Lamb Island Dairy Remediation
Final Performance
Monitoring Plan
SFWMD Contract No. C-13410

HSA Project No. 8005.7106.00
October, 2004

LAMB ISLAND DAIRY REMEDIATION
FINAL PERFORMANCE MONITORING PLAN
Task 2.2 – SFWMD Contract No. C-13410
OCTOBER, 2004

Table of Contents

FIGURES

TABLES

APPENDICES

1.0 Glossary and Acronyms

Bion Corporation Bion worked extensively with dairy farmers in Florida and other States in developing treatment systems for dairy farm animal wastes. The typical Bion system was comprised of several serial gravity settling ponds followed a larger pond called the "eco-reactor" where coagulant salts (ferric or aluminum) were added to precipitate phosphorus with sufficient volume to allow the flocculated materials to settle and be retained.

EB Equipment Blank

ET Evapotranspiration

FCEB Field Cleaned Equipment Blank

FDEP Federal Department of Environmental Protection

HIA High intensity area – area where cows are held between milking. It was not an uncommon practice to have a density of 10 cows per acre in the HIAs.

HSA HSA Engineers & Scientists

LIMS Laboratory Information Management System

P Total phosphorus content as measured by EPA method 365.2.

RPD Relative Percent Difference

RS Replicate Sample

RSD Relative Standard Deviation

SOP Standard Operating Procedures

SFWMD South Florida Water Management District

SRP Soluble reactive phosphorus

Terrace Berm A shallow berm ranging from 6 to 12 inches above grade level intended to retain incremental amount of sheet flow storm water runoff on pasture lands.

TMDL Total Maximum Daily Load

2.0 Project Description

2.1 Introduction and background

The Lamb Island Dairy Site, also known as the former Ferrell Dairy, includes approximately 808 acres in the southeast corner of Section 36 of Township 35 South, Range 33 East and in the southwest corner of Section 31 of Township 35 South, Range 34 East of Okeechobee County, Florida. Between the years of 1982-1988 there were approximately 1000-1100 head of cattle on the property, both lactating and dry and there were approximately 800 head on the property from 1988 to 1994. The Site was acquired by the South Florida Water Management District (SFWMD) in 1994, in accordance with the Kissimmee River Restoration and Headwaters Revitalization Program to restore the historical river flood plains in the Cypress Slough. Per a lease agreement with the SFWMD, the previous property owner was allowed to keep beef animals on the property. All animals were removed from the Site in late 1998.

In 1990, Site dairy operations were required to be in accordance with the FDEP Dairy Rule, with a total P concentration discharge limit of 1.2 mg/L (ppm). A Works of District Permit was issued for the Site in 1997, with a lower discharge limit of 0.35 mg/L total P since the land had been converted to improved pasture (#47-00416-Q, SWET 2002). The Lake Okeechobee Protection Program has established a Total Maximum Daily Load (TMDL) of 154 tons (140 metric tons) per year for Lake Okeechobee. This relates to an in-lake concentration goal of 0.04 mg/L total P.

In 2000, Dames & Moore (D&M) conducted a waste management assessment (Dames & Moore 2000) on the Dairy including characterization of the serial waste storage ponds, the high intensity grazing and cow lounging areas (HIAs), and the treatment ponds. The primary phosphorus sources were identified as barn washwater, cow spray and runoff from the HIA and the perimeter dike. The D&M report includes a description of the Bion wastewater treatment system that was installed at the dairy. The Bion system included treating the animal wastes and rinsewaters from the Dairy barn into settling ponds and then adding iron salts before the “eco-reactor”, a large pond used for solids settling.

In 2003, HSA Engineers & Scientists (HSA) was retained by the (SFWMD) to implement remedial alternatives to minimize storm water phosphorus discharges from the Site. The implemented alternatives were intended to reduce P discharges to the maximum extent practicable while taking into consideration cost effectiveness as well as the minimization of long term operation and maintenance requirements.

Site construction occurred during the summer of 2004 and the following remedial measures were completed:

- As shown in **Figure 1**, construction of a surface water containment berm around the HIA (containing the high P soils) which allows gravity flow of

storm waters to the existing eco-reactor and swale. Biological (wetland) P uptake will occur in the eco-reactor cells as long as the area remains hydrated;

- Construction of a containment berm at the edge-of-farm to effect increased capture of pasture surface water runoff;
- Construction of terrace berms in the pasture runoff containment area;
- Construction of a wetland/marsh at the southern end of the pasture runoff containment area. Biological P uptake will occur in this area as long as the area remains hydrated;
- Alum amendment of the dairy wastes (residual manure solids) material contained in Ponds 1 and 2 leaving inactivated material in-place;
- Backfill Pond 1;
- Backfill Pond 2;
- Alum amendment of the impounded waters contained in the settling pond (Pond 3) and cooling pond to inactivate soluble phosphorus content; and,
- Dewatering and backfilling the onsite perimeter ditch.

The remedial design included collecting storm water runoff in two areas, (1) the high intensity area (HIA); and, (2) the outer pasture. An approximate 40-acre surface water containment area was created by constructing an earthen berm around the original HIA and other high-P soils. The HIA collection system design included using the existing berms on the north side of the eco-reactor. Ditches on the upstream side of the berm will convey the runoff by gravity to the eco-reactor.

Aside from the 40-acre collection system, the HIA containment area includes an additional estimated 21.5 acres of storage contained in the eco-reactor (~6.5 acres) and the existing swale (~15 acres) located downstream of the eco-reactor. Berms will be constructed on the south and east sides of the swale routing runoff to a discharge location at the southern end of the swale **(Figure 1)**.

An approximate 109-acre surface water containment area was created by constructing earthen berms along the eastern and southern sides of the property. Ditches on the upstream side of the berm will convey the runoff by gravity to a new discharge location on the south side of property (**Figure 1**). Ditches were also constructed on the upstream side of the containment berms to convey the runoff by gravity to the wetland/marsh at the southern end of the containment area.

Three terrace berms (6-12 inch berm height) were constructed across the pasture area as also shown in **(Figure 1)**. The terrace berms are designed to increase runoff retention, evapotranspiration (ET), and phosphorus uptake in the pasture area.

The cumulative runoff from the HIA will flow by gravity through the former eco-reactor and swale system via a series of metal culverts with riser inlets. Runoff from the HIA containment area will ultimately flow by gravity through a culvert at an existing discharge location and the outer pasture area runoff will ultimately flow by gravity through a culvert at a new discharge location (**Figure 1**).

Now that the P reduction treatment system has been built, the site will be monitored over a one year period under this contract to assess system performance relative to its effectiveness at reducing the phosphorus load of the storm waters. Based on a number of site conditions (*i.e.,* amount of rainfall, extent of vegetative cover on pastures, extent of periodic dry out in wetlands areas, etc.), HSA has estimated the edge of farm runoff total phosphorus discharge concentrations will range from 0.24 to 1.2 mg/L as P. This monitoring plan describes the materials and methods to be used to collect water samples and associated data in order to assess the effectiveness of the constructed phosphorus reduction remedial measures and to compare actual P removal to predicted levels developed from water quality modeling.

The guidance contained in this document will assist in maintaining consistency in sampling locations, parameter lists and frequencies as well as providing documentation of the project scope and an ongoing historical perspective.

2.2 Duration

2.21 Initiation Conditions

The monitoring described in this document will be initiated on approximately November 1, 2004, depending on the exact date that site construction is completed and based upon concurrence by the District project manager. Sampling will continue for one calendar year and a total of 15 sampling events will be completed during the year.

3.0 Geographic Location

3.1 Regional Area

Lamb Island Dairy is located approximately 12 miles north of the town of Okeechobee, Florida north of CR 68. **Figure 2** provides a regional map of the area and shows the location of the Lamb Island Dairy.

3.2 Sampling Locations

There are a total of seven water quality monitoring locations (six surface water and one shallow groundwater monitoring well) that will be used to supply data relative to this plan. The shallow groundwater well is 10 feet deep from the ground surface, and is a 1.5-inch diameter PVC well with four feet of slotted screen (0.010-inch slot size) at the bottom of the well. It was constructed to obtain shallow water table data. As some of these sampling sites are new due to the recent remedial construction activities, they have yet to have GPS coordinates defined. As part of the first sampling trip, the GPS coordinates of all six water quality sites will be obtained and the data provided in the first quarterly monitoring report. We will coordinate with the District Project Manager and make sure these sampling stations are being registered in the Laboratory Information Management System (LIMS) and DB Hydro database if deemed necessary by the District. The locations of all monitoring sites are depicted on the map in **Figure 1**.

3.3 Access and Authority

The HSA field team representatives will access the sites through the locked gates (combination locks) located on the western side of the property. The District retains ownership of this property and has granted HSA access to the site for the purposes of completing the remedial construction and post construction monitoring.

4.0 Data Quality Objectives

4.1 Data Uses, Resolutions, and Conclusions

As described in the introduction, the extent of phosphorus removal achieved by the newly constructed remedial systems will be evaluated. Influent and effluent total P content of the HIA runoff treatment system will be evaluated and the edge-of-farm runoff total P concentrations will also be assessed.

4.2 Data Quality

Data quality refers to the level of uncertainty associated with a particular data point or value. In most cases, data quality can be determined by calculating relative standard deviation (RSD) from replicate samples submitted to the same laboratory. The Laboratory to be used is US Biosystems Laboratory, a NELAC certified lab that also successfully participates in the FDEP CERP low phosphorus round robin. Replicate samples will be collected on a frequency of 10% of all samples collected on the site. Since a maximum of four samples will be collected each sampling event, one replicate sample will be collected whenever samples are obtained on the site during each sampling event. HSA recommends a relative percent difference (RPD) of <20% be applied when assessing replicate performance. A field blank will also be collected during each trip and the field blank will pass if the field blank result is less than 2 times the respective MDL.

4.3 Parameter and Frequency Rationale

Total P, soluble reactive P (SRP) and total aluminum will be collected quarterly from the onsite monitoring well shown in **Figure 1**. Monitoring well samples will be collected quarterly on or about the following days:

- November 15, 2004;
- February 15, 2004;
- May 15, 2005; and,
- August 15, 2005

Laboratory analysis of the groundwater samples from the monitoring well will help determine the amount of P leaching from Pond 3. In order to reduce the P content of Pond 3, alum was added to the pond. Monitoring data from the well adjacent to the pond will provide information related to the long term effectiveness of the pond water alum amendment remedial measure.

Total P samples will be collected when there is flow or no flow (standing water) associated with any of the six surface water sampling sites (see **Figure 1** for surface water sampling locations). Four of the 15 monitoring trips will be scheduled in advance and 11 of the trips will be reserved to respond to intense rainfall events in the area. District recording rainfall stations S-65C and S-65D are the closest District rainfall stations to the Lamb Island Dairy. For the 11 rain event driven sampling trips, the District's web site will be monitored and rainfall of one-half inch or more will trigger a sampling trip within 48 hours of occurrence. A maximum of 15 sampling trips will be completed during the monitoring period, with the trips being completed due to quarterly scheduled events, rainfall driven, or at the request of the District Project Manager. The minimum frequency of sequential sampling events will be one week.

The sixth surface water sampling location is the Pond 3 water column which will be collected quarterly at the same time as the monitoring sampling listed above. The quarterly samples will provide a record of the long-term effectiveness of alum amendments on the total P and SRP content of the pond waters.

4.4 Expected Levels and Concern Triggers

There are no trigger levels or target levels for the testing to be completed. The tests are being performed to determine the performance of the phosphorus reduction measures implemented. There are no trigger levels or target levels for the aluminum analyses as well. Aluminum is being measured to assess the soluble levels produced in nearby shallow groundwater related to post alum amendment of residual solids. Based upon the results of on-farm samples collected by HSA during 2003, the total P content of the feed to the HIA treatment system, or SW1, averaged 5.08 mg/l as P. The Final Detailed Design estimated the treatment system performance using varying runoff P concentrations (3.5 mg/L and 7.9 mg/L). Dependent on a number of site conditions encountered during each visit, (*i.e.,* amount of rainfall, extent of vegetative cover on pastures, extent of periodic dry out in wetlands areas, etc.) HSA has estimated the edge of farm runoff total P discharge concentrations (sample sites SW3 and SW5 are shown on **Figure 1**) will range from 0.24 to 1.2 mg/L as P.

5.0 Instrumentation

Sample collection will be performed in accordance with the Florida Department of Environmental Protection (FDEP) surface water sampling and groundwater sampling Standard Operation Procedures (SOPs) outlined in the FDEP QA001/01 and that are consistent with HSA's Quality System. Surface water samples will be collected using grab sampling techniques at a six inch depth by use of a dip pole or, if accessible, by directly dipping the sample into a clean, laboratory bottle. Monitoring well samples will be collected after purging the well with a peristaltic pump, in accordance with the FDEP groundwater SOP (FS2200), followed by filling the sample bottle directly from the peristaltic discharge stream. TP samples will be preserved with sulfuric acid to a pH of less than 2. Aluminum samples will be preserved with nitric acid to a pH of less than 2. Soluble reactive phosphorus samples will be field filtered through a 0.45

micron filter, cooled and submitted to laboratory unpreserved. Field filtered will be flushed with 250 ml of analyte free water prior to filtering the samples.

5.1 Stage

There is a total of 3 new staff gauges installed on the farm. During each of the 15 sampling trips, water levels will be measured at each of these gauges. The gauge locations are shown in **Figure 1** and include:

- **Gauge 1, Overflow culvert gauge**: Water level will be measured and compared to the elevation of the board setting in the bypass/overflow culvert (will be used to compute instantaneous flow and load calculations at the eco-reactor inflow);
- **Gauge 2, Off – farm discharge culvert adjacent to sampling station 3:** Water level will be measured and compared to the elevation of the board setting in the riser culvert; and,
- **Gauge 3, Off – farm discharge culvert adjacent to sampling station 5:** Water level will be measured and compared to the elevation of the board setting in the riser culvert.

5.2 Flow

At all 3 stage locations listed above, instantaneous flows, P loads and P load reductions will be computed based on the elevation of water above the top board setting in the respective riser culverts along with analytical phosphorus test results. The broad crested weir equation will be used to calculate flows at all of the stations and the methods of calculations and resulting flows will be supplied in the quarterly monitoring reports

5.3 Weather

Four of the 15 monitoring trips will be scheduled in advance and 11 of the trips will be reserved to respond to intense rainfall events in the area. District recording rainfall stations S-65C and S-65D are the closest District rainfall stations to the Lamb Island Dairy. For the rain event driven sampling trips, the District's web site will be monitored and rainfall of one-half inch or more will trigger a sampling trip within 48 hours of occurrence.

6.0 Monitoring Parameters, Detection Limits, and Completeness Target.

The analytical results obtained during each sampling event will be supplied to the District project manager who will in turn make sure the information will be subsequently registered in a LIMS compatible format (i.e., MS Excel spreadsheet). This process aids in the creation of chain of custody sheets, quality assurance and determining completeness. Completeness is defined as the usable data obtained compared to amount expected to have been collected (takes into account samples or data that did not meet the specified DQO). As the number of samples collected in grab is totally dependent on rainfall and amount of storm water flow observed at the

site, assigning a specific threshold for completeness is difficult however a realistic goal for project completeness is 75 %.

Samples will be collected in accordance with the FDEP Quality Assurance Rule, Chapter 62-160.210 F.A.C., the associated FDEP SOPs, and HSA's Quality Manual.

6.1 Surface Water

The site will be monitored over a one year period under this contract to assess system performance relative to its effectiveness at reducing the phosphorus load of the storm waters. Based on a number of site conditions (*i.e.,* amount of rainfall, extent of vegetative cover on pastures, extent of periodic dry out in wetlands areas, etc.), HSA has estimated the edge of farm runoff total P discharge concentrations to range from 0.24 to 1.2 mg/L as P. The surface water samples will be collected in order to assess the effectiveness of the constructed phosphorus reduction remedial measures to reduce the P content of off-farm surface water discharges.

Total P samples will be collected when there is flow or no flow (standing water) associated with any of the six surface water sampling sites (see **Figure 1** for surface water sampling locations). Four of the 15 monitoring trips will be scheduled in advance and 11 of the trips will be reserved to respond to intense rainfall events in the area. District recording rainfall stations SC65C and SC65D are the closest District rainfall stations to the former Lamb Island Dairy. For the 11 rain event driven sampling trips, the District's web site will be monitored and rainfall of one-half inch or more will trigger a sampling trip within 48 hours of occurrence. These rainfall driven trips are anticipated to occur during the rainy season in the summer of 2005 but a major frontal system during the winter months could also trigger a sampling event. A maximum of 15 sampling trips will be completed during the monitoring period, with the trips being completed due to quarterly scheduled events, rainfall driven, or at the request of the District Project Manager. The minimum frequency of sequential sampling events will be one week.

6.1.1 Grab Samples

Sample collection will be performed in accordance with the FDEP surface water sampling (FS 2100) and groundwater sampling SOPs (i.e., FS 2200) and in accordance with the HSA Quality System guidelines per FA 3300. Surface water samples will be collected using grab sampling techniques by use of a dip pole or, if accessible, by directly dipping the sample into a clean, laboratory bottle. Monitoring well grab samples will be collected after purging the well with a peristaltic pump, in accordance with the FDEP groundwater SOP (FS 2200), followed by filling the sample bottle directly from the peristaltic pump discharge stream.

6.1.1.1 Parameters

Total P (holding time of 28 days) and SRP (holding time of 48 hours) will be analyzed in surface water samples and a reporting limit of 10 ppb will be used. USEPA method 365.2 will be used as the method of analysis. USEPA method 3010A/200.8 will be used as the method of analysis for total aluminum, with a

reporting limit of 20 ppb. One out of every ten samples will be collected in duplicate however at a minimum, at least one duplicate will be collected each sampling trip. Precision of 20 % RPD or less will be the project target. The laboratory will analyze and report spike recoveries on a one out of 20 sample basis and an acceptable spike recovery range will be between 90 to 110 percent.

6.2 Groundwater

Samples from the on-Site monitoring well will be collected on a quarterly basis to assess the water table groundwater quality adjacent to Pond 3. The monitoring well location is provided in **Figure 1**.

Monitoring well samples will be collected after purging the well with a peristaltic pump, in accordance with the FDEP groundwater SOP (FS 2200), followed by filling the sample bottle directly from the peristaltic pump discharge stream. Field parameters will be tested using one of the meters provided in **Table 1**. Since we do not know, at the present time, which piece of equipment will be available, we can only say that the appropriate equipment for pH, turbidity, conductivity and dissolved oxygen will be used from our **Table 1** list. Field calibration will be performed in accordance with instrument manufacturer's recommendations and in accordance with SOP numbers FT1000 -- FT600.

Total P will be analyzed in the groundwater samples and a reporting limit of 10 ppb will be used. USEPA method 365.2 will be used as the method of analysis. One out of every ten samples will be collected in duplicate. Total aluminum will be analyzed in the groundwater samples and a reporting limit of 20 ppb will be used. USEPA method 3010A/200.8 will be used as the method of analysis. Precision of 20 % RPD or less will be the project target. The laboratory will analyze and report spike recoveries on a one out of ten sample basis and an acceptable spike recovery range will be between 90 to 110 percent.

7.0 Quality Control and Custody

7.1 Ethics

Every person performing field sampling will commit to following project specific requirements, field SOPs, HSA Quality System guidelines and other instructions as issued, to ensure that samples collected are of acceptable quality and legally defensible.

7.2 Quality Control Samples

For each sample collection trip, a field cleaned equipment blank (FCEB) will be collected. At a minimum, one equipment blank (EB) and one replicate sample (RS) will be collected quarterly. These quality control terms are defined as follows:

- **Equipment Blank (EB)** - A sample composed of deionized water (one liter or enough to fill one set of all containers) that is used to rinse all sampling equipment at the first field site before a field sample is taken. At a minimum,

one EB will be collected quarterly. Equipment blanks are prepared by pouring deionized water into the sample collection container and through each piece of sampling equipment.

- **Replicate Sample (RS)** - Two distinct samples collected nearly simultaneously from the same sampling site. A minimum of one RS sample will be collected quarterly from one location per project. Note: RS is collected for grab samples only.

- **Field Cleaned Equipment Blank (FCEB)** – Field cleaned equipment blanks are prepared by pouring deionized water through each piece of field cleaned sampling equipment and into the sample container. The field-cleaned equipment blank for grab samples is filtered, preserved and handled as a routine sample.

7.3 Documentation

This section contains the minimum guidelines and requirements for field documentation which meets FDEP SOP and HSA Quality System guidelines. This section is written for the purpose of standardizing the field reportable data and dialogue so that the intermediate-users and end-users can more readily access, comprehend and utilize that data. Field documentation must be sufficient and clear to allow history tracking for any sample collected or any measurement performed. Accuracy, consistency and legibility are key factors that will enhance the utilization of the field data. For all documents the following standards will apply:

- Print text, do not use cursive;
- Dates will be recorded as MM/DD/YYYY;
- Time will be recorded in 24 hour format using local time;
- Flow or no flow conditions documented;
- Logs and notes will be recorded on site and at the time of collection in the standard HSA bound field notebook;
- Entries are to be made in waterproof ink; and,
- Samplers must be registered in the appropriate database (District project manager to assist with this requirement).

7.3.1 Chain of Custody

The chain of custody will accompany all samples submitted to the contract laboratory. This form must be legible, accurate and complete. The chain of custody is the primary source for the minimum data required to uniquely identify samples for the analytical laboratory and database. The chain of custody sheets used on this project will identify project, collectors, sample matrix, collection agency, sample Identification number, sample site, sample date, sample time, sample type and collection method. Also contained on the chain of custody sheet are the parameters to be analyzed and the number of bottles submitted to the laboratory. The chain of custody will be signed by the collector before it is relinquished to the laboratory.

7.3.2 Field Notes

Relevant field observations are noted in a bound waterproof notebook that is project specific. Information to be entered into the field notes include project name, frequency, trip type, date, collectors, responsibilities, weather, acids, labs being submitted to, sample id, site id, time collected, water depth, flow or no flow conditions, sampling equipment and sample type. A specific field notebook will be prepared for this project that contains text prompts for all of the required field data. This project specific field notebook will then become the permanent record of field activities for the monitoring program. Copies of the field notes will be supplied to the District project manager by the end of the following business day. Original field notes will be submitted to the District at the end of the project.

7.3.3 Field Data Validation and Responsibilities

All staff associated with the project is responsible for ensuring the accuracy and completeness of data.

7.3.3.1 By Sampling Team

The sample team will review and validate the sampling data collected during the course of the sampling event. This includes chain of custody forms, calibration verification information and field notes. Signature by the samplers indicates the data has been reviewed and validated.

7.3.3.2 By Laboratory

In the process of entering the chain of custody data into the database, the laboratory will review the data for completeness and accuracy. Incomplete or inaccurate data may result in the inability to enter data, or may result in flagging the data as suspect or may require further corrective actions.

7.3.3.3 By Field Project Manager

It is the field project manager's responsibility to review chain of custody sheets, field notes, and calibration sheets as well as the entry of these items into the database.

7.3.4 Corrections

If sample collectors, the laboratory, or the project manager discover errors in any of the field notes, custody sheets, or calibration sheets, corrections may be required. Corrections to custody sheets or field notes may only be made by staff who participated in the production of the document. Changes are made by striking through the error, writing the correction, initialing and dating the change. On occasion, a detailed explanation of the error may be required. HSA's project quality assurance manager, Tom Emenhiser will initiate corrective actions including better field notes, corrections to field meter calibration procedures, corrections to field preservation techniques, etc.

7.4 Sample Submission

Samples will be transported on wet ice at 4^{o} Celsius to the laboratory for analysis. Samples will be submitted to the laboratory on the same day as collection or via courier the following day.

7.5 Field Audits

One internal field audit will be conducted during the one year sampling program. The field audit will be performed using the template provided in **Appendix 1** and will be conducted by Mr. Tom Emenhiser, the District's contract field sampling auditor for six years and manager of HSA's West Palm Beach Office. HSA will submit to an external audit if requested by the District PM and respond to any identified deficiencies.

7.5.1 Audit Reports, Corrective Actions, and Responses

Findings of the audit and corresponding corrective actions will summarized on the audit report shown in **Appendix 1** and will be discussed with the field manager and the project manager.

8.0 Quality Assurance and Data Management

After the data validation process is completed, all data will be maintained in HSA's electronic project data file on the office server so that end users can retrieve and review all information relative to a sampling event. All analytical data and field conditions will be retained in the HSA files for a minimum of five years after project completion.

HSA will maintain records of field notes and copies of all records relative to the chain of custody and analytical data.

9.0 Project Reporting

Quarterly reports, prepared in District electronic data base compatible formats, will be prepared during the year of sampling and site monitoring and will include the following information:

- A tabular summary of samples collected and the laboratory test results. Included in this summary will be the date of collection, weather conditions and any site specific information impacting the sampling results;
- A summary table showing the water level elevations recorded during each monthly visit;
- Using the broad crested weir equation, flows will be computed and reported based on the water level data obtained;
- All data relevant to P load reduction estimates;
- A summary of QA/QC data and all information on precision, accuracy completeness, related to the samples will be summarized;
- A summary of equipment blank results; and,
- Report findings, conclusions and recommendations.

10.0 Project Contacts and Responsibilities

10.1 Project Manager

Mr. Jim Laing is the District's project manager and HSA's project manager is Mr. Terry Horan. Mr. Horan can be reached at the HSA West Palm Beach office at 1486-A Skees Road, West Palm Beach, Florida. Mr. Horan's telephone number is (561) 688-9008 and his e-mail address is thoran@hsa-env.com. US Biosystems, FDOH# E86240, will be the analyzing laboratory and may be contacted at (561) 447-7373. This project is not being managed by a Contract Manager.

10.2 Field Project Manager and Leader

The field project manager for this project is Mr. Ron Durham and he is also located in the HSA West Palm Beach Office. The field project manager is responsible for maintaining this document and making sure that any changes are well documented and communicated to the field staff and other parties as necessary. Mr. Durham's e-mail address is rdurham@hsa-env.com.

10.3 Analytical Lead/Contract Manager

Mr. Jim Laing (561 682-6667) will take the lead for the District and designate other District employees as necessary.

10.4 HSA Quality Assurance Lead

Mr. Tom Emenhiser, also of HSA's West Palm Beach Office, will lead the quality assurance efforts on this project and will conduct the field audit described above.

10.5 Reporting Lead

Mr. Terry Horan will be responsible for preparing the quarterly monitoring reports and Mr. Jim Laing will be the District's contact point to receive and review the submittals.

11.0 Revisions and Modifications

[This section is left for future changes as they are made and should be referenced throughout the document as revisions occur. Sections should be added chronologically. As revisions are made a note should be made in the corresponding section of the plan.

FINAL

Monitoring Plan

For

Lamb Island Dairy Remediation

_____

Ron Durham, HSA Field Project Manager Date

_____

Terry Horan, HSA Project Manager Date

_____

Tom Emenhiser, HSA Project QA Manager Date

_____

Jim Laing, SFWMD Project Manager Date

FIGURES

GW Monitoring Well

SW6

Culvert

Culvert

Staff Gauge
No. 1

HIA Containment Berm

SW1

Overflow Culvert

Eco-Reactor

SW2

Culvert

Terrace Berm

Terrace Berm

Edge of Farm
Containment
Berm

Staff Gauge
No. 2

Discharge
Culvert

SW3

SW4

Terrace Berm

Staff Gauge No. 3

Discharge Culvert

SW5

North

Scale: 1" = 500'

Figure 1 Site Plan and Monitoring Stations

LEGEND

SW5 Surface Water Sampling Location

Surface Water Flow Direction

Alum Amended Pond Waters

Pond 1 & 2 Backfilled With Soil
After Alum Amending Animal
Wastes

Culvert

TABLES

Table 1
Testing and Sampling Equipment

Item	Manufacturer/Model #	Calibration	Uses
Multi parameter Probe	YSI/Model 556	each use - per manufacture/SOPs	pH, ORP, Conductivity, Temperature, and Dissolved Oxygen Monitoring and data logging capability.
Multi parameter Probe	Insitu/ Troll 9000	each use - per manufacture/SOPs	pH, ORP, Conductivity, Temperature, and Dissolved Oxygen Monitoring and data logging capability.
Turbidimeter	Hach/ Model 2100P	each use - per manufacture/SOPs	Turbidity Monitoring
Depth to water probe	Solinst/ Model 101	N/A	Water Level Measurement

APPENDICES

FIELD AUDIT

Status And Temporal Variability Monitoring Networks
Florida Department of Environmental Protection
MS 3525
2600 Blair Stone Road
Tallahassee, Fl 32399-2400
Telephone (850) 245-8517

Sampling Agency:
Field Personnel:
Auditor(S):
Audit Date:
Project Name:
Site:
Audit Type:
Copies of Audit Report to:
Overall Sampling Performance

SUMMARY

Documentation (FD1000)	Yes	No	NA
1. Used waterproof ink and corrected errors without obliteration			
2. Described sampling location (Lat/Long, Map, Photos)			
3. Recorded preservation information and verification if different from sampling manual			
4. Labeled sample bottles properly (bar codes, date, time)			
5. All sections of field sheet completed correctly, including Ground Water: purging equipment; purging procedure; well casing compositions; well diameter; water table depth; depth of well; volume of water in well; purge volume calculations; total volume of water purged; date; starting and ending times for purging; purging rate; flow meter readings; stabilization measurements; water level drawdown measurements; FLUWID, Microland use Surface Water: total depth; secchi depth, field measurements; weather conditions; equipment used Sediments: sample collection depth; areal location of sample; sample collection devices Biology: physical and chemical characterization information; stream or river habitat assessment information; lake habitat assessment information; biorecon information			
6. Instrument calibration log: • Unique ID for meter • Standards concentration, date of preparation or expiration date • Date, time and results of each initial calibration and calibration verifications (link to sampling project) • Name of analyst performing verification • Corrective actions performed on instrument			
7. Custody sheet completed properly (date, time, sites, number of samples, comments, labels)			
8. Cleaning log: • Type and date of analyte free water • Time and date of lab cleaning • Time and date of field cleaning			
9. Lot numbers and dates of use recorded for all reagents, detergents, solvents, and chemicals			
10. All instruments and sampling equipment identified with a unique code, and including: • Maintenance and repair procedures • Routine cleaning procedures • Filling solution replacement for probes • Parts replacements for probes • Date procedures performed on each unit • Names of personnel performing maintenance and repair • Descriptions of malfunctions and repair			

***COMMENTS:**

Field Quality Control (FQ 1000)	Yes	No	NA
1. Blank collected in same manner as samples and represent normal sampling conditions. Circle one: a) Precleaned EB b) Field cleaned EB c) Field blank (no equipment)			
2. Field reference samples were analyzed under field conditions and were acceptable			

Field Testing and Calibration (FT 1000 - FT 1600)	Yes	No	NA
1. Sample measurements were chronologically bracketed between acceptable calibration verifications			
2. Sample measurements were quantitatively bracketed between acceptable calibration verifications			
3. Meter was rinsed with DI water between standards and allowed to stabilize before recording readings			
4. pH was calibrated first with the 7 buffer, then a 4 or 10, depending on the expected sample range			
5. Calibration verifications for pH were within ±0.2 su			
6. Meter was checked weekly to ensure a $\geq$ 90% theoretical slope			
7. Calibration verifications for conductance were within ± 5%			
8. Calibration verifications for DO were within ± 0.3 mg/L DO when compared to the table of theoretical values for water saturated air			
9. DO electrode was stored in a water saturated air environment when not in use			
10. Initial calibration of turbidimeter was performed using primary standards and met acceptance criteria for NTU range			
11. Sample cells were inspected for scratches, cleaned as necessary and placed correctly in turbidimeter			
12. Sample cells were rinsed between calibrations and sample collections			
13. Temperature was verified monthly at a minimum of two temperatures and met acceptance criteria of ±0.2 ℃			
14. Sample measurements were not collected until meter readings stabilized			

***COMMENTS:**

General Sampling Procedures (FS 1000, FS 2000), Miscellaneous	Yes	No	NA
1. Paperwork, supplies and equipment were inventoried before going into the field			
2. Sampling manual was in the field vehicle			
3. Sampling equipment and bottles were clean and appropriate			
4. Analyte free water was less than 1 week old			
5. Samples were collected in a logical order			
6. Care was taken to avoid contamination of samples			
7. Samplers wore gloves and changed as necessary			
8. Samples were properly preserved within 15 minutes			
9. pH was tested on preserved samples; paper was not inserted into bottle			
10. Samples were properly filtered if necessary			
11. Headspace was left in all sample bottles and whirlpaks			
12. Samples were packed properly • Bacteria whirlpaks packed together in bag • Acidified sample bottles packed separately • All samples placed together in large bag, protected from ice • Custody sheet completed, bagged and placed in cooler			
13. At least one sampler on site has attended Sampler Training Workshop			

Surface Water Sampling (FS 2100)	Yes	No	NA
1. Samples were collected from downstream to upstream and upwind from power sources			
2. Samples were collected on upstream side of bridge, body or boat without disturbing the sediments			
3. Water samples were collected prior to sediment samples (if any)			
4. Intermediate collections devices were well rinsed with sample water; rinse water was discarded away from sample site			
5. Whirlpaks were collected as grab samples by immersing the closed Whirlpak and opening it underwater; OR an open whirlpak was plunged opening downward below the surface and filled in a continuous sweeping arc; OR collected from an intermediate collection device without interruption of the flow			
6. Sample containers were submerged neck first, inverted into flow, slowly filled and returned to surface (if sample containers were used as collection device)			
7. Field parameters were measured at appropriate depth(s)			
8. Water depth was at least 10 cm			
9. Water samples were collected at the appropriate depth and corresponded with field parameter measurement depth			
10. Sample was collected at correct location in waterbody			
11. Depth was measured to nearest 0.1m			
12. Secchi depth and stage height were determined if appropriate			

***COMMENTS:**

Sediment Sampling (FS 4000)	Yes	No	NA
1. Lake was at least 1m deep at its deepest point			
2. Samples were collected in the proper location			
3. Surface water samples were collected prior to sediment samples			
4. A minimum of 3 grabs were collected			
5. Only the top 2-3cm of sediments were transferred to the sample jar			
6. Sample jar was filled ¾ full			

Groundwater Sampling (FS 2200)	Yes	No	NA
1. Any standing water was removed from well head			
2. Water level was measured to nearest 0.01 ft without sounding the bottom			
3. Well volume was correctly determined			
4. Depth to water was measured at intervals during purging; drawdown was stabilized so pumping rate matched recharge rate			
5. Pump or tubing was placed at top of water column			
6. A closed flow cell was used to measure stabilization			
7. At least one well volume was purged before beginning purge stabilization measurements and at least ¼ well volume was purged between measurements			
8. Purging completion was measured as: • DO = 20%. If DO = 20%, reasons were justified and consecutive measurements were within the greater of ± 0.2 mg/L or 10% • Turbidity = 20 NTU. If turbidity = 20 NTU, reasons were justified and consecutive measurements were within the greater of ± 5NTU or 10% And at least three consecutive measurements of following parameters were within stated limits: • temperature ± 0.2° C • pH ± 0.2 su • specific conductance ± 5.0% of reading			
9. If well failed to meet stabilization criteria after 5 well volumes, all instruments, equipment, tubing, etc. were tested and found functional before collecting sample			
10. Low permeability well was purged at low flow rate. If well purged dry, well was allowed to recover then sample was collected.			
11. Pump and tubing decontaminated between wells.			
12. A new filter was flushed with sample water before collecting filtered samples.			
13. For wells with in-place plumbing, purging and sampling was upstream of storage tanks where possible			
14. For wells with in-place plumbing, flow rate was reduced to less than 500mL/minute (1/8" stream) or 0.1 gal/min before collecting samples			

***COMMENTS:**