Appendix 4-1: Implementation Strategies for Source Control Programs for Watersheds in the Northern and Southern Everglades

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INTRODUCTION

This appendix expands on the philosophy behind the source control strategies in the watersheds across the Southern and Northern Everglades regions, and how it is applied in the Everglades Construction Permit (ECP) basins [Everglades Agricultural Area (EAA) and C-139 basins], the non-ECP basins (basins traditionally not served by the Stormwater Treatment Areas), and in the Lake Okeechobee Watershed during Water Year 2008 (WY2008) (April 1, 2007–May 30, 2008).

The source control approach for each basin is dictated through legislative mandates. The basin-specific strategy is implemented through agency rules and cooperative agreements. Concurrently, the District stays abreast with technical information on the subject and stakeholder perspective, and conducts supplemental water quality monitoring, Best Management Practices (BMPs) research and demonstration, and data analyses. These are necessary to ensure that regulatory decisions are balanced and based on sound technical grounds.

Figure 1 shows the basic framework for the source control strategies implemented in the watersheds across the Southern and Northern Everglades. Within this basic framework, implementation strategies vary among the watersheds, and even among the basins in each watershed, in concert with the water quality goals associated with the watershed or basin, the attainment status of meeting the water quality goal, and the statutory requirements of Florida legislation in regard to implementing the framework of the source control program. For example:

- **BMP Level of Implementation Requirements:** Whereas BMP implementation through Rule 40E-63, Florida Administrative Code (F.A.C.), permits at the 25-point level in the EAA proved effective, more comprehensive BMP plans and supplemental projects to develop the technical information for a more effective program are necessary in the C-139 basin (at a 35-point level.)
- **Coordinating Agencies:** The Everglades Forever Act designates the South Florida Water Management District (SFWMD or District) to implement the

Everglades Construction Project and enforce BMPs and other requirements of Rules 40E-61 and 40E-63, F.A.C. In contrast, the Northern Everglades and Estuaries Protection Program [NEEPP; Section 373.4595, Florida Statutes (F.S.)] identifies the District, the Florida Department of Environmental Protection (FDEP), and the Florida Department of Agriculture and Consumer Services (FDACS) as the Coordinating Agencies mandated to develop a Lake Okeechobee Protection Plan (LOPP), including development of a program of non-point source BMPs, in accordance with Section 403.067, Florida Statutes (F.S.), that complements the District's existing regulatory programs and is designed to achieve the objectives of LOPP. In 2001, the SFWMD, FDEP, and FDACS executed a Memorandum of Understanding to establish agreement on the comprehensive implementation of the LOPP. As a result, the FDACS adopted rules to implement a voluntary BMP program for agricultural landowners complementary to the District's Lake Okeechobee Watershed Works of the District source control rule (Chapter 40E-61, F.A.C.) for total phosphorus (TP) reductions and Environmental Resource Permit (ERP) rule for design of stormwater management systems.

- **BMP Implementation Mechanism**: In contrast to the mandated BMP implementation through specific BMP rules such as 40E-61, and 40E-63, F.A.C., BMP implementation through cooperative agreements and ERPs is dominant in the non-ECP basins.

This appendix provides a parallel of the source control strategies employed in each basin, and the basic concepts that apply across basins, as provided below:

- The BMP plan and the BMP equivalent point system used to ensure an equitable level of effort;
- The BMPs for agricultural and non-agricultural operations, and the importance of comprehensive BMP plans that address different phosphorus species and transport mechanisms;
- The concept of overall BMP program effectiveness and the adaptive source control implementation strategy, where program implementation evolves based on technical information and compliance with performance measures in accordance with a timeline established by an SFWMD regulatory rule;
- The need for accountability with BMP requirements, as exemplified by the permit renewal process and routine field verification and inspection process;
- The integrated regulatory approach, where the contents of and compliance with Environmental Resource Permits (ERPs), Surface Water Management (SWM) Permits, and Consumptive Water Use Permits (CUPs) are reviewed to ensure that they are aligned with basin specific water quality goals;
- Analysis of water quality and quantity data (e.g., phosphorus, nitrogen, flow) from a basin-wide perspective to an upstream-focused approach to ensure the program is effective, identifies priority tributaries, and establishes site-specific strategies for compliance with program performance measures; and
- Use of a practical approach for program implementation based on lessons learned and leveraging resources through incentive-based actions and cooperative agreements.

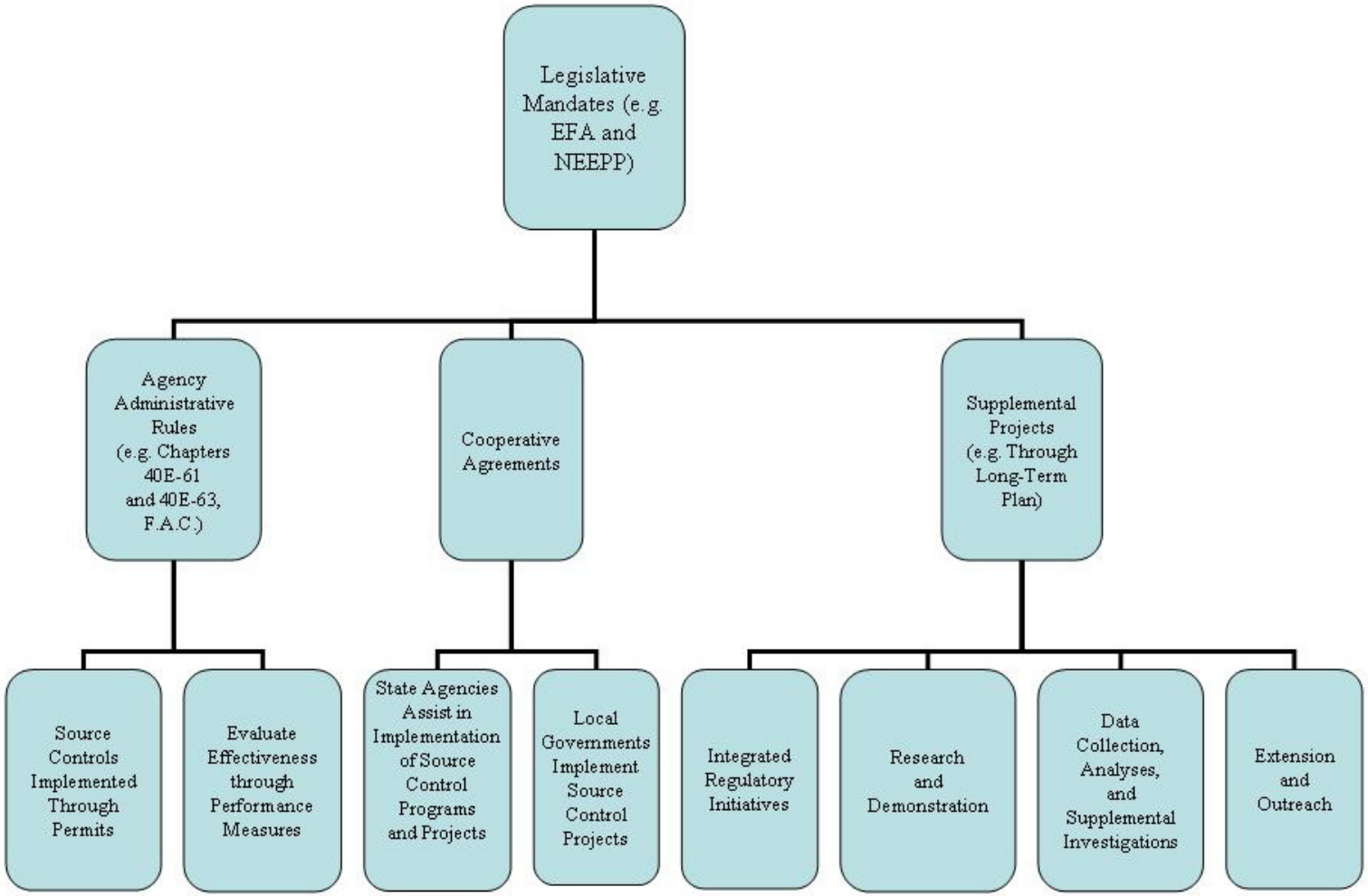

Figure 1. Framework for implementation of source controls in watersheds across the Northern and Southern Everglades regions.

SOURCE CONTROL STRATEGIES

REGULATORY BEST MANAGEMENT PRACTICES PLAN

Each Works of the District (WOD) permit approves an onsite implementation plan for BMPs (BMP plan) for reducing phosphorus levels to meet basin-wide phosphorus performance measures. The BMP plan typically includes operational programs or infrastructure enhancements designed to reduce phosphorus levels in discharges to the WOD. The District is responsible for ensuring that a base level of BMPs is established for each permit area.

Within non-ECP basins, consisting of the Feeder Canal, L-28, C-111, C-11 West, North New River Canal (NNRC), North Springs Improvement District (NSID), Acme, and Boynton Farms basins, where a BMP rule does not exist, implementation of BMP plans is mandated by incorporating BMP requirements for phosphorus in new or modified ERP and SWM permits for priority dischargers. BMP requirements in ERP and SWM permits are tailored to site-specific conditions and site discharge characteristics, and may include both structural and non-structural BMPs. For example, operational controls integrated into the ERP process have resulted in total diversion of flow and no discharges to the Everglades Protection Area (EPA) from the Acme, and NSID basins to the EPA during WY2008. Public education strategies were integrated into ERP permits for the NSID and Acme basins; and ERP permits for water control districts located within the C-11 West and North New River basins. The District has also provided cost-share funding for BMP plans and capital improvement projects that incorporate both structural and non-structural BMPs developed to reduce and/or alter practices that result in the TP discharge into stormwater runoff that eventually would discharge into the EPA from the Acme, NSID, and C-11 West basins. Additionally, the Long-Term Plan for the Feeder Canal basin was revised on December 10, 2007, to recommend additional funding to support the initiation of rule development for a regulatory source control program. Additional funding would be provided in Fiscal Years (October 1 through September 30) 2009 and 2010.

In the EAA and C-139 basins, the District must ensure that BMP plans between different permittees are consistent and comparable. To accomplish this task, a system of BMP equivalents was developed by assigning points to BMPs within four basic categories consisting of water management practices, nutrient management practices, control of sediment and particulate matter, and pasture management (if applicable). Points were originally based on the review of reports and publications produced by University of Florida Institute for Food and Agricultural Services (UF/IFAS); on the best professional judgment of District staff; and extensive cooperative workshops conducted among effected landowners, consultants, and other interested stakeholders. This BMP plan development approach considers that both flow and concentration are targeted through a balanced plan. The plan implementation also has to be verifiable for compliances purposes at the parcel level. With these objectives in mind, the number of points assigned to each BMP was developed as a negotiated solution in a regulatory context. The BMP points system has proven successful in ensuring implementation of a consistent base level of BMPs between permitted areas.

The minimum level of BMP plan implementation in the EAA and C-139 basins is established by Chapter 40E-63, F.A.C., permits, as BMP equivalents or points. By using the BMP-equivalents approach, each permittee has the flexibility to develop a BMP plan that is best suited for site-specific soil types, hydrology, and crop conditions. For each proposed BMP, the permittee must consider how the BMP will be implemented, how staff responsible for BMP

implementation will be trained, and how BMP implementation will be documented. If either basin is determined to be out of compliance, then there is a system outlined by rule for increasing the level of BMP implementation.

The source control program for Lake Okeechobee began in 1989 under the current Chapter 40E-61, F.A.C., which requires a permit for an approved phosphorus control plan for all land uses. Based on existing rule criteria, permittees are presumed to be in compliance unless parcel-level monitoring data indicate otherwise. Because of budgetary constraints, limited parcel-level monitoring is conducted by the SFWMD through a network of moving sampling sites, originally used to determine parcel-level compliance. Based on the legislative changes to LOPA in 2000 (NEEPP), the FDACS became the primary agency for working with agricultural lands to encourage incentive-based BMP implementation while the SFWMD focused on non-agricultural land uses. The parcel-level SFWMD monitoring then evolved, in part, to direct FDACS to agricultural land uses exhibiting poor water quality. The monitoring program has been very limited in scope and does not measure the effectiveness of the source control program. It is concentration-based and only targets those land areas that are shown to be significant contributors of phosphorus. In the Lake Okeechobee Watershed, the current rule requires an applicant with agricultural or non-agricultural land uses to provide a plan for BMP implementation for review by Lake Okeechobee source control staff in order to receive a Lake Okeechobee WOD Permit. This BMP plan must describe the practices, whether structural or operational, to be implemented by the applicant to reduce the amount of phosphorus discharged from the subject property into the watershed. Based on the District's permit database, there are approximately 803 existing WOD permits within the Lake Okeechobee Watershed boundary. However, agricultural landowners have elected to implement BMPs voluntarily through participation in the FDACS incentive-based BMP program.

Table 1 provides a general description of BMPs that can be implemented in the EAA, C-139, and Lake Okeechobee Watershed to meet permit requirements. The BMP equivalent points are not currently used in the Lake Okeechobee basins. The list is not exhaustive and implementation of other applicable BMP options is allowed.

Table 1. Best Management Practices (BMP) summary and BMP equivalent points for the Everglades Agricultural Area (EAA), C-139, and Lake Okeechobee basins.

BMP	Points	Description
Nutrient Control Practice		***Minimizes the Movement of Nutrients Off-Site***
Nutrient Application Control	2 ½	Controlled application of nutrients with a 4-foot setback from canals: banding, pneumatic application – AIRMAX; fertigation; and fertilization placement near root under plastic.
Nutrient Spill Prevention	2 ½	Formal spill prevention protocols (storage, handling, transfer, and education/instruction).
Successive Vegetable Planting to Minimize P	2 ½	Successive planting of high/low phosphorus (P) demand crops to avoid P buildup and no successive P application.
Plant Tissue Analysis	2 ½ 5	Determines plant nutrient requirements next growing season (crop specific). Citrus only — because plant tissue analysis provides information on current season, additional points are allowed.
Nutrient Application Control	5	Determines the P requirements of the soil and follow standard recommendations for application rates (crop specific).
Split Nutrient Application	5	Applying small portions of P at various times without exceeding the total recommendation.
Slow Release P Fertilizer	5	Specially treated fertilizer.
Reduced P Fertilization	5	P application rate is at least 30% below the recommendation.
No Nutrients Imported Via Direct Land Application	15	No application of P in any form. Native and semi-improved range may apply fertilizer at maintenance levels every 6–8 years.
No Nutrients Imported Indirectly Through Cattle Feed	15	No P import to the basin through cattle feed (Note: native range is not excluded by use of mineral supplements or molasses).
Nutrient Management Plan	Up to 35	Managing the amount, source, placement, form, and timing of the application of nutrients on lands with cattle operations.
Water Management Practices		***Minimizes the volume of off-site discharges***
½ Inch Detained 1 Inch Detained	5 10	Delay discharge (based on measuring daily rain events using a rain gauge).
Improved Infrastructure	5	Recirculate water inside farm boundaries to improve water quality prior to offsite discharge (e.g., rice and vegetables), fallow field floodwater with no direct discharge (instead allow to drain via evapotranspiration, seepage, use as irrigation water), or increasing water detention using properly constructed canal berms.
Water Table Management	5	Optimizing drainage and irrigation schedules and/or using low volume irrigation methods to decrease discharge.
Approved and Operational Surface Water Reservoir	35	Properly permitted, constructed, and maintained storage system meeting specified Environmental Resource Permit Basis of Review criteria (version in effect at the time of permitting or in effect at the time of permit modification for modified systems).
Temporary Holding Pond	15	Temporary agricultural activities (as described in Chapter 40E-400, F.A.C.) with a properly constructed and permitted temporary holding pond.

Table 1. Continued.

BMP	Points	Description
Particulate Matter & Sediment Controls		***Minimizes the Movement of Particulate Matter and Sediments***
Any 2 Any 4 Any 6 Any 8	2 ½ 5 10 15	• Leveling fields • Grassed swales/field ditch connections • Ditch bank berms • Aquatic weed control • Barriers at discharge locations • Sediment sump/trap in canals • Maintain forage to reduce soil erosion/range seedings • Soil stabilization through infrastructure improvements • Culvert bottoms above ditch bottoms • Cover crops • Vegetated ditch banks • Slow drainage velocity near pumps • Canal cleaning program • Field ditch drainage sumps • Ditch bank stabilization
Pasture Management		***On-Farm Site Operation and Management Practices***
	2 ½ 2 ½ 5 5 10	• Restricted placement of feeders, cowpens, or feed and water to reduce "hot spots" near drainage ditches (2 ½ points each) • Provide shade structures to prevent cattle in waterways • Low cattle density (1 head/2 acres, non-irrigated pasture) • Reduced P in feed (by a minimum of 20%) • Restrict cattle from waterways through fencing of canals in a manner that protects the discharge water quality
Urban Xeriscape	5	Use of plants that required less water and fertilizer.
Detention Pond Littoral Zone	5	Vegetative filtering area for on-site stormwater runoff.
Other BMPs	TBD	BMPs proposed by permittee and accepted by SFWMD.

Note:

A BMP plan is required for each land use or crop, and shall be implemented across the entire farm acreage (drainage area). For the Everglades Agricultural Area Basin, a minimum of 25 points is required for each BMP plan.

For the C-139 basin, the minimum required points for each BMP plan are based on compliance status as follows:

- Level I: Initial phase 15 points for each BMP plan.
- Level II: First incidence out of compliance, no additional BMPs; however, on-site verification of BMPs begin. Frequency of visits based on compliance record.
- Level III: Second incidence out of compliance, 10 additional BMP points for each BMP plan (25 points total).
- Level IV: Third incidence out of compliance, 10 additional BMP points for each BMP plan (35 points total)

For the Lake Okeechobee Watershed, a BMP plan to reduce the amount of phosphorus must be submitted for review. A minimum point criterion is not used.

TBD = To Be Determined.

BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) selected for a BMP plan should include water management, nutrient control practices, particulate matter and sediment controls, and pasture management (if applicable) to ensure control of different phosphorus species and transport mechanisms. This type of plan is referred to as a comprehensive BMP plan. Comprehensive BMP plans have been implemented in the EAA since the program's inception; however, they are not currently required by Rule 40E-63, F.A.C., in the C-139 basin, or by Rule 40E-61, F.A.C., in the Lake Okeechobee Basin.

Sometimes more emphasis may be warranted in a particular BMP category based on available water quality and quantity data. For example, based on water quality data analysis in the C-139 basin, total dissolved phosphorus (TDP), and specifically soluble reactive phosphorus (SRP) are present in high levels throughout some areas of the C-139 basin (CWF, 2007). SRP is typically related to inorganic soluble phosphorus sources such as fertilizers. It is apparent that some sort of nutrient control practices should be emphasized in every BMP plan for land uses where fertilizer is applied. However, in certain parts of the C-139 basin, and in different times of year, the species of phosphorus that is discharged may vary (i.e., particulate phosphorus). Therefore, it is important to have a balanced BMP plan where specific BMP types should be emphasized during different times of the year.

Nutrient Application Practices

Nutrient application practices refer to practices that improve nutrient application and minimize nutrient losses. **Table 2** indicates the equivalent points assigned to typical BMPs in this category. Some BMPs may be more applicable than other based on the characteristics of each farm, or urban area. The typical nutrient BMPs are presented side-by-side to facilitate comparison.

Table 2. BMP equivalents point table for nutrient control practices.

Nutrient BMPs					
Description	**Points**	**Description**	**Points**	**Description**	**Points**
Soil Testing	5	Vegetables: Successive Planting	2.5	Slow Release Fertilizer	5
Nutrient Application Control	2.5	Citrus (typical): Plant Tissue Analysis	2.5	Reduced Fertilization	5
Nutrient Spill Prevention	2.5	Sod (typical): Split Application	5	Pastures: No Nutrients Land applied	15

Soil testing requires that, prior to applying nutrients, growers obtain soil tests and develop recommendations that are crop and farm-specific. Growers follow those recommendations or explain the reasons for any deviations. Soil testing is essential in that it prevents over fertilization by determining nutrient plant requirements in addition to those provided by the soil. Application rates require technical justification and documentation to verify implementation. Yield response curves can be developed to justify application rates. In contrast, nutrient application control is based on the application method and guidelines followed during application (e.g., no overlapping application, canal setbacks). Nutrient spill prevention requires basic documentation of how fertilizer spills will be dealt with or prevented.

There are BMPs that are applicable to specific crops, such as split application in sod farms, or plant tissue analysis — which may occur in lieu of soil testing for citrus groves. Split application requires that nutrient application be divided into different applications to maximize uptake by the plant. Documentation similar to that collected for soil testing is required. There are multiple applications and costs associated with those activities. Slow-release fertilizers, which prevent losses by delivering the nutrients required as different stages of crop growth, serve the function of split application and are of greater cost than traditional fertilizers. Finally, BMPs that prevent import of phosphorus such as "no nutrients land applied," receive a high point equivalent, as they provide an ideal source control.

Water Management Practices

Water management BMPs refer to practices that improve drainage and irrigation management to minimize off site discharges. Water management practices are generally provided in accordance with approved surface water or Environmental Resource Permits (ERP). ERP-approved water management practices apply to both agricultural and non-agricultural operations (e.g., urban areas). The equivalent point system is based on the level of detention that is anticipated and the water management system that has been developed (operational and infrastructure) to ensure that water quality and quantity is provided. **Table 3** describes the points assigned to typical BMPs in this category. The typical BMP points are presented side-by-side to facilitate comparison.

Table 3. BMP equivalents point table for water management practices.

Water Management BMP Sub-Categories					
Canals and Soils	**Points**	**Infrastructure Improvements**	**Points**	**ERP Design Criteria**	**Points**
½-inch detained	5	Infrastructure improvements for recirculation	5	ERP approved and operational impoundment	35
1-inch detained	10	Reduced flow through water table management (irrigation)	5		
No direct discharge	15	Holding Pond	15		

For agricultural systems where runoff storage is provided in canals and soils, such as those with canals and no ERP-approved impoundment, detention is typically achieved by delaying discharge at pump structures. In these cases, providing 1 inch of detention is assumed to require closer attention to pump operation than a half inch (i.e., because of high ground water elevations and less water tolerant crops). To avoid over-drainage, permittees must provide start and stop pump elevations, conduct calculations to demonstrate storage is available, and implement internal water-table management to ensure storage is provided for day-to-day operation. A half inch of storage is generally provided with less effort because of the characteristics of the EAA. Additionally, equivalent points are provided to agricultural operations that have invested in infrastructure to enhance detention levels or reduce discharge (e.g., surface water impoundments, recirculation systems, or means to optimize drainage and irrigation schedules).

Water management systems designed, built, and operated in accordance with the most recent ERP design criteria (surface water impoundments), which discharge via gravity structures with set control elevations and that provide longer detention times, are assigned the highest level of equivalent points based on providing the greatest attenuation. However, high TP concentrations from the C-139 basin and increasing rainfall-runoff trends from the basin suggest that the equivalent points assigned need reexamination. As indicated above, the BMP plan development serves to set minimum requirements for improving water quality on individual farms so that achieving compliance with water quality requirements, at the basin level, is realized. Technical evaluation of existing water management practices is being considered, particularly in areas where lands are primarily drained by gravity with no control structures.

Particulate Matter and Sediment Control Practices

The purpose of sediment control BMPs is to prevent or minimize the transport of phosphorus off-site with sediments and particulate matter. The points assigned to sediment controls increase proportionally to the number of sediment controls selected. It is difficult to pinpoint the level of effort for the different sediment controls, as it generally varies from grower to grower based on farm needs (e.g., frequency and extent of canals cleaned). Sediment control examples are presented in **Table 4**.

Table 4. BMP equivalents point table for particulate matter and sediment controls.

Sediment Controls	Points	Examples
Any 2	2.5	Leveling fields
Any 4	5	Canal cleaning
Any 6	10	Vegetated berms
Any 8	15	Aquatic weed control
		Cover crops

For the EAA basin and for customized BMPs in the C-139 basin, District staff can evaluate the BMP equivalent points assigned to a specific BMP on a case-by-case basis and with adequate technical justification (e.g., level of effort and effectiveness) provide incentives for implementation. To this date, however, there have not been any requests for such evaluation. For instance, it appears that sediment controls to prevent particulate phosphorus transport due to biological material may require an additional level of effort compared to other sediment controls. Based on research conducted by the UF/IFAS, particulate phosphorus transport can be reduced by maintaining low canal velocities, longer pump periods, ensuring water level control (to prevent over-drainage) and aquatic weed control. Increased equivalent points for a biological sediment control package, including these individual practices, could provide an opportunity for optimization of this BMP.

DISCUSSION OF BMP PROGRAM EFFECTIVENESS

The effectiveness of BMP program implementation consists of verifying proper implementation of approved BMP plans and achieving phosphorus performance measures in terms of reducing phosphorus loads from an area. Although the BMP point system has been effective in establishing the grounds for an equivalent level of effort when implementing BMP plans in the Everglades, it is not a measure of BMP effectiveness. Through rule development and the supplementary projects described in Chapter 4 of this volume, District staff are conducting analyses and data collection necessary to refine the BMP program, so that phosphorus loading requirements are consistently achieved or improved upon. There are many challenges associated with pinpointing the effectiveness of individual BMPs and external factors. The proposed rule development approach in the C-139 and Lake Okeechobee basins include optimizing implementation of BMPs at the farm level.

Specific BMP implementation (methods, frequency, and rationale) and available farmwater quality and quantity data are reviewed with permittees at the time of site verifications, as an indicator of BMP Plan effectiveness. This evaluation is on a case-by-case basis. Specific BMP implementation in comparison to BMP technical datasheets as produced by the UF/IFAS and other technical sources is discussed with permittees. UF/IFAS also provides BMP workshops annually for EAA growers to provide training and updates on any new technical information. **Table 5** provides the list of grower attendees at Water Year 2007 (WY2007) (May 1, 2006–April 2007) and WY2008 workshops.

Table 5. Attendees at University of Florida Institute for Food and Agricultural Services (UF/IFAS) workshops in the EAA in Water Years 2007 and 2008.

Training Group	Date of Training	Number or Attendees
Open General BMP Training	October 12, 2006	43
U.S. Sugar	September 20, 2006	13
	September 28, 2006	7
Star Farms – Star Ranch	November 08, 2006	8
East Beach WCD East Shore WCD South Florida Conservancy District South Shore WCD Pelican Lake WCD	December 8, 2006	9
Hundley Farms	December 18, 2006	4
TKM - Bengard	January 10, 2007	33
Open General BMP Training	October 9, 2007	65
Okeelanta	September 26, 2007 September 26, 2007	23
U.S. Sugar	September 25, 2007	12
Sugar Farms Cooperative	December 12, 2007	18
	December 13, 2007	13

PERMIT RENEWALS

WOD permits are required to be renewed every five years, which provides for a concurrent basinwide evaluation of individual permit compliance. This is necessary because permittees are required to maintain compliance with BMP plan implementation, reporting, training, and administrative requirements in addition to complying with mandated phosphorus loading levels basinwide.

For instance, all EAA Everglades Works of the District (EWOD) permits were renewed during WY2008. The information evaluated as part of the renewal process included administrative information, such as permittee name and address, landowners, tax I.D. numbers, and acreages. Updating this administrative information on a regular basis is crucial in keeping an updated BMP program. Permit renewals are not the only time when permits are updated; permittees are also required to report any changes affecting their BMP plans or discharge monitoring plans, and to modify their permits if these changes occur before the permit renewal date.

For permit renewals, several steps are conducted. For instance, BMP plans are evaluated to ensure that they are current. Water management records, which are submitted periodically, are reviewed; permittees are required to provide additional information and modify their plans as necessary. Recent BMP verification reports and BMP annual reports are also reviewed to make sure that permittees are able to meet their BMP plans and that described land uses are accurate. Discharge monitoring plans are examined to make sure that the flow calibrations used to report water quantity data are correct and current. If there is missing data, problems with the discharge monitoring plans are identified and the landowner must correct them.

The EAA EWOD permit renewal process provides updates in all of the above areas for EAA permits, and ensures that BMP plans continue to be appropriate and effective. The next expiration date for EAA EWOD permits is June 30, 2012.

For the C-139 basin, the expiration date has been extended pending revision to the current 40E-63, F.A.C., rule section. For the Lake Okeechobee Basin, permits have been automatically renewed; however, this is an approach that is being reconsidered under the current rule. Renewal is relevant because permits are reissued to meet criteria current at the time of renewal, which may differ from that used for original approval. For basins where water quality problems are detected, adaptive management may involve creating stricter regulatory requirements for permit renewal.

ADAPTIVE MANAGEMENT APPROACH AND BMP OPTIMIZATION

The Everglades Forever Act (EFA) requires an "adaptive management approach including a process development and engineering component to identify and implement incremental optimization measures for further phosphorus reductions" as part of the Long-Term Plan [Chapter 373.4592(3)(b), F.S.] After six years of BMP implementation in the C-139 basin and 13 years in the EAA, much basin information has been gathered to improve the BMP program**.** As initial optimization of the current strategy, addressing the different phosphorous species and transport mechanisms is key. The traditional technical knowledge of BMPs needs to be expanded to assist growers with basin-specific implementation practices, and assessment timeframes need to allow for BMPs to translate into phosphorus loading reductions.

Additional research is necessary to determine BMP effectiveness in the C-139 basin, with the most apparent need being to understand factors affecting the effectiveness of above-ground surface water impoundments (AGI) to remove total phosphorus (TP) and, in particular, their effect on SRP which represents the largest fraction of phosphorus in the basin runoff. Also, it is known that the rainfall-runoff ratio in the C-139 basin has been increasing in recent years despite AGI construction. There are opportunities to optimize these existing BMPs to make them as effective additional requirements are mandated. **Figure 2** provides the conceptual framework for how BMP optimization is being proposed in the C-139 basin.

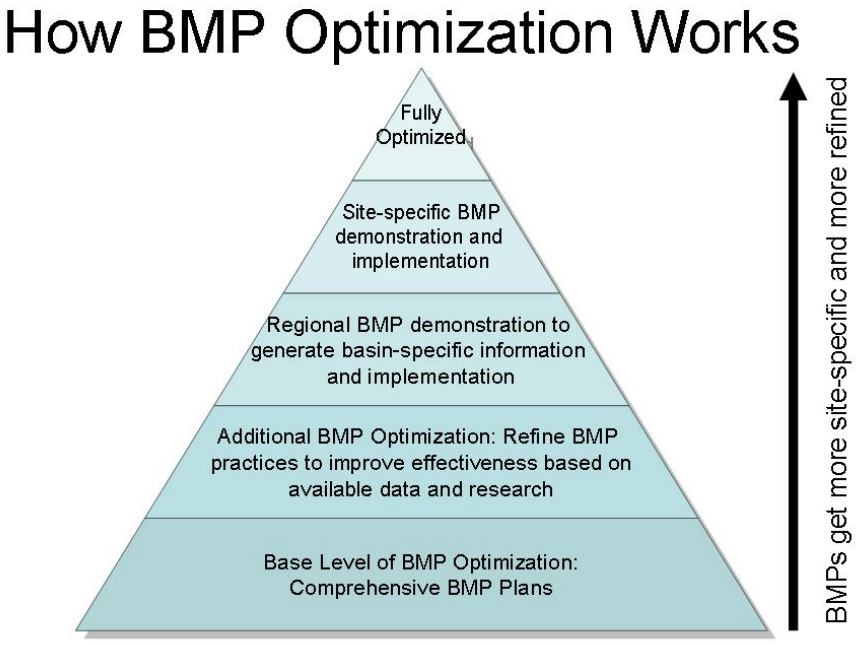

Figure 2. C-139 basin BMP optimization conceptual framework.

Similarly, the NEEPP requires that through a phased, comprehensive, and innovative approach, the Lake Okeechobee Watershed should meet the TMDL of 140 metric tons (mt) of TP established in Chapter 403-067, F.A.C., by January 1, 2015. The water quality component of the restoration plan includes nutrient source controls. The source control program to achieve this goal "shall be watershed based, shall provide for consideration of all water quality issues needed to meet the total maximum daily load, and shall include research and monitoring, development and implementation of best management practices, refinement of regulations of existing regulations, and structural and non-structural project, including public works." With the TP load average for the WY2004–WY2008 period being about three times higher than the proposed TMDL despite implementation of regulatory and voluntary incentive-based programs, it is apparent that careful consideration of source control program requirements is needed. Technical data resulting from BMP demonstration and evaluation projects within the Lake Okeechobee Watershed (see Chapter 10 of this volume) and other relevant analyses will be considered by the coordinating agencies for subsequent BMP optimization measures if water quality problems are detected from agricultural and non-agricultural sources despite adequate implementation of adopted BMPs.

Keys for successful BMP optimization require that technical documentation be developed and field verified through BMP demonstration and research, both at the regional level and on a site-specific basis. Continued extension and outreach to and among landowners and growers is crucial through distribution of available technical and research information. BMP optimization must also be based on results from an optimized water quality and quantity monitoring network and by targeting the BMPs that are designed to improve water quality for specific situations. **Figure 3** shows an example of a possible BMP optimization path for a surface water impoundment.

Concurrent with BMP optimization efforts, it is important that external factors beyond the reach of regulatory farm BMPs are understood and addressed. These can include historical accumulation of phosphorus in soils, limited runoff storage of basin works, or flood protection needs, or high-phosphorus water supply sources. These external factors may require regional solutions beyond the scope of farm-level BMP implementation. It is essential that a regulatory BMP program include a technical component for in-depth and updated understanding of hydrologic, water quality, agricultural, historic, regulatory conditions, flood control operations, and stormwater treatment projects that could effect discharge levels from the watershed. Effective adaptive management includes being able to discern these factors for a new perspective, adjusting the source control program, or adding coordination in light of new knowledge or conditions.

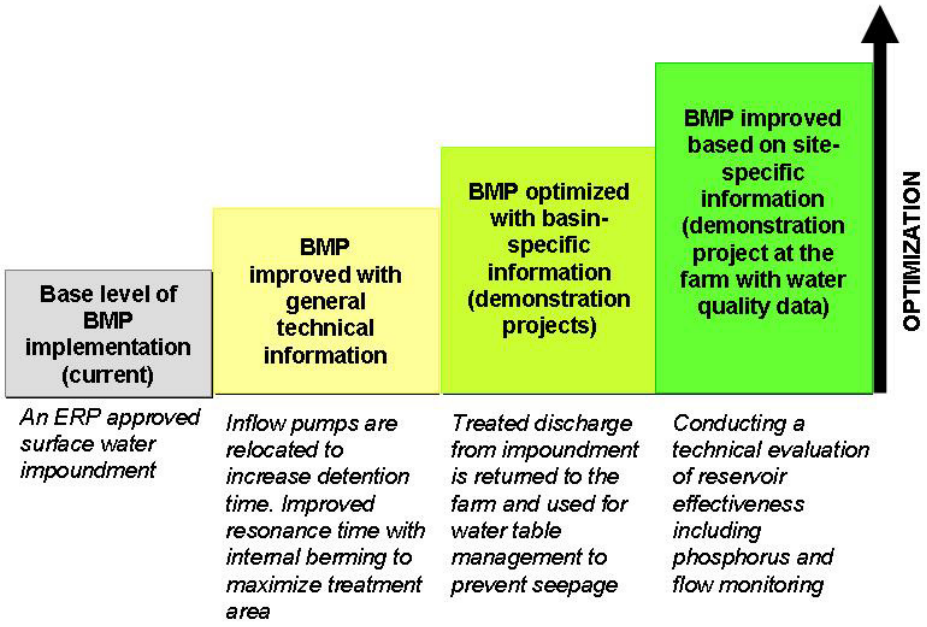

Figure 3. Example of BMP optimization for a surface water impoundment.

BMP Demonstration

BMP optimization consists of improving BMP implementation techniques or infrastructure towards maximizing the effectiveness of a farm BMP plan to reduce phosphorus in discharges. Development of demonstration projects for reducing phosphorus in farm discharges is needed to develop more effective implementation. This is consistent with Rule 40E-63, F.A.C., and current EFA requirements for the District to conduct research and testing of BMPs in cooperation with landowners. Demonstrating agricultural practices that will reduce phosphorus loading levels from C-139 basin farms is necessary to support the adaptive management approach because of the lack of technical documentation on demonstration projects for farms with similar soils, water management challenges, and agricultural practices.

In addition to the ongoing C-139 Basin Vegetable Production Demonstration Project to optimize phosphorus application rates in vegetable fields, a C-139 Basin BMP Demonstration and Effectiveness Grant (demonstration grant) is being established to begin during WY2009 to cost-share projects. The focus of the demonstration grant is on innovation or optimization of traditional BMPs that are presumed to be effective in removing phosphorus, focusing on implementation techniques that will result in the greatest water quality improvement under the basin-specific conditions. Funds will be used for the greatest basin-wide benefits. At the time this report was written, the District had identified the following priority topics for demonstration:

- Optimization of phosphorus application rates in vegetable, sugarcane, and citrus operations. The objective is to substantially reduce phosphorus applied in comparison to standard recommendations or industry standards.
- Improving phosphorus application practices and irrigation water management for vegetables (bedding methods, mulching, water table management) to prevent phosphorus losses.
- Defining feasible practices for mining or binding of phosphorus in sandy soils to prevent losses of historically accumulated phosphorus via runoff or seepage.
- Implementing comprehensive water conservation practices including improving water table management, employing low-volume irrigation practices, moisture sensors, seepage canals, improving design and construction of ditch and canal infrastructure, and tailwater recovery to minimize groundwater use and prevent unnecessary discharge to the District's canal system.
- Optimization of surface water impoundments to increase detention time and volume attenuation, reactive phosphorus uptake, and retention of sediment phosphorus.
- Effective control of aquatic weed vegetation control to prevent phosphorus-laden particulates, prevent the formation of high-phosphorus flocculants, and minimize SRP through timely removal of mature vegetation and adequate disposal.

Chapter 10 of this volume provides further information on BMP demonstration projects in the Lake Okechobee Watershed.

INTEGRATED REGULATORY INITIATIVES

Integrated regulatory initiatives are on going in all the basins in the Northern and Southern Everglades. Additional focus was placed on several basins due to newly identified water quality improvement needs, and the recognized importance of having properly implemented environmental resource permits and consumptive water use permits in meeting water quality goals. This section will highlight the integrated regulatory strategies in the C-139 basin, the Feeder Canal Basin, and the overall strategy in the Lake Okeechobee Watershed.

Integrated Regulatory Strategy in the C-139 Basin

The C-139 basin integrated permit compliance initiative was initiated with a landowner workshop on April 19, 2007. District staff introduced an integrated regulatory approach to achieve the water quality goals mandated by the EFA. In this regard, the District initiated review of Surface Water Management or Environmental Resource Permit (SWM/ERP) and Consumptive Water Use (CWU) authorizations in the basin to ensure that the water quality requirements of these permits are met, as they supplement the phosphorus control efforts of the EWOD authorizations. The total number of permits that have been issued in the C-139 basin that are subject to this effort are shown in **Table 6**. Properties were prioritized based on permittees' request for consultation, location, acreage, land use, water quality concerns (not in particular order). The evaluation of the properties generally consisted of review of all permits, consultation with permittees, request for submission of outstanding items or a timeline for addressing them. **Table 7** shows the summary of reviews conducted during WY2008.

Table 6. Permit summary for the C-139 basin.

EWOD		SWM/EPR		CWU
Permits	**Farm Basins**	**Permits**	**Applications**	**Permits**
33	56	40	>184	35

Table 7. Summary of permittees and acreage covered for integrated permit compliance initiative.

Review Status	Acreage	Number of Permittees Represented
One-on-one consultations were conducted and request for information sent	130,835 (79%)	14
Reviewed files for remaining consultations and ready to schedule meeting	3,332 (2%)	2
Total area reviewed	134,167 (81%)	16

Integrated Regulatory Strategy in the Feeder Canal Basin

The Integrated Permit Compliance efforts within the Feeder Canal Basin aim to ensure that landowners are in compliance with ERP, SWM, and Water Use permit requirements as well as requiring implementation of BMPs. This effort is similar to the effort being implemented in the C-139 basin. The effort was initiated with a landowner workshop held on February 22, 2007. During WY2008, the District conducted one-on-one consultations with landowners to ensure that they comply with these permits as well as to facilitate implementation of phosphorus source control BMPs. A total of seven one-on-one consultations were conducted with the landowner permittees that perform intensive row crop farming and citrus production within the basin. This represents approximately 31 percent of the total acreage in the basin (excluding the McDaniel Ranch area and the Seminole Tribe reservation area). Significant portions of the remaining acreage to be targeted consist of native, pasture, and federal conservation lands. **Table 8** shows the summary of reviews conducted in the West Feeder Canal sub-basin areas during WY2008.

Table 8. Summary of permittees and acreage covered for integrated permit compliance initiative.

Review Status	Acreage	Number of Permittees Represented
One-on-one consultations were conducted and request for information sent.	10,281 (32%)	7
Reviewed files for remaining consultations and meeting scheduling.	6,325 (20%)	4
Total Area Reviewed	16,606 (52%)	11

Integrated Regulatory Strategy in the Lake Okeechobee Watershed

The Lake Okeechobee source control staff coordinates permitting efforts with the ERP staff. Staff receives copies of applications received for ERPs within the current source control program boundary. These applications are discussed among staff at weekly staff project status meetings. If a Lake Okeechobee WOD source control permit or permit modification is also required, then staff coordinates that permitting is concurrent. Often, the BMPs proposed for the source control program include the proposed water management system that is regulated under the ERP.

The ERP review includes a requirement for landowners to submit a nutrient load analysis as part of the submittal process if there is a proposed change in land use and the property is located within the Lake Okeechobee Protection Program boundary. The District provides a phosphorus budget calculator on the District's ePermitting web site at www.sfwmd.gov, under the *What We Do, Permitting/Regulation* section (*E-permitting* tab), as an alternative for the permittee to use in providing a nutrient load analysis. The permittee must show that the proposed change will not increase the nutrient load over the existing load. This is required to demonstrate that there will be no further impairment to the downstream water body, Lake Okeechobee.

The ERP staff also reviews exemptions applications under Chapter 373.406 (9), F.S. These are for projects that have the primary purpose of environmental restoration. Most of these projects are for BMPs submitted through the FDACS BMP program.

SUMMARY OF IMPLEMENTATION STRATEGIES

There are differences and similarities among the regulatory source control programs for the Southern and Northern Everglades. The District is in the process of adjusting the control strategies for the basins that are not meeting performance measures. This occurs via rule development, supplemental projects, and interagency coordination to meet statutory obligations.

The basis for the BMP regulatory program is the implementation of a comprehensive array of BMPs to address different species of a nutrient or constituent (e.g., phosphorus, nitrogen, or floc) and transport mechanisms. The effectiveness of comprehensive BMP plans has been demonstrated at the basin level in the EAA. This concept is being expanded to the regulatory programs in the C-139 and Lake Okeechobee. BMP points are used to create an equitable level of effort among BMP plans, but they are not a measure of BMP performance. Understanding the performance of individual BMPs is needed when demonstrating improved implementation of BMPs for optimization. BMP performance during BMP demonstration is a useful relative indicator of water quality effects and can be used as a tool to reevaluate BMP requirements when water quality problems persist despite their implementation at a more basic level.

Defining the source control strategy for a basin implies using a common sense regulatory approach including periodical verification and documentation to ensure accountability (permit renewal, annual reporting, and field inspections). This is essential because effective BMP implementation requires day-to-day managing of BMP activities. Participation in demonstration projects is a very effective tool for BMP education and grower-to-grower dissemination might be the most trusted means for engaging the community in trying new practices.

There are other factors beyond those controllable by the regulatory BMP program, including basin characteristics, regional challenges, other regulatory mandates, and authorizations. Accurate measurement of performance in consideration of these conditions, reevaluation of strategies, and coordination with other entities are necessary elements of program success.