nitrogen. Milk usually has about 3.1 percent protein. Milk usually contains about 0.5 percent nitrogen and about 0.1 percent phosphorus.

APPENDICES

APPENDIX 1: GLOSSARY

The definitions that follow apply to this BMP manual only and may not be consistent with definitions used in other material.

Anaerobic – An environmental condition absent of free oxygen, or with greatly reduced concentrations of free oxygen.

Animal feeding operation – A facility (other than an aquatic animal production facility) where both of the following conditions exist:

- a. Animals have been, are being, or will be stabled or confined and fed, or maintained for a total of 45 days or more in any 12-month period; and
- b. Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.
- c. Two or more animal feeding operations under common ownership are deemed to be a single AFO if they are adjacent to each other or if they utilize a common area or system for the disposal of wastes.

Best Management Practice – A practice or combination of practices determined by the coordinating agencies, based on research, field-testing, and expert review, to be the most effective and practicable on-location means, including economic and technological considerations, for improving water quality in agricultural and urban discharges. Best management practices for agricultural discharges shall reflect a balance between water quality improvements and agricultural productivity.

Biosolids – Solid, semisolid, or liquid residue generated during the treatment of domestic wastewater in a domestic wastewater treatment facility.

Clay liner – Soil used to line an earthen pond classified by NRCS as clay, loamy clay, or clayey loam. This type of soil should contain very little to no grit when wetted and rubbed between the fingers and should be able to be compressed into a flat, thin ribbon. Often, this material is found below the 80 inches listed in the soil survey, but can be “mined” from lower portions of the profile and used to line ponds or ditches.

Comprehensive nutrient management plan – A plan developed by NRCS or a Technical Service Provider following NRCS criteria to manage the amount, source, placement, form and timing of the application of animal manure, fertilizer or other

plant nutrients in order to minimize nutrient loss or runoff, protect water resources and maintain the productivity of crops.

Concentrated animal feeding operation – A large AFO as defined in subsection 40 CFR 122.23(4)(i) for dairies with 700 or more mature cows that are confined; a medium AFO as defined for dairies with 200 to 699 mature cows; or, any AFO that has been so designated on a case-by-case basis, in accordance with subsection 62-670.400(3), F.A.C.

Confined – Animals that stay or are brought into an area that is not considered a pasture at least once a day. For dairies, all cows that are milking in a permanent parlor are considered confined, even if they spend the rest of the day on pasture.

Continuous grazing – The grazing of a specific unit by livestock throughout the year or for that part of the year during which grazing is feasible.

Cyanobacteria – Also known as blue-green algae, these are bacteria that produce their energy through photosynthesis. Certain cyanobacteria produce cyanotoxins that can be toxic to animals and humans.

Dairy – Any place or premises where one or more dairy cows are kept and from which a part or all of the milk is provided, sold, or offered for sale to a milk plant, receiving station, transfer station, or the general public.

Denitrify – Process where anaerobic bacteria converts nitrate to N₂ gas.

Design storage period – The anticipated maximum period of time all wastewater must be stored based on timing of wastewater application events, local climate, crops, and soils.

Discharge – The release of process wastewater to surface waters of the state. Agricultural runoff is not a discharge.

Dry soil – Soil that has a water-holding capacity of 0.1 inches of water per inch or less of soil, is in Hydrologic Group A, and has no restrictive layer that would hold water within the root zone for an extended period of time.

Evapotranspiration – The combined loss of water through evaporation and emission of water vapor (transpiration) through plant leaf openings (stomata).

High water table soils – Soils that have a seasonal high water table within 18 inches of the surface. See **Table 1** for a non-inclusive list of most of these soils.

Karst – A geologic formation generally consisting of well-drained sands over unprotected limestone.

Land application or land applied – The application of collected manure, litter, or process wastewater onto or incorporated into the soil.

Land application area – The land under the control of an AFO owner or operator, whether it is owned, rented, or leased, to which collected manure, litter or process wastewater from the production area is or will be applied.

Level spreader – A device used to disperse concentrated runoff uniformly over the ground surface as sheet flow.

Lined or liner – Concrete, plastic, clay, or other artificial coating that is used to prevent significant leakage into the surrounding soil. Liners must be structural secure, with a minimum of 4 inches of concrete used, a minimum of 40 mil HDPE or similar plastic, or two foot of clay.

Manure – Excreta of animals and excreta mixed with residual materials that have been used for bedding, sanitary, or feeding purposes for animals. Compost, as defined in 62-701.200(23), F.A.C., and other processed manure products that have been stabilized as defined in 62-701.200(24), F.A.C. are not considered manure.

NPDES Permit – A federal permit issued pursuant to 40 CFR Part 122.21(a).

Nutrient management plan – A plan developed for an AFO to manage the amount, source, placement, form, and timing of the application of animal manure, fertilizer, or other plant nutrients (N and P only) to minimize nutrient loss or runoff, protect water resources, and maintain the productivity of crops. If required for permitting purposes, the plan must be developed by USDA-NRCS, a Technical Service Provider, or a Florida licensed professional engineer experienced in this area.

Phosphorus or P – Phosphorus measured in elemental form. To convert P to P_2O_5 (phosphate) multiply P by 02.29.

Potassium or K – Potassium measured in elemental form. To convert K to K_2O multiply by 1.20.

Paddocks – A subdivision of a pasture designed to provide short-duration grazing followed by an appropriate rest period (based on species, soil

type, and weather conditions) for re-growth and stand maintenance.

Pasture – An open area, whether fenced or unfenced, with grasses where animals graze. It does not receive applications of collected manure or process wastewater. Pastures are not regulated by the FDEP or EPA.

Plate water – Clean warm water that exits the plate cooler which is used to chill milk.

Prescribed grazing – The controlled harvest of vegetation by grazing or browsing animals, to achieve a specific objective (improve water filtration, protect stream banks, etc.).

Private drinking water well – A well that is a source of drinking water for human consumption for one or two residences or a for a commercial center that serves less than 25 people.

Process wastewater – Water generated in the dairy production area (not in pastures) consisting of any of the following: spillage or overflow from animal watering systems; washing, cleaning, or flushing pens, barns, manure pits; direct contact swimming, washing, or spray cooling of animals. Process wastewater also includes any water which comes into contact with any raw materials, products, or byproducts including manure, litter, feed, or bedding within the production area.

Production area – The part of an AFO that includes animal confinement areas (barns and lots), manure storage areas (WSP or solids storage areas), and non-clean raw material storage areas (grain and silage storage areas that are not covered).

Public drinking water well – A well that is a source of drinking water for human consumption that serves more than two houses or a commercial operation with more than 25 people.

Rotational Grazing – Sequential grazing of pasture subdivisions, followed by a period of non-grazing for recovery and re-growth.

Rinsate – The solution remaining after rinsing something like a pesticide container.

Riparian – Vegetated ecosystems along a watercourse, characterized by a high water table and subject to periodic flooding and influence from the adjacent watercourse.

Sinkhole – A naturally occurring geological feature that has an open connection to the groundwater. Areas that have topsoil and a root zone over the entire area or ponded areas that do not have an

open connection to groundwater are not sinkholes in this manual.

Spodic horizon – A subsurface horizon in which amorphous materials consisting of organic matter, aluminum, and iron have accumulated.

Surface waters – Water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs is classified as surface water when it exits from the spring onto the earth's surface.

Vegetated buffer – An area covered with vegetation suitable for nutrient uptake and soil stabilization, located between a production area and a receiving water or wetland.

Waste storage pond – A man-made excavated impoundment constructed to hold manure, litter, and/or process wastewater. WSPs include waste

lagoons designed for physical and/or biological treatment.

Watersheds – Drainage basin or region of land where water drains downhill into a specified body of water.

Wetlands – As defined in subsection 373.019(27), F.S., wetlands are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above.

APPENDIX 2: TABLES

Table 1: List of Selected High Water Table Soils in Florida

Adamsville Var.	Citronelle	Goldhead	Manatee	Pellicer	Susanna
Alapaha	Clara	Grady	Margate	Pennsuco	Symrna
Allanton	Copeland	Grifton	Martel	Pepper	Talquin
Anclote	Cracker	Hallandale	Mascotte	Perrine	Tamiami
Ankona	Croatan	Harbeson	Maurepas	Perrine Var.	Tantile
Apalachee	Cudjoe	Heights	Meadowbro	Pickney	Tavernier
Aqualfs	Dania	Hicoria	Meadowbrook	Pineda	Tennile
Aquents	Dasher	Hilolo	Meggett	Pinellas	Tequesta
Aquults	Delks	Holopaw	Micco	Placid	Terra Ceia
Astor	Delray	Homosassa	Monteocha	Plantation	Tidewater
Bakersville	Demory	Hontoon	Moultrie	Plummer	Tisonia
Basinger	Dirego	Hosford	Mouzon	Pomona	Tocoi
Bayvi	Dorovan	Hydraquents	Mulat	Pompano	Tomoka
Bessie	Duckston	Iberia	Murville	Popash	Tooles
Bethera	Dunbar	Immokalee	Myakka	Pople	Torry
Bibb	Durbin	Islamorada	Myakka Var.	Pottsburg	Tuscawilla
Biscayne	Eaton	Isles	Nettles	Psammaquents	Valkaria
Bivans	EauGallie	Janney	Nittaw	Punta	Wabasso
Bladen	Ebro	Johnston	Nutall	Rains	Wabasso Var.
Blichton	Ellabelle	Jupiter	Ochopee	Rawhide	Wacahoota
Bluff	Elloree	Kaliga	Ocoee	Riviera	Waccasassa
Boardman	Ellzey	Kanapaha	Okeechobee	Rutlege	Wauberg
Boca	Emeralda	Kenner	Okeelanta	Saddlebunch	Wauchula
Bohicket	Estero	Kesson	Oklawaha	Salerno	Waveland
Bonsai	Eureka	Keylargo	Oldsmar	Samsula	Weekiwachee
Boulogne	Everglades	Keywest	Oldtown	Sanibel	Wehadkee
Bradenton	Evergreen	Kingsferry	Oleno	Santee	Wekiva
Brickyard	Farmton	Kingsland	Olustee	Sapelo	Wesconnett
Brighton	Favoretta	Kinston	Ona	Scranton	Weston
Broward Var.	Felda	Lacoochee	Osier	Seffner	Winder
Buccaneer	Fellowship	Lauderhill	Pahokee	Sellers	Woodington
Byars	Fellowship Var.	Lawnwood	Paisley	Shenks	Wulfert
Canova	Flemington	Ledwith	Palmetto	Shired	Yellowjacket
Cantey	Floridana	Leon	Pamlico	Smyrna	Yonges
Captiva	Floridana Var.	Lignumvitae	Pansey	Solite	Yulee
Chaires	Fluvaquents	Lokosee	Pantego	St. Johns	
Chewacla	Ft. Drum	Lynchburg	Parkwood	Starke	
Chobee	Ft. Green	Lynn Haven	Parkwood Var.	Steinhatchee	
Chobee Var.	Gator	Lynne	Peckish	Stockade	
Chowan	Gentry	Malabar	Pelham	Surrency	

Source: This table was compiled by Mike Holloway and Dr. Del Bottcher based on commonly accepted criteria for high water table soils.

Table 2: Daily Manure Production

Lactating Holstein	
Weight:	130 lbs
Volume:	15 gallons
Total Nitrogen:	0.95 lbs
Total Phosphorus:	0.13 lbs
Dry Holstein	
Total Nitrogen:	0.59 lbs
Total Phosphorus:	0.11 lbs
Lactating Jersey or other 900 lb cow	
Weight:	87 lbs
Volume:	10 gallons
Total Nitrogen:	0.63 lbs
Total Phosphorus:	0.09 lbs
Dry Jersey or other 1,000 lb cow	
Total Nitrogen:	0.38 lbs
Total Phosphorus:	0.07 lbs
Heifer 200-500 lbs	
Total Nitrogen:	0.15 lbs
Total Phosphorus:	0.03 lbs
Heifer 500-700 lbs	
Total Nitrogen:	0.25 lbs
Total Phosphorus:	0.05 lbs
Heifer 700-900 lbs	
Total Nitrogen:	0.38 lbs
Total Phosphorus:	0.07 lbs

Sources: ASABE Standards
 NRCS Agricultural Waste Management Field Handbook
 UF-IFAS: Van Horne - Dairy Manure Management Circular 1016

Table 3: Nitrogen and Phosphorus Remaining with the Wastewater after Separation

	N Remaining	P Remaining
Sand lane or mechanical sand separation	100%	100%
Sand and heavy solid separator	95%	95%
Screen separator	93%	90%
Static or "vat" settling basin separator	85%	80%
Water holding separators or ditches*	75%	70%
*water holding separators or ditches that are cleaned frequently as a slurry may be capable of higher removal rates.		

Sources: Midwest Plan Services Structures and Environment Handbook (MWPS-1)
 NRCS Agricultural Waste Management Field Handbook
 Handling Sand-Laden Manure - JP Harner and JP Murphy
 Effectiveness of Liquid-Solid Separation for Treatment of Flushed Dairy Manure: A Case Study ASAE Technical Library.
 JP Chastain, MB Vanotti, MW Wingfield
 Nutrient and Solids Separation of Flushed Dairy Manure by Settling. ASAE Technical Library. JC Converse

Table 4: Nitrogen and Phosphorus Remaining for Typical Wastewater Treatment Systems

Overall nitrogen remaining for crop uptake with the described systems <i>These losses are in addition to any solids separation</i>	N Remaining
Cows on Pasture	40%
Cows on concrete floor to storage pond with less than 7 days hold time then sprayed through sprinkler or thinly surface applied	35%
Cows on concrete floor to storage pond with less than 7 days hold time then incorporated or seepage ditch	40%
Cows on concrete floor to storage pond with 7 to 30 days hold time then sprayed through sprinkler or thinly surface applied	30%
Cows on concrete floor to storage pond with 7 to 30 days hold time then incorporated or seepage ditch	35%
Cows on concrete floor to storage pond with greater than 30 days hold time then sprayed through sprinkler or thinly surface applied	10%
Cows on concrete floor to storage pond with greater than 30 days hold time then incorporated or seepage ditch	15%
From WSP samples to crop uptake if applied via sprinkler or thinly surface applied	50%
From WSP sample to incorporated or seepage ditch	80%
Solids thinly applied	75%
Solids incorporated	95%
<i>If pH is 6.5 or less reduce losses by 10 percent losses should not exceed the percentage of ammonia in samples</i>	

Overall phosphorus remaining for crop uptake with the described systems* <i>These losses are in addition to any solids separation</i>	P Remaining
Pasture, WSP less than 21 days with agitation, any application	100%
WSP less than 21 days without agitation and cleaned once every two years	80%
WSP 21 to 60 days without agitation and cleaned once every five years	90%
WSP 60 to 100 days without agitation and cleaned once every ten years	50%
WSP greater than 100 days without agitation and cleaned every twenty five years	20%
<i>*During cleanout of ponds, all P that has settled will need to be accounted for. If the farm is in nutrient balance without cleanout material included, this material must be removed from the farm.</i>	

Sources: Midwest Plan Services Structures and Environment Handbook (MWPS-1)
 NRCS Agricultural Waste Management Field Handbook
 Nitrogen Cycling in Manure and Soils: Crop Utilization and Losses.
 JHAM Steenwoorden, Institute for Land and Water Management Research, The Netherlands
 Atmospheric Disposal of Nitrogen. HA Elliott, RC Brandt, KS Martin. Penn State University
 Losses of Manurial Nitrogen in Free-Stall Barns. RE Muck and BK Richards. Cornell University
 Ammonia Volatilization from Dairy Manure Spread on the Soil Surface DA Lauer, DR Bouldin, SE Klasner.
 Cornell University and University of Georgia
 Dairy Manure Management: Strategies for Recycling Nutrient to Recover Fertilizer Value and Avoid Environmental Pollution.
 HH Van Horne, et al IFAS, Circular 1016
 Measurement of ammonia volatilization from a field in upland Japan, spread with cattle slurry.
 Zhen Yang, et al, Nanjing University.

Table 5: Uptake Rates for Crops

See IFAS uptake rates for other crops

	(lbs/ac/crop)	
	N	P
Irrigated (or heavy soil), well managed cropland		
Corn	240	50
Tropical fall corn	180	29
Sorghum	180	29
Rye or oats	90	13
Ryegrass (part of a triple crop or with bermudagrass)	150	21
Ryegrass (full growing season)	200	29
Bermudagrass (other than common - Coastal, Tifton 85, etc.)	370	40
Stargrass or limpograss (grown year round on high water table)	500	65
Non-irrigated sandy soil, well managed for hay		
Bermudagrass (other than common - Coastal, Tifton 85, etc.)	285	29
Bahiagrass	119	50
Ryegrass	100	15
Corn and sorghum (not recommended for waste uptake on sandy soils)		
Pastures (cows rotated frequently - not continuous grazing)		
Bermudagrass/ryegrass(irrigated or wet soils)	450	47
Bermudagrass/ryegrass(moderately irrigated or marginal soils)	405	40
Bermudagrass/ryegrass(dry soils)	265	31
Note: Rates suggested here are for well-managed crops. Rates can be increased if the farmer cuts hay in addition to grazing, or can demonstrate that the cropping system allows for increased nutrient removal rates.		

Sources: NRCS Agricultural Waste Management Field Handbook.*Utilization of Dairy Waste Effluent in Year Round Cropping Systems, KR Woodard et al. FDEP Final Report WM 714.**IFAS Standard Fertilization Rates.**Productivity of Clay Tailings from Phosphate Mining II: Forage Crops. P Mislevy, et.al. 1990.**Forage Yield and Nutrient Uptake of Warm-Season Annual Grasses in a Swine Effluent Spray Field. MR McLaughlin, et.al. 2004.**Stargrass. Vendramini and Mislevy. IFAS SS-AGR-72. 2014.**Floralta Limpograss (Hermarthria altissima) CG Chambliss, et al. IFAS SS-AGR-67. 2002.*

Table 6: Forage Grazing Heights

Forage	Average Height (inches)	
	Begin Grazing	End Grazing
Bahiagrass	6	1-2
Bermudagrass	6	2-4
Clovers	6	3
Indiangrass	14	6-10
Limpograss	24	12 rotational and 16 continuous
Pearl Millet	14	6
Rhodesgrass	18	8
Rhizoma Peanut	12	4
Ryegrass, annual	6	3-4
Stargrass	12-18	6-8
Small Grains (oats, wheat, rye)	6	4

Source: Table adapted from UF-IFAS Publication SS-AGR-133 (<http://edis.ifas.ufl.edu/AG268>) and <http://agronomy.ifas.ufl.edu/foragesofflorida/detail.php?sp=Limpograss&type=G>

Table 7: Pasture Stocking Rates**Rotational Grazing Cows per acre recommended based on Nitrogen**

Soil conditions	No winter grain			Winter grain or location in south Florida		
	Dry soil	wet or irrigated	moderate soil	Dry Soil	wet or irrigated	moderate soil
dry cows	2.0	4.2	3.7	3.1	5.3	4.7
heifers 200-500 lbs	8.2	16.8	14.7	12.4	21.0	18.9
heifers 500-700 lbs	4.8	9.8	8.6	7.2	12.3	11.0
heifers 700-900 lbs	3.2	6.5	5.7	4.8	8.2	7.4
lactating cows on pasture 6 hours a day	5.0	10.4	9.1	7.6	13.0	11.7
lactating cows on pasture 9 hours a day	3.4	6.9	6.1	5.1	8.7	7.8
lactating cows on pasture 12 hours a day	2.5	5.2	4.5	3.8	6.5	5.8
lactating cows on pasture 15 hours a day	2.0	4.2	3.6	3.1	5.2	4.7
lactating cows on pasture 18 hours a day	1.7	3.5	3.0	2.5	4.3	3.9
lactating cows on pasture 21 hours a day	1.4	3.0	2.6	2.2	3.7	3.3

Continuous Grazing Cows per acre recommended with no rotation based on Nitrogen

Soil conditions	No winter grain			Winter grain or location in south Florida		
	Dry soil	wet or irrigated	moderate soil	Dry Soil	wet or irrigated	moderate soil
heifers 200-500 lbs	5.4	11.1	9.7	8.2	13.9	12.5
heifers 500-700 lbs	3.2	6.5	5.7	4.8	8.1	7.3
heifers 700-900 lbs	2.1	4.3	3.8	3.2	5.4	4.9
lactating cows on pasture 6 hours a day	3.3	6.9	6.0	5.0	8.6	7.7
lactating cows on pasture 9 hours a day	2.2	4.6	4.0	3.4	5.7	5.1
lactating cows on pasture 12 hours a day	1.7	3.4	3.0	2.5	4.3	3.9
lactating cows on pasture 15 hours a day	1.3	2.7	2.4	2.0	3.4	3.1
lactating cows on pasture 18 hours a day	1.1	2.3	2.0	1.7	2.9	2.6
lactating cows on pasture 21 hours a day	1.0	2.0	1.7	1.4	2.4	2.2

*Assumes high uptake bermudagrass - for Jersey or other small cows, numbers can be increased by a factor of 1.5. Also, animal numbers shown in table may be increased for more intensively managed pastures where mechanical harvesting for hay/haylage is done when there is excess grass production.

* A 60% of loss of the excreted nitrogen is assumed due to volatilization/denitrification processes.

Rotational Grazing Cows per acre recommended based on Phosphorus

Soil conditions	No winter grain			Winter grain or location in south Florida		
	Dry soil	wet or irrigated	moderate soil	Dry Soil	wet or irrigated	moderate soil
heifers 200-500 lbs	1.8	3.3	2.6	3.0	4.6	3.9
heifers 500-700 lbs	1.0	1.9	1.5	1.8	2.7	2.3
heifers 700-900 lbs	0.7	1.3	1.0	1.2	1.8	1.5
lactating cows on pasture 6 hours a day	1.5	2.9	2.3	2.6	4.0	3.4
lactating cows on pasture 9 hours a day	1.0	1.9	1.5	1.7	2.6	2.2
lactating cows on pasture 12 hours a day	0.8	1.4	1.1	1.3	2.0	1.7
lactating cows on pasture 15 hours a day	0.6	1.1	0.9	1.0	1.6	1.3
lactating cows on pasture 18 hours a day	0.5	1.0	0.8	0.9	1.3	1.1
lactating cows on pasture 21 hours a day	0.4	0.8	0.7	0.7	1.1	1.0

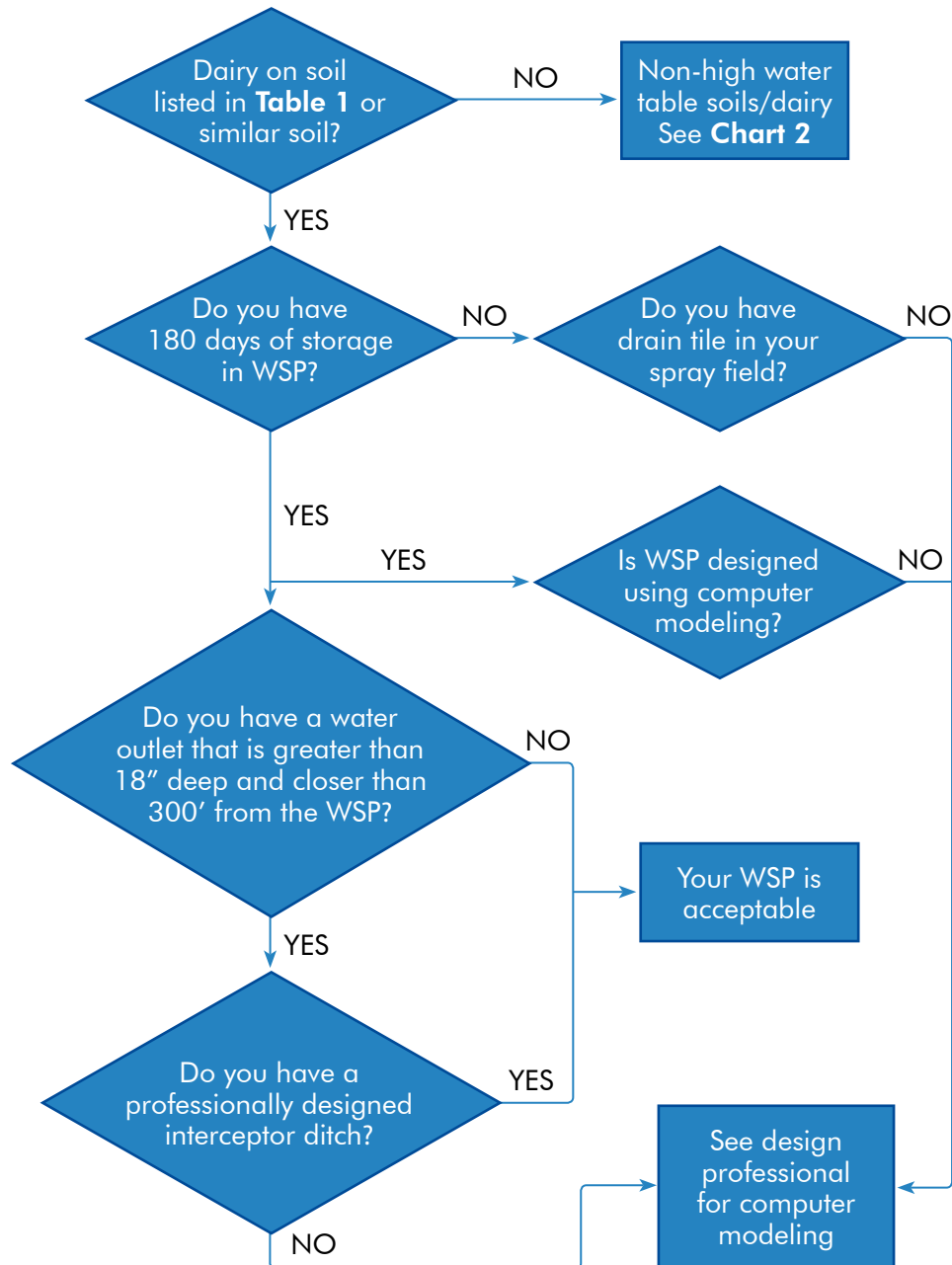
Continuous Grazing cows per acre recommended with no rotation based on Phosphorus

Soil conditions	No winter grain			Winter grain or location in south Florida		
	Dry soil	wet or irrigated	moderate soil	Dry Soil	wet or irrigated	moderate soil
heifers 200-500 lbs	1.2	2.2	1.7	2.0	3.0	2.6
heifers 500-700 lbs	0.7	1.3	1.0	1.2	1.8	1.5
heifers 700-900 lbs	0.5	0.9	0.7	0.8	1.2	1.0
lactating cows on pasture 6 hours a day	1.0	1.9	1.5	1.7	2.6	2.2
lactating cows on pasture 9 hours a day	0.7	1.3	1.0	1.1	1.7	1.5
lactating cows on pasture 12 hours a day	0.5	0.9	0.8	0.9	1.3	1.1
lactating cows on pasture 15 hours a day	0.4	0.8	0.6	0.7	1.0	0.9
lactating cows on pasture 18 hours a day	0.3	0.6	0.5	0.6	0.9	0.7
lactating cows on pasture 21 hours a day	0.3	0.5	0.4	0.5	0.7	0.6

Source: Tables 2 and 5 used to derive these values.

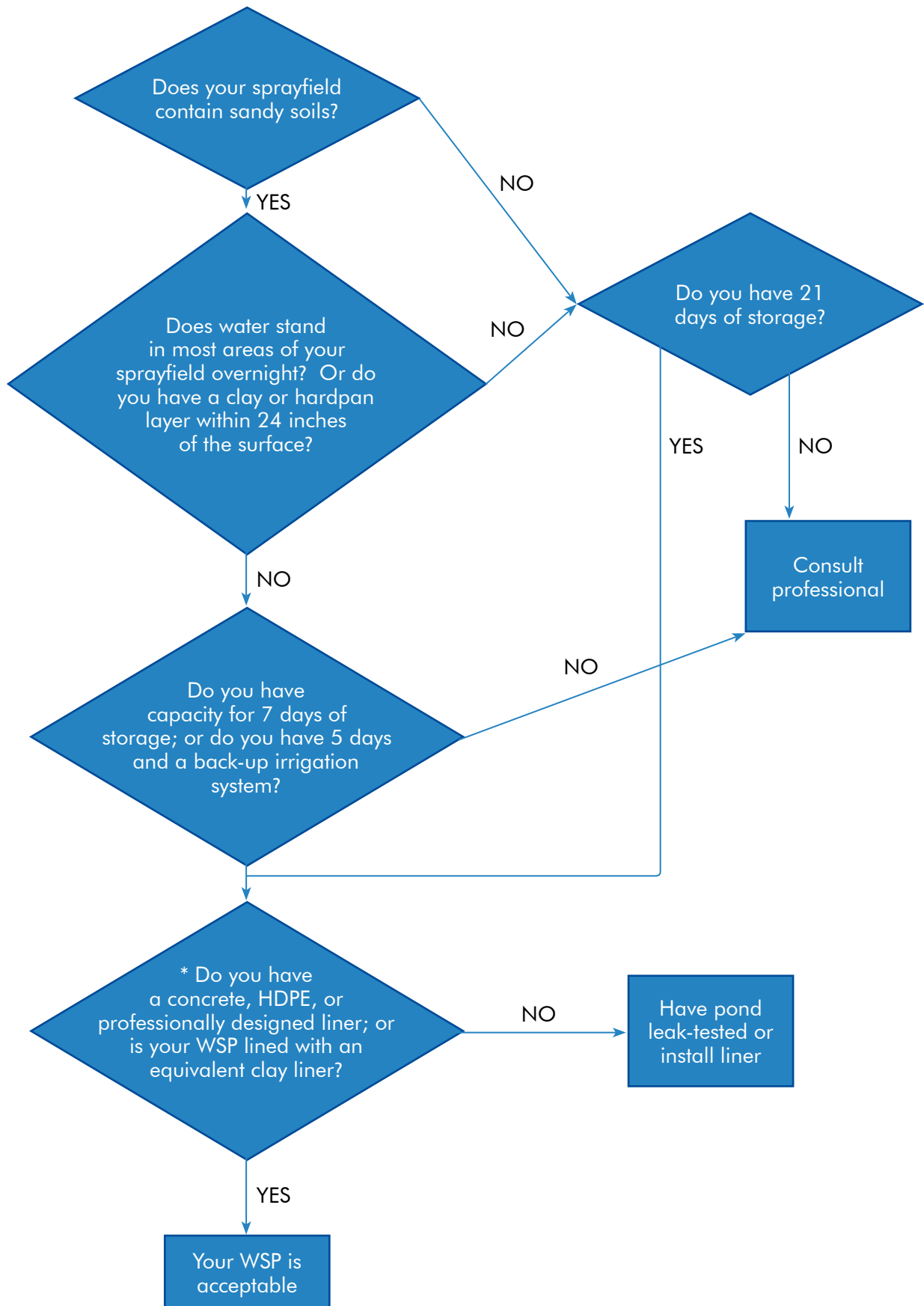
APPENDIX 3: FLOWCHARTS

Flowchart 1: Waste Storage Pond for High Water Table Soils

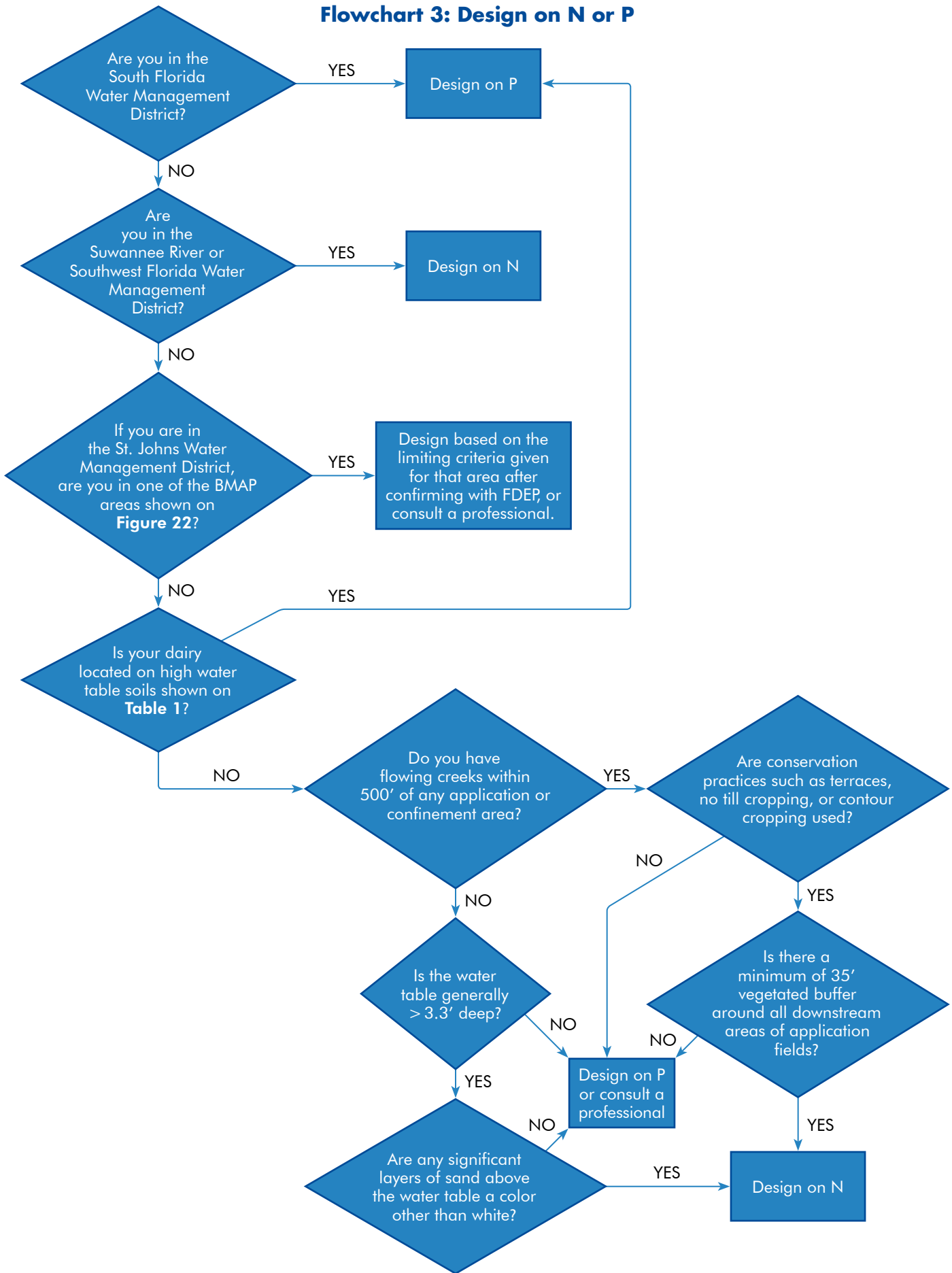


Flowchart 2: Waste Storage Pond for Non-High Water Table Soils

If you do not apply waste on-site skip to here (*)



Flowchart 3: Design on N or P



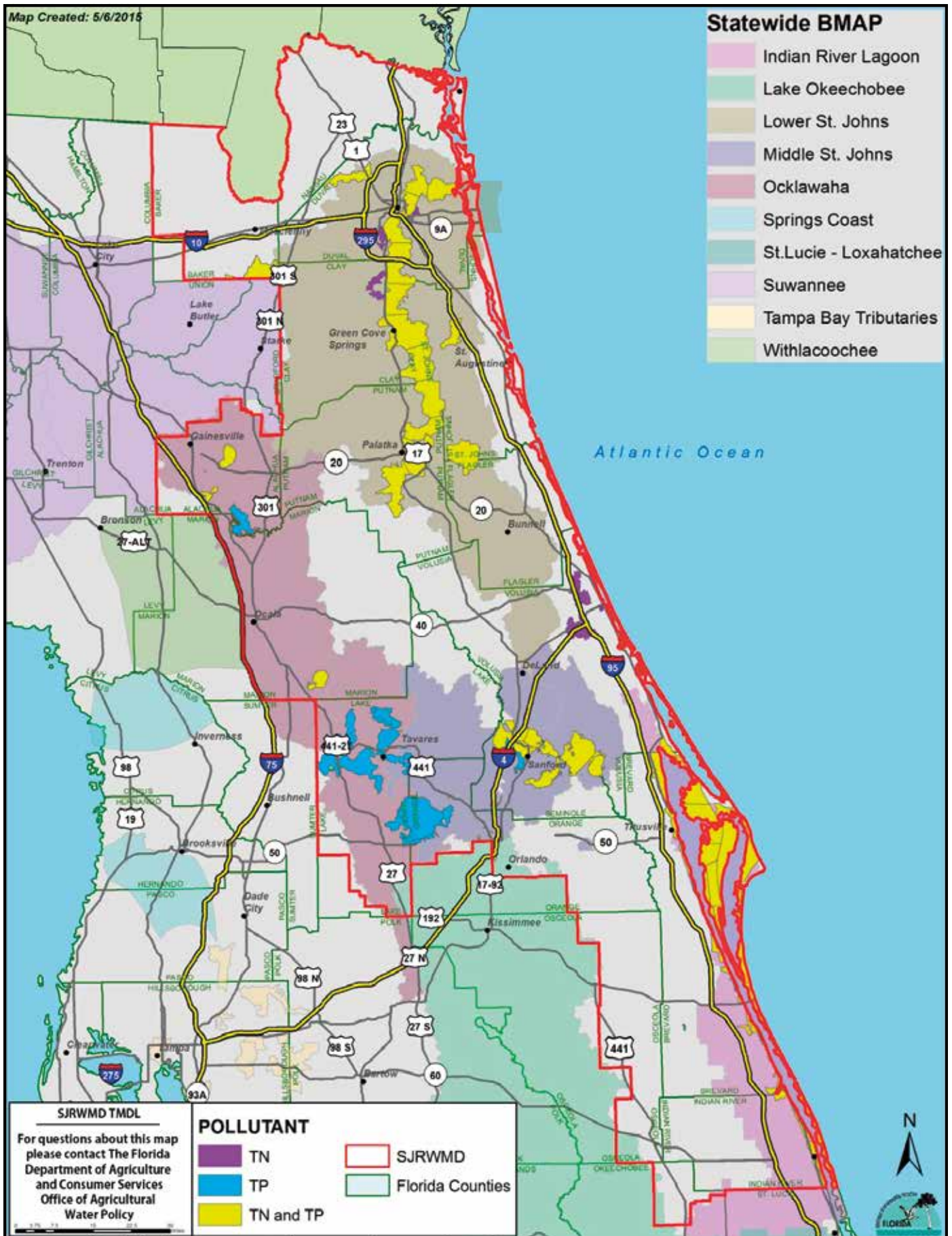


Figure 22

APPENDIX 4: ADDITIONAL BMP REFERENCES

1. Calculating Manure and Manure Nutrient Application Rates. Joern, B. and Brichford, S. 2011. Purdue University Extension. Agronomy Guide AY-277. <https://www.extension.purdue.edu/extmedia/AY/AY-277.html>
2. Small Farm Nutrient Management Primer: For Un-Permitted Animal Feeding Operations. T.M. Bass and L.M. Risse, Feb. 2015. Bul. 1293 UGA Extension Service. <http://extension.uga.edu/publications/detail.cfm?number=B1293>
3. Whole Farm Nutrient Planning. Lesson 2. LPES Curriculum. 2001. Koelsch, R. University of Nebraska. Courtesy of MPS, Iowa State. <http://www.extension.org/pages/14850/lesson-2-whole-farm-nutrient-planning>
4. Certification Training for Operators of Animal Waste Management Systems: Type A, Rev. 2006 North Carolina Cooperative Extension Service. http://www.soil.ncsu.edu/certification/Manual08/Manual_A.pdf
5. USDA Web Soil Survey. 2013. <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>

APPENDIX 5: SOIL AND TISSUE TESTING

Soil Testing

The soil testing process comprises four major steps, and understanding each one clearly will increase the reliability of the process tremendously. The steps in the soil testing process are:

- soil sampling
- sample analysis
- interpretation of test results
- nutrient recommendations

Soil Sampling: Soil samples need to be representative of the field and soil types and the soil analysis results will be only as good as the submitted sample. Samples collected from areas that differ from typical characteristics of the dairy pasture/fields should be submitted separately and should not be consolidated with the primary samples. Using a management zone (area that is managed similarly) as a guiding factor to collect and consolidate samples is strongly recommended to optimize resources. Consult the IFAS Soil Testing page at: http://edis.ifas.ufl.edu/topic_soil_testing for further information and to obtain the appropriate soil test sheet.

Sample Analysis: The soil samples that are submitted to the testing laboratories undergo a series of physical and chemical processes that are specific to the soil types, crops, and management regimes. Once the soil samples are homogenized through grinding and/or sieving, a precise volume of the sample will be extracted for plant nutrient through an extraction procedure. The following standard methods are followed at the IFAS Extension Soils Testing Laboratory (ESTL) for different soils in Florida:

- a. Mehlich-3 extraction - method used on all acid-mineral soils with a pH of ≤ 7.3 .
- b. AB-DTPA extraction – method used on alkaline (calcareous) soils with a pH of 7.4 and above.
- c. Water extraction - method used for extraction of P in all organic soils.
- d. Acetic acid extraction - method used on all organic soils for extraction of K, Mg, Ca, Si, and Na.

It is extremely important that procedures used at private laboratories are well understood before submitting the samples, because BMPs are tied to the standardized procedures used by the ESTL. Similarly, it is also very important to note that

the ESTL laboratory does not offer any test for N because there is no reliable test for plant available N under Florida conditions. N recommendations are based on crop nutrient requirements found in the research literature. More information regarding the procedures used at the IFAS ESTL in Gainesville can be found in the extension publication, Circular 1248, at: <http://edis.ifas.ufl.edu/ss312>.

Interpretation of Test Results: The primary goal of laboratories that offer soil test services is to provide interpretation of the soil test results. These should be based on soil test-crop response trials and field calibration of the test results using optimum economic yields. Economic yield increases resulting from added nutrients cannot be obtained once the test results are interpreted as 'High' resulting in no recommendation for that particular nutrient. The interpretations provided are specific to the soil and plant species.

Nutrient Recommendations: Nutrient recommendations based on soil test results are formulated based on the optimum economic crop response to an added nutrient to the soil. Recommendations can originate from crop nutrient requirement research, soil test results, and/or tissue test results as discussed below. Sometimes higher crop uptake values for waste disposal are used since they are based on the maximum crop uptake potential instead of economic responses.

Tissue Testing

Tissue testing is the analysis and diagnosis of the plant's nutritional status based on its chemical composition. It is commonly performed as analyses on dried leaves, with results compared to recommended nutrient ranges. Several types of hand-held field test equipment are also available. Growers are encouraged to contact their local extension agent before embarking on a tissue testing regimen.

References

1. Mylavarapu, R.S. and E.D. Kennelley. 2002. UF/IFAS Extension Soil Testing Laboratory Analytical Procedures and Training Manual. Soil and Water Science, Circular 1248, Cooperative Extension Service, IFAS. <http://edis.ifas.ufl.edu/SS312>.

APPENDIX 6: INSTALLING NEW IRRIGATION SYSTEMS: DESIGN CONSIDERATIONS

Seepage Irrigation

Seepage irrigation artificially raises the water table for certain row crop or plasticulture operations. It is also a fundamental irrigation method for “top-down” irrigation crops, such as potatoes, that cannot tolerate saturated growing conditions. Depending on the crop type, seepage irrigation may be employed as a semi-closed, fully closed, or flood system.

- A fully closed seepage system is the most efficient of these types, as it maintains a raised water table yet eliminates most evaporation.
- A semi-closed system utilizes a series of rows and spigots, allowing water to run down the field through furrows to saturate the field and raise the water table. While still effective, this method can result in the offsite discharge of irrigation water if not managed properly. This not only wastes water, but also leaches fertilizers more quickly.
- Flood irrigation is used more typically in regions with very little or no topographic relief. Using this technique, a great deal of water is required to hydrate large areas by filling perimeter ditches. This method is highly inefficient and difficult to manage.

Center Pivot or Linear Move

Center-pivot or linear-move systems typically have an endgun to reach corners of a field, which is usually equipped with an end gun shutoff to prevent water from being applied outside the target area. Soil type(s), soil slope, source water quality, and water supply should all be taken into account when selecting a sprinkler package for one of these systems. In general, the sprinkler package will be a small percentage (usually less than 10%) of the total system cost.

The most common sprinklers used on new systems are: reduced angle impact sprinklers (usually 6 degree), low-pressure sprinklers on top of the irrigation boom, and low-pressure drop nozzle retrofits. Each of these options is more water conserving than high-angle impact sprinklers on the top of the irrigation boom. Further water conservation savings can be generated by removing non-crop areas from irrigation; coordinating application amounts with variations in soil type and field topography;

and, eliminating double application due to pivot overlap. Variable rate irrigation technology does this, is particularly well suited to center pivot irrigation systems, and may reduce water use by an average of 15%.

When used with wastewater from short-term WSPs, large guns are usually required to prevent clogging and allow for even distribution of wastewater. Some pivots are fitted with both efficient sprinklers for fresh water and guns for wastewater, but this requires a valve on each sprinkler and can be very time consuming to switch between the systems.

Traveling Gun

This term refers to either cable-tow or hard-hose traveling sprinkler systems. The primary advantage of traveler systems is that they can be easily moved from field to field and are well suited to fields of irregular size and shape. While travelers tend to have the poorest overall water-use efficiency among sprinkler alternatives, they are easy to move around and have very few clogging issues.

Regardless of the drive mechanism, new traveler systems should be equipped with hard-hose systems so that the sprinkler cart travels at a uniform speed from the beginning of the pull until the hose is fully wound onto the hose reel. Nozzle sizes on gun type travelers are typically ½ to 2 inches in diameter and require high operating pressures of 75 to 100 PSI at the gun for uniform distribution. Nozzle type (ring versus taper bore) should be selected to match irrigation application rates to soil infiltration rates. On heavy soils, guns should be operated in a 300 to 330 degree arc to minimize application rates. Trajectory angles on new systems should be less than 27 degrees to reduce the impact of wind.

Solid Set

Solid-set systems include both portable-pipe and buried systems. For maximum water savings, sprinklers should have a reduced angle that is below 23 degrees trajectory. A solid-set system should be designed to maintain adequate pressure and provide minimal overlap. Solid-set systems with automatic controllers are well suited for irrigating during non-peak evapotranspiration periods, although larger nozzles or additional system components may be needed to compensate for peak periods or to prevent clogging.

Prior to implementing an irrigation schedule, the irrigation system should be evaluated to determine the system's rate of application per acre and other performance variables. Mobile Irrigation Labs (MILs) can help with this. There are a number of MILs strategically positioned around the state that will perform this service for free.

APPENDIX 7: INCENTIVE PROGRAMS FOR QUALIFYING FARMS

Implementation of Best Management Practices can reduce non-point sources of pollution, conserve valuable soil and water resources, and improve water quality. The implementation of these management practices can also be expensive and, in some cases, may not be economically feasible for agricultural producers. To reduce the financial burden associated with the implementation of selected practices, several voluntary cost-share programs have been established. These programs are designed to conserve soil and water resources and improve water quality in the receiving watercourse. The narrative below is intended to provide basic information regarding the primary federal, state, and regional cost-share programs. Sources of additional information have also been included, and growers are encouraged to contact the identified agencies or organizations for current information about each program.

I. Programs Administered by USDA — Farm Services Agency (FSA)

Conservation Reserve Program (CRP): This program encourages producers to convert highly erodible cropland or other environmentally sensitive lands to vegetative cover including grasses and/or trees. This land use conversion is designed to improve sediment control and provide additional wildlife habitat. Program participants receive annual rental payments for the term of the contract in addition to cost share payments for the establishment of vegetative cover. CRP generally applies to highly erodible lands and is more applicable to North Florida.

Conservation Reserve Enhancement Program (CREP): CREP uses a combination of federal and state resources to address agricultural resource problems in specific geographic regions. This program (which is not limited to highly erodible lands) is designed to improve water quality, minimize erosion, and improve wildlife habitat in geographic regions that have been adversely impacted by agricultural activities.

Emergency Conservation Program (ECP): The ECP provides financial assistance to producers and operators for the restoration of lands on which normal agricultural operations have been impeded by natural disasters. More specifically, ECP funds are available for restoring permanent fences, terraces,

diversions, irrigation systems, and other conservation installations. The program also provides funds for emergency water conservation measures during periods of severe drought.

For further information on CRP and CREP, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at www.fsa.usda.gov.

II. Programs Administered by NRCS

Conservation Plans

Conservation planning is a natural resource problem-solving and management process, with the goal of sustaining natural resources. Conservation Plans include strategies to maintain or improve yields, while also protecting soil, water, air, plant, animal, and human resources. They are particularly well-suited to livestock operations and farming operations that produce multiple commodities. Conservation Plans are developed in accordance with the NRCS FOTG. Assistance in developing a plan can be obtained through the local Soil and Water Conservation District (SWCD), the NRCS, the Cooperative Extension Service, and private consultants who function as technical service providers. However, the decisions included in the Conservation Plan are the responsibility of the owner or manager of the farm. Conservation Plans are usually required to receive cost share for any of the programs described below.

Environmental Quality Incentives Program (EQIP): EQIP provides financial assistance for the implementation of selected management practices. Eligibility for the program requires that the farm have a NRCS-approved conservation plan. Practices eligible for EQIP cost share are designed to improve and maintain the health of natural resources and include wildlife habitat, cross-fences, water control structures, brush management, prescribed burning, nutrient management and other erosion control measures.

Conservation Security Program (CSP): CSP is a voluntary conservation program that supports ongoing stewardship on private lands. It rewards farmers and operators who are meeting the highest standards of conservation and environmental management. Its mission is to promote the conser-

vation and improvement of soil, water, air, energy, plant and animal life.

Wetlands Reserve Easement (WRE): WRE under the Agricultural Conservation Easement Program is a voluntary program designed to restore wetlands. Program participants can establish easements (30-year or perpetual) or enter into restoration cost-share agreements. In exchange for establishing a permanent easement, the landowner usually receives payment up to the agricultural value of the land and 100 percent of the wetland restoration cost. Under the 30-year easement, land and restoration payments are generally reduced to 75 percent of the perpetual easement amounts. In exchange for the payments received, landowners agree to land use limitations and agree to provide wetland restoration and protection.

For further information on these programs, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at the following web site: www.nrcs.usda.gov.

III. Programs Administered by State and Regional Entities

Office of Agricultural Water Policy: To assist agricultural producers in the implementation of BMPs, the Florida Department of Agriculture and Consumer Services/Office of Agricultural Water Policy contracts with several of the state's Soil and Water Conservation Districts and Resource Conservation and Development Councils to provide cost share, as funding is available.

Water Management District Cost-Share Programs: Some of the WMDs may have agricultural cost-share programs in place for eligible producers. Some may offer up to 75% of costs for irrigation system improvements.

For further information on these programs, including eligibility criteria, please contact your soil and water conservation district, your WMD, or FDACS. Information and links to other sites are also available on the Internet at the following web site: <http://www.freshfromflorida.com/Divisions-Offices/Agricultural-Water-Policy>.

APPENDIX 8: EXAMPLE RECORD KEEPING FORMS

General Records — Non-CAFO Dairies

NOI Filed (Date): _____

Dairy Name					
Address	City	State, Zip	County	Latitude (decimal)	Longitude (decimal)

	Office Phone	Cell	Other	Email
Owner				
Manager				

	Herd Size	
	Summer	Winter
Lactating		
Dry		
Springer		
Heifer		
Calves		
Total Herd		

Field	Acres	Irrigated Acres	Wastewater Applied Acres	Solids Applied Acres
1				
2				
3				
4				

Total Acres	
Pasture Acres	
Waste Applied Acres	
# of Fields Where Waste is Applied	

Initial Nutrient Balance Calculations			
Step 1	Limiting Nutrient (N/P/N&P)		
Step 4	Lb N/Lactating Cow per day		
Step 4	Lb P/Lactating Cow per day		
Step 5		Lb. N/day	Lb P/Day
	Wastewater		
	Sep. Solids		
	Scraped		
Step 6 N in Balance? (Y/N)			
Step 6 P in Balance? (Y/N)			

Note: This record should be filled out once, unless significant changes are made. Steps 4, 5, and 6 are initial estimates made at the time the NOI is filed, or from existing records.

Waste Storage Pond / Lagoon Capacity and Manure/Stormwater Generation

Wastewater Production _____ Year _____

Date Measured or Calculated	Wash Water/ Hose Output (gallons/day)	Cooling Sprinkler Output (gpd)	Fresh Water Flushes (gpd)	Plate Cooling Water (gpd)	Runoff from HIAs (do not include surface of WSP)	Cow Manure Production (gpd)	Misc (gpd)	Sum (gpd)

See Step 2 of the Dairy BMP Manual Waste Storage Calculation section for guidance in calculating these values. Wastewater production is the average volume of wastewater entering the waste treatment system every day. For dairies without freestall barns, wastewater production is fairly constant all year for a constant herd size, with some variation depending on how much runoff from rainwater enters the wastestream. Cooling systems in freestall barns increase the summer wastewater volume.

Waste Storage Pond Capacity			Design 25-yr, 24-hour storm (Fig. 20, inches)			
Pond ID	Liner Type (none, clay, synthetic, concrete)	Level at Minimum Freeboard (feet)	Volume at Minimum Freeboard (cubic feet)	Total Impervious Surface Area Draining to the WSR. (acres or square feet)	25-yr, 24-hr. Stormwater added to pond (cubic feet)	Pond storage capacity (days)
WSP 1						
WSP 2 / Lagoon						

Note: This record should be completed at the time the NOI is filed. Wastewater production continues to be recorded each quarter for 1 year of 5, unless significant changes occur that would require new calculations to be completed.

Daily/Weekly Inspection Logsheet

Month/Year _____

Date	Final WSP / Lagoon level	Precipitation, inches	WSP / Lagoon Liner, bank/ berm insp. (weekly)	Water line insp. (Min. weekly)	Sand lanes (min. weekly)	Solids separator and ditch insp. (weekly)	Irrigation equip. Insp. (weekly)	Inspector initials
Max.		<i>"Checkmark" means in good order; an "X" means maintenance or repair is needed.</i>						
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
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25								
26								
27								
28								
29								
30								
31								

Manure Analysis (Quarterly from onsite stack)*			Name of Laboratory:					
Date	Location sample taken	Animal (lactating, dry)	Estimated weight of animal	Total Phosphorus	P (lbs/ton) as P ₂ O ₅	TKN	N-Adjusted (lbs/ton)	% Moisture content

* Only required if scraping occurs. At least 1 year of 5, may be reduced to annual if consistent.

Waste Pond/Lagoon Analysis (Quarterly from pond or discharge)*			Name of Laboratory:					
Date	Location sample taken	Description of Sample	Total Phosphorus	P (lbs/1000 gal)* as P ₂ O ₅	TKN	N-Adjusted (lbs/1000 gal)	K as K ₂ O	% Solids

* At least 1 year of 5, may be reduced to annual if consistent.

Irrigation Water Source Analysis (Quarterly from well)*			Name of Laboratory:				
Date	Location sample taken	Nitrate Nitrogen (ppm)	Total Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)	pH	Salinity

* At least 1 year of 5, may be reduced to annual if consistent.

Separated Solids Analysis (Quarterly or before application)*			Name of Laboratory:				
Date	Location sample taken	Description of sample	Total Phosphorus	P (lbs/ton) as P ₂ O ₅	TKN	N-Adjusted (lbs/ton)	% Moisture content

* Only required if separation occurs. Each separator must have its own samples. Moisture content or percent solids only needed if analyzed on a dry weight basis.

Crop Harvest Analysis*			Name of Laboratory:								
Date	Field ID	Crop	Plant Date	Harvest Date	Yield (lbs wet** weight)	Acres Harvested	% Moisture	% Protein	% N	% P	% K

* Plant tissue analysis required at each land application field harvest
 ** Use % moisture to convert wet weight to dry weight. Wet x (100-%moisture) = dry

Soil Sample Analysis			Name of Laboratory:							
Sample Date	Field Location	# of Samples	P205	K20	pH	Ca	Mg	Mn	Fe	Records Location

APPENDIX 9: CONTACT INFORMATION

Emergency Information

Emergency Reporting Numbers	24 hours	
State Warning Point <i>Division of Emergency Management – contact in case of oil or hazardous substance spill</i>	Toll-Free	1-800-320-0519
Emergency Information and Follow-Up Numbers	Monday - Friday	
State Warning Point Information Line	8:00 am - 5:00 pm	(850) 413-9900
DEP Emergency Response	8:00 am - 5:00 pm	(850) 245-2010
State Emergency Response Commission <i>For follow-up reporting only</i>	Toll-Free	1-800-635-7179

Non-Emergency Information

Florida State Agency Numbers	Toll Free	
Department of Agriculture and Consumer Services	www.freshfromflorida.com	
Office of Agricultural Water Policy	(850) 617-1727	
Division of Agricultural and Environmental Services	(850) 617-7900	
Bureau of Pesticides	(850) 617-7917	
Bureau of Compliance Monitoring	(850) 617-7850	
Department of Environmental Protection	www.dep.state.fl.us	
Non-point Source Management Section	(850) 245-2836	
Hazardous Waste Management Section	(850) 245-8707	
Northwest District Office (Pensacola)	(850) 595-8300	
Northeast District Office (Jacksonville)	(904) 256-1700	
Central District Office (Orlando)	(407) 897-4100	
Southeast District Office (West Palm)	(561) 681-6600	
Southwest District Office (Tampa)	(813) 632-7600	
South District Office (Ft. Myers)	(239) 344-5600	
Water Management Districts	www.flwaterpermits.com	
Northwest Florida (Tallahassee)	(850) 539-5999	
Suwannee River (Live Oak)	(386) 362-1001	1-800-226-1066
St. Johns River (Palatka)	(904) 329-4500	1-800-451-7106
Southwest Florida (Brooksville)	(352) 796-7211	1-800-423-1476
South Florida (West Palm)	(561) 686-8800	1-800-432-2045
Other Helpful Numbers – Main offices		
NRCS – Florida Office (Gainesville)	(352) 338-9500	
UF/IFAS Extension Administration	(352) 392-1761	
Association of Florida Conservation Districts <i>Soil and Water Conservation Districts</i>	(407) 321-8212	

APPENDIX 10

Notice of Intent and BMP Checklist



ADAM H. PUTNAM
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Office of Agricultural Water Policy

FDACS-OAWP
Mayo Building
407 S. Calhoun St. MS-E1
Tallahassee, FL 32399

NOTICE OF INTENT TO IMPLEMENT WATER QUALITY / QUANTITY BMPs FOR FLORIDA DAIRY OPERATIONS (2015)

Rule 5M-17.003, F.A.C.

- Before beginning, check all boxes below that apply to your operation:
 - I have an existing National Pollutant Discharge Elimination Permit (NPDES).
If so, you have no further obligations under this manual. Permit No: _____
 - I have an existing Comprehensive Nutrient Management Plan approved by NRCS, or Nutrient Management Plan approved by FDEP. If so, skip the **Nutrient and Waste Storage Pond Calculations** section.
- In consultation with Florida Department of Agriculture and Consumer Services (FDACS) field staff, complete the **Notice of Intent (NOI)**, **Nutrient and Waste Storage Pond Calculations**, and the **BMP Checklist** (all of these documents are in the manual), selecting the BMPs applicable to your property. The NOI may list multiple properties only if all the following apply: they are within the same county, they are owned or leased by the same person or entity, and the same BMPs identified on the checklist are applicable to them.
- Submit the NOI and the BMP Checklist to FDACS field staff or mail it to:

FDACS Office of Agricultural Water Policy
Mayo Building, 407 S. Calhoun Street, MS-E1
Tallahassee, Florida 32399
- Keep a copy of the NOI, the Nutrient and Waste Storage Pond Calculations, BMP Checklist, and the Appendix 8 records in your files as part of your BMP record keeping.

For assistance in completing this NOI form and the BMP Checklist, or with implementing BMPs, contact FDACS staff at (850) 617-1727 or AgBmpHelp@freshfromflorida.com.

You can visit <http://www.flrules.org/Gateway/reference> to obtain an electronic version of this NOI form.

Person To Contact and Name of Farm

Name: _____

Business Relationship to Landowner/Leaseholder: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ FAX: _____

Email: _____

Landowner or Leaseholder Information (check all that apply)

NOTE: If the Landowner/Leaseholder information is the same as the Contact Information listed above, please check: Same as above. If not, complete the contact information below.

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ FAX: _____

Email: _____

Complete the following information for the property on which BMPs will be implemented under this NOI. You may list multiple parcels if they are located within the same county, are owned or leased by the same person or entity, and are applying the same BMPs on them.

Operation Name: _____

County: _____

Tax Parcel Identification Number(s) from County Property Appraiser

Please submit a copy of your county tax bill(s) for all enrolled property, with owner name, address, and the tax parcel ID number(s) clearly visible. **If you cannot provide a copy of the tax bill(s), please write the parcel owner's name and tax parcel ID number(s) below in the format the county uses.** Attach a separate sheet if necessary (see form provided).

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Additional parcels are listed on separate sheet. (check if applicable)

Total # of acres of all parcels listed (as shown property tax records): _____

Total # of acres on which BMPs will be implemented under this NOI: _____

In accordance with section 403.067(7)(c)2, Florida Statutes, I submit the foregoing information and the BMP Checklist as proof of my intent to implement the BMPs applicable to the parcel(s) enrolled under this Notice of Intent.

Print Name: _____

(check all that apply) Landowner Leaseholder Authorized Agent (see below)*

*Relationship to Landowner or Leaseholder: _____

Signature: _____ Date: _____

Name of Staff Assisting with NOI: _____

NOTES:

1. You must keep records of BMP implementation, as specified in the BMP manual. All BMP records are subject to inspection.
2. Notify FDACS if there is a full or partial change in ownership with regard to the parcel(s) enrolled under this NOI.
3. Remember that it is your responsibility to stay current with future updates of this manual. Visit the following website periodically to check for manual updates: <http://www.freshfromflorida.com/Divisions-Offices/Agricultural-Water-Policy>

Additional Tax Parcel Listings

Operation Name: _____

County: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

FLORIDA DAIRY OPERATIONS WATER QUALITY / QUANTITY BMP CHECKLIST

BMP #	BMP Group <small>(See body of manual for full description of practices)</small>	In Use	Planned	Will not implement <i>(check reason below)</i>			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other

1.0 Nutrient Management

1.1. Level 1: General Feed Ration BMPs

1. Seek the help of a qualified nutritionist when formulating diets if you are not trained in nutrition principles.						
2. Ensure that phosphorus is less than 0.42% of total feed ration (dry matter basis). Do not discount P in grains and forage, as ruminant bacteria make P available.						
3. Store feed so it has no contact with rainwater (wet brewers grain is an exception).						
4. Use moisture analysis results to adjust and mix feeds to ensure the proper ration of formulated diets.						
5. Clean up feed spills immediately, and land-apply or compost spoiled feed.						
6. If applicable, contain or treat silage leachate so that it does not affect surface or ground waters.						

1.1.1. Milking Cows Feed Ration BMPs

1. Adjust feed for each group based on the phase of lactation and amount of milk production. Note that dry cows eat about half as much dry matter as high-production lactating cows.						
2. Feed the minimum amount of nitrogen required to maintain good milk production.						
3. If feasible, milking three times per day may reduce the amount of nutrients excreted by 7% per unit of milk.						



1.1.2. Heifers or Dry Cows Feed Ration BMPs




1. Implement forage testing and feed programs for heifer groups ranging from 0 to 6 months, 7 to 11 months, and from 12 to 24 months to ensure that heifers are not over-conditioned or under-conditioned.						
2. Sort heifers into more uniform groups and feed all sorted heifers at feed bunks at the same time or use some form of locking head gate(s) to prevent dominant heifers from consuming more than their proportionate share of feed.						
3. Carefully monitor heifer body weight. A reasonable average daily gain goal is 1.7 pounds.						
4. Eliminate or limit the supplementation of P in heifer and dry cow diets as the recommended percentage of dietary dry matter (0.20-0.35%) is normally provided in basal feeds.						


1.2. Level 1: Wastewater Generation BMPs

1. When practical, divert clean roof water, runoff water, and plate water from the waste management system.						
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BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
2.	Install timers to control flush times, if needed.						
3.	Reduce use of udder washers when cows are clean.						
4.	Use timer, temperature, and/or humidity controllers to cycle cooling systems.						
5.	Reduce flushing times to a minimum needed to adequately clean the floors.						
6.	Establish protocols that minimize water use for cleaning milking equipment.						
Level 2: Additional Wastewater Generation BMPs							
7.	Eliminate udder washers.						
8.	Use recycled water in all freestall barns.						
9.	Use high-pressure misters instead of sprinklers.						
10.	Use scraping in addition to or instead of flushing.						
1.3. Level 1: Solid Separation BMPs							
1.	Clean sand lanes daily.						
2.	Clean static separators before they are full to allow for maximum separation.						
3.	Clean inclined screens at least weekly to prevent screen from clogging.						
4.	Ensure that all solids from separators or other manure piles are on impervious surfaces and the runoff is directed into the wastewater system.						
Level 2: Additional Solid Separation BMPs							
5.	Choose a solids separation system using the information in Table 3 of Appendix 2 so that the maximum amount of nutrients are removed from the wastewater. This will result in less nutrients in the wastewater but more solids to be removed from the farm.						
1.4. Level 1: Waste Storage Pond BMPs							
1.	Verify that the WSP meets the minimum storage requirement.						
2.	Keep the water level in the WSP as low as practical.						
3.	Minimize wastewater production to maximize reserve capacity in the WSP.						
4.	Inspect and maintain all pumping equipment.						
Level 2: Additional Waste Storage Pond BMPs							
5.	If you have a high water table with a close surface outlet, either move the surface outlet (ditch, tile drain) or install interceptor tile or a ditch that pumps back into the pond.						
6.	On a non-high water table soil that does not have a lined pond, line the existing pond or build a lined pond.						
7.	If the pond does not meet the lining requirements, use an artificial liner or add bentonite to the existing clay to make it acceptable. The amount of bentonite is dependent upon soil type.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
1.5. Level 1: Offsite Manure Hauling BMPs							
	1. Use water-tight trucks or trailers so spillage does not occur.						
	2. Dispose of product only at a bona fide agricultural site.						
	3. Provide the receiving farmer a copy of the latest analysis so the product can be spread at agronomic rates.						
1.6. Level 1: Onsite Manure Storage and Composting BMPs							
	1. Mix raw manure with enough dry material so that leaching does not occur from pile.						
	2. Ensure that there is no discharge from manure storage areas into watercourses, lakes, wetlands, drinking water wells, or sinkholes. Possible measures include distance setbacks (minimum 30 feet of vegetative buffer), constructing an impervious base (concrete or compacted clay), using a berm upgradient of the manure pile to deflect incoming flow, and/or covering the pile with a tarp or other waterproof material. Use the BMP checklist to provide a written description of the measures you are using or will use.						
	3. Manure storage areas located in a karst area must be on an impervious surface that drains back to the waste system or covered with a tarp or other waterproof material to prevent leaching.						
Level 2: Additional Alternative Waste Handling and Treatment BMPs							
	4. Evaluate the addition of alum to flocculate soluble and particulate P. This will reduce the amount of P that is land applied through irrigation, but may increase chemical treatment and offsite hauling costs. A second option is to evaluate the potential for a constructed wetland system. In either case, the evaluation should contain an economic analysis (capital and operating) of the options.						
1.7. Level 1: Crop Fertilization and Land Application BMPs							
	1. Follow published UF-IFAS N fertilizer rate recommendations or those listed in Table 5 in Appendix 2 . If those rates are not adequate for crop production, and more is needed, then this must be justified based on measured crop uptake.						
	2. For established fields, take annual soil samples in November or December. Refer to Appendix 5 for guidance on P extraction methods and sample collection. Keep a copy of all laboratory test results to track changes over time.						
	3. Do not apply supplemental commercial P to waste application fields that are based on N. On dairies where waste application is based on P, ensure that applications from all sources of P do not exceed crop uptake.						
	4. Do not apply wastewater to saturated fields, except in an emergency.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
	5. Maintain cropping system nutrient balance based on annual averages. However, if located on karst terrain, try to maintain a balance of readily available N throughout each crop cycle.						
	6. Keep written records of N and P applications.						
For Hay or Silage Production							
	7. Do not apply supplemental commercial fertilizer unless the field is not receiving enough N or P from applied waste. On farms with crop fertilization based on P, apply supplemental N only in the spring and after each cutting.						
	8. Begin spring harvest (first cutting) for hay or silage when the plant reaches a height of 14 to 18 inches, and cut every 4 weeks for silage or every 4 to 6 weeks for hay.						
1.8. Level 1: Sampling and Recordkeeping BMPs							
	1. Use the record forms in Appendix 8 or an equivalent system to demonstrate that the farm is maintaining nutrient balance.						
	2. Collect WSP samples quarterly; solid samples quarterly or whenever they are removed from the separator (if less than four times a year); and crop tissue samples after each cutting. Sampling is required for one year out of every five years, unless significant operational changes are made.						
	3. Use a reputable lab to perform the appropriate analyses.						
2.0 Irrigation Management							
2.1. Level 1: Irrigation Management BMPs							
	1. Install rain gauges on your operation and monitor them to help schedule irrigation events. Rain events of ¼ to ½ inch are usually sufficient to substitute for the next irrigation event.						
	2. Use available tools and data to assist in making irrigation decisions. Tools may include water table observation wells, on-site soil moisture sensors, crop water use information, thermometers, rain gauges, and other weather-related data. Real-time weather data, although not required, is available through FAWN or other regional services, or by installing your own on-site weather station. Indicate on the BMP checklist what tools you are or will be using.						
	3. If a Mobile Irrigation Lab is available, get an evaluation to check the distribution or emission uniformity and the conveyance efficiency of the irrigation system(s). This should be done every three to five years. Make adjustments as needed.						
	4. Do not irrigate beyond field capacity. When irrigation needs are greater (during long, warm days) or when plants are in the elongation phase of growth, splitting irrigation events into multiple daily applications may be of benefit.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
5.	Irrigate with wastewater first to keep the WSP as low as possible and always below the maximum operating level.						
2.2. Irrigation Maintenance BMPs							
1.	On a periodic basis, examine sprinkler nozzles or emitters for wear and malfunction, and replace them as necessary.						
2.	When using small nozzles, flush irrigation lines regularly to prevent clogging. To reduce sediment build up, make flushing a regular part of your maintenance schedule.						
 3.	Test irrigation source water quality annually to detect issues with water chemistry that may result in irrigation system plugging or affect plant health.						
4.	Ensure that the pump, engine/motor, and fuel tank (if applicable) are mounted on a firm foundation, and that they are operating within the manufacturer's specifications.						
3.0 Dairy Watering Requirements and Sources							
3.1. Level 1: Water Requirement BMPs							
1.	Locate watering troughs and associated shade facilities to keep cattle away from perennial streams or watercourses as much as possible.						
2.	Construct troughs or tanks with a stable base to reduce health hazards to livestock.						
3.	Ensure that water troughs are at least 100 feet away from surface waters.						
4.	Maintain riparian buffers to prevent bank damage and manure deposits in the watercourse.						
5.	Maintain all wells, troughs, and other associated structures in good working order.						
4.0 Pasture and Grazing Management							
4.1. Level 1: Grazing BMPs							
1.	Use travel lanes to move cows away from concentrated areas and disperse them across pastures.						
2.	As practicable, use rotational grazing techniques.						
3.	Use incentives such as portable shade, feed, and water structures to disperse cows over the entire pasture and locate them on flat (less sloping) areas. Move them as necessary to prevent large barren areas.						
4.	If using hay to feed onsite in a pasture, use a feeding panel or hay ring to restrict access and reduce trampling. Try to introduce only a one-day supply of feed at a time.						
5.	Avoid overgrazing by following the leaf length information in Table 6 of Appendix 2 to ensure that pastures have adequate forage.						


BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other

4.2. Level 1: Special Grazing BMPs for Heifer Operations

1. Locate feed bunks or fence-line feeders at least 200 feet away from wetlands, streams, lakes, springs or spring runs.						
2. Account for the N and P contribution from collected manure (from piles) that is land applied to pastures, and reduce commercial fertilization accordingly. Book values can be used to determine this.						
3. For HIAs that are denuded and close to drainage ditches/canals, wetlands, streams, lakes, or sinkholes, install and maintain vegetated buffers to protect water quality.						

5.0 Sediment and Erosion Control Measures

5.1. Level 1: Stormwater BMPs


1. Install gutters and downspouts on all buildings adjacent to HIAs, and divert this water away from the HIA toward pastures or other vegetated areas.						
2. Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure that they operate as designed.						
 3. If you have an existing operation that does not have an ERP or other WMD surface water permit and has a history of downstream flooding issues, develop and implement a written stormwater management plan that provides specific responses to various types and levels of rainfall, as feasible. The goal of the plan should be a reduction in volume of off-site discharge while maintaining a healthy rooting environment. Evaluate the plan's effectiveness, and make adjustments as needed.						

5.2. Level 1: Erosion Control BMPs

1. Manage livestock and vegetation to minimize areas of erosion.						
2. Minimize denuded areas in feeding, watering, and other high-traffic locations.						
3. Seed and mulch denuded areas, as needed, to promote healthy pastures.						
4. Use level spreaders, filter strips and grassed waterways to treat and infiltrate water.						
5. Use temporary exclusion fencing on denuded areas to allow for the re-growth of vegetation.						
6. Install or maintain field borders around the perimeter or, at a minimum, in areas where runoff enters or leaves the pasture.						
7. Use silt fences and other appropriate BMPs during any onsite construction activities.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other

5.3. Level 1: Ditch Maintenance BMPs

1. Maintain permanent vegetative cover on ditch banks.						
2. Protect ditch banks from erosion in areas subject to high water velocities, using rip-rap, concrete, headwalls, or other buffering materials.						
3. Keep all control structures free from obstructions.						
 4. Do not remove sediments below the ditch's original invert elevation, which can be determined by permit drawings, basic survey drawings, and/or changes in soil characteristics and color. Keep drawings of the design cross-sectional area for future reference.						

5.4. Level 1: Road Construction BMPs

1. Stabilize access roads or trails that cross streams and creeks, using rock crossings, culverts, or bridges.						
2. Maintain vegetative cover on road banks.						
3. When constructing above-grade access roads, keep road width to a minimum, maintain hydrology, and locate the road(s) a minimum of 25 feet from regulated wetlands.						


Level 2: Additional Road Construction BMPs

4. Install a new culvert of the appropriate size, if the existing culvert is not functional. Contact NRCS or FDACS for technical assistance.						
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6.0 Water Resource Protection

6.1. Level 1: Wetlands Protection BMPs

1. Do not dredge or fill in wetlands. Consult with the WMD and the NRCS prior to conducting activities in or near wetlands to ensure that you are complying with any permitting or NRCS program eligibility requirements.						
2. Minimize adverse water quality impacts to receiving wetlands by applying measures progressively until the problem is addressed. Practices such as filter strips, sediment sumps, conservation buffers, swales, or holding water on-site may preclude the need for more aggressive treatment measures.						
3. Install and/or maintain a minimum 25-foot, non-fertilized vegetated buffer upland of the landward boundary of all wetlands and lakes, unless you have an existing WMD permit (e.g., ERP, or management and storage of surface waters permit) that specifies a different buffer. For any nutrient or fecal coliform impaired waters, expand the buffer to at least 50-feet.						
4. For existing operations without an ERP that are unable to meet the vegetated buffers specified above, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (Use the comments section at the end of the BMP checklist).						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
5.	Install a filter strip to treat runoff from concentrated livestock areas, such as feed areas, shade, or water areas, that are directly adjacent to wetlands and sinkholes.						
6.2. Level 1: Streams Protection BMPs							
1.	Install and/or maintain a riparian buffer along perennial streams on production areas that exceed 1-percent slope and discharge directly to streams, or where pasture allows direct access to the stream by cows. Contact FDACS, NRCS, or an NRCS-approved Technical Service Provider for assistance in properly designing the riparian buffer.						
2.	Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function and to maintain natural flows.						
Level 2: Additional Stream Protection BMPs							
3.	Install exclusion fencing, where necessary.						
6.3. Level 1: Protection for First- and Second-Magnitude Spring Recharge Basins							
1.	Install and/or maintain a minimum 100-foot non-fertilized vegetated buffer upland of the landward boundary of springs and spring runs.						
2.	Install and/or maintain a minimum 50-foot non-fertilized vegetated buffer around sinkholes.						
3.	If you have a sinkhole on your property, never use it to dispose of used pesticide containers or other materials.						
6.4 Level 1: Well Operation and Protection BMPs							
1.	Use backflow-prevention devices at the wellhead to prevent contamination of the water source, if injecting fertilizer, wastewater, or chemicals.						
2.	Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.						
 3.	Maintain records of new well construction and modifications to existing wells.						
7.0 Integrated Pest Management and Pharmaceuticals							
7.1. Level 1: Pesticide and Pharmaceutical BMPs							
1.	Practice IPM and use all pesticides in accordance with the label. When applying a pesticide close to a stream, canal, pond, or other waterbody, choose a pesticide with an active ingredient that has a lower toxicity to aquatic organisms.						
2.	Store pesticides in a roofed structure with a lockable door, at least 100 feet from wells, surface waters, and sinkholes.						
3.	When mixing pesticides in the field, conduct loading activities at random locations. Use a check valve or air gap separation to prevent backflow into the tank when filling a sprayer.						
4.	Rinse, recycle, or dispose of empty pesticide containers following federal, state, and local regulations.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement (check reason below)			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
5.	Dispose of spent needles and unused pharmaceutical products by using an approved biomedical container, or by following other guidance approved by the EPA.						

8.0 Odor Prevention and Management

8.1. Level 1: Odor Management BMPs

1.	In populated areas, establish a vegetative buffer around the farm consisting of dense lower vegetation combined with higher vegetation. Cedar trees combined with pines work well.						
2.	Consider wind direction and neighbor locations before applying waste. Do not apply wastewater if winds are more than 10 mph.						
3.	If odors are a problem, clean out settling basins at least once every two weeks.						
4.	When practical, inject or incorporate manure into the soil.						

9.0 Animal Mortality Management

9.1. Level 1: On-Site Carcass Disposal BMPs

1.	For below-ground burial, move dead cows to an upland area at least 100 feet from adjacent property and at least 200 feet from watercourses, streams, wetlands, wells, or sinkholes. Locate burial sites at least 2 feet above the seasonal high ground water table and allow for at least 2 feet of cover. Identify burial sites on a map and keep it available for future reference.						
2.	For above-ground burial, move dead cows to an upland area at least 100 feet from adjacent property and at least 200 feet from watercourses, streams, wetlands, wells, or sinkholes. Cover with 6 inches of compacted soil and at least 2 feet of additional soil.						
3.	If composting onsite, establish a compost area using the setbacks given above.						

10.0 Recycling and Industrial Materials Management

10.1. Level 1: Waste Reduction BMPs

1.	Store fertilizers in an enclosed, roofed structure with an impervious floor and lockable door, at least 100 feet from wetlands, waterbodies, or sinkholes.						
2.	Recycle used oil, solvent bath waste, and antifreeze using appropriate means.						
3.	Ensure that all regulated petroleum storage tanks are registered, and meet the requirements of FDEP rule for secondary containment.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement <i>(check reason below)</i>			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other

11.0 Closure

11.1. Level 1: Closure BMPs

1. Clean all areas where concentrated manure has accumulated, including WSPs.						
2. Breach, fill, or use WSP for an approved alternative water use purpose.						
3. Contact the WMD about proper abandonment of onsite wells.						
4. Identify and properly dispose of chemicals and other waste materials.						

Florida Dairy Operations BMP Checklist Comments Section

BMP # Describe Alternative Measures Used	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
BMP # Enter "Other" reasons for not implementing BMPs	
Field Notes:	
ERP #	



