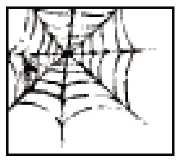
Archived Publication

This information provided in this document is for reference. Please be aware that the information in this document may be outdated or superseded by additional information.



EPA promulgated regulations for Concentrated Animal Feeding Operations (CAFOs) in February 12, 2003 that expanded the number of operations covered by the CAFO regulations and included requirements to address the land application of manure from CAFOs. The rule became effective on April 14, 2003. NPDES-authorized states were required to modify their programs by February 2005 and develop state technical standards for nutrient management. On February 28, 2005, in response to litigation brought by various organizations, the Second Circuit court issued its decision in *Waterkeeper Alliance et al. v. EPA*, 399 F.3d 486 (2d Cir. 2005). EPA has updated the CAFO rule to reflect the changes requested by the Court. Visit www.epa.gov/npdes/caforule to view the 2008 CAFO Final Rule and supporting documents.

Tables

Figures

CHAPTER 5: VOLUNTARY PERFORMANCE STANDARDS FOR CAFOS

The examples contained in this chapter are for informative purposes only. The examples assume, but do not guarantee, that the CAFO meets all applicable federal, state, and local requirements.

EPA's long-term vision for CAFOs includes continuing research and progress toward environmental improvement. Currently, CAFOs, USDA, land grant universities, state agencies, equipment vendors, and other agricultural organizations, are working to develop new technologies to reduce: nutrient, pathogen, and other pollutant losses to surface water; ammonia and other air emissions; and groundwater contamination from animal manure. In the future, as these technologies are developed and improved, EPA believes that they may offer CAFOs the potential to match or surpass the pollutant reduction achieved by complying with the current requirements. At that time, EPA believes that some CAFOs will voluntarily develop and install new technologies and management practices equal to or better than the current requirements described in Chapter 2 of this manual in exchange for being allowed to discharge the treated effluent. (For the purposes of this chapter, the current technology controls required under the CAFO ELG described in Chapter 2 will be referred hereafter as the "baseline" technology requirements.) This is why EPA has created the *voluntary performance standards program* for CAFOs.

The *voluntary superior environmental performance standards* provision in 40 CFR 412.46(d) is available to new source Large CAFOs subject to 40 CFR Part 412, Subpart D (swine, poultry, and veal calves). This provision provides that these CAFOs may request from the Director alternative NPDES permit effluent limitations based upon a demonstration by the CAFO that site-specific innovative technologies will achieve overall environmental performance across all media that is equal to or superior to the reductions achieved by the baseline standards as provided by 412.46(a), which contains the Subpart D, new source CAFO production areas stadards. This chapter does not address the *voluntary superior environmental performance standards* for new swine, poultry, and veal CAFOs.

The remainder of this chapter presents an overview of the baseline requirements and the *voluntary performance standards program* which includes a description of who can participate in the program and how participation in the program will impact existing CAFO NPDES permits, as well as a step-by-step description of the requirements associated with participation in the program.

A. Overview of the Baseline Requirements

As described in Chapter 2, the baseline production area requirements for all existing beef, dairy, heifer, veal, swine, and poultry CAFOs are the same. However, baseline requirements vary for new operations. A summary of the requirements is presented in Table 5-1.

Table 5-1. Summary Description of Baseline Requirements

Existing and New Large Beef, Dairy, Heifer and Existing Large Swine, Poultry and Veal CAFOs
1. Baseline requirements prohibit the discharge of manure and process wastewaters. 2. A CAFO may discharge when rainfall events cause an overflow from a storage structure designed, constructed, operated and maintained to contain the following: • All manure, litter, and all process wastewaters including manure, wastewater, and other wastes accumulated during the storage period as reflected by the design storage volume (see Chapter 2 section B.1 of this document); • Direct precipitation from a 25-year, 24-hour rainfall event; and • Associated runoff from a 25-year, 24-hour rainfall event.

B. Overview of the Voluntary Performance Standards Program

Program Benefits

CAFOs are expected to derive substantial benefits from participating in this program, through greater flexibility in operation, increased good will of neighbors, reduced odor emissions, potentially lower costs, and overall improved environmental stewardship. EPA is considering other possible incentives to encourage participation in this program.

Under the voluntary performance standards program, existing and new Large beef, heifer, and dairy CAFOs and existing Large swine, poultry, and veal CAFOs are allowed to discharge process wastewater that have been treated by technologies that the CAFO demonstrates results in equivalent or better pollutant removals from the production area than would otherwise be achieved by the baseline requirements. Some CAFOs already achieve zero discharge and, in a few cases, will successfully demonstrate "no potential to discharge." This approach focuses on waste-generating operations, plus areas that have the potential to produce significant volumes of contaminated runoff such as freestall barn and yard areas, holding areas around milking centers, and unroofed feedlots. Although these voluntary programs are targeted toward the CAFO's wastewater discharges, EPA encourages operations electing to participate in the program to consider environmental releases holistically, including opportunities to lower releases to multiple environmental media.

1. Program Participation

All CAFOs electing to participate in the program should have a good compliance history (e.g., no ongoing violations of existing permit standards or history of significant noncompliance). In most cases, participation will result in an individual NPDES permit addressing the site-specific nature of the alternative technology and establishing site-specific discharge limitations.

2. Pollutants of Concern

In general, all CAFOs applying for the voluntary performance standards program must design the treatment technology to achieve equal or less quantities of BOD_5, total nitrogen (ammonia, nitrite/nitrate, and organic nitrogen), total phosphorous, and total suspended solids than the baseline system. EPA selected these parameters because of their high concentrations in manure-type waste streams and their impact on surface water quality if not treated. In addition, many conventional wastewater treatment technologies, in the process of treating these four selected pollutants, will result in treatment and removal of other pollutants. To qualify for voluntary alternative performance standards, the CAFO may also be required to remove other specific pollutants, such as pathogens and metals, if these pollutants are present in the waste stream at concentrations that may impact surface water quality, as determined appropriate by the permitting authority.

3. Required Technical Analysis

CAFOs requesting site-specific effluent limitations to be included in NPDES permits must submit a supporting technical analysis and any other relevant information and data that would support such site-specific effluent limitations. See section C of this chapter for more information.

4. Validation of Equivalent Pollutant Reductions

The CAFO must attain the limitations and requirements of a permit based on alternative technologies as of the date of permit coverage (40 CFR 412.31(a)(3). In the event these alternative limits will not be met as of the date of permit coverage, such as due to startup of certain wastewater treatment technologies, the permitting authority would need to incorporate a compliance schedule into an enforceable order that would establish milestones for implementing the alternative technologies and fully meeting the permit limitations. The permitting authority should consider whether it is appropriate to select a permit term that is less than five years to allow the permitting authority to evaluate whether the alternative technologies have resulted in the permit limitations being met.

If the permitting authority grants a request for voluntary alternative performance standards, the CAFO should, at a minimum, be required to take monthly effluent samples from the treatment system to verify continued permit compliance. The permitting authority may determine the CAFO must take more frequent samples (such as during start-up) or collect samples on a basis other than monthly (such as during all discharge events in the case of intermittent discharging technologies). CAFOs should be required to analyze for the following pollutants: BOD_5, total nitrogen, total phosphorous, and suspended solids. The permitting authority may also require a CAFO to monitor other pollutants on a regular basis. If monthly pollutant discharges from the alternative treatment system are greater than specified in the NPDES permit, a CAFO may be subject to both state and U.S. EPA enforcement actions.

General Versus Individual NPDES Permits

A general NPDES permit is written to cover a category of point sources with similar characteristics for a defined geographic area. The majority of CAFOs may appropriately be covered under an NPDES general permit because CAFOs generally involve similar types of operations, require the same kinds of effluent limitations and permit conditions, and discharge the same types of pollutants.

Individual NPDES permits may be most appropriate for CAFOs that are exceptionally large operations, that are undergoing significant expansion, that have historical compliance problems, and/or that have significant environmental concerns. Individual permits will generally include all of the permit conditions contained in the general NPDES permit as well as some additional requirements. Additional requirements could include liners and covers for manure and wastewater storage units and more frequent water quality monitoring.

5. Relationship to Existing NPDES Permits

EPA expects that most CAFOs will be subject to a general, rather than an individual, permit that requires compliance with the baseline effluent guidelines requirements. If a CAFO decides to pursue voluntary performance standards based on a treatment technology that allows a discharge, EPA expects the permit authority would require the CAFO to prepare and submit an application for an individual NPDES permit. The application will include general information about the CAFO (e.g., ownership, responsible persons, location, receiving stream), waste characteristics, information about the treatment system including design and operational parameters, and expected effluent quality from the proposed treatment system. A CAFO may not discharge from the alternative treatment system until the permitting authority has issued a NPDES permit that allows the discharge.

C. Step-By-Step Requirements for Participation in the Voluntary Performance Standards Program

The voluntary performance standards program has two main requirements: the CAFO must estimate the pollutant discharge associated with the baseline system, and must demonstrate that the alternative treatment technology achieves an equivalent or better reduction in the quantity of pollutants discharged from the production area. This section provides detailed recommendations for how these showings should be made, along with a description of the information that must be submitted to the permitting authority to obtain alternative performance standards.

1. Determining Baseline Pollutant Discharge

If a CAFO decides to participate in the voluntary performance standards program, the CAFO must conduct a technical analysis to estimate the pollutant discharge

> **Technical Analysis of Discharge**
>
> **§412.31(a)(2)** ...The technical analysis of the discharge of pollutants must include:
> (A) All daily *inputs* to the storage system, including manure, litter, all process waste waters, direct precipitation, and runoff.
> (B) All daily *outputs* from the storage system, including losses due to evaporation, sludge removal, and the removal of waste water for use on cropland at the CAFO or transport off site.
> (C) A calculation determining the predicted median annual overflow volume based on a 25-year period of actual rainfall data applicable to the site.
> (D) Site-specific pollutant data, including N, P, BOD_5, TSS, for the CAFO from representative sampling and analysis of all sources of input to the storage system, or other appropriate pollutant data.
> (E) Predicted annual average discharge of pollutants, expressed where appropriate as a mass discharge on a daily basis (lbs/day), and calculated considering paragraphs (a)(2)(i)(A) through (a)(2)(i)(D) of this section.

associated with the baseline[1] waste management system (e.g., anaerobic treatment lagoon). At a minimum, the technical analysis must include the information in the text box at right (see 40 CFR 412.31(a)(2)).

In an expected limited number of circumstances, the calculated median annual overflow volume based on a 25-year period of actual rainfall data may be zero. In these instances, the permit authority may allow the CAFO to calculate an average overflow volume for the 25-year period.

One approach for estimating pollutant discharges is to use a computer simulation model, spreadsheet, or similar program. One can either develop a new model or revise an existing model that estimates pollutant discharges from waste management systems. These models can be used to evaluate site-specific climate and wastewater characterization data to project the pollutant discharge from your baseline system. The model should evaluate the daily inputs to the waste management system, including all manure, litter, all process wastewaters, direct precipitation, and runoff. The model should also evaluate the daily outputs from the waste management system, including losses due to evaporation, sludge removal, and the removal of wastewater for use on cropland at the CAFO or transported off site. CAFOs may use the model to predict the median annual overflow from the storage system that would occur over a 25-year period. Next, the CAFO should use these overflow predictions, combined with representative pollutant concentrations in the overflow, to predict the annual average discharge of pollutants (including nitrogen, phosphorus, BOD_5, and total suspended solids) over the 25 years evaluated by the model. See 40 CFR 412.31 (a)(2)(i)(E) for the complete list.

Site-specific information that a CAFO should gather and input to the model to calculate the predicted annual discharge of pollutants from the baseline system includes the following (also see 40 CFR 412.31(a)(2)):

- Data on actual local precipitation from the past 25 years. Precipitation data are available from the National Weather Service and possibly a local airport. One can also obtain local precipitation data from EPA's Better Assessment Science Integrating point and Nonpoint Sources (BASINS) model at: http://www.epa.gov/OST/BASINS/b3webwn.htm. State weather data are located at: http://www.epa.gov/ost/ftp/basins/wdm_data/. Historical weather may also be obtained from National Climate Data Center.

- Soil type and permeability in drylot areas. Site-specific soil permeability data may be obtained from the local Soil Conservation District office.

- The rate of evaporation from the storage system (e.g., lagoon, pond, holding tank). Evaporation rate data are available from the National Weather Service or EPA's BASINS model website.

- The concentration of BOD_5, total nitrogen, total phosphorous, suspended solids, and other pollutants as required by the Director, measured in a representative sample collected from the waste management system.

---

[1]Recall a baseline system at the CAFO is a system that meets the requirements as described in Chapter 2 (see 40 CFR 412.31(a)(1)).

- Starting volume in the waste management system based on process wastes and runoff collected since the last land application or waste management system pump-out and/or sludge clean-out;
- Projected total design storage volume to store manure, wastewater, and other wastes accumulated during the storage period as reflected by the design storage volume (see Chapter 2 of this document);
- Change in the waste management system's volume due to the estimated daily flow of process wastes;
- Change in the storage system volume due to direct precipitation and evaporation;
- Change in the storage system volume due to runoff from open lot areas; and
- Change in volume due to waste management system pump-out and/or sludge cleanout and land application.

The model should calculate the net change in the volume of the liquid storage area daily and add it to the previous day's total. If the total volume is greater than the maximum design volume, then the excess volume overflows. Also, CAFOs can calculate the mass pollutant discharge from the overflow by multiplying the overflow by the pollutant concentration (BOD_5, total nitrogen, total phosphorous, total solids) measured in the representative sample.

Examples 1 and 2 at this end of this chapter present the results of a technical analysis conducted for an example dairy and swine CAFO, representatively. Appendix P provides step-by-step example calculations showing the methodology used to predict the median annual overflow volumes and annual average discharge of pollutants for Examples 1 and 2.

2. Demonstrating That an Alternative Control Technology Achieves Equivalent or Better Pollutant Reductions

EPA recommends that CAFOs follow the steps shown below to demonstrate that an alternative control technology will achieve equivalent or better pollutant reductions:

- Measuring volume or quantity of manure, wastewater, and runoff generation from production areas.
- Collecting samples of manure, wastewater, and runoff to determine raw or untreated pollutant concentrations for treatment system design using the same pollutant parameters as measured for baseline.
- Preparing a conceptual design of the treatment system showing equipment sizing, operational requirements, and expected pollutant reductions by each treatment step.
- Estimating the volume and frequency of discharge from the treatment system.
- Estimating or measuring the concentration of the effluent from the treatment system.

- Results of pilot testing to verify the treatment system will achieve equivalent or better pollutant reductions than baseline for all required constituents (including BOD_5, total nitrogen, total phosphorous, and suspended solids), and to gather information for design of the full scale treatment system. Any pilot testing needs to be related to representative/typical production and climate conditions expected at the CAFO. Therefore, multiple testing episodes or sites may be necessary to adequately capture the actual conditions at the CAFO. Consider on-site pilot testing to demonstrate the proposed system will work at the CAFO.

Examples 1 and 2 summarize the methods that could be used by the example CAFOs to determine if an alternative treatment system performed equivalent or better than the baseline system. In these examples, the permit authority would require the CAFO to continue to collect testing data until the alternative technology has been proven at the site. Thereafter, the CAFO may only need to collect samples frequently enough to demonstrate compliance with their NPDES permit limitations.

Can a CAFO Demonstrate Equivalency Using Practices Already in Existence at the Site?

Yes. If the practices already in place at the operation provide equivalent or better pollutant reductions than the predicted average annual pollutant discharge for the baseline requirements, then the CAFO can apply for an alternative performance standard. Example 3 shows how data from an existing pollution prevention/treatment system were compared to the baseline system to develop site-specific permit limits for an egg production facility.

3. Obtaining an Alternative Performance Standard

The next step in participating in the voluntary performance standards program is to submit an application to the permitting authority along with the technical analyses, conceptual design, results of any pilot-scale testing and any other relevant data before construction of the full-scale treatment system. The permitting authority should review the application, technical analyses, and conceptual design, and then compare the pilot-scale testing results with the predicted annual average discharge of pollutants to verify the proposed treatment system is reasonable, appropriate, and will likely achieve the predicted results. In addition, the permit authority should confirm the quantity of pollutants discharged from the production area are equal to or less than the quantity of pollutants discharged under baseline. The Director has the discretion to request additional information to supplement the CAFO's application, including inspection of the CAFO (40 CFR 412.31(a)(2)(E)(ii)). Once an application is approved, a CAFO can proceed with detailed design and construction of the alternative control technology. Following construction of the treatment system but prior to start-up (see 40 CFR 412.31(a)(3)), the CAFO must obtain an NPDES permit specifying the discharge limitations. Also see section B.4 of this chapter.

Example 1: Whole Milk Dairy, Lancaster, PA

Background

Amish Country Dairy (ACD) is a Large CAFO located in Lancaster County, PA. ACD currently milks 1,200 dairy cows per day, plus manages 400 heifers and 400 calves. Milk cows are confined in a

Example 1: Whole Milk Dairy, Lancaster, PA

550,000 square foot area containing 3 free-stall barns, the a milking parlor, and yard. Free-stall barn alleys are cleaned 3 times per day (every 8 hours) using a flush system. Sawdust is used for bedding in the free stall barn. Silage is kept covered. All flush water, cow wash-water, and parlor cleanup and sanitation water is directed to the existing 3,351,252 cubic foot manure holding lagoon.

All liquids in the holding lagoon are applied to crop land four times each year consistent with the site's NMP. Thus the lagoon has 90 days of storage capacity. To help show the storage structure has adequate capacity, ACD assumes that the storage volume is never less than the accumulated sludge volume plus the minimum treatment volume. Although solids are periodically removed and thus more volume is available to store process wastewater, runoff, and precipitation, this conservative assumption reserves the sludge volume for the maximum amount of accumulated solids over the storage period.

Approximately 40 percent of the milk cow confinement area is paved or roofed. Precipitation from roofed areas drains on to the paved portion of the milk cow confinement area before being discharged to the manure holding lagoon. All paved areas have curbing to contain manure and precipitation. Unpaved areas have reception pits to collect manure and precipitation before discharge to the manure holding lagoon. Heifers and calves are managed on a non-paved 300,000 square foot dry lot that discharges to the manure holding lagoon. Any overflows from the lagoon may eventually reach a receiving surface water body (in this case, the Susquehanna River).

Summary of Baseline Overflow Volume and Pollutant Loading Calculations

Process Wastewater Generation:	25,857 ft^3/day (193,400 gal/day)
Sludge Volume (constant):	870,807 ft^3
Minimum Treatment Volume (constant):	1,530,000 ft^3
Total Existing Storage Lagoon Volume:	3,351,252 ft^3 (25 million gallons)
Volume in Lagoon at Start:	2,400,807 ft^3 (Sludge Volume + Minimum Treatment Volume)
Precipitation Volume (median):	40 in/yr
Evaporation Rate (median):	57 in/yr
Runoff (median):	17,033 ft^3/yr
Liquid/Solids Removal for Crop Application:	Completely dewater all lagoon liquids 4 times per year

Calculated Baseline Overflow Volume Method:

Daily accumulation of lagoon liquids (ft^3/day) =	Process Waste (ft^3/day) + Runoff (ft^3/day) + ((Precipitation - Evaporation (ft/day)) x Lagoon Surface Area (ft^2)
Volume of Lagoon Liquids (ft^3) =	Previous days volume (ft^3) + Accumulation volume (ft^3/day)

Example 1: Whole Milk Dairy, Lancaster, PA

If the Volume of Lagoon Liquids (ft3) is greater than the following:
Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)], then

Overflow Volume = Volume of Lagoon Liquids (ft^3) - [Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]; and

Volume of Lagoon Liquids (ft^3) is adjusted to the following:
[Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)] (the maximum volume of liquids the lagoon can store)

If it is a land application day:

The Volume of Lagoon Liquids (ft^3) = 0

Model Calculated Overflow Volume for ACD: 57,386 ft^3/yr (429,247 gal/yr)

ACD collected a representative sample of liquid from the storage lagoon to calculate the annual pollutant discharge of BOD_5, total nitrogen, total phosphorous, and total suspended solids (TSS) as a result of the overflow volume. The sample was collected from the top 12 inches of the lagoon surface since the majority of overflow will likely be attributed to this zone. The sampling results are shown below:

BOD_5:	600 mg/L	(5.0 lbs per 1000 gallons)
Total nitrogen:	268 mg/L	(2.2 lbs per 1000 gallons)
Total phosphorous:	208 mg/L	(1.7 lbs per 1000 gallons)
TSS:	1,500 mg/L	(12.5 lbs per 1000 gallons)

Based on the overflow and the measured concentration, the annual pollutant discharges from the lagoon were calculated by multiplying the flow by the concentration as shown in the example for BOD_5 below:

$$BOD_5 : 600 \text{ mg/L} \times 3.785 \text{ L/gal} \times 429{,}247 \text{ gal/yr} \times 2.2 \text{ lbs/kg} \times 1 \text{ kg}/10^6 \text{ mg} = 2{,}145 \text{ lbs/yr}$$

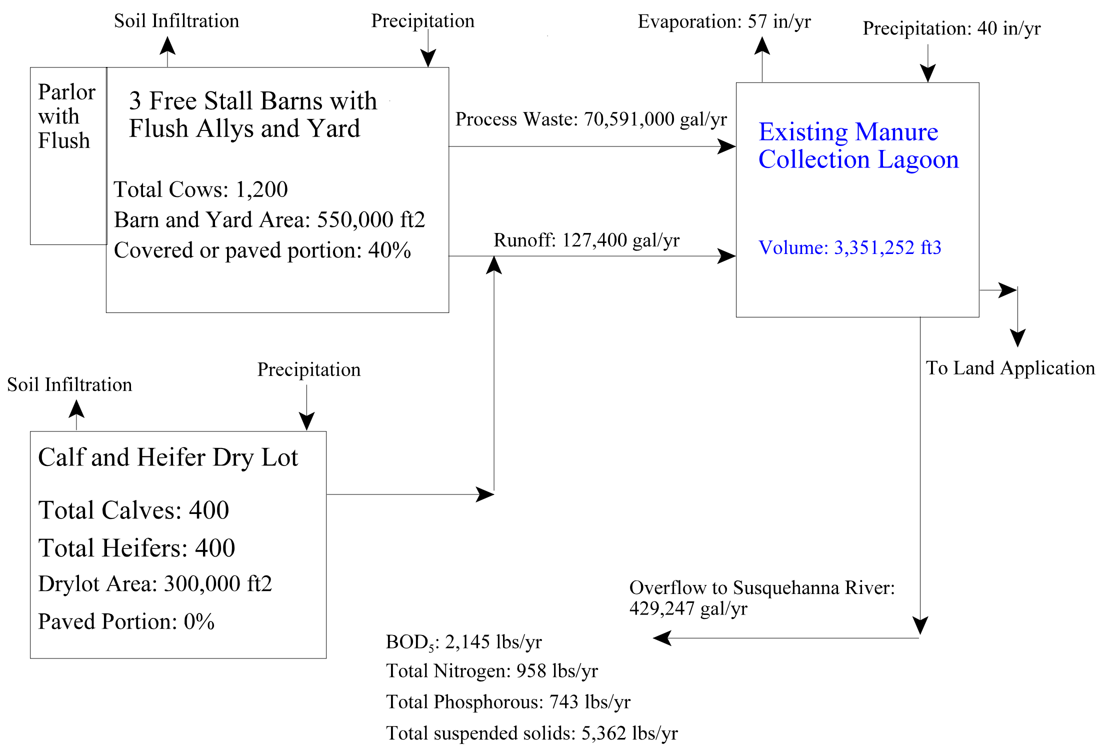
A summary of the pollutant loadings based on the overflow rate and concentration is shown below.

BOD_5	2,145 lbs/yr
Total nitrogen	958 lbs/yr
Total phosphorous	743 lbs/yr
TSS	5,362 lbs/yr

Diagram of Baseline Waste Management System

The following figure is a block diagram of ACD summarizing the inputs and outputs from the manure storage lagoon and the overflows and pollutant loadings. Any overflows from the lagoon eventually reach a surface water body (in this case, the Susquehanna River).

Example 1: Whole Milk Dairy, Lancaster, PA



Waste Characterization and Alternative Treatment System Evaluation

ACD in cooperation with their consultant, Tick Engineering, has decided to voluntarily pursue an alternative to their existing lagoon in order to have a constant discharge of treated water to the Susquehanna River. The treatment train they have selected consists of primary clarification, aerobic biological treatment and final polishing using an engineered wetland. Pilot scale testing of the system was conducted June 15 to November 15 at ACD by Tick Engineering using actual process wastewater. A summary of the conceptual design calculations and pilot scale treatment test results are included below.

<u>Waste Flow and Characterization</u>

A daily composite sample of manure, flush-water, wash-water, parlor cleanup and sanitation water and rainwater was collected by Tick Engineering during a seven day operational period in April 2003 to characterize the waste load discharged to the storage lagoon. The combined volume of manure, flush-water, wash-water, parlor cleanup water and rainwater was also measured during the seven day sampling period in April, 2003. The average daily flow to the lagoon, which included one day of rainfall was 176,410 gallons. Waste characterization data and calculated average daily loading to the treatment system is summarized below:

Example 1: Whole Milk Dairy, Lancaster, PA

Pollutant	**Concentration (mg/L)**	**Influent (lbs/day)**
BOD_5	1,701	2,496
Total nitrogen	478	702
Total phosphorous	74	109
TSS	12,269	18,018

Daily pollutant loadings were calculated by multiplying the concentration for each constituent by the average daily flow as shown in the example below for BOD_5:

BOD_5 Loading: 1,701 mg/L x 3.785 L/gal x 1 kg/1,000,000 mg x 2.2 lbs/kg x 176,410 gal/day = 2,496 lbs/day

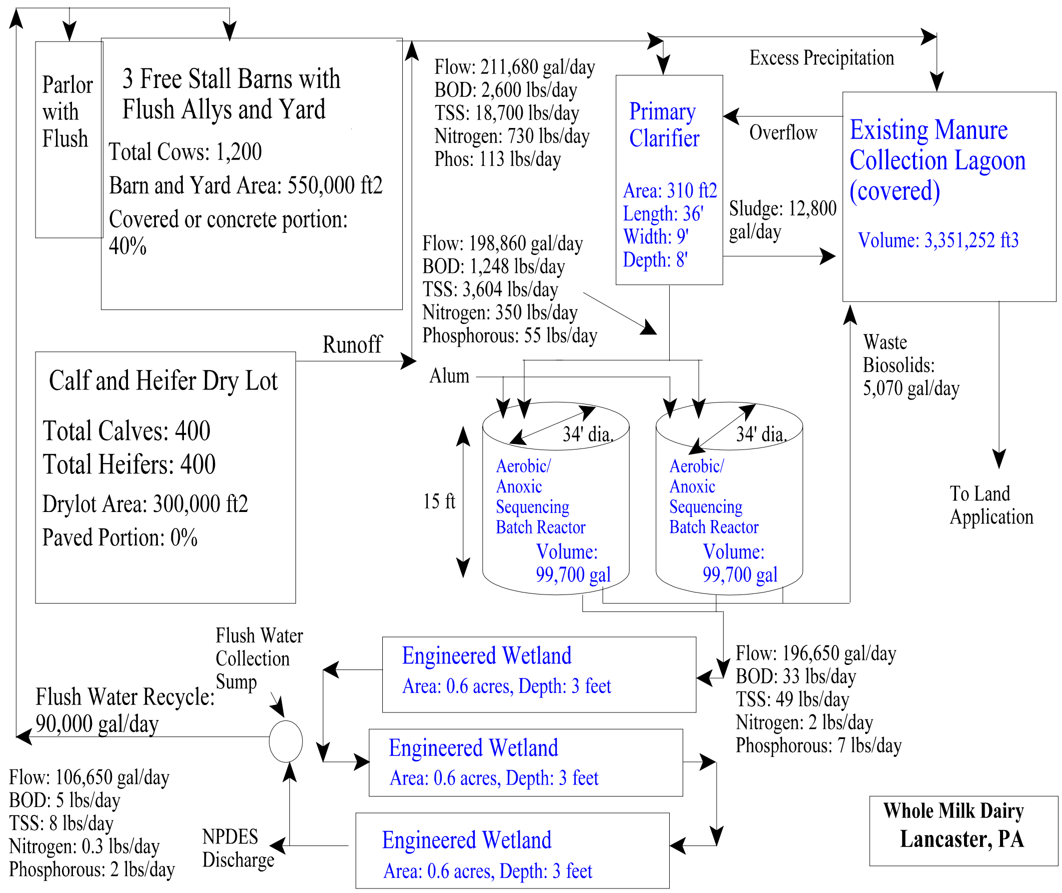
Treatment system design is based on a flow excess of 20% or 211,690 gallons per day. Flows greater than 211,690 gal/day will overflow back to the existing 3,351,252 cubic foot lagoon. During dry weather periods, excess water and direct precipitation from the lagoon will be pumped back to the beginning of the treatment system for processing. The following figure is a flow diagram showing the treatment equipment and sizes, flows in and out of each treatment unit, and the pollutant reductions by each treatment step. Note that ACD will have the capability of recycling nearly 90,000 gallons per day of treated effluent for manure flushing.

<u>Alternative Treatment System Effectiveness</u>

The average concentration of target pollutants measured in the effluent from the pilot scale treatment system during the 6-month study is shown below. The calculated monthly loadings for the full-scale treatment system is based on an average daily flow of 176,410 gallons entering the treatment system minus a recycle flow of 90,000 gallons per day for manure flushing.

Example 1: Whole Milk Dairy, Lancaster, PA

Diagram of Alternative Treatment System



Comparison of the Baseline Overflow to the Discharge from the Alternative Treatment System

Pollutant	Baseline Overflow (lbs/yr)	Treatment System Discharge (lbs/yr)
BOD_5	2,145	1,830
Total nitrogen	958	110
Total phosphorous	743	730
TSS	5,362	2,920

Conclusion: The loadings comparison clearly shows the proposed treatment system consisting of primary clarification, aerobic biological treatment and final polishing using an engineered wetlands would achieve a quantity of pollutants discharged from the production area that is equal to or less than the quantity of pollutants that would be discharged using baseline treatment. Note this analysis pertains to the technology-based requirements of the CAFO rules, and does not include an assessment of whether such a discharge would meet the State's water quality standards.

Example 2: KF Pork Producers, Dubuque, IA

Background

KF Pork Producers (KFP) is a Large CAFO located in Dubuque County, Iowa. KFP currently has 7,000 grower swine with an average weight of approximately 140 pounds. Swine are housed in a 57,400 square foot barn with 10 confinement pens. Manure is washed from pens daily using a flush system. All manure and flush water drains into storage tanks beneath the partially slotted concrete floor. Storage tanks are emptied daily by pumping the manure and flush water to an existing 3,931,800 cubic foot manure holding lagoon.

KFP, in consultation with local residents, avoids de-watering the storage structure on weekends and holidays. Liquids in the holding lagoon are applied to crop land (to the maximum daily hydraulic loading) on the 7th, 14th, 21st, and 28th days of each month during the freeze free period between April 21 and September 14, assuming that there has been no significant precipitation during the three days prior to the day of application. [The nutrient applications are tracked by KFP's Nutrient Management Plan, and are not further considered here.] KFP assumes that the storage volume is never less than the accumulated sludge volume plus the minimum treatment volume. Although there are times that solids are removed and more space is available for process wastewater, runoff, and precipitation, this conservative assumption reserves storage space for the maximum amount of accumulated solids over the storage period.

<u>Summary of Baseline Overflow Volume and Pollutant Loading Calculations</u>

Process waste generation:	8,356 ft^3/day (62,500 gal/day)
Sludge Volume (constant):	486,091 ft^3 (3.6 million gal)
Minimum Treatment Volume (constant):	661,500 ft^3 (4.9 million gal)
Total existing storage lagoon volume:	3,931,800 ft^3 (29.4 million gal)
Volume of Liquids and Solids in Lagoon at Start:	1,206,083 ft^3 (Sludge Volume + Minimum Treatment Volume + Accumulated Process Wastes Since Last Liquid Application)
Precipitation Volume (average):	26 in/yr
Evaporation Rate (average):	98 in/yr
Liquid/Solids Removal for Crop Application:	Land apply lagoon liquids to the maximum hydraulic loading of the crop land on days 7, 14, 21, and 28 of each month unless there has been precipitation in the past three days before the application day (This occurs between the freeze free days between April 21 and September 14)

Calculated Baseline Overflow Volume Method

Daily accumulation of lagoon liquids (ft^3/day) = Process Waste (ft^3/day) + [Precipitation - Evaporation] (ft/day) x Lagoon Surface Area (ft^2)

Example 2: KF Pork Producers, Dubuque, IA

Volume of Lagoon Liquids (ft^3) = Volume of Lagoon Liquids from Previous Day (ft^3) + Daily accumulation of lagoon liquids (ft^3)

If the Volume of Lagoon Liquids (ft^3) is greater than the following:
Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)], then

Overflow Volume = Volume of Lagoon Liquids (ft^3) - [Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]; and

Volume of Lagoon Liquids (ft^3) is adjusted to the following:
[Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)] (the maximum volume of liquids the lagoon can store)

If it is an application day (day 7, 14, 21, or 28 of the time period between April 21 and September 14), the Volume of Lagoon Liquids (ft^3) = Volume of Lagoon Liquids (ft^3) - Max Hydraulic Loading (ft^3)

Model Calculated Overflow Volume for KFP: 158,419 ft^3/yr (1,184,970 gal/yr)

KFP collected a representative sample of liquid from the storage lagoon to calculate the annual pollutant discharge of BOD_5, total nitrogen, total phosphorous, and total suspended solids (TSS) as a result of the overflow volume. The sample was collected from the top 12 inches of the lagoon surface since the majority of overflow will likely be attributed to this zone. The sampling results are shown below:

$BOD_{5:}$	1,650 mg/L
Total nitrogen:	270 mg/L
Total phosphorus:	102 mg/L
TSS:	3,000 mg/L

Based on the overflow and the measured concentration, the annual pollutant discharges from the lagoon were calculated by multiplying the flow by the concentration as shown in the example for BOD_5 below:

$$BOD_5: 1650 \text{ mg/L} \times 3.785 \text{ L/gal} \times 1{,}184{,}970 \text{ gal/yr} \times 2.2 \text{ lbs/kg} \times 1 \text{ kg}/10^6 \text{ mg} = 16{,}280 \text{ lbs/yr}$$

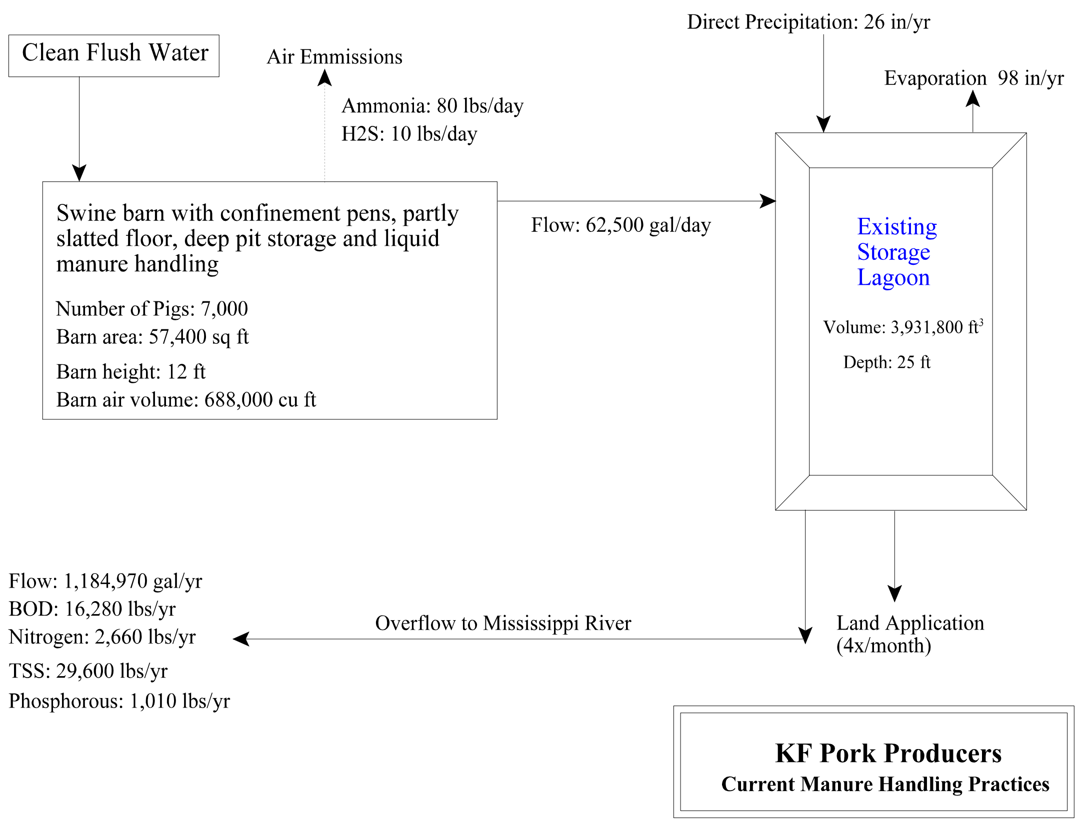
A summary of the pollutant loadings based on the overflow rate and concentration is shown below.

$BOD_{5:}$	16,280 lbs/yr
Total nitrogen:	2,660 lbs/yr
Total phosphorus:	1,010 lbs/yr
TSS:	29,600 lbs/yr

Diagram of Baseline Waste Management System

The following figure is a block diagram of KFP summarizing the inputs and outputs from the manure storage lagoon and the overflows and pollutant loadings. Any overflows from the lagoon discharge to a surface water body (in this case, the Mississippi River).

Example 2: KF Pork Producers, Dubuque, IA



Waste Characterization and Treatment System Evaluation

KFP realized it was not cost effective to haul excess nutrients in the liquid manure. KFP, in cooperation with their consultant WB Engineering, conducted a whole-farm audit to determine if pollutant releases could be reduced at the facility by application of new technologies. WB Engineering examined discharges of pollutants from lagoon overflows, estimated air emissions of ammonia and hydrogen sulfide, and worked with KFP to determine if changes in swine feed rations could lower the amount of ammonia and phosphorous entering the manure. Finally, WB examined manure application rates to determine if more frequent removals of manure/sludge from the lagoon could provide additional storage capacity and less frequent overflows.

As a result of the whole-farm audit, KFP decided to further evaluate a new wastewater treatment system plus an off-gas treatment system for air removed from both the swine barn and manure pits. Changes in feed rations were not implemented on recommendations from both an animal nutritionist and the local agricultural extension agent, and additional application rates of manure to KFP's crop land would have exceeded nutrient requirements according to the facilities NMP.

The treatment train selected for KFP consists of primary clarification, a vibrating membrane filtration system, and final polishing using a biological trickling filter. For off-gas from the swine barn and manure pits, a biofilter using an inorganic media was selected to remove ammonia and hydrogen sulfide. Pilot scale testing of both the wastewater and air treatment system was conducted March 20 to September 20 2003 by WB Engineering. A summary of the conceptual design calculations and pilot scale treatment test results are included below.

Example 2: KF Pork Producers, Dubuque, IA

Waste Flow and Characterization

A daily composite sample of manure and flush-water was collected by WB Engineering during a seven day operational period in March 2003 to characterize the waste load discharged to the storage lagoon. The volume of manure and flush-water was also measured during the seven day sampling period in April, 2003. The average daily flow to the lagoon was 62,500 gallons. Waste characterization data and calculated average daily loading to the treatment system for the target pollutants is summarized below:

Pollutant	Concentration (mg/L)	Influent (lbs/day)
BOD_5	3,766	1,960
Total nitrogen	753	392
Total phosphorus	301	157
TSS	11,863	6,174

Daily pollutant loadings were calculated by multiplying the concentration for each constituent by the average daily flow as shown in the example below for BOD_5:

BOD_5 Loading: 3,766mg/L x 3.785 L/gal x 1 kg/1,000,000 mg x 2.2 lbs/kg x 62,500 gal/day = 1,960 lbs/day

The wastewater treatment system design is based on a flow excess of 20% or gallons per day. Flows greater than 75,000 gal/day will overflow to the existing 1,500,000 cubic foot lagoon. During dry weather periods, excess water from the lagoon will be pumped back to the beginning of the treatment system for processing. Note that KF will have the capability of recycling nearly 22,600 gallons per day of treated effluent for manure flushing.

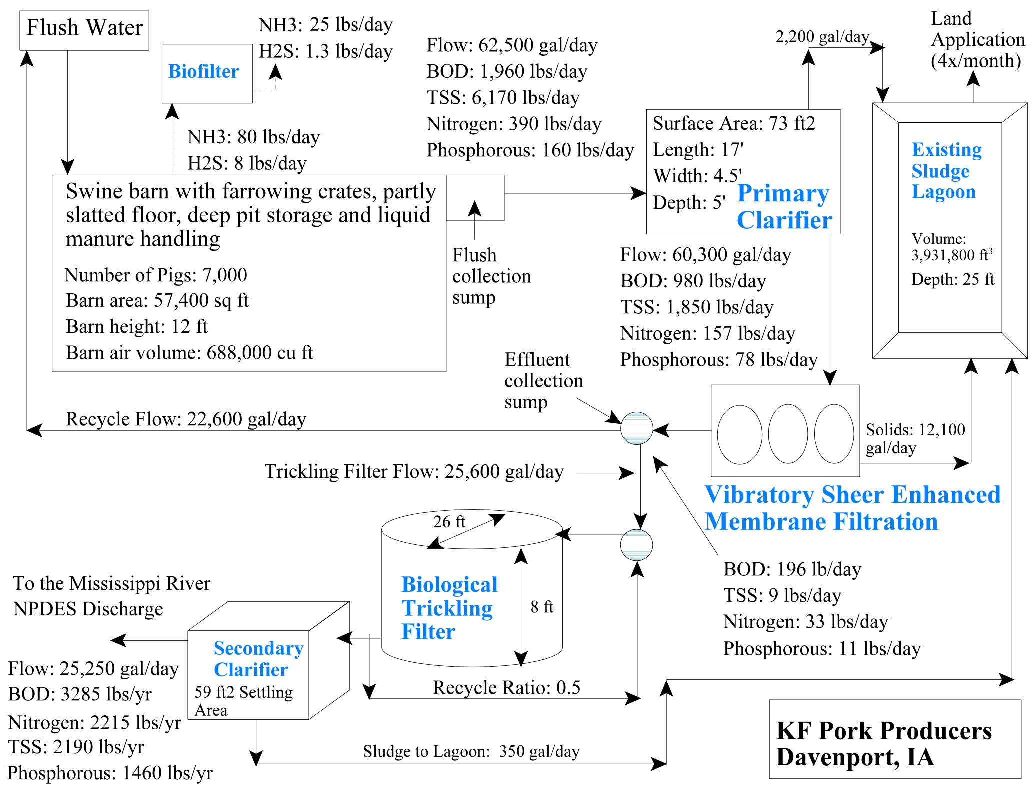
Off-gas from the swine barn and deep pit areas was characterized by collecting air samples from areas near the exit fans. The average concentration of ammonia and hydrogen sulfide measured in the off-gas was 54 ppm and 4 ppm, respectively. Based on a measured exhaust rate from all the exit fans for the barn and pit areas, WB engineering estimates approximately 80 lbs/day of ammonia and approximately 10 lbs/day of hydrogen sulfide is emitted to the atmosphere. Design of the biofilter for treatment of off-gas was provided by BIOREM and consisted of new fans and duct work to move air through a single discharge point, and an in-ground biofilter to destroy ammonia and hydrogen sulfide.

Treatment System Effectiveness

The average concentration of target pollutants measured in the effluent from the pilot scale wastewater treatment system during the 6-month study is shown in the table below. The calculated monthly loadings for the full-scale treatment system is based on an average daily flow of 25,250 gallons. The remaining 37,750 gallons of water that entered the treatment system is used for either recycle or contains concentrated treatment residuals that are discharged to the existing storage lagoon. KFP now has the additional flexibility to collect solids and concentrated nutrients from the existing sludge lagoon and haul them offsite for other uses.

Example 2: KF Pork Producers, Dubuque, IA

Diagram of Alternative Treatment System



Comparison of the Baseline Overflow to the Discharge from the Alternative Treatment System

Pollutant	Baseline Overflow (lbs/yr)	Treatment System Discharge (lbs/yr)
BOD_5	16,280	3,285
Total nitrogen	2,664	2,215
Total phosphorous	1,006	1,460
TSS	29,602	2,190

The average concentration of ammonia and hydrogen sulfide measured in the off-gas from the biofilter during the 6 month pilot scale treatment test is shown below. The biofilter removed approximately 70 percent of the ammonia and 87 percent of the hydrogen sulfide in the gas stream. The biofilter also eliminated all odors from the swine CAFO's offgas.

Biofilter Treatment Results During the 6-Month Pilot Test

Pollutant	Influent Loading (lbs/day)	Gas Flow (cfm)	Effluent Loading (lbs/day)	Odor
Ammonia	80	23,000	25	None
Hydrogen Sulfide	10	23,000	1.3	None

Example 2: KF Pork Producers, Dubuque, IA

Conclusion: Comparison of the pilot scale testing results with the calculated overflow discharges indicates the proposed treatment system can not achieve a quantity of pollutants discharged for all the targeted pollutants that is equal to or less than the quantity of pollutants that would be discharged under the baseline performance standards. Because the proposed treatment system cannot achieve this reduction for all target pollutants, the permitting authority denies the facility's request for an individual NPDES permit for operation and discharge of water from the proposed treatment system. If modifications to the treatment system can be made that lower the annual discharge of phosphorous, then an individual permit may be considered.
KF Pork Producers has still decided to install a new biofilter system to remove odors, ammonia and hydrogen sulfide from their air stream to address complaints from neighbors regarding smells from the facility.

Example 3: Birvan Egg Farms, Okeechobee County, FL

Background

Birvan Egg Farms (Birvan) is a Large CAFO located Okeechobee County, Florida. Birvan currently has 40,000 laying hens with an average weight of approximately 3 pounds. Birds are housed in a high-rise cage system. Manure drops from the cages to the floor below and is picked up by the wet flush system and is transferred to the anaerobic digester. The anaerobic digester removes the majority of nutrients, BOD_5 and volatile solids while generating methane that is used in the facilities boiler system. Effluent from the anaerobic digester is pumped through a vibrating membrane filtration system for polishing residual solids, BOD_5 and nutrients before land application of the polished water to a small grass field. All solids are hauled and sold off-site. Birvan elected to install an anaerobic treatment system rather than a holding pond due to space constraints and the lack of crop land to apply liquids and solids. The manure treatment system has been in operation since 1996.

Birvan calculated the overflow volume and loading from a baseline system (a liquid storage structure) that could have been installed at the facility and compared the results with the loadings currently being obtained from the existing treatment system.

Summary of Baseline Overflow Volume and Pollutant Loading Calculations

Estimated Storage Lagoon Volume if Constructed:	58,200 ft3 (435 thousand gallons)
Process Waste Generation:	374 ft^3/day (2,800 gal/day)
Volume of Liquids and Solids in Lagoon at Start:	635 ft^3 (Sludge Volume + Minimum Treatment Volume + Accumulated Process Wastes Since Last Liquid Application)
Precipitation Volume (average):	61 in/yr
Evaporation Rate (average):	90 in/yr
Sludge Volume (constant):	5,900 ft^3
Minimum Treatment Volume (constant):	9,200 ft^3
Assumed removal rate:	2x per month from January 21 to December 9

Example 3: Birvan Egg Farms, Okeechobee County, FL

Calculated Baseline Overflow Volume Method:

Daily accumulation of lagoon liquids (ft^3/day) =	Process Waste (ft^3/day) + [Precipitation - Evaporation (ft/day)] x Lagoon Surface Area (ft^2)
Volume of Lagoon Liquids (ft^3) =	Previous days volume (ft^3) + Accumulation volume (ft^3/day)

If the Volume of Lagoon Liquids (ft3) is greater than the following:
Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)], then

Overflow Volume =	Volume of Lagoon Liquids (ft^3) - [Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]; and

Volume of Lagoon Liquids (ft^3) is adjusted to the following:
[Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)] (the maximum volume of liquids the lagoon can store)

Model Calculated Overflow Volume for Birvan: 3,162 ft^3/yr (23,651 gal/yr)

Birvan collected a representative sample of liquid from the digester to calculate the annual loading of BOD_5, total nitrogen, total phosphorous, and total suspended solids (TSS) that would be discharged as a result of the overflow volume. The sample was collected from the top 12 inches of the digester surface since the majority of overflows will likely be attributed to this zone. The sampling results are shown below:

BOD_5:	1,500 mg/L
Total nitrogen:	750 mg/L
Total phosphorus:	100 mg/L
TSS:	3,200 mg/L

Based on the overflow and the measured concentration, the annual pollutant discharges from the storage system was calculated by multiplying the flow by the concentration as shown in the example for BOD_5 below:

$$BOD_5: 1500 \text{ mg/L} \times 3.785 \text{ L/gal} \times 23{,}651 \text{ gal/yr} \times 2.2 \text{ lbs/kg} \times 1 \text{ kg}/10^6 \text{ mg} = 295 \text{ lbs/yr}$$

A summary of the pollutant loadings based on the overflow rate and concentration is shown below.

BOD_5:	295 lbs/yr
Total nitrogen:	148 lbs/yr
Total phosphorus:	20 lbs/yr
TSS:	433 lbs/yr

Treatment System Evaluation

Birvan has been collecting monthly samples for BOD_5, total nitrogen, total phosphorous, and total suspended solids from the existing treatment system since early 1997. The measured monthly concentrations in the treatment system effluent and the total flow through the treatment system over the past 12 months is shown below.

Example 3: Birvan Egg Farms, Okeechobee County, FL

Measured Treatment System Effluent Concentration and Total Influent Flow During the Past 12 Months

Month	**BOD_5 (mg/L)**	**Nitrogen (mg/L)**	**Phosphorous (mg/L)**	**TSS (mg/L)**	**Total Flow (gal)**
June	20	3.3	0.6	14	83,800
July	21	5.2	0.8	15	83,200
August	13	1.6	0.7	10	84,600
September	8	0.8	0.6	9	83,900
October	9	0.6	0.4	7	84,200
November	18	3.5	0.6	13	84,700
December	13	2	0.7	11	84,300
January	6	0.7	0.4	9	82,900
February	8	0.7	0.4	8	83,900
March	19	1.8	0.8	13	84,700
April	20	4.2	1.2	15	85,100
May	7	2.7	0.8	14	84,300
Median	**13**	**1.9**	**0.6**	**12**	**84,250**

As shown in the figure below, the vibrating membrane filter generates a concentrated waste stream equaling 20% of the influent flow (16,850 gal/month). This concentrated waste stream is sent to a 10,000 gallon holding tank prior to off-site shipment. Effluent from the vibrating membrane filter enters a lift station where submersible pumps transfer approximately 45,000 gallons per month back to the layer house for manure flushing. Based on a measured average flow rate of approximately 22,400 gallons per month at Outfall 001 and the concentration of pollutants in the vibrating membrane treatment system effluent, the following annual loadings to St. Lucie Canal were calculated and compared to the baseline overflow loadings.

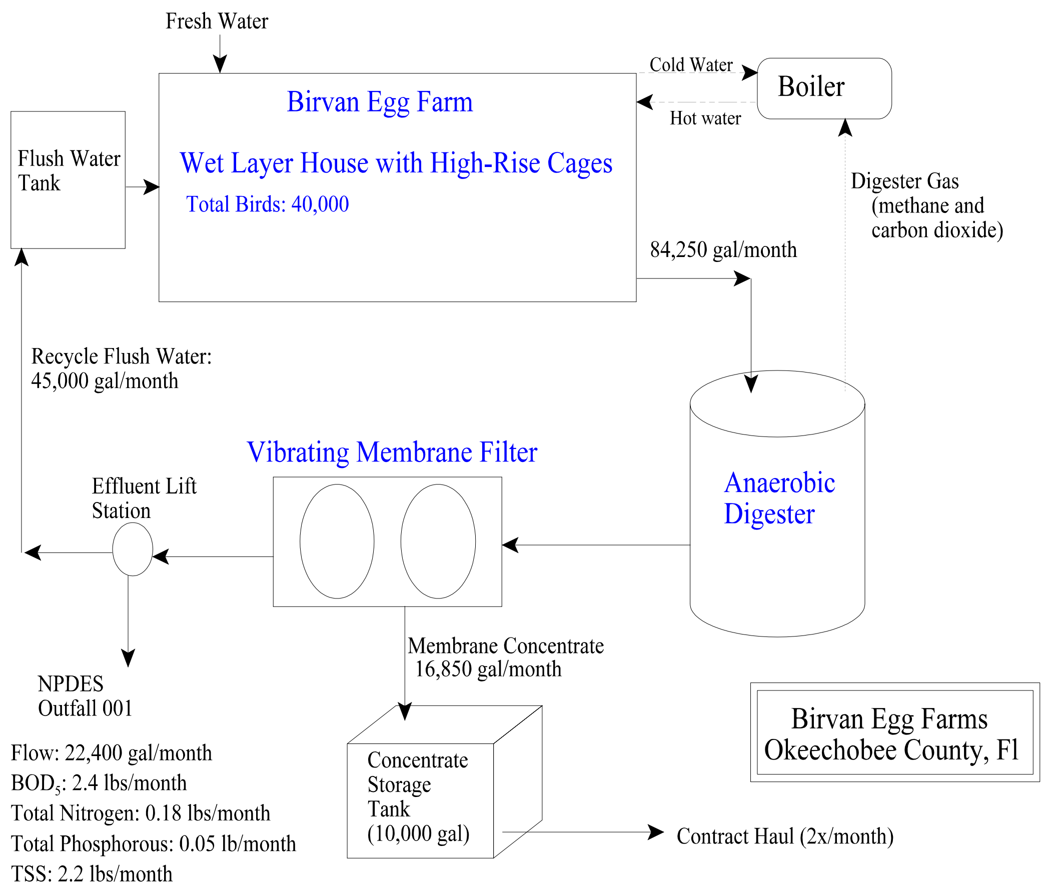
Comparison of the Calculated Baseline Overflow Discharge to the Treatment System Discharge

Pollutant	**Baseline Overflow (lbs/yr)**	**Treatment System Discharge (lbs/yr)**
BOD_5	295	29
Total nitrogen	148	4.2
Total phosphorous	20	1.3
TSS	433	27

Conclusion: The comparison shows that the existing treatment systems consisting of an anaerobic digester and vibrating membrane filtration system achieves better performance than the baseline system for all targeted pollutants. If water quality constraints for fecal coliform in the St. Lucie canal make additional treatment necessary, Birvan is also considering increasing the temperature of the digester to make it thermophilic, a practice known to reduce fecal coliform in the effluent.

Example 3: Birvan Egg Farms, Okeechobee County, FL

Diagram of Existing Treatment System



4. Future Case Studies

EPA may provide additional case studies in the future, such as examples of whole-farm multi-media evaluations, voluntary alternative standards as applied to silage leachate, or alternative technologies for handling mortalities. Additional suggestions and recommendations may be sent to EPA at the address provided in Chapter 1 of this document.